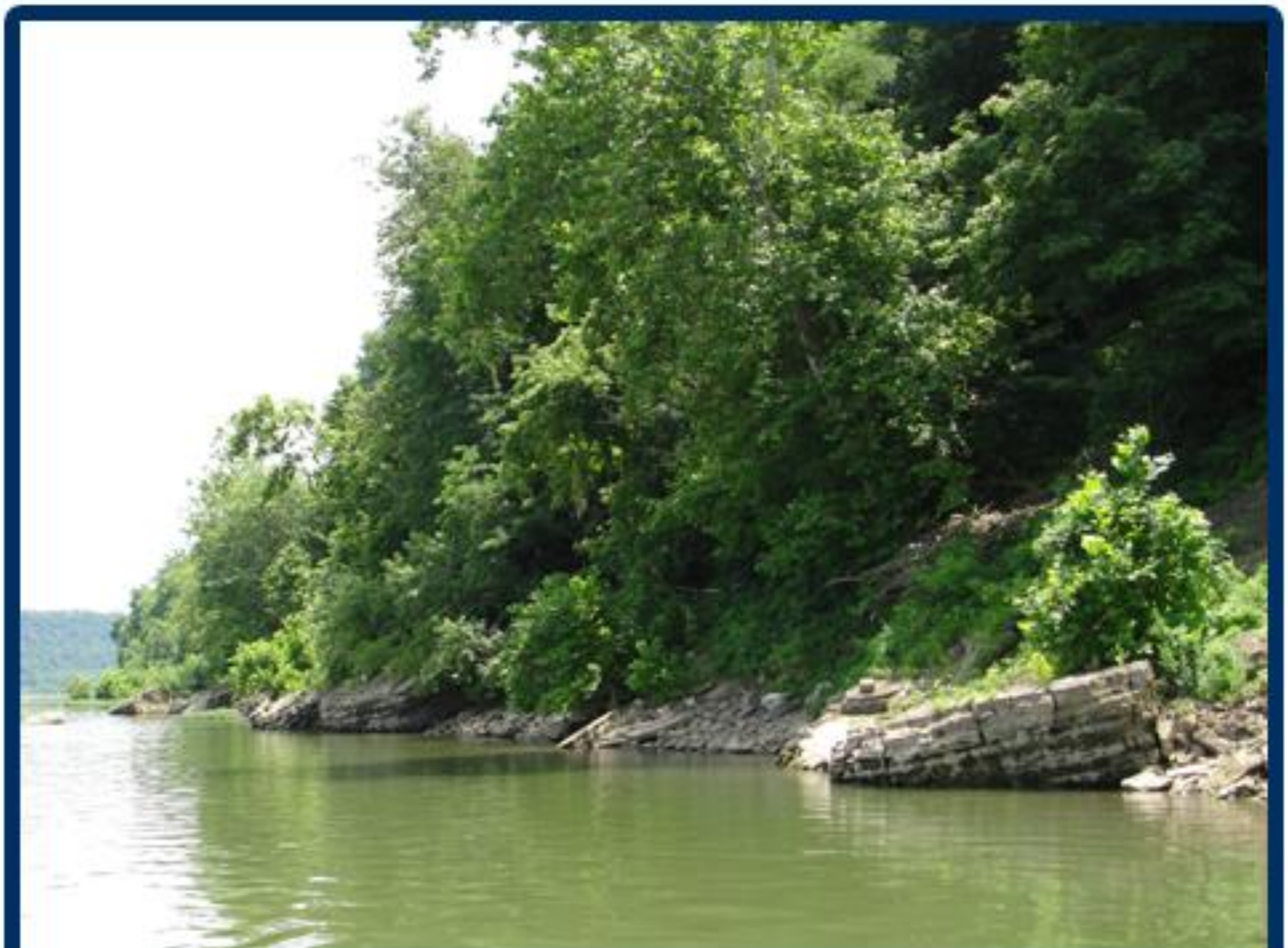
Biological Programs 2009
Intensive Survey Results
Series 6
Report 3

A Biological Study of the McAlpine Pool of the Ohio River



Executive Summary

- Since 2004, ORSANCO has been using a probabilistic (random) design for monitoring fish communities in the Ohio River and conducting biological assessments.

- The Ohio River was divided into 19 assessment units based on the locations of high-lift navigational dams. Using the random design, each assessment unit was assigned 15 sampling locations.

- Once fish assemblages are sampled, each site is assessed using a site quality score (0- 5) which is generated from an Ohio River fish index (MORFIn). The expectations for the MORFIn are based on each site's substrate composition. For an assessment unit (i.e. pool) to meet its aquatic life-use designation, the average of the quality scores for the pool must be greater than 2.0.

- In 2009, fish population data from McAlpine pool yielded 42 species and 2 hybrid taxa, representing 10 different families. One of these taxa was listed in KY as of special concern [black buffalo (*Ictiobus niger*)], while one was listed in IN as of special concern [river redhorse (*Moxostoma carinatum*)].

- At the species level, gizzard shad (*Dorosoma cepedianum*) was the most abundant, comprising 23.9% of the catch, with 394 individuals.

- Previous analyses have identified a relationship between flow and MORFIn scores and the need for sampling thresholds and/or flow calibration. These analyses demonstrated that increased flows appeared to cause lower MORFIn scores due to decreased sampling efficiency and changes in fish behavior.

- Flows were variable in 2009 when sampling was conducted. Sampling was conducted at low flows as well as at moderately elevated flows. Flows did not appear to affect electrofishing surveys.

- In 2009, 66.6% of the sites assessed in McAlpine pool had site quality scores $\geq$2.0 and the pool had an average quality score of 3.0 (out of 5.0). This score indicates the pool is in 'Good' biological condition. Therefore, the McAlpine pool will be reported to EPA as meeting its aquatic life-use designation.

- As of 2009, all 19 pools (AUs) have been assessed which comprises 981.0 miles or 100.0% of the resource.

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A Biological Study of the McAlpine Pool of the Ohio River (2008)

1.0 Introduction

The Ohio River Valley Water Sanitation Commission (ORSANCO) is an interstate water pollution control agency created in 1948 by an act of Congress to monitor and improve the water quality of the Ohio River. Until that time, water quality issues on the Ohio River had been charged to state water quality agencies. However, due to large-scale interstate implications and large pollution loads received by the Ohio River, these agencies were not sufficiently equipped to work with such a system. ORSANCO's role is to work in conjunction with state agencies to develop a set of pollution control standards exclusive to the Ohio River. The creation of these standards requires the establishment of monitoring programs that can efficiently be used on the Ohio River.

The routine ambient monitoring programs of ORSANCO are primarily directed at three monitoring and assessment priorities: spill detection (through an organics detection system), trend assessment (manual sampling system), and aquatic resource characterization (macroinvertebrate and fish studies). Another priority, water quality impacts assessment, is achieved through entire watershed intensive surveys.

In 1993, following direction from state and federal agencies, ORSANCO staff developed and implemented an intensive survey design that used electrofishing methods designed for the navigational pools of the Ohio River. This entailed extensive sampling of fish communities throughout the entire length of a particular pool. The surveys were intended to provide background information on fish populations and lay a foundation for establishing biological criteria (biocriteria) for the Ohio River. With appropriate biocriteria in place, information on the biological community provides insight into the health of the Ohio River.

After several years of collecting background data on fish populations of the Ohio River, ORSANCO developed the Ohio River Fish Index (ORFIn, Emery et al. 2003). The ORFIn incorporates 13 attributes, or metrics, of the fish community that when compiled provide an accurate representation of the overall condition of the Ohio River fish community. These 13 metrics take into account several different aspects of the fish population, including diversity, abundance, feeding and reproductive guilds, pollution tolerance/intolerance, and fish health. In 2008, ORSANCO recalibrated the original ORFIn and adjusted for more-detailed habitat classifications and a contemporary means of scoring the fish metrics (i.e. continuous in lieu of discrete scoring). A new assessment approach was also adopted for the modified ORFIn (MORFIn).

An important aspect of biological monitoring is the reduction of human induced bias in the samples. The use of probabalistic sample site selection was designed to reduce this bias. Within this design, sample sites are randomly selected by computer generation, eliminating the tendency to sample only in the best or worst locations. Many states already have programs in place that use this design for sampling on smaller streams, and it is also used by the U.S. Environmental Protection Agency's (USEPA) Environmental Monitoring and Assessment Program (EMAP). ORSANCO has now begun using this approach on the Ohio River for its biological monitoring. In 2009, the Belleville, Markland, McAlpine pools, and Open Water section were sampled as part of ORSANCO's normal monitoring. This report presents the 2009 survey of the McAlpine pool including the data collected and assessment results based on the fish population surveys.

2.0 Study Area

2.1 Ohio River

The Ohio River (Figure 1) begins at the confluence of the Monongahela and Allegheny rivers and flows 981 miles in a southwesterly direction to the confluence with the Mississippi River. Twenty navigational dams maintain a nine-foot minimum depth for commercial navigation throughout the entire length of the river. There are over 600 permitted discharges to the Ohio River, 49 of which

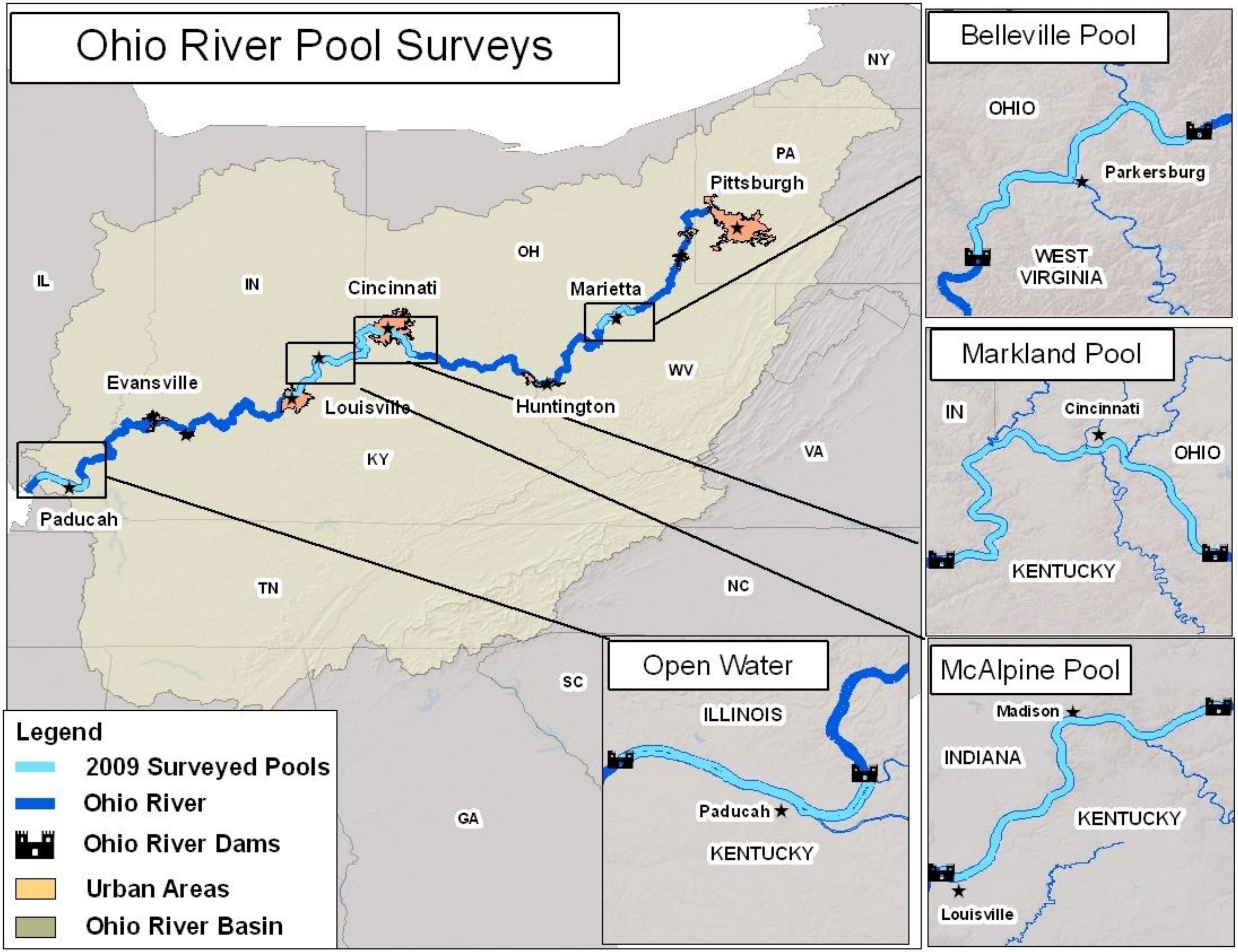

Figure 1. *The Ohio River basin and the four pools selected for 2009 sampling.*

are power-generating facilities. The Ohio River Basin contains nearly ten percent of the nation's population, more than 25 million people, and serves as an avenue for transportation of approximately 250 million tons of cargo each year (ORSANCO 1994). The Ohio River dissects four ecoregions: the Western Allegheny Plateau, the Interior Plateau, the Interior River Lowland, and the Mississippi Alluvial Plain (Omernik 1987).

2.2 McAlpine Pool

The McAlpine pool is 75.3 miles long, extending from Markland Locks and Dam (ORM 531.5) to McAlpine Locks and Dam (ORM 606.8). The pool has a gradient drop of 0.3 feet per mile and averages 2,040 feet wide and 25 feet deep (ORSANCO 1994). The pool is bordered by the states of Kentucky and Indiana.

2.3 McAlpine Pool Land Cover

This pool lies in a portion of the Ohio River heavily influenced by industry with a large amount of barge activity. The McAlpine pool receives water from the following tributaries: the Kentucky River in Kentucky at mile point 545.8 with a drainage area of 6.970 square miles, the Little Kentucky River in Kentucky at mile point 546.5 with a drainage area of 147 square miles, the Indian Kentucky River in Indiana at mile point 550.5 with a drainage area of 150 square miles, Silver Creek in Indiana at mile point 606.5 with a drainage area of 226 square miles, and the Salt River in Kentucky at mile point 629.9 with a drainage area of 2,890 square miles. These watersheds are primarily forested but also have a considerable amount of pasture lands and row crops. (Figure 2).

