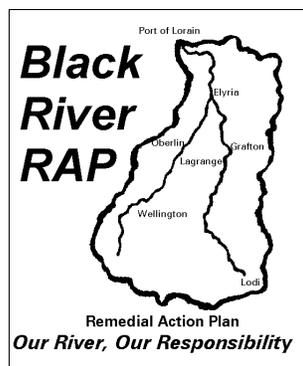
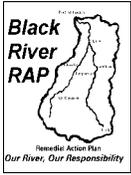




‘A Success in the Making’

An Application for Change in Status
for the
Fish Tumors and Other Deformities
Beneficial Use Impairment





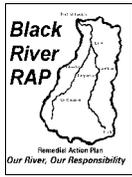
The Black River Remedial Action Plan

Turning The Corner

'A Success In The Making'

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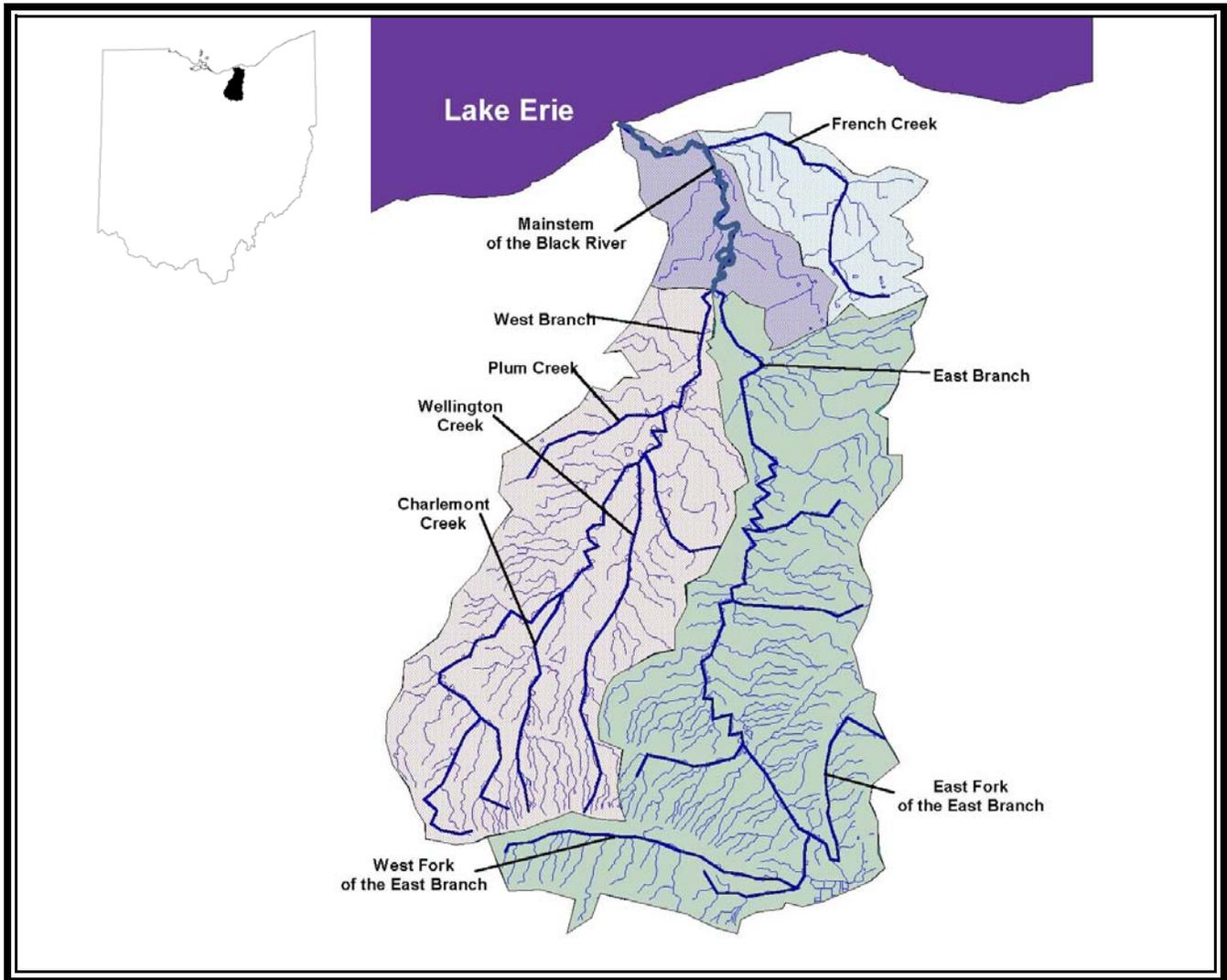


Figure 1. The Black River Watershed and Area of Concern



A Message from Christopher Jones, Director

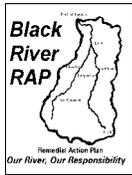
The State of Ohio is dedicated to the restoration and protection of all waterbodies in the state, including Lake Erie and its tributary river systems. A legacy of Lake Erie's industrial past led four Ohio rivers to be designated as areas of concern by the International Joint Commission. In the last decade, remarkable progress has been made in the restoration processes of the Ashtabula, Black, Cuyahoga and Maumee Areas of Concern. These improvements are largely due to the determination and hard work of the Remedial Action Plan Coordinating Committees. An important element of Ohio's commitment to the restoration and protection of the Lake Erie basin is participating in and continued support for the Remedial Action Plans for the four Areas of Concern in Ohio.

Although returning to pristine conditions may not be realistic for these areas of concern, the restoration of impairments to beneficial uses is both desirable and achievable. Celebrating incremental improvements in the environmental restoration process is important to demonstrate significant accomplishments. Therefore, I am pleased to recommend the re-designation proposal for the Black River's Fish Tumors and Other Deformities Beneficial Use Impairment to "In Recovery Phase."

I commend the work of the conscientious individuals, groups, organizations and industries that comprise the Black River Remedial Action Plan Coordinating Committee. Realizing the importance of the Black River, they committed themselves to restoring not only the originally-designated lower river segment, but the entire watershed as well. While the Black River RAP Coordinating Committee acknowledges that much work remains to be done, this re-designation will show the Black River is indeed turning the corner and will offer a promise to the region of further improvements to come. The progress seen in the health of the Black River fish communities is but a single milestone. Other improvements and milestones are sure to follow as the Black River progresses towards final and complete restoration.

A handwritten signature in black ink that reads 'Christopher Jones'.

