Chapter C1: Background

The Ohio River was chosen for a § 316(b) case study because it is representative of large industrial rivers in the United States with cumulative impacts resulting from multiple CWIS. The river is a major waterway flowing southwest from Pittsburgh toward the Mississippi River.

Throughout its entire length, the river consists of a series of navigation pools controlled by locks and dams maintained by the U.S. Army Corps of Engineers. The locks serve to pass barges from one pool to the next, and the dams regulate pool elevation. In addition to navigation, the Ohio River provides water for industrial and municipal uses, and is an important source of recreation, including pleasure boating, swimming, and fishing.

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This chapter provides background on the Ohio River case study area. Section C1-1 is an overview of the nine Ohio River facilities in scope of the Phase II rule for which I&E data are available, Section C1-2 describes the environmental setting of the case study, Section C1-3 discusses water withdrawal and uses within the Ohio River Basin, and Section C1-4 describes socioeconomic conditions near the Ohio River facilities, including industrial, commercial, and recreational activities. Technical details of the plants are discussed in detail in Chapter C2. Chapter C3 discusses EPA's evaluation of I&E data for Ohio River facilities, Chapter C4 addresses economic values of baseline damages, and Chapter C5 presents the benefits analysis.

C1-1 Overview of Nine Ohio River Case Study Facilities

Figure C1-1 indicates the locations of all CWIS on the Ohio River, including both in scope and out of scope facilities. EPA evaluated I&E data for nine of the in scope facilities, including W.H. Sammis, Cardinal, Kammer, Philip Sporn, Kyger Creek, W.C. Beckjord, Miami Fort, Tanners Creek, and Clifty Creek (upstream to downstream). I&E results were extrapolated to other CWIS facilities as described in Chapter C3 of this report. Locations of the nine case study facilities are indicated in Table C1-1 and Figure C1-2.

W.H. Sammis Generating Station, Ohio

The W.H. Sammis plant is located in Jefferson County, Ohio, one-half mile upstream of the New Cumberland Lock and Dam, near Stratton at rivermile 53.9 (Environmental Science and Engineering, 1991). The W.H. Sammis plant is a coal-fired facility with seven steam electric generating units capable of producing 2,392 MW (Geo-Marine Inc., 1978). The facility uses once-through cooling with a maximum intake flow of 1,360 MGD (Environmental Science and Engineering, 1991).

Cardinal Plant, Ohio

The Cardinal facility is located on the Ohio shore of the Ohio River approximately 3 miles southwest of Brilliant, Ohio, and 20 miles upriver from Wheeling, West Virginia. The facility is located in the Pike Island Pool of the Ohio River, 76.7 miles downstream from Pittsburgh, Pennsylvania. The Cardinal facility has three coal-fired units. Units 1 and 2 began operations in February and July 1967, respectively, are rated at 590 MW, and employ a once-through cooling system (American Electric Power Service Corporation, 1981). Unit 3 went on-line in September 1977, is rated at 600 MW, and operates a closed cycle system with a cooling tower.

