Biennial Assessment of Ohio River Water Quality Conditions

for 2005, 2006, 2007, 2008, and 2009

ORSANCO

OHIO RIVER VALLEY WATER SANITATION COMMISSION
AN INTERSTATE AGENCY
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The Ohio River Valley Water Sanitation Commission
5735 Kellogg Avenue
Cincinnati, Ohio 45230

EXECUTIVE SUMMARY

The Ohio River is one of the nation's great natural resources. It provides drinking water to nearly five million people; is a warm water habitat for aquatic life; provides numerous recreational opportunities; is used as a major transportation route; and is a source of water for manufacturing and power generation. The Ohio River forms in Pittsburgh, Pennsylvania at the confluence of the Allegheny and Monongahela rivers and flows in a southwesterly direction for 981 miles to join the Mississippi River near Cairo, Illinois. The first 40 miles of the Ohio River stay 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. This report fulfills the following requirements of the Ohio River Valley Water Sanitation 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).

This report is a biennial assessment of Ohio River water quality conditions in terms of the degree to which the river supports each of its four designated uses: warm water aquatic life, public water supply, contact recreation, and fish consumption. The Ohio River Valley Water Sanitation Compact commits "...each state to place and maintain the waters of the basin in a satisfactory sanitary condition, available for safe and satisfactory use by public and industrial water supplies after reasonable treatment, suitable for recreation, capable of maintaining fish and other aquatic life...."

This assessment uses three classifications to describe the attainment of Ohio River designated uses: fully supporting (good water quality), partially supporting (fair water quality), and not supporting (poor water quality). ORSANCO conducts water quality monitoring and assessments on behalf of the Ohio River mainstem states (Illinois, Indiana, Kentucky, Ohio, Pennsylvania and West Virginia). This report provides a status of water quality from 2005-2009; however, in some cases data outside this range has been utilized in assessments. In addition, an Integrated List containing waters in need of Total Maximum Daily Loads (TMDLs) was completed (Table 10) in an effort to promote interstate consistency for Ohio River TMDLs.

Warm Water Aquatic Life Use Support

The Ohio River warm water aquatic life use support has not been assessed in this report. Assessments are usually based on chemical and physical water quality data collected from ORSANCO's 17 Clean Metals and Bimonthly sampling stations and two PA DEP stations located on the mainstem, instream monitors for dissolved oxygen and temperature operated by the US Army Corps of Engineers and hydropower operators, and direct measurements of fish communities from a large number of stream bank sites. Clean metals monitoring data for total iron compared to states aquatic life criteria (ORSANCO has no iron criteria) indicated aquatic life impairments at 12 monitoring stations. No other chemical criteria for the protection of aquatic life were exceeded.

Fish communities were assessed using ORSANCO's Modified Ohio River Fish Index (MORFIn) for evaluating fish population data. Each Ohio River pool is an individual assessment unit and all pools have been evaluated. Based on an assessment of biological data (fish community), the Dashields and Montgomery pools (ORM 6.2-31.7) of located wholly within Pennsylvania would also be considered impaired, while the remainder of the Ohio River would be considered Fully Supporting the aquatic life use based on this data.

In addition, ORSANCO collects and assesses against its water quality criteria, daily temperature and dissolved oxygen data from certain Ohio River dams monitored by the US Army Corps of Engineers or hydropower operators. Based on this data, the aquatic life use would be impaired due to dissolved oxygen conditions at

Cannelton Dam and for temperature at Newburgh Dam.

Having highlighted what would be considered impaired, the commission's assessment is not assessing the aquatic life use because of differences in states' approaches to handling data with conflicting results. Indiana and West Virginia intend to list the Ohio River for aquatic life use impairments based on water quality criteria violations for total iron even though the biological data do not indicate impairment. This is considered a "Independent Application" approach. Pennsylvania does not intend to list any segments of the Ohio River as impaired for the aquatic life use until they have implemented their own biological monitoring and assessment program. Kentucky believes strongly in the "Weight of Evidence" approach where the biological data is a better indicator of the aquatic life use such that the river would be assessed as fully supporting even though total iron criteria violations would otherwise indicate impairment.

As a result of this significant inconsistency in approaches, ORSANCO's Technical Committee recommends that a letter be sent to US EPA describing the situation.

Public Water Supply Use Support

Ohio River public water supply use support was assessed based on chemical water quality data collected from the Bimonthly Sampling Program (Appendix D), bacteria monitoring (Appendix F, G), and questionnaires sent to water utilities to assess impacts on Ohio River drinking water utilities caused by source water conditions (Figure 10). Data included in this report were collected from 2005 through 2009. The river was designated as fully supporting this use if pollutant criteria were exceeded in ten percent or less of the samples collected. The river is considered partially supporting and impaired if criteria for one or more pollutants are exceeded in 11-25 percent of the samples collected, or if frequent intake closures or frequent "non-routine" additional treatment was necessary to meet finished water maximum contaminant levels (MCLs). The river is considered not supporting and impaired if criteria for one or more pollutants are exceeded in greater than 25 percent of the samples collected, or if source water quality caused finished water Maximum Contaminant Levels (MCL) violations, resulting in noncompliance with provisions of the Safe Drinking Water Act (SDWA).

Based on the above assessment methodology, the entire river fully supports the public water supply use.

Fish Consumption Use Support

Fish consumption use support is based on violations of water quality criteria for the protection of human health from consumption of fish and fish consumption advisories. The river is fully supporting if water quality criteria for one or more pollutants is exceeded in ten percent or less of samples and no tissue criteria for mercury are exceeded. Sites are classified as partially supporting and impaired if water quality criteria for one or more pollutants are exceeded in greater than ten percent of samples or fish tissue criteria are exceeded in any fish samples, but fish consumption advisories allow for the consumption of some fish. The river is considered not supporting and impaired if fish consumption advisories do not allow consumption of any fish.
Through the Ohio River Watershed Pollutant Reduction Program, ORSANCO collected "high volume" Ohio River water samples that were analyzed for dioxin and polychlorinated biphenyls (PCBs). These data sets were compared to applicable ambient water quality criteria established for the protection of human health due to water and fish ingestion. Dioxin and PCB monitoring exceeded the applicable water quality criterion in every sample. Because of the widespread criteria violations for dioxin and PCBs, the entire river is assessed as partially supporting and impaired by these pollutants.

For mercury, dual criteria, addressing water column and fish tissue data, are used in the assessment of fish consumption. The ambient criterion for mercury was exceeded in ten percent or more of the samples collected at seven water quality monitoring stations. Similar results have been reported in previous assessments; however, levels in fish tissue have not exceeded the applicable criterion. In 2009, however, a special sampling of large trophic level four fish (hybrid striped bass) yielded different results. Eight of the twenty fish samples exceeded the 0.3 mg/kg fish tissue criterion. The analysis was for total mercury, whereas the criterion is for methyl mercury. The results indicate possible impairment of fish consumption use in over 800 miles of the river. As

further analyses are needed to make a comprehensive assessment of potential use impairments; ORSANCO will collect additional fish and water samples in fiscal year 2011 with analyses for total and methyl mercury as well as other parameters needed to assess the methylization of mercury in the river.

Contact Recreation

Bacteria data from longitudinal surveys completed since 2003 (Appendix F), as well as recreation season monitoring bacteria data (Appendix G) from the six largest CSO urban areas for 2005-2009 were used to assess the contact recreational use (Appendix H). Because bacteria data are so variable and influenced by precipitation, it was decided to use all the available longitudinal data (back to 2003) instead of just the results from 2005-2008 (the last year longitudinal data was collected).

Impairments are based on exceedances of ORSANCO's stream criteria for bacteria. For the longitudinal surveys, sites are designated Partially Supporting if 11-25% of samples exceed the single sample maximum criterion, and Not Supporting if greater than 25% of samples exceed the single sample maximum, or the geometric mean criterion is exceeded. For the recreation season monitoring, a month is considered to exceed criteria if the single sample maximum is exceeded in more than 10% of samples, or the geometric mean criterion is exceeded. Then, if 11-25% of months exceed criteria, the site is designated Partially Supporting, and Not Supporting if greater than 25% of months exceed criteria. Six hundred thirty three miles of the Ohio River, about two-thirds of the river, are classified as impaired for the contact recreation use.

Use Support Summary

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

State	River Miles	Aquatic Life Use Impairment	Contact Recreation Use Impairment	Public Water Supply Use Impairment	Fish Consumption Use Impairment
PA	0.0-40.2	Unassessed	40.2	0	40.2
OH-WV	40.2-317.1	Unassessed	239.3	0	276.9
OH-KY	317.1-491.3	Unassessed	69.4	0	174.2
IN-KY	491.3-848.0	Unassessed	244.8	0	356.7
IL-KY	848.0-981.0	Unassessed	41.4	0	133.0
TOTAL	981.0	Unassessed	635.1	0	981.0

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PART I: INTRODUCTION

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

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

This report generally covers the time between January, 2005 and December, 2009, although certain assessments use earlier data. The assessment methodologies and supporting data used to generate this assessment are contained within this report and its appendices. For this report, Ohio River water quality is determined by the degree of support for each of the following designated uses: warm water aquatic life habitat, public water supply, contact recreation, and fish consumption. Each designated use is evaluated using specific numeric water quality criteria, the existence of advisories against consuming fish, surveys and questionnaires, and a direct measure of biological communities within the Ohio River. Based on water quality conditions, the Ohio River is classified as fully, partially or not supporting each of the designated uses. Fully supporting indicates minor or no water quality problems. A designation of "partial support" indicates impairment, but data suggest fair water quality. A designation of "not supporting" also indicates impairment; however, in this case data indicate poor water quality.

Contained in this report are assessments of Ohio River designated use attainment, as well as an "Integrated List" of waters requiring Total Maximum Daily Loads (TMDLs). ORSANCO's role in completing Ohio River use attainment assessments and an Integrated List is to facilitate interstate consistency. However, the states' are not obligated to incorporate any or all of this assessment into their own reports. Specifically, the United States Environmental Protection Agency (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 drains 203,940 square miles, which is approximately five percent of the contiguous United States (Figure 1). Although the river is 981 miles in length and flows through or borders 6 states, only five percent of the basin actually drains directly into the Ohio River. Instead the river is fed by numerous tributaries, including the Allegheny, Monongahela, Kanawha, Wabash, Green, Cumberland, and Tennessee rivers. These are only a few of the watersheds that make up the Ohio River Basin, which covers portions of 15 states. Over 25 million people, approximately ten percent of the United States' population, reside in the Ohio River Basin. An estimated 3.6 million people live in cities and towns adjacent to the Ohio River.

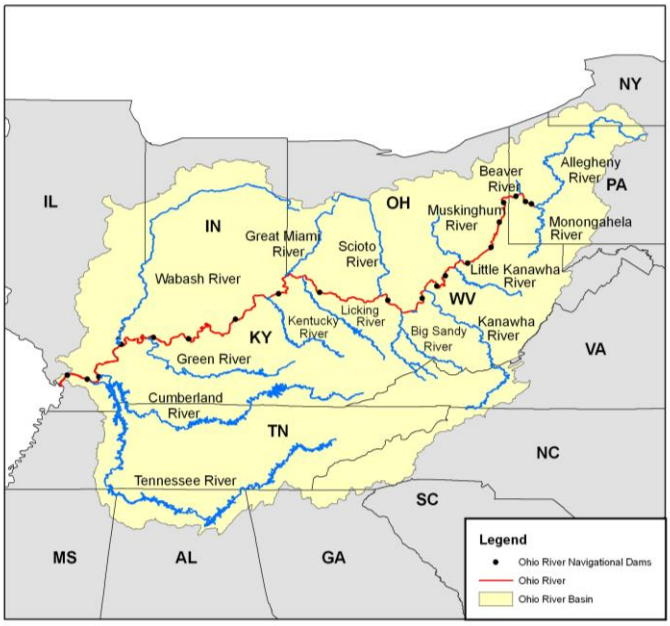


Figure 1: The Ohio River is fed by numerous tributaries. Twenty lock and dam systems regulate the water levels and allow navigation on the river.

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

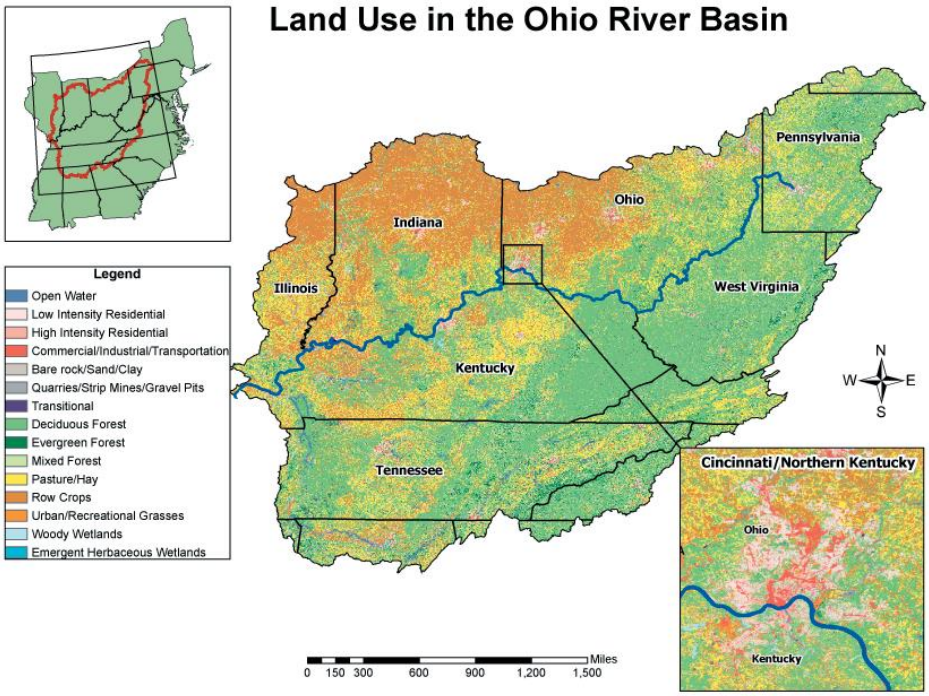


Figure 2: The Ohio River Valley supports a variety of land use types. Like most of the Midwest, states such as Ohio and Indiana are dominated by agriculture. As shown in the inset (Cincinnati/ Northern Kentucky), highly populated regions of the river are characterized by residential, commercial, and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

Description of Ohio River Pools

The Ohio River is divided into 21 segments by 20 navigational dams (Figure 1). These dams have a significant impact on the flow, water quality and aquatic communities of the river. The modern high lift dams have resulted in a deeper, slower moving river than existed prior to their construction. Because each pool has its own unique characteristics, these water bodies often have been used for assessment and reporting purposes in the past. For this 2010 Biennial Assessment, aquatic life use attainment is determined using the navigational pools as separate assessment units; however, the degree of use support for the remaining uses is assessed for each river mile. It was determined that this method provided a more accurate description of the river. The following descriptions include the boundaries of each water body as well as other relative information.

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

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

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

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

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

- **Pike Island-Hannibal** (mile point 84.2-126.4) This 42.2-mile-long water body encompasses the entire Hannibal Pool and is bounded by the Pike Island Locks & Dam upstream and the Hannibal Locks & Dam 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 the Hannibal Locks & Dam upstream and the Willow Island Locks & Dam on the downstream end. The following tributaries intersect this water body: Fishing Creek at mile point 128.3 with a drainage area of 220 square miles, Middle Island Creek at mile point 154.0 with a drainage area of 560 square miles, and Little Muskingum River at mile point 168.3 with a drainage area of 315 square miles.

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

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

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

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

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

- **Greenup-Meldahl** (mile point 341.0-436.2) This 95.2-mile-long water body is bounded by the Greenup Locks & Dam upstream and Meldahl Lock & 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 the Meldahl Lock & Dam upstream and the Markland Locks & Dam on the downstream end. Major tributaries intersecting this water body include the Little Miami River (river mile 464.1, drainage area 1,670 square miles), Licking River (river mile 470.2, drainage area 3,670 square miles), and Great Miami River (river mile 491.1, drainage area 5,400 square miles).

- **Markland-McAlpine** (mile point 531.5-604.4) This 72.9-mile-long water body is bounded by the Markland Locks & Dam upstream and the McAlpine Locks & Dam on the downstream end. The Kentucky River, which empties into this navigational pool, has a drainage area of 6,970 square miles. Other tributaries include the following: Little Kentucky River at mile point 546.5 with a drainage area of 147 square miles; Indian Kentucky River at mile point 550.5 with a drainage area of 150 square miles; and Silver Creek at mile point 606.5 with a drainage area of 225 square miles.

- **McAlpine-Cannelton** (mile point 604.4-720.7) This 113.9-mile-long water body is bounded by the McAlpine Locks & Dam upstream and the Cannelton Locks & Dam on the downstream end. Several tributaries intersect this portion of the Ohio River. The Salt River has a drainage area of 2,890 square miles. Other tributaries intersecting this water body include Big Indiana Creek at mile point 657 with a drainage area of 249 square miles, Blue River at mile point 663 with a drainage area of 466 square miles, and Sinking Creek at mile point 700.9 with a drainage area of 276 square miles.

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

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

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

- **Smithland-Lock & Dam 52** (mile point 918.5-938.9) This 20.4-mile-long water body is bounded by the Smithland Locks & Dam upstream and Lock & Dam 52 on the downstream end. The Cumberland River drains into the Ohio River at river mile 920.4 and has a drainage area of 17,920 square miles. The Tennessee River also empties into the Ohio River in this pool 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 water years 2005-2009.

Uses of the Ohio River

The Ohio River Basin encompasses 15 states. As such, the Ohio River is known for a variety of different uses. Specifically, through 29 public drinking water utilities and numerous industries, the river provides drinking water to approximately five million people. Forty-nine electric power-generating facilities located along the river provide greater than five percent of the United States' power generating capacity. In addition, the river serves as a transportation highway for commercial navigation. Each year, barges carry in excess of 150 million tons of cargo along the Ohio River. The majority of the commercial cargo consists of coal, oil and petroleum. Finally, the Ohio River serves as a source of recreation for many individuals throughout the basin. The river provides warm water habitat for over 140 species of fish, drawing fishermen and nature enthusiasts to the banks of the river. It also provides recreational opportunities for boaters and a natural setting for dining and festivals. According to the Clean Water Act, states must assess the degree to which state waters meet their designated uses. Designated uses for the Ohio River include contact recreation, aquatic life, public water supply, and fish consumption.

Flows

A series of locks and dams, operated and maintained by the United States Army Corps of Engineers, 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 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 can affect the various uses of the Ohio River adversely. Aquatic biota, for example, may experience lower dissolved oxygen levels during low flow periods. During high flow conditions, bacteria levels often increase due to combined sewer overflows (CSOs).

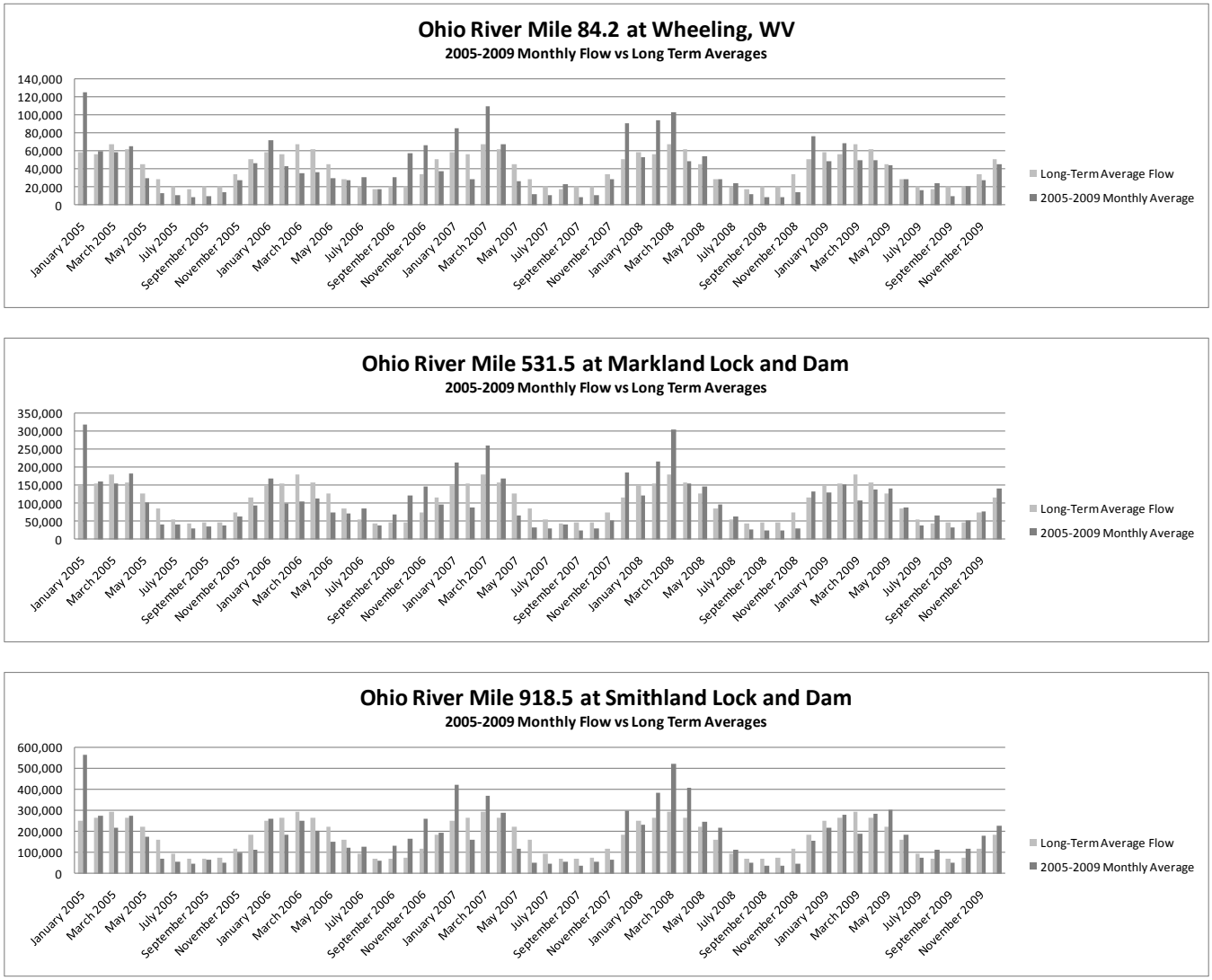


Figure 3: Flow data from the Ohio River at Wheeling, WV; Markland, KY; and Smithland, KY. Monthly average flows are compared to long-term flows. Flows in 2006-2007 tended to be lower than the long-term average. Wheeling, WV (the upper most site shown) had the highest percentage of flows greater than the long-term average.

