DELISTING TARGETS FOR THE WAUKEGAN HARBOR AREA OF CONCERN: FINAL REPORT

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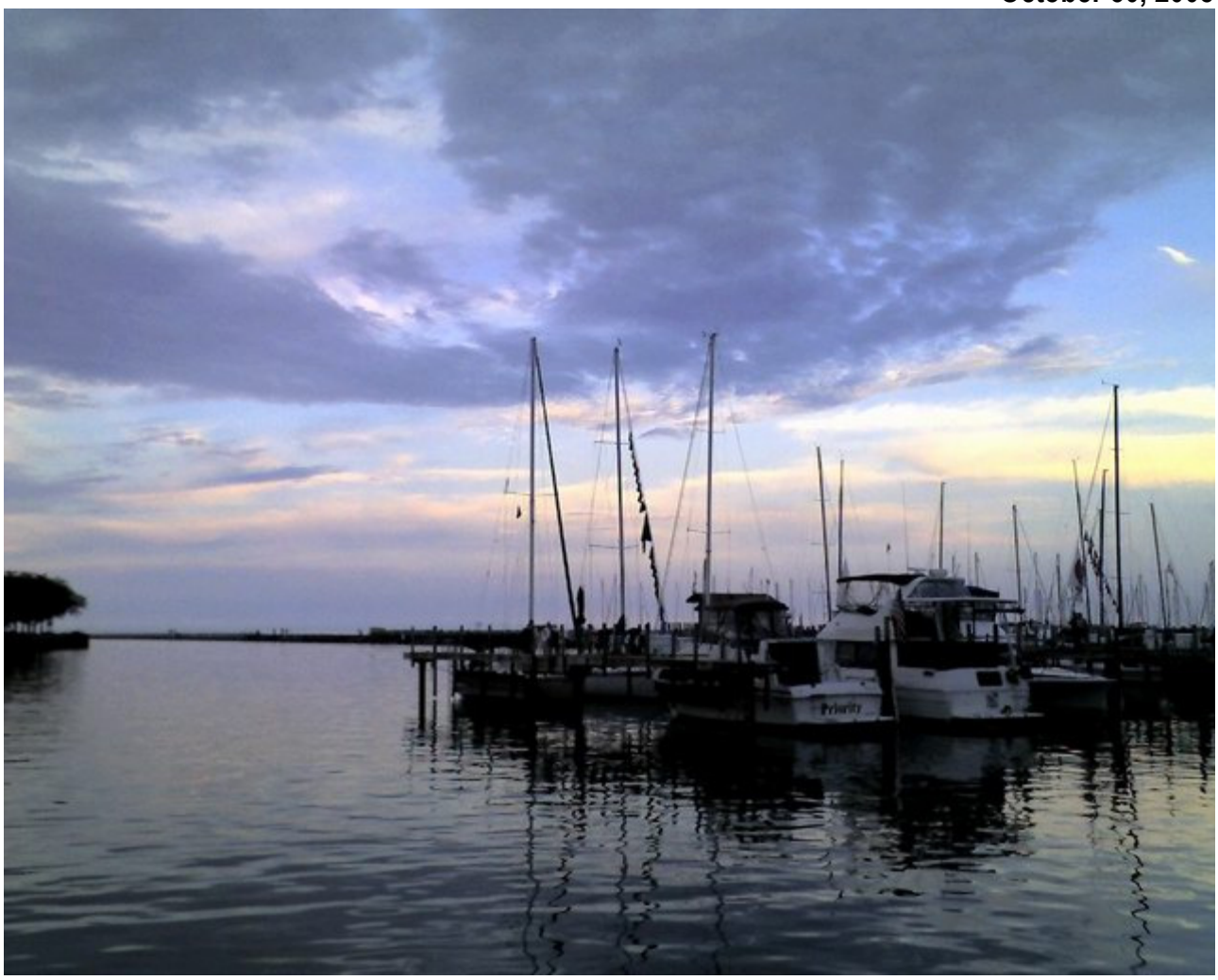

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1.0 INTRODUCTION AND BACKGROUND

In 1978 the Great Lakes Water Quality Agreement was adopted to address water quality concerns relating to the chemical, physical, and biological integrity of the waters of the Great Lakes. Within the Great Lakes Water Quality Agreement there was a provision for the protection of full and unimpaired uses of the Great Lakes. Use impairments were identified as impacts on any of the fourteen beneficial uses (BUs). The original listing of Areas of Concern (AOCs) within the Great Lakes was based on the presence of beneficial use impairments (BUIs). BUIs were defined by the International Joint Commission (IJC) along with generalized criteria for determining when a BU was impaired (Statewide Public Advisory C for Michigan Areas of Concern Program 2004). The first set of guidance for delisting targets was put forth in 1991 by the International Joint Commission (IJC). These criteria were fairly general, and led to a more specific set of guidance published by the U.S. Environmental Protection Agency (USEPA) in 2001.

According to the Great Lakes Water Quality Agreement and the Great Lakes Critical Program Act, Remedial Action Plans (RAPs) are required for every AOC. In the determination of the boundaries/extent of the Waukegan Harbor impact area, the Illinois Environmental Protection Agency (Illinois EPA) in partnership with the Waukegan Harbor Citizens Advisory Group (CAG) and the public, enlarged the study area beyond the AOC boundaries to include potential sources of contamination affecting the Waukegan Harbor nearshore waters of Lake Michigan. This area became known as the Waukegan Expanded Study Area (ESA) and includes remediation planning for sources of pollution other than PCBs. The boundaries of the ESA were drawn to incorporate additional sites, including but not restricted to; Johns Manville Corporation, Greiss-Pfleger Tannery, Diamond Scrap Yard, U.S. Steel, Waukegan Tar Pits, Waukegan Paint and Lacquer, North Shore Gas Manufactured Gas Plant sites, Duphar Nutrition and Waukegan Paint and Lacquer. Also tracked or coordinated by the CAG are the Yeoman Creek Landfill Superfund site and the Waukegan River Watershed planning and restoration actions.

The RAP process is broken down into three phases. In the first stage the impaired uses of the ESA were determined. This portion was completed in December of 1994 for the Waukegan Harbor AOC and resulted in the listing of six BUIs including: Restrictions on Fish and Wildlife Consumption, Degradation of Benthos, Restrictions on Dredging Activities, Beach Closings, Degradation of Phytoplankton and Zooplankton Populations, and Loss of Fish and Wildlife Habitats. Stage two of the RAP process was also finished in December of 1994 and specified the remedial and regulatory measures needed to delist. This document was reviewed and accepted by the IJC in September of 1995. The final stage was completed in 1999 and details progress towards delisting.

The primary goal of developing delisting targets is to create a plan for the delisting/restoration of the AOC. The delisting targets develop an endpoint for measuring progress in the remediation of the harbor and restoration of the BUs that were considered to be impaired within the AOC. In addition to elimination of the BUIs associated with the AOC, restoration of the AOC will also provide numerous ancillary benefits including:

- Increased public use and enjoyment of the Waukegan Harbor AOC associated with increased active recreational uses such as fishing and swimming;

- Increased public use and enjoyment of the Waukegan Harbor AOC associated with increased non-active recreational uses such as wildlife viewing and the general ability to "connect with nature" as aesthetics improve in the AOC;
- Avoiding increased costs for navigation;
- Opening the harbor to larger recreational vessels;
- A potential increase in property values within the AOC following restoration;
- Increased desirability of the AOC for investment and development following elimination of the AOC designation; and
- High quality, extensive dune area preserved and protected.

2.0 PROJECT RATIONALE

Throughout the Great Lakes, there is renewed interest in determining goals and targets for delisting AOCs (i.e. determining at what point the AOC is "clean" enough that the impaired beneficial uses can be considered for delisting). Although the process of listing and delisting AOCs has been largely defined by the IJC and U.S. Environmental Protection Agency (USEPA), this renewed interest in delisting is especially relevant for the Waukegan Harbor AOC, where active involvement by the Illinois EPA, USEPA, CAG, various local and regional governments, universities and citizens' groups has resulted in significant progress. It is important to note that the development of delisting targets requires a cooperative effort of expert personnel knowledgeable regarding the local conditions in the AOC and representing the international, federal, state, regional, and community levels. Thus, the development of delisting targets that are accepted by Illinois EPA, the USEPA, other agencies, regional and local governments, and the public is the major goal of this project.

The process of delisting AOCs is defined by policies and guidance established by the IJC, USEPA, and Environment Canada. These policies are, in turn, carried out by the states and provinces wherein the AOCs reside. The original listing of Great Lakes AOCs was based on the presence of BUIs within each candidate area. The IJC lists fourteen BUIs that may apply to Great Lakes Areas of Concern, six beneficial uses are considered impaired based on the 1999 Waukegan Harbor Remedial Action Plan (RAP) Final Stage III Report. These BUIs are listed in Table 2-1.

Annex 2 of the Great Lakes Water Quality Agreement (GLWQA) provided no guidance for listing or delisting BUIs. The first set of guidance for setting delisting targets was put forth in 1991 by IJC. These criteria were fairly general and led to a more specific set of guidance published by the USEPA in 2001. In addition to the generalized guidance published by USEPA, the states of Michigan (2006) and Ohio (2005) have developed generic statewide criteria that can be applied to AOCs within these jurisdictions. These and other AOC-specific criteria were considered in the development of delisting targets for the Waukegan Harbor AOC.

The goal of developing delisting targets is to provide an endpoint definition of "how clean is clean" that will lead to the creation of a plan for the restoration/delisting of the harbor. Restoration of the Waukegan Harbor AOC will result in benefits that can be described both qualitatively and quantitatively. Restoration is expected to enhance the more qualitative beneficial uses of the harbor, including swimming, fishing for recreational catch and consumption, wildlife viewing, biodiversity and genetic preservation of nearshore and aquatic organisms. In addition, the quality of life is improved with enhanced aesthetics from the natural beauty of the harbor and the adjacent view of Lake Michigan. Many people experience the environment in positive ways, such as a relief from the stresses and pressures of urban life or by having a spiritual experience or a connection with nature. In general, we can attribute many social and psychological benefits to preserving the natural beauty of our environment. Quantitative benefits arising from the removal of impediments to dredging include increased efficiency and avoidance of increased cost for navigation, as well as opening the harbor to larger recreational vessels.

Table 2-1: IJC Guidelines for Listing Areas of Concern and Summary Assessment of Current Waukegan Harbor Conditions

USE IMPAIRMENT	LISTING GUIDELINES	ASSESSMENT OF CURRENT CONDITIONS
Restrictions on Fish and Wildlife Consumption	When contaminant levels in fish or wildlife populations exceed current standards, objectives or guidelines, or public health advisories are in effect for human consumption or fish or wildlife. Contaminant levels in fish and wildlife must be due to contaminant input from the watershed.	Use impairments still exist. Substantial progress has been made. Fish consumption warnings signs formerly posted in Waukegan Harbor were removed in 1997. In January 2005, the advisory was updated to state that all sizes of white sucker and sunfish from Waukegan Harbor should be limited to one meal per month because of PCBs. For all other Waukegan Harbor fish, follow the fish advisory for Lake Michigan.
Degradation of Benthos	When the benthic macroinvertebrate community structure diverges from un-impacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when the toxicity (as defined by relevant, field-validated bioassays with appropriate quality assurance controls) of sediment, associated with contaminants at a site, is significantly higher than controls.	Use impairments still exist. A 1996 Illinois EPA survey indicated degraded harbor substrate conditions based on benthic life. However, the status of Waukegan Harbor as an existing commercial and recreational navigation feature requiring periodic maintenance dredging may preclude establishment of a fully restored benthic community.
Restrictions on Dredging Activities	When contaminants in sediments exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities.	Use impairments still exist. Needed maintenance dredging has been delayed due to high contaminant levels in harbor sediments. Sediment disposal will need to be accomplished in an engineered disposal facility or existing landfill.
Beach Closings	When waters, which are used by the community used for total body contact recreation, exceed standards, objectives, or guidelines for such uses.	Several studies indicate that Waukegan beach closures are the result of increased bacterial levels due to the large resident gull population in the vicinity of the harbor.
Degradation of Phytoplankton and Zooplankton Populations	When phytoplankton or zooplankton community structure significantly diverge from un-impacted control sites of comparable physical and chemical characteristics. In addition, this use will be considered impaired when relevant, field validated, phytoplankton or zooplankton bioassays (e.g., Ceriodaplinia; algal fractionation bioassays) with appropriate quality assurance/quality controls confirm toxicity in ambient waters.	Use Impairments still exist. Benthic macroinvertebrate sampling was used as a surrogate or indicator of phytoplankton and zooplankton community quality. A comparison of 1996 and 1972 macroinvertebrate sampling data showed little (if any) improvement in the harbor macroinvertebrate community.
Loss of Fish and Wildlife Habitat	When fish and wildlife management goals have not been met as a result of loss of fish and wildlife habitat due to a perturbation in the physical, chemical, or biological integrity.	Use impairments still exist with regard to fish habitat. The Waukegan AOC is "not impaired" in terms of its ability to support healthy marsh bird and amphibian communities. However, land based invasive plants pose a threat to existing dunal habitat.

