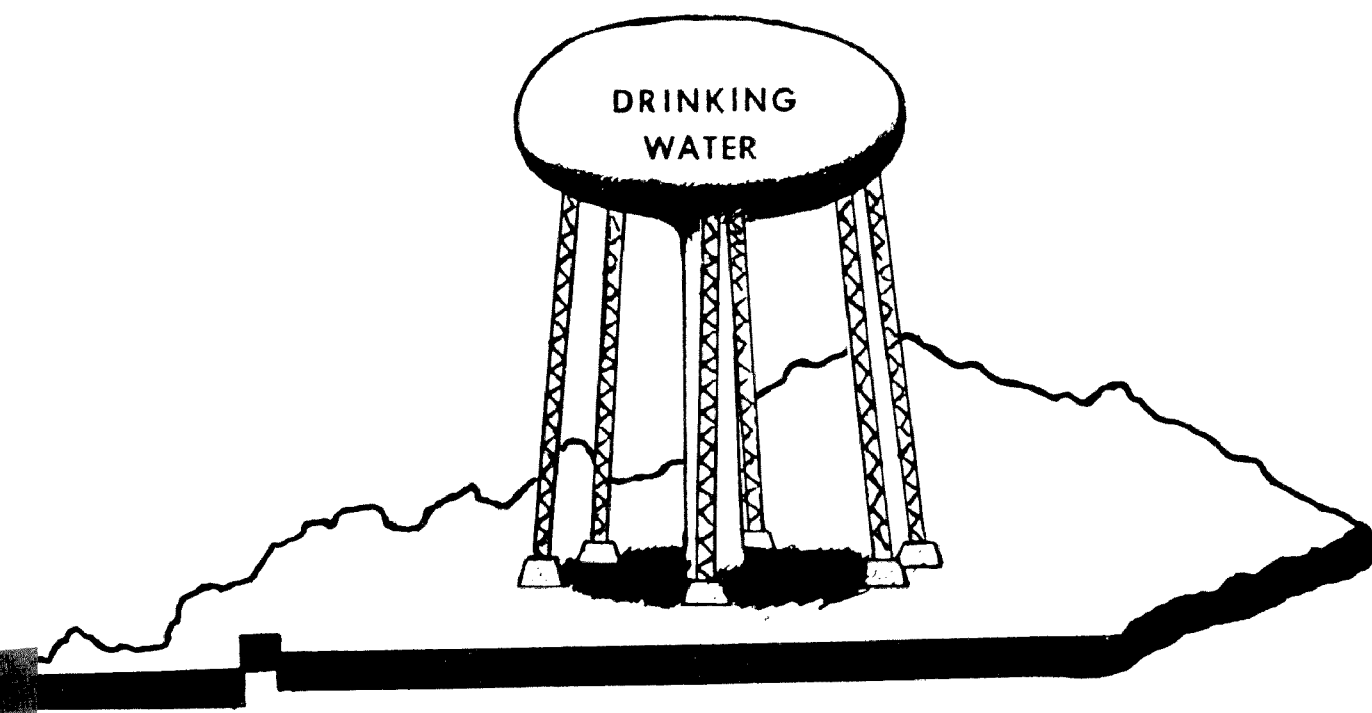


EVALUATION
of the
KENTUCKY WATER SUPPLY PROGRAM
SUMMARY



Bureau of Water Hygiene
Environmental Protection Agency
Region IV
May 1972

PREFACE

The information contained in this SUMMARY has been condensed from EVALUATION OF THE KENTUCKY WATER SUPPLY PROGRAM. The significance of the findings is further discussed for all who have an interest in the quality and protection of drinking water in Kentucky.

The SUMMARY highlights the important results and areas of major need. It is intended to conserve the valuable time of those who do not wish to study the numerous details of the complete report. For more detailed information, consult the Kentucky State Department of Health, Environmental Protection Agency, or the complete text.

