2006 Biennial Assessment of Ohio River Water Quality Conditions

Executive Summary

The Ohio River is one of the nation's great natural resources. It provides drinking water to nearly three million people, is a warm water habitat for aquatic life, provides numerous recreational opportunities, is used as a major transportation route, and is a source of water for manufacturing and power generation. The Ohio River forms in Pittsburgh, Pennsylvania at the confluence of the Allegheny and Monongahela rivers and flows in a southwesterly direction for 981 miles to join the Mississippi River near Cairo, Illinois. The first 40 miles of the Ohio River are entirely within the state of Pennsylvania. The remaining 941 miles form the state boundaries between Illinois, Indiana, and Ohio to the north, and Kentucky and West Virginia to the south.

The Ohio River Valley Water Sanitation Commission (ORSANCO, the Commission) is an interstate agency charged with abating existing pollution in the Ohio River Basin, and preventing future degradation of its waters. ORSANCO was created in 1948 with the signing of the Ohio River Valley Water Sanitation Compact by eight states (New York, Pennsylvania, West Virginia, Virginia, Ohio, Kentucky, Indiana, and Illinois) and the federal government. This report fulfills the following requirements of the Ohio River Valley Water Sanitation Compact:

1. To survey the district to determine water pollution problems.
2. To identify instances in which pollution from a state(s) injuriously affects waters of another state(s).

This report is a biennial assessment of Ohio River water quality conditions in terms of the degree to which the river supports each of its four designated uses: warm water aquatic life, public water supply, contact recreation, and fish consumption. The Ohio River Valley Water Sanitation Compact commits "...each state to place and maintain the waters of the 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… and adaptable to such other uses as may be legitimate."

This assessment uses three classifications to describe the attainment of Ohio River designated uses: fully supporting (good water quality), partially supporting (fair water quality), and not supporting (poor water quality). ORSANCO conducts water quality monitoring and assessments on behalf of the Ohio River mainstem states (Illinois, Indiana, Kentucky, Ohio, Pennsylvania and West Virginia). This report provides a status of water quality from 2003-2005; however, in some cases data outside that range are used in assessments. In addition, an Integrated List containing waters in need of Total Maximum Daily Loads (TMDLs) was completed (Table 8) in an effort to promote interstate consistency for Ohio River TMDLs.

Warm Water Aquatic Life Use Support

Ohio River warm water aquatic life use support was assessed based on chemical water quality data collected from ORSANCO's 17 clean metals and bimonthly sampling stations located on the mainstem, as well as direct measurements of fish communities from a large number of stream bank sites. Bimonthly samples were collected by contract samplers and analyzed for certain physical and chemical parameters by a contract laboratory. Data collected from October 2003 through July 2005 were used to determine aquatic life use support (Appendix D, E). In October 2000, the Commission adopted dissolved metals criteria. Dissolved metals sampling and analyses measured the portion of metals that were dissolved in the water column. Recent findings demonstrated that widely accepted field sampling methods and laboratory techniques were responsible for significant contamination of total recoverable metals data. This prompted the development of "clean techniques" for both sample collection and analysis. ORSANCO used a modified Virginia Division of Environmental Quality grab sample collection technique. Low-level metals analyses were performed by the Virginia Department of General Services, Division of Consolidated Laboratory Services (Virginia DGSDCLS). Clean metals and bimonthly sampling, which occurred every other month at the 17 mainstem locations, detected no violations of ORSANCO's dissolved metals or bimonthly parameter criteria during this reporting period; therefore, no impairment designations resulted from this data.

Fish communities were assessed using ORSANCO's Ohio River Fish Index (ORFIn) for evaluating fish population data. Although numeric criteria had not been adopted into ORSANCO Pollution Control Standards, use of the ORFIn allowed for the comprehensive assessment of Ohio River fish conditions. Aquatic life use assessment using biological data was significantly different from the

methodology detailed in the 2004 report. Using the new monitoring program, the Ohio River was assessed on a pool-by-pool basis. Fifteen randomly selected sites were used to represent fish community condition in a pool. Sites were assessed as passing or failing when ORFIn scores were compared to expected values for a specific habitat type. Impairment was indicated when greater than 25 percent of sites within a pool had failing ORFIn scores. Sites sampled from July to October in 2004 and 2005 fell under the purview of the 2006 report. Many sites sampled in 2004 did not earn passing ORFIn scores. However, when resampled in 2005 these same pools produced ORFIn scores that indicated full support of the aquatic life use. Biologists determined that the 2004 data were not representative of fish community condition and therefore, only 2005 data were used in the analysis (Appendix C).

Sites were classified as fully supporting if fewer than ten percent of water samples exceeded the criteria for one or more pollutants and biological data did not indicate aquatic life impairment. Fair water quality was indicated by exceedances of criteria in 11-25 percent of the samples or biological data that suggested impairment. Sites were classified as not supporting if both water quality and biological data indicated impairment. No impairment was indicated from either the water quality data or the biological data. Nine hundred eighty-one miles, or 100 percent, of the Ohio River were classified as fully supporting the aquatic life use.

Public Water Supply Use Support

Ohio River public water supply use support was assessed based on chemical water quality data collected from the bimonthly sampling program (Appendix E), bacteria monitoring (Appendix F, G), and questionnaires sent to water utilities to assess impacts on Ohio River drinking water utilities caused by source water conditions. Data included in this report were collected from November 2003 to July 2005. The river was designated as fully supporting this use if pollutant criteria were exceeded in less than ten percent of the samples collected. The river was in fair condition (impaired, but partially supporting) if one or more pollutants exceeded the criteria in 11-25 percent of the samples collected, if frequent intake closures due to elevated levels of pollutants were necessary to protect water supplies, or frequent "non-routine" additional treatment was necessary to protect water supplies. Poor river conditions were indicated by exceedances of criteria in greater than 25 percent of the samples collected, or if source water quality caused finished water Maximum Contaminant Levels (MCL) violations, which resulted in noncompliance with provisions of the Safe Drinking Water Act (SDWA).

The entire length of the river was classified as fully supporting the public water supply use. Surveys were received from 20 out of 29 water utilities that used the Ohio River as a source for drinking water. No utility indicated violations of the Safe Drinking Water Act for MCLs in finished water that could be attributed to Ohio River source water quality. Bacteria criterion for the protection of public water supplies was violated at four Pittsburgh monitoring locations; however, these exceedances occurred less than ten percent of the time. Therefore, no impairment was indicated.

Contact Recreation Use Support

Data from ORSANCO's Recreation Season Monitoring Program (Appendix F) and longitudinal bacteria surveys (Appendix G) were used to assess the contact recreation use support. ORSANCO conducted recreation season monitoring at six urban centers with large combined sewer systems. Monitoring was conducted during the recreation period of May through October. In 2003, 2004, and 2005, ORSANCO also sampled the Ohio River approximately every five miles from Pittsburgh, PA to Cairo, IL during longitudinal bacteria surveys.

There are approximately 49 combined sewer systems located along the Ohio. Combined sewer overflows (CSOs) and other nonpoint sources have been identified as significant causes of bacteria problems in the Ohio River, particularly during heavy rain events. Impairments were based on exceedances of ORSANCO's stream criteria for bacteria. Using the geometric mean and instantaneous maximum bacteria values, sites were classified as having good (less than ten percent of sites exceeded criteria), fair (11-25 percent of sites exceeded criteria), or poor (greater than 25 percent of sites exceeded criteria) water quality. Approximately 475 miles of the Ohio River were classified as impaired (fair or poor water quality) for the contact recreation use. Over 50 percent of the Ohio River was classified as fully supporting this use.

Fish Consumption Use Support

Fish consumption use support was assessed based primarily on the states' issuance of fish consumption advisories (Appendix H) and ORSANCO fish tissue contaminants data (Appendix I, J, K). Sites were classified as fully supporting if there were no fish consumption advisories and if PCBs, dioxins, and mercury did not exceed criteria. If contaminants exceeded criteria and fish consumption advisories were in effect, sites were considered impaired with fair water quality. Poor water quality was indicated by "no consumption" advisories. Under these advisories, it is recommended that no fish from the river be consumed by any individuals. None of these types of advisories were observed during the reporting period.

Through the Ohio River Watershed Pollutant Reduction Program, ORSANCO collected "high volume" Ohio River water samples that were analyzed for dioxin and polychlorinated biphenyls (PCBs) (see page 22). These data were compared to applicable ambient water quality criteria established for the protection of human health due to water and fish ingestion. Dioxin and PCB monitoring exceeded the applicable water quality criterion in every sample. Because of the widespread sampling for dioxin and PCBs, the entire river was assessed as impaired by these contaminants. Some states have statewide advisories for mercury. In the case of these statewide mercury advisories, the Commission's fish tissue contaminants data were compared to ORSANCO's methylmercury criterion (0.3 mg/kg) contained in its 2003 Pollution Control Standards. No impairments based on mercury were indicated. All 981 miles (100 percent) of the Ohio River were classified as partially supporting fish consumption use due to advisories for PCBs and widespread dioxin violations.

State-by-state summary of impaired uses of the Ohio River.

State	River Miles	Aquatic Life Impairments	Public Water Supply Impairments	Contact Recreation Impairments	Fish Consumption Impairments
PA	0-40.2	0	0	40.2	40.2
OH-WV	40.2-317.1	0	0	88.8	276.9
OH-KY	317.1-491.1	0	0	41	174
IN-KY	491.1-848.0	0	0	277	356.9
IN-IL	848.0-981.0	0	0	28	133
Total	981.0	0	0	475	981

Table of Contents

List of Figures

List of Tables

Part I: Introduction

The Ohio River Valley Water Sanitation Commission (ORSANCO, the Commission) is an interstate water pollution control agency for the Ohio River. ORSANCO was established in 1948 through the signing of the Ohio River Valley Water Sanitation Compact by representatives of the eight member states: Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia, and approved by Congress. Under the terms of the Compact, the states pledged to cooperate in the control of water pollution within the Ohio River Basin. Article VI of the Compact states that the guiding principle "shall be that pollution by sewage or industrial wastes originating in a signatory state shall not injuriously affect the various uses of the interstate waters." ORSANCO carries out a variety of programs, which primarily focus on the Ohio River mainstem, to address this principle. General program areas include water quality monitoring and assessment, emergency response, pollution control standards, and public information and education. The Commission also provides an excellent forum for information exchange and technology transfer among the states' water pollution control and natural resources agencies.

The Compact designates the Ohio River to be "available for safe and satisfactory use as public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining aquatic life... and adaptable to such other uses as may be legitimate." No degradation of Ohio River water quality, which would interfere with or become injurious to these uses, is permitted. ORSANCO monitors and assesses the Ohio River on behalf of the compact states. This report focuses on the water quality of the mainstem of the Ohio River, though monitoring is conducted on tributaries as well. The Ohio River forms in Pittsburgh, Pennsylvania, at the confluence of the Allegheny and Monongahela rivers. The river is 981 miles long and generally flows southwest to join the Mississippi River near Cairo, Illinois. The first 40 miles of the Ohio River are wholly within Pennsylvania. The remaining 941 miles form the state boundaries between Illinois, Indiana and Ohio to the north, and Kentucky and West Virginia to the south.

This report generally covers the time between October 1, 2003 and September 30, 2005, although certain assessments use earlier data. The assessment methodologies and supporting data used to generate this assessment are contained within this report and its appendices. For this report, Ohio River water quality is determined by the degree of support for each of the following designated uses: warm water aquatic life habitat, public water supply, contact recreation, and fish consumption. Each designated use is evaluated using specific numeric water quality criteria, the existence of advisories against consuming fish, surveys and questionnaires, and a direct measure of biological communities within the Ohio River. Based on water quality conditions, the Ohio River is classified as fully, partially, or not supporting each of the designated uses. Fully supporting indicates minor or no water quality problems. A designation of "partial support" indicates impairment, but data suggest fair water quality. A designation of "not supporting" also indicates impairment; however, in this case data indicate poor water quality.

Contained in this report are assessments of Ohio River designated use attainment, as well as an "Integrated List" of waters requiring Total Maximum Daily Loads (TMDLs). ORSANCO's role in completing Ohio River use attainment assessments and an Integrated List is to facilitate interstate consistency. However, the states are not obligated to incorporate any or all of this assessment into their own reports. Specifically, the United States Environmental Protection Agency (US EPA) has prepared "Guidance for 2006 Assessment, Listing, and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act." This guidance states that "data and information in an interstate commission 305(b) report should be considered by the states as one source of readily available data and information when they prepare their Integrated Report and make decisions on segments to be placed in Category 5; however, data in a 305(b) Interstate Commission Report should not be automatically entered in a state Integrated Report or 303(d) list without consideration by the state about whether such inclusion is appropriate."

Part II: Background Information

Chapter 1: The Ohio River Watershed

Basin Characteristics

The Ohio River drains 203,940 square miles, which is approximately five percent of the contiguous United States (Figure 1). Although the river is 981 miles in length and flows through or borders six states, only five percent of the basin actually drains directly into the Ohio River. Instead the river is fed by numerous tributaries, including the Allegheny, Monongahela, Kanawha, Wabash, Green, Cumberland, and Tennessee rivers. These are only a few of the nested watersheds that make up the Ohio River Basin, which covers portions of 15 states. Over 25 million people, approximately ten percent of the United States' population, reside in the Ohio River Basin. An estimated 3.6 million people live in cities and towns adjacent to the Ohio River.

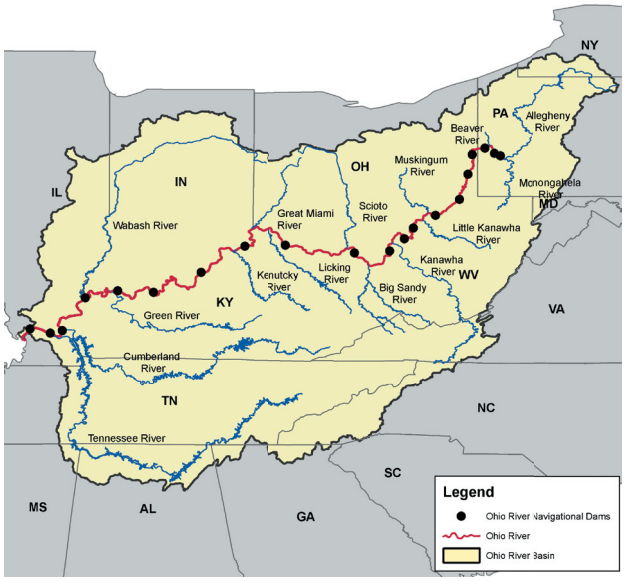


Figure 1. The Ohio River is fed by numerous tributaries. Twenty lock and dam systems regulate water levels and allow navigation on the river.

The Ohio River watershed is comprised of a number of different land use types, including agricultural, industrial, urban, and forested areas (Figure 2). Land use is a significant factor in determining both the runoff characteristics of a drainage basin and the water quality of its streams. Land uses such as agriculture, industry, and mining can lead to impairments in water quality. Due to the high concentration of people in the watershed, urban runoff is a large contributor to degraded water quality as well. For example, in paved areas, water is conveyed to streams and rivers more quickly, transporting pollutants directly to the water bodies. In contrast, runoff is conveyed more slowly in forested areas where water can infiltrate the soil.