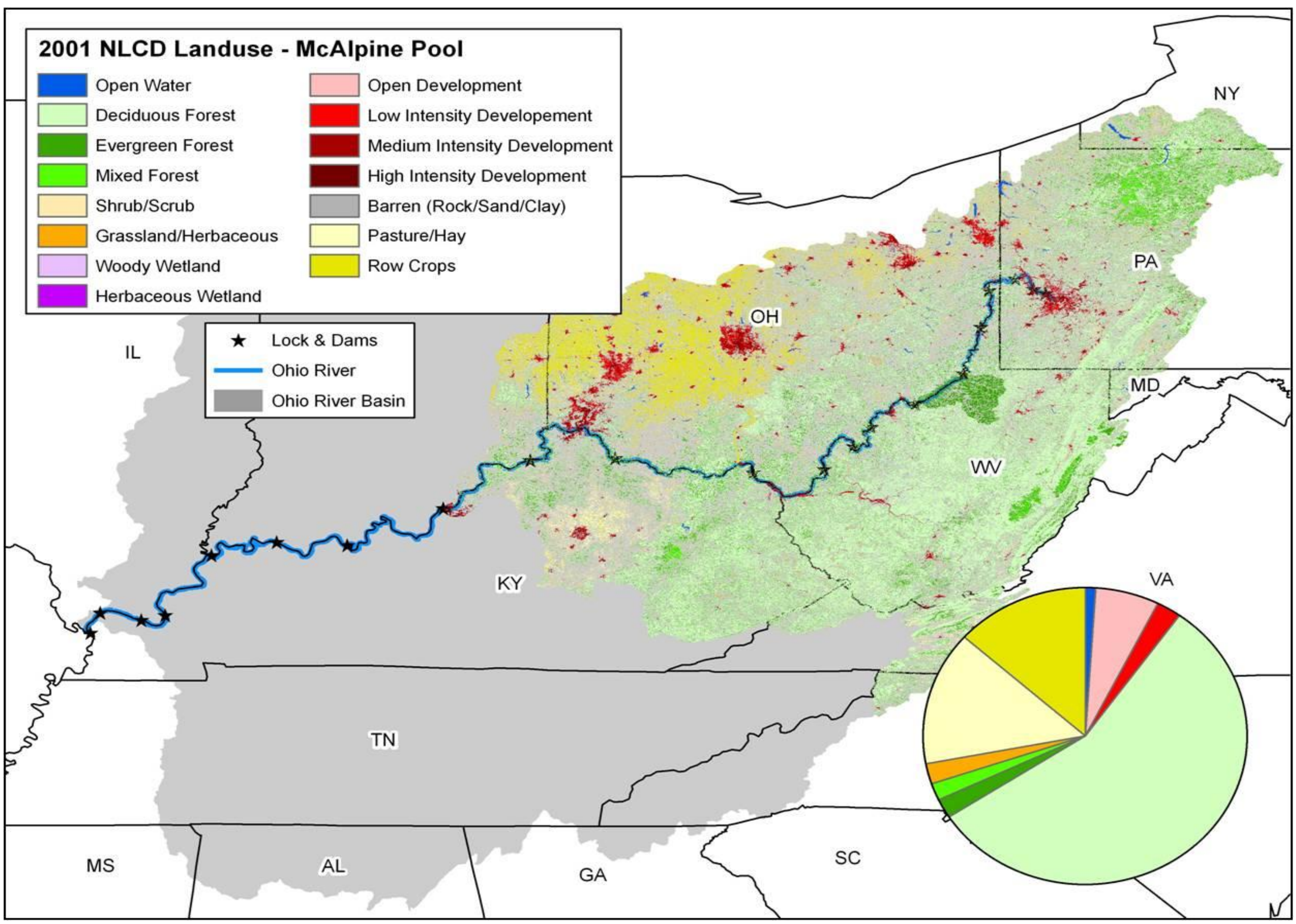

Figure 2. *Land cover within the McAlpine pool catchment area.*

3.0 Methods

3.1 Survey Design and Site Location

A random, probability-based survey design was used to select sampling site locations within each Ohio River survey pool. The USEPA National Health and Environmental Effects Laboratory, Western Ecology Division provided assistance by generating the survey design for this project. The target population was the linear shorelines of the McAlpine pool of the Ohio River from mile marker 531.5 (Markland Locks and Dam) to 606.8 (Hannibal Locks and Dam). The total linear extent of the target population was approximately 150.6 miles. The sample frame was generated using RF3 river double lines for the Ohio River and river mile coverage provided by ORSANCO. A generalized random tessellation stratified (GRTS) survey design for a linear network with reverse hierarchical randomization (RHR) was used to select all sampling locations. This survey design provided coordinates for 15 sampling sites in each of the selected pools. The data collected from these sites were used to make an assessment of the pool (see Section 3.6 and Appendix A).

Sites were sampled as closely as possible to the location generated from the design, but in cases of restricted access or unsafe sampling conditions (e.g. barge loading/mooring area), sampling zones were shifted if possible (up to a maximum of 500m up- or downstream). The survey design supplied additional sampling sites to be used if a site could not be placed within 500m of the original location.

3.2 Index Period and Sampling Restrictions

All sampling was conducted under the required conditions as described by Emery et al. (2003). This included sampling between June 29 and October 31 when water levels were within one meter of "normal flat pool" and Secchi depths were greater than 0.3m (12 in). These sampling restrictions were used to reduce community variability by increasing the likelihood that samples were collected during the stable, low-flow conditions usually present on the Ohio River during the summer and early fall months.

3.3 Fish Collections

Standard collection techniques were employed throughout the surveys as described by Emery et al. (2003). Fish were collected using boat electrofishing techniques at night because nighttime electrofishing typically yields samples of increased diversity and richness (Sanders 1992).

ORSANCO crew conducting night-time electrofishing

A sampling crew consisted of a three-person team working from an 18-foot aluminum johnboat. Each boat was equipped with a 5000-watt generator and a Smith-Root Type 5.0 GPP electrofishing unit. Sampling was conducted over a 500m long section of near-shore habitat (shoreline out to a maximum distance of 100 ft or a depth of 20 ft.) and was sampled for a minimum of 1800 seconds (Gammon 1998). Time could vary depending upon the complexity of the habitat within a given zone. Stunned fish were captured with nets and placed into large, aerated tubs for processing. Each fish was measured, inspected for anomalies, and identified to lowest possible taxonomic level (species) before being returned to the water. Fish that could not be confidently identified in the field (e.g. minnows) were preserved in a ten percent formalin solution and identified in the laboratory.

Typical 500 meter electrofishing reach

3.4 Habitat Characterizations

Large rivers have distinct habitat types, including unique microhabitats (Reash 1999). Therefore, extensive habitat surveys were conducted for each electrofishing zone, including thorough substrate and depth measurements. Descriptions of the riparian corridor adjacent to the sampling zone and the presence of woody material available as fish cover were also recorded. Depth and substrate composition were measured at 66 points throughout each 500m zone. Six points along the shoreline were selected throughout the length of the zone at 0, 100, 200, 300, 400 and 500m. From each of these points, depth was recorded at 10ft intervals beginning at the shore/water interface and moving away from the shore for 100ft. Woody cover, which included submerged brush, logs, and stumps, was estimated visually. Using these data, each site, or electrofishing zone, was assigned to one of five existing classes of habitat: 'A', 'B', 'C', 'D' or 'E' (Emery et al, in prep). By assigning each sampling site to one of five habitat categories, biologists can reduce the amount of assessment variability, or 'noise', because each habitat class has a slightly different expectation. Sites assigned to habitat class 'A' are characterized by a >81% presence of boulder, cobble, and gravel at depths <10 feet. Sites assigned to habitat class 'B' are characterized by a ≤81% and >50% presence of boulder, cobble, and gravel at depths <10 feet. Classes 'C', 'D', and 'E' each exhibit substrate compositions of boulder, cobble, and gravel that are ≤50%. Sites that fall in habitat class 'C' exhibit a lower percentage of smaller substrates (≤77%; sand, fine, and hardpan) at depths <10 feet. Class 'D' and 'E' sites similarly exhibit large amounts of sand and fine substrates (>77%), however these two classes differ with respect to depth. Habitat class 'D' sites are relatively shallow while class 'E' sites exhibit a larger percentage of >20' depths.

3.5 Water Quality and Flow Condition Data

Basic measures of water quality were collected at each site prior to sampling. The following parameters were measured with a YSI meter and an optical dissolved oxygen (DO) meter: water temperature, pH, DO, and conductivity. Water samples were also collected using a Kemmerer and consisted of a single-point, mid-depth grab sample at the downstream end of each 500m zone. Samples were collected approximately 100ft from shore at each site on three separate occasions throughout the field season. Samples were kept at or below 4ºC until sent off for laboratory analyses. Water quality parameters analyzed included: ammonia nitrogen, chloride, hardness, nitrate-nitrite, total Kjeldahl nitrogen (TKN), phenolics, sulfate, total suspended solids (TSS), total phosphorus, and total organic carbon (TOC).

Secchi depth was measured using a standard Secchi disc just prior to electrofishing. The potential effects of flow on fish assemblages are unclear therefore flow was also monitored. Flow data were obtained from the U.S. Army Corps of Engineers. These included daily average flow volumes and velocities from the nearest-upstream sampling station to any particular site. There are 234 flow stations on the mainstem of the Ohio River from which data is recorded or modeled. Harmonic mean flow (HMF), the 22-year average flow, was calculated for every Julian day and flow station by ORSANCO using raw flow data obtained from the U.S. Army Corps of Engineers (ORSANCO 2003)

3.6 Pool Assessment

In 2009, ORSANCO employed a probabalistic sampling and assessment approach of biological condition. Individual navigational pools served as the primary assessment units. Therefore, the McAlpine pool served as one distinct assessment unit (AU) and will be reported on as such in the 305(b) report issued to EPA. The approach to assessing each AU involved sampling a statistically determined number of sites (15). Observed MORFIn scores were compared to habitat derived expectations for each site (Emery et al. 2003).

The five distinct habitat classes (A, B, C, D, and E) each exhibit different levels of historical MORFIn performance (i.e. different fish assemblages are found at each habitat). To account for these variations in our assessment, the condition of each site was determined by comparing its performance (i.e. MORFIn score) to those of previously sampled sites within its particular habitat class. The distribution of historical MORFIn scores was determined by compiling reference fish data (i.e.

data from least-disturbed sites) from the five distinct habitat classes over a fifteen year period. A fish quality score between 0 and 5 was given to each individual site based upon how each site scored relative to the statistical distribution (5th, 25th, 50th, 75th, and 95th percentiles) of historical MORFIn scores (see Appendix A for a detailed explanation). For example, a fish quality score of 3 is applied to a site whose score falls between the 50th and 75th percentiles of the historical MORFIn scores specific to that habitat class (Figure 3). To further aid in interpretation, condition ratings were applied to each site quality score as follows: 0=Very Poor, 1=Poor, 2=Fair, 3=Good, 4=Very Good and 5=Excellent. Essentially, a site is considered in 'Good' biological condition when its MORFIn score is equal to or slightly better than the historical average (Figure 4).

To obtain a final bio-assessment of each pool, an average fish quality score was calculated. The 25th percentile (average fish quality score of at least 2.0) was established as the criterion for determining whether a pool 'passes' (meets its aquatic life-use designation) or 'fails' (does not meet its aquatic life-use designation). The pool was assessed as 'passing' if its average fish quality score was above the 25th percentile (≥2.0). Any pool with an average fish quality score less than 2.0 (i.e. a rating of 'Poor' or ''Very Poor') was assessed as failing to meet its aquatic life-use designation.

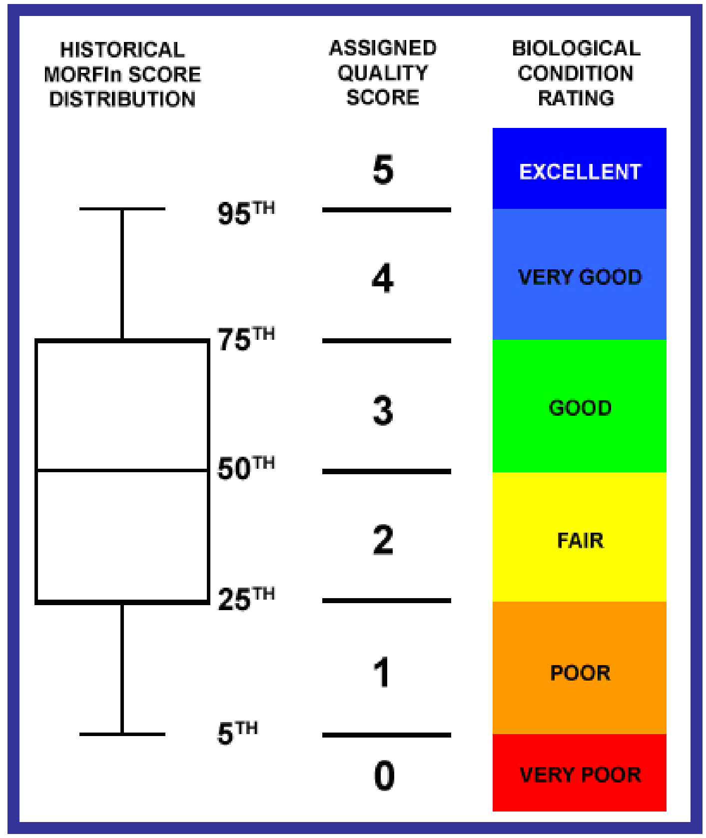

Figure 3. *Approach used to assign fish quality scores for each habitat class.*

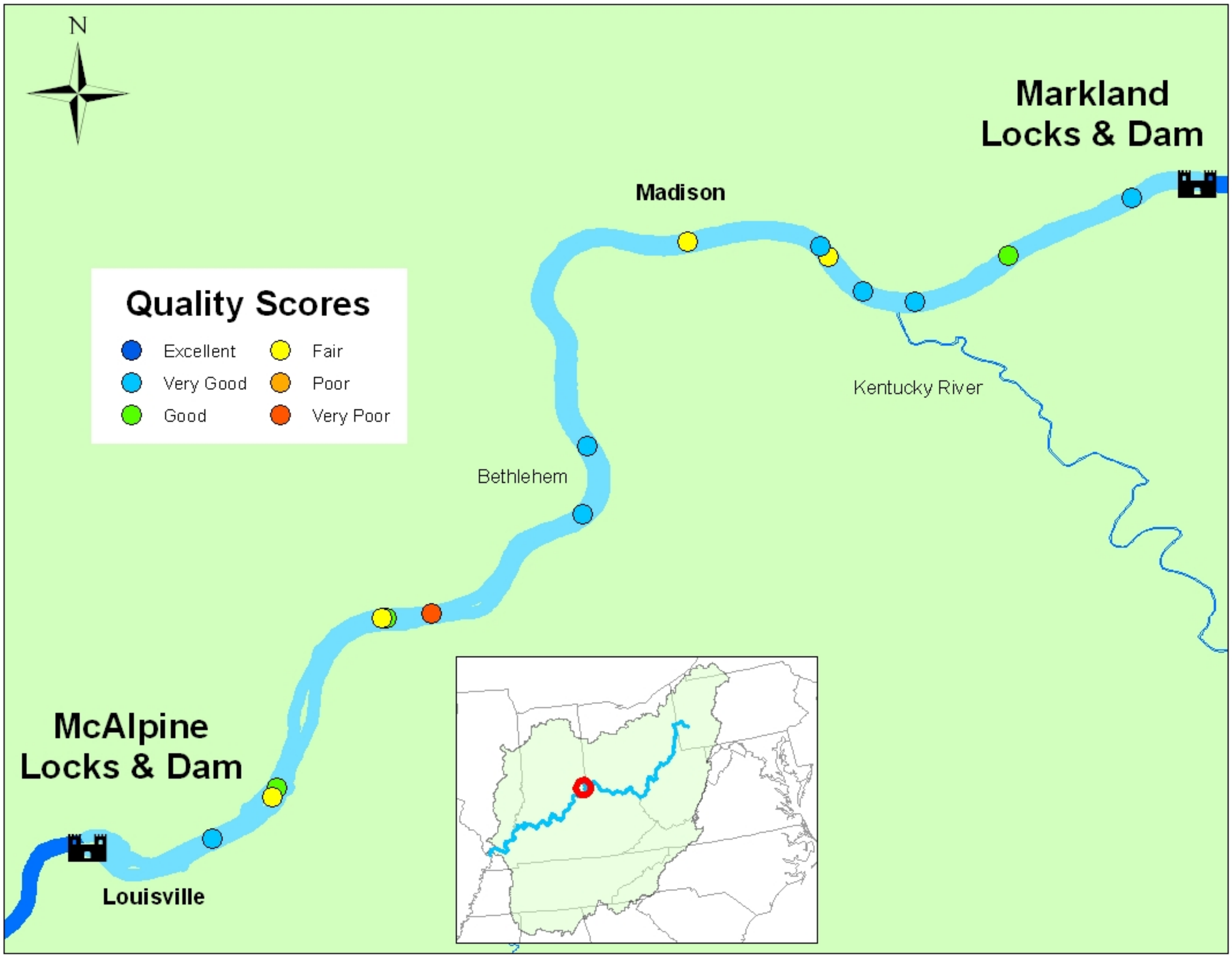

Figure 4. Sites within McAlpine Pool.

