OHIO RIVER WATER QUALITY MONITORING NETWORK AND ASSESSMENT STRATEGY

September 1996

Ohio River Valley Water Sanitation Commission
5735 Kellogg Avenue, Cincinnati, OH 45228

INTRODUCTION

The Ohio River Valley Water Sanitation Commission

In 1948, the Ohio River Valley Sanitation Compact was signed by eight states -- Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia -- with the approval of the U.S. Congress. In doing so, these states pledged to work together for the control and prevention of pollution in the waters they share. The Compact authorized the governing body it created, the Ohio River Valley Water Sanitation Commission (ORSANCO), to coordinate efforts to improve the quality of surface waters and promulgate rules and regulations as necessary for the abatement and prevention of water pollution in the Compact District. The Commission consists of three representatives from each state, appointed by their respective governors, and three representatives of the federal government appointed by the president. The Commissioners establish the policies and programs of the Commission and employ a technical staff to administer and carry out these programs. Funding for the operation of the Commission and its programs comes from the eight states in proportion to their land area and population within the Compact District, and from the federal government in the form of a grant administered by the U.S. Environmental Protection Agency under Section 106 of the Federal Clean Water Act.

Under the terms of the Compact, or in accordance with the terms of the states' pledge to maintain the waters of the Ohio River Valley Water Sanitation District in a satisfactory sanitary condition, available for safe use as public and industrial water supplies (after reasonable treatment), suitable for recreational activities, capable of maintaining fish and other aquatic life, and acceptable for other legitimate uses (fish consumption). Activities to achieve those objectives are set forth each year in a Program Plan, which describes the tasks to be conducted during the coming year. The Commission's programs are designed to achieve the Compact's objectives in a cooperative manner with those state and federal agencies having concurrent responsibility for water pollution control.

Ohio River Basin Description

The Ohio River Basin encompasses portions of 14 states in an area of more than 200,000 square miles, which constitutes greater than five percent of the total United States land mass (Figure 1). The Ohio River is 981 miles long and flows through or borders six states -- Illinois, Indiana, Kentucky, Ohio, Pennsylvania and West Virginia. More than 25 million people reside in the Ohio River Basin, or approximately 10 percent of the total U.S. population. Of these, approximately three million people use the Ohio River as a source of drinking water.

From an economic standpoint, approximately 600 businesses employing 35,00 0 people with a combined annual payroll of $1 billion are directly dependent on the Ohio River. Electric utilities using the Ohio River constitute over five percent of the nation's power generating capacity, while an estimated $43 billion in commodities are transported annually along the river system. Festivals and special events generate $100 million annually in communities along the river, including an increasing number of fishing and boating events. More than 100 species of fish live in the Ohio River. Given these important attributes, it is clear that protection and improvement of the water quality of this great resource are vital to the health and economic prosperity of the region and the nation.

The Ohio River conjoins with the upper Mississippi River at Cairo, IL and provides approximately two-thirds of the total flow of the Mississippi River at the confluence. As such, the Ohio River watershed may have an influence on water quality of the lower Mississippi River, and subsequently the Gulf of Mexico. Although water quality degradation has been identified in these

regions, water quality management programs for the Ohio River have not considered the entire watershed as a source of pollution to the lower Mississippi River. Water quality improvements in the Ohio River watershed may be expected to have a positive impact on downstream water quality including that of the lower Mississippi River and Gulf of Mexico.

Compact Authorizations

The Ohio River Valley Water Sanitation Compact, signed in 1948 by the governors of eight states and authorized by Congress, is the Commission's sole authorizing document and has a number of implications to ORSANCO's water quality monitoring and assessment programs. Compact directives addressing such programs include the following:

- The Commission shall seek to maintain or achieve full support of the beneficial uses of the Ohio River.
- The Commission shall identify instances in which pollution from a state(s) injuriously affects the waters of another state.
- Tributaries with water of lesser quality than the Ohio River at the confluence shall be identified.
- The Commission shall survey the District to determine water pollution problems.

Commission Policies and Guidance

The Commission has adopted a number of policies which address its water quality monitoring and assessment programs. In May1995, a five-year Strategic Plan that provides guidance concerning relevant program areas was adopted. Such guidance regarding water quality monitoring and assessment programs includes the following:

- Coordinate water quality monitoring for the Ohio River and lower reaches of its tributaries.
- Continue efforts to understand water quality impacts from nonpoint sources and combined sewer overflows.
- Evaluate tributaries for compliance with Compact requirements (tributary waters should be of equal or better quality than the Ohio River immediately upstream of the confluence).
- Determine water quality impacts from major urban and industrial areas caused by sources including, but not limited to, storm water and ground water.

In May 1994, the Commission's Technical Committee adopted objectives relating to ORSANCO's monitoring and assessment programs and established priorities for its monitoring activities as described below.

