ORSANCO

OHIO RIVER VALLEY WATER SANITATION COMMISSION
AN INTERSTATE AGENCY
ESTABLISHED JUNE 30, 1948

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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

TWENTIETH YEARBOOK 1968

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To regard the past with tempered satisfaction;

to embrace the present with renewed enthusiasm;

to contemplate the future with greater confidence . . .

. . . are sentiments that qualify as a theme for this 20th annual report of the Ohio River Valley Water Sanitation Commission. As custodian of the obligations jointly undertaken by eight states to coordinate a regional program of pollution control, the commissioners of ORSANCO have reason to conclude that past performance has provided a firm base on which to advance current aspirations.

Since the creation of ORSANCO by means of an interstate compact in 1948 there has been a great change nationally as reflected in terms of social concern and political action concerning the urgency of water pollution control. As pioneers in provoking such a change and in devising for the Ohio Valley a regional mechanism to be responsive to it, the eight states take not a little pride in their self-inspired leadership. Nevertheless, whatever satisfaction this may arouse must be tempered with acknowledgment that records are made to build on — not simply to stand on. Viewed in this fashion, the 20-year record of cooperative effort by state governments in the Ohio Valley illuminates even greater potentials for enhancing regional capability to deal with the complexities of managing water quality.

Not the least of these complexities has evidenced itself in the endeavors made by the signatory states during the past two years in complying with the criteria and standards provisions of the national Water Quality Act of 1965. The act 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. Heretofore, the Ohio Valley states had utilized their interstate commission for the establishment of standards, based on hearings and joint deliberations of the entire membership on what decisions might be appropriate for various parts of the region.

All the ORSANCO states individually submitted standards to the Secretary of the Interior prior to the deadline date of June 30, 1967. One year later two states had received federal approval, four had been given partial approval and two were still being negotiated. Of concern to the ORSANCO commissioners are a number of unresolved differences among several state schedules and the need for reconciling them in the interests of regional compatibility. In some cases the incongruous situation is presented where different standards are applicable to the same stretch of river bordering two states.

While reconciliation of standards promises to be a major issue on the ORSANCO agenda in the months ahead, other aspects of regional-program development are likewise commanding attention. These include expansion of river-quality monitoring and evaluation capability; development of an automated forecast procedure for quality management; a reconnaissance of subsurface disposal potentialities and limitations in the region; an assessment of changes in aquatic-life resources of the Ohio River; and a continuation of investigations on river-oxygen enrichment utilizing hydropower facilities.

MONITORING CAPABILITY

Starting in 1951, the signatory states delegated to ORSANCO the task of developing and operating a river-quality monitoring network. As is detailed elsewhere in this report, this important undertaking has been progressively expanded and today probably represents the largest and most sophisticated endeavor of its kind anywhere in the world. A distinguishing feature of the system is the use of electronic robot monitors, which were pioneered under staff auspices some nine years ago. Equally significant has been the development of capability in the art of quality-data processing and evaluation. This has reached the point where, among other things, it became possible to inaugurate this year a monthly fact-sheet and appraisal of quality conditions in the Ohio River and some of its tributaries. These assessments, which are completed and distributed to any interested parties within a few days following the end of each month, provide a comparison of river conditions with the quality criteria adopted by ORSANCO.

The promptness with which this can be done reflects increased skill of the staff in devising and applying computer programs to an IBM 1130 installation at ORSANCO headquarters. Studies underway suggest that ultimately it may be possible to interpret river-quality data so as to forecast impending changes some days in advance of their occurrence.

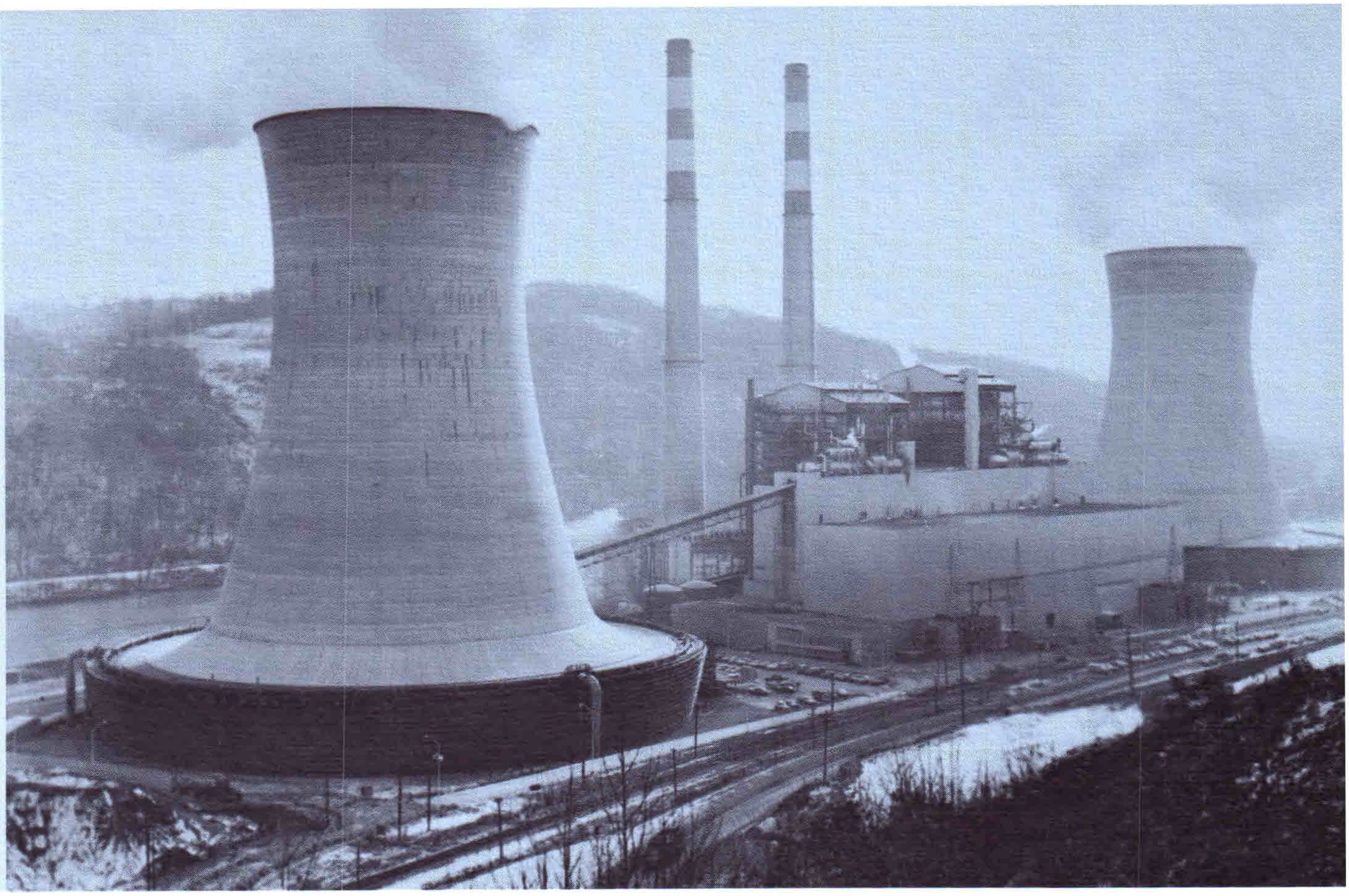
Allied to this endeavor is a staff research proposal to demonstrate the application of automated forecast procedures for river-quality management. For this purpose a mathematical model to simulate changes in a 170-mile stretch of the Ohio River is under development. Inputs to the model would reflect the influence of tributary streams, surface runoff, storm-sewer overflows, wastewater discharges, and hydrologic variability, along with river quality changes registered from a battery of robot monitors. Supplementary support for executing the project is being sought from the Federal Water Pollution Control Administration since it is believed that if such a methodology can be perfected it will have usefulness on a national scale. Among other things, it would provide a "tool" for correlating reservoir releases and hydropower operations with quality needs, proportioning effluent discharges in accord with variations in river flow, and in tailoring the degree of treatment at sources of waste production to maintain desired levels of water quality.

AQUATIC-LIFE RESOURCES

Ten years ago ORSANCO and The Kentucky Department of Fish and Wildlife Resources sponsored a comprehensive inventory of the aquatic-life resources of the Ohio River. The object was to establish a baseline of reference with respect to species composition, distribution and relative abundance of various fishes. Findings are summarized in the 1960 annual report of the Commission. Among other things, the study revealed the presence of 131 different species of fish, and a standing crop estimated to be equivalent to 150 pounds of fish per acre of water surface.

It was intended to undertake similar studies in future years and thus establish an empirical basis for appraising the suitability of the river for the maintenance of aquatic life and the production of a harvestable fish crop.

Such a comparative survey is now underway. It involves periodic collection and identification of fishes at 23 locations on the Ohio, Allegheny, Monongahela



and Kanawha rivers. Participating with ORSANCO in the cooperative survey are aquatic biologists of signatory states, the Federal Water Pollution Control Administration, the U. S. Fish and Wildlife Service and the Corps of Engineers.

In addition to the inventory on species and abundance of fish, a study will be made of the influence of river-water characteristics on their flavor. For this purpose, hatchery-raised channel catfish are being segregated in porous nets submerged in the river for a 5-day period, after which they are cooked and tested for edibility and flavor by a group of tasters at the laboratory of the U. S. Bureau of Commercial Fisheries. Efforts will also be made to identify by chromatographic techniques what chemical compounds in the river water may be responsible for off-flavors in the fish flesh.

RIVER OXYGEN ENRICHMENT

Another of several quality-management techniques that are being explored is the potential of manipulating operations of hydroelectric generating plants to enhance river-oxygen resources. Two member companies of the ORSANCO Electric Power Industry Committee — the American Electric Power Corporation and the Public Service Company of Indiana — have been working with the staff on this project. The Ohio River Division of the Corps of Engineers is also a participant.

Studies were inaugurated last year during the low-flow season at the Corps of Engineers Markland Dam, which is the site of new generating facilities of the Public Service Company of Indiana on the Ohio River. Turbines and gates were manipulated in a variety of ways, during which dissolved-oxygen conditions upstream and downstream were measured under each set of operating conditions. A further effort to confirm and embellish findings will be made during the autumn low-flow period of 1968.

Meantime, a companion study with the American Electric Power Corporation is being made at its Winfield Dam facility on the Kanawha River. Oxygen levels in the river at this site sometimes are depressed to zero. Preliminary findings indicate that as a result of "bleeding" air into the turbines substantial enrichment of oxygen in the river water may be obtained for a considerable distance downstream. The significance of this study is allied to the announcement by the Federal Power Commission several years ago that the Ohio River navigation-dam improvement program of the Corps of Engineers will create conditions that would support hydropower

Control of thermal pollution is the function of the twin cooling towers that dominate the new Fort Martin steam-electric generating station located on the Monongahela River. The "lamp-chimney" design of the 370 foot high hollow structure creates a natural draft that causes outside air to swirl through a cascade of heated water within the tower.

Photo from Allegheny Power System, one of the owners of the facility along with Monongahela Power, West Penn Power, The Potomac Edison and Duquesne Light companies.

development totalling 900 megawatts capacity. An 81-megawatt facility has now been placed in operation at the Markland (Indiana) navigation dam, and designs are being prepared for generating installations at several other locations.

Findings from this cooperative study of ORSANCO and its Electric Power Industry Committee, some of whose members are involved in the design and operation of the new hydropower projects, should illuminate possibilities for coordinating these operations with river quality requirements.

DEEP WELL DISPOSAL

Industries are finding it increasingly attractive to consider the installation of wells for the disposal of wastewaters. Employment of subsurface disposal, notably with respect to the disposition of difficult-to-treat or toxic wastes, in some cases offers a relatively simple and economical alternative to conventional pollution control practices.

Taking cognizance of this trend and desiring to fortify themselves for appropriate regulation of subsurface disposal installations, the ORSANCO states directed the staff last year to undertake an assessment of the situation.

Specifically, this assignment embraces three components: A reconnaissance of geologic and hydrologic characteristics of the Ohio Valley with respect to subsurface-disposal potentialities and limitations; development of criteria for evaluation and approval of installations; and recommendations relating to legislative and administrative aspects of regulation.

The Ohio Basin Office of the Federal Water Pollution Control Administration has generously responded to an invitation to participate jointly with the ORSANCO staff in development of this report.

Information developed thus far reveals that 15 deep wells for the disposal of industrial wastes already have been installed in the ORSANCO district, about 15 more are installed within the borders of the ORSANCO states but outside the Ohio Valley drainage area. Of the wells within the district, seven are presently being operated, six are constructed but not operating, and two have been plugged and abandoned.

It appears that deep-well industrial waste disposal is feasible from a technological standpoint throughout most of the Ohio River basin. Several small areas have been identified where such practice is restricted or is impossible because of the lack of available disposal horizons or complex geological structure. In addition, there are local situations where deep-well disposal may be restricted because of unusual geohydrologic conditions or the presence of abandoned unplugged oil and gas wells.

HISTORICAL PERSPECTIVE

This foreword has highlighted the status of current activities of ORSANCO, certain details of which are discussed more fully in succeeding sections of the report.

Since this annual summary also coincides with the 20th anniversary of the ORSANCO compact, it appears appropriate to offer some commentary that conveys historical significance to this cooperative endeavor of eight states. Happily, for this purpose, there appeared in *State Government* magazine early in 1968 a critique of the Ohio River Valley Water Sanitation Commission by Richard H. Leach, professor of political science at Duke University. With the permission of Professor Leach and the Council of State Governments, which publishes the magazine, the article has been reproduced in this report.

The Ohio River Valley Water Sanitation Commission, based on a compact among eight States, is approaching its twentieth anniversary. Its accomplishments for the people of the Ohio River Valley, in controlling and abating pollution of their streams, have been large indeed. The article that follows tells why and how the agency was founded, summarizes its functions and methods, and appraises its outstanding record of results in its almost two decades of work. Richard H. Leach, who gives us the paper, is Professor of Political Science at Duke University. He has written extensively on the fields of interstate compacts and intergovernmental relations.

ORSANCO: A Twenty-Year Record

by Richard H. Leach

IT WILL SOON be twenty years since ORSANCO —the Ohio River Valley Water Sanitation Commission—came into being. Its success during that period is outstanding in the annals of interstate compact activity, as Edward J. Cleary, long-time Executive Director of ORSANCO, so well demonstrates in a recently published book.[1] ORSANCO has functioned quietly, and at a remarkably low level of expenditure. In doing so it has proved anew that interstate cooperation as a method of state government action is applicable to often neglected problem areas. It is thus appropriate to salute ORSANCO as its anniversary approaches and to seek to understand its program and accomplishments.

INDUSTRIALIZATION AND POLLUTION

One hundred and fifty-five thousand square miles in fourteen States are drained by the Ohio River and its nineteen major tributaries. The entire area is thickly populated and highly industrialized and over the years has become heavily dependent upon the waters of the Ohio for domestic and industrial uses as well as for transportation, recreation and the generation of electric power. Yet nowhere in the United States did urbanization and industrial development bring "a greater foulness to streams than in the Ohio Valley."[2] Vast amounts of untreated sewage were dumped into the main river and its tributaries daily, as was an unknown amount of industrial waste. The result throughout the entire valley was an increasingly unsanitary, unhealthy, unpleasant and uneconomic river system. By the mid-1930's, in the words of Federal Security Administrator Paul V. McNutt, the pollution problem in the Ohio River Valley "overshadowed that of any other drainage basin in the United States."[3]

Perhaps because the diversified nature and sources of pollution, and the many governmental agencies which necessarily had to be involved in controlling them, made the problem

[1]Edward J. Cleary, *The ORSANCO Story. Water Quality Management in the Ohio Valley Under an Interstate Compact.* Baltimore, 1967.

[2]Ohio River Valley Water Sanitation Commission, *2nd Annual Report* (1950), 5.

[3]House Report 2653, 76th Congress, 3rd Session, 2.

a difficult one to approach, the States in the valley had become used to inaction. Ohio had let it be known as early as 1908 that "its river cities need not install sewage treatment facilities until communities in other States on the banks of the Ohio did likewise."[4] If such specific declarations of policy were not made by the other States in the valley, they were as inclined as Ohio to let another State take the first step. The steadily increasing industrialization of the region, and the accompanying rise in population, however, finally made action of some sort imperative.

A tentative step toward solution was taken in 1928 when an informal agreement was reached among eleven of the States in the basin to act jointly in controlling the discharge of certain taste-producing phenols from coke plants into the rivers. Then came the severe droughts of 1930 and 1934, which so reduced the amount of available water in the basin's rivers that only the most callous could ignore any longer the prevailing stench or overlook the menace pollution represented to the public health.

ESTABLISHMENT OF A COMPACT

Under the leadership of the Cincinnati Chamber of Commerce, civic organizations and sanitary authorities in almost every State were brought together to seek ways to take appropriate action. Because it was obvious to everyone that successful measures on such a matter had to be interstate in character, a regional program of pollution abatement, based on an interstate compact, was considered from the outset. Congress supported the growing demand for interstate action by authorizing negotiation of a compact in 1936,[5] and shortly thereafter an Ohio River Valley Water Compact Commission was formed to draft an appropriate document. With the help of the Council of State Governments, agreement on the terms of a compact was reached in 1938. By 1940 Indiana, West Virginia, Ohio, New York, Illinois and Kentucky had accepted it, and Congress had approved it. Pennsylvania and Virginia, however, had reservations regarding their participation, and it was not until 1948 that they were removed. Finally, on June 30, 1948, the compact became effective.[6]

Through the compact, the signatory States pledged themselves to cooperate faithfully with each other in the abatement of existing pollution and in the control of future pollution in the Ohio River Basin and in particular "to enact any necessary legislation to enable each . . . state to place and maintain the waters of said basin in a satisfactory sanitary condition, available for safe and satisfactory use as public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining fish and other aquatic life, free from unsightly or malodorous nuisances due to floating solids or sludge deposits, and adaptable to such other uses as may be legitimate."[7]

CREATION OF ORSANCO

The compact was not made to prescribe how pollution should be controlled. For this purpose it created as the agent of the party States the Ohio River Valley Water Sanitation Commission, soon to be called ORSANCO in common usage, composed of three representatives from each member State and three from the federal government. Although the compact followed the usual pattern of such instruments in not setting requirements for membership, the States have generally seen to it that their representatives are persons vitally concerned with pollution control in the course of their every-day jobs. Members of state health commissions and of state stream pollution control boards and representatives of industries drawing water from rivers in the basin are most commonly designated as commissioners.

The commission itself meets three times a year, and throughout the year the program it decides upon is carried out by a small professional staff, recently consisting of the Executive Director who doubles in brass as Chief

[4]Ohio River Valley Water Sanitation Commission, *1st Annual Report* (1948-9), 3.

[5]49 Stat. 1490 (1936).

[6]A detailed discussion of the growing problem of pollution in the valley and of the history of the movement toward the compact is given in Cleary, *op. cit.*, *Part I.*

[7]Ohio River Valley Water Sanitation Compact, Article I.

Engineer, an Assistant Director, two sanitary engineers, a chemist-biologist, and a chemical engineer. The professional staff in turn is served by a small clerical and secretarial staff under the overall guidance of an office manager. The commission is also assisted in its work by a number of advisory committees, which in 1966 included some 242 specialists among their members.

The most important committee is the engineering committee, which consists of the chief engineers of the party States. It reviews staff studies, examines proposals and develops recommendations for the guidance of the commissioners in establishing sewage treatment requirements. "Because this Committee is composed of the chief engineers of state programs it has logically developed as the clearinghouse for coordinating a host of administrative and technical matters that contribute to effective functioning of both state and interstate affairs. Here, for example, ideas are exchanged on data assembly and evaluation, on staffing and organization, on improvement of survey and analytical techniques, and on the conduct of public relations and enforcement procedures."[8]

Other committees represent water users, aquatic life research interests and industrial enterprises.[9] These latter committees review control proposals under consideration by the commission and advise it on probable workability and reception by industry.

