OHIO RIVER

Recommended Pollution Control Standards

Pittsburgh to Cairo Point

OHIO RIVER VALLEY WATER SANITATION COMMISSION

OHIO RIVER VALLEY
WATER SANITATION COMMISSION

414 WALNUT STREET, CINCINNATI, OHIO 45202

LYLE W. HORNBECK
CHAIRMAN

ROBERT K. HORTON
EXECUTIVE DIRECTOR
AND CHIEF ENGINEER

To the Chairman and
Members of the Commission

Gentlemen:

In conformance with action by the Commission, a study has been made by the staff directed toward the assembly and interpretation of information needed for updating pollution-control standards for municipal and industrial wastes discharged to the Ohio River.

Findings and recommendations from that study, which have been reviewed by the Engineering Committee, are set forth in this report.

At a meeting on May 15, 1970, the Commission directed that a public hearing be held, pursuant to authority contained in Article VI of the compact, for the purpose of considering the findings and recommendations in this report, and for receiving such other data and information as may be pertinent to the updating of pollution-control standards for the Ohio River.

Such a hearing will be held in Room 842, U. S. Post Office and Court House, Fifth and Main Streets, Cincinnati, Ohio, commencing at 9:00 A.M. on the 16th day of September, 1970, and continuing thereafter from day to day until completed. Members of the Hearing Board are: Lyle W. Hornbeck, Commissioner from New York and Chairman of the Hearing Board; Barton Holl, Commissioner from Ohio; and James S. Shropshire, Commissioner from Kentucky.

Respectfully submitted,

Robert K. Horton
ROBERT K. HORTON

August 14, 1970
Cincinnati, Ohio

POLLUTION CONTROL STANDARDS

FOR THE OHIO RIVER

Pittsburgh, Pa., to Cairo Point, Ill.

RECOMMENDATIONS

On the basis of investigations made pursuant to Article VI of the compact, and in accordance with findings of the Engineering Committee, it is recommended that, subject to revision as changing conditions may require, the following pollution control standards, together with accompanying definitions and application procedures, be established for sewage and industrial wastes discharged to the Ohio River.

Pollution Control Standard No. 1

All sewage from municipalities or political subdivisions, public or private institutions, or installations, or corporations, and all industrial wastes, other than cooling water, discharged or permitted to flow into the Ohio River from the point of confluence of the Allegheny and Monongahela rivers at Pittsburgh, Pa., designated as Ohio River mile point 0.0, to Cairo Point, Ill., located at the confluence of the Ohio and Mississippi rivers, and being 981.0 miles downstream from Pittsburgh, shall be so treated or otherwise modified as to provide for:

(a) Substantially complete removal of settleable solids;

(b) Substantially complete removal of debris, oil, scum and other floating materials;

(c) Substantially complete removal of materials producing in the receiving stream turbidity, color, odor, or objectionable taste conditions;

(d) Reduction of all materials that singly or in combination are toxic or harmful to aquatic life to such degree that the concentration thereof in the discharge does not exceed the 96-hour median tolerance limit for aquatic life;

(e) Substantially complete removal of the following chemical substances:

Inorganic chemicals

Arsenic	Lead
Barium	Mercury
Cadmium	Selenium
Chromium, hexavalent	Silver
Cyanide	

Organic chemicals

Acrylonitrile	Methoxychlor
Aldrin	Naphthalene
Carbamate compounds *	Organophosphorus compounds *
Chlordane	Phenolic compounds
DDT	Tetraethyl lead
Dieldrin	Tetramethyl lead
Endrin	Toxaphene
Heptachlor	2,4-dichlorophenoxyacetic acid
Heptachlor epoxide	2,4,5-trichlorophenoxyacetic acid
Lindane	2,4,5-trichlorophenoxyproprionic acid

* Expressed in terms of parathion equivalent cholinesterase inhibition

(f) Reduction of radioactive materials to such degree that:

(1) Total gross activity (alpha, beta and gamma), above natural background, from all emitters exclusive of tritium does not exceed 100 picocuries per liter (pc/l); (2) activity from alpha emitters does not exceed 3 pc/l; and (3) activity from tritium does not exceed 300,000 pc/l;

(g) Reduction of fecal coliform bacteria to such degree that the density thereof does not exceed 400 per 100 ml at any time during the months of May through October, nor exceed 2,000 per 100 ml at any time during the months of November through April;

(h) Control of hydrogen ion concentration to such degree that the pH is not less than 5.0 nor greater than 9.0;

(i) Reduction of 5-day biochemical-oxygen-demand load (in pounds per day) as follows:

(1) Not less than 90 percent reduction (monthly-average) during the months of May through October; provided, however, that a lesser degree of reduction may be applied, but not less than 75 percent, if as a result the biochemical-oxygen-demand (BOD) load does not exceed that amount which will increase the BOD of the river, on a calculated basis, by more than 0.05 milligrams per liter at flows equal to or exceeding "critical" flow values specified in the following table:

River Reach		Critical flow (Min. 7-day flow once in 10 years) cfs
From	To	
Pittsburgh (mi. 0.0)	Willow Is. Dam (161.7)	6,600
Willow Is. Dam (161.7)	Gallipolis Dam (279.2)	7,700
Gallipolis Dam (279.2)	Meldahl Dam (436.2)	9,900
Meldahl Dam (436.2)	McAlpine Dam (605.8)	12,100
McAlpine Dam (605.8)	Uniontown Dam (846.0)	14,300
Uniontown Dam (846.0)	Smithland Dam (918.5)	28,900
Smithland Dam (918.5)	Cairo Point (981.0)	48,500

(2) Not less than 75 percent reduction (monthly-average) during the months of November through April;

(j) Reduction of not less than 75 percent of total suspended solids;

(k) Reduction of heat content to such degree that the aggregate heat-discharge rate from the municipality, subdivision, institution, installation or corporation, as calculated on the basis of discharge volume and temperature differential (temperature of discharge minus upstream river temperature), does not exceed the amount calculated by the following formula,

provided, however, that in no case shall the aggregate heat-discharge rate be of such magnitude as will result in a calculated increase in river temperature of more than 5 deg. F.:

$$\text{Allowable heat-discharge rate (Btu/sec)} = 62.4 \times \text{river flow}^{*} \text{ (cfs)} \times (T_A - T_R) \times 90\%$$

Where T_A = Allowable maximum temperature (deg. F.) in the river as specified in the following table:

	T_A		T_A
January	50	July	89
February	50	August	89
March	60	September	87
April	70	October	78
May	80	November	70
June	87	December	57

T_R = River temperature (deg. F.) upstream from the discharge

* Minimum values for river flow to be used in the formula shall not be less than "critical" flow values specified in the following table:

