ORSANCO

1967

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(1) Consultant as of October 1, 1967. (2) Executive Director and Chief Engineer as of October 1, 1967. (3) Resigned.

The Commissioners of the

OHIO RIVER VALLEY WATER SANITATION COMMISSION

an interstate compact agency
created jointly in 1948 by the

State of Illinois
State of Indiana
Commonwealth of Kentucky
State of New York
Commonwealth of Pennsylvania
Commonwealth of Virginia
State of West Virginia
State of Ohio

with approval of the
Congress of the United States

respectfully submit their

NINETEENTH YEARBOOK 1967

HEADQUARTERS: 414 Walnut St., Cincinnati, Ohio 45202 Telephone: 421-1151

"Our main business is not to see what lies dimly at a distance, but to do what lies clearly at hand"

— Thomas Carlyle.

ACTIVITIES OF THE Ohio River Valley Water Sanitation Commission (ORSANCO) and its eight member states during the past year were dominated by efforts to satisfy a mandate of the amended Federal Water Quality Act. This involved promulgation by the states of quality standards for all interstate streams and the submission of plans for their implementation and enforcement.

The complex task of devising sewage and industrial-waste control requirements has been an integral component of the Ohio Valley pollution control program since its inception. But compliance with the new federal law introduced a significant departure from prior regional practice.

Heretofore, the signatory states relied on the interstate commission for the conduct of investigations and hearings, following which the entire membership deliberated on the findings and then jointly reached conclusions on what standards and regulations were appropriate for specified stretches of an interstate stream. The Commission thus served as a regional mechanism for coordinating action and, most importantly, for assuring compatibility of requirements in contiguous states. Furthermore, under terms of the compact, such a procedure is prerequisite for any exercise of Commission enforcement powers.

The Federal Water Quality Act, which was passed in October 1965, is explicit in requiring each state to conduct hearings on interstate waters and individually adopt standards to be submitted for approval to the Secretary of the Interior. The date of June 30, 1967, was the deadline for completing these actions.

Expressing concern over this provision of the federal law, the Attorney General of the Commonwealth of Kentucky in a letter to the Secretary of the Interior, said: "Practical consideration of the problems to be dealt with . . . seems to indicate the wisdom of combined, joint or contemporaneous hearings on proposed standards for state boundary waters and, even more desirably, hearings conducted by an interstate agency to avoid the inevitable conflicts both in testimony received and recommendations adopted." Pointing out that ORSANCO provided a ready-made forum and vehicle for the required hearings and promulgation of standards in the Ohio Valley, he asked if use of the interstate agency for this purpose would be recognized as complying with federal requirements.

In response to this query the Solicitor of the Department of Interior offered an opinion that if the states expressly delegated authority to ORSANCO to act for them in conducting hearings this could be construed to satisfy the requirement of the federal act so far as public hearings were concerned. Nevertheless, it still would be incumbent upon the states independently to adopt standards and file plans for their implementation and enforcement.

INTERSTATE COORDINATION

Discussion of this option among the Ohio Valley compact states led to a conclusion by a majority of commissioners that independent conduct of hearings and promulgation of standards appeared to be the preferred course of action. Concerning compatibility of standards, the signatory states felt that in large measure this would be facilitated by adhering to the ORSANCO quality criteria for various water uses on which there had been previous unanimous agreement. In some situations this hope was not fully realized, partly because of differences among contiguous states regarding stream-use classifications. In turn, this led to application of different criteria with resulting variations in standards.

With respect to ORSANCO participation in state hearings the following action was adopted by the Commission (*Resolution No. 18-66,* minutes of meeting on September 7-8, 1966):

"RESOLVED: It shall be and hereby is the enunciated policy of the Commission that upon request

from each state party to a hearing regarding the establishment of water-quality criteria by means of such hearing the Commission shall participate. Representation from the Commission shall be determined by the Chairman thereof in consultation with the states party to the hearing. Such degree of participation by the Commission shall be as agreed to by the participating states but not in limitation of presentation of testimony, or evaluation of evidence."

HEARINGS AND STANDARDS

The signatory states conducted 25 initial hearings for the Ohio River and its interstate tributaries within the compact district. Seven of the proceedings were concerned with the Ohio River main stem, 16 dealt only with the tributaries, and two others included consideration of both tributaries and portions of the main stem. (See tabulation below showing places and dates.)

The ORSANCO staff participated in all of these proceedings, offering viewpoints with respect to variances in proposed standards and water-use determinations, and suggesting possibilities for their reconciliation prior to formal adoption by the states. In addition, at the request of Ohio and West Virginia, the Commission developed a reference report containing staff findings and conclusions relating to quality standards and their implementation for some 450 miles of the upper Ohio River.

On two occasions during intervals between hearings, the Engineering Committee of ORSANCO — whose membership includes the chief sanitary engineers of the signatory states as well as three technical experts representing the federal government — reviewed proposed standards with a view toward facilitating their reconciliation. Although the committee did not iron out all differences, it did conclude that this effort had paved the way for resolution of inconsistencies.

HEARINGS CONDUCTED BY THE SIGNATORY STATES RELATING TO THE ESTABLISHMENT OF WATER QUALITY STANDARDS

State	Ohio River Mile Point	Tributary Stream	Location of Hearing	Date of Hearing
Pennsylvania	0.0 to 40.0	Allegheny, Monongahela, Little Beaver	Pittsburgh, Pa.	January 4, 1967
Pennsylvania		Beaver and Little Beaver	New Castle, Pa.	September 22, 1966
Pennsylvania		Allegheny	Meadville, Pa.	November 29, 1966
West Virginia	40.0 to 317.1		Parkersburg, W. Va.	March 27, 1967
West Virginia		Kanawha	Charleston, W. Va.	February 21, 1967
West Virginia		Kanawha	Princeton, W. Va.	March 13, 1967
West Virginia		Big Sandy and Guyandot	Williamson, W. Va.	March 20, 1967
West Virginia		Monongahela River	Morgantown, W. Va.	April 13, 1967
Ohio	40.0 to 317.1		Marietta, Ohio	March 28, 1967
Ohio		Beaver and Little Beaver	Youngstown, Ohio	July 26, 1966
Ohio		Miami and Wabash	Dayton, Ohio	February 28, 1967
Ohio	317.1 to 491.3		Cincinnati, Ohio	March 30, 1967
Kentucky	317.1 to 491.3		Maysville, Ky.	March 9, 1967
Kentucky	491.3 to 848.1		Louisville, Ky.	December 22, 1966
Kentucky	848.1 to 981.0	Tennessee and Cumberland	Paducah, Ky.	March 2, 1967
Kentucky		Big Sandy	Prestonburg, Ky.	March 23, 1967
Indiana	491.3 to 848.1		Evansville, Ind.	December 21, 1966
Indiana		Miami	Richmond, Ind.	November 30, 1966
Indiana		Wabash	Logansport, Ind.	January 10, 1967
Indiana		Wabash	Vincennes, Ind.	January 19, 1967
Indiana		Miami	Indianapolis, Ind.	March 17, 1967
Illinois	848.1 to 981.0		Metropolis, Ill.	October 7, 1966
Illinois		Wabash	Lawrenceville, Ill.	October 6, 1966
Virginia		Kanawha	Radford, Va.	February 14, 1967
Virginia		Big Sandy	Grundy, Va.	March 22, 1967

In addition, the Engineering Committee recommended certain modifications of the ORSANCO quality criteria, which were approved by the Commission. These changes included: A more precise definition of limiting values for strontium-90 and alpha emitters in the radioactivity criteria for public water supply; a reduction in permissible limits of cyanide and fluoride concentrations for waters for public water supply; and the inclusion of wastes from agricultural practices in the category of those discharges subject to compliance with minimum requirements for control. These modifications are detailed in the revised version of the criteria, which will be found in a following section of this report.

Meantime, the Aquatic-Life Advisory Committee, which is continually engaged in the assessment of new knowledge relating to criteria for fish and aquatic life, presented an interim report on its most recent findings.

These point to recommendations of minimum dissolved oxygen levels of 4.0 mg/l for well-rounded, warm-water fish habitats, 3.0 mg/l for commercial, non-game and forage fish habitats, and 5.0 mg/l for cold-water fish habitats. With respect to temperature, the committee suggested that daily mean values should not exceed 90 degrees F. with no individual value above 93 degrees except during the months of December through February, when the temperature should not exceed 55 degrees. It also concluded that pH values should be maintained between 6.0 and 8.5. Finally, the committee recommended that zones of admixture in areas where wastewaters are discharged should not be permitted to extend entirely across a stream, but should leave at all times a passageway consisting of not less than one fourth of the width and one fourth of the cross section of the stream. These recommended changes in aquatic-life criteria are under consideration by the Commission.

All of the ORSANCO states met the June 30 requirement for submission of quality standards and a plan for their implementation. The matter of federal approval now awaits action by the Secretary of the Interior, whose review is expected to be completed before the end of this year.

Operating experience with the unique robot monitor system pioneered by ORSANCO seven years ago led to the installation in April of "second generation" equipment to replace the original interrogation and recording devices. A network of 14 electronic sentinels located on streams in the Ohio Valley is automatically controlled from Cincinnati headquarters through a 700-mile telemeter circuit. Here Chemist-Biologist William L. Klein is employing voice transmission facilities used during periodic field checks on robot-monitor functioning.

CONTROL INSTALLATIONS

Despite preoccupation with affairs resulting from the broadened commitment of federal interest in future pollution control activities, reports from the states signatory to the Ohio Valley compact revealed progress in meeting current obligations relating to their regional program.

As detailed elsewhere in this report, the new control installations that went into operation this past year totalled 76, of which 58 were for sewage treatment at municipalities serving a population of 91,000, and 18 were for industrial wastes. Additions or improvements to existing control facilities were completed at 23 municipal and 20 industrial installations.

The situation over-all in the Ohio Valley district may be summarized in this fashion: Municipal treatment facilities now in operation serve slightly more than 94 percent of the 11,400,000 sewered population. Eighty-eight percent of the 1,840 industrial plants discharging wastewater directly to streams are now reported to be complying with ORSANCO minimum requirements. Under construction are new control installations for 51 communities and 39 industries.

Along the main stem of the Ohio River treatment facilities now in operation serve 99 percent of the almost 3,700,000 sewered population, and 91 percent of the 202 industrial enterprises discharging directly to the river have provided wastewater discharge controls. New facilities are under construction to serve 6 communities and 7 industrial plants.

Significant developments with respect to upgrading existing facilities include the initiation of engineering studies for the addition of secondary treatment facilities by the Allegheny County Sanitary Authority (Pittsburgh, Pa. metropolitan area), by the City of Cincinnati, by the Northern Kentucky Sanitation District No. 1 (forming part of the Cincinnati metropolitan area) and by both the Jeffersonville and Clarksville, Indiana, treatment works, which are in the Louisville metropolitan area.

QUALITY MANAGEMENT

Basic to the practice of river quality management is the systematic acquisition and evaluation of information on quality characteristics and flow variations. ORSANCO has made substantial progress since 1951 on the application of techniques for this purpose, most notably in pioneering the development of an automatic quality measuring "tool" called a robot monitor. Six years experience in the use and expansion of this electronic sentinel system, coupled with computer analysis of flow and quality data, reveals possibilities in the not too distant future of providing forecasts of changes in river quality.

Meantime, a staff suggestion several years ago that the Corps of Engineers might utilize quality output from a robot monitor system in scheduling flow releases from multiple-purpose reservoirs has been acted upon favorably by the Ohio River Division of the U. S. Army Engineers. The Commission received a prospectus from the Pittsburgh District office of the Corps in August 1967, outlining the first phase of a proposed monitor program involving the installation of three units for continuous measurement of water quality in the vicinity of the new Allegheny River reservoir. (The Allegheny is one of the two major streams that come together at Pittsburgh to form the Ohio River.)

Earlier in the year the Commission staff developed for the Corps and the Ohio Basin office of the Federal Water Pollution Control Administration a proposal titled "Water Quality Correlation Project and Management-Model Study of the Allegheny River," which invited consideration of a contractual arrangement for expansion and utilization of the ORSANCO monitor and computer system. Following a review of this proposal the Corps expressed a preference for establishing a monitor system of its own. Installation of the Allegheny Reservoir monitors is regarded by the Corps as the initial step in development of a comprehensive monitoring network for the Allegheny, Monogahela and upper Ohio River basins. It is contemplated that the monitor equipment will be compatible with the existing ORSANCO units, a number of which are located on the main stem of the Ohio River. (See map on page 10.)

Another aspect of river-flow manipulation that may influence future quality conditions in the Ohio River — operation of hydroelectric plants located at the new navigation dams — will receive preliminary study. This development stems from informal discussions initiated by the staff with representatives of the Federal Power Commission and members of the ORSANCO Electric Power Industry Advisory Committee. To further the acquisition of information that may be useful in design of a proposed hydropower installation on the Ohio River, the American Electric Power Service Corporation will collect and analyze

quality data above and below a recently completed hydropower plant at the Markland (Ind.) navigation dam, mile 532. The owner of this plant, Public Service Company of Indiana, will cooperate in this venture by manipulating the installation to simulate various operating conditions.

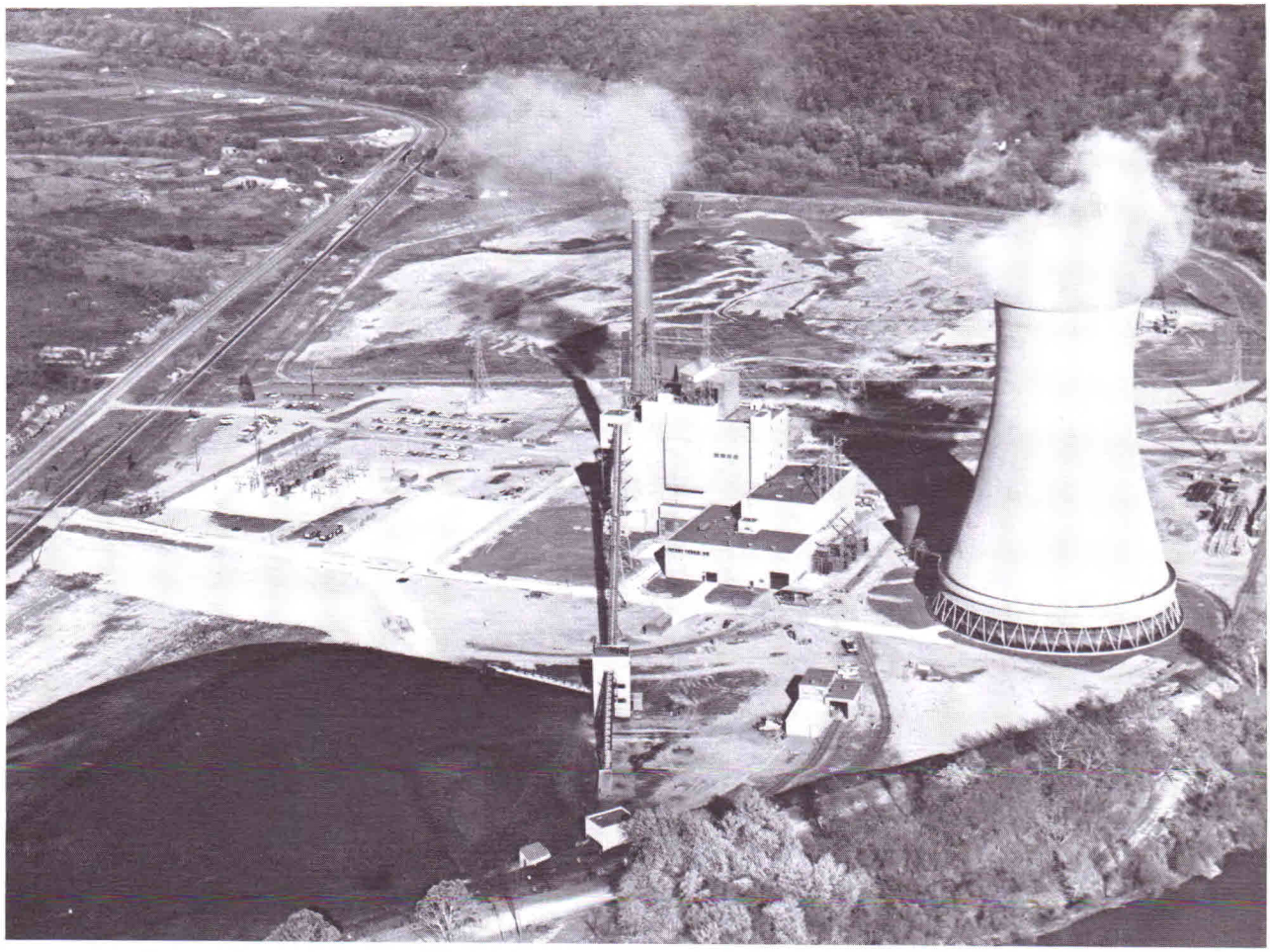
Allied to this project is another study being undertaken by the Appalachian Power Company at its Winfield and Marmet hydropower installations on the Kanawha River. Here, there are occasions when there is virtually no dissolved oxygen in the river. This study is exploratory in nature, looking toward the potentialities of venting air through the turbine to restore oxygen depletion. ORSANCO is furnishing river oxygen data from its robot monitor station at Winfield.

REGIONAL SERVICE PROJECTS

Because of its basin-wide orientation, responsibilities and membership representation, the Ohio River Valley Water Sanitation Commission possesses unique opportunities for advancing regional quality management aspirations. This view was reiterated by the Executive Director in a report to the commissioners in which he recalled a number of past endeavors that had proven mutually beneficial to the signatory states and then outlined several projects that now could lay claim for attention as regional service undertakings.

