Assessment of Ohio River Water Quality Conditions

2009 - 2013

Ohio River Valley Water Sanitation Commission
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EXECUTIVE SUMMARY

The Ohio River is one of the nation's great natural resources. The Ohio not only provides drinking water for over five million people, but serves as 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 the manufacturing and power industries. The Ohio River takes its headwaters in Pittsburgh, Pennsylvania at the confluence of the Allegheny and Monongahela Rivers and flows southwesterly for 981 miles, joining the Mississippi River near Cairo, Illinois. The first 40 miles of the Ohio River are wholly 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. 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 by public and industrial water supplies after reasonable treatment, suitable for recreation, capable of maintaining fish and other aquatic life…."

Every two years, ORSANCO completes an assessment of Ohio River designated uses in cooperation with the Ohio River 305(b) Coordinators Work Group composed of representatives from each of the main stem states. This biennial assessment reports the conditions of Ohio River water quality and the ability to which the river supports each of its four designated uses; warm water aquatic life, public water supply, contact recreation, and fish consumption. The 305(b) report fulfills the following requirements of the Compact:

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

Three classifications are used in this assessment 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 Ohio River main stem states (Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia). This report provides a status of water quality generally over the period from July, 2008-2013; however in some cases, historical data outside this range was used in assessments. In addition, a proposed Integrated List containing waters in need of Total Maximum Daily Loads (TMDLs) was completed in an effort to promote interstate consistency for Ohio River TMDLs. The states use ORSANCO's assessments in developing their integrated lists of waters requiring total maximum daily loads (303(d) lists). Not all 303(d) lists produced by the states will coincide with ORSANCO's 305(b) assessments.

A "weight of evidence" approach was utilized in the 2014 Ohio River use assessments as approved by ORSANCO's Technical Committee at its February 2014 meeting. A weight of evidence (WOE) approach involves using professional judgment to make the best, most accurate assessment using data and information which are believed to be most relevant to override other conflicting information. For instance, in a situation where water chemistry data indicate impairment while biological data do not, the water body may still be classified as "Fully Supporting" because biological data are a better indicator of the aquatic life status. United States Environmental Protection Agency's (US EPA) guidance indicates "Independent Application" should be used when two or more contradictory data sets exist. The weight of evidence approach is directly opposed to US EPA's policy of independent application, which stipulates that if any one data set indicates impairment, then the water body should be designated as impaired. Although not consistent with EPA, ORSANCO concluded that a direct measurement of aquatic life using biological data is the most effective way of determining whether or not the Ohio River supports its aquatic life use designation. US EPA participated in the 305(b) Workgroup and made their policy of independent application evident. Use of the WOE approach had an effect on the aquatic life use and fish consumption use assessments which are detailed below.

AQUATIC LIFE USE SUPPORT

The Ohio River warm water aquatic life use was assessed based on fish population surveys and water chemistry data collected through the Bimonthly and Clean Metals Monitoring Programs. These results were then compared to applicable criteria for the protection of aquatic life. Water quality criteria violations found in greater than ten percent of samples at a monitoring station would indicate impairment on their own. Aquatic life criteria for total iron are exceeded in greater than ten percent of samples in many segments of the river. Violations of aquatic life criteria were also observed for both dissolved oxygen and temperature in the lower river. Although physical and chemical criteria violations exist, the Commission utilized the WOE approach. Based on an assessment of fish population surveys from 2009-2013, which indicate full support for every pool, the entirety of the Ohio River is assessed as fully supporting the aquatic life use.

CONTACT RECREATION USE SUPPORT

The Ohio River contact recreation use was assessed in this report based on bacteria data from river-wide longitudinal surveys completed since 2003, as well as bacteria data collected annually from the six largest combined sewer overflow (CSO) urban areas during the contact recreation season from 2009-2013. Although this report assesses the river based on the past five years, all available bacteria longitudinal survey data from 2003 to 2008 were included due to the influence of precipitation on bacteria, as rain events cause a high degree of variability.

Impairments are based on exceedances of the Commission's stream criteria for bacteria. Bacteria criteria violation rates in excess of ten percent result in an impaired designation. Approximately two-thirds of the Ohio River, roughly 630 miles, is classified as either partially supporting or not supporting the contact recreation use. This evaluation is consistent with previous assessments.

PUBLIC WATER SUPPLY USE SUPPORT

The Ohio River public water supply use was assessed based on chemical water quality data collected from the Bimonthly and Clean Metals Sampling Programs, bacteria monitoring, and questionnaires sent to Ohio River drinking water utilities to assess impacts on those utilities caused by source water conditions. A summary of finished water maximum contaminant level (MCL) violations as well as intake closures and application of non-routine treatment caused by unusual river conditions is included in this report. The river is considered to be impaired if human health criteria violations for one or more pollutants are exceeded in greater than 10 percent of the samples collected, or if source water quality caused finished water MCL violations, resulting in noncompliance with provisions of the Safe Drinking Water Act (1974). Several utilities had MCL violations for trihalomethanes. Because these compounds can be formed during the water treatment process, as opposed to directly resulting from river conditions, these MCL violations do not result in an impaired assessment. There were no violations of human health criteria for protection of public water supplies in greater than ten percent of samples. The entire river is therefore designated as fully supporting the public water supply use.

FISH CONSUMPTION USE SUPPORT

The Ohio River fish consumption use was assessed based on fish tissue data as well as PCBs, dioxin, and mercury water quality data. Impairment exists if water quality criteria for one or more pollutants are exceeded in greater than ten percent of samples. Based on these criteria, the entire river is designated as partially supporting fish consumption use for PCBs and dioxin. This determination is based on historic monitoring results that were two or more orders of magnitude greater than the applicable criteria.

Violations of the total mercury water quality criterion in excess of ten percent of samples would on their own, indicate impairment in the lower half of the river. Five water quality monitoring stations in the lower half of the river had violations of the 0.012 ug/L criterion in excess of ten percent of the samples. Eleven stations had at least one violation of the total mercury water quality criterion. The water quality criterion for total mercury in the water column is established to protect against undesirable accumulation of methylmercury in fish tissue in excess of 0.3 mg/kg using a consumption-weighted approach. Using a WOE approach, fish tissue measurements of methyl mercury are a more direct measure of whether the fish consumption use is met. In this report, fish tissue methyl mercury data were evaluated using an approach contained in the USEPA's *Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion* (but noting that USEPA does not support a weight of evidence approach). The assessment of methyl mercury fish tissue data is applied on a pool by pool basis utilizing a fish consumption-weighted approach to average the methyl mercury fish tissue concentrations from multiple samples of fish of trophic levels three and four. Based on this assessment, the fish tissue data do not indicate impairment, and utilizing a weight of evidence where the fish tissue data are considered a more reliable indicator of impairment than the water quality criterion, the entire river is assessed as fully supporting the fish consumption use for mercury.

USE SUPPORT SUMMARY

The following table is a state-by-state summary of impaired uses of the Ohio River.

State	River Mile (Total Miles)	Aquatic Life Use Impairment	Contact Recreation Use Impairment	Public Water Supply Use Impairment	Fish Consumption Use Impairment
PA	0.0-40.2 (40.2)	0.0	40.2	0.0	40.2
OH-WV	40.2-317.1 (276.9)	0.0	242.2	0.0	276.9
OH-KY	317.1-491.3 (174.2)	0.0	64.2	0.0	174.2
IN-KY	491.3-848.0 (356.7)	0.0	243.6	0.0	356.7
IL-KY	848.0-981.0 (133.0)	0.0	40.6	0.0	133.0
TOTAL	981.0	0.0	630.8	0.0	981.0

PART I: INTRODUCTION

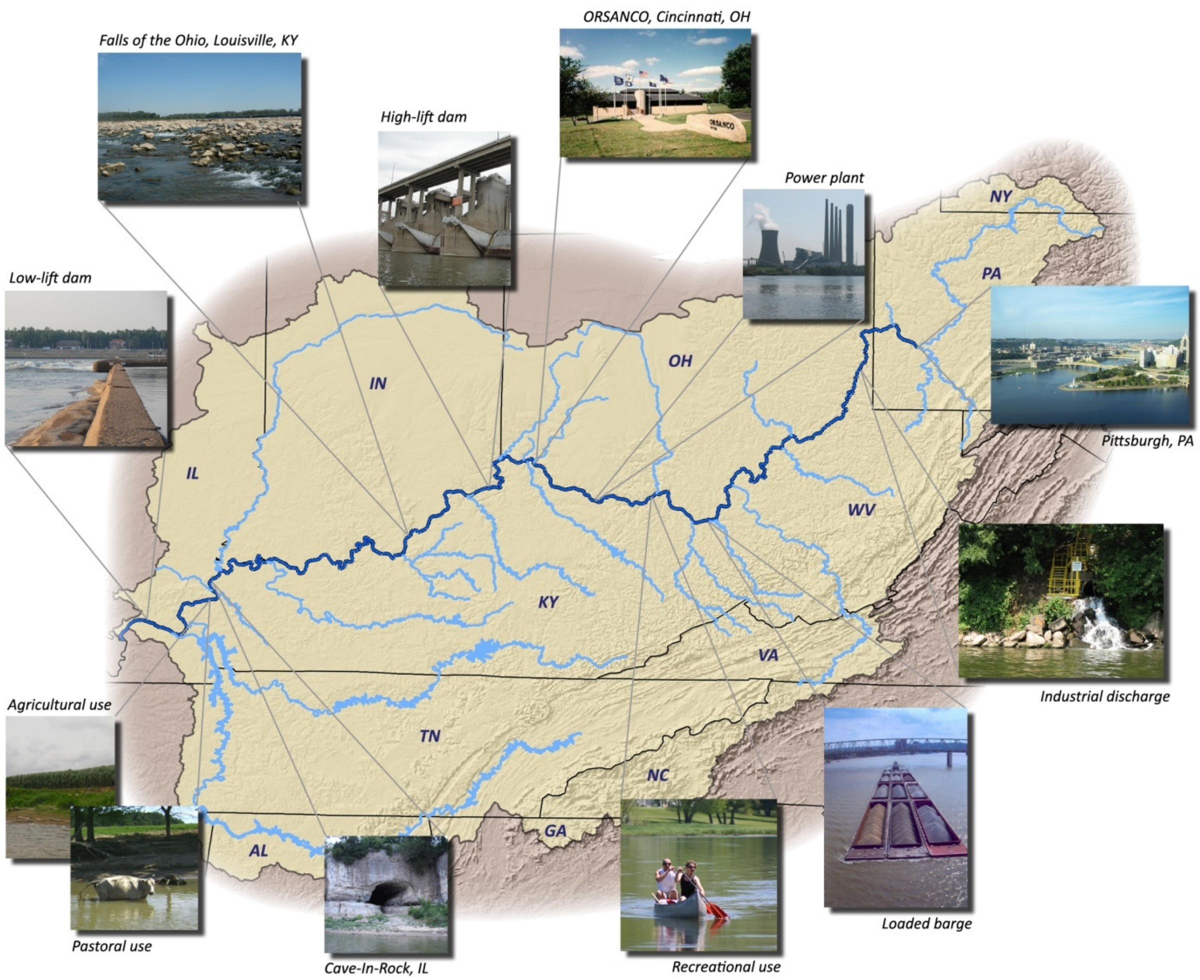
The Ohio River Valley Water Sanitation Commission (ORSANCO; the Commission) is an interstate water pollution control agency for the Ohio River. ORSANCO was established in 1948 after the Ohio River Valley Water Sanitation Compact was signed by governors from eight member states; Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia, and West Virginia and approved by Congress. Under the terms of the Compact, the states pledged to cooperate in controlling water pollution within the Ohio River basin. Article VI of the Compact states that, "Pollution by sewage or industrial wastes originating in a signatory state shall not injuriously affect the various uses of the interstate waters". To address this principle, ORSANCO carries out a variety of programs, primarily focusing on the Ohio River main stem. General program areas include water quality monitoring and assessment, emergency response, pollution control standards, and public information and education. The Commission also provides a 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, shall be permitted. ORSANCO monitors and assesses the Ohio River on behalf of the compact states. This report focuses on the water quality of the Ohio River main stem. However, monitoring is also conducted on tributaries to the Ohio.

This report generally covers the time between July, 2008 and December, 2013, although certain assessments use other data. Methodologies and supporting data used to generate this assessment are contained within this report and its appendices. Ohio River water quality is evaluated 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, surveys and questionnaires, and direct measurements of biological communities within the Ohio River. Based on water quality condition, the Ohio River is classified as fully, partially, or not supporting each of its 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 also indicate poor water quality.

Contained in this report are assessments of Ohio River designated use attainment, as well as a recommended "Integrated List" of waters requiring Total Maximum Daily Loads (TMDLs). ORSANCO's role in completing Ohio River use assessments and an Integrated List is to facilitate interstate consistency. However, Compact states are not obligated to incorporate any of this assessment into their own reports. Specifically, United States Environmental Protection Agency (USEPA) 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

CHAPTER 1: OHIO RIVER WATERSHED

BASIN CHARACTERISTICS

The Ohio River is 981 miles long and borders or runs through six states in the eastern region of the United States. The Ohio takes its headwaters in Pittsburgh, Pennsylvania at the confluence of the Allegheny and Monongahela Rivers and flows southwesterly to its confluence with the Mississippi River in Cairo, Illinois. The river basin stretches across a 203,940 square mile area, including parts of an additional eight states; New York, Maryland, Virginia, North Carolina, Tennessee, Georgia, Alabama, and Mississippi (Figure 1). Numerous tributaries feed the Ohio including the Allegheny, Monongahela, Kanawha, Wabash, Green, Cumberland, and Tennessee Rivers. In fact, more than 90% of Ohio River flow is from tributaries. Approximately ten percent of the US population resides in the basin, equating to more than 30 million people, five million of which rely on the river as a source of drinking water (Tetra Tech Inc. 2007). An estimated 3.6 million people live in cities and towns adjacent to the Ohio River.

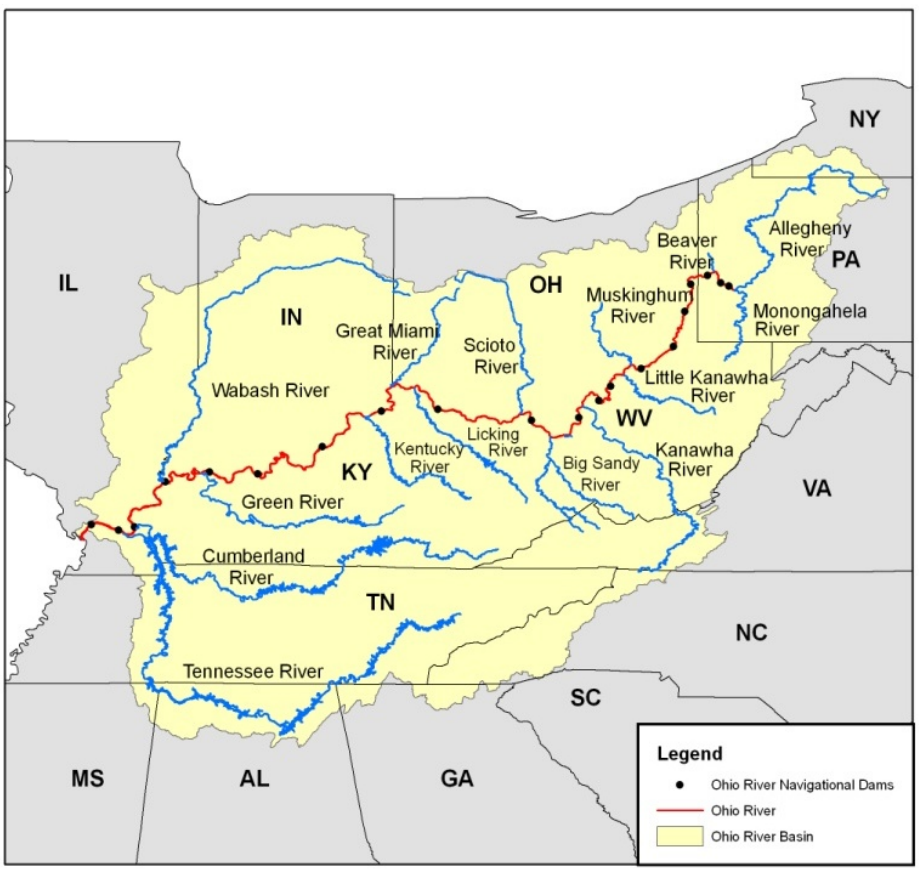


Figure 1. The Ohio River basin, including 19 high-lift locks and dams and tributaries.

Nineteen high-lift locks and dams installed by the US Army Corps of Engineers for navigation purposes maintain a nine-foot minimum river depth and regulate flow, facilitating the transport of more than 230 million tons of cargo on the river every year (Tetra Tech Inc. 2007). The dams create pools, the area of water between them, and are typically named for the downstream dam. The river has an average depth of 24 feet with an average width of 0.5 miles (ORSANCO 1994).

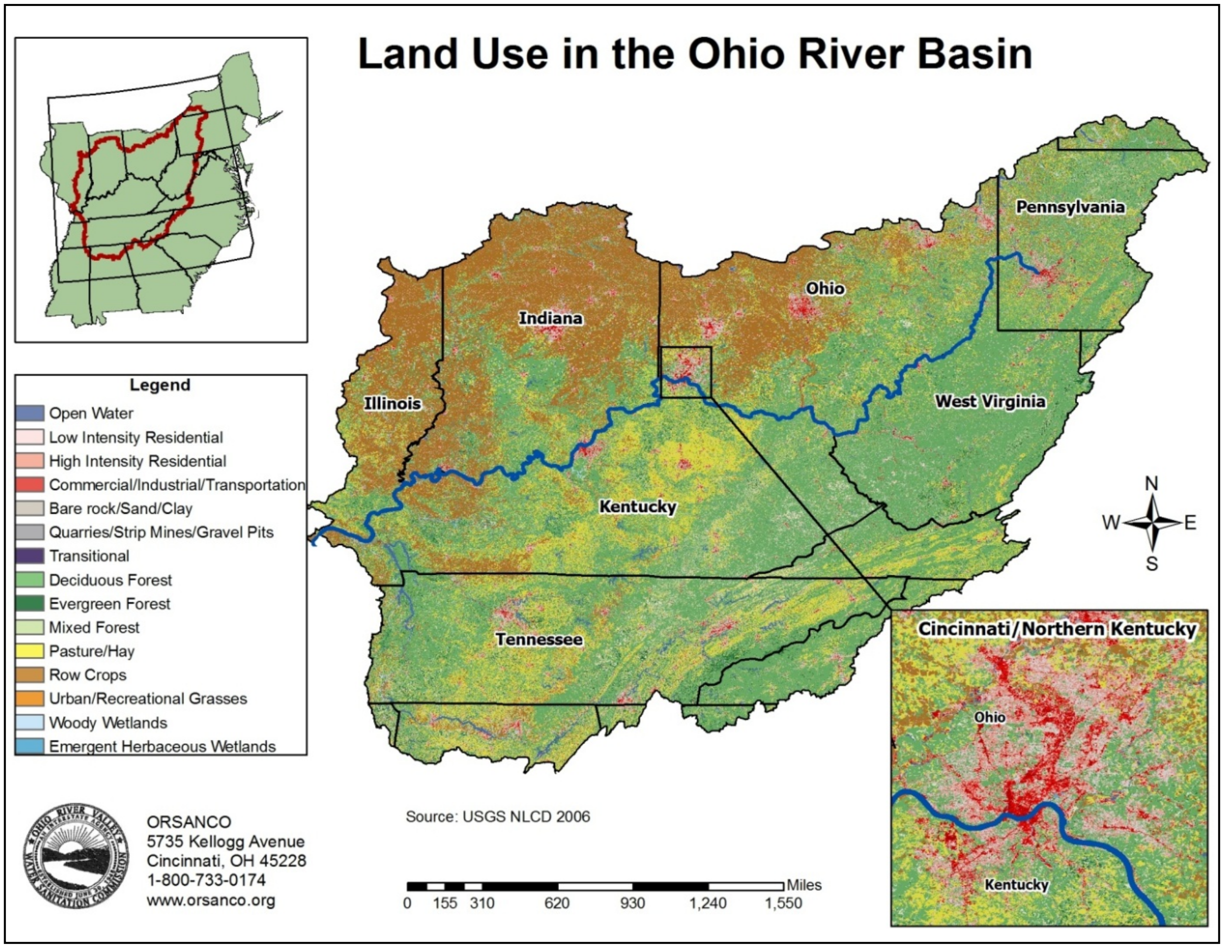


Figure 2. Land use in the Ohio River Basin (USGS NLCD 2006).

Deciduous forests comprise the majority of the land cover in the Ohio River watershed, while pastures, row crops, and urban development make up the major land uses (Figure 2). Land use is an important 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 may contribute to impairments in water quality. Like most of the Midwest, states such as Ohio and Indiana are dominated by agriculture. Highly populated regions of the river are characterized by residential, commercial, and industrial land use types. Nonpoint source pollution from both urban and agricultural areas is a large contributor to degraded water quality. Several point source pollution issues also exist along the Ohio. Of the 800 permitted discharges into the Ohio River, 49 come from power-generating facilities, 180 from municipal wastewater discharges, and over 300 from industry.

DESCRIPTION OF OHIO RIVER POOLS

The Ohio River is a series of pools connected by 19 high-lift locks and dams installed for navigational purposes (Figure 1). These dams are effective in maintaining a minimum river depth and regulating flow, but also affect 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 often been used for assessment and reporting purposes in the past. For the 2014 Biennial Assessment, aquatic life use attainment is determined using the navigational pools as independent assessment units; however, the degree of use support for the remaining uses is assessed for each river mile. It was determined that this method provides 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 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 Emsworth Locks & Dam upstream and 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 Dashields Locks & Dam upstream and 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 Montgomery Locks & Dam upstream and New Cumberland Locks & Dam downstream. The Ohio River leaves Pennsylvania to be bordered by Ohio to the north and West Virginia to the south 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, enters the Ohio at river mile 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 New Cumberland Locks & Dam upstream and Pike Island Locks & Dam on the downstream end. The following tributaries intersect this pool; 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 Pike Island Locks & Dam upstream and Hannibal Locks & Dam on the downstream end. 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 Hannibal Locks & Dam upstream and 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 pool 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 Belleville Locks & Dam upstream and 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-Robert C. Byrd** (mile point 237.5-279.2). This 34.7-mile-long water body is bounded by Racine Locks & Dam upstream and Robert C. Byrd (R.C. Byrd, formerly Gallipolis) Locks & Dam on the downstream end. Leading Creek, with a drainage area of 151 square miles, intersects this water body at mile point 254.2. Two other major tributaries empty into this pool, the Kanawha River with a drainage area of 12,200 square miles and Raccoon Creek, intersecting Racine at mile point 276.0 with a drainage area of 684 square miles.
- **Robert C. Byrd-Greenup** (mile point 279.2-341.0). This 61.8-mile-long water body is bounded by RC Byrd Locks & Dam on the upstream end and Greenup Locks & Dam downstream. The following tributaries intersect this water body; the 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 at Ohio River mile 336.4.

- **Greenup-Meldahl** (mile point 341.0-436.2). This 95.2-mile-long water body is bounded by 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, Kinniconnick 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 Meldahl Locks & Dam upstream and Markland Locks & Dam on the downstream end. Major tributaries intersecting this water body include the Little Miami River at river mile 464.1 with a drainage area of 1,670 square miles, the Licking River at mile point 470.2 with a drainage area of 3,670 square miles, and the Great Miami River at mile point 491.1 with a drainage area of 5,400 square miles.
- **Markland-McAlpine** (mile point 531.5-604.4). This 72.9-mile-long water body is bounded by Markland Locks & Dam upstream and 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 604.4-720.7). This 113.9-mile-long water body is bounded by McAlpine Locks & Dam upstream and Cannelton Locks & Dam on the downstream end. Several tributaries intersect this portion of the Ohio River including the Salt River with a drainage area of 2,890 square miles. Other tributaries intersecting this pool 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 Cannelton Locks & Dam upstream and 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 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 J.T. Myers Locks & Dam upstream and Smithland Locks & Dam on the downstream end. The Wabash River, with a drainage area of 33,100 square miles empties into this pool at Ohio River mile 848. Other tributaries to this navigational pool include the Saline River at mile point 867.3 with a drainage area of 1,170 square miles and the Tradewater River at mile point 873.5 with a drainage area of 1,000 square miles.
- **Smithland-Lock & Dam 52** (mile point 918.5-938.9). This 20.4-mile-long water body is bounded by Smithland Locks & Dam upstream and Lock & Dam 52 on the downstream end. The Cumberland River drains into the Ohio 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 at river mile 932.5 with 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 mouth 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.

