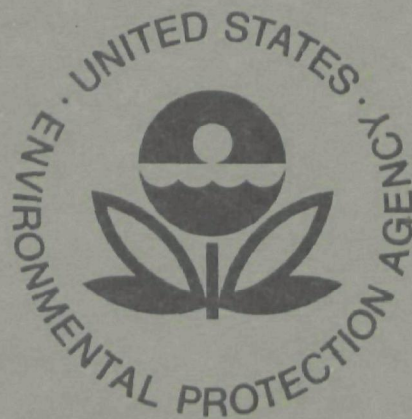


MANPOWER REQUIREMENTS FOR WASTEWATER COLLECTION SYSTEMS IN CITIES OF 150,000 TO 500,000 IN POPULATION



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**CENTER FOR MANPOWER
RESEARCH AND TRAINING
NORTH CAROLINA A&T STATE
UNIVERSITY
GREENSBORO, NORTH CAROLINA
27411 GRANT AWARD NO. T-900211**

MARCH 1974

MANPOWER REQUIREMENTS FOR WASTEWATER
COLLECTION SYSTEMS IN CITIES
OF 150,000 TO 500,000 IN POPULATION

by

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for the
Manpower Development Staff
Office of Water Program Operations
U.S. Environmental Protection Agency

Grant Award No. T-900211

March 1974

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ACKNOWLEDGMENT

Special appreciation is expressed to Robert C. Rose, Project Director, and Roger K. Brittingham, Manpower Development Specialist, both from the U.S. Environmental Protection Agency, Office of Water Program Operations, Washington, D.C.; to Arthur Gurley, Jr., Manpower Development Specialist, E.P.A. Region IV, Atlanta, Ga.; to Horace L. Smith, Director of the Wastewater Control Division, City and County of Denver, Col.; and to James R. Gardner, Stan M. Rose, and Michael Swaim, Occupational Analysts, North Carolina Occupational Analysis Field Center, for their sustaining cooperation and assistance.

Grateful acknowledgment is extended to the municipal employees of the following cities for their invaluable contribution in providing information for this manual: Atlanta, Ga.; Charlotte, N.C.; Knoxville, Tenn.; Norfolk, Va.; and Richmond, Va.

Appreciation is, also, extended to wastewater control officials of Akron, Ohio; Albuquerque, N.M.; Arlington, Va.; Birmingham, Ala.; Austin, Tex.; Baton Rouge, La.; Buffalo, N.Y.; Cincinnati, Ohio; Corpus Christi, Tex.; Dallas, Tex.; Dayton, Ohio; Denver, Col.; Des Moines, Iowa; El Paso, Tex.; Flint, Mich.; Fort Lauderdale, Fla.; Fort Worth, Tex.; Fresno, Calif.; Hartford, Conn.; Jersey City, N.J.; Kansas City, Kansas; Las Vegas, Nev.; Louisville, Ky.; Miami, Fla.; Minneapolis, Minn.; Nashville, Tenn.; Omaha, Neb.; Portland, Ore.; Providence, R.I.; Grand Rapids, Mich.; Sacramento, Calif.; St. Petersburg, Fla.; Salt Lake City, Utah; San Jose, Calif.; Shreveport, La.; Spokane, Wash.; Tacoma, Wash.; Tampa, Fla.; Toledo, Ohio; Tulsa, Okla.; Tucson, Az.; Wichita, Kans.; Worcester, Ma.

PREFACE

The nation's awareness of water pollution has steadily grown particularly in recent years. We are becoming alarmed that this environmental problem will continue to get worse unless effective measures are promptly taken to bring pollution under control. A number of factors have contributed to this situation, among these are an increase in population, urbanization and industrialization and their resultant discharge of partially treated and untreated waste into lakes, streams, and estuaries through wastewater plants and collection systems that are oftentimes inadequate, antiquated, and sometimes non-existent. Substandard sewer maintenance, for example, has resulted in undue infiltration of the collection system and the overloading of treatment plants. Upgrading the collection and treatment of wastewater then is crucial in the water pollution control program. The 1972 Amendments to the Federal Water Pollution Control Act (P.L. 92-500) are the latest and most visible examples of the increased national interest in water pollution abatement and control.

The water pollution control manpower area is expanding rapidly attributed to higher water quality standard requirements, increased treatment facilities construction programs, and growing technological developments, thereby increasing the demand for skilled personnel and expanding employment opportunities. The development of an adequately trained manpower force will be one of our biggest challenges.

This Manual has been prepared to provide specific occupational information relative to job duties and worker traits with important applications both to wastewater system staffing and training. It identifies specific manpower requirements in terms of type and numbers which are needed to efficiently operate and maintain wastewater collection systems in cities from 150,000 to 500,000 in population. This study is a sequel to the EPA Manpower Manual entitled, "Manpower Requirements for Wastewater Collection Systems in Cities and Towns up to 150,000 in Population", published in June 1973.

Occupational Descriptions and Staffing Guides have been developed to assist officials in charge of manpower staffing and training. Users should bear in mind that information contained in this manual is of a composite nature and does not necessarily apply to specific systems. To be of maximum utility, manpower and training estimates based on such data should be supplemented by information on local conditions.

This study was directed by Elie Namour of the Center for Manpower Research and Training at North Carolina A & T State University. The Center for Manpower Research and Training is supported by the

U.S. Department of Labor to educate students and conduct research in the field of human resource development. Project staff consisted of four research assistants: Charles Galbreath, Dorothy Warren, Ronald Lovelace and Kenneth Alston. Five students assisted in data collection during the summer of 1972 and two students in the summer of 1973. Acting as consultants were Arthur L. White, Engineering Technician, City of Greensboro, N.C. and Dr. John Boulger, Industrial Psychologist, Director of Psychological Services, Farr Associates, Greensboro, N.C.

Chapter 2 "Wastewater Collection System" was prepared with the assistance of Dr. Charles Smallwood, Jr., Professor of Civil Engineering at North Carolina State University, Raleigh, N.C. and Horace Smith, Director of Wastewater Control, City and County of Denver, Colorado. Allen Roberts, Assistant Director of the Utilities Department, Fort Lauderdale, Florida, contributed to Chapter 3, "Determination of Quantitative Manpower Requirements." The Department of Labor's Occupational Analysis Field Center in Raleigh, N.C. provided advisory assistance and training for research personnel of the project. The Center, also, reviewed the Occupational Descriptions presented in this Manual.

1. INTRODUCTION

Recent emphasis on the construction of wastewater collection systems as well as the formulation of wastewater management methods, was provided by the Federal Water Pollution Control Act Amendments of 1972 that made specific provisions "to eliminate the discharge of pollutants." The amendments, also, imposed stringent requirements applicable to both wastewater collection operations and maintenance.

The provisions contained in the Federal Water Pollution Control Act Amendments of 1972 are administered and coordinated by the Environmental Protection Agency (EPA) which was created by Executive Order in December 1970. Included among its responsibilities are the establishment and enforcement of water quality standards, the development of a National Pollutant Discharge Elimination System, and issuance of grants for the construction of public wastewater treatment plants and collection systems. Funds are, also, provided for research and demonstration projects relating to operation and maintenance methods and procedures, design criteria and for the development of new systems. Other technical and financial support is given for assessment of manpower requirements as well as the training of personnel in various aspects of water pollution control.

Manpower Planning will play a greater role to provide a sufficient number of properly trained personnel to ensure the efficient operation and maintenance of wastewater collection systems and the fullest utilization of resources. To accomplish this, the EPA through its Manpower Development Staff of the Office of Water Program Operations assumes the responsibility for the development, maintenance and dissemination of information relative to manpower planning methods, tools and techniques such as those found in this Manual.

PURPOSE:

This Manual contains some of the data essential in fulfilling the need for manpower planning in the water pollution field that is presented in a practical and easily accessible form. The specifications provided herein are based upon a thorough investigation of the requirements for effective operation and maintenance of wastewater collection systems in cities of 150,000 to 500,000 in population.

Occupational Descriptions are included that itemize the main duties, working conditions and the particular demands of the jobs required, in terms of physical demands, and behavioral and psychological traits of the personnel. These are considered essential in the satisfactory accomplishment of the required tasks. Staffing

Guides have been prepared that quantify manpower requirements which specify by occupations the recommended numbers of personnel in order to assist manpower planners, trainers, and wastewater collection management personnel in making more effective selection of workers and more efficient use of resources. Task Descriptions are included that provide guidance for the development of curricula and training programs.

SCOPE:

The accelerated growth throughout the nation in the water pollution control field anticipates a marked increase in the numbers of personnel required to fill increased needs as well as the opportunities provided by an increase in job diversification. During the course of this research, the following twenty-five occupations were identified:

Superintendent	Maintenance Equipment Operator
Assistant Superintendent	Construction Equipment Operator
Maintenance Supervisor II	Automotive Equipment Operator
Maintenance Supervisor I	Laborer
Equipment Supervisor	Maintenance Mechanic II
TV Technician II	Maintenance Mechanic I
TV Technician I	Maintenance Mechanic Helper
Foreman	Electrician
Maintenance Man II	Construction Inspector Supervisor
Maintenance Man I	Construction Inspector
Mason II	Dispatcher
Mason I	Stock Clerk
	Clerk Typist

These jobs essentially include those related directly to Repair, Cleaning, Inspection and Preventive Maintenance of storm sewers, sanitary sewers and waste pumping stations (lift stations). Occupations related to construction have been omitted as well as those related to plumbing inspection, billing operations and engineering which may be included in future research. These functions, as well as those listed above, will be found in the U.S. Department of Labor's Dictionary of Occupational Titles. It was, also, observed that most cities contract out the construction of new sanitary and storm sewers. As a result, new sewer construction activities are not included in this study.

The Manual consists of five chapters. Chapter I briefly describes the interests and responsibilities of the U.S. Environmental Protection Agency and discusses the purposes, scope and methods employed during the progress of the study. Chapter 2 identifies the different components of the wastewater collection system and describes the maintenance requirements of the system. Chapter 3 presents staffing guides for cities of different sizes. Chapter 4

presents Occupational Descriptions for the twenty-five jobs identified in the study. These descriptions consist of Occupational Definitions and Qualification Profiles that describe the extent of Formal Education, General Requirements, General Educational Development, Specific Vocational Preparation, Aptitudes, Interests, Temperament, Physical Demands and Working Conditions. The Occupational Descriptions will be submitted to the U.S. Department of Labor for incorporation in the Dictionary of Occupational Titles. Chapter 5 outlines Task Descriptions for the operation of sewer inspection and cleaning equipment and the repair and maintenance of sewers and lift stations.

METHODOLOGY:

The following summary shows the overall pattern of procedural organization in the design of the study. The research was based on field observations and interviews conducted with supervisory and technical staff. The cities studied were divided into five categories depending on the size of population. A sample of five cities in four states was selected for intensive observation of all crews involved in the repair, cleaning, and maintenance of storm sewers, sanitary sewers, and wastewater lift stations. Task Descriptions were written by trained interviewers using a prepared questionnaire.* During this phase, most of the tasks described were observed under a variety of environmental and operational conditions. The Task Descriptions were then properly evaluated with extensive interviews with workers, leadmen, foremen, maintenance supervisors, and technical consultants.

The next phase was the acquisition of sufficient and meaningful facts on which to structure the development of Occupational Definitions and Staffing Guides free from distortion due to local or regional conditions. Forty-four (44) additional cities in various states were visited to interview wastewater control administrative personnel. Data were recorded on prepared questionnaires and available Job Specifications were studied. The following twenty-nine (29) states were included in the sample:

*Readers interested in becoming acquainted with data collection instruments used in the study are referred to "Research Report: Manpower Requirements for Waste Water Collection Systems in Cities and Towns up to 150,000 in Population", prepared by Elie Namour for the Environmental Protection Agency, Washington, D.C.: June 1973. Included in the Research Report are statistical data, findings, conclusions, and recommendations relating to staffing wastewater collection systems.

<u>State</u>	<u>Number of Cities</u>
Alabama	1
Arizona	1
California	5
Colorado	1
Connecticut	1
Florida	4
Georgia	1
Iowa	1
Kansas	2
Kentucky	1
Louisiana	2
Massachusetts	1
Michigan	2
Minnesota	1
Nebraska	1
Nevada	1
New Jersey	1
New Mexico	1
New York	1
North Carolina	1
Ohio	3
Oklahoma	1
Oregon	3
Rhode Island	1
Tennessee	1
Texas	4
Utah	1
Virginia	3
Washington	2
TOTAL	<u>49</u>

2. WASTEWATER COLLECTION SYSTEM

The purpose of a wastewater collection system is to accept, at the point of origin, liquid waste and to convey it in essentially unaltered condition to treatment points and then to carry treated wastewater to a receiving body of water. There are three types of sewerage systems. The storm sewer is the oldest type and has been uncovered in the most ancient cities. It has the function of carrying runoff from rainfall quickly away from streets and parking lots so that transport is not impeded.

The combined sewer is the second type in a historical view. Sanitary wastewater was first introduced into storm sewers in the mid-nineteenth century and the sewers were then called Combined Sewers. During dry weather there is always a small flow of sanitary wastewater and during storms it is mixed with the very large volume of storm runoff. The separate sanitary sewer was introduced about the turn of the century so that the objectional small volume of sanitary waste could be treated before it was discharged into harbors alongside of the untreated storm water. The combined sewer system is found in many of our oldest and largest cities where the cost of converting to a separate system of storm and sanitary sewerage is now prohibitive. Most systems are separated.

It is important to recognize that sewerage systems are gravity flow systems and include as few pumps or other working parts as possible. Accordingly the design is strongly influenced by the topography of the community. The steep slopes of mountainous terrain introduces pipe erosion problems resulting from high velocity flow. Flat coastal systems suffer from infiltration of groundwater and from sedimentation in the pipes resulting from low velocity flow. The common materials of sewer systems are vitrified clay and concrete although asbestos cement, cast-iron, galvanized steel and plastic are, also, widely used. Figure 1 on page 6 shows the variety of plans that may be employed.

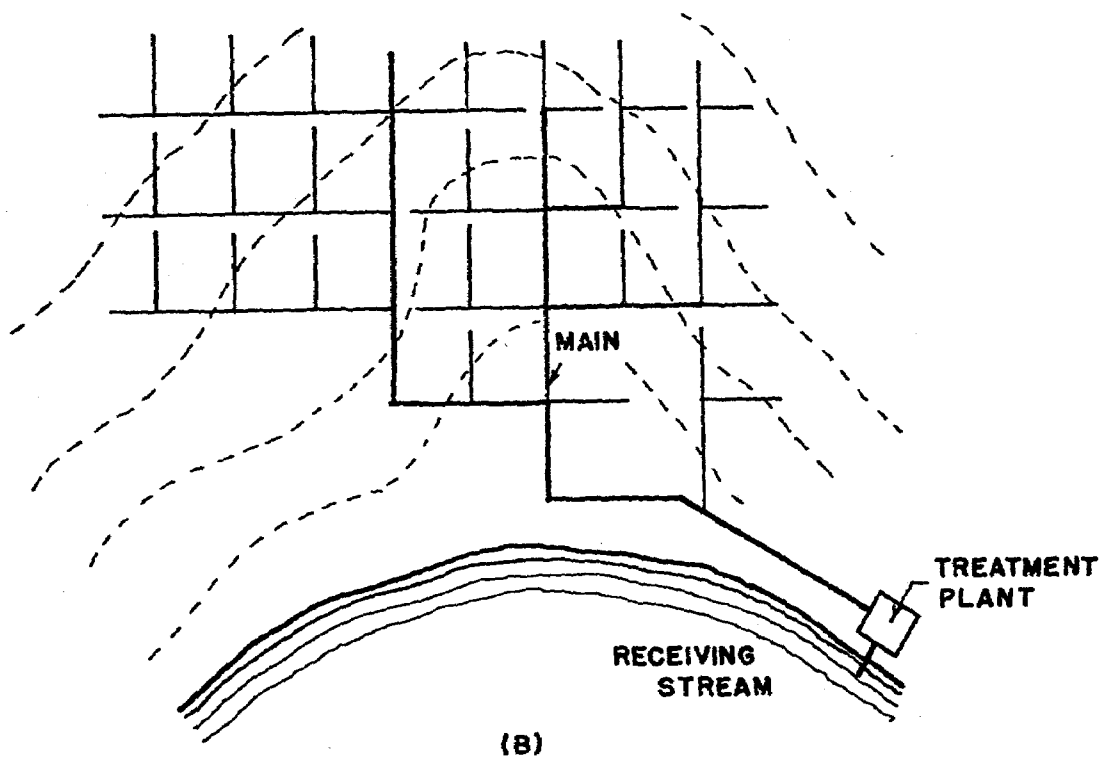
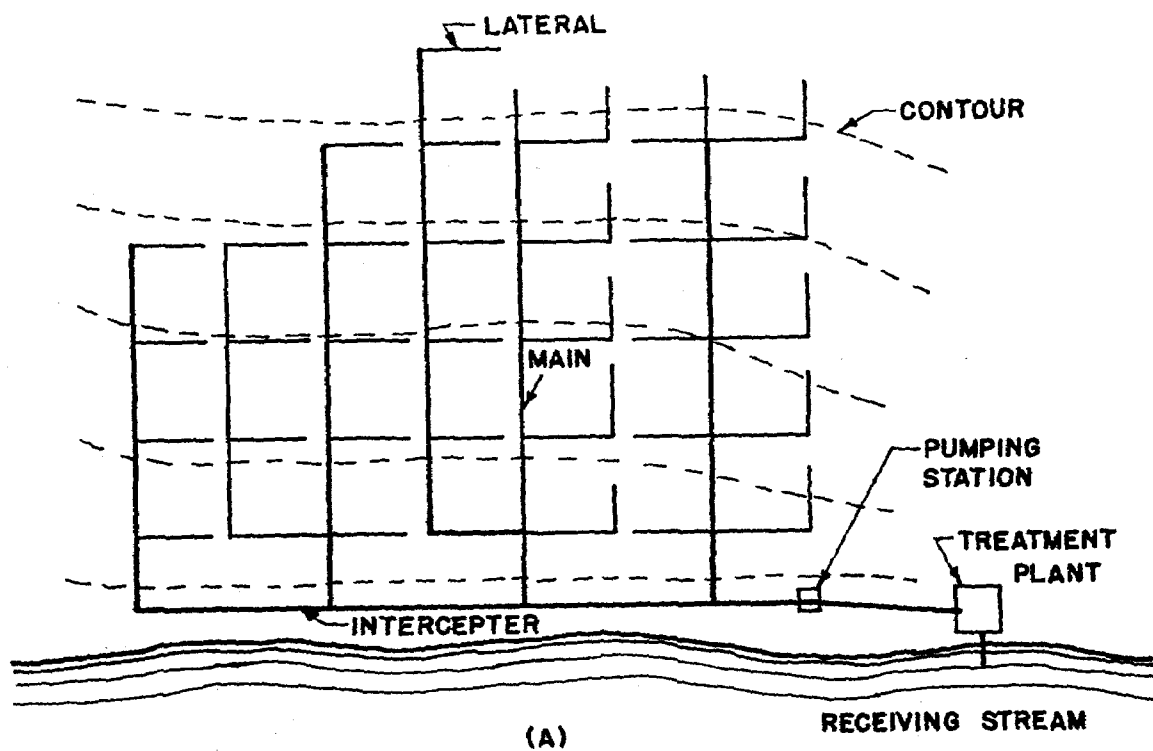
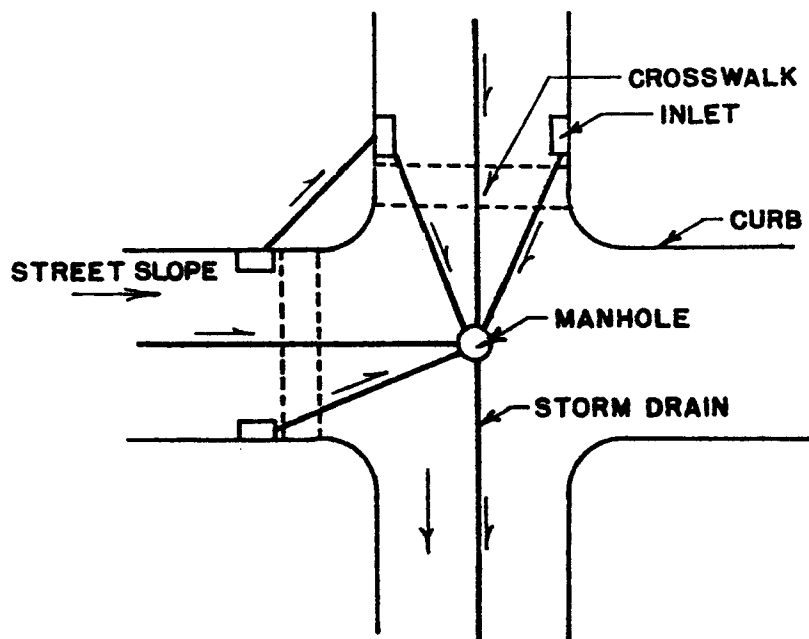


FIGURE 1

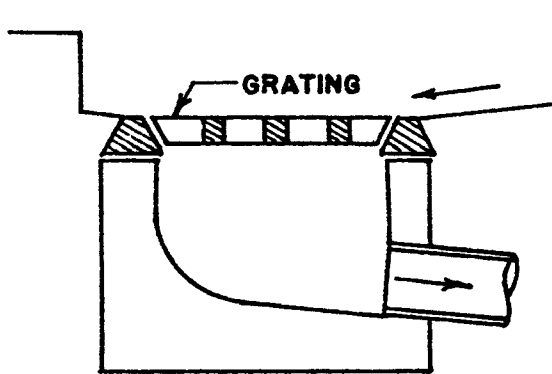
STORM SEWER SYSTEMS

Storm sewer lines (Figure 1, page 6) are designed to carry surface runoff as quickly as possible to natural water course.

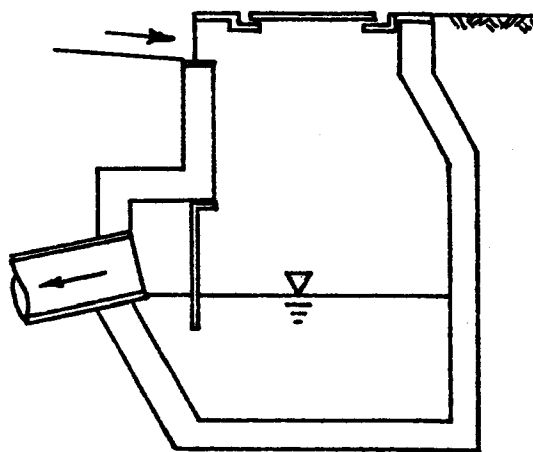
- a. CURB AND GUTTER: In most cases the curb and gutter of the street system carry the water to a street inlet which in turn conveys the water to the storm drain. Thus, the street curb and gutter are essential parts of an urban storm drain system.
- b. STREET INLET: The street inlet is usually located near intersections where it accepts water from the street either through a grated street opening or through an opening in the curb. A pipe from the inlet discharges directly to the storm drain (Figure 2, page 8).
- c. CATCH BASIN: The catch basin is simply a street inlet that has a deep trap that retains leaves, grit, and heavy debris which otherwise would be carried into the sewer. They are utilized wherever a large amount of surface dirt is to be expected. Since they must be cleaned periodically many cities do not use them. Figure 2, page 8, illustrates the difference between the inlet and the catch basin.
- d. LATERAL LINES: Lateral lines serve short residential streets and are commonly about 18 inches in diameter.
- e. MAIN LINES: The main lines collect the drainage from the laterals. The size is a function of the frequency of the design storms. Downtown business districts may be protected against a 5 or 10 year storm. Residential neighborhoods may only be protected against a 2 or 5 year storm. Sizes, thus, may go to 72 inches in diameter.
- f. INTERCEPTORS: These lines intercept flow from the mains before it is discharged to a stream. They then guide the flow parallel to a stream to a point where the flow may be released without danger of eroding stream banks or to a point of treatment.
- g. OUTFALLS: Outfalls carry flow into a receiving body of water. An interceptor may become the outfall if there is no treatment plant as in most storm systems.



**INTERSECTION
PLAN**



INLET



CATCH BASIN

FIGURE 2

COMBINED SEWER SYSTEM

The extremely wide variation of flow in a combined sewer ranging from very small nighttime sanitary waste flows to a very large storm flows require the introduction of special bypass devices so that large excess flows go directly to a receiving body of water. The normal sanitary or "dry weather" flow is diverted to the treatment plant.

- a. LEAPING WEIRS: Normal sanitary wastewater drops through a vertical pipe (see Figure 3, page 10). Large flows "leap" over the opening of the vertical pipe and go to the point of discharge.
- b. DIVERTING WEIRS: Normal sanitary wastewater flow is turned from its normal direction of flow and is "diverted" to the treatment plant. Storm flows are very large and pass over the weir to the discharge point.
- c. SIPHON SPILLWAY: The siphon is only activated by very large storm water flows and then diverts flow directly to stream. Low sanitary or "dry-weather" flow goes to a treatment point.

SANITARY SEWER SYSTEMS

Sanitary sewer systems include laterals, the mains, the interceptors, and the outfalls similar to the storm sewer system (see Figure 1, page 6). They differ from storm drainage systems in that they are normally smaller (laterals are 8 inches in sanitary and perhaps 18 inches in storm systems). They are, also, commonly much deeper in the ground than a storm drain. They must be sufficiently deep to catch waste from household basements.

The "house connection" is either a 4-inch cast-iron pipe or a 6-inch vitrified clay pipe that connects the house drains to the lateral or main.

Additional maintenance to minimize infiltration and avoid expensive waste treatment is usually required to keep lines and manholes tight against external water.

It is, also, necessary to inspect and insure that illegal connections are not made. Such illegal connections would include:

- a. Connections to roof leaders, yard drains, etc.
- b. Discharges of acid or alkali from chemical processing.
- c. Drainage from gas service stations that might have oil or gasoline in it.

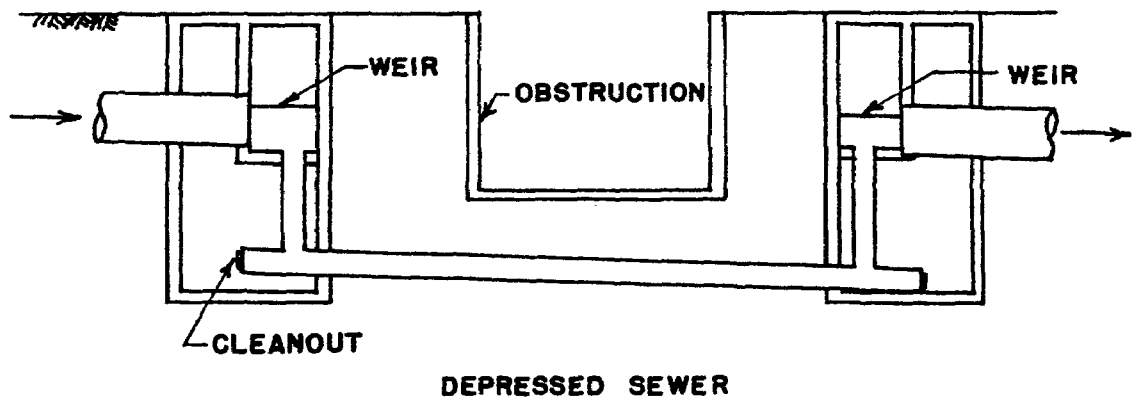
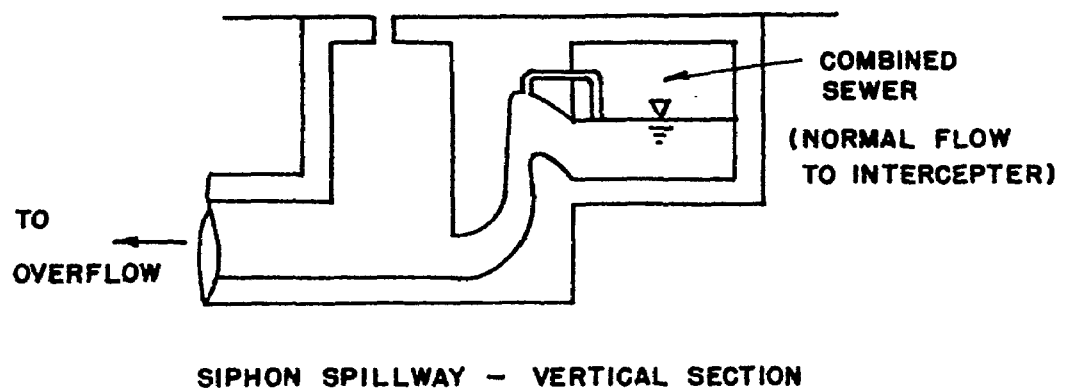
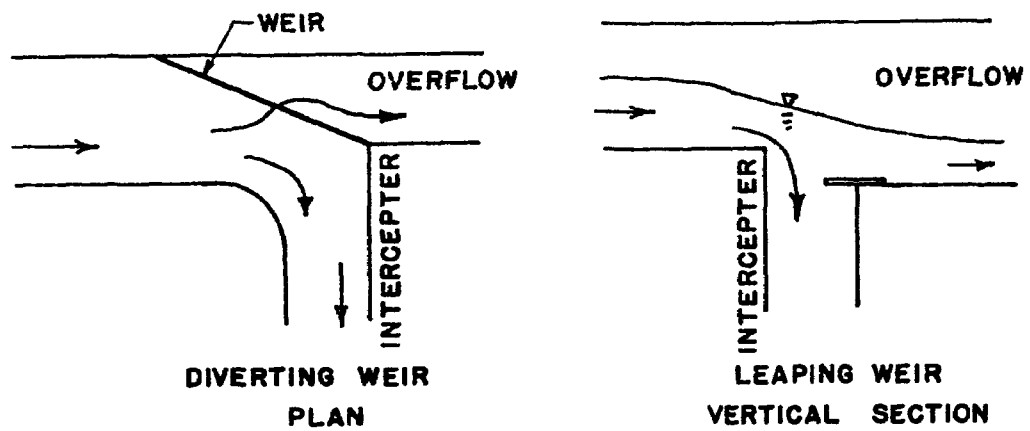


FIGURE 3

APPURTENANCES

MANHOLES:

Manholes (Figure 4, page 12) are ground surface openings in a sewer and serve many purposes among which are the following:

- a. Access to sewers for men and equipment. Equipment usually dictates a bottom diameter of at least 4 feet.
- b. Vents to prevent accumulation of explosive or toxic gases.
- c. Vents to prevent corrosion by hydrogen sulfide.
- d. Provide locations for gauging flow.
- e. Allow for changes in direction of flow.
- f. Allow for connections at different elevations.
- g. Allow for reductions in velocity.
- h. Relief valve for excessive flows especially in storm drainage systems.
- i. Allow for changes in pipe sizes.