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INTRODUCTION

Historically, water in the United States has been involved in the transmission of much infectious disease, and many epidemics were sustained and spread by pathogenic organisms in drinking water. With the advent and widespread application of modern water treatment techniques, especially filtration and disinfection with chlorine, water-borne disease occurrence declined dramatically until it became unusual for public water supplies to be implicated in disease transmission. Today, however, there is evidence that growing complacency in public drinking water regulation and surveillance has replaced the aggressiveness which characterized earlier efforts. Even though water pollution control programs will surely be expanded in the future, this alone cannot assure safe drinking water. Both today and in the future, delivery of adequate quantities of safe, wholesome drinking water will be dependent upon properly designed, constructed, and operated water systems and vigorous health agency regulation and surveillance.

Recognizing the importance of drinking water and its impact on public health, Dr. William P. McElwain, Commissioner, Kentucky State Department of Health, requested that the Environmental Protection Agency evaluate the Kentucky Water Supply Program. In making the request, Dr. McElwain stated that "A potential health hazard appears to be evident to the people of our commonwealth through lack of adequate surveillance of public water supplies and training of water plant operators."

This evaluation was conducted to determine the effectiveness of the Kentucky Water Supply Program, and if necessary, to recommend such improvements as may be needed to assure safe, wholesome drinking water for the residents of Kentucky.

SCOPE

WATER SUPPLIES IN KENTUCKY

According to the 1970 census, 3,218,706 people reside in Kentucky. About 2 million of these people are served by 423 public water supplies. Many of the remaining 1.2 million people live in rural areas and obtain their drinking water from individual water systems. In addition to the public supplies, there are an estimated 1,800 water systems generally known as "semi-public" which may serve as many as 2.5 million residents and traveling public annually at restaurants, service stations, recreational facilities, schools, trailer courts, and other establishments.

WATER SUPPLIES STUDIED

In discussion with Mr. Ralph C. Pickard, Deputy Commissioner for Environment, and Mr. Nick G. Johnson, Director, Division of Sanitary Engineering, it was agreed that the study would generally follow the procedures used in the national Community Water Supply Study and the Evaluation of the Tennessee Water Supply Program.

It was agreed that investigation of a representative number of water supplies was sufficient to judge the effectiveness of the Kentucky Water Supply Program. Although statutory authority excludes private individual water systems from the current water supply program, it was decided that each type of supply used by Kentucky residents should be represented in the Study. A sample of public, "semi-public", and individual water supplies was selected for study. The technique used for selection of the study sample was not intended to provide a perfect

random sample. However, the results are considered to reasonably represent water supply practice in the State.