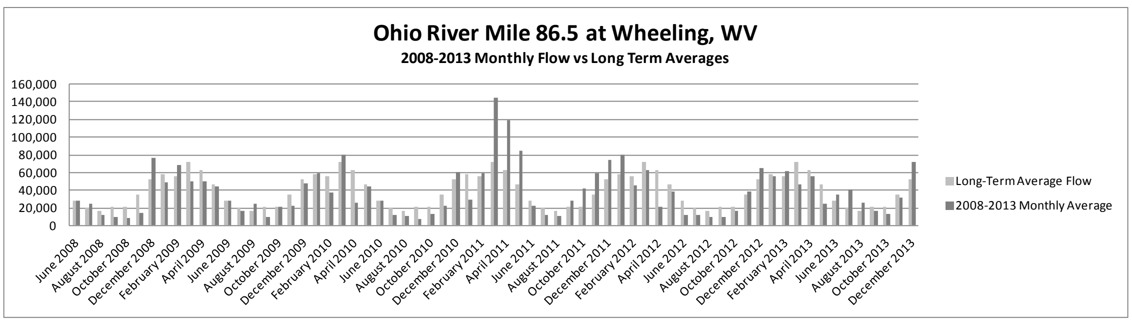
Appendix A contains additional data on basin characteristics including locations of locks and dams, locations of tributaries, and hydrologic data for 2008-2013.

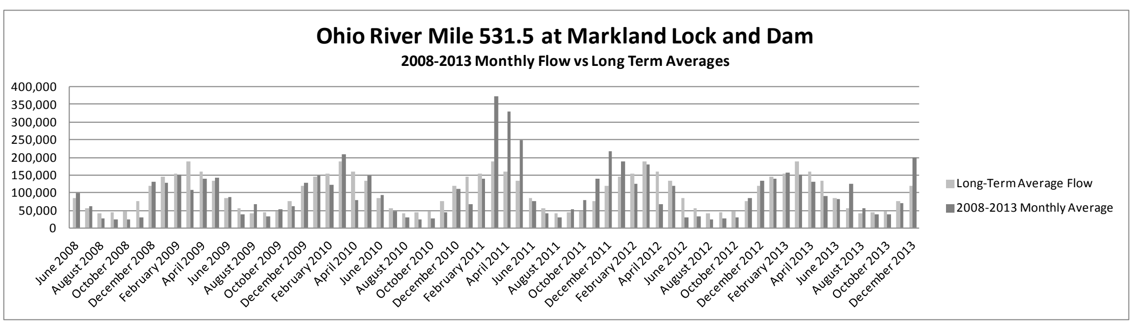
USES OF THE OHIO RIVER

According to the Federal Clean Water Act (1972), states must assess the degree to which their waters meet their designated uses. The Ohio River Basin encompasses 14 states and as such, is known for a variety of different uses. Designated uses for the Ohio River include aquatic life, contact recreation, public water supply, and fish consumption. Specifically, through 33 drinking water intakes the river provides drinking water to approximately five million people. Forty-nine power-generating facilities located along the river provide greater than five percent of the United States' power-generating capacity. In addition, the river acts as a transportation highway for commercial navigation. Each year, barges carry in excess of 280 million tons of cargo down the main stem. The majority of commercial cargo consists of coal, oil, and petroleum. As a great natural resource, the Ohio River provides warm water habitat for over 140 species of fish, drawing fishermen and nature enthusiasts to its banks throughout the basin. Additionally, the Ohio serves as a source of recreation for swimmers and boaters and adds aesthetic value as a majestic backdrop for dining and festivals.

FLOWS

A series of locks and dams, operated and maintained by the United States Army Corps of Engineers, regulates pool elevation on the Ohio River. These dams create 20 pools with guaranteed, regulated minimum flows to assure commercial navigation at all times. Long-term monthly 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 three locations; Wheeling, WV, Markland, KY, and Smithland, KY. At all three locations the average monthly flows tended to be lower than the long-term average. Both high and low flow conditions may adversely affect the various uses of the Ohio River. Aquatic biota, for example, may experience lower dissolved oxygen levels during low flow periods. During high flow conditions, bacteria levels often increase due to wet weather sources including combined sewer overflows (CSOs).





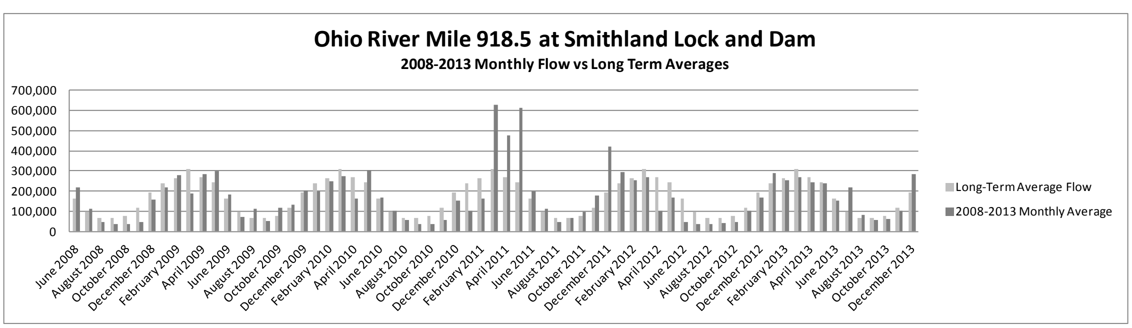


Figure 3. Ohio River flow data at Wheeling, WV; Markland, KY; and Smithland, KY.

CHAPTER 2: GENERAL WATER QUALITY CONDITIONS

Figure 4 presents box and whisker plots of all Ohio River Bimonthly and Clean Metals monitoring data for the period July 2008 through June 2013. The data represents 30 sampling events conducted over the five year period, consisting of one round of sampling every other month beginning in January. Data are presented from upstream to downstream stations, which is left to right on the graphs. River mile points for each station can be found in the data tables in Appendix B.

Several general conclusions about the data are outlined in this chapter. A common occurrence in many of the data sets is a significant decrease in concentration between the Belleville and R.C. Byrd stations. This might be explained by the dilution caused by the Kanawha River whose flow is generally about 25 percent of the Ohio River flow. Many of the pollutant concentrations tend to increase in a downstream direction, while much fewer tend to decrease in a downstream direction which would be indicative of dilution of pollutants from upstream sources. Many of the total metals concentrations increase in a downstream direction because they are associated with (adsorbed to) suspended sediments which also increase in a downstream direction. West Point, a station discontinued in 2010, has been excluded from the following discussion. This station was believed to be directly in the mixing zone of a particular discharger.

Ammonia concentrations are fairly consistent along the entire river, with the exception of the mid-river where stations from Greenup Locks and Dam to McAlpine Locks and Dam show higher maximums and elevated medians. All observed ammonia nitrogen concentrations are well below ORSANCO's criteria for the protection of aquatic life.

Median chloride concentrations tend to be fairly consistent along the length of the river, although a recent analysis of long-term temporal trends (see Chapter 6) shows basin-wide increase of chloride over time. Median concentrations are less than 40 mg/L and most of the data is below 50 mg/L, while all the data remains well below ORSANCO's water quality criterion of 250 mg/L.

Hardness increases steadily and consistently in a downstream direction. Median concentrations range from about 100 mg/L in the upper river to 170 mg/L in the lower river, which would generally be considered moderately hard to hard water. These concentrations would be considered moderate for river water quality.

Nitrate-Nitrite Nitrogen tends to increase consistently in a downstream direction with clear increases beginning between the Greenup and Meldahl stations. Upstream of Greenup, median concentrations remain consistently below 1 mg/L. Only one sample collected on the Ohio River (Newburgh, January 2010) has been above the stream criterion of 10 mg/L.

Very few detections of Phenolics tend to occur, and analytical quality assurance has been suspect in many reported detections. The current Method Reporting Limit causes any reported detection, most qualified between the method detection limit and the reporting limit, to represent an exceedance of the water quality criterion of 5 µg/L.

Sulfate concentrations in the upper river increase steadily from New Cumberland to Belleville, decrease between Belleville and R.C. Byrd due to dilution from the Kanawha River, then rise slightly below the Big Sandy River with a subsequent decline throughout the lower two-thirds of the river. All Ohio River concentrations are well below the water quality criterion of 250 mg/L. The most significant temporal trend identified is on the Big Sandy River, but tributary information is not included in this report.

Total Kjeldahl Nitrogen (TKN) concentrations increase slightly in a downstream direction in the middle of the river, from the R.C. Byrd station to the Anderson Ferry station. That station has the highest concentrations on the river with a median concentration around 0.7 mg/L. ORSANCO does not have a criterion for TKN.

Total Organic Carbon concentrations are fairly consistent throughout the river with slight increases in the downstream direction. Median concentrations are in the range of 3 mg/L while maximum concentrations rarely exceed 10 mg/L.

Median total phosphorus concentrations steadily increase from 0.05 mg/L at New Cumberland to a high of 0.11 mg/L at L&D 52 the most downstream station. Median concentrations are consisitently below 0.05 mg/L upstream of Cincinnati and remain consistent at 0.1 mg/L from Anderson Ferry and downstream (the lower half of the river). Maximum concentrations are generally under 1 mg/L. There currently is no stream criterion for total phosphorus.

Total Suspended Solids concentrations increase steadily in a downstream direction with median concentrations under 10 mg/L in the upper river and near 30 mg/L in the lower river.

Dissolved aluminum is one of a few pollutants that consistently decrease in a downstream direction, with the highest median concentration of near 15 µg/L occurring at New Cumberland, and decreasing to less than 5 mg/L at Lock and Dam 52. In contrast, Total Aluminum generally increases in a downstream direction. The Commission does not have a criterion for Aluminum.

Arsenic concentrations, both dissolved and total, tend to increase in a downstream direction. The maximum median concentration occurs at the lowest station on the river at Lock and Dam 52. Arsenic criteria are never exceeded, with a maximum concentration for total arsenic of 1.6 µg/L occurring at McAlpine Locks and Dam, which compares to the most stringent criterion for Total Arsenic of 10 µg/L.

Barium concentrations tend to be fairly consistent over the length of the river, with the highest median concentrations occurring in the lower river. No samples have exceeded the total recoverable barium water quality criterion of 1 mg/L.

Cadmium is detected more frequently in the lower half of the Ohio River, with the detections of dissolved cadmium occurring infrequently and the most detections of total cadmium occurring at Newburgh Locks and Dam. Typical concentrations remain well below the most stringent criterion for dissolved cadmium is 2.2 µg/L (at typical hardness).

Total and dissolved calcium concentrations tend to increase in a downstream direction, with a slight decrease at the R.C. Byrd station due to dilution from the Kanawha River. Maximum median concentrations for both total and dissolved Calcium occur at Smithland Locks and Dam. Almost all calcium found in the river is in the dissolved phase, as indicated by nearly equal total and dissolved concentrations. There is no water quality criterion for Calcium.

Total and dissolved chromium concentrations remain fairly consistent throughout the river, with a slight trend of higher dissolved concentrations upstream and higher total concentrations in the lower river. The dissolved criterion of 74 µg/L is well above typical concentrations in the Ohio River.

Copper concentrations are highest in the upper river with the highest median concentration occurring at the New Cumberland station. The maximum dissolved concentration of 6.61 µg/L also occurred at New Cumberland. The dissolved criterion of 9 µg/L was never exceeded.

Iron tends to be found predominantly in the solid phase as can be noted by the lack of detections of dissolved Iron. Total iron concentrations are fairly consistent from New Cumberland to Belleville, then increase slightly downstream from the R.C. Byrd station. ORSANCO does not have an iron criterion although violations of states' criteria are common.

Lead is found predominantly in the particulate phase. Median concentrations of Total Lead remain relatively consistent throughout the river, while maximum concentrations tend to be higher in the lower half of the river. No dissolved concentrations exceeded the dissolved criterion of 2.5 µg/L (at typical hardness).

Both total and dissolved Magnesium concentrations increase in a downstream direction. Magnesium, similar to Calcium, remains predominantly in the dissolved phase as is noted by nearly equal dissolved and total concentrations. The highest median concentrations are found at Smithland, and Lock and Dam 52 stations. There is no criterion for Magnesium.

There are relatively few detections of dissolved mercury; however Total Mercury concentrations frequently exceed the water quality criterion of 0.012 µg/L. Total Mercury median concentrations tend to be relatively consistent in the upper half of the river, and are significantly higher in the lower river. The highest concentrations of Total Mercury occur at J. T. Myers Locks and Dam.

Dissolved nickel is one of the few parameters which decrease in a downstream direction with the exception of slight increases at Greenup Locks and Dam and McAlpine Locks and Dam, while total recoverable concentrations slightly increase in a downstream direction. The maximum dissolved concentration of 4.5 µg/L occurred at the Markland Locks and Dam station. The dissolved criterion of 52 µg/L (at typical hardness) was never exceeded.

Dissolved and total Selenium concentrations are fairly consistent and equal throughout the entire river with the exception of increases at the Louisville station. Total selenium concentrations never exceeded the criterion of 5 µg/L.

Thallium is rarely detected in dissolved form and only slightly more so in particulate form. Thallium concentrations are consistently below 0.2 µg/L. The ORSANCO human health water quality criterion for Thallium, 0.24 µg/L, has not been exceeded.

Dissolved and total Zinc concentrations are consistent along the entire length of the Ohio River, with the maximum total recoverable concentration of approximately 60 µg/L occurring at both Louisville and J.T. Myers Locks and Dam. The dissolved criterion of 117 µg/L (at typical hardness) is never exceeded throughout the entire river.

These trends are graphically depicted following this section in Figure 4. The Bimonthly and Clean Metals data from July 2008 to June 2013 is included in box and whisker plots. The boxes shows the interquartile range and median and whiskers correspond to minimum and maximum values.

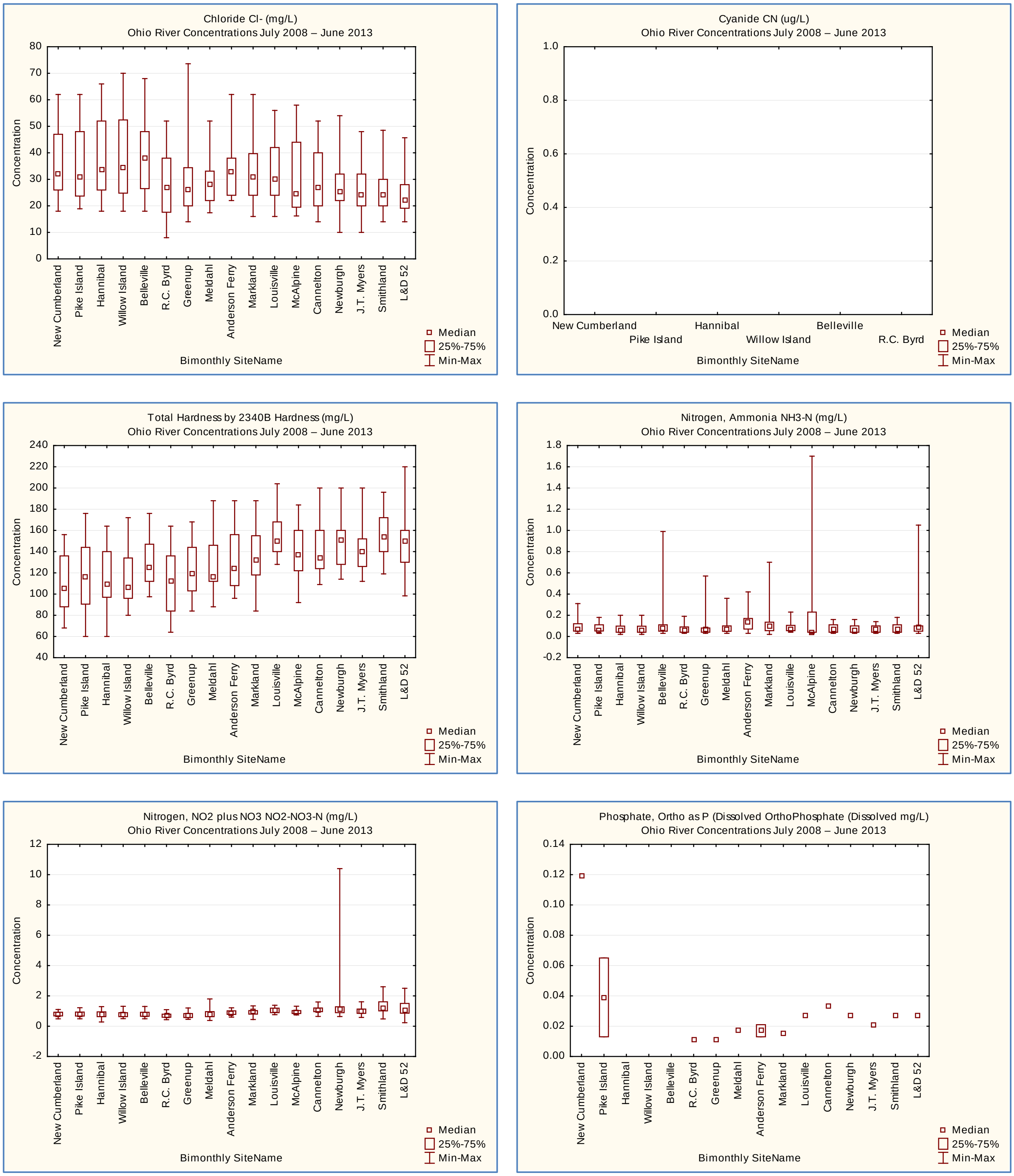
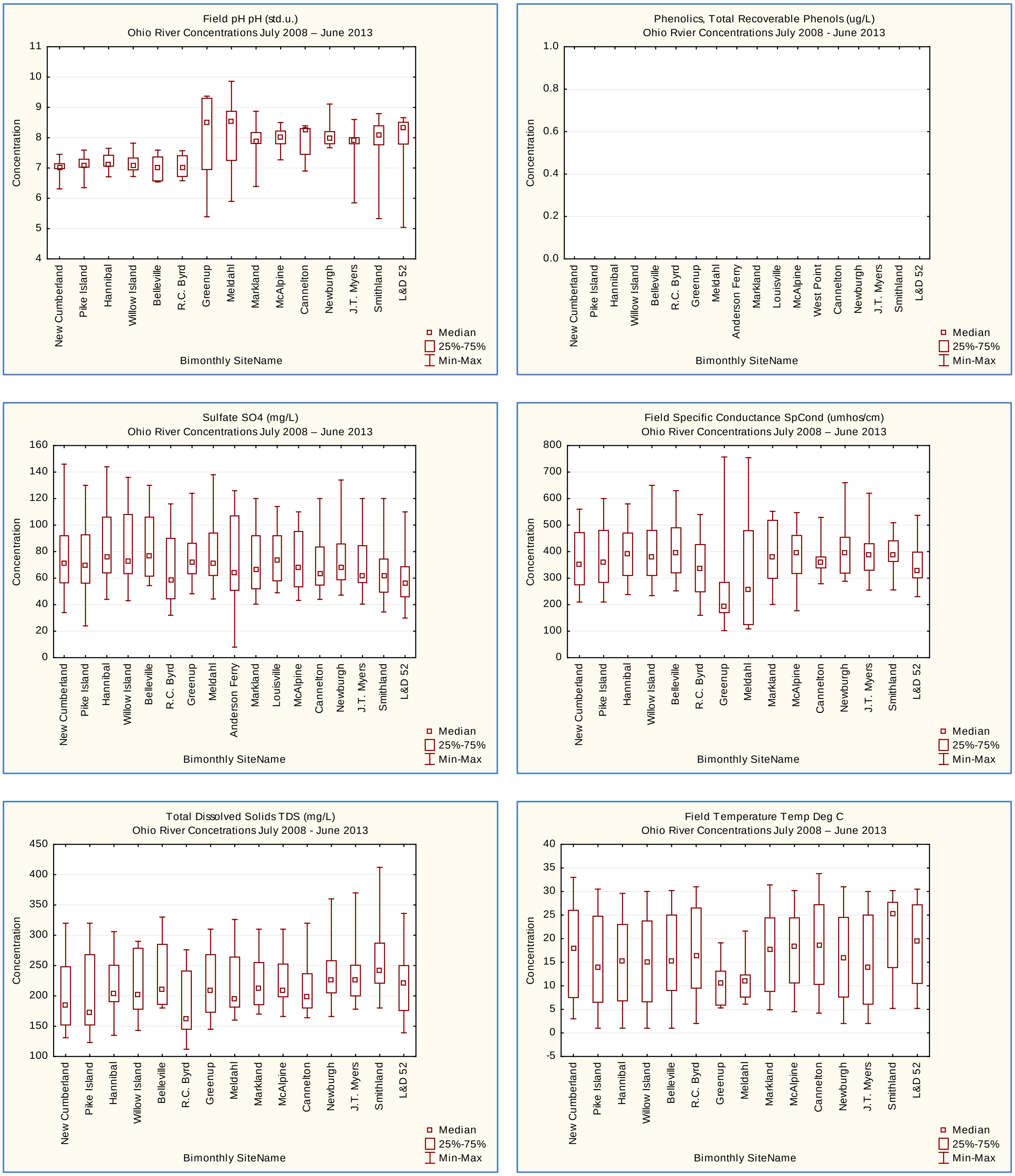


Figure 4. Bimonthly and Clean Metals data from July 2008 to June 2013.