Chapter 2: General Water Quality Conditions

Figure 4 presents box and whisker plots of all the Ohio River Bimonthly and Clean Metals monitoring data for the period January 2005 through December 2009. The data represents 29 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 C and D.

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 would 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. As a general rule, West Point tends to have the highest concentrations for many of the parameters.

Ammonia concentrations are fairly consistent along the entire river, with the exception of the mid-river where stations from Greenup L&D to West Point, Kentucky 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 trends (see Chapter 6) shows basinwide increase of chloride. 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 "middle of the road" 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. All data collected on the Ohio River is below the stream criterion of 10 mg/L.

Very few detections of Phenolics occur, but were more prevalent at the Newburgh and L&D 52 stations, which resulted in impairments to the public water supply use. The current Method Reporting Limit causes any reported detection to represent an exceedance of the water quality criterion of 5 ug/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.

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 West Point station. West Point has the highest concentrations on the river with a median concentration around 0.8 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 are consistently around 0.5 mg/L for the entire upper half of the river, then steadily increase from Meldahl to a high of 0.2 mg/L at West Point, from there concentrations remain consistent at 0.1 mg/L from Cannelton and downstream (the lowest quarter of the river). Maximum concentrations remain 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 ug/L occurring at New Cumberland, and decreasing to less than 5 mg/L at L&D 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 L&D 52. Arsenic criteria are never exceeded, with a maximum concentration for total arsenic of 4 ug/L occurring at West Point, which compares to the most stringent criterion for Total Arsenic of 10 ug/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 West Point. Typical concentrations remain well below the most stringent criterion for dissolved cadmium is 2.2 ug/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 West Point and Smithland. 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 ug/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 7.28 ug/L also occurred at New Cumberland. The dissolved criterion of 9 ug/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 state 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 ug/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 West Point, Smithland, and L&D 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 ug/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 West Point.

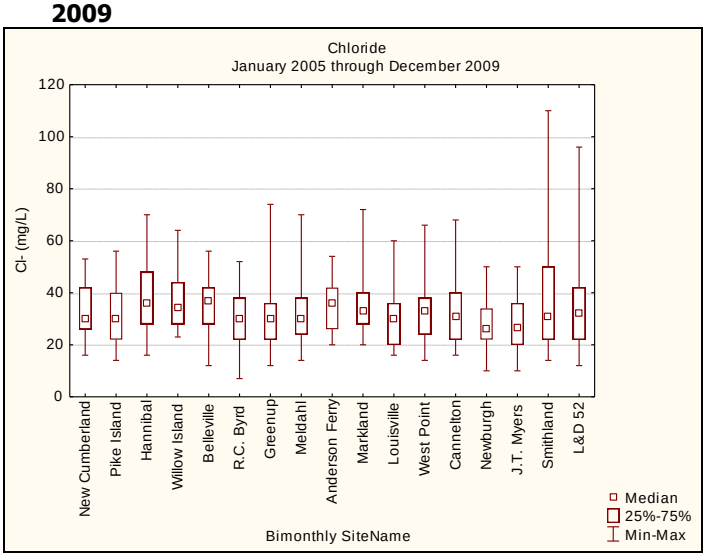
Dissolved nickel is one of the few parameters which decrease in a downstream direction with the exception of a

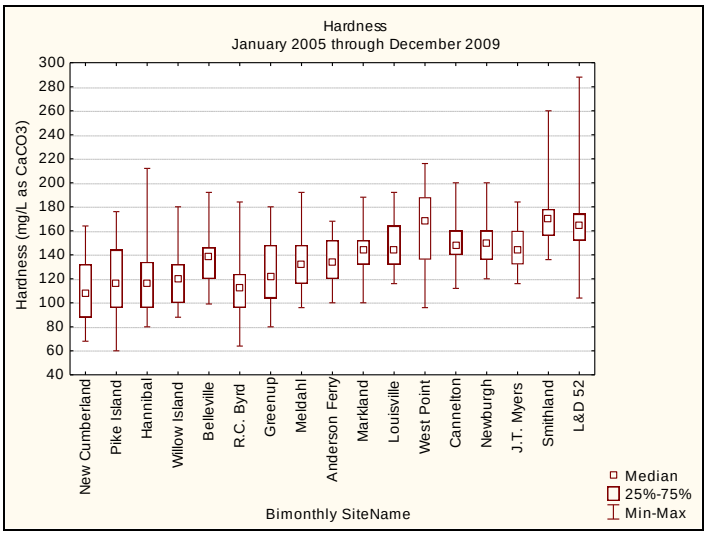
spike at West Point, while dissolved concentrations remain fairly consistent throughout the river. The maximum dissolved concentration of almost 7.6 ug/L occurred at the Greenup Station. The dissolved criterion of 52 ug/L (at typical hardness) was never exceeded.

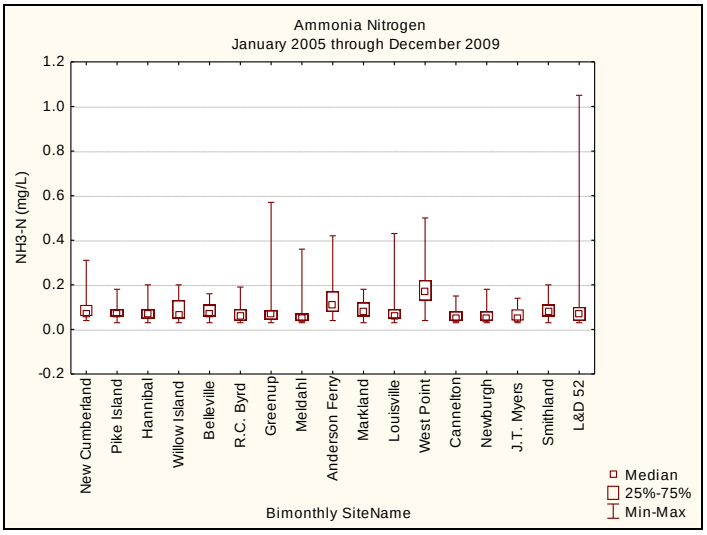
Dissolved and total Selenium concentrations are fairly consistent and equal throughout the entire river with the exception of a spike at West Point. Total selenium concentrations never exceeded the criterion of 5 ug/L.

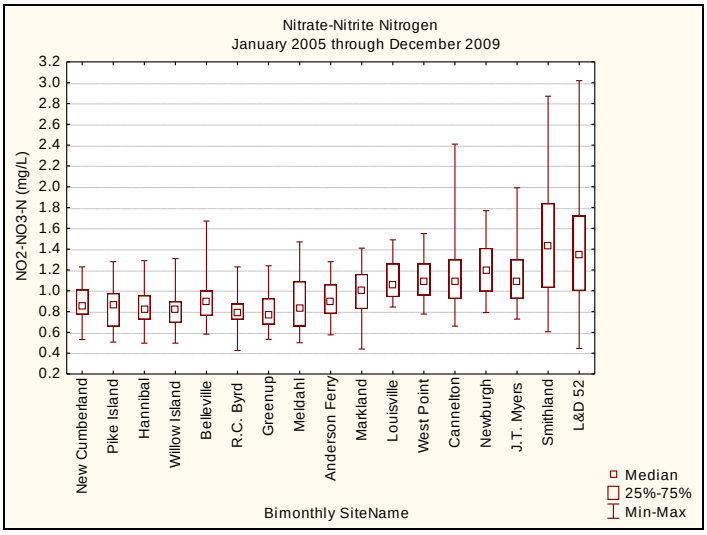
Dissolved and total Zinc concentrations are consistent along the entire length of the Ohio River, with the maximum concentration of approximately 90 ug/L occurring at Anderson Ferry. The dissolved criterion of 117 ug/L (at typical hardness) is never exceeded throughout the entire river.

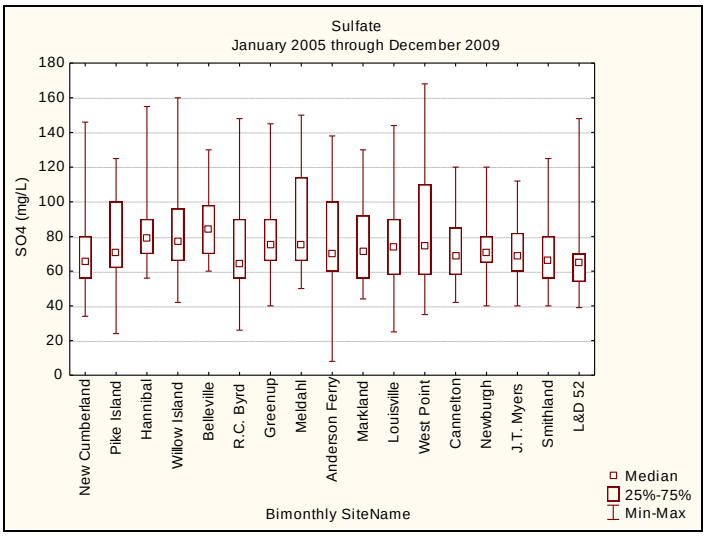
Figure 4: Boxplots: Median 25th, 75th Maximum, Minimum All Bimonthly and Metals Data January 2005-December 2009

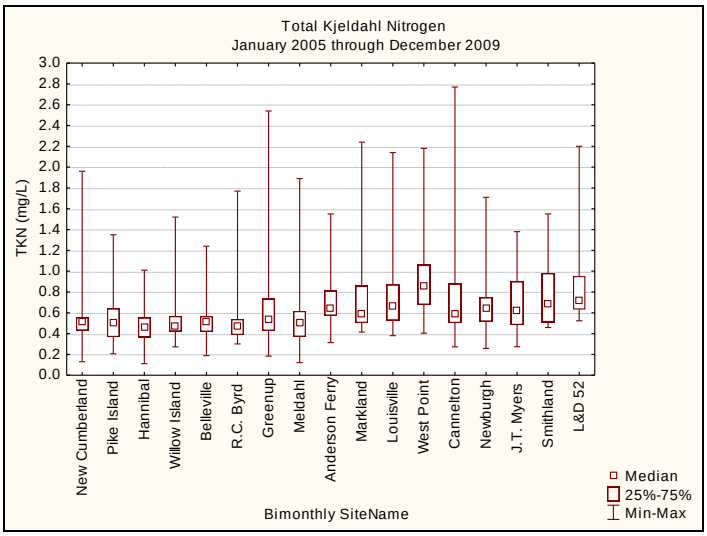


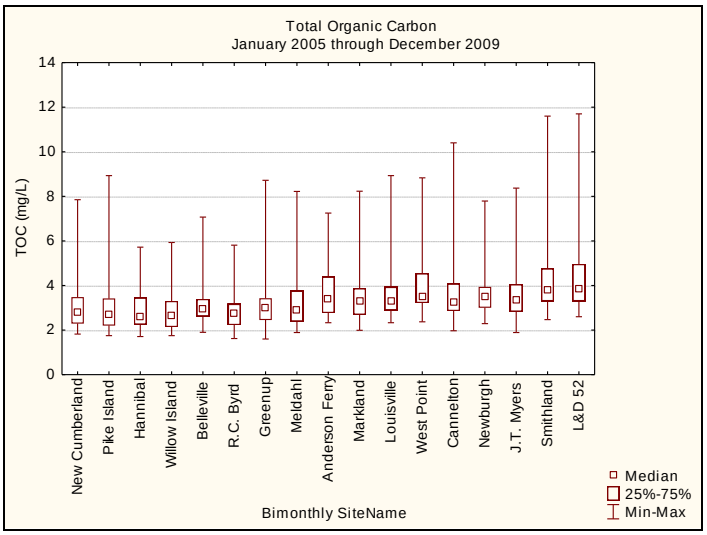


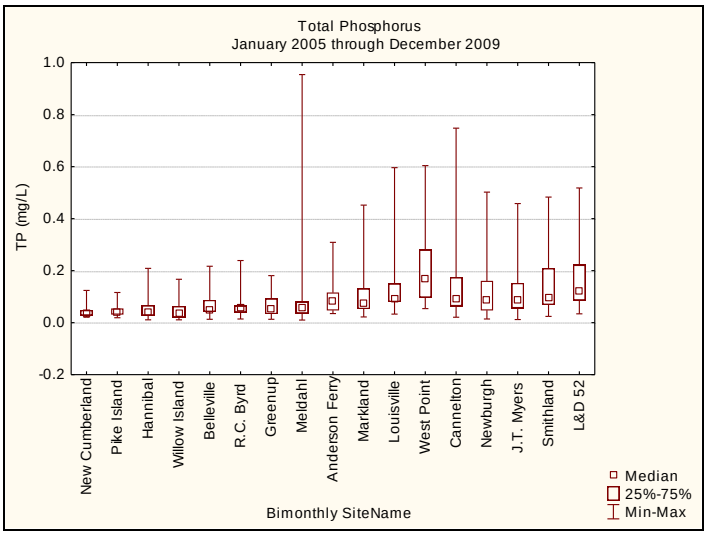


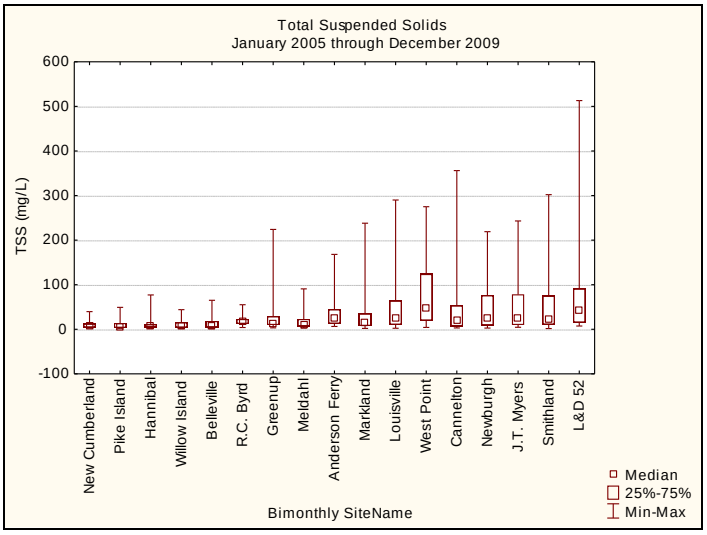


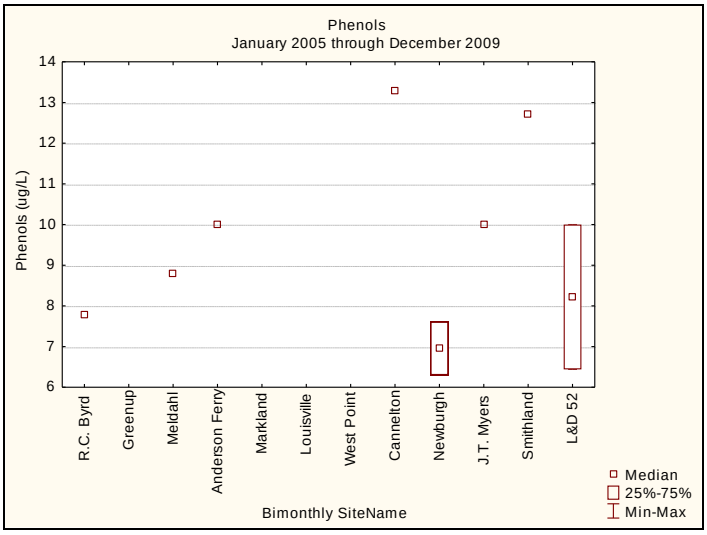


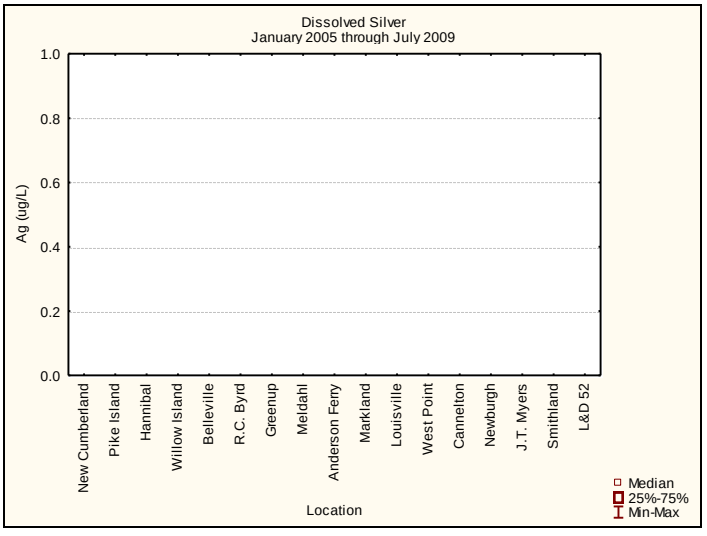


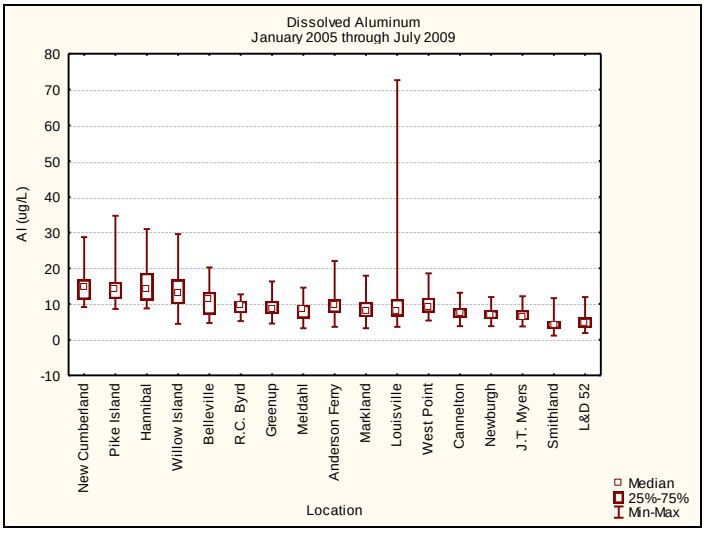

Total Organic Carbon
January 2005 through December 2009
TOC (mg/L)
Bimonthly SiteName
Median
25%-75%
Min-Max

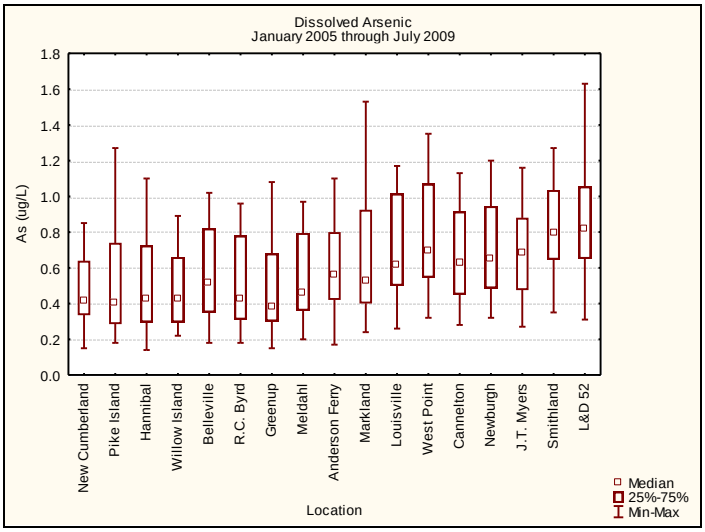

Total Phosphorus
January 2005 through December 2009
TP (mg/L)
Bimonthly SiteName
Median
25%-75%
Min-Max

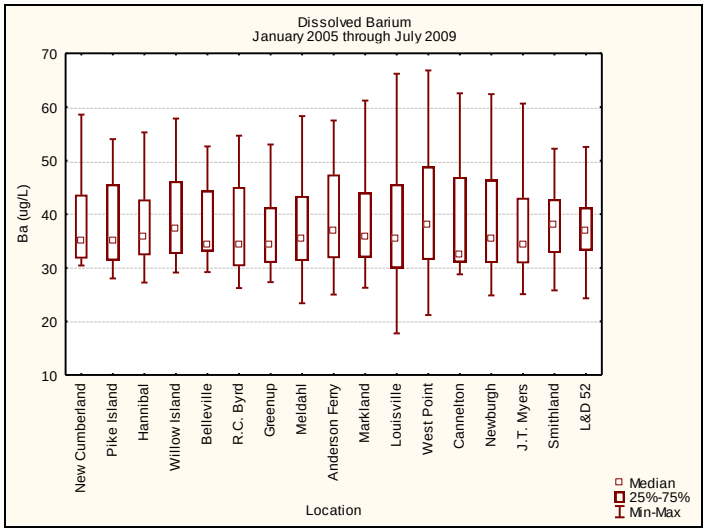

Total Suspended Solids
January 2005 through December 2009
TSS (mg/L)
Bimonthly SiteName
Median
25%-75%
Min-Max

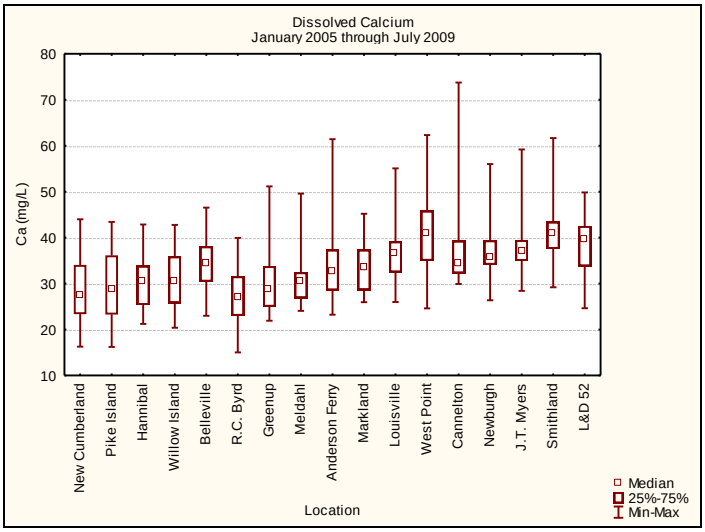

Phenols
January 2005 through December 2009
Phenols (ug/L)
Bimonthly SiteName
Median
25%-75%
Min-Max

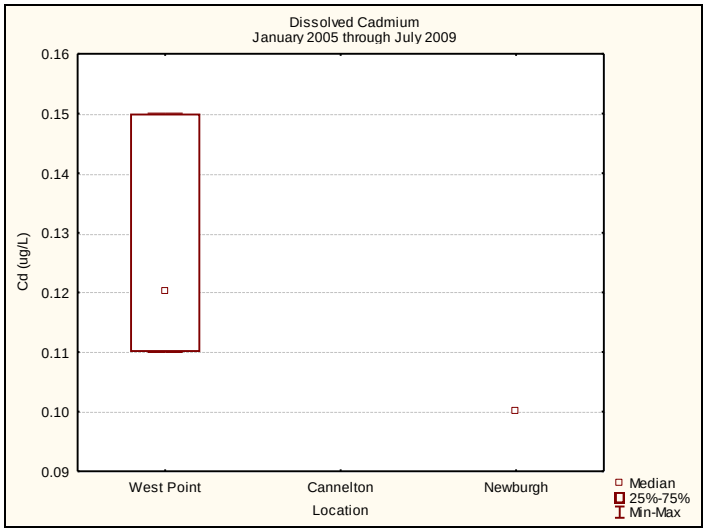

Dissolved Silver
January 2005 through July 2009
Ag (ug/L)
Location
Median
25%-75%
Min-Max