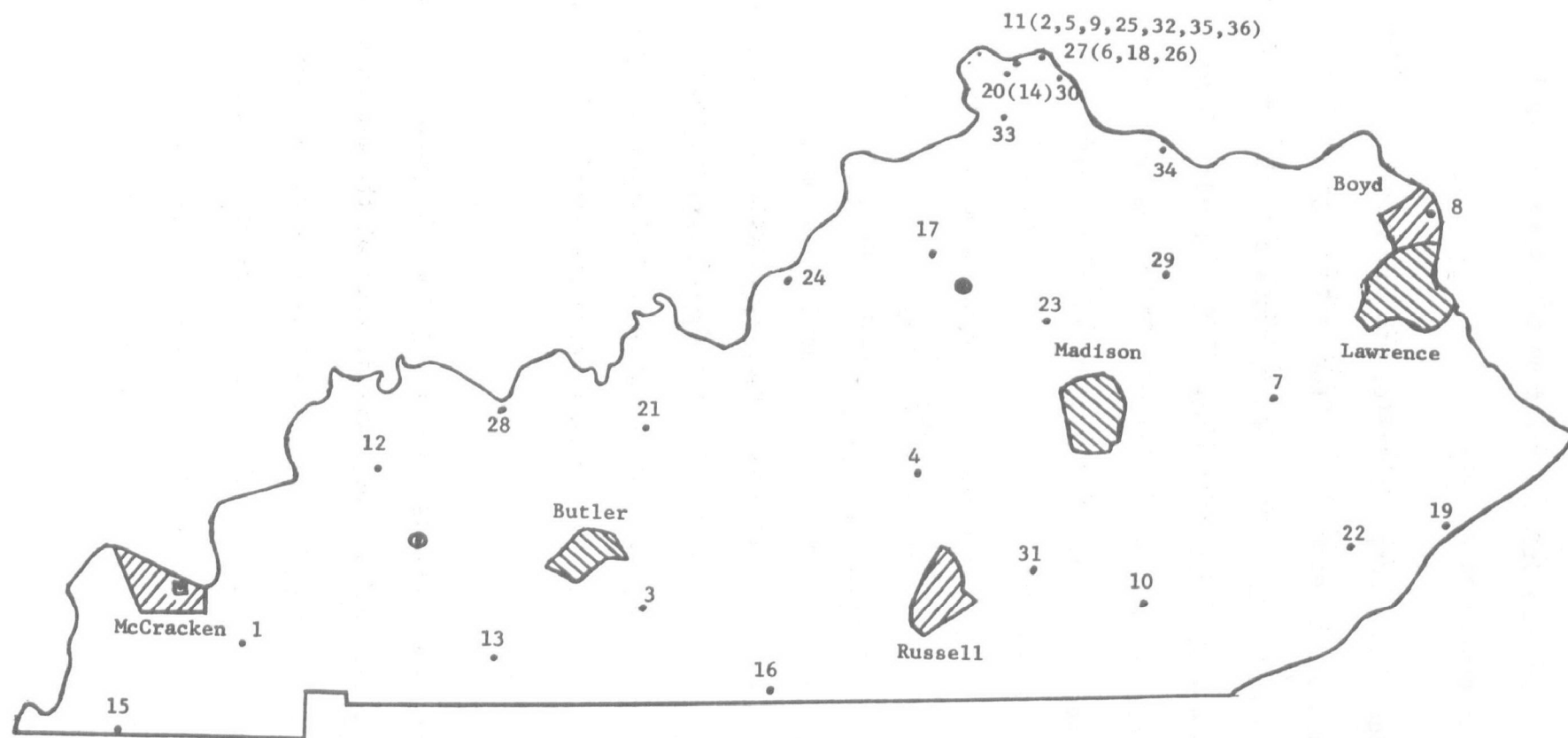
Twenty (20) public water supplies were selected to reflect sizes, types of source, methods of treatment, and geographical location within the State. In addition, 16 public water supplies from north-central Kentucky that were investigated during the national Community Water Supply Study of 1969, were resurveyed for inclusion in this Study. These 36 supplies provide a cross-section of the State's public water supply practice and represent about one-tenth of all public water supplies in the State. It is estimated that these 36 systems serve over 1,230,636 people or about 61 percent of all those served by public water supplies in Kentucky. The location of water supplies surveyed is shown in Figure I.

Eleven (11) of the 36 public water supplies selected for study adjust the fluoride content of their water for dental health protection. A special fluoride study was made of these and three other systems, which were selected to provide a representative sample of fluoridation practice in the State.

For the purpose of evaluating "semi-public" water systems, three counties were selected for study, one in each of the geographical areas of the State. The counties were Boyd in the east, Russell in the central, and McCracken in the western part of the State. Fifty-nine (59) "semi-public" water systems were surveyed, and this represents approximately three percent of the estimated 1,800 supplies in this

FIGURE 1

LOCATION OF WATER SUPPLIES SURVEYED



- Public water supply surveyed (See Table I, Appendix A for supply name corresponding to number)
- ▨ County surveyed for rural individual supplies
- ▨ County surveyed for semi-public supplies
- ⊗ Frankfort—Water Supply Program Headquarters Office
- ⊙ Earlington—Western Regional Office
- ⊠ Paducah—State Branch Laboratory

category. It is estimated that perhaps as many as 2.5 million residents and travelers may drink water from this type of supply at some time during the course of a year.

Rural individual water supply practice was investigated in three other counties, again one in each of the State's three geographical areas. The counties were Lawrence in the east, Madison in the central, and Butler in the western part of the State. Five hundred forty (540) individual water systems were surveyed. These systems serve approximately 2,700 people or about 0.2 percent of those served by individual systems in the State.