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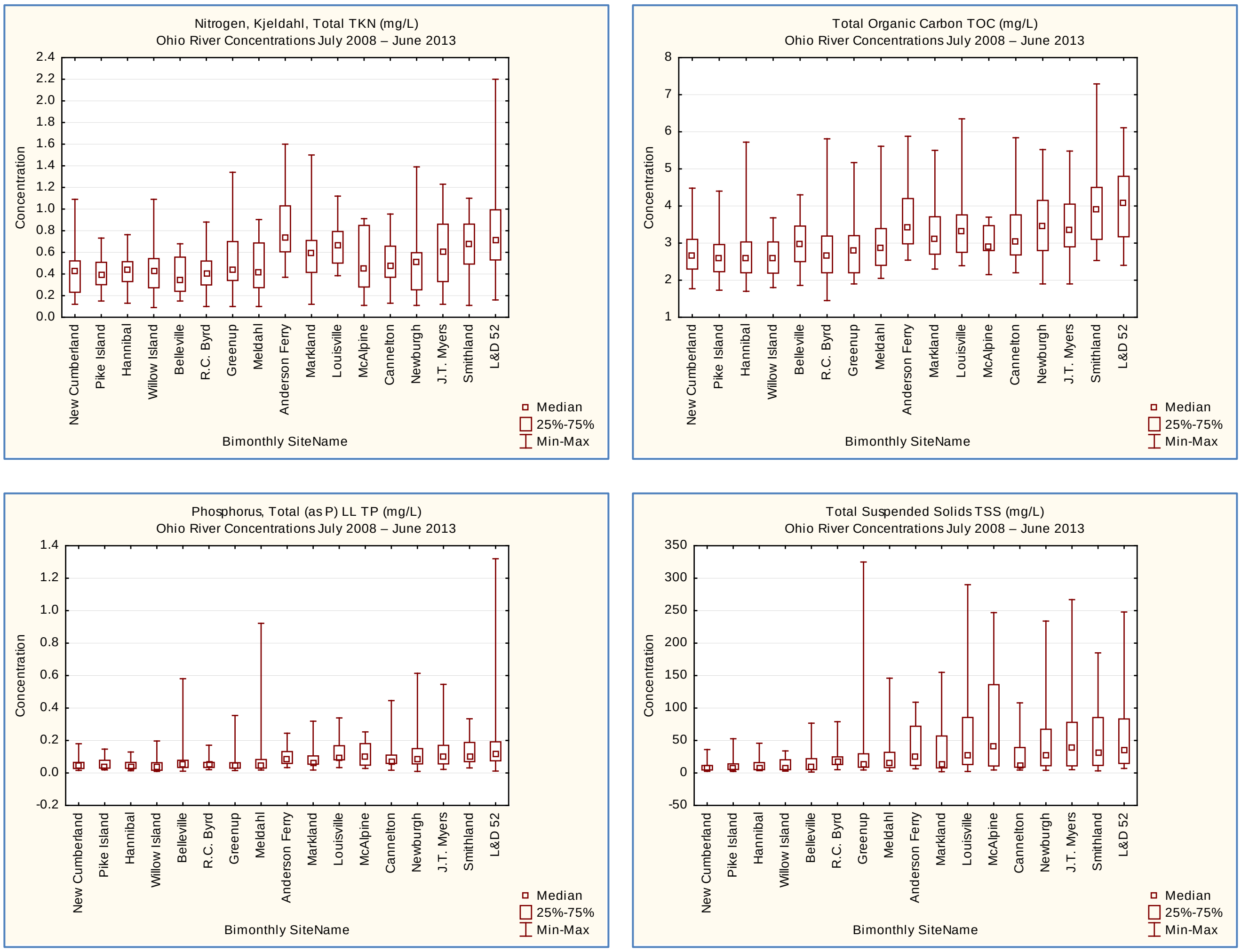

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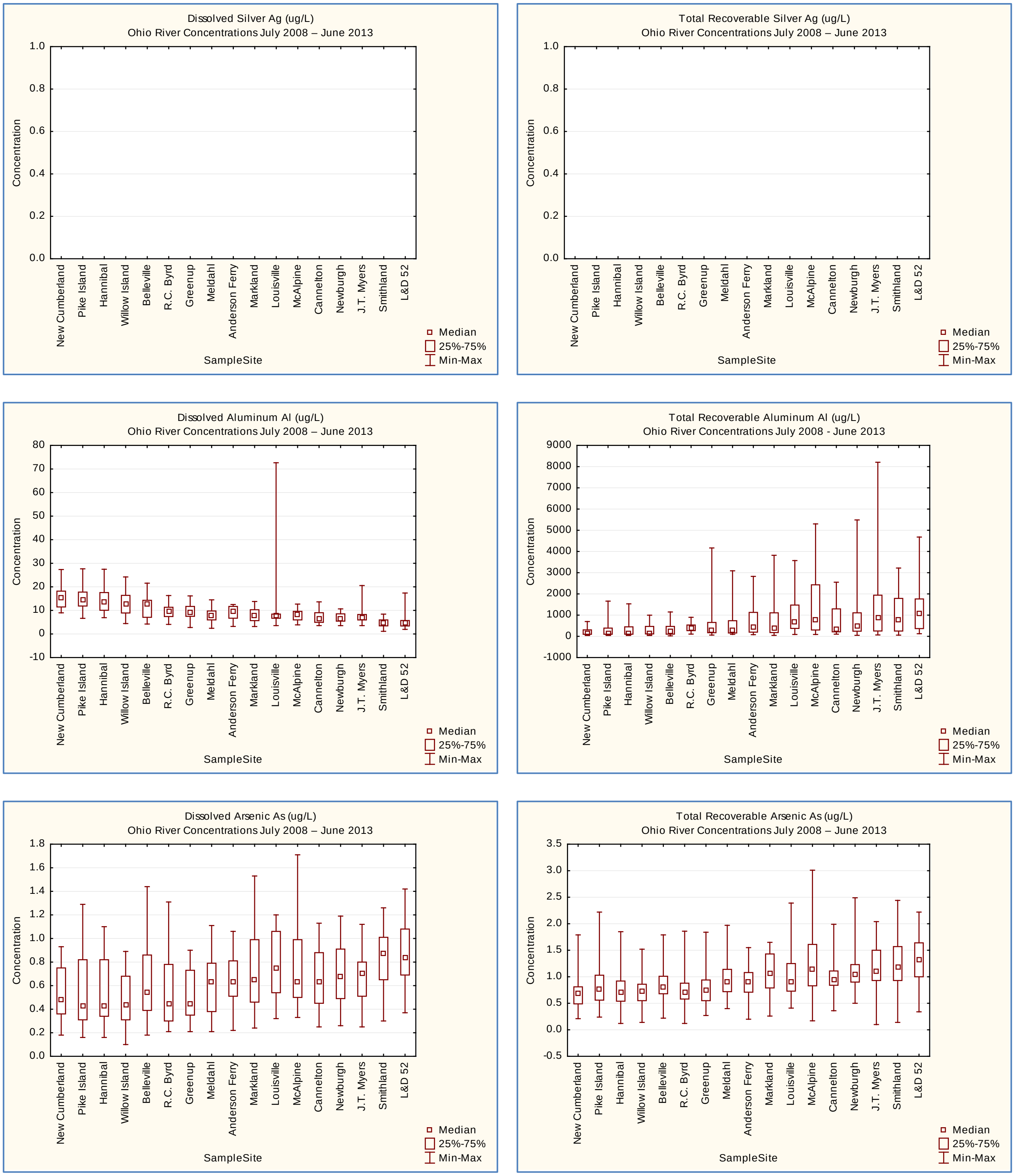

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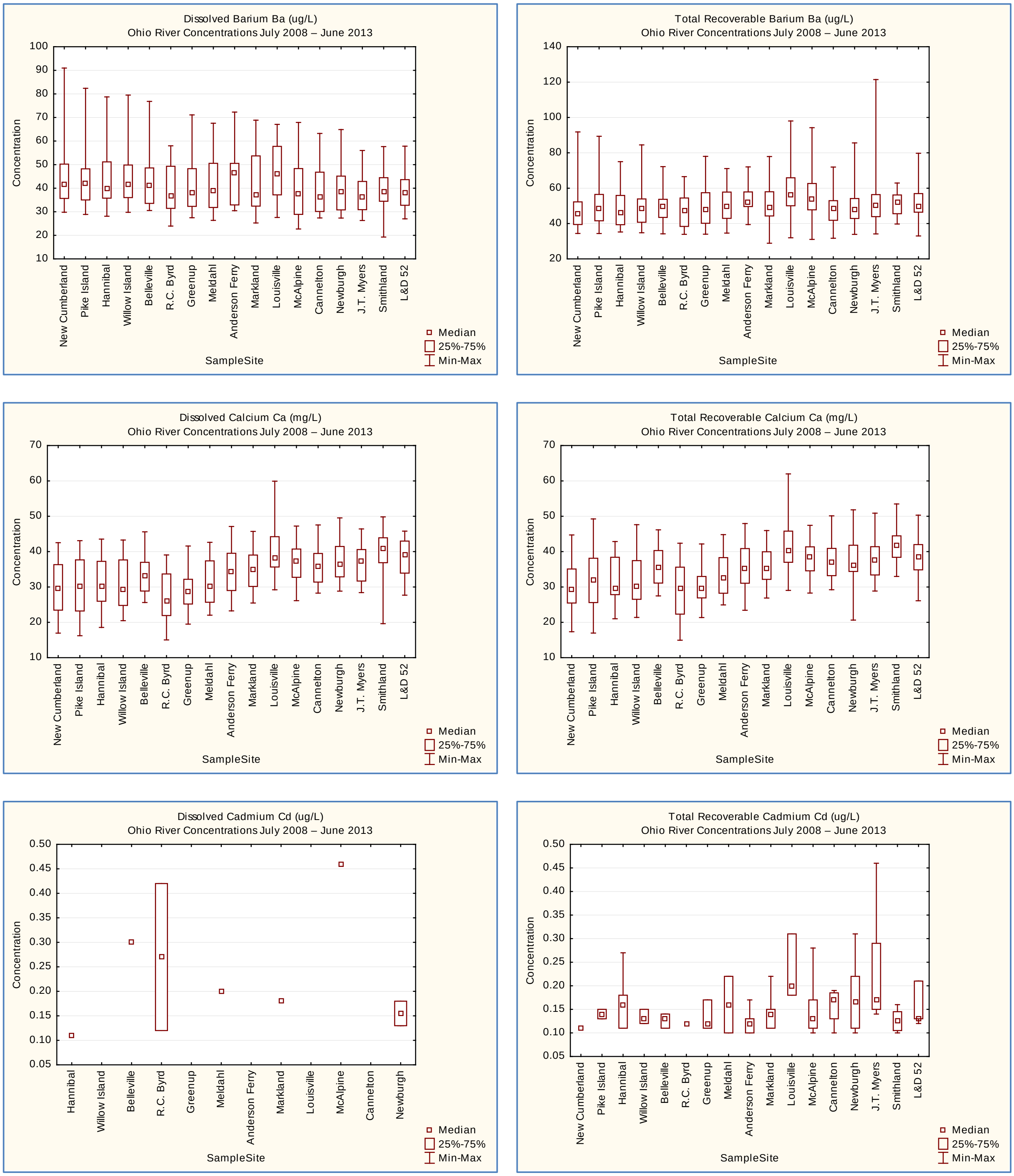

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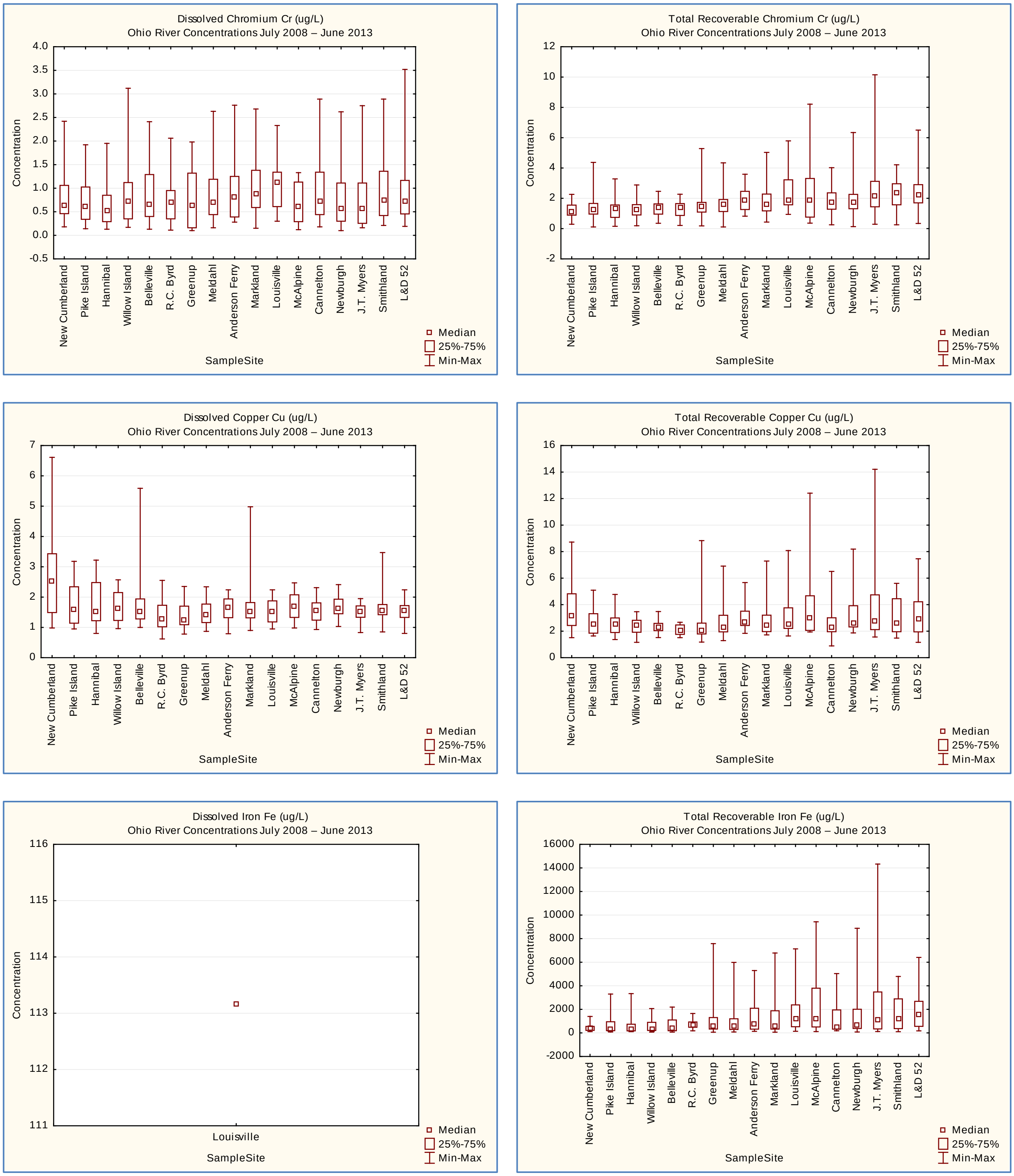

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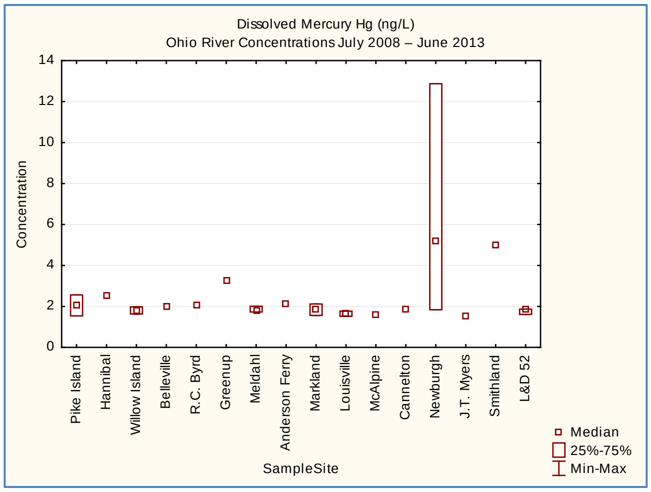

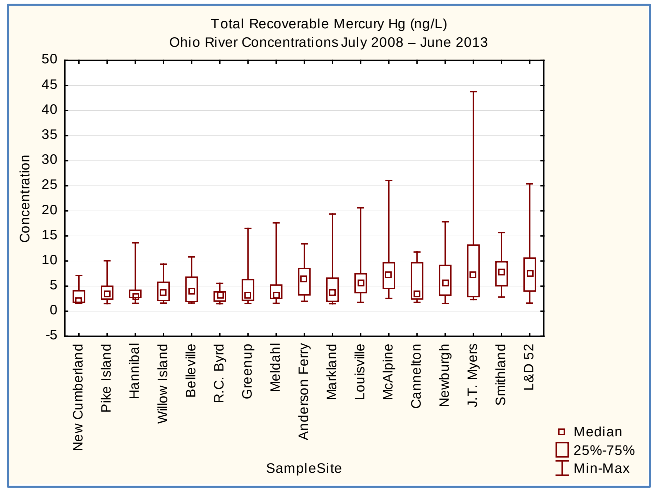

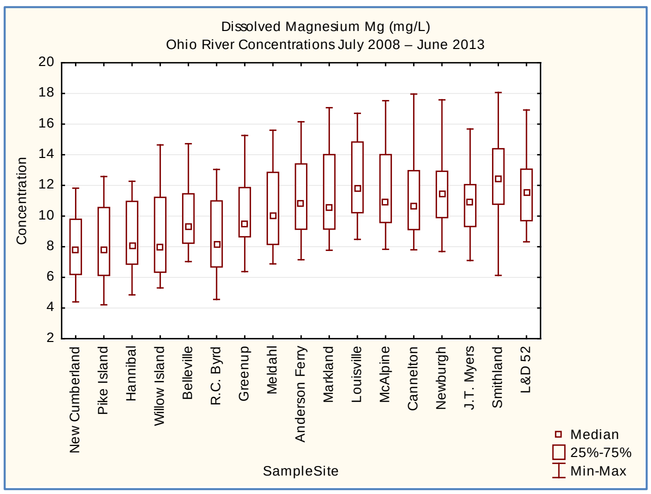

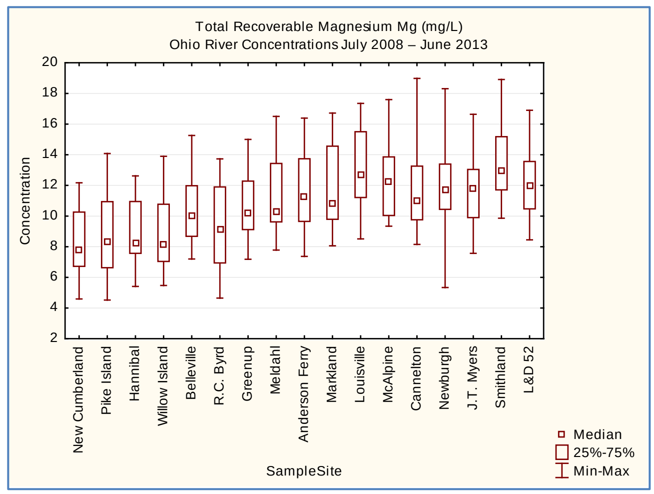

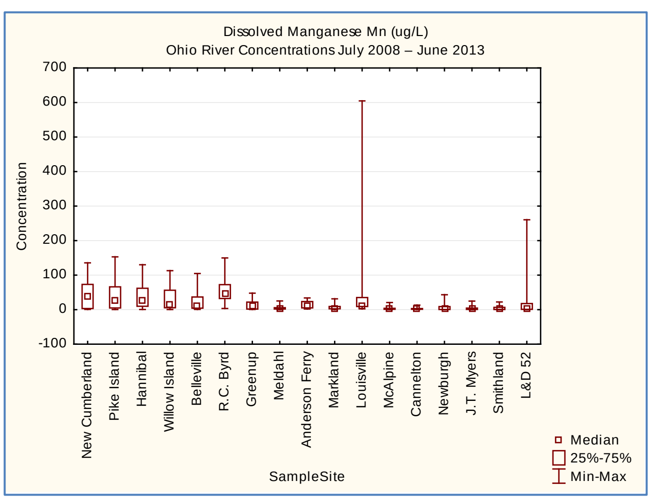

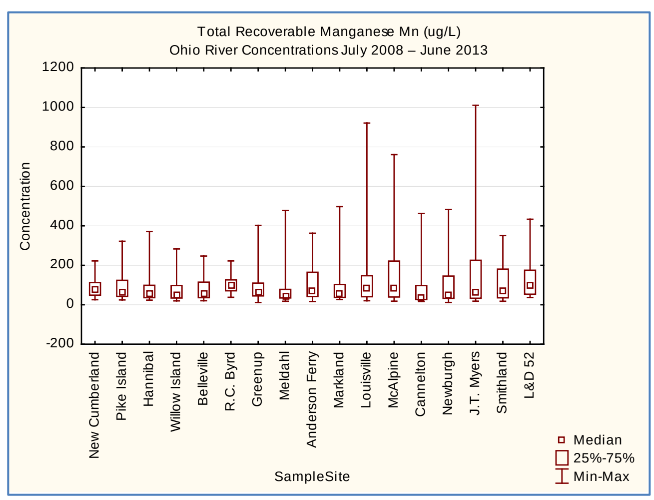

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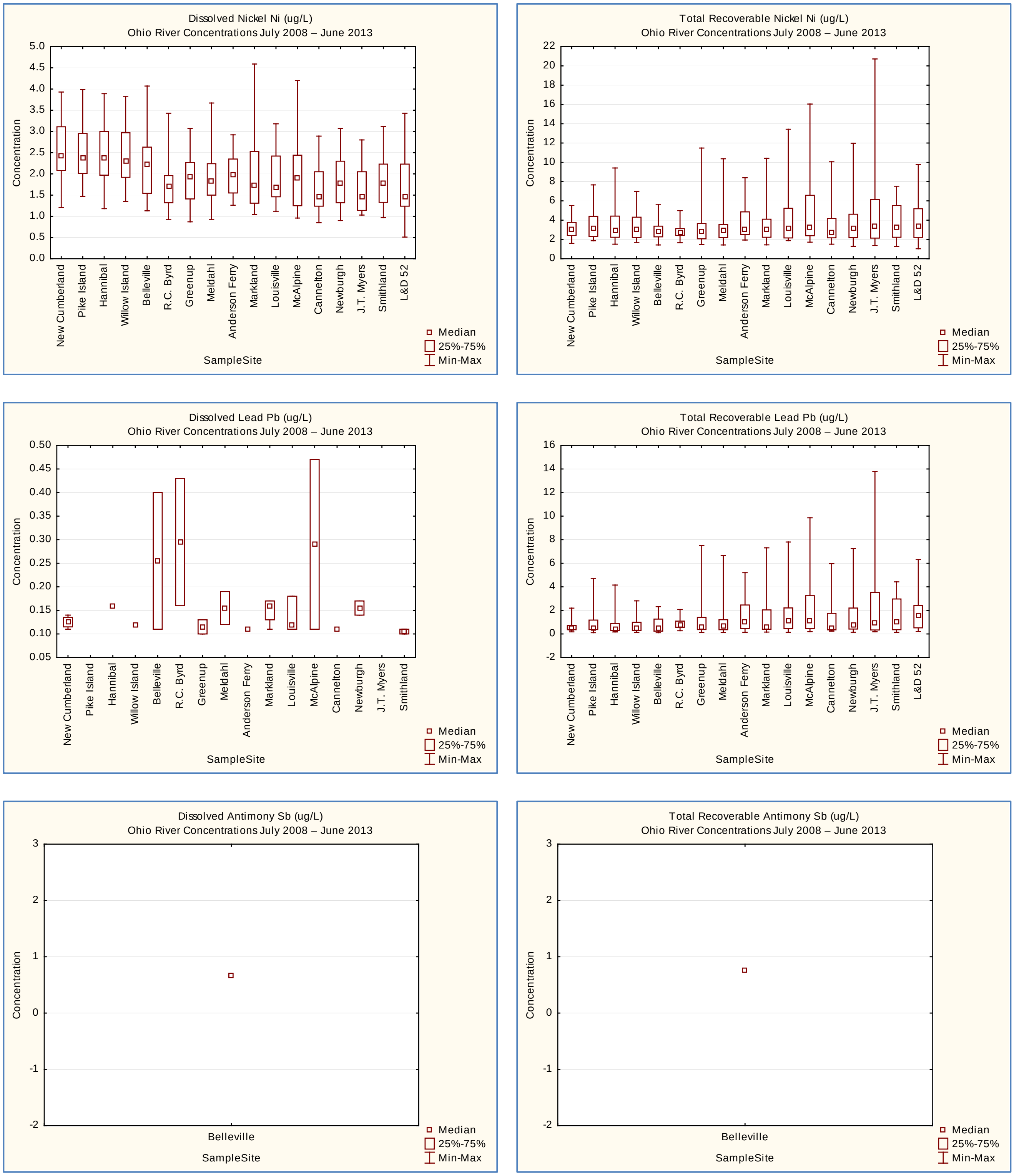

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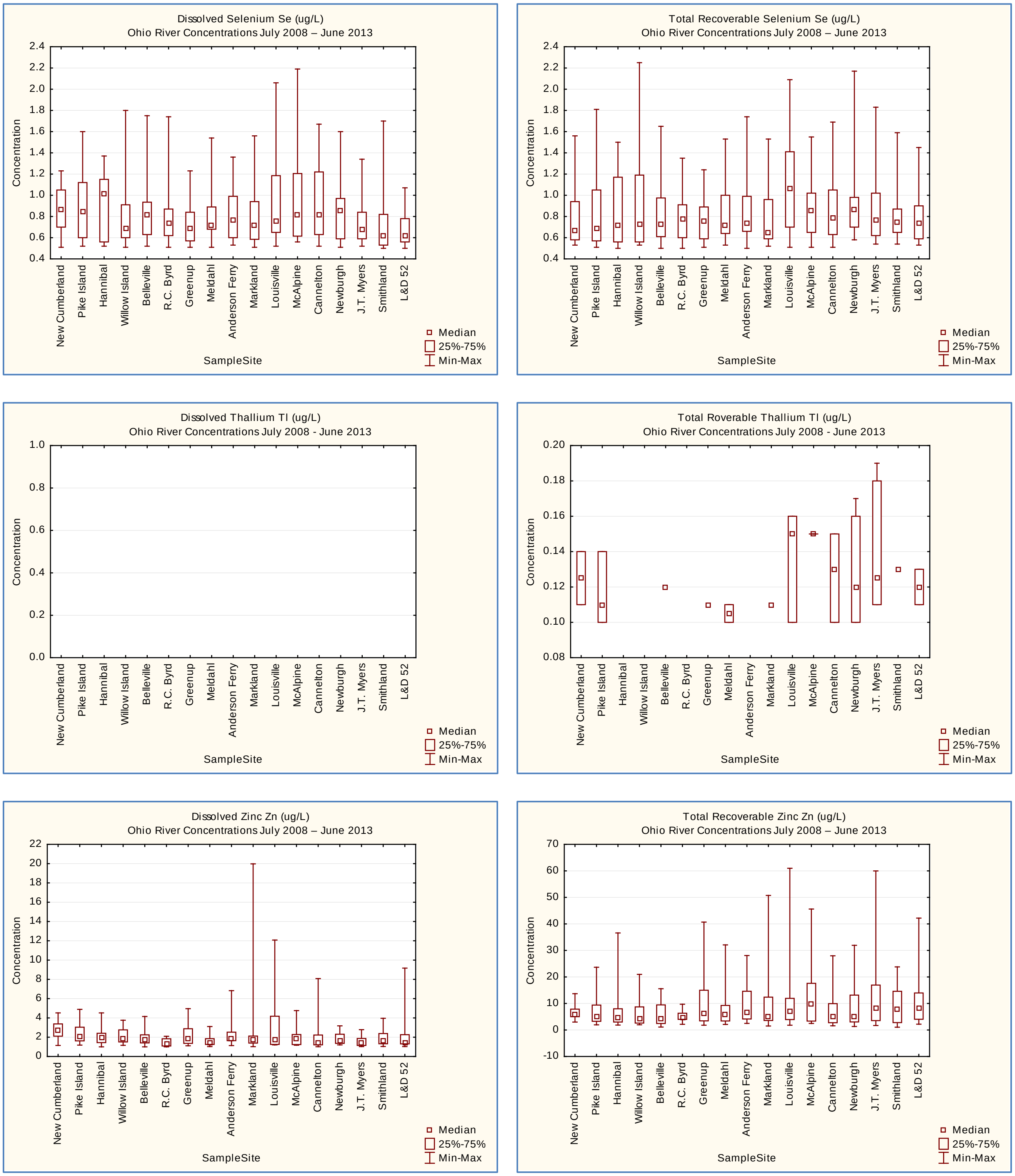


Figure 4. Bimonthly and Clean Metals data from July 2008 to June 2013.

