

**Waukegan River
Section 319
National Monitoring Program Project**

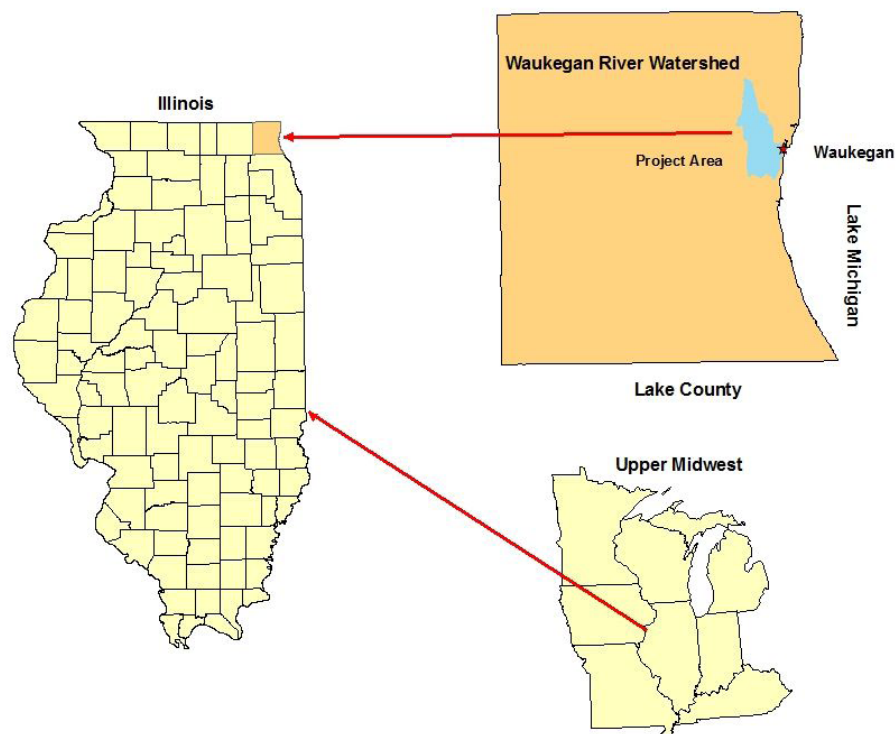


Figure 13: Location of the Waukegan River Project in the Waukegan River Watershed of Lake County, Illinois

