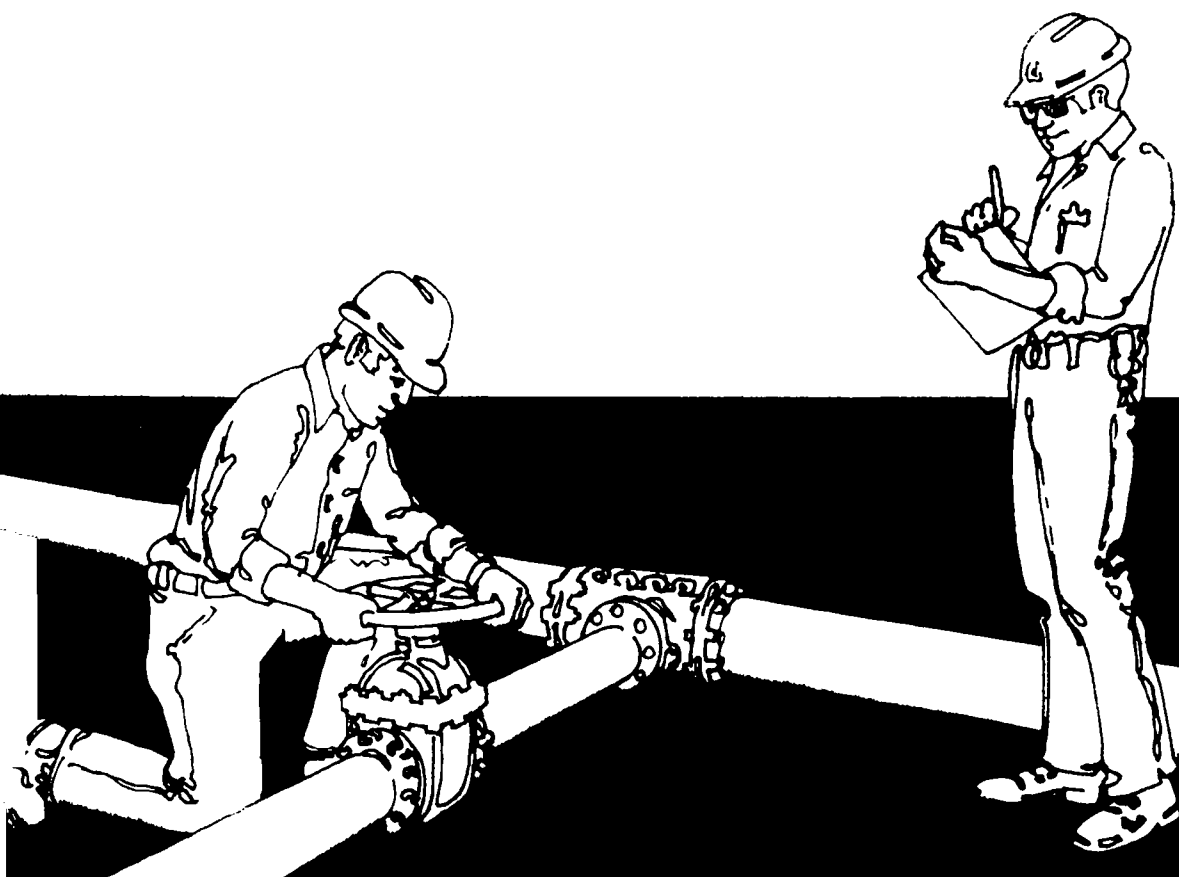


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# Basic Management Principles For Small Water Systems

An AWWA Small-Systems Resource Book



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American Water Works Association

# Basic Management Principles For Small Water Systems

An AWWA Small-Systems Resource Book

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American Water Works Association

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## Preface

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This handbook is an adaptation of materials developed by the American Water Works Association in 1981 under a federally funded training project designed to improve system management of water and sanitation facilities on Indian lands. The problems of managing operation and maintenance (O&M) activities on Indian reservations are similar to the problems experienced by small water systems everywhere. Recently, programs involving planned O&M management systems similar to the ones discussed in this book have been widely accepted by small-to-medium-size water utilities for planning, scheduling, and controlling O&M activities. There are many variations of the system approach presented in this text, and the concepts and procedures can be adapted to meet a wide range of operating and maintenance requirements.

The material covered by this book extends beyond the management process of planning, organizing, directing, and controlling O&M work. The text also discusses in detail how O&M work activities play a vital role in goal setting and the budget process, and how service levels and work performance standards can be used to prepare annual work programs and schedule daily work activities. Throughout the book there are numerous examples of records that should be kept to control inventory and equipment, examples of financial and nonfinancial reports that should be prepared periodically, and discussions of how these reports can be interpreted and used to monitor and improve field operations. The text repeatedly emphasizes the importance of data collection and reporting for monitoring work performance, taking corrective action where necessary, and estimating future service levels and system requirements.

The major portion of this handbook was originally prepared by Clyde A. Burke of Burke and Associates, Aurora, Colo., as part of the training program for management of O&M facilities on Indian lands. Appreciation is extended to the US Environmental Protection Agency and the US Indian Health Service for funding and technically reviewing the original project.

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# O&M MANAGEMENT

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1

A manager is a supervisor, a decision-maker, and an administrator. He works through other people to get jobs done. This chapter describes some of the things O&M (operations and maintenance) managers do and how they do them. It also provides information about management tools such as work programs, schedules, and O&M manuals. The first section in the chapter describes managers and management from the viewpoint of a manager in a small O&M organization. The second section provides some details about the management process, the process of planning, organizing, directing, and controlling O&M work. This section also explains how O&M goals can be set and how progress toward achieving the goals can be measured. Other sections describe O&M manuals, office operations, and community relations—important parts of an O&M manager's everyday work. After completing this chapter, you should be able to:

- Describe the management process; what managers do and how they do it.
- Establish specific goals for operations and maintenance work.
- Describe the purpose and content of an O&M manual.
- Take steps to improve office operations and community relations.

## MANAGERS AND MANAGEMENT

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A manager is someone who works through other people to get jobs done. A manager plans, organizes, directs, and controls work—this is the management process. In this section, managers and management are described from the viewpoint of a manager in a

small O&M organization. Examples of O&M work in a typical small community—Centerville, USA—are used to show how a trained water-system operator, Jim Roybal, became a manager.

## Managers

The Centerville town council originally hired Jim Roybal to operate and maintain the community's water system. Roybal operated and maintained the system by himself. Every day, he checked the pumps, valves, and pressure tanks. He also maintained the records needed to monitor the water system. Then, after Roybal had been with the system for about two years, the town council assumed responsibility for a wastewater system and a solid-waste collection system. The operation and maintenance of these two systems were also assigned to Roybal. Within a few weeks, however, it became obvious that Roybal needed help. There was too much work for one person—too many inspections, too many tests, too many service requests. To help Roybal with his workload, the town council hired Bob Chambers. As soon as Chambers reported for work, Roybal became the manager of the Centerville O&M organization. Roybal began getting work done through Chambers.

The day Chambers reported for work, he and Roybal spent all morning inspecting the systems' facilities and equipment. They talked about the work Roybal had been doing to operate and maintain the water system, and they planned and scheduled the work that would need to be done to maintain the wastewater system and to collect and dispose of solid wastes. During this period, Roybal began thinking and acting like a manager:

- *He made decisions* about who would do what work and when it would be done. For example, he decided that Chambers should be assigned to collect solid wastes, and he and Chambers worked with the town council to determine collection days and routes.
- *He supervised O&M work* by assigning Chambers to specific jobs, checking on Chambers' progress during the day, and teaching him how to keep the necessary records.
- *He administered O&M work* by handling the paper work needed to process complaints, paying Chambers, and keeping track of the operation and maintenance of all three systems.

About a year after Chambers was hired, the town council decided to add 150 homes to the solid-waste collection system and to begin maintaining 70 recently installed septic tanks. The town council also authorized Roybal to hire another person to handle the increased work load. Roybal decided that Chambers could handle nearly all of the maintenance work and solid-waste collection, and that the new employee, Bill Dobbs, should be assigned to operations work. A diagram of the three-person O&M organization is shown in Figure 1.

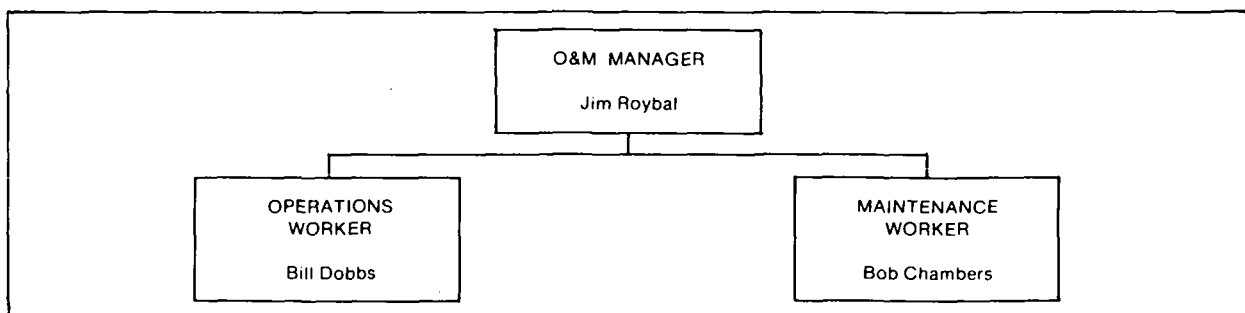


Figure 1 Centerville's O&M Organization Chart

Today, Roybal still does some of the work he did when he ran the water system on his own. More than ever before, though, he is a manager—he works through people to get work accomplished; he makes decisions about who will do specific jobs and when they will be done; he supervises the work by assigning specific jobs, checking the work being done, and training his subordinates; and he administers the work.

## The Management Process

Jim Roybal's experience as a manager is not unusual. All managers in all organizations do the same kinds of things Roybal does to manage work—they work through people to get work done, make decisions, supervise work, and administer work. These are only some of their duties, however. Managers in an O&M organization also plan, organize, direct, and control work. They set goals and then work through people to achieve their goals. The work they do—the planning, organizing, directing, and controlling—is called the *management process*.

*Planning work.* As a manager, Roybal had to decide who should do what work. He had to think ahead, planning the work to be assigned to Chambers and Dobbs. Also, in an informal way, he set some goals. For example, one of Roybal's goals was to have Chambers handle nearly all of the maintenance and solid-waste collection. To achieve this goal, Roybal had to establish work priorities and plan collection routes. He also had to make alternate plans for the time when Chambers was on vacation or did not report to work.

An O&M Manager, even in a small organization, sets goals, establishes work priorities, and makes plans to help achieve the organization's goals. A successful manager handles several kinds of plans. In addition to daily planning, he usually prepares long-range plans. For example, if he thinks that a certain truck will need to be replaced next year, he makes plans to replace the truck. If he thinks that a certain well might run dry, he makes plans to find another source of water. If he has been told that his budget will be cut next year, he tries to find a way to provide adequate services with less money. Instead of waiting for problems to occur, a successful manager plans ahead and takes steps to avoid difficulties.

A manager bases his plans on clearly defined goals. For example, one goal is to provide a continuous supply of clean drinking water. To help achieve this goal, the O&M manager may plan to have someone take 30 water samples during the next month, inspect four pumps, and exercise certain valves. A successful manager thinks ahead; he makes plans that will help him achieve his goals.

*Organizing work.* What people and equipment should be assigned to a certain job? Who should be in charge of the work? How should it be done? By organizing work, a manager provides answers for these questions.

As the manager, Jim Roybal organized his staff in two sections: one responsible for operations and one responsible for maintenance. He put Dobbs in charge of system operations and Chambers in charge of maintenance and solid-waste collection. All three people work together to get jobs done, but Roybal still relies on each subordinate as the person responsible for a certain kind of work.

This part of the management process involves making decisions about who should be doing what work and how the work should be organized. For example, should someone on the maintenance staff be responsible for collecting solid wastes, or should operations personnel be assigned to the work? Are changes needed? Maybe the work should be turned over to a private contractor. If so, what organizational changes would be required? A successful manager organizes work—he makes sure that each person has only one boss; he delegates authority and responsibility for certain tasks rather than trying to do everything himself; and he makes sure that everyone has a clear understanding of who is supposed to be in charge of each task.



*Directing work.* As with planning and organizing work, directing work is part of the management process. Directing work involves preparing work schedules, assigning people to do the work, and then supervising the work. As a manager, Jim Roybal directs work every day, based on the way he planned and organized work. He takes notes about the work that has to be done, he gives instructions to Chambers and Dobbs, and then he checks (or monitors) the work being done. He also provides on-the-job training by guiding and helping both subordinates.

Directing work is perhaps the most difficult part of the management process. A good manager is expected to be a leader, advisor, teacher, helper, and boss, all at the same time. He also must communicate his plans and instructions in ways that subordinates understand. The way a manager directs work—the management style he uses—influences the results he gets. Some management styles work better than others. Generally, a manager who thinks and acts like a team leader gets better results than a manager who thinks and acts like a director. A manager who encourages good performance is generally more successful than one who demands good performance.

*Controlling work.* Is all the work that needs to be done being completed? Are results in line with plans and goals? If not, what corrective actions are needed? Asking and answering questions like these is the process a manager uses to control work. The process involves determining the difference between the plans that were made, the goals that were set, and the actual results that are being achieved, and then taking corrective actions to remedy problems. For example, suppose that Chambers cannot handle all of the solid-waste collection on Mondays and Tuesdays—he cannot complete his route. To solve the problem, Roybal might reroute Chambers' collection schedule to ease the Monday/Tuesday workload, or he may assign Dobbs to help Chambers on these days. Either way, the manager recognizes that his goals are not being met—the Monday/Tuesday route cannot be completed—so he takes some kind of corrective action.

A manager who takes steps to bring actual results in line with his plans is controlling work. This part of the management process is similar to the corrective actions a driver takes to keep his vehicle headed in the right direction. If he is successful—if he keeps the vehicle under control—he will usually reach his destination. A successful manager takes corrective actions based on plans and goals. For example, he may adjust a preventive-maintenance schedule, revise a sick-leave policy, or change work assignments to help him achieve certain goals.

A diagram of the management process is shown in Figure 2. As the figure illustrates, the management process is a sequence of actions. One action leads to another. Planning leads to organizing; organizing leads to directing; directing leads to controlling.

As a manager, Jim Roybal uses the management process every day. His success depends on how well he uses the process. The way he plans and controls work has an impact on results, such as the cost of the work to the organization. The way he organizes and directs his subordinates also has an impact on results, such as how efficiently the work gets done.

A manager is someone who gets work done through other people. He plans, organizes, directs, and controls work. The methods he uses influence the results he gets. The way a manager plans and controls work, for example, can increase work quality, improve productivity, or reduce costs. The lack of good planning and control, of course, leads to poor quality work, low productivity, and high costs.

## MANAGEMENT TOOLS

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A good carpenter uses the tools of his trade—hammers, saws, planes, screwdrivers, etc.—to help him do his job. Likewise, a good manager uses a variety of tools to help him manage work. This section describes several management tools—management procedures that help an O&M manager plan, organize, direct, and control work.

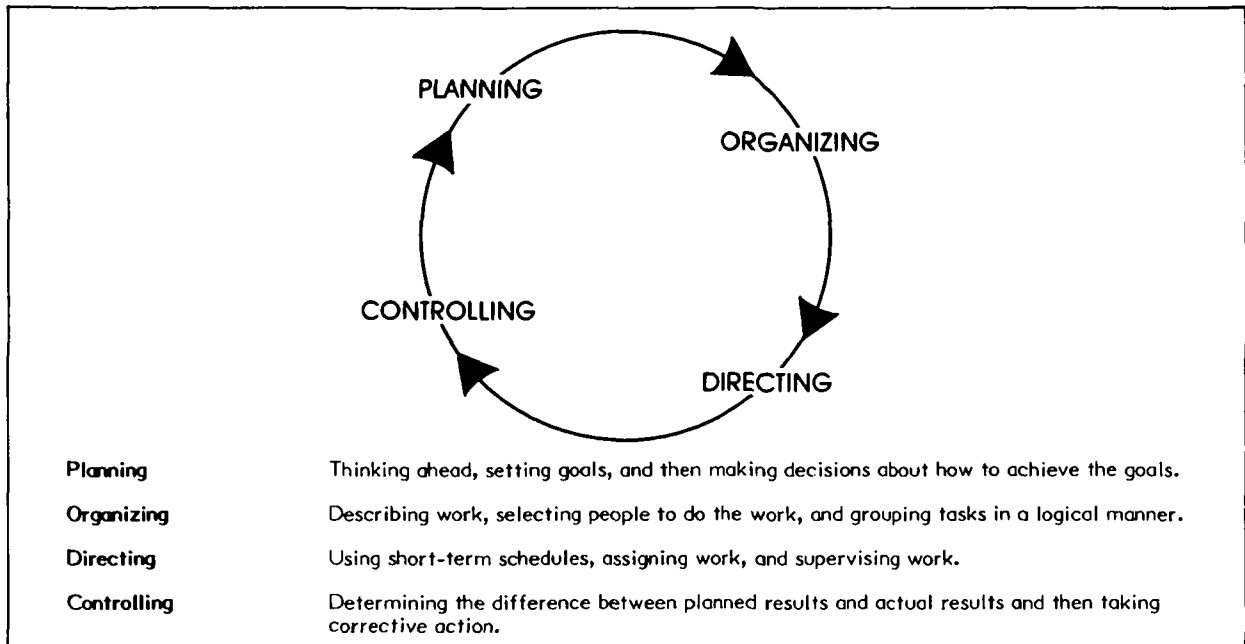


Figure 2 The Management Process—A Sequence of Actions

### Town Council Policies

Town councils usually adopt a number of policies to govern O&M work. The following examples illustrate two types of small-town O&M policies.

- Centerville's O&M organization shall have responsibility for providing clean, continuous, and safe drinking water; it shall also be responsible for collecting and processing wastewater in accordance with Centerville's standards.
- Centerville's O&M organization shall have responsibility for preserving the investment made in water and wastewater facilities and equipment.

Both of these policies provide guidelines for the community's O&M staff, but they do not deal with the problems of managing O&M work on a day-to-day basis. For example, how much work will need to be accomplished to preserve the investment made in water and wastewater facilities and equipment? Does the O&M staff need to perform more preventive-maintenance than corrective work? In effect, the town council's policies require the O&M manager to make these decisions. As the policies are stated, it is the O&M manager's responsibility to determine exactly what work will be needed to operate and maintain the community's water and wastewater systems. A good O&M manager will take advantage of this situation by using one of his management tools: setting specific goals.

*Setting specific goals.* Specific goals provide a sense of direction. They serve as targets—something that the O&M staff can work toward. The process of setting goals involves making decisions about the kinds and amounts of work that will need to be done to satisfy the town council's policies regarding O&M work. For example, to meet the council's policy regarding "clean, continuous, and safe drinking water," the O&M manager will have to decide how often the water should be sampled and tested, whether chemical usage needs to be checked every day, and what equipment servicing should be performed in accordance with his O&M manual. These decisions represent specific goals. In effect, the O&M manager says to the town council: "This is the work our staff needs to accomplish to satisfy your policies. These are our goals."

It is best to review policies and set goals on an annual basis— usually during the time each year when the town's budget is prepared. Policies and goals should be put down in writing in a special document called a *Statement of O&M Goals*. This document provides everyone involved in any part of the operation and maintenance of the town's water system with an official record of the work that needs to be performed. A typical statement of O&M goals is shown in Figure 3. This example shows the first page of the O&M organization's policies, decisions, and specific goals. It shows that the O&M manager has reviewed the condition of his facilities and equipment and has set certain goals that he wants to achieve during the coming year. His goals are based on the town council's policies and on his best estimate of how much work will need to be completed.

*Using goals.* O&M goals are used throughout the management process—from the planning stage through the work-control stage. Successful managers work toward accomplishing O&M goals every day in planning, scheduling, and assigning work and in measuring progress gained against the goals that were set. Specific goals also help a manager communicate with subordinates and town officials.

Managers who set specific goals usually achieve most of their goals each year. Some goals may not be reached, however. Emergency work or other important work may take priority over normally required work. Such circumstances cannot be avoided. Managers learn from experience that work on some goals will have to be postponed until the following year. For example, an O&M manager who wants to replace 1000 ft (300 m) of service line that are starting to deteriorate might get only 400 ft (120 m) replaced during the year. In this case, the balance of his goal—600 ft (180 m)—becomes one of his goals for the following year.

<p><u>CENTERVILLE</u> ANNUAL O&amp;M GOALS</p>
<p><u>Centerville Policy</u></p> <p>The O&amp;M organization has responsibility for providing clean, continuous, and safe drinking water and for collecting and processing wastewater in accordance with community standards.</p>
<p><u>Management Decisions</u></p> <p>The Centerville O&amp;M manager has reviewed the condition of water and wastewater facilities and equipment. He has concluded that the O&amp;M program will be guided during the current year by the following specific goals:</p>
<p><u>Specific Goals</u></p> <p>The O&amp;M staff will:</p> <ol style="list-style-type: none"> <li>1. Sample and test water from each source in accordance with sampling and testing requirements.</li> <li>2. Monitor chemical levels and usage on a daily basis and replace chemicals as needed.</li> <li>3. Service water pumps, valves, and electrical motors in accordance with recommended procedures.</li> <li>4. Read all water meters on a quarterly basis.</li> <li>5. Replace 1,250 feet of water service line and 150 feet of water main line.</li> <li>6. Service O&amp;M vehicles on a weekly basis.</li> </ol> <p style="text-align: right;">continued . . .</p>

Figure 3 A Statement of O&M Goals

## Planning Work

Planning work involves thinking ahead—setting goals and then deciding how to achieve these goals. O&M planning consists of establishing:

- Long-range plans
- Annual work programs and budgets
- Weekly or monthly plans and schedules.

*Long-range plans.* Town councils and O&M managers in many communities recognize the fact that water and wastewater systems will not last forever. They know that major parts of both systems will wear out; certain kinds of equipment will need to be replaced in five or ten years. To deal with this kind of problem, town councils and O&M managers work together to develop long-range plans for replacing water lines, pumps, pressure tanks, vehicles, and other items. Some communities even establish special funds, called *holding accounts* or *reserve funds* to provide money for replacing equipment when needed. This kind of planning usually covers a period of five to fifteen years. O&M managers participate in the long-range planning process when their input is needed by the town council. This usually occurs when long-range plans need to be updated.

*Annual work programs.* An annual work program is one of the management tools that a manager can use every day to achieve his goals. An annual work program is an estimate (based on O&M goals and an inventory of O&M facilities) of the amount of work that needs to be done and the number of man-days that will be needed to do the work to achieve the organization's specific goals. For example, suppose an O&M manager decides that to achieve one of his goals, water meters should be read four times during the year. If the community has 360 meters, the *annual quantity of work* is 1440 meter readings ( $4 \times 360$ ). To determine the number of man-days needed for this one activity, the manager divides the annual quantity of work by the *number of meters* that (on the average) can be read in one day—say 60 meters. Therefore, in this example, it will take 24 man-days ( $1440/60$ ) during the year to read all of the meters. The same process is used for each activity to prepare a complete annual work program.

After the manager has prepared his annual work program, he develops a budget to determine how he will spend the money to implement his annual work program. The annual-work-program budget helps the manager plan, organize, direct, and control work.

*An annual-work-program budget.* A typical annual-work-program budget for Centerville is shown in Figure 4. Notice that for each activity a *planned service level* is shown. The service level is the amount of work needed to achieve the O&M organization's goals (shown in Figure 3). The man-days and dollars needed to complete each activity in the program are also listed.

*Using an annual-work-program budget.* An annual-work-program budget is used in three ways:

1. *To help budget and allocate money.* For example, a town council can use an annual-work-program budget to evaluate a budget request. The budget shows how the O&M manager intends to spend the money he is requesting.
2. *To establish work priorities.* An annual-work-program budget is a handy reminder of the goals that have been set by the O&M manager and of the amount and type of work needed to achieve those goals.
3. *To evaluate progress.* The annual-work-program budget serves as a "benchmark" for the O&M staff to help them evaluate the progress they have made in achieving the goals they have set.

*Weekly schedules.* There are no easy ways to plan and schedule O&M work, but as a general guide, a manager should try to schedule work on a weekly basis. Once a week, the

CENTERVILLE  
O&M ANNUAL-WORK-PROGRAM BUDGET

Activity	Planned Service Level	Planned Work Quantity	Man-Days Required	Dollars Required
101 - Meter Reading	4 times/year	1,440 meters	24	\$ 2,400
102 - System Operations Work	as needed		120	10,000
103 - Solid-Waste Collection	52 times/year	15,600 stops	208	15,800
104 - Other Operations	as needed		60	7,500
201 - Vehicle Service & PM	52 times/year	260 man-hours	33	4,125
202 - Equipment Service & PM	see O&M manual		110	16,250
203 - Septic-Tank Pumping	2 times/year	500 tanks	84	10,500
301 - Service Requests	as requested	600 requests	200	15,000
302 - Replace W/WW Line	900 feet/year	900 feet	45	7,020
303 - Routine Corrective Maintenance	as needed		75	12,500
401 - Miscellaneous Maintenance	as needed		66	8,250
402 - Administrative/Supervisory Time	as needed		550	35,000
TOTAL MAN-DAYS REQUIRED .....			1,575	
TOTAL DOLLARS REQUIRED .....				\$144,345

Figure 4 O&M Annual-Work-Program Budget

CENTERVILLE  
O&M WEEKLY OPERATIONS SCHEDULE  
for 1/26 - 1/30

DAY	MORNING	AFTERNOON
Monday 1/9	John - Routine operations all week (S.W.C.) Steve - Read Meters (Route "A") Barry - Check pressure tanks; record values	Take storage - Tank readings; Check chlorinator
Tuesday 1/10	Steve - Read Meters (Route "B") Barry - Exercise Valves in Areas "A" and "B"	Exercise Valves in Area "C"
Wednesday 1/11	Steve - Read Meters (Route "B") Barry - Take supplies inventory	SUMMARIZE OPERATIONS RECORDS
Thursday 1/12	Steve - Attend WPCF MEETING Barry - Sample lagoon; Start pump "A", "STOP PUMP B"	Check pressure tanks; record values
Friday 1/13	Steve - Attend WPCF MEETING Barry - Help John set up New Collection ROUTES	
(Other Work)	John - Try to get truck 07 INTO SERVICE STATION SOMETIME THIS WEEK Barry - Mix Chemicals by Friday P.M.	

Figure 5 O&M Weekly Operations Schedule

manager should write down the work that needs to be done during the coming week and establish a timetable for the work to be done, based on the goals he wishes to accomplish.

All schedules should be put on paper or on some kind of scheduling board so that all staff members can refer to the schedule easily. A *weekly operations schedule* is shown in Figure 5. Notice that the schedule shows who will be doing specific work during the week. In this example, the O&M manager has assigned three people to operations work.

The weekly operations schedule simply shows the work each person has been assigned to do each day of the week. Weekly scheduling can result in better performance, better decisions, fewer interruptions, better use of resources, less confusion, and lower costs—good reasons for an O&M manager to prepare weekly schedules.

## Getting Organized

Organizing work is an important part of successful management. It involves grouping work into logical tasks (or functions) and assigning certain responsibilities to each group in the organization. O&M managers need to decide how the staff should be organized, how work should be grouped into tasks, and who should be responsible for performing each task.

*Principles of organization.* An O&M staff can be organized in a variety of ways. For small-to-medium-size organizations, however, several business principles apply regarding how work should be organized and how responsibilities should be assigned to each individual.

1. *Unity of Command.* This principle states that each staff member should report to (or be accountable to) only one boss.
2. *Control.* There is a limit to the number of people a manager can supervise effectively. As a general rule, no more than six to eight O&M employees should report to one O&M manager. As an organization grows, the same ratio of managers to employees should be maintained. For example, an organization that has 25 supervised employees should probably have three or four O&M managers, each supervising six to eight persons.
3. *Delegation of Responsibility.* No O&M manager can do everything by himself. Therefore, he should delegate some of the work to employees.
4. *Establishing Clear Lines of Communication.* There should be clear lines of communication between the manager and his subordinates. In effect, this principle means that subordinates have a right to know what the manager expects, and open communication should exist between the manager and employees. Job descriptions, specific O&M goals, and other management tools can be used to support the communication process.
5. *Using Line Managers and Staff.* Line managers are subordinates who are appointed to sub-management positions by the manager. They have authority over other employees and are responsible for making sure that work gets done. Line managers should not assign management responsibilities to assistants or clerical personnel. Staff responsibilities should be limited to work that supports O&M managers.
6. *Flexibility.* O&M organizations must be aware of and respond to changing workloads and conditions. Therefore, an O&M manager should make necessary organizational changes in job duties to accommodate changing workloads, conditions, and goals.

*Organization charts.* An organization chart is a diagram that shows how a company or a public agency is organized to do work. Figure 6 shows an organization chart for a small-to-medium-size O&M staff. The chart shows the lines of authority and responsibility from the town council to the O&M employee. Organization charts for large, complex O&M staffs are similar to the chart shown in Figure 6 but include more lines, boxes, and position titles.

*Organization manuals.* The complexity of an organization chart depends on the work being done, the size of the organization, and how the work has been organized. All of these factors are usually summarized in an organization manual or a similar kind of

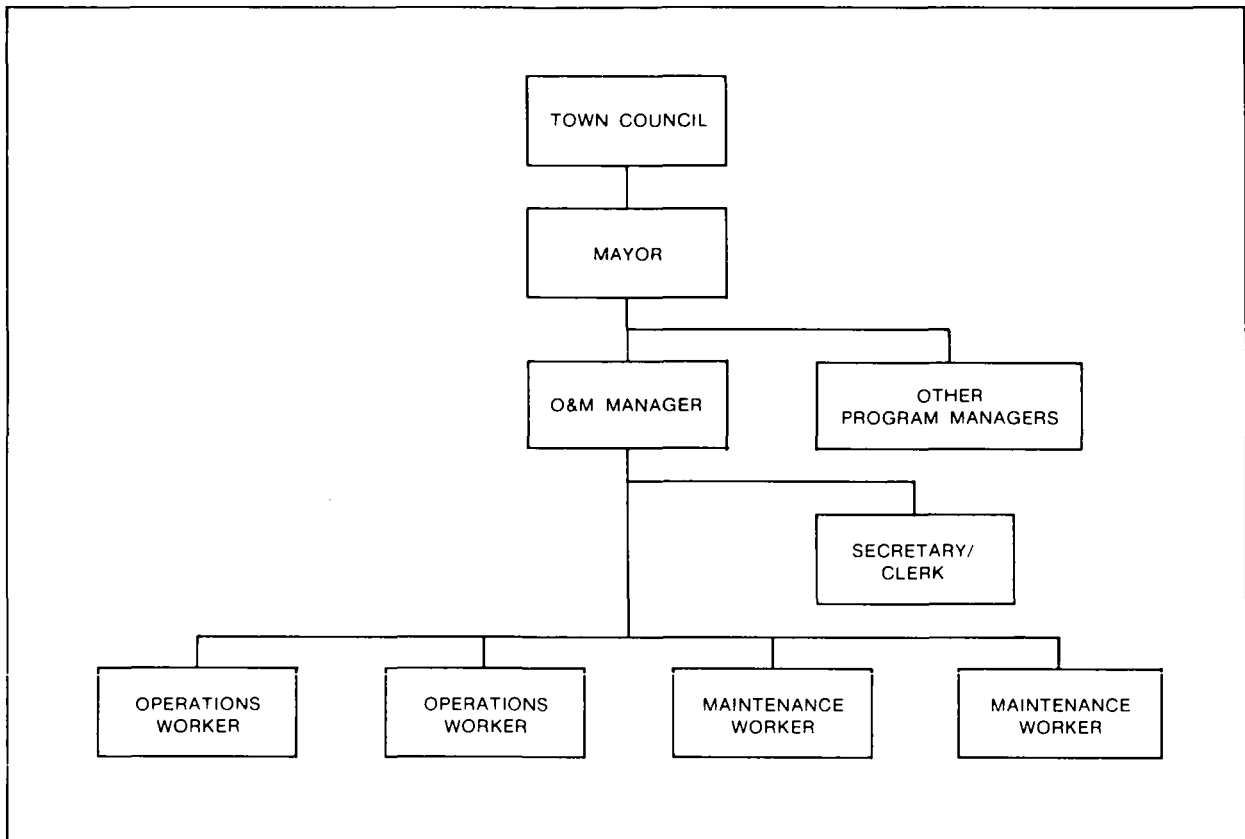


Figure 6 O&M Organization Chart

manual, such as a town-management manual. The manual usually covers the following four areas of information:

1. *The organization's role.* A general description of the organization and its purpose and responsibilities within the community.
2. *Job descriptions.* Descriptions of the duties and responsibilities, working relationships, and working conditions associated with each position in the organization.
3. *An organization chart.* A chart similar to the one shown in Figure 6.
4. *An organization statement.* A description of the way the organization works on a day-to-day basis—a statement that helps explain the organization chart.

*Management audits.* Does the organizational chart contribute to O&M goals? Should the O&M facility be organized in a different way? Is the organization completing the work that is needed to achieve the O&M goals? A management audit—another management tool—can provide some answers to these questions. A management audit evaluates the procedures used in operating and maintaining a community's water facilities. It analyzes the way work is planned, organized, directed, and controlled. As a general rule, management audits are designed to discover better ways of performing and managing work.

The person who performs the management audit will inspect work procedures, job descriptions, and management practices. He will also analyze the way the O&M organization is structured and look for ways to improve it. Based on the results of the audit, he will usually recommend certain changes—changes that can improve performance and reduce costs.

## Directing Work

Directing work involves using O&M schedules, assigning work to people, and supervising the work. An O&M manager spends a great deal of time scheduling, rescheduling, assigning work, and checking the work being done. The methods he uses can help (or hinder) progress toward achieving his goals.

*Using schedules.* Weekly schedules help the O&M manager set priorities and assign work. For example, a manager can use his schedule to review the work completed by operators and maintenance personnel. After reviewing the work completed, the manager can assign new work to each individual. Usually, assigning new work is simple because the manager has used his weekly schedule to plan ahead:

- He has already made decisions about what work is needed.
- He has set work priorities.
- He has decided who should do which jobs.

Schedules are subject to change, however. Nearly every day something happens to interrupt a good O&M weekly schedule. A schedule prepared on Friday may need to be adjusted by the following Monday or Tuesday because unforeseen problems can prevent scheduled work from being completed. For example, a sewer line may clog without warning or a water pump may freeze. Such situations cannot be anticipated in advance. A good manager will recognize the possibility of disruptions and will “work the schedule,” making whatever changes are needed to handle emergency work or changes in work priorities. Generally, a manager can expect to complete 70 to 80 percent of the scheduled work each week. Work that is not completed by the end of the week should be rescheduled for the next week.

*Assigning work.* Do subordinates understand instructions? Do they know what is to be done? Answers to these questions depend on how well a manager assigns work. Every morning, each employee should be given clear instructions from the O&M manager. Experienced employees usually know what is expected of them. An employee assigned to collect solid wastes usually knows the route, and an employee assigned to take water samples usually knows how to do it. But other work—such as service requests, troubleshooting, and nonroutine maintenance—requires specific, detailed instructions. It is important that the O&M manager clearly specify the work he wants accomplished.

Many O&M managers use a work-order-and-report form to schedule and assign routine work (except for meter reading and solid-waste collection). An O&M work-order-and-report form is shown in Figure 7. As the figure illustrates, such a form summarizes a manager’s instructions. It provides an outline of the work the manager expects to be done.

*Monitoring work.* As a regular part of his job, an O&M manager needs to check on the work to make sure that it is being performed as expected. If the work is being performed as expected, the manager should let the employee know that he is doing a good job. If the work is not being performed the way it should be, the manager should take time to show the employee how the work should be done. The employee may not be sure how to do the job or he may have misunderstood the assignment. In any case, the manager should provide on-the-job assistance to help the employee improve his work. As one O&M manager reported, “If I don’t take time to correct little problems when I’m checking work, the little problems usually come back to me as big problems. It is a whole lot easier to work with little problems.”

*Supervising work.* There are almost as many styles of supervising work as there are supervisors. Some supervisors take a hard-line approach with employees. Others tend to let employees work things out by themselves. Some supervisors use a team approach. Still others try a participative or democratic approach. The best approach depends on at least three factors: the boss, the subordinate, and the situation.



CENTERVILLE Work Order and Report			Order Date: 1/24/- -		
			Report Date:		
Activity/Project: Replace Water Lines			Activity No. 302		
LOCATION: 236 Sunset Ave.					
INSTRUCTIONS: Remove and replace broken					
line in loop #2 just					
south of house					
LABOR			EQUIPMENT		
Name	Hours		Type	ID No.	Hrs
	Reg	O/T			
J. Stevens			Pickup	09	
M. Howard			Dump Truck	18	
A. Stubbs			Backhoe	28	
R. Barrett					
Cost:			Cost:		
MATERIALS					
Description			Unit	Amount	Cost
2 12' sections of #6					
Sealer					
ACCOMPLISHMENT					
QUANTITY: _____ UNIT: _____					

Figure 7 O&M Work-Order-and-Report Form

*The boss.* Every manager generally feels comfortable with a certain supervisory style. The style he uses depends mainly on his assumptions about what motivates employees. For example, if a manager thinks that employees are generally lazy, cannot be motivated, cannot act on their own, and need close supervision, he will probably dictate every move his employees make. This style is known as the *hard-line* approach.

On the other hand, many managers treat employees as members of a team. Managers who use a *team approach* generally believe that employees are ready and willing to work and that they can be motivated by building a team spirit. Other supervisory styles may be used, but the important point to remember is that the supervisor's approach tends to be governed by the way a supervisor views his subordinates.

*The subordinate.* The way a subordinate reacts to a certain supervisory style also has an influence on the approach used by the supervisor. Some subordinates have a negative

attitude; others do not like to be part of a team. The subordinate's attitude often affects the supervisor's style. Since no two employees have identical backgrounds, schooling, or interests, an approach that succeeds with one employee may fail with another. As a result, many supervisors have concluded that each employee should be treated as an individual and supervised in ways that help meet his needs. For example, some employees need constant recognition; others need to feel like they are a part of a team.

*The situation.* Different situations require different supervisory styles. For example, an operator standing ankle-deep in water who is about to touch an electrical connection needs to be told in a hard-line approach, "Stop! Don't move!" This situation demands a quick command rather than a team discussion about the forces of electricity.