There are measurable and immeasurable benefits to restoring the AOC in terms of human health effects. At beaches with degraded water quality associated with storm water runoff or sewage discharges, bacterial

and parasitic infections can be measured in direct medical costs or in sick days off of work for afflicted adults or caring for sick children. Restrictions on fish consumption lead to losses in market revenues from fisheries, and consumption of contaminated fish can cause negative health impacts/effects. Restoration should lead to improvements in human health that cannot easily be quantified due to a lack of our understanding or ability to establish cause-and-effect from exposure to biological and chemical agents from contaminated sites. For example, gastroenteritis can result from swallowing contaminated water while swimming, or from eating contaminated food. The relative contribution of cumulative exposures to chemicals in the environment to major disease processes is very difficult to assess. PCBs, one of the major contaminants in sediments and fish tissues in the Waukegan Harbor AOC, contributes to several health effects including thyroid problems, reproductive and immune system impairments, decreased IQ in children of mothers with PCBs stored in their bodies, diabetes, and cancer.

It is equally important to reduce or eliminate anthropogenic chemical discharges into our waterways. Chemicals released to the environment cycle between air, soil, water, sediments, and biota and are transported globally through the atmosphere. Thus, we cannot eliminate our exposure to potentially toxic chemicals by merely avoiding direct contact with known contaminated sites. Routes of exposure to toxic chemicals include dermal, oral, and respiratory/inhalation from swimming and other recreational uses.

Ecosystem health is important to humans as well as to the fish and wildlife. Maintaining genetic diversity and healthy populations of fish and wildlife will result in immediate as well as long term beneficial uses.

Restrictions on dredging directly and indirectly impact navigational uses of the AOC related to recreational uses and commercial transportation. Additionally, since Waukegan Harbor is recognized by the U.S. Coast Guard as the only harbor of refuge providing safe operation for barges and commercial vessels during inclement weather between Calumet Harbor, Illinois and Milwaukee, Wisconsin dredging of the Harbor will ensure that this safety function continues to be available. Dredging restrictions have a negative impact locally and regionally since commercial transportation of bulk commodities is negatively impacted by the shallow harbor depth. Recreational uses by deeper draft vessels are also negatively impacted by the lack of harbor maintenance.

Lastly, the development of delisting targets for the BUIs within the AOC is an essential part of the next RAP update. These targets will be utilized to specify measurable endpoints that will enable Illinois EPA and associated stakeholders to know when the remediation in the AOC has accomplished the specified RAP goals.

3.0 WAUKEGAN HARBOR ENVIRONMENTAL CONDITIONS

3.1 BACKGROUND

Location

The Waukegan Harbor AOC is located on the west shore of Lake Michigan in Waukegan, Illinois approximately forty miles north of Chicago. The harbor is surrounded by industrial, commercial, municipal, recreational, open and vacant lands. Following adoption of the AOC, the Illinois EPA and the CAG met and developed what is know as the Waukegan Expanded Study Area (ESA) to address some of the additional known areas of contamination and National Priority List (NPL) sites that could impact the original AOC. The ESA is bound by the Dead River in Illinois Beach State Park on the north, the bluff line parallel to Sheridan Road on the west, the south boundary of the former U.S. Steel Property at 22nd St. in North Chicago on the south, and the nearshore waters of Lake Michigan on the east. The study area also includes a portion of the Waukegan River which cuts through the ESA and is a tributary to Lake Michigan with an outlet approximately ¼ mile south of the Waukegan Port District boat launching area. Another tributary located within the ESA is the North Ditch tributary, located just north of the Outboard Marine Corporation property, which drains portions of the study area north of Waukegan Harbor (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999). The harbor itself, however, has no tributary flow.

Natural Features

Waukegan Harbor itself is largely a manmade structure comprising 35 to 40 acres constructed in the late 19th century. The harbor is approximately 37 acres with water depths from 14 to 21 feet. The sediment on the bottom of the harbor consists of 1 to 10.5 feet deep of organic silt over 9 feet of coarse to fine sand. Very stiff silt that typically ranges from 50 to 100 feet deep underlies the sand. The entire harbor is surrounded by a 20 to 25 foot long steel sheet piling that extends into the sand layer above the glacial till. The Waukegan Port District boat launching area and the retaining wall near the harbor mouth are the only two areas not bordered by the steel sheet piling (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

Waukegan Harbor Environmental History

In 1975 PCB contamination was discovered in the Waukegan Harbor AOC. The source of the pollutant was later linked to manufacturing activities at Outboard Marine Corporation (OMC) where hydraulic fluids containing PCBs were discharged into the AOC (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999). As a result, 700,000 pounds of PCBs were estimated to be present in the soil on the OMC Plant property and 300,000 pounds were in the soils and sediment of the Waukegan Harbor (Outboard Marine Corporation Fact Sheet 2007). By the early 1980's, OMC was listed on the National Priorities List and under the Superfund program an over twenty million dollar remediation project of harbor sediment in and around the facility was funded. Through this remediation effort, which focused on the North Channel and Slip 3, one million pounds of PCB contaminated sediments were removed and disposed of in confined disposal facilities. As only sediment with PCB levels of 50 ppm or higher were removed, residual contamination was left behind following Superfund remedial dredging project (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

Waukegan Harbor is part of the OMC Superfund site that includes: the Waukegan Harbor site, the Waukegan Manufactured Gas and Coke Plant on the eastern edge of the harbor, the PCB containment

cells on the northern portion of OMC Plant 2 and in former Slip 3, and the OMC Plant 2 site north of the harbor. OMC Plant 2 is the source of PCB contamination, causing the harbor to be listed as an International Joint Commission Great Lakes AOC in 1981. At this time the IJC identified six beneficial use impairments: 1) Degradation of Benthos, 2) Restrictions on Dredging, 3) Degradation of Phytoplankton and Zooplankton Populations, 4) Restrictions on Fish and Wildlife Consumption, 5) Loss of Fish and Wildlife Habitat, and 6) Beach Closures (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

In 1992 the harbor was dredged in order to remove contaminated sediment. As a part of this sediment remediation project 38,000 cubic yards of sediment containing approximately one million pounds of PCB (95% of the PCB estimated to be in the harbor area) were removed, treated, and disposed of properly (Remedial Investigation Report OMC Waukegan Harbor Site 2008). The remediation project achieved the original PCB cleanup objective, but left some PCBs in place in the harbor. Following dredging activities, the removed sediment was stored in containment cells with extraction wells to maintain an inward water flow. The water from this process was treated to remove PCBs prior to its release. At this time additional dredging was hampered by lack of an appropriate disposal area as well as high costs. Numerous disposal options have been explored as part of the U.S. Army Corps of Engineers Navigational Dredging Project or as part of the Great Lakes National Program Office Great Lakes Legacy Act Project. These efforts examined 20 and 3 sites respectively (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

In 2001, three Waukegan Harbor shippers, Lafarge Cement, National Gypsum, and Blue Circle Cement Co., invested in a dredging project in the harbor. Through this project the navigability of the harbor was improved with the removal of over 4,000 cubic yards of sediment. This sediment was collected in Slip 1 and portions of the entrance channel while removed sediment was taken to the Zion landfill for disposal (Environmental Progress, Illinois EPA, Spring 2002, Tammy Mitchell).

As a result of heavily contaminated harbor sediment, fish populations in the AOC were also contaminated with PCBs. In response to the elevated levels of PCBs in fish tissue, warning signs were placed around the harbor advising the public of the dangers of consuming Waukegan Harbor fish. Sixteen years later, in 1997, the Waukegan Harbor Public Health Advisory against the human consumption of fish was removed (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999). Following the removal, the Illinois Fish Contaminant Monitoring program continues to re-evaluate the effects of PCB contamination on harbor fish. In 2005, the sport fish consumption advisory was reviewed based on data collected between 2001 and 2004. The advisory was updated to state that consumption of white sucker and sunfish should be limited to one meal per month.

In 2002, the USEPA Region 5 Superfund Division conducted a 5-Year Review of the OMC site to determine the extent to which the 1992 efforts were successful in protecting human health and the environment. Illinois EPA determined at this time that the 50 ppm cleanup level for PCBs may not be protective as PCB levels in harbor-caught fish were still above action levels. PCB remediation levels at other sediment sites were set as low as 0.25 to 1.0 ppm (Remedial Investigation Report OMC Waukegan Harbor Site 2008).

Beginning in 2004, a series of stakeholders meetings were convened in order to formulate remedial alternatives for Waukegan Harbor. Attendees at these meetings included: the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, National Oceanic and Atmospheric Administration, the

Office of Congressman Mark Kirk Illinois 10th Congressional District, Illinois EPA, Illinois Department of Natural Resources, Illinois Attorney General's Office, City of Waukegan, Waukegan Port District, Waukegan Harbor Citizens Advisory Group, Alliance for the Great Lakes, and Waukegan Harbor Shippers.

Based on census data collected in 2000, the City of Waukegan qualifies as an Environmental Justice Community based on the high percent of low-income and minority residents. The census shows that Waukegan's population is 44.8 percent Hispanic and 19.2 percent African-American. Waukegan also has the highest increase in poverty rates in Lake County, rising to 13.9 percent in 1999 from 9.5 percent in 1989 (Waukegan Environmental Justice Revitalization Project).

3.2 DEGRADATION OF BENTHOS

In 1972, the Illinois EPA conducted a benthic survey of Waukegan Harbor. In this study four stations were sampled with results suggesting that each of the stations be classified as polluted. Pollution tolerant forms, specifically aquatic worms, were predominant at each location indicating environmental degradation. Table 3-1 depicts the results of this study.

Table 3-1: Benthic Organisms Collected in Waukegan Harbor by the Illinois EPA (1972)

	ORGANISMS PER SQUARE FOOT			
ORGANISM	**STATION 1**	**STATION 2**	**STATION 3**	**STATION 4**
Scuds	7	2	0	0
Fingernail clams	2,100	12	1,110	150
Gilled snails	14	0	7	0
Midge Larvae	7	0	0	85
Leeches	36	7	392	14
Aquatic Worms	3,900	105	6,800	13,600

In 1973, the Illinois EPA conducted a follow up survey near the mouth of the Dead River, in the nearshore areas near the North Shore Sanitary District Sewage Treatment Plant, and at the mouth of the Waukegan River in Lake Michigan. Near the mouth of the Dead River and a half mile off of the shoreline balanced benthic populations were found. However, immediately offshore of the North Sanitary District Sewage Treatment Plant an absence of benthic life was found. It is important to note that since 1973, the treated water from the sewage treatment plant has been diverted from Lake Michigan to the Des Plaines River. The resulting reduction in nutrient loading, chloride, and biodegradable loads to the lake should have a positive impact on the benthic environment.