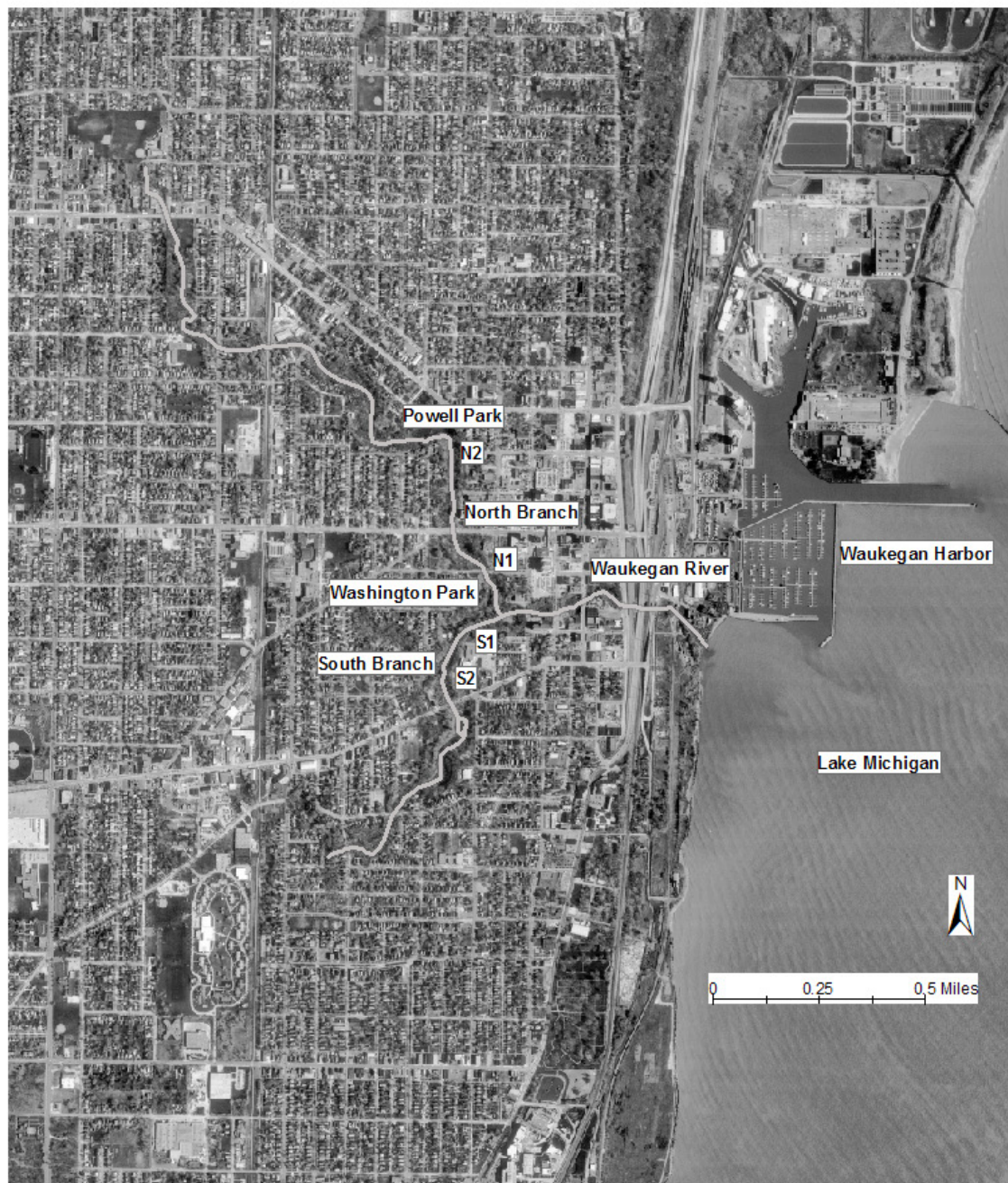


Figure 14: Monitoring Locations in the Waukegan River Watershed

PROJECT OVERVIEW

The Waukegan River watershed is located about 35 miles north of Chicago (Figure 1). The project locations for the Waukegan River Section 319 National Monitoring Program project are located in Washington and Powell Parks in the City of Waukegan, Illinois (Figure 2). The watershed is 12.5 miles long and contains 7,397 acres, with major land uses consisting of single and multi-family dwellings (35.0 %), transportation (24.4 %), public and private open space (11.8 %) (Table 1). Washington Park is situated in an area that represents the most urbanized reach of the river and is located at the confluence of the North Branch and the South Branch about 1/2 mile upstream from the river mouth on Lake Michigan. Powell Park is located on the North Branch 1 mile from the river mouth and within a residential area. Most of the watershed was urbanized prior to any requirements for stormwater detention. Therefore, there is little control over stormwater quantity or quality, resulting in flashy runoff rates and heavy stormwater pollutant loads. Water quality concerns also include cross-connections between sanitary and storm sewers, potential sanitary sewer overflows during wet weather, severe streambank erosion, channel downcutting, and artificial lining.

Erosion control methods used to repair the eroding stream channels included vegetative stabilization (dogwoods, willows, and grasses) combined with structural stabilization (Lunkers, fiber rolls, A-jacks, and stone). A series of pool-and-riffle complexes were created by constructing six rock grade control structures (Newbury Weirs) from granite boulders in a reach covering 1000 feet of the South Branch starting at the confluence and two structures in a reach covering 300 feet of the North Branch in Washington Park.

The Waukegan River Section 319 National Monitoring Program project is being used to demonstrate the effectiveness of stream restoration techniques implemented on the Waukegan River. The stream habitat and urban fisheries were surveyed before implementation of the stream restoration techniques. The in-stream habitat and stream fisheries were also surveyed to provide post-implementation data. The monitoring strategy included macroinvertebrate sampling, physical habitat monitoring, and fisheries monitoring during the spring, summer, and fall cycles of the project period.