- Realign monitoring and assessment efforts to reflect the following priorities:
  - Priority 1 Spill Detection
  - Priority 2 Water Quality Trends Identification and Assessment
  - Priority 3 Aquatic Resource Characterization
    - A. Fish Population
    - B. Fish Tissue
    - C. Biological Criteria
  - Priority 4 Water Quality Impacts Assessment
    - A. Combined Sewer Overflows
    - B. Toxic Substances
    - C. Nonpoint Sources
    - D. Sediment
    - E. Tributaries
    - F. Point Sources

- Continue to evaluate, develop and refine large-river monitoring/assessment techniques.
- Continue to collect sufficient fish tissue to support the development of states' fish consumption advisories.
- Collect the necessary data to support development of numerical biological criteria.
- Integrate biological methods into overall monitoring/assessment programs.
- Increase coordination with state and federal agencies to maximize return on monitoring and assessment efforts.
- Strive to achieve compatibility between tributary watershed and Ohio River water quality monitoring activities and assessments.
- Develop the capability to relate specific causes to stream water quality.
- Continue efforts to better understand ground water/surface water relationships between the Ohio River and its underlying alluvial aquifer.

MONITORING GOALS AND OBJECTIVES

Water quality monitoring programs of the Commission incorporate those activities which provide chemical, physical, biological and other environmental data required to implement the provisions of the Compact and the Clean Water Act. Water quality monitoring is essential to fulfill water quality objectives that protect the designated uses of rivers, lakes and streams. Information gathered through monitoring activities, both at fixed stations and through intensive and special surveys, enables pollution control agencies to do the following:

- Identify sources of pollutants and determine their effect on water quality.
- Determine water quality trends.
- Determine the presence and levels of toxic substances.
- Develop water quality controls and measure their effectiveness.
- Monitor progress toward meeting water quality goals.

Comprehensive and accurate characterization of water quality conditions in the Ohio River provide the foundation for all the Commission's programs. To achieve economy and consistency, the Commission is charged by the member states with the major responsibility for collecting ambient data on the Ohio River and the lower reaches of its major tributaries. Monitoring programs include daily analyses for 22 volatile organic compounds at 14 locations; bimonthly sampling for physical and chemical constituents at 31 locations; special sampling for dissolved oxygen and bacterial parameters during critical periods; intensive surveys to investigate sources of toxics; biological studies to determine fish diversity and community health; fish tissue contaminant studies to assist states in issuing consumption advisories; and studies to address special problems. Municipal and industrial water users also provide water quality data to supplement ORSANCO's efforts.

The Commission's Monitoring strategy establishes plans and procedures for achieving two basic monitoring goals:

Support implementation of Compact directives:

- Place and maintain the interstate waters of the Ohio River Basin in a satisfactory condition for water supply, recreation, support of fish and aquatic life, and other legitimate uses (Article I).

- Determine whether pollution originating in a signatory state injuriously affects the various uses of the interstate waters (Article VI).
- Determine whether tributary water quality is at least equal to that of the Ohio River main stem above their confluence (Article VI).
- Evaluate pollution of waters particularly with regard to the construction of treatment plants for the disposal of sewage, industrial and other wastes (Article VI and VIII).
- Survey and study pollution problems and prepare reports for the prevention and reduction of stream pollution within the Compact District (Article VIII).
- Investigate incidents of noncompliance with Pollution Control Standards adopted by the Commission (article IX) .

Provide effective coordination and integration of monitoring efforts in the Ohio River Basin.

Specific objectives in conducting and managing water monitoring activities include the following:

- Show current conditions and demonstrate improvements (or degradation) in water quality over time.
- Identify sources of pollution and determine their effect on water quality.
- Evaluate compliance with Commission stream criteria and treatment standards.
- Determine the extent to which the designated uses of the Ohio River are met.
- Support development of water quality-based controls and assess their effectiveness.
- Support water quality management decisions.

BASE MONITORING PROGRAMS

Manual Sampling

General Description

Bimonthly (once every two months) surface water grab samples are collected from 17 main stem stations and 14 tributaries. Water column samples are analyzed for 19 nutrients, metals (in total form), and other conventional pollutants. In addition, quarterly samples are analyzed for five additional metals. Grab samples are collected as close to mid-stream as possible, using lock chamber walls and bridges to accomplish this. Samples are collected by contract personnel. Appendix A contains more specific information such as parameter lists, station locations and descriptions, collection frequency, etc.

Program Goals

- **Long-term Trends** -- Determine whether water quality conditions are improving or degrading in terms of statistically significant increases or decreases in water quality parameter concentrations.
- **Status of Use Support** -- Data are used to assess the degree of beneficial use support in conjunction with the biennial Assessment of Water Quality Conditions 305(b) report. Aquatic life and public water supply uses are assessed with this data.
- **Problem Identification** -- On a regular basis, data are compared against stream criteria to identify water quality problems and assess the need for intensive surveys or corrective actions.