Christopher Jones
Director
Ohio Environmental Protection Agency



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A Message from Ken Pearce

Black River Remedial Action Plan Chairperson

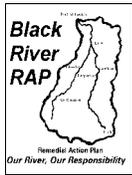
Turning the Corner. After more than ten years of study and hard work, I am pleased the Black River RAP effort can finally use that phrase. With all the hard work over the years, it is encouraging to be able to say the Black River is turning the corner.

At the beginning of the process, the task of 'restoring' the Black River looked to be a long, dark tunnel. Now after more than ten years of effort, there is some light at the end of the tunnel. It was encouraging to have the Ohio Department of Health conduct a risk assessment on the Black River in 2001 and we anxiously await the report of that study. The Coordinating Committee was rejuvenated to know others had noticed the positive changes in the water and sediment quality. It was another proud moment when the Black River Landing Fish Habitat Shelf was constructed and that local anglers were among the first to notice the changes in the number of desirable fish species. This habitat shelf showed that fish habitats can be improved in an urban river.

Recent studies conducted by the Ohio Environmental Protection Agency have shown many improvements around the Black River watershed. The most recent biological indices, used by the agency, show higher scores for the Black River and Lorain County. Our area is now consistently scoring near the top of Ohio's Lake Erie shorelines and rivermouths, meaning the Black River has become a better 'neighbor' to Lake Erie. The Ohio EPA has shown the percentage of assessed Black River streams in attainment have doubled, compared to twenty years ago.

But the most brilliant light so far is a noticeable improvement in the health of the fish communities resulting in the ability to present this application for the re-designation of the Fish Tumors and Other Deformities Beneficial Use Impairment. As you will see in the application, the Black River RAP Committee has decided sufficient progress has been made in both water/sediment quality and fish community health to allow us to request this change in designation. Since this impairment was, most likely, the major reason for the Black River to be listed as an Area of Concern, it is a major turning point in the recovery efforts for the river.

I am proud of my association with the Black River RAP Coordinating Committee and all the member organizations, agencies and individuals. Through the concerted efforts of the Committee, this is but one area of improvement in the Black River watershed. We will continue to "Turn the Corner." The Coordinating Committee and the greater Black River watershed community will continue in efforts to restore the natural resource that is "Our River, Our Responsibility."



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Executive Summary

In the 1970s and 1980s, it was common to see abnormalities in the Black River fish populations. Fish crew surveys by the Ohio Environmental Protection Agency routinely yielded catches where one in every two to three fish had external deformities, eroded fins, lesions or tumors. In 1982, studies conducted by Dr. Paul Baumann of USGS, Biological Resources Division showed liver cancers afflicting almost 40% of the population of Black River brown bullhead catfish, while only about 20% of the bullhead catfish had normal livers.

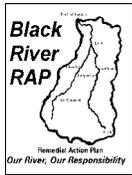
The tumors and other deformities evident in the Black River fish populations were the toxic legacies of the industrial heritage of the river. Industrial ventures on the banks of the Black River included steel making, ship building, and materials transport. Over the early years, many of these industries discharged wastes to the river without environmental oversight. The overall health of the Black River and the fish populations within it suffered as a result.

A steel mill coking operation was once located on the banks of the river at approximately River Mile 3.2. Effluent from this coking operation contaminated the bottom sediments with polynuclear aromatic hydrocarbons (PAH). In the early 1970s, the effects of the PAH-contaminated sediments became evident in the external tumors and cancerous livers of the Black River fish populations. The coking facility ceased operations in the early 1980s.

Over the years, the Black River gained notoriety as the river with fish tumors. Tumor frequencies were so high, the Ohio Department of Health advised against eating any fish caught from the lower five to six miles of the Black River or even coming into contact with the water or sediments. In 1985, the Black River was designated by the International Joint Commission as one of forty-three Areas of Concern (AOC) in the Great Lakes. In the decade following the coking plant closure, newer sediments blanketed over the old contaminated layers and the fish populations started to recover.

Under a consent decree from the US EPA, the steel mill was required to dredge the stretch of the river in the vicinity of the coking plant outfall. The dredging operation removed 50,000 cubic yards of contaminated material between 1989-1990. Some re-suspension of contaminated material during the dredging operation caused a spike in fish tumor prevalence in the following years.

In 1991, a Remedial Action Plan was started for the Black River to restore any of up to fourteen beneficial use impairments (BUI). The Fish Tumor and Other Deformities BUI was possibly the single most important reason for the Black River's designation as an Area of Concern.



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Since its inception, the Black River Remedial Action Plan Coordinating Committee has been closely monitoring available fish community data. At this time, some 13 years after the dredging, the Black River fish, including the brown bullhead catfish, are approaching the incidence levels of abnormalities one would expect to find in un-impacted river systems. Overall, neoplastic (abnormal tissue growth that forms a mass that may be benign or malignant) and cancerous livers in brown bullheads have dropped from about 60% in 1982 to about 7% in 1998. During that same time, healthy bullhead livers increased from about 20% to 68%. The numbers of external deformities on Black River fish have improved as well. While it was once common to see half of every fish catch with some sort of deformity, the data shows the number of external abnormalities in the lower Black River fish has dropped more than 71% since 1982.

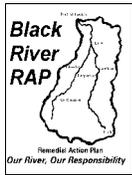
Dramatic improvements in the incidence of external tumors in Black River fish can be noted from the remedial dredging area downstream to Lake Erie. Upstream of the dredging area, the improvements are not as dramatic. This is likely due to some PAH contamination having 'migrated' upstream with periodic climatic-induced flow reversals plus the presence of other point source impacts at this stretch of the river.

The Black River RAP Coordinating Committee has determined sufficient progress in the Fish Tumor or Other Deformities BUI has been documented and that no additional remedial action steps are necessary. While the incidence of abnormalities in Black River fish communities may not satisfy a re-designation to "Restored," the improvements that have been noted are remarkable and show this stretch of the river to be in a stage of recovery.

The PAH contaminated sediment had been linked to fish tumors and deformities and there are no on-going sources of PAH contamination. The Committee has further determined that natural processes should complete the restoration of this beneficial use. The Black River Coordinating Committee proposes a re-designation of the Fish Tumors and Other Deformities BUI from 'Impaired' to 'In Recovery Phase.' The Committee plans to continue to review the data collected by the Ohio EPA and others on the health of the fish communities within the Black River.

While no formal de-listing targets for this impairment have been set, either by the US EPA or the IJC, the Coordinating Committee has been utilizing the draft *Delisting Guidelines for Ohio Areas of Concern* for guidance. The assessment process used by the Black River Coordinating Committee may be able to provide a case study for other areas of concern with similar problems.