PART III: SURFACE WATER MONITORING AND ASSESSMENT

CHAPTER 1: MONITORING PROGRAMS DESIGNED TO ASSESS OHIO RIVER DESIGNATED USE ATTAINMENT

MONITORING PROGRAMS

The Ohio River Valley Water Sanitation 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 including:

- Bimonthly Sampling (nutrients/ions)
- Clean Metals Sampling
- Temperature and Dissolved Oxygen Monitoring (operated by the US Army Corps and Hydropower Facilities)
- Fish Population Monitoring
- Contact Recreation Bacteria Monitoring
- Longitudinal and Tributary Bacteria Surveys
- Fish Tissue Sampling
- High Volume PCBs
- Algae and Nutrients
- Special Studies

Some inherent difficulty exists when monitoring a river system as expansive as the Ohio. Challenges related to both spatial and temporal coverage of the river must be approached in order for the Commission to be most effective. To best assess the attainment status of the Ohio River's designated uses, ORSANCO combines multiple monitoring programs as outlined above. Water quality criteria used to assess use support are contained in the 2013 Revision of *Pollution Control Standards for Discharges to the Ohio River* (Table 4).

OTHER SOURCES OF DATA

Pennsylvania Department of Environmental Protection (PADEP) and United States Geological Survey (USGS) chemical monitoring data for the Ohio River in Pennsylvania was compared to ORSANCO Water Quality Criteria. United States Army Corps of Engineers or electric utility/hydropower agencies temperature and dissolved oxygen data were assessed for compliance with Aquatic Life Criteria. Data collected by various drinking water utilities on the main stem is used as a supplement to ORSANCO bacteria monitoring for assessment of Contact Recreation Criteria.

BIMONTHLY AND CLEAN METALS SAMPLING

The Bimonthly and Clean Metals Sampling Programs are used to assess aquatic life and public water supply uses. These programs collect water column grab samples from 15 Ohio River stations once every other month (Table 1). Samples collected by ORSANCO staff and hired contractors are analyzed for certain chemical and physical parameters by a contract laboratory. In October of 2000, ORSANCO changed the aquatic life use criteria for metals to utilize dissolved metals rather than total recoverable metals. Dissolved metals are available to aquatic life because they are dissolved in the water column, making these data more accurate and representative for assessments. Dissolved metals criteria for the protection of aquatic life have very low concentrations, some in only single parts per billion. Therefore, collecting uncontaminated samples and performing 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. Clean Metal parameters as well as Bimonthly Sampling Program analytes were used to determine the degree of support for aquatic life (Table 2). Applicable results from main stem stations were compared to established stream criteria. For this 2014 report, Bimonthly and Clean Metals data from July 2008 to June 2013 were used to make use assessments. This discrepancy in sampling period exists due to a time-lag in receiving results from the laboratory. Data from these programs were also used to assess the public water supply use.

Table 1. Station Locations for Bimonthly and Clean Metals Sampling

Station	River Mile	Period of Record
New Cumberland	54.4	Jul-92 to Present
Pike Island	84.2	Jul-92 to Present
Hannibal	126.4	Sept-77 to Present
Willow Island	161.8	Nov-75 to Present
Belleville	203.9	Nov-75 to Present
R.C. Byrd	279.2	Nov-75 to Present
Greenup	341.0	Jul-92 to Present
Meldahl	436.2	Jul-92 to Present
Anderson Ferry	477.5	Jul-92 to 2011
Markland	531.5	Nov-75 to Present
Louisville	600.6	Nov-75 to 2011
McAlpine	606.8	Jul-92 to May-97, Jul 2011 to Present
West Point	625.9	Nov-75 to 2011
Cannelton	720.7	Nov-75 to Present
Newburgh	776.0	Jul-92 to Present
J.T. Myers	846.0	Nov-75 to Present
Smithland	918.5	Jan-83 to Present
Lock and Dam 52	938.9	Jul-93 to Present

Table 2. Clean Metals and Bimonthly sampling parameters.

Parameter	Analysis	Detection Limit (µg/L)
Aluminum	EPA 1638	1.0
Antimony	EPA 1638	0.5
Arsenic	EPA 1638	0.1
Barium	EPA 1638	10.0
Cadmium	EPA 1638	0.1
Calcium	EPA 200.7	500.0
Copper	EPA 1638	0.1
Chromium	EPA 1638	0.5
Iron	EPA 200.7	50.0
Lead	EPA 1638	0.1
Magnesium	EPA 200.7	500.0
Manganese	EPA 1638	0.1
Mercury	EPA 245.7	0.0015
Nickel	EPA 1638	0.1
Selenium	EPA 1638	0.5
Silver	EPA 1638	0.1
Thallium	EPA 1638	0.1
Zinc	EPA 1638	1.0

Parameter	Analysis	Detection Limit
Ammonia as Nitrogen	EPA 350.1	0.03 mg/L
Chloride	SM 4500 Cl E	2.0 mg/L
Hardness as CaCO3	SM 2340 B	3.0 mg/L
Nitrate-Nitrite as N, by FIA	EPA 353.2	0.05 mg/L
Phenolics	EPA 420.4	0.01 ug/L
Sulfate	ASTM D516-90	12.5 mg/L
Total Dissolved Solids	SM 2540 C	5.0 mg/L
Total Kjeldahl Nitrogen	EPA 351.2	0.1 mg/L
Total Organic Carbon	SM 5310 C	0.5 mg/L
Total Phosphorus	EPA 365.3	0.01 mg/L
Total Suspended Solids	SM 2540 D	1.0 mg/L
Total Cyanide	EPA 335.4	0.005 mg/L

DISSOLVED OXYGEN AND TEMPERATURE MONITORING

As part of the aquatic life use assessment, dissolved oxygen and temperature data from 2009-2013 were used to assess support of this use. In addition to metals and nutrients/ions, both dissolved oxygen and temperature levels play a role in whether or not the river has the ability to support aquatic life. Dissolved oxygen and temperature in the Ohio River main stem is monitored by ORSANCO, United States Army Corps of Engineers and electric utility/hydropower agencies at 14 river stations. Measurements are taken in hourly, 30-minute or 15-minute increments by ORSANCO, US Army Corps of Engineers and Hydropower or other electric power utilities operating on the Ohio River.

Table 3. Dissolved oxygen and temperature monitoring stations.

Station	River Mile	Operating Agency	Frequency	Date of Operation	Comments
MONTGOMERY	31.7	USACE	Hourly	2009, 2011-2013	No Data 2010
NEW CUMBERLAND	54.4	ORSANCO	15 Min	Sept 2012-2013	
PIKE ISLAND	84.2	ORSANCO	15 Min	Sept 2012-2013	
HANNIBAL	126.4	Hydropower ORSANCO	Hourly 15 min	2009-2013 2012-2013	Data issues early 2011 and late 2013
BELLEVILLE	203.9	USACE	Hourly	2012-2013	Annually
RACINE	237.5	Hydropower	Hourly	2009-2013	
GREENUP	341.0	Hydropower	Hourly	2009-2013	Data issues mid-2010 and late 2013
RENSLAR	462.6	ORSANCO	15 Min	Sept 2012-2013	
MARKLAND	531.5	Hydropower	15 Min	2009-2013	Multiple instruments
McALPINE	606.8	Hydropower	Hourly	2011-2013	Sent weekly
CANNELTON	720.7	USACE ORSANCO	Hourly 15 Min	2009-2010 Sept 2012-2013	
NEWBURGH	776.1	USACE ORSANCO	Hourly 15 Min	2009-2010 Sept 2012-2013	
J. T. MYERS	846.0	USACE ORSANCO	Hourly 30 Min	2009-2010 2011-2013	
SMITHLAND	919.0	USACE ORSANCO	Hourly 30 Min	2009-2010 2011-2013	

FISH POPULATION MONITORING

Fish population pool surveys data from 2009 through 2013 were used to assess support of aquatic life use. ORSANCO biologists monitor fish populations annually from July through October, conducting between 100 and 200 surveys of fish communities. The monitoring strategy includes both fixed station and probability-based sampling using boat electrofishing along 500-meter shorelines. Because fish populations differ depending on their environment, habitat types within electrofishing zones are also noted (Figure 5). Routine fish population assessments are conducted at 15 randomly chosen sites in three to four pools each field season, providing complete coverage of the river every five years. Data from the 15 random sites are used to extrapolate information about the entire pool. If impairment is found, pools may be re-sampled the following year. In 2009 survey pools included Belleville, Markland, McAlpine, and Open Water. In 2010, John T. Myers, Racine, and Montgomery pools were sampled. New Cumberland, Willow Island, Cannelton, and Greenup pools were surveyed in 2011. In 2012, Emsworth, Pike Island, Meldahl, Cannelton, and Newburgh pools were sampled. Dashields, Hannibal, R.C. Byrd, and Smithland pools were surveyed in 2013.

At the conclusion of each field season, ORSANCO assesses the biological condition of the survey pools using an index specific for the Ohio River. In 2003, the Ohio River Fish Index (ORFIn) was created using ten years of fish population data. Though it utilizes attributes common in multi-metric indices (abundance and diversity values, pollution tolerance, and number of fish with DELT anomalies, etc.) the ORFIn was comprised of metrics specifically designed for the Ohio River fish population. In 2008, the ORFIn was re-evaluated and updated to create the *modified* ORFIn (*m*ORFIn). Biologic condition ratings are assigned to Ohio River pools based on *m*ORFIn scores and are then assessed as either supporting or failing to support the aquatic life use designation.

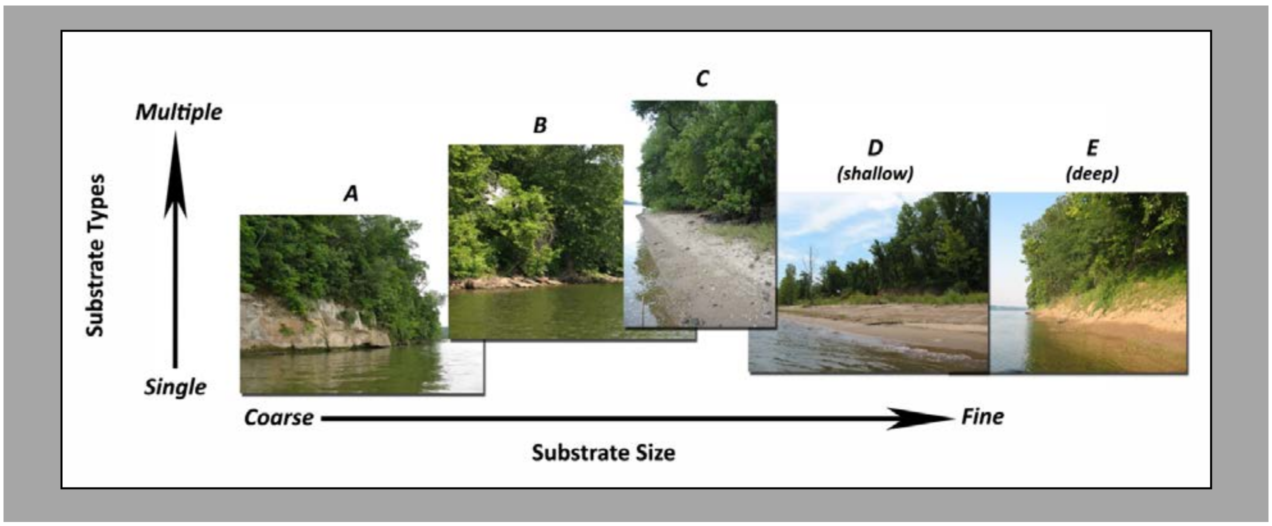


Figure 5. Fish population scores are based on habitat class, ranging from substrates that are highly coarse to fine.

CONTACT RECREATION BACTERIA SAMPLING

The Commission collects bacteria samples from April (beginning in 2012) 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 rounds of sampling are completed monthly for each urban community sampling location and analyzed for fecal coliform and *E. coli*. There were at least three sites in each community sampled; one being upstream of the CSO community, one downtown, and one downstream during 2009. Due to budget constraints, there were at least two sites in each community sampled; one being downtown and one downstream during 2010-2013.

In addition to routine bacteria sampling, the Commission conducted longitudinal surveys for bacteria from May to October in 2003-2007 under the Ohio River Watershed Pollutant Reduction Program (Appendix B). For this work the Ohio was broken down into three segments: an upper, middle, and lower segment. For each segment five rounds of samples were collected, one round each week for five consecutive weeks. Sampling sites begin in Pittsburgh (Ohio River Mile 0) and end in Cairo (Ohio River Mile 981) with one river cross-section sample collected approximately every five miles. Each site was sampled fifteen times from 2003-2006, allowing for the calculation of three geometric means per site.

In 2007 and 2008 one round of sampling was completed each year for the entire river in a consecutive order beginning at mile 0 and ending at mile 981. Samples were analyzed for *E.coli* by the ORSANCO staff using Colilert, a Most Probable Number method. A minimum of ten percent duplicate samples were sent to a contract laboratory for analyses by the membrane filtration method for *E. coli* and fecal coliform. Through intensive longitudinal monitoring, the Commission has been able to monitor the entire river for bacteria and the contact recreation use.

FISH TISSUE SAMPLING

The Commission harvests fish from July to October for tissue analysis to determine pollutant levels in commonly consumed Ohio River fish. Tissue contaminants analyzed include PCBs, chlordane, mercury, cadmium, lead, and certain pesticides. Within the past several years, mercury contamination has come to the forefront of the fish consumption arena. In 2009, ORSANCO expanded the fish tissue program to include methyl mercury analyses, primarily focusing on large, hybrid striped bass that would be most likely to contain higher concentrations than most other species. Results indicated that these fish were exceeding methyl mercury concentrations in forty percent of samples. In 2010, the mercury program began to focus on methyl mercury and was expanded to include not only large hybrid striped bass, but channel catfish, freshwater drum, and other species. Pollutant contamination in fish tissue based on samples composed of generally three fillets from a single species. States also use tissue data collected by the Commission to develop and issue appropriate fish consumption advisories.

Recently, ORSANCO collaborated with the six other main stem states in an effort to develop a uniform fish consumption advisory protocol in order to better advise the public on safe consumption of Ohio River fish. Working with state and USEPA representatives, the Commission developed the Ohio River Fish Consumption Advisory Protocol (ORFCAP). Thresholds have been agreed upon by a panel that will allow for standardization in consumption advisories across Ohio River basin states. Within the ORFCAP, the river is divided into four reporting units and identifies two primary contaminants of concern, PCBs and mercury. Fish consumption advisories are specifically designed to protect sensitive populations using five advisory groupings for PCBs and four for mercury. ORSANCO also developed a website to serve as an electronic reference source for residents of the Ohio River basin. The site provides an explanation of fish consumption advisories, outlines various Ohio River contaminants, explains how to follow the advisory, and offers an interactive map with an option to click on a particular river area to view consumption advice. Please visit the consumption advisory website at the following address: www.orsanco.org/fca.

ALGAE AND NUTRIENTS

Nutrients (nitrogen and phosphorus) have been identified as the third most common impairment to waters of the United States (US EPA 2010). Excess nutrients can have impacts within the receiving stream and also in downstream waters as nutrients are exported from the system. An abundance of nitrogen and phosphorus in the Ohio has the potential to affect all designated uses of the river. One side effect of these nutrients is their contribution to low dissolved oxygen levels that can have a negative impact on the biological community. Not only are there negative ecological impacts, but associated problems for drinking water utilities may occur as a result of this influx to river systems. An abundance of nutrients can cause algae-related taste and odor problems for water utilities and have the potential to produce toxins that may lead to illness in people who come in contact with the water.

Many streams in the Mississippi River watershed are listed as impaired by excess nutrients in the system and do not reach their aquatic life use designation (Turner and Rabalais 2003). All of these streams lead to the Mississippi River and finally the Gulf of Mexico off the coasts of Louisiana and Texas. As a result of excess nutrients entering the northern Gulf of Mexico, a hypoxia zone now exists ranging from 8,000 to about 22,000 km^2 since 1985 (Hill, et al. 2011). These nutrients typically cause algal blooms, leading to large fluctuations in dissolved oxygen, falling below 2 mg O_2 per liter in the summer (Turner and Rabalais 2003) (Dodds 2006). The low dissolved oxygen levels lead to the creation of a "dead zone" which has adverse affects for aquatic life and their habitat. In 2008, the Gulf Hypoxia Action Plan identified the Ohio River as the largest contributor of both nitrogen and phosphorus to the Gulf of Mexico. A major tributary of the Ohio, the Wabash River, was identified in a 2005 ORSANCO study to be a significant source of nutrients to the Ohio, Mississippi, and Gulf of Mexico and has been continually studied since 2010.

In August and September 2010 and again in 2012, algal blooms were reported in both the upper and lower Ohio River. Drinking water utilities reported taste and odor issues and filter clogging, which adds to the cost of treating water. Algae problems have been reported throughout the Ohio River Basin, including the state of Ohio, where three lakes were closed to recreation due to toxic algae. In order to limit problems associated with algal blooms on a national scale, US EPA has asked states to develop numeric nutrient criteria for lakes, rivers, and streams. ORSANCO is developing these criteria for the Ohio River. To support this effort, samples are collected twice per month at seven water utilities covering the upper, middle, and lower reaches of the river, and tested for both algae (identified to lowest taxa possible) and nutrients (nitrogen and phosphorous).

The Commission operates a special monitoring program for nutrients for the purpose of numeric nutrient criteria development. Samples are collected twice monthly at seven Ohio River water utilities from March through November for Total Kjeldahl Nitrogen, Ammonia-Nitrogen, Nitrate/Nitrite Nitrogen, Total Phosphorus, and Chlorophyll. Summary results for the period July 2008 through June, 2013 are presented in Figure 6, and all data can be found in Appendix K. The Commission has a water quality criterion of 10 mg/L for Nitrate/Nitrite Nitrogen which was never exceeded.

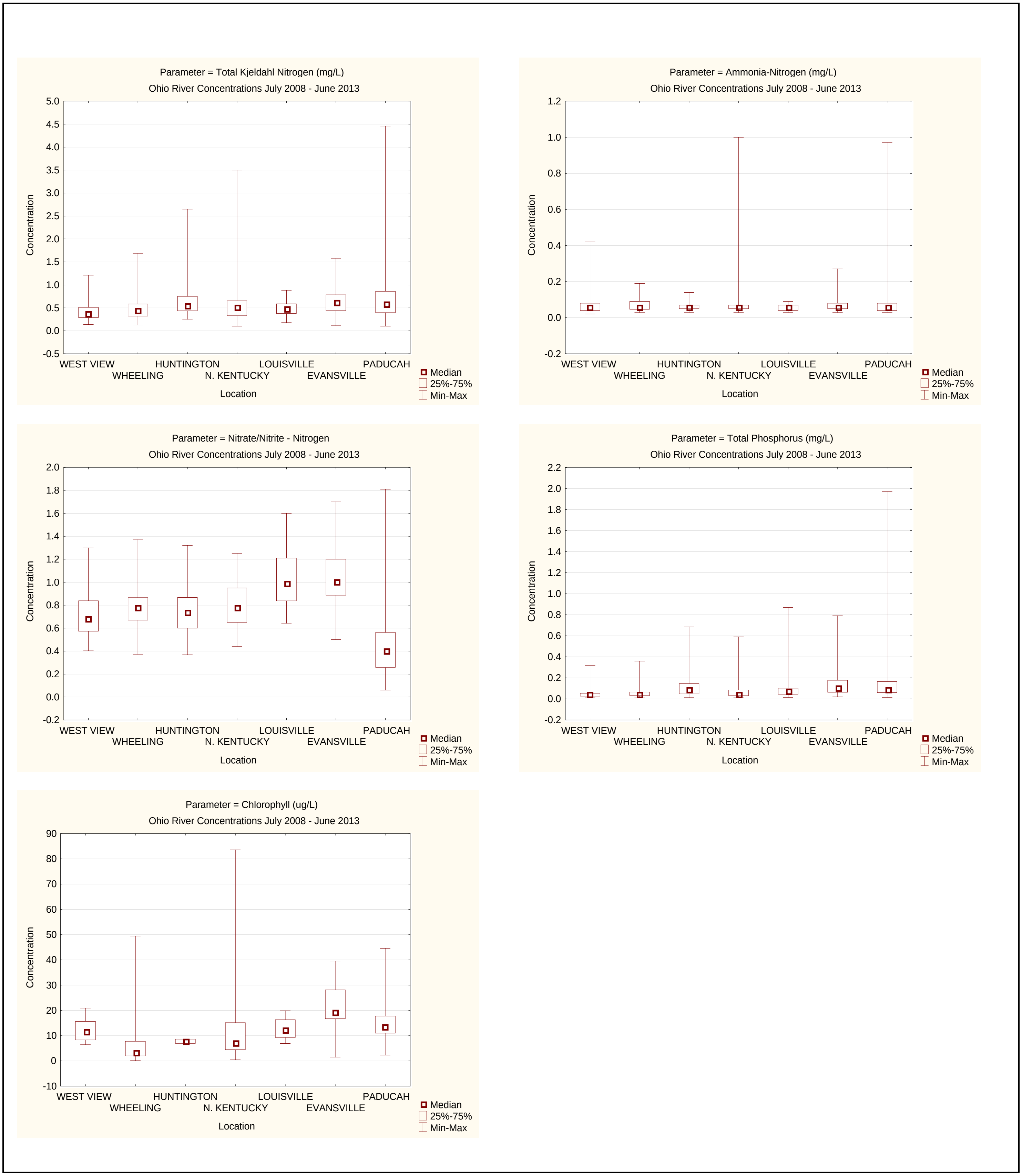


Figure 6. Summary of Nutrients and Chlorophyll Data, July 2008 through June 2013.