Sampling Goals

The primary goal of the Bimonthly Sampling Program is to characterize ambient water quality conditions through the collection of surface grab samples at 31 monitoring stations. Samples are analyzed for concentrations of 24 constituents.

Data Assessment and Reporting

For identification of long-term trends, multiple years of data are assessed using the Seasonal Kendall *Tau* Test for Trends to determine the presence/absence of a statistically-significant positive or negative trend. The test is nonparametric and removes the influences of seasonality that are normally found in water quality data sets. The degree of use support (aquatic life and public water supply) is assessed in terms of the frequency at which water quality parameters exceed stream criteria. Individual sample results are also reported in a semiannual publication, *Quality Monitor*, and are entered to the U.S. EPA maintained national water quality data base (STORET).

Program Needs

- **A review of monitoring locations with respect to water body delineations is needed.** The Ohio River main stem is currently subdivided into 34 water bodies. Use support assessments are applied to each water body based in part on data from 17 Bimonthly Sampling stations, therefore locations of sampling sites are important with respect to water body delineation. Because each station on average provides data to assess 58 river miles, the siting of stations and delineation of water bodies are critical. It is currently believed that improvements to station locations and water body delineation could be achieved.
- **Phased implementation of dissolved metals collection and analysis techniques is needed.** Metals, several which are used to assess aquatic life use support, are currently measured as total recoverable. Many sources have suggested that dissolved metals are more appropriate for assessing risks to aquatic life and that current total recoverable criteria are overly stringent. Side-by-side collection of dissolved and total recoverable metals at several Bimonthly Sampling stations would provide important information to begin addressing this issue.
- **An evaluation of the use of contract samplers may be necessary if collection techniques for low detection level (and/or dissolved) metals analysis are implemented.** Special sample collection and handling techniques are necessary to analyze for dissolved metals at sub-part per billion detection levels. These techniques may require specialized training and expertise, as well as two individuals to perform.

Organics Detection System (ODS)

General Description

Daily water column grab samples are collected from raw water supply intakes at 11 facilities on the main stem and three tributaries. Water samples are analyzed by gas chromatograph (GC) for 22 volatile organic compounds (VOCs). Analyses are performed by personnel from the participating entities by utilizing analytical equipment owned and maintained by ORSANCO. Results are quality assured, maintained, evaluated and reported by ORSANCO. Grab samples are collected at various points in the water column depending on the intake location (e.g., some intakes are submerged 40 feet or more at mid-stream, while others are located at the surface along the river bank). Appendix B contains more specific information such as parameter lists, station locations and descriptions, collection frequency, etc.

Program Goals

- **Detection of Volatile Organic Compounds** -- Detect the presence/absence of spills or unusual river conditions due to the presence of volatile organic compounds (VOCs), such as petroleum-based substances and other toxic materials.
- **Status of Water Quality Conditions** -- To assess the degree of public water supply use support for the 305(b) Report and where operationally practicable, quantify VOCs concentrations and compare such levels to stream criteria or drinking water MCLs.

Sampling Goals

The primary goal of the Organics Detection System is to identify the presence/absence of any of 22 VOCs analyzed by the network. A secondary goal is to determine the concentration of such compounds in the water column at certain stations.

Data Assessment and Reporting

Data are reviewed on a regular basis to make real-time detections of spills containing VOCs. Confirmed detections of unusual VOC concentrations result in immediate reporting to state and federal emergency response agencies, as well as public water supplies which are imminently threatened. Data are summarized and reported in the semiannual *Quality Monitor* publication as a percentage of samples in which each VOC was determined to be present. VOC results are compared against stream criteria (in some cases they are compared against drinking water standards when stream criteria are absent). Certain exceedance frequencies are then considered when making public water supply use support decisions for the 305(b) report.

Program Needs

- **Equipment upgrades are needed system-wide in order to maintain the existing ODS.** Among desirable attributes of such equipment are enhanced detection levels, ability to detect more compounds, and automated systems requiring less human intervention.
- **A review of possible additional monitoring stations for spill detection/public water supply protection should be undertaken.**

Contact Recreation Monitoring

General Description

At six Ohio River stations, five water column grab samples are collected monthly from May through October during the recreational season. The five samples are distributed uniformly over the month at stations which are downstream of urban centers having large numbers of combined sewer overflows (CSOs). All samples are collected approximately 12 inches below the water surface, with some station collection points near or on the shore and others at midstream. Surface water is collected to assess that portion of the water contacted most frequently during recreational activities. Water samples are analyzed for both fecal coliform and *E. coli* at four stations and only for fecal coliform at the other two stations. These parameters are bacterial indicators associated with waste from humans and other warm-blooded animals. ORSANCO has established stream criteria for both indicators. Appendix C contains more specific information such as parameter lists, station locations and descriptions, collection frequency, etc.