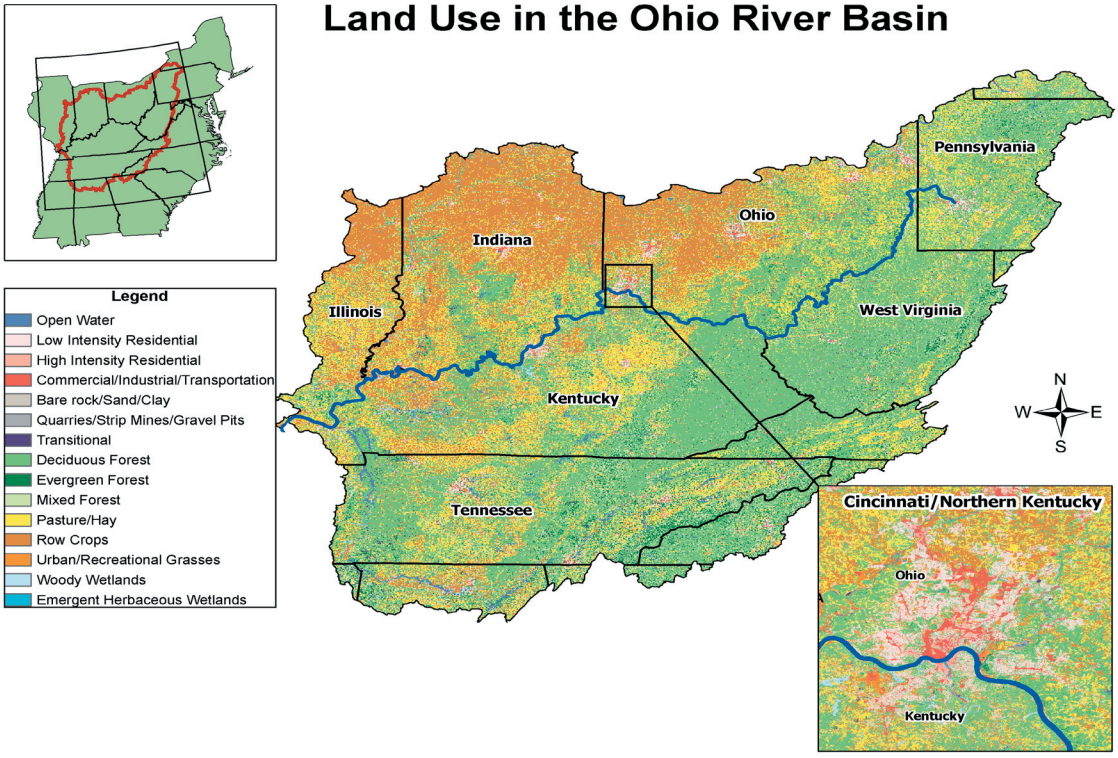


Figure 2. The Ohio River Valley supports a variety of land use types. Like most of the Midwest, states such as Ohio and Indiana are dominated by agriculture. As shown in the inset (Cincinnati/Northern Kentucky), highly populated regions of the river are characterized by residential, commercial, and industrial land use types.

Description of Ohio River Pools

The Ohio River is divided into 21 segments by 20 navigational dams (Figure 1). These dams have a significant impact on the flow, water quality and aquatic communities of the river. The modern high lift dams have resulted in a deeper, slower moving river than existed prior to their construction. Because each pool has its own unique characteristics, these water bodies have been used for assessment and reporting purposes in the past. For the 2006 Integrated Report, aquatic life use attainment is determined using the navigational pools as separate assessment units; however, the degree of use support for the remaining uses is assessed for each river mile. It was determined that this method provided a more accurate description of the river. The following descriptions include the boundaries of each water body as well as other relative information.

- **Pittsburgh Point-Emsworth** (mile point 0-6.2) This water body is bounded by the confluence of the Allegheny and Monongahela rivers (the origin of the Ohio River) on the upstream end and by the Emsworth Locks & Dam on the downstream end. Chartiers Creek, with a drainage area of 277 square miles, intersects this water body at mile point 2.5.

- **Emsworth-Dashields** (mile point 6.2-13.3) This 7.1-mile-long water body encompasses the entire Dashields Pool and is bounded by the Emsworth Locks & Dam upstream and the Dashields Locks & Dam on the downstream end.

- **Dashields-Montgomery** (mile point 13.3-31.7) This 18.4-mile-long water body is bounded by the Dashields Locks & Dam upstream and the Montgomery Locks & Dam on the downstream end. Two tributaries that enter this navigational pool include the Beaver and Raccoon rivers at river miles 25.4 and 29.6, respectively.

- **Montgomery-New Cumberland** (mile point 31.7-54.4) This 22.7-mile-long water body is bounded by the Montgomery Locks & Dam upstream and New Cumberland Locks & Dam downstream. Pennsylvania borders Ohio and West Virginia at river mile 40.2. The Little Beaver River, with a drainage area of 510 square miles, intersects this water body at mile point 39.5. Yellow Creek, with a drainage area of 240 square miles, intersects this water body at mile point 50.4.

- **New Cumberland-Pike Island** (mile point 54.4-84.2) This 29.8-mile-long water body encompasses the entire Pike Island Pool and is bounded by the New Cumberland Locks & Dam upstream and the Pike Island Locks & Dam on the downstream end. The following tributaries intersect this water body: Buffalo Creek at mile point 74.7 with a drainage area of 160 square miles, and Short Creek at mile point 81.4 with a drainage area of 147 square miles.

- **Pike Island-Hannibal** (mile point 84.2-126.4) This 42.2-mile-long water body encompasses the entire Hannibal Pool and is bounded by the Pike Island Locks & Dam upstream and the Hannibal Locks & Dam downstream. The following tributaries intersect this water body: Wheeling Creek in Ohio at mile point 91.0 with a drainage area of 108 square miles, Wheeling Creek in West Virginia at mile point 91.0 with a drainage area of 300 square miles, McMahon Creek at mile point 94.7 with a drainage area of 91 square miles, Grave Creek at mile point 102.5 with a drainage area of 75 square miles, Captina Creek at mile point 109.6 with a drainage area of 181 square miles, Fish Creek at mile point 113.8 with a drainage area of 250 square miles, and Sunfish Creek at mile point 118.0 with a drainage area of 114 square miles.

- **Hannibal-Willow Island** (mile point 126.4-161.7) This 35.3-mile-long water body encompasses the entire Willow Island Pool and is bounded by the Hannibal Locks & Dam upstream and the Willow Island Locks & Dam on the downstream end. The following tributaries intersect this water body: Fishing Creek at mile point 128.3 with a drainage area of 220 square miles, Middle Island Creek at mile point 154.0 with a drainage area of 560 square miles, and Little Muskingum River at mile point 168.3 with a drainage area of 315 square miles.

- **Willow Island-Belleville** (mile point 161.7-203.9) This 42.2-mile-long water body is bounded by Willow Island Locks & Dam on the upstream side and Belleville Locks & Dam downstream. Duck Creek, with a drainage area of 228 square miles, intersects this water body at mile point 170.7. The Muskingum River has a drainage area of 8,040 square miles and enters the Ohio River at mile point 172.2. Other tributaries intersecting this water body include the Little Kanawha River at mile point 184.6 with a drainage area of 2,320 square miles, Little Hocking River at mile point 191.8 with a drainage area of 103 square miles, and Hocking River at mile point 199.3 with a drainage area of 1,190 square miles.

• **Belleville-Racine** (mile point 203.9-237.5) This 33.6-mile-long water body encompasses the entire Racine Pool and is bounded by the Belleville Locks & Dam upstream and the Racine Locks & Dam on the downstream end. The following tributaries intersect this water body: Shade River at mile point 210.6 with a drainage area of 221 square miles, Shady Creek at mile point 220.6 with a drainage area of 115 square miles, and Mill Creek at mile point 231.5 with a drainage area of 230 square miles.

• **Racine-Kanawha River** (mile point 237.5-265.7) This 28.2-mile-long water body is bounded by the Racine Locks & Dam upstream and Kanawha River on the downstream end. Leading Creek, with a drainage area of 151 square miles, intersects this water body at mile point 254.2.

• **Kanawha River-Robert C. Byrd** (mile point 265.7-279.2) This 13.5-mile-long water body is bounded by the Kanawha River upstream and the Robert C. Byrd (R.C. Byrd, formerly Gallipolis) Locks & Dam on the downstream end. The Kanawha River has a drainage area of 12,200 square miles. Raccoon Creek, with a drainage area of 684 square miles, intersects this water body at mile point 276.0.

• **Robert C. Byrd-Greenup** (mile point 279.2-341.0) This 61.8-mile-long water body is bounded by the R.C. Byrd Locks & Dam on the upstream and the Greenup Locks & Dam downstream. The following tributaries intersect this water body: Guyandotte River at mile point 305.2 with a drainage area of 1,670 square miles, Symmes Creek at mile point 308.7 with a drainage area of 356 square miles, and Twelvepole Creek at mile point 313.2 with a drainage area of 440 square miles. The Big Sandy River, forming the border between West Virginia and Kentucky, enters the Ohio River at mile point 317.1 with a drainage area of 4,280 square miles. The Little Sandy River, with a drainage area of 724 square miles, enters the Ohio River at mile point 336.4.

• **Greenup-Meldahl** (mile point 341.0-436.2) This 95.2-mile-long water body is bounded by the Greenup Locks & Dam upstream and Meldahl Locks & Dam on the downstream end. The following tributaries intersect this water body: Pine Creek at mile point 346.9 with a drainage area of 185 square miles, Little Scioto River at mile point 349.0 with a drainage area of 233 square miles, Tygarts Creek at mile point 353.3 with a drainage area of 336 square miles, the Scioto River at mile point 356.5 with a drainage area of 6,510 square miles, Kinniconick Creek at mile point 368.1 with a drainage area of 253 square miles, Ohio Brush Creek at mile point 388.0 with a drainage area of 435 square miles, Eagle Creek at mile point 415.7 with a drainage area of 154 square miles, and White Oak Creek at mile point 423.9 with a drainage area of 234 square miles.

• **Meldahl-Markland** (mile point 436.2-531.5) This 95.3-mile-long water body is bounded by the Meldahl Locks & Dam upstream and the Markland Locks & Dam on the downstream end. Major tributaries intersecting this water body include the Little Miami River (river mile 464.1, drainage area 1,670 square miles), Licking River (river mile 470.2, drainage area 3,670 square miles), and Great Miami River (river mile 491.1, drainage area 5,400 square miles).

• **Markland-McAlpine** (mile point 531.5-606.8) This 75.3-mile-long water body is bounded by the Markland Locks & Dam upstream and the McAlpine Locks & Dam on the downstream end. The Kentucky River, which empties into this navigational pool, has a drainage area of 6,970 square miles. Other tributaries include the following: Little Kentucky River at mile point 546.5 with a drainage area of 147 square miles, Indian Kentucky River at mile point 550.5 with a drainage area of 150 square miles, and Silver Creek at mile point 606.5 with a drainage area of 225 square miles.

• **McAlpine-Cannelton** (mile point 606.8-720.7) This 113.9-mile-long water body is bounded by the McAlpine Locks & Dam upstream and the Cannelton Locks & Dam on the downstream end. Several tributaries intersect this portion of the Ohio River. The Salt River has a drainage area of 2,890 square miles. Other tributaries intersecting this water body include Big Indiana Creek at mile point 657 with a drainage area of 249 square miles, Blue River at mile point 663 with a drainage area of 466 square miles, and Sinking Creek at mile point 700.9 with a drainage area of 276 square miles.

• **Cannelton-Newburgh** (mile point 720.7-776.1) This 55.4-mile-long water body is bounded by the Cannelton Locks & Dam upstream and the Newburgh Locks & Dam on the downstream end. The following tributaries intersect this water body: Anderson River at mile point 731.5 with a drainage area of 276 square miles, Blackford Creek at mile point 742.2 with a drainage area of 124 square miles, and Little Pigeon Creek at mile point 773 with a drainage area of 415 square miles.

- **Newburgh-John T. Myers** (mile point 776.1-846.0) This 69.9-mile-long water body is bounded by the Newburgh Locks & Dam upstream and John T. Myers Locks & Dam (J.T. Myers, formerly Uniontown) on the downstream end. The Green River empties into this pool at river mile 784.2 and has a drainage area of 9,230 square miles. Pigeon Creek, with a drainage area of 375 square miles, intersects this water body at mile point 792.9.

- **John T. Myers-Smithland** (mile point 846.0-918.5) This 72.5-mile-long water body is bounded by the J.T. Myers Locks & Dam upstream and the Smithland Locks & Dam on the downstream end. The Wabash River has a drainage area of 33,100 square miles and enters the Ohio River at river mile 848. The Saline River, with a drainage area of 1,170 square miles, intersects this water body at mile point 867.3. The Tradewater River, with a drainage area of 1,000 square miles, intersects this water body at mile point 873.5.

- **Smithland-Lock & Dam 52** (mile point 918.5-938.9) This 20.4-mile-long water body is bounded by the Smithland Locks & Dam upstream and Lock & Dam 52 on the downstream end. The Cumberland River drains into the Ohio River at river mile 920.4 and has a drainage area of 17,920 square miles. The Tennessee River also empties into the Ohio River in this pool. It has a drainage area of 40,910 square miles.

- **Lock & Dam 52-Cairo** (mile point 938.9-981) This 42.1-mile-long water body is bounded by Lock & Dam 52 upstream and the Mississippi River on the downstream end (the endpoint of the Ohio River). Lock & Dam 52 as well as Lock & Dam 53 are currently being replaced by a single lock and dam facility called Olmsted Locks & Dam at river mile 964.4.

Appendix A contains additional data on basin characteristics including locations of locks and dams, locations of tributaries, and hydrologic data for water years 2004 and 2005.

Uses of the Ohio River

The Ohio River Basin encompasses 15 states. As such, the Ohio River is known for a variety of different uses. Specifically, through 29 public drinking water utilities and numerous industries, the river provides drinking water to approximately three million people. More than 49 electric power-generating facilities located along the river provide greater than five percent of the United States' power generating capacity. In addition, the river serves as a transportation highway for commercial navigation. Each year, barges carry in excess of 150 million tons of cargo along the Ohio River. The majority of commercial cargo consists of coal, oil, and petroleum. Finally, the Ohio River serves as a source of recreation for many individuals throughout the basin. The river provides warm water habitat for over 129 species of fish, drawing fishermen and nature enthusiasts to the banks of the river. It also provides recreational opportunities for boaters and a natural setting for dining and festivals. According to the Clean Water Act, states must assess the degree to which state waters meet their designated uses. Designated uses for the Ohio River include contact recreation, aquatic life, public water supply, and fish consumption.

Flows

A series of locks and dams, operated and maintained by the United States Army Corps of Engineers, regulate pool elevation on the Ohio River. These dams create 20 pools with guaranteed, regulated minimum flows to assure continued commercial navigation during droughts. Long-term average flows in the Ohio River, depending on location and time of year, range from 14,000 to 497,000 cubic feet per second (cfs). Hydrologic conditions varied considerably over the reporting period. Flow data, reported on a monthly basis by the National Weather Service, are contained in Appendix A. Figure 3 provides a comparison of flow over the reporting period compared to long-term average flows at Evansville, IN. Evansville is downstream of most major tributaries with the exception of the Wabash, Cumberland and Tennessee rivers. Flows in 2004 were generally higher than long-term averages. This can be attributed to increased rainfall throughout the year. In contrast, the latter part of 2005 was a drier year characterized by lower flows. Both high and low flow conditions can affect the various uses of the Ohio River adversely. Aquatic biota, for example, may experience lower dissolved oxygen levels during low flow periods. During high flow conditions, bacteria levels often increase due to combined sewer overflows (CSOs).

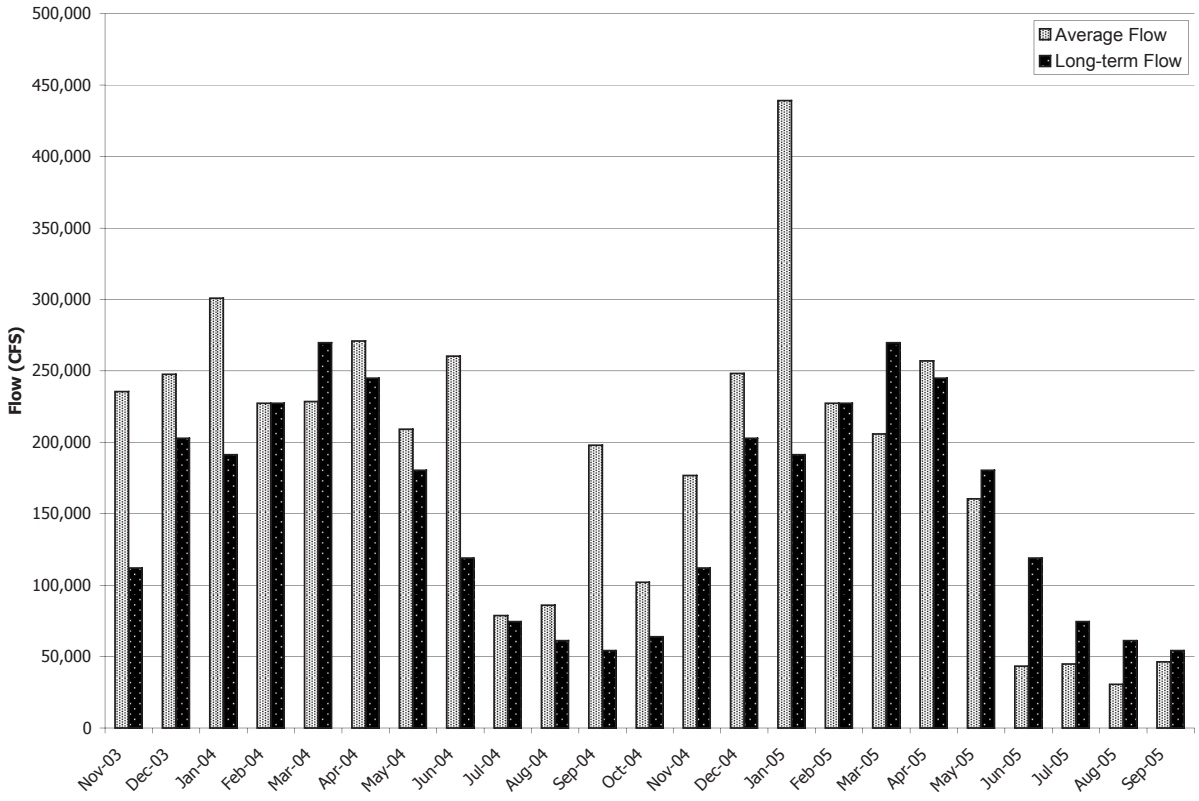


Figure 3. Flow data from the Ohio River at Evansville, IN. Monthly average flows are compared to long-term flows. Most flows in 2004 exceeded the long-term average, whereas 2005 flows were generally lower than the long-term average flows.