MEMBERSHIP AND DUTIES

Both the membership of the commission and of the staff have been remarkably stable over the years. Indiana, indeed, has had only four representatives on the commission since it began to operate in 1948, and Virginia only five. Mr. Cleary, the first Executive Director, still continues in that post. The average length of service of all commissioners is over seven years. Though there has been more turnover in the professional staff, it too has changed surprisingly little.

The compact does not prescribe the commission's duties in detail. It does say that the commission shall study the pollution problem in the basin, make a comprehensive report on the reduction and prevention of stream pollution therein, draft and recommend uniform legislation dealing with pollution to the several States, and consult with and advise state and local officials with regard to particular pollution problems and the construction of sewage treatment plants.[10] In addition, it establishes a floor for the minimum treatment of all sewage dumped into the rivers in the basin. "The Compact clearly state[s] that no single standard of sewage treatment could be prescribed because of such variable factors as size, flow, location, character, self-purification and usage of waters within the Compact district. As a consequence, the commission is called upon to conduct investigations and evaluate these factors before reaching decisions."[11] In general, as in this case, indeed, the compact leaves the commission free to use its discretion as to how best to accomplish the objective of the compact. Guided by the principle that no sewage or industrial waste originating within a signatory State shall adversely affect the use of water by another State, the commission is thus free to establish the standards for water quality it believes to be necessary in the different parts of the basin.

This, of course, constitutes the heart of the commission's work. Before standards could be set, however, it was necessary first to win public support for the commission and its work. It had taken twenty years to get the compact adopted, and during those years a good many government officials, industrial representatives and private citizens had been involved in the process. As a result, the compact had a wide circle of friends from the moment of its birth. Nevertheless, it was still necessary to "sell" the idea to a larger public, especially since a very

[8]Edward J. Cleary, "Role of an Interstate Agency in Water Pollution Control." A paper presented to Panel III, National Conference on Water Pollution, Washington, D.C., December 13, 1960. Mimeo., p. 3.

[9]Industries represented on the committees are steel, metal finishing, chemicals, coal, oil refining, pulp and paper, and electric power.

[10]Ohio River Valley Water Sanitation Compact, Article VII.

[11]Cleary, "Role of an Interstate Agency," *op. cit.*, p. 3.

large investment of public and private funds would be needed to bring the cause to a successful conclusion. Some 3,000 communities and industries had to be activated to accept an obligation to combat pollution. To that end, the commission launched a three part public affairs program consisting, as Edward J. Cleary described it, of a buckshot campaign, designed to hit anyone in sight, a rifle shot campaign, aimed at particular industrial groups, and a community action program designed to arouse public officials and lay groups to the need for action.[12] In the course of the program, the commission developed "community action" materials, prepared exhibits, published handbooks for municipal officials and industrial use, made and loaned movies, and presented radio and television shows—all to arouse the people of the valley to the necessity for action. In addition to its informative *Annual Reports,* it makes the findings of all its technical studies widely available as part of an extensive publications program.

SETTING AND ENFORCING STANDARDS

Once the need to make the public aware of ORSANCO had been recognized and met, the commission could proceed to tackle its central responsibility. Obviously, setting water quality standards depended first on ascertaining "what substances [were] present in the waters. Then each substance [had to] be studied to determine the maximum concentration that [could] be tolerated without deleterious effect, beyond which the water would be unsuitable for certain uses. Uniform methods of testing polluting substances, particularly industrial wastes, had to be established."[13]

In order to develop a continuing record of what is happening and to be alerted on pollution potentials in the waters under its jurisdiction, the commission operates a network of forty-eight water quality monitor stations along the rivers of the basin.[14] In addition, the commission carries on a broad research program. Its staff engages in technical studies of its own, and the commission sponsors research by state, federal and private agencies. The U.S. Public Health Service undertook a series of radiation studies and in 1963 conducted a series of fish population sampling studies. The Kettering Laboratory of the University of Cincinnati contracted to engage in a taste and odor study. And the Biology Department of the University of Louisville made a three-year (1957–1960) inventory and evaluation of the aquatic life resources of the Ohio River for ORSANCO and the Commonwealth of Kentucky, jointly.

On the basis of all the information it can gather on the specific situation before it, the commission drafts recommendations for abatement and control. When it decides on a standard for sewage treatment higher than the minimum established by the compact,[15] or when it seeks to specify treatment for industrial discharges, it is required by the compact's terms to hold a public hearing before it adopts the regulation. If it then issues an abatement order, it is further required to have the assent of at least a majority of the commissioners, from a majority of the signatory States, as well as the assent of a majority of the commissioners from the State in which the order is to be issued.

The Ohio River Valley Water Sanitation Commission is set apart from most compact agencies by the fact that the compact empowers it to secure compliance with the standards it sets.[16] Article IX of the compact makes it the duty of the municipality, corporation, person or entity to whom the commission issues an order, to comply with it, but the commission

[12]See Chapter 9 of *The ORSANCO Story, op. cit.,* for details of the program in operation.

[13]Ohio River Valley Water Sanitation Commission, *4th Annual Report* (1952), 7.

[14]Twenty-six of the stations are operated by personnel at municipal and private water supply treatment plants; nine are serviced under a cooperative arrangement with the U.S. Geological Survey; thirteen are served by ORSANCO robot monitor units.

[15]The quality criteria currently in effect were set by ORSANCO Resolution No. 16-66, and are to be found in *ORSANCO 1966, op. cit.,* pp. 10-11.

[16]The Interstate Sanitation Compact, in effect between New York and Connecticut, gives the Interstate Sanitation Commission power to bring action "in the proper court or courts to compel the enforcement of any and all of the provisions of [the] Compact" or of any of the commission's orders made in pursuance thereof. (Article XI). None of the other pollution compact agencies are endowed with similar powers.

is given power to call on any court of general jurisdiction or on any United States District Court in any of the compact States to enforce its order by mandamus, injunction, order of specific performance, or some other equally appropriate form of legal action. Ordinarily, the commission does not use court action to secure compliance with its orders. It has won adherence to them through its educational efforts and the persuasion of facts. Since 1948, in fact, the commission has been requested to intervene in only six situations. In only one case (Middleport, Ohio) was it necessary to proceed as far as the conduct of a public hearing before securing compliance. The fact that it has not been necessary to rely on its enforcement power attests, perhaps better than anything else, to the great power and prestige the commission has built up in its twenty-year career.

RELATED PROGRAMS

In addition to its basic job of establishing and enforcing appropriate standards of water quality throughout the basin, the commission carries on a number of other programs. At first, it assisted each of the party States to strengthen its own anti-pollution laws and machinery. By 1953, when certain amendments to the West Virginia pollution control act became effective, the commission could report that "each of the states now has . . . adequate legislation to accelerate control action; in two states this required a completely new law,"[17] which the commission helped to formulate. The commission coordinates the stream sanitation activities of the several state pollution control agencies and of the three federal agencies active in the area—the U.S. Public Health Service, the U.S. Corps of Engineers, and the U.S. Fish and Wildlife Service. And it serves as liaison between the States and other federal agencies, such as in the discussions, initiated in 1966, with the Federal Power Commission concerning the effect of expanded hydroelectric operations in the basin on water quality conditions.

[17]Ohio River Valley Water Sanitation Commission, *5th Annual Report* (1953), 4.

SOURCES OF FUNDS

The commission's activities are supported by pro rata appropriations from the party States, the amount each State contributes being set by a formula which takes into account the relative population and land area of that State in the Ohio River Basin. For some years the States' contribution to the commission's budget ran around $100,000 per annum; since 1955 it has been $130,000. The revenues collected from the party States during fiscal year 1966 were as follows:

State	*Percentage of Allocation*	*Revenues Collected*
Illinois	5.10	$ 6,660.00
Indiana	18.10	23,530.00
Kentucky	20.75	26,975.00
New York	1.10	1,430.00
Ohio	24.90	32,370.00
Pennsylvania	15.20	19,760.00
Virginia	3.50	4,550.00
West Virginia	11.35	14,755.00
	Total	$130,000.00

In addition to appropriations from the States, the commission has received grants from the federal government, amounting each year for the last ten years to about $110,000.00, under the terms of the Federal Water Pollution Control Act, and a great deal of valuable voluntary assistance as well. Not only do various industry committees perform research for the commission at no cost to it, but many of the data on which the commission bases its orders are contributed to it gratis by industrial, municipal, state and federal agencies. Were the actual cost of these services assumed by the commission, its cost of operation might be as much as doubled.

In any case, the commission represents a very inexpensive way for the States to accomplish an important objective; indeed, there may not be a better bargain for money expended in the whole area of government activity. It would appear, however, that in their pride over their economy, the States are forcing the commission to do less and to proceed more slowly than it otherwise might in the execution of its task. No account has been taken of inflation and generally higher salary levels in either state appropriations or federal grants, with the result that the "money now available to operate the Commission is not adequate to maintain a program equivalent to that of even a few years ago. In 1966 some activities had to be curtailed . . . includ[ing] radio-activity monitoring, robot-monitor expansion, and public affairs projects. As a result, the Commissioners [have] recommend[ed] to the Governors of the eight states that appropriations . . . be increased by 40 per cent."[18] The state response will likely be favorable, inasmuch as ORSANCO has amply demonstrated the value of its services.

RESULTS TO DATE

Indeed, the results of the Ohio River Valley Water Sanitation Commission's work have been impressive. As Joseph L. Fisher, President of Resources for the Future, Inc., has observed, "ORSANCO is a unique institution for water quality management with a remarkable record of accomplishment in controlling water pollution throughout a large river valley."[19] As long ago as 1960, a national magazine featured an article on "The Rejuvenated Ohio," a story about the new Ohio River, and the title does not overstate what the commission has accomplished.[20] In 1963, the American Society of Civil Engineers selected the ORSANCO program for its outstanding achievement award, citing it as "the most effective large-scale water pollution abatement program ever undertaken in the Western Hemisphere."[21]

By the time of publication of the 1966 annual report, treatment facilities were in operation servicing 94 per cent of the 11,400,000 sewered population in the entire drainage district, and facilities then under construction would service 1.1 per cent more. By way of contrast, when the commission began to operate in 1948, less than 38 per cent of the district's population treated its sewage. Of the more than 1,200 communities in the basin, only slightly more than 300—most of them very small towns—had yet to begin or complete adequate municipal sewage treatment plants at the time of the latest information at hand. On the industrial side, the progress made under the aegis of the commission has been almost as remarkable. In 1953, when accurate records first became available, out of 1,247 industrial plants in the basin, only 323 had adequate pollution control facilities. In 1966, 89 per cent (1,569) of the 1,769 industrial establishments in the district had installed facilities which complied with the minimum requirements set by ORSANCO. In the process, a total investment far in excess of $1 billion had been made. The commission figured that that amount had been expended by 1961, when all the funds spent by the municipalities and industries involved, as well as by the commission and the state and federal governments, were included. The total figure has risen a good deal above that point by now.

These figures are all the more remarkable when the steady increase since 1948 in the population of the valley and in the number of industrial plants therein are taken into account.

But figures alone do not tell the whole story. Before the commission began to function, the Ohio River and its tributaries had degenerated from the "showcase of nature's charms" they once had been to "an open sewer." "Game fish bellied up and died; riverfront . . . [beaches were] covered with a foul slime . . . on its best days, the river gave off the medicinal odor of phenol poured out of coke ovens."[22] The whole drainage district, in fact, was dying. By 1966, there was tangible evidence at every hand that the rivers had been reborn. Clean sand awaited summer swimmers on most of the basin's beaches. Boating and other recreational uses of the rivers were booming as never before. Commercial and sport fishing had once again become important activities, so much so that in the summer of 1966 the *Cincinnati Enquirer* could devote a feature story to the Ohio, a "fisherman's paradise."[23] And the water used for municipal supply and industrial uses is

[18] Cleary, *The ORSANCO Story*, *op. cit.*, p. 238.
[19] Cleary, *op. cit.*, p. v.
[20] *Time*, January 11, 1960, p. 17.
[21] The citation is quoted in Cleary, *op. cit.*, p. 283.
[22] *Time*, *op. cit.*
[23] *Cincinnati Enquirer*, August 21, 1966, quoted in *ORSANCO 1966*. 18th Yearbook of the Ohio River Valley Water Sanitation Commission (Cincinnati, 1966), p. 32.

much cleaner and thus costs less to process and use. Finally, it goes without saying that the impact of a rejuvenated water system on the economy of the entire basin has been tremendous.

WORK FOR THE FUTURE

Even so, it is too early to claim complete success for ORSANCO. As Edward J. Cleary observes in the final pages of his book, "the record reveals substantial progress toward attainment of the goals established for the ORSANCO program. However, the ultimate measure of success . . . will be found in stream quality conditions."[24] There is still a way to go before all stretches of the tributaries to the Ohio will be clean enough to satisfy the demands for use placed upon them. Only when the tributaries, as well as the main stream, attain acceptable quality levels will it be possible to say that the compact has accomplished what it was intended to do. Even then, it will have the job of maintenance and gradual raising of standards; for victory, even in a number of battles, will not mean a successful conclusion to the war itself.

Policing and prompt action against violators have already come to demand priority in the commission's work, as the number of sewage treatment plants and industrial waste facilities increases steadily on the one hand and the "limited capability of the state regulatory agencies to gear their operations to an increasing burden of inspection and surveillance" becomes more obvious on the other.[25]

REASONS FOR SUCCESS

The success of the Ohio River Valley Water Sanitation Commission can be attributed to a number of factors. For one thing, it has not deviated from the work prescribed by the compact—pollution control. Although pollution is but one of many problems which exist in the Ohio River Basin, the commission has steadfastly refused to be enticed by the possibilities of attempting to solve such problems as flood control, navigation, soil conservation, reforestation and recreation. No doubt, too, its way was made easier by the fact that each of the party States already had an agency concerned wholly or in part with pollution control, with which the commission could immediately begin to work (if in fact the head of the state agency was not already a member of the commission) and whose efforts could contribute to a massive attack. The commission has always been respectful of these agencies, and in return they have been willing to work with the commission. As a matter of basic policy, the commissioners early agreed that the commission's role should be "coordination and supplementation of state efforts,"[26] and it has consistently stuck to that method of procedure. The commission's success on the industrial side can be credited in part to the care it exerted to secure industrial participation in the review and formulation of measures to curb pollution, and in part to the dollars and cents value of stream sanitation which the commission demonstrated in a great many cases.

Finally, the commission's success is due to its decision to rely mainly on education and persuasion to win adherence to its standards rather than on compulsion by law. Perhaps the most important result of its work is the creation of public awareness of and interest in attacking the pollution problem throughout the valley.

A MATTER THAT BEARS WATCHING

Only one cloud would seem to be on ORSANCO's horizon, the threat of which is still impossible to judge. The Federal Water Quality Act of 1965 ignored such interstate instrumentalities as ORSANCO.[27] Indeed, it seemed to go against Congress' own earlier expression of support for interstate action directed toward pollution control; it required each State *individually* to conduct hearings and submit proposed water-quality standards and a plan for

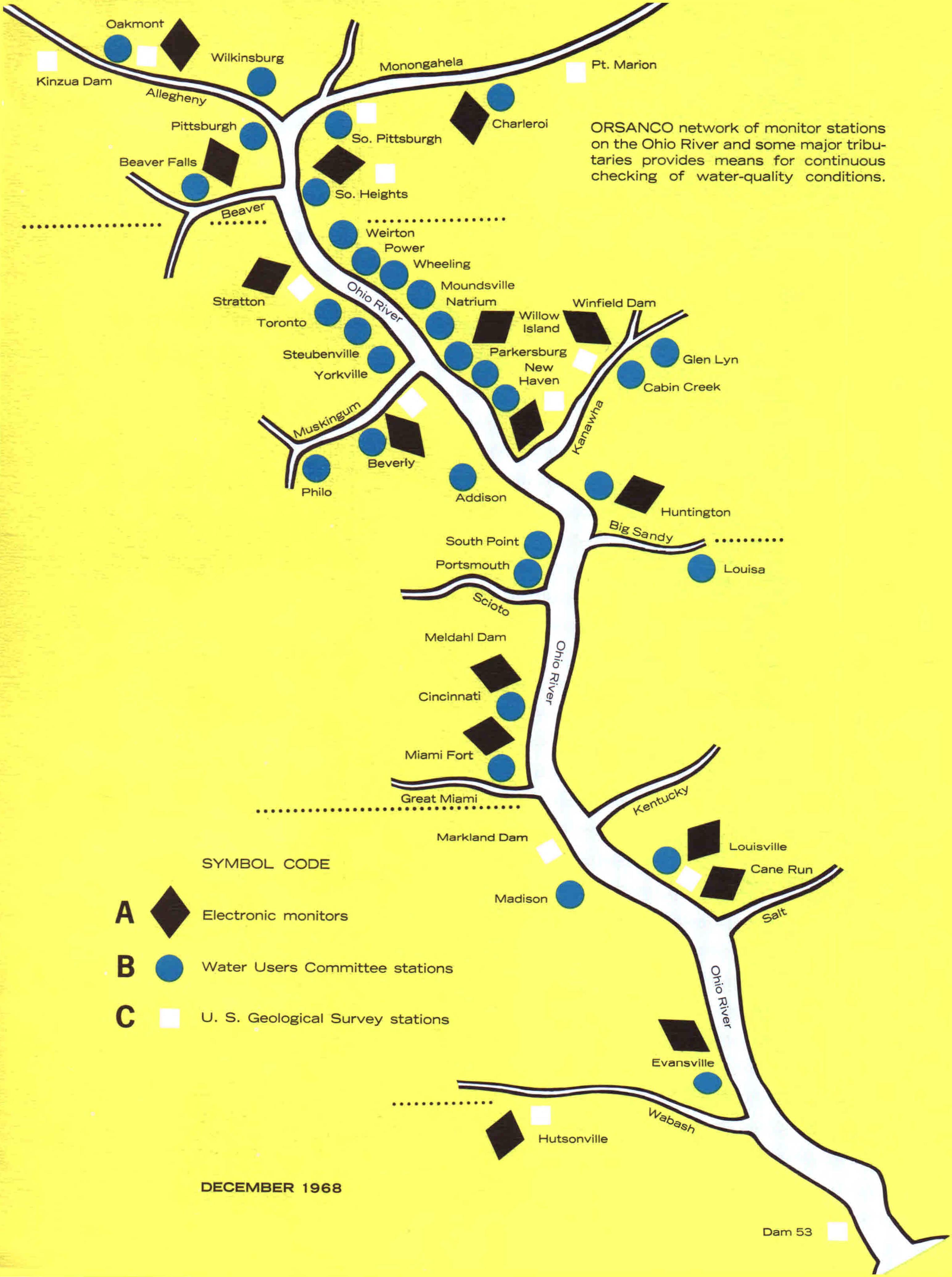
[24]Cleary, *The ORSANCO Story, op. cit.*, p. 221.

[25]*ORSANCO 1965. Seventeenth Annual Report of the Ohio River Valley Water Sanitation Commission* (Cincinnati, 1965), p. 3.

[26]Edward J. Cleary, "Role of an Interstate Agency," *op. cit.*, p. 2.

[27]Other anti-pollution agencies include the Interstate Sanitation Commission (New York, New Jersey, and Connecticut), the Interstate Commission for the Potomac River Basin, and the New England Interstate Water Pollution Control Commission.

their implementation by June 30, 1967. Although it would appear on the surface that the habit the States have developed, of working together under the compact to develop uniformity in policies and procedures, would not be broken, the new federal requirements seemed to constitute a deemphasis on the cooperative approach, if not a reversal of it. At the least, the response and results will bear watching, as the long-term effectiveness of the interstate method may well depend upon how the States respond individually over the next few years to the Federal Water Pollution Control Commission.



