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ABSTRACT

The document is a final report of a study of the basic competencies required by water utility operators using a ground water source, conducted at Southwest Wisconsin Vocational-Technical Institute from July to August 1974. The overall purpose of the project is to develop a competency-based curriculum model for statewide use in municipal engineering technician programs. The research was carried out in the form of a competency survey mailed to water treatment plant operators. The survey revealed characteristics of the utilities and the operators, the operators' competencies and training desires. The resultant data are displayed in tables and the survey instrument is appended. (Author/NJ)

FINAL REPORT

Project No. 03-024-151-225

ASSESSMENT AND DETERMINATION OF BASIC COMPETENCIES NECESSARY FOR UTILITY OPERATORS UTILIZING GROUND WATER SUPPLIES

PART I

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Much appreciation is extended to the members of the Project Advisory Committee for their support and guidance.

Finally, gratitude is expressed to the water treatment plant operators who responded with willingness and sincerity to the survey and made completion of this project possible.

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SUMMARY

A study of the basic competencies required by water utility operators using a ground water source was conducted at Southwest Wisconsin Vocational-Technical Institute from July to August, 1974.

One hundred eighty-four (184) Certified Water Treatment Plant Operators were mailed a competency survey. One hundred four (104) of these surveys were returned representing a 56.5% response.

The survey revealed characteristics of the utilities and the operators, the operators' competencies and his training desires.

This survey made no attempt to determine the degree of competency of the operator in performing the tasks or the need for upgrading his skills. It does indicate those competencies which he performs in addition to those subjects he would like further training in.

CHAPTER I

INTRODUCTION

THE PROBLEM:

Southwest Wisconsin Vocational-Technical Institute initiated in 1971 a two year program entitled Municipal Services Aide. Since then, the program has been developed into an associate degree program entitled Municipal Engineering Technician. The program was developed to meet the demanding needs of towns, villages and smaller cities who need persons with backgrounds and technical training in the diversified work areas which make up responsible municipal employment. The program was designed to train for the statewide employment of students skilled in the technical areas of municipal utility operation to include electrical generation, water and waste water utility operator, surveying, environmental sciences, and related skills such as technical report writing. Since the development of the program, graduates have secured employment statewide as assistant city engineers, water and waste water plant operators and in other related areas. A need also has developed and is beginning to be met with the cooperation of the Department of Natural Resources to provide training to employed workers on a local and statewide basis.

The problem is fundamentally one of the inadequacy of available instructional materials to facilitate proper instruction for full-time day students or part-time evening students. Most convenient texts or training manuals direct themselves to the treatment of surface water. The majority of communities, nationwide and in Wisconsin, use ground water as a source for municipal use. In Wisconsin, it is essential since perhaps only 30 communities utilize surface water. Therefore, the available texts and other instructional materials are

of little value for the instructors. Also, the available texts ignore or treat lightly the daily operations of a utility such as billing procedures, purchasing, budgeting and economics, responsibility to state and federal agencies, public relations and safety, etc.

The available general materials also are not competency based or readily adaptable to individualized self paced instruction.

The problem was ascertained by the district's inability to secure information of any quantity to be used in teaching the Municipal Engineering Technician, Municipal Services Aide programs or part-time extension programs.

THE OBJECTIVE OF THE STUDY:

The overall purpose of this project is to develop a competency based curriculum model for statewide use in part-time extension programs and in the full-time Municipal Engineering Technician program.

Specific objectives include the following:

1. To identify competencies for entry level and midmanagement level positions in the municipal services employment area by means of a research instrument.
2. To develop resultant competency based guides which would be flexible enough to be used statewide on an extension basis or in full-time programs.
3. To develop competency based curriculum guides that are flexible enough to be adopted to group or self paced instruction methodology.
4. To examine and refine existing curriculum materials.
5. To utilize available individuals with expertise in water treatment with emphasis on ecology and environment studies.

It is assumed that the tabulation of resultant survey and other participant data will allow for realistic competency curriculum guides to be developed.

CHAPTER II

METHODOLOGY

A random sample of individuals Certified by the State of Wisconsin as M1, P1, or G1 Water Treatment Plant Operators were surveyed to identify the competencies required for their positions in the municipal water utility area.

The survey was constructed following a literature review which revealed a lack of this type of information and absence of any similar survey instruments.

The researcher prepared an initial list of tasks based on his previous employment in the municipal water utility field. A review of the State of Wisconsin Public Water Supply - 1970 publication yielded much information concerning the characteristics of utilities using a ground water source. This information demonstrated a general lack of chemical treatment beyond chlorination and fluoridation. Because of this information, specific tasks on chemical treatment were not included in the survey.

An initial rough draft for the survey instrument was prepared in July, 1974 and in addition to a list of competencies, a number of questions were inserted which would reveal in more detail specific characteristics of both the operator and the utility.

The initial survey was presented to an Advisory Committee (Appendix B) consisting of Certified Operators employed by small and medium-sized communities using a ground water supply. The Chief of the Certification Section of the State of Wisconsin, Department of Natural Resources, also served on the Committee. The Committee, in a one day session, reviewed the survey instrument and made suggestions for its revision. The minutes of this meeting are found in Appendix C.

The goal of this meeting was to finalize a survey which would be valid in determining the operator's competencies and characteristics and still be interesting and easy for him to complete. (Appendix A)

The Department of Natural Resource made available a list of at least one Certified M1, P1, or G1 Operator from each Wisconsin community utilizing a ground water supply. All S1 Operators were excluded since they generally represented utilities using a surface water supply. Large communities were likewise excluded since they are in the minority and would not represent accurately the competencies required in the large number of small and medium-sized communities. The largest utility surveyed was Fond du Lac, with a population of 35,515.

Of a list of 400 individuals, 184 Operators were selected randomly using the stratified random sample method.

The first mailing of the survey was sent July 23, 1974. A copy of the cover letter is in Appendix D. The survey was sent to the Operator's home address with a numbered, self-addressed envelope.

A second mailing was sent August 12, 1974, with a new cover letter. A copy of this cover letter is in Appendix E.

CHAPTER III

RESEARCH FINDINGS & ANALYSIS

UTILITY CHARACTERISTICS

The following characteristics are based on 104 surveys completed by Certified Operators.

In addition, a portion of the information was derived from the State of Wisconsin Public Water Supply - 1970 publication and is duly noted. This information is included to present a more complete picture of the utility characteristics.

