## CHAPTER SEVEN

### Public Works

In considering the policies, organization, and funding of the local public works department, the administrator must have a clear perspective of the importance of the public works function in the lives of the citizens of the community. The administrator must also understand the contribution public works activities make to the image of the city government as an efficient, business-like organization.

All of the necessities of living, working, and moving about in the city are directly affected by the performance of the public works department. Through the efforts of public works employees and the functioning of public works policy, citizens are supplied with water, waste material is removed and disposed of, the quality of shelter is determined, and the ability to move from place to place is provided. A citizen's concept of the efficiency with which the city is run, and of the wisdom with which city tax dollars are spent, is largely shaped by their daily experiences with public works functions. The greatest care, therefore, should be taken to ensure the smooth, efficient operation of this department.

### Organization and Management

The structure of any organization is strongly influenced by the skills and talents available, as well as by the size of the job to be performed. Every effort should be made to ensure that a well-qualified person is placed in charge of the public works department. At one time, general wisdom said that a licensed engineer should be in charge, but a person who is a good manager and knowledgeable about the various programs, engineering principles, etc. can function quite well, particularly if the department has a highly qualified engineering staff or qualified engineering consulting services are available. The key is to ensure that the city has the best-qualified staff and services that funding will permit.

Often, the budget of a smaller city simply cannot be stretched to hire the services of a qualified engineer. In such cases, someone with supervisory experience in civil engineering work (e.g., a former contractor's experienced superintendent) generally can handle the job. Only in the smallest cities should the administrator attempt to serve as director of public works, and only then with adequate experience and background.

The administrator should take advantage of opportunities for improving the skills of public works employees by encouraging them to attend professional seminars offered by various educational institutions and organizations, such as the job related training programs offered through the Engineering Extension Service of Texas A&M University and other training programs sponsored by the Texas Public Works Association (an affiliate of the Texas Municipal League). Allowing key employees to visit other cities to observe their operational methods also can be instructive and provide a source of ideas for improved performance.

## Engineering Functions

Most of the day-to-day engineering tasks performed by a small city public works department do not necessarily require a licensed engineer; however, the administrator can avoid liability risks by knowing which tasks are required by law to be performed by a licensed engineer. Generally speaking, only a licensed engineer or architect should undertake the design of any building, public works facility or the like. For information concerning any aspect of standard engineering practice, contact the Texas Society of Professional Engineers, 3501 Manor Road, Austin, Texas 78723. You might also contact the Consulting Engineers Council of Texas, The Texas Board of Professional Engineers, the Texas Society of Architects, or the Texas Board of Architectural Examiners.

The practice of employing a consulting engineer for overall system design (a water distribution system) or the design of a major facility (a wastewater treatment facility) is common even among larger cities. The small city with limited staff expertise may find it advantageous to retain an engineering firm on a consulting basis, so that by paying a small monthly fee, the administrator and the director of public works will have continuing access to advice on the many technical engineering problems that arise from time to time. Consulting fees for various types of works have been standardized by the Texas Society of Professional Engineers; any reputable consulting engineer can provide a standard fee scale.

The administrator should take care to recommend that the council select a consulting engineer who is well qualified and with whom the administrator can work comfortably. The Texas Society of Professional Engineers publishes suggested procedures for the selection of consulting engineers, and the Texas Department of Housing and Community Affairs has a publication, *How to Select Consultants,* that could be helpful.

Engineering functions in a small city usually are supervised either directly by the city administrator or by the director of public works, though this duty might be assigned to another official in the department if available skills permit its delegation. Engineering functions normally include the following:

- Conducting or overseeing all of the city's engineering work.
- Coordinating the efforts of the public works department with other municipal departments.
- Supervising the work of consulting engineers who perform work for the city.

In *Urban Public Works Administration*, the International City Management Association points out the wide range of activities included in the municipal engineering function:

- Surveys, studies, and investigations.
- Development of the city's capital improvements program in conjunction with the planning commission.
- Planning, design, and cost estimating of construction projects.
- Preparation of maps and records.
- Inspection and supervision of construction projects.
- Public works maintenance, repair, and reconstruction work.

The city engineer ordinarily provides these services for all of the other sections of the public works department, and often will provide services for other city departments.

Therefore, the city engineer may be involved in the design or construction of streets, sidewalks, water and wastewater facilities, solid waste facilities, street lighting, public building construction, park and recreation facility design and layout, and many other facilities. Because of the breadth of service required, the additional skills and expertise of a consulting engineer is often useful.

## Inspection Functions

The inspection function involves the enforcement of codes and ordinances adopted by the city for the protection of life, health and property; provision for the well being of citizens; and the orderly growth of the city. Inspections also are made to ensure compliance with standards and specifications governing major public works construction projects.

The number of organizational units needed to administer local regulations and conduct inspections will vary with the size of the city and with the scope of the city's administrative structure. Regardless of the means used to parcel out these responsibilities, it is always desirable to consolidate as many inspection services as possible in one agency and assign the issuance of licenses and permits to that same agency.