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

RIVER QUALITY APPRAISAL

FOLLOWING IS A SUMMARY of quality conditions in the Ohio River and some of its major tributaries during 1967. The summary is based on an evaluation of more than 800,000 items of analytical information including measurements on chemical, physical and bacteriological characteristics at ORSANCO-sponsored monitor stations. The location of each station is shown in the accompanying tabulation.

Quality analyses are made through one or more of the following arrangements: 32 locations (22 on the Ohio River main stem) are monitored on a voluntary basis by managers of municipal and industrial water treatment plants, who are members of the ORSANCO Water Users Committee; 14 locations (7 on the Ohio River) are monitored by the U. S. Geological Survey under a contractual arrangement with ORSANCO; 16 locations (10 on the Ohio River) are under 24 hour surveillance using ORSANCO robot monitor units.

Supplemental data is obtained from the Federal Water Pollution Control Administration, which periodically makes analyses on trace elements and radioactive substances.

Basic data on river flow is furnished by the U. S. Geological Survey, which operates a network of stream-gaging stations. This information is supplemented by inputs from the Cincinnati River Forecast Center of the ESSA Weather Bureau. Forecasts from the Weather Bureau, which are made daily for

ORSANCO WATER QUALITY MONITOR STATIONS

OHIO RIVER STATIONS

	Mile Point	Type
Pittsburgh, Pa.	2.3	B
South Heights, Pa.	15.8	A, B, C
Stratton, Ohio	55.0	A, C
Toronto, Ohio	59.1	B
Weirton, W. Va.	62.2	B
Steubenville, Ohio	65.3	B
Power, W. Va.	79.3	B
Yorkville, Ohio	83.6	B
Wheeling, W. Va.	86.8	B
Moundsville, W. Va.	111.0	B
Natrium, W. Va.	119.4	B
Willow Island, W. Va.	161.0	A, B
Parkersburg, W. Va.	183.7	B
New Haven, W. Va.	241.6	A, B, C
Addison, Ohio	260.7	B
Huntington, W. Va.	304.2	A, B
South Point, Ohio	318.0	B
Portsmouth, Ohio	350.7	B
Meldahl Dam	436.2	C
Cincinnati, Ohio	462.8	A, B
Miami Fort, Ohio	490.3	A, B
Markland Dam	531.5	C
Madison, Ind.	559.5	B
Louisville, Ky.	600.6	A, B
Cane Run, Ky.	616.8	A, C
Evansville, Ind.	791.5	A, 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 at Philo, Ohio	172.2	66.8	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 Cabin Creek, W. Va.	265.7	72.0	B
Kanawha River at Winfield Dam, W. Va.	265.7	31.1	A, C
Big Sandy River at Louisa, Ky.	317.1	20.3	B
Wabash River near Hutsonville, Ill.	*848.0*	*163.8*	A, C

thirteen locations on the Ohio River and its tributaries, include estimates on volume and velocity of flow for the current day and for each of the next three days.

In the following sections, observed river conditions, as measured by specific quality characteristics, are matched against criteria adopted by ORSANCO for judging the suitability of river water for various uses.

Information is given on the percentage of time the observed values for each constituent were within ranges specified in the criteria. In addition, the appraisal reveals the extent to which maximum and minimum values for each constituent exceeded or fell short of criteria specifications.

FINDINGS IN BRIEF

Of the twenty-one chemical and bacteriological criteria adopted by ORSANCO for appraising river quality levels, the following criteria were met 100 percent of the time at all monitor stations on the Ohio River during 1967:

- For public water supply: Dissolved solids, radioactive substances, arsenic, barium, cadmium, chromium, fluoride, lead and silver (no data is available on cyanide and selenium, as is explained in a subsequent section);
- For industrial water supply: Temperature, and dissolved solids;
- For aquatic life: Temperature.

Only for four quality characteristics did conditions in 1967 fall short of meeting criteria specifications 100 percent of the time at monitor stations. These characteristics were: Dissolved oxygen, coliform density, pH and threshold odor.

The dissolved-oxygen criterion for industrial water supply was met 95 percent of the time or more at all stations.

The dissolved-oxygen criterion for aquatic life was met as follows: 91 percent of the time at South Heights, 95 percent at Stratton, 74 percent at Huntington, 93 percent at Cincinnati, 81 percent at Miami Fort, 83 percent at Louisville and 67 percent of the time at Cane Run.

Monthly-average coliform densities met the ORSANCO criteria for public water supply for 5 months of the year at Steubenville, for 10 months at Wheeling, 8 of 11 months at Huntington (no data for July), 12 months at Portsmouth, 10 months at Cincinnati, 10 months at Louisville, and for none of the months at Evansville.

Monthly-average coliform densities met the criteria for recreational use in four of the five recreational months (May through September) at Portsmouth, in three of these months at Cincinnati and Louisville, in two of the months at Wheeling and Huntington, and in none of the months at Steubenville and Evansville.

During 1967, pH values at Huntington, Cincinnati, Miami Fort and Louisville met the ORSANCO criteria for aquatic life 100 percent of the time. At South Heights and Stratton, pH values of less than 5.0 (the lower limit specified in the criteria) were registered on five and six days, respectively. At Cane Run, values greater than 9.0 (the upper limit specified in the criteria) were observed on 25 days.

Specifications on threshold-odor levels contained in the ORSANCO criteria for public water supply were met 100 percent of the time at four of five monitor locations. At Huntington, threshold odors exceeded the specified upper limiting value of 24 on five days during the year; the maximum level recorded at this station was 30.

Concentrations of the following substances were at all times below limiting values recommended in U.S. Public Health Service standards for drinking water: Chloride, sulfate, nitrate, methylene-blue active substances, copper and zinc.

Alkalinity levels during 1967, in terms of yearly-average values, varied from 18 mg/l (at Toronto) to 77 mg/l (at Dam 53).

Monthly-average values of hardness-producing materials varied from 87 mg/l (observed at South Heights in December) to 225 mg/l (observed at New Haven in July). According to classifications used by the U. S. Geological Survey, the Ohio River may be regarded as varying from "moderately hard" (concentrations of 61 to 120 mg/l) to "very hard" (concentrations greater than 180 mg/l).

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

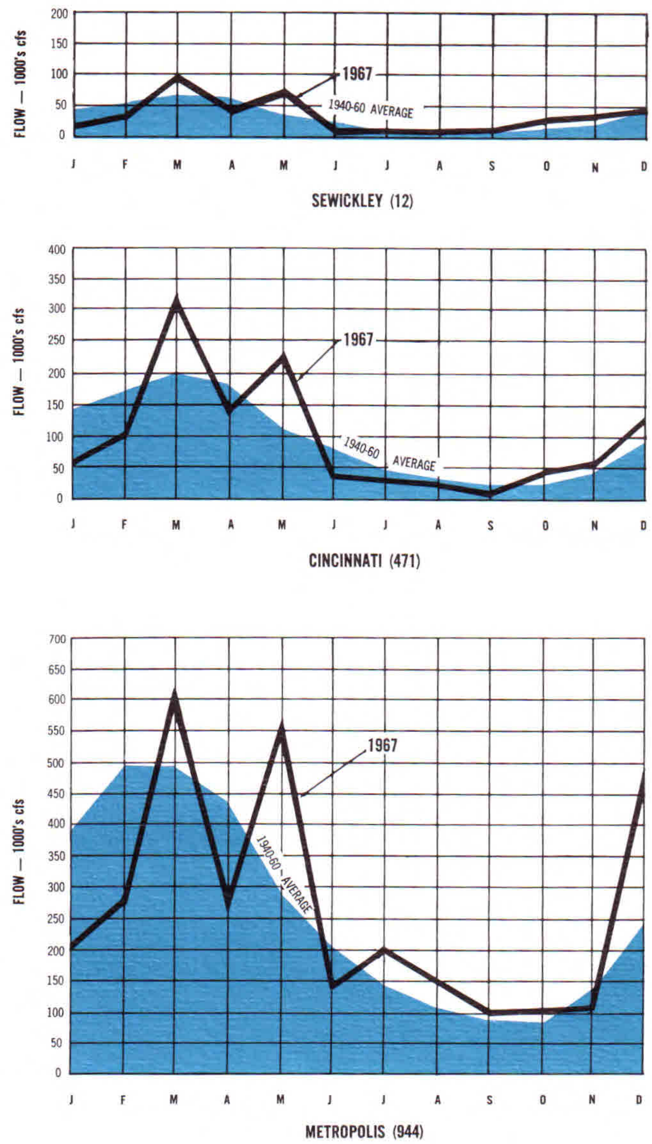
RIVER FLOW— Monthly-average flows during 1967 at three Ohio River gaging stations are shown in the accompanying graphs. The stations for which data is presented include Sewickley at mile 12, Cincinnati at mile 471 and Metropolis at mile 944. Also shown on the graphs are average, or "normal," flows for each month at each station as revealed by records over a 21-year period (1940 through 1960).

In terms of yearly-average values, flows in 1967 were three to five percent above "normal" levels. For example, yearly-average flows in 1967 were 35,000 cfs at Sewickley, 101,000 cfs at Cincinnati and 273,000 cfs at Metropolis. The average flows for the past 21 years at these stations were, respectively, 34,000 cfs, 97,000 cfs and 261,000 cfs.

During the critical low-flow months of August, September and October, the volume of dilution water during 1967 in some sections of the river exceeded 21-year average values by much wider margins. At Sewickley, for example, the 21-year average during August, September and October is 12,000 cfs, whereas in 1967 the average flow (19,000 cfs) for these months was 58 percent greater than this value. At Metropolis, the average flow for the three months in 1967, which was 123,000 cfs, exceeded the 21-year average value of 93,000 cfs by 32 percent. At Cincinnati, the average flow during August, September and October of 1967 (30,000 cfs) was three percent greater than the 21-year average value of 29,000 cfs.

The fact that flows in 1967 exceeded normal levels is further manifestation of a cyclic pattern of flow variations previously observed in the Ohio River. An analysis of records shows that extreme low-flow conditions occur in the Ohio River about once every eleven years. Drought flows of greatest severity and duration have occurred in 1930-31, 1941-42, 1952-53 and 1963-64. Conditions in 1967 reflect an upward trend in minimum or dry-weather flows since 1964. This trend may be expected to continue until around 1968-69, at which time the start of a downward trend in minimum or dry-weather flows may be expected.

Generally, there is an inverse relationship between volume of flow and river quality conditions. The greater the flow, the better are quality conditions — simply because there is more water available for dilution. It may be expected, therefore, that under existing levels of waste treatment, quality conditions in the Ohio River, at least for certain constituents, were better in 1967 than conditions would be in years when there is less flow. This situation, of course, must be taken into account when determinations are made concerning the need for additional waste-control measures.



Monthly-average flows in the Ohio River at three gaging stations during 1967 and comparison with normal flows at each station over a 21-year period (1940 through 1960)

VISIBLE ASPECTS OF POLLUTION — Fifty-seven incidents of visible, or "obvious," pollution were reported from surveillance operations conducted by state agencies or ORSANCO during 1967. These incidents included: 28 fish kills, 17 spills of oil and other petroleum products, 10 related to objectionable appearance (color, debris, foam, etc.) and 2 complaints of unpleasant taste and odors in public water supplies.

Of the 28 fish kills, two occurred on the Ohio River and 26 on tributaries. Causes of the kills were attributed to: Accidental spills from industrial plants, 8; acid mine drainage, 4; sewage discharges during periods of low flow, 6; accidents involving transport of toxic substances, 2 (one train, the other truck); insecticides, 1; land runoff, 1; unknown, 6.

Causes of spills in which oil and other petroleum products were involved included: Leaking barges or accidental damage to barges, 5; operations at petroleum processing plants, 8; operations at other industrial plants, 2; operations at oil-transfer stations, 1; storm-sewer discharges, 1.

Each of the fifty-seven incidents was investigated by a representative of the state involved or by the ORSANCO staff. Where responsibility could be fixed, steps were taken by state control agencies to eliminate or minimize chances for recurrence.

DISSOLVED OXYGEN — The situation with respect to dissolved oxygen (DO) conditions during 1967 is revealed in the accompanying qualigrams, which were constructed by plotting daily minimum values of DO (lowest hourly readings on each day) against frequency of occurrence.

The ORSANCO criteria for aquatic life specify 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 in the Ohio Valley, the ORSANCO Aquatic Life Advisory Committee has concluded that if DO concentrations never go below 4.0 mg/l, stream conditions may be regarded as meeting the more detailed specification of 5.0 and 3.0 mg/l for respective time periods.

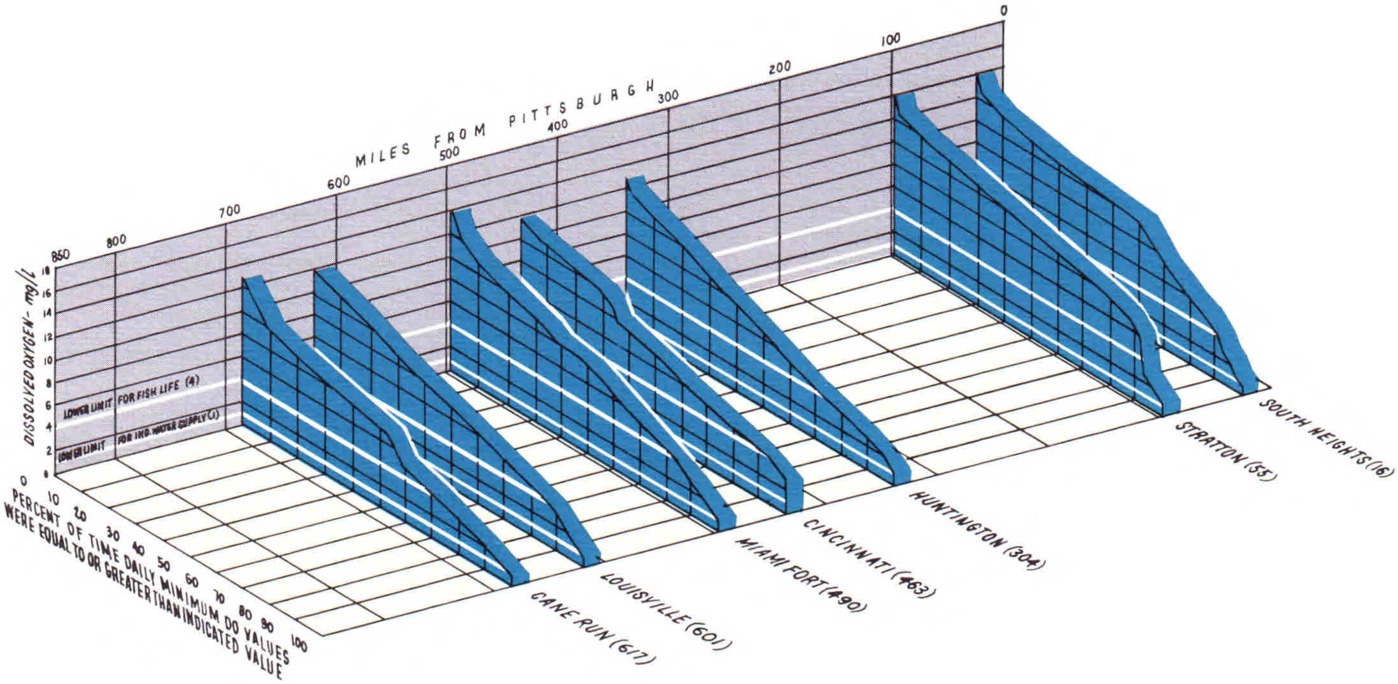
On the basis of this interpretation, the percent of time the DO criterion was met at various stations can be readily determined from the qualigrams. For example, the qualigram for South Heights shows that on 91 percent of the days in 1967 there were no hourly DO values below the specified lower limit of 4.0 mg/l. At other stations, the criterion was met as follows: Stratton, 95 percent of the time; Huntington, 74 percent; Cincinnati, 93 percent; Miami Fort, 81 percent; Louisville, 83 percent; Cane Run, 67 percent.

The ORSANCO criteria for industrial-water supply specify that DO concentrations 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 percent of days on which hourly DO readings did not go below 1.0 mg/l varied from 96.8 (at South Heights) to 100 (at Cincinnati). Daily-average values of 2.0 mg/l or greater were recorded as follows: 96.8 percent of the time at South Heights, 98.4 percent at Stratton, 98.8 percent at Huntington, 100 percent at Cincinnati, 98.3 percent at Miami Fort, 94.8 percent at Louisville, 94.9 percent at Cane Run.

The principal source of oxygen-demanding wastes affecting conditions at South Heights and Stratton is the discharge from the Allegheny County Sanitary Authority (Alcosan) treatment plant, which receives waste from the Pittsburgh metropolitan area. The Alcosan plant is 13 and 52 miles upstream from South Heights and Stratton, respectively. The fact that the DO criterion was met 92 and 95 percent of the time at these two monitor stations suggests a relatively rapid rate of oxygen recovery in this reach of the river.

Between Stratton and Huntington, the net effect of de-oxygenation and re-oxygenation influences is such as to cause an overall reduction in oxygen levels at Huntington. Thus, the criterion was met only 74 percent of the time at Huntington contrasted with 95 percent of the time at Stratton. The greatest single source of oxygen-demanding materials in this reach of the river, at least during 1967, was the Kanawha River, which empties into the Ohio River about 40 miles upstream from Huntington.

Between Huntington and Cincinnati there is a zone of recovery in which DO conditions, as measured by the percent of time the criterion is met, are restored to approximately the same level as that found in the South Heights and Stratton reaches. At Cincinnati the criterion was met 93 percent of the time during 1967.



DISSOLVED-OXYGEN QUALIGRAMS — 1967
(Daily-minimum values)

Effluents from sewage treatment plants in the Cincinnati metropolitan area produce a zone of oxygen depletion, which is evidenced by findings at Miami Fort where the criterion was met only 81 percent of the time. Miami Fort is 18 miles below the Cincinnati area discharges.

From Miami Fort to Louisville (111 miles), the effects of de-oxygenation are balanced by the influences of natural re-oxygenation with the result that conditions at these two stations are approximately the same. Below Louisville, however, there is another relatively short zone of oxygen depletion.

This appraisal of conditions in 1967 corroborates findings during the past several years and confirms a conclusion that if the DO criterion is to be attained 100 percent of the time in all reaches of the Ohio River, additional requirements should be imposed for reduction of the biochemical-oxygen-demand characteristics of certain waste discharges into the main stem as well as some tributaries. Areas of principal concern are the Pittsburgh metropolitan zone, Kanawha River, Huntington-Portsmouth reach, and the Cincinnati and Louisville metropolitan areas.

At Pittsburgh, plans for secondary treatment were completed and submitted to the Pennsylvania Department of Health for approval during the summer of 1968. A program for improving oxygen conditions in the Kanawha River has been underway for several years, and by mid-1968 secondary-treatment facilities for all significant organic industrial wastes had been completed and were being placed in operation. Planning for secondary-treatment facilities at Cincinnati and Louisville has been initiated.

COLIFORM DENSITY — Any interpretation of coliform measurements must be circumscribed because of certain limitations of this test. Coliform bacteria themselves are not disease producing. The test for coliforms presumes the presence of bacteria of fecal origin and thus the potential presence of pathogenic organisms. The test may also indicate the presence of bacteria of non-fecal origin, such as those normally found in soil runoff. Therefore, 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 field surveys to determine whether there are sewage discharges in the vicinity of the sampling point, and the extent to which analytical results are influenced by such discharges.

The ORSANCO water quality criteria contain the following specifications with regard to coliforms:

For Public Water Supply: — (and food processing industry): Coliform group not to exceed 5,000 per 100 ml as a monthly average value; 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.

For Recreational Purposes: — Coliform group not to exceed 1,000 per 100 ml as a monthly average value; nor exceed this number in more than 20 percent of the samples examined during any month; nor exceed 2,400 per 100 ml on any day.