Two of these new projects were regarded with some favor and the staff was instructed to consider their implementation. One of them — development of

Water cooling tower with a height of 320 feet dwarfs the new steam-electric generating plant of the Kentucky Power Company on the Big Sandy River near Louisa, Ky. This natural-draft cooling installation, first of its kind in the western hemisphere, is one of five being built at plants of the American Electric Power System to prevent thermal pollution in streams of the Ohio River Valley.



automated forecast procedures for river quality management — has been inspired by the increasing versatility of the ORSANCO Robot Monitor system and the improving capability of the staff in river-model simulation and electronic computer techniques.

The proposal envisages an intensive investigation of changes taking place in a 170-mile stretch of the Ohio River based on an evaluation of the influence of tributary streams, surface runoff, storm sewer overflows, hydropower generation, wastewater discharges and river-flow variations. The aim of the project is to devise the methodology of utilizing forecasts of river quality changes so that steps may be taken to minimize the occurrence of undesirable conditions.

The other project is concerned with a reconnaissance of deep-well waste disposal potentialities and limitations in the Ohio Valley. Questions to be explored in such a study include: What legal principles apply to the use of underground strata? What safeguards can be imposed to insure compatibility of multiple use of underground strata and to prevent impairment of underground resources for future use? What guidelines can be formulated for the states to follow in reaching decisions on applications for deep-well-disposal projects? How are sites for patrol wells selected and who will be charged with responsibility for continuous monitoring? What types of strata can be used for what types of waste?

The oldest regional service project on which the Commission has been engaged is the systematic acquisition and evaluation of river quality data. What this encompasses, along with a summary and appraisal of quality conditions of streams in the Ohio Valley district during the past year, is presented in a separate section of this report. As has been done in prior annual reports, the findings are matched against criteria adopted by the Commission (see pages 8-9).

Aside from the importance of this monitoring project to undertakings of the Commission, it is proving useful in satisfying requests from both state and federal agencies for certain types of quality data. For example, it was possible to accommodate a need of the Federal Water Pollution Control Administration for daily quality variations over a period of eight years on two major tributaries. The Virginia State Department of Health was supplied with hourly variations of quality over a one-year period on one of its streams flowing into the Ohio Basin. During periods of low summer flow the daily maximum and minimum values of dissolved oxygen at a critical point in the Ohio River below Cincinnati are furnished to the pollution control agencies of Indiana, Kentucky and Ohio. Recently inaugurated is a service whereby Pennsylvania receives daily summaries of quality changes recorded at five stations of the ORSANCO network. Also being satisfied is a request from the Corps of Engineers for hourly data on dissolved oxygen variations in the middle section of the Markland Dam navigation pool. Computer programs developed by ORSANCO make it relatively easy to retrieve quality information and provide print-outs of the data.

Further details on activities of ORSANCO this year are set forth in the pages that follow. In brief, what transpired reflects further the spirit that has characterized conduct of this regional enterprise for 19 years, and which is captured in these words from an essay of Thomas Carlyle: "Our main business is not to see what lies dimly at a distance, but to do what lies clearly at hand."

ORSANCO QUALITY CRITERIA

ORSANCO RESOLUTION No. 16-66

(Adopted May 12, 1966; Amended September 8, 1966, and May 11, 1967)

WHEREAS: The assessment of scientific knowledge and judgments on water-quality criteria has been a continuing effort over the years by the Commission in consultation with its advisory committees; and

WHEREAS: The Commission now finds it appropriate to consolidate viewpoints and recommendations relating to such criteria;

NOW, THEREFORE, BE IT RESOLVED: That the Ohio River Valley Water Sanitation Commission hereby adopts the following statement and specifications:

Criteria of quality are intended as guides for appraising the suitability of interstate surface waters in the Ohio Valley for various uses, and to aid decision-making in the establishment of waste-control measures for specific streams or portions thereof. Therefore, the criteria are not to be regarded as standards that are universally applicable to all streams. What is applicable to all streams at all places and at all times are certain minimum conditions, which will form part of every ORSANCO standard.

Standards for waters in the Ohio River Valley Water Sanitation District will be promulgated following investigation, due notice and hearing. Such standards will reflect an assessment of the public interest and equities in the use of the waters, as well as consideration of the practicability and physical and economic feasibility of their attainment.

The ORSANCO criteria embrace water-quality characteristics of fundamental significance, and which are routinely monitored and can be referenced to data that is generally available. The characteristics thus chosen may be regarded as primary indicators of water quality, with the understanding that additional criteria may be added as circumstances dictate. Unless otherwise specified, the term average as used herein means an arithmetical average.

MINIMUM CONDITIONS APPLICABLE TO ALL WATERS AT ALL PLACES AND AT ALL TIMES

1. Free from substances attributable to municipal, industrial or other discharges or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits;
2. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges or agricultural practices in amounts sufficient to be unsightly or deleterious;
3. Free from materials attributable to municipal, industrial or other discharges or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance;
4. Free from substances attributable to municipal, industrial or other discharges or agricultural practices in concentrations or combinations which are toxic or harmful to human, animal, plant or aquatic life.

STREAM-QUALITY CRITERIA

FOR PUBLIC WATER SUPPLY AND FOOD PROCESSING INDUSTRY

The following criteria are for evaluation of stream quality at the point at which water is withdrawn for treatment and distribution as a potable supply:

1. **Bacteria:** Coliform group not to exceed 5,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 20,000 per 100 ml in more than five percent of such samples.
2. **Threshold-odor number:** Not to exceed 24 (at 60 deg. C.) as a daily average.

3. **Dissolved solids:** Not to exceed 500 mg/l as a monthly average value, nor exceed 750 mg/l at any time. (For Ohio River water, values of specific conductance of 800 and 1,200 micromhos/cm (at 25 deg. C.) may be considered equivalent to dissolved-solids concentrations of 500 and 750 mg./l.)

4. **Radioactive substances:** Gross beta activity not to exceed 1,000 picocuries per liter (pCi/l), nor shall activity from dissolved strontium-90 exceed 10 pCi/l, nor shall activity from dissolved alpha emitters exceed 3 pCi/l.

5. **Chemical constituents:** Not to exceed the following specified concentrations at any time:

Constituent	Concentration (mg/l)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium (hexavalent)	0.05
Cyanide	0.025
Fluoride	1.0
Lead	0.05
Selenium	0.01
Silver	0.05

FOR INDUSTRIAL WATER SUPPLY

The following criteria are applicable to stream water at the point at which the water is withdrawn for use (either with or without treatment) for industrial cooling and processing:

1. **Dissolved oxygen:** Not less than 2.0 mg/l as a daily-average value, nor less than 1.0 mg/l at any time.
2. **pH:** Not less than 5.0 nor greater than 9.0 at any time.
3. **Temperature:** Not to exceed 95 deg. F. at any time.
4. **Dissolved solids:** Not to exceed 750 mg/l as a monthly average value, nor exceed 1,000 mg/l at any time. (For Ohio River water, values of specific conductance of 1,200 and 1,600 micromhos/cm (at 25 deg. C.) may be considered equivalent to dissolved-solids concentrations of 750 and 1,000 mg/l.)

FOR AQUATIC LIFE

The following criteria are for evaluation of conditions for the maintenance of a well-balanced, warm-water fish population. They are applicable at any point in the stream except for areas immediately adjacent to outfalls. In such areas cognizance will be given to opportunities for the admixture of waste effluents with river water.

1. **Dissolved oxygen:** Not less than 5.0 mg/l during at least 16 hours of any 24-hour period, nor less than 3.0 mg/l at any time;
2. **pH:** No values below 5.0 nor above 9.0, and daily average (or median) values preferably between 6.5 and 8.5.
3. **Temperature:** Not to exceed 93 deg. F. at any time during the months of May through November, and not to exceed 73 deg. F. at any time during the months of December through April.
4. **Toxic substances:** Not to exceed one-tenth of the 48-hour median tolerance limit, except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency.

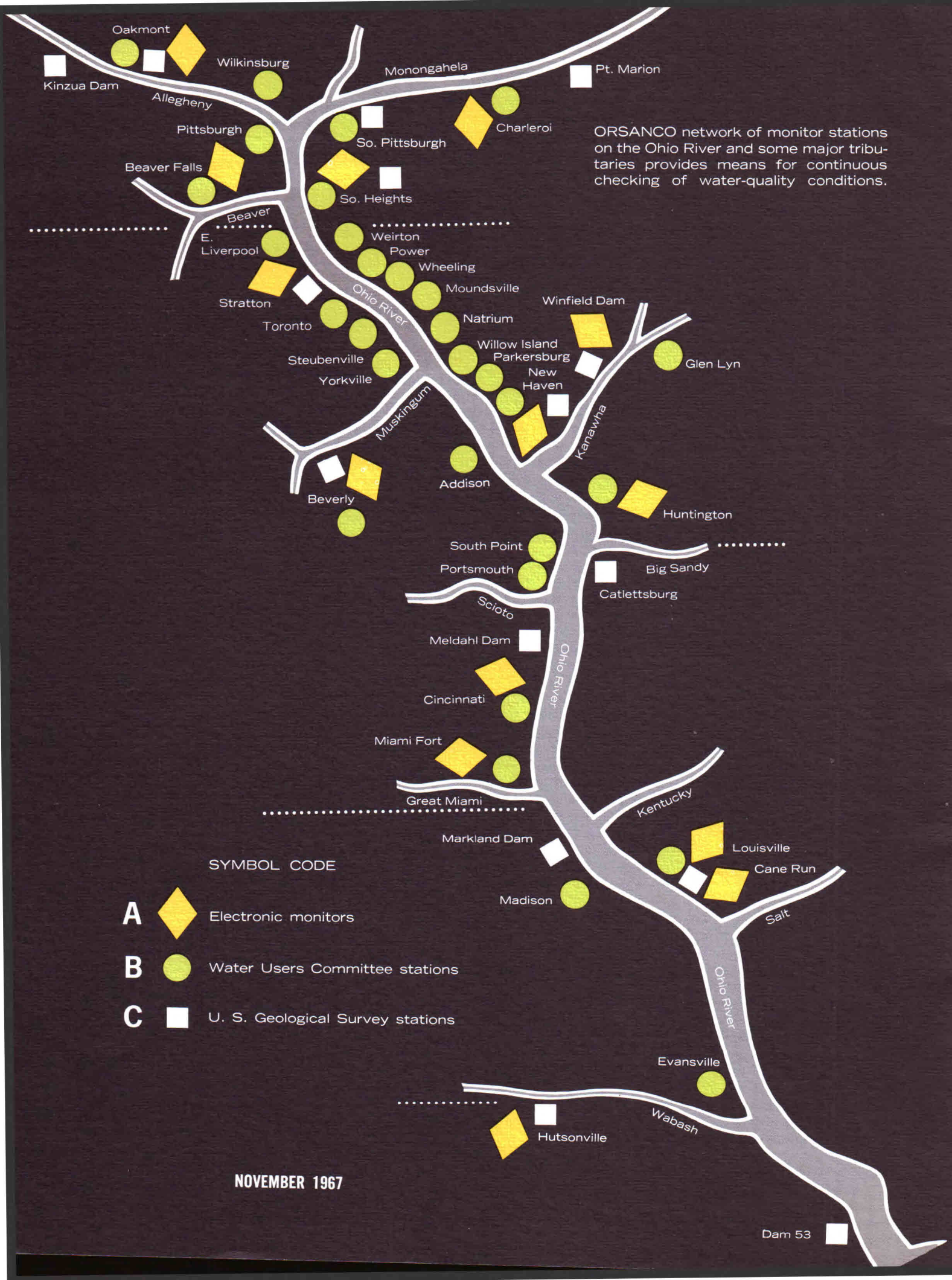
FOR RECREATION

The following criterion is for evaluation of conditions at any point in waters designated to be used for recreational purposes, including such water-contact activities as swimming and water skiing:

Bacteria: Coliform group not to exceed 1,000 per 100 ml as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 2,400 per 100 ml (MPN or MF count) on any day.

FOR AGRICULTURAL USE AND STOCK WATERING

Criteria are the same as those shown for minimum conditions applicable to all waters at all places and at all times.



ORSANCO network of monitor stations on the Ohio River and some major tributaries provides means for continuous checking of water-quality conditions.

NOVEMBER 1967

RIVER QUALITY APPRAISAL

FOLLOWING IS AN APPRAISAL of quality conditions in the Ohio River and some of its major tributaries during 1966. Ranges in chemical, physical and bacteriological indicators have been defined. In addition, river conditions have been matched against the ORSANCO quality criteria, which have been established to aid in appraising the suitability of surface water in the Ohio Valley for various uses. These criteria are listed in a preceding section.

The appraisal is based on information from three sources: Analyses from water quality monitor stations; measurements of river flow; and visual surveillance for detection of pollution.

Measurements of chemical, physical and bacteriological characteristics are accomplished primarily by means of an ORSANCO-sponsored monitoring program, which has been in operation since 1951. The monitor network presently (October 1967) includes 40 sampling locations on the Ohio River and its tributaries as shown on the accompanying map. Quality analyses at each location are made through one or more of the following arrangements:

ORSANCO WATER QUALITY MONITOR STATIONS

OHIO RIVER STATIONS

	Mile Point	Type		Mile Point	Type
Pittsburgh, Pa.	2.3	B	New Haven, W. Va.	241.6	A, B, C
South Heights, Pa.	15.8	A, B, C	Addison, Ohio	260.7	B
East Liverpool, Ohio	40.2	B	Huntington, W. Va.	304.2	A, B
Stratton, Ohio	55.0	A, C	South Point, Ohio	318.0	B
Toronto, Ohio	57.5	B	Portsmouth, Ohio	350.7	B
Weirton, W. Va.	62.2	B	Meldahl Dam	436.2	C
Steubenville, Ohio	65.3	B	Cincinnati, Ohio	462.8	A, B
Power, W. Va.	79.3	B	Miami Fort, Ohio	490.3	A, B
Yorkville, Ohio	83.6	B	Markland Dam	531.5	C
Wheeling, W. Va.	86.8	B	Madison, Ind.	559.5	B
Moundsville, W. Va.	111.0	B	Louisville, Ky.	600.6	A, B
Natrium, W. Va.	119.4	B	Cane Run, Ky.	616.8	A, C
Willow Island, W. Va.	161.0	B	Evansville, Ind.	791.5	B
Parkersburg, W. Va.	183.7	B	Dam 53	962.6	C

TRIBUTARY STATIONS

	Mile at which tributary enters Ohio River	Miles from sampling station to confluence of tributary with Ohio River	Type
Allegheny River at Kinzua, Pa.	0.0	198.0	C
Allegheny River at Oakmont, Pa.	0.0	12.3	A, B, C
Allegheny River at Wilkinsburg, Pa.	0.0	8.9	B
Monongahela River at Pt. Marion, Pa.	0.0	90.8	C
Monongahela River at Charleroi, Pa.	0.0	42.5	A, B
Monongahela River at South Pittsburgh, Pa.	0.0	4.0	B, C
Beaver River at Beaver Falls, Pa.	25.4	5.3	A, B
Muskingum River near Beverly, Ohio	172.2	28.0	A, B, C
New River at Glen Lyn, Va.		93.9	B
Kanawha River at Winfield Dam	265.7	31.1	A, C
Big Sandy River near Catlettsburg, Ky.	317.1	12.9	C
Wabash River near Hutsonville, Ill.	848.0	163.8	A, C

30 locations are monitored by personnel at municipal and private water-supply treatment plants. Twenty-three are on the Ohio River main stem; there are two each on the Allegheny and Monongahela rivers and one each on the Beaver, Muskingum, and New rivers. This is a voluntary service provided through the ORSANCO Water Users Committee.

15 locations are monitored under contract arrangements with the U. S. Geological Survey. Seven are on the Ohio River, and eight are situated on tributaries. Data assembled by the Geological Survey supplements that from locations monitored by the Water Users Committee and, in addition, includes analyses for certain mineral constituents that are not routinely measured at water-treatment plants.

14 locations are served by ORSANCO robot monitor units. Eight of these electronic sentinels are on the Ohio River and 6 are located on tributaries.

Supplemental data on certain chemical constituents and radioactive substances is obtained from the Federal Water Pollution Control Administration.

Visual surveillance activities are conducted by the ORSANCO staff accompanied on occasion by state-agency personnel. Observations are made through use of a chartered airplane, and these are supplemented by boat patrol. Additional observations are made by monitor-station operators who report unusual incidents, such as accidental spills. River patrol offers an effective means for pinpointing sources of oil and other floating material, foams and wastewater discharges having objectionable color.

FINDINGS IN BRIEF

Quality conditions in the Ohio River during 1966 may be summarized as follows:

Dissolved-oxygen concentrations met the industrial water supply criteria 96 to 100 percent of the time, depending on the station. However, dissolved-oxygen values in some reaches of the river below major metropolitan regions were less than criteria levels specified for aquatic life for as much as one-third of the time. Recommended remedial measures to improve oxygen conditions were developed by the staff for consideration by the Commission.

Bacterial quality conditions met the public water supply criteria more than 90 percent of the time at all stations except Evansville and Weirton. The criteria were met about 50 percent of the time at Evansville and none of the time at Weirton. Monthly-average coliform densities were less than 1,000 per 100 ml, the limiting value specified in the recreational criteria, during four of the five recreational months (May through September) at Huntington, Portsmouth and Louisville, during three months at Wheeling, one month at Cincinnati and none of the months at Weirton and Evansville. Staff recommendations have been made for additional reduction of bacterial concentrations in sewage-treatment plant effluents in all reaches of the river.