Figure C1-1: Locations of all Ohio River In Scope and Out of Scope CWIS

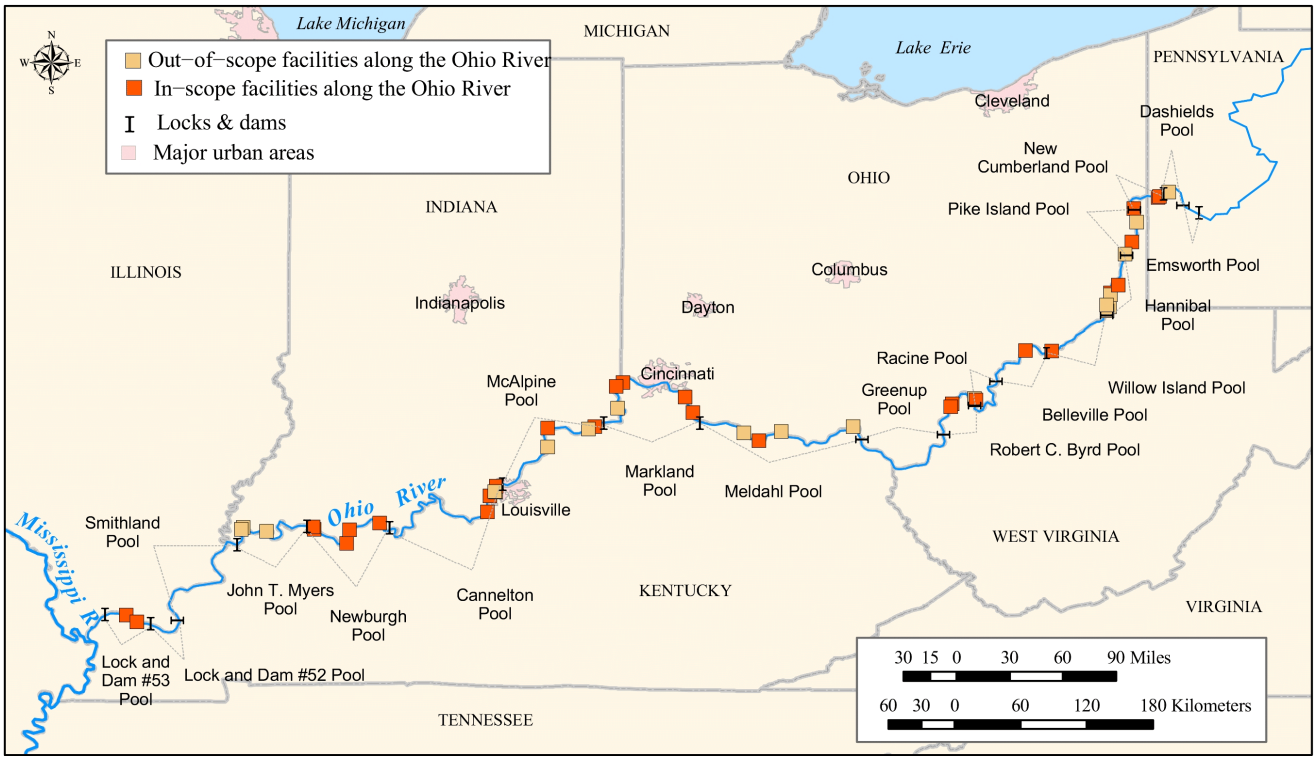
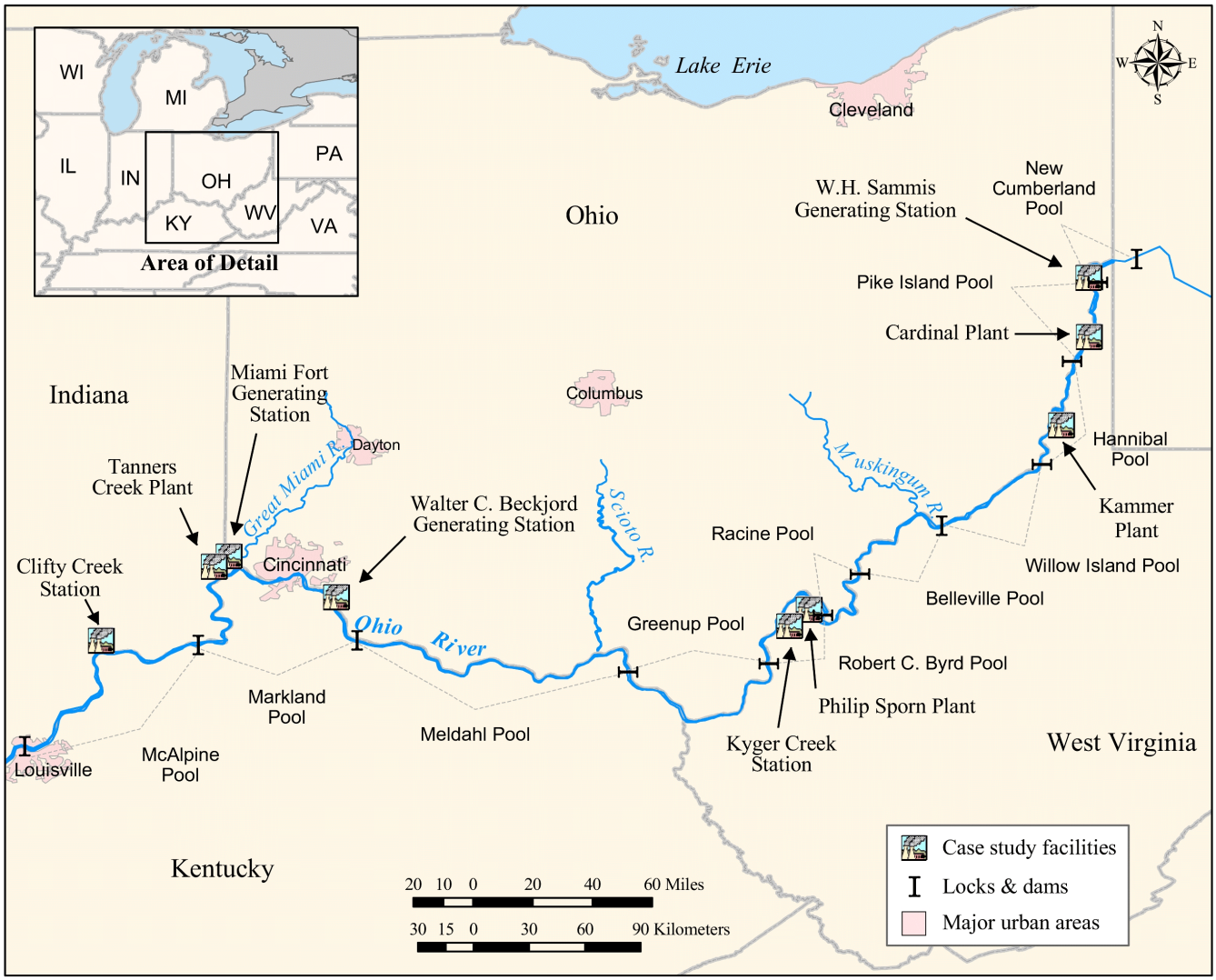


Table C1-1: Case Study Facilities and Navigational Pool Locations

Plant	Watershed HUC Code	Plant Location (rivermile)	Ohio River Navigational Pool
W.H. Sammis	05030101	53.9	New Cumberland
Cardinal	05030106	76.7	Pike Island
Kammer	05030106	111.1	Hannibal Pool
Philip Sporn	05030202	242	Robert C. Byrd
Kyger Creek	05030202	260	Robert C. Byrd
W.C. Beckjord	05090201	453	Markland
Miami Fort	05090203	490	Markland
Tanners Creek	05090203	494	Markland
Clifty Creek	05140101	560	McAlpine

Source: EA Engineering Science and Technology and Perry, 2001.