Program Goals

- **Determine the suitability of the Ohio River for contact recreational use as assessed by the identification of bacteriological indicators.**
- **Notify local health departments so that they can advise the general public concerning the suitability of the river for contact recreation.**
- **Evaluate the impacts of bacterial inputs from sources downstream of urban areas with large numbers of combined sewer overflows (CSOs).**

Sampling Goals

The primary goal of contact recreational monitoring is to determine concentrations of bacterial indicator organisms (fecal coliform and *E. Coli*) in surface waters downstream of major urban centers.

Data Assessment and Reporting

The primary use of the data is to report to local health departments concerning the suitability of the Ohio River for contact recreation. As such, weekly updates of river bacterial levels are provided to health departments for all counties bordering the Ohio River. In addition, information is provided monthly to state agencies through ORSANCO's *Quality Updates*, and to various other entities semi-annually through the *Quality Monitor*. Data are assessed to determine if stream criteria are being met and the contact recreational use is supported.

Program Needs

- **Additional monitoring stations would permit enhanced coverage of bacterial conditions in the river.** Currently, there are only six monitoring stations in "worst-case" locations along 981 river miles. This limited information is used to make judgements about contact recreational use support for the entire river. Further, there is little or no information available on bacterial levels in rural areas or low density urban areas. Data concerning bacterial levels in other than "worst case" locations would be valuable. It is feasible that county health departments could provide in-kind sample collection services and ORSANCO would cover analytical costs. At a $20 per sample analytical cost, one recreational season (May - October) monitoring site would cost $600 - $750.
- **Data should be entered into STORET, U.S. EPA's national water quality data base.**

Dissolved Oxygen/Temperature Interrogation

General Description

ORSANCO interrogates dissolved oxygen and temperature data weekly from 13 locations (immediately upstream of 12 dams and at one power plant). *In situ* monitors are owned and operated by the U.S. Army Corps' of Engineers (seven locations), hydropower operators (five locations), and one coal-fired power plant operator. Hourly measurements are stored at each location, and ORSANCO electronically down-loads this data. Appendix D contains more specific information such as parameter lists, station locations and descriptions, collection frequency, etc.

Hydropower operators are regulated by the Federal Energy Regulatory Commission (FERC). In their licenses, they are required to develop a memorandum of understanding (MOU) with the U.S. COE concerning their operations. Typically, these MOUs contain stipulations that require hydro-operators to shut down during periods of low dissolved oxygen to provide reaeration of the entire river flow at the dam.

Program Goals

- **Determine the suitability of the Ohio River to sustain aquatic life based on dissolved oxygen and temperature indicators at 13 locations.**
- **Determine the need to modify hydropower operations to maximize dam reaeration potential.**

Sampling Goals

Determine hourly temperatures and dissolved oxygen levels at 13 locations along the Ohio River, especially during the critical summer months at dams.

Data Assessment and Reporting

Hourly temperature and dissolved oxygen (D.O.) data, for one 24-hour period, are electronically downloaded on a weekly basis and compared to ORSANCO's stream criteria for the protection of aquatic life. The frequency of data retrieval is increased to a daily basis when average daily D.O. levels drop below 6 mg/L and ORSANCO contacts the hydropower operator when applicable. Generally, the U.S. COE is also contacted to ensure that instrument measurements are correct. For one 24-hour period once each week, hourly temperature and D.O. data are summarized to provide daily maximum, minimum and average readings. This information is placed on the Commission's bulletin board for easy access by any interested party.

Program Needs

- It would be desirable to retrieve and interrogate data from all stations on a daily basis, rather than once per week as is the current practice.

BIOLOGICAL MONITORING PROGRAMS

Fish Population Surveys

General Description

In recent years, ORSANCO's fish population surveys have been redefined. Historically, lock chamber studies were the sole means by which fish population data were gathered until 1990, when electrofishing methods were initiated. Electrofishing methods solved two primary disadvantages of the lock chamber studies -- it is nondestructive, meaning that fish are caught and released, and it is not limited to a few fixed sites on the river, as it can be performed almost anywhere. While the Commission is replacing lock chamber studies with electrofishing as the primary fish collection method for population studies, lock chambers will continue to be sampled infrequently for the purpose of maintaining a long-term data base.

Fish population studies involve collecting all fish within a certain area, either lock chamber or electrofishing zone (½ km along shoreline), and recording species, weight and length. This information, such as number of species, numbers of fish, and fish biomass, can be used to generate a numerical score. Ideally, this numerical score is then compared against a scale to evaluate the relative health of the fish community. Current activities are geared toward developing numerical biological criteria for determining the degree of aquatic life use support, taking into account all of the influencing factors such as habitat, ecoregion, river mile, location within a pool, etc.