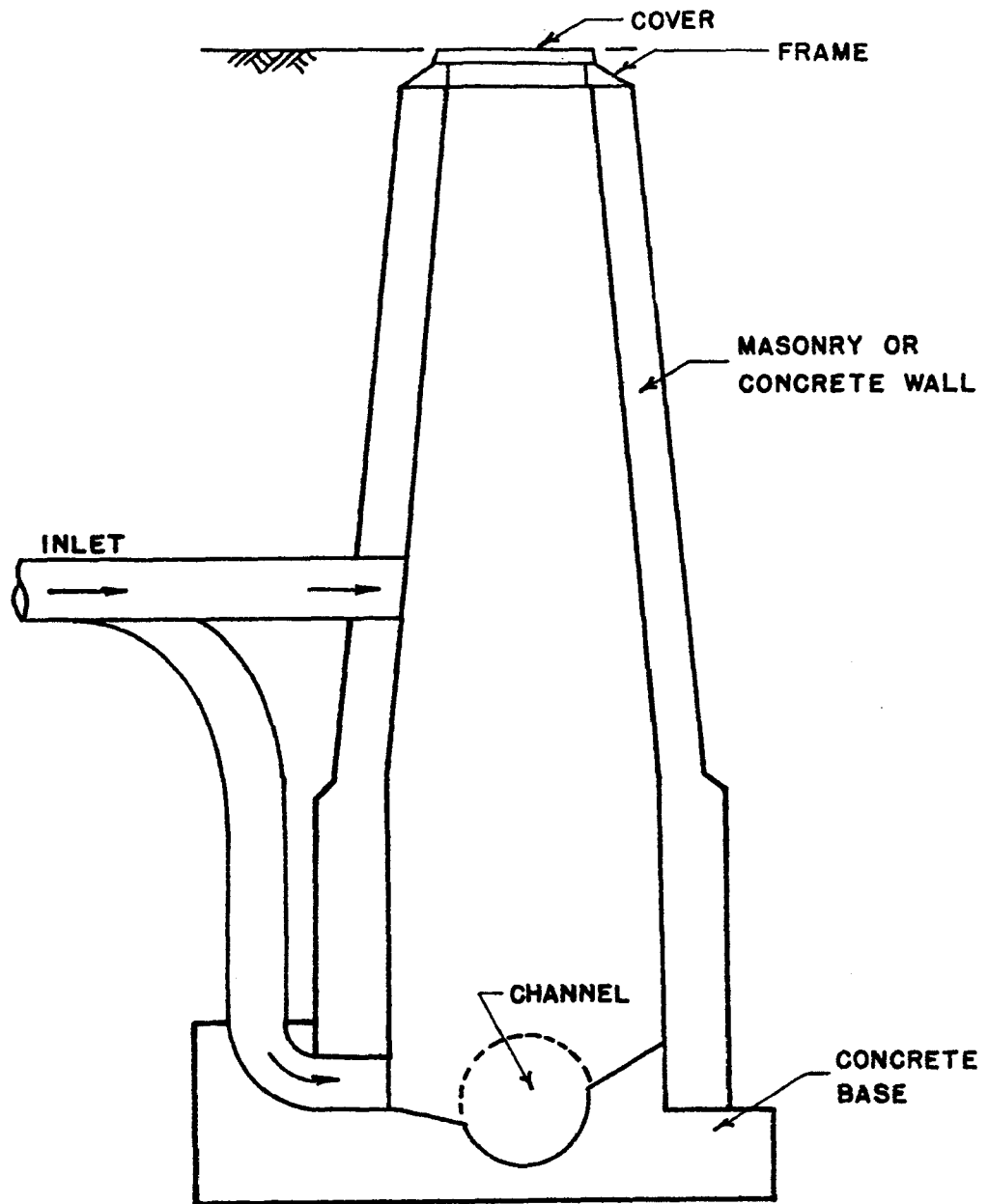
INVERTED SIPHON:

A sewer line requiring a sudden change in grade to pass under an obstruction and then a grade reversal to regain its original slope. Wastewater in the depressed section of the pipe is not always flowing and solids tend to drop out and collect in the low points, resulting in a continuous maintenance problem.

PUMP AND LIFT STATIONS:

When wastewater cannot be carried by gravity over a ridge or past an obstacle, it may be necessary to "pump" the sewage into a "pressure main" that carries it to a treatment plant. In other cases it may be sufficient to "lift" the wastewater from a low-lying gravity sewer to another gravity sewer at a higher elevation.

Lift stations frequently use compressed air in alternating chambers to "push" the water higher and to avoid moving parts in contact with the flow. Pumps must have non-clog impellers so that solids in the wastewater do not damage the pump.



**DROP MANHOLE
SECTION**

FIGURE 4

SYSTEM DEFICIENCIES

Irregularities, flaws, malfunctions and failures will exist to some degree within any wastewater collection system. The following is an inventory of the type of deficiencies: (1) Protruding building sewer connections; (2) Misaligned lengths of pipe; (3) Deviation in grade between lengths on conduit; (4) Porous pipe; (5) Leaky joints; (6) Sludge buildup; (7) Hydrogen sulfide generation; (8) Pipe deterioration; (9) Incrustations; (10) Root intrusions; (11) Infiltration and exfiltration; (12) Sand and gravel inclusion; (13) Grease and grit buildup; (14) Storm water inflow; (15) Structural failure of pipe; (16) Hydraulic overload.

The causes of the defects of the system can be grouped into categories of (1) Faulty design, manufacture and construction; (2) Excessive waste discharges into the facilities; (3) Inadequate maintenance; (4) Soil and groundwater stresses; (5) Facility disturbance by conflicting utility construction; (6) Changes in land and water uses, wastewater loading, and service area contribution. Some of the effects of the deficient conditions are: Odors; Street caveins; Flooded basements; Polluted water courses; and Overloaded treatment facilities.

OPERATION AND MAINTENANCE

STATE OF THE ART:

There has been a void in the technology relating to maintenance of wastewater collection systems. This condition can be attributed to the general disassociation of the engineering profession for the function of maintenance and, in part, to the misconception that the maintenance of sewers is an unsophisticated activity if not, in fact, unnecessary except for system malfunctions or facility failures. The public has little opportunity to define the service which it expects from a wastewater collection system until existing service is disrupted, at which time that definition is very explicit and vociferous.

The requirements of the function of wastewater collection can be summarized as a system of conduits which is hydraulically adequate, durable, structurally sound, contains a minimum of irregularities and flaws, is operated and maintained on a timely and routine basis to the extent that major repair and replacement efforts are minimal and, consequently, public convenience is maximum with the disruption of service at a minimum. An analysis of this summary reveals the need to plan maintenance standards in connection with facilities development. It cannot be assumed that maintenance will be provided to the extent necessary to sustain the criteria of design and construction.

An Ad Hoc Committee on Wastewater Collection Systems of the Water Pollution Control Federation (WPCF) in 1971-72 conducted an inventory for the purpose of establishing an information base upon which to assess the present "State of the Art" of the function and activities of Wastewater Collection. This inventory was primarily directed towards the identification of the improvement needs of, and the deficiencies in, the activities of wastewater collection. Some observations contained in the report of that committee relating to operation and maintenance are:

"There are issues why sewer systems should be maintained to any particular level or what methods, techniques, or equipment are best. Too many answers to these questions lack anything in the way of quantitative evaluation and are presently, only, a matter of speculation...Most of the knowledge that we have relating to operation and maintenance requirements, results, or evaluation of the conditions of sewers for that matter is based upon uncontrolled observations rather than real research studies on systems...Any level of preventive maintenance using modern methods and equipment tends to reduce emergencies and repair and replacement, but reasonable speculation, based upon the inventory, indicates that funding for operation and maintenance is, generally, restrained to the level required for emergency maintenance."

There was general agreement among those contributing to the WPCF inventory on the "State of the Art" of Wastewater Collection that because of the apparent lack of attention to all aspects and activities relating to the development and operation and maintenance of wastewater collection facilities, most systems are not functioning to a satisfactory level of performance. Considering the observations that preventive maintenance has not, generally, been provided on a continuing and routine basis, then it must be stated that collection systems, as a rule, must be renovated to the extent that preventive maintenance would then be effective in offsetting further system deterioration.

The WPCF prepares "Manuals of Water Pollution Control Practice" of which MOP No. 7 is entitled "Sewer Maintenance." It was prepared in 1966, and it represented the "State of the Art" for the methods, techniques, and equipment utilization for maintenance practices which were current for the period. It is still the best published information for the overall function of sewer maintenance practice. This manual speaks to the need for preventive maintenance and discusses procedures associated with the activity; yet, as the WPCF Ad Hoc Committee determined, preventive maintenance for sanitary sewers, or wastewater collection facilities, is not a general practice among municipalities having responsibility for that function and that there is little background to guide those managers, or superintendents, who would care to do so.

CONSTRAINTS:

There are deficiencies in the activities of wastewater collection that constrain the implementation of preventative maintenance of which the activities of planning and management are most neglected. The lack of standards for maintenance of collection systems is a deficiency of planning and the failure to recognize the need for such standards is a deficiency of management. In addition, there is a sparsity of middle management responsible for the function of system maintenance.

Legislative and technological advancements, related to water pollution control, have been preoccupied with the establishment of standards and development of processes, equipment, facilities, and manpower for the treatment and disposal of wastewaters and, consequently, the needs of the collection system have received little attention towards improvement requirements. This, of course, is a deficiency of planning; and there is a need to provide for a balanced program of collection system maintenance.

MANAGEMENT:

It has been stated that management has the responsibility to require standards of performance for systems maintenance. Unless management responsibility is specified, there will be neither the definition of maintenance standards nor will there be the implementation of a viable program for collection system maintenance activities.

It is most important to differentiate between the techniques, methods, and procedures of collection system maintenance and the management of the activities of that function. Individual maintenance activities will alleviate specific, or isolated problems of the collection system. A balance, or management, of maintenance activities will, however, minimize, if not in some cases, eliminate, problems from occurring in the collection system. Herein lies the difference between the application and the management of maintenance activities. Management provides emphasis, implementation, direction, and control through the development and coordination of a comprehensive wastewater collection program; the identification of program requirements; the procedures for the implementation, acceptance, and maintenance of the program; the establishment of organizational principles and procedures; and the surveillance, evaluation, and adjustment of the progress of the program. Management emphasis, as it relates to preventive maintenance for wastewater collection facilities, identifies its importance and promotes the progress of such an activity.

The implementation of a preventive maintenance program must be managed through the political element in order to be positioned for public acceptance. A viable maintenance program must be provided

direction through the establishment of goals and objectives, and, of course, must be controlled in its progress in order to minimize deviation from its charted direction. A program must be designed which will accomplish the stated goals and objectives; and to this end, individual elements, or components, of the program will be identified according to its specific performance, or functional classification.

Any program, and preventive maintenance for collection systems is no exception, must be provided momentum through organization. Organizational development, or planning, must consider the goals and objectives, the conditions of the system, and the service or performance requirements of wastewater collection. Management tools must be established which will capture, record, and report information relating to program progress and performance. Evaluation and analysis of those records in comparison with stated objectives provides a basis for program adjustment or a revision of the objectives or service requirements.

PREVENTIVE MAINTENANCE

BASIC ASSUMPTIONS:

There is no standard practice with respect to wastewater collection system preventive maintenance; therefore, the approach to such a program must be based upon certain assumptions, or premises, as follows:

1. A clean system will not generate hydrogen sulfide and, therefore, odors and deterioration will either be eliminated or minimized. Additionally, the absence of debris from the system stops malfunctions due to that source. The capacity of the system will not be usurped.
2. The cleaning process provides a degree of system investigation and surveillance to the extent of detecting obstructions and, additionally, detects trends of reaches of the system to become problem prone.
3. The analysis of the histories of malfunctions and failures will augment and intensify the knowledge gained in the cleaning process.
4. A sophisticated inspection and surveillance procedure is required to clearly identify and locate aggravated system defects.

5. The identification and analysis of the service area and waste and wastewater contribution to problem reaches will greatly assist in the evaluation of the cause of system malfunctions and defects and the alleviation thereof. Many system malfunctions can be minimized or eliminated, by controlling the contribution to the system.
6. Routine repair and replacement should be scheduled in order to compensate for normal system depreciation.
7. Some problems and defects require major repair, replacement or relief to provide the degree of service demanded by the public.
8. Some problems and defects which can be alleviated by operation and maintenance procedures can be eliminated more economically through repair, replacement or relief to the system.

OBJECTIVES:

From the foregoing it becomes obvious that preventive maintenance for collection systems is more conceptual than standard practice because of the lack of definition of program level. The general concept is to insure the integrity of the wastewater collection system as planned, designed, and constructed and the provision of uninterrupted service to the public by:

1. The routine cleaning and inspection of the system.
2. The scheduled maintenance of problem prone reaches of the system.
3. The expedient resolution of emergency related problems.
4. The scheduled repair and replacement of deterioration prone reaches of the system.
5. The scheduled relief of hydraulic over-loaded reaches of the system.
6. The quality and quantity control of wastewater contribution to the collection system.

The effort required to attain the goals and objectives subscribed to above will define a comprehensive work program of wastewater collection system operation and maintenance. Most collection systems have depreciated from their intended performance levels due to an accumulation, or backlog, of deficiencies and defects. The initial effort towards the attainment of preventive maintenance must recognize the concentrated program required to renovate the facilities to their original potential for service.

A program which is directed towards the aforementioned objectives must relate the condition of the collection system; the system maintenance activities and organization; and the performance and service of the facilities. An inventory of these components is the logical first step in the development of a preventive maintenance program.

The system condition can be described as the percentage of capacity which is related to deficiencies and deterioration. In order to establish an effective maintenance program and provide efficient performance at the expected level of service, the percentage should not be too much in excess of the normal annual depreciation factor; if it does, then the program should be geared to restore the system to that limit.

The inventory of the collection system organization and its activities is indicative of the type of maintenance policy. If the efforts of the organization are concentrated upon emergency maintenance and unbudgeted repair and replacement activities, then it is reasonable to assume that the system has deteriorated far beyond the level of the annual depreciation factor.

A system which has deteriorated and which, additionally, requires emergency maintenance and unscheduled repair and replacement will generally have associated negative public and political response due to inadequate performance.

STRATEGY:

The strategy for the development of a program of preventive maintenance can now be outlined as follows:

1. Establish management.
2. Inventory, analyze, and evaluate the conditions of the system, its performance and service, the historical maintenance program, and the historical capital repair and replacement program.
3. Compare the performance and service of the system with expected, or anticipated, standards.
4. Relate the deficiencies of the system to its service and performance inadequacies.
5. Apply the maintenance premises in conjunction with the inventory in order to, at least, estimate the magnitude of maintenance functions and activities required to accomplish the scope of work identified in the goals and objectives.

WORK PROGRAM:

The resulting work program brought about by the application of the aforementioned strategy will consist of the components of:

1. Operations - to provide routine, recurring, and emergency cleaning, repair, and replacement.
2. Inventory - to provide continuing system investigation and evaluation.
3. Control - to provide routine surveillance of the contribution of wastes and wastewater to the system.
4. Planning - to develop programs for the maintenance, renovation, improvement and expansion of the system.
5. Projects - to provide major repair, replacement, relief and expansion of the system.
6. Customer Service - to investigate and settle public complaints and claims regarding system failures and malfunctions and to arrange and manage the public demand for service.
7. Administration - to capture, record, and maintain records and to service organizations demands and requirements such as purchasing and payroll procedures.
8. Management - to implement, direct, evaluate, and adjust the program.

A balanced work program should be directed towards preventive maintenance which requires emphasis to the condition of the system. In the development of the program that emphasis will manifest itself in new systems to the extent that routine repair and replacement is budgeted in the operational budget to the level of annual system depreciation; and in deteriorated systems to the extent that capital repair, replacement, and relief is budgeted for projects sufficient to renovate the system to the level of annual system depreciation.

OPERATION AND MAINTENANCE ACTIVITIES

There are generally accepted functions and activities of wastewater collection system operation and maintenance. The functional classifications are: (1) Cleaning; (2) Repair and replacement; (3) Inspection and control; and (4) Relief.

CLEANING:

The activities of cleaning can be characterized according to the type of equipment or tool used and the purpose of the cleaning, as follows:

Flushing is accomplished by the discharge of water from tank trucks, called flushers, through manholes into the conduits of the system. The purpose of the activity is to generate a hydraulic surge which will dislodge accumulations of sludge, grit, sand and gravel, and grease.

Balling is used to generate a combined pressure and rotating action which will scour accumulations of sludge, grit, sand and gravel, and grease. It uses a spirally grooved ball which is inserted into the sewer line and water is pumped into the manhole. This water passes around the ball through the spiral grooves that loosens dirt from the walls of the line and drives the ball forward forcing the accumulated debris ahead to the next manhole for removal.

Rodding is accomplished by simultaneously thrusting and rotating a tool through the system conduits manually or using a power rodder. The purpose of the activity is to cut intruded roots, dislodge accumulated grease and grit, and to remove incrustations. The power rodder can either be truck mounted or trailer mounted. For best mobility on typical urban streets the truck mounted power rodder is preferred. This rodder has the equipment to unstop mains from 8 inches in diameter to about 36 inches in diameter. The crew should be equipped with three men to provide safe operation and safe handling of traffic problems created by working at manholes at street intersections. The truck should be equipped with at least 500 feet of rods and a complete set of tools involving all sizes of cutters.

Jetting is the feeding of a high velocity water jet through the system conduits in order to dislodge accumulated grease and grit, and sand and gravel. The water jet should be truck mounted. The truck should be equipped with a minimum of 500 feet of hose and a variety of nozzles for various size lines and types of problems. Basically, the machine works with pressures of approximately 1,000 PSI with a majority of holes in the nozzles jetting to the rear, so that the hydraulic power pulls the nozzle through the line and flushes the solids in the line downstream. This machine is most effective in pipe sizes of 8 inches through 15 inches in diameter.

Bucketing is the use of a bucket machine to remove large quantities of silt and grit from outfall lines. The bucket is pulled through the line between two manholes by means of a winch with the bucket's jaws open to scoop up debris. When full, the bucket travel is reversed with its jaws closed and is returned to ground level at first manhole where it is emptied.

Vacuuming is accomplished by a vacuum jet rodder which generates a suction through a hose which discharges into a container and the suction end is inserted into the manholes of the system. The purpose of the activity is to remove debris which has been dislodged from the conduits of the system by a high velocity cleaner.

Routine cleaning is budgeted as the basic program and additional effort is budgeted to provide emergency and recurring cleaning. Recurring cleaning is that effort which is applied to known problem prone reaches of the system in order to eliminate emergencies from recurring. Emergency cleaning, of course, is that cleaning which is applied to remove obstructions which have caused a malfunction.

REPAIR AND REPLACEMENT:

The causes of repair and replacement are: (1) Connection protrusions; (2) Conduit misalignment and grade deviation; (3) Leaky joints; (4) Porous pipe; (5) Deterioration; (6) Structural failure; (7) Aggravated cleaning requirements.

The scope of repair and replacement ranges between the effort for the repair at a point in the system, the partial replacement of a reach of the system, and the total replacement of a reach (between manholes) or several reaches of the system.

The methods of repair and replacement are classified as:

1. Sealing joints through the use of internal chemical grouting equipment.
2. Reclining of damaged old sewer line by the insertion of a polyethelene pipe which has been joined by a heat fusion into the existing conduits of the system.
3. "Digups", or excavations, for point system repair, partial reach replacement, or aggravated cleaning requirements.
4. Construction of system by-passes or parallel facilities to replace an ineffective or inoperative reach, or reaches, of the collection system for any of the causes, or combination thereof, listed above.

The magnitude of wastewater collection facility repair and replacement can be grouped into routine and capital efforts. Routine repair and replacement is related to normal system depreciation while capital repair and replacement is associated with major system renovation.

INSPECTION AND CONTROL:

The control of collection systems is to prohibit the discharge of harmful and detrimental wastes or excessive wastewater into the collection system. This activity is accomplished by authority of regulations through surveillance of inspectors and sampling and measuring crews. This control minimizes system deterioration and insures maximum system hydraulic capacity.

The emphasis of system condition must, also, be sustained through efforts directed towards knowledge of that condition. This activity is accomplished by multiple means, but the most modern and effective method is accomplished by a television surveillance program. A closed circuit television system is utilized for remote visual inspection of sewer lines. A TV camera is drawn through the line and a TV monitor shows the condition of the sewer. Greater efficiency would be accomplished if TV surveillance were used in conjunction with a telegrout system for the internal sealing of leaking sewer lines. The sewer sealing equipment is used with a television camera for remote internal repair of leaking sewer lines. The equipment is pulled through the pipe, its packer is inflated and a chemical grout compound is pumped over the suspected leak to seal the line.

RELIEF:

The relief of collection systems is to augment existing hydraulically overloaded conduits with the construction of supplementary facilities.

PERSONNEL:

Maintenance activities are accomplished by crews consisting of men and equipment, the makeup of which is dependent upon the particular activity being performed. Routine cleaning can be accomplished by either flushing, jetting, or balling the system. The number of crews is dependent upon the magnitude of the system and the frequency that is desired to completely clean the facilities. Most advocates of preventive maintenance program the cleaning cycle at annual intervals.

The cleaning process will identify system problems which require corrective maintenance, e.g.: rodding, jetting, bucketing, sealing,

or repair and replacement. The extent of the corrective maintenance requirements is dependent upon the system condition and, therefore, establishes the type and number of crews for this purpose. The initial cleaning cycles will identify areas, or reaches, of the system which should be scheduled for either routine or capital repair or replacement projects. It will, additionally, identify problem prone reaches of the system which need to be scheduled for recurring maintenance. In addition to the indicated system maintenance activities, there are activities which are necessary to keep the system current with other functions such as raising man-holes in association with a street paving overlay program.

The supervision of the maintenance process is the key to the success of the work program. It is most necessary and important to develop rigid schedules and to capture and report appropriate system performance and service information for inventory and evaluation purposes. There, also, is the need to include basic repair and replacement activities in a preventive maintenance program. It has been stated previously that an effective program will include as a matter of routine, the scheduled repair and replacement which will maintain the level of system depreciation to a minimum of one year.

Irrespective of organizational input with respect to the activity of routine repair and replacement, there must be the ability to quickly respond to emergencies requiring repair and replacement. Where feasible, an emergency construction crew, with appropriate excavation and supplementary equipment and tools should be budgeted in the normal operating budget. This same crew can be utilized for the normal repair and replacement program. Smaller systems, for economical reasons, must rely upon contractual services for this activity, but it should be available for immediate response in case of emergencies.

3. DETERMINATION OF QUANTITATIVE MANPOWER REQUIREMENTS

ORGANIZATION:

The primary objective of this section is to familiarize the reader with management and systems concepts required in developing an organization. In developing any organization, manpower guidelines must be projected since responsibilities of public utilities are steadily increasing in complexity and status. As this trend continues more pressure is exerted both externally and internally to provide increased and efficient service at a low unit cost while economical conditions are steadily increasing the total cost of operations.

This observation is typical to the majority of wastewater collection managers and can be correlated to the organizational requirements and management principles used to meet immediate and future planning. An organization must be recognized as a dynamic plan of action which must be controlled and coordinated if major objectives are to be accomplished. Of course, the structural complexity must be homogeneous to allow continuity, but at the same time providing interaction and interface with other systems.

The systems approach in management is necessary to establish a basis for analytical determinations. A systematic analysis of task performance must be identified in relation to functional responsibilities. The internal relationships and external interfaces provide a network of complexity that must be sorted in a logical sequence to determine proper manpower utilization through basic systems concepts. The systems approach deals particularly with the management principles of planning and controlling of the activities. Hierarchy of objectives is similar to the hierarchy of technical and administrative attributes; specific objectivity is primary at the crew/foreman levels and becomes broader in scope at the higher management level. Objectivity at the departmental level must be converted to policy decisions which can be interpreted and applied throughout all segments of the organization where applicable. From policy evolves operating procedures which meet the objectives of the city and requirements of the department.

While the management concepts are intended to present a framework for the development of a total organization, emphasis must be placed upon the behavioral aspects required and the development of fundamental system approaches. The modern wastewater collection manager must deal with environmental problems and regulations interfaced with modern technology and specialization projected toward an organizational mechanism capable of meeting and satisfying objectives and constraints.

The organizational structure is a plan of action--past, present, future, and has a distinct identity in each phase but is characterized by the accomplishments achieved. The degree of achievement is based on how successfully the manager plans, controls, coordinates and directs the responsibilities assigned. These responsibilities are massaged and emerge as policies and procedures with specific objectives for each of the functions of the organization. In wastewater collection systems, the source of responsibility is specified in ordinance, by control authorities at state levels or by the Environmental Protection Agency (EPA) at the federal level. Very few organizations are created and adopted with an adequate staff to perform all the essential functions required mainly because of political strategies.

CONSTRAINTS:

There are certain constraints to be considered when designing an organization to meet the total responsibilities assigned and to delegate certain authority based on functional requirements. Figure 5, page 26, lists some of the external and internal constraints to be considered when formulating a realistic and practical organizational structure. Intuitive knowledge alone will not perceive the solution to accomplishing assigned responsibilities. Management knowledge and intelligence must be used to focus attention on each constraint and to evaluate the total ramifications affecting the organization.

FUNCTIONALLY ORGANIZED STRUCTURES:

An organization can be among the most formidably complex interactive systems to manage. Modern management techniques must be exemplified in order to plan, control, organize and direct the functions assigned. A systems approach within the framework of the structure represents one of management's latest innovations to cope with the external and internal pressures created by complex interactive social, economic, and political systems. Organizational problems have to be analyzed and discussed from many perspectives; the design of a functionally-organized structure with an integrated information system represents one attempt to meet this challenge.

Although an organization is functionally designed to take advantage of technology and specialization, it must be operationally-oriented both vertically to establish a chain of command and assignment of specific division responsibilities and horizontally for total involvement in multiple division functions.

The organizational charts in this chapter represent organizations designed to handle multiple functions internally with flexibility for expansion, specialization for innovating new technology, and

CONSTRAINTS TO BE CONSIDERED

External Constraints

Environmental Forces

- Economic growth
- Social change of area
- Public awareness
- Requirements
(Federal, State, Local)

Technological Forces

- New technology
- Specialization
- Computer usage

Consulting Firms

- Engineering services
- Management services
- Legal advice

Internal Constraints

Environmental Forces

- Population
- Terrain
- Area served
- System size

Organization

- Centralized/Decentralized
- Type of organizational structure
- Communications
- Information system
- Span of control
- Efficiency of operation
- Interaction
 - between related divisions
- Finance Dept.
- Engineering Dept.
- Fleet maintenance
- Self-reliant vs. contractors

Personnel

- Qualifications
- Training
- Behavioral patterns
- Complexity of paperwork

Design Objectives

Interaction

- Compliance with regulatory requirements
- Other adjacent utilities (Mutual Aid)
- Other city departments
- Consultants
- Contractors

Personnel

- Specialization/Professionalism
- Qualified employees
- Training & safety program
- Liberal benefits
- Promotional opportunity
- Increased motivation
- High morale
- Development of technical skills

Organization Characteristics

- Flexibility
- Functional control-consolidation
- Increase efficiency
- Reduce duplication of effort
- Simplicity of paperwork
- Computer usage
- Information system
- Reliable communications system
- Assignment of responsibility & authority
- Standardization
- Service-oriented
- Use of modern technology
- Totally self-reliant

FIGURE 5

independent operation to ensure reliability of service. External functions are handled smoothly with the centralized administration for better coordination and control of the total department. This structure not only meets the immediate operational requirements of wastewater collection systems, but can be expanded to meet future needs at a minimum cost allowing for adequate evaluation by Activities, Location, and Programs utilizing data processing techniques.

Primary consideration in the design of the organization structures in this Manual is to achieve maximum efficiency through continuity of effort by utilizing specialized technical knowledge where applicable, twenty-four hours per day, seven days per week. This utilization of personnel permits better usage of equipment, and the centralization of field operations which will eliminate the duplication of effort, reduce the overall cost of operation, and increase the reliability and efficiency of the department.

Centralization of administrative functions allows for the conversion of manually kept operational records to sophisticated computerized inventory and maintenance programs. The data is provided through a simplified work order system, which produces detailed and summary reports pertaining to labor-equipment-materials by function-location and program. The versatility of the computer provides an analytical method to project future requirements based on functional responsibilities. This will allow management to plan, control, coordinate and direct proper implementation.

It is not the intention of these organizational structures to represent a futuristic model of operation, but rather to have a practical approach to provide service to an exploding and concerned population which has recognized the importance of environmental control. This demand for quantity and quality of service in the wastewater collection field has demanded higher levels of professional management in order to innovate and supervise programs. Many management personnel have been forced to deal with administrative and technical problems on a day-to-day basis, increasing the workload and adding to the aggravation and frustration of operations. The organizational structures emphasize executives doing executive work leaving the routines established by management to competent supervisors responsible for compliance and control of established standards and policies, not only for uniformity purposes, but with the intention of relieving management of performing routine tasks.

STANDARDIZATION:

Job specialization is a demonstrated successful fact in industrial complexes; wastewater collection industry must change and adapt to some of these recognized methods of operation. Complex work can be segregated in relatively simple components, each accomplished effectively by employees performing single or a similar group of functions. More opportunity is afforded to match the desires, capacities and

interest of personnel in the job since a greater variety of jobs involving different duties, responsibilities, training, and background is required. This allows establishment of standard methods for performing each task and written standard practice instructions to be formulated so that carefully devised methods may be instituted and controlled.

The traditional method of operating small independent isolated sections creates unfavorable cost situations which nullify some of the savings realized in increasing operational efficiency. Inefficiency in performing necessary and required work without standardization of work task and established criteria of performance cannot be indiscretely accepted. Proper control by qualified supervisors will prevent discrimination of work forces since each work group has obligations to the total operations. Each supervisor must justify expenditures within his own budget. Securing the greatest results for the least expenditure of effort with the necessary feedback into the system can be accomplished within the functionally designated divisions.

Adoption of plans is extremely difficult in a large organization. Without careful planning to ensure a smooth implementation to provide uniformity by functions, details will be neglected and objectives will become distorted. For this reason, it is extremely important that careful consideration be given to all phases of implementation, starting with the delegation of duties and the realignment of functions to allow the individual supervisor to know in what area his efforts are to be concentrated.

The number of personnel assigned to a supervisor is determined by:

1. The functions performed
2. Required number of personnel to a crew based on function
3. Number of crews required based on work performance
4. Backlog of work
5. Established work criteria in a predetermined time frame

This arrangement allows for a well-balanced and sufficiently large work force to handle normal conditions. Minor peak loads within a division can be handled without difficulty, by establishing priorities and reassigning personnel on a temporary basis to reduce the backlog. This, also, provides a method to cross-train personnel within a section and/or division. Major peaks should be analyzed to determine frequency and severity, which will indicate either the need for additional personnel or the authorization of overtime during the time frame established. This is essential and necessary if continuity is to be maintained throughout the department.

INFORMATION COLLECTION:

Information is the name of the game and essential for a successful operation. The desire for valid information by management is essentially unlimited. The random collection of information available must be sorted and arranged for quick statistical comparisons that can be used as indicators when planning operational strategies. The contents of any reporting system must, also, be timely for management purposes. The source of this raw data is generated at the crew level and must be thoroughly analyzed to determine several factors. Depending on what factors you want to analyze, there are a number of ways to collate the facts provided from the work order system. Several factors have to be considered:

1. Areas of specialization
2. Functional assignment
3. Type of work performed
4. Volume of work performed
5. Crew size involved

MANPOWER DETERMINANTS:

The determination of manpower needs for wastewater collection systems is a complex problem requiring the consideration of many variables. Among the more important ones are:

1. The size of the system in miles of sewer lines.
2. The age of the system.
3. The standard of sewer construction.
4. Funds available in the budget.
5. The scope of the municipality's responsibility such as the maintenance of lateral lines.
6. The extent of contractors' use.
7. The establishment of minimum maintenance capabilities.
8. The type of equipment used.
9. The accessibility of work sites to equipment.