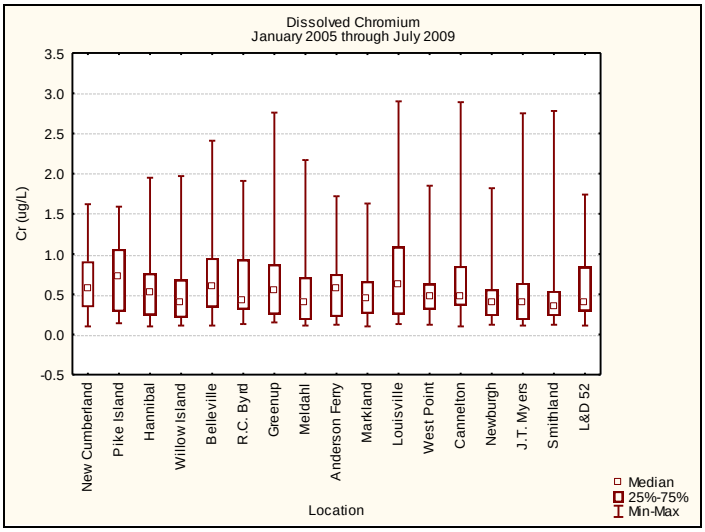

Dissolved Aluminum
January 2005 through July 2009
Al (ug/L)
Location
Median
25%-75%
Min-Max

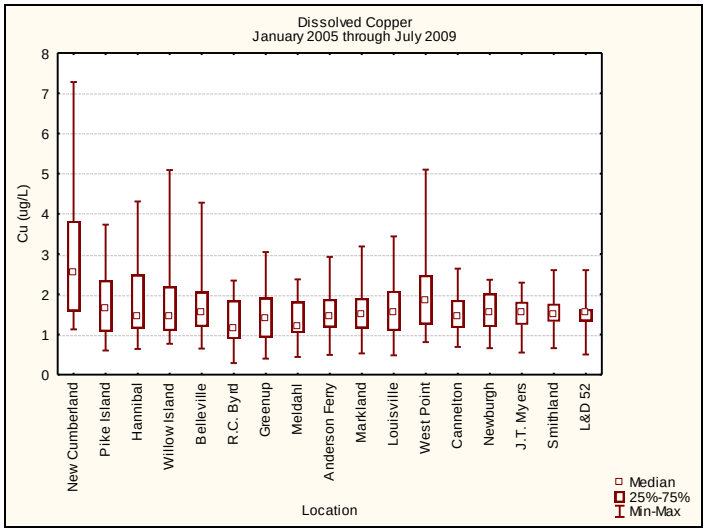

Dissolved Arsenic
January 2005 through July 2009
As (ug/L)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

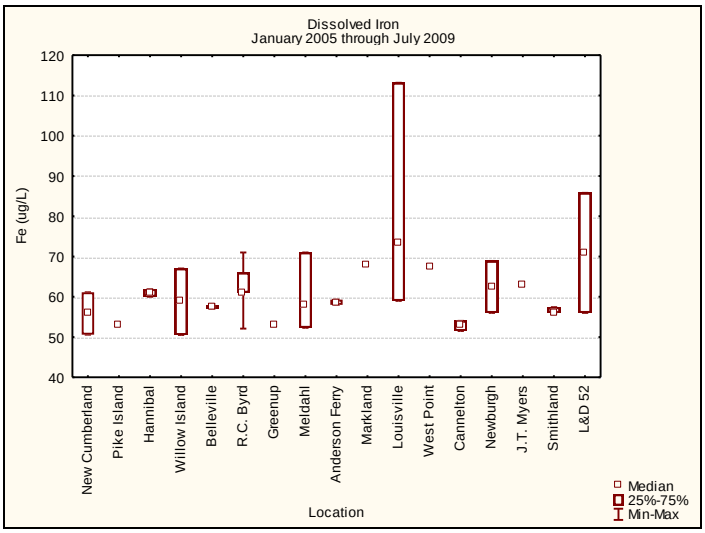

Dissolved Barium
January 2005 through July 2009
Ba (ug/L)
10
20
30
40
50
60
70
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

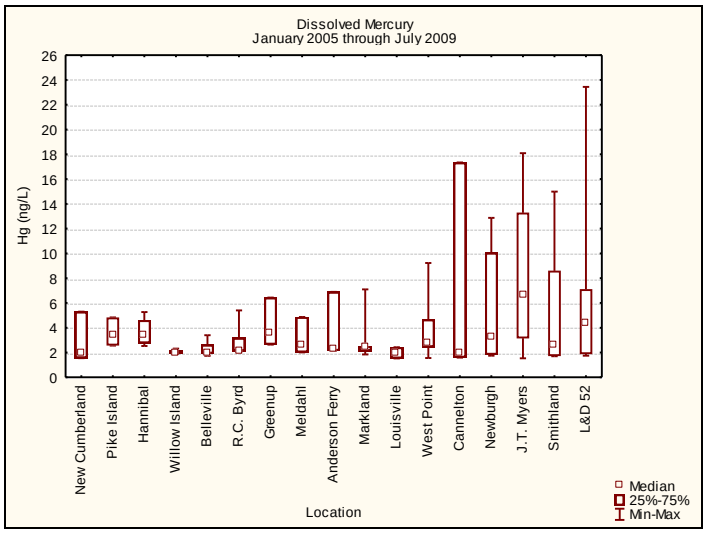

Dissolved Calcium
January 2005 through July 2009
Ca (mg/L)
10
20
30
40
50
60
70
80
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

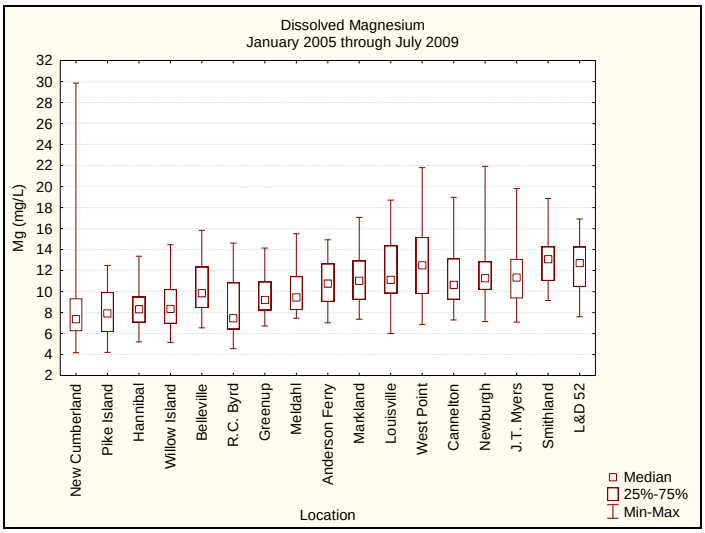

Dissolved Cadmium
January 2005 through July 2009
Cd (ug/L)
0.09
0.10
0.11
0.12
0.13
0.14
0.15
0.16
West Point
Cannelton
Newburgh
Location
Median
25%-75%
Min-Max

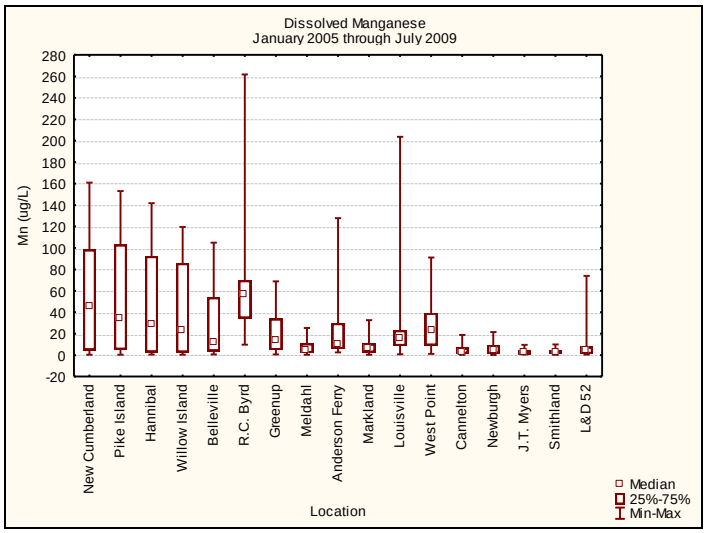

Dissolved Chromium
January 2005 through July 2009
Cr (ug/L)
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

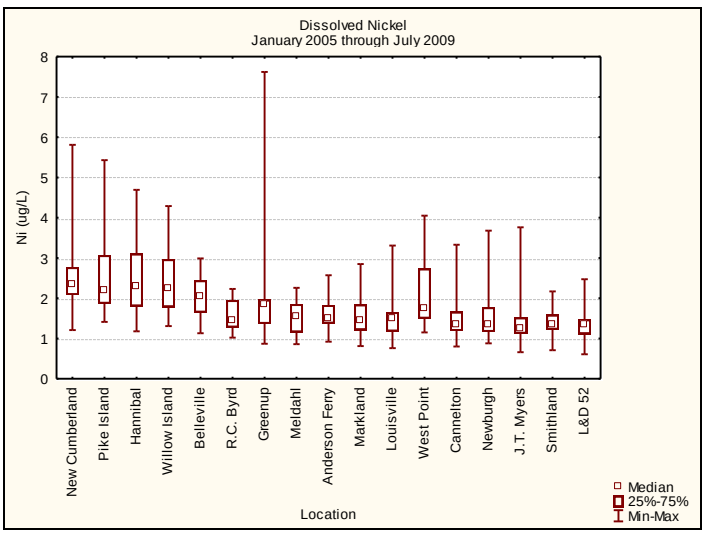

Dissolved Copper
January 2005 through July 2009
Cu (ug/L)
0
1
2
3
4
5
6
7
8
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

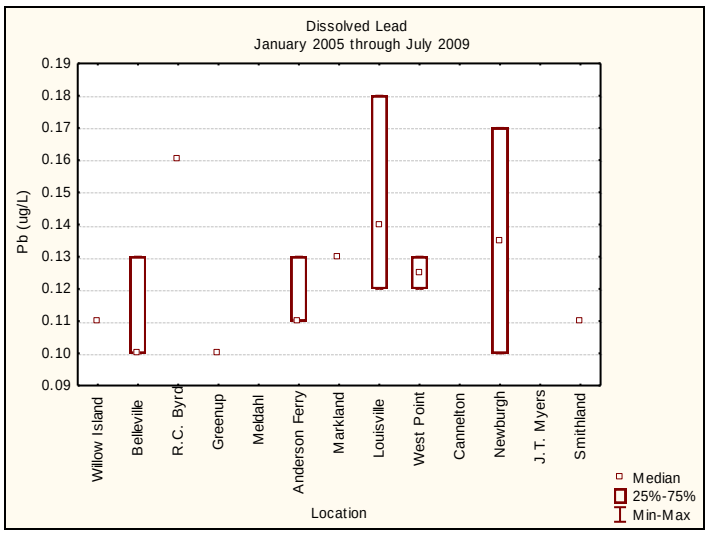

Dissolved Iron
January 2005 through July 2009
Fe (ug/L)
120
110
100
90
80
70
60
50
40
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

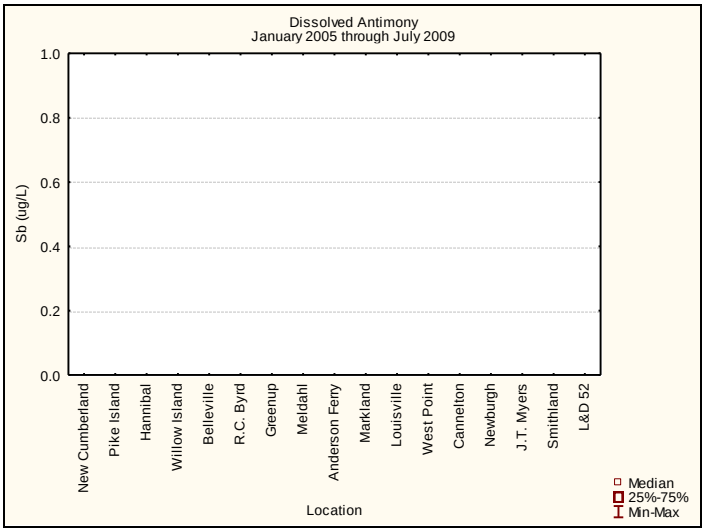

Dissolved Mercury
January 2005 through July 2009
Hg (ng/L)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

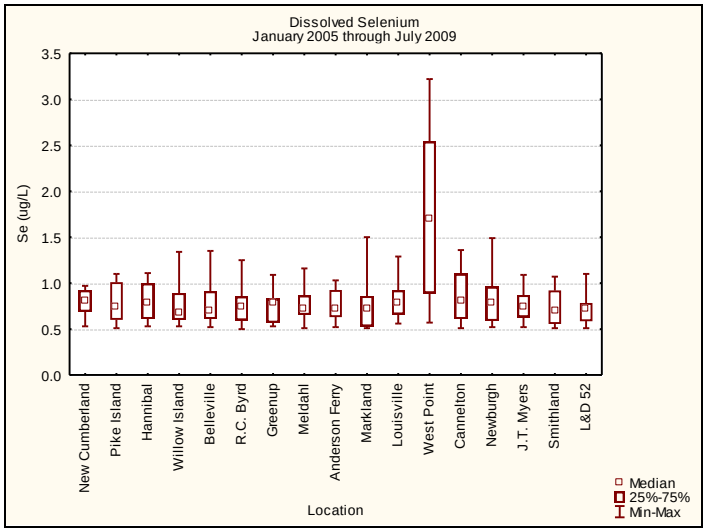

Dissolved Magnesium
January 2005 through July 2009
Mg (mg/L)
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

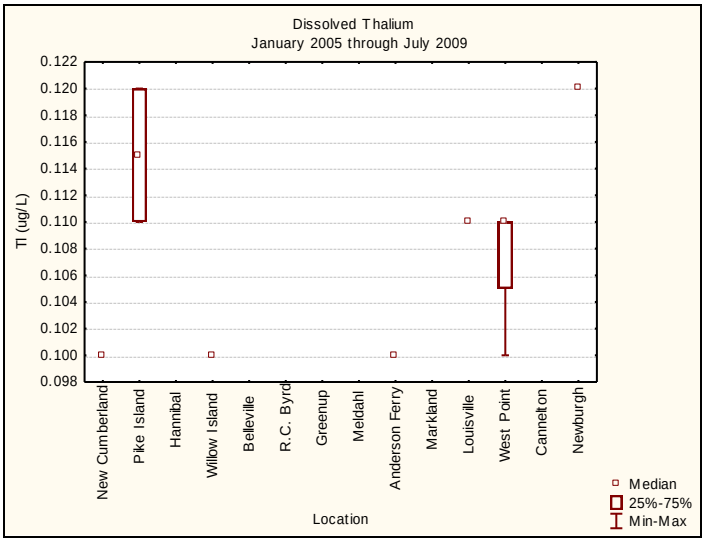

Dissolved Manganese
January 2005 through July 2009
Mn (ug/L)
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
-20
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

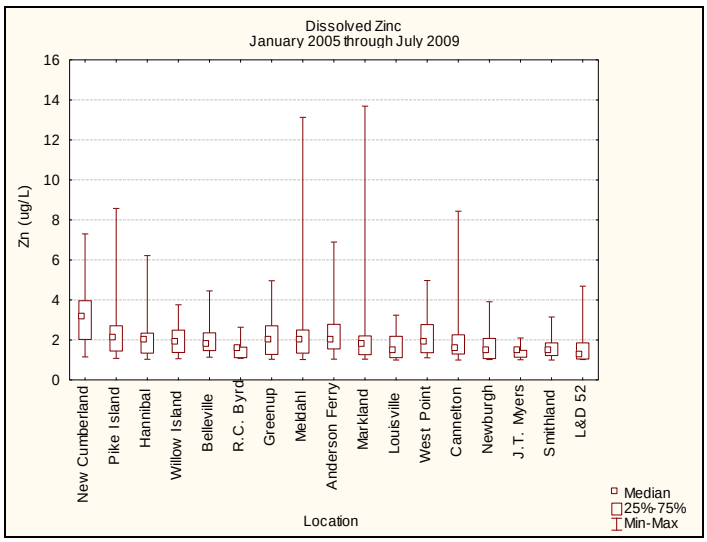

Dissolved Nickel
January 2005 through July 2009
Ni (ug/L)
8
7
6
5
4
3
2
1
0
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

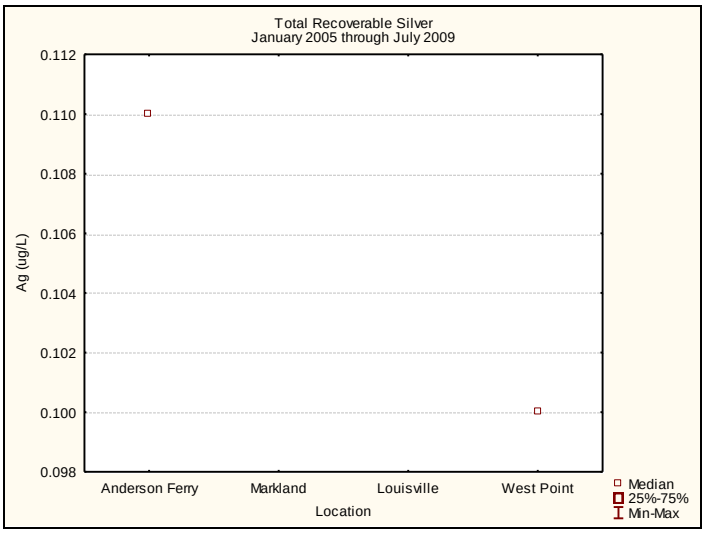

Dissolved Lead
January 2005 through July 2009
Pb (ug/L)
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
Location
Median
25%-75%
Min-Max

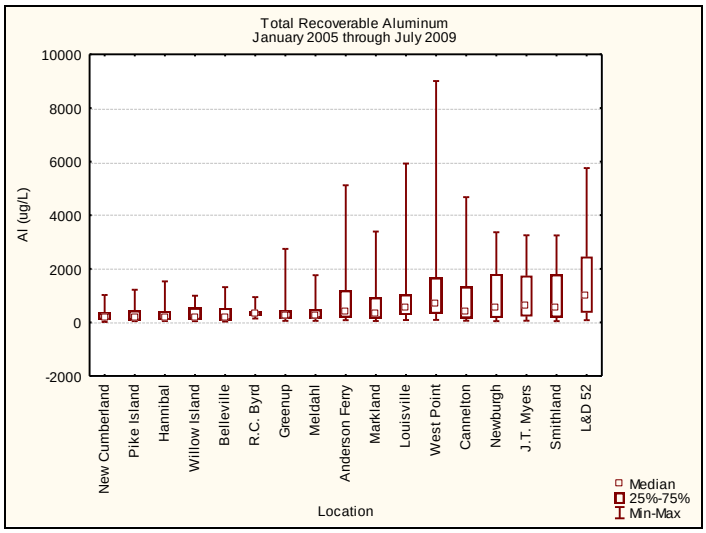

Dissolved Antimony
January 2005 through July 2009
Sb (ug/L)
1.0
0.8
0.6
0.4
0.2
0.0
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

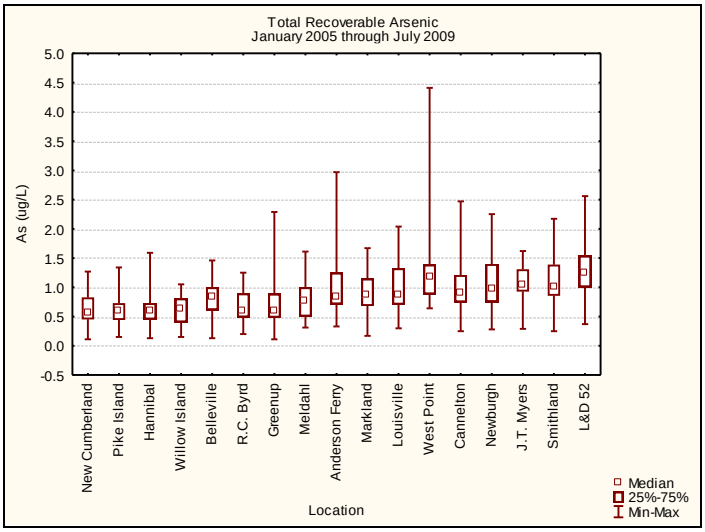

Dissolved Selenium
January 2005 through July 2009
Se (ug/L)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

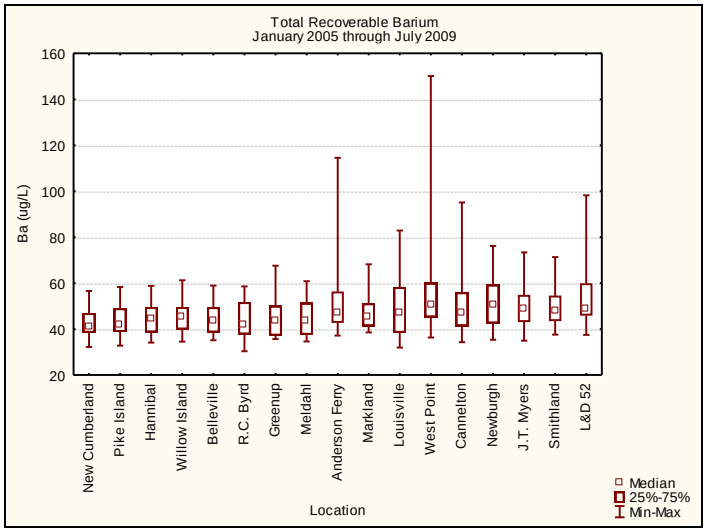

Dissolved Thalium
January 2005 through July 2009
Tl (ug/L)
0.122
0.120
0.118
0.116
0.114
0.112
0.110
0.108
0.106
0.104
0.102
0.100
0.098
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
Location
Median
25%-75%
Min-Max