Chapter 2: Program Descriptions

Monitoring Programs

Water Quality

Many states along the Ohio River rely on ORSANCO's monitoring programs to provide them with a comprehensive picture of pollution problems in the Ohio River. The Commission, in turn, employs a variety of sampling techniques to respond to changing conditions and fulfill the information needs of the member states. ORSANCO supports a number of water quality monitoring programs, including bacteria, bimonthly, algae and nutrients, fish tissue, high volume, and clean metals sampling. The bimonthly sampling program consists of 17 mainstem and 14 tributary monitoring sites. Clean metals data are collected from 17 mainstem sites. Samples for both programs are collected every other month. Ten water treatment facilities monitor for nutrients two times each month. The effectiveness of efforts by ORSANCO and its member states to control and abate water pollution in the Ohio River can be measured through these monitoring programs.

Biological

Biological monitoring efforts in 2004 and 2005 focused on the implementation of a probability-based survey program assessing fish populations in individual pools of the Ohio River. This new monitoring strategy enabled biologists to use 15 randomly selected sites in a pool to report on the biological condition of the entire pool. Four pools were assessed each year, with the entire river (20 pools) being assessed every five years. In addition to the probability-based sampling, ORSANCO established 18 fixed monitoring stations along the length of the Ohio River. Sampling at these fixed sites will allow biologists to track changes in the fish community over time. Electrofishing is conducted at both probability and fixed station sites. Results are used to calculate Ohio River Fish Index (ORFIn) scores, a measure of fish community condition in the Ohio River.

Integrated Monitoring

Integrated monitoring efforts are designed to determine whether water chemistry data can provide an explanation for biological monitoring results, as well as to determine whether ambient water quality stations, which are located at either end of Ohio River pools, adequately describe the water quality conditions of the entire pool. Water quality data are collected one year prior to biological sampling, during the low flow months of July, August and September. In 2005, water quality information was collected from Montgomery and Willow Island pools to coincide with biological sampling conducted in 2006.

Watershed Pollutant Reduction Program

Originally, ORSANCO was created to coordinate the water pollution control efforts of states that bordered the Ohio River. The basin encompasses areas in 15 states. According to the Compact, waters from one state should not injuriously affect Ohio River uses in another state. As an interstate agency, ORSANCO has the unique opportunity to take a watershed approach to protect water quality by addressing issues and developing solutions through the coordinated efforts of numerous state agencies.

Total Maximum Daily Loads (TMDLs)

The Watershed Pollutant Reduction Program, with input from the public, identified PCBs, dioxin, and bacteria as three pollutants for which TMDLs should be developed. Information gathered through Watershed Pollutant Reduction Program monitoring- including high volume, sediment, atmospheric, and monitoring at Publicly Owned Treatment Works (POTW)- has provided valuable input into determining TMDLs, the maximum amount of a pollutant that can be incorporated by a body of water without causing impairment or exceeding state water quality standards. Sampling efforts in previous years focused on collecting information about PCBs and dioxins, two high-priority pollutants. ORSANCO has developed dioxin and PCB TMDLs for select reaches of the river. The Commission continues to develop TMDLs for PCBs and dioxins in other areas of the river and will begin work on a bacteria TMDL in 2007.

Longitudinal Bacteria Studies

Elevated bacteria levels continue to limit contact recreation in the Ohio River. In the past, advisories and recommendations were based on bacteria monitoring in large CSO communities, including Evansville, Louisville, Cincinnati, Huntington, Wheeling, and Pittsburgh. The addition of a mobile water quality laboratory allowed ORSANCO to expand its monitoring beyond these heavily populated areas to more remote locations along the river. The entire river was monitored through ten longitudinal surveys consisting of cross-sectional sampling every five miles on the mainstem and major tributaries of the Ohio River. ORSANCO's mobile laboratory permitted on-site analysis of bacteria samples, and enabled scientists to adhere to stringent sample "hold-time" while conducting large-scale surveys in isolated areas.

Pollution Control Standards

Urban Wet Weather Studies

Pollution from urban areas significantly impacts the quality of waterways in the Ohio River Basin. Urban pollution sources include stormwater, runoff, and combined sewer overflows (CSOs). Combined systems, which can be found in many of the large, old communities along the river, carry both wastewater and stormwater. During heavy rainfall or snowmelt, the systems can become overloaded, causing wastewater to bypass sewage treatment and discharge into nearby waterways. Through partnerships with states and cities, ORSANCO has taken a lead role in determining the water quality impacts of urban wet weather pollution on the Ohio River. Wet weather studies have been completed in three urban areas: Cincinnati, Wheeling, and Louisville. The Cincinnati study identifies CSOs and sanitary sewer overflows (SSOs) as the main source of bacteria pollution (75%). In Louisville, data suggest that upstream sources account for a majority of the bacteria pollution.

Enforcement of Pollution Control Standards

ORSANCO participated in the negotiation of a federal consent decree in conjunction with the US Department of Justice, US Environmental Protection Agency (EPA), Ohio EPA, and Metropolitan Sewer District (MSD) of Greater Cincinnati, OH, to control its sources of wet weather pollution from CSOs. The consent decree, finalized in May 2004, required Greater Cincinnati MSD to update its long-term control plans and use ORSANCO's Ohio River water quality model from the Cincinnati Wet Weather Study in its analysis of control alternatives.

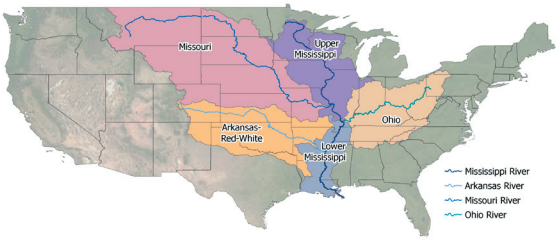
Collaborative Initiatives

Watershed-Scale Nonpoint Source Pollution Abatement

ORSANCO partnered with local, state and government agencies to evaluate the effectiveness of watershed-scale nonpoint source pollution abatement programs, using the Upper Big Walnut Creek in Ohio as a case study. Participants included the following companies and organizations:

- US EPA Office of Research and Development
- Subcontractor Malcolm-Pirnie, Inc.
- USDA Natural Resources Conservation Service
- Ohio DNR Division of Soil and Water Conservation
- Upper Big Walnut Creek Watershed Partnership
- City of Columbus

Project members developed a model to correlate field-scale pesticide runoff loss with downstream water quality monitoring data before and after implementation of environmental restoration. Future projects in the Big Walnut Creek watershed and similar watersheds can use recommendations from this effort to evaluate and improve other nonpoint source pollution abatement programs.



Abatement of Gulf of Mexico Hypoxia

Each year the Mississippi River discharges excess levels of nutrients to the Gulf of Mexico. These nutrient loads lead to hypoxia, or low oxygen levels, in the Gulf of Mexico. Studies have shown that the Ohio River contributes approximately 30 percent of the total nutrients in the Mississippi River. ORSANCO is working to develop a nutrient reduction strategy for the Ohio River sub basin of the Mississippi River watershed. In addition, a grant from US EPA has provided ORSANCO with an opportunity to act as a convener for the Ohio River Sub Basin Committee (ORSBC). This committee will forge new partnerships with agricultural and conservation agencies to broaden participation in nutrient reduction efforts.

Environmental Monitoring and Assessment Program (EMAP)

ORSANCO is assisting in a comprehensive ecological survey of the Great River Ecosystems (GRE) of the United States. EMAP-GRE, which is overseen by US EPA, focuses on the Missouri, Upper Mississippi, and Ohio rivers. The effort requires the collaboration of dozens of state and federal agencies, as well as private organizations. ORSANCO helped to develop fish population and fish tissue collection methods for the project. ORSANCO also trained various field crews from several states throughout the basins in these methods. In addition to the EMAP-GRE project, ORSANCO conducts field work for a regional EMAP project (REMAP). According to US EPA, this program tests the applicability of EMAP at regional and local scales.

Drinking Water Protection

Protecting Ohio River drinking water utilities from spills and other threats to water quality is one of ORSANCO's highest priorities. Along with state and federal agencies, ORSANCO works to ensure that adequate notification takes place for all spills to the Ohio River and provides monitoring as necessary to determine the location and severity of spills that impact Ohio River water quality. One technological tool that enables ORSANCO to accomplish this goal is the Organics Detection System (ODS).

Organics Detection System (ODS)

The ODS is a cooperative effort among the Commission, water utilities, and industries along the Ohio River and its tributaries. The ODS provides daily analyses of river water for the presence of over 20 volatile organic compounds at 15 locations. This cooperative partnership has repeatedly demonstrated its effectiveness in ensuring the safety of public water supplies. If unusual levels are detected, downstream water utilities are notified and efforts are undertaken to determine the source. In 2003, ODS alerted staff to detections of tetrachloroethylene, propylene oxide, and a combination of benzene, toluene, and styrene. As a result of this detection system, ORSANCO was able to notify downstream water utilities and protect their water supplies.

Part III: Surface Water Monitoring and Assessment

Chapter 1: Monitoring Programs To Assess Ohio River Designated Use Attainment

The Ohio River Valley Water Sanitation Commission Compact requires that the Ohio River be capable of maintaining fish and other aquatic life, suitable for recreational usage, and in safe and satisfactory condition for public and industrial water supply. The Commission operates a number of monitoring programs to assess the degree of use support:

- bimonthly sampling
- clean metals sampling
- fish population monitoring
- contact recreation bacteria monitoring
- longitudinal bacteria surveys
- fish tissue sampling
- high volume PCB and dioxin water sampling

The first two are indirect chemical measures of biological health, while fish population surveys directly monitor the biological integrity of one component (fish) of the aquatic community. Monitoring a large river system such as the Ohio River presents challenges related to spatial and temporal coverage. However, ORSANCO combines multiple monitoring programs to assess the attainment status of the Ohio River's designated uses (Figure 4).

Bimonthly & Clean Metals Sampling

The bimonthly and clean metals sampling programs are used to assess aquatic life and public water supply uses. These programs entail the collection of water column grab samples from 17 site-specific Ohio River stations once every other month (Table 1, Appendix B). The samples are collected by contract samplers and ORSANCO staff and are analyzed for certain physical and chemical parameters by a contract laboratory. In October 2000, ORSANCO changed the aquatic life use criteria for metals from total recoverable metals to dissolved metals. This change was based on the conclusion that dissolved metals data were much more accurate and representative of metals dissolved in the water column, and therefore available to aquatic life. Dissolved metals criteria for the protection of aquatic life have very low concentrations, some in the single parts per billion range. Therefore, collection of uncontaminated samples and low-level analyses using clean techniques is essential. However, although dissolved criteria are used, every sample is analyzed for both total recoverable and dissolved metals. The Commonwealth of Virginia state laboratory provides the clean metals sampling equipment and analyses. Nonmetal parameters monitored in the bimonthly sampling program as well as clean metals parameters are used to determine the degree of support for aquatic life (Table 2). Applicable results from mainstem stations are compared to established stream criteria. For the 2006 report, bimonthly and clean metals data from October 2003 to July 2005 were used to make use assessments. Data from these programs also were used to assess the public water supply use.

Table 1. Station locations for clean metals and bimonthly sampling.

Station Name	River	Mile Point
New Cumberland	Ohio	54.4
Pike Island	Ohio	84.2
Hannibal	Ohio	126.4
Willow Island	Ohio	161.7
Belleville	Ohio	203.9
R.C. Byrd	Ohio	279.2
Greenup	Ohio	341.0
Meldahl	Ohio	436.2
Anderson Ferry	Ohio	477.5
Markland	Ohio	531.5
Louisville	Ohio	600.6
West Point	Ohio	625.9
Cannelton	Ohio	720.7
Newburgh	Ohio	776.1
J.T. Myers	Ohio	846.0
Smithland	Ohio	918.5
Lock & Dam 52	Ohio	938.9

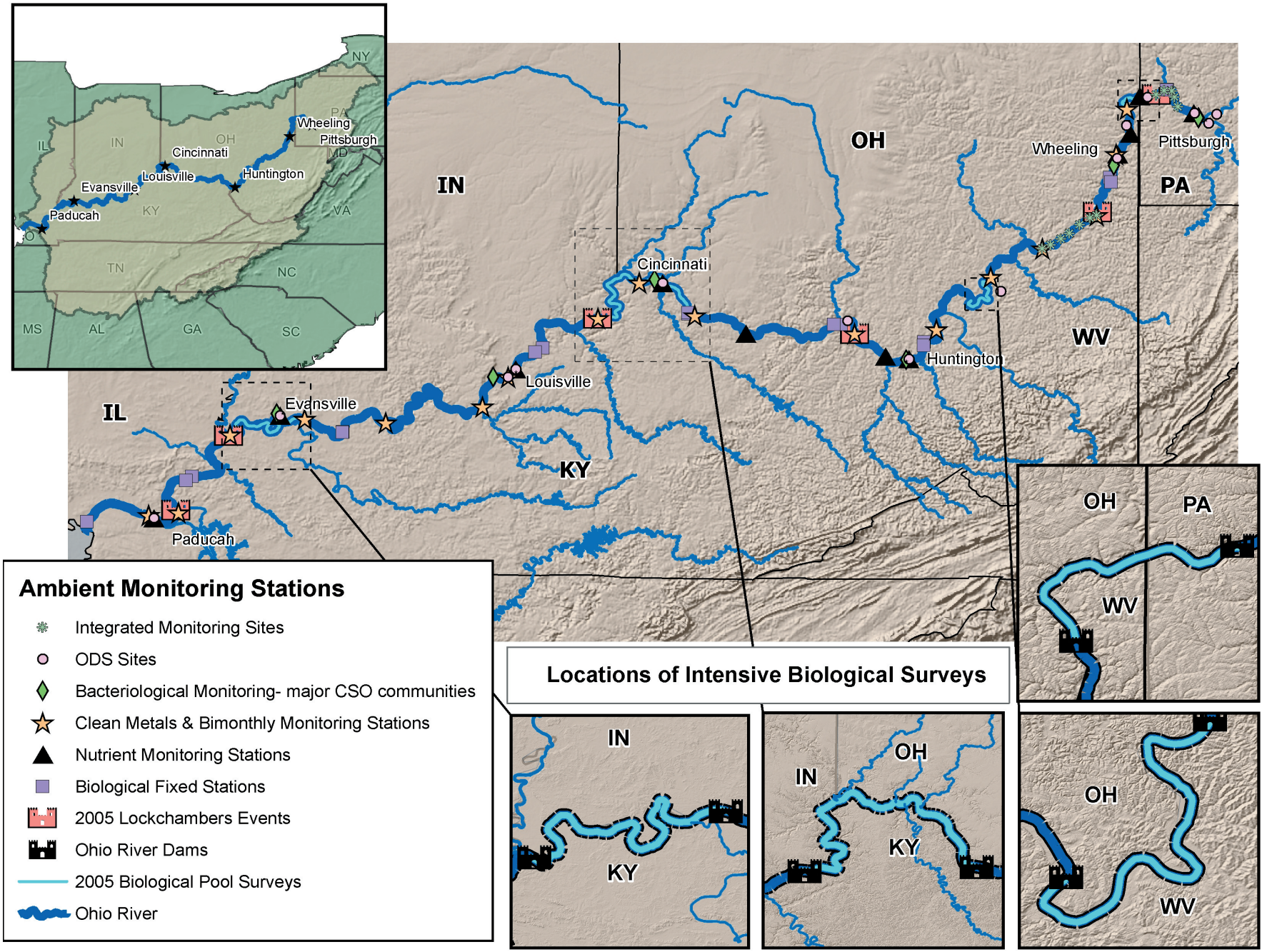


Figure 4. Locations of ORSANCO's ambient monitoring sites along the Ohio River. Sites include bimonthly and clean metals sampling locations, fish population study sites, ODS sites, Integrated Monitoring sites, lockchamber events, nutrients, and bacteriological monitoring sites.