This project has demonstrated that biotechnical streambank stabilization techniques are more cost-effective than traditional armoring approaches in reducing erosion and also provide additional water quality and in-stream habitat benefits. It has been shown that rock grade control structures (Newbury Weirs) that mimic natural pool and riffles add to the in-stream physical diversity which in turn leads to increased biodiversity. In addition to enhancing habitat, pool and riffle structures are effective in reducing erosion of the streambed, improving stream stability and increasing water aeration. Currently, the project is in the post-BMP monitoring phase, with monitoring completed in October 2006. Data analysis and Final Report preparation activities have begun. The Final Report is expected to be completed on or before June 2009.

PROJECT BACKGROUND

Project Area

The project area consists of four stations located within two city parks of Waukegan, IL (Figure 2). Stations located in Washington Park are S1 and S2 on the South Branch of the Waukegan River and station N1 on the North Branch. Station N2 is located in Powell Park on the North Branch. The parks are situated within an older, highly urbanized area of the city.

Relevant Hydrologic, Geologic, and Meteorological Factors

The Waukegan River falls from 730 msl to 580 msl, with the steepest lands located in Washington

and Powell Parks. Information from the Midwestern Regional Climate Center indicates that the Waukegan River watershed has a mean annual of 32.82 inches of precipitation.

Land Use

The 7,397 acre watershed of the Waukegan River is largely urbanized, with over 80% of the City of Waukegan lying within the watershed boundaries. As of the 2000 census there were 87,901 people living in Waukegan with a population density of 1,475.0/km² (3,819.8/mi²). Because this is an older town, there are very few stormwater detention basins.

Table 1: Land Use of the Waukegan River Watershed

Land Use	Acres %	
Agricultural	6.9	0.1
Disturbed Land	139.1	1.9
Forest and Grassland	495.9	6.7
Government and Institutional	449.0	6.0
Industrial	204.3	2.8
Multi-Family	169.8	2.3
Office	1.2	0.0
Public and Private Open Space	872.8	11.8
Retail/Commercial	482.1	6.5
Single Family	2416.8	32.7
Transportation	1801.9	24.4
Utility and Waste Facilities	161.6	2.2
Water	28.3	0.4
Wetlands	167.1	2.2
TOTAL	7396.8	100

Source: Lake County Planning, Building and Development, 2000, (Waukegan River Watershed Plan, 2007).

Water Resource Type and Size

The Waukegan River Section 319 National Monitoring Program project is located in the northeastern corner of Illinois (Figure 1). The length of the Waukegan River/Ravine main channel and tributaries, which drain predominantly urban areas in Waukegan, IL, is approximately 12.5 miles. Discharge of the Waukegan River is into Lake Michigan, just east of the downtown area and only 6,000 feet from the City's fresh water intake.

Water Uses and Impairments

As an urban stream, stormwater has caused severe channel erosion. The primary pollutant of concern is sediment. Severe bank erosion, due to unstable stream channels and high velocity runoff, is increasing nonpoint source pollution loads into Lake Michigan, breaking smaller sewer lines that were buried in the stream and endangering other sewer lines. In addition to the physical destruction, aquatic habitat has been impaired due to the lack of water depth in pools, limited cobble substrates, and limited stream aeration.

Pollutant Sources

High volume of runoff from impervious surfaces is degrading the urban streams within the Waukegan watershed. The steepest lands, and therefore the most eroded, are located in Washington and Powell Parks along the Lake Michigan bluffs.

Pre-Project Water Quality

Aquatic resources were limited by shallow pool depth and high summer water temperatures. Fine silts filled both pools and runs to the extent that little rock substrates were visible.

Water Quality Objectives

The purpose of the project is to restore the stream banks for the Waukegan River in Washington Park and Powell Park, which have become a source of urban nonpoint source pollution and a danger to the public. The detrimental effects of stormwater runoff will be reduced or mitigated.

Project Time Frame

The project was initially funded in 1994 as a 319 Watershed Project. Monitoring began in 1994 and was officially approved in 1996 as a Section 319 National Monitoring Program project. Monitoring activities concluded in October of 2006. This allowed for ten years of post-BMP implementation.