River Reach		Critical flow (Min. daily flow once in 10 years) cfs
From	To	
Pittsburgh (mi. 0.0)	Willow Is. Dam (161.7)	6,500
Willow Is. Dam (161.7)	Gallipolis Dam (279.2)	7,400
Gallipolis Dam (279.2)	Meldahl Dam (436.2)	9,700
Meldahl Dam (436.2)	McAlpine Dam (605.8)	11,900
McAlpine Dam (605.8)	Uniontown Dam (846.0)	14,200
Uniontown Dam (846.0)	Smithland Dam (918.5)	28,500
Smithland Dam (918.5)	Cairo Point (981.0)	48,100

Pollution Control Standard No. 2

All cooling water from municipalities or political subdivisions, public or private institutions, or installations, or corporations discharged or permitted to flow into the Ohio River from the point of confluence of the Allegheny and Monongahela rivers at Pittsburgh, Pa., designated as Ohio River mile point 0.0, to Cairo Point, Ill., located at the confluence of the Ohio and Mississippi rivers, and being 981.0 miles downstream from Pittsburgh, Pa., shall be so regulated or controlled as to provide for reduction of heat content to such degree that the aggregate heat-discharge rate from the municipality, subdivision, institution, installation or corporation, as calculated on the basis of discharge volume and temperature differential (temperature of discharge minus upstream river temperature), does not exceed the amount calculated by the following formula, provided, however, that in no case shall the aggregate heat-discharge rate be of such magnitude as will result in a calculated increase in river temperature of more than 5 deg. F.:

$$\underset{\text{(Btu/sec)}}{\text{Allowable heat-discharge rate}} = 62.4 \times \underset{\text{(cfs)}}{\text{river flow*}} \times (T_A - T_R) \times 90\%$$

Where T_A = Allowable maximum temperature (deg. F.) in the river as specified in the following table:

	T_A		T_A
January	50	July	89
February	50	August	89
March	60	September	87
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May	80	November	70
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T_R = River temperature (deg. F.) upstream from the discharge

* Minimum values for river flow to be used in the formula shall not be less than "critical" flow values specified in the following table:

River Reach		Critical flow (Min. daily flow once in 10 years) cfs
From	To	
Pittsburgh (mi. 0.0)	Willow Is. Dam (161.7)	6,500
Willow Is. Dam (161.7)	Gallipolis Dam (279.2)	7,400
Gallipolis Dam (279.2)	Meldahl Dam (436.2)	9,700
Meldahl Dam (436.2)	McAlpine Dam (605.8)	11,900
McAlpine Dam (605.8)	Uniontown Dam (846.0)	14,200
Uniontown Dam (846.0)	Smithland Dam (918.5)	28,500
Smithland Dam (918.5)	Cairo Point (981.0)	48,100

Pollution Control Standard No. 3

All sewage, lavatory and galley wastes discharged from commercial and pleasure watercraft and from other floating facilities operating or moored on the Ohio River shall be treated or otherwise modified to such degree that the discharge shall be free from odor, color, settleable solids and other visible matter, shall not contain a 5-day biochemical-oxygen-demand greater than 50 mg/l, and shall not contain a fecal-coliform concentration greater than 50 per 100 ml.

Definitions and Procedures for Application of Pollution Control Standards Nos. 1, 2 and 3

The following definitions and application procedures are incorporated as part of Pollution Control Standards Nos. 1, 2 and 3:

(a) "Sewage" means the water carried human or animal wastes from residences, buildings, industrial, commercial and governmental establishments, or other places, together with such groundwater infiltration and surface-waters as may be present. The admixture with sewage, as defined, of industrial wastes, as hereinafter defined, shall also be regarded as sewage.

(b) "Industrial waste," other than cooling water, means any liquid, gaseous, solid material or waste substance or combination thereof including garbage, refuse, decayed wood, sawdust, shavings, bark, sand, lime, cinders, ashes, offal, oil, tar, dyestuffs, acids, chemicals, heat and all discarded matter resulting from any process or operation, including storage and transportation, manufacturing, commercial, agricultural and governmental operations, or from the development and recovery of any natural resources.

(c) "Cooling water" means water used as a heat transfer medium to which no process, waste or other materials, exclusive of chlorine, are added prior to discharge.

(d) "Substantially complete removal" means removal to the lowest practicable level attainable with current technology. In the case of specific chemical substances listed in Paragraph (e) of Pollution Control Standard No. 1, substantially complete removal shall be interpreted to mean removal to levels at or below those specified in U. S. Public Health Service Standards as maximum limiting concentrations for public water supplies.

(e) Methods for determining waste constituents and characteristics shall be those set forth in the most recent edition of "Standard Methods for the Examination of Water and Wastewater," prepared and published jointly by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation, except that such other methods may be used as are approved by the Commission.

PURPOSE AND SCOPE

This report has been directed toward the assembly and interpretation of information needed in establishing pollution-control standards for municipal and industrial wastes discharged to the Ohio River.

Article I of the Ohio River Valley Water Sanitation Compact pledges the eight signatory states to take such action as is needed to place and maintain the waters of the compact district in a satisfactory sanitary condition, available for use as public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining fish and other aquatic life, free from nuisances and adaptable to such other uses as may be legitimate.

Article VI authorizes the Commission to adopt, prescribe and promulgate rules, regulations and standards for the treatment or modification of sewage and industrial wastes to such degree as may be necessary to meet river quality conditions specified in Article I.

Between 1949 and 1954 the Commission, after conducting a series of public hearings, adopted treatment standards for sewage discharges in each of seven sections of the Ohio River, extending from Pittsburgh to Cairo. All of the standards adopted at that time provided for substantially complete removal of settlea.e solids and removal of not less than forty-five percent of total suspended solids. In addition, some of the standards contained specifications regarding the reduction of coliform organisms and biochemical-oxygen-demand content of discharges.

Minimum, or basic, requirements for the treatment and control of industrial wastes in the Compact District were adopted by the Commission in 1955. These requirements specified that all industrial wastes should be treated or otherwise modified so as to maintain the following conditions in the receiving waters:

1. Freedom from anything that will settle to form putrescent or otherwise objectionable sludge deposits which interfere with reasonable water uses.

2. Freedom from floating debris, scum and other floating materials in amounts sufficient to be unsightly or deleterious.

3. Freedom from materials producing color or odor in such degree as to create a nuisance.

4. Freedom from substances in concentrations or combinations which are toxic or harmful to human, animal or aquatic life.

The foregoing requirements were enunciated in connection with the adoption of a statement of policy and procedure on the control of industrial wastes, which statement represented an agreement on basic principles among the eight signatory states and established a framework for the development of additional control measures.