Temperature conditions at all Ohio River monitor stations were below the limiting values prescribed in the criteria for aquatic life as well as industrial water supply. The maximum winter temperature was about 10 degrees below the aquatic-life limit, and the maximum summer temperature was about three degrees below the limit.

Values of pH were within the range acceptable for aquatic life and for industrial water supply (namely, 5.0 to 9.0) all of the time at all robot monitor stations except Cane Run; here the values were above 9.0 on about one-fourth of the days. Daily-average pH values were within the preferred range for the maintenance of aquatic-life (6.5 to 8.5) at all except three stations where values were outside the range for one-fifth to three-fourths of the time.

Dissolved-solids concentrations at all monitor stations were within limiting values prescribed for public and industrial water supplies.

Monthly-average hardness levels varied from 108 mg/l to 270 mg/l. This range of values would classify the Ohio River as "moderately hard" to "very hard" in terms of U. S. Geological Survey designations.

Concentrations of sulfate were below the limiting value recommended in the U. S. Public Health Service (PHS) drinking water standards except during one month at two locations in the upper Ohio River.

Concentrations of chloride and methylene-blue-active substances (MBAS) at all stations were below

limiting concentrations specified in the PHS drinking water standards.

Concentrations of the following substances were within limits specified in the public water supply criteria: Arsenic, barium, cadmium, chromium, lead, silver and radioactive materials.

Fluoride concentrations were below the limit of 1.0 mg/l specified in the criteria at all stations except Wheeling, where values ranged as high as 1.9 mg/l and were greater than 1.0 mg/l for 12 percent of the time.

These comments summarize only the major findings. Further details and other findings on quality conditions in the Ohio River and in some of the tributaries are presented in the following pages.

RIVER FLOW — Monthly-average flows during 1966 at three Ohio River gaging stations are shown in the accompanying graphs. The stations for which data is presented include Sewickley, in the extreme upper reach of the river (at mile 12); Metropolis, near the mouth (at mile 944) and Cincinnati, about midway between (at mile 470). Also shown on the graphs are the average — or normal — monthly-average flows at each station based on records over a 21-year period (1940 through 1960).

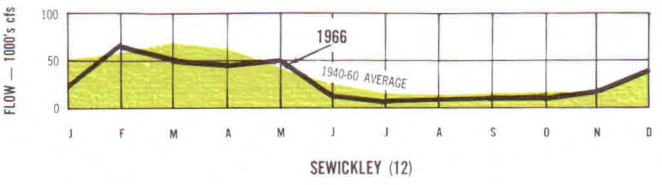
During the months of July through October (usually the most critical months with regard to maintaining satisfactory quality conditions) flows at Sewickley averaged only about 43 percent of those normally expected. During the 4-month period flows at Cincinnati were 66 percent of normal, and at Metropolis flows averaged 83 percent of normal.

Minimum monthly-average flow recorded during the year at Sewickley corresponded to a drought flow that has a probability of occurrence of once in eight years. The minimum monthly-average flow at Cincinnati and at Metropolis corresponded to flows that have a probability of occurrence of about once a year.

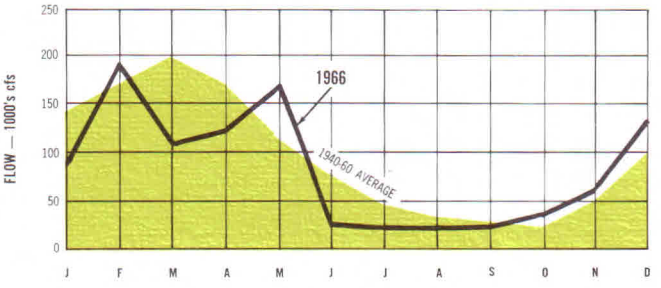
This analysis of flow conditions reveals the existence during the summer of 1966 of rather severe drought conditions at Sewickley, whereas conditions at Cincinnati and Metropolis were close to normal.

River quality conditions — particularly those related to the content of dissolved mineral solids such as chlorides, sulfates and hardness-producing constituents — reflect the differences in flow patterns at the various stations. In the upper river, for example, quality conditions in 1966 were comparable to those in 1963-65. In the middle and lower reaches of the river, however, quality in 1966 was better than that in 1963-65. Minimum flows in 1963-65 correspond to drought flows having a frequency of occurrence of once in sixteen years in the upper river, and once in fourteen years in the middle and lower reaches of the river.

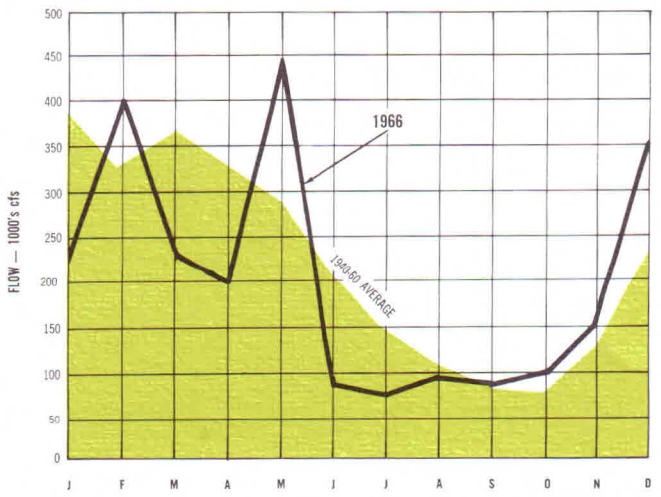
Fluctuations between maximum and minimum flows are much greater in the upper river than in the lower



SEWICKLEY (12)



CINCINNATI (471)



METROPOLIS (944)

river. Ratios of maximum to minimum (monthly-average flows) in 1966 were: 16 to 1 (60,900 to 3,900 cfs) at Sewickley; 10 to 1 (190,000 to 20,000 cfs) at Cincinnati; and 5 to 1 (444,000 to 84,000 cfs) at Metropolis.

Basic data on river flow is furnished by the U. S. Geological Survey. Supplementary data is obtained from the Cincinnati River Forecast Center of the U. S. Weather Bureau, which provides daily flow forecasts for twelve locations along the Ohio River and its tributaries.

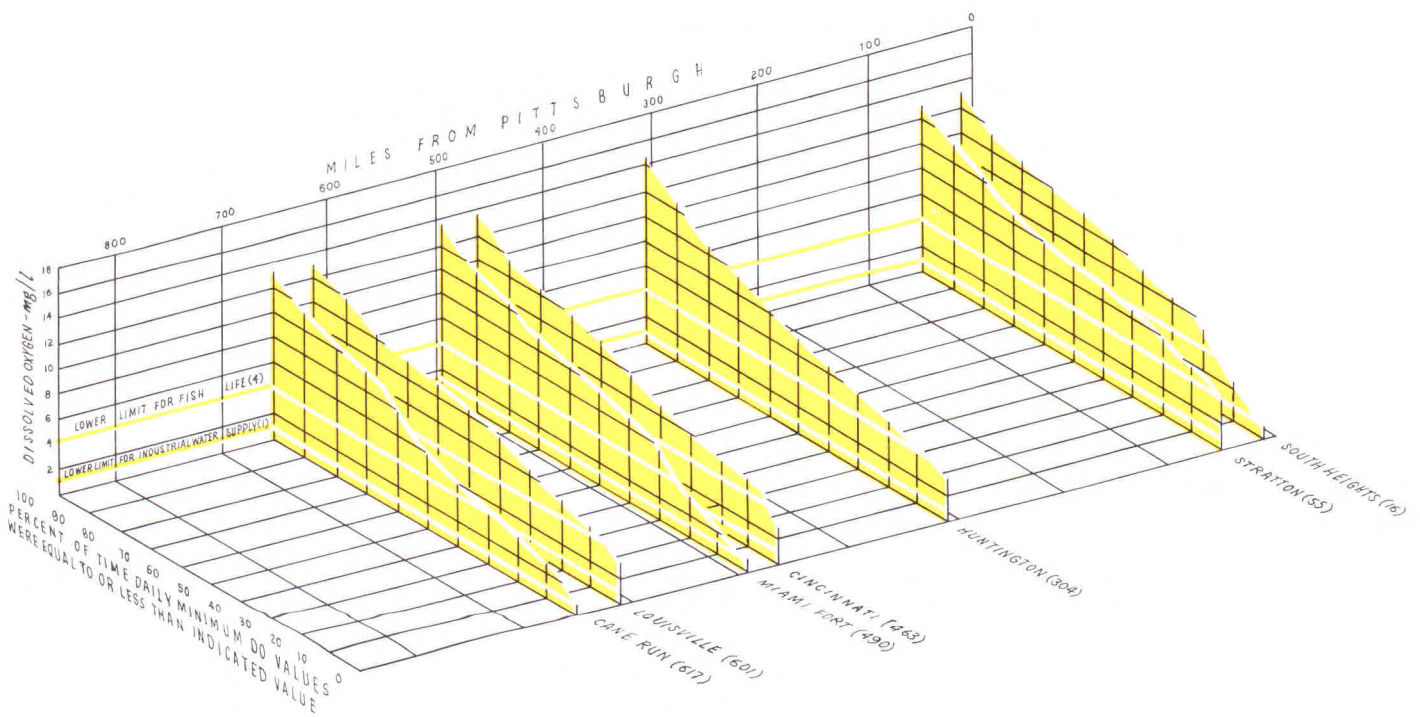
VISIBLE ASPECTS OF POLLUTION — The occurrence of fish kills, accidental spills and other visible violations are matters of continuing concern. Incidents of visible pollution recorded from surveillance operations during the period July 1, 1966, to June 30, 1967, were as follows: Fish kills, 44; accidental spills, 7; oil pollution, 11; abnormal color, 14; objectionable appearance (debris, foam, etc.), 18; taste and odor, 7.

This total of 101 incidents should be regarded as only a "sampling" of conditions because surveillance opportunities are limited. Many of them were discovered in the course of aerial patrol. Each of these occurrences was investigated by a representative of the state concerned or by the ORSANCO staff. Where responsibility could be fixed, the state control agencies took steps to prevent a recurrence.

Three stretches of the Ohio River continue to have frequent occurrences of visible pollution, namely, Pittsburgh to Wheeling, Huntington to Portsmouth and Louisville to the mouth of the Salt River. All of these are areas of concentrated industrial activity.

Discharges of oil and floating matter are the most frequent cause of unsightly conditions. Sources of these materials include not only industrial plants, but also discharges from boats and floating facilities such as marinas and terminals.

DISSOLVED OXYGEN — The situation with respect to dissolved oxygen (DO) conditions during 1966 is revealed in the accompanying qualigrams. The latter are constructed by plotting daily minimum values of dissolved oxygen (lowest hourly readings on each day) against frequency of occurrence.



DISSOLVED-OXYGEN QUALIGRAMS — 1966
(Daily-minimum values)

The ORSANCO criteria specify that the DO content of river water used as a source of industrial water supply should not be less than 1.0 mg/l at any time, nor less than 2.0 mg/l as a daily-average value. The qualigrams show that DO concentrations were 1.0 mg/l or greater for 100 percent of the time at Stratton, Huntington, Cincinnati, and Louisville. At South Heights, Miami Fort and Cane Run, hourly values were 1.0 mg/l or greater on 96.5, 99.2, and 99.6 percent of the days, respectively. The criterion of 2.0 mg/l or greater for daily-average values was also met for 100 percent of the time at Stratton, Huntington, Cincinnati and Louisville, and for 96 to 99.6 percent of the time at South Heights, Miami Fort and Cane Run.

The criterion for the maintenance of well-balanced, warm-water aquatic life habitats specifies that DO concentrations should not be less than 5.0 mg/l during at least 16 hours of any 24-hour period, nor less than 3.0 mg/l at any time. For practical purposes in applying this criterion, the ORSANCO Aquatic Life Advisory Committee has agreed that if DO levels never go below 4.0 mg/l, stream conditions may be regarded as compatible with the more detailed specification. On the basis of this interpretation, the qualigrams reveal that the aquatic-life requirement was met at the several stations as follows: Stratton, 99.6 percent of the time; Cincinnati, 99.4 percent; Louisville, 94.8 percent; Huntington, 93.1 percent; Miami Fort, 77.3 percent; Cane Run, 63.2 percent. At South Heights, data is lacking for most of the months of July, September and October, which generally are the critical periods with respect to maintenance of satisfactory DO levels. During other months of the year, daily minimum values of DO at South Heights were 4.0 mg/l or greater for 83.5 percent of the time.

These findings lead to the conclusion that if the DO criteria are to be attained in all reaches of the Ohio River, additional requirements should be imposed for reduction of the biochemical-oxygen-demand content of certain wastewater discharges into the main stem as well as some tributaries. In September 1966, the ORSANCO staff submitted to the Commission a report containing recommendations on measures for correcting DO deficiencies. Several alternates were evaluated, and the staff concluded that the following additional requirements would satisfy necessities with the least financial investment:

1. Treatment of wastewaters discharged by the Allegheny County Sanitary Authority plant at Pittsburgh to reduce the BOD loading from this source to not more than 60,000 lb. per day.

2. Treatment of wastewaters in the reach between Mile 237.2 (Racine Dam), and Mile 604.6 (McAlpine Dam) to such degree as is necessary to reduce the BOD of each discharge to not more than 4,000 lb. per day or by 85 percent, whichever amount of reduction is less.

3. Treatment of wastewater discharges between Mile 604.6 (McAlpine Dam) and Mile 720.7 Cannelton Dam) in accordance with the following schedule:

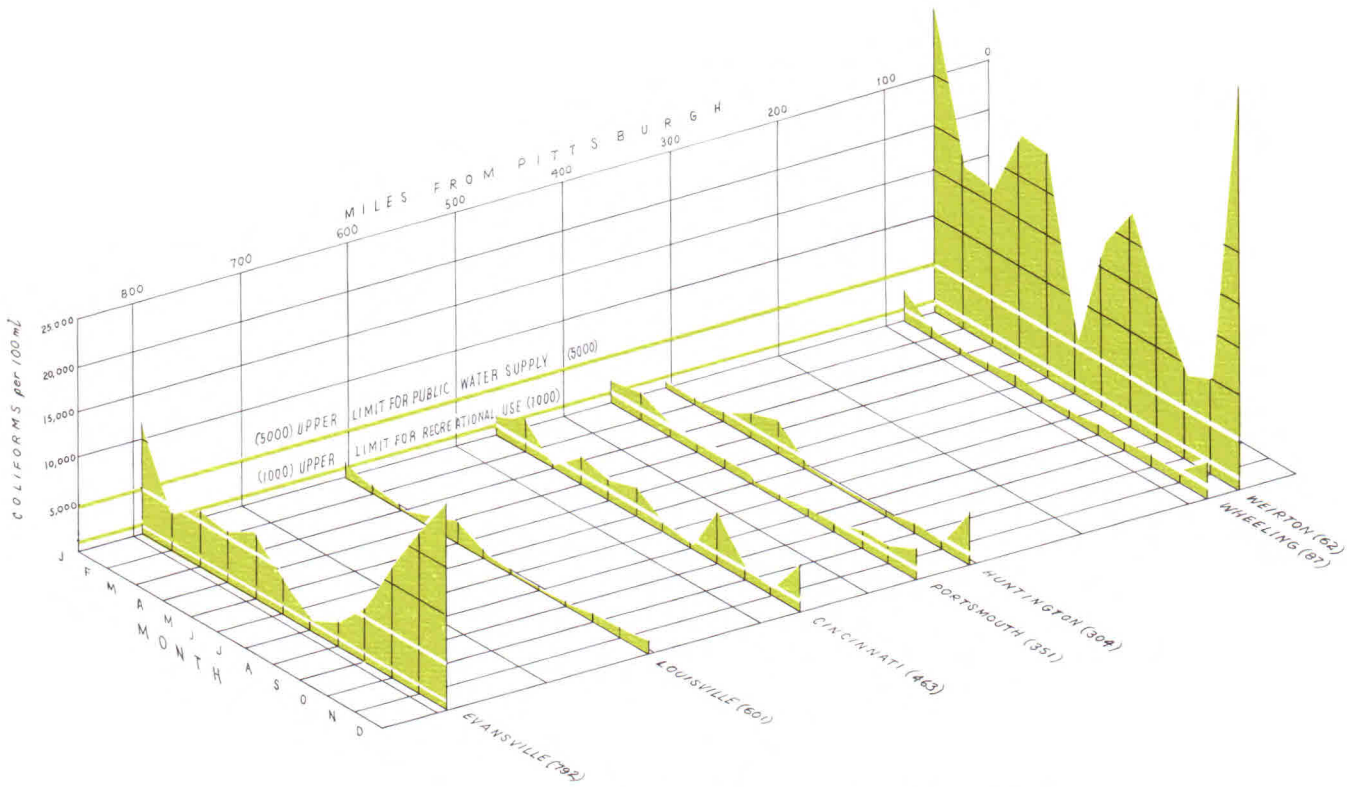
   a. Secondary treatment (BOD reduction not less than 85 percent) in the Jeffersonville-Clarksville (Indiana) area. This degree of treatment is needed to remedy a local situation created by operation of hydropower facilities at McAlpine Dam.

   b. Treatment of all other wastewater discharges to such degree as is necessary to reduce the BOD of each discharge to not more than 8,000 lb. per day or by 85 percent, whichever amount of reduction is less.