4.0 Results

4.1 Fish Population

In 2009, fish population data (Appendix B) were collected from 15 randomly selected locations throughout the length of the McAlpine pool (Figure 4). These collections produced 42 species and 1 hybrid taxa, representing 10 different families. One of these taxa was listed in KY as of special concern [black buffalo (*Ictiobus niger*)], while one was listed in IN as of special concern [river redhorse (*Moxostoma carinatum*)]. No federally listed taxa were collected from the McAlpine pool. At the species level, gizzard shad (*Dorosoma cepedianum*) was the most abundant, comprising 23.9% of the catch (Figure 5). The sucker family (Catostomidae) made up 25.6% of the catch, followed by the shad and herring family (Clupeidae) which made up 24.2% of the catch (Figure 6).

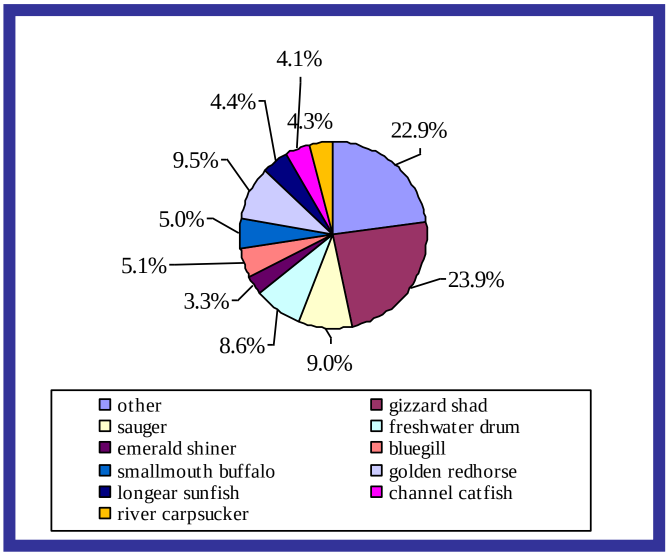

***Figure 5.** Species composition of fish sampled in McAlpine pool.*

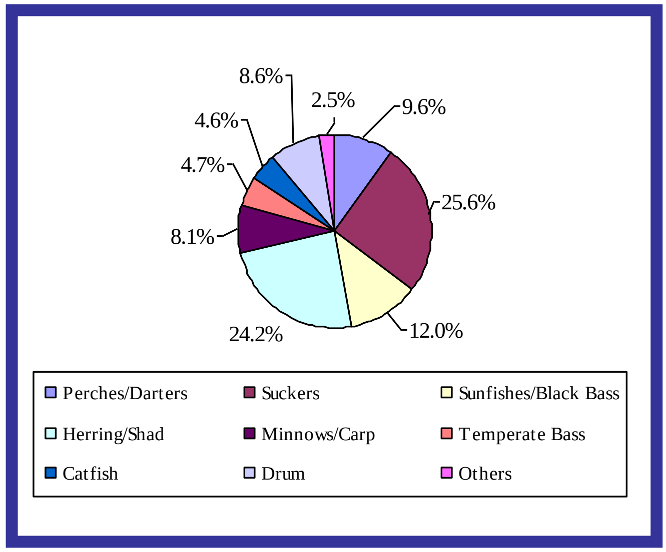

***Figure 6.** Sampled fish composition by family in McAlpine pool.*

***Table 1.** Electrofishing site list for the McAlpine pool including habitat designation, MORFIn scores, and quality scores.*

Site #	River Mile	Bank	Date	Latitude	Longitude	Habitat Class	MORFin Expectation	MORFin	Quality Values	Quality Score
1	534.1	LDB	16-Sep-09	38.764164	85.013289	D	41.80	59.14	4	Very Good
2	540.5	LDB	16-Sep-09	38.720382	85.105346	D	41.80	57.51	3	Good
3	544.5	LDB	17-Sep-09	38.686709	85.174896	C	44.55	64.42	4	Very Good
4	547.1	RDB	16-Sep-09	38.693667	85.213788	D	41.80	59.87	4	Very Good
5	549.5	LDB	22-Sep-09	38.719619	85.239539	D	41.80	49.31	2	Fair
6	550.2	LDB	21-Sep-09	38.727759	85.245849	D	41.80	67.32	4	Very Good
7	556.1	RDB	21-Sep-09	38.73137	85.34457	C	44.55	47.06	2	Fair
8	571.9	RDB	22-Sep-09	38.578526	85.419293	B	46.71	63.97	4	Very Good
9	575.4	LDB	18-Aug-09	38.528298	85.4232	B	46.71	73.51	4	Very Good
10	584.4	LDB	02-Sep-09	38.453851	85.536186	B	46.71	24.93	0	Very Poor
11	585.9	LDB	02-Sep-09	38.450224	85.569095	D	41.80	52.67	3	Good
12	586.4	RDB	02-Sep-09	38.450058	85.573056	B	46.71	49.44	2	Fair
13	596.5	RDB	01-Sep-09	38.324168	85.65149	D	41.80	54.59	3	Good
14	597	LDB	01-Sep-09	38.317301	85.655041	D	41.80	49.02	2	Fair
15	600.3	RDB	01-Sep-09	38.285969	85.699688	D	41.80	67.64	4	Very Good

Table 2. *Species collected in the McAlpine pool during the 2009 survey. Species information are determined by and relative to the state of Kentucky and Indiana (T = 'Threatened' and SC = 'Species of Concern').*

Family	Species	Latin Name	KY	IN
Lepisosteidae	Longnose Gar	*Lepisosteus osseus*		
Lepisosteidae	Shortnose Gar	*Lepisosteus platostomus*		
Hiodontidae	Mooneye	*Hiodon tergisus*		
Clupeidae	Skipjack Herring	*Alosa chrysochloris*		
Clupeidae	Gizzard Shad	*Dorosoma cepedianum*		
Clupeidae	Threadfin Shad	*Dorosoma petenense*		
Cyprinidae	Spotfin Shiner	*Cyprinella spiloptera*		
Cyprinidae	Common Carp	*Cyprinus carpio*		
Cyprinidae	Silver Chub	*Macrhybopsis storeriana*		
Cyprinidae	Emerald Shiner	*Notropis atherinoides*		
Cyprinidae	River Shiner	*Notropis blennius*		
Cyprinidae	Mimic Shiner	*Notropis volucellus*		
Cyprinidae	Bluntnose Minnow	*Pimephales notatus*		
Cyprinidae	Bullhead Minnow	*Pimephales vigilax*		
Catostomidae	River Carpsucker	*Carpiodes carpio*		
Catostomidae	Quillback	*Carpiodes cyprinus*		
Catostomidae	Highfin Carpsucker	*Carpiodes velifer*		
Catostomidae	Northern Hog Sucker	*Hypentelium nigricans*		
Catostomidae	Smallmouth Buffalo	*Ictiobus bubalus*		
Catostomidae	Black Buffalo	*Ictiobus niger*	SC	
Catostomidae	Silver Redhorse	*Moxostoma anisurum*		
Catostomidae	Smallmouth Redhorse	*Moxostoma breviceps*		
Catostomidae	River Redhorse	*Moxostoma carinatum*		SC
Catostomidae	Golden Redhorse	*Moxostoma erythrurum*		
Ictaluridae	Channel Catfish	*Ictalurus punctatus*		
Ictaluridae	Flathead Catfish	*Pylodictis olivaris*		
Moronidae	Morone Sp	*Morone sp*		
Moronidae	White Perch	*Morone americana*		
Moronidae	White Bass	*Morone chrysops*		
Moronidae	Hybrid Striper	*Morone saxatilis x M. chrysops*		
Centrarchidae	Green Sunfish	*Lepomis cyanellus*		
Centrarchidae	Warmouth	*Lepomis gulosus*		
Centrarchidae	Bluegill	*Lepomis macrochirus*		
Centrarchidae	Longear Sunfish	*Lepomis megalotis*		
Centrarchidae	Redear Sunfish	*Lepomis microlophus*		
Centrarchidae	Smallmouth Bass	*Micropterus dolomieu*		
Centrarchidae	Spotted Bass	*Micropterus punctulatus*		
Centrarchidae	Largemouth Bass	*Micropterus salmoides*		
Centrarchidae	Black Crappie	*Pomoxis nigromaculatus*		
Percidae	Logperch	*Percina caprodes*		
Percidae	River Darter	*Percina shumardi*		
Percidae	Sauger	*Sander canadensis*		
Percidae	Walleye	*Sander vitreus*		
Sciaenidae	Freshwater Drum	*Aplodinotus grunniens*		

4.2 Metric Performance

Each site's performance and scores for the MORFIn metrics are shown in Table 3. The number of native species collected at each site ranged from 9 to 23, with an average of 16.7 species per site. The number of sucker species found at each site ranged from 1 to 8 and the number of centrarchid species varied from 0 to 6. The number of great river species ranged from 0 to 4. The number of intolerant species ranged from 0 to 4 at the sampled sites. The percentage of tolerant individuals at each site did not exceed 4.8% and the percentage of simple lithophils ranged between 8.5% and 58.3%. All sites had below 4.8% non-native individuals and the percent detritivores ranged from 5.4% to 33.3%. The percent invertivores ranged between 0.0% to 60.7%, and the percent piscivores ranged from 9.1% to 59.6%. Nine of the fifteen sites had DELT (deformities, eroded fins, lesions and tumors) anomalies, though no individual site exhibited more than three DELT anomalies. The CPUE (catch per unit effort) ranged from 42 to 246 individuals and averaged 135.1 individulas per site.

4.3 Habitat Surveys

Intensive habitat surveys at each of the 15 sampling locations revealed that the benthic substrate in McAlpine pool was dominated by sand, followed by nearly equal proportions of fines and gravel (Figure 7). There was some variation among the individual sites and the percentage of fines increased as river miles increased (Figure 8) within the pool. The percentages of substrate variables were used to give each site a habitat classification of 'A', 'B', 'C', 'D', or 'E'. Nine sites in the McAlpine pool was classified as class 'D' habitats, 4 sites were class 'B' habitats, 2 sites were class 'C' habitats, and no sites were classified as 'A' or 'E'. (Table 1).

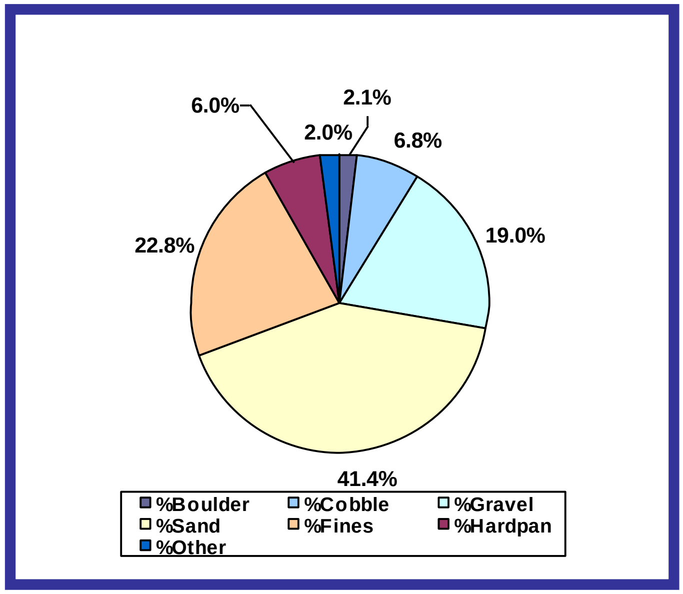

Figure 7. *Substrate composition of the McAlpine pool.*

Submerged vegetation was present at all 15 sites sampled, as was overhanging vegetation. Riparian land cover was primarily natural forest with some residential, agricultural, and industrial uses present. Barge activity was moderately high throughout the pool, with mooring structures present at 8 of the 15 sites (see Appendix C).

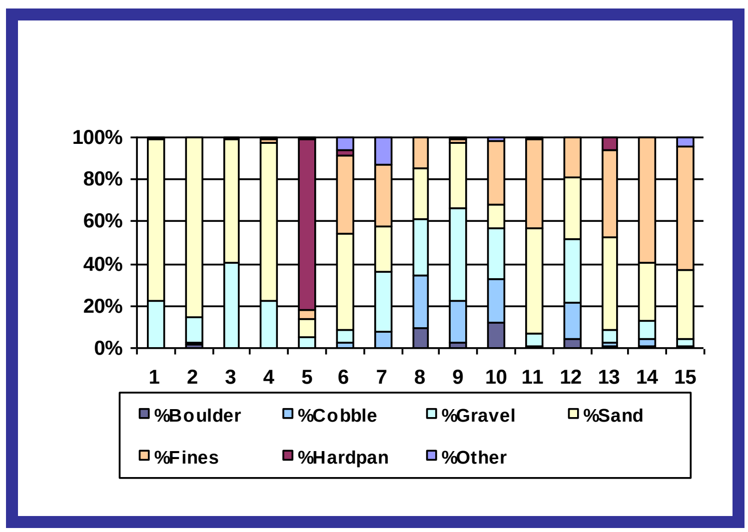

Figure 8. *Substrate composition at each site sampled in the McAlpine pool.*

Table 3. MORFIn metrics and scores from scores from the 2008 survey of Dashields.

Table 3. MORFIn metrics and scores from the 2009 survey of McAlpine pool.