Normal, day-to-day situations also call for different supervisory styles. An operator who is late for work only once in a while should not be treated (or supervised) in the same way as a person who is late on a regular basis. An employee who usually works alone needs to be supervised differently than someone who is usually part of a maintenance crew.

*Effective supervision.* The boss, the subordinate, and the situation all influence the methods a manager uses to supervise employees. As a general guide, effective supervisors usually observe four principles:

1. They treat employees as individuals. They recognize that each employee has different needs and will be motivated by different things.
2. They use several different supervisory styles, depending on the situation and the employees being supervised.
3. They take advantage of the fact that people like to be recognized for what they do. A subordinate who does a good job needs to be told that he is doing a good job. An employee who is lazy needs to be disciplined.
4. They use management tools, such as annual work programs and schedules, to keep lines of communication with subordinates open.

## Controlling Work

Work control completes the management process—the cycle of management actions that includes planning, organizing, and directing work. Work control keeps activities headed in the right direction—toward achieving the goals of the O&M organization. There are several methods of controlling work: policies, budgets, and management procedures.

*Control through policies.* Policies provide the guidelines for setting O&M goals. Policies also control (or limit) management actions. For example, a policy that states, "No overtime work is permitted except in a dire emergency," limits a manager's use of his staff. Except in dire emergencies, he cannot ask his subordinates to work overtime. A policy that states, "All vehicle repairs must be performed by local dealers" limits a manager's use of his own staff, even if someone on the staff is qualified to do the work. Both of these policies are *Do Not* policies. Other policies require action, such as, "The O&M organization shall maintain the community's facilities." These policies are *Do* policies. Both kinds of policies establish a framework within which a manager must perform his duties.

*Budget controls.* Budgets place obvious controls on an O&M organization. A given budget will usually allow only a certain number of staff people to be hired and will limit the amount of money that can be spent for equipment, materials, and tools. From a manager's point of view, a budget limits the number of ways he can operate and maintain his facilities and equipment; the budget controls his actions as a manager. To use a budget effectively, a manager must make the best use of the money available. He may not have all of the money he needs, but a good manager can usually find ways to get the most mileage out of each dollar.

*Control through procedures.* The process of using certain procedures to control work involves four basic steps:

1. Determining the results of work
2. Determining the difference between planned results and actual results
3. Evaluating the differences between planned results and actual results
4. Taking corrective action.

*Determining results.* A manager can determine the results of work by using a *performance summary*, which compares planned work performance against actual work performance. A manager records workmanship, the amount of work completed, and the productivity of a certain kind of work on his performance summary. These performance records will provide most of the information a manager will need to measure his progress toward achieving O&M goals. For example, if a manager sets a goal of having his staff read 1440 meters in one year, he can keep track of the progress being made toward accomplishing that goal by referring to his performance summary. A performance summary for Centerville is shown in Figure 8. On this summary, the manager has recorded planned and actual work quantities, man-hours, and productivity for several kinds of work.

*Determining the differences between planned results and actual results.* A performance summary allows the manager to review his progress toward achieving O&M goals. For example, the performance summary in Figure 8 shows that the manager planned to have someone read 1440 meters during the year. As the report shows, 50 percent of the meter reading has been completed in the first six months of the year. Work on this activity is proceeding just about as planned.

CENTERVILLE										
O&M PERFORMANCE SUMMARY										
for <u>January 1, 19</u> through <u>June 30, 19</u>										
Activity	Work Unit	Work Quantity			Man-Hours			Productivity		
		Planned	Actual	%	Planned	Actual	%	Planned	Actual	%
101 - Meter Reading	meters	1,440	720	50	192	100	52	7.5	7.2	96
102 - System Operations Work	man-hours				960	482	50			
103 - Solid-Waste Collection	stops	15,600	9,670	62	1,664	756	45	9.3	12.8	138
104 - Other Operations	man-hours				480	201	42			
201 - Vehicle Service & PM	man-hours				260	62	23			
202 - Equipment Service & PM	man-hours				880	620	70			
203 - Septic-Tank Pumping	tanks	500	205	41	672	312	46	0.7	0.7	100
301 - Service Requests	requests	600	525	88	1,600	750	47	0.3	0.7	233
302 - Replace W/WW Line	lin. ft.	900	520	58	360	200	56	2.5	2.6	104
303 - Routine Corrective Maintenance	man-hours				600	462	77			
401 - Miscellaneous Maintenance	man-hours				528	222	42			
402 - Administrative/Supervisory Time	man-hours				4,400	2,100	48			
TOTAL MAN-HOURS.....					12,596	6,267	50%			

Figure 8 O&M Performance Summary

However, there are differences between planned work results and actual work results for other kinds of work. For example, someone planned to average 9.3 stops per man-hour on solid-waste collection (shown as activity 103). Actual productivity, however, is nearly 13 stops per man-hour.

*Evaluating the differences between planned results and actual results.* Differences between planned work results and actual work results usually create questions that need to be answered. For example, if the crew picking up solid wastes is more productive than planned—if it is using fewer man-hours to get work done than was planned—how will this affect the staff's progress toward achieving O&M goals?

Notice the planned and actual man-hours used for equipment service and preventive maintenance (PM) in activity 202. Half of the year is past, but 70 percent of the planned man-hours have already been spent on this work. How will this affect the man-hours needed to reach other goals? What caused the difference between the planned man-hours used and the actual man-hours used? These are the kinds of questions that a manager needs to answer to improve the performance of his staff.

*Taking corrective action.* As soon as a manager knows why differences occurred between planned work results and actual work results, he should take corrective action. A variety of corrective actions may be needed—from helping employees improve performance to making minor changes in the annual work program. The important point to remember is that effective managers take some kind of action to help the O&M staff achieve its goals and improve the overall performance of the organization.

## O&M MANUALS

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How is a particular water or wastewater system supposed to work? How should it be maintained? What should be checked on a pressure pump that fails? A good O&M manual provides the technical information a manager needs to know to operate and maintain his system. O&M manuals are designed to serve two purposes: (1) they help a new operator learn how to operate a certain system; (2) they help an experienced operator or maintenance worker troubleshoot problems or repair various parts of a system.

In a small O&M organization, most employees expect the manager to know how things work and how to keep them working. They look to the manager as a technical expert and as "the man who has all the answers." Since most employees will ask the manager for help instead of reading a manual, the manager needs to be able to provide good instruction and correct answers to employees' questions. O&M manuals can supply managers with correct and thorough information.

### Contents of O&M Manuals

Each O&M manual covers one specific type of water treatment system. It provides a description of the particular system and includes procedures for operating and maintaining the system. A table of contents for a typical O&M manual should include the following items:

- Introduction
- Description of System
- System Operation
- Troubleshooting
- Lubrication and Maintenance
- Repairs
- Appendices

*Introduction.* The introduction in an O&M manual tells the reader how to use the manual and where to find certain information. It also provides a description of the water treatment system and specifies who is responsible for performing various tasks.

*Description of System.* This section of the O&M manual provides a detailed description of the water treatment system, listing the types, sizes, and purposes of each of the components of the system. Diagrams, maps, and charts are included in this section to show the location of major components of the system, such as water mains, pumphouses, and storage tanks. Photos, such as the ones shown in Figure 9, are sometimes included to help the reader identify system components.

*System Operation.* This section outlines the work that needs to be done to run the system. Step-by-step operating instructions describe the work procedures to follow, such as "Turn on well pump located at 17th and Main Street." In addition, a schedule of tasks for work that needs to be done is included in this section. Figure 10 shows a task schedule that might be included in the System Operation section of an O&M manual. Also included in the System Operation section are instructions for using operation logs or checklists.



Figure 9 Photographs in O&M Manuals Help Identify System Components

*Troubleshooting.* One section of the manual is usually set aside for troubleshooting—finding out what went wrong and how to correct the problem. As a general rule, this section contains a listing of possible problems and solutions. Part of an O&M troubleshooting chart is shown in Figure 11. Manufacturers' manuals also contain troubleshooting charts that employees and managers can insert into this section of the O&M manual for future reference.

O&M TASK SCHEDULE	
<u>TASK</u>	<u>SCHEDULE</u>
Fill chlorine tanks	Every two weeks
Add fluoride	Once every two months
Add air to pressure tanks	About once a week
Complete O&M checklist	Every day
Check electrical use	Every day
Use alternate pumps	Every week

Figure 10 Task Schedule From an O&M Manual

O&M TROUBLESHOOTING CHART		
<u>Alarm</u>	<u>Possible Problem</u>	<u>Try This</u>
R-6 Alarm: Storage Tank at Low Level	1. Float switch inside storage tank not working	1. Go into the storage tank through the manhole in the top of the tank. Check for anything that might block the switch. Leave the tank, move the switch up and down, and listen to see whether the tank starts to fill.
	2. Well pump not working	2. First, check the circuit breaker. Then: (a) press the reset on the pump starter, and (b) check the voltage across pump wires. Call an electrician if there is no voltage. If the problem is a clog, call a service company for help in removing and repairing the well pump.
R-7 Alarm: Circulating Loop Not Flowing	1. Circulating pump off	1. First, get circulation back by switching on the other circulation pump. Then: (a) check circuit breakers and the pump-starter reset, and (b) see "Troubleshooting the Centrifugal Pump" (page 72).
	2. Valve closed	2. Check the valve chart (in the Appendix) for the operating positions of the valves.
	3. Flow switch shows no flow when there is flow	3. Replace or repair the flow switch

Figure 11 Part of an O&M Troubleshooting Chart

*Lubrication and Maintenance.* As the title suggests, this section of the O&M manual provides information on what, when, and how to lubricate equipment. Instructions in this section are usually provided by checklists that describe the point or part to be lubricated, the type of lubricant to be used, and how often the point or part should be lubricated. This section also provides information regarding preventive-maintenance checks and inspections, including guidelines on what problems to look for and how to inspect and test components of the system.

*Repairs.* This section of the manual usually includes two things: (1) detailed instructions on how to repair or replace items that tend to break down regularly, such as meters and pumps; and (2) a reference list telling readers where to find information on how to repair or replace items that wear out or break down only once in a while, such as motors, tanks, and electrical parts.

*Appendices.* Important operation and maintenance information not found in the main part of an O&M manual is usually contained in appendices in the back of the manual. The following is a list of the kind of information included in the appendices of O&M manuals.

- *Work Safety Guidelines:* Descriptions of hazards or dangerous conditions, with appropriate safety guidelines to follow and medical treatments to use for certain kinds of accidents.
- *Glossary:* A list of terms and definitions frequently used in O&M work.
- *Sample Work Records:* Samples of various work records and forms frequently used in O&M work.
- *Suppliers:* A list of local dealers who supply parts for equipment and other necessary supplies.
- *Chemicals:* Technical descriptions of the chemicals used in water treatment systems.
- *References:* A list of other publications containing information on O&M procedures.

O&M manuals provide technical information in simple terms. The information is illustrated with diagrams, charts, and photos. As such, an O&M manual is usually a manager's best source of information on the technical aspects of his job. It belongs on his desk, not in a bookcase down the hall.

## OFFICE OPERATIONS

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Small-to-medium-size O&M organizations usually need only one or two people in the office—one to answer the phone, handle correspondence and records, type letters, and so on; and maybe a part-time administrative assistant or bookkeeper. As a result, office operations do not pose major problems. Most of the time, things seem to run smoothly. Most of the problems are in the field, not in the office.

As the O&M organization grows and business becomes more complex, however, an O&M manager may find himself confined to his desk, becoming involved in more and more administrative details. Some of the details are important, but many experts say that at least half of the paperwork and routine procedures usually can be handled by an assistant or a clerk. This section describes several ways managers can avoid being confined to a desk handling mounds of administrative work.

### Paperwork and Procedures

As business activities increase, many managers become so involved in paperwork and office procedures that they do not have time to manage field work. The increased

paperwork and procedures stem from problems associated with delegating work, adopting new work habits, and using time efficiently.

*Delegating work.* Most managers will admit that it has been a long time since they closely compared the work office personnel are doing today with the work they did two or three years ago. More than likely, staff personnel are still doing about the same work they did when they were hired, but the manager is doing more paperwork than he did before. This situation creates problems for the O&M manager because he needs to be spending most of his time managing field work. The manager should delegate to staff personnel all of the paperwork they are qualified to handle, such as accounting forms and contract papers. This practice will relieve the manager of office work and allow him to devote more time and energy to managing field operations and maintenance.

*Adopting new work habits.* Many O&M organizations grow in size and complexity as new services and procedures are added. During this process, office procedures also tend to grow in complexity—automated bookkeeping systems replace manual procedures, communication systems are improved, and work reports and performance summaries are adopted. Rather than adapting to new services and procedures, however, employees sometimes cling to outdated work habits. For example, a clerk may not trust a new bookkeeping system, so he will keep a second, outdated set of books on hand (even though the new system is more accurate than the old system). In addition, some managers forget that their two-way radios offer a more convenient means of locating an employee than the telephone. Outdated work habits increase workloads, escalate costs, and reduce efficiency. O&M managers should encourage staff personnel to adopt new work habits to streamline work loads, diminish costs, and improve efficiency.

*Using time efficiently.* Recent studies indicate that office staffs—from managers and assistants through secretaries and clerks—do not make good use of all the time that is available. Frequently, staff members spend too much time doing unproductive work. Some examples of unproductive work that occupy staff time are as follows:

- *Meetings.* Some meetings are essential. Others, especially informal get-togethers without an agenda, frequently waste time.
- *Handling paperwork more than once.* Some people handle the same paperwork six or seven times. They will use a “hold” box for work to be completed and will sort through the box several times a week, without completing the work.
- *Creating work.* Frequently, a clerk or secretary will create work by taking far more time than needed to complete a task or by reworking something already done.
- *Interruptions.* Lengthy telephone calls, people who stick their heads in doorways “just for a minute,” and salesmen who drop by without an appointment frequently waste staff members’ time.

O&M managers who find themselves spending more and more time behind a desk should begin looking for ways to delegate work, improve work habits, and make better use of time. In delegating work, an O&M manager needs to ask himself several questions: (1) Is there someone on the office staff who could do some of the things I am doing? (2) Can a certain form be completed by a clerk? (3) Can I get someone else to handle a routine service request? If the answer to these questions is yes, the manager should be delegating some of his work.

The manager should also look for ways to eliminate time-wasters and duplicated efforts. Is the bookkeeper still keeping a duplicate set of books? Did the last meeting or the last interruption waste time? If so, it is the manager’s responsibility to do something about those situations that are unproductive.

The management process can also help improve staff members’ use of time. For example, the manager should set goals for office work just as he does for O&M work. Office goals should set standards for work quality and work performance. Progress



toward the office goals should be measured informally and should not involve more paperwork. As with O&M work, it is up to the manager to plan, organize, direct, and control office work.

### Controlling Work Forms

Work forms usually help a manager direct the activities of the O&M organization. They standardize the way some decisions are made and simplify routine administrative procedures. As an O&M organization takes on greater responsibilities and as the staff becomes larger, however, some work forms tend to increase the amount of work to be done. In many cases, the work form (or the information on the form) is essential, but the form is complicated and difficult to fill out.

Controlling work forms is essential for streamlining office procedures. Several techniques are used to help control the use of work forms. For example, some managers review all work forms once a year. They look for information that duplicates or overlaps information from other forms. Some managers look for ways to combine the information requested on two or more forms.

## COMMUNITY RELATIONS

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Just about everything an O&M manager does has an effect on how the community views him and the services his organization provides. If he argues with an irate citizen, word can get around that the manager “argues all of the time.” If a pressure pump fails and water is not available for a day, the manager “does not know what he is doing.”

Most O&M managers agree that it is easy to get a bad reputation but very hard to build a good reputation. Part of the problem is that many people in the community do not notice most of the O&M work being done. The employee who worked half the night replacing a pump gets no public thanks for his effort because nearly everyone was asleep. The work an employee did at the lagoon on a hot summer day goes unnoticed because no one was there to see the results of his hard work. It is not enough for an O&M staff to do a good job. The staff has to let the community know it is doing a good job. The staff has to work hard at community relations.

### Building a Good Reputation

Community relations is the process of building a good reputation—letting people know about the work being done and the goals being reached. Good community relations start with good O&M work and good management. The process then expands to good relations with town officials and members of the community. It is nearly impossible to build a good reputation if members of the community see sloppy workmanship, poor performance, or poor service. No amount of public relations work will overcome a poor image if the water service fails every other week, if garbage is not picked up on time, or if a trench is left open for days, without good reason.

Good public relations depend, first of all, on doing work in ways that seem reasonable to the public. This puts an O&M manager on the spot. The manager is responsible for setting up a preventive-maintenance program that will prevent water-service interruptions, scheduling solid-waste collection so that garbage is picked up on time, and waiting until he has the new water pipe needed to service new homes before digging a trench. To handle his responsibilities, the O&M manager must rely on the people who work for him. O&M staff members should know what work is to be done, when it should be done, and how to do it. The staff then needs to do the work in ways that are acceptable to members of the community.

From the management side, good public relations start with the O&M manager and the way he works through staff members to achieve his goals. The employee side involves

a variety of actions that can impress or upset members of the community. An employee who is reading meters, for example, can make a favorable or negative impression on residents by his actions. These positive or negative community impressions can be influenced by the O&M manager. As "the boss," the manager can influence his subordinates' attitudes and actions. By using the management process, certain management tools, and effective supervisory techniques, the manager can encourage good employee performance, which will build good community relations. The first place an O&M manager should build a good reputation is inside the O&M organization. This good reputation will extend into the community.

*Keeping town officials informed.* Most town officials handle a variety of community responsibilities. One of their responsibilities is to oversee water, wastewater, and solid-waste collection. As a general rule, town officials become sincerely concerned about the O&M organization's activities only when residents demand it or when something goes wrong. When things are proceeding smoothly, town officials tend to ignore the good work being done by the O&M staff. Therefore, the second place to build a good reputation is with town officials—the mayor, town council members, and others who hold important positions. Most of this type of community-relations work consists of (1) being aware of O&M activities and (2) keeping officials informed of the work being done by the O&M staff.

To fulfill these goals, the O&M manager should recognize the town officials' point of view. For example, suppose that an O&M organization's septic-tank truck has been inoperable for two weeks, and the substitute septic service has failed to meet all of the community's needs. A town council member learns from the gas station owner that the station's septic tank has been overflowing for a week and that the owner has twice asked the O&M staff to take care of the problem. This situation puts both the council member and the O&M manager in an uncomfortable position. The council member will want to know why he has not heard of the problem before being confronted with it by the gas station owner, who expects him to know about such problems.

To avoid this situation, the O&M manager should inform the council members at the town council meeting that the O&M staff's septic-tank truck has been inoperable for two weeks and that the company the manager hired as a substitute service accidentally missed the gas station on its route. Town council members may still blame the O&M manager for allowing problems to occur, but at least they did not hear the information from a third party. From a community-relations point of view, council members gain the impression that the manager is aware of the activities and problems of the O&M organization and has kept them informed.

At every town council meeting, an O&M manager has an opportunity to build a good reputation with town officials. For example, if officials know that the O&M manager sets specific goals, plans and schedules work, and checks on work being done, they are likely to be impressed. An annual report to the town council is an opportunity for the O&M manager to build good will and gain council support for his program.

*Meeting the public.* This is the real test of an O&M manager's community relations effort. The manager influences public opinion by what he says and does. For example, suppose that the manager of a small O&M organization hears the following comments:

- *Resident:* "You must know what you are doing. You found the leak right away."
- *Town official:* "I appreciate your cooperation with council policies."
- *Newspaper story:* "Once again, (the O&M manager) tried to resolve the problem with the equipment manufacturer. He is looking out for the community's interest."

Comments such as these may be offset by negative comments from several irate residents. Nonetheless, the fact that something positive has been said about the O&M manager shows that he is headed in the right direction. He is working to build a good public image for the O&M organization.

*Keeping the community informed.* Part of building a good public image involves keeping the community informed as to what is going on. When will the new lift station be completed? What happened to the plans to extend the water line to Route 126? What is the problem with the water pressure lately? The O&M manager needs to provide answers to questions such as these.

Many O&M managers become so involved in day-to-day operations that they tend to forget that the community has a real interest in extending the water line to Route 126 or in solving the problem with the water pressure. Some O&M managers forget that they are in business to provide a valuable and necessary community service. This situation can be changed when the O&M manager becomes aware of the things that residents may need or want to know. Plans to tear up a major intersection or replace a bad section of water main are examples of the kind of information that needs to be announced to the media—television, radio, newspapers:

“The maintenance manager of the Centerville water utility announced today that his staff will begin replacing the water line across Main Street, beginning next Tuesday. This project, an important part of the O&M program, should be completed by Friday noon. An alternate route around the work will be posted tomorrow. . . .”

An announcement such as this, given to the media or posted on community bulletin boards, keeps citizens informed. Another means of informing the community of O&M work is a simple “fact sheet.” Such a sheet can help inform residents of the specific tasks being performed by the O&M staff. The fact sheet might include basic information, such as the size of the water system, the number of gallons of water used per year, and the number of storage tanks, pumps, and other items that help provide water service to the community.

*Interviews.* Frequently, the O&M manager will be interviewed by the media. During the interview, the O&M manager should be sure to know all of the facts before commenting on a certain subject. As a general rule, the manager should prepare for the interview, if at all possible, and provide honest, direct answers. A good O&M manager will think in advance about the toughest questions the media representative might ask and will decide ahead of time how to respond to difficult questions.

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# PERSONNEL ADMINISTRATION

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# 2

Personnel administration is the “people side” of the management process. It has an impact on nearly everything an O&M manager does or wants to do. The manager himself is influenced every day by personnel policies and practices. Most town governments have established personnel departments to handle the problems associated with personnel actions. This chapter describes the work of a personnel department and an O&M manager's role in effective personnel administration.

Effective personnel administration starts with reasonable policies and effective supervisory skills. It includes a variety of activities designed to make sure that people at work are treated fairly and are provided with the knowledge, skills, and opportunities required to satisfy the needs of both the O&M organization and each employee.

Personnel administration activities may be classified into four categories: (1) *describing and classifying work* by developing job descriptions, establishing qualifications and goals for each position, and developing wage and salary structures; (2) *recruiting and selecting employees* by evaluating and hiring people based on certain qualifications; (3) *training employees* by providing the instruction that is needed to help employees perform their work well; (4) *evaluating employees* by making decisions about how well employees are doing their jobs.

Upon completing this chapter you should be able to:

- Prepare a good job description for the position you now hold.
- Describe three important aspects of recruiting and selecting employees.
- Describe typical training needs and sources.
- Describe the employee-evaluation process.

## PERSONNEL POLICIES

Personnel policies provide many of the guidelines a manager needs to supervise employees. They are the basic rules that govern the way people are treated at work. Nearly all O&M organizations have personnel policies that cover routine activities. Hiring a new employee, for example, is considered a fairly routine procedure, so hiring policies are established to govern who can be hired and how. Paying employees is also a routine activity, so payroll policies are established to cover when and how much each employee is paid. Policies such as these provide standard decisions—uniform and consistent answers to personnel-related questions. A hiring policy that states, “People will be employed without regard to race, sex, age, or national origin,” provides a standard hiring decision. A payroll policy that states, “Friday is pay day,” provides a standard payroll decision.

### Personnel Policy Topics

Personnel policies cover a wide variety of topics. Large O&M organizations may have dozens of specific policies; small organizations may have only a few to govern day-to-day personnel activities. Figure 1 provides a list of typical personnel policy topics. As shown in this figure, policies in a small O&M organization need to cover many aspects of personnel management—from selecting and paying employees to dismissing them. Good personnel policies usually cover three items: (1) terms of employment—working hours, salary ranges, and so on; (2) personnel actions, such as selecting, hiring, and promoting employees; (3) employee training.

Many times specific details of a written policy are covered by unwritten policies. For example, an O&M organization’s written policy may state, “Work hours are from 8 a.m. to 5 p.m.” However, the O&M manager may supplement the written policy by saying to his staff, “We work from 8 a.m. to 5 p.m. and any other time of the day necessary to keep the system running.” The expanded policy may not be in writing, but it serves as one of the O&M organization’s policies, nonetheless.

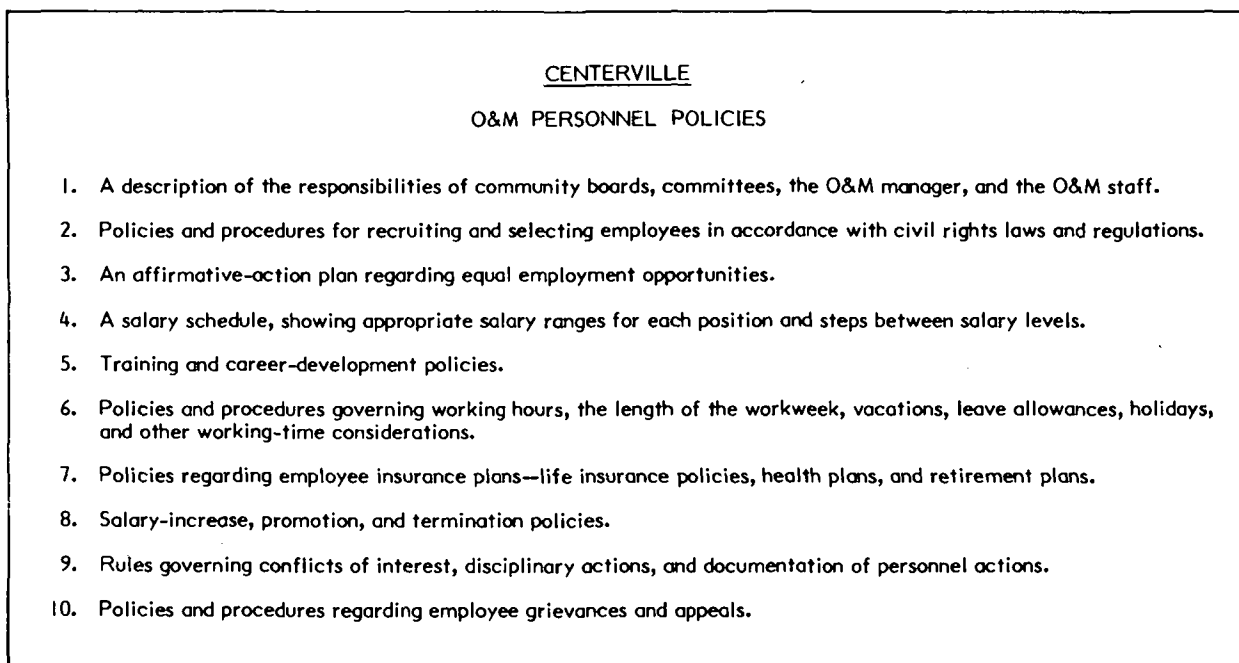


Figure 1 Typical Topics Included in O&M Personnel Policies

## Developing and Using Personnel Policies

An O&M personnel policy is shown in Figure 2. Like most personnel policies, it lists specific details about the O&M organization's basic rules, it leaves room for interpretation, and it remains fairly constant (that is, it can be used for months or years without change).

*Specific details.* A good personnel policy describes the O&M organization's basic rules regarding starting salaries and salary increases. Some policies are even more specific than the policy shown in Figure 2 and cover fringe benefits and employee grievances.

*Room for interpretation.* The personnel policy shown in Figure 2 mentions that merit increases can be granted for an increase in job responsibilities, but it allows a manager to define the increased responsibilities and to decide upon the amount of merit increase that may be appropriate. This kind of flexibility is typical of most personnel policies.

*Long-term usage.* Although personnel policies are usually reviewed once or twice each year, they usually remain about the same year after year. As such, they can be used for months or years.

A personnel policy, such as the one shown in Figure 2, is usually developed by an administrative staff—a personnel department, an administrative office, or a personnel specialist. It is approved by the town's mayor or by town council members, and all employees are expected to abide by it. Personnel policies should be enforced by the O&M manager. The responsibility for developing and using personnel policies rests with the administrative staff and the O&M manager. The administrative staff is usually

<u>CENTERVILLE</u>	
O&M PERSONNEL POLICY	
1. <u>Salaries and Wages.</u> Employees shall be paid at a rate no lower than the federal minimum wage. Subject to this minimum wage, the salary for each position shall be in accordance with prevailing local practices for comparable positions in local, public and/or private agencies.	
2. <u>Salary Increases.</u> The O&M manager may grant periodic (step) increases in accordance with the prevailing practice in comparable local public and/or private agencies. Salary progression shall be based on merit, availability of funds, and job performance, with inflation factors taken into account.	
3. <u>Merit Increases.</u> These increases shall be granted based on three factors:	
a. Successful completion of job-related training, college courses, or special workshops as approved by the administrative staff	
b. Increase in job responsibilities and duties without a change of position or promotion	
c. Supervision of additional employees.	
4. <u>Compensating New Employees.</u> Any starting salary over \$6,000 which involves an increase of more than 20 percent or \$2,500 (whichever is smaller) over an individual's previous salary shall be approved by the town council.	
5. <u>Promotions or Job Change.</u> A promotion of an employee or a change in his title or position which involves a salary increase of more than 20 percent of present salary or \$2,500 (whichever is smaller within a single twelve-month period) shall be approved by the town council.	
6. <u>Basis for Salaries.</u> Salary ranges shall be established for each position and shall be based on a salary and classification plan prepared by the personnel department and approved by the town council.	
<u>Stuart Ball</u> Centerville Mayor	<u>February 3, 1981</u> Date

Figure 2 O&M Personnel Policy

responsible for putting onto paper the policies a town council wants to use. The O&M manager usually helps revise policies as needed and is responsible for making sure that policies are followed.

Sometimes, personnel policies create problems. For example, if a personnel policy states that "equal work will be granted equal pay," an O&M manager may have to determine what is meant by "equal work." One employee who is paid \$5.00 per hour may feel that he is doing the same work as another employee who is paid \$5.50 per hour. Are both employees really doing "equal work?" Are they being treated fairly? Once the manager has made these decisions, he faces the difficult task of explaining the policy (and his decisions) to both employees. If there are real differences between the two jobs, he must describe the differences to both subordinates in detail.

## DESCRIBING AND CLASSIFYING WORK ---

Operation and maintenance work involves a wide variety of activities, and hiring and training employees should be based on these activities. In addition, the work to be performed needs to be described and classified. What work has to be done? Who should do it? How should the O&M staff be organized to do it? The process of describing and classifying work provides answers to questions such as these.

### Describing O&M Work

As soon as the town council decides that someone should be hired to operate and maintain its water and wastewater systems, it must answer a number of questions. What do we want the people we hire to do? What should they be paid? What qualifications are needed? How do we want them to do the work? Who will supervise their work? To answer these questions, the town council should prepare a job description (sometimes called a job specification) for the positions in the O&M organization.

*Job descriptions.* A job description simply describes the duties, responsibilities, working relationships, and working conditions associated with a certain kind of work. Job descriptions are used to: (1) describe to an employee the work associated with a certain position; (2) assist in finding qualified people to do the work; (3) help determine the rate of pay for each position; and (4) help organize the work.

The number of jobs that need to be described depends mainly on the size and age of the water system being operated and maintained. A small water system that is only a few months old may require only one person and one job description. Nonetheless, the job description should spell out the work that needs to be done to operate and maintain the town's water system. In a small water system, the person in charge of the system must be a jack-of-all-trades; that is, he must do almost everything that needs to be done. If the water system expands, however, two or three people will be needed to do the work. Each person on this staff becomes responsible for part of the work formerly done by the jack-of-all-trades. Two or three job descriptions may be needed to define who performs specific work. One person may be named the supervisor/operator and another may be the maintenance worker. The duties, responsibilities, working relationships, and working conditions associated with each position are spelled out in detail in each job description.

*Typical job descriptions.* Most small-to-medium-size O&M organizations (four to ten employees) find that only a few job descriptions are needed. For example, the work of an O&M staff of five employees may be documented in just three job descriptions: one for the O&M manager, one for an operator, and one for the position of service worker. If a part-time clerk is needed, a separate job description would be prepared to spell out the clerk's duties and responsibilities. One description is needed for each position, regardless of the number of people assigned to that position.

Figures 3 and 4 show typical job descriptions. Notice that each job description has four

<p><u>CENTERVILLE</u></p> <p>POSITION TITLE: O&amp;M MANAGER</p> <p><u>Purpose of Job</u></p> <p>Supervise and manage the community's water, wastewater, and solid-waste collection systems.</p> <p><u>Job Duties and Responsibilities</u></p> <ol style="list-style-type: none"> <li>1. Develop annual operation-and-maintenance programs and budgets.</li> <li>2. Implement annual operation-and-maintenance programs, using appropriate planning and scheduling techniques.</li> <li>3. Keep accurate records of the kinds and amounts of work performed and the amount of money spent.</li> <li>4. Inform the town council of the status of the operation-and-maintenance program and budget.</li> <li>5. Prepare special reports, as needed, to ensure economical and efficient use of resources.</li> <li>6. Schedule, assign, and monitor work being done.</li> <li>7. Purchase equipment, tools, and supplies needed to carry out operation-and-maintenance programs.</li> <li>8. Provide on-the-job training of subordinates.</li> </ol> <p><u>Working Relationships</u></p> <ol style="list-style-type: none"> <li>1. Report to and serve under the overall supervision of the town council's O&amp;M Committee.</li> <li>2. Supervise staff of 6 to 10 employees.</li> <li>3. Maintain frequent contact with Centerville's residents and nearby utility organizations.</li> <li>4. Work with the administrative officer on matters pertaining to personnel actions, accounting, and budgeting.</li> </ol> <p><u>Working Conditions</u></p> <p>Considerable outside work. May need to work long hours during certain periods.</p>
---

Figure 3 Job Description for O&M Manager

sections: (1) *Purpose of the Job*, which describes why the position is needed; (2) *Job Duties and Responsibilities*, which lists typical tasks performed by the person holding the position; (3) *Working Relationships*, which explains the way the position fits into the organization and how the position relates to other positions on the O&M staff; (4) *Working Conditions*, which describes the conditions under which the individual holding the position is expected to work.

*Preparing job descriptions.* When preparing job descriptions, an O&M manager should work with the town's administrative staff and his own subordinates to establish typical job duties and responsibilities, working relationships, and working conditions. The process of preparing a job description usually involves three steps: analyzing work, summarizing work, and revising job descriptions.

*Analyzing work.* As the first step in preparing a job description, the O&M manager should analyze the work that needs to be done and list the duties and responsibilities associated with the work. For example, suppose that a small O&M staff is being burdened with more and more paperwork. Up to this point, the manager and one of his service workers have handled all of the paperwork, but both agree that a part-time clerk is now needed to help with the job. The O&M manager will not get funding for the part-time clerk, however, without some justification for creating the position. The manager must demonstrate the need for a part-time clerk. He does this by listing all of the clerical duties and responsibilities he and his service worker have been handling. He closely examines the work and lists all of the tasks he thinks should be handled by a part-time clerk.



<p><u>CENTERVILLE</u></p> <p>POSITION TITLE: O&amp;M SERVICE WORKER</p> <p><u>Purpose of Job</u></p> <p>To perform a variety of needed operation-and maintenance activities on the community's water and wastewater systems.</p> <p><u>Job Duties and Responsibilities</u></p> <ol style="list-style-type: none"> <li>1. Perform well and pump repairs, septic-tank pumping, household plumbing repairs, and similar tasks.</li> <li>2. Perform daily inspection and periodic servicing of vehicles and equipment.</li> <li>3. Respond to service requests and emergency work requests as needed.</li> <li>4. Keep track of all vehicles, equipment, and tools.</li> <li>5. Keep accurate records of work performed and submit daily work reports to the O&amp;M manager.</li> </ol> <p><u>Working Relationships</u></p> <ol style="list-style-type: none"> <li>1. Report directly to the O&amp;M manager.</li> <li>2. Coordinate daily schedules and assignments with operators and other service workers.</li> <li>3. Maintain a courteous and responsive attitude toward Centerville's residents.</li> </ol> <p><u>Working Conditions</u></p> <p>Considerable outside work, sometimes under adverse conditions.</p>
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Figure 4 Job Description for O&M Service Worker

*Summarizing work.* As the second step in preparing a job description, the O&M manager should describe in short sentences or phrases the tasks and working relationships associated with the work. When doing this, the O&M manager may find it helpful to work with the town's administrative staff to condense the list into typical duties, responsibilities, and working relationships. With help from the administrative staff, the O&M manager summarizes (in one page or less) the job description into four sections: (1) purpose of the job; (2) job duties and responsibilities; (3) working relationships; (4) working conditions.

*Revising job descriptions.* The completed job description is then reviewed and compared with job descriptions for other positions in the O&M organization. Revisions are made in the other job descriptions to account for any changes created by the new position. For example, if the O&M manager is successful in creating a part-time clerk's position, the clerical work in the manager's job description needs to be eliminated. Most newly created positions will affect other positions.

### Evaluating and Classifying Work

The process of evaluating and classifying work is used to help develop a wage and salary structure for each position. What is the monetary value of an O&M manager or an operator; that is, how much money is each person (or position) worth? Part of the answer to this question depends on the salaries nearby communities are paying. If an O&M manager in a nearby town is being paid \$20 000 per year, it is not likely that Centerville can attract an O&M manager for \$13 000 per year. If both positions require the same skills and the work is about the same, Centerville will probably have to pay about the same salary as the nearby town is paying. It will have to pay the "going rate" in order to compete for qualified O&M staff personnel.

*Job evaluation procedures.* Determining the going rate for each position in an O&M

organization is one way to establish the monetary value of each position. For example, if a nearby town pays \$5.60 per hour for O&M clerks, the monetary value of that position should fall within the \$5.60-per-hour range—the wage may be as low as \$4.85 per hour or as high as \$6.00 per hour, depending on a variety of factors, but the job value should fall within the range of \$5.60 per hour.

The going-rate method is one means of establishing wage and salary values for O&M positions. As a general rule, however, it is used in combination with other techniques of establishing wage and salary values, such as *ranking plans* or *job classification plans*.

*Ranking plan.* When a ranking plan is used to establish wage and salary values for each position in an O&M organization, a job evaluation committee ranks each job in order of increasing value. Committee members first read each job description and determine the relative difficulty of each job, the responsibilities involved, the experience requirements, and other similar factors. Committee members then rank each position from low to high levels of importance. For example, a simple ranking for three positions in an O&M organization using three job factors might be as shown in Figure 5.