### *Building Inspection*

The municipal building code prescribes minimum standards governing the erection of buildings, their service equipment (heating, lighting, air conditioning, plumbing, etc.) and other improvements that are incorporated into buildings to ensure safe occupancy.

Compliance with the building code is secured, first, by means of a permit system which requires any person proposing to build a new structure or an addition to an existing structure to obtain the consent of the city before construction begins, and second, by on-site inspections by municipal building officials of construction work underway. At the time an application for a building permit is reviewed, the building inspector can determine compliance with the city's zoning ordinance and also ensure that the property upon which the building is to be erected has been properly platted according to the city's subdivision regulations.

The building inspector should posses a general knowledge of sound engineering practice in the design and construction of buildings, of fire prevention, and other principles. In some cities, it may be necessary for one official to personally conduct all inspections. In such cases, the city can benefit by obtaining the part-time services of a local engineer or architect to assist with the examination of plans and issuance of permits. For cities close to metropolitan areas, such as the Austin area, there may be a firm with which the city can contract to do plan examination and inspections.

Several standard building codes are available for use by smaller cities, and by the year 2000, the three large code companies - Southern Building Code Congress, the International Conference of Building Officials, and the Building Officials and Code Administrators - had joined together to produce a single code, the International Residential Code. In 2001, the Texas Legislature declared that the International

Residential Code is the proper municipal building code for one and two family residential construction. More information can be obtained from any of the three code companies, which are: Southern Building Code Congress (9420 Research Blvd., Echelon III, Suite 150, Austin, Texas 78759, 512-346-4150); International Conference of Building Officials (9300 Jollyville Road, Suite 200, Austin, 78759-7455, 512-794-8700); International Conference of Building Officials (9300 Jollyville Road, Suite 200, Austin, Texas 78759-7455, 512-794-8700); and Building Officials and Code Administrators, International (4051 West Flossmoor Rd., Country Club Hills, Illinois 60478-5795, 708-799-2300 or 1-800-369-4069).

Some adaptation of these model codes may be necessary to make them accommodate local climatic and geographical conditions. When the Residential or Energy Conservation Code should be applicable to most any condition, but the code should be studied by the local officials prior to its adoption. Abridged editions of some codes are available for the use of smaller communities. Each city should remember that the city can only adopt a single code of a specific year, and should changes be developed by the code organization, the city will need to adopt the specific changes or adopt again the specific code of another specific year. In other words, the city cannot adopt the Southern Standard Building Code of 1998 and have it automatically adjust for changes made in year 2000. To pick up changes, the city will have to adopt the Code of year 2000. Unfortunately we have noted that some cities have adopted a code, for example the Code of 1975, but by 1998 have not updated it to take advantage of the new construction materials and techniques.

It is very important that all construction within the city comply with the appropriate codes. Often property owners will forget that they need to get a permit and just start projects without checking with the building official. For this reason, it is imperative that the building official or another city employee canvass the city regularly to look for construction that may be in progress without a permit and, too often, not meeting the requirements of the codes. City administrators or city secretaries in small cities will make it a practice to tour the entire city at least once every week or two and note every project that appears to be under construction or preparing to get under way. The list is then checked to ensure that the appropriate permits have been issued and that the apparent construction is permitted within the zoning classification.

### *Plumbing Inspection*

State law provides that a person is not required to be a licensed plumber to perform plumbing repair work: (a) located outside a city and connected to a public water system that does not require a license to perform plumbing; or (b) inside a city with a population of less than 5,000 unless an ordinance of the city requires a person to be licensed (Note: plumbing work on new construction still requires a licensed plumber). A city with a population over 5,000 must have a licensed plumbing inspector. However, there is no such requirement for cities under 5,000 population unless the city adopts a plumbing code.

Since plumbing inspection activities are similar to those conducted by the water and sewer department, the plumbing inspector may be an employee of that department. Any other duties in the public works department that may be assigned to the plumbing

inspector are immaterial, as long as adequate coordination is maintained between plumbing inspection and building inspection activities.

Suggested plumbing codes are available from the Texas Municipal League, the Building Officials and Code Administrators International, and the Southern Building Congress.

### *Electrical Inspection*

As in the case of plumbing work, most cities require that all electrical work be performed by qualified electricians. Although no state-level licensing procedure for electricians exists at this time, the local chapter of the National Electrical Contractors Association can help develop testing and licensing procedures. Also, reciprocal licensing arrangements with nearby cities which already have established licensing systems may be a feasible alternative to organizing separate local procedures. In some areas, such as the Lower Rio Grande Valley, the cities have organized a single license that is recognized by all of the cities.

Regardless of the procedure that is to be used, the city's electrical inspector should be qualified and, if possible, licensed. The temptation to use a local electrician or electrical contractor for inspections on a part-time basis should be resisted because of the conflicts of interest likely to arise. In many cities, the electrical inspector also serves as the city's electrician and performs all electrical maintenance work required by the city.