Table 2. Clean metals and bimonthly sampling parameters, including both dissolved and total recoverable metals (SM- Standard Methods).

Element	Analysis	Detection Limit
Aluminum (Al)	EPA 1638	1.0 µg/L
Antimony (Sb)	EPA 1638	0.1 µg/L
Arsenic (As)	EPA 1638	0.5 µg/L
Barium (Ba)	EPA 1638	10 µg/L
Cadmium (Cd)	EPA 1638	0.1 µg/L
Calcium (Ca)	EPA 1638	1000 µg/L
Copper (Cu)	EPA 1638	0.1 µg/L
Chromium (Cr)	EPA 1638	0.1 µg/L
Iron (Fe)	EPA 1638	100 µg/L
Lead (Pb)	EPA 1638	0.1 µg/L
Magnesium (Mg)	EPA 1638	1000 µg/L
Manganese (Mn)	EPA 1638	0.1 µg/L
Mercury (Hg)	EPA 1631	0.0002 µg/L
Nickel (Ni)	EPA 1638	0.1 µg/L
Selenium (Se)	EPA 1638	0.5 µg/L
Silver (Ag)	EPA 1638	0.1 µg/L
Thallium (Tl)	EPA 1638	0.2 µg/L
Zinc (Zn)	EPA 1638	1.0 µg/L
Ammonia Nitrogen (NH_3-N)	EPA 350.3	0.03 mg/L
Chloride	EPA 325.3	1.0 mg/L
Hardness (THard)	SM 2340C	1.0 mg/L
Nitrate + Nitrite (NO_3/NO_2)	EPA 353.3	0.02 mg/L
Phenolics	EPA 420.1	0.005 mg/L
Total Kjeldahl Nitrogen (TKN)	SM 4500	0.20 mg/L
Sulfate (SO_4)	HACH 8051	1.0 mg/L
Total Suspended Solids (TSS)	EPA 160.2	1.0 mg/L
Total Phosphorus (TPhos)	EPA 365.3	0.01 mg/L
Total Organic Carbon (TOC)	EPA 415.1	0.5 mg/L
Total Cyanide (CN)	EPA 335.2	5.0 µg/L

Fish Population Monitoring

Fish population data from 2004 and 2005 were used to assess support of the aquatic life use. The Commission monitors the fish population annually from July through October, conducting between 100 and 200 surveys of the fish community. The monitoring strategy includes both site-specific and probability-based sampling. Samples consist of 500-meter shoreline zones that are electrofished by boat at night. The fish are netted, weighed, measured, species recorded, and any unusual abnormalities such as growths or lesions are noted. Habitat types within the zone also are recorded. Work usually is conducted in four pools throughout a field season, completing the entire length of the Ohio River (20 pools) in five years. If impairment is found, pools may be resampled the following year. In past years, the sampling effort has focused on developing a numeric index to determine the integrity of fish communities. That index has been completed and includes a number of important factors such as number of fish, fish biomass, species diversity, and abundance of pollution tolerant and intolerant species. The Ohio River Fish Index (ORFIn) was based on the nationally used Index of Biotic Integrity (IBI), which was designed to assess smaller streams. The ORFIn, however, has been customized to assess the Ohio River, with expected values developed for different habitats found in this large river system. Aquatic life use support is assessed by comparing measured, numeric index values to expected values. Pools with greater than 25 percent of sites scoring below criteria for specific habitat types were assessed as impaired.

Contact Recreation Bacteria Sampling

The Commission collects bacteria samples from May through October in six large urban communities with combined sewer systems to evaluate support of the contact recreation use. Locations include Pittsburgh, Wheeling, Huntington, Cincinnati, Louisville, and Evansville (Appendix B). Five samples are collected monthly from three site-specific locations in five of the urban areas (four locations in Pittsburgh) and analyzed for fecal coliform and E. coli. In addition to routine bacteria sampling, the Commission conducted longitudinal surveys for bacteria from May to October in 2003, 2004, and 2005 under the Ohio River Watershed Pollutant Reduction Program (site list in Appendix B). In 2003 and 2004, this work involved collecting five rounds of samples, one round each week, from Pittsburgh (Ohio River Mile 0) to Cairo (Ohio River Mile 981), with one river cross-section sample collected approximately every five miles. Surveys were repeated in 2004 and 2005. Samples were analyzed for E. coli by ORSANCO staff using Colilert, a Most Probable Number method. A minimum of ten percent of duplicate samples were sent to a contract laboratory for analysis by the membrane filtration method for E. coli and fecal coliform. Through intensive longitudinal monitoring, the Commission was able to monitor the entire river for E. coli, the water quality parameter related to contact recreation usage.

Fish Tissue Sampling

The Commission also collects fish tissue samples between July and October and analyzes them for certain contaminants to assess support of the fish consumption use. In 2003 and 2004, approximately 101 fish tissue samples were analyzed from various Ohio River locations depending on fish population monitoring efforts and lockchamber survey locations. Pollutant contamination in the tissue is based on a composite of up to five fillets from various species. Tissue contaminants analyzed include PCBs, chlordane, mercury, cadmium, lead, and certain pesticides. The states use the data to develop and update public fish consumption advisories.

High Volume PCB and Dioxin Sampling

The Commission also conducts high volume water sampling for dioxin (2,3,7,8-TCDD, see page 22) and polychlorinated biphenyls (PCBs) to evaluate the fish consumption use. These chemicals have been known to bioaccumulate in fish tissue. High volume sampling is a method that concentrates 1,000 liters of water into a single sample, thereby lowering the detection level approximately 1,000 times. This achieves detection levels necessary to measure concentrations in the parts per quadrillion range. At least three rounds of sampling were completed at each of 35 Ohio River stations between 1997 and 2004. Filtered samples were analyzed by a contract laboratory, which generates results for dissolved and particulate fractions.

Other Sources of Data

Although many states rely on ORSANCO to monitor water quality in the Ohio River, most states collect some data on the Ohio River each year, though not as extensively as ORSANCO. ORSANCO contacted state and local agencies, as well as monitoring groups, to solicit Ohio River data for this assessment. All available, usable data were compiled and included in Appendix L. The data were compared to ORSANCO's Pollution Control Standards to make the use assessments.

Chapter 2: Aquatic Life Use Support Assessment

The Ohio River Valley Water Sanitation Commission Compact calls for the Ohio River to be in a satisfactory sanitary condition capable of maintaining fish and other aquatic life. The Commission assesses the degree of use support every two years, as the states are required to do by section 305(b) of the federal Clean Water Act. Data from a number of monitoring programs are used in making use attainment assessments, including bimonthly and clean metals sampling, as well as biological data collected during electrofishing and lockchamber events.

Aquatic Life Use Assessment Methodology

Bimonthly & Clean Metals Sampling

Both clean metal and nonmetal parameters are analyzed through ORSANCO's monitoring program. Data are collected from 17 fixed stations along the river (Appendix B). Grab samples are collected from these stations once every other month, providing approximately 11 samples during the period between November 2003 and July 2005. Of the 20 lock and dam systems along the Ohio River, ORSANCO maintains monitoring locations in 15 of the pools, with two pools having two monitoring points. In the 2006 analysis, ORSANCO extrapolated data from these 17 sites to the entire river and considered all 981 miles assessed because no differences in impairment status were seen between monitoring locations.

Fish Population Monitoring

While monitoring chemical parameters is a common and valuable strategy used to determine impairment, it also is useful to expand the focus beyond water chemistry and directly examine the effects of pollution on aquatic life. To further understand the status of the river and the degree to which it is meeting its aquatic life use, ORSANCO also conducts biological assessments of the Ohio River using the Ohio River Fish Index (ORFIn). The ORFIn combines various attributes of the fish community to give a score to the river based on its biology. The ORFIn is comprised of 13 metrics, which serve as surrogate measures of more complicated processes. Examples of metrics include the number of species, the number of pollution tolerant individuals, and the percent of top piscivores in the fish community. The values for each metric are compared to conditions found at the least disturbed locations in the Ohio River to derive a score. Metric scores then are combined to generate a single score for the site. A higher final score indicates a more desirable fish community, often having more species or fewer pollution-tolerant individuals in the fish community. The total score is compared to an expected score, which varies depending on the habitat type and location. Expected scores were developed using historical data collected from reference stations.

Since 2004, aquatic life has been assessed on a pool-by-pool basis. Four navigational pools are assessed each year, with the entire river (20 navigational pools) being fully assessed every five years. In 2004 and 2005, New Cumberland, Racine, Markland, and J.T. Myers pools were sampled (Figure 5, Appendix A). Fifteen sites were randomly selected to represent all sites within the pool. Sites were sampled using electrofishing between July and October. A pool was designated as impaired when greater than 25 percent of those randomly selected sites had failing ORFIn scores.

Aquatic life use attainment was determined using the two types of monitoring programs described above. Attainment was assessed as either "fully supporting" indicating no impairment, "partially supporting" meaning the segment was impaired due to violations of chemical water quality criteria for the protection of aquatic life or biological data, or "not supporting" meaning biological and water quality data indicated impairment. A full description of each designation follows:

Fully Supporting

- Fewer than ten percent of water samples exceed the criteria for one or more pollutants.
- Biological data does not indicate impairment (less than 25 percent of sites in a pool receive failing ORFIn scores).

Impaired- Partially Supporting

- One or more pollutants exceed the water quality criteria in 11-25 percent of the samples, **OR**
- Biological data indicates impairment (25 percent or more of the sites in a pool receive failing ORFIn scores).

Impaired- Not Supporting

- One or more pollutants exceed the criteria in greater than 25 percent of the samples, **AND**
- Biological data indicate impairment (25 percent or more of the sites in a pool receive failing ORFIn scores).

Aquatic Life Use Assessment Summary

All sections of the river were designated as fully supporting the aquatic life use based on biological and water quality data (Table 3). This assessment was determined using water quality data from 17 bimonthly and clean metals sampling sites as well as biological data from four navigational pools. Data from the 17 bimonthly and clean metals sampling sites were considered to be representative of the entire river because the level of impairment did not change from upstream to downstream sites. Parameters such as dissolved oxygen, ammonia, and various dissolved metals have criteria that must be met to provide protection of warm water aquatic life. No violations of the aquatic life criteria for clean metals or bimonthly parameters were observed (Appendix D and Appendix E, respectively).

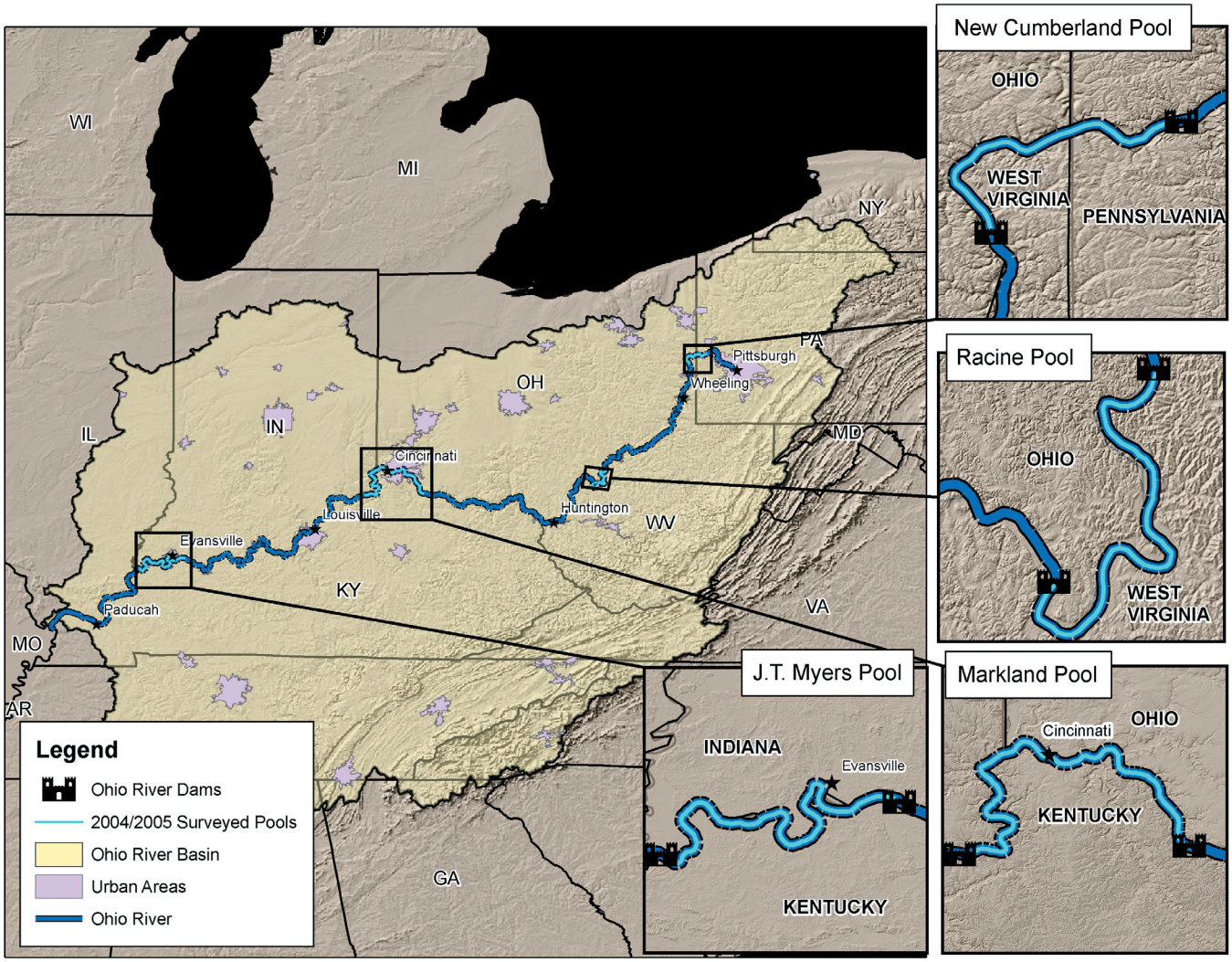


Figure 5. Location of Ohio River pools sampled during 2004 and 2005 fish population surveys. Fifteen randomly selected sites were sampled in four pools in 2004, including Racine, New Cumberland, Markland, and J.T. Myers. Pools were resampled in 2005.

Table 3. Summary of aquatic life use assessment for 2003-2005 based on 17 monitoring stations and fish population surveys. All 981 miles of the Ohio River fully support warm water aquatic life.

States	River Miles	Total Miles in Waterbody	Support Assessment	Causes of Impairment
PA-OH-WV-KY-IN-IL	0-981	981	Full Support	None

The four navigational pools, totaling 221.5 miles, were assessed using biological data from 15 randomly selected sites in each pool. The assessed pools included New Cumberland, Racine, Markland, and J.T. Myers. Fish populations in these pools were sampled in both 2004 and 2005. During each fish community assessment, biologists attempted to determine the fish community potential of that pool. Calculation of ORFIn scores for these four pools in 2004 resulted in an impairment designation for each pool, with greater than 25 percent of the sites having failing ORFIn scores. Uncharacteristically high flows during 2004 prompted resampling events in these pools in 2005 to confirm or refute 2004 results. Following repeat sampling events in 2005, only one site in each of the Racine and J.T. Myers pools scored below the expected value for that habitat type (Appendix C). All other sites in those pools as well as sites in Markland and New Cumberland pools earned passing ORFIn scores. These results were in sharp contrast to the results obtained in 2004. Numerous factors such as water quality can cause changes in the fish community. However, rarely do such drastic changes occur in such a short period of time, unless pollution is extremely acute. Water quality results from 2004 did not indicate that this was the case.