The Illinois Natural History Survey conducted an additional study in 1987. The dominant species found were aquatic worms and fingernail clams. This study also found a correlation between low biomass and contaminated areas (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

From 1994 to 1995, the Illinois EPA conducted an Intensive Survey of the Waukegan River. Twelve stations were sampled for water and sediment chemistry, macroinvertebrate community structure, and habitat information. According to the findings of this study, the river was assessed as providing "partial support/moderate impairment." The study also determined that the major causes of impairment were priority organics, metals, and habitat alteration from urban runoff, runoff/leachate from landfills, in-place

contaminants, and atmospheric deposition (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

In 1996, the Illinois EPA conducted another survey of the benthic community of the Waukegan Harbor AOC. Macroinvertebrate samples were collected once at 10 stations in the harbor, with ten major groups of organisms collected. Oligochaeta was the predominant group making up 88% of the total collected (Assessment of Waukegan Harbor Macroinvertebrates). The survey shows continued degradation of the harbor substrate conditions based on benthic life Biotic Index values of 3.80 to 4.03 warranting the classification of very poor. This degradation was attributed in part to the suspension of harbor sediments caused by the prop wash on commercial vessels. Increased levels of organic material also added to the degraded conditions. The study further concluded that no tributary was able to deliver additional sediments to the harbor or move sediments lake-ward (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

3.3 DEGRADATION OF PHYTOPLANKTON AND ZOOPLANKTON POPULATIONS

In 1972 and 1974 Commonwealth Edison monitored phytoplankton communities in Lake Michigan near Waukegan Harbor. Samples were taken from Lake Michigan between Zion and Waukegan. In this study, 249 genera representing six algal divisions were identified. Dominant phytoplankton by number were *Stephanodiscus binderanus* and *S. hantzchii vel tenuis* and by volume *Rhizosoenia eriensis*. Commonwealth Edison also monitored zooplankton. *Cladocera* dominated zooplankton catch and the dominant species observed was *Bosmina longirostris (*Final Stage III Report Waukegan Harbor Remedial Action Plan 1999*)*.

In 1980, McNaught investigated the effects of PCB on the photosynthesis of phytoplankton. Results showed an inhibition of 5.7% when a PCB concentration of 5 ng/L was used. An inhibition by 8.9% and 18.9% was found when concentrations of 100 ng/L and 500 ng/L were used, respectively. In Lake Michigan PCB concentrations are in the range of 5 ng/L (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

Ross examined the effects of sediment contamination on protozoan communities. When protozoan communities were exposed to sediment from Slip 3 it was found that the contamination from harbor sediment significantly altered the structure of the indigenous protozoan community. Results from this study were later confirmed in the laboratory. Impacts were greater in communities found within lower portions of the water column where suspension of particles that carry toxic chemicals was greater (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

The Stage III RAP document states the following in regard to further studies addressing impacts to phytoplankton and zooplankton populations:

> The studies of Ross et al. (1988) and Risatti et al (1990) show that the photosynthesis of the green alga *Selenastrum capticornutum* was inhibited by sediment elutriats from several sampling sites within the harbor. Burton et al. (1989) reported toxicity to *Daphnia magna*, *Ceriodaphnia dubia*, and *S. capricornutum* when these organisms were exposed to sediments or sediment elutriates from

the inner harbor. Also, Marking et al. (1981) observed water flea (probably *Daphnia magna*) mortalities of 100 percent from some sediment suspension sampled taken from the harbor.

3.4 LOSS OF FISH AND WILDLIFE HABITAT

The value of fish and wildlife habitat is limited due to the nature of Waukegan Harbor as a man made harbor as well the associated industrial development. The Waukegan beach has dune and swale habitat similar to that found in the Illinois Beach State Park. Contained in these areas are a variety of rare and federally endangered plant species (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999). According to the 1997 Illinois Natural Resource Database, 37 species in the Waukegan ESA are on the state endangered or threatened list. Also, the state threatened fish, Longnose Sucker, has been found near Waukegan between Waukegan and Zion as of 1995 (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

In the nearshore Lake Michigan area, fish and wildlife habitat are impacted through sediment accumulation and contamination. According to the U.S. Department of the Interior Fish and Wildlife Service fish spawning and rearing habitat as well as avian foraging habitat have been adversely impacted. Sediment accumulation has the potential to bury spawning and shelter areas used by small or immature fish (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

There are several types of natural and excavated wetlands located in the ESA near the north and west of Waukegan Harbor. There are approximately 17.5 acres of lake shore community, or wetland vegetation communities characterized by creeping juniper and nodding wild rye which develop along large rivers and wave-affected lakes. These wetlands are recognized as Lake Michigan Beach area and include the two Waukegan beaches. The remaining wetlands located north of the harbor are comprised of 3.1 acres of marsh and 3.1 acres of pond. Excavated wetlands comprise approximately 4.8 acres of ponds and 2.3 acres of wet meadows. The most extensive wetlands are located at the extreme north end of the ESA immediately south of the Dead River and are part of the Illinois Beach State Park. Wetlands are important as they provide storage of stormwater runoff and improve the quality of water by promoting sediment deposition, microbial degradation, and vegetative uptake of nutrients. Wetlands also provide habitat to water-loving vegetation and numerous wildlife species (Final Stage I & II Report Waukegan Harbor Remedial Action Plan 1994).

3.5 BEACH CLOSINGS

There are two beaches within the confines of the Waukegan Harbor AOC, Waukegan North and Waukegan South. The Illinois Department of Public Health (IDPH) has established a fecal coliform standard of 500 colonies per 100 ml or an *E. coli* standard of 235 colonies per 100 ml in the Illinois Swimming Facility Act and Code. Since the two Waukegan beaches are operated by a unit of local government located on Lake Michigan, these beaches are exempt from meeting the IDPH Swimming Facility Act. However, the City of Waukegan does voluntarily follow and accepts these standards. The Illinois Pollution Control Board has established fecal coliform standards for full contact recreation at a geometric mean less than or equal to 200 colonies per 100 mL and not more than 10% of samples can exceed 400 colonies per 100 mL. The North Shore Sanitary District (NSSD) and the Lake County Health Department conducted daily sampling from June to August from 1988 to 1994. In 1995, NSSD no longer assisted with beach monitoring and

LCHD monitored the beaches four (4) days per week from Memorial Day to Labor Day, 1995 to 2000. From Memorial Day to Labor Day 2001 to 2007, LCHD returned to the seven (7) days per week, daily sampling schedule. Waukegan South was sampled twice a day, 5 days per week in August 2006 and throughout the 2007 season during predictive model development (SwimCast). In 2008 and after SwimCast implementation, LCHD returned to sampling four (4) days per week and one (1) weekend per month. Morning and afternoon samples continue to be collected at Waukegan South four days per week. Prior to 1997, a beach faced closure if two consecutive samples had fecal coliform counts greater than 500 counts per 100 mL or total coliform counts greater than 5,000 counts per 100 mL. Based on these guidelines the beaches averaged 9 closures per year for Waukegan North Beach and 12 closures per year for Waukegan South Beach (data from 1988 to 2007) (Pfister 2008, personal communication). Table 3-2 showcases the number of closed beach days from 1988 to 2008 (to August 1, 2008) and Table 3-3 shows fecal coliform counts from 1983 to 2001, the final year that LCHD monitored for fecal coliform. *E. coli* became the fecal indicator bacteria utilized from 2002 to date as it is the current USEPA recommended organism for freshwater beaches. The current bacteriological criteria are as follows: (a) the single sample maximum shall not exceed 235 cfu/100 mL for E. coli, (b) the geometric mean of 5 most recent samples collected during a 30 day period shall not exceed 33 cfu/100 mL for enterococci or 200 cfu/100 mL for fecal coliform, and (c) beach advisory signs will be posted and removed based on indicator data and the output of the predictive model selected.

Table 3-2: Summary of Beach Closings at Lake Michigan Beaches in Waukegan, Illinois

YEAR	WAUKEGAN NORTH DAYS CLOSED	WAUKEGAN SOUTH DAYS CLOSED	TOTAL DAYS CLOSED
1988	0	3	3
1989	3	2	5
1990	10	10	20
1991	2	0	2
1992	0	1	1
1993	0	6	6
1994	0	0	0
1995	0	3	3
1996	4	2	6
1997	6	20	26
1998	1	7	8
1999	6	2	8
2000	11	10	21
2001	10	22	32
2002	33	54	87
2003	23	24	47
2004	19	19	38
2005	6	12	18
2006	10	15	25
2007	29	29	58
2008	11	15	26 as of 8/1/08

It should also be noted that prior to 1998 a closure required two consecutive days of beach water exceeding either the fecal coliform or total coliform standards. Since 1998, any single, daily sample

exceeding either fecal coliform or *E. coli* standards resulted in a closure. This change in swim ban determination also increased the number of closures (Pfister 2008, personal communication). Additionally the switch from fecal coliform to *E. coli* as the indicator organism may have also increased the number of closures due to the lower *E. coli* standard.

Table 3-3: Summary of Fecal Coliform Bacteria Counts at Lake Michigan Beaches in Waukegan, Illinois

	WAUKEGAN NORTH			WAUKEGAN SOUTH		
YEAR	GEO MEAN	% > 400	CS > 500	GEO MEAN	% > 400	CS > 500
1983	28	4	0	26	3	0
1984	44	8	1	24	7	0
1985	32	6	0	23	1	0
1986	66	18	4	42	8	0
1987	79	13	1	52	4	1
1988	76	8	0	82	10	3
1989	71	12	1	67	9	1
1990	91	20	5	67	10	4
1991	49	9	1	64	10	0
1992	49	6	1	55	10	1
1993	41	5	0	51	15	5
1994	53	12	5	116	10	4
1995	83	11	0	192	32	5
1996	142	22	2	220	37	2
1997	126	26	6	451	58	19
1998	62	2	0	134	12	1
1999	56	16	0	53	5	1
2000	125	21	2	150	20	2
2001	95	14	0	205	30	3

In 1990, the North Shore Sanitary District conducted a study on the source of fecal contamination. According to study results the Waukegan River was receiving fecal contamination. Follow-up investigations located the source of this problem which consisted of several cross connections between storm water and sanitary sewer lines. The Illinois EPA requested that the City of Waukegan to correct the cross connections, however follow-up monitoring suggested the problem had not yet been corrected while simultaneously pinpointing several additional problem sewers. Since 1990 the City of Waukegan has taken remedial actions to correct sanitary sewer overflows and storm/sanitary sewer cross-connections as they have been discovered (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999). In spite of this on-going program, additional illicit discharges or cross-connections between sanitary and storm sewers have been found in recent years at multiple locations throughout the Waukegan River watershed (Pfister 2008, personal communication).