The National Electrical Code (published by the National Fire Protection Association, 1 Battery Park, Quincy, MA, 02169-7471) is the most commonly used electrical code and is available for adoption by any city. Care should be exercised to ensure that the Code, as all Codes, is kept current after its initial adoption.

### *Housing Inspection*

Many cities have adopted codes which establish minimum standards applicable to all dwelling units. Minimum housing codes normally apply to all existing dwellings and establish minimum requirements governing sanitary facilities, windows, exits, and other aspects. Effective enforcement of a housing code in conjunction with other codes and ordinances can help prevent the development of slums and substandard housing conditions.

The responsibility for ensuring compliance with the housing code can be assigned to the city's building inspector, though a survey of existing conditions may indicate a need for supplementary personnel. Police officers also can be trained to be on the lookout for violations. Standard housing codes suitable for adaptation by smaller cities are available from a number of sources, including the Southern Building Code Congress and the International Conference of Building Officials.

### *Construction Inspection*

Skilled inspection is needed to ensure that all major construction projects contracted for by the city comply with the plans and specifications developed to govern the quality of the work. These inspections are usually the responsibility of the city engineer and staff, often supported by employees provided by the consulting engineer who developed the plans and specifications for the project to be inspected. The consulting engineer will, as a

matter of course, provide regular inspections, but unless the city contracts with the engineer to provide continuous inspections, the city must arrange for a competent person to be on the job at all hours when the contractor is working. Even the most conscientious contractor may have employees who will attempt to cut a corner or do sloppy work, and this must not be permitted. There are far too many stories of sewer lines that are not bedded properly and settle, interrupting flow, or water lines that are not properly braced with thrust blocks that under pressure may actually blow out a bend (corner). Should the city be unable to provide qualified staff to provide the inspection, it should consider contracting with the consulting engineer or some other source to provide the construction inspection.

In order to ensure quality work and a completed facility commensurate with its cost, qualified personnel and appropriate procedures must be utilized for all inspection work. Furthermore, the construction inspector must have the authority to accept or to reject all materials and workmanship, as well as any construction procedures being followed. The inspector must have authority to stop the work until improper materials are replaced or improper construction methods are done properly. Defective construction or defective materials may not show up until several years have passed, but then it is too late to go back to the contractor. The city must assure that proper materials are used and that appropriate construction procedures are followed in every construction project, particularly those that are buried under ground.

### *Minor Construction Inspection*

Standards should be developed for such work as sidewalks, driveways, curbs, and gutters, and municipal inspections of these improvements should be required to ensure compliance. Responsibility for these inspections ordinarily is a function of the engineering division and can be performed by most anyone with a thorough knowledge of construction standards and procedures.

## Planning

In smaller cities, the ordinances and regulations, which serve as the framework for the comprehensive planning process usually, are assigned either directly to the city administrator or to the public works department for administration. It is important that standard procedures be established and adhered to in the development and administration of the comprehensive plan and the administration of the land use regulations in order to guard against unauthorized or incompatible uses. Frequent advice from the city attorney is recommended. As noted above in the sections relating to inspections, it is important that the city is canvassed frequently to ensure that new construction or new activity complies with the land use regulations. Please note that there is another chapter in this manual that is devoted to planning, but as planning is so closely related to the public works functions, we have included a brief discussion here.

## Capital Improvements Programming

It is a financial fact of life in every city that the demand for new streets, water lines, wastewater facilities, parks, community buildings, and other capital improvements

always exceeds the supply of current funds. Capital improvements programming is the primary method used by most cities to cope with the perpetual imbalance between capital demands and limited financial resources.

A capital improvements program (CIP) is a long-term plan, usually spanning five to six years, for financing major cost items which have a useful life of several years, such as buildings, land, streets, utility lines, and expensive equipment. The CIP document lists all of the capital items scheduled for construction or acquisition during the next five or six years; the time when construction or acquisition is to occur; the amount expected to be spent during each year of the CIP; and the sources of funding for each expenditure. Inevitably, there will be a gap between the needs and funds available to meet these needs, but careful study, prioritizing, and scheduling can at least ensure that the top priority projects are considered and included in the program.

***Steps in Preparation of a Capital Improvements Program***

Preparation of a CIP requires five major steps. First, a list of proposed capital improvements is prepared on the basis of recommendations from the planning and zoning commission, city council, citizen groups, and staff. The city's comprehensive plan will be the source of most CIP items; but whatever the source, each item included in the list should be supportive of the community's goals as expressed in the plan.

Next, cost estimates are developed for all proposed CIP items. In addition to stating the up-front costs of each item, these calculations usually include a description of savings that will result from its acquisition or construction, as well as the impact the item would have on future revenues or operating costs.