Subsequent to the adoption of that statement, a series of industrial-waste control measures, expressed in terms of policy resolutions, were established dealing with acid mine drainage, chloride discharges, oil and oily substances, phenolic discharges, color-producing materials and toxic substances.

The recommendations set forth in this report are designed to update the sewage-treatment standards previously adopted, and to transpose certain of the industrial-waste control measures into more formal effluent standards. The recommendations, moreover, provide a mechanism for integrating waste-control requirements established by the individual states, and thus they constitute an essential element of a regional plan for controlling pollution in the Ohio River.

A list of municipalities and industries reported by the signatory states to be discharging wastes directly to the Ohio River is appended to this report.

HYDROMETRIC DATA

The following table shows minimum 1-day, 7-day and 30-day flows that may be expected at various gaging stations on the Ohio River at an average frequency of once in ten years:

Gage	Flow to be expected once in ten years (cfs)		
	Min. daily avg.	Min. 7-day avg.	Min. 30-day avg.
Sewickley, Pa. (mi. 11.5)	6,500	6,600	6,700
Parkersburg, W. Va. (184.4)	7,400	7,700	8,800
Huntington, W. Va. (311.6)	9,700	9,900	10,900
Cincinnati, O. (470.5)	11,900	12,100	12,900
Louisville, Ky. (607.0)	14,200	14,300	14,500
Evansville, Ind. (792.3)	16,300	16,600	18,100
Metropolis, Ill. (944.0)	48,100	48,500	50,100

Values shown in the table for minimum 7-day and 30-day flows have been supplied by the U. S. Army Corps of Engineers; values for minimum 1-day flows have been extrapolated from information supplied by the Corps. All values reflect the effects of flow augmentation that may be expected from upstream reservoirs now in operation or that will be in operation by the mid 1970s.

INTERPRETATION AND APPLICATION

Pollution Control Standard No. 1

Settleable, floating and taste-and-odor producing materials

Recommendation:

All sewage and industrial wastes discharged to the Ohio River shall be so treated or otherwise modified as to provide for:

(a) Substantially complete removal of settleable solids;

(b) Substantially complete removal of debris, oil, scum and other floating materials;

(c) Substantially complete removal of materials producing in the receiving stream turbidity, color, odor, or objectionable taste conditions.

These three requirements provide for compliance with "minimum conditions" specified in water-quality criteria adopted by ORSANCO in 1966. Water-quality criteria and implementation plans adopted by the states bordering the Ohio River are in harmony with these requirements.

Toxic substances

Recommendation:

All sewage and industrial wastes discharged to the Ohio River shall be so treated or otherwise modified as to provide for reduction of all materials that singly or in combination are toxic or harmful to aquatic life to such degree that the concentration thereof in the discharge does not exceed the 96-hour median tolerance limit for aquatic life.

In its Fourth Progress Report (September 1967), the ORSANCO Aquatic Life Advisory Committee (ALAC) recommended the following criterion for the purpose of determining acceptable levels of toxic wastes in streams of the Ohio Basin:

"The final concentration of any waste in the receiving water should not exceed one-tenth of the 96-hour median tolerance limit (Tlm) except that other limiting concentrations may be used in specific cases when justified on the basis of available evidence and approved by the appropriate regulatory agency."

The recommended control standard provides that the concentration of toxic substances in the discharge shall not exceed the 96-hour median tolerance limit for aquatic life. Critical flow (minimum 7-day flow occurring once in ten years) in the uppermost reach of the Ohio River is 6,600 cfs, or 4,265 million gallons per day (mgd). At this flow, the stream-quality criterion recommended by ALAC would be met, after mixing, following the discharge of 426.5 mgd of a waste that had been treated to conform with the recommended control standard. Other than for cooling water discharges from electric power generating stations, there is no single sewage or industrial waste discharge to the Ohio River whose magnitude presently exceeds 150 mgd. Thus, the control standard incorporates a factor of safety with regard to substances potentially toxic to aquatic life.

Compliance with the recommended control standard should insure the maintenance of river quality conditions at levels meeting or exceeding (better than) the most stringent requirements established individually by the signatory states. Indiana, for example, requires that concentrations of toxic substances in the receiving stream not exceed one-tenth of the 96-hour median tolerance limit (the same stream criterion as that recommended by ALAC). Illinois, Kentucky, Ohio and West Virginia have specified that concentrations should not exceed one-tenth of the 48-hour median tolerance limit. Pennsylvania requires that toxic substances be reduced to levels that will "not pollute the receiving stream."

Specific chemical substances

Recommendation:

All sewage and industrial wastes discharged to the Ohio River shall be so treated or otherwise modified as to provide for substantially complete removal of the following chemical substances:

Inorganic chemicals

Arsenic	Lead
Barium	Mercury
Cadmium	Selenium
Chromium, hexavalent	Silver
Cyanide	

Organic chemicals

Acrylonitrile	Methoxychlor
Aldrin	Naphthalene
Carbamate compounds*	Organophosphorus compounds*
Chlordane	Phenolic compounds
DDT	Tetraethyl lead
Dieldrin	Tetramethyl lead
Endrin	Toxaphene
Heptachlor	2,4-dichlorophenoxyacetic acid
Heptachlor epoxide	2,4,5-trichlorophenoxyacetic acid
Lindane	2,4,5-trichlorophenoxyproprionic acid

* Expressed in terms of parathion equivalent cholinesterase inhibition

The foregoing list includes chemicals that are known to be highly toxic or detrimental to river quality. The list has been compiled on the basis of information in existing drinking water standards, new drinking water standards now under development, report of the National Technical Advisory Committee on Water Quality Criteria submitted to the Secretary of the Interior on April 1, 1968, and Coast Guard regulations pertaining to dangerous cargoes.

Current drinking water standards, which were issued by the U. S. Public Health Service in 1962, contain limiting concentrations for all of the inorganic chemicals included in the foregoing list except mercury. It is presumed that a limiting concentration for mercury will be included in the new drinking water standards now under development.

All of the organic chemicals listed, except acrylonitrile, tetraethyl lead, tetramethyl lead and naphthalene, are pesticides or herbicides for which limiting concentrations are recommended in the new drinking water standards under development and in the report of the National Technical Advisory Committee on Water Quality Criteria.

From the standpoint of health considerations, acrylonitrile, tetraethyl lead and tetramethyl lead appear to be the most significant of the chemicals listed by the Coast Guard as "dangerous cargoes," because of their extreme toxicity and widespread use. For this reason, these chemicals are included in the recommended control standard.

Naphthalene, although not as toxic as some of the other chemicals, is included in the recommended control standard because of the severe effects it has, even in minute quantities, on taste-and-odor characteristics of public water supplies and the difficulty in controlling these effects at water treatment plants.