As noted in Table 3-2, beach closings were much higher in 1997 than previous years. This increase was attributed to an expanding gull colony that had developed on the OMC property and beaches. Gull harassment began in 1988 and ended in 2000 as nearly 10,000 gulls were nesting at the Coke Plant Superfund site and were associated with elevated bacterial levels at the beaches (Pfister 2008, personal communication). The theory that the gull population was responsible for the increase in fecal coliform is

supported by the presence of beach closures on dry weather days. The Lake County Health Department sampled for fecal streptococci in addition to fecal coliform in the hope of isolating the source of bacterial contamination. The ratio of fecal coliform to fecal streptococci can be used sometimes to estimate the source of contamination although the sampling results from these efforts were inconclusive due to the inherent uncertainty in this comparison method due to variation in survival between the two organisms (Pfister 2008, personal communication). However, when the gull harassment efforts ceased in 2000 elevated fecal coliform concentrations returned shortly thereafter illustrating a possible association. Alternative bacterial source tracking efforts by LCHD in 2002 utilizing ribotyping to determine source contamination, found that 55% of the *E. coli* in beach water samples matched avian (gull) *E. coli* while 7% of the *E. coli* matched the DNA of human/sewage *E. coli*, 4% matched *E. coli* from other mammals, and 34% were unidentified (Pfister 2008, personal correspondence). Improved beach management efforts in 2004 by the City of Waukegan (i.e., more frequent removal of garbage to lessen attraction of wildlife to the beach and gull harassment efforts) reduced exceedences from the previous year (Pfister 2008, personal communication).

3.6 RESTRICTIONS ON FISH AND WILDLIFE CONSUMPTION

In 1981 a fish advisory warning against consumption of Waukegan Harbor fish was posted by the Illinois Department of Public Health. In 1993 the Illinois Department of Conservation Fishing Information Regulation noted, "the Department of Public Health advises no fish from Waukegan Old North Harbor be consumed." PCBs and chlordane are the two contaminants of greatest concern in the Waukegan Harbor AOC. During the 1980's the U.S. Food and Drug Administration set guidelines for PCBs and chlordane in food at 2 ppm and 0.3 ppm respectively. Based on these standards, Lake Michigan fish frequently exceeded acceptable consumption standards during the 1980s. By the mid-1990s, the results of monitoring showcased a turnaround in the presence of PCBs and other organic compounds in the tissue of fish species from the Waukegan Harbor AOC (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999). Table 3-4 showcases these results below. Sampling since 1986 shows a reduction in PCBs in trout and salmon.

Table 3-4: Summary Data, Mean Concentrations of PCBs in Fish Tissue from Illinois Waters of Lake Michigan, 1986, 1990, 1994 (Illinois EPA, 1996)

	MEAN PCB CONCENTRATIONS (mg/kg)		
SPECIES	1986	1990	1994
Lake Trout	3.81	2.27	1.12
Brown Trout	2.22	1.35	0.83
Rainbow Trout	0.72	1.33	0.66
Chinook Salmon	4.6	0.93	0.57
Coho Salmon	0.69	No data	0.7
Yellow Perch	No data	<0.1	<0.1

By 1996, the harbor had seen significant improvements in terms of PCB contamination. Levels of PCBs had significantly declined in fish monitoring from the harbor and Lake Michigan showing no appreciable differences in PCB concentrations between harbor fish and those from the open waters. In 1997, when the consumption warnings were removed, the Illinois EPA said, " Fish taken from the Harbor are now in the same consumption advisory categories as apply to fish caught elsewhere in Lake Michigan, and fish

consumption is no longer considered an 'impaired use'" (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

In 1997, concurrent with the removal of fish consumption warnings in the North Harbor, the Illinois Department of Public Health issued new consumption advisories for Lake Michigan fish. These advisories restricted consumption of larger fish as well as bottom feeders. Included were catfish, carp, and lake trout larger than 27 inches (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

In the Waukegan Harbor AOC carp should be used as an indicator species as they are both bottom feeders and common. Long term monitoring of contaminant levels over a range of length and weight and especially in young fish can be used as an indication of overall environmental conditions. Larger/older carp have higher levels of PCBs because of greater exposure. Therefore, it is necessary to monitor younger individuals in order to determine present contaminant loading. Future fish monitoring should be directed towards obtaining a large study size to see the extent to which new generations are accumulating PCBs (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

PCBs are known to not appreciably degrade or easily attenuate, but bio-accumulate in fish. In 2003, the USEPA evaluated the short- and long-term effects of consumption of PCB contaminated fish. Carp fillets taken from Waukegan Harbor in 2000 and 2001 averaged 4.5 and 3.8 ppm PCBs, exceeding the State of Illinois' do-not-eat criteria of 1.9 ppm. In rock bass, PCB concentrations were estimated at 0.5 ppm for fillets, exceeding the State's safe level for fish of 0.05 ppm PCBs. Currently bass are a catch and release only species, therefore they are not listed on the statewide sport fish consumption advisory. A 2003 risk evaluation indicated that on average PCB concentrations in Waukegan Harbor needed to be reduced five fold in order to reach a cancer level of 1 in 10,000 and about ten-fold to achieve an acceptable non-cancer risk. From 2001 to 2005, the average PCB concentration in all fish was 2.62 ppm, and from the 2003 to 2005 subset average concentration was 0.57 ppm. These results support an overall trend of decreasing PCB concentrations in fish populations (Remedial Investigation Report OMC Waukegan Harbor Site 2008). Table 3-5 depicts the results from this study.

Table 3-5: Summary of PCB Concentrations in Fish Fillet Samples

FISH TISSUE DATA SET	ALL FISH		GAME FISH ONLY		BOTTOM FISH ONLY	
	AVERAGE PCB CONCETRATION (MG/KG-WET)	NUMBER OF SAMPLES	AVERAGE PCB CONCENTRATION (MG/KG-WET)	NUMBER OF SAMPLES	AVERAGE PCB CONCENTRATION (MG/KG-WET)	NUMBER OF SAMPLES
2001-2005	2.62	24	0.30	6	3.40	18
2003-2005	0.57	12	0.30	6	0.84	6

In 2005 the sport fish consumption advisory for Waukegan Harbor was updated to state that all sizes of white sucker and sunfish should be consumed no more than once per month.

In the Waukegan Harbor AOC hunting is not allowed due to the high level of urbanization and thus no studies on the effects of contamination on wildlife species have been conducted (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999).

3.7 RESTRICTIONS ON DREDGING ACTIVITY

There have been numerous studies conducted in the Waukegan Harbor AOC to determine the characteristics of the sediment in the AOC. Some of these studies focused primarily on PCB contamination alone, while others covered a wide range of parameters including PCBs and metals. A study conducted by Ross in 1985 and 1986 found that the highest levels of PCB contamination were in Slip 3, and that concentrations generally decreased towards the harbor mouth. Sampling by Illinois EPA in 1990 confirmed these results.

In the "Biological and Toxicological Investigation and Sediment Collection from the Waukegan Harbor Project Area," PCB levels were found to be significantly lower than earlier studies conducted by Ross and Risatti. In this study, the average concentration over 13 stations was 196 ppb with a range of 15 to 627 ppb. Furthermore, PCB concentrations were higher at entrance channel stations indicating the washing out of sediments from the harbor into the open lake. Sediments were also analyzed for metals during this study and were found to contain one and half times more cadmium and chromium, 13 times more sodium, and one and a half times more zinc than other nearby water systems (Biological and Toxicological Investigation and Sediment Collection from the Waukegan Harbor Project Area 1989).

In 1990 sediment samples were collected at seven stations. Results are showcased in Table 3-6 (Final Stage III Report Waukegan Harbor Remedial Action Plan 1999 – Tables 2.9 and 2.10).

Table 3-6: Sediment Concentrations in the Waukegan Harbor Area, November 14, 1990 (ppm)

PARAMETER	NORTH BEACH	NORTH HARBOR	SLIP 1	INNER HARBOR	PUBLIC MARINA	ENTRANCE CHANNEL	PORT DIST. HARBOR
Arsenic	1 N	41 H	13 H	23 H	6 M	10 H	4 M
Barium	9N	52 M	31 M	43M	27.0 M	34 M	22 M
Cadmium	1 K	12 H	7.0 H	12H	1 K	1 *	1.0 K
Chromium	4.0 N	90.0 H	47.0 M	88.0 H	22.0 N	34.0 M	15.0 N
COD	39,200 N	117,650 H	77,648 M	91,000 H	24,900 N	62,600 M	23,600 N
Copper	2N	160 H	53 H	86 H	26 M	50 M	30 M
Cyanide	0.52 K	1.2 K	2.4 K	3.3 K	0.65 K	0.87 K	9.3 H
Iron	3,200 N	26,000 H	14,000 N	20,000 M	9,000 N	18,000 M	12,000 N
Kjeldahl Nitrogen	60 K	2,500 H	900 N	1,700 M	175 N	175 N	450 N
Lead	10 K	140 H	12,000 H	120 H	39 N	60 M	10,000 H
Manganese	96 N	460 M	91 N	450 M	220 N	480 M	24 N
Mercury	0.1 K	0.4 N	0.19 N	0.34 N	0.1 K	0.13 N	0.1 K
Nickel	5K	26M	340 H	21 M	9 N	16 N	400 H
Phosphorous	329 N	826 H	250 N	545 M	202 N	428 M	510 M
Potassium	1,000 K	1,900	1,000	1,500	1,000 K	1,300	1,000
Silver	1 K	1 K	13	1 K	1 K	1 K	10
Volatile Solids	2.3 N	9.8 H	7.3 M	8.3 H	4.2 N	4.8 N	2.2 N
Zinc	20 N	280 H	15 N	210 H	100 M	130 M	15 N
PCB	0.01 K	9.000 M	4.600 M	1.900 M	0.200 N	0.260 N	0.037 N

Sediment Classification (USEPA, 1977)
N= Nonpolluted

M= Moderately Polluted
H= Heavily Polluted
* Lower Limits, K=Less Than

Results in Table 3-6 above were compared to guidelines for the pollution classification of Great Lakes harbor sediments and with sediment results from the Illinois/Indiana area of Lake Michigan, as detailed in Table 3-7.

Table 3-7: Comparison of Mean Concentrations of Various Parameters in Sediments from the Illinois Area of Lake Michigan (ppm)

Parameter	Waukegan Harbor Area (1)	Waukegan Harbor Area (2)	Great Lakes naval Training Center Harbor (3)	Wilmette Harbor (3)	Chicago Harbor (4)	Calumet Harbor (5)	Lake Calumet (6)	Indiana Harbor (7)	Lake Michigan (8)
Volatile Solids (%)	5.6 M	-	4.4 N	4.6 N	4.3 N	8.8 H	-	3.6 N	2.3 N
Kjeldahl Nitrogen	851 N	-	951 N	1,060 M	760 N	872 N	-	946 N	592 N
Phosphorous	456 M	-	368 N	229 N	217 N	205 N	20.0 N	478 M	291 N
COD	62,371M	-	46,000 M	48,850 M	53,333 M	72,500 M	-	98,000 H	47,000 M
Arsenic	14 H	-	8 M	6 M	3.6 M	4.7 M	29.8 H	20 H	7.4 M
Barium	31 M	283 H	-	-	-	-	-	-	-
Cadmium	5.0 *	8.0 H	1.2 *	0.4*	3.0 *	3.0 *	1.8 *	0.5K	0.5 K
Chromium	43 M	5 N	23 N	13 N	28 M	41 M	76.7H	58M	12 N
Copper	58 H	104 H	87 H	30 M	35 M	38 M	57.5 H	110 H	23 N
Lead	3,196 H	202 H	134 H	31 N	107 H	132 H	187.0 H	120 H	18 N
Manganese	260 N	531 H	589 H	537 H	490 H	710 H	-	970 H	430 M
Mercury	0.19 N	-	0.32 N	0.18 N	0.34 N	0.38 N	-	0.13 N	0.03 N
Nickel	117 H	18 N	-	-	-	-	23.6 M	-	-
PCBs	2.29 M	2,426 H	0.225 N	0.070 N	0.133 N	0.585 N	-	0.4000 N	0.017 N

(1) Illinois EPA, 1990, Seven Samples, Includes Samples from Waukegan Harbor (except Slip No.3), New Harbor and North Beach
(2) Metals 23 Samples (Risatti et al., 1990); PCBs 18 Samples (Ross et al., 1988), (Includes Samples from Slip No. 3).
(3) Three Samples (City of Chicago and Illinois EPA, 1985).
(4) Three Samples (Stations 15, 16, 17), (USACE, 1981)
(5) Four Samples (Stations 1, 2, 3, 4), (USACE, 1981).
(6) Thirty-seven Samples (Ross et al., 1988).
(7) One sample (City of Chicago and Illinois EPA, 1981).
(8) Eight Samples (Stations 5A, 5H, 5J, IN, 7N, 2S, 5S, 7S), (City of Chicago and Illinois EPA, 1981).