Figure C1-2: Case Study Facilities and Navigational Pool and Dam Locations on the Ohio River.



Kammer Plant, Ohio

Kammer Plant is located in northwestern West Virginia on the Ohio River. The facility is on the Hannibal Pool at rivermile 111.1. The Kammer facility consists of three fossil-fueled electric generating units capable of generating 675 MW (225 MW each). A once-through cooling system draws in water from the Ohio River through six circulating water pumps at 665 MGD when the facility operates at design conditions. The intake structure is divided into three sections, each containing three intake gates, three trash racks, three traveling screens, and two circulating water pumps (Balleto and Brown, 1980a).

Philip Sporn Plant, West Virginia

The Philip Sporn Plant is located within the Robert Byrd Pool on the West Virginia side of the Ohio River near New Haven. It is approximately 7.2 km (4.5 miles) downstream of the Racine Locks and Dam (Balletto and Brown, 1980b). The plant consists of five fossil-fueled once-through cooling generating units rated at 1050 MW that began operating between 1950 and 1960 (Balletto and Brown, 1980b). The units operate on circulating water systems. Units 1-4 contain one turbine condenser each, and unit 5 contains two turbine condensers. The plant has three intake structures, one for units 1 and 2, a second for units 3 and 4, and a third for unit 5.

Kyger Creek Station, Ohio

The Kyger Creek facility is located near Chesire, Ohio, at rivermile 260. This is about 21 miles upstream of the Gallipolis lock and dam, in the waterbody bounded by the Kanawha River and the Racine Locks and Dam (Brown and Van Hassel, 1981). Kyger Creek has five coal-fired units that use a once-through cooling system. Units 1 through 5 went on-line between February and December 1955 (Brown and Van Hassel, 1981).

W.C. Beckjord Generating Station, Ohio

The W.C. Beckjord facility is located 29 km (18 miles) upstream of Cincinnati, Ohio and 4.8 km (3 miles) downstream of New Richmond, Ohio at rivermile 452.9 (Cincinnati Gas & Electric Company, 1979). The facility is located within the Markland Pool. This section of the Ohio River is sparsely populated and agriculture is the dominant form of business. The W.C. Beckjord facility has six coal-fired units that use once-through cooling (Cincinnati Gas & Electric Company, 1979). There are two circulating pumps on each unit. Units 1 through 3 were activated in 1952, 1953, and 1954, respectively, while units 4 through 6 went on-line between 1958 and 1969. Three separate intake structures (cribhouses) provide water for the circulating pumps on the six units. Units 1 and 2 are in one cribhouse, units 3 and 4 are located in the second, and units 5 and 6 are in the third.

Miami Fort Generating Station, Ohio

The Miami Fort Station is located 32 km (20 miles) downstream of Cincinnati, Ohio, and Newport and Covington, Kentucky, at rivermile 490 (Cincinnati Gas & Electric Company, 1979). It sits on the lower third of the Markland Pool, less than a mile upstream of where the Great Miami River enters the Ohio River. This section of the Ohio River is heavily industrialized and receives discharge of chemical, industrial and sewage waste. Six generating units are in operation at the Miami Fort Station; units 3, 4, 5, and 6 are once-through cooling systems and units 7 and 8 are off-stream cooling systems. Units 1 and 2 were retired in 1971. Units 3, 4, and 5 are used only in times of high energy demand or when other units are not in function (Cincinnati Gas & Electric Company, 1979).

Tanners Creek Plant, Indiana

Tanners Creek is located near the town of Lawrenceburg, Indiana, approximately 494 miles downstream from Pittsburgh, Pennsylvania (Balletto & Zaabel, 1978b; Energy Impact Associates Inc., 1978b). Tanners Creek is located in the Markland Pool of the Ohio River, formed by the structures of the Meldahl Lock and Dam upstream and the Markland Lock and Dam downstream. The facility uses once-through cooling, drawing approximately 1,066 MGD from the Ohio River. There are four coal-fire units with a total rated power output of 1,040 MW. There are two separate intake structures. The intake screen house servicing units 3 and 4 is located upstream of the screen house servicing units 1 and 2.

Clifty Creek Station, Indiana

Clifty Creek is located near the town of Madison, Indiana, at rivermile 560 (Balletto and Zabel, 1978a; Energy Impact Associates, 1978a; EA Science and Technology, 1987). Clifty Creek resides within the McAlpine Pool on the Ohio River, formed by the boundaries of the Markland Lock and Dam upstream and the McAlpine Lock and Dam approximately 76 km (47 miles) downstream. This coal-fired facility has six generating units that use once-though cooling. Each unit is capable of producing 217 MW (EA Science and Technology, 1987), for a total rated capacity of approximately 1,300 MW.