Third, a determination is made of the city's ability to pay for the items included in the draft CIP, together with a description of the method by which each will be financed. Ability to pay will be determined by a financial analysis of past, current, and future revenue, expenditure, and debt patterns. Options for financing particular items include special assessments, state or federal grants, fees or taxes, current revenues (pay-as-you-go), reserve or surplus funds, general obligation bonds, revenue bonds, or certificates of obligation. The objective of this step is to determine, for each year, the minimum city government costs that must be taken care of before any new capital expenditure can be financed.

The next step is for the staff to organize all proposed CIP items for an orderly presentation to the planning and zoning commission and to the city council. Each is ranked in recommended priority order. Items which overlap or duplicate previously approved projects, or which are inconsistent with the city's comprehensive plan, are identified and perhaps downgraded. And last, the planning and zoning commission recommends a tentative CIP to the city council. The CIP is aired at public hearings, thoroughly reviewed by the council, and then finally approved for formal council action.

Based on information contained in the CIP, a capital budget is prepared to show all capital expenditures in priority order, together with summaries of the financial activities planned for each year, including the amounts of bonds to be issued, amounts of operating funds required, and so forth.

### *Capital Improvements Budgeting*

The capital budgeting process normally takes place on a cyclical basis. Under a 6-year CIP, Year 1 is the current capital budget, which is adopted by the council at the same time it approves the operating budget. Many times the capital budget is included as a component of the operating budget. Years 2 through 6, having been approved by the council when it adopted the CIP, remain in the record as expressing the council's intent to carry forward with the balance of the CIP.

At the conclusion of Year 1, the council approves another one-year capital budget and extends the CIP, with revisions, for another year. Thus, Year 2 of the previous CIP becomes Year 1 of the new 6-year program, and the cycle begins anew.

Capital programming and budgeting offers several advantages. By scheduling ample time for construction or acquisitions, costly mistakes can be avoided: for example, streets will not have to be dug up repeatedly if they are planned in relation to other facilities. Also, by working with a list of planned projects, sites ordinarily can be purchased as necessary at less cost than on a cash basis. And by spacing out projects over several years, the city's tax and debt load can be stabilized and balance maintained between debt service and current expenditures.

Ideally, capital improvements programming should be based on a comprehensive plan for the future development of the community. It should also be based on long-term fiscal planning. Cities which operate on this basis will have a head start in capital improvements programming.

## Traffic Engineering

The constant growth of the state's automobile population demands that effective measures be taken to control the flow of traffic and minimize the hazards of driving. Prior to World War II, it was common for the entire traffic function to be assigned to the police department. However, with the rapid post-war growth of traffic and development of effective street design, traffic management has come to be recognized as a separate discipline within the realm of the public works department. Enforcement has, of course, remained a police responsibility.

The shortage of qualified traffic engineers, coupled with the budgetary limitations of smaller cities, often leads to conditions under which untrained personnel find themselves assigned to perform technical traffic-related duties. If it does become necessary to "make-do" with local personnel who have no formal training in this field, every effort should be made to upgrade the level of their competence.

Opportunities for training are offered through the Traffic Safety Section of the State Department of Transportation. Additionally, seminars and short courses are periodically sponsored by the Institute of Traffic Engineers, the International Municipal Signal Association, and a number of state universities, particularly the Texas Transportation Institute at Texas A&M University.

Personnel with the responsibility for traffic control also should be encouraged to visit cities with a professional traffic engineering staff for consultation. Also, it may be advantageous for the city to employ a consulting traffic engineer to develop a basic

traffic-pattern and traffic regulation system to serve as a guideline for ongoing efforts by city staff. Regardless of the source of advice, all traffic control devices must comply with the provisions contained in the *Texas Transportation Code* and the *Texas Manual on Uniform Traffic Control Devices*, published by the Texas Department of Transportation.

Space does not permit a discussion of all of the essentials of good traffic engineering practice, but three of the most common misuses of traffic control regulations should be mentioned.

*Traffic Signals* are often viewed as the answer to traffic problems. Perhaps the most common misconception about traffic control is that installation of a traffic signal will reduce accidents. This is seldom the case. Only when a traffic signal is fully warranted by the volume and pattern of traffic flow can it be expected to do anything other than increase the occurrence of accidents. A traffic signal is designed only to regulate traffic flow by assigning right-of-way. It must be properly designed for specific intersection conditions, traffic volumes, and traffic patterns, if it is to function advantageously. The provisions contained in the *Texas Manual of Uniform Traffic Control Devices*, published by the Texas Department of Transportation, must be strictly adhered to.

*Stop signs* should be installed only when it is necessary for all traffic to come to a complete stop to avoid accidents. When stop signs are placed at intersections where their use is not justified, the respect of the motorist for all stop signs will be reduced. Over use of the stop sign can render this device completely ineffective for proper traffic control. Consideration should be given to the use of "yield" signs where caution before entering an intersection is required. Adequate enforcement of speed limits is the proper way to reduce speeds on a thoroughfare.