PROJECT DESIGN

Nonpoint Source Control Strategy

Biotechnical stream restoration techniques (a combined vegetative and structural approach) were selected to demonstrate how these techniques can be more cost-effective than traditional engineered approaches in reducing erosion, enhancing habitat and stabilizing the stream.

Projects on the North Branch of the Waukegan River

Lunkers and a-jacks were installed in Powell Park. Lunkers with stone were installed in Washington In May of 1992 Lunkers and A-jacks were installed at station N2 in Powell Park. In September of 1992 Lunkers with stone and A-jacks were installed at station N1 in Washington Park. Willows, dogwoods, and grasses were planted on the stream banks where lunkers were installed. In January of 1996 two Newbury Weirs were constructed at station N1. Two sampling stations, N1 and N2 (Figure 2), are utilized for background data collection, but were not part of the Section 319 National Monitoring Program project.

Projects on the South Branch of the Waukegan River

In September of 1994, lunkers, a-jacks, stone, dogwoods, willows, and grasses were used to stabilize a severe bank erosion site at station S1 on the South Branch of the Waukegan River. Smaller bank erosion sites were stabilized with coir coconut fiber rolls, willows, and grasses. Because the original bank stabilization efforts did not significantly increase stream depth, in January of 1996, a series of six pool-and-riffle complexes were created by the construction of rock grade control structures (Newbury Weirs) from granite boulders in a 1000 foot reach of the South Branch beginning at the confluence. Station S2 did not have any projects installed and was utilized as control. Both station S1 and S2 were primary sampling stations.

Water Quality Monitoring

Variables Measured

Biological parameters are measured during the spring, summer, and fall cycles of the project period. Flow is measured continuously.

Biological

Fish samples
Macroinvertebrates
Habitat

Chemical and Other

None

Covariates

Dissolved oxygen (DO)
Temperature
Flow

Sampling Scheme

The stream was divided into an upstream untreated reference site designated as station S2 and a severely eroding downstream treated area designated as station S1. With this design, urban water quality will affect both the control (S2) and the rehabilitated station (S1) uniformly. At each location fish, macroinvertebrates, and habitat were sampled during the spring, summer, and fall seasons. Sampling was also conducted at stations N1 and N2 on the North Branch as additional reference (Figure 2).

The scoring used for each category to measure stream health were the Index of Biotic Integrity (IBI) for fish, the Macroinvertebrate Biotic Index (MBI) for aquatic insects, and Potential Index of Biotic Integrity (PIBI) for habitat. Major criteria used to determine stream health include percentage of fish species and number of individuals for the IBI; the number of individuals in each taxon and a tolerance value for each taxon for MBI; and, percentage of substrate types, percent of pool, and the average width for the PIBI.

DATA MANAGEMENT AND ANALYSIS

Data Management and Storage

Water quality data are stored and maintained in the USEPA NonPoint Source Management System (NPSMS) databases.

Findings to Date

The biological sampling since 1994 indicates that the number of fish species and abundance in the South Branch had improved after the construction of lunkers and rock grade control structures (Newbury Weirs). The IBI rose sharply from a limited aquatic resource into the moderate category after construction (Figure 3). Both N1 and S1 where lunkers and Newbury Weirs were applied averaged higher IBI scores and fish population with more fish species than the untreated control at S2 or the N2 bank armored site from 1996 through 2006.

Documented fish kills occurred in 1998 and 1999 impacting the South Branch. The fish kills were observed at very low flow conditions with no turbidity present in the water column. Fish kills were not observed during sampling event activities after 1999. After the 1996 peak IBI scores continued to decline. Tolerant fish species dominated the fish population at all four stations which helped drive down the IBI scores. The Mottled Sculpin was the only intolerant species caught during the entire period making up less than one percent of the total catch. Coho Salmon had the highest overall percent of intermediate species. The occurrence of this non-native species was influenced by annual spring stocking of Lake Michigan. Eighty percent of the Coho Salmon were caught during the spring sampling period. Table 2 shows the percent of the total catch of fish species for each station over the thirteen year period.