All other discharges to reaches of the river not specified in the above schedule would be required to be treated in accordance with existing sewage-treatment standards.

COLIFORM DENSITY — Determinations of the density of the coliform family of bacteria are used as an indicator of the presumed presence of pathogenic organisms. Coliform bacteria themselves are not disease-producing. Furthermore, the standard coliform test measures bacteria originating from soil runoff as well as fecal bacteria contained in sewage discharges. For these reasons an assessment of whether the density of coliforms represents a potential health hazard in a particular location usually cannot be made without the benefit of additional information, notably that provided by field surveys for location of sources of sewage contamination. Interpretation of the results of coliform-density analyses presented in this report, therefore, should be tempered with these limitations in mind.

The accompanying profiles show monthly-average coliform densities at seven locations along the Ohio



COLIFORM DENSITY PROFILES — 1966
(Monthly-average values)

River during 1966. In general, coliform counts reach a peak during the months of December through February, and are at a minimum during the months of July through September. Highest counts occurred at Weirton. Here the minimum monthly-average value of 6,000 per 100 ml was greater than the maximum monthly values at all other stations except Evansville.

The ORSANCO coliform criterion for river water used as a source of public water supply specifies, among other things, that the monthly-average density should not exceed 5,000 per 100 ml. As shown by the profiles, this condition was achieved 100 percent of the time at Wheeling, Portsmouth and Louisville. This specification was met during eleven months of the year at Huntington and Cincinnati, during only four months at Evansville, and during none of the months at Weirton.

In addition to the monthly-average limiting value, the criterion permits an over-run, stating that coliform levels should not exceed 5,000 per 100 ml in more than 20 percent of the samples examined during any month, nor exceed 20,000 per 100 ml in more than five percent of such samples. As shown by the following tabulation, river conditions in 1966 matched these latter specifications to about the same degree they met the limitation on monthly-average values.

Station	Number of months in which 80 percent or more of daily coliform values were less than 5,000 per 100 ml	Number of months in which 95 percent or more of daily coliform values were less than 20,000 per 100 ml
Weirton	0	1
Wheeling	12	12
Huntington	11	11
Portsmouth	11	12
Cincinnati	11	11
Louisville	12	12
Evansville	5	7

The ORSANCO coliform criterion for waters used for recreational purposes specifies, among other things, that the monthly-average density should not exceed 1,000 per 100 ml. In 1966, monthly-average densities were less than 1,000 per 100 ml during four of the five recreational months (May through September) at Huntington, Portsmouth and Louisville, during three months at Wheeling, one month at Cincinnati and none of the months at Weirton and Evansville.

The recreational criterion also permits an over-run, stating that coliform values should not exceed 2,400 per 100 ml on any day, and that not more than 20

percent of the samples examined in any month should exceed 1,000 per 100 ml. The extent to which these latter conditions were met during 1966 is indicated in the following tabulation:

Station	Number of months during May-Sept. in which coliform values did not exceed 2,400 per 100 ml	Number of months during May-Sept. in which 80 percent or more of coliform values were less than 1,000 per 100 ml.
Weirton	0	0
Wheeling	1	2
Huntington	2	3
Portsmouth	4	3
Cincinnati	0	2
Louisville	4	4
Evansville	0	0

This appraisal leads to the conclusion that while bacterial conditions at some monitor stations are close to meeting the criteria for public water supply and recreational use, river quality conditions might be enhanced through more intensive disinfection of sewage discharges. In a report to the Commission in September 1966, the staff recommended that disinfection schedules be established that would insure reductions in the number of coliform organisms in sewage discharges of 90 to 99.99 percent, the degree of reduction for a specific discharge depending on the location and size of the discharge and season of the year.

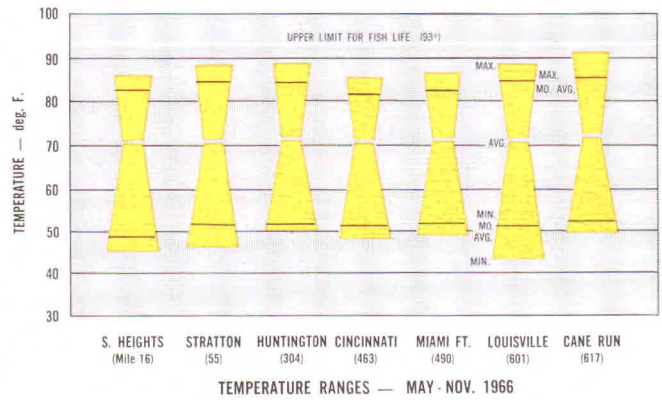
TEMPERATURE — The accompanying charts show ranges in temperature at robot monitor stations during two seasonal periods (May-November and December-April) of 1966. At all stations, temperatures throughout the year were well below tolerance limits specified in the ORSANCO criteria for the maintenance of aquatic life and for water used as a source of industrial supply.

The criterion for aquatic life (which is more restrictive than that for industrial water supply) specifies that river temperatures should not exceed 93 deg. F. at any time during the months of May through November, nor exceed 73 deg. F. during the months of December through April. The highest temperature recorded at any station during the May-November period was 90.1 deg. F.; this single value occurred at Cane Run. The highest single temperature during the months of December through April was 62.9 deg., F., which was recorded at Huntington.

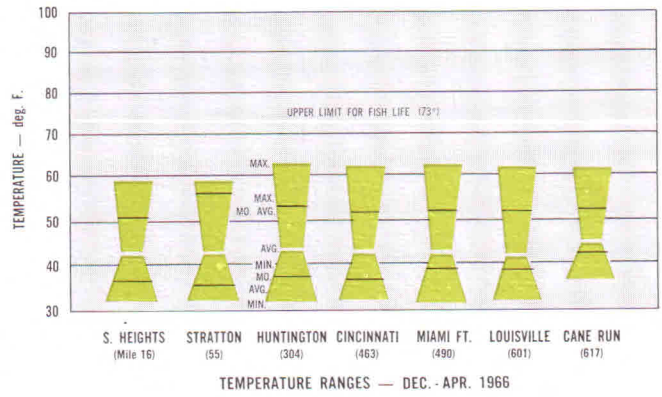
The ORSANCO Aquatic Life Advisory Committee, which is engaged on a continuing basis in evaluating scientific data relating to criteria, suggested in the spring of 1967 that consideration be given to modifying the temperature specifications. Proposals by the committee for the maintenance of a well-rounded, warm-water fish population, and also for commercial, non-game and forage fish habitats included the following: (a) Specifying a maximum daily-average temperature of 90 deg. F. for the months of March through November, and in addition, limiting the maximum temperature at any time during these months to 93 deg. F.; (b) specifying a maximum temperature at any time of 55 deg. F. for the months of December through February.

Although these proposals have not yet been acted upon by the Commission, it might be noted that limitations on stream temperatures imposed by them were met 100 percent of the time at all stations. The highest daily-average temperature recorded at any station was 87.8 deg. F. (at Cane Run), and the highest individual temperature reading during the months of December through February was 49.5 deg. F. (at Huntington).

DISSOLVED SOLIDS — The accompanying profiles summarize monthly-average values of specific conductance and dissolved solids at seven Ohio River



TEMPERATURE RANGES — MAY - NOV. 1966



TEMPERATURE RANGES — DEC. - APR. 1966

robot monitor stations in 1966. The profiles are based on measurements of specific conductance (in micromhos/cm at 25 deg. C.), and conversion of these measurements into dissolved-solids levels (in mg/l) in accordance with previous correlation studies (see annual report for 1965). For the Ohio River, a conductance value of 800 micromhos/cm corresponds to a dissolved-solids concentration of about 500 mg/l.

The ORSANCO criteria for public water supply specify that concentrations of dissolved solids should not exceed 500 mg/l as a monthly-average value, nor exceed 750 mg/l at any time. These conditions were met 100 percent of the time at all seven robot monitor stations, four of which (Stratton, Huntington, Cincinnati, Louisville) are located at or near public-water-supply intakes.

Since limiting values of dissolved-solids concentrations specified in the criteria for industrial-water-supply purposes are greater than those for waters used as a source of public supply, the industrial supply criterion was also satisfied.

HARDNESS — Monthly-average values of the hardness content of Ohio River water at five locations are portrayed in the accompanying profiles. The Ohio River may be regarded as ranging from "moderately hard" to "very hard" according to a U. S. Geological Survey classification (*Water Supply Paper No. 1812, 1962*), which offers the following designations:

Soft water	0 to 60 mg/l
Moderately hard	61 to 120 mg/l
Hard	121 to 180 mg/l
Very hard	More than 180 mg/l.

Yearly-average hardness levels during 1966 were: 160 mg/l at Wheeling; 189 mg/l at New Haven; 146 mg/l at Portsmouth; 150 mg/l at Cincinnati; 151 mg/l at Louisville, and 170 mg/l at Evansville. The highest monthly-average value, 270 mg/l, occurred at New Haven during October; the lowest monthly-average value was 108 mg/l, which was observed at Wheeling in December.

The ratio of maximum to minimum monthly-average concentrations of hardness at the various stations exhibited a decreasing trend proceeding downstream. At Wheeling the ratio in 1966 was 2.2 to 1; at Louisville and Evansville the ratio was 1.5 to 1. The high ratio between maximum and minimum monthly-average values in the upper river suggests there are potentialities for "evening out" month-to-month variations in hardness through the practice of proportionate discharge of wastewaters (scheduling releases in proportion to river flow), and through coordinated releases of stored water from upstream reservoirs.

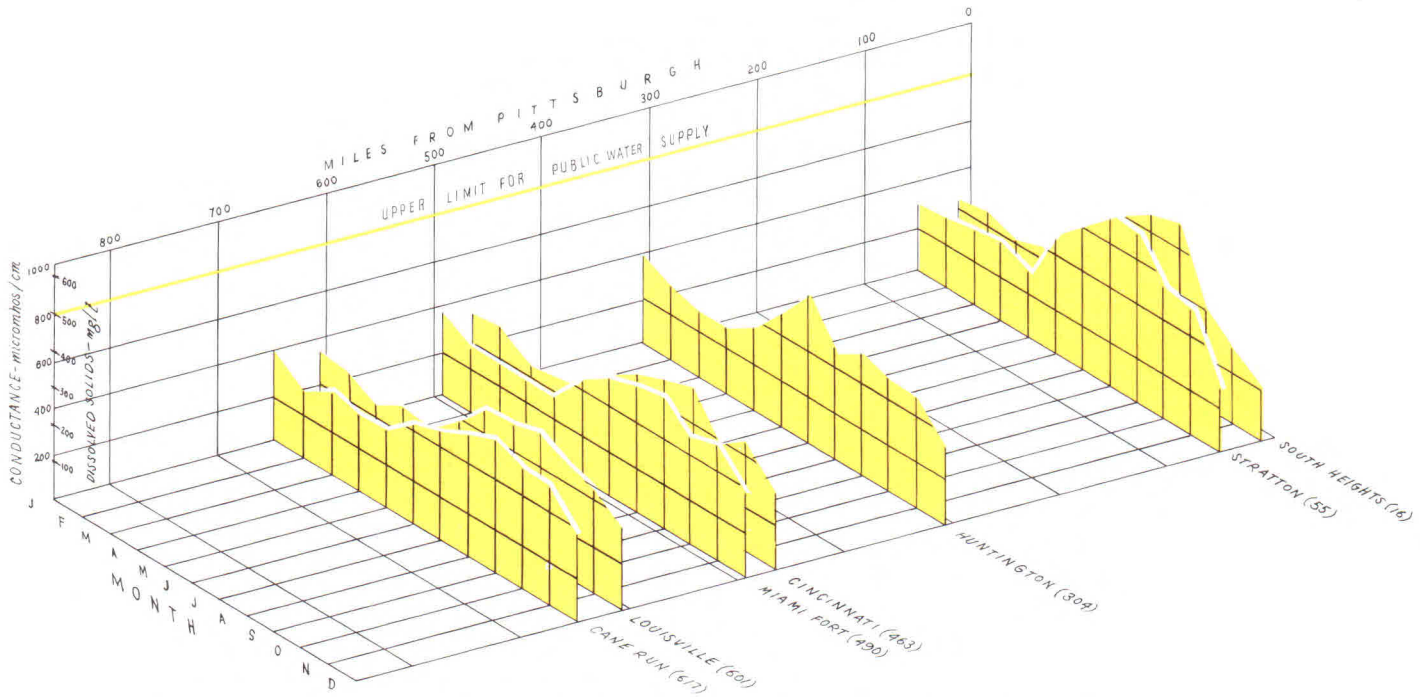
The only city on the Ohio River that softens its water supply is Louisville, where the objective is to produce treated water with a hardness level of 120 mg/l or less (the level varies depending on the hardness of river water and on the capacity of water-softening facilities in relation to consumer demand). During 1966, the range in monthly-average hardness levels at Louisville was 124 mg/l to 189 mg/l, which range indicates that in order for Louisville to meet its objective of 120 mg/l, the water-softening facilities would be used during at least part of every month.

RADIOACTIVE SUBSTANCES — Data on levels of radioactive substances is available from monitor operations of the Federal Water Pollution Control Administration. During 1966, a total of eleven samples of Ohio River water were analzyed, three of which were collected at Toronto, Ohio (mile 58), and eight of which were collected at Cairo, Ill. (mile 981). Results of these analyses (supplied by FWPCA in advance of publication) are summarized in the following tabulation. Values are expressed in terms of picocuries per liter (pCi/l), which is equivalent to micro-microcuries per liter.

	Dissolved	Suspended	Total
Beta	1 to 12	0 to 19	3 to 26
Alpha	0 to 2	0 to 7	0 to 7

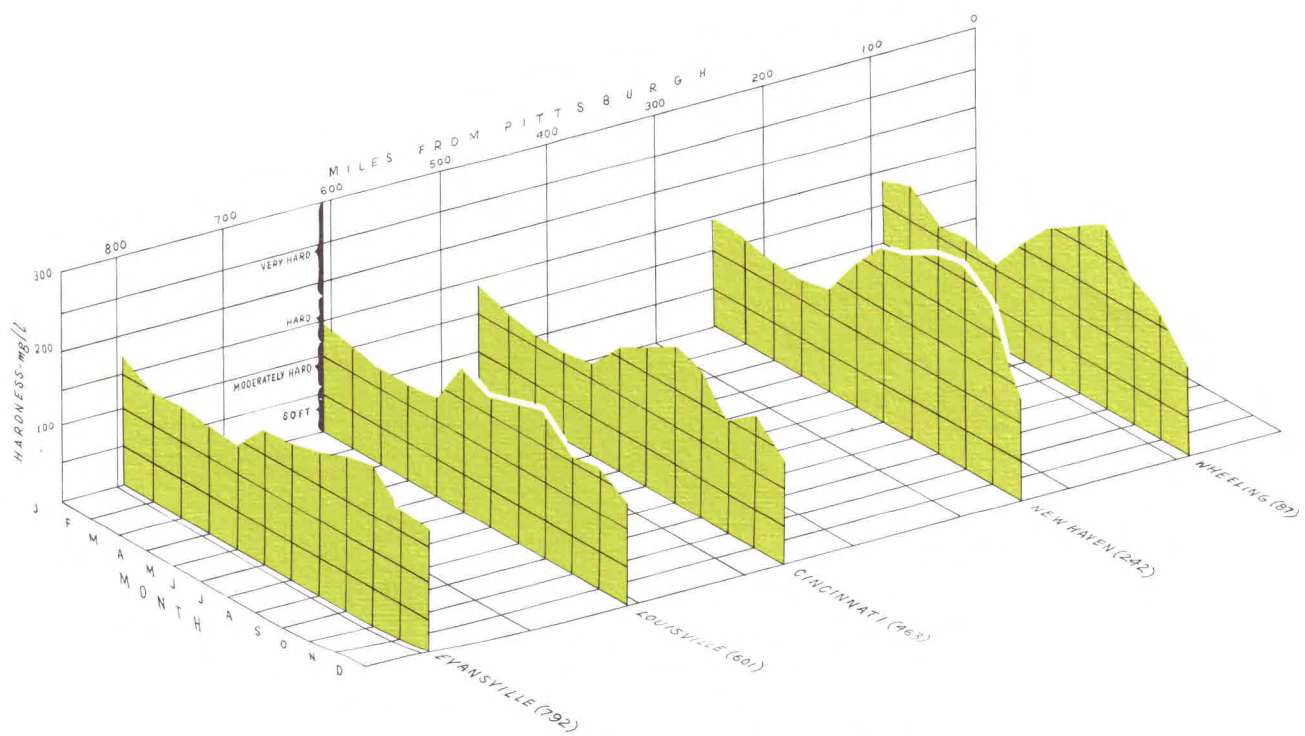
The criteria for public water supply specify the following limitations on radioactive substances: Gross beta activity not to exceed 1,000 pCi/l, activity from dissolved alpha emitters not to exceed 3 pCi/l, and activity from dissolved strontium-90 not to exceed 10 pCi/l.

The data available indicates that in 1966 levels of gross beta activity and activity from dissolved alpha emitters were well within limits specified in the criteria. No information is available for 1966 on activity from dissolved strontium-90. However, it might be noted that in 1965 the highest observed value of strontium-90 activity was 1.8 pCi/l, or less than one-fifth of the limiting value specified in the criteria.