Site #	Rmi	Bank	# Individuals	# Individuals w/o G & E	# Individuals w/o GETHEx	# Species	# Species Score	# Suckers	Suckers Score	# Centrarchid Species	Centrarchid Species Score	# Great River Species	Great River Species Score	# Intolerant Species	Intolerant Species Score	% Tolerant Individuals	Tolerant Individuals Score	% Simple Lithophils	Simple Lithophils Score	% Non-native Individuals	Non-native Individuals Score	% Detritivores	% Detritivores Score	% Invertivores	Invertivores Score	% Piscivores	% Piscivores Score	# DELTs	DELT score	CPUE	CPUE score	Expected MORFIn	Observed MORFIn
1	534.1	L	155	109	107	20	80.4	7	100.0	2	33.3	2	66.7	3.0	60.2	0.9	90.3	36.7	64.6	1.8	83.0	20.2	30.6	32.1	49.2	28.4	36.5	2	50.0	153	24.0	41.80	59.1
2	540.5	L	155	143	138	21	87.9	8	100.0	4	66.7	1	33.3	4.0	79.2	3.5	62.9	49.7	88.1	3.5	67.6	27.3	5.6	49.0	74.9	11.9	7.8	2	50.0	150	23.6	41.80	57.5
3	544.5	L	217	175	174	19	73.5	8	100.0	2	33.3	2	66.7	4.0	79.5	0.6	93.9	58.3	100.0	0.6	94.7	16.6	43.3	58.9	90.0	9.1	3.0	3	25.0	216	34.4	44.55	64.4
4	547.1	R	118	98	98	15	44.5	6	100.0	0	0.0	2	66.7	3.0	61.1	0.0	100.0	56.1	99.8	0.0	100.0	14.3	51.4	44.9	69.1	17.3	17.2	2	50.0	118	18.6	41.80	59.9
5	549.5	L	83	80	78	18	66.4	7	100.0	2	33.3	0	0.0	3.0	61.3	2.5	73.5	33.8	59.6	1.3	88.4	27.5	4.7	31.3	48.7	17.5	17.5	1	75.0	81	12.6	41.80	49.3
6	550.2	L	148	139	135	22	95.5	7	100.0	3	50.0	2	66.7	2.0	42.7	0.0	100.0	43.9	77.9	2.9	73.3	15.8	45.9	46.8	72.1	23.7	28.2	0	100.0	144	22.9	41.80	67.3
7	556.1	R	60	59	57	15	44.8	3	46.5	6	100.0	0	0.0	0.0	5.9	1.7	82.0	8.5	14.3	1.7	84.3	13.6	53.9	27.1	42.8	23.7	28.2	0	100.0	58	9.1	44.55	47.1
8	571.9	R	127	117	114	20	81.7	4	66.7	6	100.0	2	66.7	3.0	62.8	2.6	72.8	28.2	50.0	0.9	92.1	17.1	41.5	25.6	41.3	28.2	35.8	0	100.0	124	20.2	46.71	64.0
9	575.4	L	247	145	144	23	100.0	6	100.0	5	83.3	2	66.7	3.0	63.0	0.0	100.0	27.6	49.0	0.7	93.6	7.6	75.0	60.7	94.3	16.6	15.6	1	75.0	246	40.0	46.71	73.5
10	584.4	L	43	21	20	9	2.1	2	28.8	0	0.0	0	0.0	0.0	7.9	4.8	49.5	9.5	16.6	4.8	55.9	33.3	0.0	0.0	3.3	38.1	52.8	0	100.0	42	7.1	46.71	24.9
11	585.9	L	87	40	40	9	2.2	1	9.6	1	16.7	2	66.7	1.0	26.6	0.0	100.0	50.0	89.5	0.0	100.0	12.5	57.7	25.0	41.0	42.5	60.4	0	100.0	87	14.5	41.80	52.7
12	586.4	R	152	56	56	12	24.0	1	9.6	2	33.3	1	33.3	0.0	8.0	0.0	100.0	19.6	34.9	0.0	100.0	5.4	82.9	30.4	49.1	32.1	42.5	0	100.0	152	25.0	46.71	49.4
13	596.5	R	150	104	103	13	31.6	3	48.8	4	66.7	0	0.0	1.0	27.3	1.0	89.8	34.6	62.0	1.0	91.1	8.7	71.2	18.3	31.4	59.6	89.9	1	75.0	149	24.8	41.80	54.6
14	597	L	89	88	88	14	38.9	2	29.5	4	66.7	0	0.0	1.0	27.3	0.0	100.0	15.9	28.3	0.0	100.0	11.4	61.7	27.3	45.0	36.4	49.7	1	75.0	89	15.1	41.80	49.0
15	600.3	R	220	120	118	20	82.7	3	49.1	6	100.0	4	100.0	1.0	27.6	0.8	91.2	36.7	65.7	1.7	84.6	10.8	63.5	35.8	58.1	34.2	45.9	1	75.0	218	36.1	41.80	67.6

R = Right Descending Bank
L = Left Descending Bank
w/o G & E = Individuals minus gizzard shad and emerald shiners
w/o GETHEx = Individuals minus gizzard shad, emerald shiners, tolerants, hybrids, and exotics
Centrarchid Species = black bass, sunfishes, crappie
Great River Species = fish expected to be predominant in great rivers
Intolerant Species = species with low pollution/disturbance tolerance

Tolerant Individuals = individuals with high pollution/disturbance tolerance
Simple Lithophils = fish that are sensitive to substrate disturbance based on reproductive needs
Detritivore = fish that feed primarily on detritus
Invertivore = fish that feed primarily on invertebrates
Piscivore = fish that feed primarily on other fish
DELT = individuals with Deformities, Eroded fins, Lesions, and/or Tumors
CPUE = Catch Per Unit Effort

4.4 Water Quality and Flow Conditions

As rain events were relatively common throughout the sampling period in 2009; river levels and flows were variable. Sampling was conducted in McAlpine pool when flows were above and below the harmonic mean flow (HMF). Flow conditions during sampling varied from 19% and 126% of the HMF (Figure 9).

Measurements of water quality parameters did not reveal any unusual or poor water conditions present at the time of fish sampling (Appendix D). Secchi depths at the time of sampling ranged from 18 to 42 inches.

The water quality parameters measured from water samples, collected three times with Kemmerers, did not reveal any parameters exceeding water quality criteria (Appendix E).

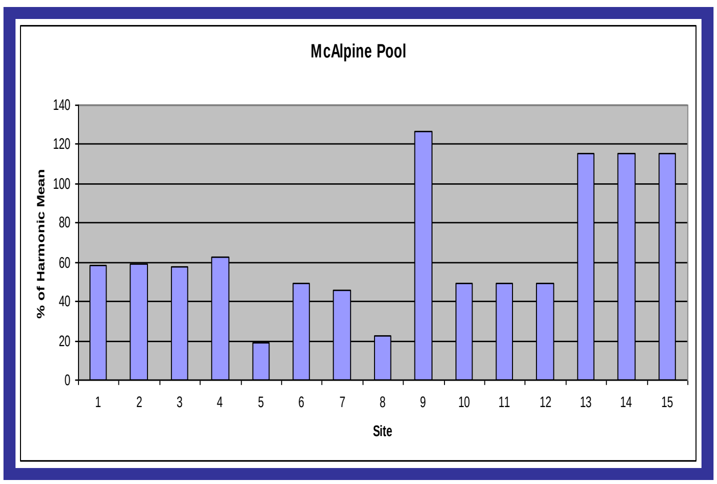

***Figure 9**. Relative flows (%HMF) at the time of sampling.*

4.5 Assessment of Condition

MORFIn scores were calculated for each of the sites sampled. The maximum score achieved by any site in this pool, out of a possible 100, was 73.5 and the minimum was 24.9. By comparing observed and expected MORFIn scores, ORSANCO determined if a site met its expectations (based on habitat class) or not (Table 3). One of the 15 sites (6.7%) assessed in 2009 scored less than the minimum expected and was assessed as very poor (Table 1; Figure 4). The remaining 14 sites received a fair (26.7%), good (20%), or very good quality rating (46.7%; Figure 4).

5.0 Discussion

5.1 Fish Population

In 2009, the fish population of McAlpine pool was in good condition. This was supported by the diversity and types of species collected. Multiple pollution intolerant species such as river redhorse (*Moxostoma carinatum*), northern hogsucker (*Hypentelium nigricans*), mimic shiner (*Notropis volucellus*), smallmouth bass (*Micropterus dolomieu*), logperch (*Percina caprodes*), and mooneye (*Hiodon tergisus*) were collected from McAlpine pool, suggesting that pollution may not be a problem in the area. Common carp (*Cyprinus carpio*) was the only non-native species collected during the survey.

The three most abundant species in the survey were gizzard shad (*Dorosoma cepedianum*, 490 individuals), golden redhorse (*Moxostoma erythrurum*, 194 individuals), and sauger (*Sander canadensis*, 184 individuals)

5.2 Metric Performance

Most of the metric scores in McAlpine pool were relatively high with the exception of three metrics: CPUE, % piscivores, and # Great River species. There was no known reason or explanation for the low percentage of % piscivorous or Great River species. Gizzard shad are not counted in CPUE, and as the most abundant species, this would negatively impact the score.

Three metrics stood out as the highest performing in McAlpine pool; % of non-native individuals, % tolerant individuals, and DELTs metrics. Only 1.4% of the catch was made up of non-native individuals, while only 1.2% (Table 3) was made up of tolerant individuals. DELT anomalies were found at 9 of the 15 sites, and no site had more than 3 individual DELT anomalies, suggesting the majority of fishes in McAlpine pool are not experiencing environmental stressors severe enough to decrease their health. These metrics indicate that McAlpine pool is in good condition. Other metrics that performed relatively well include: # sucker species, % simple lithophilic spawners, # species, and % invertivores.

5.3 Habitat Surveys
The habitat assessments show that in McAlpine pool there was a relatively high number of class 'D' habitats, followed by 'B' and 'C' habitat types. This indicated that the majority of the benthic substrate were comprised of fines, gravel, and sand. The heterogeneous substrate compositions, supplemented with the presence of submerged vegetation, provided adequate habitat to support the diverse populations of fishes in the pool.

5.4 Water Quality and Flow Conditions
The fluctuations in river level could potentially have affected the survey of McAlpine pool. Rain events were relatively frequent throughout the field season causing some sampling to be conducted during higher flow events. However, there seemed to be no correlation between high flows and MORFIn scores as all four sites sampled during higher than normal flows scored 'Fair' to 'Very Good'. High flows can alter fish behavior and increase turbidity, though Secchi depths indicated sufficient visibility for sampling. No water quality measurements exceeded their respective criteria or provided any major insight into the assessment results for McAlpine pool.

5.5 Conclusions and Assessments of Condition
The overall average quality score in Hannibal pool was 3.0, indicating the pool is in 'Good' biological condition. Despite one of the sites assessed as being in very poor condition, the assessment of McAlpine pool met the criteria established by ORSANCO's Biological Water Quality Subcommittee (Appendix A). The data collected in 2009 indicated that McAlpine pool met its aquatic life-use designation.

6.0 Interpool Comparison

6.1 Purpose
As of 2009, all 19 pools have been surveyed and assessed. This section was developed to compare McAlpine pool to other previously surveyed pools in the Ohio River.

6.2 Land Cover
McAlpine lies in the middle portion of the Ohio River and therefore has a moderately sized catchment area. Despite many industrial facilities immediately surrounding the pool, the primary land cover within the watershed is deciduous forest. Agricultural practices are secondary land uses but in higher proportions than pools in the upper third of the Ohio River (Figure 10).

6.3 Substrate Composition
This pool was dominated by sand and had an almost equal percentage of fines and gravel. The substrate composition is most similar to its closest downstream pool (Cannelton; Figure 11).