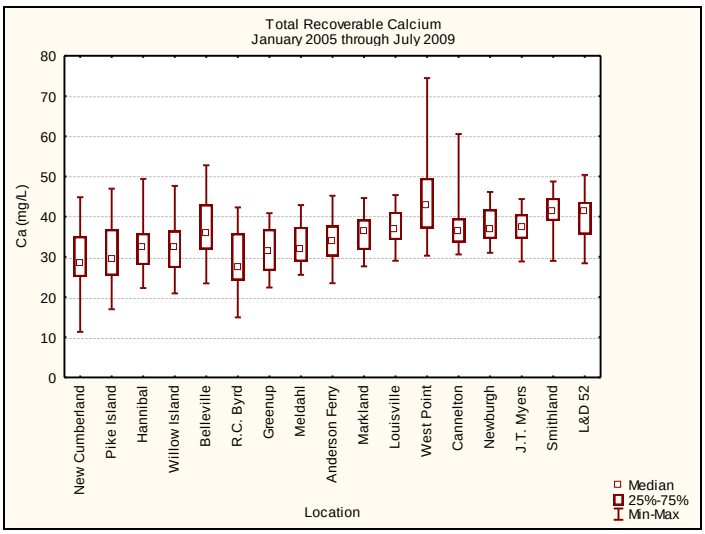

Dissolved Zinc
January 2005 through July 2009
Zn (ug/L)
16
14
12
10
8
6
4
2
0
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

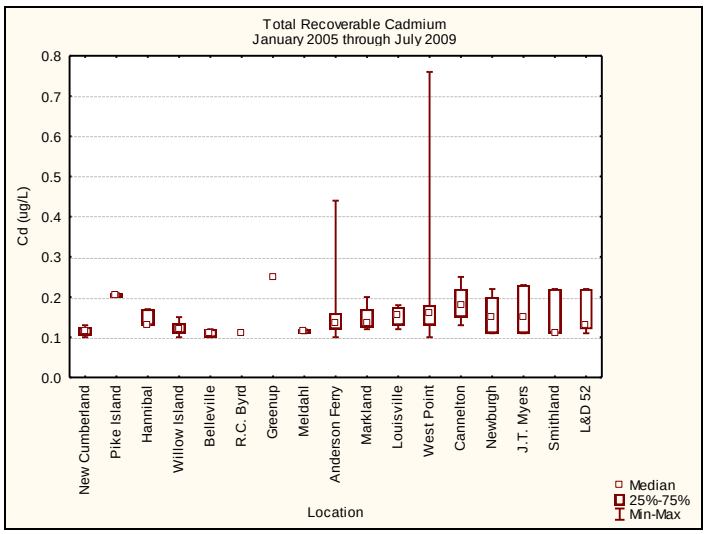

Total Recoverable Silver
January 2005 through July 2009
Ag (ug/L)
0.112
0.110
0.108
0.106
0.104
0.102
0.100
0.098
Anderson Ferry
Markland
Louisville
West Point
Location
Median
25%-75%
Min-Max

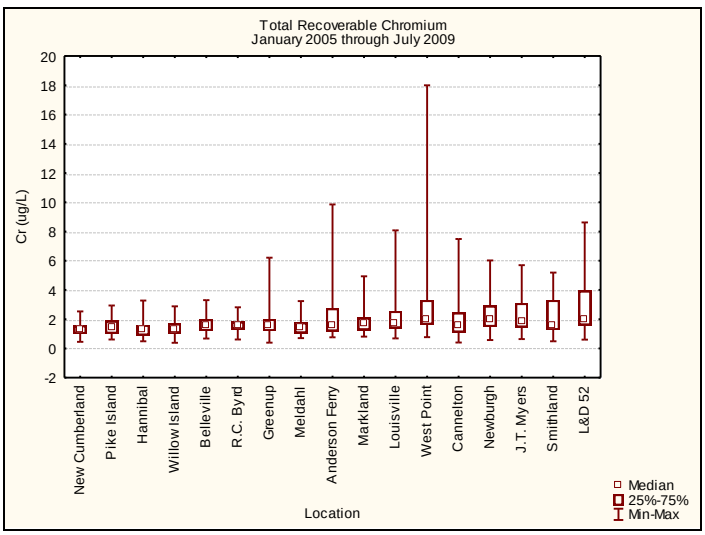

Total Recoverable Aluminum
January 2005 through July 2009
Al (ug/L)
10000
8000
6000
4000
2000
0
-2000
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

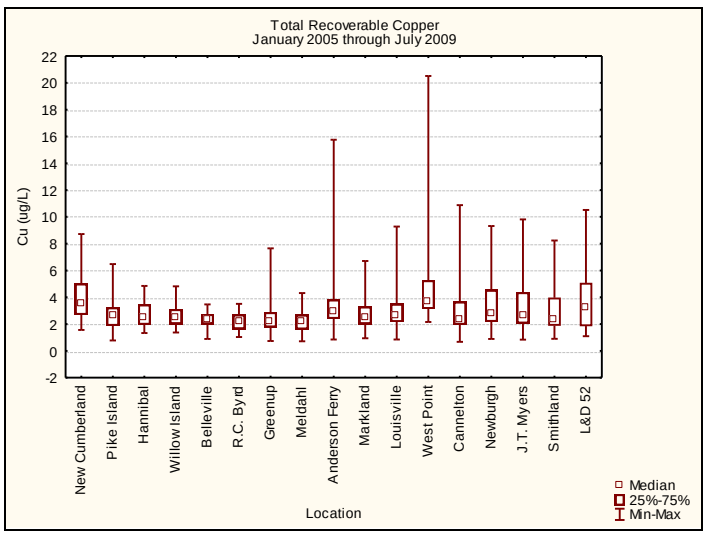

Total Recoverable Arsenic
January 2005 through July 2009
As (ug/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

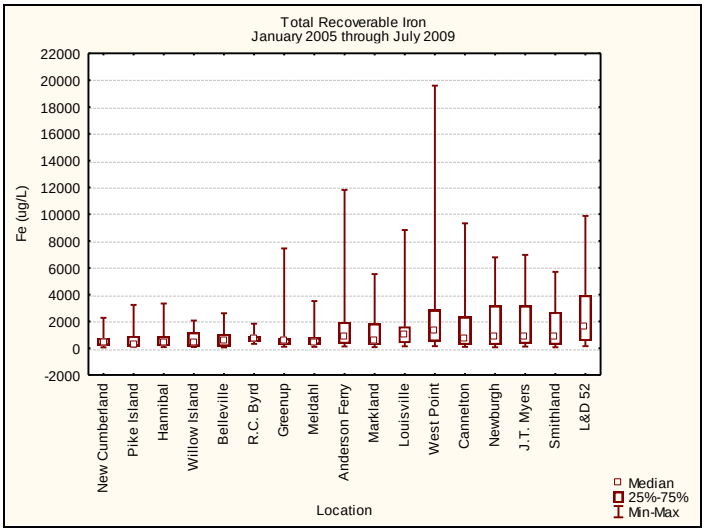

Total Recoverable Barium
January 2005 through July 2009
Ba (ug/L)
160
140
120
100
80
60
40
20
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

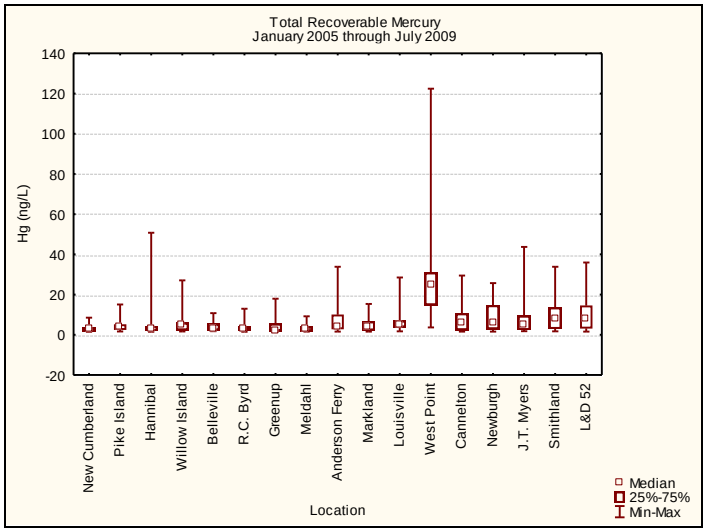

Total Recoverable Calcium
January 2005 through July 2009
Ca (mg/L)
80
70
60
50
40
30
20
10
0
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

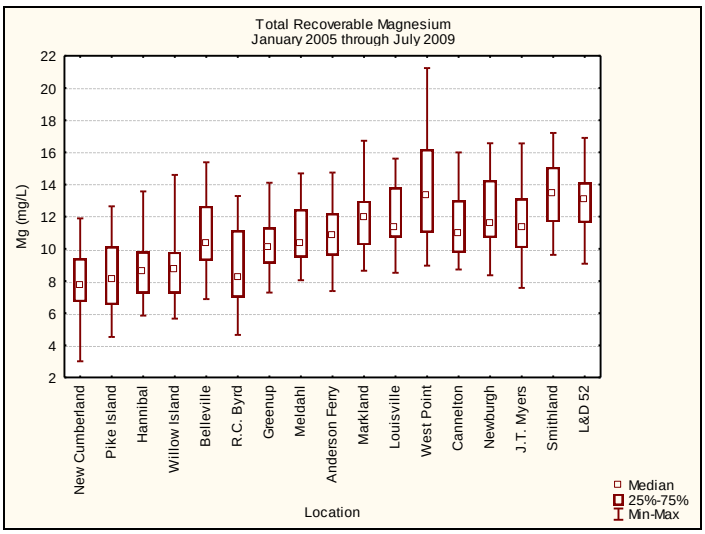

Total Recoverable Cadmium
January 2005 through July 2009
Cd (ug/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

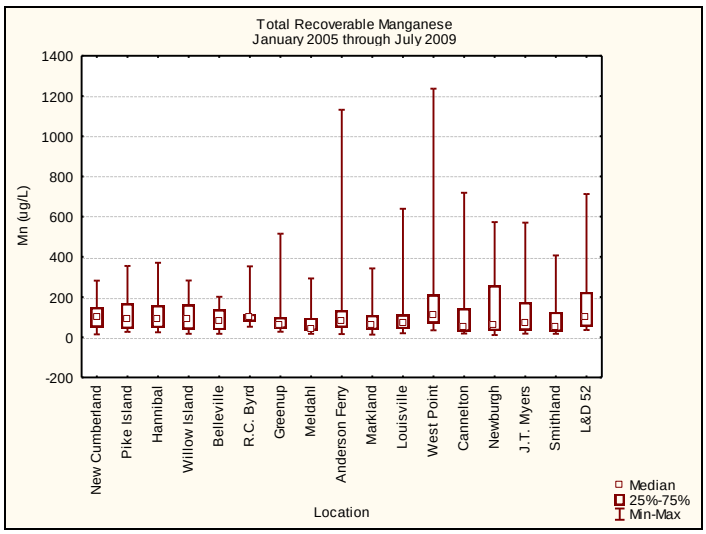

Total Recoverable Chromium
January 2005 through July 2009
Cr (ug/L)
20
18
16
14
12
10
8
6
4
2
0
-2
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

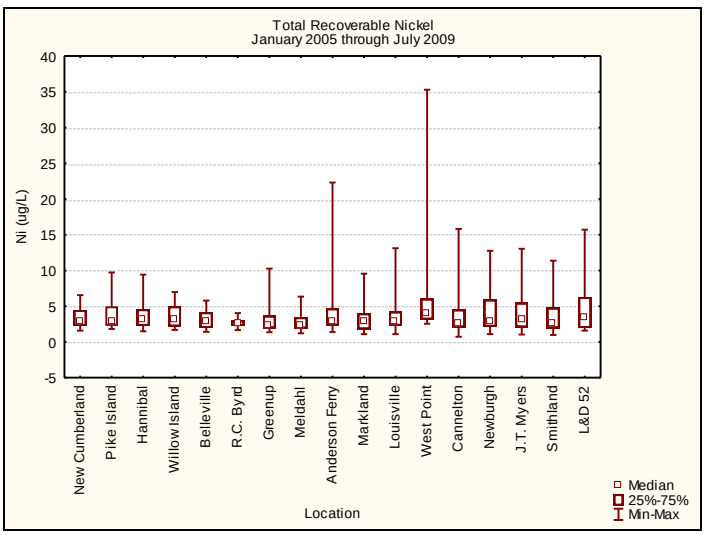

Total Recoverable Copper
January 2005 through July 2009
Cu (ug/L)
22
20
18
16
14
12
10
8
6
4
2
0
-2
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

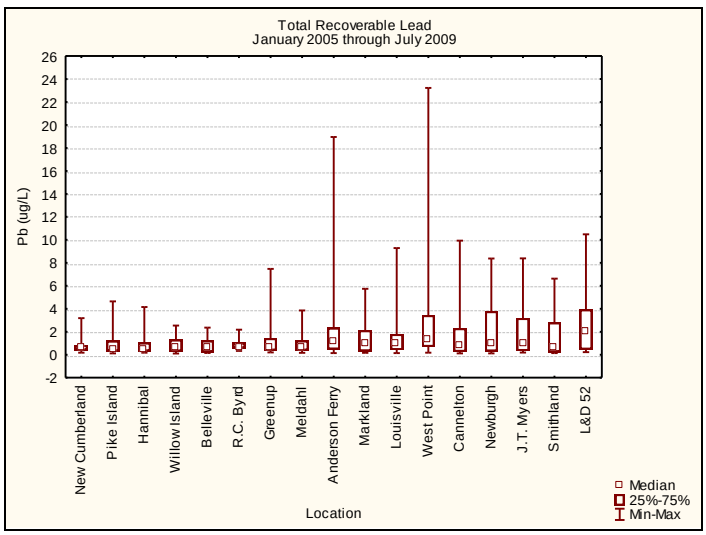

Total Recoverable Iron
January 2005 through July 2009
Fe (ug/L)
22000
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

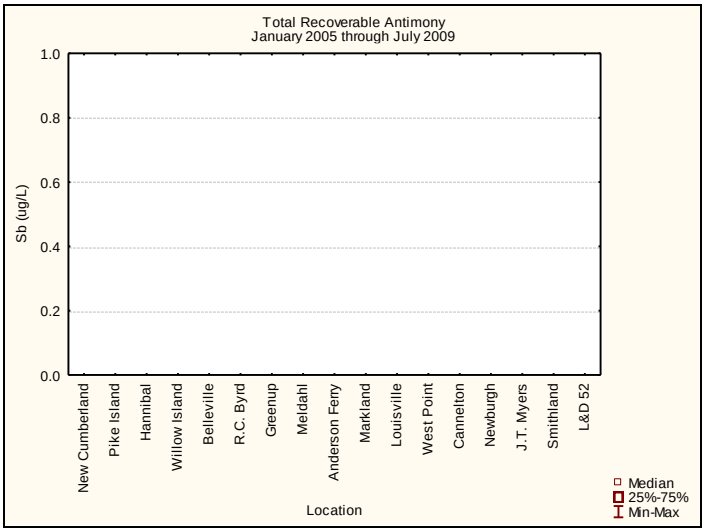

Total Recoverable Mercury
January 2005 through July 2009
Hg (ng/L)
140
120
100
80
60
40
20
0
-20
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

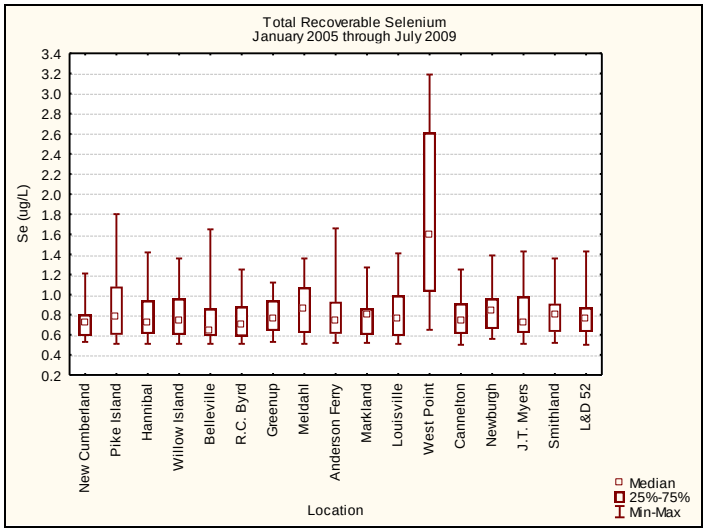

Total Recoverable Magnesium
January 2005 through July 2009
Mg (mg/L)
22
20
18
16
14
12
10
8
6
4
2
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

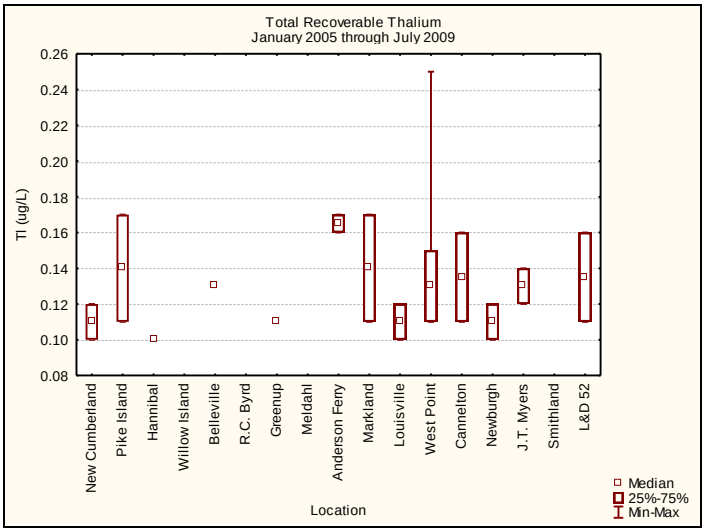

Total Recoverable Manganese
January 2005 through July 2009
Mn (ug/L)
1400
1200
1000
800
600
400
200
0
-200
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max


Total Recoverable Nickel
January 2005 through July 2009
Ni (ug/L)
40
35
30
25
20
15
10
5
0
-5
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max


Total Recoverable Lead
January 2005 through July 2009
Pb (ug/L)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
-2
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max


Total Recoverable Antimony
January 2005 through July 2009
Sb (ug/L)
1.0
0.8
0.6
0.4
0.2
0.0
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max


Total Recoverable Selenium
January 2005 through July 2009
Se (ug/L)
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max


Total Recoverable Thalium
January 2005 through July 2009
Tl (ug/L)
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
New Cumberland
Pike Island
Hannibal
Willow Island
Belleville
R.C. Byrd
Greenup
Meldahl
Anderson Ferry
Markland
Louisville
West Point
Cannelton
Newburgh
J.T. Myers
Smithland
L&D 52
Location
Median
25%-75%
Min-Max

PART III: SURFACE WATER MONITORING AND ASSESSMENT

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

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:

- Bimonthly Sampling
- Clean Metals Sampling
- Fish Population Monitoring
- Contact Recreation Bacteria Monitoring
- Longitudinal Bacteria Surveys
- Fish Tissue Sampling
- High Volume PCB and Dioxin Sampling
- Temperature and Dissolved Oxygen monitoring (operated by the US Army Corp and Hydropower Facilities)

Monitoring a large river system such as the Ohio River presents challenges related to spatial and temporal coverage. However, ORSANCO combines multiple monitoring programs to assess the attainment status of the Ohio River's designated uses (Figure 5). Water quality criteria used to assess use support are contained in the 2009 Revision of *Pollution Control Standards for Discharges to the Ohio River* (Appendix P).

Bimonthly & Clean Metals Sampling

The Bimonthly and Clean Metals sampling programs are used to assess aquatic life and public water supply uses. These programs entail the collection of water column grab samples from 17 Ohio River stations once every other month (Appendix B, Table 1). The samples are collected by contract samplers and ORSANCO staff and analyzed for certain physical and chemical parameters by a contract laboratory. In October 2000, ORSANCO changed the aquatic life use criteria for metals from total recoverable metals to dissolved metals. This change was based on the conclusion that dissolved metals data were more accurate and representative of metals dissolved in the water column, and therefore available to aquatic life. Dissolved metals criteria for the protection of aquatic life have very low concentrations, some in the single parts per billion range. Therefore, collection of uncontaminated samples and low-level analyses using clean techniques is essential. However, although dissolved criteria are used, every sample is analyzed for both total recoverable and dissolved metals. The Commonwealth of Virginia state laboratory provides the clean metals sampling equipment and analyses. Clean metal parameters as well as Bimonthly Sampling Program analytes (Table 2) are also used to determine the degree of support for aquatic life. Applicable results from mainstem stations are compared to established stream criteria. For this 2010 report, Bimonthly and Clean Metals data from January 2005 to December 2009 were used to make use assessments. Data from these programs also were used to assess the public water supply use.