10. Distances work crews have to travel.

11. The topography of the area.

The translation of these multiple factors into working figures is a difficult undertaking. Factorial characteristics are different for each system and there is no single predominating parameter which can be utilized as a reliable determinant of staffing needs.

CREW FUNCTIONS:

Manpower requirements are more logically evaluated in terms of crew functions. To maintain an efficient wastewater collection system, certain tasks must be performed. Sewer lines must be inspected, cleaned, opened, and repaired. Appurtenances such as manholes must be checked, patched, cleaned, their walls raised, and their covers repaired. Lift stations must be inspected and their mechanical and electrical equipment adjusted and repaired. A recommended approach is one where scheduled routine preventive maintenance dominates work activities rather than a mad rush for emergencies. The next step is to determine the types and sizes of crews needed to perform the above-mentioned duties. This chapter shows typically acceptable organization charts for the maintenance of wastewater collection systems in cities with the following population sizes: 150,000; 200,000; 300,000; 400,000; and 500,000. The preparation of these charts was based on extensive field observations, numerous interviews with supervisory personnel in different localities, and the judgment of the researcher. The charts include functions of crews, titles of workers, and number of personnel required. References to the description of each worker's duties can be found in Chapter 4. It should be pointed out that judgment must be exercised by the user since the factors which control and modify manpower requirements are numerous and should be supplemented by local considerations. With the exercise of due caution, the charts provided in this chapter should be useful in providing preliminary approximation of requisite staffing needs. In short, weight should be given to local conditions that may modify the estimated values.

CONSTRUCTION INSPECTION AND LIFT STATION MAINTENANCE:

Manpower requirements for the inspection of new sewer construction and the maintenance of lift stations are not related to size of city population which has been selected as the predominant staffing determinate. Construction inspection is chiefly determined by the time length of construction projects. On the average, a construction inspector spends two hours a day in the office studying blueprints and specifications in preparation for project inspections, preparing reports, and conferring with city engineers. He, also, spends

three hours a day per site conducting field inspection of work in progress. An average day schedule consists of office work and two construction site visits. Therefore, manpower requirement is computed by dividing the estimated number of daily site visits by 2. For example, 10 work site visits per day require 5 construction inspectors. When four or more Construction Inspectors are employed, a Construction Inspector Supervisor would be needed to supervise, coordinate and schedule inspection activities on a full-time basis.

The maintenance of a wastewater lift station of less than 6,000 gallons per minute requires a Maintenance Mechanic I and his Helper approximately 30 minutes for each routine preventive maintenance check up, excluding travel time. A crew consisting of one Maintenance Mechanic I and one Maintenance Mechanic Helper can perform routine preventive maintenance and minor repairs to approximately 8 lift stations a day counting travel and standby time. Hence, the manpower requirement for each occupation is computed by dividing the number of lift station visits per week by 40. For example, 8 lift stations visited five times per week (total of 40 visits) require a crew of one Maintenance Mechanic I and one Maintenance Mechanic Helper. It was observed that the overhaul and repair of pumps and equipment of 15-20 lift stations require the services of a Maintenance Mechanic II on a full-time basis. Therefore, staffing needs for this occupation is computed by dividing the number of lift stations by 15.

Computations for manpower requirements for Construction Inspection and Lift Station Maintenance are in Table I, page 39.

MANPOWER REQUIREMENTS:

The following organization charts and staffing guide are based on the preventive maintenance concept outlined in Chapter 2. This concept requires that sufficient manpower be allocated to perform routine scheduled preventive maintenance as opposed to emphasis on "emergency responses". It is, also, assumed that new and major construction of storm and sanitary sewer lines are handled by outside contractors, and that the maintenance of lateral lines is the responsibility of the private property owner. Otherwise, an emergency crew consisting of one (1) Maintenance Man II and one (1) Maintenance Man I will be needed for each 50,000 people served.

Wastewater collection systems in cities of more than 200,000 in population require division into equal districts. Cities of 200,000 and 300,000 are divided into two districts while cities of 400,000 and 500,000 are divided into three districts. Each district has:

1. One (1) Sewer Patrol Crew: The operation of the Sewer Patrol Crew is based on the Maintenance Control Concept used by Navy Public Works Centers. The Patrol Crew,

as well as the TV Inspection Crew, conducts continuous inspection of wastewater collection facilities, submits inspection reports describing deficiencies, causes, and recommended corrective action, including preliminary cost estimates of required maintenance or repair. It prepares job orders, estimates labor hours and material requirements, and makes preliminary decisions, in concurrence, with MAINTENANCE SUPERVISOR I as to what crew could most efficiently perform the job.

2. A number of Cleaning Crews which use such sewer cleaning equipment as a power rodder, high velocity water jet, vacuum jet rodder, flushing truck, bucket machine, wayne ball machine, and eductor. Most sewer cleaning equipment needs a crew of two (2) men except the bucket and wayne ball machines which require a crew of three (3).
3. One (1) Major Repair Crew, one (1) Minor Repair Crew, and one (1) Masonary Crew.
4. One (1) MAINTENANCE SUPERVISOR I who administers the district under the direction of MAINTENANCE SUPERVISOR II.

There are certain crew functions which, because of their supportive roles, are more efficiently performed in a centralized manner rather than in subdivided districts. The following fall under such a category:

1. Equipment Operators Pool: Provides heavy construction equipment and trucks with Construction Equipment Operators and Automotive Equipment Operators to support various crews.
2. Laborers Pool: Provides additional laborers when needed to various crews.
3. TV/Grouting Crews: Involved in the internal inspection and sealing of sewer lines.
4. Lift Station Maintenance Crews.
5. Construction Inspectors.

Table 1, on page 39, presents a Staffing Guide based on the organization charts depicted on pages 34 - 38. It lists manpower requirements per occupation for five cities of different sizes and provides a form for preparing a staff complement. The user should read Chapter 3 in its entirety before attempting to use Table 1.

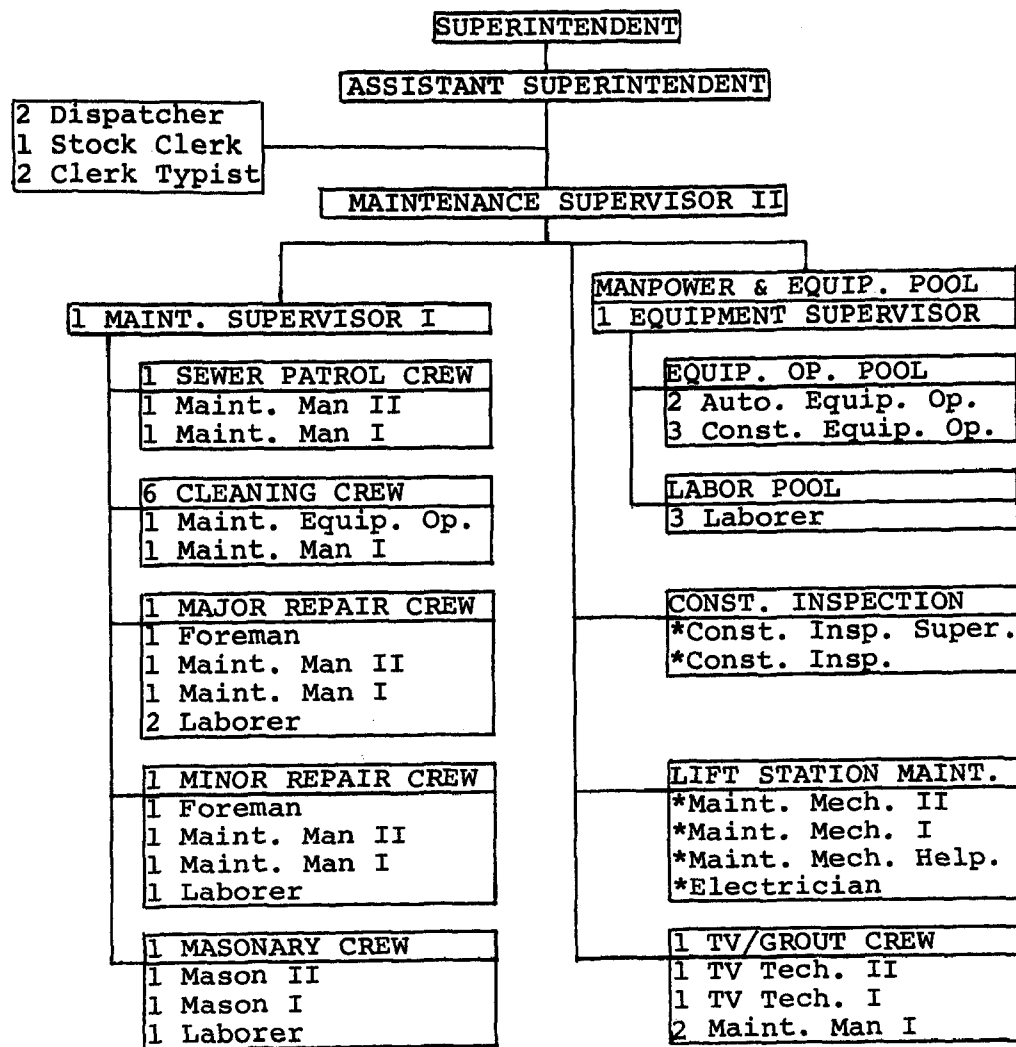
CAREER LATTICE:

Figure 11, on page 40, illustrates a Career Lattice for a wastewater collection system that includes all occupations identified

in this Manual except such office jobs as Clerk Typist and Dispatcher. A career lattice reflects entry, promotional and transfer opportunities that exist for each worker. It "utilizes the interrelationships among jobs to create promotional opportunities and facilitate mobility of workers among jobs. A career lattice provides for mobility in three directions: horizontal mobility to jobs at the same relative level of complexity but in a different area of work, vertical mobility to more complex jobs in the same area of work, and diagonal mobility to more complex jobs in a different but related area of work."¹

¹ "A Handbook for Job Restructuring" (Washington: U.S. Department of Labor, Manpower Administration, 1969, page 2).

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM MAINTENANCE
(in type and number of crews and manpower requirements per crew)

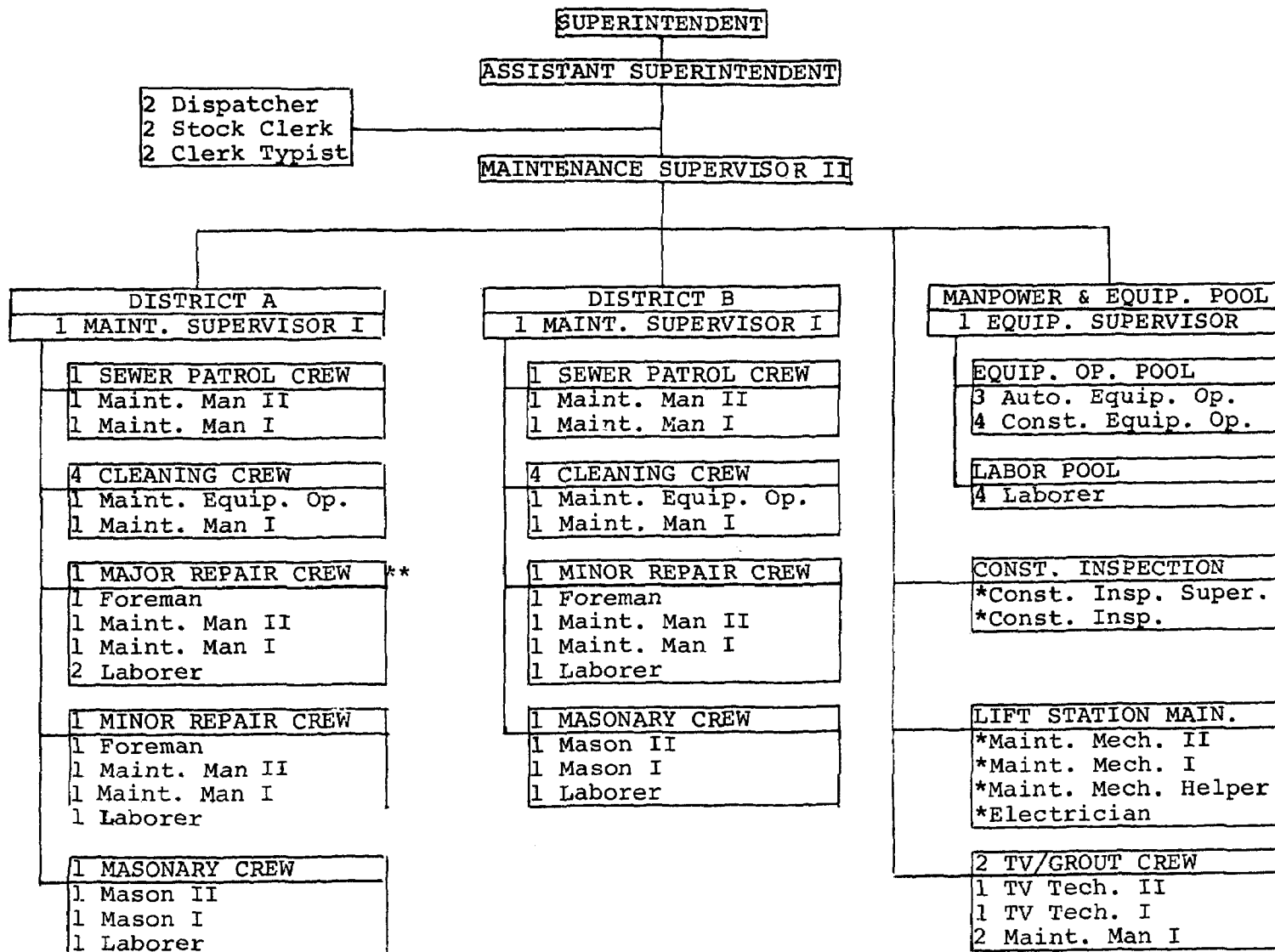


CITY POPULATION: 150,000

Figure 6

* See Table I, page 39

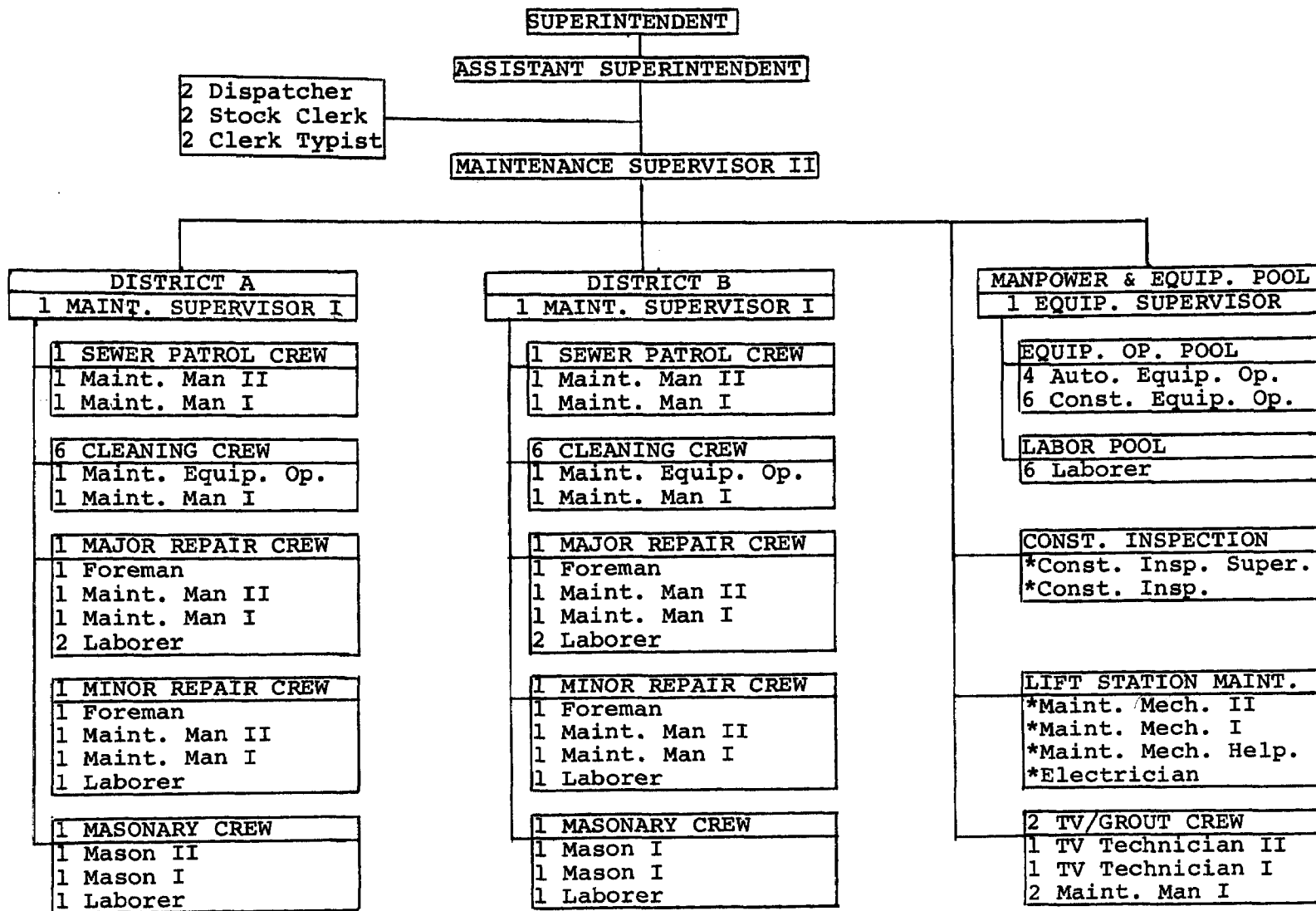
TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM MAINTENANCE
(in type and number of crews and manpower requirements per crew)



CITY POPULATION: 200,000
Figure 7

* See Table I, page 39
** Used also in District B

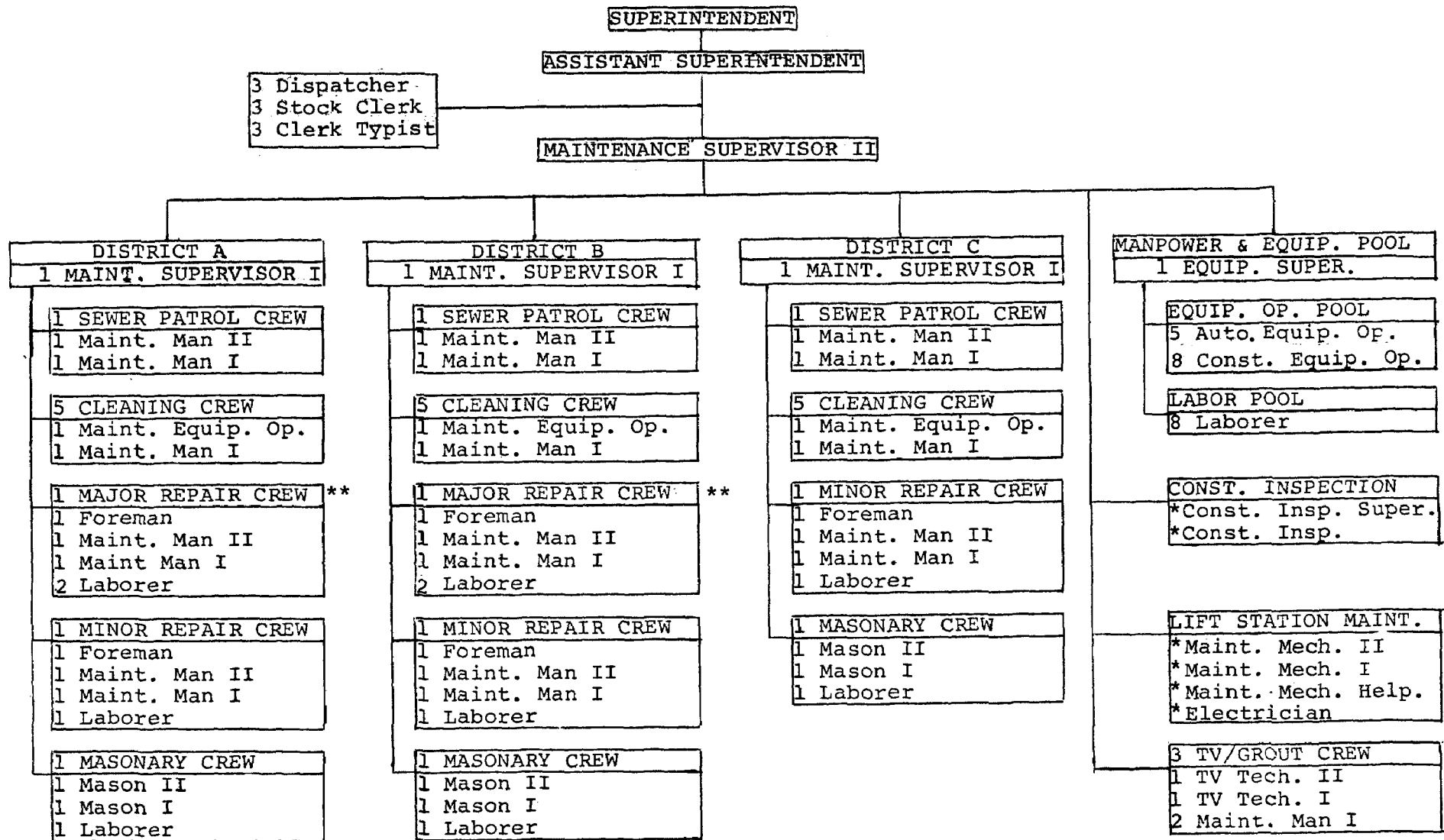
TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM MAINTENANCE
(in type and number of crews and manpower requirements per crew)



CITY POPULATION: 300,000
Figure 8

* See Table I, page 39.

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM MAINTENANCE
(in type and number of crews and manpower requirements per crew)

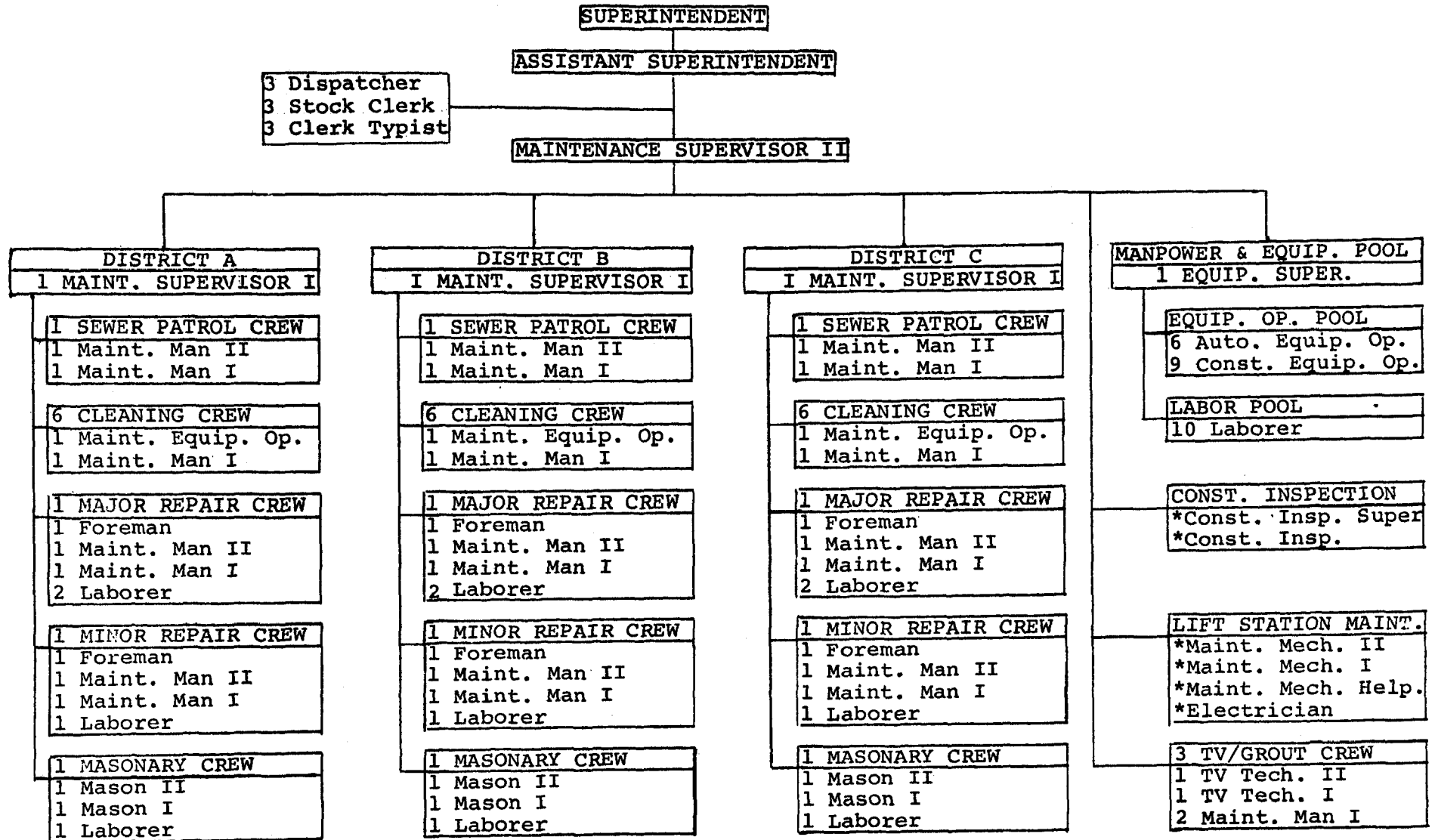


CITY POPULATION: 400,000

Figure 9

- * See Table I, page 39
** Used also in District C

TYPICAL ORGANIZATION CHART FOR WASTEWATER COLLECTION SYSTEM MAINTENANCE
(in type and number of crews and manpower requirements per crew)



CITY POPULATION: 500,000
Figure 10.

TABLE I

STAFF COMPLEMENTS FOR WASTEWATER COLLECTION SYSTEM MAINTENANCE
(Estimated Number of Personnel)

POPULATION SIZE

Occupational Title	150,000	200,000	300,000	400,000	500,000
Superintendent	1	1	1	1	1
Assistant Superintendent	1	1	1	1	1
Maintenance Supervisor II	1	1	1	1	1
Maintenance Supervisor I	1	2	2	3	3
Equipment Supervisor	1	1	1	1	1
TV Technician II	1	2	2	3	3
TV Technician I	1	2	2	3	3
Foreman	2	3	4	5	6
Maintenance Man II	3	5	6	8	9
Maintenance Man I	11	17	22	29	33
Mason II	1	2	2	3	3
Mason I	1	2	2	3	3
Maint. Equipment Operator	6	8	12	15	18
Const. Equipment Operator	3	4	6	8	9
Auto. Equipment Operator	2	3	4	5	6
Laborer	7	10	14	18	22
Dispatcher	2	2	2	3	3
Stock Clerk	1	2	2	3	3
Clerk Typist	2	2	2	3	3
Sewer Maintenance Staff	48	70	88	116	131
Maintenance Mechanic II (a)					
Maintenance Mechanic I (b)					
Maint. Mechanic Helper (b)					
Electrician (c)					
Const. Inspector Super. (d)					
Construction Inspector (e)					
Total Staff					

- (a) Divide number of lift stations maintained by 15 (see page 31).
 (b) Divide number of lift station visits per week by 40 (see page 31).
 (c) Divide number of lift stations maintained by 15 (see page 31).
 (d) Determined by the number of Construction Inspectors employed and developed on a judgmental basis (see page 31).
 (e) Divide estimated daily construction site visits by 2 (see page 31).

Unit processes included in this Staffing Table are:

1. Maintenance of sanitary sewer main lines and appurtenances (lateral lines are not included)
2. Maintenance of storm main lines
3. Maintenance of lift stations
4. Inspection of newly constructed main lines and appurtenances

CAREER LATTICE FOR A WASTEWATER COLLECTION SYSTEM

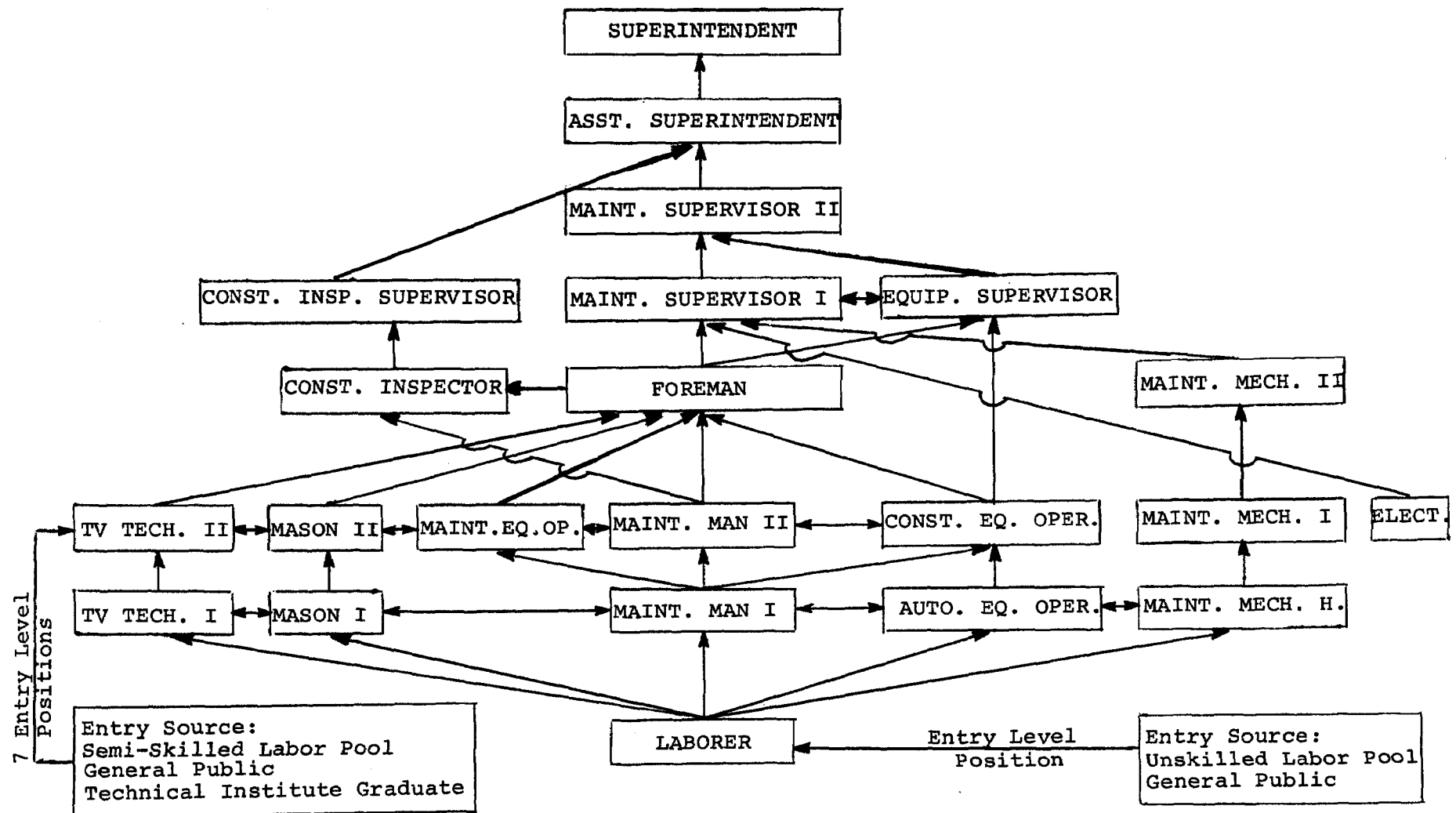


Figure 11

4. OCCUPATIONAL DESCRIPTIONS

The objective of an Occupational Description is to portray the responsibilities, skills and knowledge required for the successful execution of identified tasks by the average worker. Such information is indispensable to provide the basis for the recruitment, selection, training, certification, placement, and promotion of wastewater personnel. An Occupational Description presents an actual picture of the job by showing what the worker does, how he does it, why he does it, the skill involved, and the machine, tools, equipment and work aids used in performing his duties. It, also, indicates the Qualifications Profile the employee should possess by specifying Formal Education, General Requirements, and Worker Traits such as General Educational Development, Specific Vocational Preparation, Aptitudes, Interests, Temperament, Physical Demands, and Working Conditions. Appendix 2 provides Worker Traits definitions prepared by the U.S. Department of Labor to explain job analysis specifications used in the Dictionary of Occupational Titles.