Sediment Classification (USEPA, 1977)
N= Non-polluted
M= Moderately Polluted
H= Heavily Polluted
* Lower Limits, K=Less Than

More recent data generally confirm the condition of sediment in Calumet Harbor and Indiana Harbor (USACE, 2008; USEPA, 1996). Calumet Harbor has metals and low levels of anthropogenic organic compounds, but is overall only moderately polluted. The Indiana Harbor and Canal is heavily polluted, with high concentrations of metals, very high concentrations of SVOCs, localized high concentrations of PCBs, and high fractions of oil and grease. In general, the industrial harbors of southern Lake Michigan show moderate to heavy pollution levels. Some of these harbors also have dredging restrictions and sediment removed from these areas requires confined disposal. Waukegan Harbor has sediment conditions similar to the other industrial harbors and reflective of historical practices. These sediment conditions have implications for both dredging as well as for the biological health of Waukegan Harbor.

In 1991, Ross compared data from Long and Morgan (1990) with Waukegan Harbor sediment data from Risatti. The results from this study are summarized in Table 3-8. According to Ross the greatest threat to the health of aquatic communities is lead. Zinc and Cadmium also present clear hazards.

Table 3-8: Comparison of Lead, Zinc, and Cadmium Concentrations in Waukegan Harbor Sediments with Effects Range Levels from Long and Morgan (1990)

	WAUKEGAN HARBOR 23 STATION(1)	WAUKEGAN HARBOR AREA 7 STATIONS (2)
Lead mg/kg		
Minimum	36	< 10
Maximum	420	12,000
Mean	202	3,196
Number > 3.5 (ER-L)	23	6
Number > 110 (ER-M)	18	4
Zinc mg/kg		
Minimum	81	15
Maximum	370	280
Mean	214	110
Number > 120 (ER-L)	12	3
Number > 270 (ER-M)	7	1
Cadmium mg/kg		
Minimum	< 1.3	< 1.0
Mean	50.0	12.0
Maximum	8.0	5.0
Number > 5.0 (ER-L)	7	3
Number > 9.0 (ER-M)	4	2

(1) Risatti et al. (1990)
(2) Illinois EPA (1990)
ER-L = Effects Range-Low (biological effects 10% of the time)
ER-M = Effects-Range-Median (biological effects 50% of the time)

Additional sediment investigations were conducted in the harbor by USEPA's Great Lakes National Program Office in January 2003, January 2005, and November 2006 through March 2007. Of the five separate PCB compounds detected within Waukegan Harbor sediments, Aroclor 1248 was the most common. The maximum PCB concentrations were found in the North Harbor, Inner Harbor, and public Marina. In general, the highest PCB concentrations occurred in sediment at depths less than three feet. This supports historic data which indicates water quality conditions were worse in the innermost reaches of

the harbor and improved toward the harbor's mouth (Remedial Investigation Report OMC Waukegan Harbor Site 2008). The investigation yielded the following results broken down by harbor segment:

- Slip 1: The sediment thickness in this section ranges from less than 0.1 feet to 13 feet. The total PCB concentrations range from 0.51 to 16.7 ppm. The average PCB concentration was 2.42 ppm;
- Slip 4: Sediment thickness in this slip ranges from 7 to 13 feet with average concentrations of total PCBs exceeding 20 ppm in at least three locations. The average PCB concentration was 0.21 ppm;
- North Harbor: The sediment in this section ranges from 0 feet to a thickness of 14 feet with PCB concentrations exceeding 20 ppm in at least three locations. The average PCB concentration in this segment was 4.9 ppm. The sediment in the northernmost portion of the North Harbor contains the highest concentrations;
- Inner Harbor Extension: The sediment in this section ranges from 0 to 9 feet with a small zone in the southern-most portion at 14 feet. The average total PCB concentration was 1.8 ppm;
- Inner Harbor: In the inner harbor, the sediment ranged from 10 to 14 feet in depth. Higher concentrations (up to 7.47 ppm) of total PCBs in sediments were detected at depths of 6 feet. The range of PCB concentration in this portion was from 1.7 to 9.6 ppm with an average of 4.0 ppm;
- Marina (public boat launch area): Sediment thickness ranged from 2 to 14 feet with an average PCB concentration of 3.4 ppm;
- Entrance Channel: In the entrance channel sediment thickness ranged from 2 to 8 feet and up to 15 feet along the northern wall. The average PCB concentration is 1.0 ppm with a concentration range of 0.079 to 8.4 ppm, and
- Outer Harbor: The outer harbor has a sediment thickness that ranges between 6 to 15 feet with an average PCB concentration of 0.23 ppm.

Data has also been collected in the Outer Harbor and the Approach Channel by USCAE. The Outer Harbor and Approach Channel are outside the Superfund project area. Repeated sampling by the USACE (2007) over the last ten years has indicated that no PCBs are present in the Approach Channel, again supporting the historical evidence of higher contamination concentrations in the innermost reaches of the harbor.

3.8 RAP IMPLEMENTATION: PROGRESS AND ACHIEVMENTS

The following is a list of efforts undertaken towards RAP implementation:

- Soil removal activities were completed at the Waukegan Manufactured Gas and Coke site in 2005;
- In July of 2005, the Waukegan Harbor CAG received a USEPA section 319 financial assistance grant to develop a watershed plan for the Waukegan River watershed;
- Between 2004 and 2005, the Waukegan Harbor CAG conducted a project at the Waukegan Public Library to reorganize the AOC and ESA information repository;
- Late in 2004, additional sediment sampling was conducted in Waukegan Harbor to fill the data gaps from the January 2003 sampling;
- In March 2003, the Federal Interagency Working Group on Environmental Justice selected the Waukegan Revitalization and Clean-up Plan as one of 15 new Revitalization Demonstration

Projects to showcase collaborative partnerships among federal agencies and other stakeholders in the area of community revitalization and environmental justice;

- In January of 2003, a sediment-sampling event was conducted in Waukegan Harbor to help USEPA and USACE determine the extent of contamination remaining in the harbor and evaluate the remediation options that may be used in addressing the remaining contaminated sediment;
- The City of Waukegan adopted the *A 21st Century Vision for Waukegan's Downtown and Lakefront* Master Plan in December 2008;
- During 2002 and 2003 several removal actions were performed by the potentially responsible parties and USEPA at the Outboard Marine Corporation site. These removal actions resulted in the removal and disposal of large amounts of acids, bases, paints, solvents, hydraulic oil, machining oil, compressed gases, metals, sludge and PCB containing transformer fluid from this Waukegan lakefront site;
- Between 2001 and 2003 the Waukegan Harbor CAG contracted with area experts to produce inventories of plant, avian, amphibian and dragonfly and butterfly populations for the Waukegan Dunes from the Waukegan swimming beaches to the Midwest Generation station.
- In the summer of 2001, the shipping companies that utilize Waukegan Harbor dredged Slip 1 and small portions of the entrance channel to a depth of 19.5 feet.
- In May 2000, the Great Lakes Water Quality Board of the IJC met with the Waukegan Harbor CAG and the public in Waukegan. The Board recognized the CAG for its long-standing commitment to the restoration and protection of beneficial uses in the Waukegan Harbor AOC. Environmental education efforts to area students were also recognized. The Board urged quick action in removing the remaining 300,000 cubic yards of harbor sediment containing low levels of residual PCBs (USEPA GLNPO).
- In July of 1999 the Waukegan Harbor Remedial Action Plan Final Stage III Report was published and submitted to the IJC for review.
- The U.S. Army Corps of Engineers completes the harbor navigational dredging Feasibility Plan in 1998.
- The Waukegan Harbor CAG established a website in 1997. To allow public access to the website and related information on the internet, the Waukegan Harbor CAG and Illinois EPA donated a computer to the Waukegan Public Library.
- In 1995, the City of Waukegan completed sewer cross connection repairs at Utica and Washington streets along Water Street.
- In December of 1994 the Waukegan Harbor Remedial Action Plan Final Stage I & II Report was published and submitted to the IJC for review.
- Initial Waukegan Harbor Stage II RAP monitoring of fish began in September of 1994.
- Approximately 2,619 tires were removed from the AOC and ESA by the Illinois EPA on April 26, 1993.
- The investigation of the Waukegan Gas and Coke site is initiated by North Shore Gas in 1993.
- The Waukegan Harbor Remedial Action Plan Stage I Report was finalized and submitted to the IJC and USEPA on July 29, 1993.
- Remediation of contaminated sediments and soils from Waukegan Harbor and the crescent ditch, the oval lagoon and the north ditch on the OMC property was completed in the summer of 1993. Approximately 6,300 cubic yards of PCB contaminated sediments were dredged from Slip 3 of Waukegan Harbor, treated onsite and deposited in a confined disposal facility constructed in Slip 3.

Another 3,800 cubic yards of PCB contaminated soils and sediments were excavated from the Crescent Ditch, 2,900 cubic yards from the Oval Ditch and 5,000 cubic yards from the North Ditch. Sediments from these areas were treated onsite and deposited in engineered containment cells along the North Ditch.

- In 1992 underground fuel storage tanks were removed from the Waukegan Port District.
- The Waukegan Harbor Citizens Advisory Group was formed in August of 1990 to begin the development of the Remedial Action Plan.
- In 1989, contaminated soils were discovered at the Waukegan Manufactured Gas and Coke Plant site.
- The amended Record of Decision for OMC was signed in 1989.
- In 1988 the Consent Decree for OMC was signed.

4.0 DELISTING TARGETS—APPLICABILITY AND STATUS IN OTHER AOCs

4.1 APPLICABILITY OF STATE WATER QUALITY STANDARDS TO DELISTING TARGETS

The Waukegan Harbor AOC shall be considered restored when there are no significant impairments to the beneficial uses of the area which have been caused by human activities. The relationship between Waukegan Harbor BUIs and Illinois Water Use Designations is presented in Table 4-1.

Table 4-1: Waukegan Harbor AOC BUIs and Illinois Water Use Designations

USE IMPAIRMENT	ILLINOIS WATER USE DESIGNATION
Restrictions on fish and wildlife consumption	• General Use
Degradation of benthos	• NA
Restrictions on dredging activities	• NA
Beach Closings	• General Use
Degradation of Phytoplankton and Zooplankton populations	• General Use
Loss of Fish and Wildlife Habitat	• General Use

The State of Illinois has adopted Water Quality Standards (IWQSs) that are applicable to all surface water bodies in the state. Although the BUIs are technically based on the IJC criteria established in Annex 2 of the 1987 Amendment to the Great Lakes Water Quality Agreement that established the AOC program, many are also related to the IWQSs/Designated Uses and/or fish contaminant advisories.

Unacceptable contaminant levels in fish and wildlife are established by the Illinois Department of Natural Resources and the Illinois Department of Public Health in conjunction with the Illinois EPA. These contaminant levels are used in conjunction with measured contaminant levels from the Illinois fish monitoring program to establish fish consumption advisories that result in the Restrictions on Fish and Wildlife Consumption BUI. Elevated contaminant levels can be caused by "food chain biomagnification", water column contamination, or sediment contamination.

Although Beach Closings are determined by the Lake County Health Department, prior to 2002 the criteria used by the County were directly related to the IWQSs for fecal coliform bacteria. Since 2002, LCHD has used *E. coli* as their fecal indicator bacteria as accepted by the Illinois Department of Public health and the USEPA for freshwater beaches.