This re-designation is an important first step in demonstrating the improvements to the Black River Area of Concern. The Black River Coordinating Committee will continue its efforts to monitor this and other beneficial use impairments and will continue in its efforts to restore them.



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Background

For more than one hundred years, the Black River mainstem has been a working river. Wooden shipbuilding began on the river in 1820. In 1897, the Cleveland Shipbuilding Co. was formed and the building of wooden ships gave way to building large steel freighters. Two years later, the facility expanded and became part of the American Shipbuilding Company. At one time, a Lorain dry dock was considered to be one of the largest dry docks in the world and held the world record for freshwater dry docks. Shipbuilding on the Black River continued through both World Wars and ended with the closing of the American Shipbuilding facility in 1983.

Shipping and material transport have always been an integral part of the Black River. The secure harbor in Lorain, which has been recognized around the Great Lakes, lured many industries to open in or move to the Black River because of the harbor facilities. Throughout the years, the harbor handled massive amounts of coal, iron ore, sand, gypsum, and lumber and boasted seven miles of dockage facilities.



Figure 2. American Shipbuilding © 2000-2002 Black River Historical Society

Steelmaking began with the first iron furnace located on the river banks in 1860. In the late 1890s to the early 1900s, steel making became a large part of the industrial fabric of the river and surrounding communities. During the second World War, steel production was a vital national priority and the mills in Lorain responded. In 1942, one Lorain blast furnace set a national record in tons of steel produced in one month.

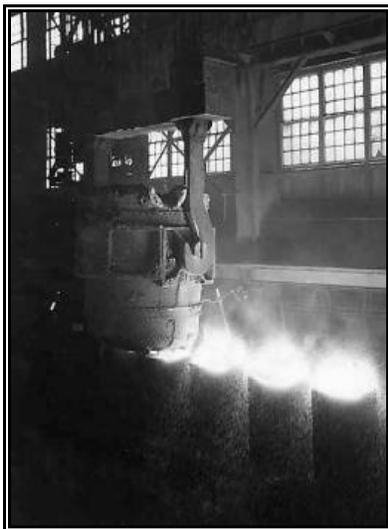
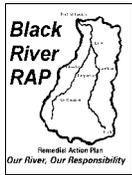


Figure 3. Lorain Steel Making © 2000-2002 Black River Historical Society

Throughout much of the Black River's industrial past, the environmental health of the river held a back seat to industrial production and profits. Environmental oversight of the municipal and industrial discharges to the river did not become a priority until the 1970s. What the river had been forced to assimilate over the previous decades led to the Black River being identified as one of the most contaminated rivers in Ohio and the Great Lakes. With the legacy of contaminated water and sediment from industrial wastes, the International Joint Commission (IJC) determined the Black River should be listed as a Great Lakes Area of Concern.



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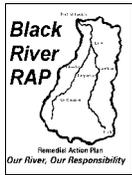
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Forty-three similarly impaired rivers and river systems were identified by the IJC. In 1985, the Commission recommended remedial action plans be developed for these areas to concentrate on the cleanup and restoration. The Ohio Environmental Protection Agency (Ohio EPA) took the lead in Ohio's remedial action plan program. There are four Areas of Concern in Ohio (Ashtabula River, Cuyahoga River, Maumee River and the Black River). The Black River is the only Ohio Area of Concern (AOC) that encompasses an entire watershed. Located in north-central Ohio, the Black River watershed drains more than 1,210 km². Although flowing primarily in Lorain County the watershed does include drainage from portions of Medina, Ashland, Huron and Cuyahoga Counties. In Elyria, the east and west branches of the river join to form the mainstem, which then flows 16 miles north and discharges into Lake Erie at the port of the City of Lorain. The lower main channel of the Black River is a working river and was the originally designated Area of Concern.

The Black River RAP was initiated by the Ohio Environmental Protection Agency in 1991. With the formation of the Black River Remedial Action Plan (RAP), a unique ecosystem approach was necessary. At the initial meetings of the Coordinating Committee, it was decided the Area of Concern should be expanded to include the entire Black River watershed because it was felt significant upstream sources of pollution were contributing to the degradation of the Black River mainstem. The Black River RAP Coordinating Committee has 26 members representing federal, state and local agencies, local industries and residents. The Committee is charged with the restoration of Impairments to Beneficial Uses in the Black River Area of Concern.

The Black River RAP Coordinating Committee understands the blue-collar legacy of the river and realizes that although this river will never be restored to pristine conditions, improvements are necessary and possible. The Coordinating Committee has worked hard on 'restoring' the river through public outreach and education and through on-the-ground activities, such as streambank rehabilitation, habitat restoration, wetland and riparian protection efforts. Recent RAP-initiated activities include the expansion of the Black River Landing Fish Habitat Shelf and an Operations and Maintenance program for home sewage treatment systems in Lorain County.

With an Area of Concern the size of the Black River watershed, the Coordinating Committee has noted that problems vary from locale to locale or from sub-watershed to sub-watershed. With that in mind, the Coordinating Committee has been active in conducting studies or environmental surveys on a sub-watershed by sub-watershed basis. With these studies, the Committee hopes to fine-tune its knowledge of where impairments exist and better understand the causes of the impairments. One outcome of these studies and surveys is the production of sub-watershed specific brochures. The brochures are being designed as owner's manuals for watershed residents, businesses and local decision-makers so that they may help to improve



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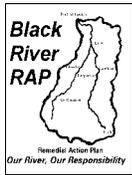
the quality of the sub-watershed in which they work, live and recreate. It is hoped that sub-watershed groups can be formed out of this exercise and these groups would become active members of the Coordinating Committee where they would be able to assist the remedial action process in restoring any beneficial use impairments (BUI) in their sub-basins.

The first two surveys are being conducted on the eastern sub-watersheds of French Creek and the northern East Branch. These two sub-watersheds are experiencing developmental pressures associated with suburban sprawl. The surveys are being conducted by the US Army Corps of Engineers-Buffalo District as part of Section 401 of the Water Resources Development Act of 1990, as amended, which authorizes the Corps to provide technical, planning and engineering assistance in the development of remedial action plans. Recently, the Black River RAP has been one of the most active AOCs within the Buffalo District in the use of this assistance opportunity.