PROGRAM EVALUATION

The basic water supply Statute, regulations, and program policies were reviewed. The Water Supply Program's activities, responsiveness to water supply problems, and staffing were also examined. Reported waterborne disease outbreaks were studied. Additionally, many residents, waterworks personnel, municipal officials, health officials and others were interviewed.

Four bacteriological laboratories were surveyed and evaluated. These included the Department's Central Laboratory, and three water treatment plants previously certified by the Department of Health. The Department's Water Chemistry Laboratory and the Water Supply Program's chemical surveillance activity were also studied.

SUMMARY OF FINDINGS AND CONCLUSIONS

WATER SUPPLY STATUS

Water Quality-Bacteriological

Bacteria of the coliform group have been used as indicators of the sanitary quality of waters since 1880 when these organisms were shown to be normal inhabitants of fecal discharges. The Drinking Water Standards recognizes the coliform group as a reliable indicator of the disease producing potential of drinking water. Failure to meet bacteriological standards indicates that drinking water is a potential carrier of infectious disease. Such a situation is a serious, potential health hazard and calls for prompt corrective action.

Seventeen (17) percent of the public water systems examined did not meet bacteriological standards one or more of the past 12 months. These systems serve approximately 12,500 people. No data existed to determine bacteriological quality of an additional 17 percent of the public water systems.

Seventy (70) percent of the rural individual supplies examined failed to meet bacteriological standards and fecal contamination was confirmed in two-thirds of these cases. These systems serve approximately 1,900 people.

Thirty-six (36) percent of the "semi-public" systems examined failed to meet bacteriological standards. It is estimated that as many as 17,971 people (State residents and the traveling public) may be exposed to this water during one year's time.

Water Quality-Chemical

Drinking water must not contain any impurities which may be toxic or otherwise hazardous to the health of man. The Drinking Water Standards list such substances in a special group of mandatory chemical standards which if exceeded, constitute grounds for rejection of the water supply.

Ninety-seven (97) percent of the public water systems examined met mandatory chemical drinking water standards.

Ninety-eight (98) percent of the rural individual water supplies examined met mandatory chemical drinking water standards.

All but one of the "semi-public" water systems met mandatory chemical drinking water standards.

Good quality drinking water should contain no impurities which would cause offense to the sense of sight, taste or smell. The Drinking Water Standards include a group of recommended chemical standards which are intended to assure that drinking water contain no substance

in quantities which would render it undesirable or aesthetically inferior. Experience has shown that when a water supply contains such aesthetic impurities, many people turn to alternate supplies which may be less safe.

Twenty-two (22) percent of the public water systems examined did not meet one or more of the recommended chemical drinking water standards. These systems serve approximately 69,250 people with less than desirable or aesthetically inferior drinking water.

Forty-one (41) percent of the rural individual water systems failed to meet one or more of the recommended chemical standards. These systems serve approximately 1,110 people.

Thirty-four (34) percent of the "semi-public" systems failed to meet one or more recommended chemical standards. As many as 13,326 people (State residents and the traveling public) may be exposed to this water during one year's time.

Facilities

Water supply facilities include all works and auxiliaries for collection, treatment, storage and distribution of drinking water from the source of supply to free flowing outlet of the ultimate consumer. Health

protection is adequate only when the source of supply is of acceptable quality, of sufficient quantity and under continuous surveillance; treatment processes are appropriate to the quality of the source; the facilities are of adequate capacity to meet maximum demands and are located, designed, and constructed to eliminate or prevent contamination; and all facilities are operated in such a manner to deliver a high quality product. Any condition, device or practice in the water supply system and its operation which allows - or may allow - impure, contaminated, or questionable water to be provided the consumer constitutes a health hazard.

Fifty-eight (58) percent of the public water systems needed additional treatment facilities and 73 percent needed important changes in the operation of present facilities. Without these additions and changes, continuous production of safe drinking water may not be maintained.

None of the 14 public water supply fluoridation programs evaluated were fully acceptable. Sixty-four (64) percent of the systems were fluoridating at less than the proper level, significantly reducing the dental health benefits of this treatment.

Twenty-eight (28) percent of the public supplies and 68 percent of the 41 "semi-public" supplies

examined which chlorinate did not provide a detectable chlorine residual in all parts of the distribution system. Unsatisfactory chlorination practice reduces the margin of safety against disease transmission through drinking water.