All water utilities dealt with in the survey obtained their water from a ground water source and all were located in the State of Wisconsin.

The average population served by the operators responding to the survey is 3,150. The typical utility in Wisconsin uses the "drilled" type of well (86.3%) and uses the air line method (86.6%) to determine the water level in the well.

TABLE I

Community Size - (1970 Census)

Maximum Population	35,515 - Fond du Lac
Minimum Population	271 - Bagley
Average Population	3,152

TABLE II

Well Type - (Based on Public Water Supply Data - 1970)

Drilled Well	86.3%
Horizontal Collector	.8%
Dug Well	.5%
Combination	12.4%
	100.0%

TABLE III

Method Used by Utility to Determine Well Water Level

Air Line	86.6%
Hand Held Tape	7.6%
Electric Tape	2.9%
None	2.9%
	100.0%

The typical utility disinfects its water with chlorine (54.8%), with three methods of chlorination sharing nearly equal popularity: hypochlorites using diaphragm pump (16.3%); chlorine gas using diaphragm feeder (15.4%); and chlorine gas using V-Notch type chlorinator (14.4%). Of these utilities, 90.5% use the Orthotolidine-Arsenite method of determining a chlorine residual.

TABLE IV

Disinfection Method

Method	Survey Results 1974	Public Water Supply Data - 1970
Hypochlorite	16.3%	20.6%
Chlorine Gas	31.7%	16.7%
a) Diaphragm - 15.4%		
b) V-Notch - 14.4%		
c) Bell Jar - 1.9%		
Liquid Bleach - Diaphragm Pump	6.7%	
Combination		1.2%
TOTAL % DISINFECTION	54.8%	38.5%

TABLE V

Method of Chlorine Residual Testing

Orthotolidine-Arsenite	90.5%
Starch - Iodine	3.8%
Tested by State	3.8%
Amperometric Titration	1.9%
	100.0%

The vast majority (93.9%) of water utilities rely on the State of Wisconsin Department of Hygiene to perform all bacteriological tests.

TABLE VI

Method of Bacteriological Testing

State Laboratory of Hygiene	93.9%
Multiple Tube	3.1%
Membrane Filter	2.0%
None	1.0%
	100.0%

The typical utility fluoridates its water (54.4%*), with 79.9%* of these utilities feeding Hydrofluosilicic Acid.

TABLE VII

Fluoridation - (Based on Public Water Supply Data - 1970)

No Flubridation	45.6%
Hydrofluosilicic Acid	43.5%
Sodium Fluoride	5.7%
Sodium Silicofluoride	5.2%
	100.0%

A typical utility has developed a policy for sizing water main (61.9%), distribution system valves (64.2%) and customer services (72.9%), and hires a contractor to excavate and install new water main (86.7%).

TABLE VIII

Have Policy for Sizing:

	Yes	No
Water Main	61.9%	38.1%
Distribution System Valves	64.2%	35.8%
Customer Services	72.9%	27.1%

TABLE IX

Hire Contractor for Excavation and Installation of New Water Main

Yes	86.7%	No	13.3%

A minority of the communities soften the water (8.4%*), treat the water for iron or manganese (24.1%*), perform their own bacteriological tests (5.1%*) and excavate and install their water main (13.3%).

TABLE X

Water Softening (Based on Public Water Supply Data - 1970)

No Softening	91.6%
Zeolite	6.5%
Lime Softening	1.7%
Combination	.2%
	100.0%

TABLE XI

Iron and Manganese Treatment (Based on Public Water Supply Data - 1970)

No Treatment	75.8%
Removal	17.7%
Sequestering	6.5%
	100.0%

A minority of communities do not disinfect (45.2%) or fluoridate (45.6%) the water, nor have they developed a policy for sizing water main (38.1%), distribution system valve (35.8%) and customer services (27.1%).

* Information obtained from State of Wisconsin Public Water Supply Data - 1970.

OPERATOR CHARACTERISTICS

All water works systems in Wisconsin are classified as either M1, P1, G1 or S1 utilities as determined by a system of rating values. This rating system is based on the water source, treatment method, distribution equipment and the average daily pumpage. Items to be rated and their assigned values are listed in Appendix G.

Wisconsin statute states that it is necessary that every waterworks utility employ at least one operator who holds a valid certificate at least equal to the utilities classification. Certification is available to all individuals who meet the qualifications for a given grade, as described in Appendix H.

All of the survey respondents are Certified M1, P1 or G1 Water Treatment Plant Operators licensed by the State of Wisconsin.

These operators have several things in common. Sixty-five point six percent (65.6%) list job titles denoting a supervisory or management capacity. While this is a large percentage, the size of community served by these operators is, on the average, somewhat small, and for economic reasons carry a small staff. These individuals, as demonstrated by their analysis, perform much of the work of the utility as well as being directly responsible for the proper and efficient operation of the utility.

Six point five percent (6.5%) of the respondents indicated a job classification at the Foreman level while the remaining 26.8% indicated the job classification of Operator.

A general job description of these three classifications is listed in Appendix I.

OPERATOR COMPETENCIES

The survey was designed to determine those competencies required by the operator in the performance of his profession. He was asked to indicate whether he performed the listed tasks MUCH (i.e. hourly, daily, weekly), SOME (i.e. monthly, yearly) or NONE. Certain tasks are seasonal and he was asked to indicate the frequency of performance during that season.

The operators indicated that they perform, with some frequency, a majority of the tasks listed. This survey made no attempt to determine the ability of the operator, his competency in performing the tasks or the need for upgrading his skills.

The competencies were grouped into general areas of utility operation such as wells, water mains, system valves, hydrants, service connections, storage facilities, positive displacement meters, differential pressure meters (Venturi and Orifice), bacterial quality, chemical treatment, public relations, maintenance and supervision.

WELLS:

Most of the competencies listed are performed by the operator, indicating considerable responsibility for the operation of the communities' wells.

Sixty-one point two percent (61.2%) indicated that they are not required to perform major pump repairs. This may be due to a lack of training in this area, the absence of proper equipment or simply an infrequent need for such repairs.