The twenty-five (25) Occupational Descriptions presented in this chapter were developed on the basis of field observations and interviews with wastewater collection personnel in forty-nine (49) cities in twenty-nine (29) states and formal reviews with analysts at the Department of Labor's Occupational Analysis Center in Raleigh, N.C. Survey instruments used are denoted in the "Research Report" submitted in conjunction with this Manpower Manual (see note on page 3).

Detailed Occupational Descriptions for the following twenty-five (25) types of personnel commonly employed in wastewater collection systems are presented on pages 43 through 121.

<u>OCCUPATIONAL DESCRIPTIONS</u>	<u>PAGE</u>
1. Superintendent	43
2. Assistant Superintendent	46
3. Maintenance Supervisor II	49
4. Maintenance Supervisor I	52
5. Equipment Supervisor	55
6. TV Technician II	58
7. TV Technician I	61
8. Foreman	64
9. Maintenance Man II	68
10. Maintenance Man I	72

<u>OCCUPATIONAL DESCRIPTIONS</u>	<u>PAGE</u>
11. Mason II	76
12. Mason I	79
13. Maintenance Equipment Operator	82
14. Construction Equipment Operator	86
15. Automotive Equipment Operator	89
16. Laborer	92
17. Maintenance Mechanic II	95
18. Maintenance Mechanic I	98
19. Maintenance Mechanic Helper	101
20. Electrician	104
21. Construction Inspector Supervisor	107
22. Construction Inspector	110
23. Dispatcher	113
24. Stock Clerk	116
25. Clerk Typist	119

OCCUPATIONAL DESCRIPTION

Title: SUPERINTENDENT, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Supervises and coordinates, through subordinates, activities of workers engaged in construction and maintenance of storm and sanitary sewers and related structures. Compiles and analyzes records on manpower, material and equipment utilization, and initiates actions to improve work efficiency. Establishes, reviews and recommends departmental policies regarding work methods and safety procedures. Submits recommendations for expansion of sewerage system and acquisition of new equipment. Periodically visits work sites to ensure that correct, efficient, and safe work procedures are followed according to established standards. Gives technical assistance to subordinates. Prepares and submits budget recommendations and reports for official records. Approves procurement of supplies and equipment. Confers with municipal authorities and state government officials to discuss adequacy of existing facilities. Cooperates with other city departments to coordinate efforts in improving standard of service and enforcing city plumbing codes and sewer ordinances. Confers with city engineers and contractors to discuss expansion of existing facilities.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a high school is the minimum requirement, preferably supplemented by college level courses in civil or sanitary engineering. A college degree is highly desirable.

2. General Requirements:

- a. Knowledge of the principles, practices and techniques of sewer construction, repair and maintenance.
- b. Knowledge of tools, equipment and materials used in wastewater collection operations.
- c. Ability to organize, coordinate and evaluate the work of subordinates.
- d. Ability to prepare written reports and budgets and maintain work records.

Title: SUPERINTENDENT (Cont'd)

3. General Educational Development:

a. Reasoning:

- (1) Apply principles of logical thinking to define problems, collect data, establish facts, and draw valid conclusions.
- (2) Interpret an extensive variety of technical instructions in books, manuals, and mathematical or diagrammatic form.
- (3) Deal with several abstract and concrete variables.

b. Mathematical:

Perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.

c. Language:

- (1) Prepare budgets, records, and reports.
- (2) Confer with subordinates, city officials, and the general public.
- (3) Evaluate engineering and technical data and interpret specifications.

4. Specific Vocational Preparation:

Six to eight years of progressively responsible experience in wastewater collection activities, including at least three years of supervisory experience.

5. Aptitudes - Relative to General Working Population:

- | | |
|---------------------|-----------------------------------|
| a. Intelligence: | Highest third excluding top 10% |
| b. Verbal: | " |
| c. Numerical: | " |
| d. Spatial: | " |
| e. Form Perception: | Lowest third excluding bottom 10% |

Title: SUPERINTENDENT (Cont'd)

- f. Clerical Perception: Middle third
- g. Motor Coordination: Lowest third excluding bottom 10%
- h. Finger Dexterity: "
- i. Manual Dexterity: "
- j. Eye-Hand-Foot Coordination: "
- k. Color Discrimination: Lowest 10%

6. Interests:

Preference for activities involving business contact with people and activities resulting in prestige or the esteem of others.

7. Temperament:

Must adjust to a variety of tasks requiring frequent change and satisfactory working relationships with people. Must adjust to planning and controlling work activities.

8. Physical Demands:

Sedentary work.

9. Working Conditions:

Inside work.

ENTRY SOURCES: Assistant Superintendent, Maintenance Supervisor II, or Superintendent of a smaller system.

PROGRESSION TO: Director of Public Works, Water and Sewer Administrator, or a smaller position in a larger or more complex system.

OCCUPATIONAL DESCRIPTION

Title: ASSISTANT SUPERINTENDENT, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Assists SUPERINTENDENT in coordinating functions of wastewater collection system to provide sewerage services with minimum interruption: Compiles data, analyzes maintenance records, and helps prepare recommendations dealing with utilization of resources, safety and work procedures, selection of new equipment, and expansion of existing facilities. Drives pickup truck to visit job sites to ensure compliance with established standards. Assists in preparing annual budgets. Confers with contractors and equipment manufacturers to discuss bid specifications and requisitions of necessary equipment. Maintains personnel records and recommends promotions and pay raises. Serves as SUPERINTENDENT in his absence.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a high school is the minimum requirement, preferably supplemented by college level courses in civil or sanitary engineering. A college degree is highly desirable.

2. General Requirements:

- a. Knowledge of the principles, practices and techniques of sewer construction, repair and maintenance.
- b. Knowledge of tools, equipment, and materials used in wastewater collection operations.
- c. Knowledge of city sewer and drain system.
- d. Knowledge of occupational hazards and ability to enforce safety precautions.
- e. Ability to assign and supervise work of subordinates and to train them in proper work techniques.
- f. Ability to prepare written reports and budgets and maintain work records.
- g. Ability to establish and maintain effective working relationships with city officials, employees, contractors and the general public.

Title: ASSISTANT SUPERINTENDENT (Cont'd)

3. General Educational Development:

a. Reasoning:

- (1) Apply principles of logical thinking to define problems, collect data, and draw valid conclusions.
- (2) Interpret an extensive variety of technical instructions in books, manuals, mathematical or diagrammatic form.
- (3) Deal with several abstract and concrete variables.

b. Mathematical:

Perform ordinary arithmetic, algebraic and geometric procedures in standard, practical applications.

c. Language:

- (1) Write and edit reports and records.
- (2) Analyze and evaluate technical data.
- (3) Confer with employees, city officials and the public.

4. Specific Vocational Preparation:

Four to six years of progressively responsible experience in wastewater collection work, including at least two years of supervisory experience.

5. Aptitudes - Relative to General Working Population:

- | | |
|-------------------------|-----------------------------------|
| a. Intelligence: | Highest third excluding top 10% |
| b. Verbal: | " |
| c. Numerical: | " |
| d. Spatial: | " |
| e. Form Perception: | Middle third |
| f. Clerical Perception: | " |
| g. Motor Coordination: | Lowest third excluding bottom 10% |

Title: ASSISTANT SUPERINTENDENT (Cont'd)

- h. Finger Dexterity: Lowest third excluding bottom 10%
- i. Manual Dexterity: "
- j. Eye-Hand-Foot Coordination: "
- k. Color Discrimination: Lowest 10%

6. Interests:

Interest in activities involving business contact with people and resulting in prestige or the esteem of others.

7. Temperament:

Must adjust to planning and controlling a variety of work activities requiring frequent change. Must have satisfactory working relationships with people.

8. Physical Demands:

Sedentary work involving periodic inspection of work sites.

9. Working Conditions:

Work is performed both inside and outside.

ENTRY SOURCES: Maintenance Supervisor II, Maintenance Supervisor I, or Construction Inspector Supervisor.

PROGRESSION TO: Superintendent or a similar position in a larger or more complex system.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE SUPERVISOR II, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Supervises, coordinates and inspects through subordinates the work of crews engaged in the maintenance and repair of storm and sanitary sewer lines and related structures: Determines priority of work orders received. Plans sewer preventive maintenance activities and schedules routine cleaning and inspection of sewerage system with sewer cleaning equipment and TV inspection system. Confers with superiors on policy and technical questions. Trains and provides technical assistance to subordinates. Inspects work in progress and upon completion for compliance with established standards. Reviews complaints of needed sewer repairs and inspects damaged sewers. Estimates labor, material, and equipment needed for planned maintenance programs and specific repairs. Keeps cost records and prepares annual budget requests, activity summaries and progress reports. Requisitions necessary materials, equipment, and supplies. Reviews time and material reports and maintains work records. Checks time slips, sick leave and arranges vacation time. Recommends promotions and pay raises.

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement usually is high school or vocational school graduation.

2. General Requirements:

- a. Knowledge of work methods, tools, equipment, and materials used in the construction, repair, and maintenance of sanitary and storm sewers, and related structures.
- b. Knowledge of city sewer and drain system and city rules, regulations and ordinances.
- c. Knowledge of work hazards and ability to enforce safety precautions.
- d. Ability to plan, coordinate, supervise and evaluate the work of employees.

Title: MAINTENANCE SUPERVISOR II (Cont'd)

- e. Ability to prepare general and detailed reports.
- f. Ability to read and interpret blueprints, diagrams, and specifications.
- g. Ability to establish and maintain effective working relationships with employees and general public.

3. General Educational Development:

a. Reasoning:

- (1) Apply principles of wastewater collection system to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
- (2) Interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

b. Mathematical:

Perform ordinary arithmetic, algebraic, and geometric procedures in standard and practical applications.

c. Language:

- (1) Confer with superiors and subordinates and interview job applicants.
- (2) Interpret technical manuals, specifications, sewer maps, and blueprints.
- (3) Prepares budgets, records, and maintenance reports.

4. Specific Vocational Preparation:

Four to six years experience in sewer maintenance and construction work including two years experience as MAINTENANCE SUPERVISOR I, or FOREMAN.

5. Aptitudes - Relative to General Working Population:

- a. Intelligence: Highest third excluding top 10%
- b. Verbal: "

Title: MAINTENANCE SUPERVISOR II (Cont'd)

- c. Numerical: Highest third excluding top 10%
 - d. Spatial: "
 - e. Form Perception: Middle third
 - f. Clerical Perception: "
 - g. Motor Coordination: "
 - h. Finger Dexterity: "
 - i. Manual Dexterity: "
 - j. Eye-Hand-Foot Coordination: "
 - k. Color Discrimination: Lowest third excluding bottom 10%
6. Interests:
- An interest in activities concerned with machines and techniques, and resulting in prestige or the esteem of others.
7. Temperament:
- Must adjust to situations involving the direction, control, and planning of a variety of activities requiring frequent change. Must also have satisfactory working relationships with people beyond giving and receiving instructions.
8. Physical Demands:
- Work is light, involving talking, hearing, seeing, and occasional reaching, handling, fingering, and feeling.
9. Working Conditions:
- Work is performed both inside and outside and occasionally involves noise from operation of equipment, and contact with water.

ENTRY SOURCES: Maintenance Supervisor I, or Equipment Supervisor.

PROGRESSION TO: Assistant Superintendent, or Superintendent.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE SUPERVISOR I, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Coordinates and supervises work crews engaged in repairing, cleaning, and maintaining storm and sanitary sewer lines: Confers with MAINTENANCE SUPERVISOR II to discuss job assignments, schedule work and equipment for crews, and evaluate workers. Assigns tasks to crews, evaluates most feasible approaches, and ensures that needed materials and equipment are provided. Drives truck to job sites to inspect periodically and evaluate work in progress to assure that correct, efficient and safe work procedures are followed according to accepted standards. Provides technical assistance and direct supervision as needed for efficient operation. Directs activities that are regarded complex enough to demand high responsibility. Inspects and evaluates completed jobs to determine conformance to specifications and work orders. Gives directions to and meets with FOREMEN, MAINTENANCE MEN II, and EQUIPMENT OPERATORS to assign work and to discuss and prescribe work methods. Reads maps and blueprints. Checks equipment used by crews to make sure that equipment functions properly and is adequately maintained. Keeps records, makes reports, and recommends improvements in work methods and standard of service. Trains and instructs subordinates.

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement usually is high school or vocational school graduation.

2. General Requirements:

- a. Knowledge of work methods, tools, equipment, and materials used in the construction, repair, and maintenance of sanitary and storm sewers, and related structures.
- b. Knowledge of city sewer and drain system.
- c. Knowledge of work hazards and ability to enforce safety precautions.
- d. Ability to plan, supervise, and coordinate preventive maintenance and repair activities, and evaluate their effectiveness.

Title: MAINTENANCE SUPERVISOR I (Cont'd)

- e. Ability to read and interpret blueprints, diagrams, and specifications.
 - f. Ability to establish and maintain effective working relationships with employees and general public.
3. General Educational Development:
- a. (1) Apply principles of wastewater collection system to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
 - (2) Interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.
 - b. Mathematical:

Perform ordinary arithmetic, algebraic, and geometric procedures in standard and practical applications.
 - c. Language:
 - (1) Confer with superiors and subordinates and interview job applicants.
 - (2) Interpret technical manuals, specifications, sewer maps, and blueprints.
 - (3) Write maintenance reports.
4. Specific Vocational Preparation:
- Four years experience in sewer maintenance and construction work including two years experience as a FOREMAN, MAINTENANCE MAN II, or MAINTENANCE EQUIPMENT OPERATOR.
5. Aptitudes - Relative to General Working Population:
- a. Intelligence: Middle third
 - b. Verbal: "
 - c. Numerical: "
 - d. Spatial: "

Title: MAINTENANCE SUPERVISOR I (Cont'd)

- e. Form Perception: Middle third
 - f. Clerical Perception: Lowest third excluding bottom 10%
 - g. Motor Coordination: Middle third
 - h. Finger Dexterity: "
 - i. Manual Dexterity: "
 - j. Eye-Hand-Foot Coordination: "
 - k. Color Discrimination: Lowest third excluding bottom 10%
6. Interests:
- An interest in activities concerned with machines and techniques, and resulting in prestige or the esteem of others.
7. Temperament:
- Must adjust to situations involving the direction, control, and planning of a variety of activities requiring frequent change. Must also have satisfactory working relationships with people beyond giving and receiving instructions.
8. Physical Demands:
- Work is light, involving talking, hearing, seeing, and occasional reaching, handling, fingering, and feeling.
9. Working Conditions:
- Work is performed largely outside and involves noise from operation of equipment, and occasional contact with water. Exposed to weather and occasionally noxious smells.

ENTRY SOURCES: Foreman, Maintenance Man II, Maintenance Equipment Operator, Maintenance Mechanic II, or Electrician.

PROGRESSION TO: Maintenance Supervisor II or Assistant Superintendent.

OCCUPATIONAL DESCRIPTION

Title: EQUIPMENT SUPERVISOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Assigns, supervises, and directs a pool of equipment operators and unskilled laborers, construction and automotive machinery and equipment, engaged in the maintenance and repair of sanitary and storm sewer lines and related appurtenances: Directs the distribution of personnel, machinery and equipment such as backhoes, loaders, draglines, cranes, dump trucks, air compressors, air blowers, pumps and power saws to field operations. Checks worker, machinery, and equipment work orders and maintains records of work performed by assigned personnel and equipment. Confers with SUPERINTENDENT, ASSISTANT SUPERINTENDENT, MAINTENANCE SUPERVISOR II and I to discuss work orders and assignment of personnel and equipment. Supervises the maintenance, reconditioning, and repair of machinery and equipment. Evaluates effectiveness of equipment, estimates equipment needed for planned maintenance and repair programs, prepares specifications, and recommends purchases. Instructs workers on operation and preventive maintenance procedures, and ensures that safety procedures are followed. Keeps records and makes reports. Checks time slips, sick leave, and arranges vacation time.

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement usually is high school or vocational school graduation.

2. General Requirements:

- a. Knowledge of operation and maintenance of automotive and construction equipment and machinery used in the construction, repair, and maintenance of sewer lines.
- b. Knowledge of sewer maintenance support operations and operational limitations of equipment.
- c. Knowledge of traffic laws, ordinances, and regulations.
- d. Knowledge of work hazards and ability to enforce safety precautions.

Title: EQUIPMENT SUPERVISOR (Cont'd)

- e. Ability to plan, supervise, and coordinate preventive maintenance and repair activities and evaluate their effectiveness.
- f. Ability to read and interpret blueprints, diagrams, and specifications.
- g. Ability to establish and maintain effective working relationships with employees and general public.

3. General Educational Development:

a. Reasoning:

- (1) Apply principles of equipment management to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
- (2) Interpret a variety of instructions furnished in written, oral, diagrammatic or schedule form.

b. Mathematical:

Perform ordinary arithmetic, algebraic, and geometric procedures in standard, and practical applications.

c. Language:

- (1) Confer with superiors and subordinates and interview job applicants.
- (2) Interpret technical manuals, specifications, sewer maps, and blueprints.
- (3) Write maintenance reports.

4. Specific Vocational Preparation:

Four years experience in sewer maintenance, heavy equipment operation and construction work including two years experience as a FOREMAN.

Title: EQUIPMENT SUPERVISOR (Cont'd)

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

An interest in activities concerned with machines and techniques, and resulting in prestige or the esteem of others.

7. Temperament:

Must adjust to planning and controlling a variety of work activities requiring frequent change. Must have satisfactory working relationships with people.

8. Physical Demands:

Medium work, involving climbing, balancing, stooping, kneeling, crouching, reaching, handling, talking, and seeing.

9. Working Conditions:

Work is performed both inside and outside, and involves noise from operation of equipment.

ENTRY SOURCES: Foreman or Construction Equipment Operator.

PROGRESSION TO: Maintenance Supervisor II.

OCCUPATIONAL DESCRIPTION

Title: TV TECHNICIAN II, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION:

Operates mobile closed circuit television and chemical sealing units to conduct internal inspection of sewer lines and to seal defective lines for prevention of water infiltration: Locates line sections to be photographed, using map and determines set-up procedures. Turns knobs to activate TV equipment for video viewing. Adjusts TV camera and monitor controls for optimal clarity and contrast. Locates and identifies infiltration points and sewer defects and determines extent of damage. Prepares description of each identified sewer defect and records all pertinent data including exact location of defect. Photographs screen picture of serious or unusual irregularities, using polaroid camera. Determines chemical composition based on type of sealing activity and oversees the preparation of sealing compound. Manipulates grout control knobs to inflate packer to desired pressure and to air test infiltration point to determine volume of needed sealing compound and to pump correct amount of sealing chemicals. Turns air release valve to deflate packer after allowing necessary time for sealing compound to set up. Communicates with workers using intercom system. Confers with MAINTENANCE SUPERVISOR I and II to discuss condition of sewer lines based on TV inspection. Services, adjusts, and makes minor repairs to equipment and attachments. Gives directions to TV TECHNICIAN I and MAINTENANCE MAN I, instructs them in the efficient and safe use of TV/Grout system, trains them in work methods, and ensures that proper procedures and safety precautions are followed. Drives TV/Grout unit truck.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a high school or a vocational school

2. General Requirements:

- a. Knowledge of sewer inspection, maintenance, and repair.
- b. Knowledge of the operation and maintenance of a closed circuit TV system and a chemical sealing unit.
- c. Ability to perform minor repair and maintenance of electrical and electronic systems.
- d. Ability to read and interpret maps, blueprints, schematics, and plans.

Title: TV TECHNICIAN II (Cont'd)

- e. Knowledge of work hazards and applicable safety precautions.
 - f. Ability to lead the work of a small crew.
 - g. Ability to establish and maintain effective working relationships with employees.
 - h. Ability to prepare records showing conditions of sewer lines.
 - i. Possession of a valid driver's license.
3. General Educational Development:
- a. Reasoning:
 - (1) Apply principles of rational systems to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
 - (2) Interpret a variety of instructions furnished in written, oral, or diagrammatic form.
 - b. Mathematical:

Perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.
 - c. Language:
 - (1) Communicate with workers on the intercom system.
 - (2) Prepare various operating reports.
 - (3) Read and interpret sketches, blueprints, schematics, and diagrams.
4. Specific Vocational Preparation:
- A minimum of four years of experience in the field of sewer maintenance experience including one year in an electronic related field.

Title: TV TECHNICIAN II (Cont'd)

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

A preference for activities of a technical nature and for activities concerned with machines and processes.

7. Temperament:

Must adjust to situations requiring frequent change and involving the direction, control, and planning of activities requiring the evaluation of information against measurable or verifiable criteria.

8. Physical Demands:

Work is light, involving climbing, stooping, kneeling, crouching, reaching, handling, feeling, talking, hearing, and seeing.

9. Working Conditions:

The work is outside and involves wet conditions and exposure to weather, noxious smells, and gases.

ENTRY SOURCES: TV Technician I.

PROGRESSION TO: Maintenance Supervisor I, or Foreman.

OCCUPATIONAL DESCRIPTION

Title: TV TECHNICIAN I, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Assists TV TECHNICIAN II in operating mobile closed circuit television and chemical sealing units to conduct internal inspection of sewer lines and to seal defective lines for prevention of water infiltration: Measures and mixes basic sealing chemicals in compound tanks. Checks set-up time of sealing compound. Sets up audio communication system. Turns winch handles to move camera and sealing packer through sewer line. Climbs into manhole, disconnects videopower cables from camera, and inserts blind plug into power cable. Assists in servicing, adjusting and repairing equipment and attachments. Erects barricades or traffic cones to protect personnel and public. May drive TV/Grout unit truck.

QUALIFICATIONS PROFILE

1. Formal Education:

Usually required to have completed eighth grade. Completion of tenth grade or graduation from high school or vocational school is highly desirable and is increasingly required.

2. General Requirements:

- a. Knowledge of the operation and maintenance of a closed circuit TV system and a chemical sealing unit.
- b. Ability to perform minor repair and maintenance of electrical and electronic systems.
- c. Knowledge of occupational hazards and necessary safety precautions.
- d. Ability to understand and follow oral and written instructions.
- e. Ability to maintain working relationships with fellow employees and the public.
- f. Possession of a valid driver's license.

Title: TV TECHNICIAN I (Cont'd)

3. General Educational Development:

a. Reasoning:

Apply common sense understanding to carry out detailed but uninvolved written or oral instruction.

b. Mathematical:

Use arithmetic to add, subtract, multiply and divide whole numbers.

c. Language:

Ability to understand and carry out instructions and to establish and maintain communication with fellow employees and supervisors.

4. Specific Vocational Preparation:

A minimum of six months of experience in the field of sewer construction and maintenance work.

5. Aptitudes - Relative to General Working Population:

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

Title: TV TECHNICIAN I (Cont'd)

6. Interests:

Preference for activities of technical nature and for activities concerned with machines and processes.

7. Temperament:

Must adjust to situations involving doing things under specific instructions and must have disposition to adhere exactly to established standards and procedures.

8. Physical Demands:

The work is medium and involves climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:

Work is outside and it involves exposure to weather, water, noise, noxious smells, gases, and the risk of bodily injury.

ENTRY SOURCES: Laborer, or General Public.

PROGRESSION TO: TV Technician II.

OCCUPATIONAL DESCRIPTION

Title: FOREMAN, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Supervises and coordinates activities of medium to large size crew engaged in the repair and minor construction of storm and sanitary sewers, and appurtenances: Assigns tasks to MAINTENANCE MEN, LABORERS, and AUTOMOTIVE EQUIPMENT OPERATORS involved in repairing and constructing sewer lines, manholes, catch basins and drainage facilities. Confers with MAINTENANCE SUPERVISOR I to receive job assignments. Reads maps and interprets sketches and blueprints to determine location of job sites, existing utilities lines, and city right-of-way limits. Provides technical assistance and prescribes work methods and safety procedures to workers. Directs AUTOMOTIVE EQUIPMENT OPERATORS in excavating and backfilling trenches. Directs MAINTENANCE MEN and LABORERS in breaking asphalt or pavement. Examines sewer lines to determine cause of malfunction and need for repair and decides on corrective action to take. Oversees work in progress to assure conformance to job specifications and enforcement of safety precautions. Supervises laying and joining of sewer lines and ensures that joints are tight and sealed properly before backfilling. Requisitions delivery and oversees removal of materials such as stone, dirt, and broken pavement. Prepares records showing actions taken, manpower and equipment utilization, and disposition of material. Requisitions tools and equipment. Drives pickup truck to and from work sites. Communicates with MAINTENANCE SUPERVISOR I and DISPATCHER, using radio telephone. Gives directions to subordinates, trains them in safety procedures and work methods, and evaluates their work.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a high school or vocational school.

2. General Requirements:

- a. Knowledge of methods, equipment, and materials used in sewer installation, repair and maintenance.

Title: FOREMAN (Cont'd)

- b. Knowledge of occupational hazards and safety precautions of work.
 - c. Knowledge of city streets and sewerage system.
 - d. Ability to supervise and coordinate the work of subordinates and to instruct them in proper work methods and procedures.
 - e. Ability to read simple diagrams, profiles, specifications, and blueprints.
 - f. Ability to carry out and transmit oral and written instructions.
3. General Educational Development:
- a. Reasoning:
 - (1) Apply principles of wastewater collection system to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
 - (2) Interpret a variety of instructions furnished in written, oral, or diagrammatic form.
 - b. Mathematical:

Perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.
 - c. Language:
 - (1) Interview job applicants, direct, and instruct employees.
 - (2) Prepare various operating reports.
 - (3) Read and interpret sketches, blueprints, and diagrams.
4. Specific Vocational Preparation:
- A minimum of four years of experience in the field of sewer maintenance and construction work, including at least two years experience as a leadman.

Title: FOREMAN (Cont'd)

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

A preference for activities resulting in prestige or the esteem of others and for activities concerned with machines and processes.

7. Temperament:

Must adjust to planning and controlling a variety of tasks requiring frequent change.

8. Physical Demands:

Medium work, involving climbing, balancing, stooping, kneeling, crouching, reaching, handling, talking, and seeing.

9. Working Conditions:

Work is performed outside. Exposed to weather, noise, risk of bodily injury, and occasionally to dust and noxious smells.

Title: FOREMAN (Cont'd)

ENTRY SOURCES: Maintenance Man II, Mason II, TV Technician II,
Maintenance Equipment Operator, or Construction
Equipment Operator.

PROGRESSION TO: Maintenance Supervisor I, Maintenance Supervisor II,
or Construction Inspector.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MAN II, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Repairs and maintains municipal storm and sanitary sewer lines, functioning as leadman and performing any combination of following tasks: Inspects manholes to determine location of stoppage. Runs rods through rod guide, fits front end of rod with auger, using wrench, and lowers guide into position. Thrusts rods into invert and advances them until auger reaches obstruction. Rotates rods manually with turning pin or attaches end of rod to portable power rodder to rotate rods. Pulls lever and depresses pedal of machine to advance cleaning tool slowly until it encounters obstruction and to rotate cable or rods until obstacle is broken. Retracts rods to drag out obstructions such as roots, grease, and other deposits. Cleans and repairs catch basins, manholes, culverts and storm drains, using hand tools. Raises manhole walls to prescribed street level, using masonry tools. Measures distance of excavation site, using tape measure, and marks outline of area to be trenched according to direction of FOREMAN. Breaks asphalt and other pavement, using air hammer, pick, and shovel. Cuts damaged section of pipe with cutters and removes broken section from ditch. Replaces broken pipes and reconnects pipe sections, using pipe sleeve. Inspects joints to ensure they are tight and sealed properly before backfilling. Packs backfilled excavation, using air and gasoline tamper. Taps mainline sewers to install sewer saddles. Replaces manhole covers. Updates sewer maps and manhole charting. Drives pickup truck to haul crew, materials and equipment. Services, adjusts and makes minor repairs to equipment, machines, and attachments. Communicates with DISPATCHER, FOREMAN, MAINTENANCE SUPERVISOR, and others, using radio telephone. Gives directions to MAINTENANCE MEN I, and LABORERS, instructs them in efficient and safe use of machines, trains them in work methods, and ensures that proper procedures and safety precautions are followed. Prepares records showing actions taken, manpower and equipment utilization, and disposition of material. Requisitions tools and equipment. May operate sewer cleaning equipment including power rodder, high velocity water jet, sewer flusher, bucket machine, wayne ball, and vac-all. May clean and disinfect domestic basements and other areas flooded as a result of sewer stoppages. May act as leadman in a large repair and construction crew under the supervision of a FOREMAN.

Title: MAINTENANCE MAN II (Cont'd)

QUALIFICATIONS PROFILE

1. Formal Education:

Usually required to have completed eighth grade. Completion of tenth grade or graduation from high school or vocational school is highly desirable and is increasingly required.

2. General Requirements:

- a. Knowledge of methods, tools, equipment, and materials used in sewer construction, repair, and maintenance.
- b. Knowledge of lay out of city streets and locations of sewer lines and related structures.
- c. Knowledge of work hazards and applicable safety precautions.
- d. Ability to locate, detect, and correct sewer stoppages and leaks.
- e. Ability to lead the work of a small crew.
- f. Ability to establish and maintain effective working relationships with employees and the general public.
- g. Possession of a valid driver's license.

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
- (2) Deal with problems involving several concrete variables in or from standardized situations.

b. Mathematical:

Make arithmetic calculations involving fractions, decimals, and percentages.

Title: MAINTENANCE MAN II (Cont'd)

c. Language:

- (1) Communicate with fellow employees and train subordinates in work methods.
- (2) Fill in maintenance report forms.

4. Specific Vocational Preparation:

Three years experience in the repair and maintenance of sewerage system is commonly required.

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

An interest in activities concerned with things, objects, machines, and techniques.

7. Temperament:

Must adjust to a variety of tasks requiring frequent change and adhere closely to established standards and procedures. Must adjust to making judgmental decisions.

Title: MAINTENANCE MAN II (Cont'd)

8. Physical Demands:

Medium to heavy work involving lifting, climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:

The work is outside and involves wet conditions, noise, risk of bodily injury, and exposure to weather, noxious smells, and gases.

ENTRY SOURCES: Mason II, Maintenance Man I, or General Public.