Program Goals

- **Evaluate the relative health of fish communities in the Ohio River.**
- **Identify spatial and temporal trends in diversity of species, numbers and biomass of fish, and consider such parameters in certain size classes.**
- **Develop biological criteria for assessing the degree of aquatic life use support.** On a pool-by-pool basis, important metrics will be identified and expected index ranges will be determined for good, fair, and poor fish community conditions.
- **Develop a habitat classification system for use in conjunction with biological criteria.**

Sampling Goals

- The primary goals of the biomonitoring programs are to collect all fish within a specified area (either lock chamber or electrofishing zone) and create a record of each fish, species, length, weight, and significant anomalies, such as tumors and classify habitat(s) at collection sites.

Data Assessment and Reporting

In the past, fish population data have been used to generate Modified Index of Well Being (MIWB) values which account for species of fish, numbers of fish, and biomass. These data were used to identify temporal and spatial trends in fish community conditions and potential adverse impacts on fish communities. The Index of Biotic Integrity (IBI) is currently being used in place of the MIWB and takes into account the distribution of fish among various species and classes of fish.

Program Needs

- **Increased resources are needed for biological criteria development in support collection of the necessary field data within a reasonable time frame.**

Macroinvertebrate Sampling

General Description

Macroinvertebrate sampling has been conducted at fish population survey locations since 1990. It is generally accepted that more than one aquatic assemblage should be measured to determine the degree of aquatic life use support. Macroinvertebrates are commonly sampled (in addition to fish communities) because they are a significant food source for fish communities and are indicators of water quality. Hester-Dendy multi-plate samplers are used to collect macroinvertebrates during a six to eight week period. Samples are then analyzed for numbers of macroinvertebrates by taxonomic class. The intent is to develop the Invertebrate Community Index (ICI) for use as a numerical criteria on the Ohio River.

Program Goals

- **Evaluate the relative health of macroinvertebrate communities in the Ohio River.**
- **Identify spatial and temporal trends in numbers of macroinvertebrates by taxonomic class.**
- **Develop biological criteria for assessing the degree of aquatic life use support.** Expected index ranges will be determined for various degrees of macroinvertebrate community conditions.
- **Develop a habitat classification system for use in conjunction with biological criteria.**

Sampling Goals

Place and collect Hester-Dendy multi-plate samplers in representative locations for collection of macroinvertebrates which will be evaluated for numbers and taxa of species.

Data Assessment and Reporting

No data assessment is currently being conducted. Because of limited resources, the data are currently being collected for assessment at a later date. The majority of resources are now being focused on fish population studies.

Program Needs

Identification of previously collected macroinvertebrate samples is needed to support future deve-lopment of numeric criteria which will be used in conjunction with fish population data to assess aquatic life health and use support.

Fish Tissue Analyses

General Description

Fish tissue is collected and analyzed for certain contaminants known to bioaccumulate. Historically, these fish were collected in conjunction with lock chamber fish population studies. Currently, because fish population studies are focusing on limited river segments, fish collection is being augmented with gill netting in lockchambers to provide wider coverage. For each collection site, an attempt is made to collect composite samples from the following trophic levels: one bottom-feeder (carp), one predator (usually bass, sauger or walleye), and three omnivores (channel catfish) of various size classes. Composite samples are composed of fillets from both sides of three-to-five fish of edible size. Fish tissue contaminant results are used to support states' issuance of fish consumption advisories. Analyte compounds include: cadmium, mercury, lead, chlordane, DDT, dieldrin, endrin, heptachlor epoxide, hexachlorobenzene, 2,3,7,8-TCDD, 2,3,7,8-TCDF, PCBs (total). Ancillary data include fish species, weight, length, and percent lipids by weight (mass lipids/total fillet mass).

Program Goals

- **Generate fish tissue contaminant data to support states' issuance of fish consumption advisories.**

Sampling Goals

- **Collect one bottom-feeder composite sample (carp), three omnivore composite samples (channel catfish), and one predator composite sample (bass, sauger, walleye, etc.), where composite samples are composed of both-side fillets from three to five edible-sized fish**. The smallest fish shall be no shorter than 75 percent of the longest fish.

Data Assessment and Reporting

Data are compiled and provided to the states annually for their use. Pennsylvania and Kentucky currently compare contaminant data to U. S. FDA action levels in developing their fish consumption advisories, while Indiana, Ohio, and West Virginia apply a risk-based protocol developed by the Great Lakes Sport Fish Advisory Task Force.

Program Needs

- States utilize different protocols for developing fish consumption advisories resulting in conflicting advisories issued for the same Ohio River waters and fish, thus enhanced consistency is needed.

SPECIAL MONITORING PROGRAMS

ORSANCO occasionally conducts studies to address special water quality concerns and interstate issues. These studies are short-term investigations normally lasting one to several years. Such studies may be performed and funded in conjunction with the Commission's regular programs, or they may be funded through grants of limited duration to address a special concern. Recent special monitoring programs and their information objectives includes the following:

Toxic Substances Control Program -- The primary purpose of these surveys was to evaluate water quality conditions of the Ohio River for targeted toxic substances in the river segments. The river was divided into seven segments, four of which were completed and are listed below. The program is currently inactive.