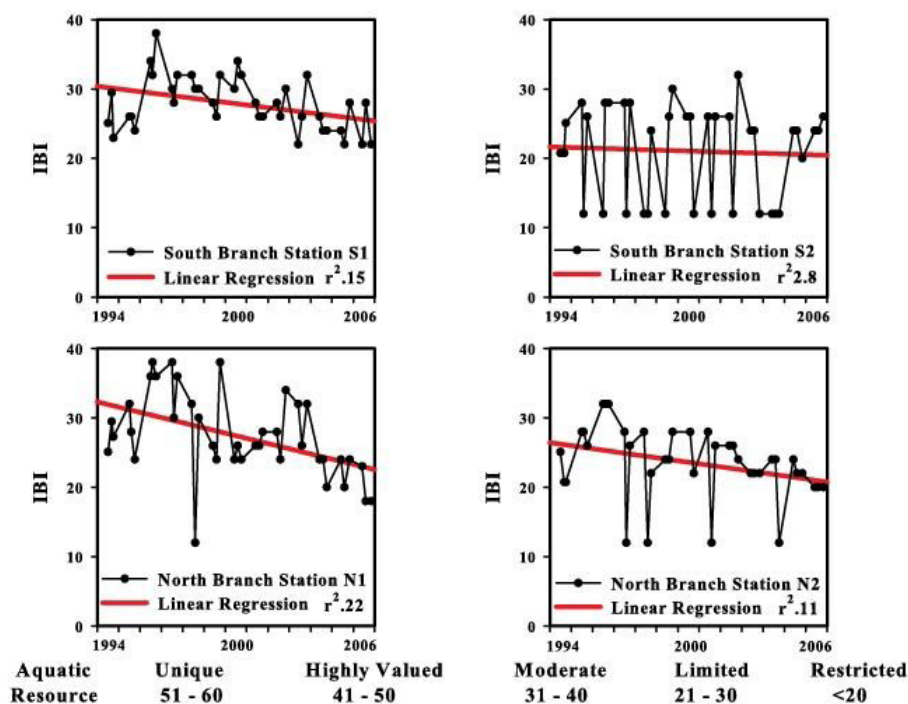


Figure 3: IBI Scores from Monitoring stations in the Waukegan River Watershed

Table 2: Percent of the Total Fish Caught during the Project Period in the Waukegan River Watershed

Fish Species	Tolerance	Native Status	Station S1 %	Station S2 %	Station N1 %	Station N2 %
Common Name						
Green Sunfish	Tolerant	Native	38.0	13.4	15.2	48.8
Mosquitofish	Tolerant	Native	8.4	37.6	1.6	0.5
Threespine Stickleback	Intermediate	Non-Native	12.2	31.1	43.5	1.2
Fathead Minnow	Tolerant	Native	12.8	8.7	7.5	9.2
White Sucker	Tolerant	Native	8.5	2.2	6.4	23.7
Goldfish	Tolerant	Non-Native	0.9	0.0	0.9	3.7
Bluegill	Tolerant	Native	1.5	0.2	4.6	2.9
Coho Salmon	Intermediate	Non-Native	0.9	4.3	1.5	2.5
Longnose Dace	Intermediate	Native	4.0	0.2	1.6	0.0
Largemouth Bass	Tolerant	Native	3.5	0.7	1.6	0.0
Golden Shiner	Tolerant	Native	2.4	0.7	1.6	0.0
Carp	Tolerant	Non-Native	1.8	0.0	1.1	1.9
Number of remaining species <1% & percent			(12) 5.1%	(3) 0.9%	(13) 12.9%	(8) 5.6%

Macroinvertebrate Biotic Index scores progressed into a poor stream condition following a similar pattern to the IBI scores (Figure 4). Some individual scores at station S1 and S2 on the South Branch jumped into the very poor stream condition category. Station S2 had MBI scores that dropped into a fair stream condition after restoration in 1996 and persisted up to 2001 where they began to move back into a poor stream condition. The station N1 restoration site also had MBI scores in the fair stream condition category during and after stream restoration from 1995 through 2001 where the scores began to creep into a poor stream condition. Station N2 maintained better quality scores throughout the project period with the exception of 2004 and 2006 having poor stream conditions.