C1-2 Environmental Setting

C1-2.1 The Ohio River Basin

The Ohio River is formed by the confluence of the Allegheny and Monongahela rivers at Pittsburgh, Pennsylvania. The river flows in a southwesterly direction for 1,582 km (981 miles) to its confluence with the Mississippi River near Cairo, Illinois; 727.2 of those kilometers (450.9 miles) form the southern boundary of Ohio. The river basin covers 525,800 km^2 (203,000 mi^2), which represents about 5 percent of the total land surface of the lower 48 states. The basin is spread over 10 states; six of those (Illinois, Indiana, Ohio, Pennsylvania, West Virginia, and Kentucky) border directly on the river. About 14.5 percent of the Ohio River drainage basin is within Ohio. The Ohio River has an average annual flow of 7,960 m^3/s (281,000 cfs) and

is a major tributary to the Mississippi River, providing just below 50 percent of the total discharge of the latter. On average, the Ohio River is 300 to 500 m (1,000 to 1,600 ft) wide, and 3-6 m (10 to 20 ft) deep (ORSANCO, 1998).

The modern river consists of a series of long navigation pools controlled by 20 lock and dam (L&D) structures. These structures are maintained by the U.S. Army Corps of Engineers. The dams regulate pool elevation on the Ohio River and allow for year-round navigation. The locks serve to pass barges from one pool to the next.

There are three major tributaries to the Ohio River. The Muskingum River enters the Ohio in the Belleville Pool at the town of Marietta (rivermile 172.2). The Muskingum is about 181 km (112 miles) long; it drains a surface area of 8,146 km^2 (3,145 mi^2) or about one fifth of the state. Agriculture is the dominant land use in the upper Muskingum basin (ORSANCO, 1990). The river is famed for its gamefish, including flathead catfish (and other catfish species), muskellunge, largemouth bass, smallmouth bass, spotted bass, and sauger.

The Scioto River enters the Ohio in the Captain Meldahl Pool at Portsmouth (rivermile 356.5). The Scioto River is about 381 km (237 miles) long and flows past the cities of Columbus and Chillicothe. The Olentangy River is its main tributary. The Scioto River drains a surface area of 6,510 mi^2. Agriculture is the dominant land use in the upper Scioto basin (ORSANCO, 1990).

The Great Miami River enters the Ohio in the Markland Pool at rivermile 491.1. It drains a surface area of 10,230 km^2 (3,950 mi^2). Agriculture is the dominant land use in the Great Miami River basin (ORSANCO, 1990).

C1-2.2 Aquatic Habitat and Biota

Historically, the Ohio River consisted of long, shallow riffle areas (such as the Falls of the Ohio), shallow island back channels, and overflow sloughs. The river and its habitats underwent dramatic change when a series of lock and dam structures were completed in 1929 to ease navigation. By 1955, the once free-flowing river was transformed into a series of 20 controlled river pools that maintain a relatively constant water level and flow rate year round for navigational purposes. Each navigational pool along the river is, to some extent, a unique environment. Aquatic species composition and stressors often differ from pool to pool, and the lock and dam structure restricts dispersal of fish, mussels, and crayfish among pools.

An important environmental impact of the lock and dam system is the loss of both island and wetland habitats. When the lock and dam system was built, the water level had to be raised in many parts of the Ohio, submerging 31 islands and 4,414 hectares (10,906 acres) of terrestrial habitat (US Army Corps Engineers, 2000). As a result, much of the diverse island and wetland areas were transformed into deep water habitats. Although these deep water habitats are still viable, they support a different set of species and severely impair the aquatic diversity and stability of the Ohio River ecosystem (Personal Communication, Patricia Morrison, Ohio River Islands National Wildlife Refuge, October 24, 2001).

Within the Ohio River mainstem area, a variety of distinct habitats help support the river's fish and wildlife. These areas include islands and backchannels, gravel/sandbars and cobble substrates, and wetlands/floodplains. Each of these habitats hosts a different set of the diverse fauna and flora of the Ohio River (US Army Corps Engineers, 2000).

- *Islands and Backchannels* - With a variety of water depths, current patterns, and substrates, the backchannels and the Ohio River islands provide a habitat for large number of fish and waterfowl species. The backchannels offer a unique nursery habitat and feeding area for larger fish. The heads and backchannels around islands are also renowned among sport fishermen for their dense fish populations (US Army Corps Engineers, 2000).

- *Gravel/Sand Bars, Cobble Substrates* - Topographical variations in the river bottom are crucial in maintaining the diverse plant and animal life of the Ohio River. For instance, clean gravel environments are the preferred spawning substrate of lithophilic fish (e.g., shovelnose sturgeon, redhorses, blue sucker, and paddlefish), species that use the clean gravel substrate for spawning, the predominant fish community of the historical Ohio River. Clean gravel environments have been threatened in recent years because human activity along the Ohio has resulted in siltation of these substrates (US Army Corps Engineers, 2000).