Radioactive materials

Recommendation:

> All sewage and industrial wastes discharged to the Ohio River shall be so treated or otherwise modified as to provide for reduction of radioactive materials to such degree that: (1) Total gross activity (alpha, beta and gamma), above natural background, from all emitters exclusive of tritium does not exceed 100 picocuries per liter (pc/l); (2) activity from alpha emitters does not exceed 3 pc/l; and (3) activity from tritium does not exceed 300,000 pc/l.

The recommended limit of 100 pc/l for gross activity reflects findings of the ORSANCO Aquatic Life Advisory Committee (Fourth Progress Report, September 1967) and requirements of the Atomic Energy Commission.

A limit of 3 pc/l for alpha activity in waste discharges is included in the recommended control standard to insure that alpha activity in the river does not exceed the maximum permissible concentration for drinking water specified in Public Health Service standards, which permissible concentration is also 3 pc/l.

The limit established by AEC for tritium in water is 3,000,000 pc/l. The recommended control standard limits tritium activity in waste discharges to one-tenth of that value. Information is available indicating that nuclear power generating plants can meet the 300,000 pc/l limit in their discharges with current technology.

Fecal coliform

Recommendation:

> All sewage and industrial waste discharged to the Ohio River shall be so treated or otherwise modified as to provide for reduction of fecal coliform bacteria to such degree that the density thereof does not exceed 400 per 100 ml during the months of May through October, nor exceed 2,000 per 100 ml during the months of November through April.

The recommended standard is intended to insure that sources of pathogenic organisms are disinfected to such degree as will safeguard the following uses of the river: (1) public water supply at all times; (2) body-contact recreation during the months of May through October; (3) partial-body-contact recreation during the months of November through April.

The states of Indiana, Ohio and West Virginia require that all sewage discharges be "satisfactorily disinfected;" however, these states have not established specific numerical limits for bacterial densities in discharges. Numerical limits established by Illinois and Pennsylvania are compared with those in the recommended ORSANCO standard in the following tabulation:

	Maximum allowable fecal-coliform density in discharges (No. of organisms per 100 ml)	
	Receiving water used for body-contact recreation	Receiving water used as a source of public water supply and for partial-body-contact recreation
ORSANCO recommended standard	Not over 400 at any time (May through October)	Not over 2,000 at any time (November through April)
Illinois	Not over 400 at any time	Not over 2,000 at any time
Pennsylvania	Monthly geometric mean: 200 Not over 1,000 in more than 10% of samples	Monthly geometric mean: 200 Not over 1,000 in more than 10% of samples

Hydrogen ion (pH)

Recommendation:

All sewage and industrial waste discharged to the Ohio River shall be so treated or otherwise modified as to provide for control of hydrogen ion concentration to such degree that the pH is not less than 5.0 nor greater than 9.0.

The pH range for discharges specified in the foregoing standard, in effect, prohibits the discharge of free mineral acidity and hydroxyl alkalinity to the river.

Biochemical oxygen demand (BOD)

Recommendation:

All sewage and industrial waste discharged to the Ohio River shall be so treated or otherwise modified as to provide for reduction of 5-day biochemical-oxygen-demand load (in pounds per day) as follows:

(1) Not less than 90 percent reduction (monthly-average during the months of May through October; provided, however, that a lesser degree of reduction may be applied, but not less than 75 percent, if as a result the BOD load does not exceed that amount which will increase the BOD of the river, on a calculated basis, by more than 0.05 milligrams per liter at flows equal to or exceeding "critical" flow values specified in the following table:

River reach		Critical flow (Min. 7-day flow once in 10 years) cfs
From	To	
Pittsburgh (mi. 0.0)	Willow Is. Dam (161.7)	6,600
Willow Is. Dam (161.7)	Gallipolis Dam (279.2)	7,700
Gallipolis Dam (279.2)	Meldahl Dam (436.2)	9,900
Meldahl Dam (436.2)	McAlpine Dam (605.8)	12,100
McAlpine Dam (605.8)	Uniontown Dam (846.0)	14,300
Uniontown Dam (846.0)	Smithland Dam (918.5)	28,900
Smithland Dam (918.5)	Cairo Point (981.0)	48,500

(2) Not less than 75 percent reduction (monthly-average) during the months of November through April.

This standard is designed to maintain oxygen conditions in the river at levels equal to or exceeding (better than) those suitable for aquatic life, as specified in stream criteria adopted by ORSANCO. Criteria specifications call for the maintenance of conditions such that dissolved-oxygen (DO) concentrations are not less than 4.0 mg/l at any time, nor less than 5.0 mg/l in terms of daily-average values.

In order to meet these specifications, a reduction in BOD of 90 percent is required during the summer, low-flow months (May through October) for some of the larger loads, notably those from sewage-treatment plants serving the Pittsburgh, Cincinnati and Louisville metropolitan areas.

Specification of a minimum reduction in BOD of 75 percent is in harmony with a policy adopted jointly by the signatory states requiring "secondary treatment" for all biodegradable wastes. Not all of the signatory states have defined "secondary treatment" in terms of the amount or percentage of BOD reduction that is required. Of those that have, Illinois and Indiana require 80 percent reduction for trickling filters and 90 percent reduction for activated sludge plants. Pennsylvania has defined secondary treatment as 85 percent BOD reduction during the months of May through October, and 75 percent reduction during the other months of the year.

The recommended standard sets forth conditions under which BOD reductions between 75 percent and 90 percent may be applied. The controlling factor in determining whether a reduction of less than 90 percent may be applied is the amount of BOD that will be added to the river by a waste discharge after it has been treated. As provided in the standard, residual loads that will not increase the BOD of the river at flows equal to or greater than "critical flow" by more than 0.05 mg/l are allowed. Studies show that an increase of 0.05 mg/l in BOD from any single source has no significant effect on DO levels in the river.

For purposes of BOD control, "critical flow" is defined as the minimum 7-day average flow that may be expected to occur at an average frequency of once in ten years.

In developing the recommended control standard, consideration has been given to such factors as: variations in critical flow, location of major tributaries, geographical distribution of population, and location of industrial centers. In recognition of these factors and in view of other practical considerations (such as the location of navigation dams), the river has been divided into seven separate reaches. These reaches are defined in the standard itself and are also shown on an accompanying map.

Critical-flow values indicated in the standard correspond to minimum 7-day flows occurring once in ten years at gaging stations within each reach nearest the upstream boundary (see page 8). In the case of the reach between Uniontown Dam and Smithland Dam, the gaging station at Golconda, Ill., (mile 903.1) has been used, and information on critical flow at this gage has been interpolated from information supplied by the Corps of Engineers for gages at Evansville and Metropolis on the basis of respective drainage areas.