Table 1: Station Locations for Clean Metals and Bimonthly Sampling

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

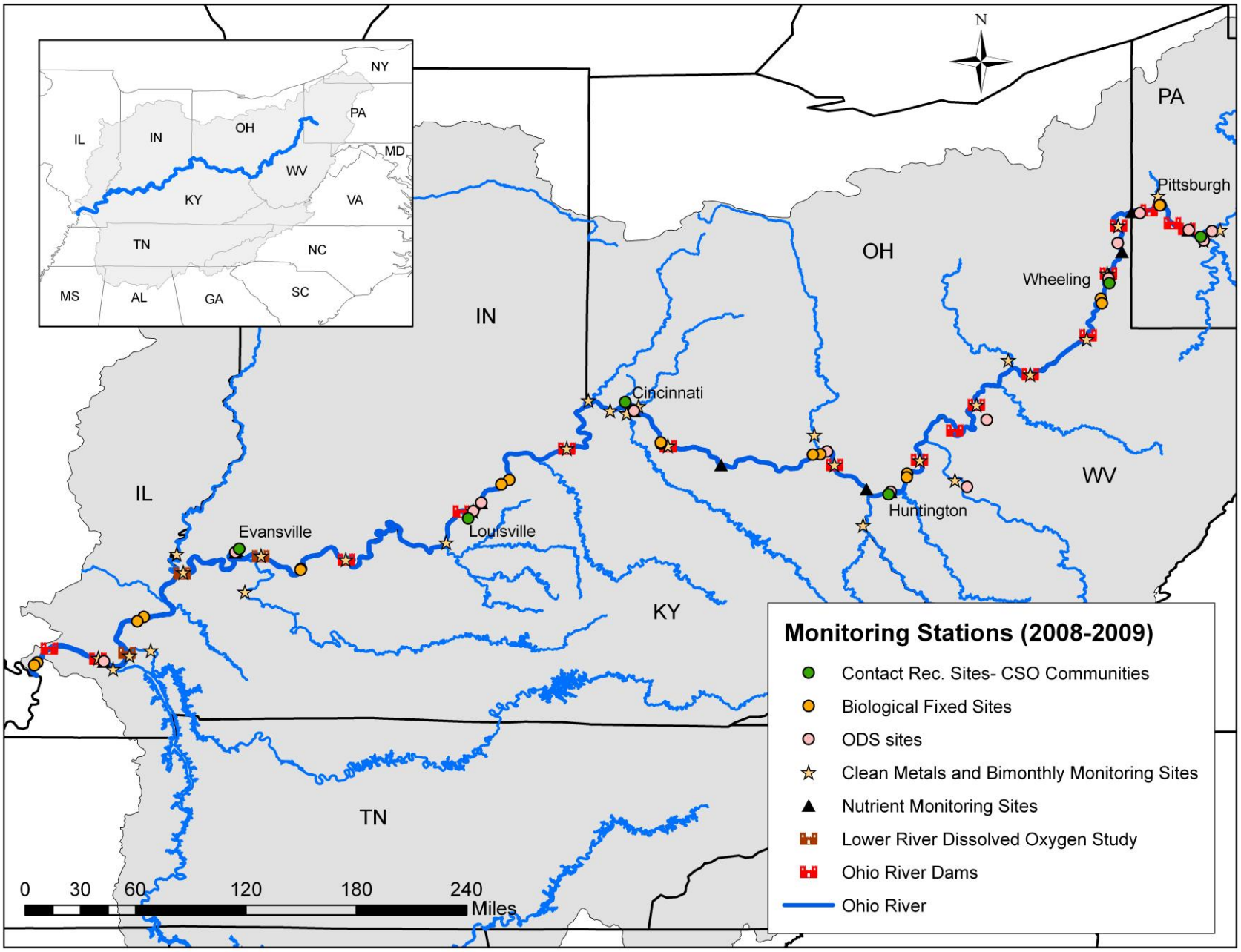


Figure 5: Ohio River Monitoring Sites

Table 2: Clean Metals and Bimonthly Sampling Parameters

Element	Analysis	Detection Limit (ug/L)
Aluminum	EPA 1638	1
Antimony	EPA 1638	0.1
Arsenic	EPA 1638	0.5
Barium	EPA 1638	10
Cadmium	EPA 1638	0.1
Calcium	EPA 200.7	1,000
Copper	EPA 1638	0.1
Chromium	EPA 1638	0.1
Iron	EPA 200.7	100
Lead	EPA 1638	0.1
Magnesium	EPA 200.7	1,000
Manganese	EPA 1638	0.1
Mercury	EPA 245.7	0.0002
Nickel	EPA 1638	0.1
Selenium	EPA 1638	0.5
Silver	EPA 1638	0.1
Thallium	EPA 1638	0.2
Zinc	EPA 1638	1

Parameters	Analysis	Detection Limit
Ammonia Nitrogen	EPA 350.3	0.03 mg/L
Chloride	EPA 325.3	1.0 mg/L
Hardness	SM 2340C	1.0 mg/L
Nitrate + Nitrite	EPA 353.3	0.02 mg/L
Phenolics	EPA 420.1	0.005 mg/L
Total Kjeldahl Nitrogen	SM 4500	0.20 mg/L
Sulfate	HACH 8051	1.0 mg/L
Total Suspended Solids	EPA 160.2	1.0 mg/L
Total Phosphorus	EPA 365.3	0.01 mg/L
Total Organic Carbon	EPA 415.1	0.5 mg/L
Total Cyanide	EPA 335.2	5.0 ug/L

Fish Population Monitoring

Fish population data from 2006 and 2007 were used to assess support of the aquatic life use. The Commission monitors the fish population annually from July through October, conducting between 100 and 200 surveys of the fish community. The monitoring strategy includes both fixed station and probability-based sampling. Samples consist of 500 meter shoreline zones that are electrofished by boat at night. The fish are netted, weighed, measured, species recorded, and any unusual abnormalities such as growths or lesions are noted. Habitat types within the zone also are recorded. Work usually is conducted in four pools throughout a field season, completing the entire length of the Ohio River (20 pools) in five years. Pools sampled in 2006 were Montgomery, Willow Island, Greenup, and Cannelton. In 2007, Emsworth, Pike Island, Meldahl, Cannelton, and Newburgh pools were sampled. Fifteen randomly selected zones are sampled in each pool to complete an assessment of the entire pool. If impairment is found, pools may be resampled the following year. Cannelton pool is listed in both 2006 and 2007 because fluctuating flows prohibited the sampling of all pool sites in 2006; sampling was completed in 2007. In past years, the sampling effort has focused on developing a numeric index to determine the integrity of fish communities. That index has been completed and includes a number of important factors such as number of fish, fish biomass, species diversity, and abundance of pollution tolerant and intolerant species. The Ohio River Fish Index (ORFIn) was based on the nationally used Index of Biotic Integrity (IBI), which was designed to assess smaller streams. The ORFIn, however, has been customized to assess the Ohio River, with expected values developed for the different habitats found in this large river system. Aquatic life use support is assessed by comparing measured, numeric index values to expected values. Pools with greater than 25 percent of sites scoring below the expected values for a specific habitat types were assessed as impaired.

Contact Recreation Bacteria Sampling

The Commission collects bacteria samples from May through October in six large urban communities with combined sewer systems to evaluate support of the contact recreation use. Locations include Pittsburgh, Wheeling, Huntington, Cincinnati, Louisville, and Evansville (Appendix B). Five rounds of sampling are completed monthly for each urban community sampling location and analyzed for fecal coliform and *E. coli*. There are at least three sites in each community sampled; one being upstream of the CSO community, one downtown, and one downstream. 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 (site list in 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 collects fish tissue samples between July and October and analyzes them for certain contaminants to assess support of the fish consumption use (Appendix L). In 2005 and 2006, approximately 91 fish tissue samples are analyzed from various Ohio River locations depending on fish population monitoring efforts. Pollutant contamination in the tissue is based on a composite of up to five fillets from various species. Tissue contaminants analyzed include PCBs, chlordane, mercury, cadmium, lead and certain pesticides. The states use the data to develop and update public fish consumption advisories.

High Volume PCB and Dioxin Sampling

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

Other Sources of Data

Although many states rely on ORSANCO to monitor water quality in the Ohio River, most states collect some data on the Ohio River each year, though not as extensively as ORSANCO. To ensure the most comprehensive data set available to assess the quality of the Ohio River, ORSANCO posted a public request for data on their website in addition to sending postcard requests to other government agencies, volunteer monitoring groups, and private industries.

Pennsylvania Department of Environmental Protection (PADEP) and United States Geological Service (USGS) chemical monitoring data for the Ohio River in Pennsylvania was compared to ORSANCO Water Quality Criteria. United States Army Corp of Engineers or electric utility/hydropower agencies data for temperature and dissolved oxygen data was assessed for compliance with Aquatic Life Criteria. Data collected by various drinking water

utilities on the Ohio River is used as a supplement to ORSANCO bacteria monitoring for assessment of Contact Recreation Criteria.

Dissolved Oxygen and Temperature Monitoring

Dissolved oxygen and temperature is monitored by United States Army Corp of Engineers or electric utility/hydropower agencies at 13 Ohio River stations in hourly or 15-minute increments by the US Army Corps of Engineers and Hydropower or other electric power utilities operating on the Ohio River. Table 3 details the locations from which ORSANCO obtains temperature and dissolved oxygen data for the assessment of aquatic life water quality criteria.

Table 3: Dissolved Oxygen and Temperature Monitoring Stations

Station	River Mile	Operating Agency	Frequency
MONTGOMERY	31.7	USACE	Hourly
HANNIBAL	126.4	Hydropower	Hourly
BELLEVILLE	203.9	USACE	Hourly
RACINE	237.5	Hydropower	Hourly
KYGER	260.0	Electric Utility	Hourly
GREENUP	341.0	Hydropower	Hourly
MELDAHL	436.2	USACE	Hourly
MARKLAND	531.5	Hydropower	15 Min
McALPINE	606.8	Hydropower	Hourly
CANNELTON	720.7	USACE	Hourly
NEWBURGH	776.1	USACE	Hourly
J. T. MYERS	846.0	USACE	Hourly
SMITHLAND	919.0	USACE	Hourly

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 to do by section 305(b) of the federal Clean Water Act. Data from a number of monitoring programs are used in making use attainment assessments, including fish population data used in the MORFIn index, Bimonthly and Clean Metals sampling data, and dissolved oxygen and temperature data.

Aquatic Life Use Assessment Methodology

Bimonthly, Clean Metals, and Dissolved Oxygen & Temperature Monitoring

Both clean metals and nonmetal parameters are analyzed through ORSANCO's monitoring program. Data are collected from 17 fixed stations along the river (Appendix B). Grab samples are collected from these stations once every other month. 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.

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

Since 2004, aquatic life has been assessed on a pool-by-pool basis. For aquatic life assessments, the river has been divided into 19 Assessment Units (AUs), based on the pools created by the 18 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). The remainder of the river below Olmsted is considered un-assessable using the MORFIn, which was calibrated using a dataset from the regulated sections of the river. Three to five of these AUs are sampled each year, with the entire river being fully assessed every five years From 2005 to 2009, all 19 AUs were sampled, totaling 964.8 miles assessed. Fifteen sites were randomly selected to represent each AU as a whole. The MORFIn results are used to assign fish assemblage condition (FAC) scores to each based upon varying index expectations associated with each sites particular instream habitat. Sites were sampled using electrofishing between July and October. During each fish community assessment, biologists attempted to determine the fish community potential of that AU. An AU is designated as impaired when the average FAC score of the randomly selected sites, representing the AU, is below 2.00.

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 exceed the criteria for one or more pollutants.
- Biological data does not indicate aquatic impairment on a pool-specific basis based on MORFIn scores.

Impaired-Partially Supporting

- One or more pollutants exceed the water quality criteria in 11-25 percent of the samples.
- Biological data indicates impairment on a pool-specific basis based on failing MORFIn scores.

Impaired-Not Supporting

- One or more pollutants exceed the criteria in greater than 25 percent of the samples.
- Biological data indicates impairment on a pool-specific basis due to failing MORFIn scores.

Aquatic Life Use Assessment Summary

Based on biological data and the MORFIn index, the Dashields and Montgomery Pools would be considered Partially Supporting and impaired (see Table 4). Those pools cover Ohio River miles ORM 6.2-31.7.

Table 4: Ohio River Biological Condition Description by Pool: 2005-2009

Mile Point	Pool	Year	Biological Condition	Overall Pool Biological Condition
0.2	Emsworth	2007	Fair	
1.9	Emsworth	2007	**Very Poor**	
4.0	Emsworth	2007	Excellent	
4.3	Emsworth	2007	Good	
5.1	Emsworth	2007	Fair	**GOOD**
6.7	Dashields	2008	Fair	
7.4	Dashields	2008	Good	
7.8	Dashields	2008	**Poor**	
8.1	Dashields	2008	**Poor**	
8.4	Dashields	2008	Good	
9.1	Dashields	2008	**Very Poor**	
9.4	Dashields	2008	Fair	
9.8	Dashields	2008	**Very Poor**	
10.0	Dashields	2008	**Poor**	
10.6	Dashields	2008	**Very Poor**	
10.8	Dashields	2008	**Poor**	
11.3	Dashields	2008	**Poor**	
11.6	Dashields	2008	Good	
12.0	Dashields	2008	Fair	
12.5	Dashields	2008	Good	**POOR**
13.7	Montgomery	2006	Good	
14.1	Montgomery	2006	Fair	
15.8	Montgomery	2006	**Poor**	
16.6	Montgomery	2006	**Poor**	
19.3	Montgomery	2006	**Very Poor**	
22.0	Montgomery	2006	Fair	

Mile Point	Pool	Year	Biological Condition	Overall Pool Biological Condition
23.1	Montgomery	2006	**Poor**	
26.1	Montgomery	2006	Fair	
27.0	Montgomery	2006	Fair	
27.1	Montgomery	2006	Good	
27.3	Montgomery	2006	Fair	
27.6	Montgomery	2006	**Poor**	
28.7	Montgomery	2006	Very Good	
30.1	Montgomery	2006	**Poor**	
30.4	Montgomery	2006	Fair	**POOR**
32.5	New Cumberland	2005	Very Good	
34.3	New Cumberland	2005	Excellent	
34.9	New Cumberland	2005	Fair	
37.7	New Cumberland	2005	Good	
39.2	New Cumberland	2005	Very Good	
40.9	New Cumberland	2005	Good	
41.9	New Cumberland	2005	Fair	
44.8	New Cumberland	2005	Good	
45.7	New Cumberland	2005	Very Good	
45.8	New Cumberland	2005	Fair	
46.6	New Cumberland	2005	Very Good	
47.9	New Cumberland	2005	Very Good	
48.6	New Cumberland	2005	Very Good	
50.2	New Cumberland	2005	Fair	
51.9	New Cumberland	2005	Good	**GOOD**
55.5	Pike Island	2007	Very Good	
56.2	Pike Island	2007	Excellent	
58.2	Pike Island	2007	Excellent	
60.1	Pike Island	2007	Excellent	
60.4	Pike Island	2007	Good	
62.8	Pike Island	2007	Very Good	
64.3	Pike Island	2007	Excellent	
64.8	Pike Island	2007	Good	
68.4	Pike Island	2007	Very Good	
72.9	Pike Island	2007	Very Good	
75.2	Pike Island	2007	Good	
78.1	Pike Island	2007	Fair	
79.0	Pike Island	2007	Good	
79.2	Pike Island	2007	Good	
79.8	Pike Island	2007	Very Good	**GOOD**
89.0	Hannibal	2008	Very Good	
89.9	Hannibal	2008	Good	
91.0	Hannibal	2008	Very Good	
92.2	Hannibal	2008	Very Good	
95.8	Hannibal	2008	Fair	
98.4	Hannibal	2008	**Poor**	
100.6	Hannibal	2008	Very Good	
103.1	Hannibal	2008	**Very Poor**	
105.0	Hannibal	2008	Good	
107.9	Hannibal	2008	Very Good	
108.4	Hannibal	2008	Good	

Mile Point	Pool	Year	Biological Condition	Overall Pool Biological Condition
109.9	Hannibal	2008	Very Good	
113.4	Hannibal	2008	Good	
118.6	Hannibal	2008	Good	
124.6	Hannibal	2008	Very Good	**GOOD**
127.4	Willow Island	2006	Good	
128.0	Willow Island	2006	Very Good	
128.5	Willow Island	2006	Very Good	
130.6	Willow Island	2006	Very Good	
132.4	Willow Island	2006	Good	
135.9	Willow Island	2006	Good	
137.8	Willow Island	2006	Good	
138.9	Willow Island	2006	Good	
140.9	Willow Island	2006	Good	
141.1	Willow Island	2006	Excellent	
141.7	Willow Island	2006	Very Good	
145.2	Willow Island	2006	Good	
150.8	Willow Island	2006	Very Good	
153.2	Willow Island	2006	Good	
157.4	Willow Island	2006	Good	**GOOD**
163.9	Belleville	2009	Very Good	
166.9	Belleville	2009	Excellent	
170.3	Belleville	2009	Fair	
170.4	Belleville	2009	Very Good	
170.8	Belleville	2009	Good	
171.3	Belleville	2009	Good	
171.4	Belleville	2009	Good	
174.3	Belleville	2009	**Poor**	
179.3	Belleville	2009	Good	
185.1	Belleville	2009	Fair	
186.4	Belleville	2009	Fair	
189.3	Belleville	2009	Very Good	
191.0	Belleville	2009	Fair	
193.5	Belleville	2009	Good	
194.6	Belleville	2009	Good	**FAIR**
205.2	Racine	2005	Fair	
208.7	Racine	2005	Good	
210.2	Racine	2005	Good	
210.7	Racine	2005	Very Good	
214.3	Racine	2005	Fair	
217.0	Racine	2005	Good	
218.0	Racine	2005	Good	
219.8	Racine	2005	Good	
223.5	Racine	2005	Fair	
225.4	Racine	2005	Good	
226.2	Racine	2005	Very Good	
226.4	Racine	2005	Very Good	
229.8	Racine	2005	**Very Poor**	
231.3	Racine	2005	Good	
235.8	Racine	2005	Fair	**FAIR**

Mile Point	Pool	Year	Biological Condition	Overall Pool Biological Condition
238.1	RC Byrd	2008	Fair	
242.7	RC Byrd	2008	Good	
247.1	RC Byrd	2008	Fair	
251.7	RC Byrd	2008	Very Good	
252.0	RC Byrd	2008	Fair	
252.3	RC Byrd	2008	Fair	
253.1	RC Byrd	2008	Good	
256.6	RC Byrd	2008	Good	
261.5	RC Byrd	2008	Good	
264.7	RC Byrd	2008	Very Good	
266.5	RC Byrd	2008	**Poor**	
267.2	RC Byrd	2008	Very Good	
268.5	RC Byrd	2008	Fair	
273.3	RC Byrd	2008	Good	
275.8	RC Byrd	2008	Fair	**FAIR**
281.6	Greenup	2006	Good	
283.4	Greenup	2006	Very Good	
290.2	Greenup	2006	Fair	
291.2	Greenup	2006	Fair	
294.3	Greenup	2006	Good	
297.3	Greenup	2006	Good	
302.5	Greenup	2006	Very Good	
305.8	Greenup	2006	**Poor**	
308.7	Greenup	2006	Good	
323.5	Greenup	2006	**Poor**	
332.5	Greenup	2006	Good	
335.9	Greenup	2006	Good	
336.4	Greenup	2006	Very Good	
336.7	Greenup	2006	Fair	
338.9	Greenup	2006	Good	**FAIR**
356.2	Meldahl	2007	Very Good	
363.6	Meldahl	2007	Excellent	
365.7	Meldahl	2007	Excellent	
378.6	Meldahl	2007	Very Good	
380.4	Meldahl	2007	Very Good	
384.9	Meldahl	2007	Very Good	
395.1	Meldahl	2007	Very Good	
396.6	Meldahl	2007	Very Good	
397.4	Meldahl	2007	Very Good	
404.8	Meldahl	2007	Very Good	
410.0	Meldahl	2007	Very Good	
410.6	Meldahl	2007	Very Good	
423.5	Meldahl	2007	Excellent	
427.9	Meldahl	2007	Excellent	
431.2	Meldahl	2007	Excellent	**VERY GOOD**
449.1	Markland	2005	Good	
462.6	Markland	2005	Very Good	
464.7	Markland	2005	Very Good	
465.5	Markland	2005	Very Good	
469.3	Markland	2005	Very Good	

Mile Point	Pool	Year	Biological Condition	Overall Pool Biological Condition
472.0	Markland	2005	Excellent	
475.9	Markland	2005	Very Good	
478.7	Markland	2005	Very Good	
480.6	Markland	2005	Excellent	
491.1	Markland	2005	Excellent	
508.5	Markland	2005	Very Good	
520.4	Markland	2005	Good	
527.9	Markland	2005	Good	
528.3	Markland	2005	Good	
530.2	Markland	2005	Good	
438.3	Markland	2009	Very Good	
445.7	Markland	2009	Very Good	
458.2	Markland	2009	Good	
469.2	Markland	2009	Good	
473.0	Markland	2009	Very Good	
477.7	Markland	2009	Fair	
487.3	Markland	2009	Good	
490.1	Markland	2009	Excellent	
508.9	Markland	2009	Very Good	
511.9	Markland	2009	Very Good	
519.0	Markland	2009	Excellent	
520.0	Markland	2009	Very Good	
527.0	Markland	2009	Very Good	
529.0	Markland	2009	Very Good	
531.0	Markland	2009	Very Good	**GOOD**
534.1	Mc Alpine	2009	Very Good	
540.5	Mc Alpine	2009	Good	
544.5	Mc Alpine	2009	Very Good	
547.1	Mc Alpine	2009	Very Good	
549.5	Mc Alpine	2009	Fair	
550.2	Mc Alpine	2009	Very Good	
556.1	Mc Alpine	2009	Fair	
571.9	Mc Alpine	2009	Very Good	
575.4	Mc Alpine	2009	Very Good	
584.4	Mc Alpine	2009	**Very Poor**	
585.9	Mc Alpine	2009	Good	
586.4	Mc Alpine	2009	Fair	
596.5	Mc Alpine	2009	Good	
597.0	Mc Alpine	2009	Fair	
600.3	Mc Alpine	2009	Very Good	**GOOD**
650.3	Cannelton	2006	Good	
652.9	Cannelton	2006	Good	
655.8	Cannelton	2006	Good	
660.9	Cannelton	2006	Good	
667.7	Cannelton	2006	**Poor**	
672.8	Cannelton	2006	Fair	
687.3	Cannelton	2006	Fair	
692.0	Cannelton	2006	**Poor**	
697.9	Cannelton	2006	Fair	
698.3	Cannelton	2006	Fair	

Mile Point	Pool	Year	Biological Condition	Overall Pool Biological Condition
711.6	Cannelton	2006	Good	
612.1	Cannelton	2007	Good	
612.2	Cannelton	2007	Very Good	
614.1	Cannelton	2007	Very Good	
617.7	Cannelton	2007	Very Good	
621.2	Cannelton	2007	Very Good	
623.8	Cannelton	2007	Very Good	
628.2	Cannelton	2007	Very Good	
639.7	Cannelton	2007	Excellent	
648.6	Cannelton	2007	Good	
656.4	Cannelton	2007	Excellent	
661.6	Cannelton	2007	Very Good	
680.7	Cannelton	2007	Good	
682.3	Cannelton	2007	Excellent	
689.8	Cannelton	2007	Very Good	
694.5	Cannelton	2007	Excellent	
696.1	Cannelton	2007	Very Good	
707.5	Cannelton	2007	Very Good	
709.8	Cannelton	2007	Very Good	
720.3	Cannelton	2007	Very Good	**GOOD**
721.2	Newburgh	2007	Excellent	
724.8	Newburgh	2007	Excellent	
736.7	Newburgh	2007	Good	
740.4	Newburgh	2007	Very Good	
742.4	Newburgh	2007	Fair	
747.3	Newburgh	2007	Good	
748.8	Newburgh	2007	Very Good	
749.3	Newburgh	2007	Very Good	
752.0	Newburgh	2007	Excellent	
754.3	Newburgh	2007	Good	
754.8	Newburgh	2007	Good	
759.7	Newburgh	2007	Very Good	
762.5	Newburgh	2007	Very Good	
768.9	Newburgh	2007	Good	
772.1	Newburgh	2007	Very Good	**GOOD**
789.4	J.T. Myers	2005	Very Good	
790.2	J.T. Myers	2005	Good	
799.2	J.T. Myers	2005	Excellent	
800.4	J.T. Myers	2005	Very Good	
802.3	J.T. Myers	2005	Good	
804.9	J.T. Myers	2005	Excellent	
809.3	J.T. Myers	2005	Very Good	
813.1	J.T. Myers	2005	Very Good	
819.4	J.T. Myers	2005	Good	
821.0	J.T. Myers	2005	Very Good	
826.6	J.T. Myers	2005	Very Good	
831.3	J.T. Myers	2005	Excellent	
831.5	J.T. Myers	2005	Good	
837.6	J.T. Myers	2005	Very Good	

Mile Point	Pool	Year	Biological Condition	Overall Pool Biological Condition
842.2	J.T. Myers	2005	Excellent	**VERY GOOD**
849.5	Smithland	2008	**Poor**	
854.6	Smithland	2008	Fair	
856.3	Smithland	2008	Fair	
859.4	Smithland	2008	Fair	
860.4	Smithland	2008	Fair	
869.7	Smithland	2008	Fair	
873.0	Smithland	2008	**Poor**	
874.9	Smithland	2008	Very Good	
881.7	Smithland	2008	Very Good	
889.4	Smithland	2008	Excellent	
903.7	Smithland	2008	Very Good	
905.7	Smithland	2008	Very Good	
910.7	Smithland	2008	Very Good	
912.0	Smithland	2008	Very Good	**FAIR**
919.2	Open Water	2009	Fair	
923.4	Open Water	2009	Excellent	
924.7	Open Water	2009	Very Good	
926.2	Open Water	2009	Excellent	
928.1	Open Water	2009	Very Good	
935.6	Open Water	2009	Very Good	
938.6	Open Water	2009	Excellent	
939.9	Open Water	2009	**Poor**	
940.7	Open Water	2009	**Very Poor**	
950.1	Open Water	2009	**Very Poor**	
950.4	Open Water	2009	Fair	
952.2	Open Water	2009	**Poor**	
953.3	Open Water	2009	Good	
954.2	Open Water	2009	**Poor**	
961.0	Open Water	2009	**Poor**	
970.3	Open Water	2009	Fair	
977.3	Open Water	2009	Good	**FAIR**

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 Appendix A. 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, which would result in an assessment of impairment. Table 5 presents a summary of states' total iron criteria violations and the corresponding assessment resulting from those violations.