*Speed limits* should permit a reasonable speed. Any speed limit the motorist considers unrealistically low will be ignored and habitually violated, thus weakening the entire speed regulation system. Prima facie speed limits across the state are established by statute, the *Texas Transportation Code* 545.352, and the standard speed limit in an urban district is 30 mph. The *Texas Transportation Code* grants to cities the authority to alter speed limits only when doing so is justified on the basis of an engineering and traffic investigation by the Texas Transportation Commission.

The city must also remember that no traffic control device may be placed on a State or federal highway without concurrence of the Texas Department of Transportation.

## Facilities and Equipment Maintenance

The maintenance and repair of city property is usually assigned to the public works department. This includes public building, grounds, and city equipment.

### *Building and Grounds Maintenance*

Even small cities generally have large investments in public building and grounds. This investment must be protected by a careful program of maintenance, which includes a wide variety of duties, including mowing lawns, carpentry and painting, custodial functions, litter control, and servicing heating and air conditioning facilities. Basic elements of a building and grounds maintenance program include:

*Timing of Activities*. The timing of maintenance activities should be coordinated with the times the facilities are used by the city or the public. This will minimize the conflict with maintenance efforts and increase maintenance productivity.

*Priorities and Scheduling*. The large number of needs typically facing maintenance personnel requires the establishment of schedules and priorities. A regular routine for standard maintenance should be established which recognizes the different intensities of use. Those areas which are more intensely used should be maintained more frequently. Less-used areas may only require service weekly or monthly. The maintenance system should also allow for quick response to requests for service when a problem exists, particularly where health or safety may be affected. In establishing schedules, the city must keep in mind that the public tends to take better care of well maintained facilities such as public restrooms while dirty, smelly, and unkempt facilities often invite vandalism.

*Work Order Systems*. Requests for unscheduled maintenance should be initiated through the use of standard work orders. Such a system provides a method of controlling and following up service needs. In addition, the system provides documentation pointing to areas where frequent problems occur, indicating the need for replacement or repair.

*Preventive Maintenance*. The maintenance schedule should include periodic servicing of equipment and facilities before deterioration occurs. For example, most major mechanical systems include preventive maintenance instructions. These instructions should be incorporated in the maintenance schedules of all facilities and equipment.

### *Equipment Maintenance*

Most cities have a major investment in motorized equipment, from lawn mowers to police cars and large construction equipment. The usual practice is to assign the responsibility for maintaining this equipment to the public works department.

If the city is large enough, a centralized facility in most cases is the most efficient and economical means of providing repair and maintenance, because it allows pooling repair and maintenance of the skilled personnel, tools, equipment, and spare parts necessary for economical service. Effective service requires specific assignment of the responsibility for all maintenance and repair functions and for the development of standard procedures applicable to equipment maintenance.

While not an item of maintenance, it is imperative that each city must have specific policies on the use of city equipment. Which employees and under what conditions may vehicles be taken to homes overnight? Is it permissible to regularly take spouses to work in a city vehicle? When and under what conditions may a vehicle be taken out of the city? Is it permissible for an employee who is authorized to take a vehicle to his/her home to use the vehicle to attend a high school athletic event, etc.? What about grocery shopping?

Further, there needs to be a specific prohibition against any employee operating a city owned vehicle after partaking of any alcoholic beverage or illegal drugs. Further, caution must be used upon taking any legal drugs which may impair the individual's ability to operate a vehicle safely. Under no condition may any employee perform any duty after partaking of any alcoholic beverage or illegal drugs, and there shall be no alcoholic

beverage nor any illegal drugs located on or in any city premises, equipment, or properties.

Service priorities should be established to ensure that the most critical equipment, such as that involved in public health or safety, receive first consideration. Regular reporting procedures indicating condition of equipment should be established to give the administrator adequate information on which to base equipment selection for purchases.

Some cities may find it advantageous to contract for major repair and overhaul, if the volume of work does not justify a heavy investment in special repair equipment and personnel skills. A request for bids should be issued to local auto or equipment repair shops and a contract for services established.

## Streets

Major street construction projects normally are contracted out to private construction firms, but the responsibility for supervising the design and inspecting their construction ordinarily remains a function of the public works department. On all construction projects, whether done by contractors under the supervision of an engineering firm or by city crews under the supervision of the director of public works or a city engineer, there must be an independent inspector who is working for the city. This inspector should be on the job at all times when the contractor is working. Even the most conscientious contractor may have an employee that will try to cut a corner on a project. Design, supervision, and inspecting minor street construction, repair, and maintenance operations are also the responsibility of the public works department. Since drainage facilities are an integral part of every street, and since skills and equipment similar to that used in street operations are also needed for the maintenance of drainage facilities, responsibility for both are usually assigned to the public works department.