Pittsburgh to Wheeling Toxics Study
Wheeling to Parkersburg Toxics Study
Parkersburg to Portsmouth Toxics Study
Cincinnati to Louisville Toxics Study

Tributary Assessments -- This program was initiated in conjunction with the Parkersburg to Portsmouth Toxics Study. Six tributaries within this segment of the Ohio were evaluated for compliance with Article VI of the Ohio River Valley Water Sanitation Compact. This article indicates that tributaries should be of equal or better quality than the Ohio River at the confluence. This program is currently inactive.

Longitudinal Bacteria Surveys -- Longitudinal bacteria surveys were conducted at each of ORSANCO's recreation season bacterial monitoring stations. The purpose of these surveys was to longitudinally characterize bacterial conditions in the Ohio with respect to the routine monitoring station, such that upstream and downstream bacteria levels were characterized in terms of the routine monitoring station. Seven longitudinal surveys were conducted in 1993. This program is currently inactive.

Herbicides in the Lower Ohio River Basin -- This study was established as a short-term monitoring program designed to determine levels of certain herbicides (atrazine is currently of prime concern) in the Ohio River and major tributary sources. The study was conducted during 1994 and 1995. Objectives of the study were met and a long-term monitoring station is being established at Cairo, IL.

Investigation of CSO Impacts in the Greenup Pool -- This two year study's primary purpose was to develop and evaluate collection methods for certain physical, chemical and biological data for the identification of impacts from combined sewer overflows (CSOs) on a large river. Survey parameters included bacteria, physical parameters, and BTX (benzene, toluene and xylene are VOCs). Results of the study indicated that bacteria levels resulting from CSOs were of concern. This study was completed in 1994.

Cincinnati Area Wet Weather Demonstration Study -- This study is in its second year and continued grant funding is uncertain. It focuses on the impacts and controls of wet weather sources of pollution on large rivers. Objectives are to quantify the relative impacts on water quality from all sources in response to wet weather events, and develop a mechanism to evaluate various CSO control scenarios.

Watershed Pollution Reduction Program -- This program was initiated in 1995 as an ongoing program which is largely dependent on outside funding. The long-term goal of the program is to generate information relevant to reducing levels of pollutants in the Ohio River which inhibit its beneficial uses. Currently, the focus is on a basin-wide screening for the presence of dioxin (in fish tissue), and a dioxin mass balance in the Kanawha River and Ohio River around Apple Grove, WV. In the future, special monitoring programs may address other pollutants including atrazine, PCBs, chlordane, copper, lead, phosphorous, and nitrogen.

Volunteer Monitoring -- A number of groups, primarily school related, collect and test water samples on a monthly basis on the Ohio River and several tributaries. Typical parameters measured include dissolved oxygen, pH, phosphate, ammonia and chlorides. Such results are evaluated with respect to criteria for the protection of aquatic life and reported on ORSANCO's electronic bulletin board and in the RiverWatcher's annual publication.