A previous discussion of chemical monitoring and aquatic life criteria stated that water quality results did not indicate impairment during 2004 or 2005, nor were any significant differences in parameters observed during this time period that could have led to a drastic change in the fish community. This suggested that, based on ORSANCO's monitoring, water quality conditions did not affect the fish community adversely in 2004. The presence of a high-quality fish community in 2005 instead suggested that either the fish migrated to these sites, establishing a stable, high-scoring fish community in just one year; or the fish community sampled in 2005 was present in 2004, but under-sampled due to adverse conditions. ORSANCO biologists and members of ORSANCO's Biological Water Quality Subcommittee agreed that it was unlikely that the fish community moved into the pools from outside areas such as tributaries or other pools in just one year. The erroneous results from 2004 can be explained best by high flow levels. River conditions in 2004 and 2005 were significantly different with regard to flow (Figure 6). The amount of flow in the river is a function of the amount of precipitation falling on the drainage basin and the runoff characteristics of the basin. Only five percent of the Ohio River Basin drains directly into the Ohio River. Therefore, the runoff characteristics of the tributaries that feed into the river also affect flow. High flow rates in the Ohio River can affect sampling in a variety of ways. Elevated flows lead to decreased transparency and visibility as well as high stages, reducing the ability of biologists to sample the fish community effectively. The fish community also reacts to high flow conditions, often retreating to deeper waters to escape adverse conditions. ORSANCO's electrofishing methods are confined to shallower waters near the banks of the Ohio River, making it difficult to sample the fish community under these conditions. Currently ORSANCO has visibility (secchi) and stage restrictions in place which help to define appropriate sampling conditions. In the future, ORSANCO will develop flow-based sampling restrictions which will drastically reduce variability associated with increased flow.

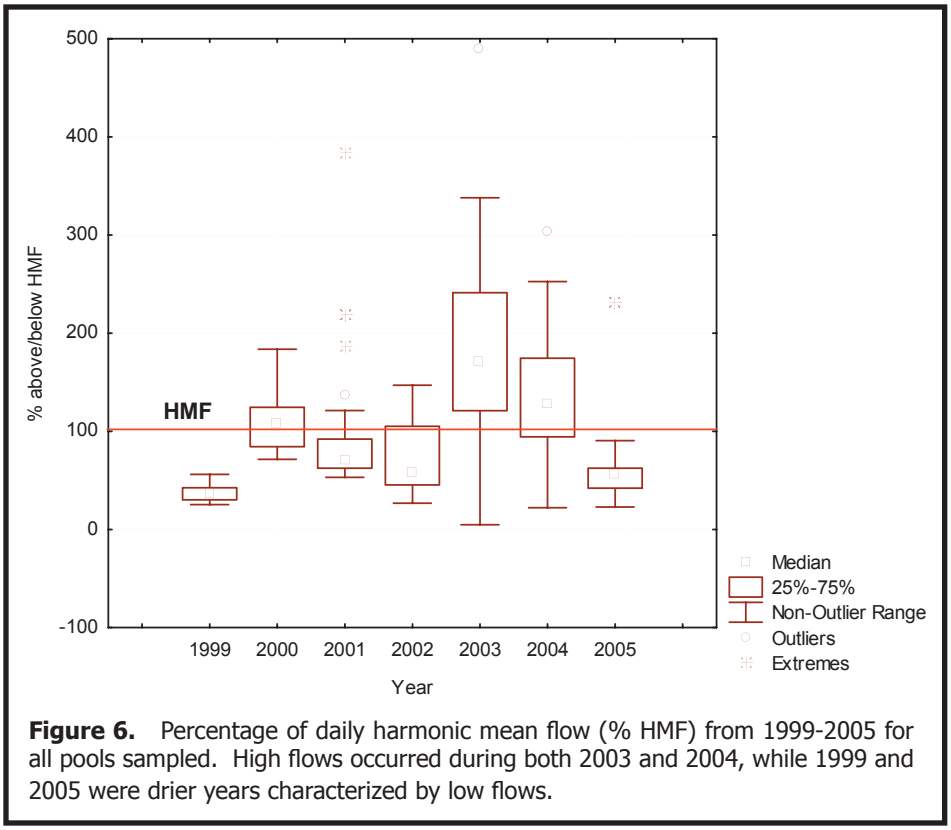


Figure 6. Percentage of daily harmonic mean flow (% HMF) from 1999-2005 for all pools sampled. High flows occurred during both 2003 and 2004, while 1999 and 2005 were drier years characterized by low flows.

Using several years of data, a possible relationship between ORFIn scores and Ohio River flow conditions was identified. Data from 1999 to 2005 indicated that as flow increased, the percentage of failing ORFIn scores increased (Figure 7). In both 2003 and 2004, two relatively wet years (Figure 6), less than 60 percent of the sites had passing ORFIn scores. Two dry years, 1999 and 2005 (Figure 6), resulted in passing ORFIn scores at over 90 percent of the sites (Figure 7). These relationships indicated that it was more likely that the fish community was present in 2004, but high flow conditions caused the fish to move deeper in the water column and impeded efforts to sample the fish community.

Based on this information, it is believed the results from 2004 are not representative of the fish community potential in each of those pools sampled. As a result, only the 2005 biological data were used in this assessment analysis and 2004 data were omitted because collection occurred under conditions that were not representative of the pool. Although 2005 also could be characterized as an abnormal flow year, it should be noted that fish are generally the most stressed under low flow conditions, when dilution is reduced, thereby increasing instream concentrations of contaminants. Under these conditions, fish are stressed further by the higher temperatures and lower dissolved oxygen conditions naturally associated with low flows. In spite of these stressors, when only 2005 biological data are used, the pools sampled all fully support the aquatic life use.

ORSANCO biologists and the Biological Water Quality Subcommittee continue to try to understand the anomalous conditions and results from 2004. To resolve the issues that arise with high flow conditions, ORSANCO may develop a flow calibration for the ORFIn, similar to what has been developed to account for varying seasonal and habitat conditions. The issue also can be resolved by redefining the acceptable fishing conditions for biological assessment. For example, using statistics biologists can determine a percentage of the harmonic mean flow that is acceptable for fish collection. If that percentage of the harmonic mean flow is exceeded, sampling will not take place until flows subside. If sampling does take place, the results will not be considered for assessment purposes.

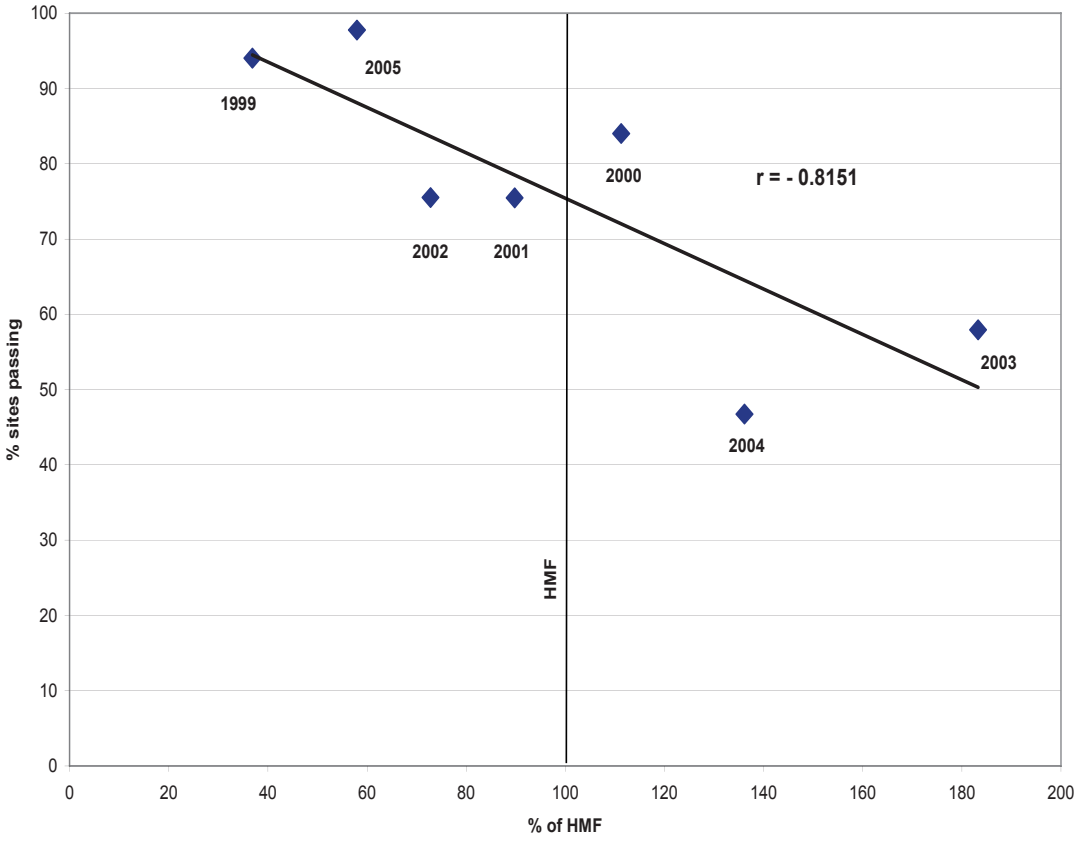


Figure 7. The percentage of sites passing in relation to harmonic mean flow (HMF) from 1999-2005. During wet years (higher % of HMF), a higher percentage of sites have failing ORFIn scores.

Chapter 3: Public Water Supply Use Support Assessment

The Ohio River Valley Water Sanitation Commission Compact requires that the Ohio River be available for safe and satisfactory use as public and industrial water supplies after reasonable treatment. The Ohio River serves as a drinking water source for over three million people within the Ohio River Basin. In order to ensure that this use is protected, the Commission operates a number of monitoring programs including bimonthly, clean metals, and bacteriological sampling.

Public Water Supply Use Assessment Methodology

The bimonthly and clean metals programs are comprised of 17 sampling stations along the Ohio River (Appendix B). Grab samples are collected from sites once every other month. Parameters monitored by ORSANCO for which there are human health criteria include arsenic, barium, silver, copper, nickel, selenium, thallium, total mercury, zinc, cyanide, chloride, fluoride, nitrates, nitrites, phenolics, dioxins, PCBs, and sulfates. Data included in this report were collected from November 2003 to July 2005. Bacteriological surveys are important to ensure that the fecal coliform criterion for drinking water—2,000 colonies/100 mL as a monthly geometric mean—is not exceeded. From 2003 through 2005 bacteria data were collected during the contact recreation season (May and October). In addition, the Commission surveyed all Ohio River water utilities, requesting information about their source water quality. ORSANCO received responses from 21 utilities, approximately 70 percent of all utilities using the Ohio River as a drinking water source. Questionnaires asked utilities if there were frequent intake closures due to spills, whether violations of finished drinking water maximum contaminant levels (MCLs) occurred due to source water quality, and whether non-routine treatment due to source water quality was necessary to meet finished water MCLs. The designations are as follows:

Fully Supporting
- Pollutant criteria are exceeded in less than 10 percent of the samples collected.

Impaired- Partially Supporting
- One or more pollutants exceed the criteria in 11 to 25 percent of the samples collected.
- Frequent intake closures due to elevated levels of pollutants are necessary to protect water supplies.
- Frequent "non-routine" additional treatment is necessary to protect water supplies and comply with provisions of the Safe Drinking Water Act (SDWA).

Impaired- Not Supporting
- One or more pollutants exceed the criteria in greater than 25 percent of the samples collected.
- Source water quality causes finished water MCL violations which result in noncompliance with provisions of the SDWA.

Public Water Supply Use Assessment Summary

Approximately 29 public water utilities use the Ohio River as their drinking water source (Figure 8). Based on available data from various ORSANCO programs and outside sources, all 981 miles of the Ohio River fully support the public water supply use (Table 4). In the past, areas in West Virginia experienced recurring phenol violations; however, between 2003 and 2005, only one violation was recorded (Appendix E). In the 2004 report, locations in Pittsburgh, Wheeling, and Louisville were designated as partially supporting the public water supply use due to multiple exceedances of the bacteria criterion. According to the Pollution Control Standards, the monthly geometric mean for fecal coliform should not exceed 2,000 colonies/ 100 mL. In June 2004, Pittsburgh reported geometric mean criterion exceedances at all four fixed monitoring station locations (Appendix F). However, this was less than 10 percent of the total number of monthly geometric means during the period between 2004 and 2005; therefore it earned a designation of fully supporting. Longitudinal bacteria survey data did not exceed the criterion at any point along the river (Appendix G), nor did total metals levels threaten the public water supply (Appendix D).

Table 4. Summary of public water supply use assessment for 2003-2005 based on 17 monitoring stations, bacteriological sampling, and a survey of the public water utilities. All 981 miles of the Ohio River fully support use as a public water supply.

States	River Miles	Total Miles in Waterbody	Support Assessment	Causes of Impairment
PA-OH-WV-KY-IN-IL	0-981	981	Full Support	None

There was no indication of impairment based on the questionnaire surveys completed by water utilities (Table 5). However, although the river fully supports this use, surveys indicated that there are issues of concern. Two facilities reported intake closures due to chemical spills or high turbidity following heavy rains. Although these closures did not result in an impairment designation because the conditions were temporary and related to single occurrences, it is important to note that the occurrence of spills can suspend use of the Ohio River as a public water supply temporarily. Six respondents indicated that non-routine treatment was necessary. No non-routine treatment resulted from pollutants listed in ORSANCO's Pollution Control Standards. Instead, much of the non-routine treatment conducted by utilities was related to preventing taste and odor problems caused by increases in algae. When algae are removed during the treatment process, some species leave behind metabolites that can affect the taste and odor of the finished water. Although "taste and odor" is considered a secondary standard, no MCL for taste and odor exists, and this secondary standard is not enforceable. Other instances of non-routine treatment were related to spills, nonpoint source pollution such as pesticides, or high levels of total organic carbon (TOC). TOC is a measure of carbon that accumulates as organic matter decays. It is removed during the treatment process, but interacts with the chlorine to produce disinfectant by-products such as trihalomethanes (THMs) and haloacetic acids (HAA^5), which are regulated by the SDWA. Therefore, even though TOC is not regulated, high levels can result in MCL violations in finished drinking water. Of the 21 returned surveys, three water utilities indicated they experienced MCL violations. Because THMs and HAA^5 were cited as the contaminants, rather than parameters indicating source water quality, these sites were not considered impaired.

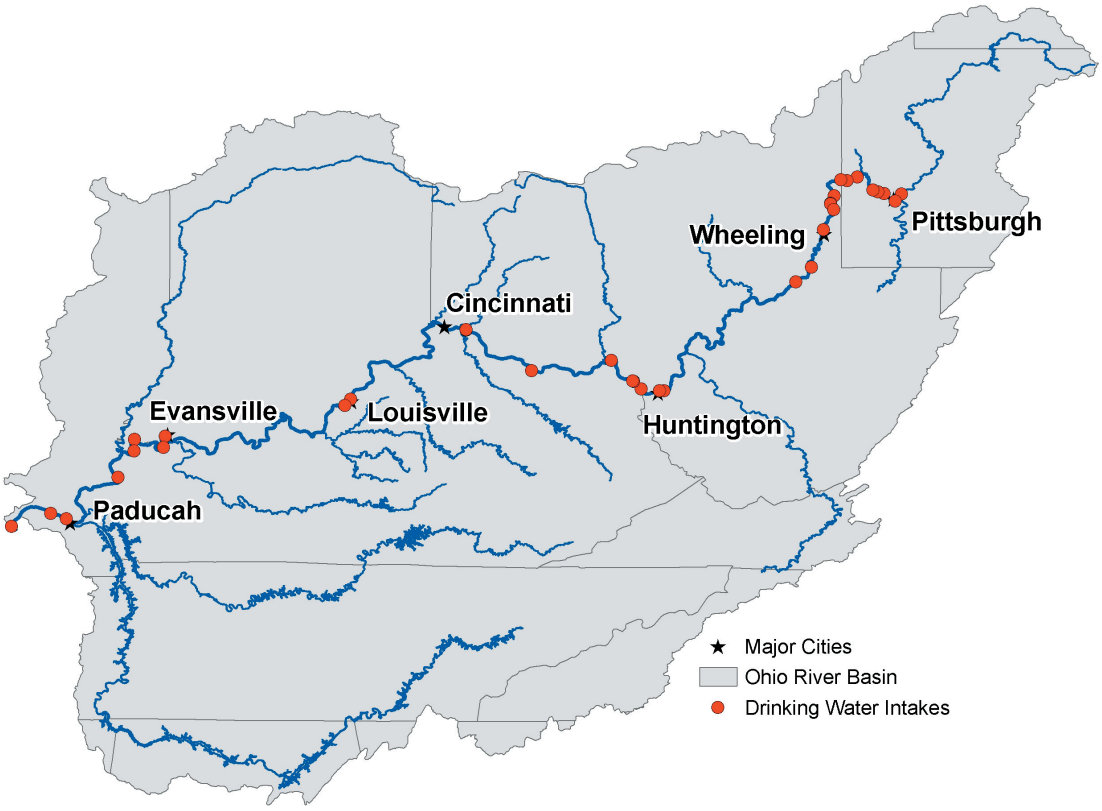


Figure 8. Map of Ohio River drinking water intakes. The 29 drinking water utilities provide drinking water to over three million people in the basin.