PROGRESSION TO: Foreman, Maintenance Supervisor I, or Construction Inspector.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MAN I, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Assists MAINTENANCE MAN II, MAINTENANCE EQUIPMENT OPERATOR, and TV TECHNICIAN II in the repair, construction, internal inspection, sealing, and maintenance of storm and sanitary sewers and related structures, performing any combination of following tasks: Breaks asphalt and other pavement, using air hammer, pick, and shovel. Assists in bracing and shoring excavations, cutting, fitting, laying, joining, and caulking sewer lines, coupling and sealing pipe joints, and in making sewer taps. Assists in building manholes and catch basins and in raising and lowering manhole walls. Chips away concrete along cracks of manholes, to prepare for repairs, using hammer and chisel. Knocks rim off manholes and breaks top of manhole wall, using sledge hammer. Mixes cement, sand and water, to prepare mortar, using shovel. Removes debris such as sticks, rags, rocks, sand, grease, and other foreign matter from bottom of manholes, using long handled shovel, long hook, spoon, fork or rod; and raises deposits to surface and dumps them into truck to be hauled away for disposition. Examines condition of lines, manholes, and inverts and informs supervisor if damage is detected. Climbs into manhole and places mirror near invert to reflect sunlight into sewer (from mirror held by other worker on surface) to determine condition of sewer line. Cuts trees, branches, bushes, and shrubs, using chainsaw and axe. Assists in unclogging storm and sanitary sewer lines by hand or using machine-driven tool. Attaches bit to end of cable, using wrench, and inserts cable into line to remove stoppage. Connects fill hose of high velocity water jet to fire hydrant and turns water on to fill water tank of water jet to prescribed level, using hydrant wrench. Inserts nozzle of hose down manhole through roller guide into main line. Fastens sections of extension tubes of vacuum jet rodder. Places sandtrap in lower manhole to catch wayne ball and debris. Assists in setting up power winch of bucket machine over manholes. Activates power winch and disengages gear to move bucket in line. Attaches auger to end of rod, using wrench. Lowers rod guide and pipe jack into manhole. Sets up audio communication system. Turns winch handles to move TV camera through sewer line. Observes and moves cable and rope while standing in manhole to move camera through sewer line without damage. Assists in servicing equipment, machines, and attachments. Conveys materials and tools about job site. Cleans work sites, removes debris, and places tools in truck after completion of job. Erects barricades or traffic cones to protect workmen and public. May drive pickup truck.

Title: MAINTENANCE MAN I (Cont'd)

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement is the completion of eighth grade. A high school or vocational school is highly desirable. Must be able to read and write.

2. General Requirements:

- a. Knowledge of the uses of sewer construction and maintenance tools and equipment.
- b. Knowledge of occupational hazards and necessary safety precautions.
- c. Ability to understand and follow oral and written instructions.
- d. Ability to maintain working relationships with fellow employees and the public.
- e. Ability to perform heavy manual labor under varying weather conditions.
- f. Possession of a valid driver's license.

3. General Educational Development:

a. Reasoning:

Apply common sense understanding to carry out detailed but uninvolved written or oral instruction.

b. Mathematical:

Use arithmetic to add, subtract, multiply and divide whole numbers.

c. Language:

Ability to understand and carry out instructions and to establish and maintain communication with fellow employees and supervisors.

4. Specific Vocational Preparation:

Approximately six months of experience as a laborer in sewer construction and maintenance work.

Title: MAINTENANCE MAN I (Cont'd)

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

Preference for activities of a concrete and organized nature dealing with things and objects.

7. Temperament:

Must adjust to situations involving doing things only under specific instructions and must have disposition to adhere exactly to established standards and procedures.

8. Physical Demands:

The work is heavy to very heavy and involves lifting heavy objects, climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:

Work is outside and it involves exposure to weather, water, noise, noxious smells, gases, and the risk of bodily injury.

Title: MAINTENANCE MAN I (Cont'd)

ENTRY SOURCES: Laborer, or General Public.

PROGRESSION TO: Maintenance Man II, Maintenance Equipment Operator,
Construction Equipment Operator, or TV Technician I.

OCCUPATIONAL DESCRIPTION

Title: MASON II, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Builds, repairs, and finishes sewer related structures such as manholes, culverts, catch basins, and retaining walls, using masonry tools, floats, trowels and screeds: Inspects masonry appurtenances to ascertain condition of structures and need for repairs. Raises or lowers manhole walls to conform with grade changes. Chips away concrete along cracks to prepare for repairs, using hammer and chisel. Knocks rim off manholes and breaks top of manhole walls, using sledge hammer. Replaces fallen bricks and patches cracks and eroded inverts with fresh mortar, using trowel. Presses bricks into cement mixture and lays them to specified levels. Smooths and finishes surfaces of concrete walls to specified textures, using floats. Places rim over brick and cements rim to ensure that cover is secure in place. Installs prefabricated manholes. Signals to CONSTRUCTION EQUIPMENT OPERATOR to align fabricated manhole and press it into proper position. Applies mortar mix on area between pre-cast concrete and existing walls to secure manhole in position. Bypasses manholes to dewater them, using pumps. Drives pickup truck to work sites to haul workers, materials, and equipment. Gives directions to MASON I, and LABORERS, instructs them in efficient and safe use of machines and tools, trains them in work methods, and ensures that proper procedures and safety precautions are followed. Requisitions tools and materials. May act as crew leader. May mix cement, sand, and water to prepare mortar, using shovel.

QUALIFICATIONS PROFILE

1. Formal Education:

Usually required to have completed at least the eighth grade. Completion of the tenth grade or graduation from high school or vocational school is highly desirable.

2. General Requirements:

- a. Knowledge of materials, methods, and standard practices of the masonry trade.

Title: MASON II (Cont'd)

- b. Knowledge of work hazards and applicable safety precautions.
- c. Ability to use effectively masonry tools.
- d. Ability to lead the work of a small crew.
- e. Ability to establish and maintain effective working relationships with employees and the general public.
- f. Possession of a valid driver's license.

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
- (2) Deal with problems involving several concrete variables in or from standardized situations.

b. Mathematical:

Make arithmetic calculations involving fractions, decimals and percentages.

c. Language:

- (1) Communicate with fellow employees and train subordinates in work methods.
- (2) Fill in work report forms.

4. Specific Vocational Preparations:

Two to three years experience in construction and masonry work.

5. Aptitudes - Relative to General Working Population:

- a. Intelligence: Middle third
- b. Verbal: Lowest third excluding bottom 10%
- c. Numerical: "

Title: MASON II (Cont'd)

- d. Spatial: Middle third
 - e. Form Perception: "
 - f. Clerical Perception: Lowest third excluding bottom 1
 - g. Motor Coordination: Middle third
 - h. Finger Dexterity: "
 - i. Manual Dexterity: "
 - j. Eye-Hand-Foot Coordination: Lowest third excluding bottom 1
 - k. Color Discrimination: Lowest 10%
6. Interests:
- An interest in activities concerned with things, objects, machines, and techniques.
7. Temperament:
- Must adjust to situations involving repetitive operations carried out according to set procedures and must adhere to accepted standards.
8. Physical Demands:
- Medium to heavy work involving lifting, climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.
9. Working Conditions:
- The work is outside and involves wet conditions, risk of bodily injury, and exposure to weather, noxious smells, and gases.

ENTRY SOURCES: Mason I.

PROGRESSION TO: Maintenance Man II, Foreman, or Maintenance Supervisor

OCCUPATIONAL DESCRIPTION

Title: MASON I, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Assists MASON II to build, repair, and finish manholes, culverts, catch basins and other sewer-related appurtenances, using masonry tools such as floats, trowels, and screeds: Removes manhole covers, using pick. Inspects structures and relays to MASON II condition of structures. Chips away concrete along cracks to prepare for repairs, using hammer and chisel. Raises loose bricks and debris from bottom of manhole to surface and dumps them in truck, using bucket and shovel. Mixes cement, sand, and water to prepare mortar, using shovel. Deposits mortar on board within reach of MASON II. Assists in preparing, smoothing, and finishing surfaces of concrete walls to specified textures, using float. Assists in dewatering manholes to bypass them. Conveys and replaces tools on truck. May drive pickup truck to haul crew, materials, equipment, and tools. Performs other duties as directed by MASON II.

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement is the completion of eighth grade. Graduation of a high school or a vocational school is highly desirable.

2. General Requirements:

- a. Knowledge of tools, equipment, and materials used in masonry work.
- b. Knowledge of work hazards and applicable safety precautions.
- c. Ability to understand and follow oral and written instructions.
- d. Ability to maintain working relationships with fellow employees and general public.
- e. Ability to perform heavy manual labor under varying weather conditions.
- f. Possession of a valid driver's license.

Title: MASON I (Cont'd)

3. General Educational Development:

a. Reasoning:

Apply common sense understanding to carry out simple 1- or 2-step instructions.

b. Mathematical:

Perform simple addition and subtraction, reading and copying of figures, or counting and recording.

c. Language:

Learn job duties from oral instructions or demonstration. Request orally or in writing work supplies and materials.

4. Specific Vocational Preparation:

Approximately six months of experience as a laborer in masonry work.

5. Aptitude - Relative to General Working Population:

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

Title: MASON I (Cont'd)

6. Interests:

Preference for activities of a concrete and organized nature dealing with things and objects.

7. Temperament:

Must adjust to situations involving repetitive operations carried out according to set procedures or sequences and involving doing things only under specific instruction with little or no room for independent action or judgment.

8. Physical Demands:

The work is heavy to very heavy and involves lifting, climbing, stooping, kneeling, crouching, reaching, handling, fingering, and seeing.

9. Working Conditions:

Work is outside and it involves exposure to weather, water, noxious smells, gases, and the risk of bodily injury.

ENTRY SOURCES: Laborer and General Public.

PROGRESSION TO: Mason II.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE EQUIPMENT OPERATOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Operates maintenance equipment such as vacuum jet rodder, eductor, high velocity water jet, bucket machine, power rodder, wayne ball machine, and sewer flusher, to clean and unclog storm and sanitary sewer lines functioning as leadman and performing any combination of following tasks: Drives and positions equipment. Manipulates control to start vacuum fan engine. Pushes buttons to activate remote controls that lift and position flexible suction hose. Positions drain of vacuum jet rodder over manhole, opens liquid release valve on vacuum body, lowers drain hose into manhole, and lets liquid drain. Inserts nozzle of high velocity water jet hose down manhole through roller guide into mainline. Observes water pressure and footage gauges to ascertain length of hose in line and to determine when obstruction is met. Moves levers to direct movement of water jet hose in sewer line. Inserts water agitating hose of eductor into manhole. Selects and attaches auger of specified size to rod, using wrench. Lowers rod guide and pipe jack into manhole, using rope attachment. Starts machine and moves levers to advance cleaning tool in sewer line, to regulate rate of speed of rod, to rotate auger to bore through and loosen obstruction, and to withdraw rod. Sets up power winches of bucket machine over manholes. Floats rope attached to tow sack down to adjacent manhole to thread sewer line. Attaches cables from two power winches to bucket so bucket can move inside sewer line in both directions. Disengages upper winch out of gear and signals MAINTENANCE MAN I to activate lower power winch to close and retract bucket. Pulls bucket to surface and empties contents into truck. Places cable through jack pulley and attaches cable to wayne ball. Inserts wayne ball into sewer line. Directs MAINTENANCE MEN I to connect fire hose to fire hydrant and to turn fire hydrant on to build up water pressure in sewer line, to move ball that removes accumulated debris downstream. Inserts flushing truck water hose into manhole and turns water on to wash debris in line. Services, adjusts, and makes minor repairs to equipment and attachments. Communicates with DISPATCHER, FOREMAN, MAINTENANCE SUPERVISOR I, using radio telephone. Gives directions to MAINTENANCE MEN I, and LABORERS, instructs them in the efficient and safe use of tools and machines, trains them in work methods and ensures that proper procedures and safety precautions are followed.

Title: MAINTENANCE EQUIPMENT OPERATOR (Cont'd)

Prepares daily reports showing manpower and equipment utilization, lines cleaned, and number of stoppages opened. May clean and disinfect domestic basements and other areas flooded as a result of sewer stoppages.

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement is usually completion of eighth grade. Graduation from high school or vocational school is highly desirable and is increasingly required.

2. General Requirements:

- a. Knowledge of the operation, servicing, and minor repair of a variety of sewer cleaning equipment.
- b. Knowledge of methods, tools, and materials used to clean and unclog storm and sanitary sewer lines.
- c. Knowledge of lay out of city streets and locations of sewer lines and related structures.
- d. Knowledge of work hazards and applicable safety precautions.
- e. Ability to detect and perform minor repairs and adjustment to equipment.
- f. Ability to locate, detect, and correct sewer stoppages.
- g. Ability to lead the work of a small crew.
- h. Ability to establish and maintain effective working relationships with employees and the general public.
- i. Possession of a valid driver's license.

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.

Title: MAINTENANCE EQUIPMENT OPERATOR (Cont'd)

- (2) Deal with problems involving several concrete variables in or from standardized situations.

b. Mathematical:

Make arithmetic calculations involving fractions, decimals, and percentages.

c. Language:

- (1) Communicate with fellow employees, and train subordinates in work methods.

- (2) Fill in maintenance report forms.

4. Specific Vocational Preparation:

One to two years experience in sewer maintenance and equipment operation is required to achieve average performance and to lead a small crew. Length of training depends on educational background and mechanical attitude and is of the informal on-the-job type.

5. Aptitudes - Relative to General Working Population:

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

Title: MAINTENANCE EQUIPMENT OPERATOR (Cont'd)

6. Interests:

A preference for activities dealing with things, objects, machines, and techniques.

7. Temperament:

Must adjust to situations involving repetitive operations carried out according to set procedures or sequences and must adhere to accepted standards. Must also adjust to situations requiring the evaluation of information against judgmental criteria.

8. Physical Demands:

Medium work involving lifting, climbing, stooping, kneeling, crouching, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:

The work is outside and involves contact with water, risk of bodily injury, and exposure to weather, noise and noxious smells.

ENTRY SOURCES: Maintenance Man I.

PROGRESSION TO: TV Technician II, Foreman, or Maintenance Supervisor I.

OCCUPATIONAL DESCRIPTION

Title: CONSTRUCTION EQUIPMENT OPERATOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Operates variety of construction and earth moving equipment to assist in sewer repair and construction: Moves hand and foot levers to operate such equipment as back hoe, front end loader, dragline, bulldozer, motor grader and trenching machine to load, unload, and haul gravel, rock, dirt, sand, equipment, and materials; Excavate and backfill trenches; Position pre-cast manholes, storm and sanitary pipes; Move and level ground to desired grade. Performs related construction duties. Observes signals of another worker to facilitate positioning and operation of equipment. Services, adjusts and makes minor repairs to equipment. Works under the supervision of a FOREMAN or a crew leader. May be designated according to type of machine operated as BACK HOE OPERATOR, DRAGLINE OPERATOR, and BULLDOZER OPERATOR.

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement is usually eighth grade. Graduation from a high school or vocational school supplemented by completion of formal operator training is highly desirable.

2. General Requirements:

- a. Knowledge of work hazards and applicable safety precautions.
- b. Ability to operate and maintain a variety of construction and earth moving equipment.
- c. Ability to detect needed mechanical work and make necessary minor repairs and adjustments.
- d. Ability to understand and follow oral and written instructions.
- e. Ability to establish and maintain effective working relationships with employees.
- f. Possession of a valid operator's license.

Title: CONSTRUCTION EQUIPMENT OPERATOR (Cont'd)

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
- (2) Deal with problems involving several concrete variables in or from standardized situations.

b. Mathematical:

Make arithmetic calculations involving fractions, decimals, and percentages.

c. Language:

Communicate with fellow employees during operation of equipment.

4. Specific Vocational Preparation:

Three to six months are required before the worker achieves average proficiency in operating equipment.

5. Aptitudes - Relative to General Working Population:

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

Title: CONSTRUCTION EQUIPMENT OPERATOR (Cont'd)

6. Interests:

Interest in activities of a concrete and organized nature dealing with things, objects, machines, and techniques.

7. Temperament:

Must adjust to situations involving repetitive operations carried out according to set procedures or sequences.

8. Physical Demands:

The work is light and involves reaching, handling, fingering, hearing, and seeing.

9. Working Conditions:

Work is outside and it involves exposure to weather, noise, vibration, hazards, and dust.

ENTRY SOURCES: Maintenance Man I, Automotive Equipment Operator, or General Public.

PROGRESSION TO: Foreman, or Equipment Supervisor.

OCCUPATIONAL DESCRIPTION

Title: AUTOMOTIVE EQUIPMENT OPERATOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Drives automotive equipment such as dump truck and tractor to perform any combination of following tasks: Hauls debris, dirt, gravel, rock, sand, and equipment. Loads and unloads materials and equipment. Drives tractor and controls mowing attachment to cut grass, bushes, and shrubs in maintenance of outfall right-of-way. Cuts and trims trees and bushes, using chainsaw, axe, and other handtools. Cleans, adjusts, greases, oils, and performs minor repairs to automotive equipment and attachments. Locates job sites, using maps, and records work performed. May act as a crew leader. May give directions to MAINTENANCE MEN I and LABORERS. Performs other manual tasks as directed.

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement is the completion of eighth grade.

2. General Requirements:

- a. Ability to recognize and report abnormal operating functions of equipment and make necessary mechanical adjustments.
- b. Ability to understand and follow oral and written instructions.
- c. Ability to perform heavy manual labor.
- d. Ability to maintain working relationships with fellow employees.
- e. Possession of a valid driver's license.

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out detailed but uninvolved written or oral instructions.

Title: AUTOMOTIVE EQUIPMENT OPERATOR (Cont'd)

- (2) Deal with problems involving a few concrete variables in or from standardized situations.

b. Mathematical:

Use arithmetic to add, subtract, multiply, and divide whole numbers.

c. Language:

Ability to understand and carry out instructions and to establish and maintain communication with fellow employees and supervisors.

4. Specific Vocational Preparation:

Short demonstration only.

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

Preference for activities of a routine, concrete, organized nature that are carried on in relation to machines and techniques.

Title: AUTOMOTIVE EQUIPMENT OPERATOR (Cont'd)

7. Temperament:

Must adjust to situations involving repetitive operations carried on according to set procedures or sequences involving doing things only under specific instructions.

8. Physical Demands:

The work is heavy and involves lifting, reaching, handling, and seeing.

9. Working Conditions:

Work is both inside and outside.

ENTRY SOURCES: Laborer or General Public.

PROGRESSION TO: Construction Equipment Operator.

OCCUPATIONAL DESCRIPTION

Title: LABORER, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Performs any combination of the following routine tasks involved with construction, repair, and preventive maintenance of storm and sanitary sewers and related structures: Places barricades or traffic cones around work site to protect workmen and public. Conveys materials and tools about job site. Cleans work sites, removes debris, and places tools in truck after completion of job. Breaks pavement and digs ditches, using air hammer, pick, and shovel. Digs dirt from around pipe, shovels, and rakes crushed stone or dirt to desired grade. Backfills ditches, using shovels, and packs dirt, using whacker and tamper. Helps to maneuver and hold pipe sections in position for MAINTENANCE MEN to tighten and caulk connections, using pipe puller. Assists in unclogging storm and sanitary sewers manually or using power operated cleaning tools. Mixes cement, sand, and water to prepare mortar, using shovel. Cuts trees, branches, bushes, and shrubs to clear right-of-way, using chainsaw and axe. Cuts weeds and grass, using power-mower. Cleans manholes, catch basins, creeks, and ditches. Raises loose bricks and debris from bottom of manhole to surface, and dumps them in truck, using bucket and shovel. Loads and unloads heavy mechanical equipment, dirt, stone, and construction materials on and from truck. Cleans tools and equipment. May drive pickup truck.

QUALIFICATIONS PROFILE

1. Formal Education:

Required to have completed the eighth grade. Must be able to read and write.

2. General Requirements:

- a. Ability to perform heavy manual labor in all kinds of weather.
- b. Ability to understand and follow oral and written instructions.
- c. Ability to use hand tools and standard equipment.
- d. Ability to maintain working relationships with fellow employees and the public.

Title: LABORER (Cont'd)

3. General Educational Development:

a. Reasoning:

Apply common sense understanding to carry out simple 1- or 2-step instructions.

b. Mathematical:

Perform simple addition and subtraction, reading, and copying of figures, or counting and recording.

c. Language:

Learn job duties from oral instructions or demonstrations, and request orally, or in writing, work supplies and materials.

4. Specific Vocational Preparation:

No previous experience is necessary.

5. Aptitudes - Relative to General Working Population:

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

Title: LABORER (Cont'd)

6. Interests:

Interest in activities dealing with things and objects of a routine, concrete, organized nature.

7. Temperament:

Must adjust to situations involving things only under specific instruction, allowing little or no room for independent action or judgment in working out job problems.

8. Physical Demands:

Heavy to very heavy work involving lifting, carrying, climbing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:

Outside work involving wet conditions and exposure to weather, noise, noxious smells, gases, and risk of bodily injury.

ENTRY SOURCES: Unskilled labor market.

PROGRESSION TO: Maintenance Man I, TV Technician I, Automotive Equipment Operator, Maintenance Mechanic Helper, or Mason I.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MECHANIC II, WASTEWATER LIFT STATION

OCCUPATIONAL DEFINITION

Repairs and overhauls wastewater pumping station equipment, using hand tools: Overhauls and repairs centrifugal-type pumps, motors, chlorinators, control valves, comminutors, and related equipment. Lubricates and adjusts pumping station equipment. Replaces packing and filter element, and changes chlorine cylinder. Evaluates station logs and makes recommendations for changes in maintenance procedures. Periodically inspects pumping stations for early detection of malfunctions. Reads and interprets technical manuals and blueprints to facilitate repair and maintenance of equipment. Provides technical assistance and prescribes work methods and safety procedures to MAINTENANCE MECHANIC I and MAINTENANCE MECHANIC HELPER. Drives pickup truck to pumping stations. Requisitions tools and equipment.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a high school or vocational school is the minimum requirement.

2. General Requirements:

- a. Knowledge of the principles of operation and maintenance of pumps, motors, and related electrical and mechanical pumping station equipment.
- b. Knowledge of work hazards and applicable safety precautions.
- c. Ability to diagnose and repair malfunctions in equipment.

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out instructions furnished in oral, written or diagrammatic form.
- (2) Deal with problems involving a few concrete variables in or from standardized situations.

Title: MAINTENANCE MECHANIC II (Cont'd)

b. Mathematical:

Make arithmetic calculations involving fractions, decimals, and percentages.

c. Language:

(1) Read and interpret technical manuals and blueprints.

(2) Read and evaluate station operation logs.

4. Specific Vocational Preparation:

Three years experience in the operation, maintenance, and repair of pumps and related mechanical and electrical equipment.

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

An interest in activities dealing with things and objects which are carried on in relation to processes, machines, and techniques.

Title: MAINTENANCE MECHANIC II (Cont'd)

7. Temperament:

Must adjust to situations requiring the making of decisions on a judgmental basis and adhere to precise and established standards.

8. Physical Demands:

Medium work involving lifting, climbing, stooping, kneeling, crouching, reaching, handling, fingering, feeling, talking, hearing and seeing.

9. Working Conditions:

The work is inside and involves contact with water, risk of bodily injury, and exposure to noise, noxious smells, gases, and poor ventilation.

ENTRY SOURCES: Maintenance Mechanic I.

PROGRESSION TO: Maintenance Supervisor I.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MECHANIC I, WASTEWATER LIFT STATION

OCCUPATIONAL DEFINITION

Conducts periodic inspection and performs routine preventive maintenance and minor repairs to wastewater pumping stations to ensure efficient operation, using hand tools: Inspects centrifugal-type pumps, comminutors, chlorinators, float switches, valves, fresh-air blowers, and warning alarms to detect malfunctions. Observes and reports malfunctions to MAINTENANCE MECHANIC II and assists in overhaul and major repair of equipment. Lubricates pumps, motors, and drives. Adjusts pump seal to tighten packing, using wrench. Cleans mechanic seal or packing gland. Replaces packing and filter element, and changes chlorine cylinder. Observes, listens to, and feels heat of pump motor to detect unusual noise or vibration. Inspects and cleans bar screen using rake. Washes sides of wet well to control grease accumulation, using water hose. Keeps records and makes routine reports. Drives pickup truck to pumping stations. Gives directions to MAINTENANCE MECHANIC HELPER, instructs him in the efficient and safe use of tools, trains him in work methods, and ensures that proper procedures and safety precautions are followed.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a high school or vocational school is the minimum requirement.

2. General Requirements:

- a. Knowledge of pumping station equipment.
- b. Knowledge of occupational hazards and necessary safety precautions.
- c. Ability to maintain pumps and related mechanical and electrical equipment.
- d. Ability to detect equipment malfunctions and perform minor repairs.
- e. Possession of a valid driver's license.

Title: MAINTENANCE MECHANIC I (Cont'd)

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out instructions furnished in oral, written, or diagrammatic form.
- (2) Deal with problems involving several concrete variables in or from standardized situations.

b. Mathematical:

Make arithmetic calculations involving fractions, decimals, and percentages.

c. Language:

- (1) Keep records and make routine reports.
- (2) Give directions and instructions to helper.

4. Specific Vocational Preparation:

One to two years experience in varied mechanical work.

5. Aptitudes - Relative to General Working Population:

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

Title: MAINTENANCE MECHANIC I (Cont'd)

6. Interests:

A preference for activities of a concrete and organized nature dealing with things, objects, processes, machines, and techniques.

7. Temperament:

Must adjust to working with precise and established standards and making decisions on a judgmental basis.

8. Physical Demands:

Work is medium and it involves lifting, climbing, stooping, kneeling, crouching, reaching, handling, fingering, feeling, talking, hearing, and seeing.

9. Working Conditions:

Work is outside and involves contact with water, risk of bodily injury, and exposure to noise, noxious smells, and poor ventilation.

ENTRY SOURCES: Maintenance Mechanic Helper.

PROGRESSION TO: Maintenance Mechanic II.

OCCUPATIONAL DESCRIPTION

Title: MAINTENANCE MECHANIC HELPER, WASTEWATER LIFT STATION

OCCUPATIONAL DEFINITION

Assists MAINTENANCE MECHANIC I to inspect and maintain wastewater pumping stations, performing any combination of following tasks: Assists in inspecting, adjusting, and minor repairing of pumping station equipment such as pumps, comminutors, chlorinators, float switches, valves, fresh-air blowers, and warning alarms. Assists in packing and lubricating pumps. Checks and cleans bar screens, using rake. Washes sides of wet well to control grease accumulation, using water hose. Performs routine maintenance to station and grounds, including mowing grass and cutting weeds. Cleans and conveys tools about work site. Performs other related duties as directed by MAINTENANCE MECHANIC I.

QUALIFICATIONS PROFILE

1. Formal Education:

Minimum requirement is the graduation from a high school or vocational school.

2. General Requirements:

- a. Knowledge of mechanics as related to repairing and maintaining pumps, motors, and related mechanical and electrical equipment.
- b. Knowledge of occupational hazards and necessary safety precautions.
- c. Ability to understand and follow oral and written instructions.

3. General Educational Development:

a. Reasoning:

Apply common sense understanding to carry out detailed but uninvolved written or oral instruction.

b. Mathematical

Use arithmetic to add, subtract, multiply, and divide whole numbers.

Title: MAINTENANCE MECHANIC HELPER (Cont'd)

c. Language:

Ability to understand and carry out instructions and to establish and maintain communication with fellow employees and supervisors.

4. Specific Vocational Preparation:

No previous experience is necessary.

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

Interest in activities of a routine and organized nature dealing with things and objects.

7. Temperament:

Must adjust to situations involving doing things only under specific instructions and must have disposition to adhere exactly to established standards and procedures.

Title: MAINTENANCE MECHANIC HELPER (Cont'd)

8. Physical Demands:

The work is medium and involves climbing, balancing, stooping, kneeling, crouching, reaching, handling, fingering, feeling, and seeing.

9. Working Conditions:

Work is inside and it involves contact with water, risk of bodily injury, and exposure to noise, noxious odors, gases, and poor ventilation.

ENTRY SOURCES: High School or Vocational School graduates,
General Public, and Laborer.

PROGRESSION TO: Maintenance Mechanic I.

OCCUPATIONAL DESCRIPTION

Title: ELECTRICIAN, WASTEWATER LIFT STATION

OCCUPATIONAL DEFINITION

Inspects, maintains, repairs, and installs electrical and electronic lift station equipment, using electrical tools: Makes regular tours inspecting electrical and electronic equipment in lift stations to ascertain proper operation. Locates defects in electrical systems and makes temporary emergency and permanent repairs. Installs, maintains, and tests electrical wiring systems, telephone circuit high water alarm units, telemetering equipment, lights and power circuits, pressure sensing switches, multi-circuit alternators, fixtures, motors, generators, control panels, fuses, switches, and other related instruments. Tests, calibrates and installs instruments and related sensing devices used for controlling automatic equipment. Reads and interprets sketches, wiring, diagrams, specifications, and codes. Keeps maintenance records. Drives pickup truck to lift stations.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a standard high school or vocational school. Electrical and electronic courses highly desirable.

2. General Requirements:

- a. Knowledge of the principles, practices, materials, and methods of the installation, repair, and maintenance of electrical and electronic equipment.
- b. Knowledge of the occupational hazards and safety precautions in electrical work.
- c. Ability to use and care for tools of the electrical trade.
- d. Ability to work from drawings and wiring diagrams.
- e. Ability to interpret and execute oral and written orders.
- f. A valid motor vehicle operator's license.

Title: Electrician (Cont'd)

3. General Educational Development:

a. Reasoning:

- (1) Apply principles of electrical and electronic systems to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
- (2) Interpret a variety of instructions furnished in written, oral, or diagrammatic form.

b. Mathematical:

Perform ordinary arithmetic, algebraic, and geometric procedures in standard, practical applications.

c. Language:

Read and interpret manuals as well as drawings, schematics, and specifications such as layouts and blueprints.

4. Specific Vocational Preparation:

Apprenticeship of 2 to 4 years of on-the-job training and completion of courses in electric and electronic equipment maintenance are generally accepted as the best method of entry. Training received in vocational or technical schools or the armed services enhances entry and advancement prospects.

5. Aptitudes - Relative to General Working Population:

- | | |
|---------------------|---------------------------------|
| a. Intelligence: | Middle third |
| b. Verbal: | " |
| c. Numerical: | " |
| d. Spatial: | Highest third excluding top 10% |
| e. Form Perception: | Middle third |

Title: Electrician (Cont'd)

- f. Clerical Perception: Lowest third excluding bottom 10%
- g. Motor Coordination: Middle third
- h. Finger Dexterity: "
- i. Manual Dexterity: "
- j. Eye-Hand-Foot Coordination: Lowest third excluding bottom 10%
- k. Color Discrimination: "

6. Interests:

An interest in activities concerned with things, objects, machines, and techniques resulting in tangible satisfaction.

7. Temperament:

Must adjust to working with precise and established standards of accuracy in situations involving the evaluation of information against measurable or verifiable criteria.

8. Physical Demands:

Medium work involving climbing, balancing, stooping, kneeling, crouching, crawling, reaching, handling, fingering, and feeling.

9. Working Conditions:

The work is both inside and outside. It involves risk of electric shock, bodily injury, and exposure to noise, noxious smells, gases, and poor ventilation.