TABLE XII

COMPETENCIES - WELLS

COMPETENCIES	MUCH	SOME	NONE
Perform water level test	49.5%	43.4%	7.1%
Maintain water level records	54.0	31.0	15.0
Read flow meters	80.2	15.6	4.2
Operate electric well pumps	89.9	9.1	1.0
Operate auxiliary driven pumps	40.6	40.6	18.8
Perform routine high lift pump maintenance (change packing, grease)	43.3	42.3	14.4
Perform major pump repair (replace sleeve, bearings, etc.)	9.2	29.6	61.2
Maintain flow records	80.2	12.1	7.1
Operate plant control valves	61.2	30.6	8.2
Maintenance of electrical pump controls	33.6	48.0	18.4

WATER MAINS:

Eighty-six point seven percent (86.7%) of the utilities relied on private contractors for the excavation and installation of new water mains.

Sixty-nine point eight percent (69.8%) of the operators do not perform a hydrostatic leakage test on new main installations. It is unclear whether the contractor performs this test or that the test is not required by the utility.

A majority of operators are required to disinfect the new main, inspect the construction and record the location of the new main.

The operators also locate main leaks, excavate and repair the leak and maintain records of the leak.

Fifty-one point six percent (51.6%) of the operators do not thaw frozen water mains with an electric welder. A lack of equipment, training or need may be responsible for not performing this potentially hazardous task.

A large majority of operators are not required to maintain either pressure or vacuum relief valve. The probable reason for this is the absence of such valves in the distribution system.

TABLE XIII
COMPETENCIES - WATER MAIN

COMPETENCIES	MUCH	SOME	NONE
Perform hydrostatic leakage tests	4.2%	26.0%	69.8%
Disinfect new installation	42.9	44.9	12.2
Maintain main location records	54.0	36.0	10.0
Inspect construction	60.0	33.0	7.0
Locate leaks	49.0	45.9	5.1
Excavate trench for main repair	21.4	35.7	42.9
Install repair clamps or sleeves	33.3	49.5	17.2
Prepare or repair lead joints	17.0	45.0	38.0
Maintain leak records	24.0	35.0	41.0
Thaw frozen main with electric welder	14.1	34.3	51.6
Maintain pressure relief valves	13.5	23.0	63.5
Maintain vacuum relief valves	12.7	16.0	71.3

SYSTEM VALVES:

A large percentage of Operators indicate they are required to perform all but one of these related competencies.

The only exception is the task of installing tapping-in valves. This may be due to the lack of necessary special equipment or lack of knowledge that such a method is available.

TABLE XIV

COMPETENCIES - SYSTEM VALVES

COMPETENCIES	MUCH	SOME	NONE
Determine type of valves	32.0%	45.7%	22.3%
Determine location of new valves	35.0	49.5	15.5
Install valves	19.4	42.8	37.8
Exercise valves periodically	17.5	67.0	15.5
Repair defective valves	21.4	53.1	25.5
Maintain valve repair records	26.5	44.0	29.5
Install tapping-in valves	19.6	28.9	51.5

HYDRANTS:

Hydrants are a critical part of the water utility since they are essential for the fire protection of the community. This is apparently recognized by the operators as a large portion are expected to perform all of the competencies listed.

TABLE XV

COMPETENCIES - HYDRANTS

COMPETENCIES	MUCH	SOME	NONE
Determine type of hydrant	44.8%	40.6%	14.6%
Determine hydrant location	44.9	35.7	19.4
Install new or replacement hydrants	28.8	45.4	25.8
Perform periodic inspection	43.4	50.5	6.1
Perform periodic flushing	48.0	46.6	6.0
Repair defective or damaged hydrants	35.7	49.0	15.3
Maintain hydrant location records	44.0	41.0	15.0
Maintain hydrant repair records	32.0	43.0	25.0
Perform flow and pressure tests	16.0	52.0	32.0

SERVICE CONNECTIONS:

As with hydrants, the majority of respondents indicated that they perform all of the service connection related competencies listed. It must be noted that while they thaw frozen services, the method most commonly used cannot be assumed as the operators indicated, in Table XIII, general unwillingness to use an electric welder on frozen water mains.

TABLE XVI

COMPETENCIES - SERVICE CONNECTIONS

COMPETENCIES	MUCH	SOME	NONE
Determine size and location of services	49.0%	38.3%	12.7%
Perform tapping operation	37.4	37.4	25.2
Install corporation stops	39.4	36.7	23.5
Install service lateral	30.3	35.4	34.3
Install curb stops	34.3	39.4	26.3
Locate leaks in service	36.3	56.6	7.1
Maintain service location records	40.0	42.0	18.0
Maintain service repair records	35.7	36.7	27.6
Thaw frozen services	26.5	41.2	32.3

STORAGE FACILITIES:

A majority of operators indicated they do not operate cathodic protection devices. This is not surprising since a significant number of utilities either have no need for such protection or do not invest in this service. Of those communities which do have such devices, a reliance upon the installer for service could be assumed.

All other competencies listed are indicated as necessary by the majority of operators.

Twenty percent (20%) of the respondents indicated they clean the storage unit MUCH, or with a high frequency. This response is confusing since a cleaning operation is generally time consuming and usually performed at the most on an annual basis.

TABLE XVII

COMPETENCIES - STORAGE FACILITIES
(Reservoirs, Stand Pipes, Elevated Tanks)

COMPETENCIES	MUCH	SOME	NONE
Maintain water level indicators	59.2%	26.5%	14.3%
Maintain water level control equipment	51.5	33.3	15.2
Perform periodic inspection of storage unit	39.2	51.0	9.8
Clean storage unit	20.0	43.2	36.8
Operate cathodic protection devices	16.5	22.7	60.8

METERS:

I. Positive Displacement Meters:

Meters are the major revenue provider for most utilities and, as such, receive a great deal of attention from the operators as well as the Wisconsin Public Service Commission, the State Agency having the ultimate responsibility for the correct use and maintenance of all meters.

This attention is reflected in the fact that over 80% of the operators perform every competency listed in the table.

II. Differential Pressure Meters (Venturi or Orifice):

A slight majority of operators do not perform routine maintenance on this type of meter, possibly because many utilities may not use these methods to determine the quantity of water supplied to the distribution system.

TABLE XVIII

COMPETENCIES - METERS

COMPETENCIES	MUCH	SOME	NONE
POSITIVE DISPLACEMENT METERS			
Install customer water meters	69.0%	20.0%	11.0%
Read customer water meters	63.6	25.3	11.1
Perform periodic accuracy tests	53.0	34.3	12.7
Repair utility-owned water meters	50.5	35.6	13.9
Maintain meter records	60.4	28.7	10.9
DIFFERENTIAL PRESSURE METERS (VENTURI & ORIFICE)			
Perform routine maintenance	22.8	20.7	56.5

BACTERIAL QUALITY:

The primary concern of any water utility is that the water supplied to the consumer is safe to drink. Table VI indicates that over 90% of the utilities rely upon the State of Wisconsin Board of Hygiene to perform the tests necessary to prove the proper bacteriological quality of the water.