During 1967, coliform densities were measured routinely at seven locations. Findings from these measurements are shown in the accompanying profiles and tables.

With regard to the criteria for public water supply, the profiles show that monthly-average values of 5,000 per 100 ml or less were observed as follows: For twelve months of the year at Portsmouth, for ten months at Wheeling, Cincinnati and Louisville, for eight of eleven months at Huntington (no data for July), for five months at Steubenville, and during none of the months at Evansville. The frequencies at which over-run specifications were met at each station were about the same as those at which the monthly-average specification was met. This is detailed in the following tabulation:

Station	Number of months average value less than 5,000 per 100 ml	Number of months 80 percent or more of daily values less than 5,000 per 100 ml	Number of months 95 percent or more of daily values less than 20,000 per 100 ml
Steubenville	5	5	8
Wheeling	10	9	10
Huntington (no data for July)	8	8	8
Portsmouth	12	12	12
Cincinnati	10	8	11
Louisville	10	7	11
Evansville	0	0	2

With regard to recreational use, the frequencies at which monthly-average and over-run specifications were met during the five recreational months of May through September are detailed in the following tabulation:

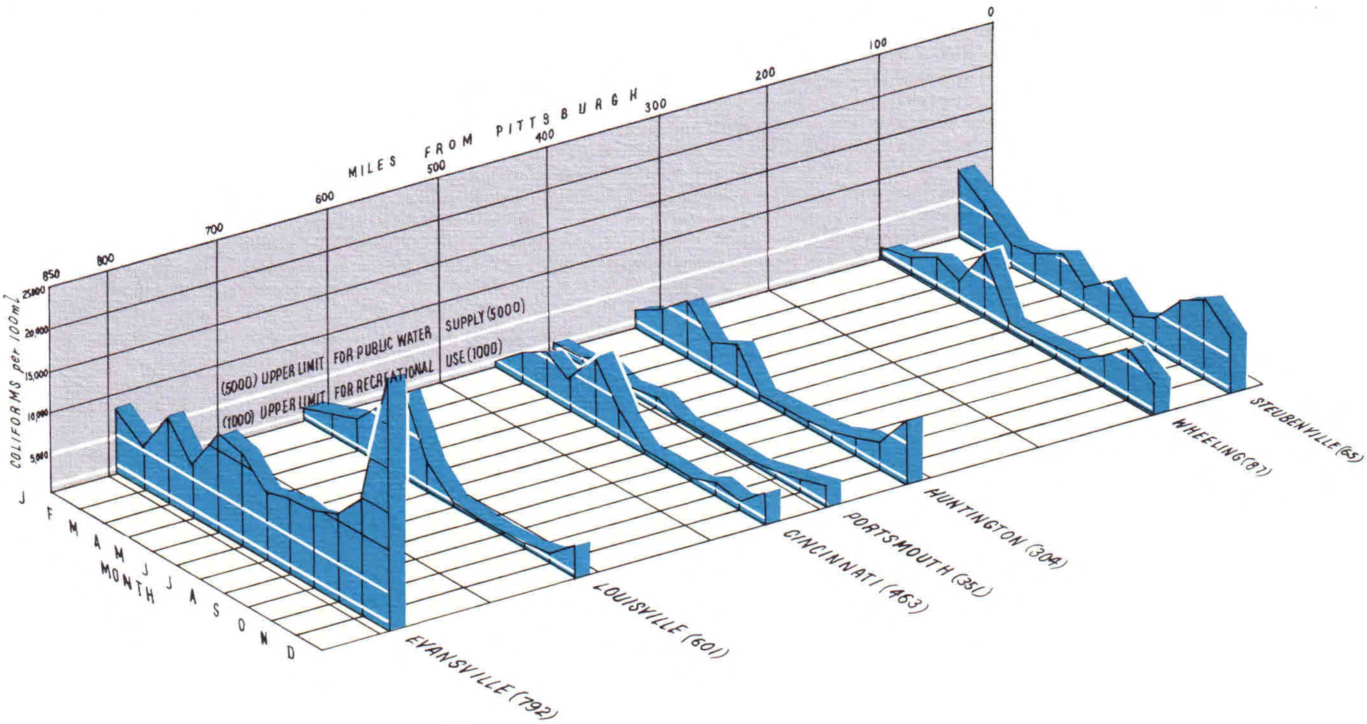
Station	Number of months during May-September in which: Monthly-average values less than 1,000 per 100 ml	80 percent or more of daily values less than 1,000 per 100 ml	All daily values less than 2,400 per 100 ml
Steubenville	0	0	0
Wheeling	2	0	0
Huntington (no data for July)	2	1	0
Portsmouth	4	3	4
Cincinnati	3	3	3
Louisville	3	3	3
Evansville	0	0	0

In order to minimize hazards from the potential presence of pathogenic organisms in the river, the staff has recommended that the Commission establish disinfection schedules for sewage discharges calling for 90 to 99.99 percent reduction in coliforms, the degree of reduction for a specific discharge depending on the location and size of the discharge and season of the year.

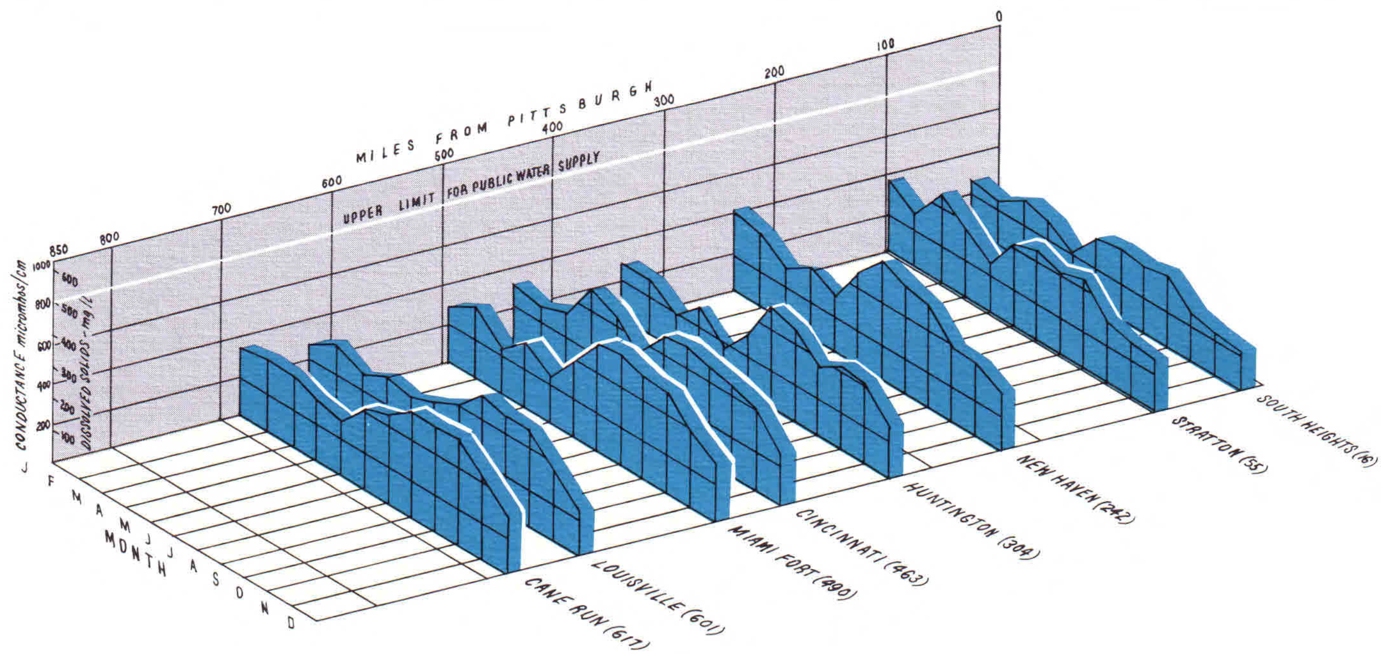
DISSOLVED SOLIDS — The accompanying profiles summarize monthly-average values of specific conductance and dissolved solids at eight Ohio River stations in 1967. The profiles are based on measurements of specific conductance and conversion of these measurements into dissolved-solids levels in accordance with ratios established by previous correlation studies. For the Ohio River, a conductance value of 800 micromhos/cm corresponds to a dissolved-solids concentration of 500 mg/l.

The ORSANCO criteria for public-water supply specify that concentrations of dissolved solids should not exceed 750 mg/l at any time, nor exceed 500 mg/l as a monthly-average value. These conditions were met 100 percent of the time at all eight stations, four of which (Stratton, Huntington, Cincinnati and Louisville) are located at or near public water-supply intakes. As shown on the profiles, the highest monthly-average concentration observed during the year was 384 mg/l, which value occurred at New Haven. The highest single concentration during the year, observed at Miami Fort, was 425 mg/l.

Since the dissolved solids criteria for public water supply are more restrictive than those for industrial water supply, it is obvious the latter criteria were also met 100 percent of the time.



COLIFORM DENSITY PROFILES — 1967
(Monthly-average values)

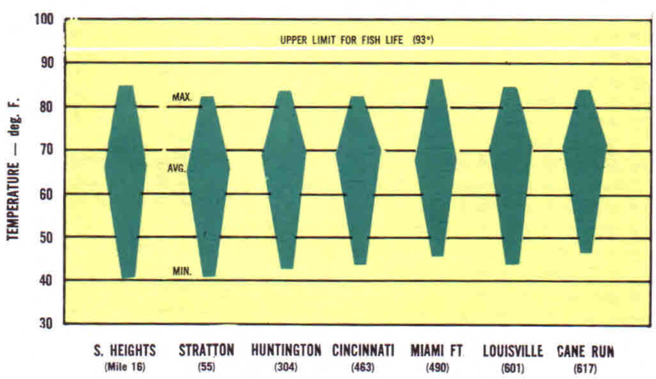


DISSOLVED SOLIDS (CONDUCTANCE) PROFILES — 1967
(Monthly-average values)

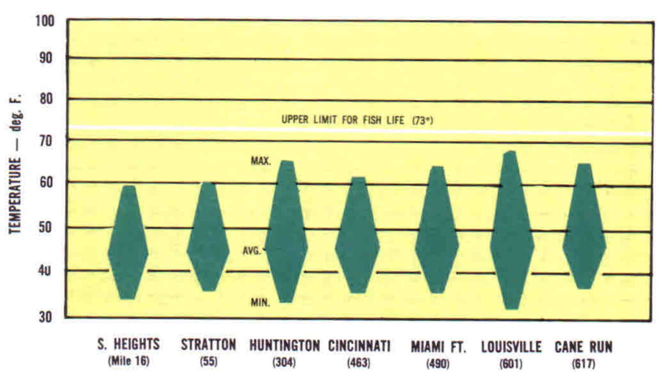
TEMPERATURE — The accompanying charts show ranges in temperature at robot-monitor stations during two periods, May-November and December-April, of 1967. Plotted on the charts are the maximum and minimum hourly readings together with average values at each station.

During all seasons of the year, maximum temperatures were below upper limits specified in the ORSANCO criteria for the maintenance of aquatic life and for water used as a source for industrial supply.

The criteria for aquatic life (which are more restrictive than those for industrial-water supply) specify that river temperatures should not exceed 93 deg. F. at any time during the months of May through November, nor exceed 73 deg. F. at any time during the months of December through April. The highest single temperature recorded during the May-November period was 85.9 deg. F.; this value occurred at Miami Fort. The highest single reading during the months of December through April, which value occurred at Louisville, was 68.0 deg. F.



TEMPERATURE RANGES — MAY-NOV. 1967



TEMPERATURE RANGES — DEC.-APR. 1967

The ORSANCO Aquatic Life Advisory Committee has recommended that the criteria for aquatic life be revised by: (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 recommendations have not yet been acted on by the Commission, it might be noted that during 1967 limitations on stream temperature that they would impose were met 100 percent of the time at all stations.

HARDNESS — Monthly-average hardness concentrations at eight locations on the Ohio River are shown in the accompanying profiles.

The highest monthly-average concentration observed in 1967 was 225 mg/l, which value occurred at New Haven. The lowest monthly-average concentration, which occurred at South Heights, was 87 mg/l.

Yearly-average levels at the various stations during 1967 were: 116 mg/l at South Heights, 129 mg/l at Wheeling, 158 mg/l at New Haven, 126 mg/l at Portsmouth, 134 mg/l at Cincinnati, 141 mg/l at Louisville, 163 mg/l at Evansville, 143 mg/l at Dam 53 (near the mouth of the Ohio River). These values were 4 to 19 percent less than yearly-average values at corresponding stations in 1966, a condition which probably may be attributable to the fact that flows were higher in 1967 than in 1966.

Seasonal variations in hardness levels, as shown by the profiles, further illustrate the inverse relationship between hardness content and river flow. In general, hardness is greater during the summer and fall when flows are low, and lowest during the winter and spring when flows are high.

Based on a designation adopted by the U. S. Geological Survey, Ohio River water may be classified as varying from "moderately hard" to "very hard." Designations used by USGS and corresponding ranges in hardness content are: Soft — 0 to 60 mg/l; moderately hard — 61 to 120 mg/l; hard —

121 to 180 mg/l; very hard — greater than 180 mg/l. Of the 96 monthly-average values measured at the eight monitor stations in 1967 and plotted in the accompanying profiles, 31 percent of the values ranged between 61 and 120 mg/l, 57 percent ranged between 121 and 180 mg/l, and 12 percent were greater than 180 mg/l.

Upstream from Wheeling, 85 percent or more of the hardness content of the Ohio River is of the non-carbonate, or permanent, type. Below Wheeling, there is a steady decrease in the ratio of non-carbonate to total hardness. At Cincinnati, for example, yearly-average values in 1967 showed the non-carbonate fraction to be 72 percent of the total hardness content, and at Dam 53 the non-carbonate fraction was only 46 percent of the total.

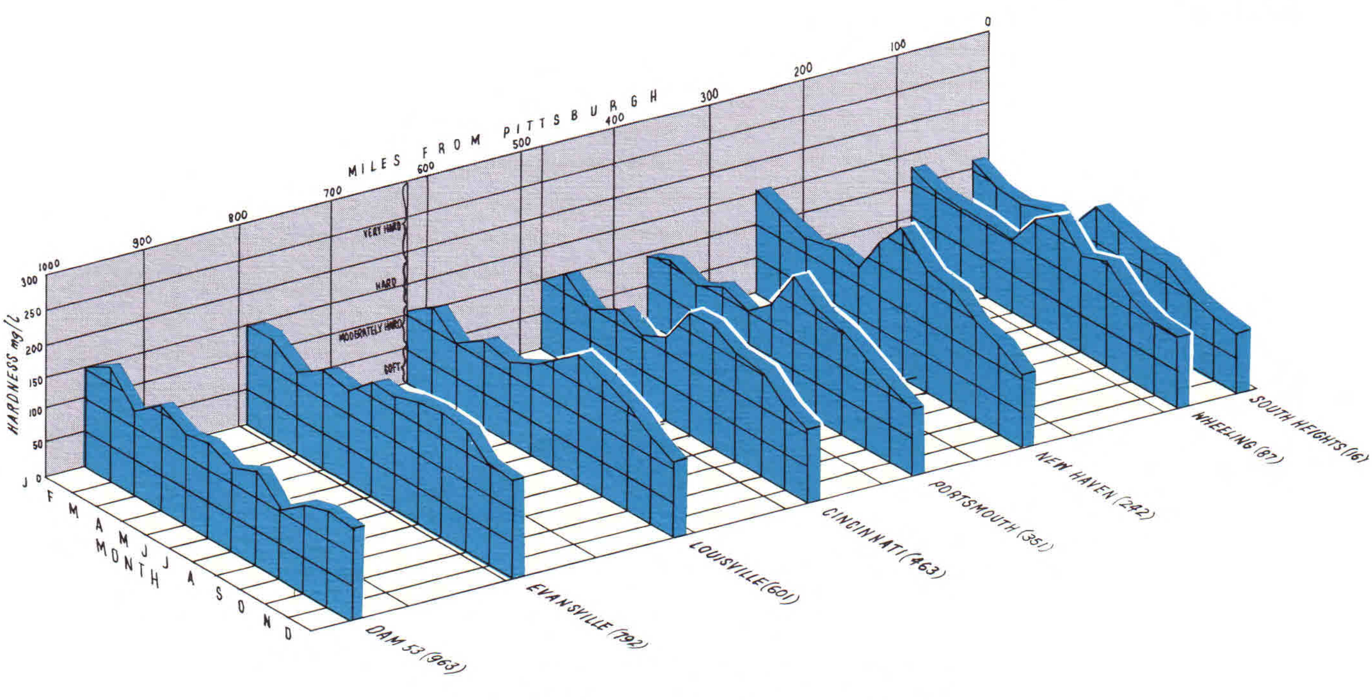
The only city using the Ohio River as a source of water supply that has installed softening facilities is Louisville, where the objective is to produce treated water with a hardness level of 120 mg/l or less. In 1967, there were three months (January, March and December) during which the hardness content of the Ohio River at Louisville averaged less than 120 mg/l.

RADIOACTIVE SUBSTANCES — Information on levels of alpha and beta activity in the Ohio River is obtained from monitor operations conducted by the Federal Water Pollution Control Administration, and has been supplied by FWPCA in advance of general publication. During 1967, a total of thirteen samples were analyzed, two of which were collected at Toronto, Ohio (mile 58), and eleven of which were collected at Cairo, Ill. (mile 981). Results of these analyses, expressed in terms of picocuries per liter or pCi/l (equivalent to micro-microcuries per liter), are summarized in the following tabulation:

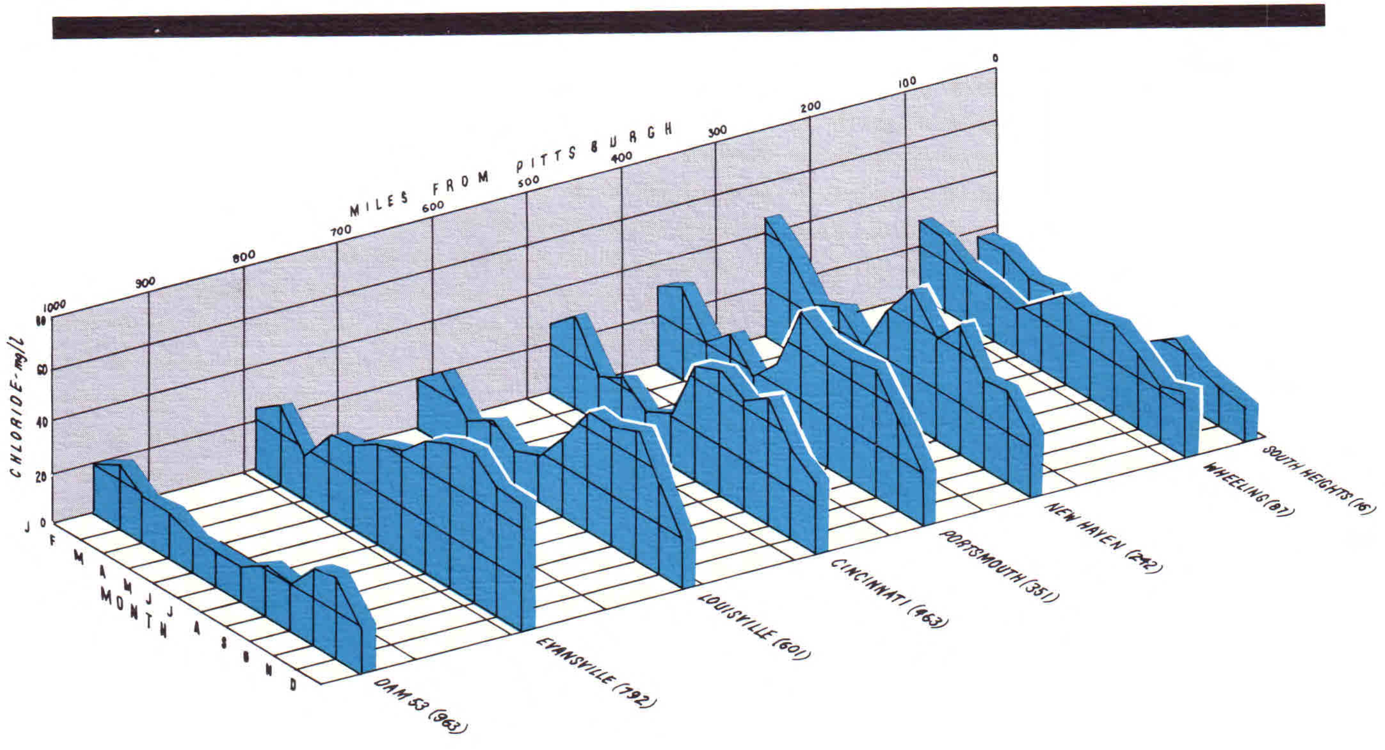
	Dissolved	Suspended	Total
Beta	4 to 8	0 to 22	6 to 28
Alpha	0 to 3	0 to 6	1 to 6

The ORSANCO criteria for public water supply specify that gross beta activity should not exceed 1,000 pCi/l, that activity from dissolved alpha emitters should not exceed 3 pCi/l, and activity from dissolved strontium-90 should not exceed 10 pCi/l.