### *Street Construction*

Traffic engineers use standard categories for characterizing types of streets. The categories, as defined by the Federal Highway Administration, include: (1) the urban principal arterial system, which carries the major portion of trips entering and leaving the urban area, as well as the majority of through movements desiring to bypass the central city; (2) the urban minor arterial street system, which connects with and supplements the urban principal arterial system, and which provides service to trips of moderate length at a somewhat lower level of travel mobility than major arterials; (3) the urban collector street system, which differs from the arterial systems in that facilities on the collector system may penetrate neighborhoods, distributing trips from the arterials through the area to the ultimate destination which may be on a local or collector street; and (4) the urban local street system, which comprises all facilities not on one of the higher systems.

Standards applicable to the design and construction of streets should be developed for each class of street. Obviously, major thoroughfares intended to carry heavy volumes of traffic will be designed to different geometric and load-bearing standards from those appropriate to residential streets intended only to provide access to adjoining property. The same standards should apply to all streets within the determined categories, whether constructed by subdivision developers, consulting engineers, contractors, or city employees. These standards can be incorporated into subdivision ordinances. The city

needs to be sure that its inspectors closely monitor all street, utility, or other construction that will eventually become city property and city responsibility.

### *Street Maintenance*

Maximum effectiveness of personnel, equipment, and financial resources requires that standard street maintenance procedures be carried out on a planned annual basis: preoccupation with emergency maintenance activities, such as patching potholes, can only result in deteriorated street conditions which will perpetuate such practices.

Standard maintenance practices including crack and joint sealing, sealcoats, resurfacing, and repairs also should be performed on a regularly scheduled basis. Best results are obtained by development of a priority rating system, which automatically schedules the order in which maintenance is performed on each street. The rating system should take into account items such as traffic volumes on the facility, age, past maintenance performed, subsurface soil conditions, and pavement construction. Not only does this approach remove the guesswork from street maintenance scheduling, it also provides the best results for the money available and provides an excellent means for answering the inquiries of citizens. Regardless of the maintenance practices, it is inevitable that potholes will occur; but when they do, the city crews must not be allowed to throw some premix into the hole and pat it down with a shovel. Repairs must be done right.

### *Drainage Facilities*

Water damage to property and inconveniences and hazards to citizens can be minimized by good drainage. Proper drainage is also necessary to prolong the useful life of city streets. Major drainage facilities should be planned for an entire watershed. Every street should be designed to allow storm water to drain away immediately. Standing water in streets and ditches is not only unsightly and hazardous to health, it also contributes greatly to street deterioration.

Drainage facilities should be subject to the same principles of scheduled maintenance as streets to ensure that adequate drainage is maintained at all times. The city should take precautions to ensure that adequate rights-of-way for drainage facilities are arranged to allow unrestricted freedom for maintenance crews to perform measures necessary to provide free flow of storm water.

## Utilities

Water supply and wastewater facilities are the public utilities most commonly owned and operated by cities. Due to their similarities (construction and maintenance, equipment, chemical treatment, billing procedures, etc.), both services are frequently placed in the same department for supervision and administration. These two services are basic to the health and welfare of the community, yet citizens frequently take them for granted. The wise administrator will place a high priority on establishing an organization capable of providing a high level of service and maintenance for water and wastewater utilities. This administrator will also endeavor to ensure that the public is aware of the importance of the utilities and is fully aware of the needs of the utility systems.

### *Water Division*

Requirements of a good water system can be divided into three basic areas: (1) establishment of an adequate source of water; (2) proper treatment of the water to guarantee that it is safe and potable; and (3) a distribution system that provides adequate volume and pressure to every home and business for everyday water requirements and for fire protection purposes.

### *Water Supply*

Lakes, rivers, and wells are the primary sources of water. The basic requirements, which any source of supply must meet, are good water quality, dependability, and adequacy for growth potential. Unfortunately, for most Texas cities, the choice of water supply is very limited.

An analysis of all available water sources to determine water quality and the economics of treatment is necessary to make an intelligent choice of source. An economic balance must be reached between the cost of water recovery, the cost of treatment, and the cost of delivery to the point of use. These factors can only be assessed after an analysis of all the possibilities by a competent engineering study.

The third requirement of a good water source, adequacy for growth usage, not only presupposes the future growth of the city, but also recognizes that per capita water use is increasing at a steady rate and probably will continue to do so. In addition, sources of supply are never static, they change continually over a period of time as lakes fill up with sediment, water tables fall, and so forth.

All cities should develop long-range plans for water supply, and fifty years has become the most commonly used projection plan. A fifty-year projection recognizes the long lead time necessary in developing sources, and should be sufficient to guard against discovering that the most desirable sources have been preempted by other users. A long-range plan for water sources can sometimes best be made by a citizen's committee working with a competent water engineer. The Texas Water Development Board can provide guidance in the development of the plan.