Pollutant associated species Chironomidae (Bloodworms or Midge fly larvae), OLIGOCHAETA (Aquatic Earthworms), and Caecidotea (Pillbugs or Sowbugs) dominated the overall population of collected species (Table 3). The average taxa richness for the thirteen year period at station N2, N1, and S2 were 8 (poor) while station S1 averaged a 10 (fair). An overall average of the EPT (Ephemeroptera + Plecoptera + Trichoptera) taxa richness for stations N1 and N2 were in a fair category with a score of 3 where 23% of the 39 sampled dates at station N1 fell into the fair, good or excellent category's and 13% of the sampled dates at station N2 were in the fair, good or excellent categories while the remaining percents fell into the poor or very poor category. At Stations S1 and S2 the overall average EPT taxa richness score was under a 1 (very poor) where 8% of the sampled dates at both stations fell into the fair, good or excellent categories.

Examining the functional feeding designations of the species collected revealed that gatherer/collectors averaged 87% of the population of all stations while 6% were predators and 4% were scrapers with the remaining percent made up of filter/collectors, omnivores, and shredders. Generalists, such as collectors and filters, have a broader range of acceptable food materials than specialists (scrapers, piercers, and shredders) (Cummins and Klug 1979), and thus are more tolerant to pollution that might alter availability of certain food.

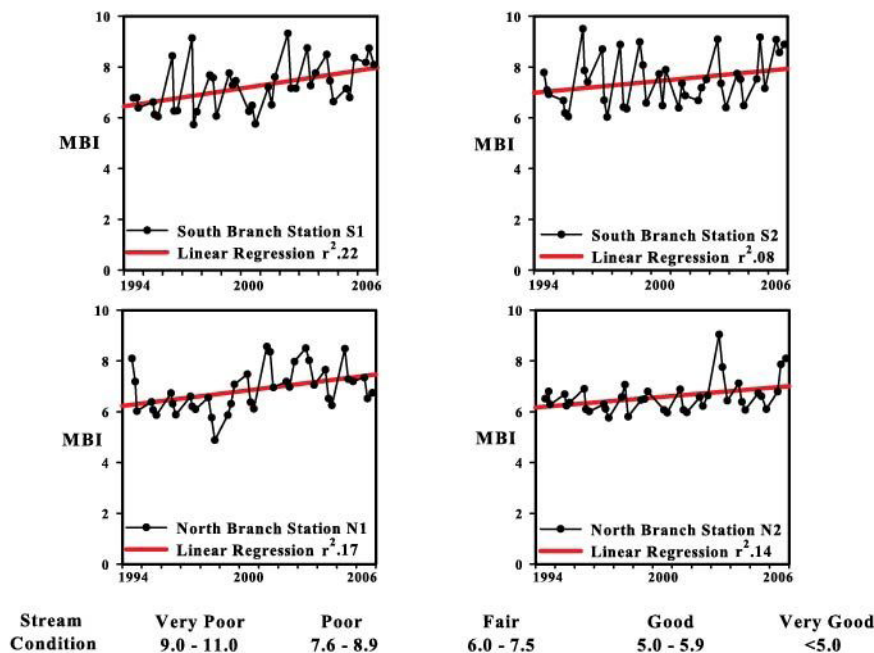


Figure 4: MBI Scores from Monitoring stations in the Waukegan River Watershed

Table 3: Percent of the Total Benthic Sampled during the Project Period in the Waukegan River Watershed

Taxon	Functional Feeding	Tolerance	S1 %	S2 %	N1 %	N2 %
Chironomidae	Gatherer/Collector	6	39.29	37.12	24.42	24.17
OLIGOCHAETA	Gatherer/Collector	10	30.02	27.83	16.35	9.00
Caecidotea intermedius	Gatherer/Collector	6	4.57	1.67	35.83	25.42
Caecidotea	Gatherer/Collector	6	9.30	15.82	12.16	29.17
Physella	Scraper	9	4.42	6.46	1.76	3.23
Erpobdellidae	Predator	8	3.48	2.55	2.76	2.13
Gammarus	Omnivore	3	0.89	0.41	3.19	1.91
Glossiphoniidae	Predator	8	0.76	1.01	0.83	1.85
Ischnura	Predator	6	2.08	1.34	0.05	0.01
Crangonyx	Gatherer/Collector	4	0.03	0.68	0.39	0.94
TURBELLARIA	Predator	6	0.41	1.29	0.03	0.49
Hydropsyche	Filter/Collector	5	0.19	0.22	0.74	0.70
Number of remaining taxa & percent		--	(55) 4.56	(45) 3.60	(25) 1.49	(30) 0.98