The committee ranking these three positions concluded that the position of O&M manager is more difficult, involves more responsibility, but requires less experience than an operator's position. Given this ranking, the manager will be paid a higher salary than the operator. The committee also concluded that the position of operator is more difficult, involves more responsibility, and requires more experience than a clerk's position. Given this ranking, the operator will be paid more than the clerk.

*Job classification plan.* The job classification plan is similar to the ranking plan, with one exception: classes or grades of work are established before each position is assigned a rank. A job classification plan is used to establish various levels of skill and responsibility within a certain class of work. For example, the committee evaluating jobs may decide that a service worker's position is actually three separate and distinct positions. Therefore, the committee will establish three classifications (and job descriptions) for the position of service worker. The classifications for the position of service worker (from low to high levels of importance) might be as shown in Figure 6. After the classifications are established, the evaluation committee reads each job description and ranks each position, using the procedures described for the ranking plan.

<u>CENTERVILLE</u>			
O&M RANKING PLAN			
POSITION	DIFFICULTY OF JOB	RESPONSIBILITY OF JOB	EXPERIENCE REQUIRED
O&M MANAGER	3	3	2
OPERATOR	2	2	3
CLERK	1	1	1

NOTE: 1 = lowest ranking; 3 = highest ranking.

Figure 5 O&M Ranking Plan

<u>CENTERVILLE</u>	
JOB CLASSIFICATION: O&M SERVICE WORKER	
POSITION	JOB DUTIES
SERVICE WORKER I	<ol style="list-style-type: none"> <li>1. Perform routine maintenance and repair work.</li> <li>2. Drive pickup truck.</li> <li>3. Usually work under close supervision.</li> </ol>
SERVICE WORKER II	<ol style="list-style-type: none"> <li>1. Perform a wide variety of routine maintenance and repair work.</li> <li>2. Operate several types of vehicles.</li> <li>3. May or may not be closely supervised.</li> </ol>
SERVICE WORKER III	<ol style="list-style-type: none"> <li>1. Perform a wide variety of maintenance and repair work.</li> <li>2. Operate several types of vehicles.</li> <li>3. Frequently work without supervision.</li> <li>4. Serve as O&amp;M manager in the absence of the regular O&amp;M manager.</li> </ol>

Figure 6 A Sample O&M Job Classification Plan

### Developing Wage and Salary Structures

The ranking plan and the job classification plan provide ways to rate the monetary value of each position in an O&M organization. Both plans are based on job descriptions and the judgments of a job evaluation committee. Once each position in an O&M organization has been assigned a specific rank, each position must be assigned a specific wage or salary range. The wage or salary range for each position is usually based on at least five considerations:

1. The going rate—the wages or salaries being paid for similar work in other communities
2. The amount of money town officials are willing to pay or can afford to pay
3. The need (or lack of need) to establish various classifications for certain positions
4. The level of federal funding expected and federal regulations regarding salary limitations
5. The fact that wage and salary ranges should overlap. (An experienced clerk, for example, may be more valuable than an inexperienced operator.)

*Base monetary values.* The wage and salary range for each position is usually established by setting a base monetary value and then adding or subtracting a certain percentage. For example, the base value for a clerk, considering going rates and other factors, might be \$5.60 per hour. The salary range might be plus or minus 15 percent—from \$4.76 per hour to \$6.44 per hour. As clerks are needed, the person hiring them will usually offer a starting salary somewhere near the base monetary value of the position.

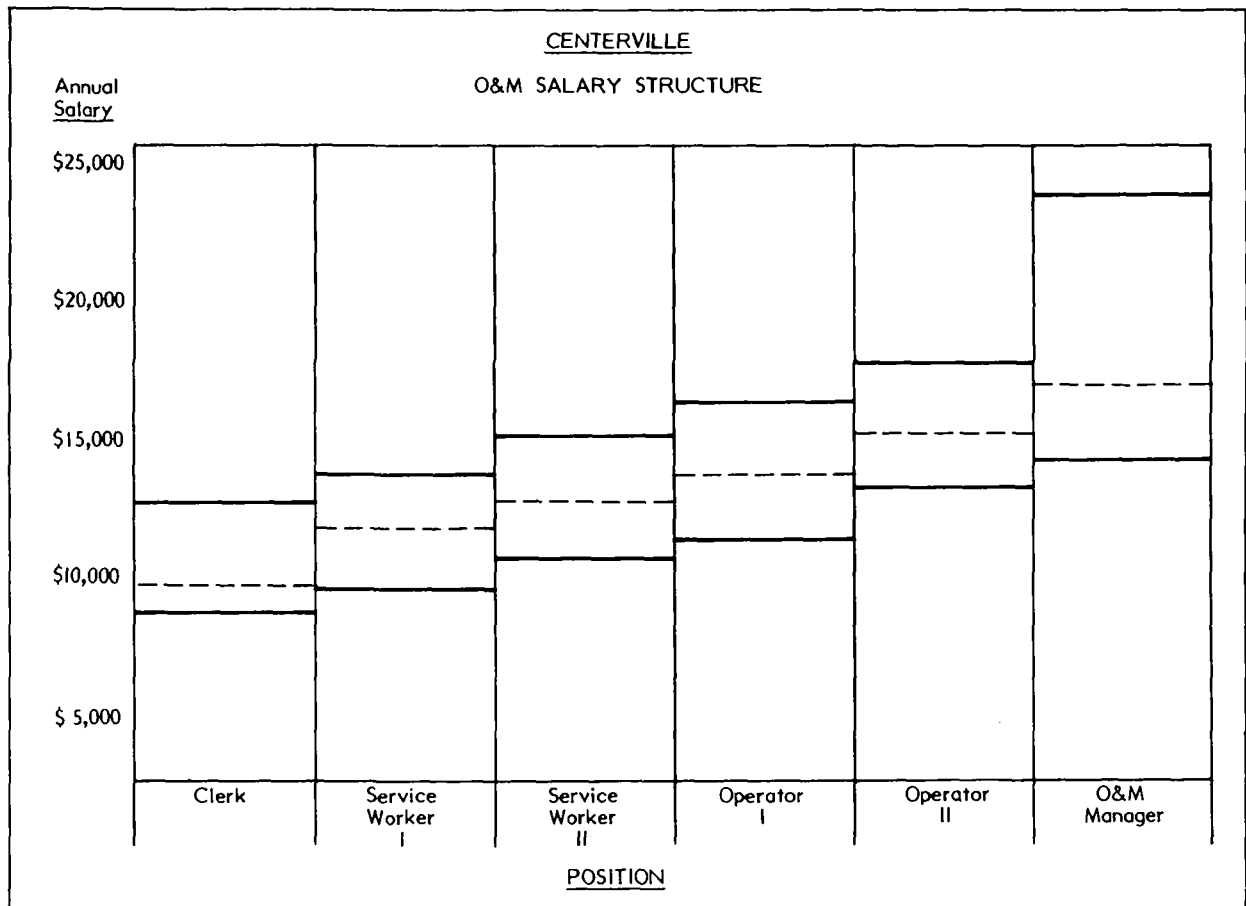


Figure 7 Salary Structure for an O&M Organization

*Salary structures.* The overall salary structure for an O&M organization might resemble the chart in Figure 7. Salary ranges are shown as boxes, and dashes in each box represent a desired or average starting salary. For example, the chart shows that the annual salary for a clerk ranges between \$9,000 and \$13,000, with a desired starting salary of about \$10,000 per year.

*Fringe benefits.* Fringe benefits—such as paid vacations, paid health insurance, and so on—are also considered in establishing a salary structure. Fringe benefits may account for 25 to 40 percent of the total cost of labor, but they are important considerations only when trying to establish a competitive compensation package. Since all employees usually receive the same fringe benefits, the committee establishing base salaries should check to see what benefits other O&M organizations are offering. The committee may adjust the base salary rates to take into account the differences in benefits. For example, if the going rate for a new clerk is about \$10,000 per year and the community offers far more benefits than other communities, the starting salary might be set at \$9,200 per year. The adjustment represents the salary the committee thinks will attract a new employee, considering both salary and fringe benefits.

## RECRUITING AND SELECTING EMPLOYEES

Hiring people is one of the O&M manager's most difficult responsibilities for several reasons: (1) town officials may not be willing to pay the going rate for O&M staff

positions; (2) the O&M work itself may not be very attractive to a large number of people; (3) the manager may not know how to recruit and hire employees. This section provides solutions to many of the problems of recruiting and selecting employees.

### Preliminary work

The process of recruiting and selecting employees involves two kinds of preliminary work: establishing employee specifications and developing an application form.

*Employee specifications.* An employee specification is a statement that describes what kind of person is required to fill a certain position. The employee specification is based on a job description and outlines the necessary qualifications, work experience, and skills. Each employee specification lists specific qualities that the person who fills the position will need to perform the work satisfactorily.

Most employee specifications are based on minimum job requirements. That is, a certain specification will outline necessary qualities that a job applicant must have before he can be considered for the position. An employee specification for Centerville's O&M organization is shown in Figure 8.

*Application forms.* Each applicant for a position in an O&M organization must fill out an application form. Most application forms provide spaces for six kinds of information:

1. *Personal Information.* The applicant's name and the name of a close relative.
2. *Position Desired.* The job title of the position the applicant wants to fill.
3. *Educational Background.* A list of the schools the applicant has attended, diplomas and degrees received, and dates of attendance.
4. *Work Experience.* A list of former employers, with employment dates; a description of the duties and responsibilities of each job; the name, address, and telephone number of the immediate supervisor on each job; and the reason for leaving each job.
5. *References.* A list of two or three people (and their addresses and telephone numbers) other than relatives who have some knowledge of the applicant's qualities.
6. *Other Information.* Information that may be needed for certain positions, such as operator's certificates held or special training received.

<u>CENTERVILLE</u>	
EMPLOYEE SPECIFICATION: O&M MANAGER	
<u>Age:</u>	Not important.
<u>Education:</u>	Must be a high school graduate. Prefer one or two years of college work in engineering, business, or related fields.
<u>Experience:</u>	Must have prior supervisory experience in public-works maintenance, water-utility operations, or solid-waste collection. Planning and budgeting experience is desirable.
<u>Physical Health:</u>	Must be able to pass a required physical examination and operate an automobile.
<u>Special Skills:</u>	Must be able to communicate well with others, especially with residents and subordinates. Good mathematical ability is desirable.
<u>Self-Reliance:</u>	Must be a self-starter. Needs to be able to work without close supervision.

Figure 8 O&M Employee Specification

The application form should help provide a clear picture of the applicant, especially in terms that are related to the employee specification. Questions on an application form that are not important in selecting a person should be eliminated. In fact, the 1964 Civil Rights Act and other laws prohibit questions that may encourage discrimination. For example, unless it is a legal requirement for the job, the application cannot include questions about a person's age or marital status.

### Effective Recruiting

Recruiting is the process of locating qualified job applicants and convincing them that the work will satisfy some of their needs and interests. The recruiting process involves two tasks: (1) informing potential applicants of available jobs; (2) interviewing qualified personnel.

*Informing potential applicants.* The first task in the recruiting process is to advertise job openings. Most O&M organizations prepare a special *position-available* notice to advertise jobs. This notice serves the same purpose as a help-wanted ad in the newspaper—it informs potential applicants of an available position, describes the position and salary range, and includes other facts about the work. Since a position-available notice may be a potential applicant's first experience with the O&M organization, it should be thorough and well written.

Figure 9 shows a poorly prepared position-available notice. Besides making the work seem boring, it says nothing about fringe benefits, the O&M staff's reputation, or the possibilities for advancement, all of which may be very good. Listing duties and responsibilities as "various" fails to provide the applicant with information he will want and need to know. The notice also fails to give information regarding where to apply for the job. A good position-available notice should be attractive and should describe the job in some detail. Figure 10 shows a well prepared position-available notice. It is interesting, well written, and serves as a selling tool that puts emphasis on the positive aspects of the position.

<u>CENTERVILLE</u>	
NOTICE OF O&M POSITION AVAILABLE	
	Date: <u>February 3, 19</u>
JOB TITLE:	Service Worker I
SALARY RANGE:	\$9,300 to \$13,800
REPORTS TO:	O&M Manager
SUPERVISES:	N/A
JOB DESCRIPTION:	Performs miscellaneous maintenance work in water and wastewater facilities, including vehicle servicing, pumphouse maintenance, septic-tank pumping, sewer-line repairs, etc.
DUTIES AND RESPONSIBILITIES:	Various
AUTHORITY	Centerville Official
PERFORMANCE STANDARDS:	N/A
QUALIFICATIONS:	Must have driver's license
APPLICATION DEADLINE:	March 2, 19

Figure 9 A Poorly Prepared O&M Position-Available Notice

<u>CENTERVILLE</u>	
NOTICE OF O&M POSITION AVAILABLE	
	Date: <u>February 3, 19</u>
JOB TITLE: Service Worker I	
SALARY RANGE: \$9,300 to \$13,000	
REPORTS TO: O&M Manager	
SUPERVISES: N/A	
JOB DESCRIPTION:	
Centerville seeks someone who is interested in working with a professional community organization. This person will perform a variety of operations-and-maintenance work in the community's water and wastewater facilities. This is a ground-floor position with good opportunities for advancement. Fringe benefits are very good.	
DUTIES AND RESPONSIBILITIES:	
Direct responsibility for vehicle servicing, pumphouse maintenance, and similar activities.	
AUTHORITY: Centerville Official	
PERFORMANCE STANDARDS: Employee helps O&M manager set goals and monitor progress.	
QUALIFICATIONS: Must have driver's license.	
IF INTERESTED IN THIS JOB, APPLY TO: Suzanne Harbor, Town Personnel Manager, at Centerville City Hall, Room 2B.	
APPLICATION DEADLINE: March 2, 19	

Figure 10 A Well Prepared O&M Position-Available Notice

*Interviewing qualified personnel.* The purpose of an employment interview is to evaluate an applicant's suitability for the available position and to encourage the applicant's interest in the position. The interviewer should give the applicant a thorough, detailed description of the available position and should add any comments he feels will be helpful in convincing the applicant of the benefits of working for the O&M organization. The interview can also encompass information that is difficult to put on paper, such as the positive feelings and attitudes shared by (all or some) employees and the unwritten benefits related to the work.

### Employee Selection

O&M managers sometimes find that selecting a certain person for a job position is easy because there are very few applicants from which to choose; the recruiting effort may have attracted only one or two people who are qualified for the work. Regardless of the number of applicants, however, it is worth the manager's time and effort to carefully screen and interview prospective employees. During the screening process, the O&M manager should find answers to several questions. Which applicants seem to be suited for the work? Which applicants should be considered for employment? Does one applicant appear to be far better suited for the work than other applicants? The screening process usually involves reviewing job applications and conducting employment interviews.

*Reviewing job applications.* A completed application form is usually the first contact an O&M manager has with a potential employee. After a quick review of the job application, the manager should focus on the applicant's (1) qualifications, (2) work history, and (3) references.

*Qualifications.* To be considered for the position, an applicant's qualifications should closely match the requirements stated in the employee specification. If the applicant does not come close to matching the employee specification, he should be sent a courteous letter informing him that the position has been filled.

*Work history.* To determine if an applicant is a likely candidate for the position, an O&M manager should carefully examine the applicant's work history. When reviewing the applicant's work history, an O&M manager should ask himself the following questions.

- Has the applicant done similar kinds of work?
- Does the applicant's "track record" look good? Has he held jobs for fairly long periods of time, or does it appear that the applicant has jumped from one job to another?
- Has all time in the experience (or education) section of the application been accounted for, or are there missing dates where the applicant may have been unemployed for long periods?

*References.* The opinions of previous employers are also important factors in determining an applicant's suitability for a position. A reference form, such as the one shown in Figure 11, can be used as a guide for asking the questions that need to be answered by former employers.

<u>CENTERVILLE</u>	
O&M REFERENCE FORM	
Applicants: _____	Date: _____
Employer Reference Name: _____	
<u>Questions</u>	
1. When was the applicant employed by you?	
From _____ to _____	
2. What position did he hold?	
_____	
3. Was his attendance regular? Yes ____ No ____	
If not regular, what was the reason?	
_____	
4. Was he liked by his co-workers? Yes ____ No ____	
If not liked, why? _____	
5. Would you employ him again in a similar position? Yes ____ No ____	
6. How would you rate him compared with other employees in the same or similar position?	
Excellent ____ Above Average ____ Average ____ Below Average ____	
<u>Comments</u>	
_____	
_____	

Figure 11 A Sample O&M Reference Form



*Conducting an interview.* An employment interview is a necessary part of a successful recruiting effort. An interview provides an opportunity for an O&M manager to assess an applicant's qualifications and sell an applicant on the available position. Usually, an employment interview is a structured discussion between an O&M manager, the applicant, and preferably, someone from the administrative staff. The person from the administrative staff can help conduct the interview and provide a second impression of the applicant. As a general rule, the first five to ten minutes of the interview should center on the O&M organization and the available position. The interviewer should discuss the history of the organization, provide an adequate overview of the organization's services, describe work related to the available position, and explain the salary range and fringe benefits. During this phase of the interview, the applicant should have a chance to evaluate the position and ask questions.

The remainder of the interview should be directed toward learning more about the applicant by talking with him about the information he provided on the application form. The interviewer needs to ask probing questions that will encourage the applicant to provide the information necessary to make a fair assessment of his qualifications. Some typical questions that the applicant should answer during the interview are as follows:

- *Your experience as a backhoe operator sounds like it fits our needs. What training have you had as a backhoe operator?*
- *We noticed on your application that you left the Metropolis City Utility. Why?*
- *What did you like most about working for the public works department?*
- *We noticed that there is a six-month gap in your employment record just after you left the army. What did you do during that time?*
- *Since you are applying for an operator's position, describe what you know about system operations.*

State and federal regulations place limitations on the questions that can be used on application forms or asked during interviews. For example, an O&M manager cannot ask an applicant's age unless it is a legal requirement for the job. It is a good idea to check with the administrative staff on what questions are and are not legal.

*Rating an applicant.* How does the applicant compare with other applicants who have been interviewed? To answer this question, each applicant should be rated after each interview. The rating can be simple, such as excellent, good, fair, or poor for each of the main factors being assessed. For example, the rating for a particular applicant might read as follows:

Experience	—	Good
Education	—	Good
Personal Appearance	—	Excellent
Language	—	Fair
Overall Impression	—	Good

Other factors also need to be considered in rating an applicant. Does the person seem to be motivated? Does the person really want to go to work? Is this the right person for the job? Predicting how well someone is suited for an available position is a difficult task, but employee selection should be given special effort and consideration.

### Taking a Positive Approach

Sometimes, an O&M manager will recruit only a few applicants and must, therefore, hire whomever he can get. Obviously, this is not an ideal situation. Taking a positive approach to recruiting and selecting applicants, however, will usually provide a good

number of applicants, increasing the manager's chances of finding the right person for the job. Three ways to take a positive approach to recruiting are as follows:

1. *Make sure the word gets out.* Start the recruiting and selection process with the thought that someone who meets the job specifications wants the job. Make sure the announcement is seen by everyone who may be interested, especially those who are highly qualified for the position. Have the announcement posted in many places throughout the community.
2. *Take a close look at applications.* Employment applications are good sources of information. Take a close look at each application to determine how well the applicant meets the job specifications. In addition, pay close attention to the applicant's work experience, education, and references.
3. *Take time to conduct a good interview.* An interview provides the best opportunity to assess potential employees. The assessment should be based on a structured discussion with the applicant. Know in advance what questions should be asked during the interview. Prepare a brief outline of the information to be covered—from describing the available position to specific questions that will help evaluate the potential employee.

## EMPLOYEE ORIENTATION AND TRAINING

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When a new employee is hired, he frequently receives haphazard training and little or no orientation because of pressures to get him into productive work quickly or because of ignorance on the part of the O&M manager. Failure to properly and thoroughly train and orient a new employee can be costly. Effective employee orientation and training pays for itself many times over the actual cost of providing the orientation and training.

### Getting Oriented

Employment interviews provide a potential employee with the information he needs to accept or reject a job offer. Orientation sessions should provide all other important, job-related details that will help a new employee make a good start in his new job. Most orientations can be conducted in two or three sessions during the new employee's first week of work. The O&M manager should conduct all of the orientation sessions.

*Orientation sessions.* When an employee starts a new job, he needs to learn a lot of basic information quickly. To acquaint the new employee with his job and the procedures of the O&M organization, the O&M manager should use the orientation sessions to describe the employee's duties and responsibilities, the organization's pay periods and fringe benefits, and the organization's policies regarding personal conduct and public relations. An orientation checklist, such as the one shown in Figure 12, provides an O&M manager with a list of items to cover during the orientation sessions. The checklist not only provides an easy way to keep track of what has been discussed with the new employee, but it also serves as a record that all of the needed topics have been covered.

*Employee handbooks.* Most O&M organizations supplement orientation sessions with an employee handbook. This handbook includes the details covered during verbal orientation sessions and serves as a reference by which employees may learn more about the O&M organization, its services, and the employee's role in the organization.

### Employee Training

Employees who are not properly trained can cost an O&M organization a lot of money. An operator who does not understand how a float switch works will usually ignore the switch. He will not properly check or test its operation, nor will he replace a defective switch before it sticks. The operator's lack of knowledge in this case could cost the

CENTERVILLE  
O&M EMPLOYEE - ORIENTATION CHECKLIST

Name of New Employee \_\_\_\_\_ Date Employed \_\_\_\_\_  
 Position \_\_\_\_\_ O&M Manager \_\_\_\_\_

\*\*\*\*\*

THE FOLLOWING ITEMS ARE TO BE DISCUSSED WITH THE NEW EMPLOYEE. CHECK OFF EACH SUBJECT AFTER IT HAS BEEN COVERED.

<ol style="list-style-type: none"> <li>1. Introduction to co-workers</li> <li>2. Purpose of the Centerville O&amp;M organization</li> <li>3. Role of the Centerville O&amp;M organization</li> <li>4. Position description, especially job duties and responsibilities</li> <li>5. Hours of work</li> <li>6. Lunch and rest periods</li> <li>7. Pay periods</li> <li>8. Performance evaluation</li> <li>9. Career development evaluation</li> <li>10. Employee benefits:                             <ul style="list-style-type: none"> <li>Vacation leave</li> <li>Holidays</li> <li>Sick leave</li> <li>Other leave</li> <li>Insurance</li> </ul> </li> <li>11. Location of restrooms and supplies</li> <li>12. Absenteeism and tardiness</li> </ol>	<ol style="list-style-type: none"> <li>13. Personal Conduct</li> <li>14. Importance of cooperation with others</li> <li>15. O&amp;M manager's availability to answer questions and help with problems</li> </ol>
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SUPPLIES ISSUED TO EMPLOYEE:

1. KEY TO OFFICE OR FACILITY \_\_\_\_\_
2. OTHER (ITEMIZE) \_\_\_\_\_

RECEIPT ACKNOWLEDGED:

Signature of Employee \_\_\_\_\_

Date Received: \_\_\_\_\_

EMPLOYEE ACKNOWLEDGMENT:  
 The items listed above have been discussed with me by the supervisor.  
 \_\_\_\_\_

Figure 12 A Sample O&M Employee-Orientation Checklist

organization hundreds of dollars. A heavy-equipment operator who does not know how to check fluid levels in his vehicle may drive it until the transmission runs dry. Repairs could cost thousands of dollars. An employee who has not been trained to properly lift heavy objects may permanently injure himself.

Good training pays for itself in other ways. For example, a new employee who has not been properly trained to perform a particular task may be afraid to ask for help. He may fumble around, pretending that he knows what he is doing. His ignorance will begin to be a source of frustration, and he will become upset and dissatisfied with his job. As this happens, the O&M manager will begin to think that he has the wrong person in the wrong position. If no training is provided, the situation can become worse; the new employee may quit or be fired. The time and cost of training in this case would have been far less than the time and cost of going through the process of hiring a new employee.

*Determining training needs.* An employee should be trained to do the work outlined in his job description. As such, the job description is a good place to start determining training needs. Any difference between the work required in the job description and the employee's knowledge or skill represents a need for training. For example, if a job

description calls for the employee to maintain water lines, the employee must know the difference between a curb stop and a corporation stop. If the employee does not know the difference between the types of stops, he will need training. Most new employees will not know how to operate and maintain all components of a water system. Some will know many of the tasks, but very few will have the hands-on experience needed to do all the work as required and in a safe manner. Therefore, it is best to assume that a new employee needs some training.

*On-the-job training.* Small-to-medium-size O&M organizations have access to very few training sources or options. On-the-job training provides one method of training new employees. To provide on-the-job training, the O&M manager should assign a new employee to work with someone on the staff who knows what he is doing. The new employee should work side-by-side with an experienced employee until the new employee demonstrates that he has mastered the work and can work on his own.

Successful on-the-job training is based on (1) the knowledge and expertise of the experienced employee, (2) careful management of the training process, and (3) recognition of the new employee's progress.

*The experienced employee's knowledge and expertise.* The experienced employee must know the proper work procedures. He should know the information in the organization's O&M manual and use it to help train the new employee. O&M checklists are especially helpful and should be used even if the experienced employee has memorized the checklists. The experienced employee should also serve as an instructor. He should show the new employee how to perform a certain procedure and then let the new employee do it until he becomes proficient.

*Careful management.* Training should be planned, monitored, and controlled. The O&M manager should check on the progress being made and should observe the new employee doing such work as checking valves, reading meters, and performing other O&M tasks.

*Employee recognition.* The new employee should be recognized for successfully learning to do the work. He should be told that he is doing the work that is expected of him and that he is doing it as it should be done.

*Workshops, short courses, and seminars.* The US Environmental Protection Agency (USEPA) and the American Water Works Association (AWWA) offer a number of workshops, short courses, and seminars in water utility operation and maintenance. These educational programs are designed to help operators pass their certification tests and can be very helpful in improving technical skills. State health departments also offer certification training.

The American Public Works Association (APWA) conducts workshops and short courses in such areas as solid-waste collection, urban drainage, and supervisory skills. In addition, APWA and the Water Pollution Control Federation (WPCF) conduct workshops in wastewater collection and treatment.

To take advantage of workshops, short courses, and seminars, O&M managers should (1) look for announcements of upcoming educational programs in their area, (2) make arrangements for employees to attend certain sessions, and (3) supplement the classroom training by making sure that the new knowledge is put into practice.

*Training experienced employees.* Although experienced employees may believe they know how to do their work well, many times they need training to upgrade their skills or learn procedures for working with new materials and equipment. Workshops, short courses, and seminars can be helpful in several ways for training experienced employees. By attending training programs, experienced employees can keep up with new developments and changes in their industry and sharpen skills that may have become dull through lack of use. In addition, experienced employees can improve their chances for promotion in the O&M organization by attending training programs. O&M managers should evaluate the performance of experienced employees on a regular basis to determine if more training is needed.

## EMPLOYEE EVALUATION

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Every O&M manager evaluates his employees—he forms opinions about them and makes judgments about each one's job performance. These *informal evaluations* may determine whether or not a particular employee receives an increase in salary or whether he is promoted or fired. Informal evaluations also have an important impact on day-to-day working relationships. For example, an O&M manager will have more respect for an employee who is usually on time for work than he will for an employee who is always late. Likewise, a manager will favor an employee who takes an enthusiastic interest in his work. *Formal evaluations* are similar to informal evaluations, but there are two important differences: (1) a formal evaluation is usually more objective than an informal evaluation; (2) a formal evaluation is usually scheduled on an annual basis following an initial three-to-six-month probationary review.

### The Need for Formal Employee Evaluations

Most formal employee evaluations are used to help determine which employees should receive pay increases or who should be promoted or fired. Some formal evaluations are used to help guide an employee by improving his performance or his chances for advancement. A formal evaluation is an official form that answers such questions as:

- Is the employee doing work that needs to be done based on his job description?
- Is work being performed as stated in O&M manuals and other references?
- Does the employee need constant supervision, or is he a self-starter?

*Evaluations from two points of view.* Formal employee evaluations serve as important management tools. From the manager's point of view, they provide an opportunity to evaluate all employees by the same standards and performance factors. From an employee's point of view, formal evaluations provide an opportunity to find out what the manager thinks of his work performance. Since most formal evaluations are discussed with each employee, the employee has a chance to talk with the boss about what he can do to improve his performance and increase his chances for pay raises. The manager has a professional obligation to make a fair assessment of his employees and to help them overcome work-related problems.

*Employee evaluation and training.* Employee evaluations may also signal the need for training. For example, when an O&M manager evaluates an employee's work quality as poor, he indicates a need for improvement in the employee's work that probably can be achieved through training. Employee evaluations also provide general measurements of an employee's initiative and dependability.

*Problems with formal evaluations.* Some O&M managers do not approve of formal evaluations because they do not like to show their feelings about a certain employee. Other managers feel that a formal evaluation cannot be truly objective because personal friendships and other factors make it very difficult to be fair. Sometimes, O&M managers have a hard time trying to correct an employee's poor work performance or bad habits and, at the same time, maintain a cooperative relationship. Formal evaluations suffer from all of these problems. Nonetheless, formal evaluations have proven to be the best means of determining salary increases, promotions, job counseling, and other personnel decisions.

### Evaluation Procedures

Most formal employee evaluations require the evaluators to rate each employee on some kind of scale, without regard to the ratings being made of other employees. The process of developing and conducting a formal employee evaluation usually involves

five steps. These steps are listed in Figure 13. As noted in step 2 of the figure, an important part of the employee evaluation process is the development of a formal Employee-Evaluation Form. This form is used to rate an employee on a variety of job-performance factors, such as knowledge of job duties, dependability, and quality of work. Figure 14 shows an O&M Employee-Evaluation Form. Under each performance category on the form, evaluators may rate an employee's work. Ratings range from unsatisfactory to outstanding. This form and the procedures listed in Figure 13 should be used to conduct a formal employee evaluation.

One of the problems associated with the evaluation process is that most evaluators tend to rate an employee higher than he may deserve to be rated. This problem can be overcome by impressing upon evaluators the importance of making fair assessments and by comparing evaluation results between evaluators over a period of two or three years. Another means of "evaluating the evaluators" is to use *performance requirements*, in which a supervisor and an employee agree on certain levels of performance that the employee should strive to achieve. For example, at the beginning of the year, the supervisor and employee might agree on two performance requirements: (1) perform work in accordance with the O&M manual, and (2) satisfactorily complete an operator-training course offered by the state. Once or twice during the year, the supervisor and the employee should meet to review the employee's progress toward meeting the performance requirements. These methods are not the only means of improving the evaluation process. Any other technique that improves the accuracy or validity of a formal evaluation should be considered for use.

### Employee Discipline

Employees who violate policies and rules need to be disciplined. For example, an employee who is frequently absent or late for work needs to be told that a work rule has been violated and that continued violation will result in disciplinary action.

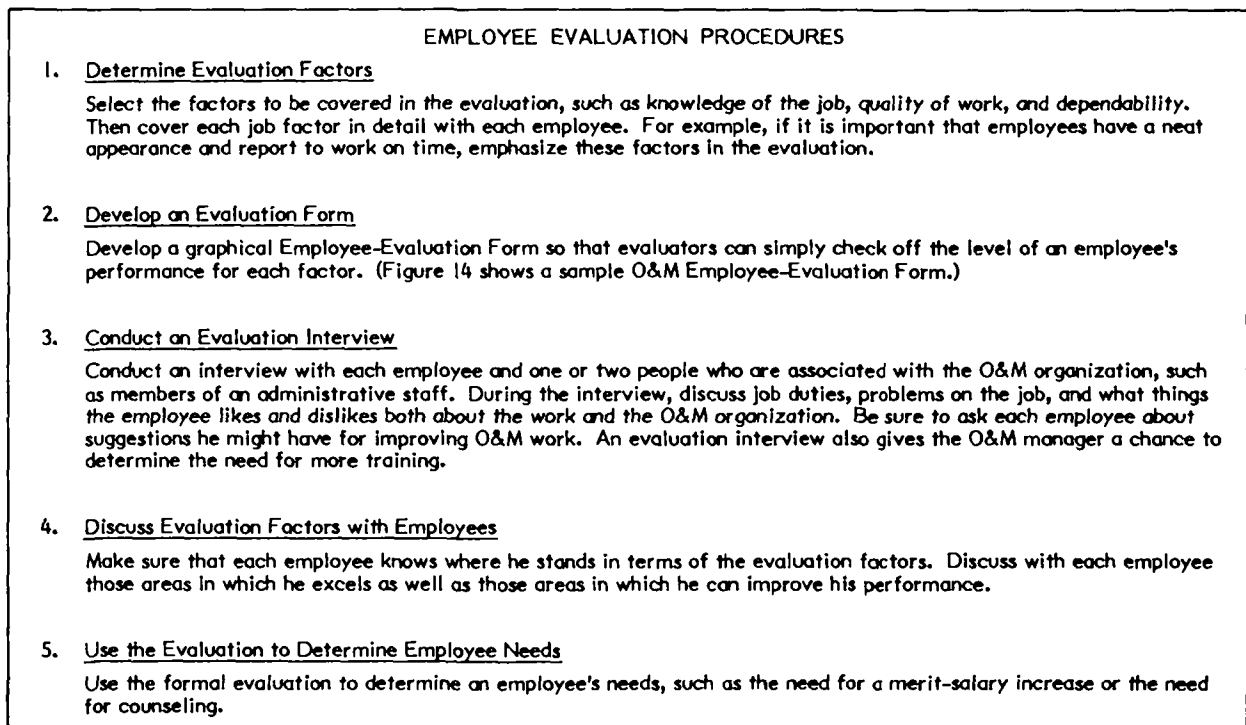


Figure 13 Steps in Developing and Using a Formal O&M Employee Evaluation

CENTERVILLE  
O&M EMPLOYEE-EVALUATION FORM

Name of Employee Evaluated \_\_\_\_\_ Date \_\_\_\_\_

Title of Employee's Position \_\_\_\_\_

Names of Evaluators \_\_\_\_\_

Evaluators must place one check mark next to the statement that best describes the employee being evaluated. Evaluators may be asked to support each rating from personnel records, work reports, or other documents.

EVALUATION FACTORS

<u>Knowledge</u>	<u>Comments</u>
<input type="checkbox"/> Falls to have basic knowledge of position	
<input type="checkbox"/> Meets minimum requirements expected	
<input type="checkbox"/> Has the knowledge to satisfactorily perform job assignments	
<input type="checkbox"/> Above average, well informed in field of assignments	
<input type="checkbox"/> Exceptionally well informed in field of assignments	
 <u>Attendance and Punctuality</u>	
<input type="checkbox"/> Unsatisfactory; frequently absent/tardy without good reason	
<input type="checkbox"/> Occasionally absent/tardy without good reason	
<input type="checkbox"/> Absent/tardy occasionally with good reason	
<input type="checkbox"/> Seldom absent/tardy	
<input type="checkbox"/> Attendance/punctuality consistently good	
 <u>Quality of Work</u>	
<input type="checkbox"/> Unsatisfactory; rarely produces reliable work	
<input type="checkbox"/> Occasionally produces inaccurate work	
<input type="checkbox"/> Average dependability and accuracy	
<input type="checkbox"/> Displays excellent ability to produce quality work	
 <u>Dependability</u>	
<input type="checkbox"/> Cannot be left to work alone	
<input type="checkbox"/> Requires close supervision, seldom works alone	
<input type="checkbox"/> Usually dependable, requires normal supervision	
<input type="checkbox"/> Frequently works independent of supervision	
<input type="checkbox"/> Always performs reliable work without supervision	
 <u>Initiative</u>	
<input type="checkbox"/> Unsatisfactory; has to be prodded	
<input type="checkbox"/> Seldom works without direction	
<input type="checkbox"/> Displays average drive and imagination	
<input type="checkbox"/> Looks for additional tasks	
<input type="checkbox"/> Looks for and takes on additional tasks	
 <u>Response to Instruction</u>	
<input type="checkbox"/> Negative and unresponsive	
<input type="checkbox"/> Reluctant but complies	
<input type="checkbox"/> Completes work, cooperates, applies himself to assignments	
<input type="checkbox"/> Attends closely to activities, voluntarily exceeds assignments	
<input type="checkbox"/> Exerts outstanding effort, enjoys assisting others	
 <u>Tolerance for Criticism</u>	
<input type="checkbox"/> Hostile toward all criticism	
<input type="checkbox"/> Easily offended, resents criticism	
<input type="checkbox"/> Accepts criticism, occasionally makes effort to improve	
<input type="checkbox"/> Accepts criticism exceptionally well; consistently makes effort to improve	
 Summary of Evaluation _____	

Figure 14 O&M Employee-Evaluation Form

## GUIDELINES FOR EMPLOYEE DISCIPLINE

1. State All Policies and Rules

Make sure that all employees know the O&M organization's policies and rules. An employee who does not know he did something wrong should not be disciplined.

2. Record Violations

Put violations in writing. After informing an employee that he has violated a policy or rule, submit to the employee a written notice that summarizes the violation and describes the action that will be taken if the violation happens again. Keep a copy of the written notice on file for use during employee evaluations and other personnel actions, such as promotions and terminations.

3. Explain Disciplinary Actions

When disciplinary action is taken, make sure the employee understands the disciplinary action. For example, tell an employee who has been late for work repeatedly that if he is late more than one morning per week, he will be forced to take two days of leave without pay. In addition, tell the employee what time is considered late and what leave-without-pay means.

4. Treat All Employees Fairly

Treat all employees in the same manner. Different employees committing the same violation under the same circumstances should receive the same disciplinary action.

5. Be Reasonable

The kind of disciplinary action that is taken should be consistent with the violation. For example, if an employee has been late for work three times in two weeks, remind him of the O&M organization's established working hours. If the employee continues to be late, two days of leave without pay might be an appropriate disciplinary action. An employee whose conduct on the job places someone else's life in danger might be suspended without pay immediately until other disciplinary action has been determined.

Figure 15 General Guidelines for Employee Discipline

*The O&M manager's responsibility.* Since most employees abide by the policies and rules established by the town council and O&M managers, disciplinary action is rarely needed. Sometimes, however, an employee will violate a certain policy or rule. When this occurs, the O&M manager should try to prevent the violation from happening again. Figure 15 provides a list of general guidelines pertinent to an O&M manager's responsibilities regarding employee discipline.