Table 5. Results from a survey of water utilities using the Ohio River as a drinking water source indicated that the entire river (981 miles) fully supports use as a public water supply. MCL violations due to disinfection by-products did not constitute impairment.

Utility Location	State	No. of Intake Closures due to Ohio River Water Quality	Causes of Intake Closures	MCL Violations	Contaminants causing MCL Violations	Non-routine Treatment Required	Contaminants resulting in Non-routine Treatment	No. of Days*
Moon Township	PA	1	Fluoride spill	-	-	-	-	-
West View	PA	0	-	-	-	X	Algae	120
Midland	PA	0	-	-	-	-	-	-
Wheeling	WV	0	-	-	-	X	Algae, TOC, Turbidity, Toluene	100
Weirton	WV	0	-	X	TOC, THMs	X	TOC	-
Sistersville	WV	0	-	X	HAA^5	-	-	-
Huntington	WV	0	-	-	-	-	-	-
Toronto	OH	3	Turbidity from flooding	-	-	-	-	-
East Liverpool	OH	0	-	-	-	X	Algae (taste & odor)	90-100
Ironton	OH	0	-	-	-	-	-	-
Portsmouth	OH	0	-	-	-	-	-	-
Louisville	KY	0	-	-	-	X	Organics from spills	16
Ashland	KY	0	-	X	THMs, HAA^5, TOC	-	-	-
Henderson	KY	0	-	-	-	-	-	-
Russell	KY	0	-	-	-	-	-	-
Paducah	KY	0	-	-	-	-	-	-
Evansville	IN	0	-	-	-	X	Oil, Pesticides, Algae	98
Mount Vernon	IN	0	-	-	-	-	-	-
Morganfield	KY	0	-	-	-	-	-	-
Paducah	KY	0	-	-	-	-	-	-
Cairo	IL	0	-	-	-	-	-	-

THM- Trihalomethane, TOC- Total Organic Carbon, HAA^5- Haloacetic acids

* Total number of days during reporting period that non-routine treatment was required for one or more of contaminants listed.

Chapter 4: Contact Recreation Use Support Assessment Results

The Compact requires that the Ohio River remain in a satisfactory sanitary condition suitable for recreational usage. The Commission operates two bacteria monitoring programs to assess the degree of contact recreational use support during the contact recreation season (May-October): routine contact recreation bacteria sampling and longitudinal bacteria surveys conducted through the Watershed Pollutant Reduction Program. Contact recreation season data from May to October 2004 and May to October 2005 were used in making assessments, as well as longitudinal bacteria surveys conducted during the contact recreation season in 2003, 2004, and 2005.

Contact Recreation Use Assessment Methodology

Data were collected from six urban communities along the Ohio River with combined sewer systems to assess the degree of contact recreation use support in these areas (Appendix B). Five samples were collected monthly from three locations in these communities: a site upstream and downstream of the community as well as a site within the major metropolitan area where combined sewer overflow (CSO) events are likely to occur. Four locations were monitored in Pittsburgh, three of which created a cross-section where the Allegheny and Monongahela rivers meet to form the Ohio River in downtown Pittsburgh (river mile 1.4L, M, R), and one site downstream of the city (river mile 4.3). Samples were analyzed for fecal coliform and E. coli.

In 2003, ORSANCO expanded the bacteria monitoring program described above to include areas outside of the CSO communities. During the contact recreation season in 2003, 2004, and 2005, the entire length of the Ohio River was sampled ten times at five-mile intervals (Appendix B). Every five miles, three-point cross-sectional samples were collected and analyzed for E. coli. The river was divided into three sections (upper, middle, and lower) and each section was sampled weekly during a five-week period, allowing for the calculation of a monthly geometric mean. This was repeated for each section in a subsequent year, allowing for the calculation of two geometric means for each section of the river. Using ambient monitoring data collected during the contact recreation season at the fixed stations and longitudinal bacteria surveys, assessment categories were assigned based on the following criteria:

Fully Supporting
- Monthly geometric mean and instantaneous maximum bacteria criteria are exceeded in not more than 10 percent of the samples collected during recreation season months.

Impaired- Partially Supporting
- Monthly geometric mean or instantaneous maximum bacteria criteria are exceeded in 11-25 percent of the samples.

Impaired- Not Supporting
- Monthly geometric mean or instantaneous maximum bacteria criteria are exceeded in over 25 percent of the samples collected during recreation season months.

Contact Recreation Use Assessment Summary

All 981 miles of the Ohio River were assessed through bacteriological surveys to determine the degree of support for contact recreational usage. Based on available data, 349 miles (36 percent) were classified as impaired and not supporting use for contact recreation; 126 miles (13 percent) were impaired, but partially supporting the use; and 506 miles (52 percent) were classified as fully supporting contact recreation (Figure 9, Table 6). Approximately thirty samples were collected annually at each fixed sampling station (Appendix F). In 2004, 18 out of 19 sites exceeded the criteria in more than 25 percent of the samples (Figure 10). In contrast, 2005 was a drier year and had only nine out of 19 monitoring sites with greater than 25 percent of the samples exceeding the criteria. In general, fewer violations were reported upstream

of each city's combined sewer systems in both 2004 and 2005. Pittsburgh exceeded the stream criterion for the protection of contact recreation most frequently during 2004 and 2005. Other municipalities such as Wheeling and Louisville experienced fewer violations in 2005 compared to past years, likely as a result of low flow conditions and fewer CSO events. The upstream site in Huntington was the only fixed monitoring station at which the percentage of both the geometric mean and the individual sampling event exceedances were less than 25 percent, earning it a designation of partial support. Overall, 2004 tended to have more violations than 2005, presumably due to increased precipitation that year. The risk to public health following increased precipitation often comes from wet weather sources such as combined sewer systems. Heavy rains can cause the flow of rainwater and sewage carried in the combined sewer pipes to exceed capacity, resulting in overflows to the river.

Although the fixed monitoring locations are useful in determining impairment near major metropolitan areas, longitudinal bacteria survey data are needed to fully assess the entire length of the river, . During 2003, 2004, and 2005 the entire length of the Ohio River was sampled ten times through longitudinal bacteria surveys (Appendix G). Higher levels of E. coli were measured in major metropolitan areas along the river (Figure 11). As discussed previously, many of these same cities such as Pittsburgh and Louisville experienced violations of the fecal coliform criterion at their fixed monitoring stations. The upper and lower sections of the river exceeded the geometric mean and individual sample criteria more frequently than the middle section of the river. Specifically, from Pittsburgh to Wheeling, 94 of 105 miles exceeded the criteria in over 25 percent of the samples and were classified as not supporting. In contrast, between Huntington and Cincinnati, 136 of 173 miles were designated as fully supporting contact recreation.

Because the Ohio River is a large system that supports navigation and contains CSOs, there is always a risk associated with recreating in the river. Data described above show that the criterion for contact recreation use often is exceeded in the Ohio River, especially in major metropolitan areas. The risk of illness from bacteria increases after precipitation due to wet weather sources of pollution. Nonpoint sources of bacteria in the river include human waste from septic systems, urban stormwater runoff, and animal waste. In addition, point sources such as CSO events often lead to increased levels of human waste in the river. Currently, 15 percent of the CSO communities in the nation are found in the Ohio River Basin. Presently, criteria are in place to protect contact recreation. Through the development of Long Term Control Plans (LTCPs), facilities will begin to characterize, model, and monitor the combined sewer system, identify sensitive areas, and develop alternative plans to meet Clean Water Act requirements. However, although facilities will continue to improve their practices of treating or storing wastewater, current evidence suggests that even after the requirements of the National CSO Control Policy are met by these treatment facilities, there may still be bacteria problems in the Ohio River with a corresponding health risk for swimming during wet weather. As a result, ORSANCO is considering alternatives for its Pollution Control Standards for the Ohio River to address wet weather water quality issues, the contact recreation use, and associated water quality criteria for bacteria.

Figure 9. Contact recreation use assessments for the 2006 report were based on data collected between 2003 and 2005. Over 50 percent of the river fully supports the contact recreation use.

Table 6. Summary of contact recreation use assessment for 2003-2005 based on fixed monitoring stations and longitudinal bacteria surveys. Of the 981 miles, 349 miles do not support contact recreation, 126 miles partially support contact recreation and 506 miles fully support contact recreation.

States	River Miles	Total Miles in Water Body	Monitoring Station at River Mile Point (MP)	Support Assessment	Causes of Impairment
PA-OH-WV	0-73	73	*1.4L, 1.4M, 1.4R, 4.3, longitudinal survey*	Not supporting	pathogen
OH-WV	73-78	5	*longitudinal survey*	Partial support	pathogen
OH-WV	78-83	5	*longitudinal survey*	Not supporting	pathogen
OH-WV	83-86	3	*longitudinal survey*	Partial support	pathogen
OH-WV	86-105	19	*86.8, 91.4, 92.8, longitudinal survey*	Not supporting	pathogen
OH-WV	105-127	22	*longitudinal survey*	Full support	--
OH-WV	127-131	4	*longitudinal survey*	Partial support	pathogen
OH-WV	131-177	46	*longitudinal survey*	Full support	--
OH-WV	177-185	8	*longitudinal survey*	Partial support	pathogen
OH-WV	185-304	119	*longitudinal survey*	Full support	--
OH-WV	304-308	4	*305.1, longitudinal survey*	Partial support	pathogen
OH-WV	308-316	8	*308.1, 314.8, longitudinal survey*	Not supporting	pathogen
OH-WV/KY	316-357	41	*longitudinal survey*	Full support	--
OH-KY	357-362	5	*longitudinal survey*	Partial support	pathogen
OH-KY	362-383	21	*longitudinal survey*	Full support	--
OH-KY	383-388	5	*longitudinal survey*	Partial support	pathogen
OH-KY	388-393	5	*longitudinal survey*	Full support	--
OH-KY	393-397	4	*longitudinal survey*	Partial support	pathogen
OH-KY	397-461	64	*longitudinal survey*	Full support	--
OH-KY	461-477	16	*462.6, 470, 477.5, longitudinal survey*	Not supporting	pathogen
OH-KY	477-484	7	*longitudinal survey*	Partial support	pathogen
OH-KY	484-488	4	*longitudinal survey*	Not supporting	pathogen
OH/IN-KY	488-491	3	*longitudinal survey*	Full support	--
IN-KY	491-501	10	*longitudinal survey*	Not supporting	pathogen
IN-KY	501-521	20	*longitudinal survey*	Full support	--
IN-KY	521-541	20	*longitudinal survey*	Partial support	pathogen
IN-KY	541-593	52	*longitudinal survey*	Full support	--
IN-KY	593-608	15	*594, longitudinal survey*	Partial support	pathogen
IN-KY	608-621	13	*608.7, 619.3, longitudinal survey*	Not supporting	pathogen
IN-KY	621-629	8	*longitudinal survey*	Full support	--
IN-KY	629-709	80	*longitudinal survey*	Not supporting	pathogen
IN-KY	709-719	10	*longitudinal survey*	Partial support	pathogen
IN-KY	719-785	66	*longitudinal survey*	Not supporting	pathogen
IN-KY	785-789	4	*longitudinal survey*	Partial support	pathogen
IN-KY	789-844	55	*791.5,793.7, 797.3, longitudinal survey*	Not supporting	pathogen
IL/IN-KY	844-849	5	*longitudinal survey*	Partial support	pathogen
IL-KY	849-862	13	*longitudinal survey*	Full support	--
IL-KY	862-873	11	*longitudinal survey*	Partial support	pathogen
IL-KY	873-894	21	*longitudinal survey*	Full support	--
IL-KY	894-910	16	*longitudinal survey*	Partial support	pathogen
IL-KY	910-981	71	*longitudinal survey*	Full support	--
	Totals	**981**			

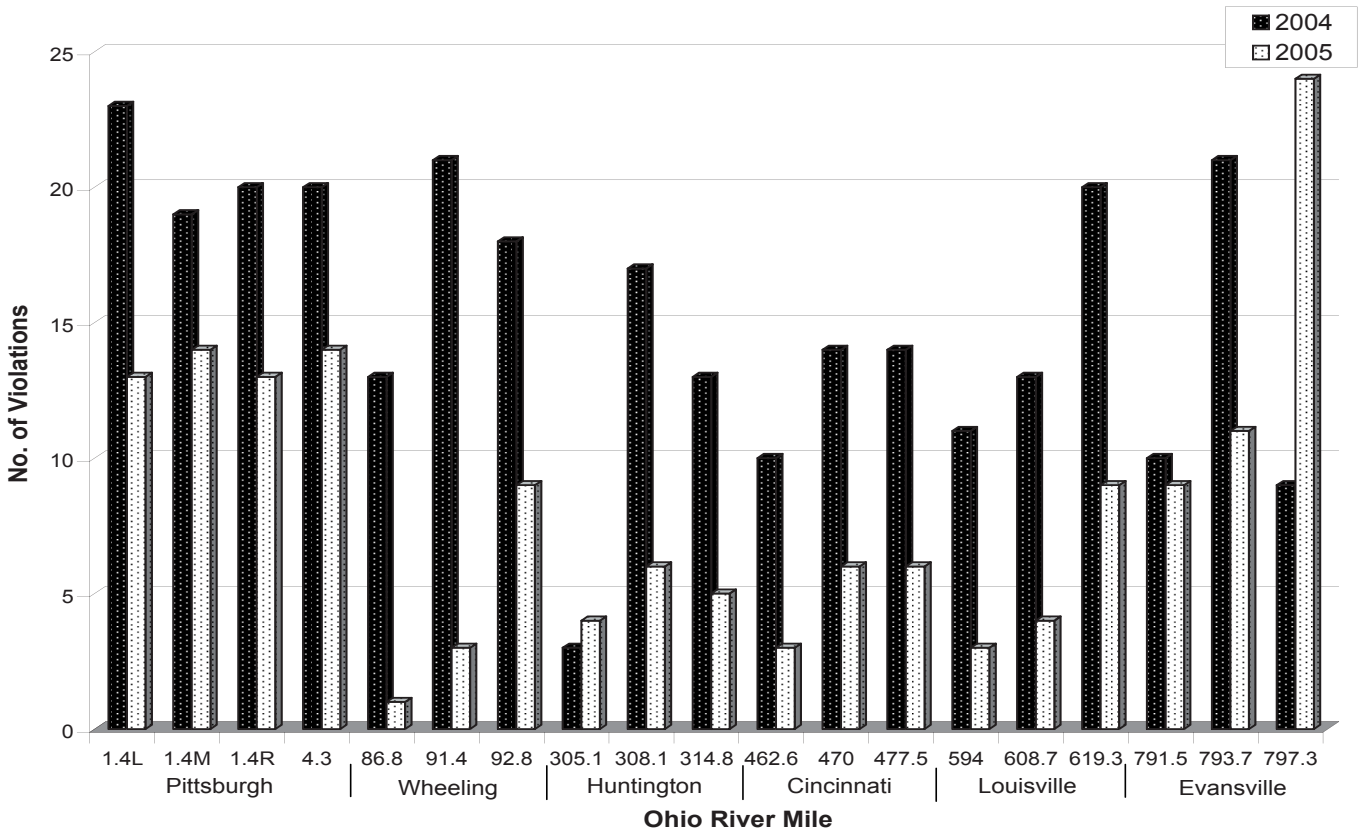


Figure 10. Number of samples, out of approximately 30 samples, exceeding the criteria at each contact recreation season monitoring location during 2004 and 2005. Sites with greater than 10 percent of the samples taken during the contact recreation season exceeding the 400 colonies/100 ml criterion are considered impaired.