- *Floodplains* - As the Ohio River advances downstream from Pittsburgh, Pennsylvania, the terrain it traverses becomes gradually flatter, resulting in a wider and slower river. Downstream of Louisville, Kentucky, the Ohio River is considered a "floodplain river." The floodplain offers a number of different habitats and zones, including constantly inundated channels and lakes, overflow riverine wetlands, and dry uplands that are rarely flooded. Fish populations depend on the overflow areas for food production, feeding, spawning, and rearing of young. Many

organisms have evolved adaptations to allow them to take advantage of habitat changes resulting from the predictable seasonal floods and low water levels. The shallow water habitats are also important feeding areas for wading birds such as the great blue herons and black crowned night herons. This important habitat is also being threatened by human activity and is quickly disappearing. In 1978 the Ohio River Basin Commission determined that the river's floodplain encompasses some 342,647 hectares (846,700 acres) of wetland, down drastically from 744,947 hectares (1,840,803 acres) in 1937 (US Army Corps Engineers, 2000). The reduction in flooding is due mostly to flood control dams constructed on the tributaries of the river and is independent of the lock and dam structure on the Ohio itself (Personal Communication, Patricia Morrison, Ohio River Islands National Wildlife Refuge, October 24, 2001).

Because of the watershed's central geographic location in the eastern United States, some species with northern affinities and others with southern affinities occur in the watershed in addition to those common to the central region of the country.

The fish community of the Ohio is especially rich in species and harbors several evolutionary lines not found anywhere else in the world. The Ohio River supports about 160 fish species, including about 25 species of sportfish (Ohio Department of Natural Resources, 2001a). Shovelnose sturgeon, paddlefish, skipjack herring, river shiner, goldeye, silverband shiner, and blue sucker are some characteristic large river fish found in the Ohio. However, the composition of the fish community has been rapidly changing over the past century because of human activities along the river. Since 1900 a number of fish species have notably declined in abundance while a number of others are now extinct, including species not found anywhere else in the world. The series of locks and dams constructed on the river facilitated siltation of considerable areas of clean gravel and rubble substrate. Lithophilic fish have consequently seen their numbers decline, while fish producing eggs or larvae that float above the bottom (e.g., freshwater drum, emerald shiner and gizzard shad) have increased in abundance (US Army Corps Engineers, 2000).

Many songbirds that winter in South America or Latin America breed or inhabit the Ohio River watershed during the spring and summer. More than 25 species of waterfowl use the river's islands and riverine habitats as feeding and resting areas. In addition to various shorebirds, waterbirds, and geese, the lower Ohio River area is also home to a significant number of bald eagles, which have been federally listed as threatened (US Army Corps Engineers, 2000).

C1-2.3 Major Environmental Stressors

a. Habitat degradation

The lock and dam structure changed the free-flowing Ohio River into a series of lake-like environments, resulting in profound habitat changes that have affected native fish and invertebrate communities (Van Hassel et al., 1988):

- higher siltation rates in the pools resulted in the loss of gravel substrate and increased the populations of soft-bottom benthic invertebrates,
- the dams raised the overall level of the river (as intended for navigation purposes) and inundated adjacent land and tributaries, thereby producing numerous embayments, and
- the lake-like nature of the river changed the physicochemical characteristics of the surface water, including temperature dynamics and nutrient cycling.

The composition and abundance of fish responded to these habitat changes. For example, the navigation pools negatively affected species that required clean gravel for spawning but increased the abundance of species that produce pelagic eggs. A number of aquatic species declined because of this profound habitat change. The shovel-nosed sturgeon (*Scaphirhynchus platorhynchus*) experienced a sharp population decline following the river's impoundment (ORSANCO, 1962).

Other species have benefitted from the habitat changes associated with the impoundments. For example, channel catfish (*Ictalurus punctatus*) prefer deep, slower flowing water and are attracted to silty bottoms; black bullheads (*Ictalurus melas*) prefer silty bottoms with turbid and warmer water. These and other species increased their populations and expanded their ranges in response to the changes (ORSANCO, 1962).

b. Non-native species

Non-native species are species that evolve in one region of the world but are intentionally or accidentally introduced in another where they lack natural enemies. If such species become established, they can quickly outcompete and overwhelm native species. The Great Lakes basin and major midwestern rivers, including the Ohio, have been affected by the presence of zebra mussels (*Dreissena polymorpha*) and sea lamprey (*Petromyzon marinus*). Numerous other exotic species have

gained a foothold in the Great Lakes region and could spread further inland. These species, which include the ruffe (*Gymnocephalus cernuus*), spiny water flea (*Bythotrephes cederstroemi*), and round goby (*Neogobius melanoslomus*), have yet to reach the Ohio River system but have the potential to do so and are therefore of longer range concern (Great Lakes Commission, 2001).

c. Pollution

Surface water pollution is a major stressor on the Ohio River. Over the past 25 years, water quality has greatly improved because of stricter state and federal surface water pollution regulations, but serious pollution problems remain.

The Ohio River Valley Sanitation Commission (ORSANCO) evaluates the water quality in the river in terms of its ability to support designated uses: aquatic life, public water supply, recreation, and fish consumption. The use designations are assessed based on numerical water quality criteria for 37 conventional pollutants, metal toxicants, and organic toxicants. For each use, the degree of support is classified into the following categories depending on measured water quality conditions (ORSANCO, 1998).

