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Executive Summary

The Illinois Environmental Protection Agency (IEPA) is conducting a Use Attainability Analysis (UAA) of the Chicago Area Waterway System (CAWS). The primary focus of the UAA is on the Chicago River System and Calumet River System waterway reaches currently classified by the Illinois Pollution Control Board (IPCB) as Secondary Contact and Indigenous Aquatic Life. Three CAWS reaches are General Use, upgraded relatively recently without undergoing the rigors of a UAA. The UAA excludes the reach of the Lower Des Plaines River currently being evaluated through a separate UAA. The purpose of the CAWS UAA is to evaluate existing conditions, including waterway use practices and anticipated future uses to determine if use classification revisions are warranted. The IEPA wishes to examine the present Secondary Contact and Indigenous Aquatic Life portions of CAWS to evaluate whether use upgrades for balanced aquatic life and contact recreation are achievable and whether downgrades of the General Use reaches are appropriate.

An upgrade to balanced aquatic life and contact recreation use designations may conflict with important existing uses, such as navigation, wastewater and stormwater management. It is the intent of the UAA, through stakeholder involvement, to consider these potential conflicts while developing criteria for uses that would meet or approach aquatic life protection and primary contact recreational uses ("fishable/swimmable") required by the Clean Water Act (CWA). If the statutory CWA uses are not attainable, the UAA will define the most optimal attainable use for each water body.

South Branch Marina

The Chicago area is home to a large and diverse series of waterways, many of which have been man-made in order to facilitate water flow away from Lake Michigan to protect drinking water and recreational uses. The Chicago area waterways have experienced many changes throughout the last century, and there have been dramatic improvements in water quality and expansions in shoreline development in the last 25 years. The City of Chicago, the Metropolitan Wastewater Reclamation District of Greater Chicago (MWRDGC), Cook County, United States Environmental Protection Agency (USEPA), IEPA, industries and local environmental organizations all have a vested interest in the future of the Chicago area waterways and have participated as valuable stakeholders in the UAA process.

1.1 UAA Process

USEPA's water quality standards regulation (40 CFR 131.10(j)) requires states to conduct a UAA when designating uses which do not include the goals of the Act, or when designating new subcategories of uses which require less stringent criteria. Alternatively, in the case of CAWS, where recent water quality improvements have occurred, IEPA wishes to examine the present Secondary Contact and Indigenous Aquatic Life designated sections of the Chicago area waterways to determine whether a use upgrade for balanced aquatic life and contact recreation are achievable and to determine whether relatively recent upgrades of General Use reaches in CAWS were appropriate.

Designated uses are those uses specified in state water quality standards for each of the waterway reaches whether or not they are being attained. Existing uses are those uses attained on or after November 28, 1975, whether they are included in the water quality standards. Once a state has designated a use or uses for a given waterway, then water quality criteria need to be developed to protect those uses.

Illinois presently has two major use designations that apply to CAWS: General Use, and Secondary Contact and Indigenous Aquatic Life Use (35 Ill. Adm. Code 303). The General Use water quality standards comply with CWA goals in that they protect aquatic life, wildlife, agricultural use, secondary contact, most industrial uses and they safeguard the aesthetic quality of the aquatic environment. Primary contact uses are protected for all General Use waters whose physical configuration permits such use (35 Ill. Adm. Code 302.202). Illinois defines primary contact as: any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing.

Secondary Contact and Indigenous Aquatic Life use standards are intended for those waters not suited for general use activities, but which are appropriate for all secondary contact uses and are capable of supporting indigenous aquatic life limited only by the physical configuration of the body of water, characteristics and origin of the water and the presence of contaminants in amounts that do not exceed the water quality standards listed in 35 Ill. Adm. Code 302 Subpart D. Secondary Contact means any recreational or other water use in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial and recreational boating (e.g. canoeing and kayaking) and any limited contact incident to shoreline activity.

Uses are considered attainable if they can be achieved by adopting effluent limits required under Sections 301(b) and 306 of the CWA and the implementation of cost-effective and reasonable best management practices (BMPs) for non-point source control. Uses that can be achieved by applying appropriate pollution control technology as require in the CWA are likewise considered attainable unless one of the six factors listed in 40 CFR 131.10(g) can be satisfied. Those six factors are:

- Naturally occurring pollutant concentrations prevent the attainment of the use.

- Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be offset by the discharge of a sufficient volume of effluent, (may be used for determining aquatic life use, but may not be used solely to determine recreational use).

- Human caused conditions or sources of pollution prevent the attainment of the use, and cannot be remedied or would cause more environmental damage to correct than to leave in place.