Nineteen (19) percent of the public water systems examined had inadequate distribution system storage and 8 percent had inadequate water pressures in some or all areas of the distribution system. Ninety-two (92) percent of the public supplies examined had inadequate cross-connection control programs. Flawless treatment avails nothing if the distribution system does not deliver adequate water for essential health needs or permits entrance of hazardous substances through cross-connections or other system deficiencies.

Eighty-three (83) percent of the "semi-public" systems rated overall less than "satisfactory" and 56 percent needed additional treatment. Thirty-four (34) percent had visible sanitary defects, which clearly present the potential for dangerous contamination.

Twenty (20) percent of the rural, individual water systems examined had sources with insufficient quantity. Nearly every one of the individual systems had one or more facility deficiencies. Very few of these systems were constructed to prevent entrance of contamination. Ninety-one (91) percent of the systems had never been tested for bacteriological quality.

Operator Competence

The water supply operator's actions or inactions influence the health of every person who drinks from the water supply. The water supply operator must be conscientious, well-trained and capable of handling all responsibilities of the water system. Even the most efficient and sophisticated water supply facility is inadequate without proper operation and maintenance.

Eighty-one (81) percent of the public water supplies examined were maintaining inadequate operational records and/or conducting inadequate water quality testing.

Thirty-nine (39) percent of the public water systems evaluated had only part-time operators and 56 percent of public water supply operators were not certified by the Kentucky State Department of Health. Most of these systems also had

water quality problems and/or facilities deficiencies.

Surveillance

The surveillance of water systems involves constant vigilance by health and waterworks officials over water quality, water system facilities, and operational practices. Bacteriological quality of drinking water can only be gauged by frequent examination of samples collected from representative points throughout the distribution system. Chemical characteristics must also be routinely examined. To prevent health hazards from developing in a water supply system, someone trained in proper water supply practice and not associated with the supply should regularly review operational procedures and physical facilities. The frequency and detail of these sanitary surveys are dependent on the complexity of the system and extent of the problems.

Sixty-four (64) percent of the public water systems studied did not meet bacteriological surveillance standards. Although ninety-four (94) percent of the public water supplies received a chemical evaluation during the past three years, most evaluations did not include all 26 constituents listed in the Drinking Water Standards. Sixty-seven (67) percent of the public supplies had not been rated by a representative of the Kentucky State

Department of Health during the previous twelve months. Without health agency surveillance, hazardous conditions will persist undetected and uncorrected.

Thirty-seven (37) percent of the "semi-public" water systems studied had not had a health agency visit in the previous two years. Even when made, these visits often do not include a full inspection of facilities and operational practices.

WATER SUPPLY PROGRAM

The funds expended for drinking water protection in Kentucky are totally inadequate to support a comprehensive program. The Division of Sanitary Engineering operates on a budget of only \$103,075 with approximately \$82,500 available for the administration of the Water Supply Program. Even taking into consideration laboratory support provided by other programs, less than 2.6 cents per capita per year is spent to protect drinking water.

Staff limitations have prevented the Water Supply Program from fulfilling its responsibilities. Evaluation of Kentucky water supply practice indicates many supplies are deficient and present a high risk to the public. Because the Division employs only five sanitary engineers, with approximately four man-years being devoted to the Water Supply Program, important activities are not being performed,

or are being performed in a superficial manner, seriously reducing the effectiveness of the program. A Water Supply Program conducted in this manner creates a false sense of security.

In spite of increases in the number of water supplies and the population served by these supplies, the staff of the Division of Sanitary Engineering has dwindled from nine in 1963-66 to five at the present time. Ten experienced men have left the program in the past seven years. Unfortunately, the water supply experience of those who left was generally greater than their replacements.

Compliance with Departmental directives has generally been obtained through persuasion and cooperation with County Health officers, who have issued "boil water" orders. However, failure to initiate legal proceedings against the City of Covington, which has ignored a written Departmental Compliance Order on fluoridation, has weakened the Department's credibility and compromised its effectiveness. In addition, the penalty for violating the Water Supply Rules and Regulations is insufficient.