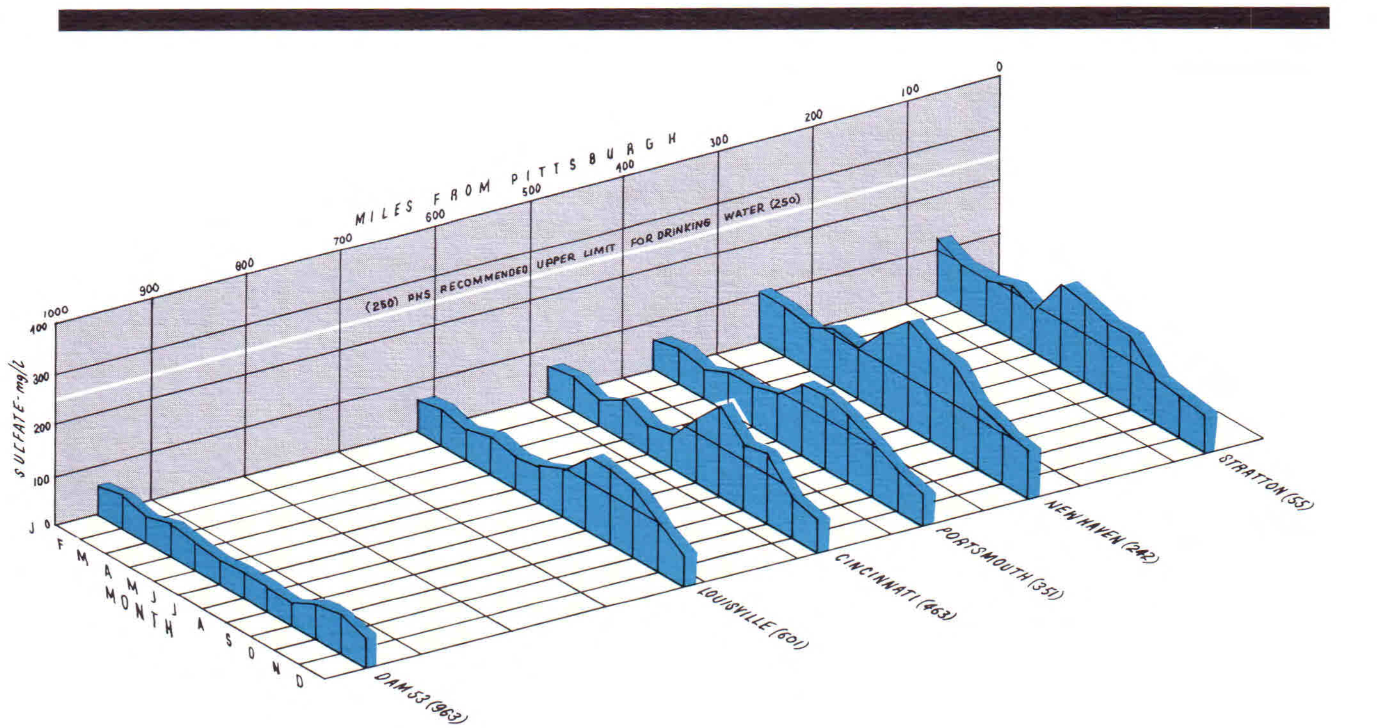
The data available indicates that in 1967 levels of gross beta activity and activity from dissolved alpha emitters were well within limits specified in the criteria. No information is available on activity from dissolved strontium-90 during 1967.



HARDNESS PROFILES — 1967
(Monthly-average values)



CHLORIDE PROFILES — 1967
(Monthly-average values)



SULFATE PROFILES — 1967
(Monthly-average values)

CHLORIDE — Monthly-average values of chloride concentrations at eight Ohio River monitor locations are shown in the accompanying profiles. Concentrations were substantially below 250 mg/l (the recommended limiting value for drinking water specified in U. S. Public Health Service standards) at all times at all stations.

Maximum monthly-average values ranged from 23 mg/l at South Heights to 59 mg/l at Evansville. The highest single value observed during the year was 78 mg/l, which value occurred at Evansville.

SULFATE — The accompanying sulfate profiles show monthly-average concentrations at six Ohio River locations during 1967. The maximum individual value, 244 mg/l, and maximum monthly-average value, 209 mg/l, were recorded at New Haven during July. Thus, all values at all stations were less than 250 mg/l, which is the limiting value for drinking water recommended in U. S. Pubic Health Service standards.

METHYLENE-BLUE ACTIVE SUBSTANCES — The test for methylene-blue active substances (MBAS) is a measure of the apparent concentration of synthetic detergent. Measurements of MBAS concentrations were made during 1967 by the Soap and Detergent Subcommittee of the ORSANCO Chemical Industry Committee at Willow Island and Anderson Ferry. Twenty-six samples were collected during the year at Willow Island and 27 samples were collected at Anderson Ferry. Measurements of MBAS concentrations were also made by the Federal Water Pollution Control Administration, which analyzed 31 samples collected at the following locations: Addison, Huntington, Cincinnati, Louisville, Cairo.

Of the total of 84 available analyses, 70 showed MBAS concentrations of less than 0.10 mg/l. The highest concentration observed during the year was 0.15 mg/l, which value occurred at Anderson Ferry, and which was about one-half the magnitude of maximum concentrations reported in previous years.

All values in 1967, therefore, were well below the recommended upper limit of 0.50 mg/l set forth in U. S. Public Health Service drinking water standards.

pH CHARACTERISTICS — The accompanying graph shows ranges in pH values at robot monitor stations during 1967.

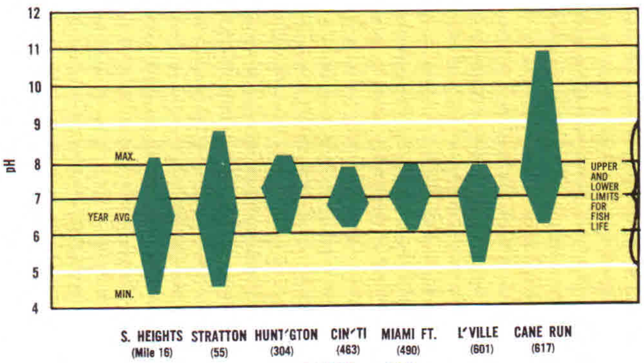
The ORSANCO criteria specify that for the maintenance of a well-balanced, warm-fish population and for industrial-water supply purposes pH values of river water should be maintained within the range of 5.0 to 9.0. For aquatic-life habitats, the criteria further specify that daily-average (or median) pH values preferably should be between 6.5 and 8.5.

In 1967, pH values were within the 5.0-to-9.0 range 100 percent of the time at Huntington, Cincinnati, Miami Fort and Louisville. At South Heights and Stratton no values greater than 9.0 were observed; however, values of less than 5.0 occurred at these stations on five and six days, respectively. At Cane Run, there were no values less than 5.0, but values greater than 9.0 were observed on 25 days during the year.

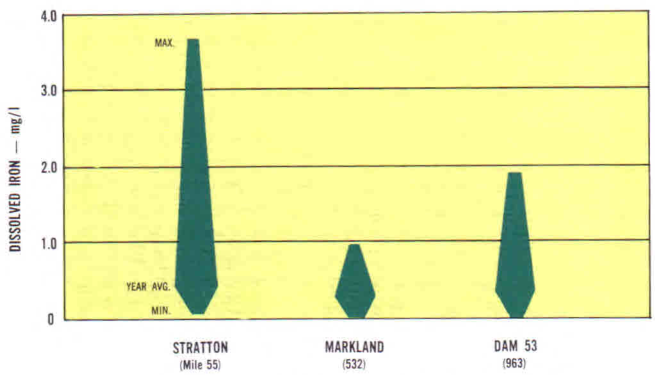
The extent to which daily-average values were within the preferred range of 6.5 to 8.5 is detailed in the following tabulation.

Station	Percent of daily-average pH values between 6.5 and 8.5
South Heights	56.5
Stratton	62.1
Huntington	89.6
Cincinnati	99.7
Miami Fort	99.7
Louisville	96.8
Cane Run	93.0

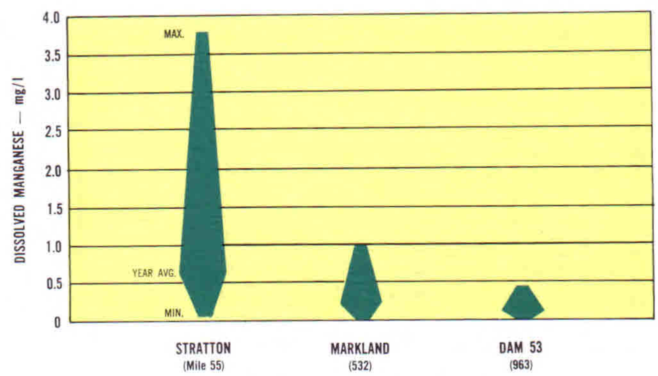
At Cane Run, all of the average pH values outside the preferred range of 6.5 to 8.5 were on the alkaline side of the scale (pH greater than 8.5). At all other stations, average values outside the preferred range were on the acid side of the scale (pH less than 6.5).



pH RANGES — 1967



DISSOLVED IRON RANGES — 1967



DISSOLVED MANGANESE RANGES — 1967

IRON — Dissolved-iron concentrations were monitored at three Ohio River stations during 1967. Yearly-average values were: 0.48 mg/l at Stratton, 0.30 mg/l at Markland Dam, and 0.32 mg/l at Dam 53. The highest single value recorded was 3.7 mg/l, which occurred at Stratton.

Ranges in iron content of the river during 1967 were essentially the same as those observed in previous years.

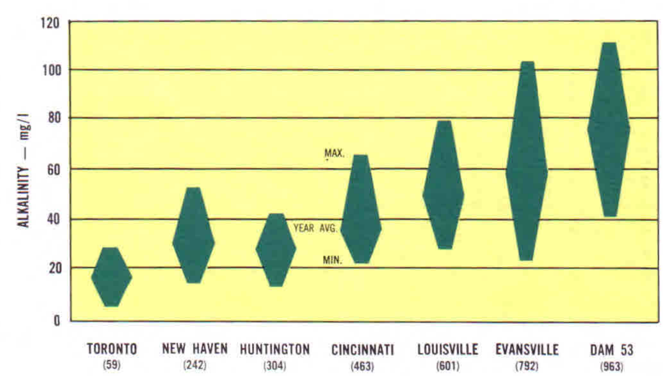
No criteria for dissolved iron have been adopted as yet by ORSANCO. Insofar as use of the river for public-water supply purposes is concerned, the Engineering Committee of ORSANCO has concluded that there is insufficient evidence to justify establishment of such criteria at this time. With regard to 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 — During 1967, manganese concentrations were monitored at Stratton, Markland Dam and Dam 53. As shown in the accompanying chart, yearly-average values at these stations were, respectively: 0.65 mg/l, 0.23 mg/l and 0.10 mg/l. The highest single concentration observed during the year was 3.8 mg/l, which value occurred at Stratton. At Markland Dam the highest individual value observed in 1967 was 1.0 mg/l, and at Dam 53 the highest value was 0.45 mg/l. These findings confirm that manganese concentrations are highest in the upper part of the river and that there is a steady decrease in concentrations moving downstream.

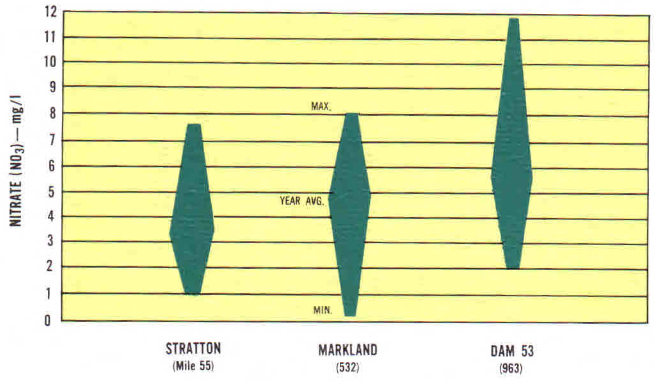
Criteria for manganese concentrations in river water have not been established by ORSANCO because of the same considerations as those pertaining to iron.

ALKALINITY — The accompanying graph shows ranges in alkalinity concentrations at seven stations. Concentrations were lowest in the upper reaches of the river and increased progressively moving downstream. This pattern, which parallels that observed in previous years, is revealed by the following yearly-average values: 18 mg/l at Toronto, 28 mg/l at Huntington, 38 mg/l at Cincinnati, 55 mg/l at Louisville, 61 mg/l at Evansville, and 77 mg/l at Dam 53.

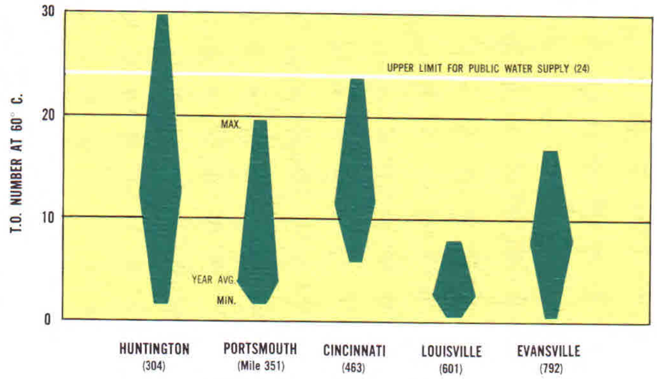
Low levels of alkalinity in the upper river can be attributed in large part to the influence of acid mine-drainage, particularly that from tributary streams. For example, the minimum monthly-average concentration of alkalinity at Toronto in 1967 was 12 mg/l, which value may be compared with minimum monthly-average concentrations of 6 mg/l and zero in the Allegheny and Monongahela rivers, respectively.



ALKALINITY RANGES — 1967



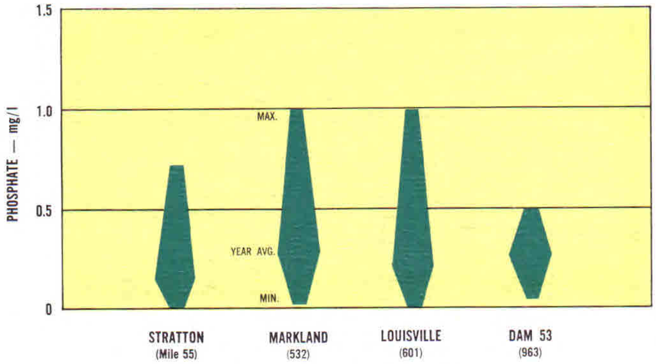
NITRATE (NO_3) RANGES — 1967



THRESHOLD-ODOR NUMBER RANGES — 1967

NITRATE — Ranges in nitrate concentrations during 1967 at three Ohio River stations are shown in the accompanying chart. Maximum values recorded were: 7.8 mg/l at Stratton, 8.2 mg/l at Markland Dam and 12.0 mg/l at Dam 53. These values are less than one-third of the limiting value of 45 mg/l recommended in U. S. Public Health Service drinking water standards.

PHOSPHATE — Information on phosphate (PO_4) concentrations is available from sampling stations at Stratton, Markland Dam, Louisville and Dam 53. Three to five samples were analyzed at each station during each month. Ranges in concentrations in 1967, which are shown in the accompanying chart, were essentially the same as those recorded in previous years. The highest concentration observed during the year was 1.0 mg/l, which value occurred at Markland Dam and also at Louisville. Findings by the University of Louisville, which resulted from a research project sponsored by ORSANCO, indicate that although phosphates and nitrates influence the growth of plankton, there is no direct correlation between concentrations of these constituents and the abundance or variety of aquatic plant life in the Ohio River.



PHOSPHATE RANGES — 1967

THRESHOLD-ODOR CONDITIONS — Information on threshold-odor conditions at five 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.). During 1967, this criterion was met 100 percent of the time at all stations except Huntington, where threshold-odor numbers exceeded 24 on five days during the year, with a maximum value at this station of 30.

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. Presence of these substances is sufficiently low so that only occasional monitoring is warranted. Findings reveal that — with only a few exceptions of minor significance — concentrations in the river during 1967 were well below limiting values specified in the criteria.

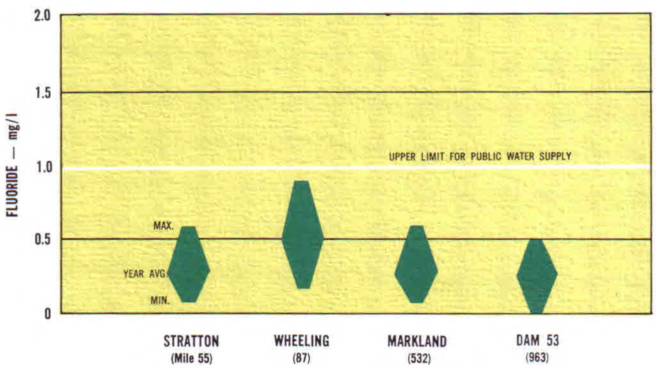
Arsenic — During 1967, analyses for arsenic were made on 54 samples, including 38 monthly-composite samples and 16 quarterly-composite samples. Of the quarterly-composite samples, fifteen were reported to contain less than 0.050 mg/l, the upper limit specified in the criteria. Results of the sixteenth sample, which was reported to contain less than 0.054 mg/l, were inconclusive on whether criteria specifications were met. Of the 38 monthly-composite samples, the highest concentration observed was 0.02 mg/l, well below the criteria limit.

Barium — Of a total of 16 analyses on quarterly-composite samples, the highest concentration observed was 0.057 mg/1, which value was well below the limiting value of 1.0 mg/l specified in the criteria.

Lead — Forty-four samples (28 monthly composites and 16 quarterly composites) were analyzed for lead during 1967. All of these contained concentrations of less than 0.05 mg/l, which is the limiting value specified in the criteria. The highest concentration observed was 0.028 mg/l, which value occurred in two samples.

Fluoride — Data on fluoride concentrations is available from the ORSANCO Water-Users Committee station at Wheeling, where analyses are made daily, and from USGS-ORSANCO cooperative stations at Stratton, Markland Dam and Dam 53, where analyses are made on samples collected three or four times a month.

Ranges in concentrations during 1967 at these stations are shown in the accompanying graph. All concentrations were less than 1.0 mg/l, which is the upper limit specified in the ORSANCO criteria for public-water supply. The highest single value during the year, 0.9 mg/l, and the highest monthly-average value, 0.7 mg/l, both occurred at Wheeling.