The majority of operators do collect samples necessary for testing and send these samples to the Board of Hygiene. Approximately one half of the respondents are responsible for preparing the bacteriological records as required by the Department of Natural Resources.

TABLE XIX

COMPETENCIES - BACTERIAL QUALITY

COMPETENCIES	MUCH	SOME	NONE
Collect distribution system samples for testing	66.3%	26.7%	7.0%
Collect plant samples for testing	58.0	24.0	18.0
Sterilize glassware for testing	40.0	10.0	50.0
Prepare culture media testing	10.0	7.0	83.0
Perform standard plate count test	4.0	6.1	89.9
Perform coliform index (M.P.N.) test	2.1	9.5	88.4
Send samples to State for testing	67.7	29.3	3.0
Prepare bacteriological records for the Department of Natural Resources	22.6	25.8	51.6

CHEMICAL TREATMENT:

Tables IV and VII demonstrated that a majority of the utilities either chlorinate and/or fluoridate their water. Tables X and XI indicate a minority either soften and/or treat for the presence of iron and manganese.

Based on the following table, a majority of the operators are responsible for the competencies required to perform the necessary chemical tests, add chemicals to the feeders, maintain the correct dosages and maintain the feed equipment. They are also expected to make a periodic inventory of chemicals to insure an adequate supply.

TABLE XX

COMPETENCIES - CHEMICAL TREATMENT

COMPETENCIES	MUCH	SOME	NONE
Add chemicals to feeders (fluoride, etc.)	57.6%	12.1%	30.3%
Determine proper dosage	51.5	14.1	34.4
Adjust feeders for proper dosage	43.9	24.5	31.6
Perform water quality laboratory tests (hardness, chlorine residual, etc.)	37.1	18.6	44.3
Maintain chemical use record	57.0	12.0	31.0
Determine chemical inventory	49.0	17.3	33.7
Perform periodic maintenance of feed equipment	40.0	32.0	28.0
Perform repairs of feed equipment	34.7	35.7	29.6

PUBLIC RELATIONS:

Most Wisconsin water utilities are publicly owned and come under the scrutiny of the consumer since the utility provides daily an essential product. Publicly owned water utilities in Wisconsin have traditionally gone quietly about the task of providing their services and made little effort to achieve publicity. The use of utility money for public relation efforts has not been encouraged by the Wisconsin Public Service Commission.

This situation is demonstrated somewhat in the following table as 100% of the operators must respond to customer complaints while 72% apparently do not prepare press releases designed to promote the utility.

However, a large percentage do conduct tours of the facilities and inform the consumer of impending problems.

TABLE XXI

COMPETENCIES - PUBLIC RELATIONS

COMPETENCIES	MUCH	SOME	NONE
Respond to customer complaints	74.3%	25.7%	0.0%
Conduct tours through facilities	26.7	55.5	17.8
Inform public of upcoming possible problems (i.e. main flushing, planned service interruption)	43.4	51.5	5.1
Prepare press releases for utility promotion	8.0	20.0	72.0

MAINTENANCE:

Among his other duties, an operator is expected to do some painting of either the utility building interiors and/or equipment. This is apparently typical of smaller communities and is probably a seasonal type of job.

TABLE XXII

COMPETENCY - MAINTENANCE

COMPETENCY	MUCH	SOME	NONE
Paint buildings (interior and equipment)	39.0%	52.0%	9.0%

SUPERVISION:

It was previously noted that 65.6% of the respondents listed job titles denoting a supervisory or management capacity while an additional 6.5% indicated a job classification at the Foreman level.

This is substantially demonstrated in the following table as the majority of operators are required to perform competencies traditional to the role of supervision.

A minority of operators are required to perform accounting type tasks such as preparing payroll records, calculating water bills, and perform utility accounting.

A major percentage do not get involved with planning such as the preparation of annual budgets or long range plans, nor do they become involved in the negotiation of salaries of others.

Only 39.0% are required to prepare specifications and bid forms for materials purchased by the utility.

TABLE XXIII
COMPETENCIES - SUPERVISION

COMPETENCIES	MUCH	SOME	NONE
Prepare reports for City Council or Water Board	39.4%	38.4%	22.2%
Prepare time sheets	58.0	19.0	23.0
Prepare payroll records	20.8	8.9	70.3
Initiate purchase requisitions	47.1	33.7	19.2
Approve purchase orders	46.0	25.0	29.0
Check invoices for material ordered	58.6	29.3	12.1
Approve invoices for payment	49.0	27.0	24.0
Take inventories	48.5	45.5	6.0
Maintain operating records for state Regulatory agencies	54.1	35.7	10.2
Prepare annual operating budget for approval	7.1	20.2	72.7
Prepare long-range plans for approval	10.0	28.0	62.0
Calculate water bills	16.2	10.1	73.7
Perform utility accounting	11.0	15.0	74.0
Prepare work schedules	52.5	24.2	23.3
Prepare specifications and bid forms for material purchases	10.0	29.0	61.0
Negotiate the salaries of others	10.0	24.0	66.0
Deal with fellow employees grievances	24.0	38.0	38.0

TRAINING REQUESTS:

Operators, in order to improve their ability and perform their tasks more competently, are usually willing to receive supplemental training.

Fifty-three percent (53%) of these operators felt that they would benefit most from training received in Operator Seminars. This type of training is generally not of the "classroom" variety and offers the operator more of an opportunity to share experiences with his peers.

The other methods of training shared nearly equal popularity, with night school being the least favored.

TABLE XXIV

METHODS OF SUPPLEMENTAL TRAINING PREFERRED

Operator Seminars	53.0%
At Utility	14.2%
Correspondence School	13.4%
Day Classes (weekly, monthly)	11.0%
Night School	8.4%

The respondents were asked what subjects they would like to know more about. This was done in an effort to determine those things which interest them and possibly aid in their job performance.