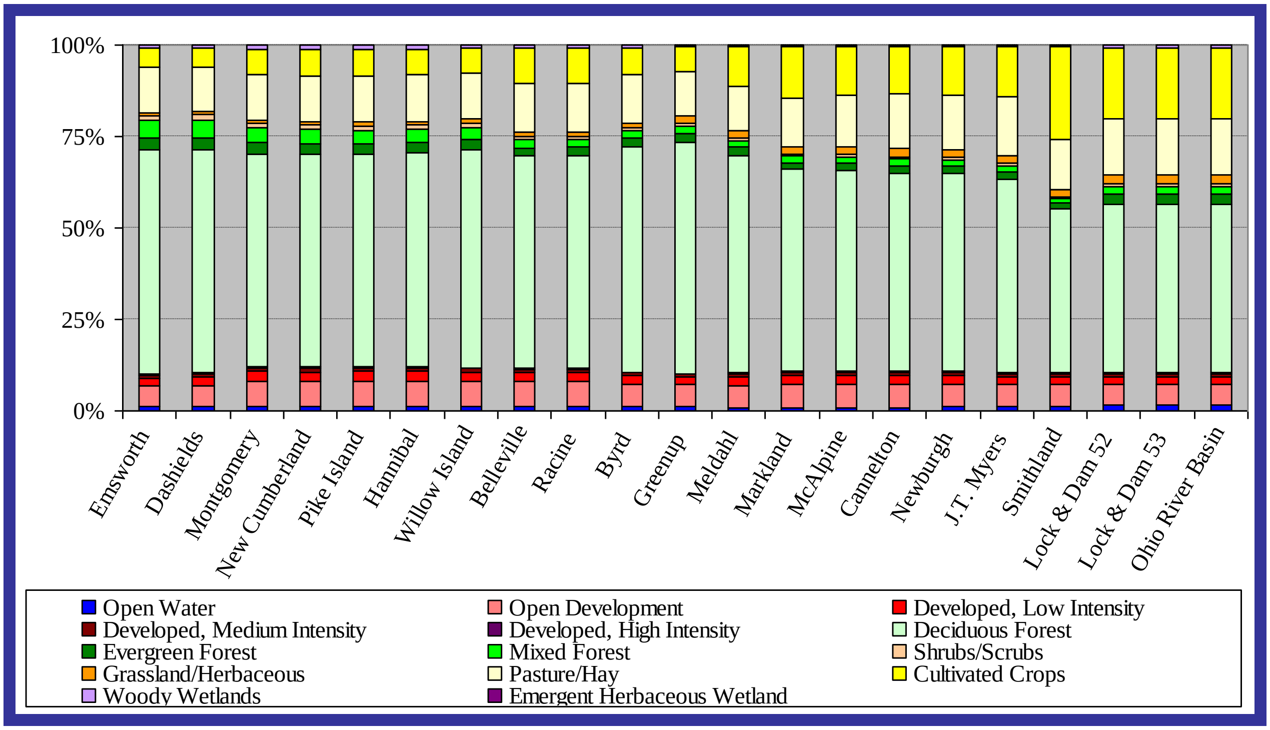

***Figure 10**. Cumulative land-cover within the catchment area of each pool of the Ohio River.*

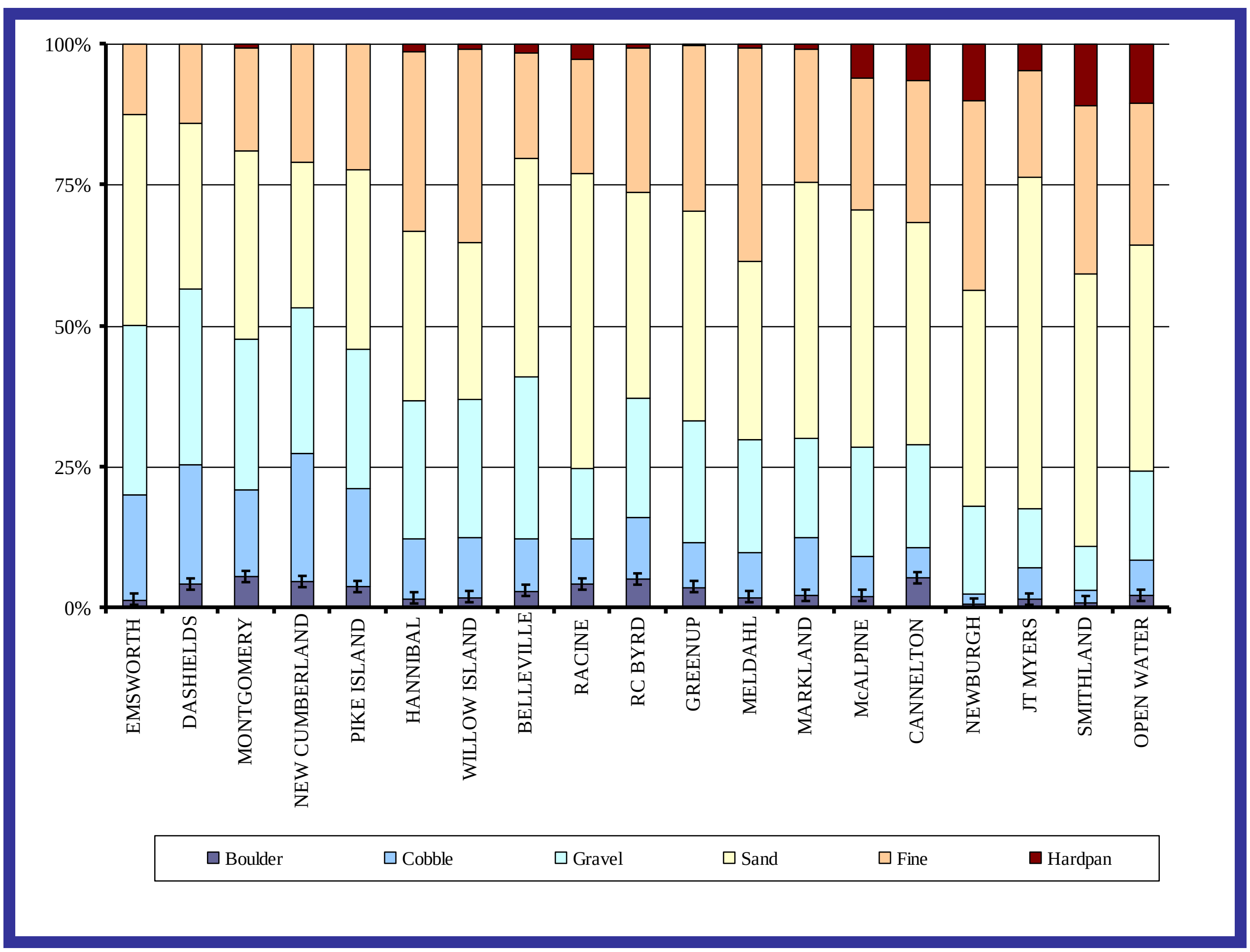

***Figure11**. Substrate composition for each pool surveyed as of 2009.*

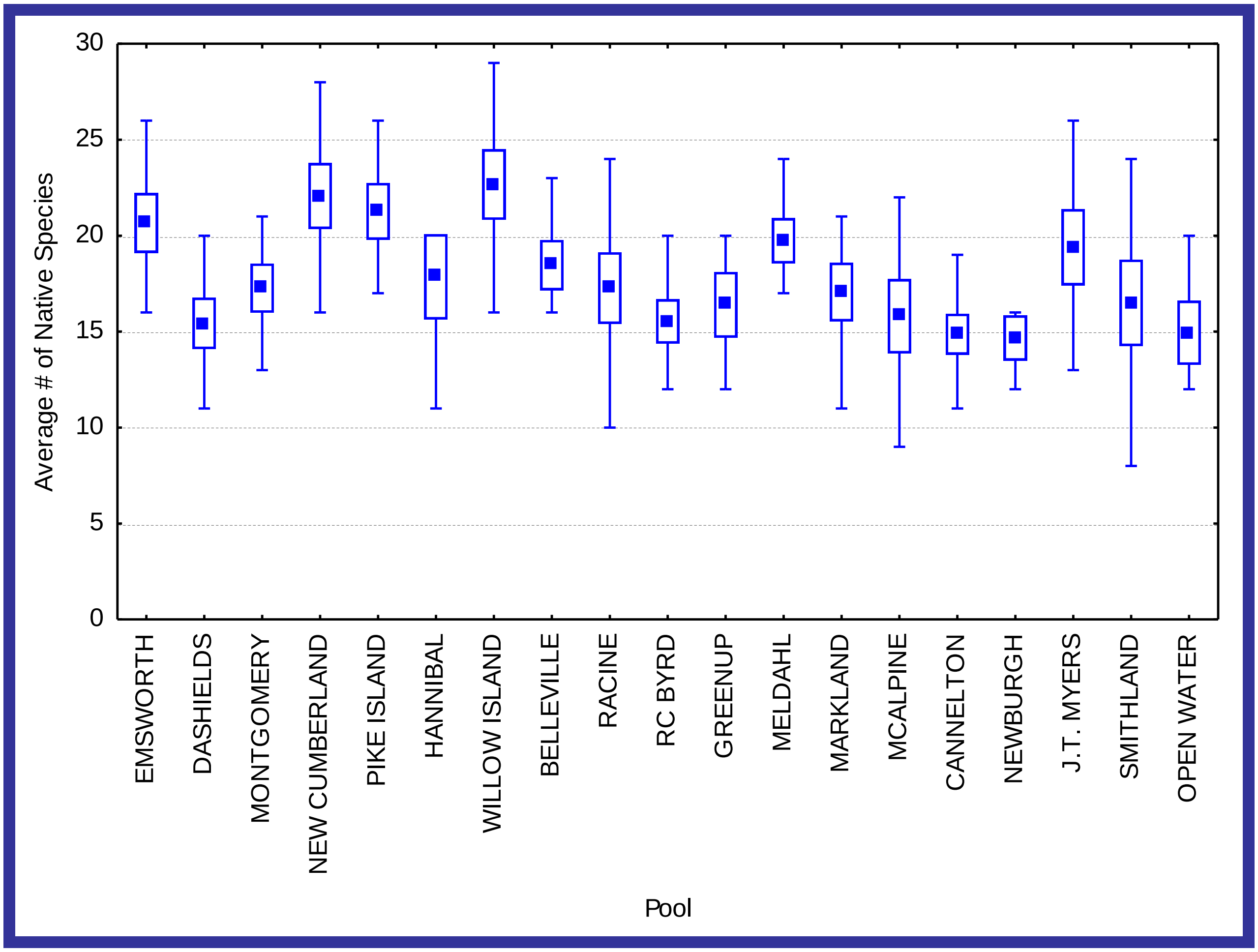

***Figure 12**. The average number of native species collected at each site within each pool surveyed as of 2009 (■=Average, □= 90% Confidence Interval, I=Non-Outlier Range).*

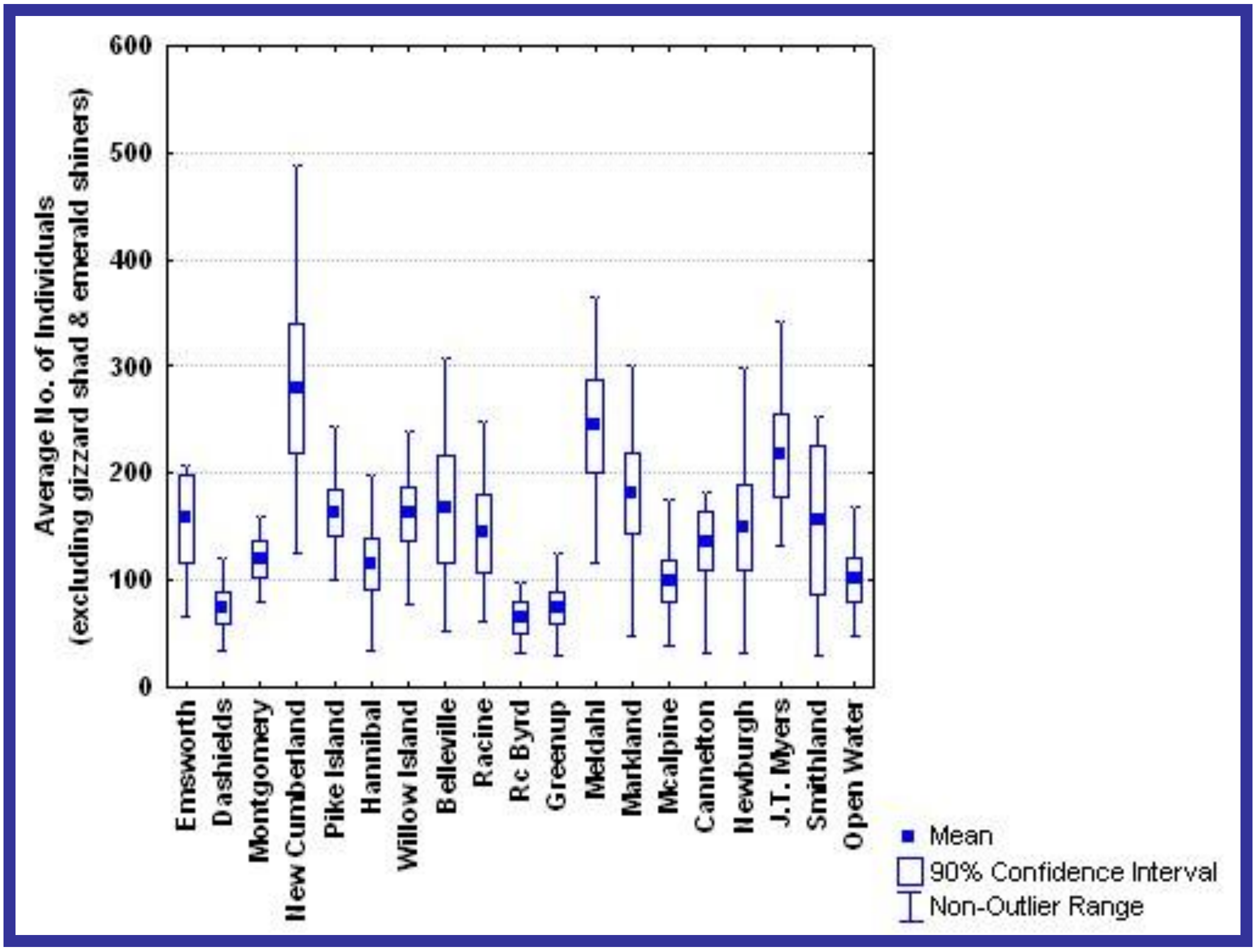

Figure13. *The average number of individuals (excluding gizzard shad & emerald shiner) collected at each site within each pool surveyed as of 2009.*

6.4 Species Richness

McAlpine pool was similar to other surveyed pools in the average number of native species per site (16.7) and ranked 14th in comparison (Figure 12).

6.5 Number of Individuals

An average of 98 individuals (excluding gizzard shad and emerald shiner) was collected at each site in McAlpine pool which ranked 15th in comparison (Figure 13).

6.6 Noteworthy Fish Observations

Sampling results from the upper portions of the pool yielded relatively high numbers of round-bodied suckers such as golden redhorse (*Moxostoma erythrurum*), smallmouth redhorse (*Moxostoma breviceps*) and silver redhorse (*Moxostoma anisurum*). These species are more common in the upper half of the river. Additionally, one threadfin shad (*Dorosoma petenense*) was collected at the uppermost site within this pool. This represents a relatively rare record for this species this far upstream. Species that are typically found in this reach [gizzard shad (*Dorosoma cepedianum*), sauger (*Sander canadensis*) and freshwater drum (*Apoidinotus grunniens*)] represented a high proportion of the species captured at most sites in the middle and lower reaches of the pool (Appendix B).

6.7 Assessment of Condition

The average quality score in McAlpine pool was 3.0 and it was assessed as being in 'Good' condition. The nearest surveyed pool upstream (Markland) and downstream (Cannelton) of McAlpine pool were also considered to be in 'Good' condition (Figure 15).

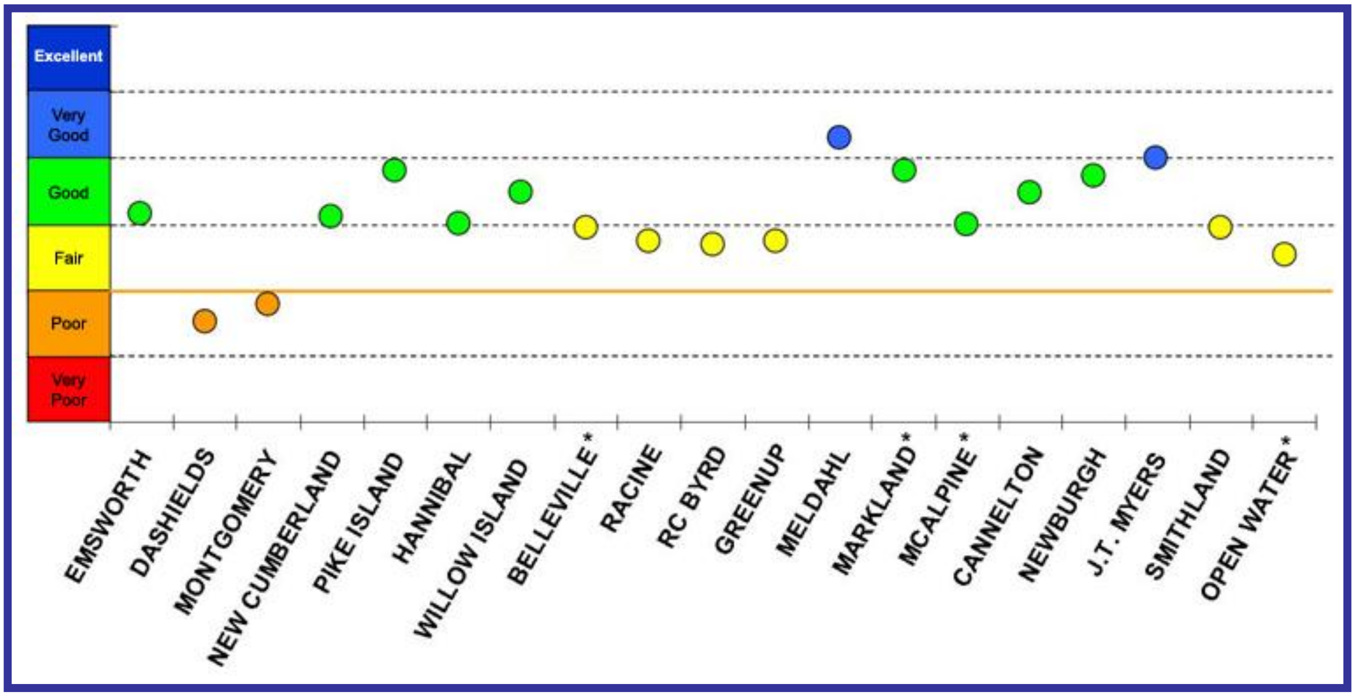

Figure 14. *The average quality score for each pool surveyed as of 2009 (* = pools surveyed in 2009). Data points are color-coded to indicate the biological condition of a pool*.