Table 4. Ohio River Valley Water Sanitation Commission Pollution Control Standards Water Quality Criteria, 2013.

Pollutant	Human Health		Aquatic Life		All Other Uses (e.g. Taste & Odor)
	Carcinogenic (ug/L)	Non-Carcinogenic (ug/L)	Acute (ug/L)	Chronic (ug/L)	
Acenaphthene		670[A,B]			
Acrolein		190			
Acrylonitrile	0.051[A,C]				
Aldrin	0.000049[A,C]				
alpha-BHC	0.0026[A,C]				
alpha-Endosulfan		62[A]			
Ammonia		1.0 mg/L[D]	36.1[E]	2.18[E]	
Anthracene		8300[A]			
Antimony		5.6[A]			
Arsenic		0.010 mg/L	340[F]	150[F]	
Asbestos		7 million fibers/L[G]			
Barium		1.0 mg/L			
Benzene	2.2[A,C]				
Benzidine	0.000086[A,C]				
Benzo(a) Anthracene	0.0038[A,C]				
Benzo(a) Pyrene	0.0038[A,C]				
Benzo(b) Fluoranthene	0.0038[A,C]				
Benzo(k) Fluoranthene	0.0038[A,C]				
beta-BHC	0.0091[A,C]				
beta-Endosulfan		62[A]			
Bis(2-Chloroethyl) Ether	0.03[A,C]				
Bis(2-Chloroisopropyl) Ether		1400[A]			
Bis(2-Ethylhexyl)Phthalate	1.2[A,C]				
Bromoform	4.3[A,C]				
Butylbenzyl Phthalate		1500[A]			
Cadmium			2.01[H]	0.25[H]	
Carbon Tetrachloride	0.23[A,C]				
Chlordane	0.0008[A,C]				
Chloride					250 mg/L
Chlorobenzene		130[B,I]			
Chlorodibromomethane	0.4[A,C]				
Chloroform	5.7[C,J]				
Chromium III			570[H]	74.1[H]	
Chromium VI			15.712[F]	10.582[F]	

Table 4. Ohio River Valley Water Sanitation Commission Pollution Control Standards Water Quality Criteria , 2013.

Pollutant	Human Health		Aquatic Life		All Other Uses (e.g. Taste & Odor)
	Carcinogenic (ug/L)	Non-Carcinogenic (ug/L)	Acute (ug/L)	Chronic (ug/L)	
Chrysene		0.0038[A,C]			
Copper		1300[B]	13.4[H]	8.96[H]	
Cyanide		140[K]			
Cyanide (free)			22[L]	5.2[L]	
Dibenzo(a,h) Anthracene	0.0038[A,C]				
Dichlorobromomethane	0.55[A,C]				
Dieldrin	0.000052[A,C]				
Diethyl Phthalate		17000[A]			
Dimethyl Phthalate		270000			
Di-n-Butyl Phthalate		2000[A]			
Dissolved Oxygen			> 4.0 mg/L[M]	> 5.0 mg/L[M]	
E. Coli		<130 CFU/100mL (GM)[N], <240 CFU/100mL (max)			
Endosulfan Sulfate		62[A]			
Endrin		0.059			
Endrin Aldehyde		0.29[A]			
Ethylbenzene		530			
Fecal Coliform		<200 CFU/100mL[N], <2,000 CFU/100mL			
Flouride		1.0 mg/L			
Fluoranthene		130[A]			
Fluorene		1100[A]			
gamma-BHC (Lindane)		0.98			
Heptachlor	0.000079[A,C]				
Heptachlor Epoxide	0.000039[A,C]				
Hexachlorobenzene	0.00028[A,C]				
Hexachlorobutadiene	0.44[A,C]				
Hexachlorocyclopentadiene		40[B]			
Hexachloroethane	1.4[A,C]				
Ideno(1,2,3-cd) Pyrene	0.0038[A,C]				
Isophorone	35[A,C]				
Lead			64.6[H]	2.52[H]	
Mercury		0.000012 mg/L	1.45[F]	0.774[F]	

Table 4. Ohio River Valley Water Sanitation Commission Pollution Control Standards Water Quality Criteria, 2013.

Pollutant	Human Health		Aquatic Life		All Other Uses (e.g. Taste & Odor)
	Carcinogenic (ug/L)	Non-Carcinogenic (ug/L)	Acute (ug/L)	Chronic (ug/L)	
Methyl Bromide		47[A]			
Methylene Chloride	4.6[A,C]				
Methylmercury		0.3 mg/kg[O]			
Nickel		610[A]	469[H]	52[H]	
Nitrite Nitrate Nitrogen		10 mg/L			
Nitrite Nitrogen		1 mg/L			
Nitrobenzene		17[A]			
N-Nitrosodimethylamine	0.00069[A,C]				
N-Nitrosodi-n-Propylamine	0.005[A,C]				
N-Nitrosodiphenylamine	3.3[A,C]				
Pentachlorophenol	0.27[A,C]				
pH				>6.0 and <9.0	
Phenol	21000[A,B]				
Phenolics					0.005 mg/L
Polychlorinated Biphenyls	0.000064[A,C,P]				
Pyrene		830[A]			
combined radium-226 and radium 228	4 pCi/L				
gross total alpha	15 pCi/L				
total gross beta	50 pCi/L				
total gross strontium-90	8 pCl/L				
Selenium	170[I]			5[L]	
Silver	0.05 mg/L		3.22[H]		
Sulfate					250 mg/L
Temperature		110 Deg F			
Tetrachloroethylene	0.69[C]				
Thallium		0.24			
Toluene		1300[I]			
Total dissolved solids					500 mg/L[D]
Toxaphene	0.00028[A,C]				
Trichloroethylene	2.5[C]				
Vinyl Chloride	0.025[C,Q]				
Zinc		7400[B]	117[H]	118[H]	
1,1,2,2-Tetrachloroethane	0.17[A,C]				
1,1,2-Trichloroethane	0.59[A,C]				
1,1-Dichloroethylene		330			
1,2,4-Trichlorobenzene		35			
1,2-Dichlorobenzene		420			

Table 4. Ohio River Valley Water Sanitation Commission Pollution Control Standards Water Quality Criteria, 2013.

Pollutant	Human Health		Aquatic Life		All Other Uses (e.g. Taste & Odor)
	Carcinogenic (ug/L)	Non-Carcinogenic (ug/L)	Acute (ug/L)	Chronic (ug/L)	
1,2-Dichloroethane	0.38[A,C]				
1,2-Dichloropropane	0.5[A,C]				
1,2-Diphenylhydrazine	0.036[A,C]				
1,2-Trans-Dichloroethylene		140[I]			
1,3-Dichlorobenzene		320			
1,3-Dichloropropene	0.34[C]				
1,4-Dichlorobenzene		63			
2,3,7,8-TCDD (Dioxin)	0.000000005[C]				
2,4,6-Trichlorophenol	1.4[A,C]				
2,4-Dichlorophenol		77[A,B]			
2,4-Dimethylphenol		380[A]			
2,4-Dinitrophenol		69[A]			
2,4-Dinitrotoluene	0.11[C]				
2-Chloronaphthalene		1000[A]			
2-Chlorophenol		81[A,B]			
2-Methyl-4,6-Dinitrophenol		13			
3,3-Dichlorobenzidine	0.021[A,C]				
4,4'-DDD	0.00031[A,C]				
4,4'-DDE	0.00022[A,C]				
4,4'-DDT	0.00022[A,C]				

[A] This criterion has been revised to reflect The U.S. EPA's q1* or RfD, as contained in the Integrated Risk Information System (IRIS) as of May 17, 2002. The fish tissue bioconcentration factor (BCF) from the 1980 Ambient Water Quality Criteria document was retained in each case.
[B] The organoleptic effect criterion is more stringent than the value for priority toxic pollutants.
[C] This criterion is based on carcinogenicity of 10^{-6} risk. Alternate risk levels may be obtained by moving the decimal point (e.g., for a risk level of 10^{-5}, move the decimal point in the recommended criterion one place to the right).
[D] Criteria applies at intakes
[E] Criteria dependant on pH or pH and temp, see formulas in section 3.2.E. and Appendix A1, A2, A3 of Pollution Control Standards, 4-day average rule (shown at pH 7.0 + most restrictive temperature)
[F] Presented in the dissolved form
[G] This criterion for asbestos is the Maximum Contaminant Level (MCL) developed under the Safe Drinking Water Act (SDWA).
[H] Presented in the dissolved form and shown at Hardness 100, specific formulas in 3.2.F.
[I] U.S. EPA has issued a more stringent MCL. Refer to drinking water regulations (40 CFR 141) or Safe Drinking Water Hotline (1-800-426-4791) for values.
[J] Although a new RfD is available in IRIS, the surface water criteria will not be revised until the National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 DBPR) is completed, since public comment on the relative source contribution (RSC) for chloroform is anticipated.

[K] This recommended water quality criterion is expressed as total cyanide, even though the IRIS RFD we used to derive the criterion is based on free cyanide. The multiple forms of cyanide that are present in ambient water have significant differences in toxicity due to their differing abilities to liberate the CN-moiety. Some complex cyanides require even more extreme conditions than refluxing with sulfuric acid to liberate the CN-moiety. Thus, these complex cyanides are expected to have little or no 'bioavailability' to humans. If a substantial fraction of the cyanide present in a water body is present in a complexed form (e.g., Fe4[Fe(CN)6]3), this criterion may be over conservative.

[L] Criteria shown to be applied in total recoverable form

[M] Dissolved oxygen minimum 5.0 mg/L April 15 – June 15

[N] Criteria based on 5-sample per month geometric mean

[O] This fish tissue residue criterion for methylmercury is based on a total fish consumption rate of 0.0175 kg/day.

[P] This criterion applies to total PCBs, (e.g., the sum of all congener or all isomer or homolog or Aroclor analyses).

[Q] This recommended water quality criterion was derived using the cancer slope factor of 1.4 (LMS exposure from birth).

CHAPTER 2: AQUATIC LIFE USE SUPPORT ASSESSMENT

The Ohio River Valley Water Sanitation 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 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 data, dissolved oxygen and temperature data, and fish population data used in the *m*ORFIn.

AQUATIC LIFE USE ASSESSMENT METHODOLOGY

Bimonthly, Clean Metals, Dissolved Oxygen, and Temperature Monitoring

Both clean metals and nonmetal parameters are analyzed through ORSANCO's monitoring program. Data are collected from 15 fixed stations along the river (Appendix B). Grab samples are collected from these stations once every other month. Continuous monitoring for dissolved oxygen and temperature is performed by the United States Army Corps of Engineers as well as hydropower plant operators at ten Ohio River locations. ORSANCO also uses those data in this assessment.

For a given monitoring station, if no pollutant exceeds any water quality criteria for the protection of aquatic life in greater than ten percent of samples, then that station is considered "Fully Supporting" the aquatic life use and not impaired. Stations having any pollutant exceed a water quality criterion for the protection of aquatic life in greater than ten percent of samples but less than twenty-five percent of samples is determined to be "Partially Supporting" the aquatic life use and impaired. Stations having any pollutant exceed a criterion in greater than twenty-five percent of samples is classified as "Not Supporting" and impaired. However, using a WOE approach, fish population data indicating full support would outweigh physical and chemical monitoring data in the assessments.

Fish Population Monitoring

While monitoring chemical parameters is a common and valuable strategy used to determine impairment, it is also useful to expand the focus beyond water chemistry and directly examine 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 conducts biological assessments of the Ohio River. The Commission utilizes the method of electrofishing as well as habitat surveys between July and October in order to characterize the fish populations of the Ohio River and consequently determine if the Ohio River is meeting its aquatic life use designation.

Since 2004, aquatic life has been assessed on a pool-by-pool basis. For aquatic life assessments, the river has been divided into 19 independent Assessment Units (AUs), based on the pools created by 19 high-lift dams as well as the area below the lowest existing high-lift dam (Smithland) to the high-lift dam currently under construction (Olmsted). Three to five of these AUs are sampled each year on a rotating basis, providing complete coverage of the river every five years. Fifteen site locations in each pool were randomly selected to represent each AU as a whole. Following each fish community assessment, biologists attempt to determine the fish community potential of that AU.

As mentioned previously, ORSANCO evaluates biological condition using an index specifically designed for the Ohio River, the ORFIn, which has been updated recently and is now referred to as the *modified* Ohio River Fish Index (*m*ORFIn). The *m*ORFIn combines various attributes of the fish community to assign a score to the river based on biological characteristics. The *m*ORFIn is comprised of 13 metrics, which serve as surrogate measures of more complicated processes. Examples of metrics include number of species, number of pollution tolerant individuals, and percent of top piscivores in the fish community. A *m*ORFIn score is calculated for each site by comparing observed ORFIn values to statistical thresholds in historical ORFIn scores within each habitat class.

After a *m*ORFIn score is calculated at each site in a survey pool, those individual scores are averaged to determine one score for the pool. Biologic condition ratings are then assigned to a pool based on the average *m*ORFIn score. Biological condition ratings for each pool are then assigned based on final *m*ORFIn scores. To determine the overall condition of a pool, the 15 individual *m*ORFIn scores were averaged and then compared to an established biocriterion (*m*ORFIn = 20.0). If a pool has an average score greater than or equal to 20.0, the pool attains its aquatic life-use designation. Conversely, if the average is below 20.0, the pool is assessed as failing (Figure 7).

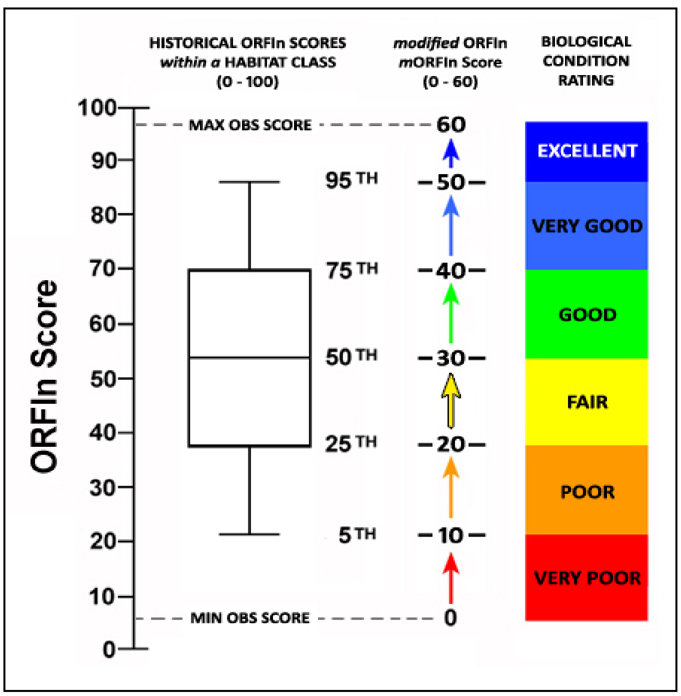


Figure 7. MORFin Calculation.

Aquatic life use assessment 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 is 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 indicate impairment. A full description of each designation follows:

Fully Supporting

- Ten percent or less of water samples exceeds the criteria for one or more pollutants.
- Biological data does not indicate aquatic impairment on a pool-specific basis based on *m*ORFIn scores.

Impaired-Partially Supporting

- One or more pollutants exceed the water quality criteria in 11-25 percent of samples, And
- A biological condition rating of poor (which corresponds to a failing *m*ORFIn score).

Impaired-Not Supporting

- One or more pollutants exceed the criteria in greater than 25 percent of samples, And
- A biological condition rating of poor (which corresponds to a failing *m*ORFIn score).

OR

- A biological condition rating of very poor.

BIMONTHLY AND CLEAN METALS MONITORING RESULTS

ORSANCO monitors a number of pollutants having water quality criteria for the protection of aquatic life through its Bimonthly and Clean Metals Sampling Programs. These data can be found in Appendices C and D. While there were no violations of ORSANCO's water quality criteria for the protection of aquatic life, there were violations of the states' total iron criteria in excess of ten percent of total samples (Table 5).

Table 5. Summary of states' total iron criteria violations.

Site Name	River Mile	Criteria (µg/L)	Total Samples July 07-June 13	WQC Violations	% Violations
Sewickly*	11.8	1500	20	0	0%
East Liverpool*	42.6	1500	22	0	0%
New Cumberland	54.4	1500	30	0	0%
Pike Island	84.2	1500	30	1	3%
Hannibal	126.4	1500	30	2	7%
Willow Island	161.8	1500	30	3	10%
Belleville	203.9	1500	28	6	21%
R.C. Byrd	279.2	1500	30	1	3%
Greenup	341.0	1500	31	5	16%
Meldahl	436.2	3500	30	1	3%
Anderson Ferry	477.5	2340	18	1	6%
Markland	531.5	2340	30	2	7%
Louisville	600.6	2340	18	5	28%
McAlpine	606.8	2340	19	7	37%
West Point	625.9	2340	18	7	39%
Cannelton	720.7	2340	30	6	20%
Newburgh	776.0	2340	30	6	20%
J.T. Myers	846.0	3500	30	7	23%
Smithland	918.5	3500	30	4	13%
L&D 52	939.9	3500	30	4	13%

*PADEP data

DISSOLVED OXYGEN AND TEMPERATURE MONITORING RESULTS

Dissolved oxygen and temperature data are collected by ORSANCO, Corps of Engineers and hydropower operators at certain locks and dams. ORSANCO collects the data and assesses it against its water quality criteria. This criterion is to protect aquatic life and shall maintain a minimum concentration of 5.0mg/L during the spawning period. Outside the spawning period the average concentration of 5.0mg/L should be achieved for each calendar day. Regarding dissolved oxygen, there were no stations had violations in excess of ten percent (table 6) for the entire period.

Table 6. Ohio River dissolved oxygen criteria violations.

Ohio River Station	Mile Point	2009 % Days Exceeding	2010 % Days Exceeding	2011 % Days Exceeding	2012 % Days Exceeding	2013 % Days Exceeding	2009-2013 % Days Exceeding
Montgomery	31.7	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hannibal	126.4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Racine	237.5	0.0%	1.9%	7.6%	2.6%	2.6%	3.0%
Greenup	341						
Upstream		4.7%	13.7%	2.7%	4.8%	0.0%	5.3%
Downstream		1.9%	6.3%	9.7%	2.0%	0.0%	4.8%
Markland	531.5						
DO #1-DS Hydro		screened data	screened data	0.9%	2.7%	0.0%	1.2%
DO #2-US Hydro		0.0%	NA	8.4%	10.0%	0.8%	6.2%
DO #3-DS Lock		NA	NA	0.0%	0.9%	0.0%	0.3%
DO #4-US Lock		NA	NA	0.0%	1.7%	0.8%	0.8%
McAlpine	606.8	NA	NA	0.0%	3.7%	0.0%	1.2%
Cannelton	720.7	0.0%	11.7%	NA	NA	NA	5.9%
Newburgh	776.1	0.0%	0.0%	NA	NA	NA	0.0%
John T. Myers	846	0.0%	12.9%	0.0%	0.0%	0.0%	3.7%
Smithland	919	5.0%	4.7%	36.8%	18.0%	0.0%	8.6%

ORSANCO's allowable maximum temperature criteria are specified for six separate periods in a year as identified by Julian days shown in Table 7. While a number of stations had water quality violations in excess of ten percent for certain periods, no stations had violations in excess of ten percent for the entire reporting period. The lower river tends to have greater numbers of violations of the temperature criteria for the protection of aquatic life.

Table 7. Ohio River temperature criteria violations.

		Montgomery	New Cumberland	Pike Island	Hannibal	Racine	Greenup US	Greenup DS	Renslar
	River Mile	31.7	54.4	84.2	126.4	237.5	341.0	341.1	462.6
	Julian day								
2009	1-49								
	50-166	0.0%			0.0%	16.6%	0.0%		
	167-181	0.0%			0.0%	0.0%	0.0%		
	182-243	0.0%			0.0%	0.0%	0.0%		
	244-258	0.0%			0.0%	0.0%	0.0%		
	259-366	0.0%			0.0%	0.0%	0.0%		
	2009 Total	**0.0%**			**0.0%**	**4.0%**	**0.0%**		
2010	1-49								
	50-166	0.0%			0.0%	0.0%	40.0%		
	167-181				0.0%	0.0%	0.0%		
	182-243				0.0%	0.0%	0.0%		
	244-258				0.0%	0.0%	0.0%		
	259-366				0.0%	0.0%	0.0%		
	2010 Total	**0.0%**			**0.0%**	**0.0%**	**21.2%**		
2011	1-49								
	50-166					0.0%	0.0%	0.0%	
	167-181					0.0%	0.0%	0.0%	
	182-243	0.0%				0.0%	0.0%	0.0%	
	244-258	0.0%				0.0%	0.0%	0.0%	
	259-366	0.0%			0.0%	0.0%	0.0%	0.0%	
	2011 Total	**0.0%**			**0.0%**	**0.0%**	**0.0%**	**0.0%**	
2012	1-49								
	50-166	10.0%			10.0%	0.0%	0.0%	4.1%	
	167-181	0.0%			0.0%	0.0%	0.0%	0.0%	
	182-243	0.0%			0.0%	0.0%	0.0%	0.0%	5.0%
	244-258	0.0%			0.0%	0.0%	0.0%	0.0%	0.0%
	259-366	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	2012 Total	**1.0%**	**0.0%**	**0.0%**	**0.5%**	**0.0%**	**0.0%**	**1.0%**	**3.4%**
2013	1-49		0.0%	0.0%	0.0%				
	50-166	0.0%	29.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
	167-181	0.0%	0.0%	0.0%	0.0%	0.0%			
	182-243	0.0%	3.0%	0.0%	0.0%	0.0%			
	244-258	0.0%	0.0%	0.0%	0.0%	0.0%			
	259-366	0.0%		0.0%		0.0%			
	2013 Total	**0.0%**	**14.2%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	
2009-2013 Total		**0.2%**	**N/A**	**N/A**	**0.1%**	**0.8%**	**2.6%**	**N/A**	**N/A**

Represents no data available

Table 7. Ohio River temperature criteria violations.