The following is a complete list of responses.

pump repairs
testing water and sewage
water meter maintenance
testing and repair of water meters
maintenance of vertical wells
disposal systems
the review of utility operation is always helpful
chemistry of water in the addition of chemicals to control oxidation, controling red water
flourine machine and equipment

any methods or regulations
water hardness control
methods of determining water main leaks
test water samples for bacterial quality and to perform coliform tests
cross connection control
hydraulic pressure and main flow between sets of various sized pipes
types of troubles others are having
ground water wells
mathematics
flow measurements and calculations
surveying
letter writing
management and drafting
lab testing - general water works practices
retirement
thaw frozen services
determine proper dosage for chemical treatment
bacteriological testing
new equipment
more training sessions to upgrade classification
installing water mains
surveying necessary for construction
soil - effect on pipe
about water
electronics
waterworks
chemical addition & uses
methods of testing
all aspects of water plant operation and maintenance
taste and odor control
finance and management
general refresher course regularly

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

PART I

The specific purpose of this study was to identify competencies required for entry level and mid-management level positions in the municipal water utility area.

The findings of the study are based, in part, on responses from 104 out of 184 certified water treatment plant operators surveyed. The survey was limited to individuals employed by generally small utilities using ground water as a water source. The operators were asked to respond to questions concerning their job title and competencies, their training desires and characteristics of their utility.

In addition to the survey, further utility characteristics were obtained by analyzing information found in the State of Wisconsin Public Water Works Supply Data - 1970, published by the Wisconsin Department of Natural Resources.

The research findings are grouped into four principal topics: (1) Utility characteristics; (2) Operator characteristics; (3) Operator competencies; and (4) Training requests. Tables and a discussion detail the findings.

CONCLUSIONS

In reviewing the findings with respect to the specific objective of the study, the following conclusions are made:

1. The operators responding to the survey were employed by utilities serving an average population of 3,152, with a population range of 271 to 35,515.

2. Fifty-six point six percent (56.6%) of the respondents listed job titles denoting a supervisory or management capacity. However, the survey reveals that they are expected to perform most of the competencies listed in the survey as a normal part of their job requirements. This reflects the small size of the communities which have limited funds and manpower. A majority of these operators have the responsibility for the proper and efficient operation of the utility.

3. While the operators have the responsibility for operation of the utility, a majority do not have the authority to:

   a. prepare payroll records

   b. prepare annual operation budgets

   c. prepare long-range plans

   d. perform utility accounting

   e. prepare specifications and bid forms

   f. negotiate the salaries of others

   Most of these competencies might be considered as supervisory or management level responsibilites. These competencies are probably performed either directly by the controlling political entity such as city councils, board of public works, etc., or by contract through private consulting firms.

4. A majority of respondents indicated they do not perform the following competencies. This list is in addition to those competencies listed in paragraph 3.

   a. perform major pump repair (i.e. bearing or sleeve replacement)

   b. perform hydrostatic test on new water main

c. maintain pressure or vacuum relief valves

d. install tapping-in valve and sleeve

e. operate cathodic protection equipment

f. perform bacteriological tests

g. perform maintenance on venturi or orifice meters

h. calculate water bills.

Although an individual respondent may not perform a particular competency, someone in the utility may be required to perform it. A response of NONE cannot be construed to imply a particular competency is not important or necessary to the successful operation of a utility.

5. The competencies required of the operator are many, pointing out the need for continued training of current operators in addition to quality training of prospective operators. The responsibility and authority of the operator will grow as he demonstrates the ability to perform capably the many competencies required to provide an adequate, continuous supply of quality water to the consumer.

6. The respondent's requests for supplemental training are listed in Table XXIV. The topics listed are diverse in their subject matter. Fifty-three percent (53%) of the operators preferred supplemental training in the form of operator seminars. Such seminars are generally not of the strictly classroom variety, and offer an operator an opportunity to exchange views with his peers. The informal setting also gives the operator the sense that he is being treated as an adult.

RECOMMENDATIONS

Based on the results of the study, the following recommendations are made:

1. The respondents indicated that they had the responsibility for the efficient and effective operation of the water utility, while not possessing some of the authority which should go with that responsibility. It is recommended that current operators, as well as operator trainees, receive more thorough training in:

   a. utility accounting

   b. utility planning and budgeting

   c. specifications and codes

   d. labor relations

   Training in these areas will up-grade the operator's skills, increase his value to his employer and generally up-grade the profession.

2. City Council, Board of Public Works, and Water Commission members should be made more aware of the many jobs and duties required of the operators and also of his needs and desires for further training. Recognition of the operator's skills and positive responses to his training needs will motivate the operator to up-grade his skills, improve his job attitude and dedication while reducing operator turnover. Certification of all trainees and operators should be encouraged as it is a means of stimulating professional growth while providing recognition to all who are successful.

3. A majority of the operators indicated that they do not perform bacteriological tests on their water. Training in this area must be provided as it makes the operator aware of the importance of safeguarding the health of the communities and prepares him for the time when such testing will become mandatory.

4. Training in OSHA (Occupational Safety and Health Act) requirements should be provided since it has become a prime consideration in the operation and liability of the utility.

APPENDIX

DIRECTIONS FOR COMPLETING QUESTIONNAIRE

The first part of the survey is concerned with personal characteristics and characteristics of your utility. Please read each question and check the appropriate space.

The second part of the questionnaire is a list of tasks which may relate to your job. Please check each task in the column which you feel is appropriate.

If you perform the task frequently (i.e. hourly, daily, weekly) check the MUCH column. If the task is performed less frequently (i.e. monthly, yearly, etc.) check the SOME column. If you do not perform the task check the NONE column.

Certain tasks are seasonal such as, main tapping. Check these tasks as to frequency performed during the season.

At the end of the survey list any tasks you do which are not included in the list given, check the method of training you would benefit most from, and list subjects you would like to learn about more.