- *fully supporting* indicates minor or no water quality problems for the designated use,
- *partially supporting* indicates that the use is precluded some of the time because of water quality problems, and
- *not supporting* indicates that the use is precluded much of the time because of water quality problems.

For the aquatic life designated use only, the partial support category is further subdivided into three subcategories for greater resolution:

- *substantially supporting* indicates minor water quality criterion violations for one chemical constituent,
- *moderately supporting* indicates criteria violations of multiple constituents or impaired aquatic communities based on direct biological measurements (including fish population and macroinvertebrate surveys and fish tissue analysis), and
- *marginally supporting* indicates significant adverse impacts on biological communities based on direct measurements.

Table C1-2 presents the 1996 designated use support of the Ohio River in Ohio.

Table C1-2: Designated Use Support for the Ohio River in Ohio

	Aquatic Life	Public Water	Contact Recreation	Fish Consumption
No. of kilometers (miles) use is fully supported	521 (323.7)	598 (371.3)	0.0	0.0
No. of kilometers (miles) use is partially supported	150 (92.9)	128 (79.6)	587 (364.5)	NA[b]
No. of kilometers (miles) use is not supported	0.0	0.0	139 (86.4)	NA
TOTAL	671 (416.6)[a]	726 (450.9)	726 (450.9)	726 (450.9)

[a] The aquatic life use was not assessed for 34.3 miles in Ohio; hence total miles do not add up to 450.9.
[b] Not available; ORSANCO (1998) did not provide a breakdown between partial uses and nonsupported uses for this parameter.
Source: ORSANCO, 1998.

ORSANCO (1998) interpreted the data in Table C1-2 as follows:

- *Warm water aquatic life:* 150 km (92.9 miles) of river were partially (but substantially) supporting this use in Ohio due to the exceedence of the chronic and/or aquatic life criteria for copper, cyanide, zinc and lead; no rivermiles in Ohio are nonsupporting of this use.

- *Public water supply:* 128 km (79.6 miles) of river were partially supporting this use in Ohio due to stream criterion violations for dioxin; no rivermiles in Ohio are non supporting of this use.

- *Contact recreation*: zero miles of river fully supported contact recreation uses; 587 km (364.5 miles) partially supported this use; 139 km (86.4 miles) do not support this use due to excessive levels of pathogens (fecal coliform and *E. coli*). The "partially support" designation must be interpreted carefully because usage was defined as such in the absence of bacterial monitoring stations (only six stations downstream from urban areas monitor for pathogens in the Ohio River over its entire course from Pittsburgh, Pennsylvania, to Cairo, Illinois). The partial support

designation in the absence of real data is due of the presence of numerous communities with combined sewer overflows (CSOs) along the entire length of the river. Waters are classified as "not supporting" when ≥25 percent of recreation season months do not meet water quality standards for bacteria.

- *Fish consumption*: zero miles of river fully support fish consumption due to the presence of fish consumption advisories which apply along the entire Ohio River along the Ohio border. The state of Ohio has instituted "restricted consumption" advisories for certain fish species because of PCBs and/or mercury; the state also developed "non consumption" advisories for channel catfish 43 cm (17 in.) or longer and all common carp because of dangerously high PCB residues.

C1-3 Water Withdrawals and Uses

Steam electric power generation in 1995 accounted for the single largest withdrawal of water from the watersheds in which the case study facilities are located, totaling 5,704 MGD or 92 percent of all surface water withdrawals (USGS, 1995).

Table C1-3 summarizes the cooling water intake flow features of the nine in scope facilities with I&E data. The table shows both design and average annual intake flows and provides flow rates for the source waterbody for comparison purposes. The mean annual flow is the average flow over the year; "7Q10" is "the lowest stream flow for seven consecutive days that would be expected to occur once in ten years" (U.S. EPA, 1998c) and hence represents the minimum expected waterbody flow.

C1-4 Socioeconomic Characteristics

C1-4.1 Industrial Activities

The Ohio River serves as a major shipping artery connecting the economies of the East and South with that of the Midwest. In terms of commercial shipping volume, the Ohio is second only to the Mississippi among U.S. rivers, transporting about 230 million tons of freight each year. Owing to its extensive lock and dam structure, the river is easily navigable and is thus ideal for industrial shipping activity, primarily by the coal and steel industries (ORSANCO, 2001).

The Ohio River is prominently used by the industrial centers of Pittsburgh, Cincinnati, and Louisville, where the coal and steel industries thrive. Consequently, the river is dotted with petrochemical plants that use it to conveniently ship and receive oil and other chemical products. Other materials such as gravel, sand and farm products are also heavily shipped along the Ohio River's 1,579 km (981 mile) course (US Army Corps Engineers, 1997).

C1-4.2 Commercial Fishing

At one time, the Ohio River supported a small commercial fishery that included carp (*Cyprinus carpio carpio*), channel catfish (*Ictalurus punctatus*), freshwater drum (*Aplodinotus grunniens*), carpsuckers (*Catostomidae* family), and smallmouth buffalo (*Ictiobus bubalus*) (ORSANCO, 1962). Today, there are no licenses issued in Ohio for commercial fishing in the Ohio portion of the Ohio River. However, Kentucky and West Virginia may allow commercial fishing in their respective portions of the river, which they share as mutual borders with Ohio.