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# RECORD KEEPING

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# 3

Has the O&M organization been waiting too long for parts to get a pump back in working order? What records are needed to control inventories of parts and supplies? Has the backhoe been serviced lately? What records are needed to keep track of the maintenance activities performed on various pieces of equipment? Where are the community's pipelines located? What records are needed to schedule preventive-maintenance servicing for facility components and structures. This chapter provides answers to questions such as these. Upon completing this chapter, you should be able to:

- Develop and implement a simple system for controlling inventories of parts and supplies.
- Set up a central storeroom of parts and supplies.
- Set up a file of inventory-control cards.
- Develop a simple system for scheduling preventive-maintenance servicing for various pieces of equipment and facility components and structures.
- Prepare a map of the facility's components and structures.

## INVENTORY RECORDS

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An inventory consists of the supplies the O&M organization needs to keep on hand to operate and maintain the community's water, wastewater, and solid-waste collection systems. The supplies may include repair parts, spare pipe and appurtenances, spare valves, chemicals, paints, electrical supplies, tools, and lubricants.

## What is Inventory Control?

Inventory control is the process of managing supplies—that is, knowing what supplies are on hand and where they are located. Effective inventory control involves (1) deciding what supplies to stock, (2) keeping a record of supplies and their location, and (3) accounting for all receipts and issues of supplies.

*Deciding what to stock.* Should a certain repair part be kept on hand? If so, is more than one needed? Should several sets of spark plugs be purchased and stored for use at a later date, or is it more economical simply to pick up a set of spark plugs when needed? Chemicals for water treatment need to be purchased, but what quantity should be kept on hand? An inventory-control system will help provide answers to these questions.

*Keeping track of supplies.* How many sets of spark plugs are on hand and where are they located? Should chemicals be stored in the pumphouse or is there a better place to store them? How many gallons of engine oil are on hand and where is the supply kept? An inventory-control system will help answer these questions.

*Accounting for receipts and issues of supplies.* Inventory control involves keeping records that show increases and decreases in the inventory. How many sets of spark plugs were received from the vendor and when were they received? Also, what happened to the old stock of spark plugs and who used them? Receiving and issuing supplies is an accounting function of the inventory-control process.

## Why Is Inventory Control Important?

An O&M manager is responsible for providing sanitation services without interruption. System failures need to be corrected without unnecessary delays. Most failures require repair parts or supplies to put the system back in working order, but repair parts or supplies may not be available locally. Therefore, repair parts and supplies not available locally are purchased in advance by the O&M organization to build an inventory of necessary materials.

The purpose of inventory control is (1) to provide needed parts and supplies quickly, thereby reducing work delays and downtime; (2) to reduce inventory costs by keeping on hand only the parts and supplies the O&M organization will need; (3) to maintain accountability by providing records of what items were purchased, how many are in stock, and when and to whom they were issued.

It is the O&M manager's responsibility to see that the parts, supplies, and tools his employees need are available. Therefore, the O&M manager or one of his assistants should keep inventory records, maintain the stock, and issue supplies. The person in charge of inventory should be held accountable for the inventory and should have sole access to the storeroom.

## Organizing the Storeroom

The storeroom should be kept neat and well organized at all times so that the person in charge of the inventory can find supplies quickly and keep track of what parts are on hand. Figure 1 provides a list of general guidelines for organizing a storeroom. (*Note:* All figures for this chapter are included at the end of the chapter.) The person who is responsible for organizing the storeroom might want to spend a day or two visiting local parts stores to obtain ideas on how to organize the storeroom efficiently.

## Deciding What Supplies to Stock

Every effort should be made to keep inventory stock to a minimum. An item should be stocked only if a definite need for the item exists or if it will take too long to obtain the item if it is not in stock. A "definite need" for an item is usually demonstrated by a history of regular usage. Some items, however, are infrequently used but may be vitally needed in an emergency. These items should also be stocked. O&M managers should recognize the

two categories of stock: (1) *demand stock*—items that have a history of frequent usage; (2) *emergency stock*—items that are used infrequently but are generally needed for emergency repairs.

*Typical stocking decisions.* The following are a few examples of situations that influence stocking decisions.

- A certain part on a pump fails only once in a while, but when it does, it takes four to six weeks to get a replacement part from the manufacturer in Dearborn, Mich. Until this pump is repaired, the system must operate on a single backup pump. In this situation, the best decision is to stock one or two of these parts.
- Inventory records show that the O&M staff normally uses about ten 1-in. elbows per month. The elbows are available from a supplier located 15 miles away. The best decision in this situation is to stock an adequate supply of elbows in order to reduce unnecessary delays and travel time.
- Almost every time the seasons change, one section or another of a 2-in. water line ruptures. A local supplier carries the pipe and pipe fittings. The best decision in this situation is to buy a few sections of pipe before the beginning of each new season, but pipe sections should not be stocked throughout the year.

In the first two examples, the items should be stocked because there is a definite need for them and because there could be a long delay or inconvenience in obtaining them when they are needed. In the third example, keeping an inventory of 2-in. pipe is not justified because it is needed infrequently and is readily available from another source. An item should be stocked only if there is a definite need for the item, based on frequency of use, or if it will take too long to obtain the item when it is needed.

*Other considerations.* In selecting inventory stock, care should be taken to exclude any items that are likely to become obsolete. The cost of a part that will not be needed in the future and cannot be returned for credit is an unnecessary expense. For example, parts should not be stocked for a 1964 pickup truck that is scheduled for replacement.

Several other factors will affect the size of the inventory stock. One factor is storage space. The lack of adequate storage space will place definite limits on what supplies can be stocked. Another factor is overhead costs. These costs include: (1) *administrative costs*—the money spent to operate a storeroom, such as wages and utility costs; (2) *capital-investment costs*—the money used to buy excess inventory.

Inventory overhead costs should be analyzed in relation to the cost-benefits of maintaining a certain level of inventory. Realistically, however, such an analysis is impractical for small O&M organizations in which inventory investments rarely exceed \$10 000. By keeping stock levels to a minimum and stocking only the supplies that are needed, unnecessary inventory costs can usually be avoided.

### Inventory-Control Cards

Inventory-control cards serve four purposes: (1) the cards ensure *accountability* by recording all supplies purchased and issued; (2) they help to determine *stock demand* by reflecting usage patterns and determining what supplies and what quantities of supplies should be stocked; (3) they enable *stock control* by recording information, such as item location, quantity on hand, and required stock level; and (4) they record *purchasing information*, including the address of the distributor, the cost for replacing specific items, and the average delay in receiving items.

An inventory-control card has two printed sides. The front side contains purchasing and stock information; the back side serves as a record of items received and issued, which can be used to verify or support accounting information on inventories. An inventory-control card should be prepared for each type of item purchased by the O&M organization. Inventory-control cards should be stored in two separate card files; one file for items that are stocked, and another file for nonstocked items. Figure 2 shows a typical

O&M inventory-control card and the procedures to follow when filling in the necessary information.

### Ordering Repair Parts and Supplies

Repair parts and supplies are ordered when (1) the *On-Hand* quantity of a stocked item falls below the *Reorder Point* recorded on the inventory-control card, (2) a new item is added to stock, (3) an item has been requested that is not stocked. A purchase order similar to the one shown in Figure 3 is used to order supplies and usually includes: (1) the project code (sometimes called the "activity code") or stock number; (2) a reason for the purchase order; (3) the date when the stock is needed; (4) a complete description of each item, the quantity needed, and price information. A copy of the purchase order should be retained in a *suspense file* or on a clipboard. This procedure helps keep track of the items that have been ordered but have not yet been received.

### Receiving Supplies

All supplies requisitioned by purchase order should be processed through the storeroom upon arrival, even if they are to be used immediately. This procedure ensures proper accountability for each item ordered. When an item is received, certain information should be recorded on the back of the inventory-control card. Figure 4 shows the back of a typical O&M inventory-control card and the procedures to follow for filling in the necessary information when an item is received.

The information recorded on the back of the inventory-control card shown in Figure 4 reveals that on June 8, 12 items were received and recorded in both the *In* and *On Hand* columns. The items were placed in stock as indicated in the *Account* column, and both the *Unit Cost* and *Total Cost* were recorded. The *Document* column verifies that the items were ordered on Purchase Order No. 8503.

After this information has been recorded on the back of the inventory-control card, the word *Received* and the date should be stamped or noted on the suspense-file copy of the purchase order. The purchase order and all other purchase documents, such as the invoice, should then be forwarded to the person who is responsible for paying the vendor.

### Issuing Supplies

As a general rule, supplies should be issued only upon written request. The request might be a simple equipment repair order or a *work-order-and-report form*, such as the one shown in Figure 5. In the work-order-and-report form shown in Figure 5, 48 ft of service line needs to be replaced. The person in charge of the storeroom issues the pipe and enters the description, quantity, and cost of the pipe in the *Materials* section of the work-order-and-report form. Then he detaches a copy of the form for his files as "proof of issue." After issuing the supplies, the person in charge of the storeroom enters the appropriate information on the back of the inventory-control cards. Figure 6 shows the information that should be listed on the back of an inventory-control card after the supplies shown on the work-order-and-report form in Figure 5 have been issued.

As recorded on both the work-order-and-report form (Figure 5) and the inventory-control card (Figure 6), 48 ft of service line in the amount of \$96.50 were issued for Activity 302. The inventory-control card indicates that 100 ft of line remain on hand, having an inventory value of \$201.

### Running Low on Supplies in the Field

Field crews will occasionally find that their supply of a certain part is running low. Because of the travel distance, it may be more convenient for the crew to get the part from a nearby supplier rather than return to the storeroom to get the part. When this occurs, the foreman or operator should find out from the supplier how much the item costs. He

should then call the person in charge of the storeroom, give the number on the work-order-and-report form for the item that is needed, and obtain a purchase order number. The purchase order number should then be given to the supplier. While the foreman or operator is obtaining the needed part from the supplier, the person in charge of the storeroom should prepare a purchase order for processing purposes. When the invoice is received from the supplier, the person in charge of the storeroom should enter the supplies received and issued on the appropriate inventory-control card.

### Tools

When tools are purchased, an inventory-control card should be completed for each type of tool. Entries should be recorded the same as for supplies (the *Amount* column is left blank) and the cards should be placed in a separate card file marked *Tools*. When a tool is issued, it should not be recorded on an inventory-control card. Instead, a tool sign-out book should be kept in the storeroom to record each tool issued and returned, the dates each tool was used, and the name of the user. Tools that are regularly used by field crews and operators on a daily basis should be permanently signed out to them. More expensive tools and tools used only once in awhile, however, should be kept in the storeroom on a wall board or shadow board. These tools should be signed out only when needed and returned immediately after each use.

### Quarterly Inventories and Reviews

Once every three months, the person in charge of the storeroom should take an inventory of the stock on hand and review all inventory-control cards. When taking an inventory of stock, all stock should be counted manually, and the quantities of each item on hand should be verified against the *On Hand* columns of the inventory-control cards. Figure 7 shows the back of a typical inventory-control card and the procedures to follow for filling in the necessary information when taking an inventory of stock on hand.

*Reviewing inventory-control cards.* Whenever an inventory is taken, it is a good practice to review all inventory-control cards in both the *Stocked Items* and *Nonstocked Items* card files. Figure 8 lists the procedures to follow when reviewing inventory-control cards.

When major items of equipment, such as pumps, generators, and vehicles, are purchased, the manufacturer will generally provide a parts list or parts manual. These documents should be kept in the storeroom and used as references when ordering parts.

## EQUIPMENT RECORDS

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Has the backhoe been serviced lately? Does it need complete preventive-maintenance servicing or only a minor inspection? How should preventive-maintenance work be scheduled? What records are needed to keep track of the maintenance activities performed on various pieces of equipment? This section provides answers to questions such as these.

### Kinds of Equipment Records

A small-to-medium-size O&M organization should keep accurate records to monitor the operation and maintenance of its equipment. Equipment-control cards, work orders, and fuel-pump logs help monitor (1) the equipment on hand; (2) how the equipment is being used; (3) repairs and preventive-maintenance activities; (4) future preventive-maintenance needs; (5) fuel, oil, and supplies used. Good records provide a way of storing information until it is needed. They also help a manager plan and control equipment maintenance, monitor fuel usage, and correct minor problems before they become major expenses.

## Equipment-Control Cards

Equipment-control cards are used to: (1) record important equipment data, such as make, model, and serial number; (2) record maintenance and repair work performed to date; (3) schedule future maintenance work. Figure 9 shows a typical O&M equipment-control card and the procedures to follow for filling in the necessary information.

## Scheduling Equipment Maintenance

Equipment-control cards can be used to schedule maintenance activities. Figure 10 lists the procedures to follow when using equipment-control cards to schedule maintenance activities. Equipment service and preventive-maintenance work should be scheduled by time interval rather than by miles or hours of usage. If an unscheduled repair is needed, the work should be recorded on the equipment-control card as soon as the work is done. If equipment repair is major, such as rebuilding an engine, a service inspection should be scheduled as soon as the repairs are completed. This practice will ensure that the piece of equipment is properly inspected and that the fluid levels are correct before the piece of equipment is placed into operation.

Equipment-control cards should be reviewed periodically to ensure that service and preventive maintenance are being performed regularly. Equipment-control cards are valuable for monitoring the condition of a piece of equipment and for detecting any recurring problems. For example, if the front tires on a pickup truck are wearing out long before the rear tires, a front-end alignment is probably indicated. If a dump truck needs to have its clutch replaced every four months, either the clutch linkage is not being properly adjusted or the operator needs to be trained in how to properly use a clutch.

## Work Orders

O&M managers and town accounting officials need to monitor how equipment is used and the costs of operating and maintaining equipment. This task is accomplished through work orders. When work orders are used to monitor equipment usage and operation-and-maintenance costs, three important guidelines should be followed.

1. *All equipment usage should be reported on the work order.* If the piece of equipment is being used for a specific job, the work should be charged to a specific job with an assigned-activity account number. On the other hand, if a piece of equipment, such as a pickup truck, is being used for various jobs, the work order should be charged to a miscellaneous or general-activity account number.
2. *Any work performed on equipment, from preventive-maintenance inspections to routine repairs, should be recorded on a work order.* In this way, the work order (a) serves as a record of the costs of labor and materials used to perform the work on equipment, and (b) provides information that needs to be recorded on equipment-control cards.
3. *Any parts and supplies received from the storeroom should be recorded on the work order.* In this way, the work order helps keep accurate inventory records.

## Fuel-Dispensing Logs

Sharply rising fuel costs have made it important to carefully manage fuel supplies and fuel usage. O&M organizations that rely on private service stations for their fuel can monitor fuel usage by receiving itemized billings from service stations. The billings should show the date of each fuel sale, the quantity of fuel purchased, the name of the operator, and the vehicle number. O&M organizations that have their own fuel pumps should have special attendants permanently assigned to operate the pumps and to record vehicle-servicing activities. These attendants should maintain a *fuel-dispensing log* similar to the one shown in Figure 11 for each pump. The log is used to record all fuel

that is dispensed. To make accurate readings in the log, a measure of the fuel on hand should be made at the beginning of each day with a measuring rod.

### Fuel-Usage Summary Reports

In addition to a fuel-dispensing log, some O&M organizations may want to monitor the amount of fuel used by each vehicle. This task can be accomplished with a *fuel-usage summary report*. Figure 12 shows an O&M fuel-usage summary report and the procedures to follow for filling in the necessary information.

### Other Records

Equipment-control cards, work orders, and fuel-dispensing logs are essential records in any O&M organization. Other records may also be important, especially if more than 10 to 15 people are employed. There are no rules that govern when other records are needed, but as a general guideline, managers of medium-size O&M organizations (10 to 50 employees) should keep records of how their systems are operating and how much it costs to maintain system components and equipment. Several summary reports may be needed to give town officials and O&M managers a quick overview of operations. Two such summary reports are the *water-service summary report* and the *equipment maintenance-and-cost summary report*.

*Water-service summary report.* The manager who has trouble keeping track of everything or the town official who wants an overview of system operations can make good use of a one-page water-service summary report such as the one shown in Figure 13. This report shows at a glance the water services provided and the resources used in a one-month period. It also provides an indication of how well the system is operating. Similar operations summaries can be developed to compare one month's services and costs with another month's services and costs or to evaluate the services and costs from the beginning of the year to the present. In addition, calculations can be made from summary reports to show chemical usage in parts per million, total costs of operation, or average costs per customer.

*Equipment maintenance-and-cost summary report.* Figure 14 shows an example of an equipment maintenance-and-cost-summary report. As the report shows, during a six-month period, the Centerville O&M organization's pickup trucks cost \$2116 to operate and maintain (\$125 in repair labor, \$74 in repair parts, \$1305 in outside repairs, and \$612 for fuel, oil, and other costs).

## FACILITY RECORDS

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Where are the community's pipelines located? What is the average depth of the system's septic tanks? When were the generators inspected last? Have the pumps been operating for excessively long periods of time? This section provides answers to questions such as these.

### Kinds of Facility Records

A community's water, wastewater, and solid-waste facilities consist of permanent components and structures, such as water mains, pumphouses, storage tanks, and lift stations. Records should be maintained for all of these permanent components and structures. Small-to-medium-size O&M organizations need only four kinds of facility records: (1) system atlases, (2) as-built plans, (3) facility-control cards, and (4) log books.

Facility records provide information needed to properly operate and maintain community sanitation systems. From the records, information can be obtained concerning what, how, and where work was done. Some records list job specifications, such as serial numbers and horsepower ratings. Other records provide a history of the

maintenance and repair procedures performed on the facility's components and structures. This section describes all four kinds of facility records and how each is used.

### System Atlases

A system atlas contains map-sketches of a water-distribution system or a sewage-collection system. It provides a graphical record of system components and structures. A good system atlas is especially useful in quickly locating buried pipelines, septic tanks, and drainfields. A simplified system atlas can be prepared by including map-sketches in a loose-leaf binder. Figure 15 shows a sample page from a system atlas and the procedures to follow to prepare a map-sketch.

*Preparing a system atlas.* The initial sketches mapping existing underground components will probably have to be made using estimates and memory. After the initial map-sketches have been prepared, they should be verified in the field every time an underground system component is excavated. To keep the system atlas up-to-date, before new system components are buried, they should be mapped in sketches.

Map-sketches should be as accurate as possible. Distances should be measured on the ground with a surveyor's tape. Pipe bearings are best taken with a survey transit, but a good hand compass with sights will suffice if it is used carefully. Map-sketches should chart distances and bearings in relation to permanent surface structures, such as buildings, fire hydrants, or monuments, to provide O&M staff personnel with a known starting point when they must relocate a buried system component. To relate map-sketches to permanent surface structures, measure the distance and bearing from an important junction in a pipeline or a corner of a septic tank to the selected surface structure. These measurements should be shown in the sketch.

The map-sketch should not be cluttered with unnecessary details, such as the location of trees, hills, and streams. These details will only make the sketch more difficult to prepare and read. Small O&M organizations may want to combine both water-distribution and sewage-collection components and structures in the same sketch. Normally, however, a separate system atlas is prepared for each system. System atlases should be reviewed and updated whenever changes are made in the systems.

### As-Built Plans

As-built plans are the engineer's design plans that have been marked by the contractor or construction foreman to show how a system was actually built or installed. They should clearly show the actual, in-place locations, specifications, and dimensions of all components and structures in the system. As-built plans should be used to update system atlases and then stored for future reference.

### Facility-Control Cards

A facility-control card should be completed for each major component and structure in the system that requires routine maintenance and/or is electrical or mechanical. The cards should be kept in a special facility-control card file. A typical facility-control card file will include cards for pumps, generators, control ponds, and major storage tanks.

Facility-control cards are used to: (1) record important data about components and structures, such as location, serial number, and technical specifications; (2) record maintenance and repair work performed to date; (3) schedule future maintenance work. As shown in Figure 16, the front of each facility-control card is used to record data about system components and structures. Spaces are provided for such information as make, model, serial number, location, and technical data. All of the spaces will not be needed for every component. For example, tire size, batteries, and gross vehicle weight are not applicable to pumps, and storage tanks may only need to be identified by type, year, location, and capacity.

The front of the facility-control card also provides space to list the periodic preventive-



maintenance requirements. The numbers at the top of the card represent one week of the year and are used to schedule preventive-maintenance activities. The back of the card serves as a record of all maintenance and repair work performed to date on the component or structure. Figure 17 lists the procedures to follow in preparing a facility-control card file.

*Scheduling preventive maintenance.* Figure 18 lists the procedures to follow in scheduling preventive-maintenance activities using the facility-control card file. Preventive maintenance is scheduled by time intervals of once-a-month or once-a-week, rather than by hours of operation. This procedure simplifies maintenance scheduling and increases the likelihood that the schedule will be followed. When the back of a facility-control card is completely filled, a new card should be prepared and stapled to the old one. The old card should not be thrown away as it documents a complete maintenance history on the system component or structure.

### **Log Books**

A log book should be maintained at all major facilities, such as lift stations and pumphouses. A log book serves as a record of facility operations. It contains gauge and meter readings, as well as operator's comments and observations. It also provides a convenient place to enter written operating instructions and emergency procedures. A sample page from an O&M log book is shown in Figure 19. To complete the log, the operator enters his name, the date and time, the appropriate gauge or meter readings, and any important comments or observations, such as abnormal operation or suggested maintenance. Of course, each log book should be tailored to fit the facilities being maintained.

The value of a log book is that it provides clues about operating problems that may occur. For example, an underground rupture in a water line leading from a pumping station may be difficult to detect visually. If log book readings indicate excessive hours of pump operation or high water usage, however, the operator should immediately recognize that there is a problem in the system. O&M managers should regularly review the log books and schedule any necessary maintenance or repairs based on the recorded observations.

### **BIBLIOGRAPHY**

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US Environmental Protection Agency (Jul. 1978).

#### ORGANIZING AN O&M STOREROOM

1. Select a clean, dry room or shed with locking doors and windows.
2. Clean out the storeroom. Dispose of unneeded or obsolete items and all junk.
3. Obtain shelving units suitable for storing parts and supplies in an organized fashion.
4. Place all similar items together on the shelves. For example, all vehicle parts should be placed on one set of shelves and all pipe fittings on another. Similar items should be placed together and identified with a 3 x 5 card, placed near the item.
5. Label the shelf sections with numbers and letters so that parts may be located quickly.
6. Leave supplies in their original packaging. The packaging protects supplies and parts from rust and dirt and aids in quick identification. Store unpackaged items, such as pipe fittings, nuts, and bolts, in boxes, trays, or other containers.
7. Store heavy items, such as large valves or bags of cement, on wooden pallets near the storeroom door to minimize handling and lifting.
8. Store frequently used items close to the point where they will be issued to minimize the time it takes to get them.
9. Store large, weather-resistant materials, such as culvert sections and lumber, outdoors (preferably in a fenced yard).
10. Store all tools, other than those routinely carried in tool boxes, on a shadow board or wall board.
11. Keep extension cords, hoses, and rope neatly coiled on wall hooks.
12. Store flammable materials in a separate shed.

Figure 1 General Guidelines for Organizing an O&M Storeroom

CENTERVILLE

O&M INVENTORY-CONTROL CARD

PART NAME: Oil Filter LOCATION: 23-P

PART NO.: PK-19 LOT SIZE: 1 each

FOR: All trucks except #25 and #34

SUPPLIER: Dave's Hardware & Supply  
236 West City, State ZIP.

MONTHLY USAGE	NATURE	ORDER LAG	MIN QTY	REORDER POINT	REORDER QUANTITY	MAX QTY
6	<i>Routine</i>	<i>1 MONTH</i>	0	6	6	12

Front of Card

PROCEDURES

- In the spaces provided on the front of the card, fill in the:
  - Part Name, Part Number, and Location of the item
  - Name and address of the Supplier
  - Description of the part's use (under For)
  - Minimum quantity in which the item is sold (under Lot Size).
- Indicate Monthly Usage by recording the average number of items used in a thirty-day period. To obtain an accurate monthly-usage figure, total the number of items issued over the past year and divide by 12. If usage records are not available, estimate the number of items issued over the past year and verify the accuracy of the estimate by recording the actual usage in future months.
- Record the Nature of usage. An item will be used either for emergency repairs or for routine maintenance.
- Enter the Order Lag, which is the average amount of time required to obtain the part from the vendor. If the item can be obtained locally and is classified as a "routine" item, there is no need to go to a supplier every time the item is needed—especially if it is a low-cost, high-usage item, such as tape. One trip per week is sufficient order-lag time for routine items. For these types of items, enter one week in the Order Lag block. If the item can be obtained locally and is classified as an "emergency" item, record the actual delay time. Then, when such an item is needed, an employee can be sent to purchase the item from the supplier immediately.
- Determine the Minimum Quantity of stock needed. This is the minimum quantity of a particular item that should always be on hand. If the item is classified as a "routine" item, enter zero. If the stock of a routine items runs out for a few days (a situation referred to as a "stock out"), the staff can probably do without the item for that long. If the item is classified as an "emergency item," enter the quantity of that item needed to handle one single emergency.
- At this point, pull all inventory-control cards for items that should not be stocked. An item should not be stocked if:
  - The monthly usage is less than one item per month, and/or
  - Its order lag is one day or less (unless the item is an emergency item with a minimum-quantity requirement).

Place inventory-control cards for items that should not be stocked in a separate card file for nonstocked items.
- For all stocked items, calculate and record the Reorder Point in the proper place on the inventory-control card. The reorder point represents the quantity of an item remaining on the shelf when a resupply order is placed. The formula for calculating the reorder point is:
 
$$\text{Reorder Point} = \text{Usage} \times \text{Order Lag} + \text{Minimum Quantity}$$

The usage and order lag parts of the formula must be expressed in the same units. For example, if the usage of sodium

Figure 2 O&M Inventory-Control Card

DATE	IN	OUT	ON HAND	ACCOUNT	UNIT COST	TOTAL COST	DOCUMENT
1/19/	12	—	12	INV. STOCK	\$5.00	\$60.00	P.O. 8502
1/21/	—	3	9	1316	\$5.00	\$15.00	W.O. 0156
1/26/	—	1	8	1316	\$5.00	\$5.00	W.O. 0159
2/2/	—	—	8	INV.	—	—	—
2/10/	—	1	7	1316	\$5.00	\$5.00	W.O. 0163
2/17/	—	1	6	1316	\$5.00	\$5.00	W.O. 0172

Back of Card

hypochlorite is 120 gallons per year and the order lag is 1 month, convert the yearly usage to monthly usage; 120 gallons ÷ 12 months = 10 gallons per month. If the usage is 10 gallons per month and the order lag is 1 week, convert the usage to a weekly basis; 10 gallons ÷ 4 weeks = 2.5 gallons per week. As a practical matter, if the reorder point is a fraction, round the reorder point upward to the next whole number. For example, round a reorder point of 2.5 to 3; .75 to 1; 3.6 to 4. The minimum quantity of the formula is used when it is important that a specified minimum quantity of a particular item be on hand at all times in addition to whatever number represents the reorder point. This method is used to ensure that inventories of certain items will not be depleted before the replacement order is received.

8. Enter the Reorder Quantity, which is the quantity of an item requested in a resupply order. The reorder quantity is equal to the monthly usage, adjusted upward to the nearest lot size. For example, if the monthly usage is 6 and the lot size is 1, then the reorder quantity is 6. On the other hand, if the monthly usage is 6 and the lot size is 12, then the reorder quantity is 12. In this case, if the vendor will only sell an item in lots of 12, the reorder quantity is 12, even though only 6 items are needed. If the monthly usage is zero, as is the case with some emergency items, then the reorder quantity is usually 1 rounded upward to the nearest whole-lot size. The reorder quantity can never be less than 1. The reason for setting the reorder quantity equal to the monthly usage is that resupply orders generally should be placed once a month. Placing a resupply order every time an item is taken off the shelf wastes time.

9. Calculate the Maximum Quantity of stock. This quantity is not a planned inventory figure; it represents a quantity of stock that should be exceeded. The formula for calculating the maximum quantity of stock is:

$$\text{Maximum Quantity} = \text{Reorder Point} + \text{Reorder Quantity}$$

For example, if the reorder point is 2 and the reorder quantity is 6, then the maximum quantity is 8.

10. On the back of the card, enter the Date and record the quantity of an item currently on hand in the On Hand column. Place the letters INV in the Account column to show that the column represents an inventory account.
11. Keep the inventory-control cards in a card file or box organized by the type of inventory. For example, inventory-control cards for administrative supplies, plumbing supplies, and vehicle parts should be filed in separate sections of the card file or box and indexed with a file tab.
12. Prepare inventory-control cards for nonstocked items as the items are ordered. Keep these cards in a separate card file, labeled Nonstocked Items. Fill out cards for nonstocked items in the same way as cards for stocked items, except omit the information for Minimum Quantity, Reorder Quantity, Reorder Point, and Maximum Quantity.

Figure 2 (continued)

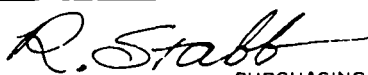
# PURCHASE ORDER

8503

<b>TO</b>	<i>Dave's Hardware &amp; Supply</i>
<b>ADDRESS</b>	<i>236 West City, State, ZIP</i>
<b>SHIP TO</b>	<i>Centerville Water Utility</i>
<b>ADDRESS</b>	<i>222 Fork Ave., Centerville, State, ZIP</i>

<b>REQ. NO</b> <i>111</i>	<b>FOR</b> <i>Stock</i>	<b>DATE</b> <i>5/81</i>
<b>DATE REQUIRED</b> <i>6/71</i>	<b>HOW SHIP</b> <i>UPS</i>	<b>TERMS</b> <i>NET</i>

QUANTITY	PLEASE SUPPLY ITEMS LISTED BELOW	PRICE	UNIT
1	<i>12 3/4" ELBOWS (#52-103)</i>	<i>\$13</i>	<i>20 \$1.10</i>
2			
3			
4			
5	<i>FOR South Side</i>		
6	<i>Repairs Stock</i>		
7			
8			
9			
10			
11			
12			

<b>INVOICES PASSED FOR PAYMENT</b>	<b>PLEASE SEND <i>2</i> COPIES OF YOUR INVOICE</b>
	 PURCHASING AGENT

**OFFICE COPY**

Figure 3 O&M Purchase Order

DATE	IN	OUT	ON HAND	ACCOUNT	UNIT COST	TOTAL COST	DOCUMENT
6/8/	12	—	12	INV STOCK	\$1.10	\$13.20	P.O. 8503

Back of Card

PROCEDURES

1. Enter the Date the item was received.
2. Enter the quantity received in the In column.
3. Enter the quantity on hand in the On Hand column. (This is the same number as the quantity received if there was a zero inventory balance or if the card is being completed on a new inventory item.)
4. If the item was ordered for stock, indicate this in the Account column. If the item was ordered for a specific project or activity, enter the appropriate code number in the Account column. (The Account column should read the same as the For block of the purchase order.)
5. Record the Unit Cost and Total Cost as they appear on the shipping invoice.
6. Enter the number of the purchase order in the Document column.

Figure 4 Using O&M Inventory-Control Cards to Receive Supplies

CENTREVILLE				Order Date: 8/22	
Work Order and Report				Report Date:	
Activity/Project: Replace Service Line				Activity No. 302	
LOCATION: 2001 West Cook Road					
INSTRUCTIONS: Replace Service Line from Meter to broken place (85' ±)					
LABOR			EQUIPMENT		
Name	Hours		Type	ID No.	Hrs
	Reg	O/T			
A. Stubbs			Pickup	17	
R. Barrett			Dump Truck	27	
H. James			Dock Hoe	65	
Cost:			Cost:		
MATERIALS:					
Description		Unit	Amount	Cost	
Service Line		Fr.	48	\$96.50	
Fittings		ea.	2	\$2.60	
ACCOMPLISHMENT					
QUANTITY: _____ UNIT: _____					

Figure 5 O&M Work-Order-and-Report Form

DATE	IN	OUT	ON HAND	ACCOUNT	UNIT COST	TOTAL COST	DOCUMENT
8/8/	—	—	148	INV	—	—	—
8/22/	—	48'	100'	302	\$2.01	\$96.50	Activity 302 MTCR. WO. 8/22

Back of Card  
PROCEDURES

1. Enter the Date the item was issued.
2. Enter the quantity issued in the Out column.
3. Enter the quantity remaining in the On Hand column. (The quantity remaining should equal the previous on-hand quantity, minus the amount issued.)
4. Record the Project, Activity, or Account Number for which the item was issued.
5. Record the Unit Cost. If the unit cost has increased recently, record the lower unit cost until all items purchased under the old price have been issued. For example, if one group of spark plugs was purchased at \$4.00 per set and another group was purchased at \$4.25 per set, record all issued spark plugs at \$4.00 per set until all of the spark plugs purchased under this price have been used.
6. Record the Total Cost. The total cost is calculated by multiplying the Unit Cost by the quantity issued (shown in the Out column).
7. Enter the issue request or work-order number to which the items were issued in the Document column.

Figure 6 Using O&M Inventory-Control Cards to Issue Supplies

DATE	IN	OUT	ON HAND	ACCOUNT	UNIT COST	TOTAL COST	DOCUMENT
1/19/	12	—	12	INV. STOCK	\$5.00	\$60.00	P.O. 8502
1/21/	—	3	9	1316	\$5.00	\$15.00	W.O. 0156
1/26/	—	1	8	1316	\$5.00	\$5.00	W.O. 0159
2/2/	—	—	8	INV.	—	—	—

Back of Card  
PROCEDURES

1. Enter the Date of the inventory.
2. Record the actual quantity of an item on hand in the On Hand column (even if it is different from the previous balance).
3. Put the notation INV in the Account column to show that the column represents an inventory account.
4. Leave all other columns blank.

Figure 7 Using O&M Inventory-Control Cards to Count Stock on Hand

- REVIEWING O&M INVENTORY-CONTROL CARDS
1. Beginning with the cards for stocked items, verify the monthly usage of each item by adding all of the items issued in the Out column for the last three months and divide the total by three.
  2. If the resulting monthly usage has dropped below one, the item no longer qualifies for stock unless it has a minimum-quantity requirement. If the item is to be dropped from stock, erase the data for Reorder Point, Reorder Quantity, and Maximum Quantity on the front of the card and transfer the card to the Nonstocked Items card file. (Use the remaining stock but do not reorder more of the item until a special request is made.)
  3. If the item still qualifies for stock, review the data for Reorder Point, Reorder Quantity, and Maximum Quantity. If the monthly usage has changed, the Reorder Point, Reorder Quantity, and Maximum Quantity should be calculated (using the formulas included in items 7, 8, and 9 of Figure 2).
  4. Compare the revised Reorder Point on the front of each card with the On-Hand quantity on the back of each card. If the On Hand quantity is less than the Reorder Point, prepare a purchase order.
  5. Review the Nonstocked Items card file. Calculate the Monthly Usage and Order Lag for each item. Add to the cards for any items that have a monthly usage of one or more and have an order lag of more than one day. For items that qualify for stock, calculate the Reorder Point, Reorder Quantity, and Maximum Quantity for each item. Prepare a purchase order for the maximum quantity needed for each item.

Figure 8 Procedures for Reviewing O&M Inventory-Control Cards

CENTERVILLE																																																			
O&M EQUIPMENT-CONTROL CARD																																																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
GENERAL DATA:														ID NO. 17																																					
TYPE: <i>Pickup Truck</i>							MAKE: <i>Ford</i>							MODEL: <i>F-100</i>							YEAR: <i>1981</i>																														
SER. NO. <i>11123JA3442</i>							PURCHASE DATE: <i>June 1979</i>							PURCHASE PRICE: <i>\$6,120</i>							LOCATION: <i>SHOP</i>																														
TECHNICAL DATA:																																																			
CAPACITY: <i>1/2 TON</i>							ENGINE: <i>5-6</i>							GVW: <i>5,660</i>																																					
HORSEPOWER: <i>165</i>							TIRE SIZE: <i>680/15</i>							CURB WT.: <i>4,105</i>																																					
CURRENT: <i>-</i>							BATTERIES: <i>1-12V</i>							WARRANTY EXPIRATION: <i>5/80</i>																																					
MANUFACTURER'S ADDRESS: <i>2249 Lake St. St. Louis, MO. 12333</i>														MAINTAINED BY: <i>A. Studds</i>																																					
MAINTENANCE REQUIREMENTS (REFER TO OWNER'S MANUAL)																																																			
TASK														FREQ.				TASK														FREQ.																			
<i>Check all lights/accessories</i>														<i>week</i>																																					
<i>Change oil/FILTER &amp; LUBE</i>														<i>Qtr.</i>																																					
<i>Check tires for wear</i>														<i>Qtr.</i>																																					
<i>Check EMISSION &amp; Belt</i>														<i>Qtr.</i>																																					
<i>Check AXLE</i>																																																			

Front of Card

Figure 9 O&M Equipment-Control Card



MAINTENANCE/REPAIR RECORD			
for <u>Ford Pickup</u>		ID NO. <u>17</u>	
NATURE OF WORK	DATE	NATURE OF WORK	DATE
Quarterly PM/Service	1/23		
" "	3/27		
" "	6/19		
" "	9/25		

Back of Card

PROCEDURES

1. Assign each piece of equipment an identification number. For example, all automobiles and trucks might be numbered in the 00-50 range.
2. Complete the general and technical information for each piece of equipment on the front of the card.
3. Enter the preventive-maintenance requirements as shown in the owner's manual. (On major equipment, such as backhoes and dozers, all of the detailed preventive-maintenance requirements cannot be recorded in the space provided. Simply summarize the type of service or preventive maintenance required and refer to the owner's manual as a guide for performing the work.)
4. On the back of the card, indicate the maintenance and repair work that has been done to date. This information can be obtained from old work orders, service station receipts, and operators.
5. Place the completed cards in the card file either in numerical order or by equipment class, such as "Trucks" or "Heavy Equipment."

Figure 9 (continued)

SCHEDULING MAINTENANCE ACTIVITIES

1. Determine when the next service for a piece of equipment is due, using the maintenance requirements shown on the front of the equipment-control card and the maintenance/repair record shown on the back of the card.
2. Attach a colored tab to the numbered block at the top of the card to indicate the week that maintenance should be scheduled.
3. Once each week review the card file and pull all cards for equipment that is scheduled for maintenance that week. If maintenance work will be performed by O&M personnel, complete a work-order-and-report form to indicate what work should be performed. If the work will be performed by a private garage or service station, prepare the service order on a purchase order form.
4. Once the maintenance work has been completed, enter the information on the cards and move the colored tab at the top of the card to the next week of scheduled maintenance.