Current Public Water Supplies Regulations were adopted July 20, 1967, and provide useful guidance for certain water supply matters. Bacteriological and chemical finished water quality standards are included. A crucial omission, however, is the lack of a specified sampling frequency for either bacteriological or chemical quality. The Regulations do not specifically require disinfection of all public water supplies,

although disinfection equipment is discussed in detail. No provision is made for the planned and orderly development of new public water supplies.

The Division of Sanitary Engineering's water supply policies are contained in a number of letters, publications and documents which provide the bases for sound water supply practice. However, the absence of a single water supply policy document has hampered Water Supply Program staff, waterworks officials, and consulting engineers.

Consistent engineering review of bacteriological laboratory results has not been provided by the Division of Sanitary Engineering, and at present no systematic procedure to examine and record bacteriological data is in use. In addition, follow-up and resampling procedures, if pursued at all, are not adequate. A bacteriological surveillance program conducted in this manner negates the conscientious efforts of those collecting and analyzing samples. Such a program creates a false sense of security for water supply operators and the public.

Operator training activities have reached a majority of the public water supply operators. Nevertheless, facility and operational deficiencies indicate that recommended waterworks practices and public health protection are not being universally applied.

An immense quantity of data must be assembled, analyzed, and stored for successful management of a water supply program. This important

activity, now being done entirely by "hand", is considered too time consuming for professional personnel, and is seldom given proper attention.

* * * * *

The Kentucky Water Supply Program is not providing the health evaluation and engineering services necessary to fulfill its responsibilities to protect the health of the citizens of Kentucky. Well established standards of good practice are not being universally applied in Kentucky. This Study documents that many water systems deliver water of marginal or poor quality and substantiates Dr. McElwain's assertion that the people of Kentucky are faced with a potential health hazard because of their drinking water.

Water supply technology was devised decades ago to treat raw water of generally high quality for protection against transmission of infectious disease. Today's industrial and agricultural practices can result in increasing quantities of toxic chemicals being found in natural waters. Conventional water treatment practices do not always remove these chemicals, and some were found in drinking water during this Study. Without complete water quality surveillance, no assurance can be given that toxic impurities will be absent from Kentucky's drinking water.

These findings are not reassuring with regard to the future. It is evident that Kentucky must vigorously pursue an expanded drinking

water program, giving increased attention to the broad problems of water supply in order to assure an adequate supply of safe drinking water on a continuing basis.

RECOMMENDATIONS

It is recommended that:

1. The Water Supply Program be restored to a stature commensurate with its importance to the health of Kentucky residents with a minimum annual budget of \$514,000. These funds should be used as follows:

a. Water Supply Activities	\$359,000
b. Laboratory Services	<u>\$155,000</u>
Total	\$514,000
2. The Water Supply Program be initially staffed with a minimum of 18 professionals and 6 secretaries.
3. Water Supply activities be further decentralized by assignment of two additional staff to assist the Sanitary Engineer stationed at the Earlington Regional Office and establishment of two new Regional Offices, one in the southeast and one in the northeast, as soon as competent staff can be recruited and trained.
4. One bacteriologist and one secretary be hired by the Division of Sanitary Engineering and assigned to the Division of Laboratory Services for additional water bacteriology work. Similarly, two chemists and one

secretary should be hired and assigned to the Division of Laboratory Services for drinking water chemical analyses.

5. The Water Supply Regulations be revised and expanded to more comprehensively reflect current recommended water supply practice. Specific features should be included to:

- a. Establish a minimum sampling frequency for acceptable bacteriological surveillance.
- b. Clarify and reword the quality standards for finished drinking water.
- c. Require mandatory disinfection of all water systems serving the public, and specify minimum distribution system residual for systems disinfecting with chlorine.
- d. Redefine a cross-connection.
- e. Provide for orderly development of new supplies.
- f. Require that water system plans and specifications be prepared by registered professional engineers.
- g. Require that an individual or group be designated legally responsible for each public water supply.