Degradation of Benthos is another BUI that is measured by guidance used by the Illinois EPA but is not directly related to established IWQSs. The BUI is normally a result of excessive and/or contaminated sediment within the watershed and/or deteriorated water quality which can be evaluated through the use of IWQSs but is more a cause-effect relationship than a direct standards comparison.

Specific determinations on handling of dredge spoils are made by the USACE and the Illinois EPA at the time of dredging. When the dredge spoils must be handled in a special manner or disposed of at a confined disposal facility due to the level of contaminants in the sediment then the Restrictions on Dredging Activities is considered to be a BUI.

4.2 SUMMARY OF DELISTING TARGETS ADOPTED IN OTHER AREAS OF CONCERNS AND THEIR RELEVANCE TO WAUKEGAN HARBOR AOC

Delisting targets developed and/or proposed in other AOCs were reviewed for relevance to the Waukegan Harbor AOC during development of the recommended restoration/delisting targets for the AOC. Harbors are special situations with regard to establishing targets because they are a dredged environment and uniquely different from flowing stream and more traditional "watershed" AOCs. While some of these other AOCs may consequently not be specifically germane to the Waukegan Harbor situation, it is still useful to review the targets established for those AOCs and look for similarities and differences. The River Raisin (Michigan) and Milwaukee (Wisconsin) AOCs targets and respective delisting target processes would be of significant interest with respect to the Waukegan Harbor AOC as these areas are also active commercial harbor AOCs. In addition, these AOCs all have legacy pollutants associated with contaminated sediments that are routinely disturbed by shipping and dredging activities as well as the need to evaluate realistic potentials for habitat/benthos restoration due to the need for routine maintenance dredging.

These targets from other AOCs are summarized in this section of the report. Progress toward delisting has been made in the following AOCs:

- In the United States:
  - Oswego AOC on Lake Ontario in New York has been delisted. It is the first U.S. AOC to be delisted.
  - Presque Isle Bay AOC in Pennsylvania is in recovery stage.
  - AOCs Clinton River, White Lake, and Saginaw in Michigan have developed delisting criteria/targets and/or milestones.
  - Torch Lake AOC, Michigan, has a well-defined restoration design with appropriate goals, indicators, and a long-term monitoring strategy.
  - Kalamazoo AOC in Michigan is close to finalizing its delisting targets and has established baseline inventories of habitat and wildlife, but needs to develop a long-term monitoring plan.
  - The U.S. side of the Detroit River AOC is progressing toward finalization of delisting targets.
  - The Degradation of Benthos BUI for the Manistique River has been recommended for delisting by the Michigan Department of Environmental Quality (MDEQ).
  - The River Raisin AOC (Michigan) is in the process of reviewing delisting targets for habitat and non-habitat BUIs.
  - Both the Rouge River and the St. Clair River (U.S. side) are in the process of developing habitat based BUI delisting targets

- In Canada:
  - Collingwood Harbour AOC and Severn Sound AOC have been delisted.

- Spanish Harbour AOC is in recovery.
- Detroit River AOC on the Canadian side has developed delisting targets that have been approved by the Canadian side PAC. The targets report has been endorsed by the Canadian PAC as the Canadian delisting targets for the Detroit River until bi-national delisting targets can be developed.

Legacy pollutants associated with contaminated sediments (mainly PCBs, metals, and PAHs) are a major problem in the Waukegan Harbor AOC that affect the restrictions on fish and wildlife consumption, degradation of benthos, and restrictions on dredging activities BUIs. Kalamazoo River in the Kalamazoo AOC (Michigan) is a site similar to portions of the Waukegan Harbor AOC with restoration activities focused primarily on PCB contaminated sediment remediation. Temporary measures implemented to contain leaching of PCBs from landfill sites in the Kalamazoo AOC include installing sheet steel piling to slow erosion of PCB-contaminated soil into the river. A record of decision (ROD) for remediation in the Kalamazoo AOC has not been issued yet.

The River Raisin AOC is particularly germane to the Waukegan Harbor AOC delisting project as the Raisin is also a harbor facility and the benthos and habitat related BUIs are significantly impacted by the shipping and potentially the dredging activities in the AOC.

The Presque Isle Bay AOC in Pennsylvania may be relevant to development of Waukegan Harbor AOC targets with respect to the contaminated sediment related BUIs, particularly with respect to consideration of natural attenuation/monitoring as an implementation strategy in the areas that are not significantly contaminated with PCBs or where implementation may involve a combination of dredging coupled with natural attenuation.

The St. Clair River AOC initially developed and adopted "yardstick" measurements of success early in the RAP process based on reviewing the then available literature applicable to the St. Clair River environment. They have recently updated their process and adopted the MDEQ guidance for the non-habitat related BUIs and are in the process of developing new targets for the "loss of fish and wildlife habitat" BUI. The AOC made significant remediation progress with respect to contaminated sediments utilizing the initial "yardsticks," which may be relevant to the Waukegan Harbor AOC with respect to the dredging restrictions BUI targets. Of specific interest also would be the contaminated sediment related studies that have been conducted to assist in developing sediment related delisting guidelines. These studies have been conducted to evaluate surficial sediments that may impair benthos and that may help determine the feasibility of remediation.

Further details of information gathered from other AOCs and their relevance to specific BUIs are discussed below:

4.2.1 Degradation of Benthos

The degradation of benthos BUI in the Waukegan Harbor AOC is demonstrated by a lack of biodiversity, a dominance of pollution tolerant species, a low number of individuals, and a dominance of Tubificidea and Oligochaeta. Illinois EPA studies conducted in the mid-1990s showed benthic Biotic Index classifications of "very poor". The degradation is caused in part by high organic contaminant concentrations in harbor

sediments, lack of proper substrate/habitat and suspension of sediments due to navigational traffic. Other studies within the ESA show poor benthic conditions associated with metal toxicity, urban influences, and sediment contamination. Thus, addressing contaminated sediments and nutrients will aid in the restoration.

The IJC delisting target for this BUI is when the benthic macroinvertebrate community structure does not significantly diverge from unimpacted control sites of comparable physical and chemical characteristics. Further, in the absence of community structure data, this use will be considered restored when toxicity of sediment-associated contaminants is not significantly higher than controls.

The MDEQ Guidance (2006) states that this BUI will be considered restored when "an assessment of benthic community, using either MDEQ's SWAS Procedure #51 for wadeable streams or MDEQ's pending rapid assessment procedure for non-wadeable rivers yields a score for the benthic metrics which meets the standards for aquatic life in any 2 successive monitoring cycles (as defined in the two procedures)" OR, in cases where MDEQ procedures are not applicable and benthic degradation is caused by contaminated sediments, the BUI will be considered restored when "all remedial actions for known contaminated sediment sites with degraded benthos are completed (except minor repairs during operation and maintenance) and monitored according to the approved plan for the site." The MDEQ guidance further indicates that the BUI only applies to surficial sediments where organisms live.

The Four Agency Framework, a government organization consisting of representatives from Federal, State, and Provincial governments focusing on the "shared" AOCs, recommends delisting based on no more benthos than observed in unimpaired areas elsewhere in the Great Lakes basin, or upon comparison with upstream/downstream populations.

On the Canadian side of the Detroit River, the delisting target reflects a benthic community that contains none of the attributes that characterize a degraded community for four years, and toxicity of sediments from test sites should not be significantly higher than controls. The Canadian RAP specifies the criteria for evaluating if the benthic community is degraded.

In the Saginaw AOC, the delisting targets require that samples of mayfly nymphs collected in the open areas of Saginaw Bay exceed 30-square meter for two consecutive years based on established sampling methods. Mayfly nymphs were used as an indicator organism because they are important to fisheries and their populations have been severely impacted since early 1950s.

Severn Sound also has as a partial delisting target, "to maintain and enhance presence of the mayfly Hexagenia as an indicator of ecosystem health."

The delisting target approach utilized for Hamilton Harbour, Ontario AOC could be considered relevant to Waukegan Harbor AOC. Specifically, these targets are: biomass estimates for mesotrophic conditions to range from 25 to 50 gram per cubic meters of wet weight of benthos; shift in oligochaete assemblages from indicators of eutrophic environments to mesotrophic indicators; an increase in the contribution of other species such as midges, fingernail clams, mayflies, and the amphipod Pontoporeia hoyi; reduction in oligochaete density from an average 10,000 animals per square meter found in 1984 to between 2,000 and 3,000 per square meter in profundal sediments; appearance of crustaceans, such as freshwater shrimp in the deep water basin and the amphipod Pontoporeia hoyi in the surficial sediments throughout the

hypolimnion; and absence of acute and chronic toxic effects attributable to trace metals or organics in benthic macroinvertebrates throughout the harbor.

The Manistique River in the Upper Peninsula of Michigan, which feeds into Lake Michigan, has been recommended for delisting and is awaiting final approval by USEPA. The basis for delisting was mainly that sediments contaminated with PCBs and other chemicals have been remediated.

4.2.2 Degradation of Phytoplankton and Zooplankton Populations

In Michigan, the only AOC impacted by this BUI is Saginaw. The MDEQ Guidance (2006) states that this BUI will be considered restored when "the Statewide delisting targets for the Eutrophication or Undesirable Algae BUI have been met in Saginaw River/Bay/AOC."

The only other AOCs impacted besides the Waukegan Harbor AOC and Saginaw are the Rochester Embayment, (New York), Cuyahoga River (Ohio), the Milwaukee River Estuary (Wisconsin), and the Grand Calumet River/Indiana Harbor AOC (Indiana).

For the Rochester Embayment, the delisting target is: "Ninety percent of ambient water samples (collected monthly for one year), compared to a control, cause no chronic toxicity to Ceriodaphnia dubia."

The Grand Calumet River/Indiana Harbor AOC delisting target is: "Phytoplankton or zooplankton bioassays confirm no toxicity in ambient waters and the community structure is diverse and contains species indicative of clean water; and Waters within the Grand Calumet River AOC are not listed as impaired due to degradation of phytoplankton or zooplankton in the most recent Indiana Integrated Water Monitoring and Assessment Report (submitted to U.S. EPA every two years) and/or the most recent Indiana Fish Consumption Advisory."

The State of Ohio's delisting target is: "Phytoplankton or zooplankton bioassays (e.g. Ceriodaphnia, algal fractionation bioassays) confirm no toxicity in ambient waters and/or community structure is diverse and contains species indicative of clean water."

4.2.3 Loss of Fish & Wildlife Habitat

The Michigan guidance for this BUI is the same as the BUI for Degradation of Fish and Wildlife populations. Water quality standards must be met, and if not, sources of water quality contamination be controlled. A restoration plan must be developed and implemented which includes: a short narrative on the historical fish and wildlife population loss and degradation in the AOC, including how habitat has been impaired by water quality; a description of the impairment and location for at least one critical habitat site or for multiple sites where determined appropriate at the local level; a locally derived restoration goal/target for each habitat site; a list of all other ongoing habitat restoration planning processes in the AOC and a description of their relationship to the restoration projects proposed in the plan; and a work plan including:

- Specific habitat restoration actions(s) to be completed
- Timetable
- Funding
- Responsible entities
- Indicators and monitoring

- Public involvement

A specific plan for reporting on habitat restoration implementation actions(s) to the MDEQ must be included. Fish and wildlife populations need not be fully restored before delisting the habitat BUI.

The Ohio guidance (2005) delisting targets are as follows:

For Fisheries Habitat:
For mainstem and tributaries, habitat quality shall average a Qualitative Habitat Evaluation Index QHEI score of 60 or better throughout the freeflowing stream stretches of the AOC;

and

Ohio Aquatic Life Water Quality Standards are met;

OR

Fish and Wildlife officials do not identify loss of, or poor quality, habitat as cause for nonattainment with fishery goals.