ENTRY SOURCES: Trade school and electrical and/or electronic apprentice program graduates. Qualified electricians.

PROGRESSION TO: Maintenance Supervisor I.

OCCUPATIONAL DESCRIPTION

Title: CONSTRUCTION INSPECTOR SUPERVISOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Supervises, coordinates and schedules activities of CONSTRUCTION INSPECTORS engaged in inspecting construction of storm and sanitary sewers and related appurtenances: Assigns construction projects to CONSTRUCTION INSPECTORS. Confers with city engineers and contractors to discuss installation of sewers and city specifications. Studies blueprints and specifications covering construction projects. Conducts periodic field inspection of work in progress and final inspection upon completion of construction project. Inspects major construction activities regarded complex enough to demand his personal attention. Trains and provides technical assistance to subordinates. Examines grades, pipe foundations, pipe jointings, pipe placement, alignment and connections; manholes and invert installation; and backfilling operations and tamping of dirt for compliance with plans and specifications. Keeps records, prepares reports, and makes recommendations concerning work methods and safety procedures.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a high school, supplemented by courses in engineering, surveying and drafting.

2. General Requirements:

- a. Knowledge of the principles, practices, techniques, equipment, and materials involved in the construction of sanitary and storm sewer lines and related structures.
- b. Ability to read and interpret blueprints and specifications.
- c. Ability to establish and maintain effective working relationships with consulting engineers, contractors, employees, and general public.
- d. Ability to plan, supervise, and coordinate inspection activities.

Title: CONSTRUCTION INSPECTOR SUPERVISOR (Cont'd)

3. General Educational Development:

a. Reasoning:

- (1) Apply principles of logical thinking to define problems, collect data, establish facts, and draw valid conclusions.
- (2) Interpret an extensive variety of technical instructions in books, manuals, and mathematical or diagrammatic form.

b. Mathematical:

Perform ordinary arithmetic, algebraic and geometric procedures in standard and practical applications.

c. Language:

- (1) Prepare records and reports.
- (2) Evaluate engineering and technical data and interpret specifications.
- (3) Confer with engineers and contractors.

4. Specific Vocational Preparation:

Four to five years experience in the construction and inspection of sewers.

5. Aptitudes - Relative to General Working Population:

- | | |
|-------------------------|-----------------------------------|
| a. Intelligence: | Highest third excluding top 10% |
| b. Verbal: | " |
| c. Numerical: | " |
| d. Spatial: | Middle third |
| e. Form Perception: | " |
| f. Clerical Perception: | " |
| g. Motor Coordination: | Lowest third excluding bottom 10% |

Title: CONSTRUCTION INSPECTOR SUPERVISOR (Cont'd)

- h. Finger Dexterity: Lowest third excluding bottom 10%
- i. Manual Dexterity: "
- j. Eye-Hand-Foot Coordination: "
- k. Color Discrimination: "

6. Interests:

Preference for activities of a technical nature and resulting in prestige or the esteem of others.

7. Temperament:

Must adjust to situations involving the direction, control, and planning of activities requiring the evaluation of information against measurable or verifiable criteria. Must also have satisfactory working relationships with people beyond giving and receiving instructions.

8. Physical Demands:

Work is light, involving climbing, stooping, kneeling, crouching, crawling, reaching, handling, feeling, talking, hearing, and seeing.

9. Working Conditions:

Work is performed inside and outside and involves exposure to noise from construction equipment.

ENTRY SOURCES: Construction Inspector.

PROGRESSION TO: Assistant Superintendent, Superintendent, or a similar position in a larger city.

OCCUPATIONAL DESCRIPTION

Title: CONSTRUCTION INSPECTOR, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Inspects all phases of construction of storm and sanitary sewers and related structures to ensure conformity with plans and specifications: Studies blueprints and specifications, preparatory to inspection of construction project. Inspects construction work in progress and upon its completion. Verifies elevation and alignment to which pipe is installed, examines pipe foundations, jointings, placement, alignment, and connections; manholes and invert installations; and backfilling operations and tamping of dirt for compliance with plans and specifications. Measures footage of pipe installed, unit quantity of earth removed, gravel used, and concrete poured. Inspects construction materials to ensure specified quality. Interprets each day's work including a descriptive record of equipment and personnel used, a sketch of trench conditions and field location of utilities exposed by construction work, and a report on field and weather conditions. Coordinates construction work of project with the operations of gas, water, telephone, and electric companies and other city departments. Selects samples of materials for testing. Ascertains and promptly refers to CONSTRUCTION INSPECTOR SUPERVISOR field conditions or problems requiring changes in the work or correction of improper construction procedures. Observes installing contractor in performance of infiltration, exfiltration, and low pressure air tests to ensure soundness and tightness of sewer installations. Visually inspects sewer lines to ensure proper installation, using lamp or mirror. Recommends acceptance or requirement of additional work upon completion of project. Prepares progress and final reports to city for payment. Confers with city engineer, contractors, and CONSTRUCTION INSPECTOR SUPERVISOR.

QUALIFICATIONS PROFILE

1. Formal Education:

Graduation from a high school or vocational school is the minimum requirement, preferably supplemented by courses in civil engineering, drafting, and surveying.

Title: CONSTRUCTION INSPECTOR (Cont'd)

2. General Requirements:

- a. Knowledge of methods, practices, equipment, and materials used in the construction of sanitary and storm sewer lines and related appurtenances.
- b. Ability to read and interpret blueprints, plans, and specifications.
- c. Ability to establish and maintain effective working relationships with consulting engineers and contractors.
- d. Ability to keep records and make reports.

3. General Educational Development:

a. Reasoning:

- (1) Apply construction principles to solve practical problems and deal with a variety of concrete variables in situations where only limited standardization exists.
- (2) Interpret a variety of instruction furnished in written, oral, diagrammatic, or schedule form.

b. Mathematical:

Perform ordinary arithmetic, algebraic, geometric procedures in standard and practical applications.

c. Language:

- (1) Confer with engineers, contractors, and superiors.
- (2) Interpret specifications and blueprints.

4. Specific Vocational Preparation:

Two to three years experience in construction or survey work. Experience as construction foreman is particularly desirable.

Title: CONSTRUCTION INSPECTOR (Cont'd)

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

Interest in activities technical in nature and are carried on in relation to processes, machines, and techniques.

7. Temperament:

Must adjust to situations involving the evaluation of information against measurable or verifiable criteria and must adhere to precise and established standards indicated by detailed written specifications and blueprints.

8. Physical Demands:

Work is light, involving climbing, stooping, kneeling, crouching, crawling, reaching, handling, feeling, talking, hearing, and seeing.

ENTRY SOURCES: Construction Foreman, Maintenance Man II or Draftsman.

PROGRESSION TO: Construction Inspector Supervisor.

OCCUPATIONAL DESCRIPTION

Title: DISPATCHER, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Dispatches work crews to repair and unstop storm and sanitary sewer lines according to complaints received from public: Answers telephone to receive complaints and requests for service from general public. Records caller's name, address and type of complaint. Locates site of trouble spot using map. Checks truck log to determine location of nearest available work crew. Transmits information and work orders to MAINTENANCE SUPERVISOR or to proper field crew, using radio telephone. Compiles, types, logs, and files information on complaints received and completed assignments, such as manpower and equipment utilization, lines cleaned and number of stoppages opened. Maintains truck log indicating location of work crews. Types and maintains reports on street cuts and contacts street department for repavement. Files sewer maps by streets showing location and measurements of storm and sanitary sewer lines and appurtenances for future reference. Performs related routine typing and filing duties.

QUALIFICATIONS PROFILE

1. Formal Education:

High school graduate.

2. General Requirements:

- a. Knowledge of the activities, methods, and operating policies and procedures of the department.
- b. Ability to speak clearly.

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out instructions furnished in oral or written form.
- (2) Deal with problems involving several concrete variables in or from standardized situations.

Title: DISPATCHER (Cont'd)

- (2) Deal with problems involving several concrete variables in or from standardized situations.

b. Mathematical:

Make arithmetic calculations involving fractions, decimals, and percentages.

c. Language:

- (1) Communicate with employees and public.
- (2) Prepare maintenance reports.

4. Specific Vocational Preparation:

Commercial courses in high school or business school.

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

A preference for activities involving business contact with people and the communication of ideas.

Title: DISPATCHER (Cont'd)

7. Temperament:

Must have satisfactory working relationships with people and must adjust to situations requiring the making of decisions on a judgmental basis.

8. Physical Demands:

Sedentary work involving reaching, handling, fingering, talking, hearing, and seeing.

9. Working Conditions:

Work is performed inside.

ENTRY SOURCES: High School graduates or General Public.

PROGRESSION TO: Progress in grade only.

OCCUPATIONAL DESCRIPTION

Title: STOCK CLERK, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

Requisitions, receives, examines, stores, records, and issues supplies, equipment, tools and parts used in municipal wastewater collection system: Fills purchase orders for materials, using manufacturers' catalogs and parts lists as reference. Receives, counts, and examines incoming supplies to verify compliance with purchase requests. Sorts and places items in bins. Maintains inventory control system. Conducts periodic and perpetual inventory to verify accuracy of stock control records. Posts materials used and unit cost on inventory cards and in proper accounts. Prepares periodic records showing utilization of supplies. Issues supplies, tools, and equipment to workers, and assists them in filling out standard forms. Determines storage and identification methods and initiates changes in operation policies and procedures. Cleans and dusts shelves and storeroom.

QUALIFICATIONS PROFILE

1. Formal Education:

High school graduate.

2. General Requirements:

- a. Knowledge of standard storeroom methods and procedures.
- b. Knowledge of types of materials, supplies, tools, and equipment stored by the department.
- c. Ability to maintain perpetual inventory system and stock records.

3. General Educational Development:

a. Reasoning:

- (1) Apply common sense understanding to carry out instructions furnished in oral, written, or diagrammatic form.
- (2) Deal with problems involving several concrete variables in or from standardized situations.

Title: STOCK CLERK (Cont'd)

b. Mathematical:

Make arithmetic calculations involving fractions, decimals, and percentages.

c. Language:

Fill out purchase orders, post figures on inventory cards and prepare inventory records.

4. Specific Vocational Preparation:

Six months to one year of storekeeping experience.

5. Aptitudes - Relative to General Working Population:

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

6. Interests:

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

7. Temperament:

Must adjust to working with precise and established standards of accuracy in situations involving the evaluation of information against measurable or verifiable criteria.

Title: STOCK CLERK (Cont'd)

8. Physical Demands:

The work is medium and involves frequent lifting, stooping, reaching, and handling.

9. Working Conditions:

Work is performed inside.

ENTRY SOURCES: Storekeepers or High School graduates.

PROGRESSION TO: Progress in grade only.

OCCUPATIONAL DESCRIPTION*

Title: CLERK TYPIST, WASTEWATER COLLECTION

OCCUPATIONAL DEFINITION

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.

QUALIFICATIONS PROFILE

1. Formal Education:

High school graduate or equivalent, including or supplemented by courses in typing and other commercial subjects.

2. General Requirements:

- a. Considerable knowledge of modern office methods and procedure.
- b. Knowledge of business English, spelling, and arithmetic.
- c. Ability to operate standard office equipment and type minimum of 40 words per minute.
- d. Ability to maintain records and prepare reports.

* Black & Veatch, Estimating Costs and Manpower Requirements for Conventional Wastewater Treatment Facilities, pp. 151-152.

Title: CLERK TYPIST (Cont'd)

- e. Ability to deal effectively with public by telephone and in person.
 - f. Ability to exercise independent judgment.
3. General Educational Development:
- a. Reasoning:
Apply common sense understanding to carry out general instructions.
 - b. Mathematical:
Make arithmetic calculations involving percentages and decimals.
 - c. Language:
Ability to transcribe dictation, make appointments and handle routine correspondence.
4. Specific Vocational Preparation:
- a. Commercial courses in high school or business school.
 - b. Minimum one year progressively responsible general office experience, including typing and operation of office equipment.
5. Aptitudes - Relative to General Working Population:
- a. Intelligence: Middle third
 - b. Verbal: "
 - c. Numerical: "
 - d. Spatial: "
 - e. Form Perception: "
 - f. Clerical Perception: Highest third excluding top 10%
 - g. Motor Coordination: "
 - h. Finger Dexterity: "

Title: CLERK TYPIST (Cont'd)

- i. Manual Dexterity: Highest third excluding top 10%
 - j. Eye-Hand-Foot Coordination: Middle third
 - k. Color Discrimination: "
6. Interests:
- Prefer activities of a concrete, organized nature involving business contact with people.
7. Temperament:
- Worker must adjust to situations involving a variety of duties characterized by frequent change.
8. Physical Demands:
- Sedentary work.
9. Working Conditions:
- Inside work.

ENTRY SOURCES: Employment Agencies or General Public.

PROGRESSION TO: Progress in grade only.

5. DESCRIPTION OF TASKS

A training curriculum is dependent on the availability of an accurate and adequate picture of the tasks and requirements of the job. Task Descriptions offer information on the nature of jobs and provide a framework for developing successful training programs.

Task Descriptions presented in this Manpower Manual are based on extensive field observations of maintenance crews and numerous interviews with supervisory personnel and engineering technicians. This chapter presents Descriptions of Tasks for three unit processes of the wastewater collection system.

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UNIT PROCESS I: SANITARY SEWER MAINTENANCE

OCCUPATION

DESCRIPTION OF TASKS

1. OPERATION OF TV INSPECTION SYSTEM*

SIZE OF CREW: 1 TV Technician II
1 TV Technician I
1 Maintenance Man I

TV Tech. II	:	Receives work assignments for the day from MAINTENANCE SUPERVISOR I.
TV Tech. II	:	Locates job site, using map.
TV Tech. II	:	Drives TV truck to work site.
TV Tech. II	:	Locates insertion and destination manholes.
M. Man I & TV Tech. I	:	Place barricades or traffic cones about worksite.
M. Man I & TV Tech. I	:	Remove tools and equipment at downstream (destination) manhole.
TV Tech. II	:	Positions TV truck at upstream (insertion) manhole.
M. Man I & TV Tech. I	:	Unload tools and equipment at upstream (insertion) manhole.
M. Man I & TV Tech. I	:	Remove manhole covers, using pick.
TV Tech. II	:	Observes sewer line to ensure that it was cleaned and threaded.
M. Man I & TV Tech. I	:	Set up winches and cable guides over manholes.
M. Man I & TV Tech. I	:	Set up audio communication system.
TV Tech. II	:	Positions TV TECHNICIAN I at downstream manhole and MAINTENANCE MAN I at upstream manhole.

* After sewer line has been previously cleaned and threaded.

OCCUPATIONDESCRIPTION OF TASKS

TV Tech. I	:	Attaches winch cable to rope at downstream manhole and inserts cable guide into manhole.
M. Man I	:	Pulls rope upstream to thread line with winch cable and rewinds rope onto reel.
M. Man I	:	Pulls out end of winch cable from manhole.
TV Tech. II	:	Turns switch to start generator that supplies electric power to camera and equipment and to adjust frequency and voltage.
TV Tech. II	:	Connects video-power cables to camera.
TV Tech. II	:	Tests TV camera and monitor.
M. Man I	:	Connects winch cables to camera.
TV Tech. II	:	Verifies that cables are securely attached to camera and oversees the insertion of camera in sewer line.
TV Tech. II	:	May use gas detector to ensure safety of MAINTENANCE MAN I prior to his descending into manhole.
TV Tech. II	:	May operate air blower to ventilate manhole.
TV Tech. II	:	Ensures MAINTENANCE MAN I dons safety harness before entering manhole.
M. Man I	:	Puts on safety harness and climbs into manhole.
M. Man I	:	Inserts flow through control plug with high water alarm device into incoming inverts.
TV Tech. II	:	Lowers camera into upstream manhole, using winch cable.
M. Man I	:	Inserts and positions camera into outgoing invert of manhole.
M. Man I	:	Climbs out of manhole and positions cable guide into manhole to protect video and winch cables.
TV Tech. II	:	Turns knobs to activate TV equipment for video viewing.
TV Tech. II	:	Adjusts TV camera and monitor controls for optimal clarity and contrast.

OCCUPATIONDESCRIPTION OF TASKS

M. Man I & TV Tech. I	:	Turn winch handles following signals from TV TECHNICIAN II to move camera through line.
TV Tech. II	:	Observes picture of sewer line on TV monitor noting structural imperfections, infiltration points and service connection locations.
TV Tech. II	:	Records information and footage on work sheet and map.
TV Tech. II	:	Signals TV TECHNICIAN I and MAINTENANCE MAN I to stop turning winch handles when irregularities are present in section of sewer line that is seen on TV monitor.
TV Tech. II	:	Records footage and type of irregularity on work sheet.
TV Tech. II	:	May photograph screen picture of irregularity, using polaroid camera.
TV Tech. II	:	Signals TV TECHNICIAN I to continue turning winch handle until camera reaches downstream manhole.
TV Tech. II	:	Turns camera off when camera reaches downstream manhole and signals TV TECHNICIAN I to retrieve camera.
TV Tech. I	:	Climbs into manhole, disconnects power and winch cables from camera, and inserts blind plug into power cable.
TV Tech. I	:	Places TV camera cover over camera lens to protect it from sunlight.
M. Man I & TV Tech. I	:	Turn winch handles to pull winch cable and video-power cable upstream.
M. Man I & TV Tech. I	:	Dismantle, clean, and put equipment back on truck.
TV Tech. II	:	May perform minor adjustments and repairs on TV camera system.

OCCUPATIONDESCRIPTION OF TASKS

2. OPERATION OF TV/GROUTING SYSTEM

SIZE OF CREW: 1 TV Technician II
1 TV Technician I
2 Maintenance Man I

TV Tech. II : Receives work assignments for the day from MAINTENANCE SUPERVISOR I.

TV Tech. II : Oversees the loading of grouting materials on truck.

TV Tech. II : Locates job site, using map.

TV Tech. II : Drives TV/grout truck to work site.

TV Tech. II : Locates insertion and destination manholes.

M. Man I : (A) and (B) place barricades or traffic cones about worksite.

M. Man I : (A) and (B) remove tools and equipment at downstream (destination) manhole.

TV Tech. II : Positions TV/grout truck at upstream manhole.

M. Man I : (A) and (B) unload tools and equipment at upstream manhole.

M. Man I : (A) and (B) remove manhole covers, using pick.

TV Tech. II : Oversees the preparation of sealing compound by TV TECHNICIAN I.

TV Tech. I. : Measures and mixes basic sealing chemicals in compound tanks.

TV Tech. I : Checks set time to determine solidification time of sealing compound.

TV Tech. II : Observes sewer line to ensure that it was cleaned and threaded.

M. Man I : (A) and (B) set up winches and cable guides over manholes.

M. Man I : (A) and (B) set up audio communication system.

OCCUPATIONDESCRIPTION OF TASKS

TV Tech. II : Ensures MAINTENANCE MAN I dons safety harness before entering manhole.

M. Man I : (A) puts on safety harness and climbs into manhole.

M. Man I : (A) inserts flow through control plug with high water alarm device into incoming inverts.

TV Tech. I : Lowers camera and packer into upstream manhole, using winch cable.

M. Man I : (A) inserts and positions camera and packer into outgoing invert of manhole.

M. Man I : (A) climbs out of manhole and positions cable guide into manhole to protect video and winch, air and grout cables.

TV Tech. II : Turns knobs to activate TV equipment for video viewing.

TV Tech. II : Adjusts TV camera and monitor controls for optimal clarity and contrast.

M. Man I : (A) and (B) turn winch handles following signals from TV TECHNICIAN II to move camera through line.

TV Tech. II : Manipulates cables to ensure free movement of cables and to prevent their entanglement.

TV Tech. II : Observes picture of sewer line on TV monitor noting structural imperfections, infiltration points and service connection locations.

TV Tech. II : Records information and footage on work sheet and map.

TV Tech. II : Signals MAINTENANCE MAN I (A) and (B) to stop turning winch handles when infiltration point is reached, as observed on TV monitor.

TV Tech. II : Observes monitor and signals MAINTENANCE MAN I (A) and (B) to pull cables until packer is properly positioned over infiltration point.

TV Tech. II : Positions TV TECHNICIAN I at downstream manhole and MAINTENANCE MAN I at upstream manhole.

M. Man I : (B) attaches winch cable to rope at downstream manhole and inserts cable guide into manhole.

OCCUPATIONDESCRIPTION OF TASKS

M. Man I : (A) pulls rope upstream to thread line with winch cable and rewinds rope onto reel.

M. Man I : (A) pulls out end of winch cable from manhole.

TV Tech. II : Turns switch to start generator that supplies electric power to camera and equipment and to adjust frequency and voltage.

TV Tech. II : Turns switch to start air compressor to supply air to grout pump and packer.

TV Tech. II : Observes air tank pressure.

TV Tech. II : Connects video-power cables to camera.

TV Tech. II : Tests TV camera and monitor.

M. Man I : (A) connects winch cables to camera and packer.

TV Tech. I : Connects packer to grout and air hoses.

TV Tech. II : Manipulates grout control knobs to test packer and grout pumps.

TV Tech. I : Observes packer to test it for proper functioning.

TV Tech. II : Verifies that cables are securely attached to camera and packer and oversees the insertion of camera and packer in sewer line.

TV Tech. II : May use gas detector to ensure safety of MAINTENANCE MAN I prior to his descending into manhole.

TV Tech. I : May operate air blower to ventilate manhole.

TV Tech. II : Manipulates grout control knobs to inflate packer to desired pressure and to air test infiltration point in order to determine volume of needed grout and to pump correct amount of sealing compounds.

TV Tech. II : Turns air release valve to deflate packer after allowing necessary time for sealing compound to set up.

TV Tech. II : Signals MAINTENANCE MAN I (A) and (B) to pull packer upstream until sealed joint can be observed on monitor to ensure success of operation.

OCCUPATIONDESCRIPTION OF TASKS

TV Tech. II : Signals MAINTENANCE MAN I (B) to continue turning winch handle until camera and packer reach downstream manhole.

TV Tech. II : Turns camera and air compressor off when camera and packer reach downstream manhole and signals MAINTENANCE MAN I (B) to retrieve camera and packer.

M. Man I : (B) climbs into manhole, disconnects power and winch cables from camera and packer and inserts blind plug into power cable.

M. Man I : (B) places TV camera cover over lens to protect it from sunlight.

M. Man I : (A) and (B) turn winch handles to pull winch cable and videopower cable upstream.

TV Tech. I & : Dismantle, clean, and put equipment back on truck.
M. Man I

TV Tech. II : May perform minor adjustments and repairs to TV camera and grout system.

3. OPERATION OF VACUUM-JET RODDER*

SIZE OF CREW: 1 Maintenance Equipment Operator
1 Maintenance Man I

M. Eq. Op. : Receives work assignments for the day from MAINTENANCE SUPERVISOR I.

M. Eq. Op. : Drives vacuum-jet truck to work site.

M. Eq. Op. : Locates manholes, using map.

M. Eq. Op. : Drives vacuum-jet truck to nearest hydrant.

M. Man I : Connects sewer jet fill hose to hydrant and turns water on to fill water tank, using hydrant wrench.

M. Eq. Op. : Observes gauge to determine when water tank is full and signals MAINTENANCE MAN I to turn water off.

* Cleaning Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Man I	:	Turns water off and disconnects hose, using hydrant wrench.
M. Eq. Op.	:	Determines position of vacuum-jet truck.
M. Man I	:	Erects barricades or traffic cones to protect workers and divert traffic around work area.
M. Eq. Op.	:	Moves lever to engage power takeoff.
M. Eq. Op.	:	Sets engine control to automatic position.
M. Eq. Op.	:	Gets out of truck.
M. Man I	:	Lifts covers of adjacent manholes, using pick.
M. Man I	:	Checks condition of manholes and presence of blockage.
M. Man I	:	Removes extension tubes from truck.
M. Man I	:	Fastens sections of extension tubes to desired depth.
M. Eq. Op.	:	Manipulates controls to start vacuum fan engine.
M. Eq. Op.	:	Flushes manhole to break up solids, using a high-pressured gun.
M. Man I	:	Inserts extension tube into manhole.
M. Eq. Op.	:	Pushes buttons to activate remote control switch to lift and position flexible suction hose.
M. Man I	:	Connects extension tube to flexible suction hose, using clipper.
M. Man I	:	Inserts roller guide into manhole.
M. Eq. Op.	:	Inserts nozzle of water hose down manhole through roller guide into mainline using long handle shovel.
M. Eq. Op.	:	Moves levers to eject water rearward from nozzle to create a thrust that forces hose through pipe.
M. Eq. Op.	:	Observes water pressure and foot indicator gauges to ascertain length of hose in line and to determine when obstruction is met.

OCCUPATIONDESCRIPTION OF TASKS

M. Eq. Op. : Manipulates levers to direct movement of hose which flushes pipe with pressured water and forces debris downstream into manhole.

M. Eq. Op. : Pushes buttons of control switch to manipulate and position vacuum tube.

M. Eq. Op. : Observes vacuum pressure gauge and moves lever to control vacuum pressure.

M. Eq. Op. : Manipulates controls to turn vacuum fan off.

M. Eq. Op. : Moves levers to draw hose back.

M. Man I : Removes roller guide from manhole.

M. Eq. Op. : Washes down manhole, using pressure gun.

M. Man I : Disconnects extension tubes and pressure gun and places them in truck.

M. Eq. Op. : When wastewater tank is full, positions drain hose over manhole, opens liquid release valve, lets wastewater drain in manhole, and finally closes liquid release valve.

M. Eq. Op. : When wastewater tank is full with solids, drives to nearest approved dump site, positions truck for dumping, releases safety lock and hydraulic dual lock, manipulates dump controls to raise and then lower vacuum truck body hydraulically to dump debris and cleans body using pressure gun.

4. OPERATION OF EDUCTOR*

SIZE OF CREW: 1 Maintenance Equipment Operator
1 Maintenance Man I

M. Eq. Op. : Receives work assignments for the day from MAINTENANCE SUPERVISOR I.

M. Eq. Op. : Drives eductor truck to work site.

* Cleaning Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Eq. Op.	: Locates manhole to be cleaned, using map.
M. Eq. Op.	: Determines position of eductor truck.
M. Man I	: Erects barricades or traffic cones to protect workers and divert traffic around work area.
M. Man I	: Lifts manhole covers, using pick.
M. Man I	: Inserts roller guide into manhole.
M. Eq. Op.	: Inserts water agitating hose of eductor through roller guide into manhole.
M. Eq. Op.	: Pulls lever to turn on machine that turns pressured water on in order to flush sewer line.
M. Man I	: Lowers eductor suction tube into manhole.
M. Eq. Op.	: Manipulates levers to control movement of water hose and suction tube.
M. Eq. Op.	: Turns machine off and raises water hose and suction tube from manhole.
M. Man I	: Lowers long handled shovel into manhole to remove large items of debris that suction tube could not handle.
M. Man I	: Deposits debris on truck to be hauled away for disposition.
M. Eq. Op.	: Examines condition of manhole and invert, notes location on map and fills work order for needed repairs to be submitted to MAINTENANCE SUPERVISOR I.
M. Eq. Op.	: May use gas detector to assure safety of MAINTENANCE MAN I prior to his descending into manhole.
M. Eq. Op.	: May operate air blower to ventilate manhole.
M. Eq. Op.	: Ensures MAINTENANCE MAN I dons safety harness before entering manhole.
M. Man I	: Puts on safety harness if he has to climb down into manhole.
M. Man I	: May descend into manhole after getting clearance from MAINTENANCE EQUIPMENT OPERATOR.
M. Man I	: Replaces manhole cover, using pick.

OCCUPATIONDESCRIPTION OF TASKS

5. OPERATION OF HIGH VELOCITY WATER JET*

SIZE OF CREW: 1 Maintenance Equipment Operator
1 Maintenance Man I

M. Eq. Op. : Receives work assignments for the day from MAINTENANCE SUPERVISOR I.

M. Eq. Op. : Drives water jet truck to work site.

M. Eq. Op. : Locates manholes, using map.

M. Eq. Op. : Drives water jet truck to nearest hydrant.

M. Man I : Connects sewer jet fill hose to hydrant and turns water on to fill water tank, using hydrant wrench.

M. Eq. Op. : Observes gauge to determine when water tank is full and signals MAINTENANCE MAN I to turn water off.

M. Man I : Turns water off and disconnects hose, using hydrant wrench.

M. Eq. Op. : Determines position of water jet truck.

M. Man I : Erects barricades or traffic cones to protect workers and divert traffic around work area.

M. Man I : Lifts covers of adjacent manholes, using pick.

M. Man I : Checks condition of manholes and presence of blockage.

M. Eq. Op. : Observes manholes to determine location of blockage.

M. Man I : Inserts roller guide into manhole.

M. Man I : Inserts funnel in downstream invert of manhole.

M. Eq. Op. : Inserts nozzle of hose down manhole through roller guide into mainline.

M. Eq. Op. : Starts machine to eject water rearward from nozzle to create a thrust that forces hose through pipe.

* Cleaning Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Eq. Op.	:	Observes water pressure and foot indicator gauges to ascertain length of hose and to determine when obstruction is met.
M. Eq. Op.	:	Manipulates levers to direct movement of hose which flushes pipe with pressured water and forces debris downstream.
M. Man I	:	Follows and observes flow of water down mainline and signals to MAINTENANCE EQUIPMENT OPERATOR when obstruction is removed.
M. Eq. Op.	:	Moves levers to draw hose back.
M. Man I	:	Removes roller guide from manhole.
M. Eq. Op.	:	Washes down manhole, using pressure gun.
M. Man I	:	Removes accumulated debris and deposits them in truck, using long handle shovel.
M. Eq. Op.	:	May use gas detector to assure safety of MAINTENANCE MAN I prior to his descending into manhole.
M. Eq. Op.	:	May operate air blower to ventilate manhole.
M. Eq. Op.	:	Ensures MAINTENANCE MAN I dons safety harness before entering manhole.
M. Man I	:	Puts on safety harness if he has to climb down into manhole.
M. Man I	:	May descend into manhole to remove debris, using rope, bucket, and invert shovel.
M. Man I	:	Removes funnel from manhole.
M. Man I	:	May climb down into manhole and place mirror near invert while MAINTENANCE EQUIPMENT OPERATOR holds other mirror on street facing sun, to cast reflected sunlight into the sewer, to determine condition of line.
M. Man I	:	Replaces manhole covers, using pick.
M. Man I	:	Cleans work site, removes debris and places tools in truck after completion of operation.

OCCUPATIONDESCRIPTION OF TASKS

M. Eq. Op. : Fills out work report showing sewer lines flushed.
M. Eq. Op. : Fills out work order if sewer lines or manholes
need repair.

6. OPERATION OF POWER RODDER*

SIZE OF CREW: 1 Maintenance Equipment Operator
1 Maintenance Man I

M. Eq. Op. : Receives work assignments for the day from
MAINTENANCE SUPERVISOR I.
M. Eq. Op. : Drives power rodder truck to work site.
M. Eq. Op. : Locates lines to be rodded, using map.
M. Eq. Op. : Determines position of power rodder truck.
M. Man I : Erects barricades or traffic cones to protect workers
and divert traffic around work area.
M. Man I : Lifts manhole covers, using pick.
M. Eq. Op. : Examines water level in manhole to determine clogging
and need for rodding line.
M. Man I : Cleans manhole and invert using long handle shovel
and fork.
M. Man I : Removes rod guide and pipe jack from side of power
rodder.
M. Eq. Op. : Starts motor and moves lever to engage power rodder
and to turn rod a foot out of rod guide.
M. Man I : Attaches 4-inch auger to rod, using wrench.
M. Man I : Lowers rod guide and pipe jack into manhole, using
rope attachment.