C1-4.3 Recreational Activities

The Ohio River is also a major recreational resource for the people living in the bordering states and beyond. The navigation pools offer excellent fishing opportunities for numerous gamefish species. The river offers a variety of artificial and natural habitats that help support this recreational fishery. The major tributaries that empty into the Ohio River are also rich in fishery resources.

Table C1-3: Characteristics of § 316(b) Utility Plants Operating CWIS in Ohio (1999)

EIA Plant Code and Name	EIA CWIS Code	CWIS Type[a]	Design Intake Flow Rate (cfs)	Average Annual Intake Flow Rate (cfs)	HUC Water-shed Code	Source Waterbody	Flow of Source Waterbody (cfs)	
							Mean Annual	7Q10
2866, W.H. Sammis	1	OF	212	1,832.7	05030101	Ohio River	37,405	3,388
	2	OF	212					
	3	OF	212					
	4	OF	212					
	5	OF	403					
	6	OF	677					
	7	OF	862					
2828, Cardinal	1	OF	892	1,265.2	05030106	Ohio River	37,533	3,392
	2	OF	892					
	3	RN	14	13.6				
3947, Kammer	1	OF	356	815.1	05030106	Ohio River	38,713	3,419
	2	OF	356					
	3	OF	356					
3938, Philip Sporn	11	OF	223	1,262.7	05030202	Ohio River	54,823	4,243
	21	OF	223					
	31	OF	223					
	41	OF	223					
	51	OF	715					
2876, Kyger Creek	1	OF	361	324.9	05030202	Ohio River	55,143	4,258
	2	OF	361	324.9				
	3	OF	361	324.9				
	4	OF	361	324.9				
	5	OF	361	324.9				
2830, W.C. Beckjord	1	OF	108	38.3	05090201	Ohio River	92,084	6,417
	2	OF	124	62.9				
	3	OF	147	130.9				
	4	OF	169	200.3				
	5	OF	260	140.7				
	6	OF	336	320.3				
2832, Miami Fort	5	OF	154	13.0	05090203	Ohio River	98,615	6,516
	6	OF	201	56.1				
	7-8	RF	35	29.6				
988, Tanners Creek	U1	OF	223	668.1	05090203	Ohio River	105,245	7,146
	U2	OF	223					
	U3	OF	312					
	U4	OF	891	625.6				
983, Clifty Creek	1	OF	339	304.8	05140101	Ohio River	117,440	7,476
	2	OF	339	304.8				
	3	OF	339	304.8				
	4	OF	339	304.8				
	5	OF	339	304.8				
	6	OF	339	304.8				

[a] OF: Once through, freshwater; RF: Recirculating with forced draft cooling tower; RN: Recirculating with natural draft cooling tower.

Sources: CWIS information: U.S. DOE, 2001a; HUC codes and source waterbody information: U.S. EPA, 1982b.

a. Recreational Fishing

Recreational fishing in Ohio, including the Ohio River and its tributaries, represents a major economic activity in the state. The Ohio Department of Natural Resources estimates that 1.5 million people fish for fun every year. Sportfishing contributes more than of $2 billion per year to the state's economy and supports more than 22,000 jobs. According to a U.S. Fish and Wildlife Service survey, Ohio ranked 11th nationally in the number of people who fish, 11th in the number of days per year spent fishing, and 12th in the amount of money spent to support recreational fishing habits. This activity has its greatest impacts in local communities around Lake Erie, Ohio's larger inland lakes, and the Ohio River (Ohio Department of Natural Resources, 2001e).

The Ohio River supports a major recreational fishery. Populations of forage and sportfish improved dramatically after severe surface water pollution was brought under control by better treatment of industrial and municipal waste water effluents (Van Hassel et al., 1988). Twenty-five of the 160 or so different fish species that live in the river support recreational fishing.

A survey of 30,000 anglers conducted in 1992 and 1993 by the Ohio River Fisheries Management Team (ORFMT) concluded that the catch rates in the Ohio River were often better than those reported for Lake Erie or other inland lakes. It was estimated that anglers in the survey spent a combined total of over 3 million hours fishing on the river. The survey also found that more recreational boaters and fishers were using the Ohio River and its tributaries than in the past (Ohio Department of Natural Resources, 2001d).

There are strict daily bag and/or size limits on game fish caught in the Ohio River. These limits are set to maintain and preserve the quality of the recreational fishery. For example, the daily limit for walleyes, sauger, and saugereyes, either in combination or as a single species, is set at 10 fish per angler. Anglers have a daily bag limit of six largemouth, smallmouth, and spotted bass, either singly or in combination. There is no minimum size limit for keeper bass in the section of the Ohio River that borders West Virginia; a 12-inch size limit on bass is enforced on that section of the river which borders Kentucky (Ohio Department of Natural Resources, 2001c).