The recommended control standard recognizes that biological treatment plants operate more efficiently during the warmer months of the year than they do during the colder months. For example, the efficiency of a plant providing 90 percent BOD reduction during the months of May through October may be expected to be as low as 75 percent reduction during the months of November through April. Studies indicate, however, that because of higher flows (greater dilution) and higher DO-saturation values during the months of November through April, 75 percent BOD reduction during this period is adequate, even for the larger loads, to maintain DO concentrations in the river at desirable levels.

In view of the geographical distribution and magnitude of existing BOD loads, and in view of projections available on population growth and economic development in the valley, it appears that the recommended standard will provide adequate protection to river quality at the present time and for some years to come. Indications are that the allocation of assimilative capacity among some of the larger loads or, alternatively, the establishment of higher degrees of BOD reduction for all loads are not likely to become matters of concern prior to 1990.

Suspended solids

Recommendation:

> All sewage and industrial wastes discharged to the Ohio River shall be so treated or otherwise modified as to provide for reduction of not less than 75 percent of total suspended solids.

This standard sets a "floor" or minimum degree of removal for both organic and inorganic suspended solids. When applied in connection with other recommended requirements dealing with settleable solids and turbidity-producing materials, the standard should provide adequate safeguards with respect to the solids content of discharges going to the river. Removal efficiencies can be expected to be greater than 75 percent in the case of well-operated biological and other treatment plants.

Pollution Control Standard No. 2
(and Part (k) of Pollution Control Standard No. 1)

Temperature

Recommendation:

> All sewage, industrial wastes and cooling water from municipalities or political subdivisions, public or private institutions, or installations, or corporations discharged or permitted to flow into the Ohio River from the point of confluence of the Allegheny and Monongahela rivers at Pittsburgh, Pa., designated as Ohio River mile point 0.0, to

Cairo Point, Ill., located at the confluence of the Ohio and Mississippi rivers, and being 981.0 miles downstream from Pittsburgh, Pa., shall be so regulated or controlled as to provide for reduction of heat content to such degree that the aggregate heat-discharge rate from the municipality, subdivision, institution, installation or corporation, as calculated on the basis of discharge volume and temperature differential (temperature of discharge minus upstream river temperature), does not exceed the amount calculated by the following formula, provided, however, that in no case shall the aggregate heat-discharge rate be of such magnitude as will result in a calculated increase in river temperature of more than 5 deg. F.:

$$\underset{\text{(Btu/sec)}}{\text{Allowable heat-discharge rate}} = 62.4 \times \underset{\text{(cfs)}}{\text{river flow}^*} \times (T_A - T_R) \times 90\%$$

Where T_A = Allowable maximum temperature (deg. F.) in the river as specified in the following table:

	T_A		T_A
January	50	July	89
February	50	August	89
March	60	September	87
April	70	October	78
May	80	November	70
June	87	December	57

T_R = River temperature (deg. F.) upstream from the discharge

* Minimum values for river flow to be used in the formula shall not be less than "critical" flow values specified in the following table:

River Reach		Critical flow (Min. daily flow once in 10 years) cfs
From	To	
Pittsburgh (mi. 0.0)	Willow Is. Dam (161.7)	6,500
Willow Is. Dam (161.7)	Gallipolis Dam (279.2)	7,400
Gallipolis Dam (279.2)	Meldahl Dam (436.2)	9,700
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McAlpine Dam (605.8)	Uniontown Dam (846.0)	14,200
Uniontown Dam (846.0)	Smithland Dam (918.5)	28,500
Smithland Dam (918.5)	Cairo Point (981.0)	48,100

This standard provides for day-to-day adjustments in heat discharge rates in accordance with variations in river temperature and river flow. Application of the standard requires, among other things, that information on flow conditions be available to dischargers on a daily basis. Such information is readily available from the ESSA Weather Bureau, Ohio River Forecast Center, Cincinnati. That agency already is providing forecasts each day for some thirteen locations on the Ohio River showing flow for the current day and for each of the next three days.

The recommended standard is designed to safeguard quality conditions in the river at flows equal to or greater than the minimum daily-average flow occurring once in ten years. The once-in-ten-year flow, thus, is the "critical" or minimum flow to be considered by dischargers in the design of cooling facilities. "Critical-flow" values for each of seven reaches of the river are shown in the standard. The reaches specified are the same as those incorporated in the control standard for BOD (see accompanying map). Critical flow values for control of temperature are based on records at gaging stations within each river reach nearest the upstream boundary (see page 8), the Golconda gage again being used for the Uniontown-Smithland reach.

The table of allowable maximum temperature values incorporated in the standard conforms to recommendations made in recent months by the Federal Water Quality Administration. The same table is currently being used by the states of Ohio and Indiana.

A study was made to determine if the recommended control standard might have to be adjusted or modified in order to provide a means for allocating the "assimilative" or heat-transfer capacity of the river among various discharges. Is it likely, for example, that application of the recommended standard could create a situation in which one power plant, say, would usurp virtually the entire heat-transfer capacity of the river, with the result that the next downstream plant could not discharge any heat at all? To examine this question, a review was made of the location and magnitude of heat loads going to the river, both with regard to existing loads and future loads insofar as they have been projected. Findings reveal that the problem of allocation is of no practical concern at the moment, nor is it likely to be in the immediate future.

The last term -- "90 percent" -- in the formula for calculating allowable heat-discharge rates is included as a "safety" or "growth-allowance" factor. Its inclusion is intended to insure the maintenance of larger "zones of passage" for fish and other aquatic life (zones unaffected by heat loads) than might otherwise exist.

Municipalities and institutions reported by the signatory states to be discharging wastes directly to the Ohio River

PENNSYLVANIA

Allegheny Co. Sanitary Authority
(Pittsburgh and 70 communities)
Aliquippa
Ambridge
Baden (Harmony Twp.)

Beaver
Brighton Twp.
Center Twp.
Conway
Coraopolis (Moon & Robinson Twp.)

Dixmont Hospital
Glenfield
Hopewell Twp.
Leetsdale (Edgeworth)
Midland

Monaca
Robinson Garden Authority
Rochester Area Sanitary Authority
(4 communities)
Sewickley (Osborne)

WEST VIRGINIA

Beech Bottom
Belmont
Benwood
Ceredo
Chester

Colin Anderson Hospital
Follansbee
Glen Dale
Huntington
Kenova

Mason
McMechen
Moundsville (W. Va. Penitentiary)
New Cumberland
Newell

New Haven
New Martinsville
Ohio County PSD
Paden City
Parkersburg

WEST VIRGINIA- (Cont.)