For Wildlife Habitat:
Forested buffers exist on 50% of residential tributaries and 25% of urban tributaries;

and

For headwater streams, Headwater Habitat Evaluation Index HHEI habitat quality shall average a score of 30 for warm water streams and 70 for cold water streams;

OR

For headwater streams and wetlands, State Aquatic Life Water Quality Standards are met;

OR

Wildlife officials do not identify loss of or poor quality habitat as cause for non-attainment with wildlife goals.

The Ohio milestones include:

- Buffers, conservation easements, riparian setback ordinances or other protective mechanisms are in place on more than 80% of the streams and tributaries
- Over 10% of major watershed and over 6% of sub-watershed is high quality wetland habitat
- Over 75% of the stream length is naturally vegetated
- Less than 15% of watershed is impervious
- Over 30% of the watershed is in forest cover

The Detroit River on the Canadian side set delisting criteria that state, "The amount of habitat required to meet applicable fish and wildlife management goals has been achieved. Loss of productive fish and wildlife habitat has ceased, and existing quality habitat is protected. At a minimum, twelve percent of the AOC watershed should be comprised of quality natural cover, and a buffer of natural riparian vegetation should border 75 percent of all First-to-Third Order streams and virtually all wetlands."

The Saginaw AOC developed the following delisting criteria for this BUI:

- Dissolved oxygen criteria: 5 mg/L during summer
- Protection of coastal marsh
- Targeted restoration: documentation of natural reproduction of Lake Sturgeon in Saginaw River, abundance measures for Yellow Perch and Walleye.

River Raisin is currently considering "Meet delisting criteria for Degradation of Fish & Wildlife Populations BUI and complete the identified habitat restoration projects" as their delisting targets for this BU.

4.2.4 Beach Closing

The IJC Criteria states that the BUI can be delisted "when waters, commonly used for total-body contact or partial body-contact recreation, do not exceed standards, objectives, or guidelines for such use."

The Michigan MDEQ Guidance (2006) states that this BUI will be considered restored when "no water bodies within the AOC are included on the list of impaired waters due to contamination with pathogens in the most recent *Clean Water Act Water Quality and Pollution Control in Michigan: Section 303(d) and 305(b) Integrated Report*, which is submitted to U.S. EPA every two years." The limits for E. coli are set by Michigan's Water Quality Standards for bacterial contamination (Rule 323.1062). The rule states that for partial and total body contact bacterial densities shall not exceed 130 E.coli per 100 ml for total body contact recreation and 1000/100 ml for partial body contact based on a specified monitoring protocol. Many of the Michigan AOCs have adopted this guidance for their delisting target or are in the process of adopting the guidance.

The Ohio Guidance (2005) document has delisting targets as follows:

Total Body Contact:
For Bathing Waters - For bathing waters (primarily Lake Erie beaches), no more than 10 posted advisory days, due to high bacteria levels, per year for five consecutive years;

OR

For Primary Contact Recreation, for stream segments designated as such in the Ohio WQS, the 75th percentile of all samples collected in one year does not exceed 1000 per 100 ml fecal coliform or the 90th percentile does not exceed 2000 per 100ml fecal coliform;

OR

For *E.coli,* the 75th percentile does not exceed 126 per 100ml or the 90th percentile does not exceed 298 per 100ml. This standard must be met for five consecutive years.

Partial Body Contact:
For Secondary Contact Recreation, for streams designated as such in the Ohio WQS, the 90th percentile of samples collected over a five year period does not exceed 5000 per 100ml fecal coliform or 576 per 100ml *E. coli*.;

and

No local or state contact advisories related to the presence of a chemical contaminant exist.

The St. Louis River AOC anticipates that this impairment can only be met when the entire AOC attains the target rather than just designated beach areas. The St Louis River AOC target considers control of sanitary and stormwater sources, absence of impaired water listings, and establishment of an effective bacterial monitoring program.

The Canadian side of the Detroit River based its delisting targets generically on total or partial body contact standards, guidelines and objectives not be exceeded, and that there are no beach closures as a result of water quality problems for two years.

The Rouge River set its target for concentrations of bacteria during dry weather flow to be below full body contact criteria at all its recreational areas for three consecutive summers. Saginaw River is similar. St. Clair River has adopted the Michigan Guidance which includes:

No waterbodies within the AOC are included on the list of non-attaining waters due to contamination with pathogens in the most recent Clean Water Act *Water Quality and Pollution Control in Michigan: Section 303(d) and 305(b) Integrated Report* (Integrated Report), which is submitted to U.S. EPA every two years.

OR, in cases where the waterbodies within the AOC are on the list of nonattaining waters due to the presence of Combined Sewer Overflows (CSOs) or are impacted by upstream CSOs, and significant progress has been made towards their elimination, this BUI will be considered restored when:

2. Monitoring in the AOC during the recreation period, using the sampling protocol outlined in Rule 62 of the Michigan WQS, meets the following criteria:

- The sampling plan and Quality Assurance Project Plan are approved by the MDEQ;
- *E. coli* concentrations are below a 30-day geometric mean of 130 counts per 100 milliliters (ml);
- at least 90% of sample results are below the daily geometric mean limits of 300 counts *E. coli* per 100 ml;
- no more than 1 of the sample results exceed the partial-body contact water quality standard of 1,000 counts *E. coli* per 100 ml based on a daily geometric mean; and
- DEQ-approved plans in a National Pollutant Discharge Elimination System (NPDES) permit are in place for addressing any remaining CSOs that are causing BUIs and the implementation plan is on schedule.

Sampling under approach 2 is done systematically throughout the recreation season, and does not specifically monitor wet weather discharges from CSOs. Meeting the above criteria does not negate regulatory requirements for separating CSOs in order to meet water quality standards.

4.2.5 Restrictions on Fish and Wildlife Consumption

IJC recommends that this BUI is restored "when contaminant levels in fish and wildlife populations do not exceed current standards, objectives or guidelines and no public health advisories are in effect for human consumption of fish and wildlife. Contaminant levels in fish and wildlife must not be due to contaminant input from the watershed." The limitation to using this criterion is that contaminants in other sites can be transported to the AOC by atmospheric deposition, and thus will stay in the food chain. A potentially more rational approach is reflected in the Delisting Targets for Ohio AOCs document (2005) that bases this delisting target on "no fish and wildlife consumption advisories attributed to sources within the AOC." Additionally, the proposed milestones include not only tracking changes in fish tissues and advisories, but also set fish tissue contaminant maximums for PCBs (50 ppb), mercury (50 ppb) and lead (86 ppb).

The Four Agency Framework recommends basing delisting targets for this BUI on appropriate assessment programs and reporting for a suite of most at risk chemicals and consumption guidelines (on the most current and restrictive guidelines).

The Great Lakes Fish Consumption Advisory Task Force limit for "no consumption" is for PCB levels above 2000 ng/g, which only applies to lake trout in Lake Michigan. Coho salmon sometimes fall into lesser categories such as "one meal per month" up to "no more than six meals per year."

The Michigan Guidance (2006) is silent with respect to wildlife consumption because there are no AOCs in Michigan with advisories for wildlife. The fish advisories are set by the Michigan Department of Community Health (MDCH). The Michigan guidance states that the BUI is considered restored when "the fish consumption advisories in the AOC are the same or less restrictive than the associated Great Lake or appropriate control site";

OR

If the advisory is more stringent than its associated Great Lake or control site, "a comparison study of fish tissue contaminant levels demonstrates that there is no statistically significant difference in fish tissue concentrations of contaminants causing fish consumption advisories in the AOC compared to a control site";

OR

If a comparison study is not feasible because of the lack of a suitable control site: "analysis of trend data (if available) for fish with consumption advisories shows similar trends to other appropriate Great Lakes trend sites." In addition, more details are given as to how to conduct the comparison, including choosing the same species as in control site, controlling for variables that affect contaminant concentrations in tissues, comparing data between the AOC and control site collected within a year of each other, and testing statistically significant differences between AOC and the control site. Michigan AOCs impacted by this BUI

include Detroit River, Rouge River, River Raisin, St. Clair River, Torch Lake, Deer Lake and Carp Creek, St. Mary's River, Saginaw River, Kalamazoo River, Muskegon Lake, White Lake, and Manistique River.

In the Saginaw River AOC (Michigan) fish contaminant delisting targets are based on a comparison of contaminant (PCBs and dioxin) levels in other areas of Great Lakes that are not listed as AOCs and on indications from caged fish studies that PCBs sources have been controlled. Comparison to a reference site could be considered in the Waukegan Harbor AOC. However, reference sites have to be carefully chosen and agreed upon by the Illinois EPA, USEPA and stakeholders.

4.2.6 Restrictions on Dredging Activities

The Michigan Guidance (2006) states that the BUI is considered to be restored when "there have been no restrictions on routine commercial or recreational navigational channel dredging by the US Army Corps of Engineers, based on the most recent dredging cycle, such that special handling or use of a confined disposal facility required for dredge spoils due to chemical contamination";

OR

In cases where dredging restrictions exist, "a comparison of sediment contaminant data from the commercial or recreational navigational channel (at the time of proposed dredging) in the AOC indicates that contaminant levels are not statistically different from other comparable, non AOC commercial or recreational navigation channels."

The Canadian Detroit River AOC delisting targets are based on contaminants in sediments not exceeding applicable standards, criteria, or guidelines. As such, there would be no restrictions on dredging or disposal activities.

> The US does not have any sediment quality guidelines, nor does the State of Illinois. One approach would be to use the Tiered Approach for Corrective Action Objectives (TACO) residential standards as representative of generally "clean" material that could have unrestricted re-use potential. However, EPA has not generally agreed to this approach in the past. In addition, sediment sometimes has nutrient (ammonia in particular) issues that make unrestricted disposal problematic from a water quality point of view; nutrients can be naturally occurring and may not be the result of or indication of anthropogenic impacts on the sediment. Any approach to assessing sediment should follow the USEPA/USACE Great Lakes Dredging Manual and tiered approach for assessment.

The Presque Isle Bay AOC depends on natural attenuation rather than formal remedial action to alleviate contaminated sediment and be delisted.

Since the Waukegan Harbor AOC has several BUIs related to contaminated sediments, the first priority likely is to move forward with the remediation of the remaining known contaminated sites. Some of the same sediments contaminated with PCBs are also ones high in metals. After these sites are remediated, those remaining sediment sites containing high levels of PAHs and metals will be the next most important priorities. Although these historic sites/sources are significant, there remains a potential for ongoing

sources and this potential needs to be monitored. Reference sites for setting specific delisting targets such as was done for Hamilton Harbour also need to be identified and studied.

5.0 DELISTING TARGETS FOR WAUKEGAN HARBOR AOC

An overall consideration for delisting any of the BUIs associated with the Waukegan Harbor AOC is that the AOC is not listed as impaired due to that particular BUI in the most recent Illinois EPA Integrated Water Quality Report and Section 303d Lists (submitted to U.S. EPA every two years). In addition, the following section of this report also contains BUI specific targets that need to be met before delisting can be considered.

Note that the "actions" associated with the delisting targets are not actions necessary to accomplish the targets but are actions that are necessary to monitor progress toward delisting or to provide reference site selection for the BUIs as appropriate.

5.1 DEGRADATION OF BENTHOS

This delisting target is to be based on benthic community health and the impacts of chemical contaminants on that community. The anticipated benthic community quality must be established on a site-specific basis considering conditions that impact the benthic community that can not be changed such as dredging activity in navigation channels, wave-induced and/or current induced sediment resuspension, ice scour and prop wash, to assure that the endpoint comparison is consistent with the ability of the habitat and external impacts to support a viable benthic community and is reflective of conditions that exist in similar active commercial harbor AOCs.