* Cleaning Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Man I : Walks over to downstream manhole, observes invert and signals to MAINTENANCE EQUIPMENT OPERATOR when rod reaches that manhole.

M. Eq. Op. : Moves lever to advance rod in sewer line.

M. Eq. Op. : Observes gauges to ascertain length of rod in pipe.

M. Eq. Op. : Moves levers to slow down rod when obstruction is met and to increase thrust force that rotates auger to bore through and loosen deposits.

M. Eq. Op. : Pushes lever to stop drive and release rotation power of rod when MAINTENANCE MAN I signals that auger has reached downstream manhole.

M. Man I : May pull up front end of rod to surface at downstream manhole, using pick rod; replace auger with a root cutter, using wrench; and lower rod back into manhole.

M. Man I : Signals to MAINTENANCE EQUIPMENT OPERATOR to retract rod.

M. Eq. Op. : Moves lever to reverse tool rotation, to retract and pull back rod to loosen obstruction.

M. Eq. Op. : May repeat process with larger size augers.

M. Man I : Observes flow of water in downstream manhole and signals to MAINTENANCE EQUIPMENT OPERATOR when flow runs freely.

M. Eq. Op. : Observes flow of wastewater to ensure success of operation.

M. Man I : Pulls out rod guide and pipe jack from manhole, using rod.

M. Man I : Removes deposits from manhole, auger, and rod and places them in buckets on truck to be hauled away for disposition.

M. Man I : Detaches auger from rod, using wrench.

M. Man I : Replaces manhole covers, using pick.

OCCUPATIONDESCRIPTION OF TASKS

M. Man I : Cleans work site, removes debris and places tools back in truck after completion of operation.

M. Eq. Op. : Completes work report showing sewer lines rodded.

M. Eq. Op. : Fills out work order if sewer lines or manholes need repair.

7. OPERATION OF BUCKET MACHINE*

SIZE OF CREW: 1 Maintenance Equipment Operator
2 Maintenance Man I

M. Eq. Op. : Receives work assignments for the day from MAINTENANCE SUPERVISOR I.

M. Eq. Op. : Drives truck to work site.

M. Eq. Op. : Locates sewer lines to be cleaned, using map.

M. Eq. Op. : Determines set up procedures and directs MAINTENANCE MAN I (A) and MAINTENANCE MAN I (B) in threading sewer line with rope and winch cable.

M. Man I : (A) removes upstream manhole cover.

M. Man I : (B) locates fire hydrant and connects fire hose, using hydrant wrench.

M. Eq. Op. : Lays out hose to upstream manhole.

M. Man I : (A) connects control valve on end of fire hose.

M. Eq. Op. : Signals (B) to turn fire hydrant on.

M. Man I : (B) turns fire hydrant on slowly.

M. Eq. Op. : Signals (A) to close control valve when hose is filled.

M. Man I : (A) closes control valve at upstream manhole.

M. Man I : (B) walks over to downstream manhole and removes cover, using pick.

* Cleaning Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Eq. Op. : Attaches tow sack to rope.

M. Eq. Op. : Inserts tow sack into invert to thread line.

M. Man I : (A) turns control valve so water pressure can push tow sack with rope to downstream manhole to thread line.

M. Man I : (B) removes tow sack, pulls out, and secures rope at downstream manhole.

M. Man I : (A) turns control valve off and secures rope at upstream manhole.

M. Man I : (B) turns off fire hydrant and disconnects hose.

M. Man I : (A) opens control valve to drain fire hose.

M. Man I : (A) and (B) retrieve hose and valve.

M. Eq. Op. : Ensures that sewer line is threaded properly.

M. Eq. Op. : Sets up power winches and roller guides over the two manholes with the assistance of (A) and (B).

M. Eq. Op. : Stations (A) at upstream manhole and (B) at downstream manhole.

M. Man I : (B) attaches winch cable to rope.

M. Man I : (A) pulls rope through sewer line to upstream manhole to thread line with winch cable.

M. Eq. Op. : Attaches both cables to ends of bucket so bucket can be pulled inside sewer line with winch cable.

M. Eq. Op. : Inserts bucket in sewer line and directs (A) and (B) in operating the bucket machine.

M. Man I : (B) activates lower winch to pull bucket in line which opens bucket jaws to scoop up debris.

M. Man I : (B) disengages lower power winch when bucket is believed to be full.

M. Man I : (A) activates upper power winch to draw bucket back which closes bucket jaws.

OCCUPATIONDESCRIPTION OF TASKS

M. Man I : (A) pulls bucket up to surface, empties contents in truck, and inserts bucket back in line.

M. Man I : (A) and (B) repeat process until line is cleaned.

M. Man I : (A) detaches winch cables from ends of bucket.

M. Man I : (B) withdraws cable downstream and rewinds cable onto reel.

M. Man I : (A) and (B) clean manholes, using long handle shovel, remove debris from work site, and dump them in truck to be hauled away for disposition.

M. Man I : (A) and (B) replace manhole covers, using pick.

M. Eq. Op. : Observes flow of wastewater to ensure success of operation.

M. Eq. Op. : Completes work report showing sewer lines rodded.

M. Eq. Op. : Fills out work order if sewer lines or manholes need repair.

8. OPERATION OF WAYNE BALL MACHINE*

SIZE OF CREW: 1 Maintenance Equipment Operator
2 Maintenance Man I

M. Eq. Op. : Receives work assignments for the day from MAINTENANCE SUPERVISOR I.

M. Eq. Op. : Drives truck to work site.

M. Eq. Op. : Locates sewer lines to be cleaned, using map.

M. Man I : MAINTENANCE MAN I (A) removes upstream manhole cover, using pick.

M. Eq. Op. : Inspects sections of sewer lines to be cleaned to determine conditions of lines and work hazards involved.

* Cleaning Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Eq. Op. : Determines set up and operation procedures.

M. Man I : MAINTENANCE MAN I (B) locates fire hydrant and connects fire hose, using hydrant wrench.

M. Man I : (A) lays out hose to upstream manhole and connects control valve on end of fire hose.

M. Man I : (B) turns fire hydrant on slowly.

M. Man I : (A) closes control valve at upstream manhole when hose is filled.

M. Man I : (B) walks over to downstream manhole, removes cover, using pick, and places sand trap in manhole to catch ball and debris.

M. Eq. Op. : Sets up hand winch over upper manhole.

M. Eq. Op. : May use power winch if line is larger than 12 inches.

M. Eq. Op. : Attaches wayne ball to end of cable.

M. Eq. Op. : Inserts ball into sewer line.

M. Man I : (A) turns control valve on and off as directed by MAINTENANCE EQUIPMENT OPERATOR to control water pressure in sewer line causing the ball to move downstream and remove accumulated debris in its way.

M. Eq. Op. : Takes precautions to ensure ball does not become loose in line or ball does not build up excessive pressure that may cause plumbing fixture to overflow.

M. Man I : (B) detaches wayne ball from cable when ball reaches downstream manhole.

M. Man I : (B) removes debris from manhole, using long handle shovel.

M. Man I : (A) retracts cable, manually or using winch.

M. Man I : (A) and (B) replace manhole covers, using pick.

M. Man I : (A) and (B) place tools and equipment back in truck, remove debris from work site and dump them in truck to be hauled away for disposition.

M. Eq. Op. : Completes work report showing sewer lines cleaned.

M. Eq. Op. : Fills out work order if sewer lines or manholes need repair.

OCCUPATIONDESCRIPTION OF TASKS

9. OPERATION OF 35mm CAMERA

SIZE OF CREW: 1 TV Technician II
1 TV Technician I
1 Maintenance Man I

TV Tech. II : Receives work assignments for the day from
MAINTENANCE SUPERVISOR I.

TV Tech. II : Drives truck to work site.

TV Tech. II : Locates sewer lines to be photographed, using map.

TV Tech. II : Determines set up procedures and directs TV
TECHNICIAN I and MAINTENANCE MAN I in threading
sewer line with rope and winch cable.

M. Man I : Removes upstream manhole cover.

TV Tech. I : Locates fire hydrant and connects fire hose, using
hydrant wrench.

TV Tech. II : Lays out hose to upstream manhole.

M. Man I : Connects control valve on end of fire hose.

TV Tech. II : Signals TV TECHNICIAN I to turn fire hydrant on.

TV Tech. I : Turns fire hydrant on slowly.

TV Tech. II : Signals MAINTENANCE MAN I to close control valve when
hose is filled.

M. Man I : Closes control valve at upstream manhole.

TV Tech. I : Walks over to downstream manhole and removes cover,
using pick.

TV Tech. II : Attaches tow sack to rope.

TV Tech. II : Inserts tow sack into invert to thread line.

M. Man I : Turns control valve so water pressure can push tow
sack with rope to downstream manhole to thread line.

TV Tech. I : Removes tow sack, pulls out, and secures rope at
downstream manhole.

OCCUPATIONDESCRIPTION OF TASKS

M. Man I : Turns control valve off and secures rope at upstream manhole.

TV Tech. I : Turns off fire hydrant and disconnects hose.

M. Man I : Opens control valve to drain fire hose.

TV Tech. I & : Retrieve hose and valve.
M. Man I

TV Tech. II : Ensures that sewer line is threaded properly.

TV Tech. I & : Set up cable winches at both manholes.
M. Man I

TV Tech. II : Loads camera with film and inspects battery.

TV Tech. II : Attaches control cable to camera.

TV Tech. II : Depresses button on camera to photograph small blackboard which gives location of manhole, manhole number, date and type of weather for future reference.

M. Man I : Attaches pulling cables to camera.

M. Man I : Climbs down manhole and positions camera in invert of sewer line.

TV Tech. I : Tightens pulling cable.

TV Tech. I & : Turn handles of cable winches manually to move camera
M. Man I inside line.

TV Tech. II : Observes footage gauge and records distances travelled by camera on a schedule sheet.

TV Tech. I & : Stop winding cable every four feet, following
M. Man I directions from TV TECHNICIAN II to allow the taking of pictures.

TV Tech. II : Snaps pictures at designated intervals until camera reaches downstream manhole or until camera encounters an obstruction and cannot pass through line.

TV Tech. I : Descends into manhole and detaches camera from cable when camera reaches downstream manhole.

OCCUPATIONDESCRIPTION OF TASKS

M. Man I : In case of an obstruction in line, rewinds cable onto reel to retract camera to upstream manhole and detaches camera.

TV Tech. II : Removes film and batteries from camera.

TV Tech. I & : Rewind cables onto reels, disassemble, clean, and
M. Man I return equipment to truck.

TV Tech. I & : Replace manhole covers, using pick.
M. Man I

TV Tech. II : Fills out work report showing sewer lines photographed.

10. OPENING OF STOPPED MAIN LINE*

SIZE OF CREW: 1 Maintenance Equipment Operator
1 Maintenance Man I

M. Eq. Op. : Drives service pick up truck to work site.

M. Eq. Op. : Locates manholes, using map.

M. Man I : Removes manhole covers, using pick.

M. Man I : Inspects manholes and relays condition of wastewater flow to MAINTENANCE EQUIPMENT OPERATOR.

M. Eq. Op. : Inspects manholes to determine location of stoppage.

M. Eq. Op. & : Run rods through rod guide, fit front end of rod
M. Man I with auger, using wrench, and lower guide into position.

M. Eq. Op. & : Thrust rods into invert and advance them until auger
M. Man I reaches obstruction.

M. Eq. Op. & : May rotate rod manually, using turning pin.
M. Man I

M. Eq. Op. : May attach end of rod to portable power rodder to rotate rods until auger loosens and dislodges debris inside pipe.

* Cleaning Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Man I : Retracts rods and drags out obstructions such as roots, grease, and other deposits.

M. Eq. Op. : Checks adjacent manholes for flow to ascertain efficiency of operation.

M. Man I : Replaces manhole covers, using pick.

M. Man I : Cleans work site, removes debris and places tools in truck after completion of operation.

M. Eq. Op. : Completes work report showing sewer lines unstopped.

11. OPENING OF STOPPED LATERAL LINE*

SIZE OF CREW: 1 Maintenance Equipment Operator
1 Maintenance Man I

M. Eq. Op. : Receives assignment from DISPATCHER or MAINTENANCE SUPERVISOR I.

M. Eq. Op. : Determines location from map or address.

M. Eq. Op. : Drives service pick up truck to work site.

M. Eq. Op. : Checks with house residents to discuss complaint and confirm problem.

M. Eq. Op. : Locates cleanout visually or using dip needle or M-Scope if cleanout is not visible.

M. Man I : Assists MAINTENANCE EQUIPMENT OPERATOR in locating cleanout.

M. Man I : Uncovers cleanout, if underground, by digging from around it, using shovel.

M. Man I : May have to dig down to lateral line, using shovel, if cleanout does not exist or cannot be located.

M. Man I : Removes cleanout plug using wrench and hammer and lifts covers off adjacent manholes, using pick.

* Cleaning Crew (if it is the responsibility of the municipality).

OCCUPATIONDESCRIPTION OF TASKS

M. Eq. Op. : Observes flow of sewage in cleanout to determine whether stoppage occurs on city or private property.

M. Eq. Op. & : Remove portable electric cleaning machine from
M. Man I truck and carry it to work site.

M. Eq. Op. : Attaches bit to end of cable, using wrench.

M. Eq. Op. : Inserts cable into line through cleanout to remove roots and debris in line.

M. Eq. Op. : Connects machine to generator.

M. Eq. Op. : Pulls hand lever and depresses foot control of machine to advance cleaning tool slowly until it encounters an obstruction and to rotate cable until obstacle is broken.

M. Man I : Retracts cable from line when water flows freely showing success of operation.

M. Eq. Op. : May deposit dye tablets in cleanout to determine whether water is flowing to manhole downstream.

M. Eq. Op. : Checks line for structural damage and reports to MAINTENANCE SUPERVISOR I if repairs are needed.

M. Man I : Cleans work site.

M. Eq. Op. & : Disassemble machine and puts it back on truck.
M. Man I

M. Man I : Replaces manhole cover and cleanout plug, using pick and wrench.

M. Eq. Op. : Calls DISPATCHER to report work done.

M. Eq. Op. : Fills out work order if lines need repair.

12. REPAIR OF MAIN LINE*

SIZE OF CREW: 1 Foreman
1 Maintenance Man II
1 Maintenance Man I
1 Laborer
1 Construction Equipment Operator

Foreman : Receives work order from MAINTENANCE SUPERVISOR I.

* Minor Repair Crew

OCCUPATIONDESCRIPTION OF TASKS

Foreman	:	Locates job site, using map.
Foreman	:	Drives pick up truck to work site.
Foreman	:	Reads blueprints to determine location of existing utilities lines and city right-of-way limits.
Foreman	:	Determines work procedures and directs workers.
M. Man I & Laborer	:	Remove tools and equipment from truck and erect barricades or traffic cones to protect workers and divert traffic around work area.
Foreman	:	Measures distance of excavation site, using tape measure and marks outline of area to be trenched.
M. Man II & I	:	Break asphalt and other pavement, using air hammer, pick and shovel.
Foreman	:	Directs CONSTRUCTION EQUIPMENT OPERATOR in the digging of trench.
C. Eq. Op.	:	Moves hand and foot levers to operate back hoe to excavate trench.
M. Man I & Laborer	:	Dig dirt away from pipe, using shovel.
Foreman	:	Examines sewer line to determine need for repair and to decide on corrective action to take.
M. Man II	:	Cuts damaged section of pipe with cutters and removes broken section from ditch.
M. Man II	:	Replaces broken pipes and reconnects pipe sections, using pipe sleeve.
M. Man I	:	Assists MAINTENANCE MAN II in replacing pipe.
Foreman	:	Inspects joints to ensure they are tight and sealed properly before backfilling.
C. Eq. Op.	:	Operates back hoe to backfill trench.
M. Man II & I	:	Packs backfilled excavation, using tamper.
M. Man I & Laborer,	:	Clean work sites, remove debris, and place tools, equipment, and barricades back on truck.
Foreman:	:	Fills out work report showing line repaired and manpower, equipment, and material utilization.

OCCUPATIONDESCRIPTION OF TASKS

13. OPERATION OF SEWER TAPPING MACHINE*

SIZE OF CREW: 1 Maintenance Man II
1 Maintenance Man I

M. Man II : Receives assignment from MAINTENANCE SUPERVISOR I.
M. Man II : Locates work site, using map.
M. Man II : Drives pick up truck to work site.
M. Man I : Removes tools and materials from truck.
M. Man I : Lowers needed tools and material into trench.
M. Man II : Climbs down into trench.
M. Man II : Wraps chain around sewer mainline.
M. Man II : Positions tapping machine on side of sewer mainline.
M. Man II : Hooks chain to tapping machine.
M. Man II : Tightens chain to mainline, using wrench.
M. Man II : Positions motor to tapping machine.
M. Man I : Fills cooling water reservoir with water.
M. Man I : Attaches water hose to reservoir.
M. Man I : Positions reservoir on bank of ditch.
M. Man II : Attaches other end of hose to tapping machine.
M. Man II : Checks blade of tapping machine.
M. Man II : Pulls crank cord to start motor on sewer tapping machine.
M. Man II : Moves valve to turn on water.
M. Man II : Turns feed control knob to engage cutter with pipe until hole is cut into sewer main.
M. Man II : Moves switch to turn off machine.

* Minor Repair Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Man II : Turns feed control knob to disengage cutter from pipe.

M. Man II : Turns valve to cut off cooling water.

M. Man I : Disassembles sewer tapping machine and accessories and removes them from trench.

M. Man II : Wipes and dries hole clean with rag.

M. Man II : Spreads epoxy adhesive compound on pipe and fitting.

M. Man II : Places and presses fitting into hole.

M. Man II & I : Place strap around main, hook, and tighten saddle to pipe.

M. Man I : Cleans machine and accessories and returns them to truck.

14. INSPECTION AND CLEANING OF A MANHOLE*

SIZE OF CREW: 1 Maintenance Man II
1 Maintenance Man I

M. Man II : Receives assignment from MAINTENANCE SUPERVISOR I.

M. Man II : Drives truck to work site.

M. Man II : Locates manhole, using map.

M. Man I : Erects traffic cones to protect workers and divert traffic around work area.

M. Man I : Takes manhole cover off, using pick. May have to use sledge hammer to loosen cover if it is stuck.

M. Man I : Removes debris from bottom of manhole using long handled shovel, long hook, spoon, fork or rod, raises them to surface and places them in bucket.

M. Man II : Examines condition of manhole and invert, notes location on map and fills work order for needed repairs to be submitted to MAINTENANCE SUPERVISOR I.

* Sewer Patrol Crew

OCCUPATIONDESCRIPTION OF TASKS

M. Man II : May use gas detector to assure safety of MAINTENANCE MAN I prior to his descending into manhole.

M. Man II : May operate air blower to ventilate manhole.

M. Man II : Ensures MAINTENANCE MAN I dons safety harness before entering manhole.

M. Man I : Puts on safety harness if he has to climb down into manhole.

M. Man I : May descend into manhole after getting clearance from MAINTENANCE MAN II, to remove debris, using rope and invert shovel.

M. Man I : Replaces manhole cover, using pick.

M. Man I : Removes debris from work site and discharges contents of bucket into truck to be hauled away for disposition.

15. BYPASSING** OF MANHOLE*

SIZE OF CREW: 1 Mason II
1 Mason I
1 Laborer

Mason I & Laborer : Erect traffic cones.

Mason I : Lifts manhole covers, using pick.

Mason II : Determines size and capacity of pump to be used.

Mason I & Laborer : Remove pump and tools from truck.

Mason II : Positions pump at upper manhole.

Mason I : Lays discharge hose or pipe from pump to lower manhole.

Mason I : Secures hose in lower manhole.

* Masonary Crew

** The "bypass" method is used to enable the worker to work in a dry manhole without blocking the flow of wastewater.

OCCUPATIONDESCRIPTION OF TASKS

Mason II : Lowers suction hose in invert of upper manhole.

Mason II : Positions inflammable plug in lower invert of upper manhole.

Mason II : Inflates plug using air pump.

Mason II : Starts pump so wastewater would bypass manhole.

Mason II : Turns pump off, deflates plug, and dismantles discharge and suction hose.

Mason I & Laborer : Place pump and attachments back in truck.

16. MANHOLE REPAIR*

SIZE OF CREW: 1 Mason II
1 Mason I
1 Laborer

Mason II : Receives work order from MAINTENANCE SUPERVISOR I.

Mason II : Drives truck to work site.

Mason II : Locates manhole, using map.

Mason I & Laborer : Remove tools and materials from truck and erect traffic cones.

Mason I : Takes manhole cover off, using pick.

Mason II : Inspects manhole to ascertain condition of structure and need for repair.

Mason I : May inspect manhole and relay condition of structure to MASON II.

Mason II & I : Dewater manhole if necessary, using one of the following two methods: Bypass manhole (see item 15) or place flow-through-sewer plug with semi-rigid hose into inlet of manhole in order to maintain a dry work site in manhole.

* Masonary Crew

OCCUPATIONDESCRIPTION OF TASKS

Mason II & I : Climb down manhole steps.

Mason II : Chips away concrete along cracks, using hammer and chisel to prepare for repairs.

Mason I : Raises loose bricks and debris from bottom of manhole to surface and loads them in truck, using bucket and shovel.

Mason I & Laborer : Mix cement, sand, and water to prepare mortar, using shovel and wheelbarrow.

Mason I & Laborer : Deposit mortar on board so MASON II can reach it.

Mason II : Replaces fallen bricks and patches cracks and eroded inverts with fresh mortar, using trowel.

Mason II : Smooths and finishes surfaces of concrete walls to specified textures, using float.

Mason I : Removes dewatering device to start flow after cement has dried.

Mason I : Replaces manhole cover, using pick.

Mason I & Laborer : Clean work site, and place tools and materials back on truck.

Mason II : Fills out work report showing manhole repaired.

17. RAISING MANHOLE WALLS*

SIZE OF CREW: 1 Mason II
1 Mason I
1 Laborer

Mason II : Receives assignment from MAINTENANCE SUPERVISOR I.

Mason II : Drives truck to work site.

Mason II : Locates manhole, using map.

* Masonary Crew

OCCUPATIONDESCRIPTION OF TASKS

Mason I & Laborer	: Remove tools and materials from truck and erect traffic cones.
Mason I	: Removes manhole ring and cover, using sledge hammer and pick.
Mason II	: Dewater manhole (see item 16, pages 151 - 152).
Mason II	: Climbs down manhole steps.
Mason II	: Places protective cover over invert.
Mason II	: Knocks rim off manhole and breaks top of manhole walls, using sledge hammer.
Mason I & Laborer	: Mix cement, sand and water to prepare mortar, using shovel and wheelbarrow.
Mason I & Laborer	: Convey materials and tools about job site.
Mason I & Laborer	: Deposit mortar on board so MASON II can reach it.
Mason II	: Spreads mixed cement on existing layer of brick, using trowel.
Mason II	: Presses bricks into cement mixture and lays them to specified level.
Mason II	: Places rim over brick and cements rim to insure that cover is secure in place.
Mason I	: Removes protective cover.
Mason I	: Replaces manhole cover, using pick.
Mason I & Laborer	: Clean work site and deposit debris and tools on truck.
Mason II	: Completes work report identifying manhole walls raised.

OCCUPATIONDESCRIPTION OF TASKS

18. INSTALLATION OF A PREFABRICATED MANHOLE*

SIZE OF CREW: 1 Mason II
1 Mason I
1 Laborer
1 Construction Equipment Operator

Mason II : Receives work order from MAINTENANCE SUPERVISOR I.

Mason II : Drives truck to work site.

Mason II : Locates manhole, using map.

Mason I & Laborer : Remove tools and materials from truck and erect traffic cones.

Mason II : Directs CONSTRUCTION EQUIPMENT OPERATOR to excavate around manhole.

C. Eq. Op. : Moves hand and foot levers to operate back hoe to excavate around manhole.

Mason II : Dewater manhole (see item 16, pages 151 - 152).

Mason I : Climbs down into manhole and places protective cover over invert.

Mason II : Directs MASON I or CONSTRUCTION EQUIPMENT OPERATOR to break walls of standing manhole.

Mason I : Breaks walls of standing manhole, using sledge hammer.

C. Eq. Op. : May operate back hoe to break walls of old manhole.

Mason II : Prepares surface or pours new invert.

Mason I : Descends into manhole, removes debris and raises them into surface using rope and bucket.

Mason II : Signals to CONSTRUCTION EQUIPMENT OPERATOR to align pre-cast manhole and to press it into proper position.

* Masonary Crew

OCCUPATIONDESCRIPTION OF TASKS

C. Eq. Op.	:	Operates back hoe to align pre-cast manhole and to press it into proper position.
Mason I & Laborer	:	Mix cement, sand, and water to prepare mortar, using shovel and wheelbarrow.
Mason I	:	Deposits mortar on board so MASON II can reach it.
Mason II	:	Applies mortar mix on area between pre-cast concrete and existing walls to secure it in position.
Mason I	:	Removes protective cover.
Mason I	:	Replaces manhole cover and ring, using pick.
Mason I	:	Backfills and tamps ground around manhole.
C. Eq. Op.	:	May operate back hoe to backfill and tamp ground around manhole.
Mason I & Laborer	:	Clean work site and deposit debris and tools on truck.
Mason II	:	Completes work report identifying newly installed prefabricated manhole.

UNIT PROCESS II: STORM SEWER MAINTENANCE

1. OPERATION OF VACUUM-JET RODDER.
(see page 130).

2. OPERATION OF HIGH VELOCITY WATER JET.
(see page 134).

3. OPENING OF STOPPED STORM LINE.
(same as Opening of Stopped Main Line, see page 144).

4. REPAIR OF STORM LINE.
(same as Repair of Main Line, see page 146).

5. INSPECTION AND CLEANING OF MANHOLE.
(see page 149).

6. MANHOLE REPAIR
(see page 151).

7. RAISING MANHOLE WALLS.
(see page 152).

8. INSTALLATION OF A PREFABRICATED MANHOLE.
(see page 154).

OCCUPATIONDESCRIPTION OF TASKS

9. CATCH BASIN INSPECTION AND CLEANING*

SIZE OF CREW: 1 Maintenance Man II
1 Maintenance Man I

M. Man II : Receives assignment from MAINTENANCE SUPERVISOR I.

M. Man II : Drives truck to work site.

M. Man II : Locates catch basin, using map.

M. Man I : Removes tools from truck and erects traffic cones.

M. Man I : Removes catch basin cover, using pick.

M. Man I : May have to use sledge hammer to loosen cover.

M. Man II : Inspects catch basin to determine presence of debris.

M. Man I : Descends into basin to remove debris from bottom of catch basin, using shovel, spoon, or fork, raises deposits to surface, and places them in bucket.

M. Man II : Lowers bucket to MAINTENANCE MAN I in basin to dump accumulated debris into bucket.

M. Man II : Flushes basin, using fire hose with creeping nozzle attachment.

M. Man II : Examines basin to ensure removal of all debris.

M. Man I : Replaces catch basin cover, using pick.

M. Man I : Cuts grass from around catch basin, using bushax.

M. Man I : Removes debris from worksite, using shovel and discharges contents of bucket into truck to be hauled away for disposition.

M. Man I : Returns bushax and handtools to truck.

M. Man II : Completes work order showing catch basin cleaned and inspected.

M. Man II : Prepares work order if catch basin needs repair.

* Sewer Patrol Crew

OCCUPATIONDESCRIPTION OF TASKS

10. CATCH BASIN REPAIR*

SIZE OF CREW: 1 Mason II
1 Mason I
1 Laborer

Mason II	:	Receives assignment from MAINTENANCE SUPERVISOR I.
Mason II	:	Drives truck to work site.
Mason II	:	Locates catch basin, using map.
Mason I & Laborer	:	Remove tools and materials from truck and erect traffic cones.
Mason I	:	Connects chain to truck and catch basin cover.
Mason II	:	Drives truck to pull catch basin cover.
Mason II	:	Examines catch basin to determine needed repairs.
Mason II	:	Climbs down into basin.
Mason II	:	Chips away concrete along cracks, using hammer and chisel.
Mason I & Laborer	:	Raise loose bricks and debris from bottom of manhole to surface and load them on truck, using bucket and shovel.
Mason I & Laborer	:	Mix cement, sand, and water to prepare mortar using shovel and wheelbarrow.
Mason I	:	Deposits mortar on board so MASON II can reach it.
Mason II	:	Patches cracks and broken parts of catch basin, using mortar and trowel.
Mason II	:	Drives truck to pull back cover on catch basin.
Mason II	:	Inspects cover to ensure proper fit.
Mason I & Laborer	:	Clean work site, and place tools and materials back on truck.
Mason II	:	Fills out work report showing catch basin repaired.

* Masonary Crew

UNIT PROCESS III: LIFT STATION MAINTENANCE

OCCUPATION

DESCRIPTION OF TASKS

INSPECTION AND PERFORMANCE OF PREVENTIVE MAINTENANCE ON A LIFT STATION*

SIZE OF CREW: 1 Maintenance Mechanic I
1 Maintenance Mechanic Helper

- M. Mech. H. : Opens station gate, using key.
- M. Mech. H. : Pulls open wet well hatch.
- M. Mech. H. : Unlocks and pulls open door of pit.
- M. Mech. I : Observes bar screen to determine need for cleaning.
- M. Mech. H. : Removes debris from screen using rake, and deposits them in container for disposal.
- M. Mech. H. : Washes down sides of wet well, using water hose.
- M. Mech. H. : Closes and locks door of pit.
- M. Mech. I : Turns humidifier control knob on to make necessary adjustments.
- M. Mech. I : Inspects operation of fresh air blower.
- M. Mech. I : May oil fresh air blower motor.
- M. Mech. I : Climbs into lift station dry pump pit or chamber.
- M. Mech. I : Observes general condition of the insides of station and makes note of needed repairs.
- M. Mech. I : Observes pump in operation to detect faulty seal.
- M. Mech. I : Feels pump motor in operation to determine relative temperature and vibration and to detect malfunctions.
- M. Mech. I : Lifts sump pump float momentarily to check operation of sump pump and to ensure that no obstructions exist on suction screen or in discharge line.

* Lift Station Maintenance Crew

OCCUPATIONDESCRIPTION OF TASKS

- M. Mech. I : May wash mechanic seal filter.
- M. Mech. I : Turns pump control panel switch to off position.
- M. Mech. I : Turns off control valves on water seal line.
- M. Mech. I : Unscrews filter ball and filter element.
- M. Mech. I : Soaks filter element to clean it.
- M. Mech. I : May replace filter element.
- M. Mech. I : Turns pump control panel switch to on position.
- M. Mech. I : Tests pumps, using manual switch setting, to ensure they are primed and will pump flow when automatically started.
- M. Mech. I : Observes packing ring to detect water leak.
- M. Mech. I : Tightens ring down, to adjust leak to optimal level, using wrench.
- M. Mech. I : May remove old packing and replace it with a new one.
- M. Mech. I : Turns valve off to stop flow of sewage.
- M. Mech. I : Removes packing ring clamp, using wrench.
- M. Mech. I : Inspects shaft surface for excessive wear.
- M. Mech. I : Cuts packing to fit around shaft, using pocket knife.
- M. Mech. I : Pushes packing around shaft, using packing iron press.
- M. Mech. I : Places packing ring clamp back on and tightens it down, using wrench.
- M. Mech. I : Observes position of check valve lever arm with pumps on and off, and notes normal position of lever for each mode.
- M. Mech. I : Turns control valve on air pressure tank to bleed off water and air, and checks air compressor's control points.