Year		Markland US-Lock	Markland DS-Lock	Markland US-Hydro	Markland DS-Hydro	McAlpine	Cannelton	Newburgh	JT Myers	Smithland
	River Mile	**531.5**	**531.6**	**531.5**	**531.6**	**606.8**	**720.0**	**776.0**	**846.0**	**918.0**
	Julian day									
2009	1-49									
	50-166	0.0%					0.0%	0.0%	0.0%	0.0%
	167-181	0.0%					0.0%	0.0%	0.0%	0.0%
	182-243	0.0%					0.0%	0.0%	0.0%	0.0%
	244-258	0.0%					0.0%	0.0%	0.0%	0.0%
	259-366	0.0%					0.0%	0.0%	0.0%	0.0%
	2009 Total	**0.0%**					**0.0%**	**0.0%**	**0.0%**	**0.0%**
2010	1-49									
	50-166	0.0%					10.5%	27.7%	15.7%	44.4%
	167-181	0.0%					0.0%	0.0%	0.0%	0.1%
	182-243	0.0%					16.6%	38.0%	18.8%	13.7%
	244-258	0.0%					0.0%	0.0%	0.0%	0.0%
	259-366	0.0%					0.0%	3.1%	0.0%	0.0%
	2010 Total	**0.0%**					**10.3%**	**19.8%**	**17.3%**	**13.0%**
2011	1-49									
	50-166		0.0%	0.0%	0.0%	0.0%				
	167-181		0.0%	0.0%	0.0%	0.0%			0.0%	0.0%
	182-243		0.0%	0.0%	0.0%	0.0%			30.0%	27.1%
	244-258		0.0%	0.0%	0.0%	0.0%			10.0%	0.1%
	259-366		0.0%	0.0%	0.0%	0.0%			0.0%	12.0%
	2011 Total		**0.0%**	**0.0%**	**0.0%**	**0.0%**			**20.7%**	**19.3%**
2012	1-49									
	50-166		0.0%	0.0%	0.0%	0.0%				
	167-181		0.0%	0.0%	0.0%	0.0%			0.0%	50.0%
	182-243		0.0%	0.0%	0.0%	0.0%			22.4%	3.2%
	244-258		0.0%	0.0%	0.0%	0.0%			0.0%	0.1%
	259-366		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	2012 Total		**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**16.4%**	**2.5%**
2013	1-49						0.0%	0.0%		
	50-166		0.0%	0.0%	0.0%	0.0%	0.0%			
	167-181		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%
	182-243		0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%
	244-258		0.0%	0.0%	0.0%	0.0%	0.0%			0.0%
	259-366		0.0%	0.0%	3.0%	0.0%	0.0%		0.0%	0.0%
	2013 Total		**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
2009-2013 Total		**0.0%**	**N/A**	**N/A**	**N/A**	**0.0%**	**2.52%.**	**N/A**	**9.5%**	**7.6%**

Represents no data available

FISH POPULATION MONITORING RESULTS

From 2009-2013, all 19 Ohio River pools were sampled. Based on *m*ORFIn scores, all pools were assessed as fully supporting the aquatic life use (Figure 8). The biological condition rating of each surveyed pool was above the established statistical threshold, thus indicating there is no impairment based on Ohio River fish population data. All fish population survey data may be viewed in Appendix H.

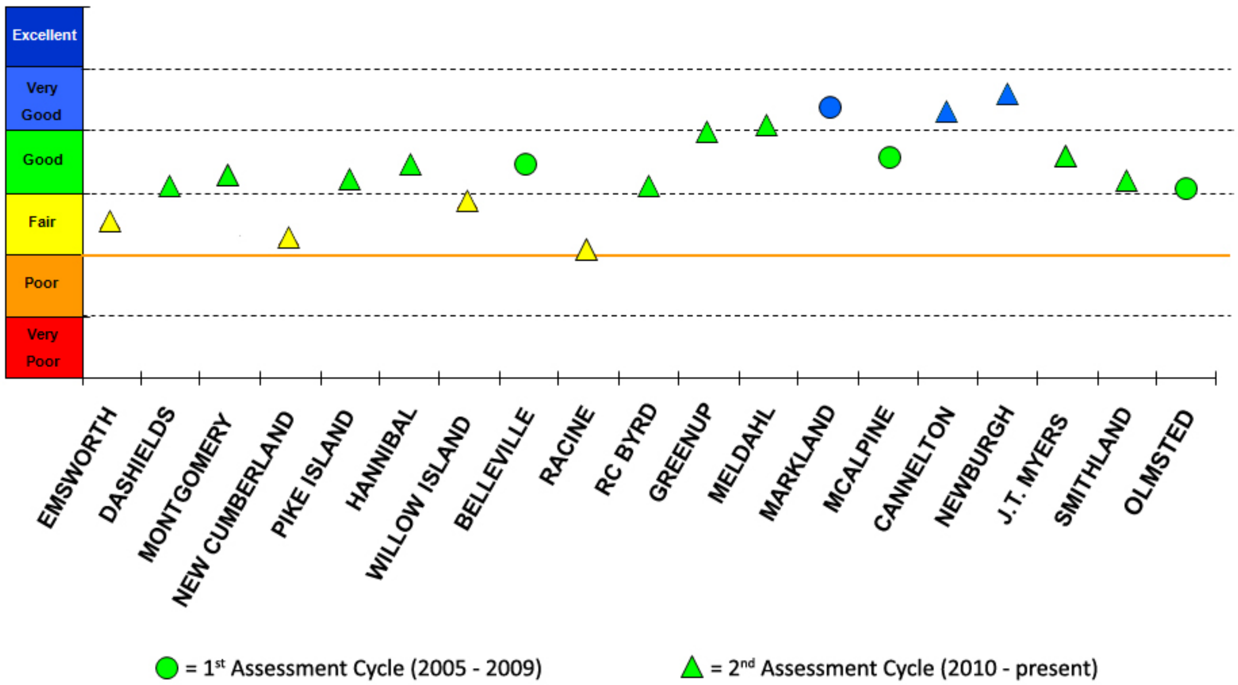


Figure 8. Ohio River fish population index scores by pool, 2009-2013.

AQUATIC LIFE USE ASSESSMENT SUMMARY

Aquatic life criteria determined by the states for total iron (ORSANCO has no iron criteria) are exceeded in greater than ten percent of samples in several segments of the river. Violations of aquatic life criteria were also observed for both dissolved oxygen and temperature in the lower river. Although chemical criteria violations exist, the Commission utilized the WOE approach and based on an assessment of fish community surveys from 2009-2013, assessed the entirety of the Ohio as fully supporting the aquatic life use.

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 five million people through 33 public and private drinking water treatment facilities. In order to ensure that the public water supply use is protected, the Commission operates a number of monitoring programs including Bimonthly, Clean Metals, and bacteriological sampling, as well as an Organics Detection System (ODS) for spills detection.

PUBLIC WATER SUPPLY USE ASSESSMENT METHODOLOGY

The bimonthly and clean metals programs are comprised of 15 sampling stations along the Ohio River. Grab samples are collected from sites once every other month. Parameters monitored by ORSANCO for which there are in-stream water quality criteria for public water supply protection include arsenic, barium, silver, copper, nickel, selenium, thallium, total mercury, zinc, cyanide, chloride, fluoride, nitrates, nitrites, phenolics, and sulfates. Data included in this report were collected from January 2009 to Oct. 2013. 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 2009 through 2013, bacteria data were collected during the contact recreation season (May through October) in Pittsburgh, Wheeling, Huntington, Cincinnati, Louisville, and Evansville. In addition, the Commission mailed surveys to all Ohio River water utilities, requesting information about their source water quality. ORSANCO received responses from 13 utilities which represent a forty percent response rate. 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, or whether "non-routine" or extraordinary treatment due to source water quality was necessary to meet finished water MCLs. In addition to the questionnaires, MCL violations were downloaded from EPA's website the Safe Drinking Water Information System (SDWIS). Assessment of these data is as follows:

Fully Supporting

- Pollutant criteria are exceeded in 10 percent or less of the samples collected.

Partially Supporting-Impaired

- One or more pollutants exceed the criteria in 11 to 25 percent of the samples collected, and there is a corresponding finished drinking water violation.

Not Supporting-Impaired

- One or more pollutants exceed the criteria in greater than 25 percent of samples collected, and there is a corresponding finished drinking water violation.

PUBLIC WATER SUPPLY USE ASSESSMENT SUMMARY

There have been exceedances of the in-stream water quality criteria for the protection of public water supply over the 2009 to 2013 period for Nitrate-Nitrite and Fecal Coliform, but only fecal coliform in excess of ten percent that would cause a designation of impairment (Table 8). ORSANCO has a water quality criterion for fecal coliform of 2000 colonies/100 mL as a monthly geometric mean for the protection of public water supplies. One monitoring station in Pittsburgh (ORM 4.3) had violations in excess of ten percent of the monthly geometric mean. At the same time, there were no corresponding finished water MCL violations for pathogens at Ohio River drinking water utilities in the vicinity of those instream criteria exceedances. As a result, using a weight of evidence approach, the segment of the Ohio River in Pittsburgh will not be designated as impaired based on fecal coliform. In addition to violations in the upper reaches of the river, one station in Wheeling also experienced water quality violations of the fecal coliform criterion.

Thirty-two public and private water utilities use the Ohio River as a drinking water source. There was no indication of impairment based on the questionnaire surveys completed by water utilities which includes MCL violations caused by source water quality and frequent intake closures or non-routine treatment techniques necessary to meet MCLs. However, several utilities had MCL violations for total trihalomethanes (Table 9). Because these compounds are formed during the water treatment process, as opposed to directly resulting from river conditions, these MCL violations do not result in an impaired assessment. One utility reported an MCL violation for Haloacetic acids (HAA^5), which are not caused directly by Ohio River water quality. One utility reported a total coliform MCL violation in March, 2011. This segment is listed as impaired due to bacteria under the contact recreation use assessment. All of the finished water MCL violations would be attributed to difficulties in treatment. Two utilities indicated intake closures due to Ohio River water quality caused by raw sewage or contaminant spills. One utility reported the use of non-routine treatment to address issues such as sewage, diesel fuel, and others.

Based on the above assessments, the entire river is designated as fully supporting the public water supply use.

Table 8. Water Quality Criterion Violations for Public Water Supply

Station	River Mile	Date	Parameter	Human Health WQC	Result (mg/L)	Total Samples	WQC Violations	% Violations
Newburgh	776.0	Jan. 28, 2010	Nitrate-Nitrite	10 (mg/L)	10.4	30	1	3%
Pittsburgh	1.4M	June 2010	Fecal Coliform	2000 CFU/100mL	3,911	30	3	10%
Pittsburgh	1.4M	July 2011	Fecal Coliform	2000 CFU/100mL	4,823			
Pittsburgh	1.4M	Sept. 2011	Fecal Coliform	2000 CFU/100mL	3,616			
Pittsburgh	4.3	June 2010	Fecal Coliform	2000 CFU/100mL	3,933	30	4	13%
Pittsburgh	4.3	July 2011	Fecal Coliform	2000 CFU/100mL	4,598			
Pittsburgh	4.3	Sept. 2011	Fecal Coliform	2000 CFU/100mL	3,414			
Pittsburgh	4.3	August 2012	Fecal Coliform	2000 CFU/100mL	2,198			
Wheeling	92.8	Sept. 2011	Fecal Coliform	2000 CFU/100mL	3,097	30	3	10%
Wheeling	92.8	June 2010	Fecal Coliform	2000 CFU/100mL	2,948			
Wheeling	92.8	July 2013	Fecal Coliform	2000 CFU/100mL	2,261			

Table 9. Survey results from Ohio River drinking water utilities.

Utility Location	Mile Point	State	Replied to Survey	Number of Intake Closures	Causes of Intake Closures	MCL Violation	Contaminants Causing MCL Violation	Non-Routine Treatment Required	Contaminats Resulting in Non-Routine Treatment	Source of Contaminants	Total Number of Days
West View	5	PA	Yes	0		No		No			
Robinson	8.6	PA	Yes	0		No		No			
Moon	11.7	PA	No			No					
Beaver Valley (NOVA)	29	PA	Yes	0		Yes	TTHM	No			
Midland	36	PA	No			Yes	TTHM				
East Liverpool	40.2	OH	No			No					
Buckeye	74.1	OH	No			No					
Toronto	59.2	OH	No			No					
Arcelor Mittal	61.7	WV	No			No					
Weirton	62.5	WV	No			No					
Steubenville	65.3	OH	Yes	0		No		No			
Follansbee (H.H.)	70.8	WV	No	2	Chromic Acid, Diesel Fuel	No					
Wheeling	86.8	WV	Yes			Yes	TTHM	No			
New Martinsville (Bayer)	122	WV	Yes	0		No		No			
Sistersville	137	WV	No			No					
Huntington	304	WV	No			No					
Ashland	320	KY	No			Yes	TTHM				
Ironton	327	OH	No			No					
Russell	328	KY	No			Yes	TTHM				
Portsmouth	351	OH	Yes			No		No			
Maysville	408	KY	No			No					
Cincinnati	463	OH	Yes	4		No		Yes	Sewage, 1,1-dichloroethene	Raw Sewage, Unknown	1 day
Northern Kentucky	463	KY	Yes			No		No			
Louisville	600	KY	Yes			No		No			
Evansville	792	IN	Yes	0		No		No			
Henderson	803	KY	Yes	0		No		No			
Mt Vernon	829	IN	No			Yes	TTHM, Coliform				
Morganfield	843	KY	No			No					
Sturgis	871	KY	No			Yes	TTHM, HAA5				
Paducah (WTP)	936	KY	No			No					
Paducah (USEC)	946	KY	Mo			No					
Cairo	978	IL	Yes	0		No		No			

Source: Safe Drinking Water Information System (SDWIS) http://www.epa.gov/enviro/facts/sdwis/search.html, 11/7/2013

TTHM – Total Trihalomethane, 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

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 2009-2012 and April-October 2013): routine contact recreation bacteria sampling and longitudinal bacteria surveys conducted through the Watershed Pollutant Reduction Program. Contact recreation season data from 2009 through 2013 and longitudinal bacteria survey data from 2003 through 2008 were used in the assessment. Longitudinal survey data outside the 2009-2013 timeframe was used in order to be able to make a comprehensive assessment of the entire river.

CONTACT RECREATION USE ASSESSMENT METHODOLOGY

There are 49 communities with combined sewer systems located along the Ohio. Combined sewer overflows (CSOs) and other non-point sources have been identified as significant causes of bacteria problems in the Ohio River, particularly during heavy rain events. Bacteria data is 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. All data can be found in Appendix G. Five rounds of sampling are completed monthly in these communities: Cincinnati, OH, Evansville, IN, Huntington, WV, Pittsburgh, PA, Wheeling, WV and Louisville, KY. There were at least three sites in each community sampled; one being upstream of the CSO community, one downtown, and one downstream during the 2009 season. Due to budget cuts, the 2010-2013 seasons had at least two sites in each community sampled; one site downstream of the community as well as a site within the major metropolitan area where combined sewer overflow (CSO) events are likely to occur. Samples were analyzed for both fecal coliform and *E. coli*.

In 2003, ORSANCO expanded its bacteria monitoring program to include areas outside of the CSO communities. During the contact recreation season in 2003 - 2008, the entire length of the Ohio River was sampled at least fifteen times at five-mile intervals (Appendix F). 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 three geometric means for each section of the river.

Impairments are based on exceedances of ORSANCO's stream criteria for bacteria. In 2012 ORSANCO revised its Pollution Control Standards for Human Health Protection for bacteria. Fecal Coliform is no longer an indicator and used only for protection of public water supply. The standard for *E. coli* state that measurements should not exceed 130/100mL as a 90-day geometric mean (at least five samples required per month). ORSANCO used the more stringent criteria when assessing the Ohio River for Contact Recreation which was a monthly geometric mean used by the States. Using these monthly geometric mean values, sites were classified as "Full Support" (not more than 10 percent of samples exceeded criteria), "Partial Support" (11-25 percent of samples exceeded criteria), or "Not Supporting" (greater than 25 percent of sites exceeded criteria). Assessment of these data is as follows:

Fully Supporting

- Criteria are exceeded in not more than 10 percent of the time.

Partially Supporting - Impaired

- Criteria are exceeded 11-25 percent of the time.

Not Supporting-Impaired

- Criteria are exceeded greater than 25 percent of the time.

CONTACT RECREATION USE ASSESSMENT SUMMARY

On a state by state basis, a total of 352.2 river miles (36%) were assessed as "Fully Supporting", 396 river miles (40%) as "Partially Supporting, and 232.8 river miles (24%) as "Not Supporting" the contact recreation use (Figure 9, Table 10). Peaks in *E. coli* levels often correspond with the location of major metropolitan areas such as Pittsburgh (Ohio River mile 1.4), Cincinnati (ORM 470), and Evansville (ORM 793.7). Violations of the monthly E. coli geometric criterion for the period 2009 through 2013 are shown (Figure 10). Between 2003 and 2006, the entire river was analyzed 15 times through longitudinal bacteria surveys, allowing for the calculation of three monthly geometric means at each site (Figure 11).

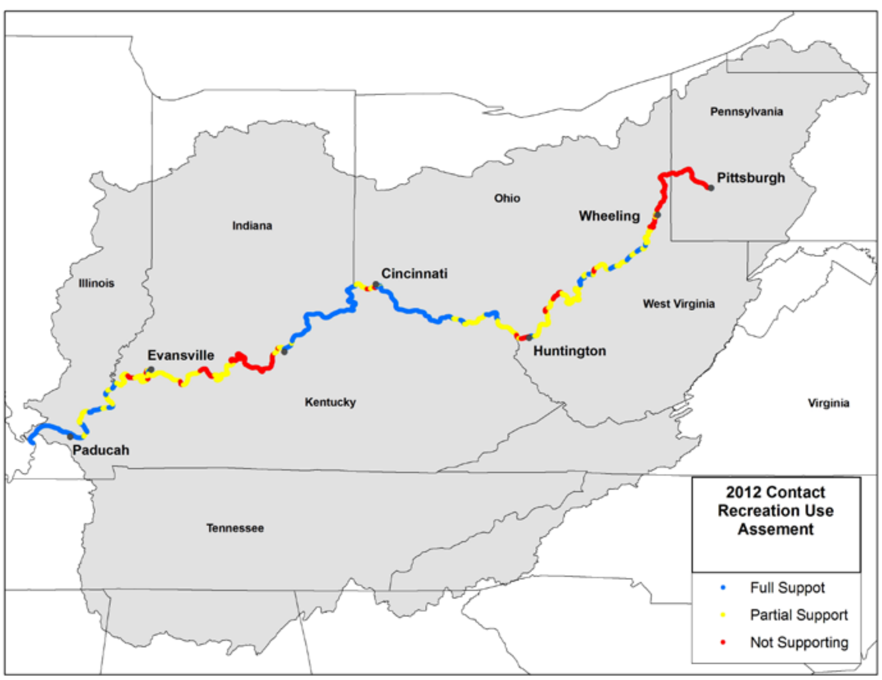


Figure 9. Ohio River miles impaired for contact recreation.

Table 10. Contact recreation use assessment summary.

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	Assessment of Longitudinal Data	# Mos. > GM '09-'13	% Mos. > GM '09-'13	Assessment of Contact Rec Data	Overall Assessment	River Mile of Assessment	Assessment Type
1.4	PA			23	92%	Not Supporting	Not Supporting	0	Reassessed
1.5	PA	41.2	Not Supporting				Not Supporting		Historical
3.3	PA	58.8	Not Supporting				Not Supporting		Historical
4.3	PA			23	92%	Not Supporting	Not Supporting		Reassessed
6.4	PA	33.3	Not Supporting				Not Supporting		Historical
9.5	PA	53.3	Not Supporting				Not Supporting		Historical
11.4	PA	53.3	Not Supporting				Not Supporting		Historical
12.5	PA	47.1	Not Supporting				Not Supporting		Historical
14.4	PA	46.7	Not Supporting				Not Supporting		Historical
17.7	PA	46.7	Not Supporting				Not Supporting		Historical
20.5	PA	46.7	Not Supporting				Not Supporting		Historical
20.8	PA	40.0	Not Supporting				Not Supporting		Historical
21.8	PA	40.0	Not Supporting				Not Supporting		Historical
22.9	PA	70.6	Not Supporting				Not Supporting		Historical
25.5	PA	35.3	Not Supporting				Not Supporting		Historical
25.8	PA	52.9	Not Supporting				Not Supporting		Historical
26.4	PA	47.1	Not Supporting				Not Supporting		Historical
28.3	PA	52.9	Not Supporting				Not Supporting		Historical
32.9	PA	41.2	Not Supporting				Not Supporting		Historical
37.6	PA	41.2	Not Supporting				Not Supporting		Historical
40.2	PA								
41.2	OH-WV	41.2	Not Supporting				Not Supporting		Historical
44.8	OH-WV	43.8	Not Supporting				Not Supporting		Historical
48.7	OH-WV	41.2	Not Supporting				Not Supporting		Historical
52.5	OH-WV	35.3	Not Supporting				Not Supporting		Historical
56.4	OH-WV	33.3	Not Supporting				Not Supporting		Historical
60.3	OH-WV	53.3	Not Supporting				Not Supporting		Historical
66.4	OH-WV	47.1	Not Supporting				Not Supporting		Historical
66.9	OH-WV	50.0	Not Supporting				Not Supporting		Historical
68.2	OH-WV	28.6	Not Supporting				Not Supporting		Historical
70.7	OH-WV	40.0	Not Supporting				Not Supporting		Historical
71.8	OH-WV	46.7	Not Supporting				Not Supporting		Historical
74.9	OH-WV	29.4	Not Supporting				Not Supporting		Historical
80.2	OH-WV	29.4	Not Supporting				Not Supporting	0-82.2	Historical
84.2*	OH-WV			1	17%	Partial Support	Partial Support	82.2-89.0	Historical
85.6	OH-WV	17.6	Partial Support				Partial Support		Historical
86.8	OH-WV			4	13%	Partial Support	Partial Support		Reassessed
91.2	OH-WV	47.1	Not Supporting				Not Supporting	89.0-91.3	Historical
91.4*	OH-WV			1	17%	Partial Support	Partial Support	91.3-92.1	Historical
92.8	OH-WV			25	81%	Not Supporting	Not Supporting		Reassessed
94.2	OH-WV	35.3	Not Supporting				Not Supporting		Historical
97.8	OH-WV	23.5	Not Supporting				Not Supporting		Historical

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	Assessment of Longitudinal Data	# Mos. > GM '09-'13	% Mos. > GM '09-'13	Assessment of Contact Rec Data	Overall Assessment	River Mile of Assessment	Assessment Type
102.6	OH-WV	29.4	Not Supporting				Not Supporting	92.1-105.2	Historical
107.7	OH-WV	11.8	Partial Support				Partial Support		Historical
113.0	OH-WV	11.8	Partial Support				Partial Support		Historical
118.3	OH-WV	11.8	Partial Support				Partial Support		Historical
123.7	OH-WV	11.8	Partial Support				Partial Support	105.2-124.3	Historical
124.9	OH-WV	6.7	Full Support				Full Support	124.3-127.0	Historical
129.1	OH-WV	17.6	Partial Support				Partial Support	127.0-131.3	Historical
133.4	OH-WV	6.7	Full Support				Full Support	131.3-136.1	Historical
138.7	OH-WV	17.6	Partial Support				Partial Support	136.1-141.5	Historical
144.2	OH-WV	6.7	Full Support				Full Support	141.5-146.9	Historical
149.6	OH-WV	11.8	Partial Support				Partial Support		Historical
155.0	OH-WV	11.8	Partial Support				Partial Support	146.9-157.7	Historical
160.4	OH-WV	0.0	Full Support				Full Support	157.7-163.1	Historical
165.8	OH-WV	17.6	Partial Support				Partial Support		Historical
171.2	OH-WV	11.8	Partial Support				Partial Support		Historical
175.1	OH-WV	17.6	Partial Support				Partial Support	163.1-177.3	Historical
179.4	OH-WV	26.7	Not Supporting				Not Supporting	177.3-181.5	Historical
183.5	OH-WV	17.6	Partial Support				Partial Support	181.5-184.7	Historical
185.9	OH-WV	5.9	Full Support				Full Support	184.7-188.4	Historical
190.8	OH-WV	11.8	Partial Support				Partial Support	188.4-193.3	Historical
195.7	OH-WV	5.9	Full Support				Full Support		Historical
200.7	OH-WV	5.9	Full Support				Full Support	193.3-203.2	Historical
205.7	OH-WV	23.5	Partial Support				Partial Support		Historical
210.7	OH-WV	23.5	Partial Support				Partial Support		Historical
215.7	OH-WV	23.5	Partial Support				Partial Support		Historical
220.4	OH-WV	23.5	Partial Support				Partial Support		Historical
225.4	OH-WV	17.6	Partial Support				Partial Support		Historical
230.4	OH-WV	17.6	Partial Support				Partial Support		Historical
235.6	OH-WV	17.6	Partial Support				Partial Support		Historical
240.4	OH-WV	18.8	Partial Support				Partial Support		Historical
245.4	OH-WV	23.5	Partial Support				Partial Support	203.2-247.9	Historical
250.4	OH-WV	35.3	Not Supporting				Not Supporting		Historical
255.5	OH-WV	29.4	Not Supporting				Not Supporting	247.9-258.0	Historical
260.6	OH-WV	23.5	Partial Support				Partial Support		Historical
265.7	OH-WV	23.5	Partial Support				Partial Support	258.0-267.8	Historical
269.8	OH-WV	41.2	Not Supporting				Not Supporting	267.8-272.5	Historical
275.2	OH-WV	11.8	Partial Support				Partial Support		Historical
280.8	OH-WV	17.4	Partial Support				Partial Support		Historical
285.9	OH-WV	21.7	Partial Support				Partial Support		Historical
291.4	OH-WV	18.2	Partial Support				Partial Support		Historical
296.6	OH-WV	15.0	Partial Support				Partial Support		Historical
302.0	OH-WV	11.1	Partial Support				Partial Support	272.5-303.6	Historical
305.1	OH-WV			0	0%	Full Support	Full Support	303.6-306.4	Reassessed
307.7	OH-WV	29.4	Not Supporting				Not Supporting		Historical