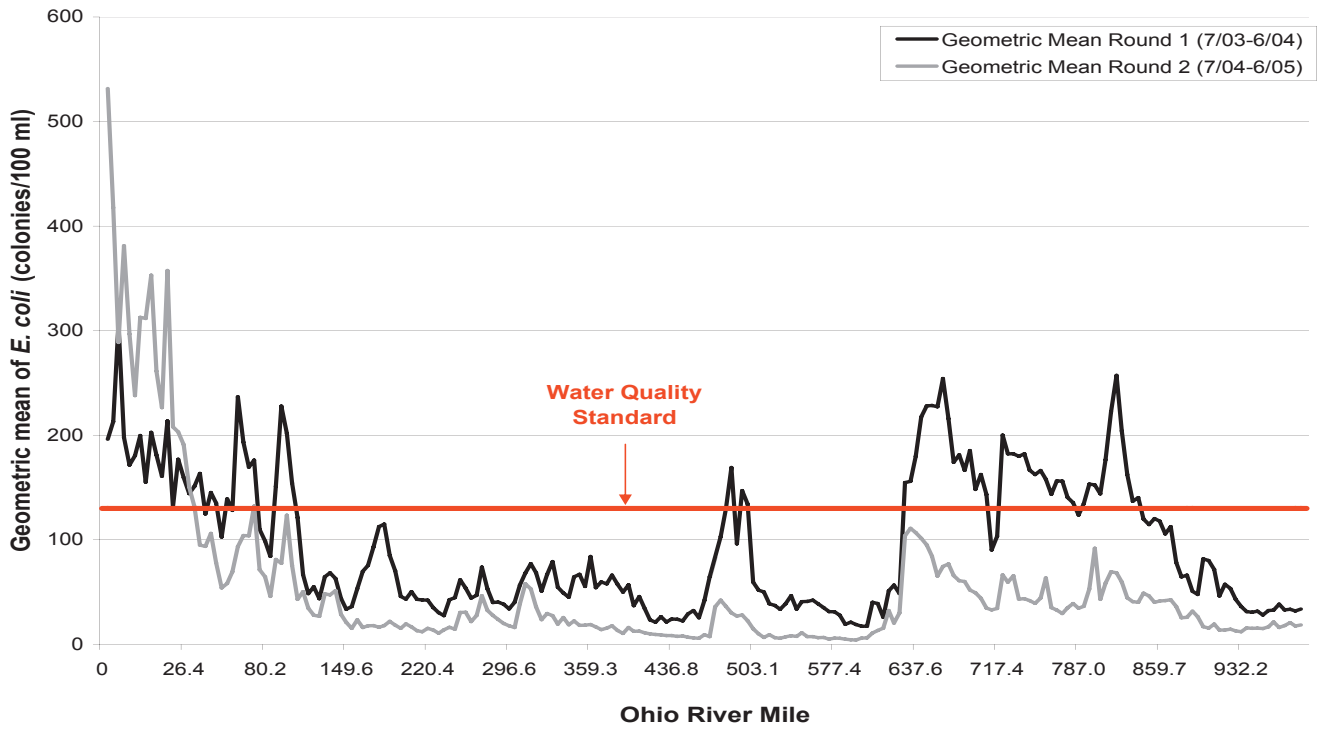


Figure 11. Between 2003 and 2005, the entire river was analyzed ten times through longitudinal bacteria surveys, allowing for the calculation of two monthly geometric means at each site. Peaks in E. coli levels often correspond with the location of major metropolitan areas such as Pittsburgh (river mile 1.4), Cincinnati (river mile 470), and Evansville (river mile 793.7).

Chapter 5: Fish Consumption Use Support Assessment

The Compact requires that the Ohio River be in a satisfactory sanitary condition and adaptable to such other uses as may be legitimate. The Commission maintains water quality criteria for the protection of human health from fish consumption, has determined such use to be legitimate, and therefore evaluates that use in the Integrated Report.

Fish Consumption Use Assessment Methodology

The Commission generally collects and analyzes between 45 and 60 fish tissue samples annually. Samples, comprised of three- to five-fish composites, are analyzed for certain organics, pesticides, and metals. These data are then used by various agencies in each of the states bordering the river to issue fish consumption advisories to the public. Fish consumption advisories specific to the Ohio River are used in making impairment decisions. Statewide advisories not specific to the Ohio River are not used to classify the river as impaired. In addition to examining fish consumption advisories, levels of total mercury, PCBs, and dioxins (see * page 35) in the water column, as well as methylmercury in fish tissue samples also were assessed against criteria for the protection of human health for fish consumption. Total mercury data were collected from 17 clean metals sites once every other month between October 2003 and July 2005. PCBs and dioxins were measured through high volume sampling. Collection of PCB and dioxin data was an ongoing process. Data from 1997 through 2004 were used in the assessment. Fish tissue samples were collected in 2003 and 2004 between July and October. The use designations are as follows:

Fully Supporting
- No fish consumption advisories are in effect, **AND**
- PCB, dioxin, and mercury data do not exceed criteria.

Impaired: Partially Supporting
- PCB or dioxin high volume water quality data exceed criteria, **OR**
- Restricted fish consumption advisories are in effect, **OR**
- Mercury fish tissue levels are greater than 0.3 mg/kg.

Impaired: Not Supporting
- "No Consumption" advisories are in effect for commonly consumed species. Under these advisories, it is recommended that no fish from the river be consumed by any individuals.

Due to the prevalence of statewide consumption advisories for mercury and the differences in states' procedures for issuing these advisories, the Commission compared mercury fish tissue data against its criterion (0.3 mg/kg) in making impairment decisions.

Fish Consumption Use Assessment Summary

Fish consumption use was assessed based on the states' issuance of fish consumption advisories (Appendix H), mercury fish tissue data, and PCB and dioxin high volume sampling water column data. The entire Ohio River was assessed and classified as partially supporting based on fish consumption advisories as well as exceedances of water quality criteria for PCBs and dioxin (Table 7). Dioxin water concentration data were compared against the Commission's water quality criterion of 0.000000005 µg/L (0.5 fg/L, Appendix I). Every dioxin sample, riverwide, exceeded the water quality criterion (Figure 12). Similarly, PCB levels were compared against the 64 pg/L human health criteria set forth in the Pollution Control Standards (Appendix J). All samples were in violation of the PCB criterion as well (Figure 13). PCB and dioxin data were extrapolated to the entire river because data showed that all samples, at all locations along the river, exceeded the criteria for human health. Restricted fish consumption advisories were in effect in all states; however, no states had "no consumption" advisories in place for the general population.

Table 7. Summary of fish consumption use assessment for 2003-2005 based on 17 monitoring stations, high volume sampling, fish tissue analyses, and fish consumption advisories. All 981 miles partially support the fish consumption use.

States	River Miles	Total Miles in Waterbody	Support Assessment	Causes of Impairment
PA-OH-WV-KY-IN-IL	0-981	981	Partial Support	PCBs, Dioxins

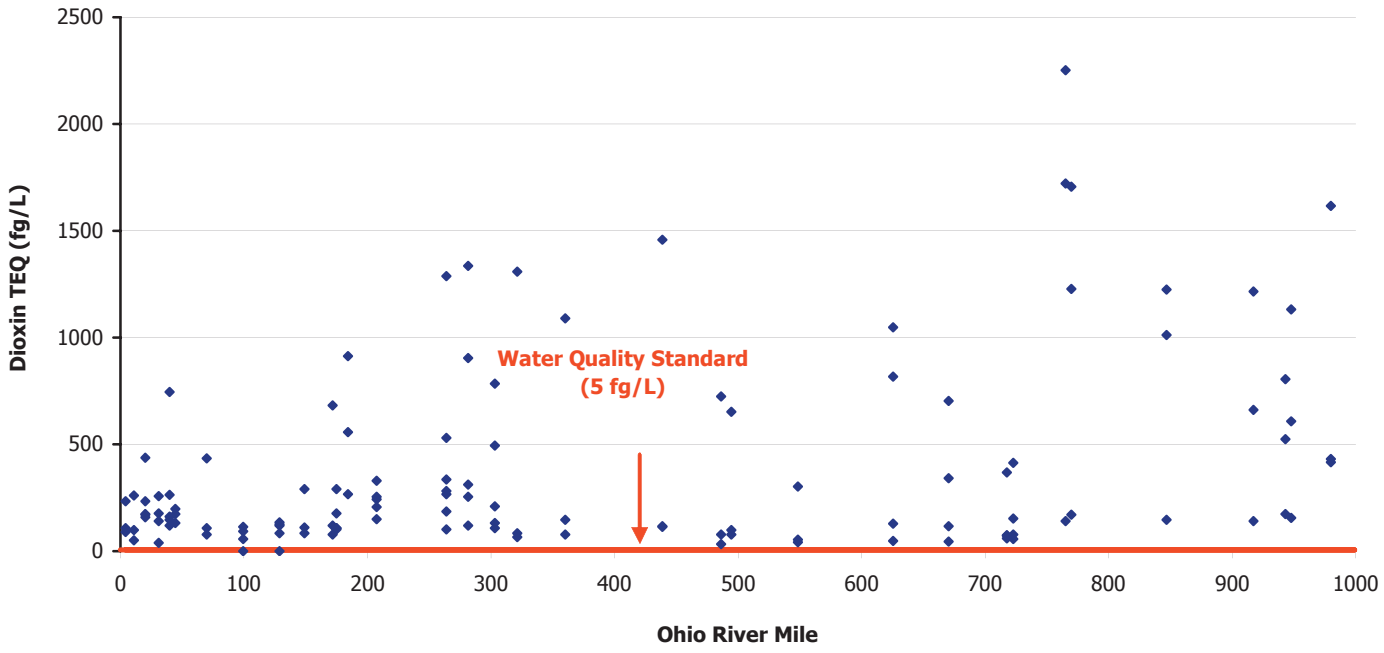


Figure 12. Dioxin TEQ (toxicity equivalency) concentrations in the Ohio River (1997-2004). All Ohio River samples analyzed for dioxins using high volume sampling techniques exceeded the water quality criteria for human health. As a result, the entire river was designated as impaired and partially supporting the fish consumption use.

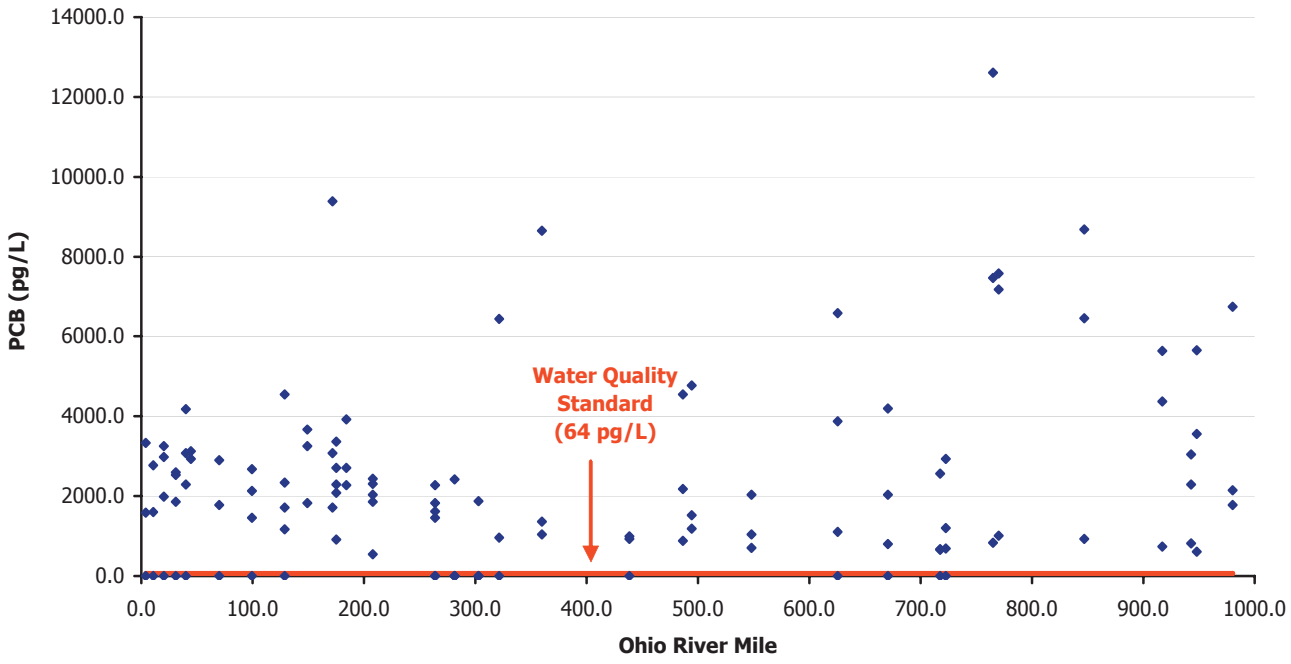


Figure 13. Ohio River PCB data collected from 1997-2004. All water samples analyzed for PCBs along the Ohio River exceeded ORSANCO's human health criteria for PCBs.

Based on fish tissue data, no segments were impaired due to exceedances of methylmercury criterion (Figure 14, Appendix K). Although many states issue statewide consumption advisories for mercury, there are distinct differences in states' procedures for issuing these advisories. As a result, the Commission compared mercury fish tissue data against its criterion (0.3 mg/kg) to make impairment decisions. There were no exceedances of the criterion in fish tissue samples. ORSANCO also set a criterion of 0.012 µg/L for total mercury in the water column to prevent the bioaccumulation of mercury in fish tissue. Data from 2003 and 2004 indicated that navigational pools from Robert C. Byrd Locks & Dam downstream to the confluence of the Ohio and Mississippi rivers (433 miles) each had multiple exceedances of the criteria (Appendix D). These exceedances occurred at 11 out of 17 sites and in more than 10 percent of the samples at each site. However, because levels of mercury in over 100 fish tissue samples did not indicate impairment, segments were not listed based on the in-stream water column mercury criteria. Through discussion of the conflicting results, it was determined that the fish tissue mercury levels were more applicable in this use assessment than the levels of total mercury found in the water column. Fish tissue data were used because the tissue levels would directly impact individuals consuming fish from the Ohio River, while total mercury is used as an indicator of potential bioaccumulation.

* Note: The term dioxin refers to a complex array of 210 polychlorinated dibenzodioxins and dibenzofurans. Seventeen of these 210 compounds have dioxin-like toxicity, the most toxic of which is 2, 3, 7, 8-tetrachlorodibenzodioxin (2, 3, 7, 8-TCDD). EPA developed a method to quantify the dioxin toxicity of these compounds, which is now reported as 2, 3, 7, 8-TCDD TEQ (toxicity equivalency), an estimated sum of the toxicity of the 17 dioxin compounds. According to ORSANCO's Pollution Control Standards, the human health criterion for 2, 3, 7, 8-TCDD (dioxin) TEQ is 5 fg/L. This standard is based on EPA's Human Health Criteria for priority pollutants; however, an explanation of the way in which this criteria was derived was not included in ORSANCO's standards. Although the Pollution Control Standards state that the criteria for 2, 3, 7, 8-TCDD (dioxin) is 5 fg/L, this criteria is actually for 2, 3, 7, 8-TCDD TEQ. This change to the current standard is under review and expected to be accepted in the summer of 2006.