- Dams, diversions or other types of hydrologic modifications preclude the attainment of the use and it is not feasible to restore the water body to its original condition or to operate such modifications in such a way that would result in the attainment of the use.

- Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses, (may be used for determining aquatic life use, but may not be used solely to determine recreational use).

- Controls more stringent than those required by Sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

1.2 Objectives of the UAA

The objectives of the study, as specified by IEPA include:

- Review and evaluation of all available environmental data from the last 5 – 10 years to determine the physical, chemical, and biological conditions of the waterway, recommending additional data gathering activities and coordinating the generation and evaluation of additional data as may be necessary to accomplish the objectives.

- Identification and characterization of the types, causes and sources of major stressors on the system including potential use impairments identified in the agency's most recent CWA Section 303(d) List.

- Assessment of available water quality and habitat management options for eliminating or reducing system stressors.

- Determination of the potential to achieve and maintain use classification other than existing classifications.

- Development of recommended use designations and associated water quality standards
- Identification of strategies that would help CAWS meet the goals of the CWA.
- Providing expert testimony before the IPCB in support of use designation changes.
- Establishment and coordination of stakeholder involvement in the UAA process.

1.3 CAWS Description

The primary focus of the UAA will be on CAWS reaches currently classified as Secondary Contact and Indigenous Aquatic Life (**Figure 1-1**). There are several major General Use waterway segments, reaches or tributaries adjoining the Secondary Contact waterways which are similar in structure and function. The three General Use reaches were upgraded in the 1980's without undergoing a UAA. The CAWS UAA addresses the following waterways:

Secondary Contact and Indigenous Aquatic Life

- North Shore Channel (NSC) downstream of the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) North Side Water Reclamation Plant (WRP)
- North Branch Chicago River (NBCR) from its confluence with the North Shore Channel to its confluence with the South Branch
- Chicago Sanitary and Ship Canal (CSSC)
- South Branch of the Chicago River (SBCR) and South Fork (Bubbly Creek)
- Calumet-Sag Channel
- The Little Calumet River from its junction with the Grand Calumet River to the Calumet-Sag Channel
- The Grand Calumet River (GCR)
- The Calumet River, except the 6.8 mile segment extending from the O'Brien Locks and Dam to Lake Michigan
- Lake Calumet

Figure 1-1
Chicago Area Waterway System (CAWS)