The development of a sub-watershed action plan will soon start on a third sub-watershed, the West Branch of the Black River. This sub-watershed is predominately rural/agricultural in nature and suffers from extreme non-point source pollution. With the help of the Lake Erie Forum and the Delta Institute, a watershed coordinator position for the West Branch has been created.

After more than ten years, the Black River Area of Concern is approaching a degree of improvement the Coordinating Committee feels is scientifically measurable and defensible.

- In 2001, the Ohio Department of Health conducted a risk assessment of the lower 6.2 miles of the Black River mainstem. Since 1983, ODH listed this area with a Contact Advisory that recommends a person not wade or swim in the advisory area. The Black River Contact Advisory is due to PAH contamination. The Ohio Department of Health felt the improvements in the sediments warranted a comprehensive risk assessment in order to determine if the Contact Advisory should remain in effect. A final report of the risk analysis is expected in the near future.
- The lower three-mile stretch of the Black River is a federal ship channel and must be periodically dredged to facilitate ship traffic. Routine monitoring by the US Army Corps of Engineers shows improvement in contaminant concentrations of the river sediments.
- Careful monitoring of the Fish Tumor and Other Deformities data over the years have shown dramatic improvements. The Coordinating Committee now feels the documented improvements to the fish communities of the Black River are defensible and approaching consistency with applicable standards, regulations, objectives, policies and guidelines.



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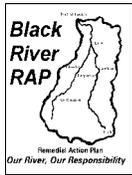
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Black River Beneficial Use Impairment Status

Beneficial Use Impairment	Black River Status
Tainting of Fish and Wildlife Flavor	Not Impaired
Added Costs to Agriculture and Industry	Not Impaired
Bird or Animal Deformities or Reproductive Problems	Unknown, but Impairment not suspected
Degradation of Phytoplankton and Zooplankton Populations	Unknown, but Impairment likely in some areas
Restrictions on Drinking Water or Taste or Odor Problems	Seasonally Impaired
Degradation of Fish and Wildlife Populations	Impaired
Degradation of Benthos	Impaired
Restrictions of Dredging Operations	Impaired
Eutrophication or Undesirable Algae	Impaired
Degradation of Aesthetics	Impaired
Loss of Fish and Wildlife Habitat	Impaired
Beach Closings	Impaired
Restrictions of Fish or Wildlife Consumption	Impaired
Fish Tumors and Other Deformities	Impaired

Figure 4. Status of the Black River Area of Concern Beneficial Use Impairments



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Fish Tumors and Other Deformities Beneficial Use Impairment

Until the 1970s, environmental concerns about what was happening to the river held a back seat to production, employment and financial bottom lines. Lack of environmental regulations and oversight led to the Black River's long history of fish tumors and other deformities.

The International Joint Commission designated the Black River as a Great Lakes Area of Concern, in part due to the river's high incidence of fish tumors. The IJC listing criterion for this Beneficial Use Impairment (BUI) states:

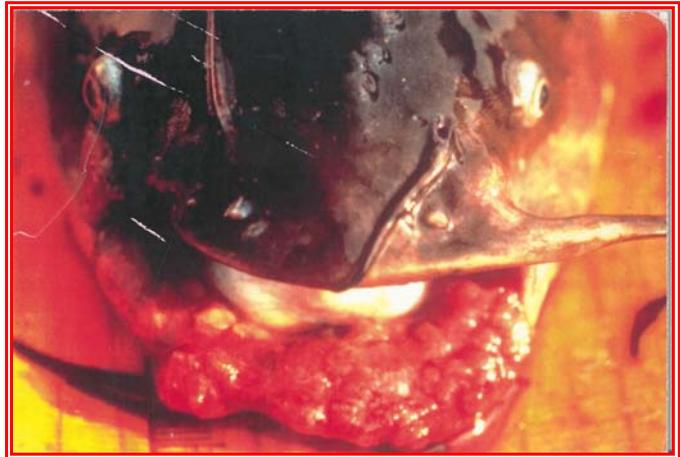
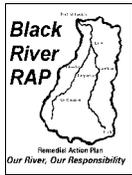


Figure 5. Lip Tumor in Black River Bullhead

“This beneficial use shall be listed as impaired when incidence rates of fish tumors or other deformities exceed rates at un-impacted control sites or when survey data confirm the presence of neoplastic or preneoplastic liver tumors in bullheads or suckers.”

A USEPA Consent Decree in 1985 dictated the removal of PAH contaminated sediments by the steel mill (USS/KOBE Steel Company). Between 1989 and 1990, a remedial dredging of the contaminated river sediments occurred between River Mile 2.9 and River Mile 3.6. Approximately fifty thousand cubic yards of contaminated sediment were removed from this section of the river. A closed clamshell dredge was used to minimize the loss and resuspension of sediments in the river. The dredged material was then transported to a specially designed containment cell located on steel mill property. The cost for the remedial dredging and containment was approximately \$1.5 million. The remedial dredging of the river sediments was completed in December 1990.

Although the remedial dredging of the contaminated sediments occurred before the formation of the Black River Coordinating Committee, the Committee has been actively monitoring the results of studies conducted on the fish communities of the lower mainstem of the Black River. The studies have come from two distinct sources, the Ohio EPA and the brown bullhead catfish studies conducted by Baumann, et al. The beneficial use impairment for Fish Tumors



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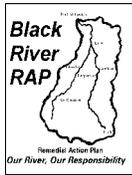
and Other Deformities in the Black River AOC has been linked to the lower mainstem due to the polynuclear aromatic hydrocarbon (PAH) contaminated sediments at and near the site of the steel mill coking facility that was located on the river in Lorain. The Black River Coordinating Committee considers the impaired area to be from the mouth of French Creek (Black River Mile 5.1) to the mouth of the Black River at Lake Erie.

A slight spike in sediment PAH concentrations occurred in 1992. This has been attributed to a



Figure 6. Location of Remedial Dredging on the Black River Mainstem

re-suspension of contaminated material during the dredging operation two years previous. Aside from this slight spike, the Black River RAP Coordinating Committee has determined the



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remedial dredging operation was successful in removing polynuclear aromatic hydrocarbons from the river sediments.