1. What is your job title? _____

2. What Trade Associations are you or your utility a member of?

_____

3. How frequently do you attend association seminars?

- ☐ quarterly
- ☐ semiannually
- ☐ annual
- ☐ not able to

4. Are you able to attend annual association conferences? (State or National)

- ☐ yes
- ☐ no

5. What method of bacteriological testing does your utility use?

- ☐ State Lab of Hygiene
- ☐ Millipore Filter
- ☐ Multiple Tube

6. What method of chlorine residual testing does your utility use?

- ☐ Starch-Iodine
- ☐ Amperometric Titration
- ☐ Orthotolidine-Arsenite

7. What type of Chlorine feed equipment does your utility use?

- ☐ None
- ☐ Liquid Bleach-Diaphragm Pump
- ☐ Hypochlorite-Diaphragm Pump
- ☐ Gaseous Chlorine-Bell Jar
- ☐ Gaseous Chlorine-Diaphragm
- ☐ Gaseous Chlorine-V-Notch
- ☐ Other _____

8. What method does your utility use to determine water level?

- ☐ None
- ☐ Hand Held Tape
- ☐ Electric Tape
- ☐ Air Line

9. Does you utility have a written policy for sizing?

a.	Water Main	☐ yes	☐ no
b.	Distribution System Valves	☐ yes	☐ no
c.	Customer Services	☐ yes	☐ no

10. Does your utility normally hire contractors for excavation and installation of new water mains?

- ☐ yes
- ☐ no

COMPETENCIES	MUCH	SOME	NONE
WELLS			
Perform water level test			
Maintain water level records			
Read flow meters			
Operate electric well pumps			
Operate auxiliary driven pumps			
Perform routine high lift pump maintenance (change packing, grease)			
Perform major pump repair (replace sleeve, bearings, etc.)			
Maintain flow records			
Operate plant control valves			
Maintenance of electrical pump controls			
WATER MAINS			
Perform hydrostatic leakage tests			
Disinfect new installation			
Maintain main location records			
Inspect construction			
Locate leaks			
Excavate trench for main repair			
Install repair clamps or sleeves			
Prepare or repair lead joints			
Maintain leak records			
Thaw frozen main with electric welder			
Maintain pressure relief valves			
Maintain vacuum relief valves			
SYSTEM VALVES			
Determine type of valves			

COMPETENCIES	MUCH	SOME	NONE
Determine location of new valves			
Install valves			
Exercise valves periodically			
Repair defective valves			
Maintain valve location records			
Maintain valve repair records			
Install tapping in valves			
HYDRANTS			
Determine type of hydrant			
Determine hydrant location			
Install new or replacement hydrants			
Perform periodic inspection			
Perform periodic flushing			
Repair defective or damaged hydrants			
Maintain hydrant location records			
Maintain hydrant repair records			
Perform flow and pressure tests			
SERVICE CONNECTIONS			
Determine size and location of services			
Perform tapping operation			
Install corporation stops			
Install service lateral			
Install curb stops			
Locate leaks in service			
Maintain service location records			
Maintain service repair records			
Thaw frozen services			

COMPETENCIES	MUCH	SOME	NONE
STORAGE FACILITIES (Reservoirs, Standpipes, Elevated Tanks)			
Maintain water level indicators			
Maintain water level control equipment			
Perform periodic inspection of storage unit			
Clean storage unit			
Operate cathodic protection devices			
MEASUREMENT POSITIVE DISPLACEMENT METERS			
Install customer water meters			
Read customer water meters			
Perform periodic accuracy tests			
Repair utility owned water meters			
Maintain meter records			
DIFFERENTIAL PRESSURE METERS (VENTURI & ORIFICE)			
Perform routine maintenance			
BACTERIAL QUALITY			
Collect distribution system samples for testing			
Collect plant samples for testing			
Sterilize glassware for testing			
Prepare culture media for testing			
Perform standard plate count test			
Perform coliform index (M.P.N.) test			
Send samples to State for testing			
Prepare bacteriological records for the Department of Natural Resources			
CHEMICAL TREATMENT			
Add chemicals to feeders (fluoride, etc.)			
Determine proper dosage			

COMPETENCIES	MUCH	SOME	NONE
Adjust feeders for proper dosage			
Perform water quality laboratory tests (hardness, chlorine redidual, etc.)			
Maintain chemicals used record			
Determine chemical inventory			
Perform periodic maintenance of feed equipment			
Perform repairs of feed equipment			
PUBLIC RELATIONS			
Respond to customer complaints			
Conduct tours through facilities			
Inform public of upcoming possible problems (i.e. main flushing, planned service interruption)			
Prepare press releases for utility promotion			
MAINTENANCE			
Paint buildings (interior and equipment)			
SUPERVISION			
Prepare reports for City Council or Water Board			
Prepare time sheets			
Prepare payroll records			
Initiate purchase requisitions			
Approve purchase orders			
Check invoices for material ordered			
Approve invoices for payment			
Take inventories			
Maintain operating records for state Regulatory agencies			
Prepare annual operating budget for approval			
Prepare long-range plans for approval			
Calculate water bills			

COMPETENCIES	MUCH	SOME	NONE
Perform utility accounting			
Prepare work schedules			
Prepare specifications and bid forms for material purchases			
Negotiate the salaries of others			
Deal with fellow employees grievances			

What other tasks do you perform for utility which were not covered in the survey?

What method of supplemental training would you benefit from?

- ☐ Correspondence school
- ☐ Day classes (weekly, monthly)
- ☐ At utility
- ☐ Night school
- ☐ Operator Seminars

What subjects would you like to know more about?

THANK YOU.

APPENDIX B

ADVISORY COMMITTEE MEMBERSHIP

David H. Genrke
Sewer & Water Operator
Belmont, WI 53510

David Kessler, P.E.
Director of Public Services
Janesville, WI 53545

Charles J. Leuck, P.E.
Director of Public Works
Fennimore, WI 53809

Donald Smith
997 Warner
Columbus, WI

A.W. Tandy, Chief
Certification & Licensing Section
Wisconsin Dept. of Natural Resources
Box 450
Madison, WI 53701

Robert G. Wolkowski, Supt.
Water & Sewage
Baraboo, WI 53913

ADVISORY COMMITTEE MEETING OF THE MUNICIPAL ENGINEERING TECHNICIAN FEDERAL PROJECT

Assessment & Determine of Basic Competencies Necessary for Utility Operators Utilizing Ground Water Supplies (03-024-151-225)

July 23, 1974

Ivy Inn Motel - Madison, Wisconsin

PRESENT:

David Gehrke - Belmont, Wisconsin
David Kessler - Janesville, Wisconsin
Charles Leuck - Fennimore, Wisconsin
Donald Smith - Columbia, Wisconsin
A.W. Tandy - Dept. of Natural Resources - Madison, Wisconsin
Robert Wotkowski - Baraboo, Wisconsin

Doyle Beyl - State Board of Vocational, Technical & Adult Education - Madison, WI
Susan Sewell - Southwest Tech - Fennimore, Wisconsin
Gary Stegeman - Southwest Tech - Fennimore, Wisconsin
Daniel Wagner - Southwest Tech - Fennimore, Wisconsin

The meeting was opened by Daniel Wagner who gave a brief welcome and introduction to the project. The objectives for this study were reviewed and it was explained that very little information is available either statewide or nationally in the area of ground water supplies. As an example of a competency based study, the Food Service Articulation final report was distributed to provide the committee an idea of the final format. The tentative time table for the project was reviewed. The research study would be accomplished in July and August with the resultant curriculum guides being written during the remainder of the fiscal year. The final reports would be available by July, 1975.