### *Water Treatment*

Water quality is evaluated relative to the presence of minerals, salts, sediment, and other foreign substances in the water, and is of importance roughly in proportion to the cost of removing impurities. Most foreign substances can be easily and inexpensively removed; certain other, more difficult impurities can be tolerated in small quantities without seriously affecting the quality of the water. Congress and the Environmental Protection Agency are continually trying to upgrade the quality of water that is being provided to citizens.

Water can be treated by sedimentation, filtering, aerating, and/or by adding chemicals. A combination of these methods frequently is needed to remove all required impurities.

Of equal importance to the design and construction of an adequate water treatment facility is the maintenance of the plant and constant monitoring of the process. It is of prime importance that the treated water be chemically analyzed by a qualified person or laboratory on a regular basis. Minimum standards applicable to the quality of treated

water have been set by the Texas State Health Department and the Texas Commission on Environmental Quality.

***Water Distribution***

The smaller city more frequently encounters problems arising from the inadequacy of its water distribution system than from any other element of the water supply system. Not only must water be available in sufficient quantity to every home, business, and industry in the city, but with sufficient pressure. There must be adequate pressure in all areas of the city for fire fighting purposes. Failure to provide adequate volume and pressure may result in severe fire insurance premium penalties to the owners of all properties affected and continual dissatisfaction of the consumers.

Poor water pressure usually results from unforeseen growth of the city. Failure to keep up preventive maintenance of the system may also reduce the ability to maintain pressure and volume. The addition of many new water users, for example, can suddenly make a water line inadequate although when constructed, it was adequate for the number of users for which it was designed. This makes it imperative that the city adhere to sound planning practices that will allow growth to be both predicted and controlled, and upon which designs for each element of the water distribution system can be based.

***Wastewater Division***

The effective collection and disposal of liquid wastes is essential to the health of the community. The realization of the finiteness of water resources and the relationship between such resources and population emphasizes the necessity of treating liquid wastes to the extent necessary to avoid the pollution of streams and other waterways. In fact, there is a growing need to recover the wastewater for irrigation, if not domestic consumption.

***Collection***

The wastewater collection system should be based on the gravity flow of liquids to the maximum extent economically practical. The topography of the community and the location of a discharge point will determine the configuration of the collection system. Force mains may be used where necessary to pump the wastewater for short distances where gravity flow is impractical. The cost of wastewater lift stations and force mains dictates that their use be determined by comparing the alternatives in relation to gravity lines. In addition, high cost of construction and maintenance of lift stations is a constant financial consideration. Even though historically, cities have primarily relied upon the gravity system to transport the liquid wastewater, grinder pumps and other new techniques are enabling viable systems to be installed where they were not feasible previously.

Other than overall planning and design, the three most important elements of a wastewater collection system are proper sizing, location, and quality of construction. Wastewater lines which are too small become overloaded and will stop up, causing raw sewage to back up into manholes and sewage inlet connections. Sloppy construction techniques and shabby workmanship can result in poor pipe joints, which allow the infiltration of storm water into the wastewater lines. Also, too often, careless alignment and improper bedding of the lines will allow sags in the pipe which allow sedimentation

in the lines and also can result in impeded flows or complete stoppages. The results of too small lines or poor construction can cause serious problems. As pointed out earlier, it is imperative that the city have a qualified inspector observing the entire construction sequence to ensure proper workmanship and techniques.

Proper maintenance of the wastewater collection system is basic to effective functioning and requires an efficient maintenance organization with adequate tools and equipment. A properly-designed system with a sufficient number of properly located manholes will make the maintenance task easier, less expensive, and more effective.

***Wastewater Treatment***

Prior to its disposal into a nearby stream, river, or other disposal means, the wastewater must be given adequate treatment so that, when released into the stream or river or applied to the lands or other discharges, no pollution will result. In past years, secondary treatment was sufficient, but with the new standards, more and more cities are being required to go to a higher level of treatment, most often called tertiary. Most often, the quality of the effluent being released is of a higher quality than the stream receiving the wastewater. (While the editor believes in the necessity of maintaining clean water, he does not believe that the whole burden should be placed on cities, as it appears to be aimed.)

Effective nonpolluting treatment requires not only adequate design of treatment facilities, but also makes it critical that facilities not be overloaded beyond their design capacities. Thus, frequent checks of the wastewater load compared to treatment capabilities, as well as good overall operational and maintenance practices, are mandatory.

The enormous cost of wastewater treatment facilities makes joint construction and use with other communities worth careful consideration. Regional wastewater systems are becoming a workable alternative in some areas, and investigation of opportunities for participation in such systems might well pay dividends in better treatment at less cost. Information about wastewater construction can be obtained from both the Texas Water Development Board and the Texas Commission on Environmental Quality.

***Utility Financing***

It is common practice in most cities to charge a fee for providing water and wastewater services, so that both are self-supporting. In many instances, utility rates are designed to produce enough revenue to allow them to contribute to other municipal services by adding funds in excess of expenses to the general treasury of the city. Since the furnishing of water services easily lends itself to measurement, these charges can more readily be based on services actually rendered. The practice is one of the most feasible methods of reserving tax money for the funding of street maintenance, police service, fire protection, and the other municipal activities which are not so easily measurable.