Figure 10 Using O&M Equipment-Control Cards to Schedule Maintenance Activities

CENTERVILLE  
O&M FUEL-DISPENSING LOG

PUMP: #2 PAGE: (no.) 1

DATE	VEHICLE/UNIT	OPERATOR	MILES/HOURS	GAS (GAL)	DIESEL (GAL)	OIL (QTS)	OPERATOR'S SIGNATURE
6/18/	(inventory)	-	-	340	401	25	<i>Stevens</i>
" "	Pickup 17	Stubbs	41,201	15	-	-	<i>Stubbs</i>
" "	Dump Truck 27	Barrett	22,532	-	50	-	<i>Barrett</i>
" "	Loader 63	Thomas	2,050	-	40	-	<i>Thomas</i>
6/19/	(inventory)	-	-	325	311	25	<i>Stevens</i>
" "	Sedan 02	Roybal	10,540	20	-	2	<i>Roybal</i>
" "	(delivery)	-	-	200(+)	-	-	<i>Stevens</i>
6/20/	(inventory)	-	-	505	311	23	<i>Stevens</i>

TRANSACTIONS

1. On the morning of June 18, Stevens (the attendant) checked the amount of fuel he had on hand. His inventory indicated that he had 340 gallons of gasoline, 401 gallons of diesel fuel, and 25 quarts of oil.
2. During the day, Stevens issued 15 gallons of gasoline to Stubbs for a pickup truck, 50 gallons of diesel fuel to Barrett for a dump truck, and 40 gallons of diesel fuel to Thomas for a loader. (The mileage or hours of operation for O&M vehicles is recorded directly from each vehicle's odometer or hourmeter.)
3. On the morning of June 19, Stevens recorded 325 gallons of gasoline, 311 gallons of diesel fuel, and 25 quarts of oil on hand.
4. After issuing fuel and oil to Roybal for a sedan, Stevens received a delivery of 200 gallons of gasoline.

Figure 11 O&M Fuel-Dispensing Log

CENTERVILLE

O&M FUEL-USAGE SUMMARY REPORT

for the period ending \_\_\_\_\_

ID NO.	EQUIP. TYPE	MAKE	MODEL	MILEAGE/HOURS	FUEL (GAL)	MPG/GPH	STANDARD MPG/GPH
15	PICKUP	FORD	F-100	1,000 mi.	75	13.3	14
16	PICKUP	CHEV	C-10	600 mi.	40	15.0	14
17	PICKUP	FORD	F-100	850 mi.	84	10.1	14

PROCEDURES

1. List each vehicle on the report form by ID Number, Make, and Model. In addition, list all vehicles of the same type together. For example, list all pickup trucks together, all dump trucks together, and so on.
2. Using the fuel-dispensing log, determine the mileage or hours of operation for each vehicle during the report period. To determine this number, subtract the first mileage/hours reading from the last reading for each vehicle in the fuel-dispensing log.
3. Compute the fuel used by each vehicle for the report period. To measure fuel usage, start the vehicles on a full tank. Disregard the first entry of the report period for fuel issued to each vehicle. Total up all other entries for fuel issued during the report period to determine the amount of fuel used by each vehicle.
4. Compute the miles-per-gallon or gallons-per-hour for each vehicle by using the following formula.
 

$$\text{MPG} = \frac{\text{total miles}}{\text{total gallons used}}$$

$$\text{GPH} = \frac{\text{total gallons used}}{\text{total hours}}$$
5. To compare the amount of fuel used by each vehicle with the amount of fuel each vehicle should be using, consult the standard MPG or GPH rating for each type of vehicle. (These standard ratings are usually based on previous experience or manufacturers' data.)

Figure 12 O&M Fuel-Usage Summary Report

CENTERVILLE

O&M WATER-SERVICE SUMMARY REPORT

for June

SERVICES PROVIDED

Total Gallons of Water Pumped	1,052,000
Average Daily Gallons Pumped	35,067
Water Services Installed	1
System Interruptions (Number/Hours)	0/0

RESOURCES USED

Operator Time (Man-Hours)	62
Service Truck (Hours)	56
Electricity Used (kW)	1,005
Chemicals Used:	
Gallons of Chlorine	10
Gallons of Fluoride	2

COMMENTS

System running normally, except that pump number 2 in the south pumphouse still needs to be replaced.

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Figure 13 O&M Water-Service Summary Report

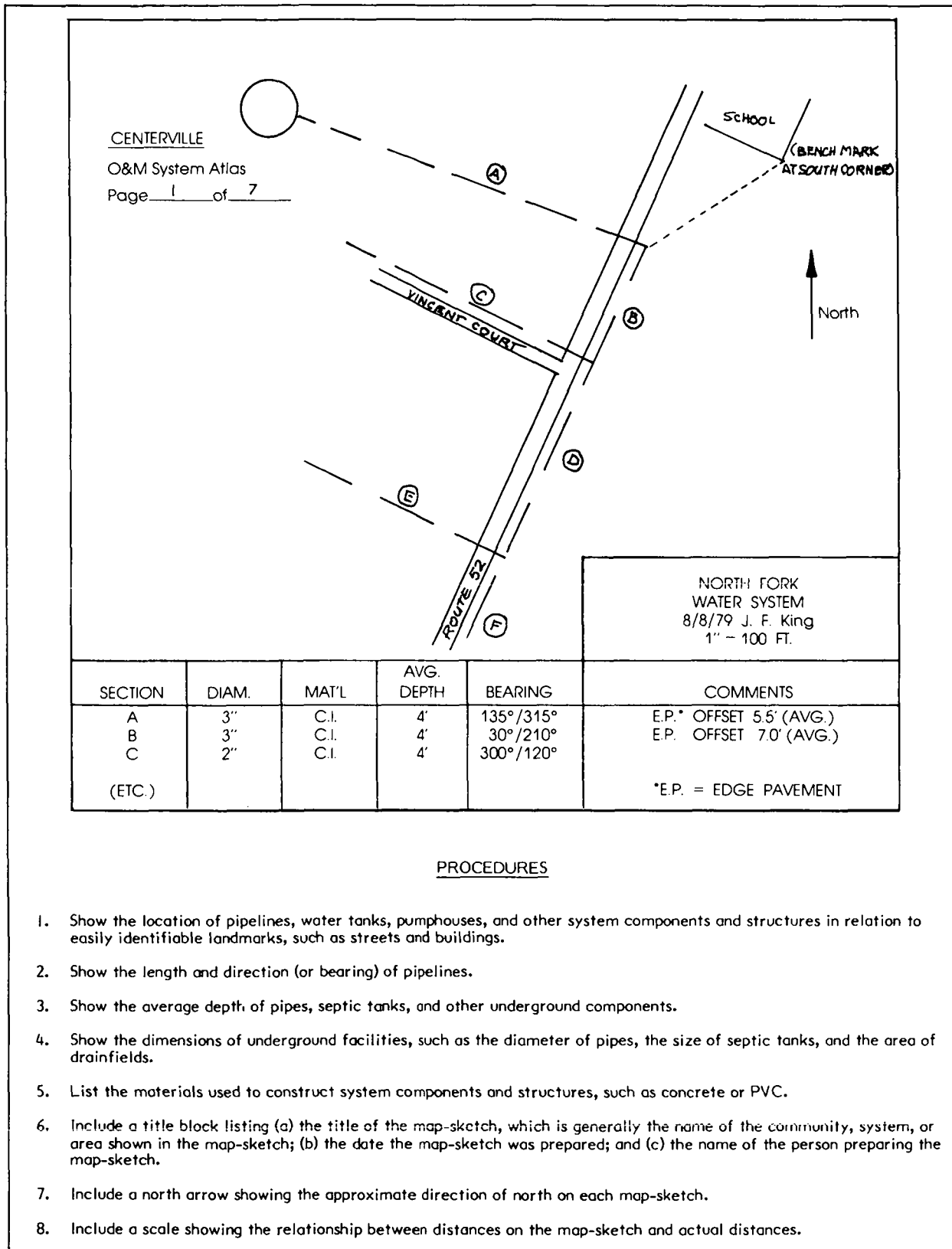
CENTERVILLE

O&M EQUIPMENT MAINTENANCE-AND-COST SUMMARY REPORT

from January 1, 19 to June 30, 19

TYPE of EQUIPMENT	TYPE of SERVICE or REPAIR	HOURS DOWN	LABOR HOURS	LABOR COSTS	PARTS COSTS	OUTSIDE CHARGE	FUEL, OIL, & OTHER COSTS	TOTAL COST
Pickup	Routine PM	9	11	\$ 45	\$ 10		\$ 612	\$ 667
	Minor Repair	16	30	80	64			144
	Major Repair	50				\$1,305		1,305
	TOTAL	75	41	\$125	\$74	\$1,305	\$612	\$2,116
Dump Truck	Routine PM	18	16	80	133		1,002	1,215
	Minor Repair	72	101	525	310			835
	Major Repair	160				1,666		1,666
	TOTAL	250	117	\$605	\$443	\$1,666	\$1,002	\$3,716
	TOTALS	325	158	\$730	\$517	\$2,971	\$1,614	\$5,832

Figure 14 O&M Equipment Maintenance-and-Cost Summary Report



PROCEDURES

1. Show the location of pipelines, water tanks, pumphouses, and other system components and structures in relation to easily identifiable landmarks, such as streets and buildings.
2. Show the length and direction (or bearing) of pipelines.
3. Show the average depth of pipes, septic tanks, and other underground components.
4. Show the dimensions of underground facilities, such as the diameter of pipes, the size of septic tanks, and the area of drainfields.
5. List the materials used to construct system components and structures, such as concrete or PVC.
6. Include a title block listing (a) the title of the map-sketch, which is generally the name of the community, system, or area shown in the map-sketch; (b) the date the map-sketch was prepared; and (c) the name of the person preparing the map-sketch.
7. Include a north arrow showing the approximate direction of north on each map-sketch.
8. Include a scale showing the relationship between distances on the map-sketch and actual distances.

Figure 15 Map-Sketch for an O&M System Atlas

CENTERVILLE																																																			
O&M FACILITY-CONTROL CARD																																																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
GENERAL DATA:																										ID NO.																									
TYPE: <i>LIFT PUMP</i>													MAKE: <i>FLYGT</i>													MODEL: <i>CP3082</i>													YEAR: <i>1981</i>												
SER. NO. <i>111/236</i>													PURCHASE DATE: <i>Aug. 1972</i>													PURCHASE PRICE: <i>-</i>													LOCATION: <i>PUMP STATION #1</i>												
TECHNICAL DATA:																																																			
CAPACITY: <i>1,200</i>													ENGINE: <i>-</i>													GVW: <i>-</i>																									
HORSEPOWER: <i>2.5 H.P.</i>													TIRE SIZE: <i>-</i>													CURB WT.: <i>-</i>																									
CURRENT: <i>230/3 PHASE</i>													BATTERIES: <i>-</i>													WARRANTY EXPIRATION: <i>8/79</i>																									
MANUFACTURER'S ADDRESS: <i>1600 HOPP COURT</i>																										MAINTAINED BY: <i>Stubbs/Kent</i>																									
CITY, STATE, ZIP																																																			
MAINTENANCE REQUIREMENTS (REFER TO OWNER'S MANUAL)																																																			
TASK													FREQ.													TASK													FREQ.												
<i>Lubricate Main Bearing ON Motor</i>													<i>MO.</i>													<i>Check Volute wear Rings</i>													<i>Ann.</i>												
<i>Check &amp; Record Amp/Volt Reading</i>													<i>Qtr.</i>																																						
<i>Run Standby Pump for 15 min</i>													<i>Qtr.</i>																																						
<i>Operate Valve Next to pump</i>													<i>Qtr.</i>																																						
<i>Check Shaft Seals</i>													<i>Qtr.</i>																																						

Front of Card

MAINTENANCE/REPAIR RECORD			
for <u><i>Lift Pump</i></u>			
		ID. NO. <u><i>007</i></u>	
NATURE OF WORK	DATE	NATURE OF WORK	DATE
<i>Lubricate Main</i>	<i>1/16/81</i>	<i>Run Standby Pump</i>	<i>6/19</i>
<i>Check Amp./Volt Reading</i>	<i>1/16/81</i>	<i>Lubricate Main</i>	<i>7/16</i>
<i>Operate Valve</i>	<i>1/16/81</i>		
<i>Check Shaft Seal</i>	<i>1/16</i>		
<i>Lubricate Main</i>	<i>2/20</i>		
<i>Lubricate Main</i>	<i>3/20</i>		
<i>Lubricate Main</i>	<i>4/22</i>		
<i>Check Amp./Volt Reading</i>	<i>4/22</i>		
<i>Operate Valve</i>	<i>4/22</i>		
<i>Check Shaft Seal</i>	<i>4/22</i>		
<i>Run Standby Pump</i>	<i>4/22</i>		
<i>Lubricate Main</i>	<i>5/16</i>		
<i>Lubricate Main</i>	<i>6/19</i>		
<i>Check Amp./Volt Reading</i>	<i>6/19</i>		
<i>Operate Valve</i>	<i>6/19</i>		
<i>Check Shaft Seal</i>	<i>6/19</i>		

Back of Card

Figure 16 O&M Facility-Control Card

#### PREPARING AN O&M FACILITY-CONTROL CARD FILE

1. Make a list of all components and structures to be included in the file.
2. Assign each component and structure an identification (ID) number. There are two ways to do this:
  - Assign a range of numbers to each classification of equipment; for example, pumps might be numbered in the 100-199 range.
  - Assign a range of numbers to a specific location. All components and structures at that location, such as pumphouse motors, tanks, and valves, should be numbered within that range. As a general rule, components and structures should be numbered in the direction of flow, from incoming to outgoing.
3. Enter the general and technical information for each component and structure on the front of the facility-control card in the appropriate spaces. This information may be obtained from office documents, manuals, or on-site inspections.
4. Using the owner's manual, list the preventive-maintenance requirements and the frequency of periodic-maintenance inspections.
5. On the back of the facility-control card, record all known maintenance and repair work performed to date.
6. Place the completed cards in a file box and group them in numerical order by class or location.

**Figure 17** Procedures for Preparing an O&M Facility-Control Card File

#### SCHEDULING PREVENTIVE MAINTENANCE

1. Review the Maintenance Tasks and Frequencies on each facility-control card. Compare these tasks and frequencies with the maintenance activities that have already been performed and recorded.
2. Determine when the next maintenance task is due and attach a colored tab in the block at the top of the card that corresponds to the week in which the work is to be done. (Each block represents one of the 52 weeks in a year. For example, if a certain component requires monthly service and the back of the card indicates that the service was just performed, then the next service will be due in four weeks. If the review is made during the 37th week of the year, the next service should be scheduled for the 41st week. Therefore, the colored tab should be placed over block number 41.)
3. Once each week, review the card file and pull all of the cards for components and structures that have maintenance work due that week. Using the Maintenance-Requirements section of the card, determine what work needs to be done. Fill out a work-order-and-report form for each card, stating the nature and location of the work to be performed.
4. When the work has been completed, enter a description of the work performed (under the Nature of Work column) and the Date on the back of the facility-control card. Then move the colored tab at the top of the card forward to the next week of scheduled maintenance.

**Figure 18** Using O&M Facility-Control Cards to Schedule Preventive-Maintenance Activities

CENTERVILLE										
O&M LOG BOOK FOR PLANT OPERATIONS										
STATION/PLANT: #1										
PAGE NO. 3										
DATE	TIME	OPERATOR/ INSPECTOR		GAUGE READINGS						COMMENTS/OBSERVATIONS
				GALS		PSI	HOURS			
1/5	9:15 AM	S. Peck	P	30.6	✓	26	0024			
1/6	10:00	"	P	29.6	✓	26	0032			
1/7	10:00	"	P	30.8	✓	27	0041			STUBBS TO CHECK #2 CHLORINE TANK
1/8	9:30	"	D	30.2	✓	26	0050			TANK OK SAYS STUBBS

Figure 19 Page From an O&M Log Book



# MANAGING MAINTENANCE SYSTEMS

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# 4

In order to deal with the problems of service requests and emergency repairs, O&M managers need to use a *systems approach* for the management of maintenance work. An effective system for managing maintenance work involves: (1) *maintenance policies* that establish rules for operating the system; (2) *work programs* that describe the kinds and amounts of work needed to successfully operate the system; (3) *scheduling procedures* that establish work priorities and balance the type of maintenance work being done; (4) *performance standards* that establish guidelines both for performing maintenance work and for making the best use of manpower, equipment, and tools; (5) *reporting procedures* that summarize, evaluate, and control work. All of these system elements work together to help O&M managers plan, organize, direct, and control maintenance work more effectively.

This chapter describes a systems approach to managing maintenance work and discusses the importance of establishing policies and procedures to properly maintain water, wastewater, and solid-waste collection systems. As with other chapters, this material is designed for a typical O&M staff of four to ten employees who have responsibility for the community's water, wastewater, and solid-waste collection. Upon completion of this chapter, you should be able to:

- Develop, implement, and use a simple system for managing maintenance work.
- Develop and use an effective preventive-maintenance program.
- Prepare and use routine maintenance schedules.
- Read and interpret maintenance work reports.

## MAINTENANCE SYSTEMS

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Nearly everything built by man begins to deteriorate as soon as it is built. Normal, everyday use—normal wear and tear—creates the need for maintenance. For example, homes and apartments need to be fixed up once in awhile: windows need to be washed, doors need to be painted, the furnace needs to be fixed, and light bulbs need to be changed. Likewise, automobiles require regular maintenance: the oil needs to be replaced, parts need to be greased, and the clutch may need to be adjusted. Regular maintenance is necessary to keep all equipment in good working condition.

### Maintenance of Utility Equipment

As is true of homes and automobiles, the normal, everyday use of water and wastewater systems creates the need for maintaining the equipment used to operate these systems: motors wear out, pumps seize, compressor tanks need to be drained, and water mains occasionally break. How much maintenance is enough? What is a proper amount of maintenance? There are many answers to these questions, but one simple answer is best—*proper maintenance* consists of inspecting, lubricating, and repairing equipment in accordance with manufacturers' recommendations, and cleaning, repairing, or replacing items when they fail.

*Design life span versus actual life span.* Most manufacturers design their products to last a certain number of years. For example, a steel water tank may be designed to last 40 years; a water pump may be designed to last 10 years; a certain gate valve may be designed to last 50 to 60 years *under normal use and proper maintenance*. The actual life span of an item, however, usually depends on how well it is maintained. Some water tanks designed to last 40 years have been unusable within 25 years because no one bothered to keep them painted or properly cleaned; others have been in use nearly 70 years because someone took very good care of them. With little or no maintenance, the community's water system will fail long before it should—parts of the system (including trucks, compressors, valves, and buildings) will have to be replaced, and that will cost a lot more than the cost of performing routine maintenance.

*Maintenance costs.* Proper maintenance involves inspecting, lubricating, and fixing equipment in accordance with manufacturers' recommendations. The cost to perform proper maintenance procedures is a lot less than the cost to replace a piece of equipment that has failed. For example, it costs less than \$5 to add oil to a truck engine, but it can cost at least \$500 to rebuild or replace an engine that seized because someone forgot to add oil. It costs about \$10 to exercise a certain valve once every six months, but replacing the same valve because it "froze up" can cost \$200 to \$800. The cost of replacing a small electrical motor that was not properly lubricated may be \$650, whereas the annual cost of lubricating the motor might only have been \$25. It costs a lot more to replace a 10 000 gal tank than it does to paint the tank periodically.

A good maintenance program pays for itself. System failure and downtime are reduced, dollars are saved, and fewer customer complaints are received.

### Kinds of Maintenance Work

Maintenance work can be classified into three categories:

1. *Corrective maintenance* is work done to repair or replace something that has failed, such as replacing the bearings on a motor, cleaning out a clogged drain, replacing a broken fan belt. Most service work requested by customers is corrective maintenance work.
2. *Emergency maintenance* is corrective maintenance work that cannot wait until the next day. Real emergencies rarely occur, but O&M managers should be prepared to handle all forms of emergency conditions.

3. *Preventive maintenance* is work done to prevent costly repairs or replacements. Most preventive-maintenance work consists of inspecting, checking, testing, and lubricating equipment. Preventive maintenance is designed to "fix something before it breaks down."

### Maintenance Management Systems

A water distribution system is a network of tanks, pumps, valves, and lines. All of the system components perform specific functions; and in order to distribute water, all components of the system must work together. Likewise, a maintenance management system has components that perform specific functions. All components of the maintenance management system must work together both to balance the kinds of maintenance work being done and to control the cost of maintenance work. All maintenance management systems have several basic components in common. Figure 1 shows a diagram of an O&M maintenance management system and the components common to all such systems.

## MAINTENANCE RESPONSIBILITIES AND POLICIES

Who should be responsible for performing maintenance work? How should the job responsibilities be spelled out? Answers to these questions depend on the size and type of the water, wastewater, and solid-waste collection systems. Very small systems, serving 50 to 100 customers, usually require only one part-time employee to operate and maintain

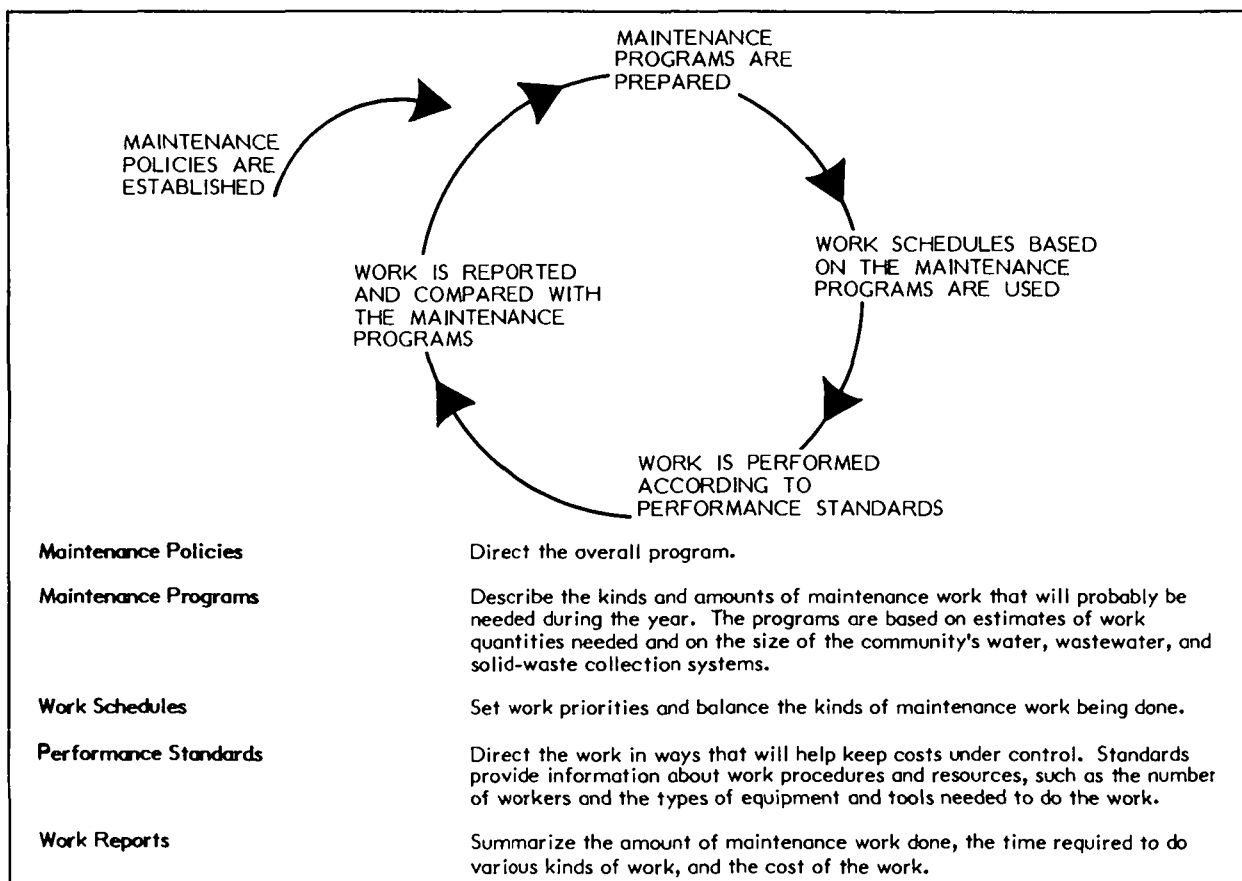


Figure 1 O&M Maintenance Management System

the system. In these systems, the part-time employee serves as a manager, operator, and jack-of-all-trades. As such, there is no need to spell out the job responsibilities for the part-time employee in great detail. The regular policies and procedures used by the town council for purchasing goods and services are all that are needed for a very small water system.

**Maintenance Policies**

Most small-to-medium-size O&M organizations (four to ten employees) can benefit by putting down in writing who is responsible for performing specific jobs. Job responsibilities are usually included in O&M documents, such as policy statements, job descriptions, or parts of O&M manuals.

The best way to begin proper maintenance of a system's components is to prepare a written policy regarding maintenance goals and the methods that will be used to achieve the goals. Policy statements are prepared by town officials and express their intentions about how maintenance work should be conducted. Town officials develop policies covering many areas of O&M management—from personnel administration to accounting and budgeting. Many town authorities also recognize the need for a maintenance policy. Figure 2 shows an O&M maintenance policy that (1) spells out general maintenance goals and states the reasons for performing maintenance work, and (2) gives some indication as to how the maintenance goals will be achieved.

Notice that the maintenance policy shown in Figure 2 provides for flexibility in terms of the amount of work to be done, the amount of money needed, and the work procedures to be used. In effect, the policy says, "We want the O&M staff to maintain our water and

CENTERVILLE

MAINTENANCE POLICY  
FOR WATER AND WASTEWATER SYSTEMS

The O&M staff responsible for operating and maintaining the water and wastewater systems shall have three overall goals:


1. To preserve the investment made in water and wastewater facilities and equipment.
2. To provide clean, continuous, and safe drinking water and to collect and process wastewater in accordance with community standards.
3. To ensure proper utilization of the O&M facilities and equipment.

These goals shall be attained through effective management of maintenance operations.

Effective management of maintenance operations shall be guided by a "maintenance management system." The system shall include provisions for:

1. Annual maintenance programs that estimate the kinds and amounts of work to be done and the number of man-days required to do the work.
2. An annual maintenance budget based on the maintenance programs.
3. Work scheduling and reporting procedures, especially for preventive maintenance.
4. Performance standards for most maintenance activities.

The maintenance management system shall be refined as needed to serve as an effective management tool.


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 Centerville Mayor

1/22  


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 Date

Figure 2 O&M Maintenance Policy

wastewater systems using good management procedures. It is up to the staff to figure out how much work has to be done, where it should be done, and when. These are their responsibilities."

A policy governing solid-waste collection and disposal can be developed in the same way, except that it might have just one basic goal, such as to collect and dispose of garbage and trash in ways that help protect the health and safety of the community. Under the terms of such a policy, the frequency of solid-waste collection would be established as an operating policy, and the management procedures to be used would be stated in much the same way as they are stated in Figure 2.

## MAINTENANCE SERVICE LEVELS

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The sequence of actions for managing maintenance systems (shown in Figure 1) starts with maintenance policies—policies that require the development of maintenance programs. Maintenance programs cover service levels, performance standards, facilities, and equipment inventory. This section describes the part of maintenance programs that deals with *service levels*.

A maintenance service level provides the best estimate of the amount of maintenance work that is needed. It is based on the preventive-maintenance recommendations of manufacturers, records of service requests and maintenance work already performed, and the amount of money available for performing maintenance work. The process of establishing maintenance service levels involves three steps: (1) defining the work to be done; (2) reporting the work being done; (3) setting specific service levels.

### Describing Maintenance Work

All maintenance systems require detailed descriptions of the maintenance work to be performed. The descriptions should define work activities and establish "units" by which work can be measured. *Activity definitions* and *work units* are used to (1) organize maintenance programs and budgets, (2) schedule and assign work, (3) report work, and (4) measure the progress being made toward achieving goals.

*How to define work activities.* The way maintenance work activities should be defined depends on the type of work being done and on the size of the O&M organization. As a general rule, a large O&M organization (50 or more employees) will define work activities in very specific terms, mainly because maintenance personnel tend to specialize in certain kinds of work. For example, a large O&M organization may define specific activities related to the repair of water hydrants in very detailed terms. A small-to-medium-size O&M organization, however, should define the same work in more general terms. Instead of listing detailed procedures for repairing water hydrants, a small-to-medium-size O&M organization could include repair procedures in a broad category, such as "Routine Corrective Maintenance," which also includes other routine repairs performed on a scheduled basis.

*How to establish work units.* Work units provide a means of measuring the amount of work planned and the amount of work actually done. Work units are usually established for such measurements as the number of lineal feet of distribution line replaced; the number of service requests completed; the number of meters read, tested, or replaced; or the number of taps installed on a sewer main.

For some work activities, it is impractical to establish work units. For example, usually very little hydrant maintenance is needed in a small-to-medium-size O&M organization. Such work could be measured in terms of the number of hydrants repaired, but this procedure is not really needed because there are so few hydrants to be maintained.

*Typical activity definitions and work units.* A list of typical activity definitions and work units is shown in Figure 3. The list is designed to be used by an O&M organization

of four to ten employees. Notice that routine operations and other work are included because employees in small-to-medium-size O&M organizations are involved in routine operations in addition to maintenance work. Some of the work units shown are measured by number, such as the number of meters or the number of tanks, whereas other work units are measured in terms of man-hours. As a general rule, when different kinds of work are combined, man-hours should be used as the measurement.

<u>CENTERVILLE</u>	
O&M ACTIVITY DEFINITIONS AND WORK UNITS	
<u>Activity</u>	<u>Work Unit</u>
<b>ROUTINE OPERATIONS</b>	
101 - <u>Meter Reading</u> : Routine, periodic meter reading to determine customer usage.	Number of Meters
102 - <u>System Operations Work</u> : Work performed by operators to monitor water and wastewater systems. Work includes taking water samples, checking water levels, and making routine tests of equipment.	Man-Hours
103 - <u>Solid-Waste Collection</u> : Removing and hauling solid wastes to designated areas.	Number of Stops
104 - <u>Other Operations</u> : Miscellaneous field work not covered by Activity 101, 102, or 103, including landfill operations.	Man-Hours
<b>PREVENTIVE MAINTENANCE</b>	
201 - <u>Vehicle Service and Preventive Maintenance</u> : Routine servicing and preventive maintenance, including daily checks of fuel and oil levels, oil/filter changes, vehicle inspection, and minor adjustments.	Man-Hours
202 - <u>Equipment Service and Preventive Maintenance</u> : Routine inspections, checks, and tests of equipment. Work includes lubricating parts and making minor adjustments.	Man-Hours
203 - <u>Septic-Tank Pumping and Disposal</u> : Routine pumping and disposal of septic tanks.	Number of Tanks
<b>CORRECTIVE MAINTENANCE</b>	
301 - <u>Service Requests</u> : Work performed in response to service requests from customers. Work includes troubleshooting, repairs or replacements, rodding, and other work directly related to service requests.	Number of Requests
302 - <u>Replace Water/Wastewater Line</u> : Scheduled replacement of water/wastewater lines, including taps, services, and related fixtures.	Lineal Feet
303 - <u>Routine Corrective Maintenance</u> : Routine repairs or replacements performed on a scheduled basis, usually as a result of preventive-maintenance inspections.	Man-Hours
<b>OTHER WORK</b>	
401 - <u>Miscellaneous Maintenance</u> : Maintenance work not included above.	Man-Hours
402 - <u>Administrative and Supervisory Time</u> : Time spent supervising work, clerical time, and all leave time.	Man-Hours

Figure 3 O&M Activity Definitions and Work Units

## Reporting the Work Being Done

O&M managers must have accurate knowledge of how much maintenance work is being done and how the staff is spending its time. This information will help a manager make decisions in planning, organizing, directing, and controlling maintenance work.

*Work-order-and-report-forms.* The best way to get the facts needed to help manage maintenance work is by following work reporting procedures. Work reporting usually involves two work forms and a daily reporting procedure. One work form—a *work-order-and-report form*—is a daily report prepared either by the employee doing the work or by the O&M manager. Figure 4 shows a completed work-order-and-report form and the facts that should be recorded on the form.

*Using work orders.* Small-to-medium-size O&M organizations should use some kind of work report form to record all field work. A work-order-and-report form is organized by activity, which means that two to eight reports might be needed during the day to account for all field work. For example, Figure 4 indicates that one employee spent eight hours on five service requests. If three other employees work all day collecting solid wastes, another form will be needed. If another employee reads meters, a third form will be required.

Some O&M organizations use separate work order forms to support the invoices they send to customers for service requests. Other O&M organizations simply lump all of the service requests together (as is the case in Figure 4). In any case, it is important that the labor and materials for each job be recorded daily.

*Work report logs.* The second work form is an O&M *work report log*. This log is completed daily and shows what work was done and how employee time was spent. The information needed for the O&M log comes from two sources: (1) work-order-and-report forms, and (2) the O&M manager's knowledge of who was doing what work. Figure 5 shows the front of a typical O&M work report log for six employees. The form indicates the transactions that transpired on a particular day. (The back of the work report log should be used to report unusual events or emergencies and to document the cost of the work performed.)

*Maintenance-work performance record.* How much work is being done and where is employee time being spent? Usually, once a month it is a good idea to summarize the work quantities and man-hours reported on the daily operations and maintenance logs. A *maintenance-work performance record*, similar to the one shown in Figure 6, summarizes work activity information for the month and year-to-date.

Notice that the performance record shows the number of man-days worked rather than man-hours. Man-hours reported on the O&M work report log are converted to man-days to simplify record keeping. To determine the number of man-days, divide the number of man-hours worked by the number of working hours in the day. For example, 72 man-hours worked divided by eight working hours in a day equals nine man-days.

## Setting Specific Service Levels

So far, the procedures for establishing service levels for maintenance work have involved (1) defining maintenance activities and work units and (2) reporting and summarizing work. The third step is to establish a level of service for each maintenance activity or partial maintenance activity.

*Goals and service levels.* The general goals stated in O&M policy statements (see Figure 2) are needed to provide overall guidance for performing maintenance activities. However, they are not very helpful in managing specific maintenance work on a day-to-day or month-to-month basis. For example, how much maintenance work is needed to preserve the investment made in water and wastewater facilities and equipment? Should the organization do more preventive maintenance than corrective work? To answer these questions, general goals must be translated into specific goals for activities that can be measured.

CENTERVILLE Work Order and Report			Order Date: 8/5
			Report Date: 8/7
Activity Project: <i>Service Requests</i>			Activity No. 101
LOCATION: <i>(See Attached)</i>			
INSTRUCTIONS: <i>Try to complete all 5 of the attached requests by 8/8</i>			
LABOR		EQUIPMENT	
Name	Hours		Type
	Reg	O/T	
<i>Artie Stubbs</i>	<i>8</i>		<i>Service Truck 07</i>
Cost:			Cost:
MATERIALS			
Description	Unit	Amount	Cost
<i>Coupling</i>	<i>2</i>		
<i>Meter</i>	<i>1</i>		
ACCOMPLISHMENT			
QUANTITY: <i>5</i>		UNIT: <i>Service Requests</i>	

FACTS NEEDED

1. The name of the activity and the activity number.
2. The person performing the work and a description of the equipment and materials used.
3. The number of hours assigned for labor and equipment.
4. The amount of work completed.