6. Cooperative compliance with Water Supply Rules and Regulations continue to be emphasized.

However, if cooperation and persuasion fail to achieve prompt compliance to protect drinking water and public health, enforcement measures as provided by statute should be initiated.

7. A single document be prepared and distributed which presents all current Kentucky Water Supply Program Policy. Provision should be made for updating this document as policy revisions occur.

8. The Division of Sanitary Engineering increase and improve its surveillance of drinking water supplies to at least the minimum levels set forth in the Public Health Service Drinking Water Standards and Manual for Evaluating Public Drinking Water Supplies. These activities should include, but not necessarily be limited to:

- a. Thorough periodic sanitary surveys of each system, setting priorities and time schedules for improving those systems with deficiencies.
- b. Bacteriological surveillance sufficient to check laboratory analyses provided by the larger public water supplies, and in the

case of small systems without laboratories,
bacteriological surveillance sufficient to
meet recommended Standards.

c. Complete routine chemical analyses of all
drinking water.

9. All water plant laboratories continue to be certified by
the Kentucky State Department of Health as to their
capability of performing "official" bacteriological
analyses.
10. Automatic data processing techniques be employed for
storage, analysis, and retrieval of water supply data.

ACKNOWLEDGEMENTS

The assistance and cooperation of Mr. Nick G. Johnson, Director, Division of Sanitary Engineering, Kentucky State Department of Health, is gratefully acknowledged. The Division of Sanitary Engineering Staff gave freely of their time and accompanied survey officers on many field evaluations. The county sanitarians of Boyd, Lawrence, Russell, Madison, Butler and McCracken County Health Departments also made substantial contributions. The Division of Laboratories, Frankfort, provided important bacteriological analyses. And finally, a special thanks is given to all the residents, waterworks personnel and utility officials who provided information and otherwise cooperated in the Study.

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APPENDIX A

TABLE I

PUBLIC WATER SYSTEMS STUDIED

<u>No.</u>	<u>Name of System</u>	<u>Population Served</u>	<u>Source</u>
1	Benton	3,074	2 Wells
2	Boone County W. D.	4,800	Covington
3	Bowling Green	39,000	Barren River
4	Bradfordsville	560	N. Rolling Fork River
5	Bromley W. D.	1,130	Covington (Ludlow W. D.)
6	Campbell County W. D. #1	44,000	Newport
7	Campton	720	2 Wells
8	Catlettsburg	10,000	Big Sandy River
9	Cold Springs W. D.	1,900	Covington
10	Corbin	12,500	Laurel River
11	Covington	60,000	Ohio River
12	Dixon	540	Dixon Lake
13	Elkton	2,800	Stinson Lake
14	Florence W. D.	11,000	Kenton County W. D. #1
15	Fulton	3,500	3 Wells
16	Gamaliel	720	Line Creek
17	Henry County W. D. #1	1,200	Henry Co. W. D. Lake
18	Highland Heights W. D.	4,000	Newport (C.C.W.D.)
19	Jenkins	4,500	Jenkins Lake, Well
20	Kenton County W. D. #1	52,700	Licking River
21	Kingswood	200	2 Springs

TABLE I (Cont'd)

PUBLIC WATER SYSTEMS STUDIED

<u>No.</u>	<u>Name of System</u>	<u>Population Served</u>	<u>Source</u>
22	Leatherwood (Blue Diamond Coal Company)	690	Mine Impoundment
23	Lexington	172,507	Kentucky River
24	Louisville	672,585	Ohio River
25	Ludlow W. D.	6,200	Covington
26	Mentor W. D.	700	Newport
27	Newport	31,300	Ohio River
28	Owensboro	58,800	25 Wells
29	Sharpsburg W. D.	1,000	Sharpsburg Lake
30	Silver Grove	1,500	2 Wells
31	Somerset	16,700	Lake Cumberland
32	Taylor Mill W. D.	5,000	Covington
33	Walton	1,800	2 Lakes
34	Western Mason County W. D.	1,560	Well
35	Wilder W. D.	650	Covington
36	Winston Park W. D.	800	Covington
		1,230,636	

* U.S. GOVERNMENT PRINTING OFFICE: 1972-741-661/REGION NO. 4