Many methods, ranging from direct metering to uniform flat charges, are used as a base for charging for utility services. Historically, as wastewater consumption is not easily measured, cities have used flat rates or charges based upon the number of facilities in homes or businesses. However, many cities are now basing wastewater charges on the amount of water consumed. They will calculate the average monthly water consumption over three or more months of the winter, when consumers are not usually irrigating their

lawns, and use that average for the entire year. The method chosen should be the result of intensive studies to determine comparative costs, revenue yields, and acceptability to local citizens.

It is very important that cities base their utility charges on carefully determined costs of service. In years past, it was customary to set high minimum fees for service and then give breaks to large consumers. In analyzing costs of service, it is now often found that the large consumer actually adds additional cost to the service rather than lower the cost per unit, as thought. For example, a consumer that uses 100,000 gallons of water in an operation that is open only eight hours in a 24-hour period requires three times the water and probably wastewater capacity as does the customer who may use the same 100,000 gallons in a business that operates 24 hours per day.

Where a utility pays its own way, capital costs can be funded through revenue bonds, which are retired by income generated by the system. Revenue bonds have distinct advantages in that they do not affect the general obligation bonding capacity of the city, but they may require a slightly higher interest rate. The advice of a competent financial advisor should be sought in determining the best course to follow.

## Solid Waste

Solid waste is being generated in substantial quantities by each citizen, and consequently is becoming a larger and larger problem to most cities. Nationally, solid waste is presently generated at the rate of 5.3 pounds per person each day.

### *Solid Waste Collection*

A wide variety of solid waste collection systems and procedures is in use, and the administrator should thoroughly investigate the effectiveness, cost, and acceptability to the citizens of all methods before choosing a particular system. Receptacles vary from the standard metal can, to plastic and paper bags, to fixed containers for mechanical collection. Collection techniques range from open bed trucks, to mechanical collection equipment, to the use of trains or small containers pulled by jeeps or small trucks. Each system may operate successfully under different conditions. All should be considered and their relative advantages and costs analyzed.

Uniformity is a necessary ingredient in the successful operation of any refuse collection system. Different categories of solid waste generators, such as restaurants, industries, and residences, produce different types and quantities of waste, and therefore must be serviced in a way which fully meets the needs of each. But within each category of waste generation, uniformity must be applied for effective, fair, and economical collection. Standards for the size and weight of containers, the location of containers, and acceptable waste to be collected must be developed and enforced. Only in this way can the administrator avoid being overwhelmed by the cost of the service and the complaints. In order to accomplish uniformity, one city has experimented with allowing customers to select the size of waste container to be used for regular collection and charging a fee based on the size of the container. Then, in the event that the customer has more material than would fit in the pre-selected container, the customer would be required to use another container such as a plastic bag, etc., and apply to the extra container a tag which

would be purchased from a grocery store. The city must take care to balance uniformity and fairness with the goal of keeping the city cleared of trash and rubbish.

An alternative to refuse collection by city personnel is the use of private contractors to provide the service. This alternative has been particularly attractive for the very small city where a heavy investment in equipment is too burdensome and the cost of operating landfills, because of the EPA mandated requirements, has risen to prohibitive levels. Where contract collection is used, particular care should be exercised to provide adequate municipal supervision, so that citizen acceptability of the service is not jeopardized. The thorough administrator not only will carefully investigate the past performance of all candidate contractors, but will also discuss the advantages, disadvantages, and pitfalls of this technique with other cities that have used it.

***Solid Waste Disposal***

Increased concern with the quality of the environment requires that the city administrator give considerable attention to the disposal of solid waste to ensure that no air, water, or visual pollution results. At the same time, budgetary pressures require that only the most efficient and economic methods of disposal be used. As mentioned earlier, Environmental Protection Agency rules regarding waste disposal have just about priced the small cities out of the landfill disposal practice. Smaller cities, and particularly those in metropolitan areas that have not already made other arrangements, may find it desirable to participate in a jointly operated landfill site with other cities in the area. An attractive alternative is a countywide landfill operated by the county, with each participating entity paying its fair share of the operating cost.

The incineration method of refuse disposal has been used with varying results. The considerable cost of incineration equipment, together with the high operating expenses, often make it uneconomical where other alternatives are available.

About the most viable program for waste disposal that has been adopted in many of the larger cities is that of recycling. Smaller cities are encouraged to actively pursue programs to recover glass, paper, plastic, metals, etc. While the sale of recycled materials may not always recover enough revenue to pay the full cost, the reduction in the amount of waste to be disposed of may be of adequate value to offset the cost. Even the small rural cities should explore recycling programs. The city should start by contacting the appropriate council of governments. Another point for information is Ecology Action, 707 East 9$^{th}$ Street, Austin, Texas 78701.