Selected PAH Concentrations (mg/kg) in Black River Sediment				
Year	Phenanthrene	Benzo(a)anthracene	Benzo(a)pyrene	Indeno(1,2,3-cd)pyrene
1980	390	51	43	26
1982	100	23	21	15
1984	0.73	0.37	0.24	0.01
1992	2.1	2.4	2.6	1.8
1994	1.9	0.31	0.24	0.20
1997	0.92	0.68	0.70	0.64

Figure 7. Black River PAH Sediment Concentrations

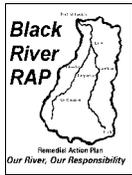
Source: Baumann 2000

With the removal of the contamination pathway, the amount of PAH compounds in the resident fish dropped significantly (see Figure 8.) and this has led to improvements in the health of the Black River mainstem fish communities. In assessing the improvements with respect to the Fish Tumors and Other Deformities BUI, the Black River RAP Coordinating Committee realizes the IJC listing criterion is twofold and an AOC would need to satisfy both parts in order to have the beneficial use re-designated. This document will show the improvements of both parts of the listing criteria (External Tumors and Liver Cancers) separately.

Whole Body PAH Residues in Brown Bullhead (ug/kg)				
Date	Phenanthrene	Fluoranthene	Pyrene	Chrysene
1980-1981	5,750	2,650	1,160	51
1982	161	129	84	13
1998	41	34	20	6.1

Figure 8.

Source: Baumann 2000



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Incidence Rates of External Fish Tumors or Other Deformities

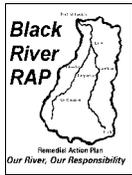
One of the goals of the Clean Water Act is the restoration and maintenance of surface waters. To measure the progress and ultimate achievement of this goal, the Ohio EPA assesses the current physical, chemical and biological conditions of a particular waterbody. The Ohio EPA places the most weight on the status of the biological communities as a true representative measurement of the state of a particular waterbody. Resident biological communities inhabit the surface water body continuously and they can reflect the long-term conditions of their environment. One of the indices used by the Ohio EPA to assess fish communities in surface waters is the Index of Biological Integrity (IBI). The IBI incorporates fish community metrics into three categories: species richness and composition; trophic condition; and fish abundance and condition. In the assessment of fish condition, the IBI contains a metric that focuses on external tumors and other deformities.

Data on the incidence rates of external fish tumors and other deformities has been available from the Ohio EPA since the early 1980s. In their routine surveys of watersheds, the Ohio EPA collects fish community data, including information on external **D**eformities, **E**roded fins, **L**esions and **T**umors, or **DELT** anomalies index. This index applies to all fish species and is a broad indicator of environmental degradation. The Ohio EPA utilizes electro-fishing techniques to sample river zones. All fish collected are examined for DELT anomalies. Anomaly data is collected on individual fish and analyzed at a community level.

DELT data is readily available for many water systems throughout the state and studies have shown the highest percentages of DELT anomalies occur in the most impaired streams while the lowest percentages have been found in the least impacted streams. The agency has determined DELT levels in Ohio should not exceed 0.5%, representing a frequency of one anomaly in every 200 fish. This level is what the Ohio EPA would expect to find at un-impacted control sites.

Black River DELT Data

The Ohio EPA first collected DELT data for Black River mainstem fish communities in 1982, which is about two years after the coke plant ceased operations and about eight years before the remedial dredging. The agency returned to the Black River mainstem in 1992 (two years after remedial dredging) and collected new data. The latest available DELT data is from 1997 (seven years after remedial dredging). Ohio EPA's Black River DELT averages by year collected and by river section are outlined below:



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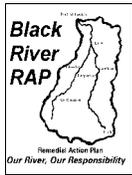
Ohio EPA Deformities, Eroded Fins, Lesions and Tumors (DELT) Data			
River Mile Vicinity	1982 Average*	1992 Average*	1997 Average*
0.1 - 0.3	No Data	6.1	1.4
0.9	10.4	6.6	No Data
2.3 - 2.7	6.3	4.8	3.2
3.0 - 3.4	11.9	3.9	2.3
3.7	(<10 Individuals per Sample)	6.8	1.25
4.8	20.1	10.3	7.0
5.0 - 5.3	No Data	3.8	2.0
5.5	(<10 Individuals per Sample)	7.5	2.75
5.8	6.7	8.5	4.9

Figure 9. DELT Anomaly Data for the Black River mainstem

* In Percent of Population

In almost all monitored river stretches, the percentage of DELT anomalies decreased from 1982 to 1997. The highest values (or worst areas), occurred in 1982, and corresponded to a population frequency of about one anomaly for every five to ten fish. By 1997, the worst area dropped to a frequency of only seven anomalies in every 100 fish.

Utilizing GIS mapping, temporal stream segment improvements in the Black River's DELT anomalies between 1982 and 1997 can be readily seen in Figures 10, 11, and 12. In developing this GIS map, 2.0% and 5.0% DELT benchmarks were arbitrarily chosen. The 5.0% arbitrary benchmark represents a value ten times higher than a DELT level one should expect at an un-impacted site (0.5%) and about ten times lower than the highest DELT level (54.9%) found in a single Ohio EPA fish crew survey pass of the Black River mainstem. The 2.0% DELT benchmark is only four times higher than a DELT level one should expect at an un-impacted site (0.5%) and about 5 times lower than the average for the lower mainstem in 1982 (11.2%).



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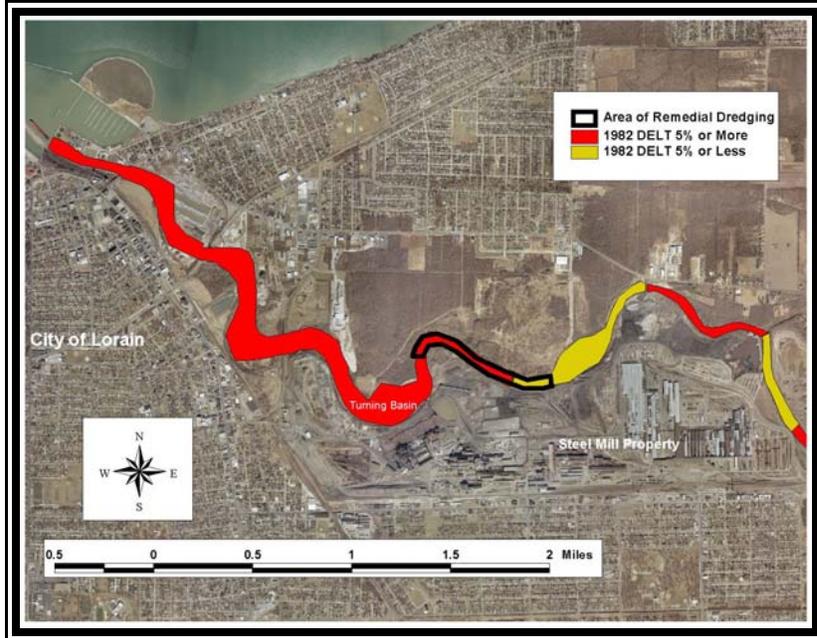
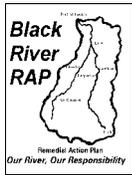