Gary Stegeman reviewed the survey rough draft to be used to gather the necessary competencies for utility operators. Mr. Tandy commented the Dept. of Natural Resources would cooperate with names of operators and in other ways if possible. The committee reviewed in detail the proposed survey with many helpful suggestions which included the following.

1- use a representative cross sampling method.
2- mail only to certified operators (to be determined by the Dept. of Natural Resources).
3- use size of the community as a guide in survey population selection.
4- mail to an operators home address rather than to place of employment.
5- larger communities may respond more effectively as small communities only have part-time personnel in many instances.
6- a personal interview method will be utilized when possible. This was stressed as the most effective method to gather the data.

After lunch Doyle Beyl provided the State Board of Vocational, Technical and Adult Education viewpoint for the committee. He mentioned the State Board

and local districts rely upon advisory committees for providing a link between the community and vocational education. He commented the funding for this research project is provided by the Vocational Amendments of 1968.

In the afternoon, the committee further reviewed the rough draft of the survey questionnaire in detail. The project personnel were reminded by the committee to keep the questionnaire simple to facilitiate employer response.

The meeting was adjourned at 2:05 p.m.

Sally Kinder
Recording Secretary

July 23, 1974

Dear Sir:

The Wisconsin State Board of Vocational, Technical and Adult Education has approved a research and curriculum development project being conducted by the Southwest Wisconsin Vocational-Technical Institute to determine basic competencies necessary for water utility operators utilizing ground water supplies.

We are interested in what tasks you, as an operator, do in the performance of your profession. Your completion of the enclosed survey will help us develop a curriculum model for statewide instruction in part-time extension programs and in the full-time Municipal Engineering Technician program.

Any information provided by you in the survey will be kept strictly confidential. We would appreciate your completion of this survey by August 9, 1974. A self addressed stamped envelope is enclosed for your use.

Many thanks.

Sincerely yours,

Gary Stegeman, Research Associate
Municipal Engineering Technician Instructor

sk

Enclosures

August 12, 1974

Dear Mr. _____:

The following individuals have graciously agreed to serve on an Advisory Committee whose purpose was to help develop the enclosed survey and determine what duties you and other Water Utility Operators perform in your profession.

David Gehrke - Belmont
David E. Kessler - Janesville
Charles J. Leuck - Fennimore
Donald Smith - Columbus
A.W. Tandy - Madison
Robert Wolkowski - Baraboo

These individuals join with myself in urging you to tell us what tasks you are required to perform. Your answers will help guide the development of meaningful curriculum for Operator training.

We recognize your pride in your profession and trust that you will help us.

Thank you in advance for your efforts. Please follow the instructions given on the first page of the survey. Please return by August 21, 1974.

Respectfully,

Gary Stegeman, Research Associate
Municipal Engineering Technician Instructor

sk

Enclosures

APPENDIX F

Advisory Committee Meeting of the Municipal Engineering Technician Federal Project

Assessment & Determination of Basic Competencies Necessary for Utility Operators Utilizing Ground Water Supplies (03-024-151-225)

January 22, 1975

Ramada Inn - Madison, Wisconsin

PRESENT:

David H. Gehrke - Belmont, Wisconsin
David Kessler - Janesville, Wisconsin
Charles J. Leuck - Fennimore, Wisconsin
A.W. Tandy - Dept. of Natural Resources - Madison, Wisconsin
Robert G. Wolkowski - Baraboo, Wisconsin

Roland Krogstad - State Board of Vocational, Technical & Adult Education Madison, Wisconsin
Gary Stegeman - Southwest Tech - Fennimore, Wisconsin
Daniel Wagner - Southwest Tech - Fennimore, Wisconsin

ABSENT:

Donald Smith - Columbus, Wisconsin

The meeting was opened by Daniel Wagner who gave a brief introduction and explained the objectives of the survey.

Gary Stegeman reviewed the report rough draft with the committee. He explained research findings and conclusions. Upon reviewing the report page by page the committee offered new ideas and conclusions which are listed below.

- method of bacteriological testing should be taught in the classroom even though it may not be used after securing employment
- approximately 7% of the survey results are just not done by the person responding (but someone in the department is doing it)
- the columns for the various competencies should indicate what a person must know and what would be nice if they knew
- possibly City Council and Town Board members should be more aware of the job and duties of the operators
- thawing frozen water mains - if it can be taught the proper and safe way then it would be a good thing to have in the curriculum. It is extremely dangerous to thaw with a electric welder if not done right and this point should be stressed to the student
- students should be oriented to the fact that water tapping in valve and sleeve equipment is available

- students should have training in specifications and codes, so that if they rely on a consultant they would know if anything had been overlooked

- operator seminars are the most preferred method of supplemental training. However, few attend the seminars. The point was brought up that they may not be allowed to dismiss themselves to attend.

- classroom instruction should include OSHA as it pertains directly to the water plant operators

The meeting was adjourned at 12:20 p.m.

Sally Kinder
Recording Secretary

A list of waterworks systems is prepared by the Department of Natural Resources and updated each year to show the classification of all waterworks systems in the state. The classification of waterworks systems is based upon a system of rating values. Items to be rated and their assigned values are listed in the following table:

Rating Values for Classification of Water Supply Works.

	Unit	Rating Value
Source	Ground Water	3
	Surface Water	100
Treatment	Aeration	2
	Coagulation (Surface Water Only)	25
	Sedimentation (Surface Water Only)	30
	Filtration (Gravity)	10
	Filtration (Pressure)	30
	Disinfection (Pre)	5
	Disinfection (Post)	5
	Ion Exchange	20
	Chemical Addition	5
	Chemical Precipitation (Softening or Iron Removal)	50
	Taste and Odor Control	5
Distribution	Raw Water Pumping	5
	Finished Water Pumping	5
	Finished Water Storage at Plant	2
	Storage on System	2

Pumpage or Usage Control	Average Pumpage -- M.G.D.	Rating Value per M. G.
	2 or less	10
	Next 5	2
	Next 20	0.5
	Next 40	0.25
	Maximum value that can be applied is 50.	
	Chemistry Laboratory	5
	Bacteriological Laboratory	5

	CLASSIFICATION
Class S1	161 or more
Class G1	91 - 160
Class P1	66 - 90
Class M1	Up to and including 65

QUALIFICATIONS OF WATERWORKS OPERATORS

Four grades of waterworks operators were established. To qualify for certification in a given grade an individual must pass the appropriate examination and meet one of the combinations of educational and experience requirements, or their equivalent as determined by the Certification Board, for that particular grade.