Recreational fishing occurs in all the Ohio River navigation pools along the southern border of Ohio. The key target fish species and their preferred habitats in the Ohio River are summarized in Table C1-4. The habitats of gamefish most often used include the main channel shoreline, sand and gravel bars, warm water discharges, stream or river confluences, and the tailwaters adjacent to locks and dams. The ORFMT survey discussed earlier confirmed that the tailwaters in particular provide outstanding sportfishing action; anglers concentrate much of their fishing efforts in these areas.

Table C1-4: Recreational Fishing in the Ohio River

Recreational Fish Species	Preferred Aquatic Habitats in Ohio River Pools										
	New Cumber-land	Pike Island	Hannibal	Willow Island	Belle-ville	Racine	Gallipolis	Greenup	Meldahl	Mark-land	Overall Habitat Preference
Channel catfish (*Ictalurus punctatus*)	1a, 2, 3	4, 5, 6	1a, 2, 4, 6	1a, 4, 5, 6, 13	1a, 4, 5, 6, 13, 16	1a, 4, 5, 6, 13	1a, 4, 5, 6	1a, 2, 5, 6, 13	1a, 3, 5, 6	1a, 4, 5, 6, 16	1a, 2, 3, 4, 5, 6, 13, 16
White bass (*Morone chrysops*)	4, 5	1b, 1c, 4, 5, 6	1b, 4, 5, 6	1a, 2, 4, 5, 6	1a, 4, 5, 6, 16	1b, 2, 5, 6, 13	1a, 4, 5, 6	1b, 4, 5, 6	3, 4, 5, 6	4, 5, 6	1a, 1b, 1c, 2, 4, 5, 6, 13, 16
Flathead catfish (*Pylodictis olivaris*)	5, 6	4,6	5,6	5,6	2, 6, 13	5, 6, 13	4, 6	6, 13	5, 6, 9	4, 6, 9	2, 4, 5, 6, 9, 13
Sauger (*Stizostedion canadense*)	4, 5	4, 6	1b, 5, 6	1b, 4, 6	1b, 5, 6, 7, 16	1b, 2, 5, 6, 13	1b, 4, 5, 6	1b, 4, 5, 6	1b, 3, 4, 5, 6	1b, 3, 4, 5, 6	1b, 2, 3, 4, 5, 6, 7, 13, 16
Spotted bass (*Micropterus punctulatus*)	2, 7	2,7,9	1.c, 1.d, 2, 9, 17	2, 5, 8, 12	5,16	2, 7	7, 9	2, 5, 7, 12	2, 7	Not Found	1c, 1d, 2, 5, 7, 8, 9, 12, 16, 17
Hybrid striped bass (*Morone saxatilis* hybrid)	1b, 5	1.b, 1.c, 4, 5, 6	1.b, 1.c, 4, 5, 6	1.b, 2, 6, 10, 13	1.b, 4, 5, 6, 16	1.b, 2, 5, 6, 13	1.b, 4, 5, 6	1.b, 4, 5, 6	3, 4, 5, 6	4, 5, 6	1.b, 1.c, 2, 3, 4, 5, 6, 10, 13, 16
Crappie/ sunfish (Centrarchidae family)	8	4, 8	4, 5, 8	1.a, 8, 14	1.d, 8, 14	5, 8, 11	4, 8	1.a, 5, 8	2, 8, 9	4, 5, 8, 9	1.a, 1.d, 2, 4, 5, 8, 9, 11, 14
Smallmouth bass (*Micropterus dolomieu*)	1b, 5, 9	1.a, 4, 9, 10	1.b, 2, 5, 9, 10	1.b, 2, 3, 5, 6, 9	3, 5, 9, 16	2, 5, 9	2, 4, 9	1.b, 6, 9, 13	2, 3, 9, 15	2, 5, 9, 15	1.a, 1.b, 2, 3, 4, 5, 6, 9, 10, 13, 15, 16
Walleye (*Stizostedion vitreum*)	Not Found	1.b, 1.d, 5, 6	1.b, 5, 6	2, 4, 5, 9	Not Found	1.b, 5, 6	1.b, 1.c, 4, 5, 6	5, 6, 13	4, 5, 15, 16	Not Found	1.b, 1.c, 1.d, 2, 4, 5, 6, 9, 13, 15, 16
Largemouth bass (*Micropterus salmoides*)	Not Found	5, 8, 10	1.c, 1.d, 2, 8, 11, 12	1.d, 2, 8, 10, 11, 12	1.c, 1.d, 2, 8, 12	1.c, 1.d, 2, 8, 12	1.c, 1.d, 4, 5, 8	1.c, 1.d, 2, 5, 8, 12	1.d, 2, 5, 8, 12	2, 5, 8, 12	1.c, 1.d, 2, 4, 5, 8, 10, 11, 12

Source: Ohio Department of Natural Resources, 2002.

1.a = throughout the pool; 1.b = upper pool; 1.c = middle pool; 1.d = lower pool; 2 = main channel shoreline; 3 = sand and gravel bars; 4 = warm water discharges; 5 = stream confluences; 6 = tailwaters adjacent to locks and dams; 7 = deep water with woody cover; 8 = embayments; 9 = rocky shorelines; 10 = around islands; 11 = woody cover; 12 = weedbeds; 13 = old lock and dam sites; 14 = backwaters with cover; 15 = bridge abutments; 16 = river confluences; 17 = deep water.