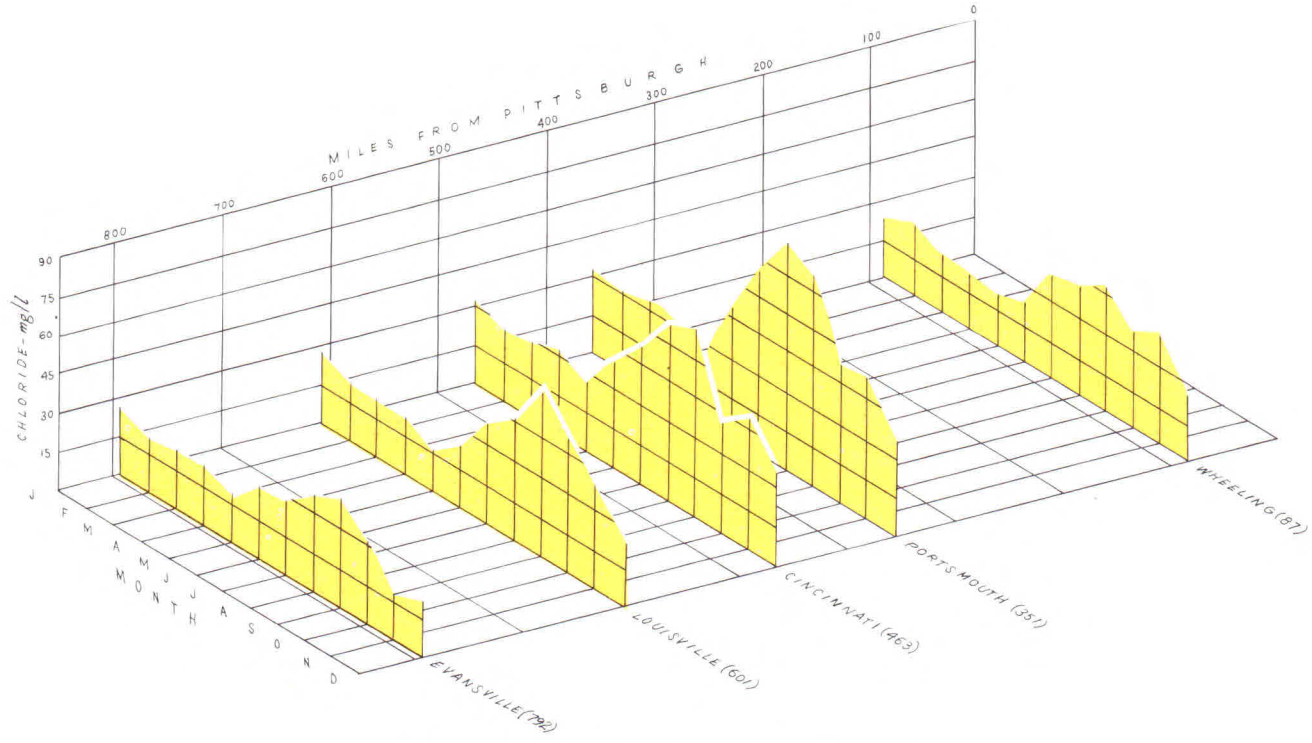
DISSOLVED SOLIDS (CONDUCTANCE) PROFILES — 1966

(Monthly-average values)



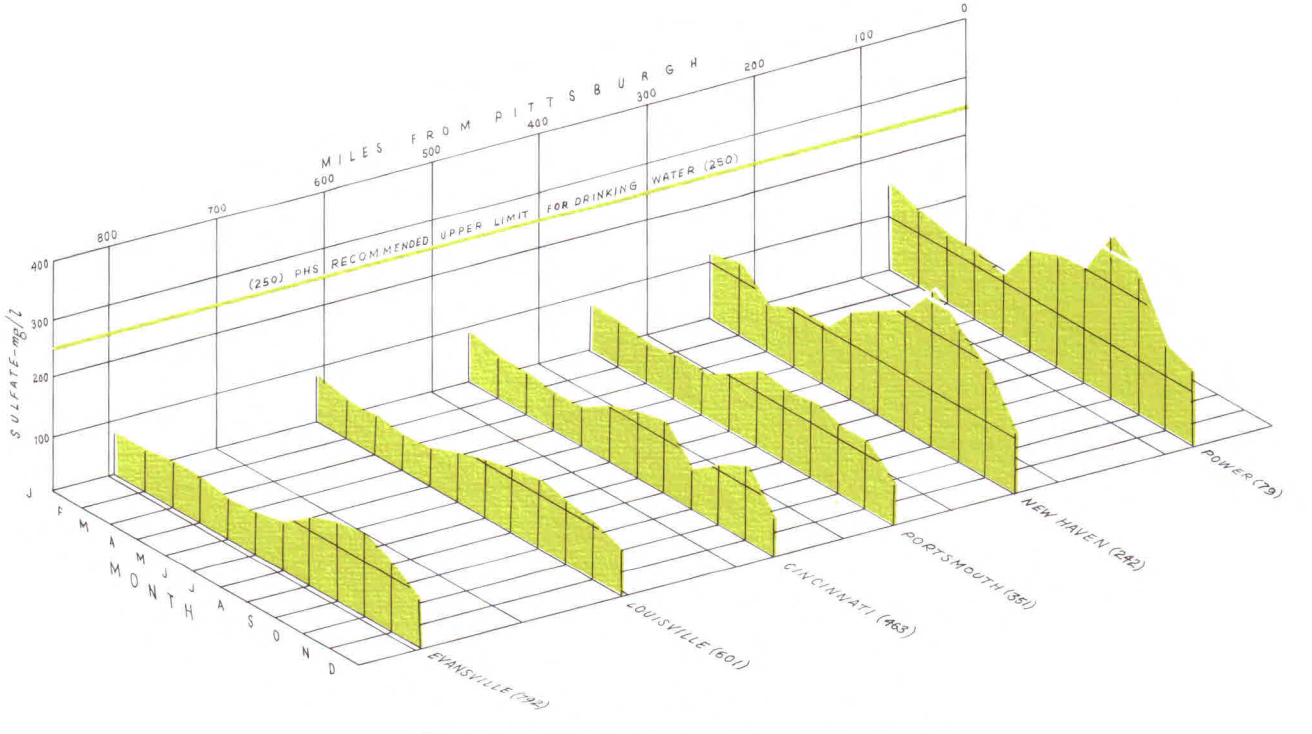
HARDNESS PROFILES — 1966

(Monthly-average values)



CHLORIDE PROFILES — 1966

(Monthly-average values)



SULFATE PROFILES — 1966

(Monthly-average values)

CHLORIDE — Conditions with respect to the chloride content of the Ohio River during 1966 are revealed by the accompanying profiles, which show monthly-average levels at five monitor stations. Concentrations were less than 250 mg/l, which is the recommended limiting value for drinking water in the U. S. Public Health Service standards, at all times at all stations.

Maximum monthly-average values ranged from 40 mg/l at Evansville to 87 mg/l at Portsmouth. The increase in chloride levels between Wheeling and Portsmouth reflects, for the most part, chloride contributed by two tributary streams, the Muskingum and Kanawha rivers.

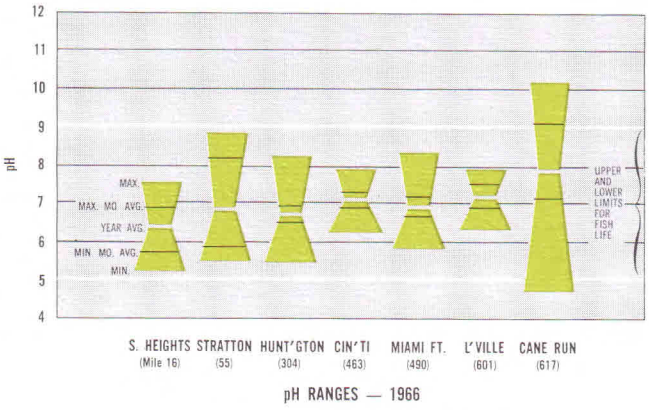
SULFATE — The accompanying sulfate profiles show monthly-average concentrations at six Ohio River stations during 1966. Concentrations were highest at Power and New Haven, where maximum monthly-average values of 280 mg/l and 269 mg/l, respectively, were recorded in September. High sulfate levels in that reach of the river are attributed to the influence of acid coal mine drainage and other industrial operations.

Except for the September values at Power and New Haven, all other values were less than 250 mg/l, which is the recommended limiting value for drinking water in the U. S. Public Health Service standards.

pH CHARACTERISTICS — The accompanying graph shows ranges in pH values observed in the Ohio River during 1966 at robot monitor stations. The widest fluctuation in values occurred at Cane Run, where both the lowest (4.8) and highest (10.1) of all values at all stations were observed. By contrast, the range in hourly values throughout the year at Cincinnati and Louisville was only 1.6 pH units (6.3 to 7.9 at both stations).

The ORSANCO criteria specify limiting pH values for two water uses: Industrial water supply and maintenance of a well-balanced, warm-water fish habitat. For both uses, the criteria list pH values of 5.0 to 9.0 as within the acceptable range. However, the criterion for aquatic life also states that daily-average (or median) values preferably should be between 6.5 and 8.5

In 1966 the recorded pH values were within the 5.0-to-9.0 range 100 percent of the time at all stations



pH RANGES — 1966

except Cane Run. At Cane Run readings were less than 5.0 during part of one day, and greater than 9.0 for part or all of the time on 26 percent of the days.

The extent to which daily-average values were within the preferred range of 6.5 to 8.5 is shown in the following tabulation:

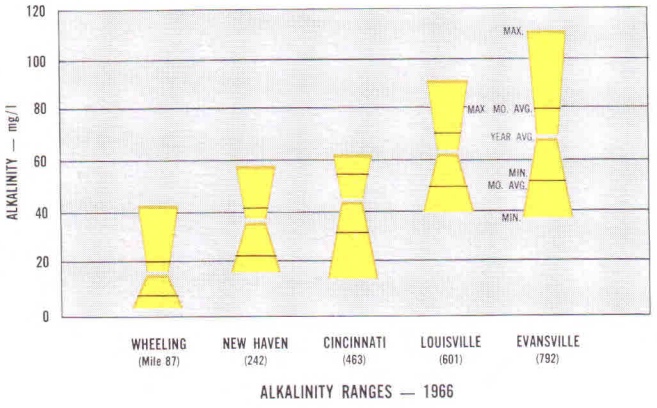
Station	Percent of daily average pH values between 6.5 and 8.5
South Heights	26
Stratton	68
Huntington	100
Cincinnati	100
Miami Fort	100
Louisville	100
Cane Run	79

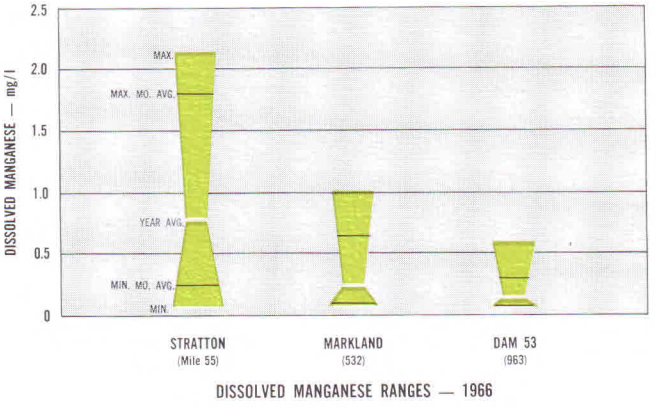
At South Heights and Stratton, virtually all of the pH values outside the preferred range of 6.5 to 8.5 were on the acid side of the scale (pH less than 6.5). Conditions at these stations presumably reflect the influence of acid discharges from coal mining and other industrial operations.

At Cane Run the relatively high pH values are attributed to the cumulative effect of alkaline tributary streams and to the local influence of waste-water discharges and biological activity.

ALKALINITY — Alkalinity concentrations during 1966 were lowest in the upper reaches of the Ohio River and increased progressively moving downstream. This pattern parallels that observed in previous years.

The accompanying graph shows ranges in alkalinity levels at five stations. The lowest (single) value re-





corded at any station was 3 mg/l (at Wheeling), and the highest value recorded was 112 mg/l (at Evansville).

Low alkalinity in the upper river can be attributed in large part to the influence of acid mine-drainage, particularly drainage from tributary streams (see appraisal of quality conditions in tributaries which follows). To illustrate, the minimum monthly-average concentration of alkalinity at Wheeling in 1966 was 8 mg/l, which value may be compared with minimum monthly-average concentrations of 8 mg/l and zero in the Allegheny and Monongahela rivers, respectively.

IRON — Dissolved-iron concentrations were monitored at three Ohio River stations during 1966. Yearly-average values were: 0.35 mg/l at Stratton, 0.31 mg/l at Markland Dam, and 0.21 mg/l at Dam 53. The highest single value recorded was 2.1 mg/l, which occurred at Stratton.

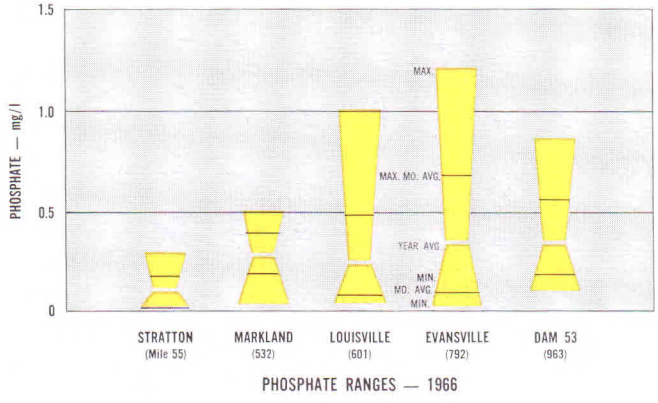
Regarding the question of limiting values for the iron content of river water, it is the view of the Engineering Committee of ORSANCO that there is insufficient evidence for justifying establishment of such a criterion at this time. Insofar as use of the river for public water supply purposes is concerned, all water supplied to consumers is first processed in filter plants that have the capability of reducing both iron and manganese content.

With regard to aquatic life, the ORSANCO Aquatic Life Advisory Committee has concluded that ". . . the setting of allowable levels for iron and manganese in mg/l is unrealistic, of little practical value, and can be very misleading."

MANGANESE — As shown in the accompanying chart, manganese concentrations during 1966 ranged from 0.0 mg/l to 2.1 mg/l. The highest monthly-average value during the year was 1.8 mg/l, which was recorded at Stratton. At Cincinnati, where analyses were made on monthly-composite samples rather than grab samples, the range in monthly values was 0.0 mg/l to 0.15 mg/l. Sources of manganese include various industrial operations and stored-water releases from certain flood control reservoirs.

A criterion for manganese has not been established by ORSANCO for the same reasons as those cited in the discussion on iron.

PHOSPHATE — The accompanying graph shows ranges in phosphate levels at five stations during 1966. Concentrations were essentially in the same range as those observed in previous years. The highest value observed was 1.2 mg/l, which occurred at Evansville. Although nitrates and phosphates influence the growth of plankton, no direct relationships between concentrations of these constituents



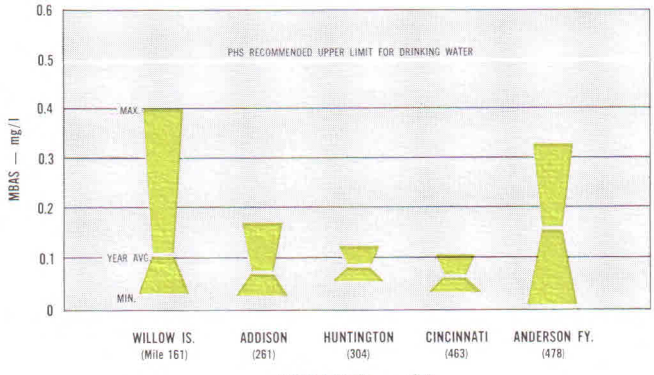
and the abundance and variety of aquatic plant life have been demonstrated for the Ohio River. This is the conclusion reached by the Potamological Institute of the University of Louisville, based on a research project sponsored by ORSANCO and the Commonwealth of Kentucky.

NITRATE — During 1966 nitrate concentrations ranged from 1.2 mg/l at Dam 53 to 14 mg/l at Stratton. Yearly-average values at Ohio River locations where data is available show: 7.1 mg/l at Stratton, 7.2 mg/l at Markland Dam, and 5.6 mg/l at Dam 53. These nitrate levels are less than one-third of the limiting value of 45 mg/l recommended in the U. S. Public Health Service drinking water standards.

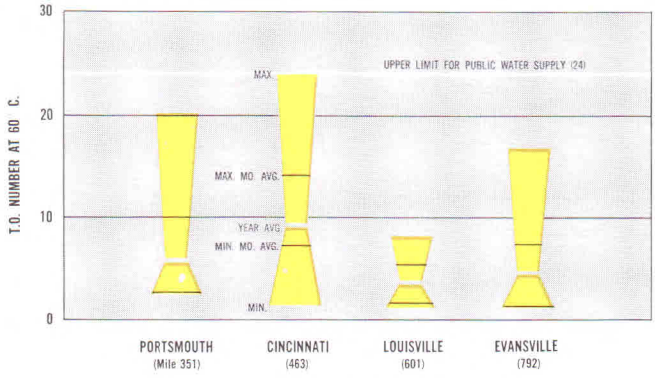
METHYLENE-BLUE ACTIVE SUBSTANCE — The test for methylene-blue active substances (MBAS) is a measure of the apparent concentration of synthetic detergent, including the original alkyl benzene sulfonate (ABS), and the bio-degradable linear alkylate sulfonate (LAS), which has replaced ABS in commercial detergents.