Figure 4 O&M Work-Order-and-Report Form for Maintenance Work



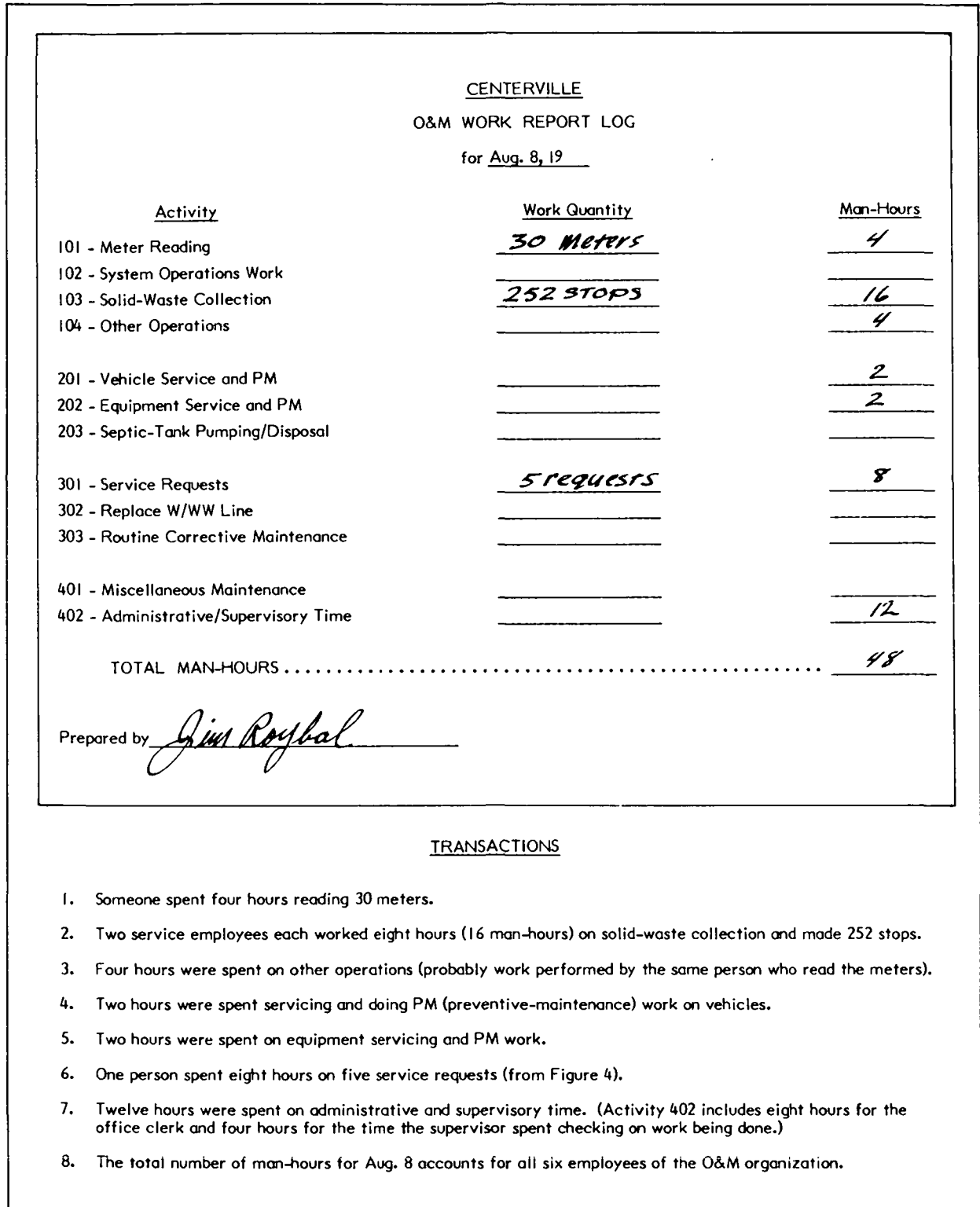


Figure 5 O&M Work Report Log

<u>CENTERVILLE</u>				
O&M MAINTENANCE-WORK PERFORMANCE RECORD				
for <u>January 1, 19</u> to <u>March 31, 19</u>				
<u>Activity</u>	<u>Work Quantity</u>		<u>Man-Days</u>	
	<u>This Month</u>	<u>To Date</u>	<u>This Month</u>	<u>To Date</u>
101 - Meter Reading (meters read)	120	360	2	8
102 - System Operations Work			19	44
103 - Solid-Waste Collection (stops)	504	1,512	5	25
104 - Other Operations			2	8
201 - Vehicle Service & PM			2	6
202 - Equipment Service & PM			8	33
203 - Septic-Tank Pumping (tanks)	6	20	3	6
301 - Service Requests (number)	40	145	50	110
302 - Replace W/WW line (lin. ft.)	84	84	3	3
303 - Routine Corrective Maintenance			5	15
401 - Miscellaneous Maintenance			5	23
402 - Administrative/Supervisory Time			<u>23</u>	<u>73</u>
	TOTAL MAN-DAYS.....		127	354

Figure 6 O&M Maintenance-Work Performance Record

- | <u>CENTERVILLE</u>             |  |
|--------------------------------|--|
| O&M MAINTENANCE SERVICE LEVELS |  |
| 1.                             | All valves and hydrants will be exercised two times a year.  |
| 2.                             | The O&M organization will respond to "water-related" service requests within 12 hours of the request.    |
| 3.                             | Customers will be notified in advance of any planned interruptions in service.                           |
| 4.                             | At least 620 man-hours per year will be allocated to vehicle servicing and preventive maintenance.       |
| 5.                             | All submersible pumps will be inspected four times per year in accordance with the O&M manual.           |
| 6.                             | Grass and weeds around the lagoon will be cut and removed at least four times during the growing season. |
| 7.                             | Residential septic tanks will be pumped once every six months.   |

Figure 7 Service Levels for O&M Maintenance Work

*Maintenance service levels.* Figure 7 shows several service levels for maintenance work. Notice that the service levels shown in the figure satisfy three requirements. They are: (1) *specific* so that they can be related to maintenance activities or parts of activities; (2) *measurable* so that as long as records are kept of the work being done, management can look back and measure whether or not the work got done; (3) *clear* so that employees who are doing the work can understand the service levels. When O&M organizations set these kinds of service levels, they are saying, "This is how much work we have to do to meet the goals of the town council's policy and maintain the community's water systems."

*Setting realistic service levels.* Maintenance service levels should be based on the work that the O&M manager and equipment manufacturers think will be needed to maintain the water systems and satisfy the O&M maintenance policy. Many times, however, differences exist between what the O&M manager thinks should be done and what the community can afford to have done. There may not be enough money to do all of the maintenance work that needs to be done. As a result, some service levels will need to be revised. For example, the O&M manager might want to respond to service requests within 12 hours, but conditions may be such that a 24-hour service level is the only realistic service level the community can afford.

The best way to make revisions in service levels is to take a close look at work reports and performance records. The following are examples of revising service levels so that they realistically meet the needs of the community.

- If the manufacturer recommends inspecting submersible pumps four times a year but O&M records show that the pumps have not been inspected in over two years, then it may not be realistic to plan on doing all of the proper inspections during the coming year.
- If the O&M organization has had no septic-tank problems when pumping once every six months, the O&M manager might revise the service level to once every 12 months, especially if the organization is doing a lot of corrective maintenance on other parts of the system.
- If O&M records show that the clerk was on sick leave more than anyone else, the O&M manager may want to increase the man-hours planned for administrative time or hire another clerk.

## MAINTENANCE PERFORMANCE STANDARDS ---

How well a job is performed (work quality) and the amount of work completed (job production) determine the cost of maintenance work. For example, if one employee reads 85 meters in one day without making any mistakes and another employee reads 100 meters in one day but makes eight mistakes in recording meter readings, the employee who reads 85 meters does a better job. He does not have to go back and correct mistakes. The quality of his work is better than the other employee, and the total cost is lower, since the cost of going back to correct mistakes is greater than the savings from the higher productivity rate. As another example, a maintenance crew that replaces 84 ft (26 m) of water line in a day may be doing a good job in terms of job production. However, if the crew does not properly backfill the trench, the new line will not last, and the crew will have to do the work over again. The cost of doing the same work again will reduce the amount of money available for other important maintenance services.

### Productivity

Productivity is the relationship between the amount of effort that is put into work and the amount of work that gets done. Productivity on a certain kind of work can be determined by dividing the number of work units by the number of man-hours required to do the job. For example, if 360 meters are read by one person in 60 hours, the productivity is 6 meters per man-hour ( $360 \div 60$ ). If 84 ft (26 m) of water line are replaced by three people working 8 hours (24 man-hours), the productivity is 3.5 ft (1.1 m) per man-hour ( $84 \div 24$ ).

As productivity increases, the cost of work decreases. For example, if 10 meters are read per man-hour rather than 6 meters per man-hour, productivity will increase 60 percent, and the cost will probably decrease 25-30 percent. Likewise, if water lines are presently

being replaced at a rate of 3.5 ft (1.1 m) per man-hour and new procedures increase replacement rates to 7.0 ft (2.2 m) per man-hour, the productivity doubles and the cost can be cut almost in half. As long as the quality of maintenance work remains the same, any increase in productivity will reduce the cost of the work. The O&M manager's goal, then, is to increase productivity without reducing work quality. O&M manuals and maintenance performance standards can help O&M managers achieve this goal.

### O&M Manuals and Maintenance Performance Standards

A good O&M manual provides the kind of information needed to perform maintenance work properly. Some of the information is provided in maintenance checklists similar to the *daily maintenance checklist* shown in Figure 8. This checklist provides a handy reminder of the work that needs to be done every day. In addition, most O&M manuals supplement daily checklists with detailed descriptions of how to do the work.

*Maintenance performance standards.* Maintenance performance standards provide O&M managers with additional information that is useful in planning and controlling maintenance work. A maintenance performance standard describes the best way to do a job from a manager's point of view. It lists the number of employees who should be assigned to do the work, the equipment and tools that should be taken to the job site, and the productivity that should be expected. The information included in a maintenance performance standard is shown in Figure 9.

In the figure, the crew size, equipment/tools, and productivity estimate are based on properly maintaining Centerville's pumphouses. In another community, the productivity estimate might be two pumphouses per day rather than three, or the crew size might be two employees rather than one. The size of the crew, equipment/tools, and productivity estimate will vary, depending on travel distances to the pumphouses and the size and complexity of the pumphouses. As Figure 9 shows, the O&M manager must decide what combination of employees, equipment, and tools will be needed to accomplish specific kinds of maintenance work. A maintenance performance standard puts management decisions about the best way to do a certain kind of work on paper in

<p>O&amp;M DAILY MAINTENANCE CHECKLIST for <u>Pumphouse "A"</u></p>	
<ol style="list-style-type: none"> <li>1. Check and record chlorine residual.</li> <li>2. Check and record fluoride residual.</li> <li>3. Visually check chlorine and fluoride pumps for proper operation (especially if residual readings are low).</li> <li>4. Check chlorine and fluoride solution containers and fill if necessary.</li> <li>5. Check and record total meter reading and gpm reading on water source meter.</li> <li>6. Check and record water loop meter for flow in gpm.</li> <li>7. Check for leaks in plumbing, tanks, and lines. Repair if necessary.</li> <li>8. Check pumphouse for damage and perform general cleanup. (Put away scattered tools and spare parts.)</li> <li>9. Be sure all columns are completed on the daily record sheet.</li> <li>10. Check all equipment late in the day to be sure no problems develop at night.</li> </ol>	

Figure 8 Daily Maintenance Checklist From an O&M Manual

<u>CENTERVILLE</u>	
O&M MAINTENANCE PERFORMANCE STANDARD	
for <u>Pumphouses</u>	
1. Crew Size	1 employee
2. Equipment/Tools	Pickup truck Tool box Flashlight
3. Work Method	See Daily Maintenance Checklist in O&M manual
4. Productivity Estimate	3 pumphouses per day

Figure 9 Information Included in an O&M Maintenance Performance Standard

<u>CENTERVILLE</u>	
O&M MAINTENANCE PERFORMANCE STANDARD	
<u>Activity</u>	
Service Requests (Activity 301)	
Work performed in response to service requests from customers. Includes troubleshooting, repairs or replacements, rodding, and other work directly related to service requests.	
<u>Work Unit</u>	
Number of Requests	
<u>Crew Size</u>	<u>Equipment</u>
1 employee	1 pickup truck 1 tool box
<u>Work Method</u>	
Service requests will be checked by one employee, usually during normal working hours. The employee assigned to check the work should follow three guidelines:	
<ol style="list-style-type: none"> <li>1. If needed, call the customer and make arrangements to check the problem.</li> <li>2. Make a thorough check of the problem and, if possible, correct the problem on the spot.</li> <li>3. If the problem cannot be corrected, state the reason on the work-order-and-report form and then discuss the situation with the O&amp;M manager.</li> </ol>	
<u>Average Daily Productivity</u>	
3 to 5 service requests	
Approved by <u>Stuart Ball</u>	Date <u>2/3</u>

Figure 10 O&M Maintenance Performance Standard

terms of crew sizes, equipment/tools, and work methods. Figure 10 shows an O&M maintenance performance standard.

*What a maintenance performance standard means.* Maintenance performance standards establish guidelines for performing maintenance work. The O&M manager who developed the standard for service requests shown in Figure 10 wants only one employee to check out each service request because he knows that most service requests can best be handled by just one employee. The O&M manager also wants the service-request employee to take only a pickup truck and a tool box because he knows that for most service requests in his community, larger vehicles and other equipment are not usually needed. Finally, the O&M manager wants to be notified in case the work is not completed so that he can make arrangements to have the work completed as soon as possible.

*Using maintenance performance standards.* When used on a regular basis, maintenance performance standards help increase productivity without reducing the quality of the work being done. Each standard describes the work the O&M manager wants done and his expectations for daily productivity. Maintenance performance standards establish guidelines for the performance of maintenance work and take the guesswork out of day-to-day operations.

## Developing Maintenance Performance Standards

When developing maintenance performance standards, the O&M manager needs to make decisions about work methods, crew sizes, equipment, tools, materials, work quality, and job productivity. A good procedure to use when developing maintenance performance standards involves five steps: (1) deciding what work to standardize; (2) defining the maintenance activity or combination of tasks; (3) outlining work methods; (4) determining the resources—employees, equipment, tools, and materials—needed to perform the work; (5) estimating the average daily productivity.

*Step 1: Standardize Work.* As a general rule, maintenance performance standards should be developed for routine work that is done frequently or for major kinds of work that require a lot of employees and equipment. Several kinds of maintenance work fit into these categories. An O&M manager in a small-to-medium-size community might want to standardize such work as meter reading, solid-waste collection, equipment servicing, septic-tank pumping, service requests, and replacing water/wastewater lines.

*Step 2: Define the Maintenance Activity.* Most of the time, the activity definition used to plan, schedule, and report work can also be used to help develop a maintenance performance standard for the work. Solid-waste collection is a good example. The work is routine and performed frequently; an activity definition (such as the one shown in Figure 3) can be useful in standardizing the work.

Some activity definitions may need to be reworked to narrow the scope of the maintenance performance standard. For example, service requests can cover a wide variety of work. As a result, an O&M manager may want to define two or three kinds of service requests and develop a separate standard for each kind. Specifically, he might develop solid-waste-collection service requests, residential service requests, and commercial service requests. The maintenance performance standard for each kind of service request should take into account the differences in work methods, crew sizes, and equipment needs.

*Step 3: Outline Work Methods.* In this step the O&M manager should talk with subordinates about how each activity should be handled. Based on these discussions, he should decide upon the work method that seems to be best for each activity. In addition, the O&M manual can be used as a basis for discussing the steps that need to be taken to maintain facilities and equipment. During discussions, the O&M manager should talk about the management-related aspects of the work. For example, if a maintenance

performance standard is being developed for equipment servicing and preventive maintenance, the manager and his subordinates should discuss routing, scheduling, safety, and work quality.

*Step 4: Determine What Resources Are Needed.* How many employees and what equipment and tools are needed to perform each activity? The answer to this question depends on many factors, such as travel distances, the amount of work to be done, and the work experience of the employees assigned to do the work. When determining what resources are needed to perform the work, several rules should be applied: (1) The number of employees assigned to each activity will have an impact on productivity. Too many or too few employees will decrease productivity and increase costs. (2) Most routine maintenance work can be handled much more efficiently by one employee rather than by two or three employees. (3) Some kinds of work, such as replacing water lines, should be done by a crew of three to six employees.

During discussions, the O&M manager and his subordinates should review the work method developed in Step 3. Every aspect of the work method—the physical motions of each person on the crew and the equipment, tools, and materials to be used—should be discussed for each activity. Members of the group should try to visualize what would happen if one or two employees were added or taken away from the crew. Based on their analysis, the group should determine the crew size and the equipment and tools that should be included for each activity on the maintenance performance standard.

*Step 5: Estimate Average Daily Productivity.* The amount of maintenance work that gets done will vary from one day to another, but for planning purposes, the O&M manager and his subordinates should determine the average amount of work that can be completed daily. For example, if 80 meters can be read on a good day and only 40 can be read on a bad day, the average daily productivity should be set at approximately 60 meters. If the number of service requests that can be answered ranges from one to seven, the average daily productivity for service requests should be set at 3.5 requests. Existing records should be used to support the estimated productivity rates. The average daily productivity rates should be entered on the maintenance performance standard.

## Revising Maintenance Performance Standards

Maintenance performance standards are designed to be used on a day-to-day basis. As such, they should be revised six months after they are developed to refine the work methods, crew sizes, and average daily productivity estimates. The following steps should be used to revise maintenance performance standards.

1. Make sure that all work that should be covered by a maintenance performance standard is covered by a specific standard.
2. Review the activity definition to make sure that it is clearly stated.
3. Review work methods to determine if they are the best methods of performing the activities.
4. Make whatever changes are needed in crew size, equipment, tools, and materials, based on work records and the experience of the past six months.
5. Revise the average daily productivity estimates as needed.

It is a good idea for the O&M manager and his subordinates to review and discuss the revisions that need to be made in the standards. In addition, existing work records should be used to revise standards. For example, a review of completed work-order-and-report forms will provide information about actual crew sizes and average daily productivity. This information should be compared with each maintenance performance standard, and, if differences are noted, the group should consider (1) taking corrective action to bring actual results in line with the standard, (2) changing the standard, or (3) taking both corrective action and changing the standard.

## WORK PROGRAMS AND BUDGETS

A *work program and budget* is an annual estimate of the amount of maintenance work to be done and the amount of money needed to achieve O&M goals. It is based on an inventory of the vehicles and equipment being operated and maintained, specific service levels, and maintenance performance standards.

### A Maintenance Inventory

The amount of work that needs to be done to operate and maintain a water or wastewater system depends mainly on the age and size of the system. The age of a system is measured in years; the size of a system is measured by a maintenance inventory. A maintenance inventory consists of all O&M vehicles and equipment being operated and maintained, from pickup trucks to water tanks and lift stations.

*Taking a maintenance inventory.* Taking a maintenance inventory is usually a simple matter of rechecking or recounting the items that belong to the system. The amount of information that needs to be collected in a maintenance inventory depends on how job activities are defined. For example, if pumphouse maintenance has been defined as an activity, the inventory should list the number of pumphouses in the system.

*Inventory records.* An O&M maintenance inventory is shown in Figure 11. Notice that the inventory simply lists the items that are classified as O&M items. This list helps determine the amount of work recorded on an annual work program.

<u>CENTERVILLE</u>	
O&M MAINTENANCE INVENTORY	
<u>Water System</u>	<u>Number of Items</u>
Water Meters	360
Lineal Feet of Main Line (approx.)	63,400
Lineal Feet of Service Line (approx.)	4,200
Storage Tanks	4
Wells	10
Pumphouses*	4
Gate Valves	42
Hydrants	4
 <u>Wastewater System</u>	
Septic Tanks	250
Lineal Feet of Collection Line (approx.)	6,200
Lift Stations	2
Lagoons	2
 <u>Solid-Waste Collection System</u>	
Number of Pick-up Points (Route Stops)	300
 <u>Vehicles and Other Items</u>	
Pickup Trucks	1
Service Trucks	1
Dump Trucks	1
Tank Trucks	1
Backhoes	1
O&M Buildings	2
 *Includes two submersible pumps, an electrical-control system, a hypochlorinator, a fluoride saturator, a water meter, and two gate valves in each pumphouse.	

Figure 11 O&M Maintenance Inventory



## Developing an Annual Work Program

Maintenance inventories, service levels, maintenance performance standards, and man-day estimates are used to develop an annual work program that reflects the O&M organization's annual work load. Depending on the activity or the kind of maintenance work being planned, three different approaches to developing an annual work program are used: (1) a maintenance-inventory and service-level approach, (2) a records-and-experience approach, (3) a best-estimate approach.

*Maintenance-inventory and service-level approach.* Some kinds of work are easier to measure than other kinds of work. For work that is easy to measure, an annual work program can be prepared by using a simple calculation:

$$\text{maintenance inventory} \times \text{service level} = \text{annual work load}$$

For example, if a community has 360 water meters that need to be read four times a year, the annual work program should call for reading 1440 meters ( $360 \times 4$ ). If an O&M organization has 300 collection points (or stops) where solid wastes are picked up once each week, the annual work program should call for 15 600 stops ( $300 \times 52$ ). If five vehicles should have a preventive-maintenance (PM) inspection once each week, the annual work program should include 260 PM inspections ( $5 \times 52$ ). If 250 septic tanks should be pumped two times each year, the annual work program should note 500 septic-tank pumpings ( $250 \times 2$ ).

Notice that all of the quantities in the previous examples are related to specific activities in addition to maintenance-inventory and service-level information. Also, notice that the maintenance-inventory usually remains fixed: there are 360 meters and 300 collection points unless someone miscounted. The service level, however, is not fixed. The town council or O&M manager might decide that solid wastes should be collected only once every two weeks; or perhaps septic tanks need to be pumped only once each year. Service levels can be changed much more easily than the maintenance inventory.

*Records-and-experience approach.* Another approach used to estimate the amount of work to be done involves a combination of work records and experience. The work itself and the maintenance inventory may be well defined, but the service level is hard to predict. Service requests are a good example. There is no way to establish a fixed service level for service requests—there is no way to predict accurately the number of customers who will ask for help. About the best that can be done to estimate an annual work quantity for service requests is to look at the work records. Suppose that work records show that over a four-year period, the O&M organization handled the following number of service requests each year: 485, 510, 520, and 560 service requests. How many service requests might be estimated for the fifth year? Obviously, the number of service requests is increasing each year, so an appropriate estimate might be 600 service requests for the fifth year.

Work records can also be helpful in estimating the number of man-days to record as work units. To do this, the O&M manager should consider holidays, vacations, sick leave, and days devoted to training. If employee records show that each employee, on the average, misses 40 workdays each year for various reasons, then 40 man-days of absence should be included in the annual work program for each employee. For an O&M organization consisting of six employees, at least 240 man-days of absence should be included in the annual work program estimate.

*Best-estimate approach.* Some kinds of maintenance work may need to be estimated without the benefit of work records or experience. For example, a brand new pumphouse has no maintenance records to help the O&M manager estimate work quantity. In this case, the O&M manager must rely on his own good judgment to make a "best estimate" of the amount of work required.

### A Sample Annual Work Program

The information collected to prepare an annual work program needs to be incorporated into a written document, activity by activity. One way to do this is to prepare an annual work program similar to the one shown in Figure 12. Notice that parts of the program are calculated by using the maintenance-inventory and service-level information. Maintenance inventory times service level equals planned work quantity, as shown in activities 101 and 103. When no maintenance-inventory or service-level information is available, the program is stated only in terms of man-hours as shown in activities 102, 104, 401, and 402.

The work program also shows the number of employees needed to do the planned amount of maintenance work. The planned work quantity is divided by the average daily productivity (from the maintenance performance standard) to provide an estimate of the number of crew-days required. The crew-day estimate is based on work records and experience. A crew-day is one crew working one day, regardless of the size of the crew. A crew-day could be one employee working one day on meter reading or five employees replacing a water line in one day.

Another calculation is needed to determine the total number of man-days required. Man-days are calculated by multiplying the number of crew-days by the number of employees who will usually be assigned to do the work. Most O&M work requires only one employee, so for most activities, the crew-days and the man-days will be the same.

The total number of employees needed to perform maintenance work requires one more calculation. The total number of employees needed is calculated by dividing the number of man-days by the number of weekdays in a year (260). In the example in Figure 12, 1575 man-days are needed to perform maintenance work each year. Therefore, six employees are needed (1575 ÷ 260).

<u>CENTERVILLE</u>								
O&M ANNUAL WORK PROGRAM								
Activity	Work Units	Planned Service Level	Inventory Units	Planned Work Quantity	Average Daily Productivity	Crew-Days Required	Crew Size	Man-Days Required
101 - Meter Reading	meters	4 times/year	360 meters	1,440 meters	60 meters	24	1	24
102 - System Operations Work	man-hours	as needed				120	1	120
103 - Solid-Waste Collection	stops	52 times/year	300 stops	15,600 stops	150 stops	104	2	208
104 - Other Operations	man-hours	as needed				60	1	60
201 - Vehicle Service & PM	man-hours	52 times/year	5 vehicles	260 man-hours		33	1	33
202 - Equipment Service & PM	man-hours	see O&M manual				110	1	110
203 - Septic-Tank Pumping	tanks	2 times/year	250 tanks	500 tanks	6 tanks	84	1	84
301 - Service Requests	requests	as requested		600 requests	3 requests	200	1	200
302 - Replace W/WW Line	lin. ft.	900 ft./year	67,600 lin.ft.	900 ft.	100 lin. ft.	9	5	45
303 - Routine Corrective Maintenance	man-hours	as needed				75	1	75
401 - Miscellaneous Maintenance	man-hours	as needed				66	1	66
402 - Administrative/Supervisory Time	man-hours	as needed				550	1	550
TOTAL MAN-DAYS REQUIRED .....								1,575
TOTAL NUMBER OF EMPLOYEES NEEDED .....								6

Figure 12 O&M Annual Work Program

*A summary of procedures and calculations.* An O&M annual work program is prepared by using (1) a maintenance inventory, (2) maintenance performance standards, (3) service-level information, and (4) records that show what work is being done or where time is being spent, activity by activity. These four items and the best estimates by the O&M manager form the basis of an annual work program.

A review of the basic calculations used in preparing the annual work program is as follows:

- planned work quantity = service level × maintenance inventory
- crew-days = planned work quantity ÷ average daily productivity
- man-days = crew-days × crew size
- total number of employees needed = total man-days ÷ 260

### Preparing an Annual-Work-Program Budget

A maintenance budget, based on the annual work program and cost information, can be prepared to determine how much money will be needed to do the amount of maintenance work planned. A maintenance budget takes into account each activity and the number of crew-days planned for each activity. Small-to-medium-size O&M organizations can best calculate a maintenance budget by determining crew-day costs for each activity.

*Crew-day costs.* A crew-day cost is simply the total cost of keeping one crew on the payroll for one day, including salary, fringe benefits, equipment, materials, and overhead. For example, for meter reading, the crew-day cost is summarized as shown in Figure 13. The same approach shown in the figure can be used to calculate crew-day costs for other activities. The example in Figure 13 shows that it costs \$100 per crew-day to send one employee out in a pickup truck to read meters. Notice that the cost includes everything except vacations and leave—fringe-benefit costs that are usually estimated under administrative and supervisory time.

*Cost adjustments.* Crew-day costs need to be adjusted to account for changes that can be expected during the coming year. For example, a 10-percent salary increase or a 5-percent decrease in equipment costs needs to be included in the crew-day cost.

*Annual-work-program budget.* An annual work program shows planned service levels, work quantities, and crew-days. This information can be used to prepare a budget. For example, the annual work program in Figure 12 shows that 24 crew-days are needed to read meters. If the cost per crew-day is \$100, the total budget for that activity will be \$2400 (24 × \$100). If 104 crew-days will be needed to collect solid wastes and the crew-day

<u>CENTERVILLE</u>		
O&M CREW-DAY COST FOR METER READING		
<u>Item</u>	<u>Cost Per Day</u>	<u>Comment</u>
Salary for 1 employee	\$40	Total daily salary
Fringe benefits	\$15	Excluding vacations and leave
Pickup truck	\$25	Including depreciation
Overhead	\$20	Miscellaneous expenses
TOTAL COST PER CREW-DAY . . . . .	\$100	

Figure 13 Calculating Crew-Day Costs

cost is \$200, the total cost of the work will be \$20 800 (104 × \$200). The same kinds of calculations are made, activity by activity, to determine the amount of money needed to complete the annual work program. Figure 14 shows a sample O&M annual-work-program budget.

### Adjusting an Annual-Work-Program Budget

An effective annual-work-program budget shows the relationship between service levels and costs. It shows that a certain amount of work will cost a certain amount of money. The O&M manager can use an annual-work-program budget to show the town council how much money the O&M organization will need to successfully perform its duties. By reviewing the annual-work-program budget, town council officials can easily see how the money the O&M manager is requesting will be used.

As an example, when presenting the annual-work-program budget to the town council, an O&M manager can say, "If you want me to conduct a weekly preventive-maintenance inspection on our vehicles, our budget shows that it will cost about \$4000 per year. If you are satisfied with our handling of service requests, the cost next year for about 600 service requests will run about \$25 000 according to our budget."

*Increasing or decreasing the budget.* As shown in Figure 14, Centerville's annual-work-program budget of \$194 345 seems adequate to meet the community's needs. Suppose, however, that Centerville could not afford this budget. In this case, the annual-work-program budget would have to be adjusted.

To adjust the budget, the O&M manager must reduce the service level for one or more activities. For example, the O&M manager might suggest slowing down the response to service requests or eliminating them altogether. If town council officials are willing to accept slower responses to service requests or cease them completely, they can cut 100 man-days and \$12 500 out of the budget. This action may or may not be the best policy for the community, but at least town council officials will recognize the impact of not providing all of the money needed to complete the annual-work-program budget.

<u>CENTERVILLE</u>				
O&M ANNUAL-WORK-PROGRAM BUDGET				
<u>Activity</u>	<u>Planned Service Level</u>	<u>Planned Work Quantity</u>	<u>Crew-Days Required</u>	<u>Dollars Required</u>
101 - Meter Reading	4 times/year	1,440 meters	24	\$ 2,400
102 - System Operations Work	as needed		120	15,000
103 - Solid-Waste Collection	52 times/year	15,600 stops	104	20,800
104 - Other Operations	as needed		60	7,500
201 - Vehicle Service & PM	52 times/year	260 man-hours	33	4,125
202 - Equipment Service & PM	see O&M manual		110	26,250
203 - Septic-Tank Pumping	2 times/year	500 tanks	84	10,500
301 - Service Requests	as requested	600 requests	200	25,000
302 - Replace W/WW Line	900 feet/year	900 feet	9	7,020
303 - Routine Corrective Maintenance	as needed		75	12,500
401 - Miscellaneous Maintenance	as needed		66	8,250
402 - Administrative Supervisory Time	as needed		550	55,000
TOTAL CREW-DAYS REQUIRED .....			1,435	
TOTAL DOLLARS REQUIRED .....				\$194,345

Figure 14 O&M Annual-Work-Program Budget

## PLANNING AND SCHEDULING WORK ---

There are no easy ways to plan and schedule O&M maintenance work. Many O&M managers report that there are so many service requests and so many system breakdowns that work cannot be planned and scheduled. The problem is compounded by employees who do not show up for work, changes in work priorities, and changes in the weather. Many O&M managers work effectively around these problems by using some basic planning and scheduling techniques and common sense to get the right kind of maintenance work done at the right place and time.

### Basic Techniques of Planning and Scheduling

Planning and scheduling work is the process of (1) planning ahead, (2) establishing work priorities, (3) setting timetables for getting work done, and (4) assigning employees to the right job at the right place and time.

*Planning ahead.* Planning ahead involves making decisions in advance about who will do what work. An O&M manager needs to know the system operations, where the potential problems are likely to occur, the abilities of his employees, and what work can be planned and scheduled in advance. A routine operation, such as solid-waste collection, provides a good example of how an O&M manager should plan ahead. If collection routes have been laid out and service levels set in advance, solid-waste collection can usually proceed smoothly.

*Establishing work priorities.* When an O&M manager plans and schedules work, he also sets priorities—he recognizes that some work activities are more important than others. Some priorities are set by town council officials or by operating requirements. For example, town council officials may feel that solid-waste collection is more important than replacing a leaking water line. Naturally, the O&M manager will assign a high priority to the town council's preference. On a day-to-day basis, however, the O&M manager can assign work priorities based on the work that is most beneficial to the system rather than on town council preferences.

*Setting a timetable.* The process of setting a timetable involves estimating the amount of time needed to do a certain job. For example, the septic tanks on the south side of Centerville may need to be pumped sometime next week, and the work will take two days. The Centerville O&M manager should set a timetable for performing pumping operations.

*Assigning employees to do the work.* Assigning employees to the right job at the right place and time involves giving specific instructions to employees on a day-to-day basis. A good manager knows that before assigning work, certain questions have to be answered, such as: (1) What work should be done? (2) Where is the work to be done and when? (3) Who should do the work? (4) What equipment and tools are needed? (5) How long should it take to do the work?

### Why Plan and Schedule Work?

Good planning and scheduling leads to (1) *better decisions*—by planning maintenance activities ahead of time, more time becomes available to consider the nature of the work, to anticipate problems, and to determine how resources should be allocated; (2) *fewer interruptions*—good planning and scheduling reduce travel time, increase productivity, and increase the amount of time employees spend on the right work at the right place and time; (3) *better use of resources*—by thinking ahead, a manager can organize work so that it is done with the proper number of employees using the correct tools and equipment; (4) *less confusion*—the manager who lays out work ahead of time reduces the confusion associated with getting work started.

## Annual Work Programs and Scheduling

An annual work program was previously described as an annual plan of estimating the amount of maintenance work that needs to be done and the number of man-days required to do the work. An annual work program can be treated as a series of building blocks—blocks of man-days that determine the shape of the program. The first block or two in the program is usually work that is done every day. Other blocks of time are added to the annual work program, depending on how far ahead of time the work can be planned. For example, in the annual work program shown in Figure 12, about 1575 man-days are needed to do the amount of work estimated for the year. Can some of the work be planned weeks or months in advance? Can an O&M manager predict that certain kinds of work will need to be done on a routine, daily basis?

Using the annual work program shown in Figure 12, the Centerville O&M manager should total the number of man-days needed for work that is performed on a daily basis: *administrative/supervisory time* requires 550 man-days and *system operations work* requires 120 man-days. The total number of man-days required for work that is performed on a daily basis is 670 man days (550 + 120). The Centerville O&M manager should set aside a block of 670 man-days for daily work.

The Centerville O&M manager should then total the number of man-days needed for work that is performed on a weekly basis: *solid-waste collection* requires 208 man-days, *vehicle service and PM* requires 33 man-days, and *equipment service and PM* requires 110 man-days. The total number of man-days required for work that is performed on a weekly basis is 351 man-days (208 + 33 + 110). The Centerville O&M manager should set aside a block of 351 man-days for weekly work.

The total number of man-days required to perform both daily and weekly work is 1021 man-days (670 + 351). This figure represents more than 60 percent of the total work load. The Centerville O&M manager now knows that more than 60 percent of the work can be predicted in advance, and about 40 percent of the work needs to be planned specifically.

## Scheduling Procedure

The scheduling technique that works best for any given O&M organization depends primarily on the size of the organization and the kind of maintenance work being done. One procedure that seems to work well in small-to-medium-size O&M organizations involves seven steps: (1) identifying work needs; (2) documenting the need for work; (3) developing a backlog of work; (4) establishing maintenance work priorities; (5) establishing operations work priorities; (6) reviewing work needs with employees; (7) assigning work.

*Step 1: Identify Work Needs.* Identifying work needs is usually an easy task. Members of the community call attention to the need for maintenance work through service requests and complaints. In addition, the O&M manager and employees notice work that needs to be done to prevent or repair breakdowns. Finally, manufacturer guidelines specify that certain kinds of preventive maintenance and servicing are needed.

*Step 2: Document the Need for Work.* It is important that the need for maintenance work be documented in writing. Most O&M organizations have a method of writing service requests. The service request is usually taken over the phone, noted on a work request form, and then given to an O&M manager, who takes action. A simple *work-order-and-report form*, such as the one shown in Figure 15, offers some advantages over a phone note or a simple work request form. Notice that the work-order-and-report form is coded by Activity Number 301 to denote that the work order is a service request. (See Figure 14.) The code number helps classify and summarize maintenance work. The work-order-and-report form also provides space for specific instructions, which can

CENTERVILLE Work Order and Report			Order Date: <b>2/3</b>		
			Report Date:		
Activity Project: <b>Service Request</b>		Activity No. <b>301</b>			
LOCATION: <b>230 Mesa Drive</b>					
INSTRUCTIONS: <b>Mr. Kahn says there is</b>					
<b>Sand in his water. Take</b>					
<b>Water Sample and Check</b>					
<b>area for Signs of Problem.</b>					
LABOR			EQUIPMENT		
Name	Hours		Type	ID No.	Hrs.
	Reg	O/T			
Cost:			Cost:		
MATERIALS					
Description			Unit	Amount	Cost
ACCOMPLISHMENT					
QUANTITY: _____ UNIT: _____					

Figure 15 O&M Work-Order-and-Report Form for Maintenance Work

eliminate confusion. Finally, the same form is used to report what work was performed, who did the work, and how much work was accomplished.

A work-order-and-report form, or other similar work form, should be used by everyone on the O&M staff to document the need for maintenance work. The clerk who answers the phone should use a work form for recording service requests. The O&M manager who notices something that needs to be done should fill out a work form for the work that needs to be done. An operator who discovers a broken door knob should document the problem on a form. A maintenance worker who notices an oil leak in a small motor should either correct the leak immediately or document it on a work form. Work forms can reduce the overall volume of paperwork handled by the O&M staff and, at the same time, serve as service requests, work orders, work reports, and cost-accounting reports.

*Step 3: Develop a Backlog of Work.* Putting work needs in writing provides a reminder of what work needs to be done and creates a written backlog of maintenance work that needs to be scheduled.

*Step 4: Establish Maintenance-Work Priorities.* Maintenance-work priorities should be established on a weekly basis by sorting and organizing work orders according to who performs specific maintenance tasks. Work orders requiring more than one employee should be separated from those requiring only one employee. Work orders should then be given to each employee with work-order numbers assigned in order of priority, ranking maintenance work from most to least important.

*Step 5: Establish Operations-Work Priorities.* The procedures for establishing operations-work priorities are nearly identical to Step 4, with one exception—routine operations work that is performed every day does not need to be scheduled in the same way that maintenance-work priorities are scheduled. For example, if one employee spends half of every day checking and inspecting pumphouses, there is no need to prepare a work-order-and-report form for that work. Other routine operations, such as meter reading and solid-waste collection, should be scheduled in the same way as maintenance work—by preparing a work-order-and-report form and assigning priorities to the work.

*Step 6: Review Work Needs With Employees.* The O&M manager should discuss the maintenance work that needs to be done in the next week with each employee. He should make clear what work he wants done and the order in which he wants it done. During this time, he should also determine which jobs will require more than one employee.

*Step 7: Assign Work.* Each morning the O&M manager should review the scheduled work with each employee and make specific daily assignments. One or more work-order-and-report forms should be given to each employee before the day's work is started.

## An Alternative Scheduling Procedure

An alternative scheduling technique that seems to work well in small-to-medium-size O&M organizations involves the same seven steps previously described with one exception in Step 2—*Document the Need for Work*. The exception involves putting most of the annual work program on work-order-and-report forms and then filing the forms by month. A description of this procedure follows.

*Alternative Step 2.* O&M work programs provide an estimate of the number of crew-days that will be needed to achieve certain O&M goals. For example, the annual-work-program budget in Figure 14 shows that water meters will be read four times a year and that it will take 24 crew-days to do the work. For "planned work" such as this, a clerk simply prepares 24 work-order-and-report forms at the beginning of the year. The clerk enters the activity number (101) on all 24 forms and numbers the forms 1/24, 2/24, 3/24, and so on to 24/24. When this step is completed, the clerk has transferred the planned amount of meter reading to work-order-and-report forms that will be used to assign, report, and summarize work. The same process is used for all other activities that need to be done on a *periodic* basis—once-a-week, once-a-month, or once every three or six months.

Work orders completed from the annual work program at the beginning of the year are filed by month. For example, if meter reading is done four times a year, one-fourth or six work-order-and-report forms would be placed in folders labeled January, April, July, and September. The same filing process is repeated for all other periodic work until all work is distributed throughout the months of the year. At the beginning of each month, the O&M manager simply pulls the file for that month and merges the filed work-order-and-report forms with the backlog of forms he has accumulated while scheduling other work.

*Advantages of Alternative Step 2.* Transferring periodic maintenance work from the annual work program to work-order-and-report forms helps an O&M manager monitor



the progress being made toward achieving the goals of the annual work program. The work-order-and-report forms, prepared in advance and pulled monthly, increase a manager's chances of completing the annual work program as planned.

### Monitoring the Work Schedule

Is the scheduled work being done? Is the staff behind schedule? Do changes need to be made in the backlog schedule? Answers to these questions are part of monitoring the work schedule. The individual who scheduled the week's work needs to monitor the schedule by checking on work being done and making necessary adjustments. If work is proceeding properly, about 80 percent of the scheduled work should get done. The remaining work should be carried over to the following week.