Figure 10. 1982 DELT percentages by River Segment



Figure 11. 1992 DELT Percentages by River Segment



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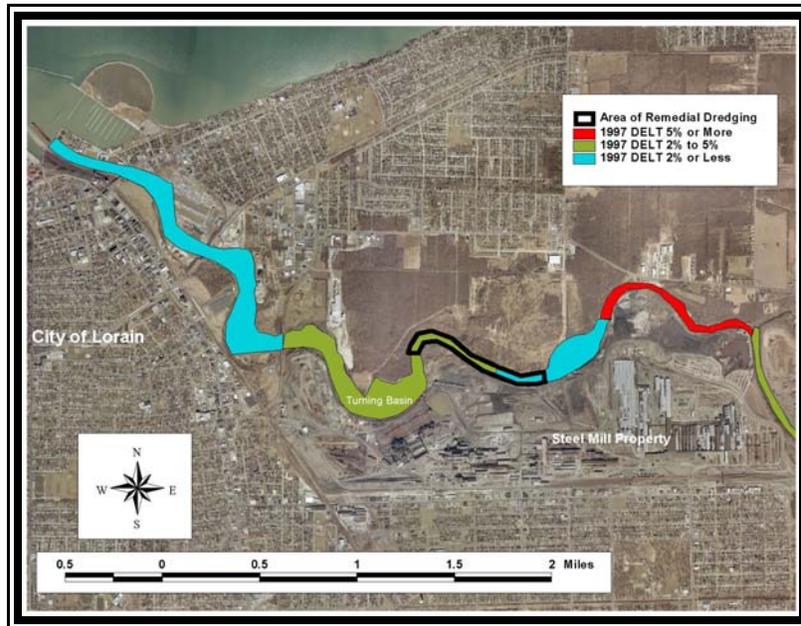


Figure 12. 1997 DELT Percentages by River Segment

In Figure 12, the river segment (in red) displaying DELT anomalies greater than 5% is upstream of the general area of the remedial dredging that occurred in 1989-1990. This stretch of the river, around River Mile 4.8, is well within the lake-influenced portion of the Black River. Lake Erie water has been noted as far upstream as River Mile 7.0 of the Black River mainstem. It is suspected some PAH contamination may have migrated upstream of the old coking plant outfall with climatic flow reversals of the river. In addition, other industrial activities at this river stretch may add to impacts to the fish communities. This stretch may be without benefit of remedial dredging, but regulatory controls to the discharges in this part of the river have improved over the years.

The Coordinating Committee has determined the tightened regulatory discharge controls in conjunction with the remedial dredging operation have demonstrated significant improvements in this stretch of

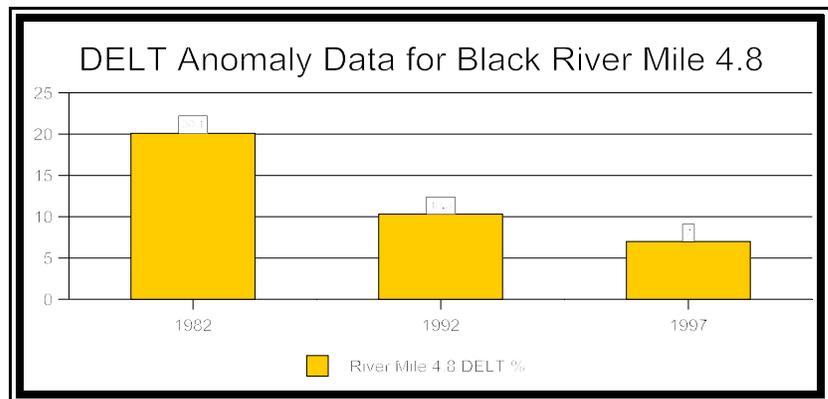
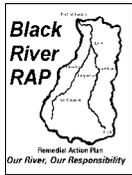


Figure 13. Yearly average DELT Anomalies for RM 4.8 of the Black River Mainstem



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the river. Although DELT anomalies remain greater than the arbitrary 5.0% benchmark value, the consistent improvements are well documented and are presented in Figure 13.

The health of the fish communities in the entire stretch of the lower mainstem has responded to the removal of the contaminated sediments. The following graph (Figure 14) shows average DELT anomalies per year for the impaired area of the Black River (from River Mile 5.8 to the mouth at Lake Erie). Over the afflicted area in the Black River mainstem, the external abnormalities, as measured by Ohio EPA's DELT data, have decreased from about 10.4% in 1982 to 2.75% in 1997. This represents a 73.6% improvement since 1982.

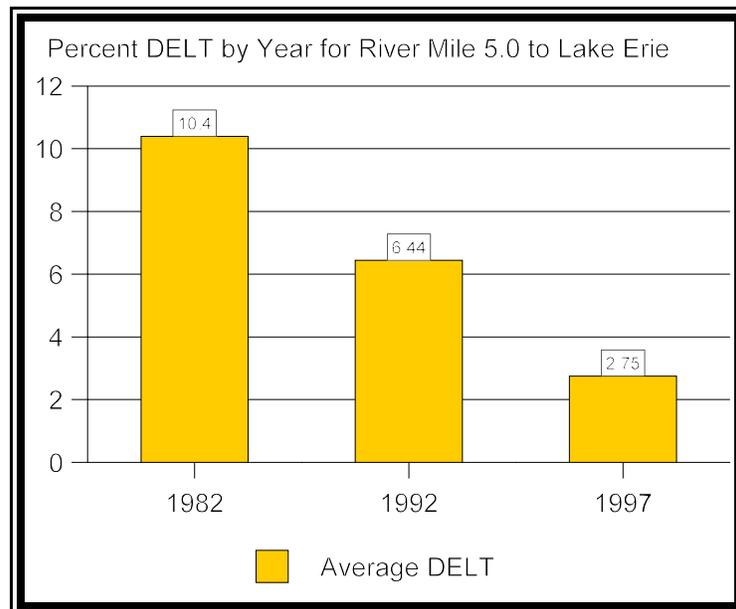
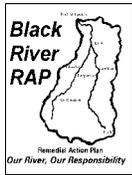


Figure 14. Yearly DELT Averages for the lower 5 miles



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Liver Tumors and Age Structures in Black River Brown Bullhead Catfish

Since the 1980s, brown bullhead catfish liver studies have been extensively conducted on the Black River by Baumann, et al. As expected by the decline in PAH concentrations, improvements in the Black River bullhead catfish communities have been documented in both their health and population age structure.