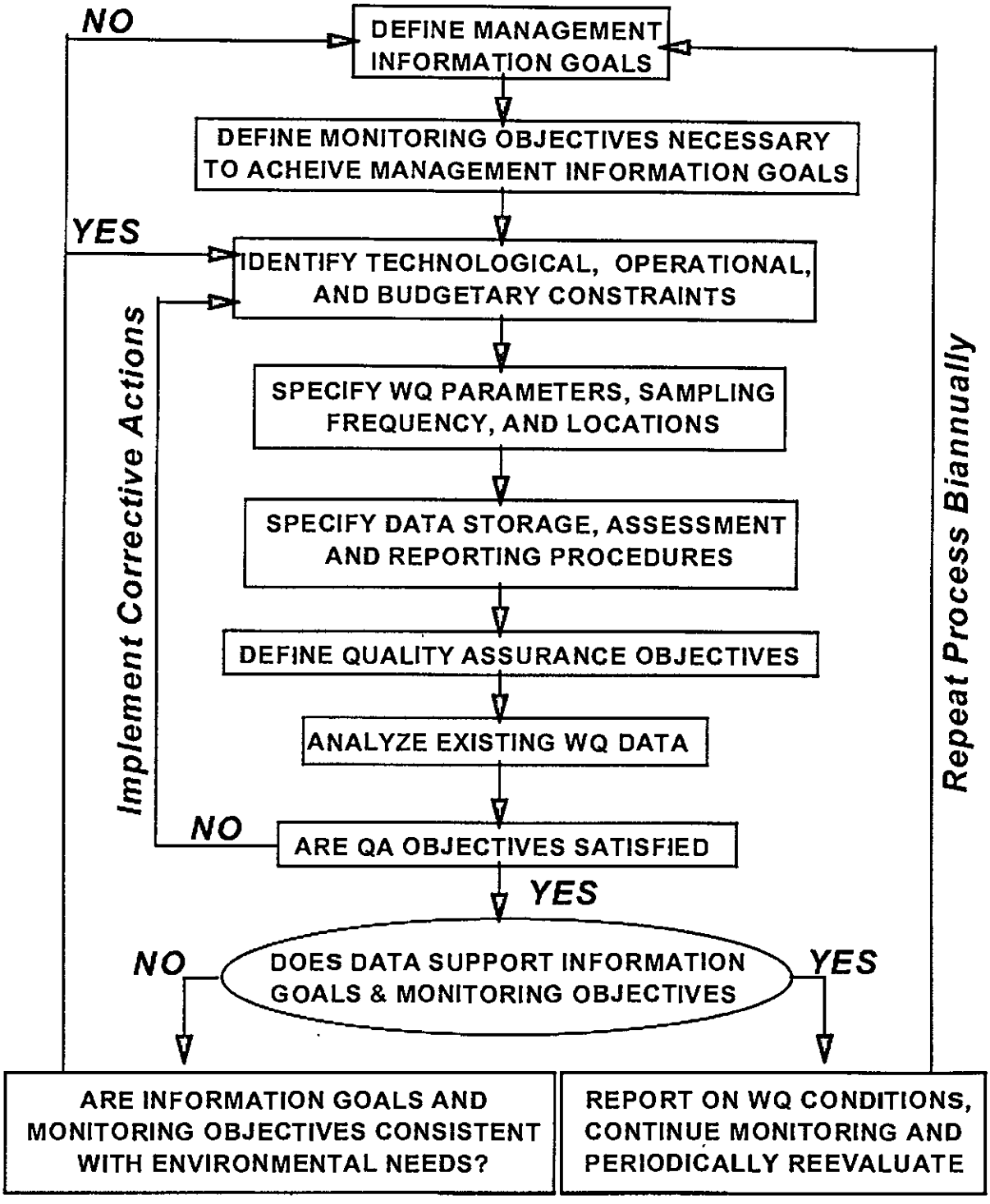
MONITORING NETWORK REVIEW

Figure 2 presents a process for the evaluation and review of Ohio River water quality monitoring networks to be performed every two years. It is initiated by defining the desired information goals and specific monitoring objectives to achieve them. Following this, limiting constraints such as logistics and resources are identified. Water quality parameters, sampling frequencies and locations, and data handling, storage and assessment are specified. Quality assurance objectives are defined and existing data are analyzed. If monitoring data support management information goals, the program needs no refinements. Should data not support information goals, the goals are reviewed and the monitoring program is adjusted to meet the information needs.

QUALITY ASSURANCE

Base monitoring programs have Quality Assurance Program Plans (QAPPs) which go through an approval process by U.S. EPA Region 5. QAPPs specify Data Quality Objectives, which may have an affect on sampling and analytical procedures, and ultimately, on information objectives. Consideration of QAPP requirements during monitoring program requirements is therefore essential.

Process for Evaluation and Review of Ohio River Water Quality Monitoring Networks



RECOMMENDATIONS

Integration of Main Stem and Tributary Monitoring Activities

Presently, there is little or no integration between ORSANCO's Ohio River main stem monitoring and states' tributary monitoring. Thus, water quality conditions in the Ohio River cannot be attributed to tributary sources (except on 14 major tributaries currently monitored by ORSANCO). In order to facilitate integration of tributary-main stem monitoring, several activities are necessary to identify links between Ohio River water quality problems and tributary sources.

- All tributary monitoring stations must be identified by STORET station code and latitude and longitude.
- Water quality parameters, as well as those exceeding stream criteria, should be identified.
- State water quality monitoring stations should be entered and their data assimilated into ORSANCO's GIS.

Review of Water Quality Parameters

A review of water quality parameters should be undertaken from time to time, specifically the Bimonthly Sampling ambient monitoring and ODS spills detection network. Parameters identified as being discharged to water in significant quantities, or commonly stored in facilities with a potential for accidental releases to water, should be monitored. Likewise, parameters which are never detected might be removed or reduced in frequency.

Review of Monitoring Locations

Sampling locations for the Bimonthly Sampling network, ODS and bacteria monitoring program, should be reviewed in terms of sources, human health protection, and ability to assess the Ohio River for support of designated uses.