Point Pleasant (Henderson)
Power
Ravenswood
Sistersville
St. Marys
Vienna
Weirton
Wellsburg
Wheeling (Bethlehem)
Williamstown

OHIO

Aberdeen
Belmont Co. Authority (Bellaire
and 3 other communities)
Belpre
Brilliant
Chesapeake

Cleves
Coney Island
East Liverpool
Gallipolis
Hamilton Co. Metropolitan Sanitary District
(Cincinnati and Hamilton Co. Communities)

Ironton
Lawrence Co. Union District No. 1
Marietta
Middleport
Mingo Junction
New Boston
(New) Matamoras
New Richmond
Pomeroy
Portsmouth
Powhatan Point

Proctorville
Rayland
Shadyside
South Point
Steubenville
Stratton
Tiltonsville
Toronto
Wellsville
Yorkville

Pollution Control Standard No. 3

Watercraft and floating facilities

Recommendation:

> All sewage, lavatory and galley wastes discharged from commercial and pleasure watercraft and from other floating facilities operating or moored on the Ohio River shall be treated or otherwise modified to such degree that the discharge shall be free from odor, color, settleable solids and other visible matter, shall not contain a 5-day biochemical oxygen demand greater than 50 mg/l, and shall not contain a fecal-coliform concentration greater than 50 per 100 ml.

The need for controlling pollutional discharges from boats and floating facilities was recognized by the Commission several years ago. Formal recognition of the problem and suggested measures for coping with it were enunciated in a resolution adopted by the Commission in January 1964.

The recommended standard reflects the intent of that earlier resolution and more recent recommendations of the Engineering Committee regarding technical control procedures.

ORSANCO:rb
August 14, 1970

Municipalities and institutions reported by the signatory states to be discharging wastes directly to the Ohio River

KENTUCKY

Ashland
Augusta
Brandenburg
Campbell-Kenton Co. Sanitary Dist. No. 1
(Covington and 25 communities)
Cloverport

Flatwoods
Greenup
Henderson
Louisville (includes 22 communities)
Maysville
Owensboro
Paducah
Russell
Shively
South Shore

Uniontown
Vanceburg
West Point
Worthington
Wurtland Water District

INDIANA

Aurora
Cannelton
Charlestown
Clarksville
Evansville (Boehne Hospital)

Hanover
Jeffersonville
Lawrenceburg (Greendale)
Leavenworth
Madison State Hospital

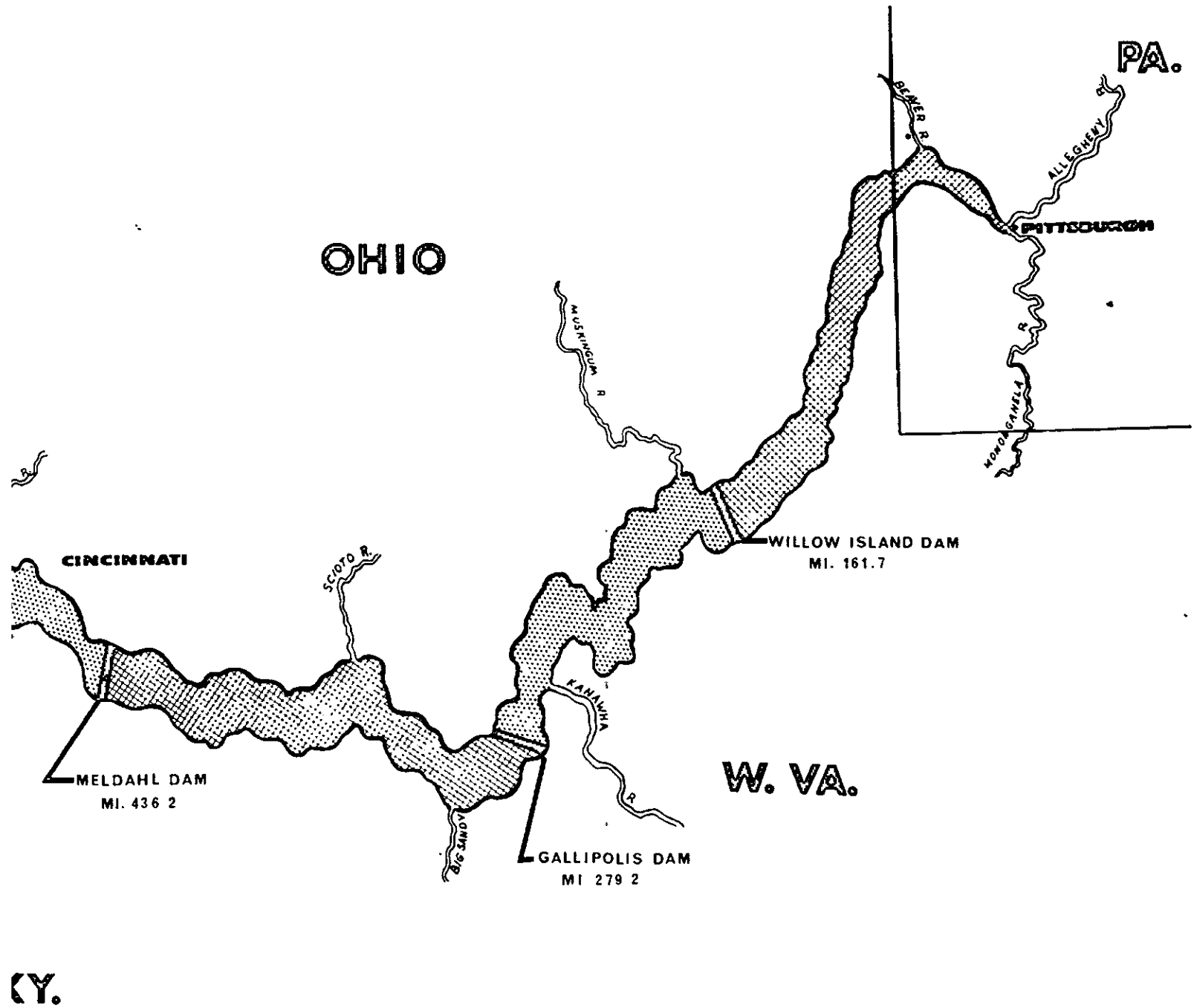
Madison
Mt. Vernon
New Albany
Newburgh
Oak Park Conservancy District

Rising Sun
Rockport
Tell City
Troy
Vevay

ILLINOIS

Brookport
Cairo
Elizabethtown
Ft. Massac State Park
Golconda Job Corps Center
Golconda