Table 4. *A compiled species list containing the number of individuals collected per pool as of 2009*

#	Species	Emsworth 07	Dashields 08	Montgomery 06	New Cumberland 05	Pike Island 07	Hannibal 08	Willow Island 06	**Belleville 09**	Racine 05	R.C. Byrd 08	Greenup 06	Meldahl 07	**Markland 09**	**McAlpine 09**	Cannelton (30) 06-07	Newburgh 07	Myers 05	Smithland 08	**Open Water 09**
1	Ohio Lamprey								**1**											
2	Silver Lamprey											1							1	
3	Paddlefish																1			**1**
4	Spotted Gar																1		1	
5	Longnose Gar	13	11	10	11	43	49	46	**49**	24	27	23	22	**15**	**40**	48	20		16	**40**
6	Shortnose Gar													**1**	**1**		9	2	13	**75**
7	Goldeye																12		2	**4**
8	Mooneye	20	11	6	22	37	10		**4**	1	7		48	**9**	**10**	8	10	4		**1**
9	Skipjack Herring	8			3	6			**2**	1	2		64	**2**	**6**	174	70	249	1	**8**
10	Gizzard Shad	167	123	266	1202	7326	1461	216	**439**	8048	301	267	2408	**185**	**490**	3527	600	444	409	**325**
11	Threadfin Shad														**1**	1	9	112	25	**3**
12	Central Stoneroller				4		3	1												
13	Goldfish				1															
14	Grass Carp				1												1			**3**
15	Spotfin Shiner			1	21	14		24	**159**	63	1	2	32	**1**	**6**	63	8	12	4	**12**
16	Common Carp	63	36	44	25	15	15	22	**36**	9	12	9	8	**28**	**12**	5	4	10	17	**51**
17	Gravel Chub												1							
18	Miss. Silvery Minnow																	1		**1**
19	Silver Carp																2		4	**6**
20	Bighead Carp																2			**2**
21	Striped Shiner						2			2										
22	Silver Chub	26	26	12	20	11	19	57	**32**	44	11	33	90	**372**	**39**	130	126	206	47	**25**
23	River Chub				1	1														
24	Golden Shiner	1			1															
25	Emerald Shiner	82	5	8	342	197	21	728	**637**	795	16	50	637	**204**	**67**	1331	166	801	28	**25**
26	River Shiner	1											54	**12**	**10**	276	3	91	2	**9**

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#	Species	Emsworth 07	Dashields 08	Montgomery 06	New Cumberland 05	Pike Island 07	Hannibal 08	Willow Island 06	**Belleville 09**	Racine 05	R.C. Byrd 08	Greenup 06	Meldahl 07	**Markland 09**	**McAlpine 09**	Cannelton (30) 06-07	Newburgh 07	Myers 05	Smithland 08	**Open Water 09**
27	Silverjaw Minnow						1													
28	Spottail Shiner				6	2	1													
29	Silverband Shiner																			**6**
30	Sand Shiner								**1**											
31	Mimic Shiner	35	1	13	76	162	16	306	**795**	402	1	61	7	**45**	**30**	195	6	43		**8**
32	Suckermouth Minnow													**1**						
33	Bluntnose Minnow				2	2	4	120	**11**	3		1	1		**1**	2			1	
34	Fathead Minnow									6										
35	Bullhead Minnow							4	**1**	5			23	**9**	**1**			8	2	**19**
36	Creek Chub				1								3							
37	Ictiobinae Sp				20															
38	Carpiodes Sp		1			14			**3**	2			1			2				**1**
39	River Carpsucker	18	18	13	46	36	64	18	**12**	50	25	49	87	**85**	**88**	122	179	86	114	**218**
40	Quillback	17	12	30	80	27	28	66	**6**	16	8	17	31	**21**	**12**	21	34	57	28	**15**
41	Highfin Carpsucker			37	3	10	13	1	**1**	7		4			**18**	1	12	3	24	
42	Northern Hog Sucker	3	1	3	132	4	2	15	**3**		1			**1**	**2**	1	1			
43	Ictiobus Sp.						19													
44	Smallmouth Buffalo	97	99	217	283	94	45	60	**75**	96	40	49	123	**110**	**102**	147	72	314	77	**76**
45	Bigmouth Buffalo									1							3	7	5	**5**
46	Black Buffalo	1	13			5	1	2	**1**			1		**1**	**1**	1	7	3	4	**7**
47	Spotted Sucker							1		1		5	1			1			7	
48	Moxostoma Sp				58															
49	Silver Redhorse	221	93	157	63	78	105	51	**55**	11	11	12	25	**3**	**41**	3			1	

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50	Smallmouth Redhorse	61	16	110	110	28	41	168	**97**	5	27	30	62	**38**	**66**	12	3	11		
51	Shorthead Redhorse																		10	
52	River Redhorse	39	13	3	5	27	35	2	**1**		2	6	1		**2**		1			
53	Black Redhorse	18			11			4	**2**							1				
54	Golden Redhorse	7	33	227	90	66	204	277	**115**	11	33	39	120	**219**	**194**	4	14		3	**1**
55	Brown Bullhead											1								
56	Blue Catfish																	1	7	**4**
57	Channel Catfish	32	17	34	123	40	62	61	**89**	70	53	58	89	**113**	**84**	48	11	330	291	**165**
58	Flathead Catfish	14	11	11	15	35	38	21	**27**	32	42	32	49	**24**	**11**	63	11	43	16	**15**
59	Muskellunge	1																		
60	Trout-Perch								**7**	3										
61	Banded Killifish							1												
62	Western Mosquitofish																			**1**
63	Brook Silverside									1						1	1	1	1	
64	Inland Silverside																		26	
65	Atlantic Needlefish																			**5**
66	Morone Sp	27		6	568	419	91	17	**35**	561	73	2	152	**44**	**63**	625	403	253	190	**31**
67	White Perch	5			4		1	3						**1**	**1**					**7**
68	White Bass	9	16	36	6	2	3	58	**41**	3	29	64	18	**19**	**26**	66	4	17	76	**54**
69	Yellow Bass																		2	**104**
70	Striped Bass						14	1								6		12	2	
71	Hybrid Striper			4	17			1	**3**	46	1			**15**	**6**	6		11	2	**45**
72	Rock Bass	16	9	8	5	1	2	3	**9**					**2**				1		
73	Lepomis Hybrid			1				9												
74	Lepomis Sp					1		16		1						2		2	1	

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75	Green Sunfish	12	3	2	4	2	2	4	**8**	6	6	4	3	**9**	**3**	2	4	10	1	**2**
76	Pumpkinseed			2			2	18	**1**					**1**						**1**
77	Warmouth							1					1	**2**	**1**			1		
78	Orangespotted Sunfish				1			2	**1**	1	1		1					2		**5**
79	Bluegill	379	32	216	53	46	36	232	**413**	58	52	112	207	**206**	**105**	103	11	31	64	**98**
80	Longear Sunfish						9	23	**18**	3	9	14	35	**149**	**91**	39	3	11	92	**110**
81	Redear Sunfish			4		1		1	**4**	1		1		**1**	**1**	16		1	20	
82	Micropterus Sp																		1	
83	Smallmouth Bass	339	163	185	262	208	92	61	**45**	6	32	7	4	**32**	**7**	7	1	4		**10**
84	Spotted Bass	125	34	15	79	74	38	62	**43**	22	30	43	90	**102**	**23**	53	49	104	31	**36**
85	Largemouth Bass	4	2	8	8	16		16	**72**	22	25	65	16	**25**	**11**	37	2	70	21	**23**
86	White Crappie	5	1						**3**		1	4		**2**		1	1			**13**
87	Black Crappie	3	1	6	2	2			**2**	3	1				**4**	3				**3**
88	Greenside Darter	5		2	11	5														
89	Rainbow Darter			4	1			2	**1**									12		
90	Fantail Darter	3		1									1							
91	Johnny Darter	1						2												
92	Banded Darter			1	4													1		
93	Yellow Perch			4	2		3		**2**											
94	Logperch	141	166	67	244	85	105	108	**48**	6	72	12	20	**24**	**7**	39	4	3	1	**1**
95	Channel Darter	16		1	9		1	3				20		**3**				1		
96	Slenderhead Darter													**1**				5		
97	Dusky Darter																	3	1	
98	River Darter					2		1	**2**	2		1	6	**7**	**1**	11		4		
99	Sauger	283	192	243	180	244	317	341	**133**	173	259	220	1174	**378**	**184**	1314	747	484	105	**127**
100	Ohio Lamprey								**1**											

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100	Walleye	44	7	11	31	70	11	1	**4**	4	1	1	3		**5**		7			**1**
101	Saugeye	2	8		5	4	1		**1**	4	1			**13**				7	2	**16**
102	Freshwater Drum	254	58	47	1468	496	211	120	**33**	375	83	121	1000	**572**	**177**	435	378	612	837	**236**
	Total # of Individuals	2618	1232	2076	5742	9958	3198	3378	**3582**	11006	1296	1441	6718	**3107**	**2051**	8953	3013	4501	**2636**	**2060**
	Total # of Taxa	43	33	42	53	43	43	51	**50**	46	36	38	41	**45**	**44**	45	44	49	**49**	**52**

Literature Cited

Emery, E.B., T.P. Simon, F.H. McCormick, P.L. Angermeier, J.E. Deshon, C.O. Yoder, R.E. Sanders, W.D. Pearson, G.D. Hickman, R.J. Reash, and J.A. Thomas. 2003. Development of a multimetric index for assessing the biological condition of the Ohio River. Transactions of the American Fisheries Society. 132:791-808.

Gammon, J.R. 1998. The Wabash River Ecosystem. Indiana University Press, Bloomington, IN.

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Annals of the Association of American Geographers. 77:179-190.

ORSANCO (Ohio River Valley Water Sanitation Commission). 1994. Ohio River Fact Book. ORSANCO, Cincinnati, OH.

ORSANCO. 2003. Pollution Control Standards for Discharges to the Ohio River. ORSANCO, Cincinnati, OH.

Reash, R.J. 1999. Considerations for characterizing Midwestern large river habitats. Pages 463-473, *In* T.P. Simon. 1999. Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL.

Sanders, R.E. 1992. Day versus night electrofishing catches from near-shore waters of the Ohio and Muskingum rivers. Ohio Journal of Science 92:51-59.

Appendix A
Assessment Unit Criteria Details

- Each individual navigational pool will serve as a separate and distinct Assessment Unit (AU), with the exception of the area below Smithland dam will also be considered one distinct AU.

    - This is based on the observation that biologically, each pool more closely resembles a lake, and not a free-flowing river. Therefore, biological condition becomes more homogeneous throughout, exhibiting little longitudinal change.

    - The dams are seen as the only real barriers that isolate individual populations. This observation is supported by research at the University of Louisville indicating little or no synchrony between pools. Each pool behaves independent of even its nearest neighbor, indicating isolated and independent populations among pools.

    - Isolated pockets, or areas, with poorly performing biotic communities have not been observed over the last ten years of sampling.

    - The BWQSC believes that a subset of randomly selected sites within each pool can accurately describe the condition of the target population (the fish population of that pool).

- All AUs will be sampled and assessed on a 5-year rotating basis. This is consistent with state schedules, and it will allow ORSANCO (after one full rotation) in each 305(b) report, to incorporate 5 years worth of data and report on 100% of the resource.

    - It is acceptable to EPA to include the most recent 5 years of data in each 305(b) report.

	Emsworth	Dashields	Montgomery	New Cumberland	Pike Island	Hannibal	Willow Island	Belleville	Racine	R. C. Byrd	Greenup	Meldahl	Markland	McAlpine	Cannelton	Newburgh	Uniontown	Smithland	Olmsted	Sites
2005				15					15				15				15			60
2006			15				15				15				11					56
2007	15				15							15			19	15				79
2008		15				15				15								15		60
2009								15					15	15					15	60
SUM	15	15	15	15	15	15	15	15	15	15	15	15	30	15	30	15	15	15	15	315

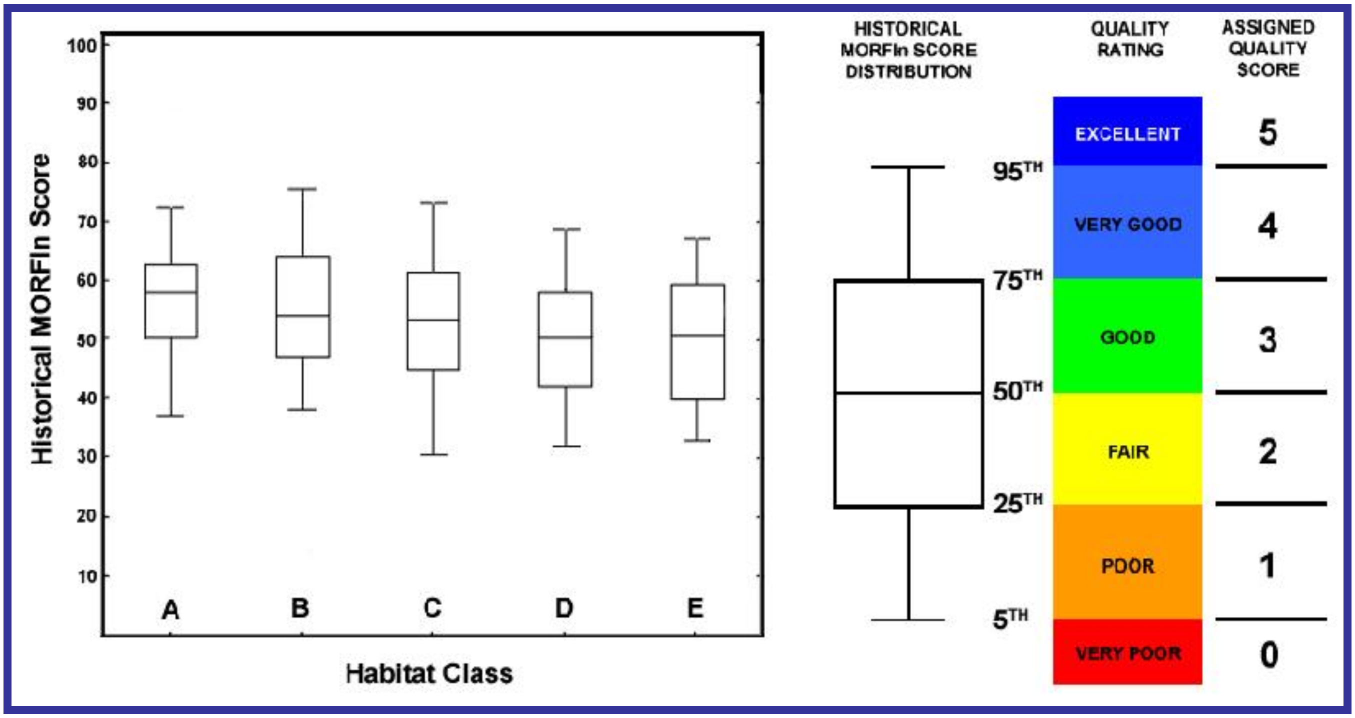
- Assessment Units that yield an average quality score that is less than 2.0 will be listed as failing to meet (support) its aquatic life-use designation. The process of conducting a bioassessment and determining an AU's biological condition is outlined below:

    - Individual sites were assigned to a habitat class ('A', 'B', 'C', 'D' and 'E') based on its substrate composition. Each of these 5 habitat classes exhibits a different range of historical MORFIn scores and expectations. Therefore, the expected MORFIn score changes for each of the habitat classes (see table below). These MORFIn expectations for each habitat are the 25th percentiles of historical MORFIn scores for each habitat.

Quality Score Constants	Class A	Class B	Class C	Class D	Class E
95th Percentile	72.53610	75.70669	73.19395	68.57603	67.26375
75th Percentile	62.59448	63.77092	61.13696	57.90023	59.17819
50th Percentile	55.97259	55.05460	52.23313	49.71604	50.53237
25th Percentile	50.03279	46.71055	44.54931	41.80374	39.59005
5th Percentile	36.62273	37.89377	30.12705	31.55379	32.57287

- A quality score (between 0 and 5) was assigned to a site based on its score relative to the statistical distribution of historical MORFIn scores. Each quality score corresponds to the ranges between the 5th, 25th, 50th, 75th, or 95th percentiles of historical MORFIn scores. For example, the range less than the 25th percentile receives a quality score <2.0 (see figure below).

- Those sites with MORFIn scores less than the 25th percentile are considered to be in poor or very poor condition and fail to meet its expected MORFIn score. The quality scores for individual sites are averaged within an AU (pool) to determine the AU's biological condition.



Appendix B. Fish survey data from the McAlpine pool.