The accompanying chart shows maximum, minimum and yearly-average values for 1966 at five stations along the Ohio River; monthly-average values are not shown because of the small number of samples at most stations. The highest concentrations observed were 0.39 mg/l and 0.32 mg/l, which reflect the situation at Willow Island (mile 161) and Anderson Ferry (mile 478), respectively.

All values, therefore, were below the upper limit of 0.50 mg/l set forth in the U. S. Public Health Service standards for drinking water. The values were comparable in magnitude to those of recent past years.



MBAS RANGES — 1966



THRESHOLD-ODOR NUMBER RANGES — 1966

THRESHOLD-ODOR CONDITIONS — Threshold-odor information at four locations on the Ohio River is shown in the accompanying chart. The ORSANCO criteria for public water supply specify that threshold-odor numbers should not exceed 24 (at 60 deg. C). This criterion was met all of the time at the four locations. The highest threshold-odor number recorded was 24, a value which was observed at Cincinnati on six days during 1966.

OTHER CHEMICAL CONSTITUENTS — The ORSANCO criteria for public water supply include limiting values for nine specific chemical constituents, namely: Arsenic, barium, cadmium, chromium, cyanide, fluoride, lead, selenium and silver. These limits are based, for the most part, on U. S. Public Health Service drinking water standards. Although monitor data on most of these constituents is meager, findings reveal that — with only a few exceptions of minor significance — concentrations in the river during 1966 were well within ranges considered satisfactory.

Data on levels of arsenic, cadmium, chromium and lead is available from USGS-ORSANCO cooperative monitor stations at Stratton and Markland Dam. Data on lead concentrations is also available from the monitor station at Dam 53. At each station from 10 to 12 monthly-composite samples were analzyed during the year for each constituent.

Additional data is available (in advance of publication) from sampling stations of the Federal Water Pollution Control Administration at Toronto, Addison, Huntington, Cincinnati, Louisville, and Cairo. A total of 12 samples, most of which were quarterly composites, were collected at these stations in 1966; six were collected at Addison, two at Cairo and one

each at the other stations. All samples were analyzed for the following constituents: Arsenic, barium, cadmium, chromium, lead and silver. Because of the limitations of analytical procedures, some analyses are reported as "less than" a specified concentration.

Data on flouride concentrations is available from ORSANCO Water-Users Committee stations at Wheeling and Cincinnati, and from USGS-ORSANCO cooperative stations at Stratton, Markland Dam and Dam 53. At Wheeling analyses are made daily; at Cincinnati analyses are made on monthly-composite samples; and at USGS-ORSANCO stations analyses are made on grab samples collected three or four times a month.

Arsenic — A total of 45 samples were analyzed for arsenic in 1966. Four of these were reported to contain "less than 0.056 mg/l" or "less than 0.065 mg/l"; these results are inconclusive on whether or not concentrations exceeded the upper limit of 0.050 mg/l specified in the criteria. Thirty-one samples showed concentrations of zero. Of the remaining ten samples, the highest concentration observed was 0.02 mg/l, well below the criteria limit.

Barium — From a total of 12 analyses in 1966, the average concentration of barium was 0.048 mg/l, and the range was 0.010 mg/l to 0.060 mg/l. The highest value, therefore, was well below the limit of 1.0 mg/l specified in the criteria.

Cadmium — Of 36 analyses, six were reported to contain concentrations of "less than 0.011 mg/l" or "less than 0.024 mg/l." These results are inconclusive with respect to whether concentrations exceeded the upper limit specified in the criteria, namely; 0.01 mg/l. In all of the remaining samples, concentrations were below the limiting value specified in the criteria. Concentrations in 24 of the samples were reported as zero.

Chromium — Analyses for *total* chromium in 36 samples showed the highest concentration to be 0.009 mg/l. Since these analyses included the measurement of all ions of chromium (including those in hexavalent form) it can be concluded that levels of hexavalent chromium were well below the limit of 0.05 mg/l specified in the criteria.

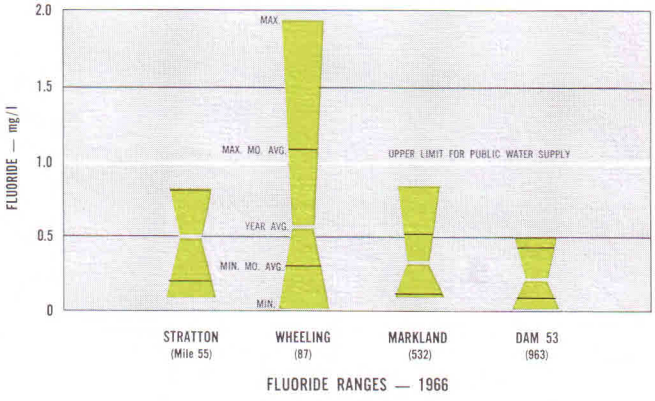
Lead — A total of 36 samples were collected and analyzed for lead in 1966. All of these contained concentrations of less than 0.05 mg/l, which is the limiting value specified in the criteria. The highest concentrations observed were 0.048 mg/l and 0.026 mg/l, which values were recorded at Addison and Cincinnati, respectively. In 24 of the remaining 34 samples, concentrations were reported to be zero.

Silver — The 12 samples collected and analyzed for silver in 1966 were reported to contain concentrations ranging from "less than 0.0009 mg/l" to "less than 0.0024 mg/l." Thus, concentrations in all samples were well below the limiting value of 0.05 mg/l specified in the criteria.

Cyanide and Selenium — Analyses for these constituents were discontinued a few years ago because concentrations consistently were found to be so low as to be of no practical significance.

Fluoride — For the year 1966, concentrations of fluoride ranged from 0.0 mg/l (at Wheeling and at Dam 53) to a high of 1.9 mg/l (also at Wheeling). The accompanying graph, which is based on data from 494 analyses, shows ranges in fluoride levels at four Ohio River monitor stations. At Cincinnati, where analyses were made on monthly-composite samples rather than grab samples, concentrations ranged from 0.1 mg/l to 0.7 mg/l, with a yearly-average value of 0.3 mg/l.

The ORSANCO public water supply criteria specify that fluoride levels should not exceed 1.0 mg/l. This level was exceeded at only one of the monitor stations — Wheeling. Here concentrations were above 1.0 mg/l for twelve percent of the time. Discharges from steel mills are a source of flouride in the upper Ohio River, but available evidence suggests they contribute only one-half or less of the total fluoride in the river (see ORSANCO report: *River-Quality Conditions During a 16-week Shutdown of Upper Ohio Valley Steel Mills*).



FLUORIDE RANGES — 1966

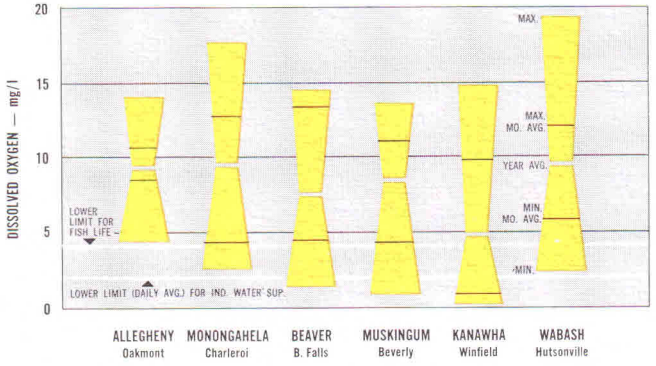
QUALITY CONDITIONS IN TRIBUTARIES

Quality conditions in some of the major streams tributary to the Ohio River are set forth in the following summary.

DISSOLVED OXYGEN — At six tributary locations, dissolved oxygen is measured hourly by means of robot monitors. The accompanying chart shows ranges in DO levels during 1966 at these locations. As in previous years, DO values in the lower section of the Kanawha River where the monitor is located were lower than those recorded in any other tributary.

Daily minimum DO concentrations were greater than 4.0 mg/l — the minimum level considered satisfactory for maintenance of well-balanced, warm-water fish habitats — on 100 percent of the days in the Allegheny River, 91 percent in the Wabash, 90 percent in the Monongahela and Muskingum, 82 percent in the Beaver and 47 percent in the Kanawha.

Daily-average concentrations were greater than 2.0 mg/l — the minimum level specified in the industrial water supply criteria — all of the time at all except two of the monitor locations. On the Muskingum River, daily-average values were below 2.0 mg/l for one percent of the time (3 days), and on the Kanawha River values were below this level for 30 percent of the time.



DISSOLVED OXYGEN RANGES — 1966

In summary, DO concentrations in all tributaries except the Kanawha River satisfied aquatic-life requirements an average of about 91 percent of the time, and the industrial water supply requirements more than 99 percent of the time.

COLIFORM DENSITY — Coliform-bacteria content is routinely monitored at Wilkinsburg on the Allegheny River, at South Pittsburgh on the Monongahela River, and at Beaver Falls on the Beaver River.

The coliform criterion for river water used as a source of public water supply specifies that monthly-average values should not exceed 5,000 per 100 ml. The criterion also permits an over-run above this value within the following limitations: Counts should not exceed 5,000 per 100 ml in more than 20 percent of the samples examined during a month, nor exceed 20,000 per 100 ml in more than five percent of the samples examined during a month.

During 1966, monthly-average coliform values were less than 5,000 per 100 ml for eleven months in the Allegheny River, for nine months in the Monongahela River, and for none of the months in the Beaver River. The extent to which the other specifications in the criterion were met is shown in the following tabulation:

	Wilkinsburg	S. Pittsburgh	Beaver Falls
Number of months in which 80 percent or more of daily values were less than 5,000 per 100 ml	8	8	0
Number of months in which 95 percent or more of daily values were less than 20,000 per 100 ml	12	9	0

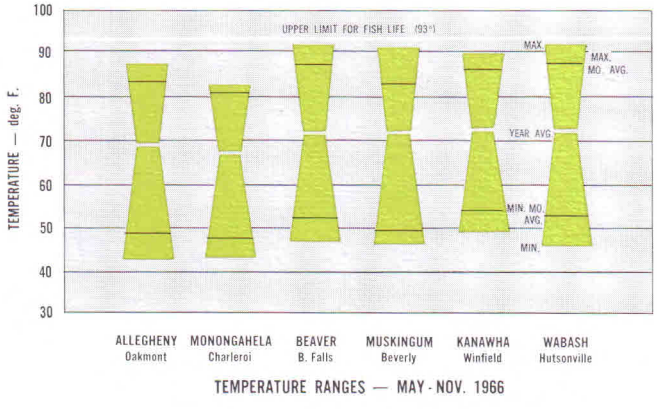
The coliform criterion for waters used for recreational purposes includes the following specifications: (a) Monthly-average densities should not exceed 1,000 per 100 ml; (b) not more than 20 percent of the samples examined during a month should exceed 1,000 per 100 ml; (c) densities on any day should not exceed 2,400 per 100 ml.

The monthly-average limitation of 1,000 per 100 ml was exceeded in four of the five recreational months

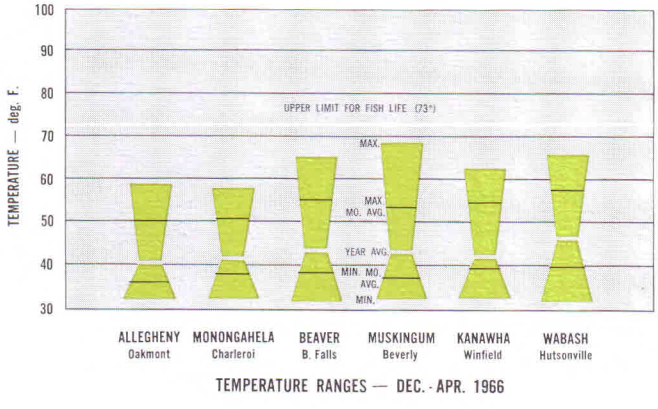
(May through September) at Wilkinsburg, and in all five months at South Pittsburgh and Beaver Falls. Daily counts were less than 2,400 per 100 ml for 68 percent of the time at Wilkinsburg, for 42 percent of the time at South Pittsburgh, and for two percent of the time at Beaver Falls.

The following table shows maximum and average coliform values at each station for the twelve months of 1966, together with maximum and average values during the five-month recreational season:

	Monongahela (S. Pittsburgh)	Allegheny (Wilkinsburg)	Beaver (Beaver Falls)
Coliform counts for Jan. thru Dec., 1966			
Maximum monthly-average value (coliforms per 100 ml)	9,300	6,500	86,000
Yearly average value (coliforms per 100 ml)	3,600	2,700	43,000.
Coliform counts for May thru Sept., 1966			
Maximum monthly-average value (coliforms per 100 ml)	9,300	4,200	72,000
Seasonal average value (coliforms per 100 ml)	5,400	2,200	44,000



TEMPERATURE RANGES — MAY - NOV. 1966



TEMPERATURE RANGES — DEC. - APR. 1966

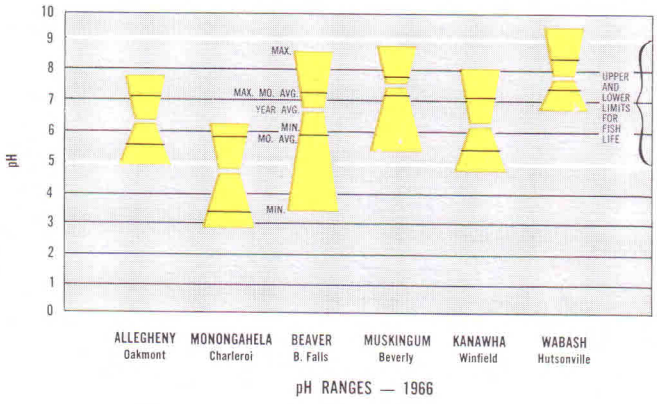
TEMPERATURE — The accompanying graphs show ranges in temperature at tributary monitor stations during two seasonal periods (May-November and December-April) of 1966. All readings were below 93 deg. F., which is the upper limit for aquatic life specified in the ORSANCO criteria. Maximum temperatures recorded were: 91.9 deg. F. in the Wabash River, 91.1 deg. F. in the Beaver River, 90.2 deg. F. in the Muskingum River, 89.7 deg. F. in the Kanawha River, 86.9 deg. F. in the Allegheny River, 82.5 deg. F. in the Monongahela River.

During the months of December through April, all temperature readings at each station were less than 73 deg. F., which is the upper limit specified in the criteria for aquatic life for this period.

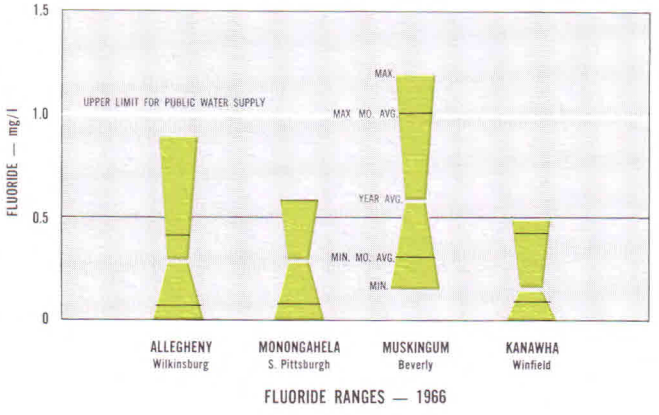
pH — The accompanying chart shows ranges in pH values during 1966 at six robot monitor stations. Except for the Monongahela River, pH levels were between 5.0 and 9.0 (the range specified in the ORSANCO criteria as suitable for the maintenance of aquatic life) for 89 to 100 percent of the days. In the Monogahela River, pH values were below 5.0 on 71 percent of the days. In the Wabash River, pH values greater than 9.0 were observed on 37 days.

Daily-average pH values at tributary robot monitors were within the preferred range for the maintenance of aquatic life, 6.5 to 8.5, the following percentages of time: Allegheny, 46 percent; Monongahela, 0 percent; Beaver, 67 percent; Muskingum, 90 percent; Kanawha, 39 percent; and Wabash, 82 percent.

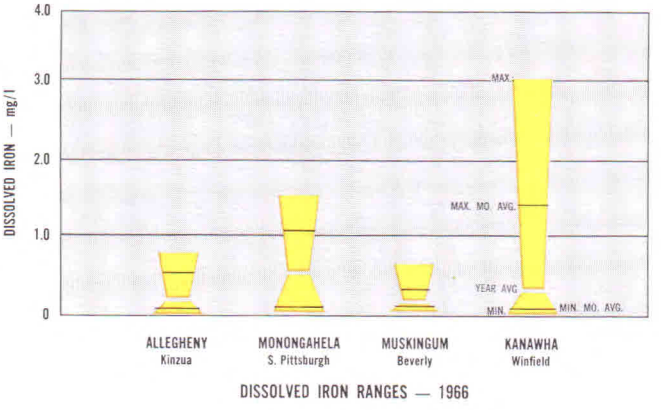
Low pH conditions on the Allegheny and Monongahela rivers are due in most part to the influence of acid discharges from coal mines.



pH RANGES — 1966



FLUORIDE RANGES — 1966



DISSOLVED IRON RANGES — 1966

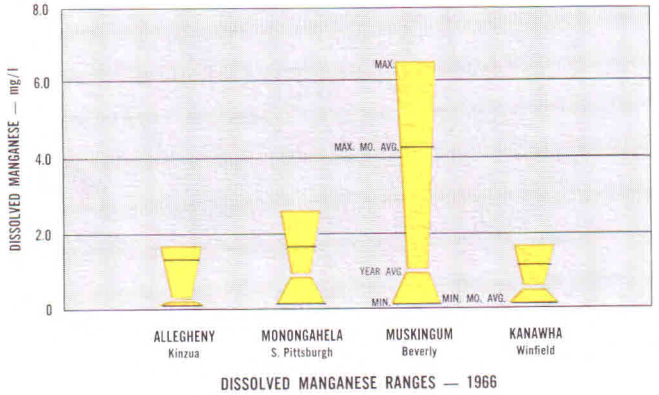
FLUORIDE — Fluoride levels in four tributaries are shown in the accompanying chart. Monthly-average levels range from 0.1 mg/l in the Allegheny, Monongahela, and Wabash rivers to 1.0 mg/l in the Muskingum. The upper limit of 1.0 mg/l specified in the ORSANCO criteria for public water supply was exceeded only in the Muskingum River, where a maximum value of 1.2 mg/l was recorded; it should be noted, however, that the Muskingum River is not used as a source for public water supply. Yearly-average levels of fluoride at other monitor locations ranged from 0.2 mg/l to 0.3 mg/l.