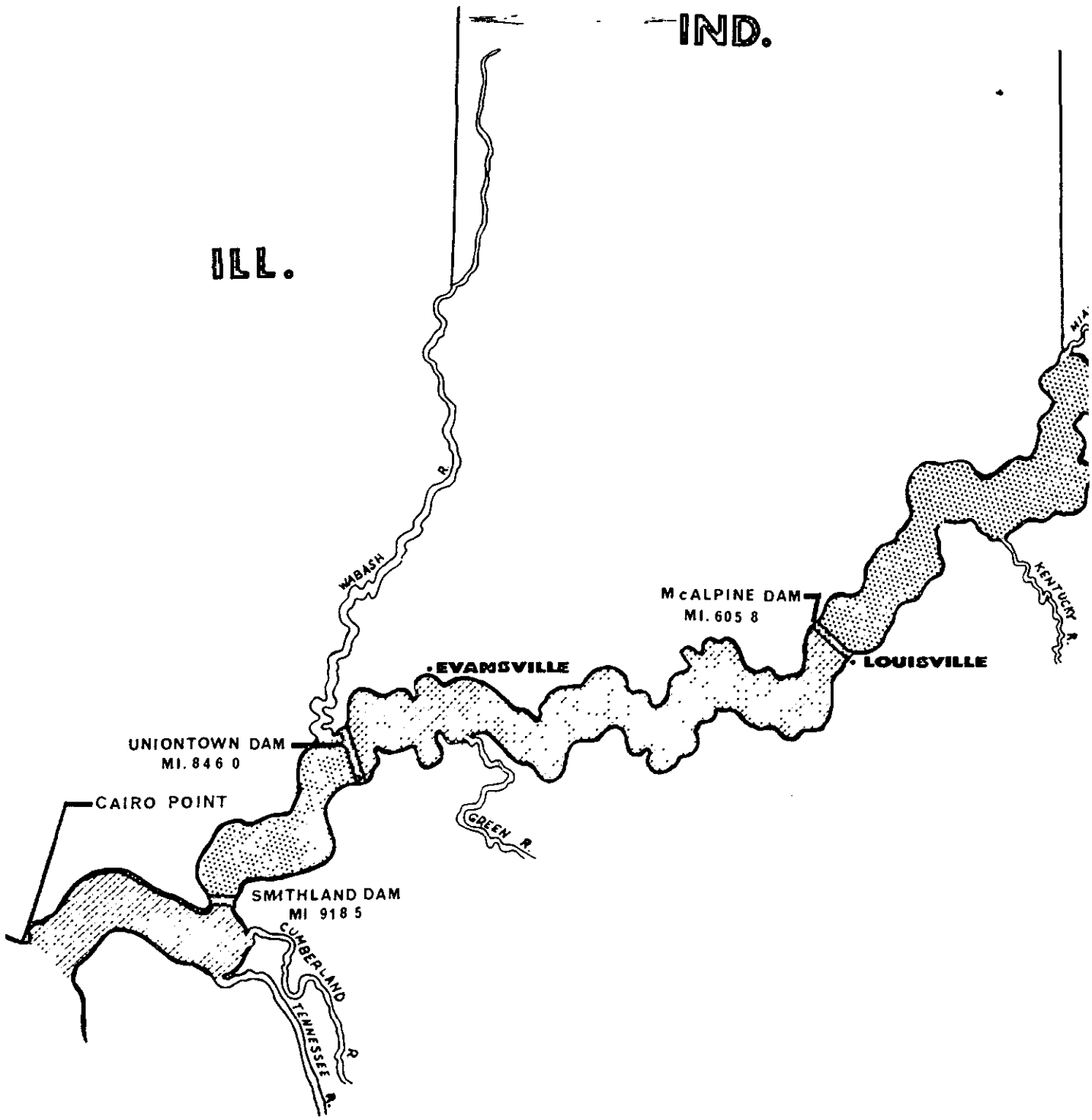
Joppa Sanitary District
Lock and Dam 52
Metropolis
Olmstead
Rosiclare
Shawneetown



OHIO RIVER

Recommended reaches for control of BOD and temperature characteristics of waste discharges

Ohio River Valley Water Sanitation Commission


IND.
ILL.
WABASH R.
McALPINE DAM
MI. 605 8
EVANSVILLE
LOUISVILLE
KENTUCKY R.
UNIONTOWN DAM
MI. 846 0
CAIRO POINT
GREEN R.
SMITHLAND DAM
MI 918 5
CUMBERLAND R.
TENNESSEE R.

Industries reported by the signatory states to be discharging wastes directly to the Ohio River

P E N N S Y L V A N I A

Air Reduction, Neville Twp.
Armco Steel Co., Ambridge
Bethlehem Steel Co., Leetsdale
Blaw Knox, Robinson Twp.
Blaw Knox Creek Works, Moon Twp.

Byers, A. M. Co., Springdale Twp.
Cowan Mfg. Co., Pittsburgh
Crucible Steel Co., Midland
Duquesne Light, Philips Sta., So. Heights
Duquesne Light, Reed Sta., Pittsburgh
Duquesne Light, Shippingport

Enon Valley Cheese Coop., Little Beaver Twp.
Federal Enamel & Stamp, McKees Rock
Freedom Valvoline Oil, Freedom
Greater Pittsburgh Airport, Moon Twp.
Gulf Oil Co., Neville Twp.

H. K. Porter Company, Ambridge
C. G. Hussey Co., Leetsdale Boro
Interstate Amiesite, Winslow Twp.
Iron City Sand & Gravel, Beaver Co.
J. & J. Car Wash, Leetsdale

Jones & Laughlin Steel Corp., Aliquippa
Koppers Co., Kobuta Plant, Potter Twp.
Liquid Carbonic, Pittsburgh
Marquette Cement Co., Neville Twp.
Marcus Ruth Jerome Co., Neville Twp.

Matlack, Inc., Neville Twp.
National Supply Co., Spang-Chalfant Div., Ambridge
National Cylinder Gas Co., Stowe Twp.
Neville Co., Neville Twp.
North Pole, I. C., Pittsburgh

North Side Cheese Co., Ohio Twp.
Otto's Suburban Dairy, Killbuck Twp.
Penn-Central R.R., Conway
Pittsburgh Chemical Co., Neville Twp.
Pittsburgh Forging Co., Coraopolis

Pittsburgh Screw & Bolt Co., Monaca
Pittsburgh Tool, Steel-Wire Co., Monaca
Pittsburgh Tube Co., Monaca
Robertson, H. Co., Ambridge
Russell Birdsall & Ward, Moon Twp.

Shenango Co., Neville Twp.
Shippingport Sand & Gravel, Shippingport
Elwin G. Smith & Co., Emsworth
Sterling Varnish, Haysville
St. Joseph Lead Co., Potter Twp.