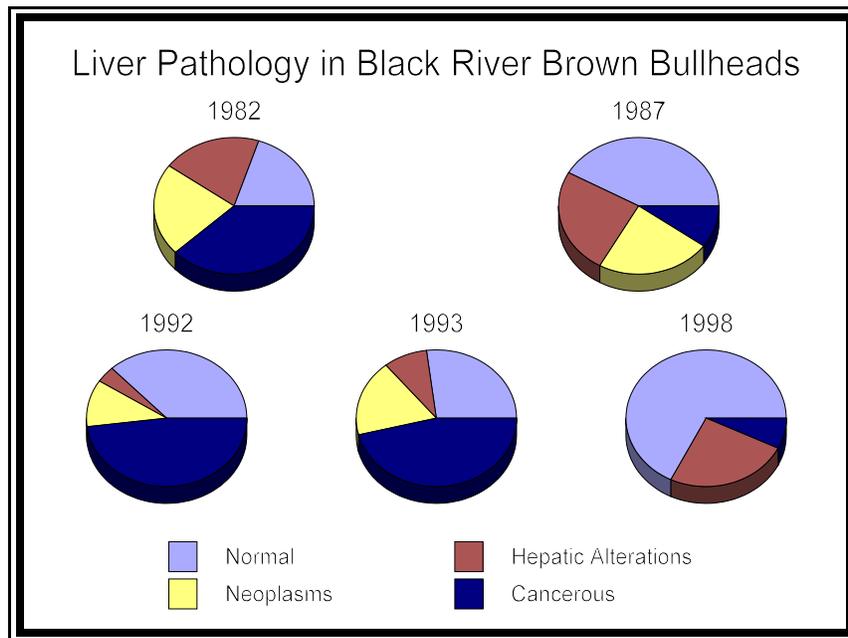


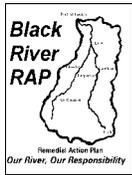
Figure 15. Liver Pathology by Year

From Baumann 2000

According to Baumann (1992 and 1996) liver tumors in bottom-feeding fish are one way of indicating exposure to cancer-causing compounds. In 1982, about one year before the closing of the coking facility at the steel mill, many of the brown bullhead catfish displayed neoplasms and cancerous livers. At that time, only 20% of the fish population had normal livers.

In 1987, four years after the closing of the coking facility, cleaner sediments from upstream blanketed the contaminated sediments and the health of the bullhead populations improved. Only about 32% of the fish had cancerous or neoplastic livers. The number of fish with normal livers increased to 42% of the population.

The remedial dredging activity, conducted in 1989-1990, re-suspended some of the contaminated bottom sediments and the bullhead population health regressed with the



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subsequent exposure to the contaminants. This is reflected in the 1992 data, whereby the neoplastic and cancerous livers increased to about the levels seen in 1982. Accordingly, the new exposure to the contaminated sediments caused a drop in normal bullhead livers to 37% of the population.

Eight years after remedial dredging, the health of the bullhead communities has responded vigorously to the removal of contaminants. In 1998, the percentage of normal livers had risen to 68% and the percentage of neoplastic and cancerous livers dropped to less than 7% of the population.

With the prevalence of contaminants in the Black River sediments causing abnormalities in bullhead livers, the studies show the age structures in the early years were abbreviated. Evidently, the longer exposure to the contaminated sediments led to mortality in older fish. In 1982 and 1983, when the exposure to contaminated sediments was the most severe, there were no age 6 fish. By 1998, age 6 fish were more prominent.

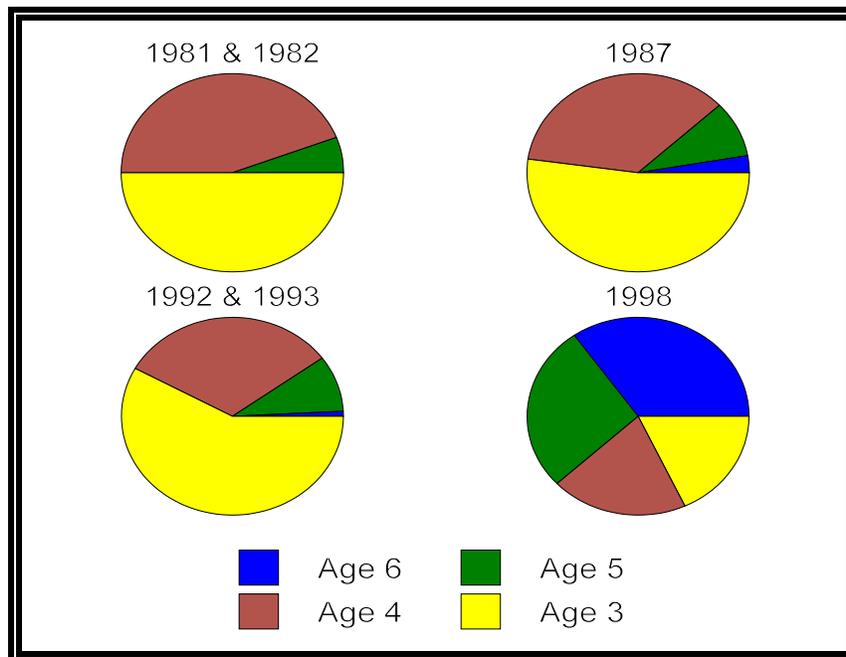
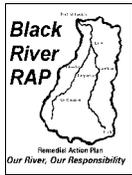


Figure 16. Black River Bullhead Age Structures by Year
From Baumann 2000



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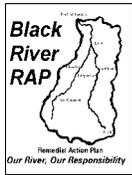
Conclusion

Through the efforts of the Ohio EPA, Drs. Baumann and Harshberger, and others, the Black River RAP Coordinating Committee has determined sufficient improvements have been documented to allow the Committee to submit this application for re-designation of the Fish Tumors and Other Deformities Beneficial Use Impairment from 'Impaired' to "In Recovery Phase."

Since the remedial dredging occurred in 1989-1990, the concentrations of PAHs in the bottom sediments of the afflicted area have dropped significantly. Although a spike in sediment PAH concentrations in 1992 (two years after dredging) led to a comparable spike in bullhead liver cancers, the Coordinating Committee sees this as further proof of the link between Black River PAH sediment concentrations and fish tumors and other deformities.