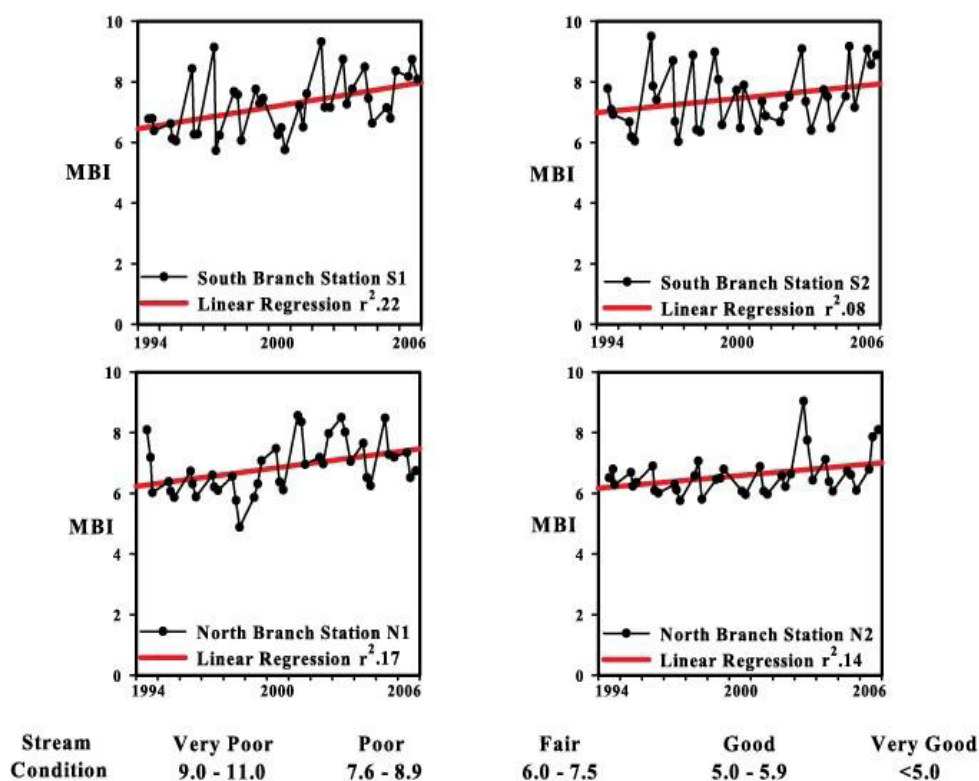


Figure 5: PIBI Scores from Monitoring stations in the Waukegan River Watershed

At treated stations S1 and N1 the PIBI scores continued to climb into the highly valued category driven by the increase in the percent of pool and a decrease in the percent of silt-mud (Figure 5). The untreated station S2 also shows a slight improvement that is driven by natural changes in the percent of pool. The station N2 bank armored project scores stay fairly consistent where an increase in the percent of claypan substrate due to scour is driving the scores down. At all stations the PIBI scores remain in the moderate to highly valued aquatic resource category.

INFORMATION, EDUCATION, AND PUBLICITY

Station S1 on the South Branch of the Waukegan River in Washington Park served as a training site for a streambank restoration class held during the Second National Nonpoint Source Watershed Monitoring Workshop. Senior personnel from the city's Public Works Department and the Waukegan Park District were taken through the restoration and stabilization process before and during construction. Workshop members participated in both the restoration installation and the fish monitoring activities.

A field manual of urban stream restoration and video of the biotechnical streambank restoration activities have been developed to highlight the biotechnical techniques that were used in the restoration.