FLUORIDE RANGES — 1967

Cadmium — Analyses for cadmium were made on 43 samples (27 monthly composites and 16 quarterly composites) in 1967. Analyses on two samples, which were reported to contain less than 0.011 mg/l, were indeterminate on whether criteria specifications were met. Of the remaining 41 samples, none showed concentrations exceeding 0.01 mg/l, the upper limit specified in the criteria.

Chromium — Analyses for total chromium in 44 samples (28 monthly-composites and 16 quarterly-composites) showed that concentrations were less than 0.01 mg/l in all samples. Since the analyses measured both trivalent and hexavalent forms of chromium, it is evident that levels of hexavalent chromium were well below the limit of 0.05 mg/l specified in the criteria.

Silver — Sixteen quarterly-composite samples were analyzed for silver during 1967, and all were found to contain less than 0.0011 mg/l. Thus, concentrations 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.

Copper, Zinc, Nickel and Cobalt — Data on concentrations of these four constituents is made available by the U. S. Geological Survey and the Federal Water Pollution Control Administration. Analyses made on Ohio River water during 1967 include 44 measurements each for copper, zinc, and nickel, and 41 measurements for cobalt.

Criteria for these constituents have not been established by ORSANCO; however, U. S. Public Health Service drinking water standards contain a recommended upper limiting value of 1.0 mg/l for copper, and a recommended upper limiting value of 5.0 mg/l for zinc.

Of the samples analyzed for copper, one contained a concentration of 0.110 mg/l, another contained 0.103 mg/l, and the remaining samples contained

0.05 mg/l or less. Thus, copper levels were well below the recommended upper limit of 1.0 mg/l.

The maximum concentration of zinc found in any sample was 0.34 mg/l, far below the recommended upper limit of 5.0 mg/l. Three samples contained concentrations of 0.22 mg/l to 0.30 mg/l, and in all other samples the concentration was 0.08 mg/l or less.

The maximum concentration of nickel reported was 0.08 mg/l. Twelve samples showed concentrations of 0.01 mg/l to 0.08 mg/l, and in all other samples concentrations were 0.01 mg/l or less.

Five of the samples analyzed for cobalt contained a concentration of 0.01 mg/l. In all other samples concentrations were less than 0.011 mg/l.

QUALITY CONDITIONS IN TRIBUTARIES

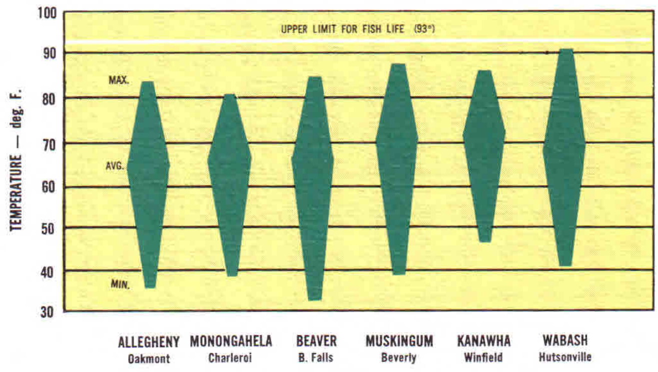
QUALITY CONDITIONS in major tributaries of the Ohio River for which detailed data is available, are described in the following sections.

Flows in tributaries during 1967, like those in the main stem, were above "normal" or long-term average levels. Because of the inverse relationship between flow and quality conditions, quality levels in the tributaries during 1967, at least for certain constituents, were better than conditions that might be expected in years when there is less flow.

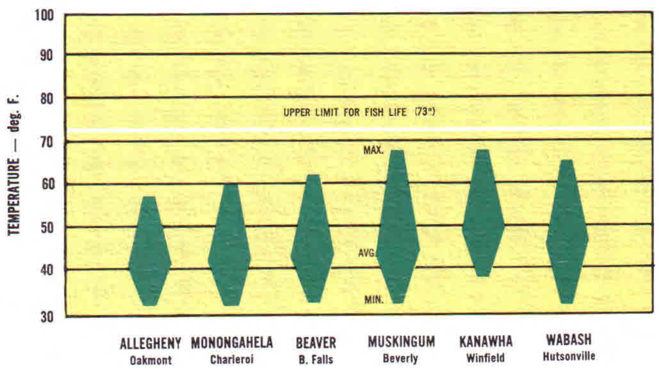
On the Allegheny River, the increase in flow during the dry-weather season (August-October) of 1967 over the long-term average level was greater than that on other tributaries. The reason is that flow in the Allegheny during the dry-weather season was augmented by releases from the new Allegheny Reservoir (Kinzua), which went into operation in early 1967. As a consequence, the variations between quality levels in 1967 and those in the past few years appear to be more pronounced on the Allegheny than on some other tributaries.

TEMPERATURE — The accompanying graphs show ranges in temperature at tributary monitor stations during two periods, May-November and December-April, of 1967. All readings were below 93 deg. F., which is the upper limit for aquatic life specified in the ORSANCO criteria. The highest temperature recorded during the months of May through November was 91.1 deg. F., which value occurred in the Wabash River.

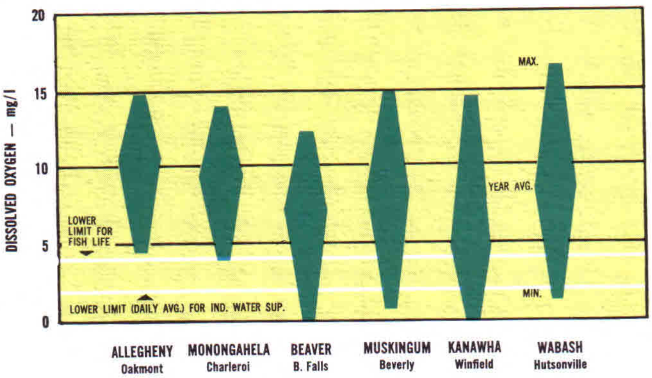
During the months of December through April, all temperature readings at all stations were below 73 deg. F., which is the upper limit specified in the criteria for aquatic life for this period. The highest temperature recorded during these months was 68.0 deg. F., which value was observed in both the Muskingum and Kanawha rivers.



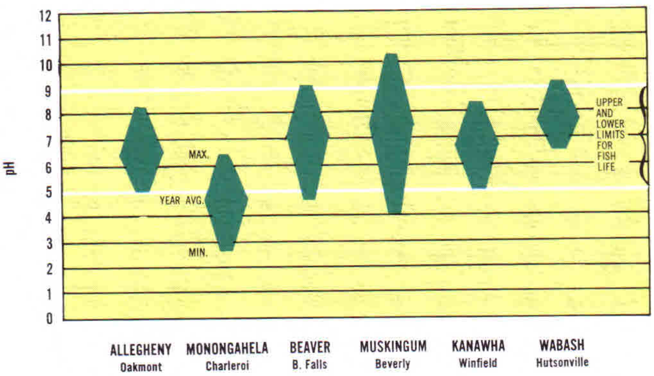
TEMPERATURE RANGES — MAY-NOV. 1967



TEMPERATURE RANGES — DEC.-APR. 1967



DISSOLVED OXYGEN RANGES — 1967



pH RANGES — 1967

DISSOLVED OXYGEN — Dissolved oxygen was measured hourly at six tributary locations by means of robot monitors. The accompanying chart shows ranges in DO levels during 1967 at these locations.

Daily-minimum DO concentrations were greater than 4.0 mg/l — the minimum level considered satisfactory for the maintenance of a well-balanced, warm-water fish population — on 100 percent of the days in the Allegheny and Monongahela rivers, 95 percent in the Wabash, 94 percent in the Muskingum, 79 percent in the Beaver and 51 percent in the Kanawha.

Daily average concentrations were greater than 2.0 mg/l — the minimum level specified in the industrial water supply criteria — on 100 percent of the days at stations on the Allegheny, Monongahela and Wabash rivers. On the Muskingum, Beaver and Kanawha rivers, daily-average DO values were greater than 2.0 mg/l on 98, 92 and 72 percent of the days, respectively.

pH — The accompanying graph shows ranges in pH values during 1967 at six robot monitor stations.

On the Allegheny and Kanawha rivers, all pH values during 1967 were within the 5.0-to-9.0 range specified in the criteria for aquatic life. On the Monongahela, there were no values greater than 9.0, but values less than 5.0 occurred in this tributary on 202 days. Values greater than 9.0 occurred on one day in the Beaver River, on thirteen days in the Muskingum and on six days in the Wabash. Values less than 5.0 occurred on one day in the Beaver and on one day in the Muskingum.

Daily-average pH values at the six tributary stations were within the preferred range of 6.5 to 8.5 the following percentages of time: Allegheny, 62 percent; Monongahela, 0 percent; Beaver, 95 percent; Muskingum, 95 percent; Kanawha 75 percent; Wabash, 99 percent.

ALKALINITY — Ranges in alkalinity at nine tributary stations are shown in the following tabulation, which is based on data for twelve months at all stations except Kinzua (where the period of record is January through September), and Louisa (where the period of record is March through December):

Tributary-station	Alkalinity - mg/l Maximum	Average	Minimum
Allegheny			
Kinzua	51	26	16
Wilkinsburg	39	17	0
Monongahela			
Charleroi	0	0	0
South Pittsburgh	11	1	0
Beaver			
Beaver Falls	77	57	36
Muskingum			
Beverly	128	104	41
Kanawha			
Glen Lyn	72	54	37
Winfield	69	31	13
Big Sandy			
Louisa	190	54	5

Decreases in alkalinity between Kinzua and Wilkinsburg on the Allegheny River, and between Glen Lyn and Winfield on the Kanawha River are attributed to acid mine-drainage and industrial wastewater discharges. The increase in alkalinity between Charleroi and South Pittsburgh on the Monongahela River has been found to reflect neutralization of river water used for cooling purposes by steel mills located on the river between these stations.

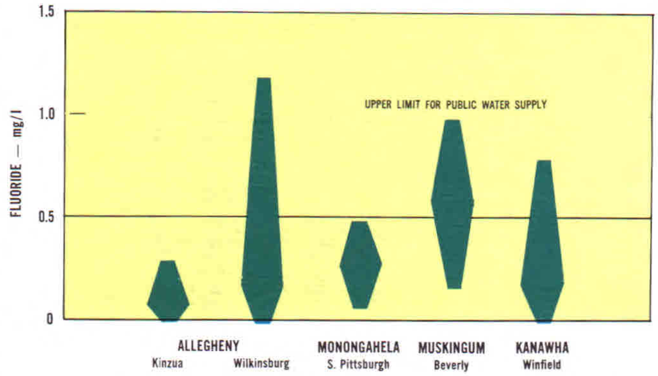
COLIFORM DENSITY — Coliform densities were measured at Wilkinsburg on the Allegheny River, at South Pittsburgh on the Monongahela River and at Beaver Falls on the Beaver River.

The extent to which coliform specifications in the ORSANCO criteria for public-water supply were met is shown in the following tabulation, together with information on maximum and yearly-average values:

	Wilkinsburg	S. Pittsburgh	Beaver Falls
Number of months in which average coliform counts did not exceed 5,000 per 100 ml	7	12	0
Number of months in which 80 percent or more of daily values were less than 5,000 per 100 ml	5	11	0
Number of months in which 95 percent or more of daily values were less than 20,000 per 100 ml	8	12	0
Maximum monthly-average value (coliforms per 100 ml)	22,000	3,200	110,000
Yearly-average value (coliforms per 100 ml)	7,000	1,200	52,000

The extent to which specifications in the criteria for recreational use were met during the months of May through September is shown in the following tabulation, together with information on maximum and seasonal-average values:

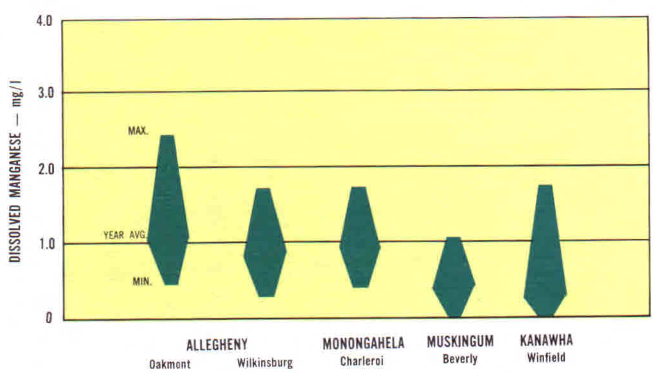
	Wilkinsburg	S. Pittsburgh	Beaver Falls
Number of months in which average coliform counts did not exceed 1,000 per 100 ml	1	2	0
Number of months in which 80 percent or more of daily values were less than 1,000 per 100 ml	1	0	0
Number of months in which all daily values were less than 2,400 per 100 ml	0	0	0
Maximum monthly-average value (coliforms per 100 ml)	22,000	3,200	110,000
Seasonal-average value (coliforms per 100 ml)	9,800	1,500	52,000



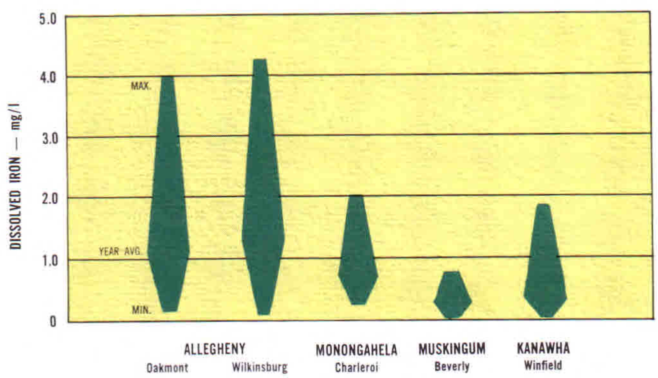
FLUORIDE RANGES — 1967

FLUORIDE — Fluoride levels at five tributary stations are shown in the accompanying chart. The chart is based on data for twelve months of 1967 at Wilkinsburg, Beverly and Winfield, and for the months of January through September at Kinzua and South Pittsburgh. Except for one analysis at Wilkinsburg, which showed a concentration of 1.2 mg/l, there were no values greater than 1.0 mg/l, which is the upper limit specified in the ORSANCO criteria for public water supply.

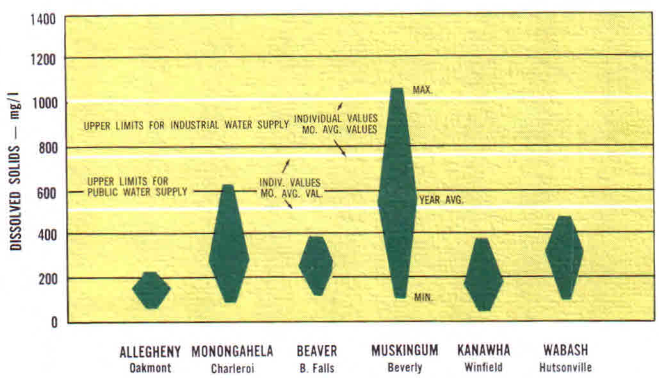
MANGANESE — Ranges in dissolved manganese concentrations at five tributary locations are shown in the accompanying chart, which is based on data for twelve months at all stations except Beverly (where the period of record is January through November). The maximum individual value recorded and the maximum yearly-average value, which were 2.5 mg/l and 1.1 mg/l, respectively, occurred at Oakmont on the Allegheny River. For other stations, yearly average values varied from 0.23 mg/l on the Kanawha River to 0.97 mg/l on the Monongahela River.



DISSOLVED MANGANESE RANGES — 1967



DISSOLVED IRON RANGES — 1967



DISSOLVED SOLIDS RANGES — 1967

IRON — Ranges in dissolved-iron concentrations at five tributary stations are shown in the accompanying chart, which is based on data for twelve months at all stations except Beverly (where the period of record is January through November). Maximum individual values at the various stations varied from 0.73 mg/l in the Muskingum River to 4.3 mg/l in the Allegheny. Yearly-average values were: 1.1 mg/l (at Oakmont) and 1.3 mg/l (at Wilkinsburg) in the Allegheny; 0.72 mg/l in the Monongahela; 0.26 mg/l in the Muskingum; 0.33 mg/l in the Kanawha.

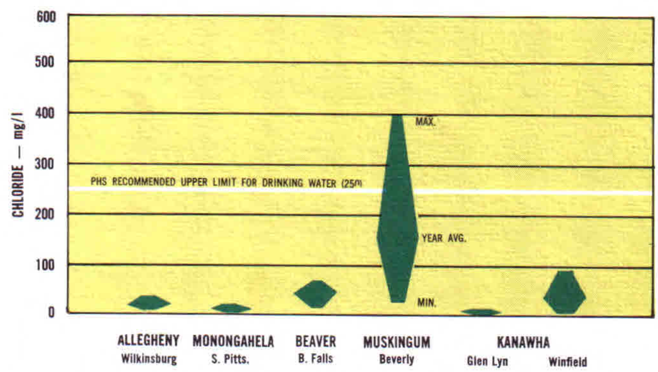
DISSOLVED SOLIDS — The accompanying chart shows maximum, average and minimum concentrations of dissolved solids at six tributary locations where robot monitor units are in operation. Values for dissolved solids concentrations were calculated from measurements of specific conductance using the relationship: Dissolved solids in mg/l = 0.625 times conductance in micromhos/cm.

In all tributaries except the Muskingum, concentrations at all times were below 750 mg/l, which is specified in the ORSANCO criteria for public-water supply as an upper limit for individual values. The highest single value observed in tributaries other than the Muskingum was 621 mg/l, which value occurred in the Monongahela.

On the Muskingum River, both the industrial-water supply criteria and public-water supply criteria were exceeded at times, although it might be noted that the Muskingum is not used as a source of public-water supply. The industrial-water supply criteria specify an upper limit of 1,000 mg/l on individual values, and a limit of 750 mg/l on monthly-average values. The limit on individual values was exceeded on two days in September and on two days in November. The highest single value recorded was 1,044 mg/l. The limit on monthly-average values of 750 mg/l was exceeded in September and October, when average values of 901 mg/l and 785 mg/l were observed.

CHLORIDE — Maximum, average and minimum chloride concentrations during 1967 at six sampling stations on five tributaries are shown in the accompanying chart (which is based on data for twelve months at all stations except South Pittsburgh, where the period of record is January through November). Only on the Muskingum River, which is not used as a source of public-water supply, did chloride levels exceed the recommended limit of 250 mg/l in U. S. Public Health Service drinking water standards. The maximum single value observed on the Muskingum was 400 mg/l.

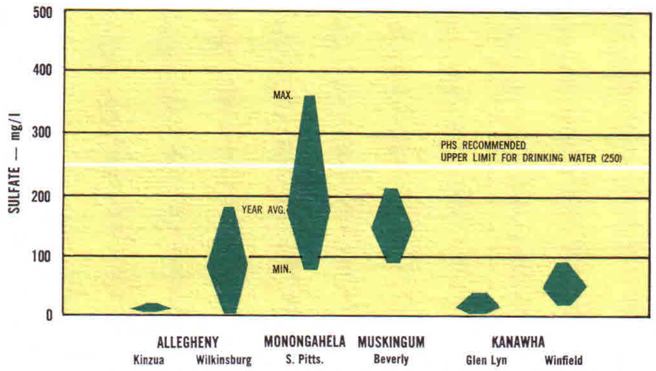
The increase in chloride concentrations in the Kanawha River from a maximum of 4 mg/l at Glen Lyn to a maximum of 95 mg/l at Winfield is believed to reflect chemical-industry and oil-production operations.