Table 5: Ohio River Violations of State Iron Criteria

Mile Point	SiteName	Criteria	Total Samples Jan '05- Jul '09	WQC Violations	% Violations	Impairment Indicated
11.8	Sewickley*	1500 ug/L	28	6	21%	Partial Support
42.6	E.Liverpool*	1500 ug/L	31	9	29%	Not Supporting
54.4	New Cumberland	1500 ug/L	28	2	7%	
84.2	Pike Island	1500 ug/L	28	3	11%	Partial Support
126.4	Hannibal	1500 ug/L	28	3	11%	Partial Support
161.8	Willow Island	1500 ug/L	28	2	7%	
203.9	Belleville	1500 ug/L	27	4	15%	Partial Support
279.2	R.C. Byrd	1500 ug/L	28	1	4%	
341	Greenup	3500 ug/L	28	1	4%	
436.2	Meldahl	3500 ug/L	28	1	4%	
477.5	Anderson Ferry	2340 ug/L	28	2	7%	
531.5	Markland	2340 ug/L	28	1	4%	
600.6	Louisville	2340 ug/L	28	5	18%	Partial Support
625.9	West Point	2340 ug/L	28	10	36%	Not Supporting
720.7	Cannelton	2340 ug/L	28	7	25%	Not Supporting
776	Newburgh	2340 ug/L	27	8	30%	Not Supporting
846	J.T. Myers	3500 ug/L	28	6	21%	Partial Support
918.5	Smithland	3500 ug/L	28	5	18%	Partial Support
939.9	L&D 52	3500 ug/L	28	8	29%	Not Supporting

* PADEP data

Dissolved Oxygen and Temperature Monitoring Results

Dissolved oxygen and temperature data are collected by the Corps of Engineers and hydropower operators at certain locks and dams. ORSANCO collects the data and assesses it against its water quality criteria. Data from 2005 was not included in the assessments because of general concerns about the quality of the data. Criterion violations in excess of ten percent would indicate Partial Support and violations in excess of twenty five percent would indicate Not Supporting. Regarding temperature, there were two stations, Newburgh and J.T. Myers, with period averages exceeding the criteria in excess of ten percent, which would result in a designation of Partial Support impairment. For dissolved oxygen, Cannelton had violations in excess of ten percent which would also result in a designation of Partial Support impairment. Table 6 provides an assessment summary for dissolved oxygen, while Table 7 provides a summary of temperature violations.

Table 6: Ohio River Dissolved Oxygen Criteria Violations

Ohio River Station	Mile Point	2006 % Days Exceeding Daily Average	2007 % Days Exceeding Daily Average	2008 % Days Exceeding Daily Average	2009 % Days Exceeding Daily Average	2006-2009 % Days Exceeding Daily Average	Impairment Indicated
Montgomery	31.7	0.0%	0.0%	0.0%	0.0%	0.0%	None
Hannibal	126.4	0.0%	0.0%	0.0%	0.0%	0.0%	None
Racine	237.5	0.0%	0.0%	0.88%	0.0%	0.13%	None
Kyger	260	0.0%	0.0%	0.0%	3.6%	0.50%	None
Greenup	341						
Upstream		0.0%	6.6%	13.0%	4.7%	3.5%	None
Downstream		0.0%	0.0%	0.88%	1.9%	0.37%	None
Cannelton	720.7	28.8%	29.9%	33.0%	0.0%	12.8%	Partially Supporting
Newburgh	776.1	0.0%	19.0%	0.0%	0.0%	1.5%	None

Ohio River Station	Mile Point	2006 % Days Exceeding Daily Average	2007 % Days Exceeding Daily Average	2008 % Days Exceeding Daily Average	2009 % Days Exceeding Daily Average	2006-2009 % Days Exceeding Daily Average	Impairment Indicated
John T. Myers	846	5.8%	18.7%	4.7%	0.0%	4.2%	None
Smithland	919	No Data	No Data	22.4%	5.0%	9.0%	None

Table 7: Ohio River Temperature Criteria Violations

Ohio River Station	Mile Point	# Periods	# Periods Exceeding Period Average	% Periods Exceeding Period Average	# Days Exceeds Max Criteria	% Days Exceed Max Criteria	Impairment Indicated
Montgomery	31.7	32	0	0.0%	0	0.0%	None
Hannibal	126.4	40	0	0.0%	0	0.0%	None
Racine	237.5	40	0	0.0%	0	0.0%	None
Kyger	260.0	40	1	2.5%	8	1.6%	None
Greenup	341.0	40	1	2.5%	0	0.0%	None
Markland	531.5	20	0	0.0%	0	0.0%	None
Cannelton	720.7	35	3	8.5%	0	0.0%	None
Newburgh	776.1	31	6	18.8%	10	3.0%	Partial Support
John T. Myers	846.0	35	5	14.2%	5	1.3%	Partial Support
Smithland	919.0	35	3	8.5%	0	0.0%	None

Overall Assessment of the Aquatic Life Use

There was no complete agreement amongst the states as to what the "official" assessment should be for the Ohio River aquatic life use. ORSANCO's biological data indicate Partial Support impairment for the Dashields and Montgomery pools which lie entirely within Pennsylvania. Pennsylvania Department of Environmental Protection (PADEP) are currently working on biological monitoring and assessment methods for large rivers that would apply to the Ohio River that they expect to have completed in the near future. As such, PADEP prefers to wait until their monitoring and assessment approaches have been implemented prior to designating the Ohio River as impaired based on biological data.

The United States Environmental Protection Agency's (US EPA) guidance indicates that "Independent Application" should be used when two or more data sets exist that are contradictory. Using Independent application, if biological data indicate Full Support while chemical data indicate an impairment, then the waterbody should be designated as impaired. On the other hand, many states believe that the "Weight of Evidence" approach should apply which involves professional judgment to make the best, most accurate assessment. Using a Weight of Evidence approach where the biological data indicated Full Support, but the chemical data indicate impairment, the waterbody might be classified as Full Support since the biological data are a better indicator of the status of aquatic life.

Regarding impairments indicated by water quality criteria violations for iron, dissolved oxygen and temperature, versus Full Support at those locations indicated by the biological data, the states were not able to agree on a consistent approach to the assessment of aquatic life. West Virginia believes that they are required by US EPA Region 3 to utilize "Independent Application", such that the iron criteria violations indicated in the Table 6 should result in a designation of impaired and either "Partially Supporting" or "Not Supporting." Kentucky believes that it is most appropriate to employ the "Weight of Evidence" approach where the iron, temperature and dissolved oxygen criteria violations would be outweighed by the biological data which indicates "Full Support". Indiana was mixed, believing that it would be appropriate to use a "Weight of Evidence" approach regarding temperature and dissolved oxygen criteria violations, but that "Independent Application" should be applied to the iron criteria violations such that those locations indicated as having iron criteria violations in excess of ten percent would be designated as "Partially or Not Supporting." This situation of differences in states' approaches to "Independent Application" versus "Weight of Evidence" does not apply to Pennsylvania, Ohio and Illinois in this assessment.

As a result of the differences in approaches outlined above, ORSANCO is not making an "official" designation of the status of aquatic life use. In this case, the states will be using ORSANCO's information to make their own independent assessments.

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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 within the Ohio River Basin through thirty three 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 17 sampling stations along the Ohio River. Grab samples are collected from sites once every other month. Parameters monitored by ORSANCO for which there are instream water quality criteria for human health include arsenic, barium, silver, copper, nickel, selenium, thallium, total mercury, zinc, cyanide, chloride, fluoride, nitrates, nitrites, phenolics, dioxins, PCBs, and sulfates. Data included in this report were collected from January 2005 to July 2009. 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 2005 through 2009, 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 23 utilities which represents a seventy 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 treatment due to source water quality was necessary to meet finished water MCLs (Figure 6). Assessment of these data are 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.
- Frequent intake closures due to elevated levels of pollutants are necessary to meet protect water supplies and comply with provisions of the Safe Drinking Water Act (meet MCLs).
- Frequent "non-routine" additional treatment was necessary to protect water supplies and comply with provisions of the Safe Drinking Water Act (meet MCLs).

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

Public Water Supply Use Assessment Summary

Thirty three public and private water utilities use the Ohio River as their drinking water source. Based on available monitoring data assessed against applicable instream water quality criteria, and surveys completed by public and private drinking water supplies using the Ohio River as a source, the entire Ohio River "Fully Supports" the Public Water Supply Use.

Data compared against criteria can be found in Appendices C, D, and H. There have been exceedances of the instream water quality criteria for the protection of public water supply over the 2005 to 2009 period for Phenol and Fecal coliform, but none in excess of ten percent that would cause a designation of impairment. Causes and sources of Phenol violations have been elusive. In the past, areas in West Virginia experienced recurring phenol violations; however between 2005 and 2007, phenol violations were found in Ohio, Kentucky, Indiana, and Illinois (Table 8). In the 2008 assessment, one location in Pittsburgh was designated as partially supporting the public

water supply use due to multiple exceedances in excess of ten percent of the monthly geometric mean bacteria criterion (2000 colonies/100mL). In this 2010 assessment using five years of data, the monthly geometric mean in Pittsburgh is not exceeded in greater than ten percent of samples, so it is not designated as impaired. In June 2006 and August 2007, Pittsburgh reported geometric mean criterion exceedances at the ORM 1.4 fixed monitoring station (Appendix G). Wheeling and Louisville also reported monthly geometric mean exceedances for fecal coliform but in less than ten percent of the monthly geometric means. total number of monthly geometric means during the period between 2006 and 2007; therefore it earned a designation of fully supporting. Longitudinal bacteria survey data did not exceed the drinking water criterion at any point along the river (Appendix F), nor did metals levels threaten the public water supply (Appendix C).

Table 8: Violations of Public Water Supply Human Health Criteria 2005-2009

SiteName	Mile Point	Date	Parameter	Human Health WQC	Result
Meldahl	436.2	28-Nov-06	Phenols (ug/L)	5 (ug/L)	8.80
Anderson Ferry	477.5	09-Nov-06	Phenols (ug/L)	5 (ug/L)	10.00
Cannelton	720.7	09-Aug-05	Phenols (ug/L)	5 (ug/L)	13.30
Newburgh	776.0	15-Sep-05	Phenols (ug/L)	5 (ug/L)	7.61
Newburgh	776.0	09-Nov-06	Phenols (ug/L)	5 (ug/L)	6.30
R.C. Byrd	846.0	19-Sep-06	Phenols (ug/L)	5 (ug/L)	7.77
J.T. Myers	846.0	09-Nov-06	Phenols (ug/L)	5 (ug/L)	10.00
Smithland	918.5	14-Nov-06	Phenols (ug/L)	5 (ug/L)	12.70
L&D 52	938.9	19-Sep-06	Phenols (ug/L)	5 (ug/L)	6.44
L&D 52	938.9	14-Nov-06	Phenols (ug/L)	5 (ug/L)	10.00

Surveys were sent to all thirty three public and private drinking water utilities using the Ohio River as a source, 24 of which responded (73% response rate). There was no indication of impairment based on the questionnaire surveys completed by water utilities (Table 9). Conditions that would indicate impairment based on the water utility surveys include MCL violations caused by source water quality, and frequent intake closures or non-routine treatment techniques necessary to meet MCLs. None of these situations occurred at any of the responding utilities, although some utilities did indicate issues with Ohio River water quality. One utility reported an MCL violation for Total Trihalomethanes (TTHMs), which are a disinfection byproduct which would not be caused directly by Ohio River water quality. Three utilities indicated intake closures due to Ohio River water quality caused by algae blooms or contaminant spills. Eight utilities reported the use of non-routine treatment to address issues such as algae blooms, atrazine, ammonia, organics and TTHMs, and spills of benzene and methylene chloride.

O H I O R I V E R V A L L E Y W A T E R S A N I T A T I O N C O M M I S S I O N

Survey of Ohio River Water Utilities for the 2010 Biennial Assessment of Ohio River Water Quality Conditions (*For the period January 2005 – Present*)

Water Utility Name:	Company/Facility:

1. Your Name:

Title:

Phone & Email:

2. Since January 2005, did you close your intake as a result of Ohio River water quality conditions in order to avoid MCL violations? ☐ Yes ☐ No

Date of incident	Incident Description (contaminants, cause, source, length of occurrence, etc.)

3. Since January 2005, did your plant have any MCL violations caused in whole or part by Ohio River water quality conditions? ☐ Yes ☐ No

Date of incident	Incident Description (contaminants, cause, source, length of occurrence, etc.)

4. Since January 2005, was "nonroutine" or additional treatment necessary to comply with SDWA MCLs as a result of Ohio River water quality conditions? ☐ Yes ☐ No

Date of incident	Incident Description (contaminants, cause, source, length of occurrence, etc.)

Figure 6: Water Utility Survey Questionnaire

Table 9: Results from a survey of water utilities utilizing the Ohio River as a drinking water source indicated that the entire river (981 miles) fully supports use as a public water supply. MCL violations due to disinfection byproducts did not constitute impairment.

Utility Location	Mile Point	State	Survey Reply?	No. of Intake Closures due to Ohio River Water Quality	Cause of Closures	MCL Violation	Causing MCL Violations	Non-Routine Treatment Required?	Contaminants resulting in Non-routine Treatment	Source of Contaminants	No. of Days*
West View	5.0	PA	yes	0	-	-	-	X	Ammonia, benzene	-	10
Robinson	8.6	PA	no								
Moon	11.7	PA	yes	0	-	-	-	-	-	-	-
Beaver Valley	29.0	PA	yes	0	-	-	-	-	-	-	-
Midland	36.0	PA	no								
East Liverpool	40.2	OH	yes	0	-	-	-	X	Algae blooms, THM	-	Spring 09, summers
Buckeye	74.1	OH	yes	0	-	-	-	-	-	-	-
Toronto	59.2	OH	no								
Weirton	62.5	WV	yes	0	-	-	-	-	-	-	-
Steubenville	65.3	OH	yes	0	-	-	-	X	Ammonia	-	21
Follansbee	70.8	WV	yes	2	Chromic acid spill, ethylene glycol spill	-		-	-	-	-
Wheeling	86.8	WV	yes	0	-	X	TTHM	X	THM	-	ongoing
New Martinsville	121.9	WV	yes	0	-	-	-	-	-	-	-
Sistersville	137.2	WV	yes	0	-	-	-	-	-	-	-
Huntington	304.0	WV	yes	0	-	-	-	X	Brominated DBPs	-	ongoing
Ashland	319.7	KY	no								
Ironton	327.0	OH	no								
Russell	327.6	KY	yes	0	-	-	-	-	-	-	-
Portsmouth	350.8	OH	yes	0	-	-	-	-	-	-	-
Adams	392.3	OH	no								
Maysville	407.8	KY	no								

Utility Location	Mile Point	State	Survey Reply?	No. of Intake Closures due to Ohio River Water Quality	Cause of Closures	MCL Violation	Causing MCL Violations	Non-Routine Treatment Required?	Contaminants resulting in Non-routine Treatment	Source of Contaminants	No. of Days*
Cincinnati	462.8	OH	no								
Northern Kentucky 1	462.9	KY	yes	4	Microcystis, methylene chloride, towboat, diesel spill	-	-	X	Mycrocystis, pregis methylene chloride	-	48
Northern Kentucky 2	463.5	KY	yes	4	Microcystis, methylene chloride, towboat, diesel spill	-	-	X	Mycrocystis, pregis methylene chloride	-	48
Louisville	600.0	KY	yes	0	-	-	-	X	Organics, atrazine	-	21 days in 2005, Springs ongoing
Evansville	791.5	IN	yes	0	-	-	-	-	-	-	-
Henderson	803.0	KY	yes	0	-	-	-	-	-	-	-
Mt Vernon	829.3	IN	no								
Morganfield	842.5	KY	yes	0	-	-	-	-	-	-	-
Sturgis	871.4	KY	yes	0	-	-	-	-	-	-	-
Paducah (WTP)	935.5	KY	yes	0	-	-	-	-	-	-	-
Paducah (USEC)	945.9	KY	yes	0	-	-	-	-	-	-	-
Cairo	978.0	IL	yes	0	-	-	-	-	-	-	-

THM- Trihalomethane, TOC- Total Organic Carbon, HAA^5- Haloacetic acids
* Total number of days during reporting period that non-routine treatment was required for one or more of contaminants listed.

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Chapter 4: Contact Recreation Use Support Assessment Results

The Compact requires that the Ohio River remain in a satisfactory sanitary condition suitable for recreational usage. The Commission operates two bacteria monitoring programs to assess the degree of contact recreational use support during the contact recreation season (May-October): routine contact recreation bacteria sampling and longitudinal bacteria surveys conducted through the Watershed Pollutant Reduction Program. Contact recreation season data from 2005 through 2009, and longitudinal bacteria survey data from 2003 through 2008 were used in the assessment. Longitudinal survey data outside the 2005-2009 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 samples were collected monthly from three locations in these communities: Evansville, IN, Huntington, WV, and Louisville, KY. Sample locations included a site upstream and downstream of the community as well as a site within the major metropolitan area where combined sewer overflow (CSO) events are likely to occur. Four locations were monitored in Pittsburgh, PA, three of which created a cross-section where the Allegheny and Monongahela rivers meet to form the Ohio River in downtown Pittsburgh (river mile 1.4L, M, R), and one site downstream of the city (river mile 4.3). There were also four locations sampled in Wheeling, WV and five locations in Cincinnati, OH. Samples were analyzed for 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. This criteria for bacteria states that fecal coliform should not exceed 400/100mL in more than 10 percent of samples taken during a month, and should not exceed 200/100mL as a monthly geometric mean (at least 5 samples required). The standards for *E. coli* state that no single sample should be greater than 240/100mL, and should not exceed 130/100mL as a monthly geometric mean (at least 5 samples required). Using the geometric mean and instantaneous maximum bacteria 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 Methodology

Fully Supporting

- Monthly geometric mean or instantaneous maximum bacteria criteria are exceeded in not more than 10 percent of the time.

Partially Supporting - Impaired

- Monthly geometric mean or instantaneous maximum bacteria criteria are exceeded 11-25 percent of the time.

Not Supporting-Impaired

- Monthly geometric mean or instantaneous maximum bacteria criteria are exceeded greater than 25 percent of the time.

Contact Recreation Use Assessment Summary

Table 10 provides a summary of all the data used in the assessment and the assessment itself.