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	Assessment of Longitudinal Data	# Mos. > GM '09-'13	% Mos. > GM '09-'13	Assessment of Contact Rec Data	Overall Assessment	River Mile of Assessment	Assessment Type
308.1*	OH-WV			3	50%	Not Supporting	Not Supporting		Historical
313.3	OH-WV	41.2	Not Supporting				Not Supporting	306.4-314.1	Historical
314.8	OH-WV			7	23%	Partial Support	Partial Support	314.1-315.9	Reassessed
317.1	OH-WV								
317.2	KY-OH	29.4	Not Supporting				Not Supporting	315.9-319.4	Historical
321.5	KY-OH	23.5	Partial Support				Partial Support		Historical
327.4	KY-OH	13.3	Partial Support				Partial Support		Historical
327.7	KY-OH	20.0	Partial Support				Partial Support		Historical
328.0	KY-OH	23.5	Partial Support				Partial Support		Historical
332.5	KY-OH	11.8	Partial Support				Partial Support		Historical
338.1	KY-OH	17.6	Partial Support				Partial Support	319.4-340.8	Historical
343.5	KY-OH	5.9	Full Support				Full Support		Historical
349.2	KY-OH	5.9	Full Support				Full Support		Historical
352.0	KY-OH	5.9	Full Support				Full Support		Historical
353.8	KY-OH	5.9	Full Support				Full Support	340.8-356.6	Historical
359.3	KY-OH	23.5	Partial Support				Partial Support		Historical
364.6	KY-OH	17.6	Partial Support				Partial Support		Historical
369.8	KY-OH	11.8	Partial Support				Partial Support		Historical
375.0	KY-OH	11.8	Partial Support				Partial Support	356.6-377.7	Historical
380.4	KY-OH	5.9	Full Support				Full Support	377.7-382.9	Historical
385.4	KY-OH	11.8	Partial Support				Partial Support	382.9-388.0	Historical
390.6	KY-OH	5.9	Full Support				Full Support		Historical
395.0	KY-OH	6.7	Full Support				Full Support		Historical
400.4	KY-OH	5.9	Full Support				Full Support		Historical
405.8	KY-OH	5.9	Full Support				Full Support		Historical
411.4	KY-OH	0.0	Full Support				Full Support		Historical
416.4	KY-OH	0.0	Full Support				Full Support		Historical
421.6	KY-OH	0.0	Full Support				Full Support		Historical
426.4	KY-OH	0.0	Full Support				Full Support		Historical
431.4	KY-OH	0.0	Full Support				Full Support		Historical
436.8	KY-OH	0.0	Full Support				Full Support		Historical
441.5	KY-OH	0.0	Full Support				Full Support		Historical
446.5	KY-OH	0.0	Full Support				Full Support		Historical
451.6	KY-OH	0.0	Full Support				Full Support		Historical
455.3	KY-OH	6.7	Full Support				Full Support		Historical
460.0	KY-OH	6.3	Full Support				Full Support	388.0-461.3	Historical
462.6	KY-OH			4	13%	Partial Support	Partial Support		Reassessed
463.9**	KY-OH			2	11%	Partial Support	Partial Support		Historical
465.0		20.0	Partial Support				Partial Support	461.3-463.8	Historical
465.4	KY-OH	0.0	Full Support				Full Support		Historical
468.7	KY-OH	6.3	Full Support				Full Support	463.8-469.3	Historical
469.9**	KY-OH			9	29%	Not Supporting	Not Supporting		Historical
470.0	KY-OH			8	26%	Not Supporting	Not Supporting	469.3-471.4	Reassessed
472.7	KY-OH	18.8	Partial Support				Partial Support	471.4-475.1	Historical

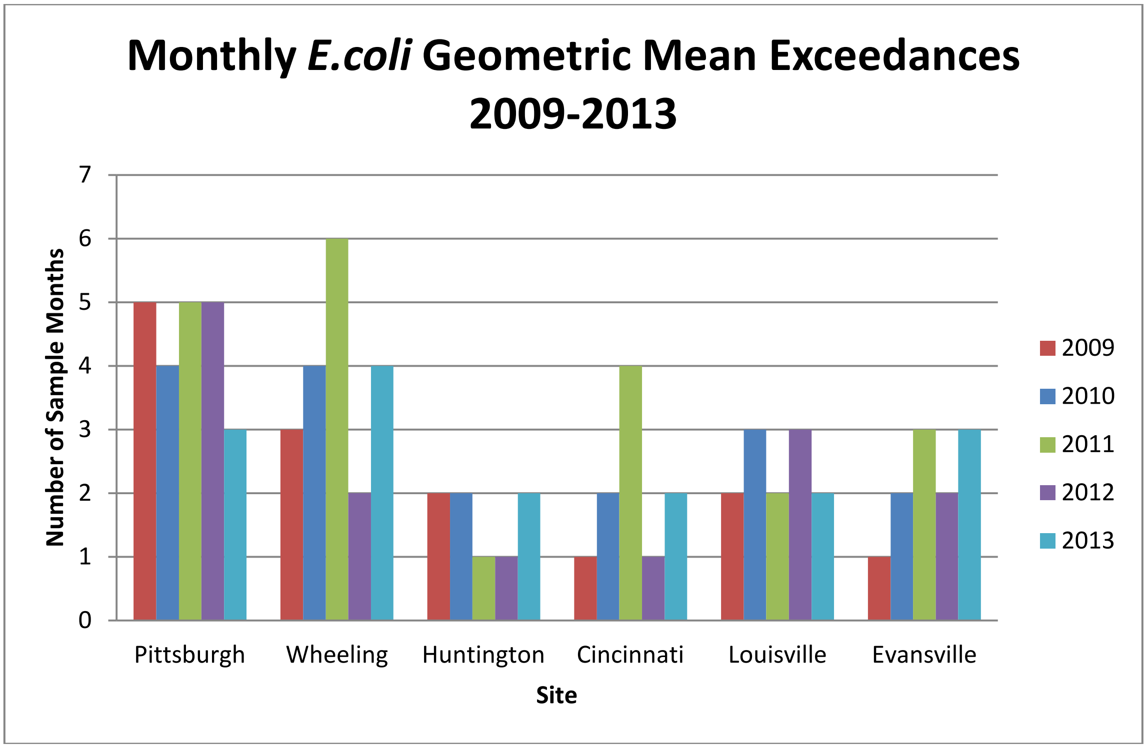
Mile Point	States	% of Longitudinal Samples > SSM (03-08)	Assessment of Longitudinal Data	# Mos. > GM '09-'13	% Mos. > GM '09-'13	Assessment of Contact Rec Data	Overall Assessment	River Mile of Assessment	Assessment Type
477.5	KY-OH			10	32%	Not Supporting	Not Supporting	475.1-477.6	Reassessed
477.6	KY-OH	12.5	Partial Support				Partial Support		Historical
482.2	KY-OH	25.0	Partial Support				Partial Support		Historical
486.2	KY-OH	12.5	Partial Support				Partial Support	477.6-488.0	Historical
489.7	KY-OH	6.3	Full Support				Full Support		Historical
491.3	KY-OH							488.0-491.3	Historical
493.2	IN-KY	6.7	Full Support				Full Support		Historical
498.0	IN-KY	6.3	Full Support				Full Support		Historical
503.1	IN-KY	0.0	Full Support				Full Support		Historical
508.3	IN-KY	0.0	Full Support				Full Support		Historical
513.4	IN-KY	0.0	Full Support				Full Support		Historical
518.5	IN-KY	6.3	Full Support				Full Support		Historical
523.4	IN-KY	6.7	Full Support				Full Support		Historical
528.4	IN-KY	6.3	Full Support				Full Support		Historical
533.2	IN-KY	6.3	Full Support				Full Support		Historical
538.5	IN-KY	6.3	Full Support				Full Support		Historical
543.5	IN-KY	0.0	Full Support				Full Support		Historical
548.3	IN-KY	0.0	Full Support				Full Support		Historical
553.6	IN-KY	0.0	Full Support				Full Support		Historical
558.8	IN-KY	6.7	Full Support				Full Support		Historical
562.7	IN-KY	6.7	Full Support				Full Support		Historical
567.6	IN-KY	0.0	Full Support				Full Support		Historical
572.5	IN-KY	0.0	Full Support				Full Support		Historical
577.4	IN-KY	0.0	Full Support				Full Support		Historical
582.9	IN-KY	0.0	Full Support				Full Support		Historical
587.8	IN-KY	0.0	Full Support				Full Support		Historical
592.2	IN-KY	0.0	Full Support				Full Support	488.0-593.1	Historical
594.0	IN-KY			5	16%	Partial Support	Partial Support	593.1-595.5	Reassessed
597.1	IN-KY	0.0	Full Support				Full Support		Historical
602.2	IN-KY	6.3	Full Support				Full Support	595.5-603.3	Historical
604.3	IN-KY	18.8	Partial Support				Partial Support		Historical
607.5	IN-KY	19.0	Partial Support				Partial Support	603.3-608.1	Historical
608.7*	IN-KY			0	0%	Full Support	Full Support	608.1-609.2	Historical
609.7	IN-KY	19.0	Partial Support				Partial Support		Historical
612.2	IN-KY	14.3	Partial Support				Partial Support	609.2-614.9	Historical
617.6	IN-KY	38.1	Not Supporting				Not Supporting		Historical
619.3	IN-KY			12	39%	Not Supporting	Not Supporting		Reassessed
623.1	IN-KY	38.1	Not Supporting				Not Supporting		Historical
628.1	IN-KY	38.1	Not Supporting				Not Supporting		Historical
630.0	IN-KY	60.0	Not Supporting				Not Supporting		Historical
631.6	IN-KY	55.0	Not Supporting				Not Supporting		Historical
637.6	IN-KY	57.1	Not Supporting				Not Supporting		Historical
643.1	IN-KY	47.6	Not Supporting				Not Supporting		Historical
648.9	IN-KY	40.0	Not Supporting				Not Supporting		Historical

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	Assessment of Longitudinal Data	# Mos. > GM '09-'13	% Mos. > GM '09-'13	Assessment of Contact Rec Data	Overall Assessment	River Mile of Assessment	Assessment Type
654.0	IN-KY	41.2	Not Supporting				Not Supporting		Historical
659.2	IN-KY	29.4	Not Supporting				Not Supporting		Historical
664.2	IN-KY	35.3	Not Supporting				Not Supporting		Historical
669.1	IN-KY	47.1	Not Supporting				Not Supporting		Historical
674.5	IN-KY	47.1	Not Supporting				Not Supporting		Historical
680.4	IN-KY	35.3	Not Supporting				Not Supporting	614.9-683.0	Historical
685.6	IN-KY	20.0	Partial Support				Partial Support		Historical
690.7	IN-KY	23.5	Partial Support				Partial Support		Historical
695.6	IN-KY	17.6	Partial Support				Partial Support		Historical
700.9	IN-KY	23.5	Partial Support				Partial Support		Historical
706.2	IN-KY	23.5	Partial Support				Partial Support		Historical
711.5	IN-KY	17.6	Partial Support				Partial Support		Historical
717.4	IN-KY	13.3	Partial Support				Partial Support	683.0-719.5	Historical
721.5	IN-KY	28.6	Not Supporting				Not Supporting		Historical
727.0	IN-KY	29.4	Not Supporting				Not Supporting		Historical
732.5	IN-KY	35.3	Not Supporting				Not Supporting	719.5-735.7	Historical
738.8	IN-KY	13.3	Partial Support				Partial Support		Historical
742.4	IN-KY	23.5	Partial Support				Partial Support		Historical
746.4	IN-KY	17.6	Partial Support				Partial Support		Historical
750.6	IN-KY	17.6	Partial Support				Partial Support		Historical
754.8	IN-KY	11.8	Partial Support				Partial Support	735.7-756.4	Historical
758.0	IN-KY	29.4	Not Supporting				Not Supporting	756.4-760.6	Historical
763.2	IN-KY	20.0	Partial Support				Partial Support		Historical
769.1	IN-KY	11.8	Partial Support				Partial Support		Historical
773.6	IN-KY	17.6	Partial Support				Partial Support		Historical
778.2	IN-KY	11.8	Partial Support				Partial Support		Historical
782.8	IN-KY	11.8	Partial Support				Partial Support		Historical
787.0	IN-KY	11.8	Partial Support				Partial Support	760.6-789.3	Historical
791.5	IN-KY			3	10%	Full Support	Full Support	789.3-792.1	Reassessed
792.7	IN-KY	23.5	Partial Support				Partial Support	792.1-793.2	Historical
793.7*	IN-KY			12	39%	Not Supporting	Not Supporting		Historical
794.2	IN-KY	29.4	Not Supporting				Not Supporting	793.2-795.7	Historical
797.3	IN-KY			0	0%	Full Support	Full Support	795.7-798.4	Reassessed
799.5	IN-KY	20.0	Partial Support				Partial Support	798.4-799.8	Historical
800.0	IN-KY	40.0	Not Supporting				Not Supporting	799.8-802.9	Historical
805.8	IN-KY	23.5	Partial Support				Partial Support		Historical
811.3	IN-KY	23.5	Partial Support				Partial Support		Historical
817.0	IN-KY	23.5	Partial Support				Partial Support	802.9-820.1	Historical
823.2	IN-KY	29.4	Not Supporting				Not Supporting	820.1-826.4	Historical
829.5	IN-KY	23.5	Partial Support				Partial Support		Historical
832.2	IN-KY	13.3	Partial Support				Partial Support		Historical
837.2	IN-KY	17.6	Partial Support				Partial Support		Historical
842.3	IN-KY	11.8	Partial Support				Partial Support		Historical
846.5	IN-KY	17.6	Partial Support				Partial Support	826.4-847.3	Historical

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	Assessment of Longitudinal Data	# Mos. > GM '09-'13	% Mos. > GM '09-'13	Assessment of Contact Rec Data	Overall Assessment	River Mile of Assessment	Assessment Type
848.0	IN-KY								
851.3	IL-KY	5.9	Full Support				Full Support	847.3-853.4	Historical
855.5	IL-KY	13.3	Partial Support				Partial Support	853.4-857.6	Historical
859.7	IL-KY	6.7	Full Support				Full Support	857.6-862.1	Historical
864.4	IL-KY	11.8	Partial Support				Partial Support		Historical
869.8	IL-KY	11.8	Partial Support				Partial Support	862.1-872.8	Historical
875.7	IL-KY	5.9	Full Support				Full Support	872.8-878.2	Historical
880.7	IL-KY	11.8	Partial Support				Partial Support	878.2-882.9	Historical
885	IL-KY	5.9	Full Support				Full Support		Historical
889.2	IL-KY	5.9	Full Support				Full Support		Historical
891.7	IL-KY	5.9	Full Support				Full Support	882.9-894.6	Historical
897.5	IL-KY	17.6	Partial Support				Partial Support		Historical
903.2	IL-KY	17.6	Partial Support				Partial Support		Historical
908	IL-KY	11.8	Partial Support				Partial Support	894.6-910.3	Historical
912.6	IL-KY	5.9	Full Support				Full Support		Historical
917.6	IL-KY	5.9	Full Support				Full Support	910.3-920.5	Historical
923.4	IL-KY	11.8	Partial Support				Partial Support	920.5-925.8	Historical
928.2	IL-KY	6.7	Full Support				Full Support		Historical
932.2	IL-KY	0	Full Support				Full Support		Historical
936.2	IL-KY	0	Full Support				Full Support		Historical
937.7	IL-KY	0	Full Support				Full Support		Historical
940.9	IL-KY	0	Full Support				Full Support		Historical
944.2	IL-KY	0	Full Support				Full Support		Historical
947.5	IL-KY	5.9	Full Support				Full Support		Historical
952.2	IL-KY	5.9	Full Support				Full Support		Historical
957.7	IL-KY	5.9	Full Support				Full Support		Historical
963	IL-KY	6.3	Full Support				Full Support		Historical
969.2	IL-KY	6.3	Full Support				Full Support		Historical
974.1	IL-KY	6.3	Full Support				Full Support		Historical
979.2	IL-KY	6.3	Full Support				Full Support	925.8-981.0	Historical

* Data based off of 2007-2009 data due to discontinued sites

**Data based off of 2009-2011 data due to discontinued sites



*Pittsburgh had GM data for 5 months in 2011 and 4 months in 2013.

**In 2013, April monitoring was added to the sampling program.

Figure 10. Number of months exceeding the E. coli geometric mean criteria at each contact recreation season monitoring location from 2009-2013.

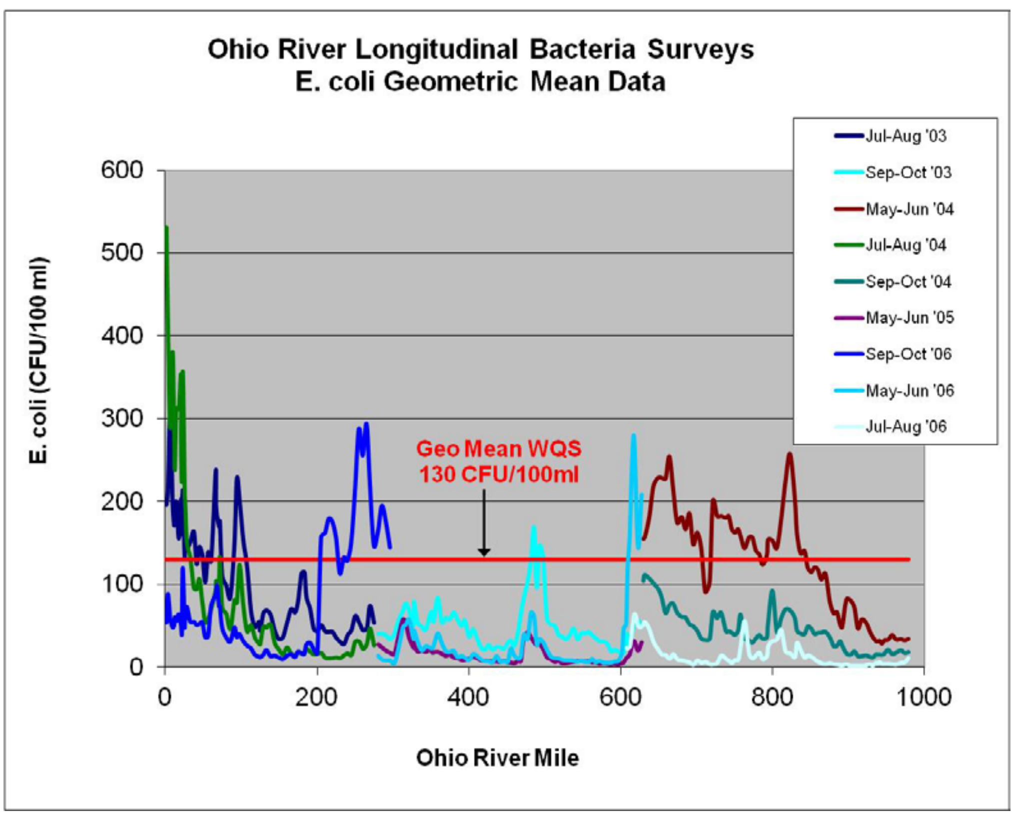


Figure 11. Geometric mean results of longitudinal surveys.

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 and therefore evaluates this use.

FISH CONSUMPTION USE ASSESSMENT METHODOLOGY

The Commission generally collects and analyzes between 45 and 60 fish tissue samples annually. Samples comprised primarily of three-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. Total mercury water column data were collected from 16 clean metals sites once every other month between 2009 and 2013. PCBs and dioxins were measured through high volume sampling. Collection of PCB and dioxin data was an ongoing process from 1997 through 2004; all data has been included in this assessment because that data would not be expected to have changed significantly since then. A full description of each designation for the fish consumption use is as follows:

For PCBs & Dioxin:

Fully Supporting

- Water quality criteria for the protection of human health from fish consumption are exceeded in less than ten percent of samples.

Partially Supporting-Impaired

- Criteria for the protection of human health from fish consumption are exceeded in more than ten percent of samples.

Not Supporting-Impaired

- Fish tissue criteria exceeded in many commonly consumed species.

For Fish Tissue Methyl Mercury:

The Commission began collecting fish tissue samples for methyl mercury in 2009. In 2009, 20 large, trophic-level 4 hybrid striped bass were collected and the tissue analyzed for total mercury. In 2010, ORSANCO was directed by TEC to use US EPA's approach for determining impairment based on methylmercury data. The mercury program was expanded to include not only large hybrid striped bass, but channel catfish, freshwater drum, and largemouth bass. In 2010 and 2011, the Commission began analyzing for MeHg because the human health criterion is 0.3 ppm for MeHg in fish.

ORSANCO used the *Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion* document (pgs. 61-62) prepared by US EPA to analyze data included in the fish consumption use assessment. The approach utilizes a consumption-weighted averaging of the fish tissue using each pool as an assessment unit. Average fish tissue concentrations for trophic levels (primarily 3 and 4) are weighted based on national consumption rates of 5.7 gms/day for trophic level 4 and 8.0 gms/day for trophic level 3.

The guidance includes several recommendations for agencies when deciding which fish should be included in a fish consumption study. EPA suggests that perhaps the most important criterion is that species are commonly eaten in the study area. Selected fish species should also have commercial, recreational, or subsistence fishing value. Agencies should target walleye and largemouth bass because they accumulate high levels of methylmercury and size range should include larger fish at each site because larger (older) fish are usually most contaminated with methylmercury. When analyzing the methylmercury data, ORSANCO averaged results across trophic levels based on the aforementioned EPA guidance document which allows data to be weighted by actual consumption rates for trophic levels 3 and 4 fish (Equation 1). Impairment is indicated when C_{avg} is greater than 0.3 mg/kg of methylmercury.

$$C_{avg} = \frac{8.0 * C_3 + 5.7 * C_4}{(8.0 + 5.7)}$$

Equation 1. Process used by ORSANCO as outlined by US EPA to average fish consumption data across trophic levels (Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion – US EPA).

Where:
C_3 = average mercury concentration for trophic level 3
C_4 = average mercury concentration for trophic level 4
**Calculation is based on apportioning the 13.7 grams/day national default consumption rate for freshwater fish for trophic levels 3 and 4.

FISH CONSUMPTION USE ASSESSMENT SUMMARY

The Ohio River is assessed and classified as not supporting the fish consumption use for PCBs and dioxin based on historic monitoring results that were two or more orders of magnitude greater than the applicable water quality criteria. Dioxin water concentration data were compared against the Commission's water quality criterion of 0.000000005 µg/L (0.5 fg/L). Every dioxin sample, river-wide, exceeded the water quality criterion (Figure 10). Similarly, PCB levels were compared against the 64 pg/L human health criteria set forth in the Pollution Control Standards (Figure 11). All samples were in violation of the PCB criterion as well. 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.

There were violations of the total mercury water quality criterion in excess of ten percent of samples (for total mercury in water, not fish tissue) primarily in the lower half of the river (Table 11). The water quality criterion for total mercury in the water column is established to protect against undesirable accumulation in fish tissue. Utilizing the USEPA's methodology for assessing the fish consumption use for methyl mercury utilizing fish tissue data, all pools had a fish consumption weighted methyl mercury fish tissue average below 0.3 mg/kg (Table 12). As a result, utilizing a weight of evidence approach relying on the fish tissue data as more reliable assessment methodology, the entire river is classified as fully supporting the fish consumption use for methyl mercury. The entire river remains impaired for dioxin and PCBs.