Site #	Rmi	Bank	Date	Common Name	Latin Name	Count
1	534.1	LDB	16-Sep-09	Channel Catfish	*Ictalurus punctatus*	3
1	534.1	LDB	16-Sep-09	Common Carp	*Cyprinus carpio*	1
1	534.1	LDB	16-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	17
1	534.1	LDB	16-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	46
1	534.1	LDB	16-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	16
1	534.1	LDB	16-Sep-09	Highfin Carpsucker	*Carpiodes velifer*	5
1	534.1	LDB	16-Sep-09	Hybrid Striper	*Morone saxatilis x M. chrysops*	1
1	534.1	LDB	16-Sep-09	Logperch	*Percina caprodes*	1
1	534.1	LDB	16-Sep-09	Longear Sunfish	*Lepomis megalotis*	1
1	534.1	LDB	16-Sep-09	Longnose Gar	*Lepisosteus osseus*	8
1	534.1	LDB	16-Sep-09	Mimic Shiner	*Notropis volucellus*	6
1	534.1	LDB	16-Sep-09	Morone Sp	*Morone sp*	8
1	534.1	LDB	16-Sep-09	Quillback	*Carpiodes cyprinus*	1
1	534.1	LDB	16-Sep-09	River Carpsucker	*Carpiodes carpio*	5
1	534.1	LDB	16-Sep-09	Sauger	*Sander canadensis*	12
1	534.1	LDB	16-Sep-09	Shorthead Redhorse	*Moxostoma macrolepidotum*	2
1	534.1	LDB	16-Sep-09	Shortnose Gar	*Lepisosteus platostomus*	1
1	534.1	LDB	16-Sep-09	Silver Chub	*Macrhybopsis storeriana*	7
1	534.1	LDB	16-Sep-09	Silver Redhorse	*Moxostoma anisurum*	2
1	534.1	LDB	16-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	10
1	534.1	LDB	16-Sep-09	Spotted Bass	*Micropterus punctulatus*	1
1	534.1	LDB	16-Sep-09	Threadfin Shad	*Dorosoma petenense*	1
2	540.5	LDB	16-Sep-09	Black Crappie	*Pomoxis nigromaculatus*	1
2	540.5	LDB	16-Sep-09	Channel Catfish	*Ictalurus punctatus*	5
2	540.5	LDB	16-Sep-09	Channel Shiner	*Notropis wickliffi*	3
2	540.5	LDB	16-Sep-09	Common Carp	*Cyprinus carpio*	5
2	540.5	LDB	16-Sep-09	Flathead Catfish	*Pylodictis olivaris*	1
2	540.5	LDB	16-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	11
2	540.5	LDB	16-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	12
2	540.5	LDB	16-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	39
2	540.5	LDB	16-Sep-09	Highfin Carpsucker	*Carpiodes velifer*	7
2	540.5	LDB	16-Sep-09	Longear Sunfish	*Lepomis megalotis*	1
2	540.5	LDB	16-Sep-09	Longnose Gar	*Lepisosteus osseus*	3
2	540.5	LDB	16-Sep-09	Morone Sp	*Morone sp*	4
2	540.5	LDB	16-Sep-09	Quillback	*Carpiodes cyprinus*	1
2	540.5	LDB	16-Sep-09	River Carpsucker	*Carpiodes carpio*	15
2	540.5	LDB	16-Sep-09	River Redhorse	*Moxostoma carinatum*	1
2	540.5	LDB	16-Sep-09	Sauger	*Sander canadensis*	5
2	540.5	LDB	16-Sep-09	Shorthead Redhorse	*Moxostoma macrolepidotum*	15
2	540.5	LDB	16-Sep-09	Silver Chub	*Macrhybopsis storeriana*	1
2	540.5	LDB	16-Sep-09	Silver Redhorse	*Moxostoma anisurum*	10
2	540.5	LDB	16-Sep-09	Smallmouth Bass	*Micropterus dolomieu*	1
2	540.5	LDB	16-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	11
2	540.5	LDB	16-Sep-09	Spotted Bass	*Micropterus punctulatus*	2
2	540.5	LDB	16-Sep-09	White Bass	*Morone chrysops*	1
3	544.5	LDB	17-Sep-09	Bluegill	*Lepomis macrochirus*	4
3	544.5	LDB	17-Sep-09	Channel Catfish	*Ictalurus punctatus*	10
3	544.5	LDB	17-Sep-09	Common Carp	*Cyprinus carpio*	1

3	544.5	LDB	17-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	17
3	544.5	LDB	17-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	42
3	544.5	LDB	17-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	67
3	544.5	LDB	17-Sep-09	Highfin Carpsucker	*Carpiodes velifer*	4
3	544.5	LDB	17-Sep-09	Longnose Gar	*Lepisosteus osseus*	2
3	544.5	LDB	17-Sep-09	Mimic Shiner	*Notropis volucellus*	4
3	544.5	LDB	17-Sep-09	Morone Sp	*Morone sp*	4
3	544.5	LDB	17-Sep-09	Northern Hog Sucker	*Hypentelium nigricans*	2
3	544.5	LDB	17-Sep-09	Quillback	*Carpiodes cyprinus*	3
3	544.5	LDB	17-Sep-09	River Carpsucker	*Carpiodes carpio*	9
3	544.5	LDB	17-Sep-09	River Shiner	*Notropis blennius*	7
3	544.5	LDB	17-Sep-09	Sauger	*Sander canadensis*	7
3	544.5	LDB	17-Sep-09	Shorthead Redhorse	*Moxostoma macrolepidotum*	12
3	544.5	LDB	17-Sep-09	Silver Chub	*Macrhybopsis storeriana*	3
3	544.5	LDB	17-Sep-09	Silver Redhorse	*Moxostoma anisurum*	4
3	544.5	LDB	17-Sep-09	Smallmouth Bass	*Micropterus dolomieu*	2
3	544.5	LDB	17-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	12
3	544.5	LDB	17-Sep-09	White Bass	*Morone chrysops*	1
4	547.1	RDB	16-Sep-09	Channel Catfish	*Ictalurus punctatus*	3
4	547.1	RDB	16-Sep-09	Channel Shiner	*Notropis wickliffi*	8
4	547.1	RDB	16-Sep-09	Emerald Shiner	*Notropis atherinoides*	6
4	547.1	RDB	16-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	16
4	547.1	RDB	16-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	14
4	547.1	RDB	16-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	16
4	547.1	RDB	16-Sep-09	Highfin Carpsucker	*Carpiodes velifer*	1
4	547.1	RDB	16-Sep-09	Mooneye	*Hiodon tergisus*	4
4	547.1	RDB	16-Sep-09	Morone Sp	*Morone sp*	2
4	547.1	RDB	16-Sep-09	River Carpsucker	*Carpiodes carpio*	12
4	547.1	RDB	16-Sep-09	Sauger	*Sander canadensis*	15
4	547.1	RDB	16-Sep-09	Shorthead Redhorse	*Moxostoma macrolepidotum*	14
4	547.1	RDB	16-Sep-09	Silver Chub	*Macrhybopsis storeriana*	4
4	547.1	RDB	16-Sep-09	Silver Redhorse	*Moxostoma anisurum*	2
4	547.1	RDB	16-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	1
5	549.5	LDB	22-Sep-09	Bluegill	*Lepomis macrochirus*	1
5	549.5	LDB	22-Sep-09	Bluntnose Minnow	*Pimephales notatus*	1
5	549.5	LDB	22-Sep-09	Channel Catfish	*Ictalurus punctatus*	7
5	549.5	LDB	22-Sep-09	Common Carp	*Cyprinus carpio*	1
5	549.5	LDB	22-Sep-09	Flathead Catfish	*Pylodictis olivaris*	1
5	549.5	LDB	22-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	12
5	549.5	LDB	22-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	3
5	549.5	LDB	22-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	9
5	549.5	LDB	22-Sep-09	Longear Sunfish	*Lepomis megalotis*	1
5	549.5	LDB	22-Sep-09	Longnose Gar	*Lepisosteus osseus*	5
5	549.5	LDB	22-Sep-09	Mimic Shiner	*Notropis volucellus*	1
5	549.5	LDB	22-Sep-09	Morone Sp	*Morone sp*	2
5	549.5	LDB	22-Sep-09	Quillback	*Carpiodes cyprinus*	2
5	549.5	LDB	22-Sep-09	River Carpsucker	*Carpiodes carpio*	8
5	549.5	LDB	22-Sep-09	River Redhorse	*Moxostoma carinatum*	1
5	549.5	LDB	22-Sep-09	Sauger	*Sander canadensis*	5
5	549.5	LDB	22-Sep-09	Shorthead Redhorse	*Moxostoma macrolepidotum*	2

5	549.5	LDB	22-Sep-09	Silver Redhorse	*Moxostoma anisurum*	10
5	549.5	LDB	22-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	10
5	549.5	LDB	22-Sep-09	White Bass	*Morone chrysops*	1
6	550.2	LDB	21-Sep-09	Black Buffalo	*Ictiobus niger*	1
6	550.2	LDB	21-Sep-09	Bluegill	*Lepomis macrochirus*	10
6	550.2	LDB	21-Sep-09	Bullhead Minnow	*Pimephales vigilax*	1
6	550.2	LDB	21-Sep-09	Channel Catfish	*Ictalurus punctatus*	1
6	550.2	LDB	21-Sep-09	Channel Shiner	*Notropis wickliffi*	7
6	550.2	LDB	21-Sep-09	Emerald Shiner	*Notropis atherinoides*	6
6	550.2	LDB	21-Sep-09	Flathead Catfish	*Pylodictis olivaris*	3
6	550.2	LDB	21-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	16
6	550.2	LDB	21-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	3
6	550.2	LDB	21-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	17
6	550.2	LDB	21-Sep-09	Hybrid Striper	*Morone saxatilis x M. chrysops*	4
6	550.2	LDB	21-Sep-09	Longear Sunfish	*Lepomis megalotis*	5
6	550.2	LDB	21-Sep-09	Longnose Gar	*Lepisosteus osseus*	3
6	550.2	LDB	21-Sep-09	Morone Sp	*Morone sp*	1
6	550.2	LDB	21-Sep-09	Quillback	*Carpiodes cyprinus*	5
6	550.2	LDB	21-Sep-09	River Carpsucker	*Carpiodes carpio*	7
6	550.2	LDB	21-Sep-09	Sauger	*Sander canadensis*	18
6	550.2	LDB	21-Sep-09	Shorthead Redhorse	*Moxostoma macrolepidotum*	12
6	550.2	LDB	21-Sep-09	Silver Chub	*Macrhybopsis storeriana*	4
6	550.2	LDB	21-Sep-09	Silver Redhorse	*Moxostoma anisurum*	10
6	550.2	LDB	21-Sep-09	Skipjack Herring	*Alosa chrysochloris*	1
6	550.2	LDB	21-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	9
6	550.2	LDB	21-Sep-09	Spotted Bass	*Micropterus punctulatus*	1
6	550.2	LDB	21-Sep-09	White Bass	*Morone chrysops*	3
7	556.1	RDB	21-Sep-09	Black Crappie	*Pomoxis nigromaculatus*	1
7	556.1	RDB	21-Sep-09	Bluegill	*Lepomis macrochirus*	10
7	556.1	RDB	21-Sep-09	Channel Catfish	*Ictalurus punctatus*	12
7	556.1	RDB	21-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	7
7	556.1	RDB	21-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	1
7	556.1	RDB	21-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	3
7	556.1	RDB	21-Sep-09	Green Sunfish	*Lepomis cyanellus*	1
7	556.1	RDB	21-Sep-09	Hybrid Striper	*Morone saxatilis x M. chrysops*	1
7	556.1	RDB	21-Sep-09	Largemouth Bass	*Micropterus salmoides*	1
7	556.1	RDB	21-Sep-09	Longear Sunfish	*Lepomis megalotis*	3
7	556.1	RDB	21-Sep-09	Longnose Gar	*Lepisosteus osseus*	1
7	556.1	RDB	21-Sep-09	Morone Sp	*Morone sp*	4
7	556.1	RDB	21-Sep-09	River Carpsucker	*Carpiodes carpio*	2
7	556.1	RDB	21-Sep-09	Sauger	*Sander canadensis*	2
7	556.1	RDB	21-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	6
7	556.1	RDB	21-Sep-09	Spotted Bass	*Micropterus punctulatus*	5
8	571.9	RDB	22-Sep-09	Black Crappie	*Pomoxis nigromaculatus*	1
8	571.9	RDB	22-Sep-09	Bluegill	*Lepomis macrochirus*	8
8	571.9	RDB	22-Sep-09	Channel Catfish	*Ictalurus punctatus*	14
8	571.9	RDB	22-Sep-09	Channel Shiner	*Notropis wickliffi*	1
8	571.9	RDB	22-Sep-09	Common Carp	*Cyprinus carpio*	1
8	571.9	RDB	22-Sep-09	Emerald Shiner	*Notropis atherinoides*	1
8	571.9	RDB	22-Sep-09	Flathead Catfish	*Pylodictis olivaris*	2

8	571.9	RDB	22-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	16
8	571.9	RDB	22-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	9
8	571.9	RDB	22-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	11
8	571.9	RDB	22-Sep-09	Green Sunfish	*Lepomis cyanellus*	2
8	571.9	RDB	22-Sep-09	Largemouth Bass	*Micropterus salmoides*	3
8	571.9	RDB	22-Sep-09	Longear Sunfish	*Lepomis megalotis*	6
8	571.9	RDB	22-Sep-09	Mooneye	*Hiodon tergisus*	1
8	571.9	RDB	22-Sep-09	Morone Sp	*Morone sp*	5
8	571.9	RDB	22-Sep-09	River Carpsucker	*Carpiodes carpio*	8
8	571.9	RDB	22-Sep-09	River Shiner	*Notropis blennius*	2
8	571.9	RDB	22-Sep-09	Sauger	*Sander canadensis*	17
8	571.9	RDB	22-Sep-09	Shorthead Redhorse	*Moxostoma macrolepidotum*	2
8	571.9	RDB	22-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	11
8	571.9	RDB	22-Sep-09	Spotted Bass	*Micropterus punctulatus*	3
8	571.9	RDB	22-Sep-09	White Bass	*Morone chrysops*	3
9	575.4	LDB	18-Aug-09	Bluegill	*Lepomis macrochirus*	25
9	575.4	LDB	18-Aug-09	Channel Catfish	*Ictalurus punctatus*	5
9	575.4	LDB	18-Aug-09	Emerald Shiner	*Notropis atherinoides*	6
9	575.4	LDB	18-Aug-09	Freshwater Drum	*Aplodinotus grunniens*	6
9	575.4	LDB	18-Aug-09	Gizzard Shad	*Dorosoma cepedianum*	96
9	575.4	LDB	18-Aug-09	Golden Redhorse	*Moxostoma erythrurum*	12
9	575.4	LDB	18-Aug-09	Highfin Carpsucker	*Carpiodes velifer*	1
9	575.4	LDB	18-Aug-09	Largemouth Bass	*Micropterus salmoides*	2
9	575.4	LDB	18-Aug-09	Logperch	*Percina caprodes*	5
9	575.4	LDB	18-Aug-09	Longear Sunfish	*Lepomis megalotis*	35
9	575.4	LDB	18-Aug-09	Longnose Gar	*Lepisosteus osseus*	2
9	575.4	LDB	18-Aug-09	Morone Sp	*Morone sp*	1
9	575.4	LDB	18-Aug-09	River Carpsucker	*Carpiodes carpio*	3
9	575.4	LDB	18-Aug-09	River Darter	*Percina shumardi*	1
9	575.4	LDB	18-Aug-09	Sauger	*Sander canadensis*	7
9	575.4	LDB	18-Aug-09	Silver Redhorse	*Moxostoma anisurum*	3
9	575.4	LDB	18-Aug-09	Skipjack Herring	*Alosa chrysochloris*	4
9	575.4	LDB	18-Aug-09	Smallmouth Bass	*Micropterus dolomieu*	2
9	575.4	LDB	18-Aug-09	Smallmouth Buffalo	*Ictiobus bubalus*	7
9	575.4	LDB	18-Aug-09	Smallmouth Redhorse	*Moxostoma breviceps*	7
9	575.4	LDB	18-Aug-09	Spotfin Shiner	*Cyprinella spiloptera*	6
9	575.4	LDB	18-Aug-09	Spotted Bass	*Micropterus punctulatus*	3
9	575.4	LDB	18-Aug-09	Walleye	*Sander vitreus*	5
9	575.4	LDB	18-Aug-09	White Bass	*Morone chrysops*	2
9	575.4	LDB	18-Aug-09	White Perch	*Morone americana*	1
10	584.4	LDB	2-Sep-09	Channel Catfish	*Ictalurus punctatus*	2
10	584.4	LDB	2-Sep-09	Common Carp	*Cyprinus carpio*	1
10	584.4	LDB	2-Sep-09	Emerald Shiner	*Notropis atherinoides*	9
10	584.4	LDB	2-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	4
10	584.4	LDB	2-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	13
10	584.4	LDB	2-Sep-09	Longnose Gar	*Lepisosteus osseus*	3
10	584.4	LDB	2-Sep-09	Morone Sp	*Morone sp*	2
10	584.4	LDB	2-Sep-09	River Carpsucker	*Carpiodes carpio*	2
10	584.4	LDB	2-Sep-09	Sauger	*Sander canadensis*	2
10	584.4	LDB	2-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	4