Table 10: Contact Recreation Criteria Assessment

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	% Mos. > GM '05-'10	Assessment of Contact Rec Data	OVERALL ASSESSMENT	RIVER MILE OF ASSESSMENT
1.4	PA		93%	Not Supporting	Not Supporting	
1.5	PA	**41.2**			Not Supporting	
3.3	PA	**58.8**			Not Supporting	
4.3	PA		78%	Not Supporting	Not Supporting	
6.4	PA	**33.3**			Not Supporting	
9.5	PA	**53.3**			Not Supporting	
11.4	PA	**53.3**			Not Supporting	
12.5	PA	**47.1**			Not Supporting	
14.4	PA	**46.7**			Not Supporting	
17.7	PA	**46.7**			Not Supporting	
20.5	PA	**46.7**			Not Supporting	
20.8	PA	**40.0**			Not Supporting	
21.8	PA	**40.0**			Not Supporting	
22.9	PA	**70.6**			Not Supporting	
25.5	PA	**35.3**			Not Supporting	
25.8	PA	**52.9**			Not Supporting	
26.4	PA	**47.1**			Not Supporting	
28.3	PA	**52.9**			Not Supporting	
32.9	PA	**41.2**			Not Supporting	
37.6	PA	**41.2**			Not Supporting	
40.2	PA					
41.2	OH-WV	**41.2**			Not Supporting	
44.8	OH-WV	**43.8**			Not Supporting	
48.7	OH-WV	**41.2**			Not Supporting	
52.5	OH-WV	**35.3**			Not Supporting	
56.4	OH-WV	**33.3**			Not Supporting	
60.3	OH-WV	**53.3**			Not Supporting	
66.4	OH-WV	**47.1**			Not Supporting	
66.9	OH-WV	**50.0**			Not Supporting	
68.2	OH-WV	**28.6**			Not Supporting	
70.7	OH-WV	**40.0**			Not Supporting	
71.8	OH-WV	**46.7**			Not Supporting	
74.9	OH-WV	**29.4**			Not Supporting	
80.2	OH-WV	**29.4**			Not Supporting	
84.2	OH-WV		33%	Not Supporting	Not Supporting	0-84.9
85.6	OH-WV	**17.6**			Partial Support	84.9-86.2
86.8	OH-WV		10%	Full Support	Full Support	86.2-89.0
91.2	OH-WV	**47.1**			Not Supporting	89.0-91.3
91.4	OH-WV		23%	Partial Support	Partial Support	91.3-92.1
92.8	OH-WV		57%	Not Supporting	Not Supporting	
94.2	OH-WV	**35.3**			Not Supporting	
97.8	OH-WV	**23.5**			Not Supporting	
102.6	OH-WV	**29.4**			Not Supporting	92.1-105.2
107.7	OH-WV	**11.8**			Partial Support	
113.0	OH-WV	**11.8**			Partial Support	
118.3	OH-WV	**11.8**			Partial Support	
123.7	OH-WV	**11.8**			Partial Support	105.2-124.3
124.9	OH-WV	6.7			Full Support	124.3-127.0
129.1	OH-WV	**17.6**			Partial Support	127.0-131.3
133.4	OH-WV	6.7			Full Support	131.3-136.1
138.7	OH-WV	**17.6**			Partial Support	136.1-141.5
144.2	OH-WV	6.7			Full Support	141.5-146.9
149.6	OH-WV	**11.8**			Partial Support	
155.0	OH-WV	**11.8**			Partial Support	146.9-157.7
160.4	OH-WV	0.0			Full Support	157.7-163.1
165.8	OH-WV	**17.6**			Partial Support	
171.2	OH-WV	**11.8**			Partial Support	
175.1	OH-WV	**17.6**			Partial Support	163.1-177.3
179.4	OH-WV	**26.7**			Not Supporting	177.3-181.5
183.5	OH-WV	**17.6**			Partial Support	181.5-184.7
185.9	OH-WV	5.9			Full Support	184.7-188.4
190.8	OH-WV	**11.8**			Partial Support	188.4-193.3
195.7	OH-WV	5.9			Full Support	

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	% Mos. > GM '05-'10	Assessment of Contact Rec Data	OVERALL ASSESSMENT	RIVER MILE OF ASSESSMENT
200.7	OH-WV	5.9			Full Support	193.3-203.2
205.7	OH-WV	**23.5**			Partial Support	
210.7	OH-WV	**23.5**			Partial Support	
215.7	OH-WV	**23.5**			Partial Support	
220.4	OH-WV	**23.5**			Partial Support	
225.4	OH-WV	**17.6**			Partial Support	
230.4	OH-WV	**17.6**			Partial Support	
235.6	OH-WV	**17.6**			Partial Support	
240.4	OH-WV	**18.8**			Partial Support	
245.4	OH-WV	**23.5**			Partial Support	203.2-247.9
250.4	OH-WV	**35.3**			Not Supporting	
255.5	OH-WV	**29.4**			Not Supporting	247.9-258.0
260.6	OH-WV	**23.5**			Partial Support	
265.7	OH-WV	**23.5**			Partial Support	258.0-267.8
269.8	OH-WV	**41.2**			Not Supporting	267.8-272.5
275.2	OH-WV	**11.8**			Partial Support	
280.8	OH-WV	**17.4**			Partial Support	
285.9	OH-WV	**21.7**			Partial Support	
291.4	OH-WV	**18.2**			Partial Support	
296.6	OH-WV	**15.0**			Partial Support	
302.0	OH-WV	**11.1**			Partial Support	272.5-303.6
305.1	OH-WV		10%	Full Support	Full Support	303.6-306.4
307.7	OH-WV	**29.4**			Not Supporting	
308.1	OH-WV		41%	Not Supporting	Not Supporting	
313.3	OH-WV	**41.2**			Not Supporting	
314.8	OH-WV		34%	Not Supporting	Not Supporting	
317.1	OH-WV					
317.2	KY-OH	**29.4**			Not Supporting	306.4-319.4
321.5	KY-OH	**23.5**			Partial Support	
327.4	KY-OH	**13.3**			Partial Support	
327.7	KY-OH	**20.0**			Partial Support	
328.0	KY-OH	**23.5**			Partial Support	
332.5	KY-OH	**11.8**			Partial Support	
338.1	KY-OH	**17.6**			Partial Support	319.4-340.8
343.5	KY-OH	5.9			Full Support	
349.2	KY-OH	5.9			Full Support	
352.0	KY-OH	5.9			Full Support	
353.8	KY-OH	5.9			Full Support	340.8-356.6
359.3	KY-OH	**23.5**			Partial Support	
364.6	KY-OH	**17.6**			Partial Support	
369.8	KY-OH	**11.8**			Partial Support	
375.0	KY-OH	**11.8**			Partial Support	356.6-377.7
380.4	KY-OH	5.9			Full Support	377.7-382.9
385.4	KY-OH	**11.8**			Partial Support	382.9-388.0
390.6	KY-OH	5.9			Full Support	
395.0	KY-OH	6.7			Full Support	
400.4	KY-OH	5.9			Full Support	
405.8	KY-OH	5.9			Full Support	
411.4	KY-OH	0.0			Full Support	
416.4	KY-OH	0.0			Full Support	
421.6	KY-OH	0.0			Full Support	
426.4	KY-OH	0.0			Full Support	
431.4	KY-OH	0.0			Full Support	
436.8	KY-OH	0.0			Full Support	
441.5	KY-OH	0.0			Full Support	
446.5	KY-OH	0.0			Full Support	
451.6	KY-OH	0.0			Full Support	
455.3	KY-OH	6.7			Full Support	
460.0	KY-OH	6.3			Full Support	
462.6	KY-OH		7%	Full Support	Full Support	
463.9	KY-OH		0%	Full Support	Full Support	388.0-464.5
465.0		**20.0**			Partial Support	464.5-465.2
465.4	KY-OH	0.0			Full Support	
468.7	KY-OH	6.3			Full Support	465.2-469.3
469.9	KY-OH		33%	Not Supporting	Not Supporting	
470.0	KY-OH		27%	Not Supporting	Not Supporting	469.3-471.4
472.7	KY-OH	**18.8**			Partial Support	471.4-475.1
477.5	KY-OH		30%	Not Supporting	Not Supporting	475.1-477.6
477.6	KY-OH	**12.5**			Partial Support	
482.2	KY-OH	**25.0**			Partial Support	

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	% Mos. > GM '05-'10	Assessment of Contact Rec Data	OVERALL ASSESSMENT	RIVER MILE OF ASSESSMENT
486.2	KY-OH	**12.5**			Partial Support	477.6-488.0
489.7	KY-OH	6.3			Full Support	
491.3	KY-OH					
493.2	IN-KY	6.7			Full Support	
498.0	IN-KY	6.3			Full Support	
503.1	IN-KY	0.0			Full Support	
508.3	IN-KY	0.0			Full Support	
513.4	IN-KY	0.0			Full Support	
518.5	IN-KY	6.3			Full Support	
523.4	IN-KY	6.7			Full Support	
528.4	IN-KY	6.3			Full Support	
533.2	IN-KY	6.3			Full Support	
538.5	IN-KY	6.3			Full Support	
543.5	IN-KY	0.0			Full Support	
548.3	IN-KY	0.0			Full Support	
553.6	IN-KY	0.0			Full Support	
558.8	IN-KY	6.7			Full Support	
562.7	IN-KY	6.7			Full Support	
567.6	IN-KY	0.0			Full Support	
572.5	IN-KY	0.0			Full Support	
577.4	IN-KY	0.0			Full Support	
582.9	IN-KY	0.0			Full Support	
587.8	IN-KY	0.0			Full Support	
592.2	IN-KY	0.0			Full Support	
594.0	IN-KY		7%	Full Support	Full Support	
597.1	IN-KY	0.0			Full Support	
602.2	IN-KY	6.3			Full Support	488.0-603.3
604.3	IN-KY	**18.8**			Partial Support	
607.5	IN-KY	**19.0**			Partial Support	603.3-608.1
608.7	IN-KY		30%	Not Supporting	Not Supporting	608.1-609.2
609.7	IN-KY	**19.0**			Partial Support	
612.2	IN-KY	**14.3**			Partial Support	609.2-614.9
617.6	IN-KY	**38.1**			Not Supporting	
619.3	IN-KY		80%	Not Supporting	Not Supporting	
623.1	IN-KY	**38.1**			Not Supporting	
628.1	IN-KY	**38.1**			Not Supporting	
630.0	IN-KY	**60.0**			Not Supporting	
631.6	IN-KY	**55.0**			Not Supporting	
637.6	IN-KY	**57.1**			Not Supporting	
643.1	IN-KY	**47.6**			Not Supporting	
648.9	IN-KY	**40.0**			Not Supporting	
654.0	IN-KY	**41.2**			Not Supporting	
659.2	IN-KY	**29.4**			Not Supporting	
664.2	IN-KY	**35.3**			Not Supporting	
669.1	IN-KY	**47.1**			Not Supporting	
674.5	IN-KY	**47.1**			Not Supporting	
680.4	IN-KY	**35.3**			Not Supporting	614.9-683.0
685.6	IN-KY	**20.0**			Partial Support	
690.7	IN-KY	**23.5**			Partial Support	
695.6	IN-KY	**17.6**			Partial Support	
700.9	IN-KY	**23.5**			Partial Support	
706.2	IN-KY	**23.5**			Partial Support	
711.5	IN-KY	**17.6**			Partial Support	
717.4	IN-KY	**13.3**			Partial Support	683.0-719.5
721.5	IN-KY	**28.6**			Not Supporting	
727.0	IN-KY	**29.4**			Not Supporting	
732.5	IN-KY	**35.3**			Not Supporting	719.5-735.7
738.8	IN-KY	**13.3**			Partial Support	
742.4	IN-KY	**23.5**			Partial Support	
746.4	IN-KY	**17.6**			Partial Support	
750.6	IN-KY	**17.6**			Partial Support	
754.8	IN-KY	**11.8**			Partial Support	735.7-756.4
758.0	IN-KY	**29.4**			Not Supporting	756.4-760.6
763.2	IN-KY	**20.0**			Partial Support	
769.1	IN-KY	**11.8**			Partial Support	
773.6	IN-KY	**17.6**			Partial Support	
778.2	IN-KY	**11.8**			Partial Support	
782.8	IN-KY	**11.8**			Partial Support	
787.0	IN-KY	**11.8**			Partial Support	760.6-789.3
791.5	IN-KY		33%	Not Supporting	Not Supporting	789.3-792.1

Mile Point	States	% of Longitudinal Samples > SSM (03-08)	% Mos. > GM '05-'10	Assessment of Contact Rec Data	OVERALL ASSESSMENT	RIVER MILE OF ASSESSMENT
792.7	IN-KY	**23.5**			Partial Support	792.1-793.2
793.7	IN-KY		63%	Not Supporting	Not Supporting	
794.2	IN-KY	**29.4**			Not Supporting	
797.3	IN-KY		40%	Not Supporting	Not Supporting	793.2-798.4
799.5	IN-KY	**20.0**			Partial Support	798.4-799.8
800.0	IN-KY	**40.0**			Not Supporting	799.8-802.9
805.8	IN-KY	**23.5**			Partial Support	
811.3	IN-KY	**23.5**			Partial Support	
817.0	IN-KY	**23.5**			Partial Support	802.9-820.1
823.2	IN-KY	**29.4**			Not Supporting	820.1-826.4
829.5	IN-KY	**23.5**			Partial Support	
832.2	IN-KY	**13.3**			Partial Support	
837.2	IN-KY	**17.6**			Partial Support	
842.3	IN-KY	**11.8**			Partial Support	
846.5	IN-KY	**17.6**			Partial Support	826.4-847.3
848.0	IN-KY					
851.3	IL-KY	5.9			Full Support	847.3-853.4
855.5	IL-KY	**13.3**			Partial Support	853.4-857.6
859.7	IL-KY	6.7			Full Support	857.6-862.1
864.4	IL-KY	**11.8**			Partial Support	
869.8	IL-KY	**11.8**			Partial Support	862.1-872.8
875.7	IL-KY	5.9			Full Support	872.8-878.2
880.7	IL-KY	**11.8**			Partial Support	878.2-882.9
885.0	IL-KY	5.9			Full Support	
889.2	IL-KY	5.9			Full Support	
891.7	IL-KY	5.9			Full Support	882.9-894.6
897.5	IL-KY	**17.6**			Partial Support	
903.2	IL-KY	**17.6**			Partial Support	
908.0	IL-KY	**11.8**			Partial Support	894.6-910.3
912.6	IL-KY	5.9			Full Support	
917.6	IL-KY	5.9			Full Support	910.3-920.5
923.4	IL-KY	**11.8**			Partial Support	920.5-925.8
928.2	IL-KY	6.7			Full Support	
932.2	IL-KY	0.0			Full Support	
936.2	IL-KY	0.0			Full Support	
937.7	IL-KY	0.0			Full Support	
940.9	IL-KY	0.0			Full Support	
944.2	IL-KY	0.0			Full Support	
947.5	IL-KY	5.9			Full Support	
952.2	IL-KY	5.9			Full Support	
957.7	IL-KY	5.9			Full Support	
963.0	IL-KY	6.3			Full Support	
969.2	IL-KY	6.3			Full Support	
974.1	IL-KY	6.3			Full Support	
979.2	IL-KY	6.3			Full Support	925.8-981.0

A total of 352.5 river miles (36%) were assessed as "Fully Supporting", 384.5 river miles (39%) as "Partially Supporting, and 243.9 river miles (25%) as "Not Supporting" the Contact Recreational Use. On a state by state basis, the following Table 11 summarizes the Contact Recreation Use assessment.

Table 11: Contact Recreation Use Assessment Summary

State	River Miles	Total State Miles	No. Miles Full Support	No. Miles Partial Support	No. Miles Not Supporting
PA	0 - 40.2	40.2	0.0	0.0	40.2
OH	40.2 - 491.3	451.1	142.4	212.1	96.6
WV	40.2 - 317.1	276.9	37.6	149.5	89.9
KY	317.1 - 981.0	663.9	308.3	241.8	113.8
IN	491.3 - 848.0	356.7	112.0	137.7	107.1
IL	848.0 - 981.0	133.0	91.6	41.4	0.0

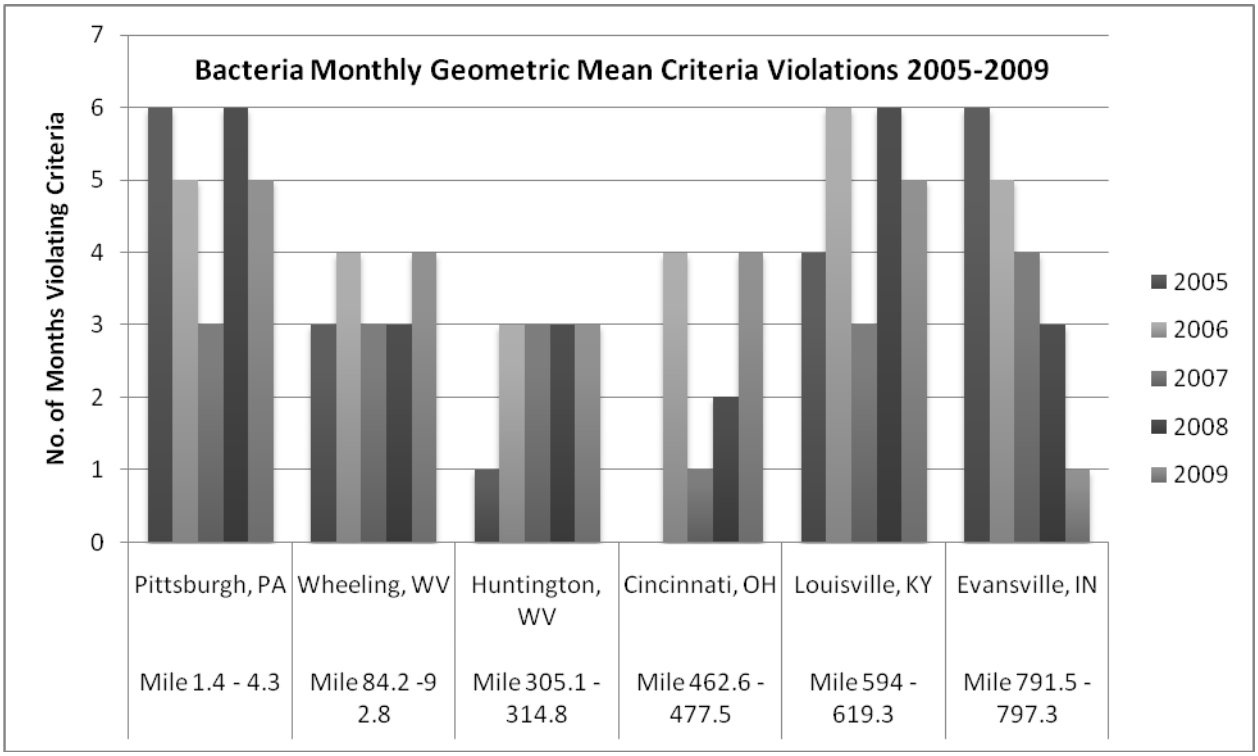

Figure 7: Number of months exceeding the geometric mean criteria at each contact recreation season monitoring location 2005 to 2009.

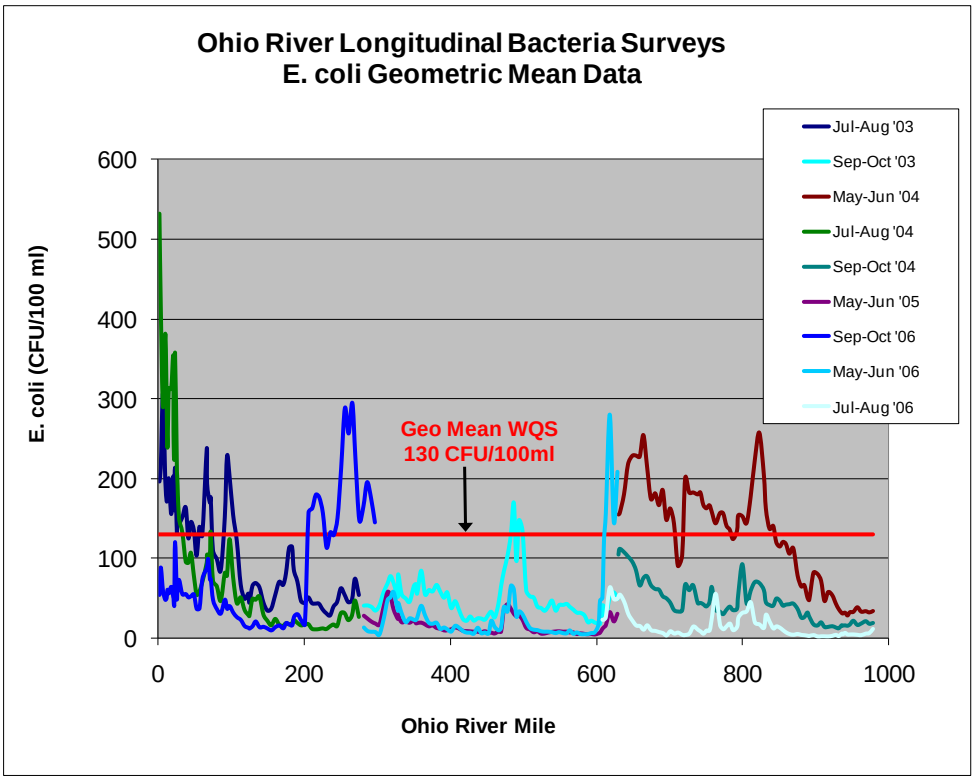

Figure 8: Geometric Mean Results of Longitudinal Surveys. Between 2003 and 2006, the entire river was analyzed fifteen times through longitudinal bacteria surveys, allowing for the calculation of three monthly geometric means at each site. Peaks in E. coli levels often correspond with the location of major

metropolitan areas such as Pittsburgh (river mile 1.4), Cincinnati (river mile 470), and Evansville (river mile 793.7).

Chapter 5: Fish Consumption Use Support Assessment

The Compact requires that the Ohio River be in a satisfactory sanitary condition and adaptable to such other uses as may be legitimate. The Commission maintains water quality criteria for the protection of human health from fish consumption 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 of three- to five-fish composites, are analyzed for certain organics, pesticides, and metals. These data are then used by various agencies in each of the states bordering the river to issue fish consumption advisories to the public. Total mercury water column data were collected from 17 clean metals sites once every other month between 2005 and 2009. 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. Fish tissue samples were collected annually. In 2009, twenty large, trophic level 4 Hybrid Striped Bass were collected and the tissue analyzed for mercury.

Assessment Methodology

Fully Supporting

- Water quality criteria for the protection of human health from fish consumption are exceeded in no more than ten percent of samples and no fish tissue criteria are exceeded.

Partially Supporting-Impaired

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

Not Supporting-Impaired

- Fish consumption advisories recommend not consuming any fish.

Fish Consumption Use Assessment Summary

The entire Ohio River is assessed and classified as partially supporting based on exceedances of the water quality criterion for PCBs and dioxin (Figures 9-10). Dioxin water concentration data were compared against the Commission's water quality criterion of 0.000000005 µg/L (0.5 fg/L) (Appendix I). Every dioxin sample, river-wide, exceeded the water quality criterion (Figure 13). Similarly, PCB levels were compared against the 64 pg/L human health criteria set forth in the Pollution Control Standards (Appendix P). All samples were in violation of the PCB criterion as well (Appendix J, Figure 14). 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.

Seven water quality monitoring stations exceeded the total mercury criterion of 0.012 ug/L in greater than ten percent of samples collected from 2005-2009. In addition, eight of the twenty Hybrid Striped Bass collected in 2009 exceeded the methyl mercury fish tissue criterion of 0.3 mg/kg. An additional 6 tissue samples collected between 2005-2009 exceed the fish tissue criterion for mercury. Mercury criteria violations are contained in Table 12. For mercury, dual criteria, addressing water column and fish tissue data, are used in the assessment of fish consumption. The ambient criterion for mercury was exceeded in ten percent or more of the samples collected at seven water quality monitoring stations. Similar results have been reported in previous assessments; however, levels in fish tissue have not exceeded the applicable criterion. In 2009, however, a special sampling of large trophic level four fish (hybrid striped bass) yielded different results. Eight of the twenty fish samples exceeded the 0.3 mg/kg fish tissue criterion. The analysis was for total mercury, whereas the criterion is for methyl mercury. The results indicate possible impairment of fish consumption use in over 800 miles of the river. As further analyses are needed to make a comprehensive assessment of potential use impairments; ORSANCO will collect additional fish and water samples in fiscal year 2011 with analyses for total and methyl mercury as well as other parameters needed to assess the methylization of mercury in the river.

All fish tissue data for 2005-2009 can be found in Appendix L. All water quality data for mercury highlighting

criteria exceedances can be found in Appendix C. The overall fish consumption assessment is included in Table 13.