MANGANESE — Ranges in dissolved manganese concentrations during 1966 in four tributaries are shown in the accompanying graph. Monthly-average concentrations varied from zero in the Allegheny, Muskingum and Kanawha rivers to 4.2 mg/l in the Muskingum River. The highest single value observed was 6.4 mg/l, which occurred in the Muskingum.

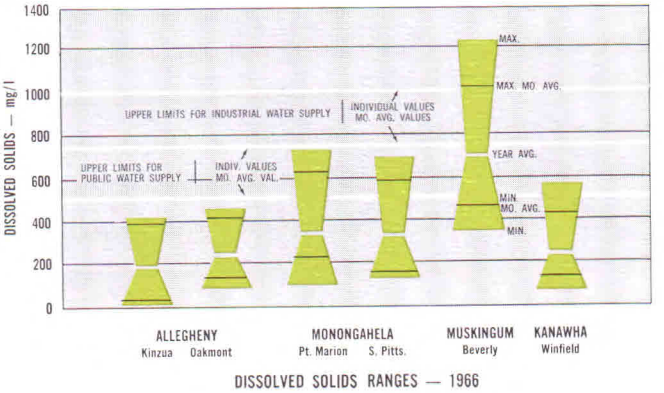
IRON — The accompanying graph shows ranges of dissolved-iron concentrations in four tributaries during 1966. Maximum monthly-average values observed were: 0.52 mg/l in the Allegheny River; 1.1 mg/l in the Monongahela River; 0.35 mg/l in the Muskingum River; 1.4 mg/l in the Kanawha River.

DISSOLVED SOLIDS — The accompanying graphs show ranges in concentrations of dissolved solids, chloride, sulfate and hardness at six stations on four tributaries during 1966. Sampling stations were as follows: Allegheny River at Kinzua, at Oakmont (dissolved solids only) and at Wilkinsburg (chloride, sulfate, hardness only); Monongahela River at Pt. Marion and South Pittsburgh; Muskingum River at Beverly; Kanawha River at Winfield.

Dissolved-solids concentrations were greater in the Muskingum River than in any of the other tributaries. In the Muskingum, both the industrial-water-



DISSOLVED MANGANESE RANGES — 1966



DISSOLVED SOLIDS RANGES — 1966

supply and public-water-supply criteria were exceeded at times. It might be noted, however, that the Muskingum is not used as a source of public water supply. The maximum monthly-average value recorded in the Muskingum was 1,011 mg/l, and the highest individual value recorded was 1,210 mg/l.

The only other tributary in which dissolved-solids concentrations exceeded the limiting value of 500 mg/l specified in the public water supply criteria was the Monongahela River. Maximum monthly-average concentrations of 624 mg/l and 589 mg/l were observed at Pt. Marion and South Pittsburgh, respectively.

On the Allegheny River there was an increase in dissolved-solids concentrations between the upstream and downstream stations. On the Monongahela, however, there was little difference between dissolved-solids levels at the two stations.

CHLORIDE — Only in the Muskingum River did chloride levels exceed the recommended limit of 250 mg/l in U. S. Public Health Service Drinking Water Standards. The highest monthly-average value observed in the Muskingum was 375 mg/l. The next highest values were 198 mg/l and 145 mg/l, which occurred in the Kanawha River and the Allegheny River (at Kinzua), respectively.

Major sources of chloride include wastes from brine-processing industries in the Muskingum basin, discharges from chemical processing industries in the Kanawha basin, and discharges of oil-field brines in the upper Allegheny basin. Runoff to the Allegheny River downstream from Kinzua apparently is relatively free of chlorides, since chloride levels near the mouth of the river are less than those upstream at Kinzua.

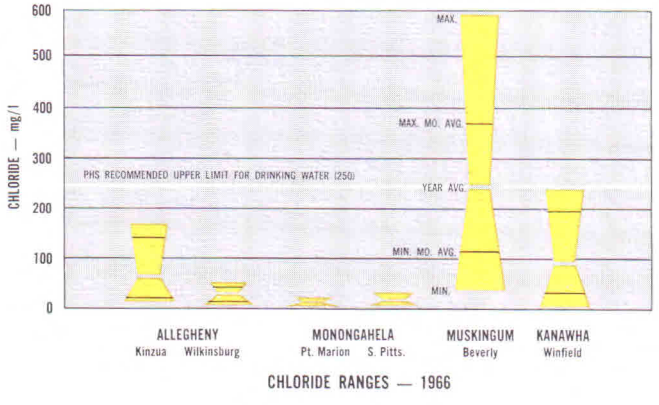
On the Monongahela River chloride levels at South Pittsburgh were only slightly higher than those at Pt. Marion. Values at both of these stations were lower than those at any other monitor location on the tributaries.

SULFATE — At both of the Monongahela River monitor stations sulfate concentrations at times exceeded 250 mg/l, which is recommended as the upper limit for drinking water in PHS standards. Maximum monthly-average values in this tributary during 1966 were 410 mg/l at Pt. Marion, and 357 mg/l at South Pittsburgh.

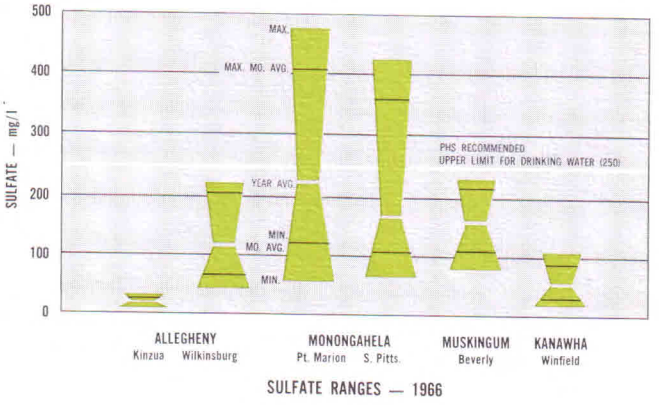
Next highest sulfate levels were recorded in the Muskingum River and the Allegheny River (at Wilkinsburg). Maximum monthly-average values at these two stations were 221 mg/l and 207 mg/l, respectively.

Drainage from coal mines is a major source of sulfate found in the Monongahela and Allegheny rivers.

On the Allegheny River, there was a several-fold increase in sulfate concentrations between Kinzua and Wilkinsburg, which may be attributed specifically to coal-mine drainage in the Kiskiminetas River (a tributary of the Allegheny) basin. The increase in sulfate concentrations is in marked contrast to the decrease in chloride levels between Kinzua and Wilkinsburg.



CHLORIDE RANGES — 1966



SULFATE RANGES — 1966

On the Monongahela River, there was evidence of a decrease in sulfate levels between the upstream and downstream sampling locations.

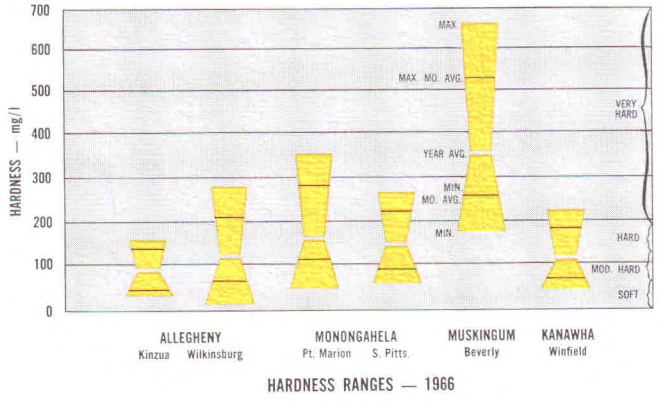
HARDNESS — The relative magnitude of hardness levels at each of the six tributary monitor stations parallels that for dissolved-solids concentrations. Hardness values were highest in the Muskingum River and lowest in the Allegheny River at Kinzua. As has been pointed out, the Muskingum is not used as a source of public water supply, and therefore the content of hardness-producing materials in the river is of primary concern with respect to its effect on quality conditions in the Ohio River.

Hardness levels in the Allegheny River at Wilkinsburg generally were about fifty percent higher than levels at Kinzua. The increase is attributed mainly to the influx of coal mine drainage in the lower portion of the Allegheny River basin.

In the Monongahela River there was a slight decrease in hardness levels between upstream and downstream stations. The levels are influenced by coal mine drainage.

Hardness levels in the tributaries may be characterized as varying from a classification of "soft" (for several months in the Allegheny River at Kinzua and the Kanawha River) to "very hard" (for some months at all stations except Kinzua) using U. S. Geological Survey designations.

Yearly-average hardness values at the six tributary stations during 1966 were: 82 mg/l in the Allegheny at Kinzua; 123 mg/l in the Allegheny at Wilkinsburg; 167 mg/l in the Monongahela at Pt. Marion; 144 mg/l in the Monongahela at South Pittsburgh; 352 mg/l in the Muskingum; 111 mg/l in the Kanawha.



HARDNESS RANGES — 1966

Major sources of hardness-producing substances include coal mine drainage in the Allegheny and Monongahela basins, and brine wastes together with mine drainage in the Muskingum basin.

OTHER CHEMICAL CONSTITUENTS — Data on concentrations of arsenic, cadmium, chromium and lead are available from USGS-ORSANCO cooperative monitor stations on the Monongahela River at South Pittsburgh and the Allegheny River at Oakmont. Analyses for these constituents (which were performed on monthly-composite samples) show that concentrations did not exceed limits specified in the ORSANCO criteria for water used as a source of public water supply.

Three samples were analyzed for arsenic at each station, and in all of them the arsenic content was found to be zero. (The limit for arsenic specified in the criteria is 0.05 mg/l.)

Ten samples from the Allegheny River and eleven samples from the Monongahela River were analyzed for cadmium. One sample from the Monongahela River contained 0.01 mg/l of cadmium, which is the maximum allowable value specified in the criteria. In all other samples, the cadmium content was zero.

Eleven samples from each station were analyzed for total chromium, in all of which the amount of chromium was zero. (The limit for hexavalent chromuim specified in the criteria is 0.05 mg/l.)

Eleven samples from each tributary were analyzed for lead. In 19 of the 22 samples, concentrations of lead were reported to be zero. One sample from the Monongahela and another from the Allegheny each contained 0.01 mg/l of lead. Another sample from the Monongahela contained 0.02 mg/l of lead. (The limit for lead specified in the criteria is 0.05 mg/l.)

TALLY FOR THE VALLEY

THE BASIN-WIDE INVENTORY of municipal and industrial wastewater control facilities is updated annually, based on information supplied by each of the member states. Summaries of the status of sewered communities and of industries discharging to the surface waters in the compact district, as of July 1, 1967, are presented in the accompanying tabulations. Additionally, the following facts emerge from an analysis of the inventory data.

Municipal Status — Treatment facilities now in operation serve 94 percent of the 11,400,000 sewered population in the 154,000 square miles encompassed by the compact district. Facilities under construction for 51 communities will service an additional 130,000 persons.

New works were placed in operation to serve 58 communities with a total population of 91,000. Facilities were upgraded at 23 existing plants serving 170,000 people. Construction was started at 19 communities with a population of 40,000. In addition, improvements to existing facilities were initiated by 17 communities whose population totals over 200,000.

From the standpoint of degree of purification provided, almost half of the population (actually 48 percent) is served by facilities employing biological or so-called secondary treatment; intermediate and primary types of treatment, equally divided, serve the other half. Measured in terms of number of communities, the analyses reveals that: 57 percent employ secondary treatment; 28 percent primary facilities; and the remaining 12 percent intermediate treatment.

Along the main stem of the Ohio River treatment facilities now in operation service 99 percent of the almost 3,700,000 sewered population. New facilities under construction will provide treatment for an additional 0.4 percent.

Classified according to degree of purification provided along the Ohio River, 43 percent of the population is served with primary treatment, 56 percent with intermediate, and the remaining one percent with secondary treatment facilities. A similar breakdown in terms of communities shows 54, 38 and 7 percent, respectively, in the primary, intermediate and secondary treatment categories.

Industrial Status — There are 1,840 industrial establishments in the district discharging wastewater directly to the surface waters. Of these about 88 percent (1,614) have provided control facilities to comply at least with minimum requirements.

The signatory states report that 79 percent (1,455) of the industrial discharges in the district are complying with all of the requirements they have prescribed thus far.

Federal Aid Program — The Federal Water Pollution Act in 1956 established a program for grants-in-aid to municipalities for construction of sewers and treatment plants. Between September 1962 and July 1964 supplemental grants were made available under the Federal Public Works Acceleration Act. During the last fiscal year additional construction-grant aid was provided through the Appalachian Regional Commission as well as the Economic Development Administration; the latter agency is also authorized to offer long-term loans to communities.

For the period July 1, 1966 through June 30, 1967, construction grants totalling $10,070,800 were allocated by the three federal agencies to 57 communities in the Ohio Valley compact district, according to the latest available information from Project Registers of the Federal Water Pollution Control Administration. These grants aided in financing sewer-system and sewage-treatment projects whose total estimated cost is $33,080,500.

Since 1956 the federal grants have totalled $101,569,300. Communities employed these funds to aid in the construction of 750 projects whose total estimated cost is $347,200,400.

Additional sources of federal grant and loan funds for sewer system and treatment plant construction are the Department of Housing and Urban Development and the Farmers Home Administration of the Department of Agriculture. Data was not available to compile a summary.

STATUS OF MUNICIPAL AND INSTITUTIONAL SEWAGE-TREATMENT FACILITIES – July 1, 1967

Number of communities (top number) and population (bottom number)

STATUS	ILL.	IND.	KY.	N. Y.	OHIO	PA.	VA.	W. VA.	TOTAL	% of TOTAL
Control currently acceptable	**61** 305,231	**140** 619,666	**191** 1,300,890	**8** 81,440	**343** 3,374,707	**292** 2,572,501	**47** 158,191	**79** 390,330	**1,161** 8,802,956	**67.7** 76.8
Treatment provided (improvements needed)	**4** 21,813	**60** 670,704	**6** 10,934	**6** 16,619	**38** 368,857	**13** 68,967	**20** 16,723	**18** 106,839	**165** 1,281,456	**9.6** 11.2
Treatment provided (improvements under construction)	**4** 23,993	**5** 534,255	**3** 8,065	**0** 0	**1** 1,148	**0** 0	**0** 0	**3** 109,678	**16** 677,139	**0.9** 5.9
New treatment works under construction	**1** 339	**11** 12,537	**2** 5,793	**0** 0	**5** 15,507	**13** 44,456	**0** 0	**19** 51,622	**51** 130,254	**2.9** 1.1
No treatment; construction not started	**8** 10,091	**67** 71,294	**8** 9,155	**7** 14,426	**28** 34,014	**106** 255,418	**15** 18,110	**84** 162,220	**323** 574,728	**18.9** 5.0
Total	**78** 361,467	**283** 1,908,456	**210** 1,334,837	**21** 112,485	**415** 3,794,233	**424** 2,941,342	**82** 193,024	**203** 820,689	**1,716** 11,466,533	**100.0** 100.0

Summaries for all states reveal status of compliance with treatment requirements as these existed June 30, 1967. The states are now engaged in upgrading requirements. Indiana has already adopted new requirements and the inventory reflects its changes.

STATUS OF INDUSTRIAL WASTE-CONTROL FACILITIES – July 1, 1967

STATUS	ILL.	IND.	KY.	N. Y.	OHIO	PA.	VA.	W. VA.	TOTAL	% of TOTAL
Complying with ORSANCO minimum requirements	16	261	153	18	361	529	57	219	1,614	87.7
Control currently acceptable	15	199	149	14	297	518	57	206	1,455	79.1
Control provided, but not adequate	12	66	10	13	57	40	2	45	244	13.3
Control facilities inadequate, improvements in progress	5	0	2	0	12	5	0	4	28	1.5
New control facilities under construction	1	12	0	0	4	12	0	9	39	2.1
Planning treatment facilities or preparing to connect to municipal sewers	1	7	0	6	3	23	0	7	47	2.6
No action by company	0	0	0	5	0	15	1	6	27	1.4
Total number of industries	34	284	161	38	373	613	60	277	1,840	100.0

Chairman Yoder, left, and vice-chairman McKay, right, elected to take office on July 1, 1967.

ADMINSTRATIVE AFFAIRS

EXECUTION OF THE Ohio River Valley Water Sanitation Compact is the responsibility of 27 commissioners. Each of the eight signatory states is represented by three commissioners appointed by the Governor of the state. Federal interests are represented by three commissioners appointed by the President of the United States. Administration of Commission affairs is conducted by a staff of eleven persons headquartered in Cincinnati. A roster of the commissioners, officers and staff is given on the inside front cover.