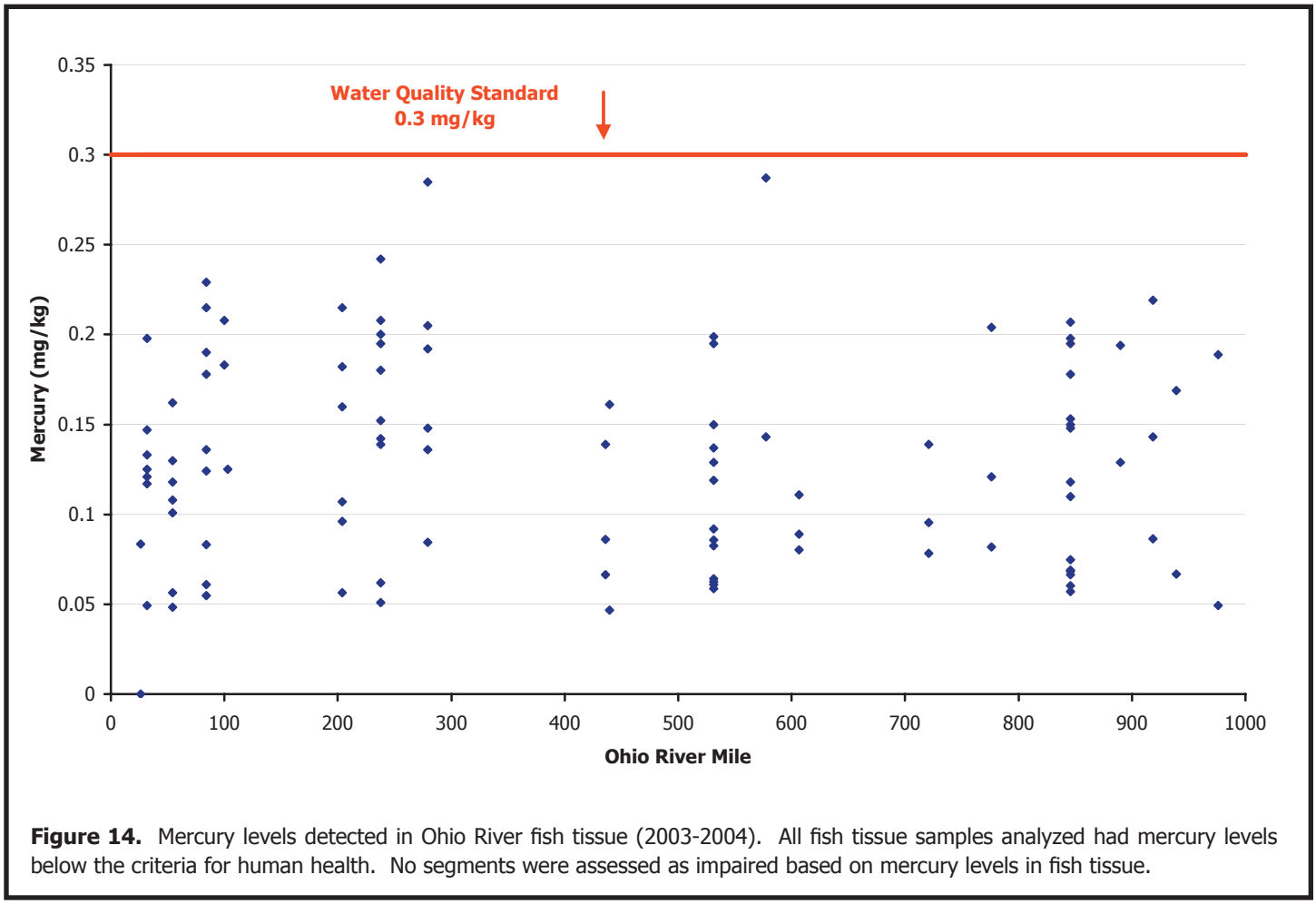


Figure 14. Mercury levels detected in Ohio River fish tissue (2003-2004). All fish tissue samples analyzed had mercury levels below the criteria for human health. No segments were assessed as impaired based on mercury levels in fish tissue.

Chapter 6: Integrated List

The Integrated Report combines requirements of both section 305(b) and 303(d) of the federal Clean Water Act. Each state completes an Integrated List, which then becomes available for public comment and is approved by the US EPA. While the Commission is not required to prepare a section 303(d) list, the preparation of a 305(b) report facilitates interstate consistency between states' Integrated Lists. The Integrated List contains a list of waters requiring Total maximum Daily Loads (TMDLs). The Commission itself is not required to complete an Integrated List or TMDLs; therefore its Integrated List does not contain a schedule for establishment of TMDLs as is required of the states. The Report also is not subject to the public review process that the official state reports are required to complete.

The Integrated List contains five assessment categories as follows:

Category 1

Data indicate that the designated use is met.

Category 2

Not Applicable ("available data and/or information indicated that some, but not all of the designated uses are supported").

Category 3

There is insufficient available data and/or information to make a use support determination.

Category 4

Designated use is impaired, but a TMDL is not needed.

- **Category 4a** A TMDL is not needed because it has already been completed.
- **Category 4b** A TMDL is not needed because other required control measures are expected to result in the support of all designated uses in a reasonable period of time.
- **Category 4c** A TMDL is not needed because the impairment is not caused by a pollutant.

Category 5

The designated use is impaired and a TMDL is needed.

The entire length of the Ohio River is assessed for each use. All 981 miles fully support warm water aquatic life and use as a public water supply (Table 8). Bacteria TMDLs for the protection of the contact recreation use are required for 475 miles of the Ohio River. The remaining 506 miles fully support contact recreation. In the 2004 report, bacteria TMDLs were required for reaches in Pittsburgh, Wheeling, and Louisville to protect public water supplies. There were no impairments based on exceedances of the bacteria criterion for the public water supply between 2003 and 2005. The full length of the river was designated as impaired for the fish consumption use, requiring a TMDL for PCBs and dioxins. A TMDL for PCBs has been completed for river miles 0-238, including sections in Pennsylvania and areas of the Ohio River bordering West Virginia and Ohio. TMDLs for both PCBs and dioxins have been completed for river miles 238-317.

Table 8. Ohio River integrated assessment summary for 2003-2005. Impaired uses include contact recreation and fish consumption. Category 5* Indicates that a PCB TMDL has been completed. A dioxin TMDL is still needed.

States	River Miles	Total Miles in Water Body	Warm Water Aquatic Life Use Support	Public Water Supply Use Support	Contact Recreation Use Support	Fish Consumption Use Support
PA-OH-WV	0-105	105	1	1	5	5*
OH-WV	105-127	22	1	1	1	5*
OH-WV	127-131	4	1	1	5	5*
OH-WV	131-177	46	1	1	1	5*
OH-WV	177-185	8	1	1	5	5*
OH-WV	185-238	53	1	1	1	5*
OH-WV	238-304	66	1	1	1	4a
OH-WV	304-316	12	1	1	5	4a
OH-WV	316-317	1	1	1	1	4a
WV-OH-KY	317-357	40	1	1	1	5
OH-KY	357-362	5	1	1	5	5
OH-KY	362-383	21	1	1	1	5
OH-KY	383-388	5	1	1	5	5
OH-KY	388-393	5	1	1	1	5
OH-KY	393-397	4	1	1	5	5
OH-KY	397-461	64	1	1	1	5
OH-KY	461-488	27	1	1	5	5
OH-IN-KY	488-491	3	1	1	1	5
IN-KY	491-501	10	1	1	5	5
IN-KY	501-521	20	1	1	1	5
IN-KY	521-541	20	1	1	5	5
IN-KY	541-593	52	1	1	1	5
IN-KY	593-621	28	1	1	5	5
IN-KY	621-629	8	1	1	1	5
IN-KY	629-844	215	1	1	5	5
IL-IN-KY	844-849	5	1	1	5	5
IL-KY	849-862	13	1	1	1	5
IL-KY	862-873	11	1	1	5	5
IL-KY	873-894	21	1	1	1	5
IL-KY	894-910	16	1	1	5	5
IL-KY	910-981	71	1	1	1	5

Chapter 7: Summary Analysis for Surface Waters

ORSANCO's biennial assessment is generated through the coordination of the Commission's 305(b) Workgroup, which is composed of representatives from each of the mainstem states as well as US EPA Regions 3, 4, and 5. This workgroup communicates via meetings and teleconferences multiple times during the report preparation process. Through these conversations, the assessment parameters, methodology, and schedule are established. This group, along with ORSANCO staff, review Ohio River monitoring data and provide input into the generation of this report. Monitoring data from ORSANCO's bimonthly sampling, clean metals sampling, bacteria monitoring, watershed protection, fish population, and fish contaminants programs, along with information from public drinking water facilities and outside data sources, provide the information needed to generate this assessment. The involvement of state personnel during the development of this report is essential to promote consistency among the states as they assess Ohio River water quality.

Most Ohio River states incorporate ORSANCO's biennial assessment into their own Integrated Report. This either occurs directly as an attachment to their reports or by reference within their reports. Most states do not conduct water quality monitoring on the Ohio River as extensively as ORSANCO, so this opportunity to share resources and promote consistency among the states that border the Ohio River is extremely valuable. ORSANCO also completes an Integrated List of waters requiring TMDLs. The purpose of developing this list is to promote consistency in Ohio River segments listed for TMDL development. The states submit their own Integrated Lists and otherwise have no requirement to complete TMDLs as contained in the Commission's report. However, the state listings in general are consistent with ORSANCO's 305(b) and Integrated List.

Aquatic Life

The aquatic life use assessment employed a new methodology for making assessments in the 2006 report. In 2004, ORSANCO began using a multimetric index to assess the fish community and aquatic life use. The Ohio River Fish Index (ORFIn) was compared against expected values from sites with good, representative fish communities. Locations with multiple ORFIn scores below the 25th percentile of expected scores were assessed as not supporting the aquatic life use. During this report cycle, biologists and members of the Biological Water Quality Subcommittee designed a monitoring schedule in which four navigational pools are sampled each year, with the entire river (20 navigational pools) being sampled every five years. Fixed monitoring locations, which are visited yearly, enable biologists to track changes in the fish community over time. For the 2006 report, all Ohio River miles within four separate segments were assessed as fully supporting aquatic life using biological data. The longest pool in this analysis was 114 miles long. Data from 2004 were omitted from this analysis because they were collected under conditions that were not representative of the pool. Biologists agreed that because the pools received passing ORFIn scores during repeat sampling events one year later, the fish community potential in each pool was indicated by 2005 data. Further analyses of stage, flow, and secchi depths observed during 2004 sampling events helped explain the anomalous data. Chemical data were in agreement with the 2005 biological data and indicated that the river was not impaired. Data were extrapolated from 17 monitoring locations to the entire river because the data did not indicate a change in impairment status along the length of the river. Using both types of data, the Ohio River was listed in Category 1 (fully supporting) for aquatic life use. Although numerous criteria were met throughout the river, ORSANCO's monitoring programs do not address all standards listed in the Pollution Control Standards. For example, ORSANCO lists a chronic criterion concentration of 5.2 µg/L for free cyanide; however, ORSANCO monitors only for total cyanide. As new technologies allow ORSANCO to sample more efficiently and effectively, the monitoring programs will evolve to better assess the quality of the river and its uses.

Public Water Supply

Currently, 29 water utilities use the Ohio River as a source of drinking water. These water utilities provide drinking water to nearly three million people, and as such, it is important that the source water be evaluated for its suitability as drinking water after treatment. The public water supply use was assessed using Ohio River water quality data as well as results of a survey sent to each utility. Approximately three-fourths of the utilities responded to the survey, which asked whether finished drinking water standards (Maximum Contaminant Levels) were violated as a result of Ohio River water quality, whether non-routine treatment was necessary to meet finished water MCLs, or whether frequent intake closures were necessary as a result of poor source water conditions. No impairments to Ohio River water quality were designated based on responses to the water utility questionnaires. Several water utilities indicated on surveys that non-routine treatment was necessary due to contaminants such as toluene, oil, and pesticides such as atrazine. While the total number of non-routine treatment days and types of contamination may indicate some impairment of the public water supply use, this is not the case. As mentioned in a previous section, no non-routine treatment resulted from exceedances of ORSANCO's Pollution Control Standards. In addition, communication with water utilities confirmed that non-routine treatment was implemented to provide a better product to water utility customers and not to comply with the Safe Drinking Water Act's minimum requirements. Therefore, the entire length of the river was designated as Category 1, fully supporting public water use. Although the river fully supports this use, it is important to recognize that spill events on the river or nonpoint sources of pollution such as agricultural or urban runoff can impact the use of the Ohio River as a public water supply.

Contact Recreation

The Ohio River is used extensively for contact recreation by boaters and swimmers alike. Only bacteria data are used to determine the status of attainment of the contact recreational use. Contact recreation bacteriological monitoring is conducted in the six largest communities with combined sewer systems along the Ohio River: Pittsburgh, Wheeling, Huntington, Cincinnati, Louisville, and Evansville. In 2003, the Commission initiated longitudinal bacteria surveys in an effort to characterize bacteria levels along the entire Ohio River, including sampling in remote locations. The 2006 report is the first in which the entire Ohio River has been sampled for bacteria. The length of the river was sampled ten times at five-mile intervals, the most comprehensive of ORSANCO's water quality monitoring programs. Based on the six urban sites, all locations, with the exception of the upstream site in Huntington, were classified as not supporting the contact recreational use. These impairments have been documented since the initiation of the monitoring sites in the early 1990s. With the addition of the longitudinal surveys, ORSANCO now can provide a more comprehensive assessment of the river, locating those areas outside the influence of major metropolitan areas that fully support this use. Although over half of the Ohio River fully supports contact recreation usage, violations occurred along the entire length. The criteria are designed to protect the many uses of the Ohio River. Because the criteria for contact recreation use often are exceeded during wet weather events, ORSANCO is asking the general public to consider alternatives to these standards during wet weather events. Additional information regarding these proposed changes can be found on ORSANCO's web site.

Fish Consumption

The entire Ohio River is designated as impaired for the fish consumption use due to elevated levels of dioxin and PCBs. The states base their fish consumption advisories on the Commission's fish tissue contaminants program. All states have Ohio River fish consumption advisories for PCBs. In addition, the Commission has operated a dioxin water sampling program since 1997 and collected samples in many segments and all regions of the Ohio River. Every sample collected exceeds the Commission's water quality criterion for human health protection from consumption of fish. Therefore, the entire Ohio River is classified as impaired for both dioxin and PCBs. Many states have statewide fish consumption advisories for mercury. However, no Ohio River fish tissue contaminant samples exceed the Commission's criterion, despite total mercury exceedances of the water column criterion at several monitoring locations. The water column mercury criterion is designed to prevent the bioaccumulation of mercury in fish tissue, but since no impairment was indicated for mercury in fish tissue, the use was not designated as impaired from total mercury contamination as measured in the water column.

TMDL Development

The Commission completed an Integrated List containing waters requiring Total Maximum Daily Loads (TMDLs) for the purpose of promoting interstate consistency in TMDL-listed waters. States are not required to implement TMDLs based solely on ORSANCO's recommendations; however this list should be consistent with the states' lists. Riverwide TMDLs are indicated for PCBs and dioxin except for segments which already have a TMDL completed. A PCB TMDL has been completed for the upper 238 miles of the Ohio River. TMDLs for both dioxin and PCBs have been completed for the section of river between river mile 238 and 317. Bacteria TMDLs are needed for over 349 miles of the Ohio River. This number has increased since the 2004 report as a result of more extensive sampling efforts.

For additional information regarding TMDLs, data reported in this publication, or public participation, please contact ORSANCO at:

Ohio River Valley Water Sanitation Commission
5735 Kellogg Avenue
Cincinnati, OH 45228
Phone: 513-231-7719
Fax: 513-231-7761
Web site: www.orsanco.org
Email: info@orsanco.org

Photo Credits

Cover- Patrick Littell, photo taken at Neville Island, PA; Page 9- 2002 Photo Contest entry, Rocky Shore; Page 14- Donald Frazier, photo of Montgomery Locks & Dam at Industry, PA; Page 15- Ken Burger, Barge heading up river (Cincinnati, OH); Page 16- ORSANCO staff photo (longear sunfish); Page 17- ORSANCO staff photos; Page 18- Dale Voelker, photo of Cincinnati waterfront (Cincinnati, OH); Page 21- ORSANCO staff photo (electrofishing); Page 22- ORSANCO staff photo (bacteriological monitoring); Page 30- ORSANCO staff photo, photo of 2005 Bassmaster Classic Tournament in Pittsburgh, PA; Page 37- Tom Ross, American Queen in Maysville, KY; Page 39- 2005 Photo Contest entry, Foggy morning; Page 40- Emilio Fernandez (Cincinnati, OH)

Appendix A

Navigation Dams
Selected Tributaries
Hydrologic Data

Appendix B

Sampling Sites and Monitoring Locations for ORSANCO Programs

Appendix C

2005 Ohio River Fish Index (ORFIn) Scores

Appendix D

Clean Metals Sampling Data

Appendix E

Bimonthly Sampling Data

Appendix F

Contact Recreation Program Data

Appendix G

Longitudinal Bacteria Survey Data

Appendix H

Fish Consumption Advisory Summaries

Appendix I

Dioxin High Volume Water Sampling Results

Appendix J

PCB High Volume Water Sampling Results

Appendix K

Fish Tissue Mercury Data

Appendix L

Additional Data from Outside Sources