CHLORIDE RANGES — 1967

NITRATE — Nitrate (NO_3) concentrations were also measured routinely on the Muskingum and Kanawha rivers. The maximum value observed in 1967 was 12.0 mg/l, which occurred on the Kanawha. This concentration was about 27 percent of the limiting value of 45 mg/l recommended in U. S. Public Health Service drinking water standards. Ranges in nitrate concentrations were as follows:

	Muskingum	Kanawha
Maximum	8.0	12.0
Yearly average	4.5	6.0
Minimum	1.8	2.0



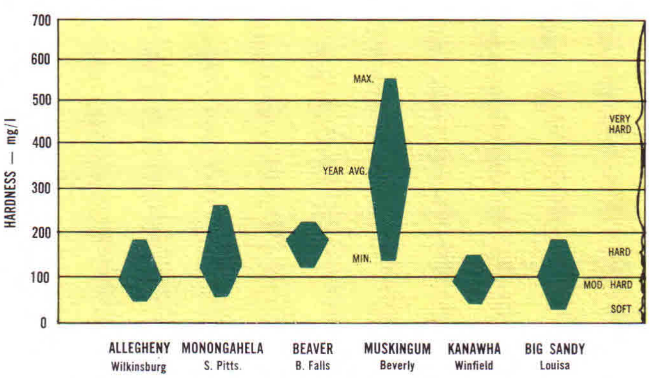
SULFATE RANGES — 1967

HARDNESS — Ranges in hardness concentrations in six tributaries are shown in the accompanying chart, which is based on data for twelve months at all stations except Louisa (where the period of record is March through December).

According to U. S. Geological Survey designations, the Allegheny and Kanawha rivers may be classified as "moderately hard" to "hard" (61 mg/l to 180 mg/l), and the other tributaries as "hard" to "very hard" (121 mg/l to more than 180 mg/l).

Yearly average hardness levels ranged from 89 mg/l on the Kanawha River to 340 mg/l on the Muskingum, and maximum values were from 153 mg/l on the Kanawha to 555 mg/l on the Muskingum.

At South Pittsburgh on the Monongahela River, hardness levels in 1967 were essentially the same as those in 1966. At Wilkinsburg on the Allegheny River, at Beverly on the Muskingum River and at Winfield on the Kanawha River, hardness levels were lower in 1967 than in 1966.



HARDNESS RANGES — 1967

SULFATE — Ranges in sulfate concentrations at six sampling stations on four tributary streams are shown in the accompanying chart, which is based on data for twelve months at all stations except Kinzua and South Pittsburgh (where the periods of record are January through September). At South Pittsburgh on the Monongahela River, seven of 27 samples contained sulfate concentrations in excess of 250 mg/l, the upper limit recommended in U. S. Public Health Service drinking water standards. The highest value observed at this station was 368 mg/l. Maximum concentrations at all other stations were below the 250 mg/l level.

The increase in sulfate concentrations between Kinzua and Wilkinsburg on the Allegheny, and the increase in concentrations between Glen Lyn and Winfield on the Kanawha reflect the influence of mine drainage and industrial operations between sampling stations.

PHOSPHATE — Concentrations of total phosphate (PO_4) were measured routinely on the Muskingum and Kanawha rivers. Maximum values during 1967 were 0.45 mg/l on the Muskingum and 0.51 mg/l on the Kanawha rivers. Ranges are shown in the following tabulation:

	Muskingum	Kanawha
Maximum	0.45	0.51
Yearly average	0.19	0.18
Minimum	0.04	0.02

OTHER CHEMICAL CONSTITUENTS — Information on concentrations of arsenic, cadmium, chromium and lead is available from analyses of monthly-composite samples at ORSANCO-USGS stations on the Allegheny and Monongahela rivers for the period January through September 1967. Additional information on these same constituents, together with information on concentrations of barium and silver, is available from analyses of quarterly-composite samples at stations operated by the Federal Water Pollution Control Administration on the Allegheny, Monongahela, Kanawha, Little Miami, Wabash and Cumberland rivers.

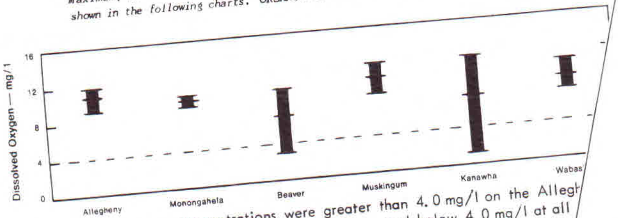
On the Allegheny River, 13 samples (nine monthly-composite samples and four quarterly-composite samples) were collected and analyzed during the year. A total of 58 analyses were made, including 13 analyses each for arsenic, cadmium, chromium and lead, and three analyses each (on quarterly-composite samples) for barium and silver. Except for two analyses for lead, which showed concentrations of 0.23 mg/l and 0.07 mg/l (on monthly-composite samples collected in February and March), all values for the six constituents were below levels specified in the ORSANCO criteria for public water supply.

On the Monongahela River, a total of 60 analyses were made on 13 samples. Nine monthly-composite samples were analyzed for arsenic, cadmium, chromium and lead, and four quarterly-composite samples were analyzed for these same constituents and for barium and silver. Fifty-two of the 60 analyses showed concentrations of constituents to be below levels specified in the ORSANCO criteria for public water supply. Two analyses showed concentrations exceeding criteria specifications. The sample collected in March contained 0.31 mg/l of lead, and the sample collected in April contained 0.03 mg/l of cadmium (which values may be compared with criteria specifications of 0.05 mg/l and 0.01, respectively). The remaining six analyses were inconclusive: Concentrations of arsenic in three quarterly-composite samples were reported as less than 0.072 mg/l, and concentrations of cadmium in three quarterly-composite samples were less than 0.014 mg/l.

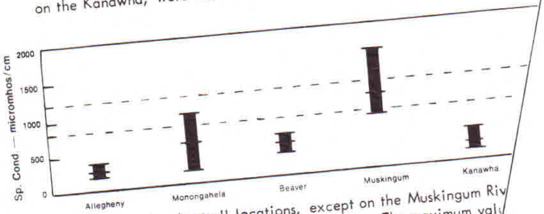
Analyses for arsenic, cadmium, chromium, lead, barium and silver were made on four quarterly-composite samples collected from the Kanawha River, on two quarterly samples from the Little Miami, on one quarterly sample from the Wabash, and on one quarterly sample from the Cumberland. Of a total of 48 analyses, none showed concentrations in excess of criteria levels. Results of six analyses, however, were inconclusive: Concentrations of arsenic in three samples (one from the Kanawha and two from the Little Miami) were reported as less than values of 0.063 mg/l; 0.088 mg/l and 0.085 mg/l; concentrations of cadmium in the same three samples were reported as less than values of 0.013 mg/l, 0.018 mg/l and 0.017 mg/l.

QUALITY CONDITIONS IN TRIBUTARIES

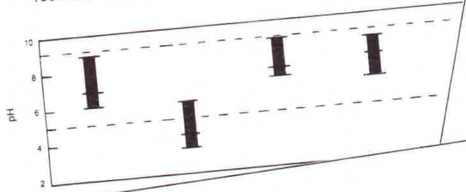
Maximum, average and minimum values of quality characteristics and flow are shown in the following charts. ORSANCO criteria values are shown by dash lines.



Dissolved oxygen concentrations were greater than 4.0 mg/l on the Allegh... Monongahela, Muskingum, and Wabash rivers, and below 4.0 mg/l at all stations. Four percent of the values on the Beaver, and 26 percent of the ... on the Kanawha, were less than 4.0 mg/l.



Conductance levels at all locations, except on the Muskingum Riv... upper limiting values specified in the criteria. The maximum valu... mhos/cm, and the maximum monthly-average value, 1,074 mic... recorded on the Muskingum.



Report from water users - - -

Members of the ORSANCO Water Users Committee, which is composed of managers of water-treatment plants on the Ohio, Allegheny and Monongahela rivers, report the following treatment problems encountered during November.

On the Monongahela River, abnormally low (pH 3.6) acid conditions were experienced from November 13 to November 16, which required additional treatment.

The high ABS (non-biodegradable detergent) concentrations in the Allegheny River, that resulted from a break in an industrial waste water lagoon, reached a peak of 4.0 mg/l in the lower Allegheny River about November 1, 1968. Concentrations of ABS in the public water supplies were reduced to below 0.5 mg/l by increased activated carbon treatment. The increased ABS levels from the Allegheny River caused no unusual treatment problems for water treatment facilities on the Ohio River.

Visual aspects were good, except for the spill of 300,000 gallons of gasoline between Cincinnati and Louisville, on the Ohio River at mile 533.5, on November 4, 1968. The incident was caused by a gasoline barge being punctured by a sunken barge in the channel. River traffic was halted until the gasoline evaporated and no unusual problems to water users were encountered.

Threshold odor levels of river water were less than 24, which is the upper limit specified in the ORSANCO public-water supply criteria at all locations, except on the Allegheny River. High threshold odor levels were experienced during the period of high ABS levels that resulted from the break in the industrial waste lagoon previously described.

Ranges in quality characteristics recorded in the various river reaches during the month were as follows:

	Hardness (mg/l)	Alkalinity (mg/l)	Coliforms Per 100 ml	Manganese (mg/l)	Sulfate (mg/l)
Allegheny River	64 - 132	11 - 39	2,000 - 40,000	0.27 - 1.01	50 - 72
Monongahela River	76 - 248	0 - 9	2 - 9,200	0.8 - 1.8	65 - 130
Upper O...	100 - 165	16 - 32	2,300 - 24,000	0.3 - 0.7	89 - 192
			... 14,000		

SUMMARY OF MEASUREMENTS -- NOVEMBER 1968

...on	Measure-ment	Max. hourly value	Max. daily-avg. value	Monthly average value	Min. daily-avg. value	Min. hourly value	Percent of values meeting criteria
	DO Temp pH Cond Flow	11.65 52.5 8.89 365	11.29 52.0 8.24 350 71.0	10.54 45.8 6.69 260 19.7	9.72 39.3 6.23 192 6.0	9.02 38.9 6.07 170	100. 100. 100. 100.
	...O ...mp ...d	10.15 56.6 5.98 944	9.97 56.3 5.93 939 17.0	9.46 49.2 4.16 552 5.7	8.93 41.8 3.40 192 .6	8.80 41.5 3.30 188	100. 100. 22. 100.
		10.12 62.0 8.90 574	9.96 61.1 8.17 569 48.0	7.18 51.6 7.43 448 5.1	3.75 44.7 7.17 323 1.4	3.30 43.5 6.90 319	96. 100. 100. 100.
			11.67 59.4 8.57 1605 316 8.5	10.35 49.4 7.72 1074 179 3.6	8.75 44.3 6.86 755 91 1.3	8.60 43.8 6.57 734 84	100. 100. 100. 70. 86.
			...4 ...	7.66 53.9 7.14 255 41 13.0	2.57 46.5 6.22 153 0 4.9	1.32 46.0 6.13 146 0	74. 100. 100. 100. 100.
			....16 ...2.1 ...81 634 5.9	7.95 43.9 7.57 603 1.7	7.74 43.3 7.34 588		100. 100. 100. 100.

An appraisal of conditions in the Ohio River and some of its tributaries based on water quality measurements from the ORSANCO robot monitor system

ORSANCO QUALITY MONITOR

for NOVEMBER 1968

(Issued December 13, 1968)

PUBLISHED MONTHLY BY THE OHIO RIVER VALLEY WATER SANITATION COMMISSION

An interstate agency representing: Illinois • Indiana • Kentucky • New York • Ohio • Pennsylvania • Virginia • West Virginia

TALLY FOR THE VALLEY

An annual inventory on the status of pollution control facilities at all sewered communities and industrial installations is compiled from information submitted by each of the states signatory to the Ohio Valley Compact. The status of facilities is summarized in the accompanying tabulations.

Following are highlights revealed by the inventory for the year ending June 30, 1968.

Municipal status — On the main stem of the Ohio River, sewage-treatment facilities now in operation serve 99.5 percent of the 3,700,000 sewered population. For the compact district as a whole, facilities are in operation serving 94.5 percent of the 11,500,000 sewered population.

During the past year, 39 new sewage-treatment plants, serving a combined population of 98,000, were placed in operation in the compact district; seven of these plants, serving a population of 21,000, are located on the Ohio River main stem. Construction of new plants, serving a population of 37,000, was started at 22 communities, all of which are on tributary streams.

The following tabulation shows percentages of sewered population on the Ohio River and in tributary basins in relation to the degree of treatment that is provided:

Degree of treatment	Percent of population served	
	Ohio River	Tributary Basins
Primary	42.1	14.4
Intermediate	55.7	8.2
Secondary	1.2	66.1
Undetermined	0.5	3.8

Industrial status — There are 1,875 industrial plants discharging effluents directly to streams in the district. Of these, 88 percent (1,642) are complying at least with minimum control requirements. Complying not only with minimum requirements, but also with all additional controls thus far promulgated are 79 percent (1,486) of the industrial plants.

Basin status — The rivers tributary to the Ohio range in size from the Little Kanawha with a drainage area of 1,185 square miles and a sewered population of 11,000, to the Wabash with a drainage area of 33,100 square miles and a sewered population of 1,866,000. The following tabulation shows on a basin-by-basin basis the amount of sewered population, percent of population served by sewage-treatment facilities, number of industrial plants and percent of industrial plants complying with minimum control requirements.

From the tabulation it will be noted that in 13 of the 21 tributary basins, 95 percent or more of the sewered population is served by sewage treatment facilities. The amount of sewered population served by treatment facilities in other basins is as follows: 80 to 90 percent in five basins, 76 percent in one basin, and 67 percent in two basins.

With regard to the control of industrial wastes, 100 percent of the industries in seven tributary basins are in compliance with minimum interstate requirements. In other basins, the percentage of industries complying with minimum requirements is: 90 to 97 percent in four basins, 80 to 90 percent in eight basins, 75 percent in one basin, and 34 percent in one basin.

Basin	Sewered Population (thousands)	Percent of population served by treatment facilities	Number of industrial plants	Percent of plants complying with minimum requirements
Ohio River	3,655	99.5	204	89.2
Allegheny	727	81.9	284	85.9
Monongahela	692	66.3	237	85.6
Beaver	646	99.6	153	89.5
Muskingum	575	98.0	127	92.1
Little Kanawha	11	76.0	8	100.0
Hocking	70	96.8	5	100.0
Kanawha	381	90.8	108	88.0
Guyandot	23	90.8	44	34.1
Big Sandy	65	67.4	85	82.4
Scioto	801	99.3	40	100.0
Little Miami	209	99.5	9	88.9
Licking	48	99.1	4	75.0
Miami	824	99.5	65	96.9
Kentucky	151	98.4	26	100.0
Salt	90	100.0	21	90.5
Green	117	99.3	21	100.0
Wabash	1,866	95.4	259	90.3
Cumberland	98	100.0	16	100.0
Tennessee	113	86.9	23	100.0
Minor Tributaries	325	89.1	136	83.1
Total	11,487	94.5	1,875	87.6

STATUS OF MUNICIPAL AND INSTITUTIONAL SEWAGE-TREATMENT FACILITIES – July 1, 1968

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	**64** 325,515	**148** 1,080,634	**201** 1,320,345	**8** 81,440	**352** 3,407,084	**297** 2,590,425	**47** 158,191	**99** 493,884	**1,216** 9,457,578	**70.5** 82.3
Treatment provided (improvements needed)	**5** 22,288	**61** 656,427	**5** 8,411	**6** 16,619	**28** 338,426	**13** 68,967	**19** 11,965	**14** 141,769	**151** 1,264,872	**8.7** 11.0
Treatment provided (improvements under construction)	**1** 3,573	**9** 100,050	**0** 0	**0** 0	**5** 13,819	**0** 0	**1** 4,758	**2** 19,728	**18** 141,928	**1.0** 1.2
New treatment works under construction	**0** 0	**14** 20,836	**1** 143	**0** 0	**5** 12,578	**11** 28,050	**2** 4,598	**5** 10,964	**38** 77,169	**2.2** 0.7
No treatment: construction not started	**8** 10,091	**55** 53,506	**8** 9,155	**7** 14,426	**24** 27,729	**104** 254,600	**13** 13,512	**84** 162,284	**303** 545,303	**17.6** 4.8
TOTAL	**78** 361,467	**287** 1,911,453	**215** 1,338,054	**21** 112,485	**414** 3,799,636	**425** 2,942,042	**82** 193,024	**204** 828,629	**1,726** 11,486,790	**100.0** 100.0

STATUS OF INDUSTRIAL WASTE-CONTROL FACILITIES – July 1, 1968

STATUS	ILL.	IND.	KY.	N. Y.	OHIO	PA.	VA.	W. VA.	TOTAL	% OF TOTAL
Complying with ORSANCO minimum requirements	17	261	155	17	369	548	62	213	1,642	87.6
Control currently acceptable	17	209	152	13	308	536	61	190	1,486	79.2
Control provided, but not adequate	10	64	9	15	48	34	1	49	230	12.3
Control facilities inadequate, improvements in progress	7	9	0	0	17	2	0	32	67	3.6
New control facilities under construction	0	3	0	0	7	10	0	8	28	1.5
Planning treatment facilities or preparing to connect to municipal sewers	1	0	0	6	8	26	0	0	48	2.6
No action by company	0	0	0	4	0	9	1	2	16	0.8
Total number of industries	35	285	161	38	388	617	63	288	1,875	100.0

Chairman M. K. McKay

ADMINISTRATIVE

THE COMMISSION IS COMPOSED of twenty-seven members, three from each of the eight signatory states, appointed by the Governors, and three federal representatives appointed by the President of the United States. Administrative affairs are conducted by a staff headquartered in Cincinnati.

Chairmanship of the Commission is rotated annually among the states. During the fiscal year covered by this report—July 1, 1967 through June 30, 1968—this post was held by Franklin D. Yoder, M.D., director of public health for the State of Illinois. Dr. Yoder has served as a commissioner since September 1, 1961.

For the year beginning July 1, 1968, Marion M. McKay, Ph.D., of Pennsylvania was elected chairman. Dr. McKay was appointed as a commissioner in 1956. However, his relationship with ORSANCO dates back to 1938 when, as a member of the conference of delegates, he participated in negotiations leading to the drafting of the Ohio River Valley Water Sanitation Compact. He is a retired professor of economics at the University of Pittsburgh and for many years served as a member of the Pennsylvania Sanitary Water Board. Currently, he is president of the Pittsburgh Civil Service Commission.

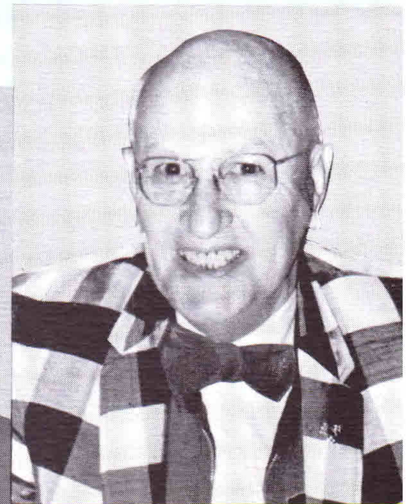
Vice-chairman for the current year is N. H. Dyer, M.D., state health commissioner for West Virginia. Dr. Dyer has served as a member of the Commission since it was established on June 30, 1948.

Joining Dr. Dyer in 20 years of service to the Commission are four other members—Clarence W. Klassen, P.E., of Illinois; Blucher A. Poole, Eng. D., of Indiana; Joseph L. Quinn, P.E., of Indiana, and E. Blackburn Moore of Virginia — all of whom have served as chairman.

Throughout this period Mr. Klassen and Dr. Poole have also been members of the Engineering Committee.

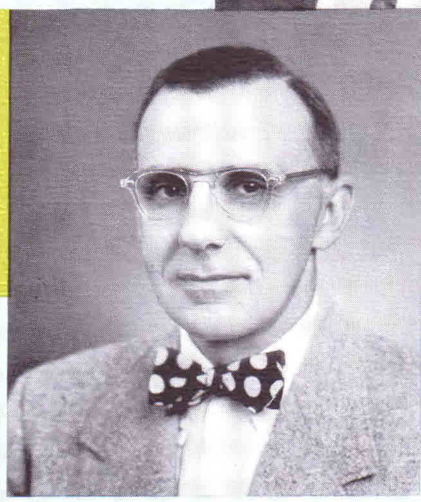
Also with 20-year tenure is Fred H. Waring, P.E., secretary. However, Mr. Waring's identification with regional pollution control goes back to November 20, Blucher A. Poole

Fred H. Waring



Joseph L. Quinn, Jr.