Superior Drawn Steel, Monaca Boro
Vasco Colonial, Monaca
Vulcan Detinning Co., Neville Twp.
Watson Standard Co., Springdale Twp.
Westinghouse, Borough Twp.

WEST VIRGINIA

Air Reduction Co., Arroyo
Allied Chemical, North Plant, Moundsville
Allied Chemical, South Plant, Moundsville
Amax Metals, Inc., Parkersburg
American Cyanamid, Willow Island

Banner Fiberboard Co., Wellsburg
Beech Bottom Power Co., Beech Bottom
Burdett Oxygen Co., Washington
Cabot Corporation, Waverly
Central Operating, Graham Sta., New Haven

Consolidation Coal Co., Res. Div., Cresap
DuPont, Parkersburg
Follansbee Steel, Follansbee
Foote Mineral Co., Graham Station
Goodyear Tire & Rubber Co., Apple Grove

Harker Pottery, Chester
Homer Laughlin China Co., Newell
Kaiser Aluminum & Chemical, Ravenswood
Knowles China Co., Newell
Koppers Co., Follansbee

Koppers Co., Arroyo
Marbon Chemical Co., Parkersburg
Marietta Mfg. Co., Point Pleasant
Mobay Chemical Co., Natrium
Monongahela Power Co., St. Marys

National Steel Co., Weirton
New Castle Refractories Co., Newell
Oglebay-Norton Co., Ceredo
Ohio Power Co., Kammer Station, Captina
Ohio Valley Div., Consolidation Coal Co., Cresap

Pantasote Co., Point Pleasant
Penn Metals Co., Parkersburg
Pillsbury Mills, Inc., Wellsburg
PPG, Natrium
Quaker State Oil Refinery, St. Marys

S. George Co., Wellsburg
Stauffer Chemical Co., Gallipolis
Taylor Smith & Taylor Co., Chester
Triangle Conduit & Cable Co., Moundsville
Union Carbide Corp., Silicones Div., Long Beach

U. S. Stamping Co., Moundsville
Valley Camp Coal Co., Moundsville
Warwood Tool Co., Wheeling
Wheeling Bronze Casting Co., Wheeling
Wheeling Machine Products Co., Wheeling
Wheeling Steel Corp., Beech Bottom
Wheeling Steel Corp., Benwood
Wheeling Steel Corp., East Steubenville
Wheeling Steel Corp., Follansbee
Wheeling Steel Corp., Sinter Plant
Windsor Powerhouse Coal Co., Windsor Heights

I N D I A N A

Aluminum Co. of America, Newburgh
USS Agri-Chemicals, Inc., Jeffersonville
Colgate-Palmolive Co., Jeffersonville
General Electric Co., Mt. Vernon
Hooker Chemical Corp., Jeffersonville
Indiana Farm Bureau Coop., Jeffersonville

Indiana Farm Bureau Refinery, Mt. Vernon
Indiana-Kentucky Electric, Clifty Creek
Indiana-Michigan Electric, Tanners Creek
Jarvis Refining Co., Troy
Jeffboat, Jeffersonville

Jeffersonville Proving Grounds, Jefferson
George Moser Leather Co., New Albany
Mt. Vernon Milling Co., Mt. Vernon
Public Service Co., New Albany
Rising Sun Packing Co., Rising Sun

Schenley Distilleries, Lawrenceburg
Seagram & Sons, Inc., Lawrenceburg
Southern Indiana Gas & Electric Co., Evansville
Southern Indiana Gas & Electric Co., Newburgh
Tennessee Corp., New Albany

O H I O

Allied Chemical Corp., Ironton
Bob Evans Farms, Gallia Co.
CG&E, Beckjord, New Richmond
CG&E, Miami Fort, Cincinnati
CG&E, West End, Cincinnati
Chevron Asphalt Co., Cincinnati

Dayton Power & Light, Stuart Plt., Adams Co.
Detroit Steel Co., Portsmouth
Dow Chemical Co., Ironton
Excelsior Salt Co., Pomeroy
Federal Paperboard, Steubenville

Koppers Co., Cincinnati
Monsanto Chemical Co., Cincinnati
North American Coal Co., Powhatan Point
Ohio Edison, Burger Plant, Belmont Co.
Ohio Edison, Sammis Plant, Jefferson Co.

Ohio Edison, Toronto Plant, Toronto
Ohio Power Co., Brilliant
Ohio Power Co., Cardinal Plant, Jefferson Co.
Ohio Valley Electric Co., Addison
Ormet Corp., Hannibal
Penn-Central R.R., Mingo Junction

Shell Chemical Co., Belpre
Titanium Metals Corp., Toronto
Toronto Paperboard, Toronto
Union Carbide & Chemicals Co., Marietta
USS Chemicals, Haver Hill

Weirton Steel Co., Steubenville
Wheeling-Pittsburgh Steel Co., Martins Ferry
Wheeling-Pittsburgh Steel Co., Mingo Junction
Wheeling-Pittsburgh Steel Co., Steubenville
Wheeling-Pittsburgh Steel Co., York

K E N T U C K Y

Allied Chemical Co., Ashland
Atomic Energy Commission, Paducah
Air Reduction Co., Louisville
American Synthetic Rubber Co., Louisville
Armco Steel Corp., Ashland

Columbia Hydrocarbon Co., Siloam
C & O R.R., Russell
C & O R.R., Silver Grove
DuPont, Louisville
DuPont, Wurtland

Fleischmann Distillery Co., Owensboro
Glenmore Distillery, Owensboro
Green River Steel, Owensboro
Henderson Electric Power Co., Henderson
Hooker Chemical Co., Greenup Co.

Island Creek Coal Co., Hamilton
Kosmos Portland Cement Co., Kosmosdale
Louisville Gas & Electric Co., Canal Plt., Louisville
Louisville Gas & Electric Co., Cane Run Plt. Louisville
Louisville Gas & Electric Co., Paddys Run Plt., Louisville
Louisville Refining Co., Louisville
Meade Container Corp., Louisville
Medley Distillery Co., Owensboro
Metal & Thermit Corp., Carrollton
Olin Corporation, Brandenburg

Owensboro Municipal Power, OMU No. 1, Owensboro
Owensboro Municipal Power, Elmer Smith Plt., Owensboro
Pittsburgh & Midway Coal Co., Caseyville
Rohm & Haas Co., Louisville
Shawnee Steam Plant, Paducah

Spencer Chemical Co., Henderson
Stauffer Chemical Corp., Louisville
West Kentucky Coal Co., Uniontown
W. R. Grace & Co., Owensboro

I L L I N O I S

Allied Chemical Corp., Metropolis
Electric Energy Plant, Paducah
Ohio Shell Co., Metropolis
Ozark Mahoning Co., Rosiclare
Southern Clay, Inc., Olmstead

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