Between 1980 and 1997, the concentration of representative PAH compounds dropped 90% or more. Due to the success of the sediment remediation, the overall health of the Black River fish communities has improved. Where it was once common to find deformed fish, external deformities in Black River fish are becoming rarer. External abnormalities (DELT) for all Black River fish, as documented by the Ohio EPA, have decreased by more than 73% since 1982. The average incidence percentage of the entire afflicted area of the mainstem is now only about 2.75% DELT anomalies, or less than three fish out of 100. Neoplastic and cancerous livers in brown bullheads are no longer the "norm" for the Black River. Since 1982, neoplastic and cancerous livers are down more than 88%. Normal livers are up 240%, from about 20% in 1982 to 68% in 1997.

The Black River has come a long way since the days when it was known as the 'river of deformed fish.' Because of this remarkable recovery, the Black River RAP Coordinating Committee requests a re-designation of the Fish Tumor and Other Deformities BUI from "Impaired" to "In Recovery Phase." The Coordinating Committee feels a designation of UNIMPAIRED, while not in hand yet, is very close and the Committee will continue to monitor the health of the Black River fish communities. Natural processes are expected to continue to improve the lower river conditions and the health of the fish communities.



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Continued Monitoring of Impairment Status

Continued monitoring of the fish communities is an important part of the 'In Recovery' designation of this Beneficial Use Impairment (BUI). Monitoring will demonstrate if either continued improvements are observed or additional remedial measures are necessary. Although the Black River RAP Coordinating Committee does not foresee additional PAH contamination impacts to the river sediments, only continued monitoring will prove the steady improvements in the Black River fish communities will continue into the future.

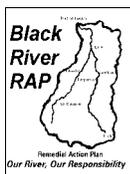
Studies of the toxic effects of the Black River sediments on mainstem fish populations were initiated many years before the inception of the Black River Remedial Action Plan. The RAP Coordinating Committee feels supplemental sampling plans for the purposes of this re-designation application are not warranted. The Committee will rely on the continuation of the work begun by the Ohio EPA and Dr. Baumann to demonstrate further improvements in the fish communities of the Black River.

Monitoring of Deformities, Eroded fins, Lesions and Tumors (DELT)

The Ohio EPA, as part of its oversight of the National Pollution Discharge Elimination System (NPDES) within Ohio, conducts intensive watershed studies on a five-year rotating basis. An important aspect within these watershed studies includes biological monitoring. Routine sampling of fish communities for the Index of Biotic Integrity (IBI) and the Modified Index of Well Being (MIWB) are part of Ohio EPA's biological monitoring program. In the assessment of the IBI, the Ohio EPA examines fish populations for external abnormalities as measured in Deformities, Eroded fins, Lesions and Tumors or DELT anomalies.

The DELT assessment applies to all fish species and is a broad indicator of environmental degradation. The Ohio EPA utilizes electro-fishing techniques to sample river zones. All fish collected are examined for DELT anomalies. Anomaly data is collected on individual fish and analyzed at a community level.

Recent adjustments to the Ohio EPA monitoring program requires the agency to produce Total Maximum Daily Load (TMDL) reports. A TMDL is scheduled for the Black River watershed in 2005. The Ohio EPA is scheduled to return to the Black River by 2011 for the next rotation of water quality sampling. DELT data will be included in the TMDL report for the Black River, including the lower five miles of the mainstem. If the data produced in any TMDL report of the Black River warrants additional monitoring, the Black River RAP, as an Ohio Area of Concern, can request additional studies be conducted by the Ohio EPA.



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Monitoring of Liver Tumors in Black River Brown Bullhead Catfish

Dr. Paul Baumann, et al, has been monitoring liver pathology in Black River brown bullhead catfish since the early 1980s and the Black River RAP Coordinating Committee hopes to engage his participation in future studies of the health of the bullhead populations with respect to liver tumors. Funding opportunities are currently being explored that would allow Dr. Baumann to continue to provide technical expertise to a number of AOCs in regard to fish tumors. If Dr. Baumann is unable to secure future funds for his studies, the RAP Coordinating Committee will attempt to secure funds for this work through any available means. At this time, the frequency of that monitoring cannot be presented with this application.

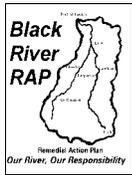
The Committee expects the earlier protocols used by Dr. Baumann will continue with future monitoring activities. The protocols are briefly outlined below.

Samples will be collected from sites upstream and downstream of the historic coking plant discharge location (~RM 3.5). Bullheads will be collected by either electro-fishing techniques or by use of overnight fyke nets. The bullheads will be measured and a total length of 250 mm will be processed (the minimum total length will be used as a filtering technique for proper age selection, age 3 or older).

Bullheads of proper length will be anesthetized with MS-222, measured, weighed, euthanized by cervical dislocation (as to Ohio State University protocol) and processed. Each bullhead will be visually inspected for observable anomalies of the skin, gills and mouth. The viscera will be examined for lesions. Any pathologies or unusual features will be noted. Gross lesions on other tissues will be excised with surrounding tissues and preserved in formalin. Tissue blocks will be cut, dehydrated with alcohol series, infiltrated with paraplast, embedded and sectioned for examination.

Monitoring Frequency

In light of current agency budget constraints and grant fund availabilities, the Black River RAP Coordinating Committee is unable at this time to definitively state the exact timing of future assessments. The Coordinating Committee proposes to seek additional funds, if necessary, available to Areas of Concern, to see that the monitoring of the Black River fish communities continues on a five-year basis.



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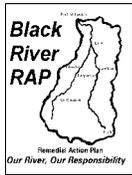
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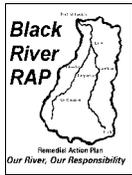
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Acronyms

AOC - Area of Concern
BUI - Beneficial Use Impairment
DELT - Deformities, Eroded fins, Lesions and Tumors
IBI - Index of Biotic Integrity
IJC - International Joint Commission
MIWB - Modified Index of Well-Being
mg/kg - milligram per kilogram (or Parts per Million)
ODH - Ohio Department of Health
Ohio EPA - Ohio Environmental Protection Agency
PAH - Polynuclear Aromatic Hydrocarbons
PPB - Parts per Billion
PPM - Parts per Million
RAP - Remedial Action Plan
RM - River Mile
ug/kg - microgram per kilogram (or Parts per Billion)
US EPA - United States Environmental Protection Agency
USGS - United States Geological Survey