This BUI will be considered for delisting when:

1. Known contaminant sources contributing to sediment contamination and degraded benthos have been identified and control measures implemented; and
2. The benthic community is representative of a similar harbor related benthic community in population and species compared to an acceptable harbor control site.

Actions

1. Identify the appropriate species and community structure that should exist in the Waukegan Harbor AOC under non-impaired conditions.
2 Determine appropriate sampling locations within the AOC based on historical sampling locations and sites of known impact.
3. Establish an appropriate harbor reference site in conjunction with Illinois EPA.

5.2 DEGRADATION OF ZOOPLANKTON/PHYTOPLANKTON

This BUI will be considered for delisting when:

1. A baseline condition has been established to evaluate the extent of this impairment. Phytoplankton and zooplankton community surveys should be conducted and compared to a non-impacted or minimally impacted harbor type reference site to set the baseline condition. If the

community structure is statistically different than the reference conditions, this BU should be considered impaired.

2. If the BU is considered to be impaired then identify the factors leading to this impairment.
   a. Ambient water chemistry sampling should be conducted to determine if nutrient enrichment is the main contributor. If nutrients are the main contributor, the BUI can be considered for delisting when the sources causing nutrient enrichment to the AOC are identified and controlled.
   b. If nutrient enrichment is not considered the cause of the impairment, conduct bioassays to determine if ambient water toxicity is causing impairment.
   c. Identify the sources of the toxicity and eliminate/control those sources.
3. The phytoplankton/zooplankton community is representative of similar harbor related communities in population and species compared to an acceptable harbor control site.

Actions

1. Identify the appropriate species and community structure that should exist in the Waukegan Harbor AOC under non-impaired conditions.
2. Develop appropriate scientifically based monitoring scenarios to establish a baseline and trends.
3. Determine appropriate sampling locations within the AOC based on historical sampling locations and sites of known impact.
4. Establish an appropriate harbor reference site in conjunction with Illinois EPA.

5.3 LOSS OF FISH AND WILDLIFE HABITAT

This BUI can be considered for delisting when:

1. A local fish and wildlife habitat management and restoration/rehabilitation plan has been developed for the entire AOC that:
   a. Defines the causes of all habitat impairments within the AOC;
   b. Establishes site-specific habitat and population targets for fish and wildlife species within the AOC;
   c. Identifies all fish and wildlife habitat restoration programs and activities within the AOC and establishes a mechanism to assure coordination among the programs/activities including identification of lead agencies;
   d. Establishes a timetable, funding mechanisms and lead agency responsibility for all fish and wildlife habitat restoration activities within the AOC.
2. The programs and actions necessary to accomplish the recommendations identified in the fish and wildlife management and restoration plan are implemented, and modified as needed to ensure continual improvement.

Actions

1. Establish appropriate fish and wildlife monitoring programs to determine current baseline conditions and trends in populations as recommended habitat site restoration projects are implemented.

5.4 BEACH CLOSING

This BUI will be considered for delisting when:

1. All known man made sources of bacterial contamination to the AOC have been controlled or treated to reduce exposures, where feasible.

Actions

1. Continue ongoing bacterial monitoring programs within the AOC and expand as necessary.
2. Conduct annual review of the data collected to determine if sample numbers and/or locations should be increased or decreased.

5.5 RESTRICTIONS ON FISH AND WILDLIFE CONSUMPTION

There is no hunting allowed within the AOC so this delisting target is focused on delisting the restrictions on fish consumption. This BUI will be considered for delisting when:

1. The fish consumption advisories in the AOC are the same or less restrictive than those in Lake Michigan or an appropriate control site;

OR

If the advisory in the AOC is more stringent than those in Lake Michigan or an appropriate control site:

2. A comparison study of fish tissue contaminant levels demonstrates that there is no statistically significant difference in fish tissue concentrations of contaminants causing fish consumption advisories in the AOC compared to a control site;

OR

If a comparison study is not feasible because of the lack of a suitable control site:

3. Analysis of trend data (if available) for fish with consumption advisories shows similar trends to other appropriate Great Lakes trend sites.

When comparison studies (per #2 above) are used to demonstrate restoration of a BUI, the studies will:

- Be designed to control variables known to influence contaminant concentrations such as species, size, age, sample type, lipids and other relevant variables from the examples in the Illinois EPA /IDNR fish contaminant monitoring programs.
- Include a control site which is agreed to by the Illinois EPA, in consultation with the CAG. It will be chosen based on physical, chemical, and biological similarity to the AOC and the 2 sites must be within the same U.S. EPA Level III Ecoregions for the Conterminous U.S. (see references).
- When a single control site cannot be found, sites may be pooled for comparisons.

- Use fish samples collected from the AOC and control site within the same time frame (ideally 1 year).
- Evaluate contaminant levels in the same species of fish from the AOC and the control site to avoid problems with cross-species comparisons. In addition, fish used for comparison studies should be the same species as the consumption advisory.

If there is no statistically significant difference (alpha = 0.05) in fish tissue concentrations of contaminants causing advisories in the AOC compared to a control site, then the BUI has been restored. If there is a significant difference between the AOC and the control site in the comparison study, then an impairment still exists.

If a comparison study is not practical for the Waukegan Harbor AOC due to the lack of an appropriate control site, then trend monitoring data (if available) can be used to determine restoration success (as per approach #3 above). If trend analysis of fish with consumption advisories shows similar trends to other appropriate, Illinois EPA approved Great Lakes trend sites, this BUI will be considered restored. If trend analysis does not show similarity to other appropriate Great Lakes trends sites, then an impairment exists.

Actions

1. Determine appropriate fish species for tissue concentration trend analysis
2. Implement an appropriate monitoring program within the AOC that will isolate on-going sources of fish contaminants to the AOC
3. Establish appropriate control/comparison sites within the AOC or a similar harbor area for evaluating relative progress toward attaining the restoration targets utilizing comparative contaminate analysis. The studies should be designed to control variables known to influence contaminant concentrations such as species, size, age, sample type, lipids, and collection dates. The control site should be chosen based on physical, chemical, and biological similarity to the AOC.

5.6 RESTRICTIONS ON DREDGING ACTIVITY

This BUI will be considered for delisting when:

1. Dredged material within the AOC is of suitable quality for “open water” disposal, unrestricted upland use, or beach nourishment.

OR

where dredged material quality does not meet 1 above:

2. A comparison of sediment contaminant data from the commercial or recreational navigation channel in the AOC indicates that contaminant levels are not statistically different from other comparable, non-AOC commercial or recreational navigation channels.

Actions

1. Track dredged material quality for projects within the AOC to determine when delisting criteria are being met through review of issued dredging permits and/or sediment quality sampling prior to and during dredging operations.

6.0 PATHWAY TO RESTORATION—HOW DO WE GET THERE?

6.1 BASIC IMPLEMENTATION CONCEPTS

Setting Restoration Goals
This project is a first step towards establishing delisting targets that are locally derived and measurable and meet the criteria for the frequency and longevity of monitoring that is consistent with federal and state regulations & GLWQA Annex 2. These goals should focus both on the overall AOC and any appropriate sub areas defined within the AOC.

Evaluate Delisting on the Basis of Outside or Natural Factors
BUIs should be evaluated for factors outside the watershed. If restoration of a BUI is not possible because of factors outside the AOC, or is typical of lake-wide or region-wide conditions, delisting can be recommended on this basis and BUI can be referred to Lakewide Management Plan (LaMP). If the BUI is due to natural causes, not human sources, delisting can be recommended on that basis.

Implementing Restoration Goals
The vehicle for ultimate implementation of the delisting/restoration efforts within the AOC focused on achieving the delisting targets is the Remedial Action Plan (RAP). This next generation RAP, and subsequent iterations, will help identify and prioritize BUIs that can be most easily delisted and identify the steps necessary to work towards implementing restoration for all BUIs. This next generation RAP constitutes a restoration work plan that must include:

- Establishment of a realistic restoration budget
- Selection of reference sites where needed
- Establishment of a timeline for implementation including such major milestones as:
  - contaminant removal
  - point source pollution monitoring and prevention
  - non-point source BMP implementation
  - habitat restoration
- Development of long term funding sources and agreements
- Establishment of necessary monitoring networks to create baseline data and measure progress in achieving delisting targets
- Establishment of implementation alternatives such as evaluation of low level, widespread contamination for feasibility of natural attenuation as a restoration alternative

Once it has been established that delisting targets have been met or that progress is moving extensively towards delisting goals, the BUI can be recommended for delisting or placement in the “recovery” stage. “Recovery Stage” is a post implementation period during which the AOC ecosystem is responding to actions taken and no further active intervention is needed, and that a period of recovery is required to fully achieve the delisting targets. The following guidelines can be used to determine if an AOC qualifies for designation as being in a “recovery stage”:

- All reasonable and practical implementation has occurred to address the sources of environmental degradation with present day tools.
- Commitments to a monitoring plan and program are in place to measure progress towards environmental restoration, and a mechanism is established to report systematically to the public at a predefined frequency.
- The severity of the impairments will influence the rate of recovery. The time scale for recovery of the AOC ecosystem is agreed upon by the Illinois EPA in partnership with the Waukegan Harbor CAG, with the agreement that this decision can be revised based on the system's response to remedial measures as indicated by an active post-remedial monitoring program.
- The Illinois EPA in partnership with the Waukegan Harbor CAG and local public are satisfied with current conditions and the natural recovery strategy.
- Entering recovery stage must be accompanied by a commitment of governments or other partners to maintain their responsibilities. Governments will continue to undertake environmental improvements as part of their mandates, beyond the needs of the RAPs.
- Pollution prevention or other maintenance plan is in place to reduce the risk of future degradation, and to insure that recovery can proceed.
- A process is in place to respond to future development pressures and emerging technologies such that environmental recovery is sustainable and further intervention can take place if warranted. This will also allow for the identification of emerging issues in the AOC.

Illinois EPA in partnership with the Waukegan Harbor CAG, working in consultation with the public and stakeholders, would then submit a recommendation to delist, or place in "recovery", the AOC, or portions thereof, and complete a Draft RAP Report to EPA and Illinois EPA. The recommendation spells out the roles and responsibilities for implementation of the RAP.

Formal request to have AOC delisted

A long-term monitoring plan must be written. Restoration must be completed or well underway and meeting restoration goals at all sites before an AOC can be delisted. Resources needed, for long-term monitoring and protection, must be in place to prevent future degradation from occurring.

6.2 TIMELINE OF THE IMPLEMENTATION

- Adopt proposed delisting targets for the Waukegan Harbor AOC by October 2008.
- Complete RAP Update by September 2010.
- Develop baseline monitoring network by September 2009.
- Begin implementation of all BUIs restoration programs within the AOC by 2012.
- Achieve "recovery"/delisting/restoration status of at least one BUI annually starting in 2012.

7.0 CONCLUSION AND RECOMMENDATIONS

Delisting targets have been developed to address the six BUIs within the Waukegan Harbor AOC. The targets were reviewed and adopted by the Illinois EPA and the project technical committee. These targets were developed specifically for the Waukegan Harbor AOC.

Recommendations:

- The delisting targets need to be incorporated into the process of goal setting in the next iteration of the planning for the AOC and tributary areas.
- Specific actions necessary to implement the delisting targets have been identified for the six Waukegan Harbor AOC BUIs. Many of these actions relate to the identification of target species for tracking trends, the establishment of control sites or the establishment of baseline conditions. The appropriate agencies and/or organizations should be identified to best carry out these actions and allow for the tracking and monitoring necessary to apply the delisting target.
- The next generation RAP update that will be initiated shortly needs to utilize the delisting targets in developing the overall goals and action plans for the Waukegan Harbor AOC.
- The Illinois EPA in partnership with the Waukegan Harbor CAG should periodically review the status of restoration efforts within the AOC and determine the degree of progress toward attainment of the delisting targets.

8.0 REFERENCES

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