Grade S1:

a. Registration as a professional engineer with satisfactory experience in operation of a waterworks.

b. A master of science degree in engineering with major emphasis in sanitary sciences with one year of satisfactory experience in operation of a waterworks.

c. A bachelor of science degree in engineering with 2 years of satisfactory experience in operation of a waterworks.

d. Four years of college training with major emphasis in chemistry or biological sciences, with 3 years of satisfactory experience in operation of a waterworks.

Grade G1:

a. A bachelor of science degree in engineering with one year of satisfactory experience in operation of a waterworks.

b. Two years of college training, with major emphasis in chemistry or biological sciences, with 2 years of satisfactory experience in operation of a waterworks.

c. High school graduation and completion of a special course of training in waterworks with a minimum of 3 years satisfactory experience in the operation of a waterworks.

d. Satisfactory completion of a special course of training in waterworks with a minimum of 4 years of satisfactory experience in operation of a waterworks.

Grade P1:

a. Two years of college training, with major emphasis in chemistry or biological science, with one year of satisfactory experience in operation of a waterworks.

b. High school graduation and completion of a special course of training in waterworks with a minimum of 2 years satisfactory experience in operation of a waterworks.

c. Satisfactory completion of a special course of training in waterworks with a minimum of 3 years satisfactory experience in the operation of a waterworks.

Grade M1:

a. Completion of a special course of training in waterworks and demonstration of aptitude in the operation of a waterworks.

JOB TITLES

(Based on U.S. Dept. of Labor Dictionary of Occupational Titles)

I. Management Level

005.168 Superintendent, Water and Sewer Systems
005.188 Supervisor, Water Works
184.168 Superintendent, Water Works
188.118 Commissioner, Public Works

Titles Not Directly Listed in Dictionary of Occupational Titles

A. Director, Public Works
B. Superintendent, Public Utilities
C. Superintendent, Water and Light Department
D. Manager, Water Utilities

General Job Description

Directs and co-ordinates activities of water utility such as treatment of water and testing for impurities, preparation of reports concerning chemical and bacteriological analysis of water for governmental agencies, determines actions to be taken in emergencies and reviews preliminary budgets. Attends council or board meetings to report on budgets, activity reports and plans for future. May hire, promote and discipline employees. May also direct and co-ordinate activities of other public works and utilities.

II. Foreman Level

862.138 Foreman, Water and Sewer Systems

Titles Not Directly Listed in Dictionary of Occupational Titles

A. Foreman, Water Works
B. Foreman, Water Treatment Plant
C. Foreman, Water and Light Utility

General Job Description

Supervises crews engaged in installing, maintaining operating, repairing, and servicing water treatment and/or distribution facilities. Requisitions materials and equipment. May prepare reports on manpower utilization, time records and material inventories. Reports utility activities to management level personnel. May also be engaged in similar work for other municipal public works departments.

III. Operator Level

954.782 Operator, Water Treatment Plant
954.884 Water Meter Installer
239.588 Meter Reader
710.281 Meter Repair Man
851.884 Pipe Layer
862.381 Maintenance Man, Water Works
862.884 Water-Pipe Tapper

Title Not Directly Listed in Dictionary of Occupational Titles

A. Operator, Water Works
B. Chief Operator, Water Treatment Plant
C. Maintenance Man, Village
D. Operator, Water and Sewer Treatment Plant

General Job Description

Controls treatment plant equipment to purify and clarify water for human consumption, controls flow of water, conducts water quality tests. May install, test, repair and read water meters. May install, maintain and repair distribution system facilities.

BIBLIOGRAPHY

Austin, John H. and Kesler, John. Educational Systems for Operators of Water Pollution Control Facilities. 1969.

Brocking, Walter J. Education of Technicians for Water Conservation and Wastewater Control. Presentation Given at Operator Training Workshop at the Water Pollution Control Federation. Dallas, Texas. October 4, 1969.

Brown, Bill Wesley. Characteristics of Outstanding Engineering Technicians in Arizona. Northern Arizona University. Flagstaff, Arizona. July 19, 1967.

Burke, D. Barlow, Jr. and others. Concerns in Water Supply and Pollution Control: Legal, Social, and Economic. Rhode Island University. Kingston, Rhode Island. March, 1971.

Clemson University. Criteria for the Establishment and Maintenance of Two Year Post High School Wastewater Technology Training Programs - Volume I. South Carolina. 1970.

Clemson University. Criteria for the Establishment and Maintenance of Two Year Post High School Wastewater Technology Training Programs - Volume II. South Carolina. 1971.

Department of the Interior; Federal Water Pollution Control Administration to the Congress of the United States. Manpower and Training Needs in Water Pollution Control. Senate Document No. 49. Washington, D.C. August 2, 1967.

Department of Interior. Water and Wastewater Technology; A Suggested 2-Year Post High School Curriculum. Washington, D.C. December, 1968.

Environmental Protection Agency. Guideline to Career Development for Wastewater Treatment Plant Personnel. Washington, D.C. September, 1973.

Purdue University. Manpower Requirements for Pollution Control and Water Resources in Indiana and a Related Pollution Control Technology Curriculum. Lafayette, Indiana. February, 1973.

U.S. Department of Labor. Dictionary of Occupational Titles, Vol. I: Definitions of Titles. 3rd ed. Washington, D.C. Government Printing Office, 1965.

Vernon, James Y. and Garrett, Donald M. Feasibility Study of Training Environmental Technicians. Final Report. Office of Education (DHEW). Washington, D.C. May 24, 1972.

Wisconsin Administrative Code. Chapter NR114. Certification of Operators of Water Works and Sewage Treatment Plants. Madison, Wisconsin: State of Wisconsin, 1972.

Wisconsin Department of Natural Resources. State of Wisconsin Public Works Supply Data - 1970. Madison, Wisconsin; State of Wisconsin, 1970.