10	584.4	LDB	2-Sep-09	White Bass	*Morone chrysops*	1
11	585.9	LDB	2-Sep-09	Channel Catfish	*Ictalurus punctatus*	1
11	585.9	LDB	2-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	6
11	585.9	LDB	2-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	47
11	585.9	LDB	2-Sep-09	Longear Sunfish	*Lepomis megalotis*	4
11	585.9	LDB	2-Sep-09	Mooneye	*Hiodon tergisus*	1
11	585.9	LDB	2-Sep-09	Morone Sp	*Morone sp*	4
11	585.9	LDB	2-Sep-09	River Carpsucker	*Carpiodes carpio*	5
11	585.9	LDB	2-Sep-09	Sauger	*Sander canadensis*	13
11	585.9	LDB	2-Sep-09	Silver Chub	*Macrhybopsis storeriana*	6
12	586.4	RDB	2-Sep-09	Bluegill	*Lepomis macrochirus*	3
12	586.4	RDB	2-Sep-09	Channel Catfish	*Ictalurus punctatus*	2
12	586.4	RDB	2-Sep-09	Emerald Shiner	*Notropis atherinoides*	30
12	586.4	RDB	2-Sep-09	Flathead Catfish	*Pylodictis olivaris*	1
12	586.4	RDB	2-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	16
12	586.4	RDB	2-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	66
12	586.4	RDB	2-Sep-09	Longear Sunfish	*Lepomis megalotis*	10
12	586.4	RDB	2-Sep-09	Longnose Gar	*Lepisosteus osseus*	7
12	586.4	RDB	2-Sep-09	Morone Sp	*Morone sp*	3
12	586.4	RDB	2-Sep-09	Sauger	*Sander canadensis*	7
12	586.4	RDB	2-Sep-09	Silver Chub	*Macrhybopsis storeriana*	4
12	586.4	RDB	2-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	3
13	596.5	RDB	1-Sep-09	Bluegill	*Lepomis macrochirus*	6
13	596.5	RDB	1-Sep-09	Channel Catfish	*Ictalurus punctatus*	5
13	596.5	RDB	1-Sep-09	Common Carp	*Cyprinus carpio*	1
13	596.5	RDB	1-Sep-09	Flathead Catfish	*Pylodictis olivaris*	1
13	596.5	RDB	1-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	9
13	596.5	RDB	1-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	46
13	596.5	RDB	1-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	2
13	596.5	RDB	1-Sep-09	Largemouth Bass	*Micropterus salmoides*	3
13	596.5	RDB	1-Sep-09	Longear Sunfish	*Lepomis megalotis*	11
13	596.5	RDB	1-Sep-09	Morone Sp	*Morone sp*	10
13	596.5	RDB	1-Sep-09	River Carpsucker	*Carpiodes carpio*	6
13	596.5	RDB	1-Sep-09	Sauger	*Sander canadensis*	34
13	596.5	RDB	1-Sep-09	Smallmouth Bass	*Micropterus dolomieu*	2
13	596.5	RDB	1-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	2
13	596.5	RDB	1-Sep-09	White Bass	*Morone chrysops*	12
14	597	LDB	1-Sep-09	Bluegill	*Lepomis macrochirus*	12
14	597	LDB	1-Sep-09	Channel Catfish	*Ictalurus punctatus*	6
14	597	LDB	1-Sep-09	Emerald Shiner	*Notropis atherinoides*	1
14	597	LDB	1-Sep-09	Flathead Catfish	*Pylodictis olivaris*	2
14	597	LDB	1-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	16
14	597	LDB	1-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	1
14	597	LDB	1-Sep-09	Largemouth Bass	*Micropterus salmoides*	1
14	597	LDB	1-Sep-09	Logperch	*Percina caprodes*	1
14	597	LDB	1-Sep-09	Longear Sunfish	*Lepomis megalotis*	10
14	597	LDB	1-Sep-09	Longnose Gar	*Lepisosteus osseus*	5
14	597	LDB	1-Sep-09	Morone Sp	*Morone sp*	3
14	597	LDB	1-Sep-09	Sauger	*Sander canadensis*	12
14	597	LDB	1-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	10

14	597	LDB	1-Sep-09	Spotted Bass	*Micropterus punctulatus*	7
14	597	LDB	1-Sep-09	White Bass	*Morone chrysops*	2
15	600.3	RDB	1-Sep-09	Black Crappie	*Pomoxis nigromaculatus*	1
15	600.3	RDB	1-Sep-09	Bluegill	*Lepomis macrochirus*	26
15	600.3	RDB	1-Sep-09	Channel Catfish	*Ictalurus punctatus*	8
15	600.3	RDB	1-Sep-09	Common Carp	*Cyprinus carpio*	1
15	600.3	RDB	1-Sep-09	Emerald Shiner	*Notropis atherinoides*	8
15	600.3	RDB	1-Sep-09	Freshwater Drum	*Aplodinotus grunniens*	8
15	600.3	RDB	1-Sep-09	Gizzard Shad	*Dorosoma cepedianum*	92
15	600.3	RDB	1-Sep-09	Golden Redhorse	*Moxostoma erythrurum*	1
15	600.3	RDB	1-Sep-09	Largemouth Bass	*Micropterus salmoides*	1
15	600.3	RDB	1-Sep-09	Longear Sunfish	*Lepomis megalotis*	4
15	600.3	RDB	1-Sep-09	Longnose Gar	*Lepisosteus osseus*	1
15	600.3	RDB	1-Sep-09	Mooneye	*Hiodon tergisus*	4
15	600.3	RDB	1-Sep-09	Morone Sp	*Morone sp*	10
15	600.3	RDB	1-Sep-09	Redear Sunfish	*Lepomis microlophus*	1
15	600.3	RDB	1-Sep-09	River Carpsucker	*Carpiodes carpio*	6
15	600.3	RDB	1-Sep-09	River Shiner	*Notropis blennius*	1
15	600.3	RDB	1-Sep-09	Sauger	*Sander canadensis*	28
15	600.3	RDB	1-Sep-09	Silver Chub	*Macrhybopsis storeriana*	10
15	600.3	RDB	1-Sep-09	Skipjack Herring	*Alosa chrysochloris*	1
15	600.3	RDB	1-Sep-09	Smallmouth Buffalo	*Ictiobus bubalus*	6
15	600.3	RDB	1-Sep-09	Spotted Bass	*Micropterus punctulatus*	1
15	600.3	RDB	1-Sep-09	Warmouth	*Lepomis gulosus*	1

Appendix C. Habitat survey data from the McAlpine pool.

Site #	River Mile	Bank	% Boulder	% Cobble	% Gravel	% Sand	% Fine	% Hardpan	% Other	Depth	% Submerged Vegetation	% Woody Cover	% Overhanging Vegetation	Landuse	Human Influence	Bank Profile
1	534.1	LDB	0.0	0.0	22.1	76.7	0.0	0.0	1.2	4.4	0.0	0.9	0.0	NF, R, I	barges, mooring cells, ramps	Slope
2	540.5	LDB	1.4	1.4	11.4	85.7	0.0	0.0	0.0	2.7	0.0	3.4	0.0	NF, A, R	barges, mooring cells	Slope
3	544.5	LDB	0.0	0.0	40.7	58.3	0.0	0.9	0.0	4.2	0.0	0.8	0.0	R, NF, A	boats/docks	Slope
4	547.1	RDB	0.0	0.0	22.7	75.0	1.1	0.0	1.1	5.4	0.0	0.2	1.0	NF, A, R	none	Slope
5	549.5	LDB	0.0	0.0	4.9	8.6	4.9	80.2	1.2	3.7	0.0	5.8	0.0	NF, A, R	none	Steep
6	550.2	LDB	0.0	2.6	6.1	45.2	37.4	2.6	6.1	4.3	0.0	2.0	0.0	NF, A, R	none	Slope
7	556.1	RDB	0.0	7.8	28.1	21.9	29.7	0.0	12.5	11.0	0.0	0.7	0.0	NF, U, P	boats/docks, ramps, barges	Steep
8	571.9	RDB	9.4	25.0	27.1	24.0	14.6	0.0	0.0	8.5	0.0	0.5	0.0	NF, I, A	barges, mooring cells, boats/docks	Slope
9	575.4	LDB	2.2	20.4	43.8	30.7	2.2	0.0	0.7	8.5	0.0	0.8	0.0	NF, R, I	barges, mooring cells, boats/docks	Slope
10	584.4	LDB	11.8	21.1	23.7	11.8	30.3	0.0	1.3	11.4	0.0	3.3	2.8	NF, R, A	boats/docks	Steep
11	585.9	LDB	0.0	0.8	6.2	50.0	42.3	0.0	0.8	2.9	0.0	3.6	0.0	NF, R, A	boats/docks, mooring cells, barges	Cliff
12	586.4	RDB	4.3	17.4	29.6	29.6	19.1	0.0	0.0	6.4	0.0	3.0	3.4	NF, A, R	boats/docks, mooring cells, barges	Slope
13	596.5	RDB	0.9	1.7	6.1	43.5	41.7	6.1	0.0	3.4	0.0	18.2	3.8	R, NF, I	boats/docks, barges, mooring cells	Cliff
14	597	LDB	1.1	3.2	8.5	27.7	59.6	0.0	0.0	7.3	0.0	18.0	2.8	R, NF, I	boats/docks, mooring cells, barges	Slope
15	600.3	RDB	0.0	1.1	3.3	32.6	58.7	0.0	4.3	7.5	0.0	2.7	3.3	R, U, NF	boats/docks, barges, ramps	Gradual

A = Agriculture, I = Industry, NF = Natural Forest, P = Pasture, R = Residential, U = Urban (Listed in order of prevalence.)

Appendix D. Water quality parameters measured prior to fish sampling in McAlpine pool.

Site #	Rmi	Bank	pH	Temp(C)	Dissolved Oxygen(mg/L)	Conductivity	Secchi(in)
1	534.1	LDB	7.58	25.57	6.74	482	30
2	540.5	LDB	7.59	25.02	6.74	518	30
3	544.5	LDB	7.77	24.33	6.33	514	36
4	547.1	RDB	7.72	24.61	6.01	482	36
5	549.5	LDB	7.28	23.56	7	455	28
6	550.2	LDB	7.54	23.45	6.87	458	20
7	556.1	RDB	6.8	23.09	7	452	18
8	571.9	RDB	7.2	23.85	7.19	478	24
9	575.4	LDB	7.77	27.2	7.37	359	24
10	584.4	LDB	5.02	26.1	7.57	383	42
11	585.9	LDB	5.92	26	7.45	381	42
12	586.4	RDB	4.98	26.4	8	383	36
13	596.5	RDB	6.8	26.5	7.91	265	36
14	597	LDB	7.03	26.4	7.55	361	24
15	600.3	RDB	7.2	26.7	7.9	366	30

Appendix E. Water quality parameters analyzed from McAlpine in 2009.

Site #	River Mile	Round	Ammonia	Chloride	Hardness	Nitrate-Nitrite	Phenolics	Sulfate	TKN	TOC	Phosphorus	TSS
1	534.1	1	Result	28	145	0.991	72	0.16	1.7	0.071	9	1
		2	0.05	26	114	0.696	56	0.78	3.7	0.212	95	
		3	<0.03	30	143	0.908	68	<0.50	3.3	0.103	21	
2	540.5	1	0.05	29	153	2.65	80	0.37	1.3	0.074	7.6	2
		2	0.05	25	117	0.762	57	0.67	3.9	0.244	100	
		3	<0.03	32	153	2.36	70	<0.50	3.3	0.119	18	
3	544.5	1	0.04	32	151	1.46	79	0.35	0.93	0.063	7.6	3
		2	0.05	26	126	0.769	58	0.88	5.3	0.214	120	
		3	<0.03	34	151	1.25	69	<0.50	3.3	0.110	17	
4	547.1	1	0.04	26	144	0.966	72	0.33	1.6	0.061	6.8	4
		2	0.05	26	116	0.705	58	0.94	3.3	0.324	120	
		3	<0.03	28	149	0.864	71	<0.50	3.6	0.109	14	
5	549.5	1	0.04	26	147	1.06	72	0.27	1.4	0.057	5.8	5
		2	0.05	25	124	0.660	57	1.1	3.5	0.450	210	
		3	<0.03	30	165	1.34	73	<0.50	3.3	0.135	15	
6	550.2	1	0.04	24	146	1.06	72	0.27	1.2	0.071	4.6	6
		2	0.05	18	138	0.660	51	1.4	4.1	0.494	220	
		3	<0.03	30	160	1.51	71	<0.50	3.6	0.114	16	
7	556.1	1	0.04	25	144	0.950	72	0.26	1.6	0.059	4	7
		2	0.04	18	130	0.724	52	1.3	4.2	0.332	220	
		3	<0.03	28	150	0.918	67	<0.50	3.6	0.102	11	
8	571.9	1	0.03	24	138	0.919	69	0.25	1.7	0.065	5	8
		2	0.04	25	126	0.772	58	0.81	3.3	0.299	230	
		3	<0.03	26	150	1.01	69	<0.50	4.6	0.132	11	
9	575.4	1	0.03	23	136	0.902	68	0.35	1.2	0.069	5.2	9
		2	0.03	24	127	0.770	59	0.98	3.3	0.480	190	
		3	<0.03	27	152	1.03	69	<0.50	9.6	0.144	12	
10	584.4	1	0.03	23	134	0.865	70	0.32	0.86	0.065	7.6	10
		2	0.03	18	137	0.750	54	1.2	3.4	0.335	220	
		3	<0.03	26	157	1.05	69	<0.50	4.2	0.141	9	
11	585.9	1	0.03	23	137	0.877	71	0.2	1.6	0.057	6.4	11
		2	0.03	20	133	0.712	52	1	3.9	0.316	170	
		3	0.03	25	160	0.960	68	<0.50	4.7	0.132	9.4	
12	586.4	1	0.03	23	134	0.835	69	0.38	1.7	0.073	6	12
		2	0.04	20	133	0.765	52	1.3	5.5	0.295	160	
		3	<0.03	26	157	0.955	67	<0.50	4.6	0.135	13	
13	596.5	1	0.04	25	143	0.887	76	0.19	1.6	0.066	13	13
		2	0.04	25	122	0.809	56	0.91	4.6	0.226	140	
		3	<0.03	26	154	0.950	65	0.17	5.2	0.165	11	
14	597	1	<0.03	25	141	0.892	75	0.18	1.6	0.055	6	14
		2	0.04	25	132	0.771	57	0.96	4.4	0.426	110	
		3	<0.03	25	154	1.10	65	<0.50	4.1	0.200	11	
15	600.3	1	<0.03	25	140	0.906	76	0.57	1.4	0.066	6.2	15
		2	0.04	20	134	0.811	52	1	4.2	0.202	210	
		3	<0.03	25	149	1.06	63	<0.50	5.2	0.146	11	