Table 12: Summary of Mercury Criteria Violations in Water and Fish Tissue Samples

River Mile	Year	Sample Matrix	Hg (mg/kg)	No. of Water Column Criteria Violations
42.6	2006	FISH	0.082	
42.6	2008	FISH	0.081	
42.6	2008	FISH	0.087	
54.4	2005-09	OHIO RIVER WATER		0
84.0	2007	HYBRID STRIPER	0.068	
84.2	2005-09	OHIO RIVER WATER		1
105.0	2009	HYBRID STRIPER	0.19	
105.0	2009	HYBRID STRIPER	0.23	
105.0	2009	HYBRID STRIPER	**0.32**	
126.4	2005-09	OHIO RIVER WATER		1
161.7	2006	FRESHWATER DRUM	**0.32**	
161.7	2009	HYBRID STRIPER	0.28	
161.8	2005-09	OHIO RIVER WATER		2
203.9	2009	HYBRID STRIPER	0.26	
203.9	2009	HYBRID STRIPER	0.28	
203.9	2009	HYBRID STRIPER	**0.34**	
203.9	2005-09	OHIO RIVER WATER		0
279.0	2008	HYBRID STRIPER	**0.33**	
279.2	2009	HYBRID STRIPER	0.2	
279.2	2005-09	OHIO RIVER WATER		1
341.0	2005-09	OHIO RIVER WATER		2
341.5	2009	HYBRID STRIPER	0.26	
436.2	2005-09	OHIO RIVER WATER		0
436.5	2009	HYBRID STRIPER	0.23	
436.5	2009	HYBRID STRIPER	0.27	
436.5	2009	HYBRID STRIPER	0.29	
477.5	2005-09	OHIO RIVER WATER		5
531.5	2005	HYBRID STRIPER	0.044	
531.5	2005-09	OHIO RIVER WATER		1
532.0	2009	HYBRID STRIPER	0.2	
600.6	2005-09	OHIO RIVER WATER		2
606.8	2009	HYBRID STRIPER	**0.4**	
625.9	2005-09	OHIO RIVER WATER		24
626.0	2007	FRESHWATER DRUM	**0.39**	
720.7	2006	HYBRID STRIPER	0.16	
720.7	2005-09	OHIO RIVER WATER		7
720.8	2009	HYBRID STRIPER	**0.33**	
776.0	2005-09	OHIO RIVER WATER		7
776.5	2009	HYBRID STRIPER	0.25	
776.5	2009	HYBRID STRIPER	**0.33**	
776.5	2009	HYBRID STRIPER	**0.33**	
846.0	2009	HYBRID STRIPER	**0.3**	
846.0	2005-09	OHIO RIVER WATER		5
890.0	2007	SAUGER	**0.3**	
918.0	2008	SPOTTED BASS	**0.35**	
918.0	2008	COMMON CARP	**0.36**	
918.5	2009	HYBRID STRIPER	**0.34**	
918.5	2005-09	OHIO RIVER WATER		5
939.9	2005-09	OHIO RIVER WATER		9

Table 13: Summary of fish consumption use assessment for 2005-2009 based on 17 monitoring stations, high-volume sampling, and a fish tissue analyses. All 981 miles partially support the fish consumption use

States	River Miles	Total Miles	Assessment Category	Causes of Impairment
ALL	0.0-981	981	Partially Supporting	PCBs, Dioxins

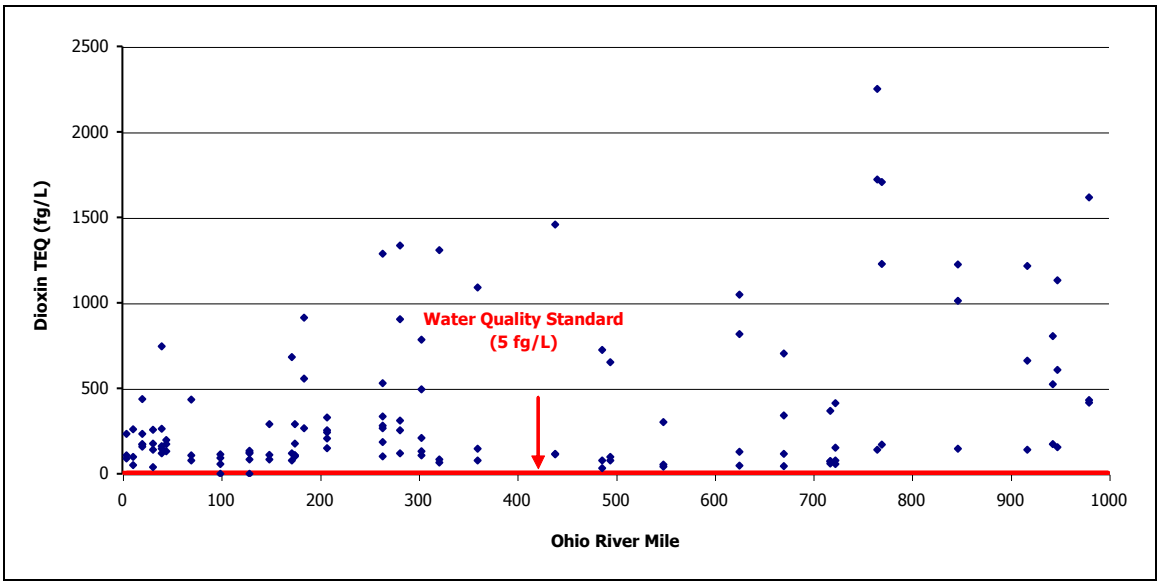

Figure 9: Dioxin TEQ concentrations in the Ohio River (1997-2004). All Ohio River samples analyzed for dioxins using high volume sampling techniques exceeded the water quality criteria for human health. As a result, the entire river was designated as impaired

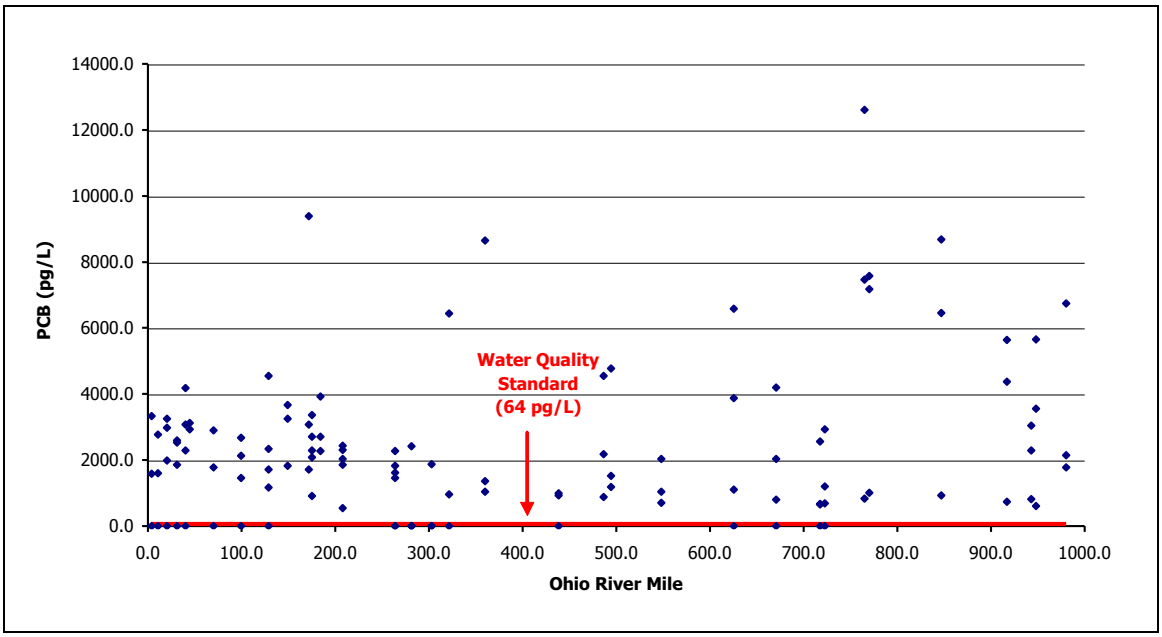

Figure 10: PCB data from the Ohio River collected from 1997-2004. All water samples analyzed for PCBs along the Ohio River exceeded ORSANCO's human health criteria for PCBs.

"Restricted" fish consumption advisories are in effect in all states covering the entire Ohio River as a result of levels of levels found in fish tissue for PCBs, dioxins, and mercury. Pennsylvania has issued "Do Not Eat" fish consumption advisories for certain species along the upper forty miles of the Ohio River. Table 14 summarizes the states fish consumption advisories issued in 2009. These advisories were not used in the fish consumption use assessment, but are provided here for informational purposes. Additional information on fish consumption advisories can be found on the states' web sites.

Table 14: Summary of Fish Consumption Advisories

State (River Segment)	PA (0-32)	PA2 (32-40)	WV (40-317)	OH (40-491)	KY (317-531)		KY (531-720)		KY (720-981)		IN (491-848)		IL(848-981)	
Population Protected	Both	Both	Both	Both	General	Sensitive	General	Sensitive	General	Sensitive	General	Sensitive	General	Sensitive
Pollutants	PCBs		Dioxins, Hg, PCBs	PCBs	Hg, PCBs						PCBs		PCB, Hg	
Paddlefish					6 ml/yr	Do Not Eat	6 ml/yr	Do Not Eat	6 ml/yr	Do Not Eat	1 ml/month	Do Not Eat		
Carp	Do Not Eat	Do Not Eat	Do Not Eat	1 ml/month	1 ml/month	6 ml/yr	1 ml/month	6 ml/yr	1 ml/month	6 ml/yr		Do Not Eat		1 ml/month
Carp <33"											1 ml/month			
Carp >33"											Do Not Eat			
Suckers			2 ml/month											
Smallmouth Buffalo			1 ml/month	1 ml/month	1 ml/month	6 ml/yr								
Bigmouth Buffalo										1 ml/month				
Blue Catifsh														1 ml/wk
Blue Catfish <14"										1 ml/month				
Blue Catfish >14"									1 ml/month	6 ml/yr				
Channel Catfish	Do Not Eat			6 ml/yr					1 ml/month	6 ml/yr		Do Not Eat		
Channel Catfish <19"											1 ml/month			
Channel Cat 19-26"											6 ml/yr			
Channel Cat >26"											Do Not Eat			
Channel Catfish >15"														1 ml/wk
Channel Catfish <17"		6 ml/yr	6 ml/yr											
Channel Catfish >17"		Do Not Eat	Do Not Eat											
Channel Catfish <21"					1 ml/month	6 ml/yr	1 ml/month	6 ml/yr						
Channel Catfish >21"					6 ml/yr	Do Not Eat	6 ml/yr	Do Not Eat						
Flathead Cat		6 ml/yr	6 ml/yr	1 ml/month	1 ml/month	6 ml/yr		1 ml/month				Do Not Eat		1 ml/wk
Flathead Cat <23"											1 ml/month			
Flathead Cat >23"											6 ml/yr			
White Bass	1 ml/month	1 ml/month	1 ml/month	1 ml/month	1 ml/month	6 ml/yr	1 ml/month	6 ml/yr	1 ml/month	6 ml/yr		Do Not Eat		1 ml/wk
White Bass <20"											1 ml/month			
White Bass >20"											6 ml/yr			
Striped Bass												Do Not Eat		1 ml/wk
Striped Bass <20"											1 ml/month			
Striped Bass >20"											6 ml/yr			
Hybrid Striped Bass		1 ml/month	1 ml/month	1 ml/month	1 ml/month	6 ml/yr	1 ml/month	6 ml/yr	1 ml/month	6 ml/yr		Do Not Eat		1 ml/wk
Hybrid Striper <20"											1 ml/month			
Hybrid Striped >20"											6 ml/yr			
Rock Bass			2 ml/month											1 ml/wk
Smallmouth Bass			2 ml/month	1 ml/month		1 ml/month		1 ml/month		1 ml/month		Do Not Eat		1 ml/wk
Spotted Bass			2 ml/month			1 ml/month		1 ml/month		1 ml/month	1 ml/month	Do Not Eat		1 ml/wk
SM Bass <15"											6 ml/yr			
SM Bass >15"											Do Not Eat			
Largemouth Bass			2 ml/month			1 ml/month		1 ml/month		1 ml/month			1 ml/wk	1 ml/month
LM Bass >13"											1 ml/month	Do Not Eat		
White Crappie														1 ml/wk
Black Crappie				1 ml/month										1 ml/wk
Sauger	1 ml/month		2 ml/month	1 ml/month	1 ml/month	6 ml/yr		1 ml/month		1 ml/month		Do Not Eat		1 ml/month
Sauger <17"											1 ml/month			
Sauger >17"											6 ml/yr			
Walleye	1 ml/month		2 ml/month	1 ml/month								Do Not Eat		1 ml/wk
Walleye <17"											1 ml/month			
Walleye >17"		1 ml/month									6 ml/yr			
Saugeye			2 ml/month									Do Not Eat		1 ml/wk
Saugeye <17"											1 ml/month			
Saugeye >17"											6 ml/yr			
Freshwater Drum	1 ml/month	1 ml/month	1 ml/month	1 ml/month	1 ml/month	6 ml/yr	1 ml/month	6 ml/yr	1 ml/month	6 ml/yr		1 ml/month		
FW Drum >13"											1 ml/month	Do Not Eat		
FW Drum <14"														1 ml/wk
FW Drum >14"														1 ml/month
Statewide Advisory	1 ml/wk	1 ml/wk	1 ml/wk	1 ml/wk	none	1 ml/wk	none	1 ml/wk	none	1 ml/wk	none	1 ml/wk	none	1 ml/wk

***Statewide advisories based on Hg for sensitive populations**

Chapter 6: Ohio River Water Quality Trends Analysis

ORSANCO first undertook a study of long-term temporal trends using the agency's own monitoring data in 1990, with 10-15 years of record at most monitoring stations. ORSANCO has since built another 18-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 15, 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 trend (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).

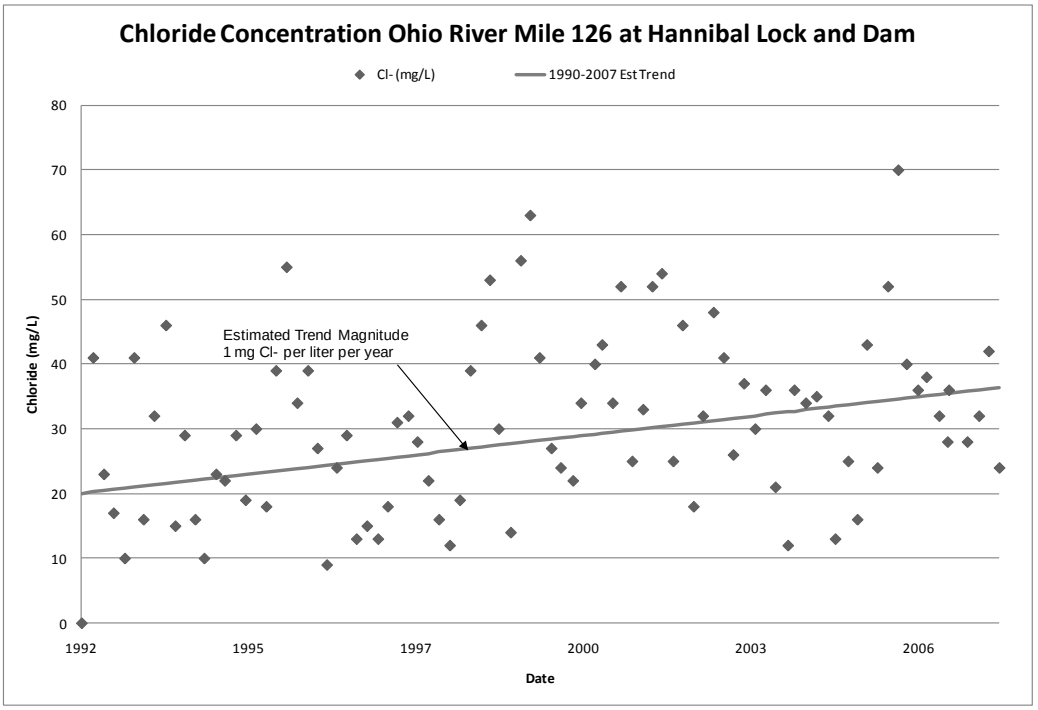

Figure 11: Chloride Concentrations are Increasing Basinwide

Table 15 - Seasonal Kendall on Direct 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 ($p < 0.05$, $Z_{0.025} = 1.96$)
inc - Significant increasing trend ($p < 0.10$, $Z_{0.05} = 1.6449$))
O - No significant trend found
dec - Significant decreasing trend ($p < 0.10$, $Z_{0.05} = 1.6449$)
DEC - Strong significant decreasing trend ($p < 0.05$, $Z_{0.025} = 1.96$)

Chapter 7: Integrated List

The Integrated Report combines requirements of both section 305(b) and 303(d) of the federal Clean Water Act. Each state completes an Integrated List, which then becomes available for public comment and is approved by the US EPA. While the Commission is not required to prepare a section 303(d) list, the preparation of a 305(b) report facilitates interstate consistency between states' Integrated Lists. The Integrated List contains a list of 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 aquatic life. While ORSANCO has collected much data to assess the aquatic life use, disagreement amongst the states with regard to the appropriate assessment based on that data has led the Commission to not make a formal assessment for the aquatic life use. Table 14 presents the proposed integrated list for the Ohio River. TMDLs already completed for PCBs and dioxin resulted in a category of 4a for certain segments of the river listed in Table 14. States are not required to implement TMDLs based solely on ORSANCO's recommendations; however, this list is consistent with the states' lists.

Table 14 does not assign a category to any segments regarding aquatic life use. This is due to a lack of consensus between the states regarding the overall use of multiple data sets having conflicting indications. The issue involves aquatic life criteria violations for total iron, dissolved oxygen and temperature that indicate impairment, while direct biological measures indicate full support of the aquatic life use. Regarding total iron criteria violations, ORSANCO does not have a water quality criterion, however many states do, but they are not consistent. Nevertheless, the applicable states' total iron criteria for the protection of aquatic life are exceeded in greater than ten percent of samples, indicating impairment, at stations located in all states along the Ohio River. At the same time, more direct biological measures indicate full support for much of the Ohio River. West Virginia and Indiana have chosen to list the Ohio River as impaired based on iron criteria violations while Pennsylvania and Kentucky will not. Ohio has no criterion and Illinois' dissolved iron criterion is not exceeded. As a result of this inconsistency between states, ORSANCO's 2010 assessment does not indicate an overall assessment or suggested listing for the aquatic life use.

Table 16: Ohio River integrated assessment summary for 2005-2009. Impaired uses include contact recreation and fish consumption. Category 5* Indicates that a PCB TMDL has been completed. A dioxin TMDL is still needed.

States	River Miles	Total Miles in Water Body	Warm Water Aquatic Life Use Support	Public Water Supply Use Support	Contact Recreation Use Support	Fish Consumption Use Support		
						PCBs	Dioxin	Mercury
PA	0-40.2	40.2	Not Assigned	1	5	4a	5	3
OH-WV	40.2-86.2	46.0	Not Assigned	1	5	4a	5	3
OH-WV	86.2-89.0	2.8	Not Assigned	1	1	4a	5	3
OH-WV	89.0-124.3	35.3	Not Assigned	1	5	4a	5	3
OH-WV	124.3-127.0	2.7	Not Assigned	1	1	4a	5	3
OH-WV	127.0-131.3	4.3	Not Assigned	1	5	4a	5	3
OH-WV	131.3-136.1	4.8	Not Assigned	1	1	4a	5	3
OH-WV	136.1-141.5	5.4	Not Assigned	1	5	4a	5	3
OH-WV	141.5-146.9	5.4	Not Assigned	1	1	4a	5	3
OH-WV	146.9-157.7	10.8	Not Assigned	1	5	4a	5	3
OH-WV	157.7-163.1	5.4	Not Assigned	1	1	4a	5	3
OH-WV	163.1-184.7	21.6	Not Assigned	1	5	4a	5	3
OH-WV	184.7-188.4	3.7	Not Assigned	1	1	4a	5	3
OH-WV	188.4-193.3	4.9	Not Assigned	1	5	4a	5	3
OH-WV	193.3-203.2	9.9	Not Assigned	1	1	4a	5	3
OH-WV	203.2-237.5	34.3	Not Assigned	1	5	4a	5	3
OH-WV	237.5-303.6	66.1	Not Assigned	1	5	4a	4a	3
OH-WV	303.6-306.4	2.8	Not Assigned	1	1	4a	4a	3
OH-WV	306.4-317.1	10.7	Not Assigned	1	5	4a	4a	3
KY-OH	317.1-340.8	23.7	Not Assigned	1	5	5	5	3
KY-OH	340.8-356.6	15.8	Not Assigned	1	1	5	5	3
KY-OH	356.6-377.7	21.1	Not Assigned	1	5	5	5	3
KY-OH	377.7-382.9	5.2	Not Assigned	1	1	5	5	3

States	River Miles	Total Miles in Water Body	Warm Water Aquatic Life Use Support	Public Water Supply Use Support	Contact Recreation Use Support	Fish Consumption Use Support		
						PCBs	Dioxin	Mercury
KY-OH	382.9-388.0	5.1	Not Assigned	1	5	5	5	3
KY-OH	388.0-464.5	76.5	Not Assigned	1	1	5	5	3
KY-OH	464.5-465.2	0.7	Not Assigned	1	5	5	5	3
KY-OH	465.2-469.3	4.1	Not Assigned	1	1	5	5	3
KY-OH	469.3-488.0	18.7	Not Assigned	1	5	5	5	3
KY-OH	488.0-491.3	3.3	Not Assigned	1	1	5	5	3
IN-KY	491.3-603.3	112.0	Not Assigned	1	1	5	5	3
IN-KY	603.3-847.3	244.0	Not Assigned	1	5	5	5	3
IN-KY	847.3-848.0	0.7	Not Assigned	1	1	5	5	3
IL-KY	848.0-853.4	5.4	Not Assigned	1	1	5	5	3
IL-KY	853.4-857.6	4.2	Not Assigned	1	5	5	5	3
IL-KY	857.6-862.1	4.5	Not Assigned	1	1	5	5	3
IL-KY	862.1-872.8	10.7	Not Assigned	1	5	5	5	3
IL-KY	872.8-878.2	5.4	Not Assigned	1	1	5	5	3
IL-KY	878.2-882.9	4.7	Not Assigned	1	5	5	5	3
IL-KY	882.9-894.6	11.7	Not Assigned	1	1	5	5	3
IL-KY	894.6-910.3	15.7	Not Assigned	1	5	5	5	3
IL-KY	910.3-920.5	10.2	Not Assigned	1	1	5	5	3
IL-KY	920.5-925.8	5.3	Not Assigned	1	5	5	5	3
IL-KY	925.8-981.0	55.2	Not Assigned	1	1	5	5	3

Chapter 8: Summary

The entire nine hundred and eighty one miles of the Ohio River is designated as impaired for the fish consumption use, caused by PCBs and dioxin. There were indications of impairment of the fish consumption use for mercury, however a comprehensive assessment is pending results of additional data. Six hundred twenty eight miles, or almost two-thirds of the river, 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. While there are indications of aquatic life use impairments for certain segments of the Ohio River based on biological data and 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 majority of the Ohio River based on direct measures of the biological community. No consensus agreement between the states was achieved on the interpretation of these conflicting data sets, so the aquatic life use is not assessed in this report while all the supporting information is provided. At the Commission's February, 2010 Technical Committee meeting, this issue was discussed. As a result, ORSANCO will be sending a letter to the US EPA highlighting this issue since the US EPA is responsible for approval of states' lists of impaired waters. At the same time, ORSANCO will be asking the states for their position regarding the use of "independent application" and "weight of evidence" approaches to making designated use assessments when different data sets provide conflicting information.

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