An updated videotape production was developed describing the biotechnical stream stabilization techniques, the monitoring program, and the physical and biological enhancements achieved.

The Illinois State Water Survey will produce two educational/informational productions at the end of the Waukegan River National Monitoring Strategy. These two productions include a completed final videotape production and a final project report which is currently being developed to document the entire aspects of the Waukegan River National Monitoring Strategy. The final videotape was produced and the final project report is being created and should be completed on or before June 2009.

TOTAL PROJECT BUDGET

The estimated budget for the Waukegan River Section 319 National Monitoring Program project for the period of FY 92-06 is shown in table 4.

Table 4: Estimated budget for the Waukegan River Section 319 National Monitoring Program

<u>Project Element</u>	<u>Funding Source (\$)</u>			
	<u>Federal</u>	<u>State</u>	<u>Local</u>	<u>Sum</u>
Proj Mgt	59,895	24,597	NA	84,492
I&E	2,023	677	NA	2,700
LT [319(h)]	227,218	NA	275,320	502,538
WQ Monit	163,047	96,842	NA	259,889
TOTALS	452,183	122,116	275,320	849,619

Source: Illinois Environmental Protection Agency (Personal Communication, 2000), Illinois Environmental Protection Agency (Personal Communication, 2001), Illinois Environmental Protection Agency (Personal Communication, 2003), Illinois Environmental Protection Agency (Personal Communication, 2004), Illinois Environmental Protection Agency (Personal Communication, 2005), Illinois Environmental Protection Agency (Personal Communication, 2006)

IMPACT OF OTHER FEDERAL AND STATE PROGRAMS

Further restoration activities on the South Branch of the Waukegan River included two projects in the Waukegan Park District's Washington and Roosevelt Parks. The Waukegan River Wetland Restoration Project that was started in 1998 to improved a degraded ½ acre wetland adjacent to the Waukegan River in Washington Park. The intent of this project was to reestablish the natural function of the wetland and to reduce nonpoint source pollution impacts. The project also included the stabilization of 300 feet of eroding streambank on the Waukegan River using bioengineering techniques in Washington Park. An interpretive observation station was constructed that overlooked the wetland site to inform the public about the project, the Waukegan River National Monitoring Project, Waukegan River Watershed and nonpoint source pollution.

The Roosevelt Park and Waukegan River Restoration Project begun in 2002 to address erosion and poor water quality conditions present in the Waukegan Park District's Roosevelt Park. The goals of this project will be addressed in two phases. The first phase will include the design and installation of an interpretive signage and pathway, stream restoration and wetland retrofit of the existing Roosevelt Park sediment basin on the South Branch of the Waukegan River. The proposed second phase will include the "daylighting" of Illinois Route 120 (Belvidere Street) stormwater culvert to connect Washington and Roosevelt Parks and stream corridor restoration on the South Branch of the Waukegan River in Washington Park. While the stream corridor restoration portion of the second phase was accomplished, the "daylighting" efforts for Illinois Route 120 did not proceed forward due to the lack of local/state funding availability. These stream and wetland restoration efforts will help improve water quality, create wildlife habitat and provide for environmental educational opportunities.

Waukegan River Watershed planning initiative begun in 2005 with a local advisory group to facilitate the work with local stakeholders to develop a comprehensive watershed plan. This plan included the selection of a watershed coordinator, formation of stakeholder and technical planning committees, stakeholder workshops, watershed data evaluation and resource inventory, and proposed Action Plan to improve water quality and to identify and reduce pollutants while protecting, restoring and enhancing the natural habitat and aesthetics.

This planning effort brought together the general public, governmental entities, local businesses, educational institutions and homeowners in the Waukegan River Watershed to improve the quality of life for their community. The results of the present planning efforts were the creation of the Waukegan River Watershed Plan in December of 2007 through the input of all the involved stakeholders.

OTHER PERTINENT INFORMATION

Participating agencies and organizations:

- U.S. Environmental Protection Agency
- Illinois Environmental Protection Agency
- Illinois Department of Natural Resources
- Illinois State Water Survey
- Private Contractor
- University of Illinois at Champaign—Urbana
- Waukegan Park District
- Waukegan Public Works Department

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