Chairmanship of ORSANCO is rotated annually among the states. During the year with which this report is concerned — July 1, 1966, through June 30, 1967, — J. O. Matlick served as chairman. Mr. Matlick, who is Commissioner of the Kentucky Department of Natural Resources, has been a member of the interstate agency since 1960.

Franklin D. Yoder, M. D., director of the Illinois Department of Health, was elected chairman for the year beginning July 1, 1967; he had been vice-chairman. Dr. Yoder's professional career has spanned the field of public-health administration, with eleven years service as director of the Wyoming Department of Health and two years on the executive staff of the American Medical Association. His responsibilities in Illinois include chairmanship of the State Sanitary Water Board.

Marion K. McKay, a commissioner from Pennsylvania since 1956, was elected vice-chairman. Dr. McKay is a retired professor of economics at the University of Pittsburgh, and for many years was a member of the Pennsylvania Sanitary Water Board. In 1938 he represented Pennsylvania as a member of the Conference of Delegates that drafted the Ohio River Valley Water Sanitation Compact.

Membership changes — Charles L. Wilbar, Jr., M. D., who resigned January 17, 1967, as Secretary of Health in Pennsylvania was succeeded in that post and also as a member of ORSANCO by Thomas W. Georges, Jr., M. D. Dr. Wilbar was a commissioner for ten years and chairman in 1961-62. Dr. Georges also is chairman of the Pennsylvania Sanitary Water Board.

Two vacancies exist among the membership. Appointments of a third commissioner are pending in both Illinois and Pennsylvania.

Members were saddened this year by the death of two former commissioners who had been distinguished by their leadership in ORSANCO affairs. W. W. Jennings passed away on March 30, 1967, and Hudson Biery on July 5th. Both men were appointed to the Commission when it was activated in 1948, and both were past-chairmen.

Staff changes — On May 11, 1967, the Commission acceded with regret to the request of Edward J. Cleary that he be relieved in October of his responsibilities as executive director and chief engineer, a post that he has held continuously for more than 18 years following establishment of ORSANCO. Arrangements have been made to retain the services of Dr. Cleary on a part-time basis.

At the same time the Commission took pleasure in recognizing the 18 years of devoted service rendered by Robert K. Horton, assistant director, and appointed him to assume the duties of executive director and chief engineer in October 1967.

Accepted with regret was the resignation of C. Scott Clark, sanitary engineer, effective August 31st. Dr. Clark, who began his career with ORSANCO as a student-in-training during summer periods and then served on the staff for two years following completion of graduate studies, is joining the new Institute of Environmental Health, University of Cincinnati.

Richard N. Smith, a data-processing technician, was welcomed to the staff on May 4, 1967. Mrs. Donna L. Nickerson resigned as a member of the secretarial staff in October.

Financial — Operating funds are derived from two sources: by appropriations from the eight states, and from federal grants.

State appropriations totalled $130,000, the same amount that has been made available annually since 1955. This year an increase was authorized and starting July 1, 1967, the annual amount will be $182,000. Appropriations from each state represent a pro rata share, based one-half in proportion to population, and one-half in proportion to land area within the Compact district. (See page 40)

Additional funds are available from grants made under provisions of the Federal Water Pollution Control Act of 1956 (Public Law 660, amended). During the past eleven years the annual grants have varied from $69,800 to $112,400, averaging $104,300 annually. During the years of 1949 to 1952 ORSANCO was the recipient of three federal grants averaging $26,000 annually.

A financial statement for the fiscal year 1966-67 appears on a following page.

Advisory committees — For over sixteen years advisory committees representing the chemical, coal, metal-finishing, paper, petroleum and steel industries have worked closely with the Commission in the control of water pollution. Some 250 management personnel represent 130 companies. Last year the Power Industry Advisory Committee was activated with membership from electric generating companies.

The Power Industry Advisory Committee is currently involved with research at Johns Hopkins University sponsored by the Edison Electric Institute. This investigation is concerned with the effect of temperature changes on aquatic life ecology. The committee is also participating in a study of hydro-generator operation at an Ohio River navigation dam concerned with reaeration aspects of turbines.

The Chemical Industry Advisory Committee completed a study of the quantity and quality of water required for production. The report, titled "Water Use and Quality Considerations in the Chemical Industry" has been approved by the Commission for publication.

During the 1967 recreational season, as in 1966, member companies of the Petroleum Industry Committee provided some 70,000 ORSANCO litter bags for boat users, as a public service. The Committee is continuing its study on oil pollution from industrial operations, as well as from losses of oil from boats, storage and transfer operations. *(continued on page 36)*

HUDSON BIERY

November 30, 1888 — July 5, 1967

More than three decades ago Hudson Biery was in the forefront of a group of citizens and legislators who envisioned the potentialities for regional action in curbing water pollution in the Ohio Valley. Their labors in negotiating an Ohio River Valley Water Sanitation Compact presented the opportunity for translating dreams into realities when the Governors of eight states signed the document on June 30, 1948.

The 27 commissioners who were then appointed to guide this complex program unanimously chose Hudson Biery to be their first chairman. Although the bylaws permitted only one year tenure in this coveted post, the contributions of Mr. Biery as senior commissioner representing the State of Ohio projected him in a leadership role concerning every aspect of Commission affairs until his retirement in September 1966. Not to be deprived of his continued counsel, his colleagues then created a unique place for him as advisor to the chairman. This distinction was terminated by his death on July 5, 1967.

These are the unadorned facts associated with the 32-year record of Commissioner Biery's efforts in behalf of what he called "a regional experiment in American government." To all of those exposed to his influence he was distinguished as a man with a mission, and happily endowed with the creativeness and conviction to inspire its accomplishment. Dedication of the most productive years of his life to public service brought no pecuniary rewards to Hudson Biery. His satisfactions came from the response that was generated among millions of people in the Ohio Valley to support efforts for restoring the wholesomeness of water resources. And he took justifiable pride in having been called upon by Congressional leaders for aid in drafting the first legislation to launch a national attack on water pollution, which was passed in 1948.

No one more richly deserved the esteem and affection with which Commissioner Biery was held by the members and staff of the Ohio River Valley Water Sanitation Commission.

THE ORSANCO STORY

Water Quality Management in the Ohio Valley under an Interstate Compact, by Edward J. Cleary, 335 pages, Library of Congress Catalog, Card Number 67-16036. Published July, 1967, by The Johns Hopkins Press, Baltimore, Md., 21218. Hard cover $8.50, paperback $2.95. Order from the publisher.

This is the case history of why and how the Ohio River Valley Water Sanitation Compact came into being, what it achieved and what may be learned from this experience of eight states in developing a regional program of river cleanup. The book is divided into four parts. The first part deals with the geographic setting, the nature of the pollution problem, and the details of negotiating the compact. Part II describes the conception and development of the various components of the program, including the monitor network. Over-all performance of ORSANCO is evaluated in Part III, and the final section of the book explores future prospects.

The Water Users Advisory Committee, whose membership consists of municipal and industrial water treatment plant managers, has completed its study on the comparison of fecal coliforms to the total coliform content of the river. This committee is now studying the treatment of filter backwash and water plant sludges which result from water processing.

The Aquatic-Life Advisory Committee has just completed its Fourth Progress Report. In this report the committee has updated earlier recommendations regarding criteria for dissolved oxygen, temperature, pH, toxicity and radioactivity. The report is based on a re-evaluation of earlier findings and an appraisal of findings and conclusions from recent research undertakings.

All of the advisory committee members serve on a volunteer basis. The Commission recognizes their contributions of time and talent with its Appreciation Scroll. This is presented to committee chairmen at the close of their terms and in certain instances to members on their retirement. To date 63 scrolls have been awarded.

Documentary films — ORSANCO films continue to be much in demand for showings both in the Compact district and outside of the district. Many requests come from Canada. In 1964 there were a total of 79 requests. In 1965 this increased to 95 and in 1966 films were sent out to fill 156 requests. A descriptive listing of ORSANCO documentary films appears on a following page.

Edward J. Cleary

Robert K. Horton

COMMISSION COMMITTEE ASSIGNMENTS

(for year ending June 30, 1968)

Executive Committee

Chairman	Franklin D. Yoder, M.D.
Vice-chairman	M. K. McKay
Past-chairman	J. O. Matlick
Illinois	Clarence W. Klassen
Indiana	Blucher A. Poole
Kentucky	Russell E. Teague, M.D.
New York	Joseph R. Shaw
Ohio	Emmett W. Arnold, M.D.
Pennsylvania	M. K. McKay
Virginia	Ross H. Walker
West Virginia	N. H. Dyer, M.D.
Federal	Raymond E. Johnson

Audit

Minor Clark, *Chairman*
Thomas W. Georges, Jr., M.D.
Ross H. Walker

Finance

Joseph R. Shaw, *Chairman*
Emmett W. Arnold, M.D.
J. O. Matlick
M. K. McKay
Franklin D. Yoder, M.D.

Long Range Planning

Clarence W. Klassen
Raymond E. Johnson
M. K. McKay
A. C. Offutt, M.D.
Russell E. Teague, M.D.

Engineering Committee

Illinois	Clarence W. Klassen
Indiana	Blucher A. Poole
Kentucky	Ralph C. Pickard *Chairman*
New York	Dwight Metzler *Vice-chairman*
Ohio	George Eagle
Pennsylvania	Walter Lyon
Virginia	A. H. Paessler
West Virginia	Edgar A. Henry
Corps of Engineers	Donald T. Williams
Dept. of Interior	Raymond E. Johnson
FWPCA	Richard A. Vanderhoof
Secretary	F. H. Waring
Staff	Robert K. Horton

Bylaws

Blucher A. Poole, *Chairman*
N. H. Dyer, M.D.
M. K. McKay

Pension Trust

Barton Holl
Robert K. Horton
Clarence W. Klassen

Salaries and Personnel

Franklin D. Yoder, M.D.
J. O. Matlick
M. K. McKay

CHAIRMEN OF ORSANCO ADVISORY COMMITTEES

(as of November 1, 1967)

Aquatic-Life Advisory Committee — Lloyd L. Smith, Jr., University of Minnesota, St. Paul, Minnesota

Chemical Industry Committee — Jack T. Garrett, Monsanto Chemical Co., St. Louis, Missouri

Coal Industry Advisory Committee — Larry Cook, Ohio Reclamation Association, Columbus, Ohio

Metal-Finishing Industry Action Committee — C. M. Fair, General Electric Co., Louisville, Kentucky

Petroleum Industry Committee — Ernest Cotton, Gulf Oil Corp., Pittsburgh, Pennsylvania

Power Industry Advisory Committee — Edward E. Galloway, Cincinnati Gas and Electric Co., Cincinnati, Ohio

Pulp and Paper Industry Action Committee — W. C. Mathews, Mead Corporation, Chilllicothe, Ohio

Steel Industry Action Committee — John P. Hahle, Wheeling Steel Corporation, Wheeling, West Virginia

Water Users Committee — Donald R. Roy, Pittsburgh Plate Glass Co., New Martinsville, West Virginia

ORSANCO DOCUMENTARY FILMS

Following is a list of ORSANCO films produced to illustrate various aspects of pollution abatement in the Ohio Valley. These 16 mm movies, in color and with sound, may be borrowed for group showings by addressing the state agencies listed on the inside back cover, or by request to Commission headquarters.

GOOD RIDDANCE This fast-moving, omnibus film depicts the progress made and the tasks that still remain in curbing water pollution in the Ohio Valley. This offers a general introduction on the regional crusade for clean streams undertaken by eight states. (29½ minutes)

BEARGRASS CREEK The story of what can happen to a stream when people along its banks disregard their obligation to prevent pollution. Of particular interest is the work being done by the University of Louisville in conducting the ORSANCO-sponsored study of aquatic-life resources. (19½ minutes)

OIL ON THE RIVER Beginning with the story of the discovery of oil in the Ohio Valley, this film shows the unhappy consequence of carelessness in handling, transportation, storage and use of oil products and then depicts preventive measures. (20½ minutes)

CRISIS ON THE KANAWHA A portrayal of industrial growth and the failure to keep pace with it in terms of river protection is the opening theme of this film. Then follows a detailed description of the remedial steps that are being taken to deal with the situation. (22 minutes)

RIVER WATCHERS Safeguarding streams from pollution hazards calls for constant vigilance. This is the story of the sentinels in the eight states who are engaged in checking sewage plant operations, aerial surveillance, virus identification, sampling of streams, forecasting river flow and evaluating the results from robot monitors. (18½ minutes)

THE FIRST FIFTEEN YEARS ORSANCO commissioners describe progress in the fifteen-year crusade for clean streams in the Ohio Valley. A highlight of the film is a visit to The Kettering Laboratory where toxicity studies are documented. (26 minutes)

COAL AND WATER A penetrating look at pollution problems created by the coal industry and the steps being taken to solve those problems. Included is a description of sealing operations in an underground mine to curb acid mine-drainage. (23 minutes)

"OOPS!" An educational film which demonstrates how careless actions within a plant may result in river pollution and steps to take to guard against such situations. Designed as an in-plant training aid to solicit employee and supervisor alertness in preventing accidental spills. (22 minutes)

FINANCIAL REPORT

The following information relative to revenues collected and expenses paid, and statement of resources, was taken from the Audit Report of Wm. H. Mers and Company, Certified Public Accountants, for the year ended June 30, 1967.

OHIO RIVER VALLEY WATER SANITATION COMMISSION

STATEMENT OF REVENUES COLLECTED AND EXPENSES PAID
YEAR ENDED JUNE 30, 1967

Revenues collected:		
From signatory states:		
State of Illinois		$ 6,630.00
State of Indiana		23,530.00
Commonwealth of Kentucky		26,975.00
State of New York		1,430.00
State of Ohio		32,370.00
Commonwealth of Pennsylvania		19,760.00
Commonwealth of Virginia		4,550.00
State of West Virginia		14,755.00
		130,000.00
From U. S. Department of Health, Education and Welfare (Grant by authority of Federal Water Pollution Control Act)		104,126.00
Sale of publications		447.09
Interest earned on bank deposit		3,336.88
Total revenues collected		237,909.97
Expenses paid:		
From state funds:		
From authorized budget of $151,000.00 (Includes $3,279.00 for renovation of robot monitor receiving station paid from an encumbrance of $3,400.00 at June 30, 1966)	$157,400.19	
From federal funds:		
From authorized budget of $104,126.00	97,523.90	
Total expenses paid		254,924.09
Excess of expenses paid over revenue collected		$ 17,014.12

STATEMENT OF RESOURCES JUNE 30, 1967

	State Funds	Federal Funds	Total
Available resources for period to June 30, 1966	$ 48,200.29	$ 5,473.03	$ 53,673.32
Add: Revenues collected:			
Annual budget — July 1, 1966 to June 30, 1967	130,000.00		130,000.00
U. S. Department of Health, Education and Welfare		104,126.00	104,126.00
Sale of publications	447.09		447.09
Interest earned on bank deposit	3,336.88		3,336.88
	181,984.26	109,599.03	291,583.29
Less: Expenses paid:			
July 1, 1966 to June 30, 1967	157,400.19	97,523.90	254,924.09
Available resources at June 30, 1967	$ 24,584.07	$ 12,075.13	$ 36,659.20

The above amount of $36,659.20 is comprised as follows:		
Cash on deposit with The Central Trust Company		$ 34,044.17
Cash on deposit with American Airlines, Inc.		425.00
Cash on deposit with Ohio Bureau of Workmen's Compensation		120.00
Petty cash on hand		200.00
Accounts receivable:		
Advances for employees:		
Employees' pension trust	$ 1,630.23	
Hospitalization	239.80	
(Hospitalization expense and employee pension trust contributions are advanced by the commission and repaid by the employees through monthly payroll deductions)		1,870.03
Total		$ 36,659.20

DISTRIBUTION OF ANNUAL SHARES OF BUDGET BY STATES

1960 Census Figures Used As Basis for Determining Annual Shares for Operating Budget

State	Area within Ohio River Drainage Basin		Population (1960) within Ohio River Drainage Basin		Weighted Average of Percentages of Area and Population	Annual Share of Budget (for total budget of $130,000)	Annual Share of Budget (for total budget of $182,000)
	Square Miles	Percent of Total	Population	Percent of Total			
Illinois	10,745	7.0%	591,109	3.2%	5.10%	$ 6,630	$ 9,282
Indiana	29,135	18.9	3,227,072	17.3	18.10	23,530	32,942
Kentucky	39,375	25.5	2,981,670	16.0	20.75	26,975	37,765
New York	1,955	1.3	168,365	0.9	1.10	1,430	2,002
Ohio	29,570	19.2	5,702,592	30.6	24.90	32,370	45,318
Pennsylvania	15,620	10.1	3,783,796	20.3	15.20	19,760	27,664
Virginia	7,175	4.6	457,312	2.4	3.50	4,550	6,370
West Virginia	20,610	13.4	1,738,006	9.3	11.35	14,755	20,657
TOTALS	154,185	100.0%	18,649,922	100.0%	100.0%	$130,000	$182,000

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Typesetting by Quality Typesetting Company, Cincinnati
Printing by Westerman Print Company, Cincinnati
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Body type is 10 pt. Times Roman and the head type is Microgramma Bold extended

REGULATORY AGENCIES OF THE SIGNATORY STATES

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State Sanitary Water Board
Springfield, Illinois 62706
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KENTUCKY

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