Monitoring the schedule also involves making room for nonscheduled work. Almost every day, something happens to interrupt the work schedule—equipment may break down, a town council official may request unexpected maintenance work, or an employee may not show up for work. The O&M manager should make allowance for these situations, both when scheduling work and when monitoring the schedule.

*Scheduling boards.* Some O&M organizations use scheduling boards (such as the one shown in Figure 16) to keep all staff members aware of the status of scheduled work. The schedule board shown in Figure 16 has six clipboards for assigned work-order-and-report forms. Four clipboards are for normal maintenance work requiring one employee, one clipboard is for crew work that requires more than one employee, and one clipboard is used to hold completed work-order-and-report forms. This kind of scheduling board allows an O&M manager to tell at a glance how planned work is

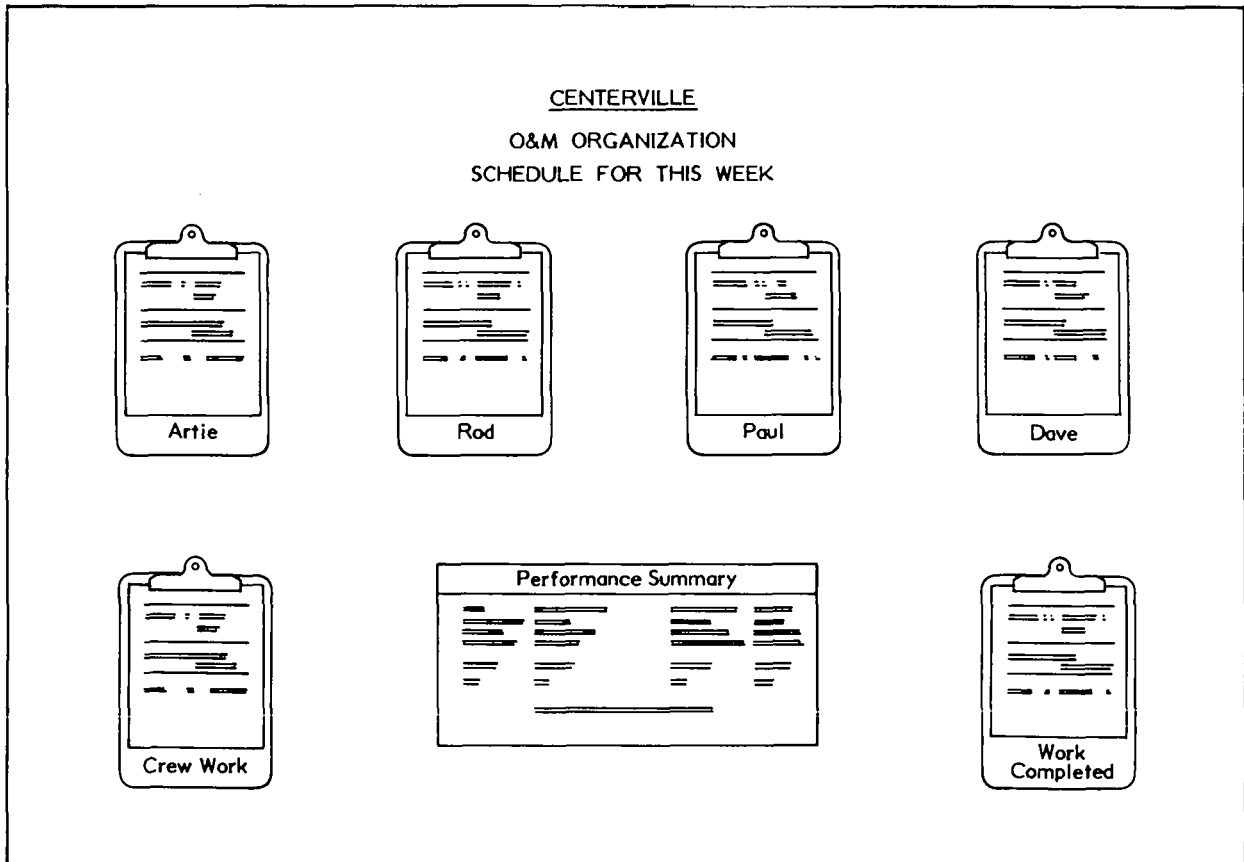


Figure 16 O&M Scheduling Board

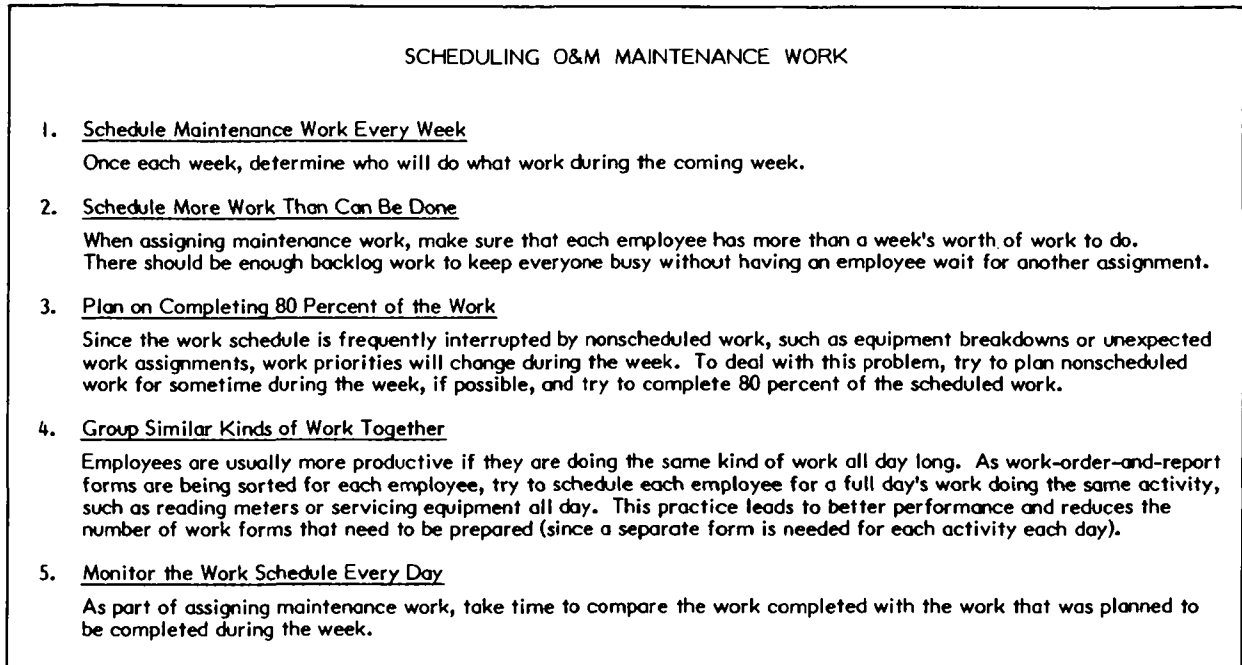


Figure 17 Tips for Scheduling O&M Maintenance Work

progressing. The clipboard system allows him to make changes in assignments just by moving work-order-and-report forms from one clipboard to another.

*Scheduling tips.* Maintenance scheduling is an important part of managing any O&M maintenance system. Figure 17 lists several important tips for scheduling maintenance work.

## CONTROLLING MAINTENANCE WORK

The process of controlling maintenance work involves (1) determining the results of work, (2) determining the differences between planned work results and actual work results, (3) evaluating work results, and (4) taking corrective actions. The work-control process keeps operations moving toward achieving the goals set by the O&M organization. The work-control process involves using work plans, maintenance performance standards, and work schedules to monitor the work being done. If there is a big difference between planned work results and actual work results, corrective action is needed.

### The Results of Maintenance Work

The results of a completed maintenance activity can be measured in terms of work quality, work quantity, man-hours, productivity, and costs.

*Work quality.* Work quality is measured simply by inspecting the completed work, such as inspecting the motor that has been replaced or the lagoon area that has been moved. Was the work done properly? Is the repaired motor running as it should? Are weeds and grass out of the water in the lagoon? An O&M manager should check on completed work routinely to maintain quality control.

*Work quantity and man-hours.* These two measurements are critical and should be monitored closely in terms of (1) whether or not the amount of maintenance work

estimated in the annual work program is being completed and (2) whether or not the man-hours were distributed as planned and recorded in the annual work program.

*Productivity and costs.* Productivity measurements can be made by dividing the quantity of work done by the number of man-hours required to do the work. The cost of maintenance work is usually measured in terms of dollars per activity or dollars per work unit.

### Maintenance Work Reports

Maintenance work reports provide the information needed to help control work. A work-order-and-report form (or a similar form) is used to collect information on what maintenance activity was performed, the amount of man-hours it took to do the work, and, in some cases, the quantity of work done. This daily report is summarized on a monthly record, such as the maintenance-work performance record shown in Figure 6. This performance record indicates the amount of work done and the actual man-days required to do each activity.

*Maintenance performance summaries.* Many of the facts needed to manage maintenance work can be provided by "planned/actual" work reports. These reports are called *maintenance performance summaries*. They summarize the difference between the work the O&M staff planned to do and the work actually accomplished. A typical O&M maintenance performance summary is shown in Figure 18. This summary compares planned/actual work data for work quantity, man-hours, and productivity over a six-month period. The activity name, work unit, and planned work quantity are taken directly from the annual work program shown in Figure 12. To determine the number of man-hours for the maintenance performance summary, the number of man-days shown in Figure 12 were multiplied by 8. Planned productivity is simply the work quantity divided by the number of man-hours. Actual work quantities and man-hours are

<u>CENTERVILLE</u>											
O&M MAINTENANCE PERFORMANCE SUMMARY											
for <u>January 1, 19</u> through <u>June 30, 19</u>											
Activity	Work Unit	Work Quantity			Man-Hours			Productivity			
		Planned	Actual	%	Planned	Actual	%	Planned	Actual	%	
101 - Meter Reading	meters	1,440	720	50	192	100	52	7.5	7.2	96	
102 - System Operation Work	man-hours				960	482	50				
103 - Solid-Waste Collection	stops	15,600	9,670	62	1,664	756	45	9.3	12.8	138	
104 - Other Operations	man-hours				480	201	42				
201 - Vehicle Service & PM	man-hours				260	62	23				
202 - Equipment Service & PM	man-hours				880	620	70				
203 - Septic-Tank Pumping	tanks	500	205	41	672	312	46	0.7	0.7	100	
301 - Service Requests	requests	600	525	88	1,600	750	47	0.3	0.7	233	
302 - Replace W/WW Line	lin. ft.	900	520	58	360	200	56	2.5	2.6	104	
303 - Routine Corrective Maintenance	man-hours				600	462	77				
401 - Miscellaneous Maint.	man-hours				528	222	42				
402 - Administrative/Supervisory Time	man-hours				4,400	2,100	48				
TOTAL MAN-HOURS .....					12,596	6,267	50%				

Figure 18 O&M Maintenance Performance Summary

summarized from periodic records, such as the maintenance-work performance record shown in Figure 6. Percentages are calculated to help interpret the data.

*Reading a maintenance performance summary.* An analysis of *Activity 101—Meter Reading* in Figure 18 reflects that the staff planned to read 1440 meters during the year. In one half of the year, the staff read 720 meters or 50 percent of the planned number of meters; 192 man-hours were planned for the project and 100 hours (52 percent of the planned hours) were actually reported. The resulting productivity for meter reading is 96 percent of the planned productivity, which is just below the planned productivity, based on the maintenance performance standard. The standard established 7.5 meters per man-hour as the planned activity goal; actual productivity is 7.2 meters per man-hour.

*Interpreting a maintenance performance summary.* Interpreting a maintenance performance summary involves (1) identifying significant differences between planned work results and actual work results, and (2) determining the necessary corrective actions to take. An interpretation of the maintenance performance summary shown in Figure 18 would be as follows:

1. What conclusions might be reached concerning the status of *Activity 201—Vehicle Service and PM*? The staff is not doing nearly as much vehicle PM work as was planned. The maintenance performance summary does not provide an explanation, but with only 23 percent of the planned hours allocated to the activity, the O&M manager should be concerned that planned vehicle maintenance not be neglected.
2. Is *Activity 203—Septic-Tank Pumping* on target? It appears that the actual number of tanks pumped is behind schedule for the number of tanks that were planned to be pumped. However, actual productivity is meeting the standard of 0.7 tanks pumped per man-hour. It seems appropriate that further evaluation of this activity is indicated.
3. The planned/actual work comparison related to *Activity 301—Service Requests* will be of interest to management and will require further investigation before all the facts are known. The staff has completed 88 percent of the planned number of service requests; the actual number of man-hours allocated to the activity is only 47 percent of the planned number of man-hours. As a result, productivity is 233 percent—more than double the planned productivity. Obviously, the staff is completing many more service requests in much less time than was planned. This fact suggests either that planned productivity was in error or that the nature of service work is changing. It will be important for the O&M manager to observe this activity over a longer period of time to determine whether the condition is a temporary trend or whether estimates should be revised.
4. Is *Activity 302—Replace W/WW Line* on target in terms of work quantity, man-hours, and productivity? According to the maintenance performance summary, this activity is progressing just about as planned. All three actual work results are close to the planned work results.

## Evaluating Results and Taking Corrective Action

Periodic performance reports are valuable sources of information that help O&M managers control maintenance work. However, any single report should be treated only as an "indicator" of work performance for that period. As soon as the reasons for differences between planned work results and actual work results are known, immediate corrective action should be taken. Various actions may be needed, from helping employees improve their performance to making minor changes in the annual work program.

Each major difference between planned work results and actual work results will

require a specific action, depending on the activity being analyzed, the employees doing the work, and other factors. It is important to remember that the only purpose for setting work standards, recording and evaluating results, and, if appropriate, altering the work plan, is to ensure that the O&M organization will achieve its goals with the resources it has available.

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# ACCOUNTING AND BUDGETING

# 5

Accounting is the process of recording and summarizing business transactions that affect the financial status of an O&M organization. It is an important tool for analyzing and monitoring revenue and expense activities and for interpreting the financial condition of the organization. Budgeting is the art of interpreting the O&M organization's goals in meaningful monetary terms. It should be used to control the financial activities of the organization.

This chapter discusses some of the more important accounting principles and practices that managers of small-to-medium-size O&M organizations need to know. A glossary has been provided at the end of the chapter to provide an easy reference of accounting terms and concepts. This chapter also discusses the importance of budgeting and shows how to skillfully and realistically prepare a budget, as well as how to use budgets as management tools for monitoring and controlling financial activities.

Upon completion of this chapter, you should be able to:

- Describe the various uses and functions of an accounting system.
- Establish a basic chart of accounts for your organization.
- Describe the impact that various transactions have on financial statements.
- Read and interpret simple accounting reports, such as income statements, balance sheets and cash-flow summaries.
- Explain the importance of using an annual O&M budget as a management tool.
- Identify three types of budgets and explain the purpose of each type.
- Discuss the steps and considerations that should be examined in preparing an operating budget.

## ACCOUNTING PROCEDURES

How is the O&M organization doing financially? How much revenue is being received and where is it being spent? Is there enough money to pay the bills, or is there a need to borrow money? A good accounting system can provide answers to these and other questions about the financial condition and requirements of an O&M organization.

### Personal and Business Accounting

A good example of basic accounting principles in action is an individual's personal checkbook. Checkbook accounting simply records deposits made to a bank and checks that are written. Figure 1 shows typical entries made by John Norton, a Centerville resident, in his personal checkbook for each banking transaction. As the figure shows, John Norton made a deposit (one *transaction*) on June 6. During the next few days, he wrote three more checks. Each check was a separate transaction that decreased his balance. Transactions from a simple, *single-entry accounting system*, such as a checkbook, can be classified and summarized at the end of the calendar year to show where money is being spent. For example, all of the checks Norton writes to the grocery store for food throughout the year can be grouped together and summarized. The same kind of grouping and summarizing can be done for deposits and other expenses.

*Personal accounts and statements.* At the end of the calendar year, John Norton classified and summarized his income and expenses as shown in Figure 2. As the figure shows, Norton prepared a summary of his income and expenses that shows the money he received and where it was spent. Each item, such as rent and car expenses, is called an *account*. As Figure 2 shows, Norton used 12 accounts: one for income, one for savings, and 10 for personal expenses.

*Business transactions and statements.* John Norton decided to start his own part-time auto-repair business. He rented an old service station, put up a sign, and bought some new tools and supplies. During the first month he was in business, he set up a simple accounting system for his auto-repair service and recorded all of the transactions for the month of June in a *journal*. His business transactions are shown in Figure 3. It should be observed that all transactions are recorded chronologically as journal entries. Journal entries contain a brief description of business transactions and record an amount or value for each transaction.

RECORD ALL CHARGES OR CREDITS THAT AFFECT YOUR ACCOUNT									
NUMBER	DATE	DESCRIPTION OF TRANSACTION	PAYMENT/DEBIT		✓ FEE (IF ANY)	DEPOSIT/CREDIT		BALANCE	
			\$			\$		\$	
-	6/6	Deposit				661	23	661	23
101	6/7	Panley's Food and Drug (groceries)	81	33				81	33
								579	90
102	6/11	McKay's Radio and TV CTV PAYMENT	100	00				100	00
								479	90
103	6/13	Tower's Department Store (weight set)	26	10				26	10
								433	80

Figure 1 Entries in a Personal Checkbook

<u>JOHN NORTON</u>	
INCOME AND EXPENSES	
<u>Gross Income from Wages</u>	\$15,600
<u>Less Personal Expenses</u>	
Rent	\$3,850
Food	3,600
Car Payments	1,020
Car Expenses (Gas & Oil)	1,550
Electricity and Water	620
Clothing	760
Vacation (Trip to Phoenix)	810
New TV Set	450
Taxes	1,750
Other Expenses	<u>460</u>
Total Expenses	<u>\$14,870</u>
NET INCOME (DEPOSIT TO SAVINGS).....	\$730

Figure 2 Classification and Summary of Personal Income and Expenses

<u>NORTON'S AUTO-REPAIR SERVICE</u>	
BUSINESS TRANSACTIONS	
for the month of <u>June</u>	
<u>Transactions</u>	<u>Amount</u>
1. Invested \$1000 in business and established business checking account (6/1)	\$1,000
2. Paid rent on service station (6/1)	160
3. Paid Doc's Sign Co. for painting sign (6/6)	50
4. Paid JC's Tool Co. for tools (6/7)	300
5. Paid Rose's Auto Supply for supplies (6/7)	68
6. Received money for tune-up on Mac's car (6/10)	61
7. Received money from Jim for an engine overhaul (6/17)	380
8. Paid Valley Power Co. for electricity (6/28)	21
9. Received invoice for supplies purchased from Rose's Auto Supply (6/28)	22
10. Received money from D.G. for replacing head gasket (6/29)	80
11. Paid myself \$6 per hour for 20 hours (6/30)	120

Figure 3 Small Business (Accounting) Transactions



*Income statements.* At the end of June, Norton classified and summarized the business transactions of his auto-repair service and prepared an *income statement* for the month of June (shown in Figure 4). Notice that the income statement for Norton's Auto-Repair Service is very similar to Norton's summary of personal income and expenses (see Figure 2). Both the income statement and the summary of income and expenses serve the same purpose—Norton's income and expenses are summarized at the end of a specified period of time. The process of classifying and summarizing income and expenses shows whether total income exceeds total expenses (*net profit*) or, conversely, whether total expenses exceed total income (*net loss*). For this reason, income statements are sometimes referred to as *profit and loss statements*.

As Figure 4 shows, total expenses for supplies in June amounted to \$90, but only \$68 payment was made (see Transaction 5—Figure 3). Determining the expense of supplies for the period in which they are used, regardless of whether payment is made, involves the concept of accounting on the *accrual basis*. Figure 4 also shows an expense for *depreciation* in the amount of \$5 for the month of June. The charge for depreciation did not result from a business transaction, nor did it involve a cash expenditure as did other expense transactions, such as rent and wages. The depreciation expense is an *adjusting entry* for the expense of assets (such as tools, purchased under Transaction 4—Figure 3) that have a useful life beyond the current operating period. The net income or profit shown in Figure 4 is \$75. This profit represents an increase of equity (recorded on the *balance sheet* shown in Figure 5).

*Balance sheet.* A balance sheet is a financial statement that reports the final balances for asset accounts, liability accounts, and equity as of a certain date. *Asset accounts* are used to record anything of value that is owned by or owed to the organization, such as cash (in the form of *accounts receivable*), inventory, equipment, vehicles, or property. *Liability accounts* reflect obligations or debts owed to others. These accounts (referred to as *accounts payable*) usually cover purchases made on a time-payment basis, notes, interest, wages, and taxes payable. *Equity* is the difference between total assets and total liabilities ( $E = A - L$ ). Equity is a concept used to measure the value or worth of a business and is sometimes referred to as *owner's equity*, *net worth*, or *net capital*.

<u>NORTON'S AUTO-REPAIR SERVICE</u>		
INCOME STATEMENT		
for the month of <u>June</u>		
<u>Income (Revenue from Customers)</u>		\$521
<u>Less Business Expenses</u>		
Wages	\$120	
Rent	160	
Supplies	90	
Electricity	21	
Other (Sign)	50	
Depreciation	5	
 Total Expenses		 <u>\$446</u>
 NET INCOME (NET PROFIT).....		 \$75

Figure 4 Small Business Income Statement

<u>NORTON'S AUTO-REPAIR SERVICE</u>			
BALANCE SHEET			
as of <u>June 30, 19</u>			
<u>Assets</u>		<u>Liabilities</u>	
Cash (in bank account)	\$802	Accounts Payable	<u>\$22</u>
Tools	300	TOTAL LIABILITIES .....	\$22
Less Accumulated Depreciation	<u>5</u> <u>295</u>	Equity (Net Worth) .....	<u>\$1,075</u>
TOTAL ASSETS .....	\$1,097	TOTAL LIABILITIES PLUS EQUITY .....	\$1,097

Figure 5 Small Business Balance Sheet

After preparing the income statement for the month of June (an operating period covering business activities from June 1 to June 30), John Norton prepared a balance sheet as of June 30 to reflect the financial condition of his business on the last day of the operating period. Figure 5 shows the balance sheet Norton prepared for his auto-repair service for the month of June. As the figure shows, two asset accounts—*cash* and *tools*—were recorded on the books at a total value of \$1097. The cash balance of \$802 resulted from Norton's original \$1000 investment (which was deposited in the bank), plus \$521 of income received from services rendered (Figure 4), minus \$719 in payments made for tools and operating expenses (items 2, 3, 4, 5, 8, and 11 in Figure 3). Although tools are subject to depreciation, they are valued at their purchase price (\$300 in Norton's case). The amount of depreciation for Norton's tools (\$5) represents an expense that is recorded for the current operating period and is reflected as such in the income statement. The *undepreciated balance* of Norton's tools (\$295) is called the "book value." *Accumulated depreciation* is an offsetting asset account.

The balance sheet shown in Figure 5 also shows that the only outstanding liability was \$22 from an unpaid invoice (Transaction 9—Figure 3). The net worth (equity) of Norton's business is shown in Figure 5 to be valued at \$1075—using the formula  $E = A - L$  ( $\$1097 - \$22 = \$1075$ ). It should also be noted that total assets equal total liabilities plus equity ( $A = L + E$ ). This calculation is called the *accounting equation* and is used to ensure that assets, liabilities, and equity balance.

*Double-entry accounting.* Double-entry accounting is a procedure that requires that each transaction be recorded to at least two accounts; that is, for every increase or decrease in one account, there must be an equal or offsetting increase or decrease in another account. Double-entry accounting also refers to transactions being recorded in the journal and then "posted" to the ledger or ledger accounts. It is important to know that the double-entry accounting method provides a check-and-balance on every transaction recorded since equal or offsetting values are recorded to at least two accounts. Figure 6 shows examples of how each of John Norton's business transactions in June were recorded to two accounts. At the end of the accounting period, the account balance resulting from business transactions appears either on the income statement or on the balance sheet.

*Accounting on the accrual basis.* Accounting on the accrual basis allocates income and expenses to the accounting period in which income was earned or expenses incurred,

<u>NORTON'S AUTO-REPAIR SERVICE</u>		
BUSINESS TRANSACTIONS		
for the month of <u>June</u>		
<u>Transaction 1</u>	Made investment and established business checking account.	
	Cash Account	\$1000
	Equity Account	1000
<u>Transaction 4</u>	Purchased tools.	
	Cash Account	300
	Tools Account	300
<u>Transaction 5</u>	Purchased supplies.	
	Cash Account	68
	Supplies Expense Account	68
<u>Transaction 9</u>	Purchased supplies on account.	
	Supplies Expense Account	22
	Accounts Payable Account	22
<u>Adjusting Journal Entry</u>	Depreciated tools for the month of June.	
	Depreciation Expense Account	5
	Accumulated Depreciation--Tools Account	5

Figure 6 Examples of Double-Entry Accounting for a Small Business

regardless of whether income was received or payments made. Therefore, in the case of supplies, it must be assumed that Norton used all of the supplies purchased during June since the total purchase value for supplies (\$90) is shown on the income statement. In contrast to this assumption, assume that the ending inventory for supplies on hand was valued at \$40. If the accrual method of accounting is used, the income statement would reflect a supplies *expense* of \$50; the balance sheet would reflect a supplies *asset* of \$40.

*Accounting on the cash basis.* Rather than recording his business transactions on the accrual basis, Norton could have elected to account for his transactions on a cash basis. When accounting on a cash basis, income and expenses are recorded only when cash is received or disbursed, regardless of the operating period in which income was earned or expenses were incurred. In the case of Transactions 5 and 9 (Figure 3), if Norton had accounted for his transactions on a cash basis, the income statement would have shown a supplies expense of \$68. In this case, there would be no balance for the asset account or liability account shown on the balance sheet because: (1) When accounting on a cash basis, supplies are fully *expensed* (the total value of supplies is recorded as an expense) when payment is made. Therefore, the need to inventory supplies is eliminated since accounting on a cash basis has no bearing on when the supplies are consumed—only on when cash is disbursed. As a result, there is no need to establish an asset account. (2) For the liability account (accounts payable), payment would probably be made on or around July 10, and the transaction would not be recorded until that time.

*Accounting on an accrual basis versus accounting on a cash basis.* The accrual method of accounting systematically matches income and expenses to specific accounting periods. Since the accrual method recognizes income and expense activities during the period in which they occur, income and expenses are neither overstated nor understated. Accounting on a cash basis, on the other hand, can grossly overstate or understate income and expenses because it has no relationship to when the activity occurred. In the case of supplies, the expense of supplies would have been understated by \$22 since Norton actually used all of the supplies purchased during June.

Overstating or understating expenses can be detrimental to a small-to-medium-size O&M organization because these practices create an inverse effect on net income for the current and succeeding accounting periods. For example, if expenses for supplies are understated in June, net income will be overstated. This would have been the case had Norton elected to account for business transactions on a cash basis. The consequences of understating expenses and overstating net income in June would inversely carry over to the July operating period. Payment for supplies made on account in July would overstate expenses (since all supplies were consumed in June) and understate net income.

*Depreciation.* Depreciation is a method of systematically assigning a portion of the costs of assets as an expense to the current accounting period. The periodic charge for depreciation is made over the useful life of assets by adjusting entries at the end of each accounting period. Norton estimated the useful life of the tools valued at \$300 to be five years and established his depreciation schedule accordingly. The five-year period is equivalent to 20 percent of the original cost of the tools per year. Since the books are closed monthly, however, the amount for depreciation expense was determined by dividing the cost of the tools by 60 months, or \$5 per month. Had the adjustment for depreciation not been made, current operating expenses would have been understated, and net income for June would have been overstated.

*Using accounting information.* In general terms, accounting information should support the financial plans of an O&M organization. There are many uses for accounting information that has been prepared in statement or report form. Specific uses of accounting information are shown in Figure 7.

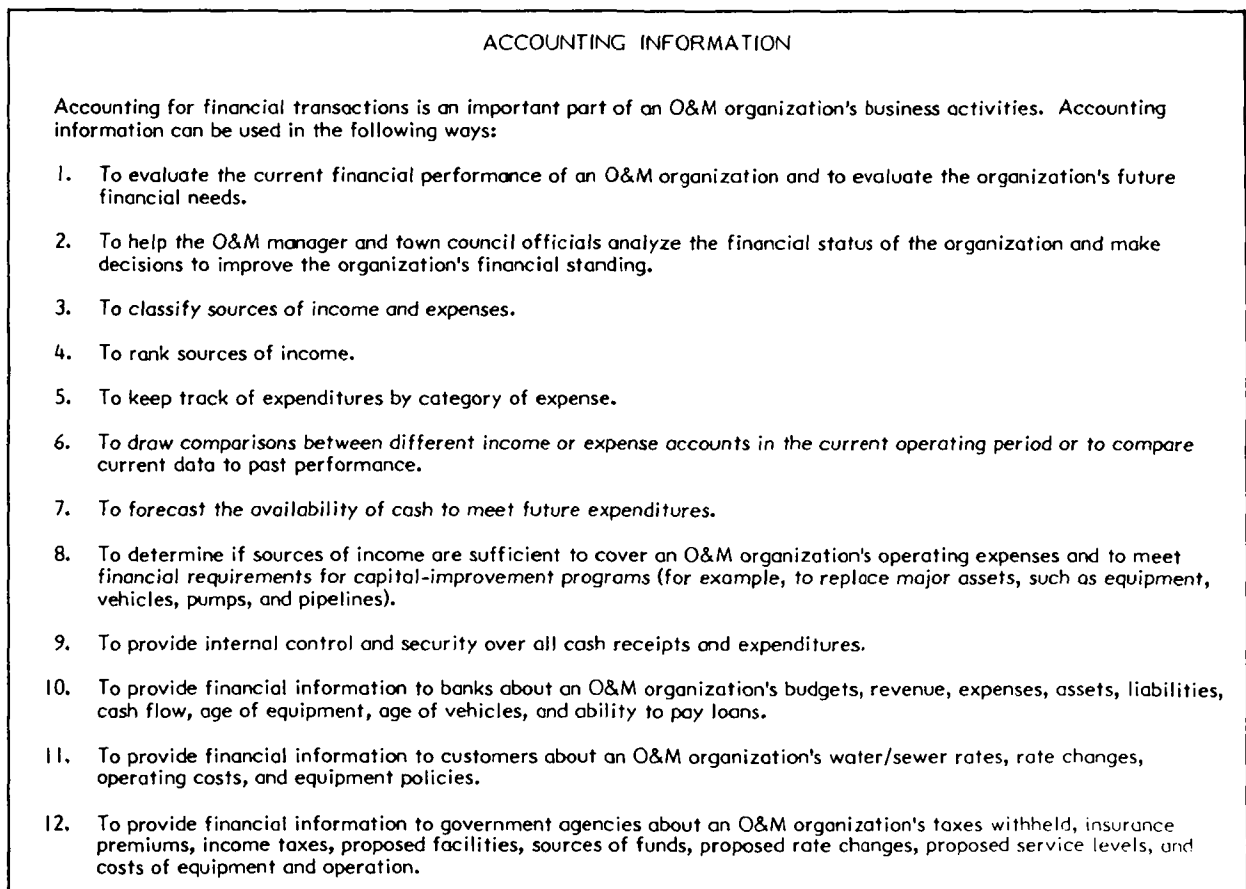


Figure 7 Uses of Accounting Information

## ACCOUNTING PROCEDURES FOR AN O&M ORGANIZATION \_\_\_\_\_

Before an O&M organization can begin recording business transactions, a system of accounts, called a *chart of accounts* needs to be established. A chart of accounts classifies assets, liabilities, equities, revenues, and expenses. Requirements governing charts of account differ from state to state. Because utilities establish their accounting structure on the basis of prescribed guidelines issued by appropriate regulatory agencies, a simplified accounting model will be used in this section to illustrate a system for classifying accounts. For specific requirements, state regulatory commissions and recommendations published by the National Association of Regulatory Utility Commissioners (NARUC) and the National Council on Governmental Accounting (NCGA) should be consulted. In addition to examining how an accounting structure is established, this section will discuss the O&M manager's role in identifying both reporting requirements and how the accounting structure can accommodate the informational needs of the O&M organization and other users of financial information.

### Establishing an Account Structure

It is important that O&M managers identify both the purpose for which accounting information will be used and the groups who will use the information. Whereas the O&M manager is not generally responsible for establishing a system of accounts, he is one of the most knowledgeable sources for identifying (1) the nature of operations—functions, activities, and services; (2) sources of income or potential income-generating sources; (3) future growth and development of facilities; and (4) how much accounting information is needed for various operating expenses. The process of establishing an account structure involves developing accounting guidelines based on an assessment of system operations.

*A chart of accounts.* A chart of accounts represents the accounting structure of a small business. The process of organizing a chart of accounts begins by assigning an account number to each of the five major classifications of accounts. An example of classifying accounts by account numbers is shown in Figure 8. Account numbers help identify accounts within a numerical range and aid in consolidating or combining related accounts by status, function, or activity. For example, asset accounts are usually listed in order of being current, fixed, or intangible assets. The ranking of assets also is an indicator of their liquidity—that is, how easily they can be converted to cash.

The next step in the process of developing a chart of accounts is to assign account titles to each account. Figure 9 shows the assignment of account titles to Centerville's accounts by account number. This chart of accounts for assets can now be used to record the transactions involving the acquisition, exchange, or removal of the O&M organization's assets. The same listing of account titles will appear on the balance sheet with ending balances.

As a general rule, large O&M organizations need a fairly detailed accounting structure, whereas small-to-medium-size O&M organizations require fewer accounts. The accounting structure shown in Figure 9 could conceivably satisfy the needs of a small O&M organization. However, the information disclosed may be insufficient. For example, the total value of cash recorded may not differentiate between cash-on-hand, petty cash, or restricted cash (a funded account for debt retirement). Inventory is another area where detailed information is essential to support operating and maintenance activities. Charging inventories of all types of supplies to a single account is generally inadequate without a backup system for classifying inventories by type or function. In the same way, a value assigned to *Account 140—Plant Equipment* would be regarded as the total value of equipment in service. But Account 140 is not descriptive of the utility's operations. To be descriptive, equipment should be itemized to reflect the value of holdings that can be assigned to source of supply, treatment, and distribution

A SAMPLE CHART OF ACCOUNTS

<u>Account Numbers</u>	<u>Account Classification</u>
100 - 199	Asset Accounts
200 - 299	Liability Accounts
300 - 399	Equity Accounts
400 - 499	Income Accounts
500 - 599	Expense Accounts

Figure 8 Classifying O&M Accounts by Account Number

CENTERVILLE  
CLASSIFICATION OF O&M ASSETS

<u>Account No.</u>	<u>Account Title</u>
110	Cash
115	Accounts Receivable - Water Sales
116	Accounts Receivable - Other Sales
120	Accrued Interest Receivable
130	Materials-and-Supplies Inventory
140	Plant Equipment
141	Accumulated Depreciation - Plant Equipment
160	Plant Buildings and Structures
165	Wells and Well Structures
170	Reservoirs
180	Land

Figure 9 Assigning O&M Account Titles by Account Number

CENTERVILLE  
O&M ACCOUNTING STRUCTURE

<u>Account No</u>	<u>Account Title</u>	<u>Amount</u>
140	SOURCE OF SUPPLY	\$500,000
141	Pumping Equipment	\$XXX
142	Building and Structures	XXX
143	Wells and Well Structures	XXX
144	Transmission Mains	XXX
145	Land	XXX
146	Land Improvements	XXX
147	Reservoirs	XXX
		<u>\$500,000</u>

Figure 10 A Detailed O&M Accounting Structure

operations. Figure 10 shows a detailed accounting structure for one segment of O&M operations—*source of supply*. The total value of assets allocated to the source of supply account is \$500,000, and subordinate asset accounts are now detailed in accounts 141-147.

The accounting structures for assets shown in Figures 9 and 10 can be applied to other major classifications of accounts. Figure 11 shows a simplified chart of accounts for a small-to-medium-size O&M organization's major types of accounts.

*Controlling and subsidiary accounts.* A principal function of an accounting system is to keep track of financial operations by keeping track of income and expense activities.

For many small-to-medium-size O&M organizations, the simplified chart of accounts shown in Figure 11 may be inadequate; some account activities may need to be expanded to improve the organization's accounting procedures. As discussed previously, it is a common accounting practice to lump similar items or activities under a single controlling account number for general reporting purposes (as is shown in Figure 10). However, for internal monitoring of income and expense activities, it is ideal if subsidiary account numbers and titles are established to provide better budget control and a more thorough analysis of accounting information.

As an example of the need for subsidiary account numbers and titles, consider *Account 220 - Maintenance Expense* in Figure 11. For most small-to-medium-size O&M organizations, a single account covering all maintenance functions would be unsatisfactory for the internal control of income and expense activities. Therefore, the O&M manager would probably recommend that additional accounts be set up to handle vehicle servicing and preventive maintenance (PM), equipment servicing and PM, routine corrective maintenance, and miscellaneous maintenance. The new accounts set up for this type of account structure are shown in Figure 12.

<u>CENTERVILLE</u>	
O&M CHART OF ACCOUNTS	
<u>Assets</u>	<u>Liabilities</u>
110 - Cash	210 - Accounts Payable
115 - Accounts Receivable - Water Sales	220 - Notes Payable (Current)
116 - Accounts Receivable - Other Sales	230 - Accrued Wages and Salaries
120 - Accrued Interest Receivable	240 - Accrued Interest Payable
130 - Materials and Supplies	250 - Sundry Payables and Accruals
140 - Plant Equipment	270 - Customers' Deposits
141 - Accumulated Depreciation - Plant Equipment	290 - Improvement Bonds
160 - Plant Buildings and Structures	294 - Notes Payable
165 - Wells and Well Structures	
170 - Reservoirs	
180 - Land	
<u>Equity</u>	
	301 - Reserve for Retirement of Bonds and Interest
	305 - Reserve for Replacement of Plant Equipment
	309 - Reserve for Construction
	370 - Retained Earnings
<u>Income</u>	<u>Expenses</u>
600 - Water Sales	501 - Wages and Salaries
601 - Industrial	502 - Fringe Benefits
602 - Commercial	510 - Administrative Expense
603 - Residential	515 - Billing and Collection Expense
620 - Other Sales	520 - Operating Expense
650 - Non-Operating Income	521 - Power
	522 - Materials and Supplies
	523 - Equipment
	524 - Vehicles
	550 - Maintenance Expense
	560 - Depreciation
	570 - Taxes and Insurance
	575 - Legal and Engineering Services
	580 - Miscellaneous Expense

Figure 11 A Simplified O&M Chart of Accounts

In Figure 12, notice that the 550 account series is structured the same as the 520 account series for operating expenses shown in Figure 11. *Account 520—Operating Expense* in Figure 11 is a *controlling account*. Account numbers 521-524 are subsidiary accounts under the primary account number (520), and the sum of their balances equals the controlling-account balance. If this type of accounting structure is used, the O&M manager will receive periodic reports on the subsidiary account balances, and for practical purposes, only the controlling-account balance, covering total operating expenses, will be reported in certain financial statements. If expenses are recognized as being part of various operations of the utility—source of supply, treatment, distribution, etc.—controlling and subsidiary accounts will be established for each of the areas of operation, as shown in Figure 13.