In addition, the states issue fish consumption advisories for certain species (Appendix J). All states have consumption advisories applicable to the Ohio River due to PCBs, while Illinois and Kentucky also list mercury as a cause for Ohio River fish consumption advisories.

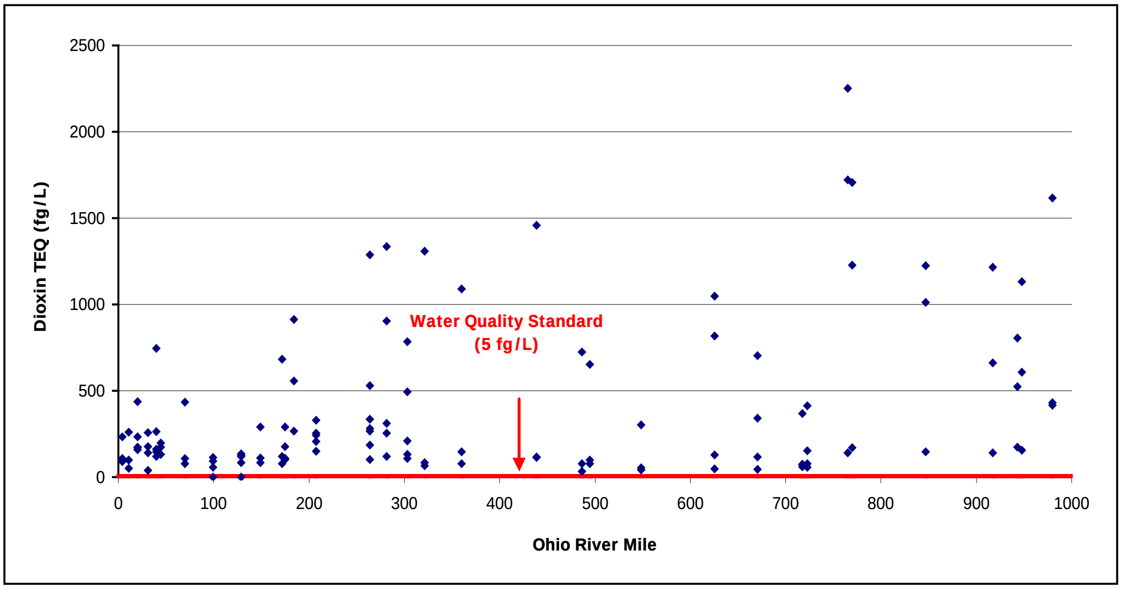


Figure 12. Dioxin TEQ concentrations in the Ohio River (1997-2004).

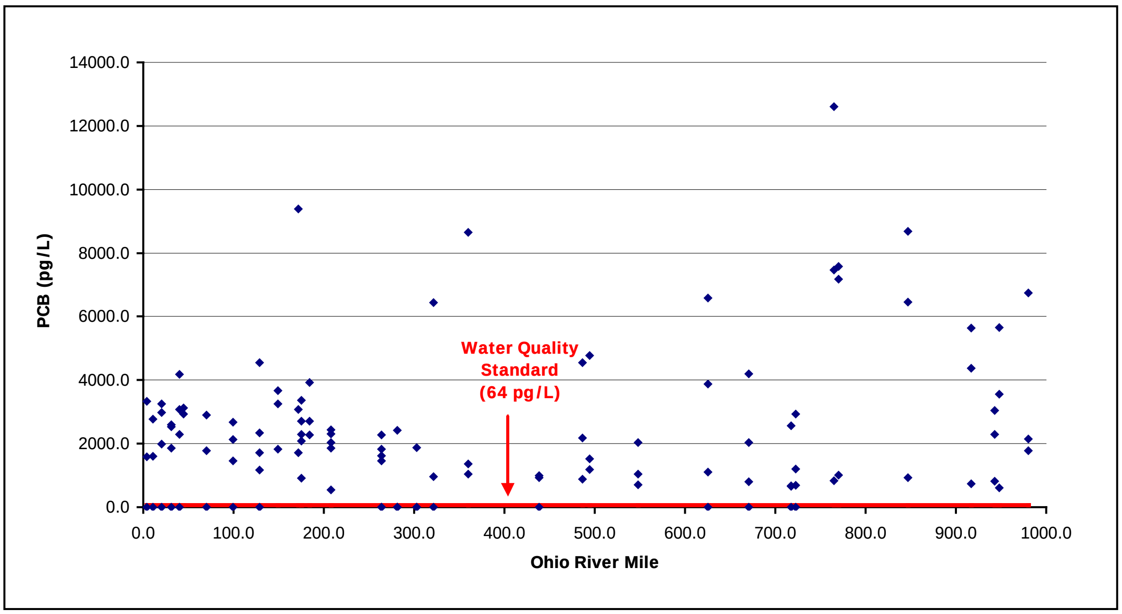


Figure 13. PCB data from the Ohio River collected from 1997-2004.

Table 11. Total Mercury Water Quality Criteria Violations

Mile Point	SiteName	Total No. Samples	Criteria Violations	% Violations
126.4	**Hannibal**	30	1	3%
341	**Greenup**	31	2	6%
436.2	**Meldahl**	29	1	3%
477.5	**Anderson Ferry**	18	2	11%
531.5	**Markland**	30	2	7%
600.6	**Louisville**	18	3	17%
606.8	**McAlpine**	19	2	11%
776	**Newburgh**	30	5	17%
846	**J.T. Myers**	30	6	20%
918.5	**Smithland**	29	2	7%
938.9	**L&D 52**	29	5	17%

Table 12. Summary of consumption-weighted pool averages for methyl mercury in fish tissue.

Pool	No. Trophic Level 3 Samples	Concentration Range of Trophic Level 3 Samples, (ppm)	No. Trophic Level 4 Samples	Concentration Range of Trophic Level 4 Samples, (ppm)	Consumption-Weighted Pool Average MeHg Concentration, (ppm) **
Emsworth	6	0.08 - 0.27	5	0.08 - 0.19	0.13
Dashields	2	0.11 - 0.23	2	0.13 - 0.15	0.16
Montgomery	2	0.09 - 0.18	3	0.12 - 0.15	0.13
New Cumberland	2	0.14 - 0.27	2	0.06 - 0.26	0.19
Pike Island	2	0.03 - 0.19	2	0.13 - 0.28	0.15
Hannibal	6	0.07 - 0.30	4	0.15 - 0.64	0.21
Willow Island	10	0.03 - 0.24	2	0.14 - 0.21	0.14
Belleville	3	0.09 - 0.20	2	0.13 - 0.40	0.19
Racine	5	0.05 - 0.44	3	0.16 - 0.30	0.20
RC Byrd	3	0.13 - 0.24	3	0.001 - 0.22	0.16
Greenup	6	0.06 - 0.36	6	0.11 - 0.3	0.17
Meldahl	2	0.11 - 0.27	3	0.13 - 0.27	0.20
Markland	3	0.11 - 0.28	6	0.04 - 0.39	0.23
McAlpine	2	0.15 - 0.21	5	0.17 - 0.45	0.20
Cannelton	3	0.09 - 0.18	3	0.13 - 0.37	0.18
Newburgh	5	0.10 - 0.29	2	0.13 - 0.16	0.16
JT Myers	5	0.06 - 0.36	5	0.06 - 0.86	0.22
Smithland	7	0.10 - 0.35	4	0.13 - 0.67	0.28
Olmsted	2	0.05 - 0.08	3	0.26 - 0.40	0.18

CHAPTER 6: OHIO RIVER WATER QUALITY TRENDS ANALYSIS

ORSANCO first undertook a study of long-term temporal trends using the Commission's own monitoring data in 1990, with 10-15 years of record at most monitoring stations. ORSANCO has since built another 21-year record to be tested for temporal trends. This study presents the results of that analysis and a comparison with the trends discovered in the earlier data set.

The Commission collects water quality samples at 17 locations on the Ohio River and near the mouth of 14 major Ohio River tributaries. Since 1990 the Commission has maintained a minimum of six sample events per year at each location. This study covers the 18-year period from January 1990 to December 2007, picking up where the previous ORSANCO trend analyses ended.

Sufficient data was available to test 18-year trends in seven non-metal water quality parameters: ammonia nitrogen, chloride, total hardness, nitrate-nitrite nitrogen, sulfate, total phosphorus, and total suspended solids. The introduction of a new sampling technique for metals in 2002 sufficiently changed the resulting data set such that this study examines only the 12-year record of total recoverable metals analysis through the end of 2002. The metals aluminum, magnesium, manganese, iron, and zinc have sufficient records for a 12-year trend test with a period ending in 2002.

A nonparametric test, the Seasonal Kendall, was performed both on direct concentrations and on a flow-adjusted basis to facilitate comparison with the Commission's earlier trend assessments. Results of the Seasonal Kendall on direct concentrations are presented in Table 13, Seasonal Kendall on Direct Concentrations. The table classifies significant trends by four trend classes with the following notation: strong significant increasing trend ("INC", $p<0.05$, $Z_{0.975} = 1.96$), significant increasing trend ("inc", $p<0.10$, $Z_{0.95} = 1.64$), strong significant decreasing trend ("DEC", $p<0.05$, $Z_{0.025} = -1.96$), significant decreasing trend ("dec", $p<0.10$, $Z_{0.05} = -1.64$). A nonparametric estimator of trend magnitude was calculated for all significant trends ($p < 0.10$).

Of 372 tests for trends (31 locations, 12 water quality parameters) 222 statistically significant ($p < 0.10$) trends were found. Analysis for the current period shows 54% increasing trends while the vast majority of trends (94%) discovered in the 1977 to 1990 studies were in the decreasing direction. One difference between the periods not indicated by that summary is that some parameters, for example copper and phenols, with decreases in the earlier period have apparently experienced declines such that infrequency of pollutant detections in the current period invalidates a test for continuing trends.

Important trends detected include increasing phosphorus concentrations at most Ohio River monitoring stations and increases in chloride concentrations at nearly all stations including tributaries. Sulfate concentrations in the Big Sandy River at the border of West Virginia and Kentucky have steadily increased and are currently reaching the level of the ORSANCO Water Quality Criterion of 250 milligrams per liter (mg/L).

Table 13. Seasonal Kendall trends in Ohio River concentrations.

Bimonthly SiteName	River	Al	Cl-	Fe	Hardness	Mg	Mn	NH3-N	NO2-NO3-N	SO4	TP	TSS	Zn
Pittsburgh	Allegheny	O	INC	DEC	INC	INC	DEC	O	INC	O	O	O	dec
South Pittsburgh	Monongahela	O	INC	O	O	INC	DEC	O	inc	O	O	O	DEC
Beaver Falls	Beaver	O	INC	DEC	O	INC	DEC	O	dec	O	INC	O	O
New Cumberland	Ohio	DEC	INC	DEC	INC	INC	DEC	O	INC	O	DEC	DEC	DEC
Pike Island	Ohio	DEC	INC	DEC	O	inc	DEC	DEC	O	O	DEC	DEC	DEC
Hannibal	Ohio	O	INC	DEC	INC	INC	dec	O	O	O	O	O	DEC
Willow Island	Ohio	dec	INC	DEC	inc	INC	DEC	DEC	O	O	DEC	DEC	O
Marietta	Muskingum	DEC	O	DEC	O	INC	DEC	O	O	O	INC	DEC	DEC
Belleville	Ohio	DEC	INC	DEC	inc	INC	DEC	O	O	O	inc	DEC	DEC
Winfield	Kanawha	O	INC	O	INC	INC	inc	O	INC	INC	DEC	O	DEC
R.C. Byrd	Ohio	O	INC	O	O	INC	O	O	O	O	INC	inc	DEC
Louisa	Big Sandy	dec	O	dec	INC	INC	dec	INC	O	INC	O	DEC	DEC
Greenup	Ohio	DEC	INC	O	INC	INC	O	O	INC	O	INC	O	DEC
Lucasville	Scioto	O	inc	O	INC	INC	O	INC	DEC	O	INC	DEC	DEC
Meldahl	Ohio	O	INC	O	DEC	O	O	DEC	DEC	INC	O	O	DEC
Newtown	Little Miami	O	INC	O	inc	INC	O	inc	DEC	O	INC	DEC	dec
Covington	Licking	O	DEC	O	DEC	O	O	DEC	DEC	DEC	O	DEC	DEC
Anderson Ferry	Ohio	dec	INC	O	O	INC	O	INC	O	O	INC	O	O
Elizabethtown	Great Miami	O	O	O	O	inc	O	O	DEC	DEC	O	DEC	O
Markland	Ohio	O	INC	DEC	DEC	O	DEC	O	DEC	inc	INC	DEC	DEC
Louisville	Ohio	O	O	O	O	INC	O	dec	O	INC	INC	O	DEC
West Point	Ohio	DEC	INC	DEC	INC	INC	O	O	O	INC	INC	O	DEC
Cannelton	Ohio	O	INC	DEC	INC	INC	DEC	O	O	INC	INC	O	DEC
Newburgh	Ohio	O	INC	O	INC	INC	O	O	INC	INC	INC	O	DEC
Sebree	Green	dec	INC	O	INC	INC	O	O	INC	INC	INC	O	DEC
J.T. Myers	Ohio	O	INC	dec	INC	INC	DEC	O	O	INC	INC	O	DEC
Route 62 Bridge	Wabash		O	O	O	O	O	O	O	O	O	O	O
Smithland	Ohio	DEC	INC	DEC	INC	INC	dec	O	O	INC	INC	O	O
Pinkneyville	Cumberland	O	INC	inc	INC	INC	O	O	O	INC	INC	O	O
Paducah	Tennessee	DEC	INC	DEC	INC	INC	DEC	O	INC	INC	DEC	O	DEC
L&D 52	Ohio	DEC	INC	DEC	INC	INC	DEC	O	inc	INC	INC	O	DEC

INC - Strong significant increasing trend ($p < 0.05$, Z0.025 = 1.96)
inc - Significant increasing trend ($p < 0.10$, Z0.05 = 1.6449))
O - No significant trend found
dec - Significant decreasing trend ($p < 0.10$, Z0.05 = 1.6449)
DEC - Strong significant decreasing trend ($p < 0.05$, Z0.025 = 1.96)

CHAPTER 7: SPECIAL STUDIES

TOTAL DISSOLVED SOLIDS STUDY

A one year monitoring study of total dissolved solids was conducted from December, 2011 through December, 2012 at 11 Ohio River sites and five major tributaries. Samples were collected weekly from drinking water, power plant and other industrial intakes. A summary of results are presented in Table 14 and shown graphically in Figure 14. No Ohio River samples exceeded the water quality criterion of 500 mg/L during the study period. There were individual TDS concentrations above 500 mg/L on the Big Sandy River and Muskingum River, however the Commission's water quality criteria apply only to the Ohio River. All results can be found in Appendix L.

Table 14. Total dissolved solids summary results.

			TDS Result, mg/L		
River	**River Mile**	**Location ID**	**Min**	**Median**	**Max**
Allegheny	8.2	AL008	62	161.5	236
Monongahela	4.5	MO005	113	218.0	362
Ohio	11.7	OH012	124	205.0	280
Beaver	6	BE002	163	276.0	386
Ohio	65.3	OH065	104	206.0	307
Ohio	86.8	OH087	106	217.0	328
Ohio	137.2	OH137	110	222.0	359
Muskingum	29	MU029	148	362.0	584
Ohio	190.5	OH191	106	227.0	364
Ohio	260	OH260	160	222.0	368
Ohio	306	OH306	126	188.5	301
Big Sandy	23.6	BS020	155	362.0	579
Ohio	462.8	OH463	150	195.0	335
Ohio	600	OH600	166	215.0	332
Ohio	791.5	OH792	160	223.0	341
Ohio	978	OH978	142	203.0	339

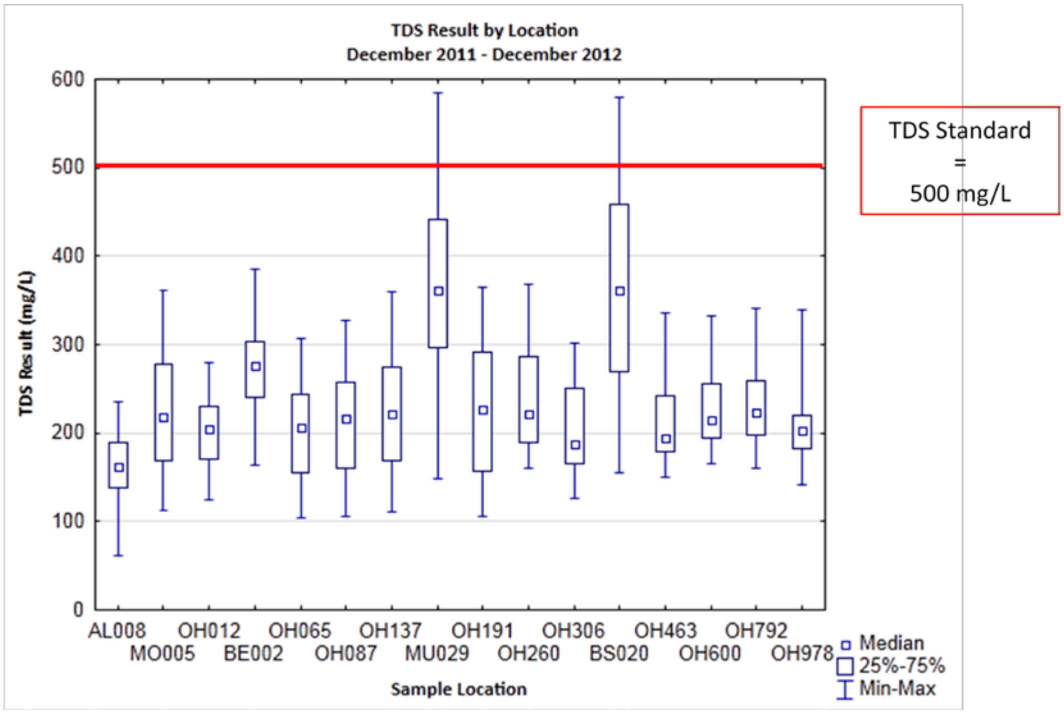


Figure 14. Summary of total dissolved solids concentrations.

CHAPTER 8: 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 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 impaired waters for which Total Maximum Daily Loads (TMDLs) may or may not be required. 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 list is offered as guidance to the states regarding which Ohio River segments to include on their 303(d) lists.

The Integrated List contains five assessment categories as follows:

Category 1	Data indicates 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	Water 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 was assessed for each use with the exception of mercury fish consumption based on mercury data. A proposed integrated list with a summary of use support information is included in this report (Table 15). Data indicate that both the aquatic life and public water supply use supports were met. Several river miles were also assessed as meeting the contact recreation use support designation, but many segments were listed as impaired and in need of TMDLs. Regarding the fish consumption use, ORSANCO has collected data for assessments, however uncertainty still exists in exactly how much is needed and appropriate methods for analyzing that data. These two facts, along with many other ambiguities, have led the Commission to forego a formal assessment of the mercury fish consumption use in the 2012 report. TMDLs were already completed for PCBs and dioxin for certain segments of the river and are shown on the list under category of 4a. States are not required to implement TMDLs based solely on ORSANCO's recommendations; however this list is consistent with those of the states.

Table 15. Proposed Ohio River integrated assessment for 2009-2013.

State	River Mile	Total Miles in Water Body	Aquatic Life Use Support	Public Water Supply Use Support	Contact Recreation Use Support	Fish Consumption Use Support		
						PCBs	Dioxin	Mercury
PA	0-40.2	40.2	1	1	5	4a	5	3
OH-WV	40.2-84.9	44.7	1	1	5	4a	5	3
OH-WV	84.9-89.0	4.1	1	1	5	4a	5	3
OH-WV	89.0-124.3	35.3	1	1	5	4a	5	3
OH-WV	124.3-127.0	2.7	1	1	1	4a	5	3
OH-WV	127.0-131.3	4.3	1	1	5	4a	5	3
OH-WV	131.3-136.1	4.8	1	1	1	4a	5	3
OH-WV	136.1-141.5	5.4	1	1	5	4a	5	3
OH-WV	141.5-146.9	5.4	1	1	1	4a	5	3
OH-WV	146.9-157.7	10.8	1	1	5	4a	5	3
OH-WV	157.7-163.1	5.4	1	1	1	4a	5	3
OH-WV	163.1-184.7	21.6	1	1	5	4a	5	3
OH-WV	184.7-188.4	3.7	1	1	1	4a	5	3
OH-WV	188.4-193.3	4.9	1	1	5	4a	5	3
OH-WV	193.3-203.2	9.9	1	1	1	4a	5	3
OH-WV	203.2-237.5	34.3	1	1	5	4a	5	3
OH-WV	237.5-303.6	66.1	1	1	5	4a	4a	3
OH-WV	303.6-306.4	2.8	1	1	1	4a	4a	3
OH-WV	306.4-317.1	10.7	1	1	5	4a	4a	3
KY-OH	317.1-340.8	23.7	1	1	5	5	5	3
KY-OH	340.8-356.6	15.8	1	1	1	5	5	3
KY-OH	356.6-377.7	21.1	1	1	5	5	5	3
KY-OH	377.7-382.9	5.2	1	1	1	5	5	3
KY-OH	382.9-388.0	5.1	1	1	5	5	5	3
KY-OH	388.0-464.5	76.5	1	1	1	5	5	3
KY-OH	464.5-465.2	0.7	1	1	5	5	5	3
KY-OH	465.2-469.3	4.1	1	1	1	5	5	3
KY-OH	469.3-488.0	18.7	1	1	5	5	5	3
KY-OH	488.0-491.3	3.3	1	1	1	5	5	3
IN-KY	491.3-595.5	104.2	1	1	5	5	5	3
IN-KY	595.5-603.3	7.8	1	1	1	5	5	3
IN-KY	603.3-789.3	186.0	1	1	5	5	5	3
IN-KY	789.3-792.1	2.8	1	1	1	5	5	3
IN-KY	792.1-848.0	55.9	1	1	1	5	5	3
IL-KY	848.0-853.4	5.4	1	1	1	5	5	3
IL-KY	853.4-857.6	4.2	1	1	5	5	5	3
IL-KY	857.6-862.1	4.5	1	1	1	5	5	3
IL-KY	862.1-872.8	10.7	1	1	5	5	5	3

Table 15. Proposed Ohio River integrated assessment for 2009-2013.

State	River Mile	Total Miles in Water Body	Aquatic Life Use Support	Public Water Supply Use Support	Contact Recreation Use Support	Fish Consumption Use Support		
						PCBs	Dioxin	Mercury
IL-KY	872.8-878.2	5.4	1	1	1	5	5	3
IL-KY	878.2-882.9	4.7	1	1	5	5	5	3
IL-KY	882.9-894.6	11.7	1	1	1	5	5	3
IL-KY	894.6-910.3	15.7	1	1	5	5	5	3
IL-KY	910.3-920.5	10.2	1	1	1	5	5	3
IL-KY	920.5-925.8	5.3	1	1	5	5	5	3
IL-KY	925.8-981.0	55.2	1	1	1	5	5	3

SUMMARY

The entire 981 miles of the Ohio River is designated as impaired for the fish consumption use, caused by PCBs and dioxin. While there are a number of water quality criteria violations for total mercury and fish tissue criteria violations for methyl mercury, the consumption-weighted pool averages were all below the fish tissue criterion, therefore no impairment is indicated for the fish consumption use based on mercury. Almost two-thirds of the river or 630 miles, is designated as impaired for contact recreation caused by *E. coli* or fecal coliform bacteria. The entire river is fully supporting the public water supply use, primarily based on the presence of finished water MCL violations. Several water utilities did have MCL violations for disinfection byproducts, and one utility had an MCL violation for coliforms, they were more likely related to water treatment issues as opposed to source water impairments. While there are indications of aquatic life use impairments for certain segments of the Ohio River based on water quality criteria violations for total iron, temperature and dissolved oxygen, at the same time there are indications of fully supporting aquatic life use for the entire Ohio River based on direct measures of the biological community. Therefore, using the weight of evidence approach, the entire Ohio River is assessed in this report at fully supporting the aquatic life use.

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