Vice-chairman N. H. Dyer



Clarence W. Klassen

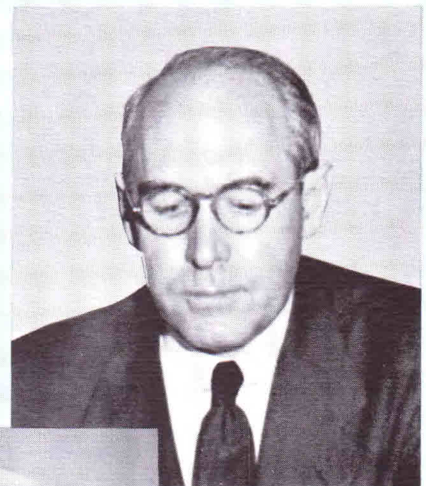
AFFAIRS

1936, when he was elected secretary of the conference of delegates appointed to draft the Ohio Valley compact. Now retired as chief sanitary engineer of the State of Ohio, Mr. Waring has made available to the Commission the benefit of over fifty years experience in water resources development.

Membership changes — Ross H. Walker, of Virginia, another of the original appointees to the Commission, resigned on December 31, 1967. Mr. Walker, a past-chairman, served the Commission for nineteen and a half years during which he provided distinguished leadership.

On May 1, 1968, J. O. Matlick, a Kentucky commissioner since 1960 and a past-chairman, retired from state service and from ORSANCO. As director of natural resources, Mr. Matlick guided development of legislation to control strip mining operations in Kentucky.

Frank C. DiLuzio, P.E., assistant secretary of the U.S. Department of the Interior, retired from government



E. Blackburn Moore

Ross H. Walker

service and from ORSANCO on December 31, 1967. He was appointed a federal commissioner in September, 1966.

Vacancies that existed in the Illinois and Pennsylvania delegations have been filled. Prof. John E. Pearson was appointed by Governor Shapiro on May 22, 1968. Mr. Pearson is professor of general, sanitary and nuclear engineering at the University of Illinois. Governor Shafer of Pennsylvania appointed Wesley E. Gilbertson, P.E., to ORSANCO effective December 21, 1967. Mr. Gilbertson is deputy secretary for environmental protection for the Pennsylvania Department of Health.

James S. Shropshire was appointed by Governor Nunn to represent Kentucky effective May 1, 1968. Mr. Shropshire is commissioner of the Kentucky Department of Natural Resources. He succeeded Mr. Matlick.

Henry H. Holland, III, was appointed by Governor Godwin to represent Virginia effective April 1, 1968. Mr. Holland is a member of the Virginia Water Control Board. He succeeded Mr. Walker.

Jacob I. Bregman, Ph.D., deputy assistant secretary for water pollution control, Department of the Interior, was appointed by President Johnson on February 12, 1968, to succeed Mr. DiLuzio.

Staff changes — Russell A. Brant, a geologist formerly with the Ohio Department of Natural Resources joined the staff on November 1, 1968. Jane W. Renaldo, who resigned in 1965, returned to assume duties as secretary-librarian on September 16, 1968. Other new appointments include: Alice L. Gosney, a data-processing technician (May 22, 1968); and John P. Donnelly, an electronics specialist (September 1, 1968).

After eleven years of service Grace B. Ziegler, a statistical assistant, resigned on November 1, 1968, to join her husband whose business interests were transferred out of state.

Financial — Operating funds of the Commission are derived from appropriations from the eight signatory states, the amount paid by each representing a pro rata share based one-half in proportion to population, and one-half in proportion to land area within the compact district. The appropriation for fiscal 1968 was $182,000. In addition, the Commission received a federal grant of $159,460 under the Federal Water Pollution Control Act.

A table of distribution of annual shares of the budget and a financial statement will be found on following pages.

Advisory committees—Since 1950 when the Commission inaugurated the establishment of industry advisory committees, it has received assistance from some 250 waste-control specialists. These committees include representation from major chemical, coal, metal-finishing, petroleum, electric power, pulp and paper, and steel companies operating in the Ohio Valley.

Also advising the Commission since 1952 is a distinguished group of aquatic-life specialists. This committee is engaged on matters relating to water-quality criteria, investigation of fish-kills and the appraisal of aquatic inventory data.

A Water Users Committee consisting of managers of municipal and industrial water supply systems in the Ohio Valley has served since 1952 as a primary component of the regional quality monitor and surveillance program conducted by the Commission.

CHAIRMEN OF ORSANCO ADVISORY COMMITTEES

(as of December 1, 1968)

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

Chemical Industry Committee — Robert F. Rocheleau, E. I. duPont de Nemours & Co., Wilmington, Delaware

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 Corporation, Pittsburgh, Pennsylvania

Power Industry Advisory Committee — R. W. Gausmann, Indianapolis Power and Light Co., Indianapolis, Indiana

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

Steel Industry Action Committee — S. L. Stovich, Bethlehem Steel Co., Johnstown, Pennsylvania

Water Users Committee — Frank A. Kohler, South Pittsburgh Water Co., Pittsburgh, Pennsylvania

COMMISSION COMMITTEE ASSIGNMENTS

(for the year ending June 30, 1969)

Executive Committee

Chairman	MARION K. MCKAY
Vice-chairman	N. H. DYER, M.D.
Past-chairman	FRANKLIN D. YODER, M.D.
Illinois	CLARENCE W. KLASSEN
Indiana	BLUCHER A. POOLE
Kentucky	JAMES S. SHROPSHIRE
New York	JOSEPH R. SHAW
Ohio	EMMETT W. ARNOLD, M.D.
Pennsylvania	WESLEY E. GILBERTSON
Virginia	E. BLACKBURN MOORE
West Virginia	EDGAR N. HENRY
Federal	LOUIS G. FEIL

Audit

BARTON A. HOLL, *Chairman*
EDGAR N. HENRY
RUSSELL E. TEAGUE, M.D.

Bylaws

BLUCHER A. POOLE, *Chairman*
LYLE W. HORNBECK
FRANKLIN D. YODER, M.D.

Pension Trust

BARTON A. HOLL
CLARENCE W. KLASSEN
ROBERT K. HORTON

Finance

JOSEPH R. SHAW, *Chairman*
MINOR CLARK
N. H. DYER, M.D.
RAYMOND H. FULLER
MARION K. MCKAY

Salaries and Personnel

MARION K. MCKAY, *Chairman*
N. H. DYER, M.D.
FRANKLIN D. YODER, 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 H. EAGLE
Pennsylvania	WALTER A. LYON
Virginia	A. H. PAESSLER
West Virginia	EDGAR N. HENRY
Corps of Engineers	DONALD T. WILLIAMS
Dept. of Interior	RAYMOND E. JOHNSON
FWPCA	RICHARD A. VANDERHOOF
Secretary	FRED H. WARING
Staff	ROBERT K. HORTON

TWO DECADES OF SERVICE

For reference purposes the following tabulation shows names and terms of those who have served ORSANCO.

STATE OF OHIO

HUDSON BIERY — 1948-1966 *(Deceased)*
Succeeded by Raymond H. Fuller
KENNETH M. LLOYD — 1948-1961
Succeeded by Barton A. Holl
JOHN D. PORTERFIELD, M.D. — 1948-1954
Succeeded by Ralph E. Dwork, M.D.
RALPH E. DWORK, M.D. — 1954-1963
Succeeded by Emmett W. Arnold, M.D.
BARTON A. HOLL — 1961
EMMETT W. ARNOLD, M.D. — 1963
RAYMOND H. FULLER — 1966

STATE OF ILLINOIS

CLARENCE W. KLASSEN — 1948
ROLAND R. CROSS, M.D. — 1948-1959 *(Deceased)*
Succeeded by L. L. Fatherree, M.D.
J. J. WOLTMANN — 1948-1952 *(Deceased)*
Succeeded by W. H. Wisely
W. H. WISELY — 1952-1954
Succeeded by Maurice E. Gosnell
MAURICE E. GOSNELL — 1955-1966
Succeeded by Kenneth E. Damann
L. L. FATHERREE, M.D. — 1960-61
Succeeded by Franklin D. Yoder, M.D.
FRANKLIN D. YODER, M.D. — 1961
KENNETH E. DAMANN — Jan. to Sept. 1966
Succeeded by John E. Pearson
JOHN E. PEARSON — 1968

STATE OF NEW YORK

MARTIN F. HILFINGER — 1948-1954
Succeeded by Joseph R. Shaw
HERMAN E. HILLEBOE, M.D. — 1948-1963
Succeeded by Hollis S. Ingraham, M.D.
CHARLES B. MCCABE — 1948-1954
Succeeded by Earl Devendorf
EARL DEVENDORF — 1954-1960 *(Deceased)*
Succeeded by Lyle W. Hornbeck
JOSEPH R. SHAW — 1954
LYLE W. HORNBECK — 1961
HOLLIS S. INGRAHAM, M.D. — 1963

STATE OF WEST VIRGINIA

N. H. DYER, M.D. — 1948
KENNETH S. WATSON — 1948-1949
Succeeded by Robert F. Rocheleau
W. W. JENNINGS — 1948-1965 *(Deceased)*
Succeeded by Luther N. Dickinson
ROBERT F. ROCHELEAU — 1949-1954
Succeeded by Harry K. Gidley
HARRY K. GIDLEY — 1954-1956
Succeeded by John Lester
JOHN LESTER — 1956-1957
Succeeded by Bern Wright
BERN WRIGHT — 1957-1966
Succeeded by Edgar N. Henry
LUTHER N. DICKINSON — 1965
EDGAR N. HENRY — 1966

STATE OF INDIANA

Blucher A. Poole — 1948
Joseph L. Quinn, Jr. — 1948
L. E. Burney, M.D. — 1948-1954
  Succeeded by A. C. Offutt, M.D.
A. C. Offutt, M.D. — 1954

COMMONWEALTH OF KENTUCKY

Henry Ward — 1948-1955
  Succeeded by Laban P. Jackson
Earl Wallace — 1948-1958 *(Deceased)*
  Succeeded by Minor Clark
Bruce Underwood, M.D. — 1948-1956
  Succeeded by Russell E. Teague, M.D.
Laban P. Jackson — 1955-1959
  Succeeded by J. O. Matlick
Russell E. Teague, M.D. — 1956
Minor Clark — 1958
J. O. Matlick — 1960-1968
  Succeeded by James S. Shropshire
James S. Shropshire — 1968

COMMONWEALTH OF PENNSYLVANIA

E. A. Holbrook — 1948-1956 *(Deceased)*
  Succeeded by Marion K. McKay
H. P. Sorg — 1948-1952
  Succeeded by H. E. Moses
Norris W. Vaux, M.D. — 1948-1951
  Succeeded by Russell E. Teague, M.D.
Russell E. Teague, M.D. — 1951-1955
  Succeeded by Berwyn F. Mattison, M.D.
H. E. Moses — 1952-1957 *(Deceased)*
  Succeeded by Karl M. Mason
Berwyn F. Mattison, M.D. — 1955-1957
  Succeeded by Charles L. Wilbar, Jr., M.D.
Marion K. McKay — 1956
Charles L. Wilbar, Jr., M.D. — 1957-1967 *(Deceased)*
  Succeeded by Thomas W. Georges, Jr., M.D.
Karl M. Mason — 1958-1966 *(Deceased)*
  Succeeded by Wesley E. Gilbertson
Thomas W. Georges, Jr., M.D. — 1967
Wesley E. Gilbertson — 1967

COMMONWEALTH OF VIRGINIA

E. Blackburn Moore — 1948-1960
  Succeeded by William H. Singleton
Ross H. Walker — 1948-1967
  Succeeded by Henry S. Holland, III
T. Brady Saunders — 1948-1962
  Succeeded by E. Blackburn Moore
William H. Singleton — 1960
E. Blackburn Moore — 1962
Henry S. Holland, III — 1968

UNITED STATES GOVERNMENT

O. Lloyd Meehean — 1948-1963
  Succeeded by Raymond E. Johnson
Leonard A. Scheele, M.D. — 1948-1956
  Succeeded by L. E. Burney, M.D.
Robert G. West — 1948-1953 *(Deceased)*
  Succeeded by E. E. Abbott
E. E. Abbott — 1953-1965
  Succeeded by Louis G. Feil
L. E. Burney, M.D. — 1956-1961
  Succeeded by Luther L. Terry, M.D.
Luther L. Terry, M.D. — 1961-1965
  Succeeded by Frank C. DiLuzio
Raymond E. Johnson — 1963
Louis G. Feil — 1965
Frank C. DiLuzio — 1965-1967
  Succeeded by Jacob I. Bregman
Jacob I. Bregman — 1968

Resume of officers—The bylaws of the Commission establish six officers. Of these the chairman and vice-chairman are elected from the membership; the others need not be selected from the membership.

Chairmen of the Commission through the years and their respective terms of office include:

1948-49 — Hudson Biery	(Ohio)
1949-50 — Joseph L. Quinn, Jr.	(Indiana)
1950-51 — Henry Ward	(Kentucky)
1951-52 — Clarence W. Klassen	(Illinois)
1952-53 — E. Blackburn Moore	(Virginia)
1953-54 — Howard E. Moses	(Pennsylvania)
1954-55 — W. W. Jennings	(West Virginia)
1955-56 — Earl Devendorf	(New York)
1956-57 — Kenneth M. Lloyd	(Ohio)
1957-58 — Blucher A. Poole	(Indiana)
1958-59 — Russell E. Teague, M.D.	(Kentucky)
1959-60 — Maurice E. Gosnell	(Illinois)
1960-61 — Ross H. Walker	(Virginia)
1961-62 — Charles L. Wilbar, Jr., M.D.	(Pennsylvania)
1962-63 — Bern Wright	(West Virginia)
1963-64 — Joseph R. Shaw	(New York)
1964-65 — Barton A. Holl	(Ohio)
1965-66 — A. C. Offutt, M.D.	(Indiana)
1966-67 — J. O. Matlick	(Kentucky)
1967-68 — Franklin D. Yoder, M.D.	(Illinois)
1968-69 — Marion K. McKay	(Pennsylvania)

All of the chairmen, with the exception of Hudson Biery, served as vice-chairman the year prior to their election. The current vice-chairman is N. H. Dyer, M. D., of West Virginia.

The office of treasurer has been held by Ralph M. Strotman (1948-50); Robert K. Horton (1950-56); and since 1956 by Mrs. Verna B. Ballman.

No change has occurred since the formation of the Commission in the secretaryship, which is held by Fred H. Waring, or in the office of legal counsel which is occupied by Leonard A. Weakley. The post of executive director and chief engineer was filled by Edward J. Cleary from 1949 to 1967 when he relinquished administrative duties to serve as consultant. Robert K. Horton assumed this office on October 1, 1967.

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)

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 $182,000)
	Square Miles	Percent of Total	Population	Percent of Total		
Illinois	10,745	7.0%	591,109	3.2%	5.10%	$ 9,282
Indiana	29,135	18.9	3,227,072	17.3	18.10	32,942
Kentucky	39,375	25.5	2,981,670	16.0	20.75	37,765
New York	1,955	1.3	168,365	0.9	1.10	2,002
Ohio	29,570	19.2	5,702,592	30.6	24.90	45,318
Pennsylvania	15,620	10.1	3,783,796	20.3	15.20	27,664
Virginia	7,175	4.6	457,312	2.4	3.50	6,370
West Virginia	20,610	13.4	1,738,006	9.3	11.35	20,657
TOTALS	154,185	100.0%	18,649,922	100.0%	100.0%	$182,000

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, 1968.

OHIO RIVER VALLEY WATER SANITATION COMMISSION

STATEMENT OF REVENUES COLLECTED AND EXPENSES PAID YEAR ENDED JUNE 30, 1968

Revenues collected:		
From signatory states, Schedule A		$171,210.00
From U. S. Department of Interior (Grant by authority of Federal Water Pollution Control Act)		159,460.00
Sale of publications		380.60
Interest earned on bank deposit		2,937.95
Total revenues collected		333,988.55
Expenses paid:		
From state funds	$167,421.64	
From federal funds	142,377.70	
Total expenses paid		309,799.34
Excess of revenues collected over expenses paid		$ 24,189.21

STATEMENT OF RESOURCES JUNE 30, 1968

	State Funds	Federal Funds	Total
Available resources for period to June 30, 1967	$ 24,584.07	$ 12,075.13	$ 36,659.20
Add: Revenues collected:			
Annual budget — July 1, 1967 to June 30, 1968 (for detail see Schedule A)	182,000.00		182,000.00
U. S. Department of Interior		159,460.00	159,460.00
Sale of publications	380.60		380.60
Interest earned on bank deposit	2,937.95		2,937.95
	209,902.62	171,535.13	381,437.75
Less: Expenses paid: July 1, 1967 to June 30, 1968	167,421.64	142,377.70	309,799.34
Available resources at June 30, 1968 before encumbrances	42,480.98	29,157.43	71,638.41
Encumbered resources at June 30, 1968	15,120.00	7,100.00	22,220.00
Available resources at June 30, 1968	$ 27,360.98	$ 22,057.43	$ 49,418.41

The above amount of $71,638.41 is comprised as follows:		
Cash on deposit with The Central Trust Company		$ 58,272.93
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:		
Signatory states:		
Commonwealth of Kentucky (payment received July 9, 1968)		10,790.00
Advances for employees:		
Employees' pension trust	$ 1,646.78	
Hospitalization	183.70	1,830.48
Total		$ 71,638.41

SCHEDULE A—REVENUES COLLECTED FROM SIGNATORY STATES

	Balance Due June 30, 1967	Annual Budget	Revenues Collected	Balance Due June 30, 1968
State of Illinois	$	$ 9,282.00	$ 9,282.00	$ ....
State of Indiana	....	32,942.00	32,942.00	....
Commonwealth of Kentucky	....	37,765.00	26,975.00	* 10,790.00
State of New York	....	2,002.00	2,002.00	....
State of Ohio	....	45,318.00	45,318.00	....
Commonwealth of Pennsylvania	....	27,664.00	27,664.00	....
Commonwealth of Virginia	....	6,370.00	6,370.00	....
State of West Virginia	....	20,657.00	20,657.00	....
Total	$	$182,000.00	$171,210.00	$ 10,790.00

*Payment received July 9, 1968

REGULATORY AGENCIES

OF THE

SIGNATORY STATES

ILLINOIS	Technical Secretary State Sanitary Water Board 616 State Office Building Springfield, Illinois 62706 Phone: 525-6580
INDIANA	Technical Secretary Indiana Stream Pollution Control Board 1330 West Michigan Street Indianapolis, Indiana 46206 Phone: 633-4420
KENTUCKY	Executive Director and Chief Engineer Kentucky Water Pollution Control Commission 275 East Main Street Frankfort, Kentucky 40601 Phone: 564-3410
NEW YORK	Deputy Commissioner Environmental Health Services New York State Department of Health 84 Holland Avenue Albany, New York 12208 Phone: 474-2933
OHIO	Chief Engineer Division of Engineering Ohio Department of Health P. O. Box 118 Columbus, Ohio 43216 Phone: 469-4470
PENNSYLVANIA	Sanitary Water Board Box No. 90 Harrisburg, Pennsylvania 17120 Phone: 787-4190
VIRGINIA	Executive Secretary State Water Control Board P. O. Box 11143 Richmond, Virginia 23230 Phone: 770-2241
WEST VIRGINIA	Chief Division of Water Resources Department of Natural Resources 1201 Greenbrier Street Charleston, West Virginia 25311 Phone: 348-2107