<u>CENTERVILLE</u>	
O&M CONTROLLING AND SUBSIDIARY ACCOUNTS	
<u>Account No.</u>	<u>Account Title</u>
550	MAINTENANCE EXPENSE
551	Vehicle Service & PM
552	Equipment Service & PM
553	Routine Corrective Maintenance
554	Miscellaneous Maintenance

Figure 12 O&M Controlling and Subsidiary Accounts

<u>CENTERVILLE</u>	
O&M CONTROLLING AND SUBSIDIARY ACCOUNTS	
<u>Account No.</u>	<u>Account Title</u>
570	DISTRIBUTION SYSTEM EXPENSE
571.0	Wages, Salaries, & Fringe Benefits
574.0	Operating Expense
574.1	Power Pumping
574.2	Materials and Supplies
574.3	Equipment
574.4	Vehicles
575.0	Maintenance Expense
575.1	Vehicle Service & PM
575.2	Equipment Service & PM
575.3	Routine Corrective Maintenance
575.4	Miscellaneous Maintenance
577.0	Depreciation Expense
578.0	Miscellaneous Expense

Figure 13 O&M Controlling and Subsidiary Accounts for Specific Operations



## ANALYZING FINANCIAL INFORMATION

The technical procedures involved in setting up an accounting system include (1) establishing and modifying a chart of accounts, (2) analyzing and recording transactions to accounts, (3) using end-of-period balances in the books for preparing financial statements and reports.

### Using Financial Information

To avoid some of the common pitfalls in analyzing and interpreting financial data, several guidelines should be followed.

1. Be sure that the accounting system provides thorough and accurate financial data.
2. A single financial statement or accounting data should not be considered "the absolute truth." Financial information of any kind may be a reasonably good indicator of the financial condition and performance of the O&M organization, but it may not convey all of the information necessary to fully assess financial performance or evaluate actual conditions from a nonaccounting perspective.
3. Financial data for any one operating period reflects an organization's financial condition at only one point in time. Comparing financial data with other periods of operation will often verify that the data falls within an acceptable range and that current financial performance is part of a trend. Comparative analysis can be effectively used to verify information or to indicate unfavorable variances from the desired trend.
4. Before jumping to what may be an erroneous conclusion, it is often appropriate to investigate and verify financial data with field operations.

An important part of planning is budgeting, which requires making cost projections for operations, maintenance, and capital-improvement programs. Data on the *income statement* and *balance sheet* can be reported in different ways to help better interpret the financial and operational performance of the O&M organization.

*Comparative income statements.* Frequently, comparative income statements are prepared to show changes in income and expense data between operating periods. Figure 14 shows a comparative income statement. Given the information shown in Figure 14,

<u>CENTERVILLE</u>				
O&M COMPARATIVE INCOME STATEMENT				
for operating periods <u>1980 and 1981</u>				
		<u>1980</u>		<u>1981</u>
<u>Income from Water Sales</u>		\$369,000		\$342,000
<u>Operating Expense</u>				
Wages, Salaries, and Fringe Benefits	\$52,000		\$56,400	
Operating Expenses	74,200		91,500	
Maintenance Expenses	93,100		80,100	
Depreciation	10,700		11,000	
Miscellaneous Expenses	<u>16,000</u>	<u>246,000</u>	<u>18,000</u>	<u>257,000</u>
NET INCOME .....		\$123,000		\$85,000

Figure 14 O&M Comparative Income Statement

the O&M manager should be alerted to examine income sources. Assuming that there was no change in the rate structure, *income* should have held relatively constant from one year to the next. On the other hand, it appears that nearly every category of utility operations increased in *expense*. In addition, it can be assumed that in order to meet the cash-flow requirements for operating expenses in 1981, maintenance activities and expenditures were curtailed.

*Recording income sources by customer class.* Income sources can be recorded by customer class to determine what percent of the utility's total income comes from each category of customer that is served by the utility. Figure 15 shows an accounting structure in which income sources are recorded by customer class. The magnitude of income received by the utility from each class of customer is vividly illustrated when computed as a percent of the utility's total income. In Figure 16, the same kind of information is recorded on a periodic basis to determine if changes in income from various customer classes are occurring on a quarterly basis. The information shown in Figure 16 can be taken a step further by comparing quarterly income with the previous year (as shown in Figure 17).

<u>CENTERVILLE</u>		
O&M INCOME ANALYSIS BY CUSTOMER CLASS		
for operating period <u>1981</u>		
	<u>Amount</u>	<u>Percent</u>
<u>Water Sales</u>		
Industrial	\$ 71,000	7.8%
Commercial	277,750	30.4%
Residential	<u>564,250</u>	<u>61.8%</u>
TOTAL .....	\$913,000	100.0%

Figure 15 Recording O&M Income Sources by Customer Class

<u>CENTERVILLE</u>				
QUARTERLY O&M INCOME ANALYSIS BY CUSTOMER CLASS				
for operating period <u>1981</u>				
	Quarterly Percent of Sales by Customer Class			
	<u>3/31</u>	<u>6/30</u>	<u>9/30</u>	<u>12/31</u>
<u>Water Sales</u>				
Industrial	7.8	14.7	12.9	5.4
Commercial	30.5	28.6	29.1	19.8
Residential	61.8	56.7	58.0	64.8

Figure 16 Recording O&M Income Sources by Customer Class on a Periodic Basis

CENTERVILLE				
COMPARATIVE QUARTERLY O&M INCOME ANALYSIS BY CUSTOMER CLASS				
for operating period <u>1980/1981</u>				
1980/1981 Comparison of Quarterly Percent of Sales by Customer Class				
	3/31	6/30	9/30	12/31
<u>Water Sales</u>				
Industrial	6.2/7.8	9.3/14.7	8.4/12.9	4.0/5.4

Figure 17 Comparing Quarterly O&M Income Sources by Customer Class With the Previous Year

*Graphs.* Many times graphs can be used to communicate financial information to the O&M organization’s staff members and to others outside of the organization. Figure 18 shows an excellent method of recording financial trends by graphing the relationship between total operating expenses and total income. The area between income and expenses in the figure represents net income or profit.

As with income, expense categories can also be compared with total operating expenses in terms of absolute dollar values and/or as a percent of total expenses. It is easier to see the magnitude of expenses if expense data is expressed in terms of percents. With the help of historical data and operating records, O&M managers can establish *norms* (normally expected expenses) for various phases of O&M activities. A sudden change in expenditure that exceeds the norm can easily be spotted and investigated, and, if appropriate, corrective action can be taken.

As an example, suppose that increases in expenses for chemicals or electrical power are larger than they were expected to be. Expenses may be excessive because of current economic conditions. On the other hand, unusually high operating and maintenance costs for vehicles may signal the need to investigate why these expenses are increasing. Figure 14 shows that operating expenses increased from one period to the other while maintenance costs decreased. The effect of reducing maintenance expenditures in order to meet the increased costs during 1981 may have been planned; however, cutting back on required maintenance activities is not a cost-effective practice. The cost of repairing or replacing a piece of equipment because it was not properly maintained can be greater in the long run than the cost of maintaining the piece of equipment on a regular basis. Steps should be taken to effectively control operating expenses so that all required maintenance activities can be performed. If this is not done, rates should be increased to cover the increased costs of operating and maintaining system facilities.

*Comparing actual and estimated income and expense performance.* Figure 19 shows another example of how the information on income statements can be used both to make comparisons with actual income and expense performance and to estimate future income and expense performance. This information is useful for several reasons: (1) The nine months of actual performance can be compared with the year-to-date actual performance to determine if there are significant changes in income or expense categories. This is one means of analyzing financial trends. (2) The data can be a useful monitoring tool to determine how actual income and expenses compare with budgeted income and expenses. (3) A monthly *cash-flow statement* for the last quarter can show the O&M organization’s ability to meet monthly expenditures for the next three months. Figure 19 shows an estimated deficit of nearly \$4000 for the last quarter of the year—the difference between an estimated income of \$34 820 and expenses of \$38 800.

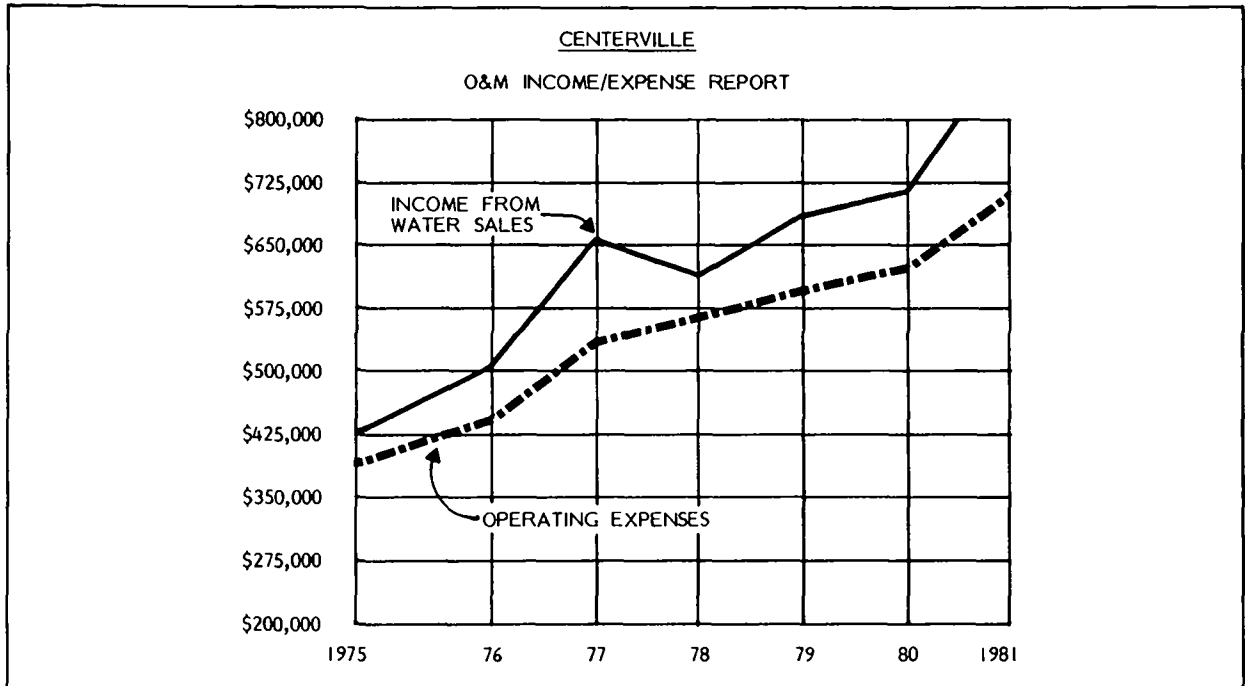


Figure 18 Using Graphs to Plot Financial Trends

CENTERVILLE  
ACTUAL AND ESTIMATED O&M INCOME AND EXPENSE PERFORMANCE  
for operating period 1981

	Actual Jan - Sept	Estimated Oct - Dec	Estimated For Year
<u>Income</u>			
Water Sales	\$72,105	\$22,930	\$95,035
Customer Repairs	3,270	1,090	4,360
Construction Grant	<u>79,200</u>	<u>10,800</u>	<u>90,000</u>
TOTAL INCOME . . . . .	\$154,575	\$34,820	\$189,395
<u>Expenses</u>			
Wages, Salaries, & Fringe Ben.	\$82,402	\$27,398	\$109,800
Operating	8,012	2,588	10,600
Maintenance	8,776	2,824	11,600
Office	1,172	388	1,560
Taxes & Insurance	2,068	732	2,800
Legal & Professional	1,130	270	1,400
Depreciation	13,040	4,360	17,400
Miscellaneous	<u>1,560</u>	<u>240</u>	<u>1,800</u>
TOTAL EXPENSES . . . . .	\$118,160	\$38,800	\$156,960

Figure 19 Comparing Actual and Estimated O&M Income and Expense Performance

*Cash-flow summaries.* Figure 19 shows that the O&M organization will be operating under a deficit condition for the last quarter of operations. In this respect, the information reported in Figure 19 is a good indicator of a potential problem regarding the organization's ability to meet monthly expenditures.

Depreciation (\$4360) in Figure 19 does not require a cash expenditure. In effect, the amount for depreciation will offset the estimated deficit of nearly \$4000. However, a cash-flow analysis takes into consideration all required expenditures, not just operating expenses. Although the detail is not shown, the assumption can be made that the organization will have other debt obligations to meet in December. These expenditures might include tax liabilities or various types of loan payments. A three-month summary of cash flow is shown in Figure 20.

*Reviewing trends in income and expense.* The O&M manager should not only be responsible for operating the community's water systems within the framework of the funds approved by the town council, he should also reduce waste and unnecessary expenses by introducing changes that will improve system efficiency. Unfortunately, most small-to-medium-size O&M organizations have very few places to trim expenses and are usually plagued with the problem of an inadequate operating budget. For these reasons, it is even more important that managers of small-to-medium-size O&M organizations know where their money is being spent and be alert to changes in their sources of income and in their operating expenses.

Analyzing financial trends based on comparative-income data will provide a great deal more information and understanding about the system's operations than an occasional review of the O&M organization's income statement. Trend information not only provides clues that help identify problems, but it can also alert the O&M manager that some action should be taken or anticipated. Figure 21 shows a semi-annual income and expense analysis for a three-year period. The figure reveals that corrective action must be taken if the organization is to remain operational. Expenses tend to be increasing by approximately \$2000 every six months whereas income is unstable and shows no growth potential.

Analyzing specific operations can also provide useful information about the long-term financial trends of an O&M organization. As an example, Figure 22 shows the historical data for *miscellaneous expenses* over the past six years. The figure shows a definite financial trend—miscellaneous expenses have grown to more than 10 times the original value during the six-year period. The increases in the miscellaneous-expense account may be perfectly normal if other expense categories have increased proportionately.

Very often, miscellaneous accounts become catch-all accounts—that is, charges that are not easily categorized into specific accounts (such as an occasional expense for special construction permits) are recorded as miscellaneous charges. When certain expense transactions become routine, the accepted practice is to set up additional expense accounts to collect specific, recurring operating charges (rather than continuing to include them in miscellaneous-expense accounts).

*Current ratio.* One measure of the financial well-being of an O&M organization is its ability to meet current financial obligations. To make this determination, a *current ratio* of current assets to current liabilities is calculated. In order for an O&M organization to be considered in good financial condition, current assets should be two to three times greater than current liabilities.

*Acid-test ratio.* To determine if an O&M organization is able to meet short-term debts, an acid-test ratio (also referred to as a *quick ratio*) is calculated. An acid-test ratio measures an O&M organization's ability to quickly convert assets to cash on short notice (30 to 90 days). To determine the acid-test ratio, current assets that are easily converted to cash within 30 to 90 days are compared to current liabilities that are payable within 90 days. In order for an O&M organization to be considered in good financial condition, the

current assets that can easily be converted to cash within 30 to 90 days should be one to two times greater than the current liabilities that are payable within 90 days.

*Depreciation of assets.* The depreciation of an O&M organization's assets should be examined periodically. The predetermined rate of depreciation should be in line with the condition of assets. For example, assume that the initial estimate of a certain backhoe's useful life was set at 10 years and that the depreciation rate was set accordingly (10 percent annually). Also assume that the backhoe had to be replaced at the end of five years. The effect of this situation is illustrated in Figure 23.

<u>CENTERVILLE</u>			
O&M CASH-FLOW SUMMARY			
	<u>Total Est. Expenditures</u>	<u>Total Est. Income</u>	Favorable (Unfavorable) <u>Balance</u>
October	\$11,000	\$15,200	\$4,200
November	10,400	10,000	(400)
December	<u>23,040</u>	<u>2,620</u>	<u>(13,420)</u>
	\$44,440	\$34,820	(\$9,620)

Figure 20 Three-Month O&M Cash-Flow Summary

<u>CENTERVILLE</u>				
SEMI-ANNUAL O&M INCOME AND EXPENSE ANALYSIS				
		<u>Total Income</u>	<u>Total Expenses</u>	<u>Net Income (Loss)</u>
Year 1	Jan - Jun	\$38,600	\$32,500	\$ 6,100
	Jul - Dec	42,300	41,300	1,000
Year 2	Jan - Jun	46,100	43,200	2,900
	Jul - Dec	43,200	46,800	(3,600)
Year 3	Jan - Jun	44,500	48,000	(3,500)
	Jul - Dec	46,000	51,500	(5,500)

Figure 21 Semi-Annual O&M Income and Expense Analysis

<u>CENTERVILLE</u>	
O&M MISCELLANEOUS-EXPENSE ANALYSIS	
Year 1 - \$310	Year 4 - \$1,580
Year 2 - \$468	Year 5 - \$2,800
Year 3 - \$885	Year 6 - \$3,900

Figure 22 A Six-Year O&M Miscellaneous-Expense Analysis

<u>CENTERVILLE</u>	
SCHEDULED DEPRECIATION OF O&M BACKHOE	
Asset Value	\$20,000
Estimated Useful Life (10 years)	
Accumulated Depreciation at the End of 5 Years	<u>10,000</u>
UNDEPRECIATED VALUE.....	\$10,000

Figure 23 Example of an O&M Asset Depreciation

The discrepancy between the actual useful life and the estimated useful life of the backhoe points out a need to reassess the guidelines used for setting the rate of depreciation on assets of this kind in the future. Had the annual depreciation rate for the backhoe been scheduled at 20 percent, the backhoe would have been fully depreciated at the end of five years. Because the useful life of the backhoe was set at 10 years, each year's depreciation expense was understated by \$2000, and each year's net income was overstated by \$2000, which distorted the organization's earning ability. The problem is further compounded because income and losses are transferred to capital, and distortions of an O&M organization's capital can present serious difficulties in determining the organization's true financial condition. In addition, on the asset side of the balance sheet, the book value (or undepreciated value) associated with the backhoe is overstated because insufficient depreciation was recorded during the five-year period. Adjusting for the \$10 000 undepreciated value of the old backhoe would result in recording the new backhoe at a value less than the replacement cost. If the backhoe was not replaced, a correcting entry of \$10 000 would be required to close out the *accumulated-depreciation account*. The correction for prior years would be treated as a loss.

As this example illustrates, it is important to compare actual experience with the guidelines used to establish depreciation rates on assets. For small-to-medium-size O&M organizations, it is especially important that funded reserves for replacing assets be adequate to meet the expense of replacing assets in a timely manner. Inventory values can also be monitored from periodic data reported on the balance sheet. The percentage of the budget spent on maintaining an inventory of parts and supplies generally should not exceed 5 percent of the total value of equipment and vehicles.

## THE BUDGETING PROCESS

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Budgeting is the art of interpreting an organization's goals in meaningful monetary terms. The purpose of this section is to (1) examine the steps used in preparing a realistic budget, and (2) describe how the budget can be used to measure financial performance against projected financial goals.

### Preparing an O&M Budget

Budget preparation should be a group project, involving the O&M manager and key O&M staff personnel. Preparing a budget without input from staff personnel can create an atmosphere of resentment and distrust in the organization. Staff personnel can actively participate in the budget process by providing the O&M manager with information concerning operating requirements. When preparing the budget, the O&M manager and staff personnel should follow several basic guidelines (shown in Figure 24).

One budget item frequently overlooked by small-to-medium-size O&M organizations is a *reserve fund* (sometimes referred to as a *contingency fund*), which is an amount of money set aside especially for the replacement of assets. The amount of money to set aside in a reserve fund is usually determined by dividing the replacement costs of various assets by each asset's expected service life.

*Revising budget estimates.* As shown in Figure 24, an estimate should be made of the O&M organization's expected income. Budget estimates help determine whether or not the income for the budget period will support the goals and expectations of the O&M organization. Since expenses are usually greater than the estimated income, budget estimates will usually require revision. For example, assume that proposed expenses are greater than estimated income. Obviously, modifications must be made either to reduce expenses or increase income. The following is a list of factors that should be considered when making revisions to budget estimates.

1. Modify goals or accomplishments in order to reduce projected expenditures. Re-

## PREPARING AN O&amp;M BUDGET

1. List Budgetary Goals  
Establish a list of specific budgetary goals to be achieved during the budget period. Then rank each goal in order of priority. (When doing this, re-evaluate the magnitude, direction, and priority ranking of existing O&M programs.)
2. Estimate Costs  
Assign an estimated cost to each budgetary goal. For continuing O&M programs, use last year's budget and actual expenses as a starting point. New programs or modifications of existing programs will require more detailed investigations to accurately estimate the costs involved.
3. Estimate Income  
Estimate expected income of the O&M organization. Use last year's budget and actual income (by income source) as a starting point. Do not be overly optimistic in estimating the O&M organization's expected income; evaluate each income source in relation to factors that may cause an increase or decrease in those revenues, such as rates, service fees, new service areas, the economy, or changes in government loans or grants.
4. Compare Income and Costs  
Compare total expected income to total expected expenses. Since expenses are usually greater than income, the process for reducing expenses or increasing income projections is the most important step in preparing the budget. To reduce expenses or increase income projections, it is necessary to determine how reliable estimates of income and expenses are compared to actual income and expenses. For example, if expenses have been underestimated by 15 percent and income overestimated by 10 percent, there will be a deficit of 25 percent. Unless an O&M organization has cash reserves to cover this deficit, the organization could face serious financial difficulties.
5. Submit Budget to Town Council  
Submit the prepared budget to the town council for approval. Presenting the budget to the town council provides an excellent opportunity to communicate important financial information regarding the O&M organization's goals to council members and to gain support for proposed plans of action.

Figure 24 Guidelines to Follow When Preparing an O&M Budget

evaluate continuing O&M programs and new programs to determine if the costs of the programs are justified; it may be best to delay action on increasing certain expenditures or starting up new programs. In nearly every case, certain expenditures can either be decreased or delayed without seriously affecting the organization's operations or quality of service. Therefore, it is essential to carefully examine goals for the budget period to determine if they are realistic, timely, and will truly increase system efficiency.

2. Evaluate expenses according to whether they are fixed or variable. This procedure is especially important for determining which expenses in the budget can be reduced. As a general rule, fixed expenses cannot be reduced. For example, if Centerville's total budget expenses (fixed and variable) exceed income by 12 percent, it would not be appropriate to decrease all categories of expense by 12 percent in order to balance the budget because certain fixed expenses, such as the mortgage payment on the utility's main building or the contract payment on a piece of equipment, cannot be eliminated or reduced. In addition, depreciation expenses against capital assets are fixed, based on the service life of the assets. It would be unwise to apply an across-the-board reduction to Centerville's depreciation fund that would affect the reserve funds for replacing assets. Since there is little that can be done to reduce fixed expenses, variable expenses are usually singled out and evaluated for possible reductions.
3. In evaluating variable expenses, examine the estimates upon which projected expenses are based. Are they realistic and do they reflect costs based on past performance? Judgments need to be made about which expenses can be reduced without seriously affecting the organization's services and adequate maintenance of facilities. For example, should administrative, operating, and maintenance expenses be reduced equally? Probably not, since it may be more important to keep the system operating and well-maintained than to purchase a new administrative billing system requiring costly equipment and forms.



4. Make value judgments about the efficiency of operations. As an example, O&M organizations usually budget a large percentage of funds for wages and salaries. In preparing the budget, consider making more efficient use of O&M personnel in order to reduce wage and salary expenses. When making value judgments, raise questions about how better operating results can be attained through more efficient operating procedures. In examining personnel requirements, determine if the size of the staff can be reduced or if personnel can be reassigned to perform more tasks more efficiently. Avoid hiring additional staff members by making changes in work schedules, work requirements, or work procedures. Review and streamline maintenance schedules to provide savings in time and materials. Look for ways to reduce the expenses for power and fuel.
5. Review water rates and service fees in relation to the actual "cost" of providing O&M services by conducting a *cost-of-service study*. This study may reveal the need to implement a new rate structure.
6. Examine revenue sources to see if they are sufficient to meet current operating expenditures and provide surplus funds for future expansion or capital-improvement programs.

These are not all of the factors that should be considered in preparing a budget. All phases of O&M operations should be carefully examined in order to prepare an accurate and realistic budget. Failure to raise questions, make comparisons, and evaluate and justify budget items will generally result in waste and inefficiency. To effectively monitor and control the O&M organization's operations, there must be a realistic, well-conceived, financial plan of action. The budget process should not be viewed as a "paper exercise," but as a means of achieving O&M goals, improving performance standards, and raising the quality of O&M services.

### Types of Budgets

For most small-to-medium-size O&M organizations, a budget combining capital expenditures, income, and expense estimates may be sufficient to meet the planning requirements of the organization. This section discusses income-and-expense budgets, capital-expenditure budgets, and cash budgets.

*Income-and-expense budget.* An income-and-expense budget (also referred to as an *operating budget*) forecasts income and expense activities during the budget period (usually one year). Income-and-expense budgets vary in complexity, depending on the size and number of services provided by the organization. Figure 25 shows an income-and-expense budget for Centerville. It is likely that the previous year's budget and actual income and expenses provided a starting point for preparing budget estimates. The organization has a balanced budget as shown by the equality between total estimated income from various sources and total estimated operating expenses. There is neither a budget surplus (total income greater than total expenses) nor a budget deficit (total expenses greater than total income) forecast for the coming year. Had there been a budget surplus, the surplus amount might have been set aside as a reserve fund or used to support a capital-improvement program.

*Capital-expenditure budget.* A capital-expenditure budget covers expenditures for such projects as purchasing new equipment or expanding O&M services. Budgeting for capital expenditures is a process in which managerial planning is especially important because of the amount of funds involved and the length of time needed to recover the capital-expenditure investment. Most small-to-medium-size O&M organizations usually have limited surplus funds. The O&M manager must, therefore, plan major capital-improvement programs around funds supplied by external sources, such as revenue bonds, loans, or grants. The budget in Figure 25 could have been a combined income-and-expense budget and a capital-expenditure budget. If this had been the case,

<u>CENTERVILLE</u>					
ANNUAL O&M INCOME-AND-EXPENSE BUDGET					
<u>ESTIMATED INCOME</u>			<u>ESTIMATED OPERATING EXPENSES</u>		
<u>Account No.</u>	<u>Description</u>	<u>Total</u>	<u>Account No.</u>	<u>Description</u>	<u>Total</u>
	Water Charges:			Salaries & Wages	\$87,000
	Res. & Comm.	\$76,000		Overtime	8,000
	Sewer Charges:			Fringe Benefits	33,500
	Residential Users	34,000		Telephone Expenses	2,000
	Repair Contracts	23,600		Electricity for Pumps	9,000
	Construction Contracts	50,000		Office Supplies	2,400
	Miscellaneous Income	<u>7,500</u>		Vehicle Expenses	6,200
				Legal Audit	1,000
	TOTAL .....	\$191,100		Miscellaneous Expenses	2,000
				Material Inventory	13,000
				Directors' Fees & Per Diem (12 Meetings)	3,000
				Depreciation Expenses:	
				Utility System	12,000
				Equipment	7,000
				Insurance	<u>5,000</u>
				TOTAL .....	\$191,100
<u>EXPLANATION</u>					
<u>Account No.</u>	<p><u>Construction Contracts</u> reflect an increase of \$15,800 (from \$34,200 to \$50,000) due to the anticipated income from contract work for the next fiscal year.</p> <p><u>Material Inventory</u> consolidates Repair Contracts and Construction Contracts.</p> <p><u>Directors' Fees and Per Diem</u> increased to cover two additional meetings.</p> <p><u>Legal Audit</u> is a new expense category this year.</p> <p><u>Depreciation Expense</u> includes adjustment on equipment under amended IRS ruling.</p> <p><u>Insurance</u> for equipment increased to provide personal liability coverage.</p>				

Figure 25 Annual O&M Income-and-Expense Budget

proposed capital expenditures for new equipment, facility improvements, or service expansion would have been identified with their estimated costs as separate expenditure categories.

*Cash budget.* A cash budget reflects the amount of cash the utility expects to receive and pay out for the budget period. As a general rule, a cash budget should be prepared for each month of the year. In a cash budget, income and expenses are scheduled from month to month to determine if enough cash will be available to pay bills when they are due. There are several advantages to having sufficient amounts of available cash. Suppliers of chemicals, for example, may give substantial discounts for prompt payment. Having sufficient funds to take advantage of these discounts can save the O&M organization substantial sums of money. If surplus funds exist, they may be invested in short-term securities or *time deposits (TD's)* and earn interest for the O&M organization until needed. Forecasting and monitoring cash-related events in a cash budget can provide the O&M manager with valuable information, such as: (1) the effect that seasonal requirements, large inventories, unusual receipts, and delays in collecting accounts

receivable will have on the organization's cash funds; (2) the amount of cash needed for capital expansion or improvements; (3) the need to obtain additional funds from outside sources, such as loans or sales of securities; (4) the availability of cash for taking advantage of suppliers' discounts; (5) the availability of excess funds for short-and-long-term investments. Although cash budgets are useful budgeting tools, small-to-medium-size O&M organizations may not need to prepare cash budgets—cash-flow statements may prove to be more helpful in anticipating cash receipts and cash expenditures.

### Using a Budget and Budget-Status Report

After the budget is approved, it should be reviewed by all O&M staff personnel who have budget responsibilities or who approve operating expenditures. It is important that staff personnel have a clear understanding of the organization's financial goals and the effect that the approved budget will have on various service operations. Budgets should be objective yet flexible so that staff personnel can accomplish the organization's goals. This does not mean that changes in the budget can be made without the O&M manager's approval; goals, priorities, and circumstances change, and the budget should be flexible enough to allow modifications.

The budget and periodic financial statements are useful for monitoring and controlling the O&M organization's operations. It is good management practice to compare budget forecasts with actual financial performance. If economic or operating conditions have changed, budget revisions should be made accordingly. For example, if income is down or expenses up from the amounts estimated, revisions in future expenditures may be needed, such as (1) realigning priorities and cutting certain expenditures to adjust for income and expense projections, (2) realigning priorities and deferring certain expenditures until the determination can be made as to whether or not income will increase in future periods, and (3) approving expenditures as budgeted from cash reserves—referred to as *deficit spending*.

**Budget-status report.** A budget-status report compares budgeted revenue and expenses with actual year-to-date revenues and expenses. Budget-status reports can be used to determine if actual revenues and expenses are running ahead of or behind budget projections. Figure 26 shows the first six months of Centerville's budget-status report. Column 1 represents the amount of money budgeted for expenses for the entire year. Apparently, it was estimated that greater expenses for salaries, wages, and benefits would be incurred in the second half of the year and that greater operating expenses would be incurred in the first half of the year. Column 2 represents "planned" expenditures for specific items at the end of the six-month period. Column 3 shows the total expenses accumulated as of June 30. Column 4 represents the percentage relationship between Columns 1 and 3—the actual costs for the first six months of the year as a percent of the budget spent.

As Figure 26 shows, half of the year has passed, and 57 percent of the total budget has been spent. Is corrective action needed? Possibly, but all the information needed to take corrective action is not contained in the report. For example, the fact that total expenses are running ahead of planned expenses by nearly \$4500 may not be cause for alarm because six more months of the year remain, and the expense items are running close to budget. The budget overrun appears to be controllable.

Many times an O&M manager will face a situation in which the amount of money spent is more than was budgeted to be spent. It is difficult to bring actual expenses back in line with planned (budgeted) expenses. When comparing actual expenses with planned expenses, three questions should be kept in mind:

1. *Is the difference between planned expenses and actual expenses really important?* A 10 percent overrun in labor expenses is usually more significant than a 50 percent overrun in office expenses or a 60 percent overrun in legal and

<u>CENTERVILLE</u>				
O&M BUDGET-STATUS REPORT				
for six-month period ending <u>June 30, 19</u>				
<u>Expenses</u>	<u>Approved Budget</u>	<u>Expenses Jan - Jun</u>		<u>Percent of Total Budget Spent</u>
		<u>Planned</u>	<u>Actual</u>	
Salaries, Wages, & Ben.	\$60,000	\$28,500	\$31,655	52.7%
Operating	5,800	3,800	4,305	74.2
Maintenance	6,000	3,000	3,820	63.6
Office	750	375	520	69.3
Depreciation	8,700	4,350	4,350	50.0
Taxes & Insurance	1,600	800	725	45.3
Legal & Accounting	800	400	380	47.5
Miscellaneous	<u>1,100</u>	<u>650</u>	<u>615</u>	<u>55.9</u>
 TOTAL .....	 \$84,750	 \$41,875	 \$46,370	 57.3% *

\*Average percent of budget spent.

Figure 26 O&M Budget-Status Report

accounting expenses. In most O&M organizations, labor costs account for 80 percent of all expenses, so a small overrun in labor expense is usually a far greater dollar amount than a large overrun in other expense categories.

2. *Can anything be done to bring actual expenses in line with planned (budgeted) expenses?* Fixed expenses, such as legal, accounting, tax, depreciation, and insurance expenses, are often beyond the control of the O&M manager. Variable expenses, such as operating costs, maintenance costs, and inventory expenses, are within the O&M manager's control.
3. *What can be done in the future to prevent actual expenses from getting out of line with planned (budgeted) expenses?* As a general guide, preparing good budget estimates and carefully monitoring expenditures can result in successful management of an O&M organization's finances.

## ACCOUNTING GLOSSARY

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**Account** Used to classify and record increases or decreases in monetary values resulting from business transactions. There are five major classifications of accounts: (1) asset accounts, (2) liability accounts, (3) equity accounts, (4) revenue accounts, and (5) expense accounts.

**Accounting** A systematic process of analyzing, summarizing, and recording events that have an impact on the financial status of a person or an organization. Through the accounting process, reports are prepared and values monitored to show the financial condition of a person or an organization.

**Accounts payable** Money that the organization owes to someone, such as an unpaid invoice for supplies purchased. An account payable is a current liability. (See *Current liabilities*.)

**Accounts receivable** Money that is owed to the organization—money that has not been received for services performed. An unpaid invoice for water service is an account receivable. An account receivable is a current asset. (See *Current assets*.)

**Accrual-basis accounting** An accounting method that monitors transactions that have occurred, regardless of whether or not cash was received or paid out. An accounting method that matches income and expenses with the accounting period, even though cash may not have changed hands during the accounting period.

**Acid-test ratio** Used in financial analyses as a measure of an organization's ability to quickly convert assets to cash on short notice (30-90 days). This ratio is also referred to as a *quick ratio* and is recommended to be 1:1.

**Balance sheet** A statement that reports on the financial condition of an organization in terms of assets, liabilities, and equity, as of a certain date.

**Cash-basis accounting** An accounting method that accounts for cash only when it is actually received or paid out. Accounting on a cash basis does not match income and expenses with the current accounting period as does accrual-basis accounting.

**Cash-flow statement** A financial statement that shows the projected cash condition of a person or organization over a period of several months. A positive cash flow means that income is greater than cash expenses. A negative cash flow means that cash expenses are projected to be in excess of income.

**Chart of accounts** A list of account numbers and titles used in an accounting system. A chart of accounts represents the accounting structure of a small business.

**Current assets** Assets that are held or used in one year or less. Usually, they include cash, accounts receivable, repair parts and supplies, metric tools, and equipment that may need to be replaced within one year. Current assets are unlike fixed or intangible assets, which either have a service life greater than one year (vehicles, buildings, land) or an intrinsic value (good will, copyrights, trademarks).

**Current liabilities** Liabilities due and payable within one year, such as accounts payable (wages, salaries, taxes). Current liabilities are often referred to as *short-term liabilities*. (Long-term liabilities, such as revenue bonds, are payable beyond a one-year period.)

**Current ratio** Used in financial-statement analysis as a means of determining the financial well-being of a business and its ability to liquidate current liabilities.

**Depreciation** An accounting procedure that systematically charges part of the cost of an asset as an expense of the current accounting period over the useful life of the asset. For example, a vehicle purchased for \$6000 might be depreciated over five years by charging \$1200 a year or \$100 a month to a *vehicle expense account* for the life of the asset. Depreciation may also be expressed as a rate, such as 20 percent per year.

**Double-entry accounting** An accounting system in which each transaction is recorded at least twice—once to record an increase or decrease in one or more accounts and once to record an equal or offsetting increase or decrease in one or more accounts. For example, a desk purchased with cash would result in two entries—a decrease in the cash account and an equal or offsetting increase in the asset account. Double-entry accounting also refers to the process of recording and posting transactions in two sets of books—a *journal* and a *ledger*. (See *Journal* and *Ledger*.)

**Equity** The difference between total assets and total liabilities ( $E = A - L$ ). Equity is a concept used to measure the value or worth of a business. It is also referred to as *owner's equity*, *net worth*, or *net capital*.

**Expense** A payment or disbursement made to others for goods or services received, such as salaries, rent, supplies, and fuel.

**Income statement** A financial statement that reports the total income and total expenses of a person or organization for a certain accounting period, such as one month or one year. An income statement shows the net income (or loss) resulting from business transactions.

**Journal** A book of "original entry," in which all transactions involving accounts debited and credited are described and recorded.

**Ledger** A book of "final entry," in which all transactions recorded in the journal are posted to ledger accounts.

**Liability** A debt (usually money) owed by a person or an organization. The value shown in an *accounts payable* account is a liability.

**Revenue** Money received from a person or an organization for services rendered or products sold. Revenue is the same as income.

**Single-entry accounting** An accounting system in which each transaction is recorded only once as a simple increase or decrease in an account. It is sometimes referred to as *checkbook accounting*, since an entry in a checkbook simply increases or decreases the cash balance.

**Transaction** Any event that has a financial impact on any account. Paying a vendor's invoice, paying an employee, and receiving a check from a customer are examples of accounting transactions.

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