OCCUPATIONDESCRIPTION OF TASKS

- M. Mech. I : Inspects switches to see if any are in tripped position; if so, clears trouble, resets switch and re-energizes.
- M. Mech. I : Raises and lowers weights on float switches to make sure they move freely and that float cables are tracking properly.
- M. Mech. I : Observes switching electrodes in wet well to ensure that they are free of grease and debris.
- M. Mech. I : Observes well levels at start and stop positions.
- M. Mech. I : Inspects to ensure that pressure relief valve lets excess pressure bleed back into wet well when pressure approaches rated force main limit.
- M. Mech. I : Reads pressure surges on pressure gauge.
- M. Mech. I : Presses test button to inspect automatic high water warning alarms.
- M. Mech. I : May grease motor bearing, using grease gun.
- M. Mech. I : Observes operation of injector to make sure air control valves are functioning properly.
- M. Mech. I : Slides weights by hand and wrench to adjust weight controls.
- M. Mech. I : Bleeds down air supply and lets air compressor turn on and off automatically to check proper operation of compressor.
- M. Mech. I : Checks oil reservoir and may fill reservoir with proper oil if needed.
- M. Mech. I : Inspects chlorinator.
- M. Mech. I : Ensures that chlorinator is on the correct feed grade and verifies that it works automatically when pump units are pumping.
- M. Mech. I : Checks chlorinator for gas leaks.
- M. Mech. I : Turns valve on tank and disconnects feed line to change chlorine cylinders.
- M. Mech. I : Turns control knob to adjust feed rate.

OCCUPATIONDESCRIPTION OF TASKS

- M. Mech. I : Fills out routine report form on sewer lift station operation.
- M. Mech. I : Records readings of running time meters if provided.
- M. Mech. I : Inspects comminutor.
- M. Mech. I : May turn switch to stop comminutor if metal objects are noted in cutter blades.
- M. Mech. I : Locks comminutor switch in off position when greasing bearing or removing metal object.
- M. Mech. H. : Removes old rags, sticks, and rocks from inside of pumping station.
- M. Mech. H. : Sweeps floor of lift station, using broom.
- M. Mech. H. : Cuts grass around pumping station, using power mower.
- M. Mech. I : Contacts MAINTENANCE MECHANIC II when equipment needs repair, using radio.

APPENDIX I

MAJOR EQUIPMENT USED IN WASTEWATER COLLECTION SYSTEM MAINTENANCE

VACUUM JET RODDER:

A machine that cleans storm and sanitary sewers by high pressure water and vacuums up the debris as they are being back-flushed into manhole or catch basin. It utilizes the centrifugal fan system.

POWER RODDER:

Used to control root intrusion. The power rodder can either be truck mounted or trailer mounted. For best mobility on typical urban streets, the truck mounted power rodder is preferred. This rodder has the equipment to unstop mains from 8 inches in diameter to about 36 inches in diameter. The truck should be equipped with at least 500 feet of rods and a complete set of tools involving all sizes of cutters.

HIGH VELOCITY WATER JET:

The Water Jet should be truck mounted. The truck should be equipped with a minimum of 500 feet of hose and a variety of nozzles for various size lines and types of problems. Basically, the machine works with pressures of approximately 1,000 PSI with a majority of holes in the nozzles jetting to the rear, so that the hydraulic power pulls the nozzle through the line and flushes the solids in the line downstream. This machine is most effective in pipe sizes of 8 inches through 15 inches in diameter.

BUCKET MACHINE:

This sewer cleaning equipment is primarily used for removal of large quantities of silt and grit from outfall lines. The bucket is pulled through the line between two manholes by means of a winch with the bucket's jaws open to scoop up debris. When full, the bucket travel is reversed with its jaws closed and is returned to ground level at first manhole where it is emptied.

WAYNE BALL MACHINE:

It uses a spirally grooved ball which is inserted into the sewer line and water is pumped into the manhole. This water passes around the ball through the spiral grooves that loosens dirt from the walls of the line and drives the ball forward forcing the accumulated debris ahead to the next manhole for removal.

EDUCTOR:

A sewer cleaning equipment that uses high pressure water and a jet pump in a recirculating process to pick up solids and withdraw wastewater through an ejector.

PHOTO-INSPECTION SYSTEM:

A camera is inserted and pulled through the sewer line to take pictures manually or automatically at specified intervals to determine the condition of the pipe and the need for repairs.

TELEVISION INSPECTION SYSTEM:

A closed circuit television system is utilized for remote visual inspection of sewer lines. A TV camera is drawn through the line and a TV monitor shows the condition of the sewer.

TELEGROUT SYSTEM:

A sewer sealing equipment is used in conjunction with a television camera for remote internal repair of leaking sewer lines. The equipment is pulled through the pipe, its packer is inflated and a chemical grout compound is pumped over the suspected leak to seal the line.

SEWER RELINING SYSTEM:

A Polyethelene pipe that has been joined by a heat fusion process is inserted through the old sewer line.

APPENDIX 2

DEFINITIONS OF WORKER TRAITS*

Those abilities, personal traits, and individual characteristics required of a worker in order to achieve average successful job performance are referred to as worker traits. They are reflected in the following six distinct components that provide the broadest and yet most comprehensive framework for the effective presentation of worker trait information: (1) The amount of general educational development and specific vocational preparation a worker must have, (2) the specific capacities and abilities required of him in order to learn or perform certain tasks or duties, (3) preferences for certain types of work activities or experiences considered necessary for job success, (4) types of occupational situations to which an individual must adjust, (5) physical activities required in work situations, and (6) physical surroundings prevalent in jobs.

GENERAL EDUCATIONAL DEVELOPMENT

This embraces those aspects of education (formal and informal) which contribute to the worker's (a) reasoning development and ability to follow instructions, and (b) acquisition of "tool" knowledges, such as language and mathematical skills. It is education of a general nature which does not have a recognized, fairly specific, occupational objective. Ordinarily such education is obtained in elementary school, high school, or college. It also derives from experience and individual study.

SPECIFIC VOCATIONAL PREPARATION

The amount of time required to learn the techniques, acquire information, and develop the facility needed for average performance in a specific job-worker situation. This training may be acquired in a school, work, military, institutional, or avocational environment. It does not include orientation training required of even every fully qualified worker to become accustomed to the specific conditions of any new job. Specific vocational training includes training given in any of the following circumstances:

1. Vocational education (such as high school commercial or shop training, technical school, art school, and that part of college training which is organized around a specific vocational objective).
2. Apprentice training (for apprenticeable jobs only).
3. In-plant training (given by an employer in the form of organized classroom study).

* Developed by the United States Department of Labor and used as occupational analysis specifications in the Dictionary of Occupational Titles.

4. On-the-job training (serving as learner or trainee on the job under the instruction of a qualified worker).
5. Essential experience in other jobs (serving in less responsible jobs which lead to the higher grade job or serving in other jobs which qualify).

APTITUDES

Specific capacities or abilities required of an individual in order to facilitate the learning of some task or job duty.

INTELLIGENCE: General learning ability. The ability to "catch on" or understand instructions and underlying principles. Ability to reason and make judgments. Closely related to doing well in school.

VERBAL: Ability to understand meanings of words and ideas associated with them, and to use them effectively. To comprehend language, to understand relationships between words, and to understand meanings of whole sentences and paragraphs. To present information or ideas clearly.

NUMERICAL: Ability to perform arithmetic operations quickly and accurately.

SPATIAL: Ability to comprehend forms in space and understand relationships of plane and solid objects. May be used in such tasks as blueprint reading and in solving geometry problems. Frequently described as the ability to "visualize" objects of two or three dimensions, or to think visually of geometric forms.

FORM PERCEPTION: Ability to perceive pertinent detail in objects or in pictorial or graphic material; to make visual comparisons and discriminations and see slight differences in shapes and shadings of figures and widths and lengths of lines.

CLERICAL PERCEPTION: Ability to perceive pertinent detail in verbal or tabular material; to observe differences in copy, to proofread words and numbers, and to avoid perceptual errors in arithmetic computation.

MOTOR COORDINATION: Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements with speed. Ability to make a movement response accurately and quickly.

FINGER DEXTERITY: Ability to move the fingers and manipulate small objects with the fingers rapidly and accurately.

MANUAL DEXTERITY: Ability to move the hands easily and skillfully. To work with the hands in placing and turning motions.

EYE-HAND-FOOT COORDINATION: Ability to move the hand and foot coordinately with each other in accordance with visual stimuli.

COLOR DISCRIMINATION: Ability to perceive or recognize similarities or differences in colors, or in shades or other values of the same color; to identify a particular color, or to recognize harmonious or contrasting color combinations, or to match colors accurately.

INTERESTS

Preferences for certain types of work activities or experience, with accompanying rejection of contrary types of activities or experience. Five pairs of interest factors are provided so that a positive preference for one factor of a pair also implies rejection of the other factor of that pair.

- | | |
|--|--|
| 1. Situations involving a preference for activities dealing with things and objects. | vs. 6. Situations involving a preference for activities concerned with people and the communication of ideas. |
| 2. Situations involving a preference for activities involving business contact with people. | vs. 7. Situations involving a preference for activities of a scientific and technical nature. |
| 3. Situations involving a preference for activities of a routine, concrete, organized nature. | vs. 8. Situations involving a preference for activities of an abstract and creative nature. |
| 4. Situations involving a preference for working for people for their presumed good, as in the social welfare sense, or for dealing with people and language in social situations. | vs. 9. Situations involving a preference for activities that are nonsocial in nature, and are carried on in relation to processes, machines, and techniques. |
| 5. Situations involving a preference for activities resulting in prestige or the esteem of others. | vs. 10. Situations involving a preference for activities resulting in tangible, productive satisfaction. |

TEMPERAMENTS

Different types of occupational situations to which workers must adjust.

1. Situations involving a variety of duties often characterized by frequent change.
2. Situations involving repetitive or short cycle operations carried out according to set procedures or sequences.
3. Situations involving doing things only under specific instruction allowing little or no room for independent action or judgment in working out job problems.
4. Situations involving the direction, control, and planning of an entire activity or the activities of others.
5. Situations involving the necessity of dealing with people in actual job duties beyond giving and receiving instructions.
6. Situations involving working alone and apart in physical isolation from others, although the activity may be integrated with that of others.
7. Situations involving influencing people in their opinions, attitudes, or judgments about ideas or things.
8. Situations involving performing adequately under stress when confronted with the critical or unexpected or when taking risks.
9. Situations involving the evaluation (arriving at generalizations, judgments, or decisions) of information against sensory or judgmental criteria.
10. Situations involving the evaluation (arriving at generalizations, judgments, or decisions) of information against measurable or verifiable criteria.
11. Situations involving the interpretation of feelings, ideas, or facts in terms of personal viewpoint.
12. Situations involving the precise attainment of set limits, tolerances, or standards.

PHYSICAL DEMANDS

Those physical activities required of a worker in a job. The physical demands referred to serve as a means of expressing both the physical requirements of the job and the physical capacities (specific physical traits) a worker must have to meet the requirements.

1. **LIFTING, CARRYING, PUSHING, and PULLING.** These are the primary "strength" physical requirements, and, generally speaking, a person who engages in one of these activities can and does engage in all. Specifically, each of these activities can be described as:

LIFTING: Raising or lowering an object from one level to another; includes upward pulling.

CARRYING: Transporting an object, usually holding it in the hands or arms, or on the shoulder.

PUSHING: Exerting force upon an object so that the object moves away from the force. This includes slapping, striking, kicking, and treadle actions.

PULLING: Exerting force upon an object so that the object moves toward the force; includes jerking.

The five degrees of this factor (Lifting, Carrying, Pushing, and/or Pulling) are:

SEDENTARY WORK: Lifting 10 lbs. maximum and occasionally lifting and/or carrying such articles as dockets, ledgers, and small tools. Although a sedentary job is defined as one which involves sitting, a certain amount of walking and standing is often necessary in carrying out job duties. Jobs are sedentary if walking and standing are required only occasionally and other sedentary criteria are met.

LIGHT WORK: Lifting 20 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 10 lbs. Even though the weight lifted may be only a negligible amount, a job is in this category when it involves sitting most of the time with a degree of pushing and pulling of arm and/or leg controls.

MEDIUM WORK: Lifting 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs.

HEAVY WORK: Lifting 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs.

VERY HEAVY WORK: Lifting objects in excess of 100 lbs. with frequent lifting and/or carrying of objects weighing 50 lbs. or more.

2. CLIMBING and/or BALANCING. These activities are defined as follows:

CLIMBING: Ascending or descending ladders, stairs, scaffoldings, ramps, poles, ropes, and the like, using feet and legs and/or hands and arms.

BALANCING: Maintaining body equilibrium to prevent falling when walking, standing, crouching, running, on narrow, slippery, or erratically moving surfaces; or maintaining body equilibrium when performing gymnastic feats.

3. STOOPING, KNEELING, CROUCHING, and/or CRAWLING. These activities are defined as:

STOOPING: Bending the body downward and forward by bending the spine at the waist.

KNEELING: Bending the legs at the knees to come to rest on the knee or knees.

CROUCHING: Bending the body downward and forward by bending the legs and spine.

CRAWLING: Moving about on the hands and knees or hands and feet. The activities in this factor involve full use of the lower extremities as well as the back muscles. Therefore, stooping rarely is rated when the worker is performing this act while in a sitting position.

4. REACHING, HANDLING, FINGERING and/or FEELING. These activities involve the use of one or both of the upper extremities and are defined as follows:

REACHING: Extending the hands and arms in any direction.

HANDLING: Seizing, holding, grasping, turning, or otherwise working with the hands or hand (fingering not involved).

FINGERING: Picking, pinching, or otherwise working with the fingers primarily (rather than with the whole hand or arm as in handling).

FEELING: Perceiving attributes of objects such as size, shape, temperature, or texture by means of receptors in the skin, particularly those of the finger tips.

5. TALKING and/or HEARING. These activities are defined as follows:

TALKING: Expressing or exchanging ideas by means of spoken words.

HEARING: Perceiving the nature of sounds by the ear.

The ability to talk is important for those job-worker situations in which the individual must impart oral information to clients or to the public, and in those situations in which he must convey detailed or important spoken instructions to other employees accurately, loudly, or quickly. Hearing is important for those job-worker situations which require the ability to receive detailed information through oral communication, and to make fine discriminations in sounds, such as making fine adjustments on running engines.

6. SEEING: Obtaining impressions through the eyes of the shape, size, distance, motion, color, or other characteristics of objects. The major visual functions are defined as follows:

ACUITY-FAR: Sharpness of vision at a distance of 20 feet or more.

ACUITY-NEAR: Sharpness of vision at 20 inches or less.

DEPTH PERCEPTION: Three-dimensional seeing and is an important factor in judging distances and space relationships so as to see objects where and as they actually are. Two-eyed vision is involved here.

FIELD OF VISION: The area that can be seen up or down or to the right or left while the eyes are fixed on a given point.

ACCOMODATION: The adjustment of the lens of the eye to bring an object into sharp focus. This item is especially important when doing near-point work at varying distances from the eye.

COLOR VISION: The ability to identify and distinguish colors.

WORKING CONDITIONS

The physical surroundings of a worker in a specific job.
Also known as Environmental Conditions.

1. INSIDE, OUTSIDE, or BOTH. These conditions are defined as follows:

INSIDE: Protection from weather conditions, but not necessarily from temperature changes.

OUTSIDE: No effective protection from weather.

BOTH: Inside and outside.

2. EXTREME COLD PLUS TEMPERATURE CHANGES. These conditions are defined as follows:

EXTREME COLD: Temperature sufficiently low to cause marked bodily discomfort unless the worker is provided with exceptional protection.

TEMPERATURE CHANGES: Variations in temperature which are sufficiently marked and abrupt to cause noticeable bodily reactions.

3. EXTREME HEAT PLUS TEMPERATURE CHANGES. These conditions are defined as follows:

EXTREME HEAT: Temperature sufficiently high to cause marked bodily discomfort unless the worker is provided with exceptional protection.

TEMPERATURE CHANGES: Variations in temperature sufficiently marked and abrupt to cause noticeable bodily reactions.

4. WET and HUMID. These conditions are defined as follows:

WET: Contact with water or other liquids.

HUMID: Atmospheric condition with moisture content sufficiently high to cause marked bodily discomfort.

5. NOISE and VIBRATION.

Sufficient noise, either constant or intermittent, to cause marked distraction or possible injury to the sense of hearing and/or sufficient vibration (production of an oscillating movement or strain on the body or its extremities from repeated motion or shock) to cause bodily harm if endured day after day.

6. HAZARDS.

This category includes a variety of industrial hazards, such as proximity to moving mechanical parts, electrical shock, working on scaffolding and high places, exposure to burns and radiant energy, and exposure to all types of explosives, all of which involve the risk of bodily injury.

7. FUMES, ODORS, TOXIC CONDITIONS, DUST, and POOR VENTILATION. These conditions are grouped because they all affect the respiratory system of the skin and are defined as follows:

FUMES: Smoky or vaporous exhalations, usually odorous, thrown off as the result of combustion or chemical reaction.

ODORS: Noxious smells, either toxic or nontoxic.

TOXIC CONDITIONS: Exposure to toxic dust, fumes, gases, vapors, mists, or liquids which cause general or localized disabling conditions as a result of inhalation or action on the skin.

DUST: Air filled with small particles of any kind, such as textile, dust, flour, wood, leather, feathers, and inorganic dust, including silica and asbestos, which make the work place unpleasant or are the source of occupational diseases.

POOR VENTILATION: Insufficient movement of air causing a feeling of suffocation; or exposure to drafts.

APPENDIX 3

GLOSSARY

Compiled from various texts, journals, technical papers and the "Glossary-Water Control Engineering": APHA, ASCE, AWWA, WPCF, 1969.

AIR-BLOWER: A device used to ventilate manholes and lift stations.

AUGER: A sharp tool used to go through various materials that become lodged in sewer lines. They are used for opening sewer line stoppages.

APPURTENANCES: Machinery, appliances, or auxiliary structures attached to a main structure to enable it to function, but not considered an integral part of it.

BACKFILL: The operation of refilling an excavation, usually after some structure has been placed therein.

BACKHOE: An excavating machine in which the bucket is rigidly attached to a hinged stick on the boom and is drawn toward the machine in operation.

BAR SCREEN: A device with uniform size openings, used to retain or remove suspended or floating solids in flowing wastewater and to prevent them from entering an intake or passing a given point in a conduit.

BEDDING: The earth or other materials on which a pipe or conduit is supported.

BIT: Cutting blade used in rodding operations.

BLUE-PRINT: A photographic print in white on a bright blue ground used for copying maps, mechanical drawings, and architects' plans.

BUCKET MACHINE: A sewer cleaning machine used when large amounts of sand, gravel, and solid material are blocking the sewer lines. Pulling the bucket back causes the jaws to close and retain the solids that are in the bucket.

BULLDOZER: A tractor driven machine having a broad, blunt horizontal blade for clearing land and road building.

CAREER LATTICE: A chart that identifies the possible horizontal, vertical and diagonal mobility paths, reflecting entry, promotional and transfer opportunities for a worker in the job system involved.

CATCH BASINS: A catch basin is a form of grit chamber intended to retain the heavy debris in stormwater which otherwise would be carried into the sewer.

CAULKING: The process of driving, pouring, or forcing lead, oakum, plastic, or other material into a joint to make it leakproof.

CENTRIFUGAL PUMP: A pump consisting of an impeller fixed on a rotating shaft and enclosed in a casing, and having an inlet and a discharge connection. The rotating impeller creates pressure in the liquid by the velocity derived from centrifugal force.

CHECK VALVE LEVER ARM: A weighted lever on the discharge side valve of a pump used to prevent wastewater from forced sewer mains to pass back through pump into wet well of a lift station.

CHEMICAL SEALING: The process of internal repair of leaking sewer lines, using a chemical compound that is pumped through the discharge holes of a packer to seal damaged lines.

CHLORINATOR: An apparatus to regulate the flow of gas from a cylinder into a sewer line.

CLEANOUT: A pipe that slopes to the street surface from a Y in the sewer and makes it possible to rod the line.

COMBINED SEWER: A sewer intended to receive both wastewater and storm or surface water.

COMMINUTORS: A machine that cuts up solids in raw sewage in preparation for purifying treatment.

COUPLING: A threaded sleeve used to connect two pipes.

CRANE: A machine for raising, shifting, and lowering heavy weights by means of a projecting swinging arm or with the hoisting apparatus supported on an overhead track.

CREW: A company of men working on one job.

CULVERT: A closed conduit for the free passage of surface drainage water under a highway, railroad, canal, or other embankment.

DEBRIS: Any material, including floating trash, suspended sediment, or bed load, moved by a flowing stream.

DEWATER: To drain or remove water from an enclosure. A structure may be dewatered so that it can be inspected or repaired.

DIP-NEEDLE: A magnetic needle pivoted to rotate in the vertical plane of the magnetic meridian with its rotation axis through its center of gravity, so that it points in the direction of the earth's magnetic intensity.

DOMESTIC WASTEWATER: Wastewater derived principally from dwellings, business buildings, institutions, and the like.

DRAGLINE: An excavating machine.

DUMP TRUCK: A truck for transporting and dumping loose materials. The body of the truck is tilted by a hydraulic cylinder.

EDUCTOR: A sewer cleaning equipment that uses high pressure water and a jet pump in a recirculating process to pick up solids and withdraw wastewater through an ejector.

EXFILTRATION: The leakage from sewer lines into the surrounding ground.

FITTINGS (PIPE): Connections, appliances, and adjuncts designed to be used in connection with pipes.

FLOAT (CONTROL): A float installed in a tank or body of liquid to control the pumps.

FLOW: The movement of a stream of water or other mobile substance from place to place; a stream of water; movement of silt; water, sand, or other material.

FLUSHING: The removing of deposits of material which have lodged in conduits, sewers, or tanks because of inadequate velocity of flows. Water is discharged into the conduits at such rates that the larger flow and higher velocities are sufficient to remove the material.

GAGE: A device for indicating the magnitude or position of an element in specific units when such magnitude or position undergoes change; examples of such elements are the elevation of a water surface, the velocity of flowing water, the pressure of water, the amount of intensity of precipitation, and the depth of snowfall.

GAS (SEWER): Gas evolved in sewers that results from the decomposition of the organic matter in the wastewater. Also, any gas present in the wastewater system, even though it is from such sources as gas mains, gasoline, cleaning fluid.

GRADE: The elevation of the invert of the bottom of a pipeline, canal, culvert, sewer, or similar conduit.

HIGH VELOCITY WATER JET: A sewer cleaning equipment with a special high velocity hose that is fitted with a hardened steel jet nozzle. It is used to spray-clean sewer lines.

HYDRANT; A discharge pipe with a valve and spout at which water may be drawn from the mains of waterworks.

HYDROGEN SULFIDE: A flammable, poisonous gas of disagreeable odor found in wastewater collection systems.

INCRUSTATION: The formulation of dense solids as a crust on the inside surface of a pipe as a result of hardness and other characteristics of the wastewater carried.

INDUSTRIAL WASTEWATER: Wastewater in which the liquid wastes from industrial processes, as distinct from domestic or sanitary wastes, predominate.

INFILTRATION: The quantity of groundwater that leaks into a pipe through joints, porous walls, or breaks.

INLET: An opening in the street surface usually in the gutter, designed to permit the passage of water from the street surface into the sewer line.

INVERT: The floor, bottom, or lowest portion of the internal cross section of a sewer.

JOINT: A connection between two lengths of pipe, made either with or without the use of a third part.

LATERAL SEWER LINE: A sewer that discharges into a branch or other sewer and has no other common sewer tributary to it.

LIFT STATION: A pumping station that lifts the wastewater to a higher elevation when the continuance of the sewer at reasonable slopes would involve excessive depths of trench, or that raises wastewater from areas too low to drain into available sewers.

MAIN SEWER LINE: A sewer line that receives wastewater from many tributary branches and sewer lines, serving as an outlet for a large territory.

MANHOLE: An opening in a sewer provided for the purpose of permitting a man to enter or leave the sewer.

M-SLOPE: An instrument for locating underground metal water pipes by electronic detection. It is also called a pipe finder.

OCCUPATIONAL DESCRIPTION: A description of job duties, responsibilities, and pre-requisite qualifications related to a specific occupation title, and developed in conformance with the Dictionary of Occupational Titles, published by the U.S. Department of Labor.

OUTFALL SEWER LINE: A sewer that receives wastewater from a collecting system or from a treatment plant and carries it to a point of final discharge.

OUTLET: Downstream opening or discharge end of a pipe, culvert, or canal.

PACKER: A device inserted in a sewer line which expands by manipulation from the surface and releases sealing compound to seal infiltration point.

PACKING RING: A ring made of graphite that forms a seal between the pump shaft and its casing.

PIPE JACK: A jack used to fasten roller guides to secure an object within a manhole.

PLUMBING FIXTURES: Receptacles that receive liquid, water, or wastewater and discharge them into a drainage system.

POLLUTION: A condition created by the presence of harmful or objectionable material in water.

POWER RODDER: A sewer cleaning machine fitted with auger rods, that are inserted in a sewer line to dislodge and cut roots and debris.

PREVENTIVE MAINTENANCE: Planned inspection and systematic cleaning of sewers and appurtenances.

PUMP: A mechanical device for causing flow, for raising or lifting water or other fluid, or for applying pressure to fluids.

PUMPING STATION: A pumping station that lifts the wastewater to a higher elevation when the continuance of the sewer at reasonable slopes would involve excessive depths of trench, or that raises wastewater from areas too low to drain into available sewers. These stations may be equipped with pneumatic ejectors or centrifugal pumps.

QUALIFICATION PROFILE: The requirements made on the worker in terms of aptitudes, general educational development, vocational preparation, physical demands and personal traits.

RELIEF (SEWER): A sewer intended to carry a portion of the flow from a district in which the existing sewers are of insufficient capacity, and, thus, prevent overtaxing the latter.

RIGHT-OF-WAY: A right of passage over another person's land.

ROD GUIDE: A bent pipe inserted in a manhole to guide rods into sewer lines.

ROD (SEWER): A light metal rod, three to four feet long with a coupling at each end. Rods are joined and pushed into a sewer to dislodge obstructions.

RODDING MACHINE: A sewer cleaning machine fitted with auger rods that are inserted in a sewer line to dislodge and cut roots and debris.

ROLLER GUIDE: A suspended pulley that guides a hose or a rope around the edge of a sewer line.

RUN-OFF: The part of rainfall that enters storm sewers.

SADDLE: An assembly of circumferential metal straps on a pipe where a connection is to be installed.

SAND TRAP: A device for separating sand from water.

SANITARY SEWER LINE: A sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with minor quantities of ground, storm, and surface waters that are not admitted intentionally.

SANITARY WASTEWATER: Wastewater discharging from the sanitary conveniences of dwellings (including apartments, houses and hotels), office buildings, industrial plants, or institutions.

SCREED: A strike board usually used to level up or strike off concrete pavement slabs or to cushion courses for block pavements.

SEAL FILTER: A filtering device used to prevent foreign matters from entering the mechanical seal chamber.

SERVICE CONNECTION: A pipeline, with its appurtenances, that branches off or connects a water or sewer main with premises.

SEWAGE: The spent water of a community. Term now being replaced in technical usage by preferable term wastewater.

SEWER: A pipe or conduit that carries wastewater or drainage water.

SEWERAGE: System of piping, with appurtenances, for collecting and conveying wastewater from source to discharge. Term declining in use.

SEWER JET: A sewer cleaning equipment with a special high velocity hose that is fitted with a hardened steel jet nozzle. It is used to spray-clean sewer lines.

SIPHON (INVERTED): A pipeline crossing a depression or passing under a structure and having a reversal in grade on a portion of the line, thus creating a V- or U-shaped section of conduit. The line is under positive pressure from inlet to outlet and should not be confused with a siphon. Also called depressed sewer.

SLEEVE: A pipe fitting for uniting two pipes of the same nominal diameter in a straight line.

SLUDGE: The accumulated solids separated from wastewater during processing, or accumulated deposits on the bottom and edges of wastewater collection appurtenances.

SOUNDING ROD: A T-shaped tool that is pushed into earth to locate pipes.

STAFFING GUIDE: The on-site employees required to properly operate and maintain a wastewater collection system.

STORM SEWER LINE: A sewer that carries storm water and surface water, street wash and other wash waters, or drainage, but excludes domestic wastewater and industrial wastes. Also called storm drain.

SUMP PUMP: A small pump with its impeller submerged in the pumped liquid.

TAMP: A tool for tamping used to drive dirt down by a succession of light or medium blows.

TAPPING MACHINE: A machine for cutting and tapping a small hole in a pipe, as a street main, that is either empty or carrying pressure. Two classes of tapping machines are made, designated as pressure-tapping and dry-tapping machines. They are sometimes called drilling machines.

TASK DESCRIPTION: Detailed description of basic work units showing methods, procedures, and techniques involved in carrying out a task.

TELEGROUT-PACKING: A sewer sealing equipment that is used in conjunction with a television camera. It is pulled through the sewer line and at the infiltration point its packer is inflated and a compound is pumped which seals the pipe.

TELEMETERING EQUIPMENT: An equipment that translates physical measurements into electrical impulses that are transmitted.

TELEVISION INSPECTION: The inspection by closed circuit television of the inside of a sewer line achieved by pulling a TV camera through the line.

TOW SACK: A sack made of burlap that is inserted into sewer line and used to thread the line.

TRENCH: An excavation made for installing pipes, masonry walls, and for other purposes. A trench is distinguished from a ditch in that the opening is temporary and is eventually backfilled.

TROWEL: A masonry tool consisting of a flat or less commonly curved blade with a handle and used to apply, spread, shape, and smooth mortar or concrete.

TURNING PIN: A tool used to insert end of rod coupling and to rotate rod.

VAC-ALL: An equipment that removes solids from a manhole as they are deposited by a high velocity cleaner and returns the water to the sewer in a sanitary method.

VACUUM JET RODDER: A machine that cleans storm and sanitary sewers by high pressure water and vacuums up the debris as they are being back-flushed into manhole or catch basin. It utilizes the centrifugal fan system.

VALVES: The openings through which water enters and leaves the cylinders of a displacement pump.

WASTEWATER: The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. In recent years, the word wastewater has taken precedence over the word sewage.

WASTEWATER COLLECTION SYSTEM: The sewer lines, appurtenances, and lift stations used in the collection and conveyance of wastewater.

WASTEWATER TREATMENT: Any process to which wastewater is subjected in order to remove or alter its objectionable constituents and, thus, render it less offensive or dangerous.

WATER SEAL LINE: A line that connects the mechanical seal filter to the mechanical seal chamber.

WAYNE BALL MACHINE: A sewer cleaning equipment that utilizes a spirally grooved ball which is pumped into the line to build up water pressure loosening, as a result, the accumulated debris to the next manhole for removal.

WET WELL: A compartment in which a liquid is collected, and to which the suction pipe of a pump is connected.

APPENDIX 4

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