APPENDIX A: Bimonthly Sampling Stations

STATION NAME	RIVER	MILE POINT	BORDERING STATES	STORET CODE
Pittsburgh	Allegheny	7.4	PA	AR7.4M
South Pittsburgh	Monongahela	4.5	PA	MR-4.5M
Beaver Falls	Beaver	5.3	PA	BR-5.3M
New Cumberland	Ohio	54.4	OH-WV	OR926.6M
Pike Island	Ohio	84.2	OH-WV	OR896.8M
Hannibal	Ohio	126.4	OH-WV	OR8546M
Willow Island	Ohio	161.8	OH-WV	OR8192M
Marietta	Muskingum	0.8	OH	MU-5.8M
Belleville	Ohio	203.9	OH-WV	OR7771M
Winfield	Kanawha	31.1	WV	KR31.1M
Gallipolis	Ohio	279.2	OH-WV	OR7018M
Louisa	Big Sandy	20.3	WV-KY	SR20.3M
Greenup	Ohio	341.0	KY-OH	OR640M
Lucasville	Scioto	15.0	OH	SC15.0M
Meldahl	Ohio	436.2	KY-OH	OR544.8M
Newtown	Little Miami	7.5	OH	LM-7.5M
Covington	Licking	4.7	KY	LR-4.5M
Anderson Ferry	Ohio	477.5	KY-OH	OR502.2M
Cleves	Great Miami	8.0	OH-IN	GM-5.5M
Markland	Ohio	531.5	IN-KY	OR4495M
McAlpine	Ohio	606.8	IN-KY	OR374.2M
West Point	Ohio	625.9	IN-KY	OR3551M
Cannelton	Ohio	720.7	IN-KY	OR2603M
Sebree	Green	41.3	KY	GR41.3M
Newburgh	Ohio	776.1	IN-KY	OR204.9M
Uniontown	Ohio	846.0	IN-KY	OR1350M
New Harmony	Wabash	51.5	IL-IN	WA9295M
Smithland	Ohio	918.5	IL-KY	OR62.5M
Pinknevville	Cumberland	16.0	KY	CR16.0M
Paducah	Tennessee	5.0	KY	TR-5.0M
Paducah	Ohio	938.9	IL-KY	OR42.1M

APPENDIX A: Bimonthly Sampling Parameters

Total Suspended Solids	Cadmium	Barium
Sulfate	Copper	Chromium
Total Hardness	Iron	Nickel
Total Phosphorous	Lead	Selenium
TKN	Manganese	Silver
Ammonia N	Mercury	pH
Nitrate-Nitrite N	Zinc	Temp
Phenols	Arsenic	Conductivity
Cyanide	Aluminum	Dissolved Oxygen
Magnesium	Chloride	

APPENDIX B: Organics Detection System Stations

STATION NAME	RIVER	MILE POINT	BORDERING STATES	STORET CODE
Pittsburgh	Allegheny	7.4	PA	AR7.40
South Pittsburgh	Monongahela	4.5	PA	MR4.5
West View	Ohio	4.5	PA	OR976.50
Beaver Valley	Ohio	34.9	PA	OR946.1
Weirton	Ohio	65.1	OH-WV	OR9159
Wheeling	Ohio	86.8	OH-WV	OR894.2
Parkersburg	Ohio	190.3	OH-WV	OR790.7
St. Albans	Kanawha	38.3	WV	KR38.3
Huntington	Ohio	304.4	OH-WV	OR674.1
Portsmouth	Ohio	350.7	KY-OH	OR630.9
Cincinnati	Ohio	462.8	KY-OH	OR518.2
Louisville	Ohio	600.6	IN-KY	OR380.4
Evansville	Ohio	791.5	IN-KY	OR189.5
Paducah	Ohio	935.5	IL-KY	OR45.5

APPENDIX B: Organics Detection System Parameters

Methylene Chloride
Trichlorofluoromethane
1,1-dichloroethylene
1,1-dichloroethane
Chloroform
1,2-dichloroethane
1,1,1-trichloroethane
Carbon tetrachloride
Bromodichloromethane
1,2-dichloropropane
Trichloroethylene
Dibromochloromethane
Bromoform
Tetrachloroethylene
Benzene
Toluene
Ethylbenzene
Chlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
1,2-dichlorobenzene

APPENDIX C: Bacterial Monitoring Stations

STATION NAME	RIVER	MILE POINT	BORDERING STATES
Pittsburgh	Ohio	4.5	PA
Wheeling	Ohio	92.8	OH-WV
Huntington	Ohio	314.8	OH-WV
Cincinnati	Ohio	477.5	OH-KY
Louisville	Ohio	619.3	KY-IN
Evansville	Ohio	797.3	KY-IN

APPENDIX D: Ohio River Dissolved Oxygen Monitoring Stations

STATION NAME	OPERATOR	MILE POINT
Montgomery	USACOE	31.7
Hannibal	City of New Martinsville, WV Hydro	126.4
Belleville	USACOE	203.9
Racine	American Electric Power Hydro	237.5
Kyger	American Electric Power	260.0
Greenup	City of Hamilton/Ohio Power Co. Hydro	341.0
Meldahl	USACOE	436.2
Markland	Cinergy Hydro	531.5
McAlpine	American Electric Power Hydro	606.8
Cannelton	USACOE	720.7
Newburgh	USACOE	776.1
Uniontown	USACOE	846.0
Smithland	USACOE	919.0