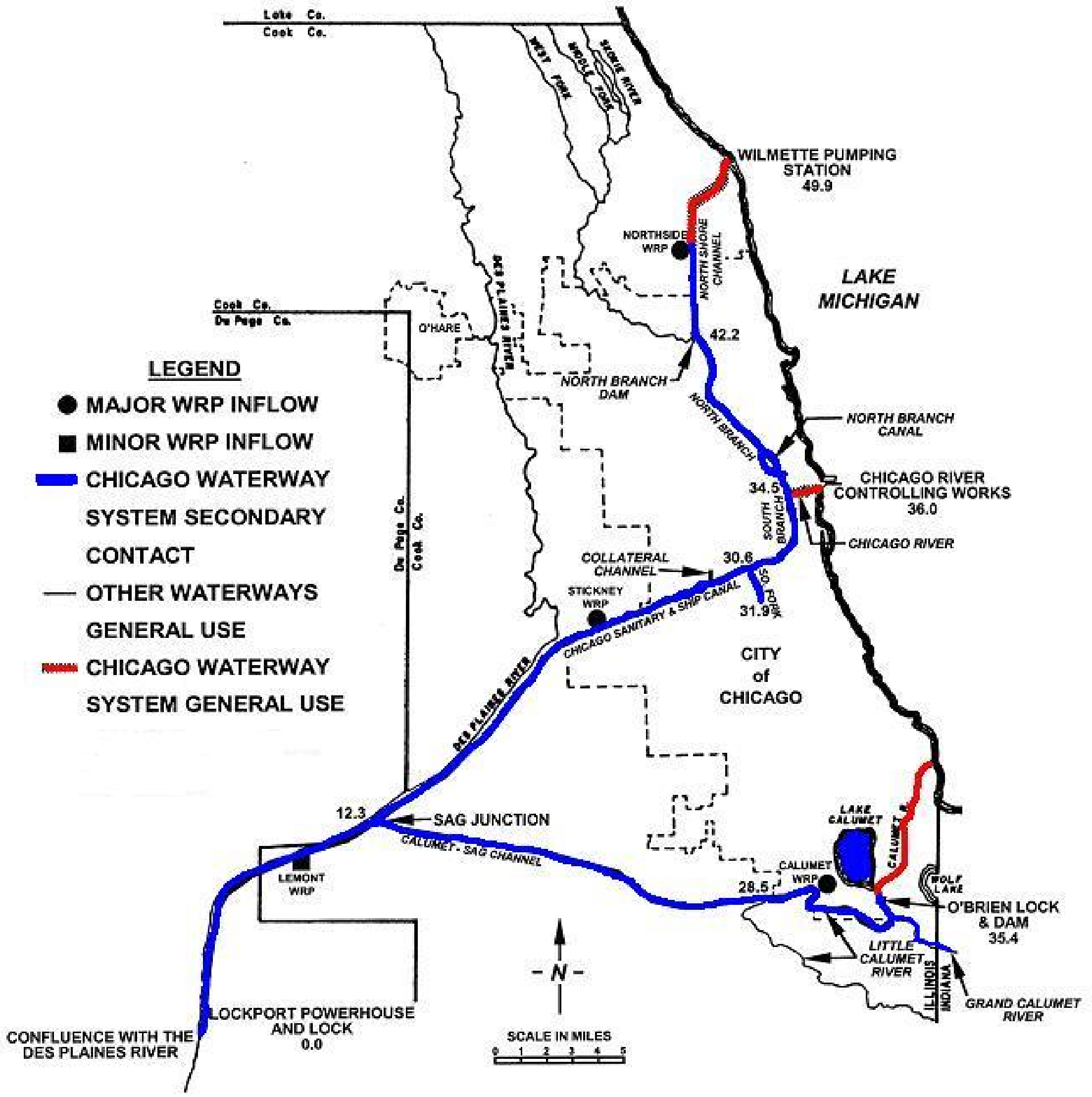

Figure provided by MWRDGC and modified by CDM

General Use

- North Shore Channel upstream of the MWRDGC North Side WRP
- Chicago River
- Calumet River upstream (lakeside) of O'Brien Lock

CAWS consists of 78 miles of man-made canals and modified river channels which provide an outlet for drainage of urban storm water runoff, treated municipal wastewater effluent and support commercial navigation. The waterways also support recreational boating, fishing, streamside recreation and aquatic habitat for wildlife. Approximately 75 percent of the waterway length consists of man-made canals where no waterway existed previously. The remainder is natural streams that have been deepened, straightened or widened. The flow is artificially controlled by four hydraulic structures managed by MWRDGC. The level of water in the waterways can be lowered in the anticipation of a storm event to provide additional storage for flood control. Wastewater effluent makes up approximately 70 percent of the annual flow going through the Lockport Powerhouse and Lock and Dam facility.

1.4 Data Analysis

The UAA process required the analysis of physical, chemical, biological, recreational and other data to characterize existing conditions and assess uses. Since the waterways were monitored extensively over the past two decades by various agencies, the UAA utilized these resources and collected additional field data to fill significant and high priority data gaps. Since there have been significant improvements in MWRDGC's wastewater treatment operations throughout the last ten years, including the construction of the Tunnel and Reservoir Project (TARP), the focus on data evaluation has been on the most recent data collected within the last five (and some cases ten) years.

More than ten different agencies and stakeholders at-large were solicited to provide relevant water quality and sediment data collected for a five year period from January 1, 1998 to December 31, 2002. Biological data which includes fish and macroinvertebrates were evaluated from data sets collected between 1992-2002. The complete data set included:

- Water Quality
- Sediment Chemistry
- Biological (fish and macroinvertebrates)
- Habitat
- Aesthetics

- Hydrological and Meteorological
- Waterway Use
- Mapping/Geographical Information Systems (GIS)
- Recreational

Water quality data was evaluated using a use attainment screening approach that identified whether CAWS reach segments are currently attaining Clean Water Act goals. In-stream water quality data were compared to General Use water quality criteria to determine whether recent water quality conditions justified a use upgrade for reaches currently designated as Secondary Contact and Indigenous Aquatic Life Use, or a use downgrade for reaches designated as General Use. The use attainment screening approach identified constituents of concern that are limiting attainment of CWA goals or potential use designations developed through the UAA.

What Does the Data Tell Us?

Water Quality

The data shows that the overall water quality in CAWS during dry weather periods for the most part meets the General Use water quality standards (screening criteria). The exceptions were for bacteria, dissolved oxygen (D.O.), temperature, ammonia and selected heavy metals. Selected reaches of CAWS had better water quality than others, with the sites with the greatest water quality problems being influenced more by the contribution of combined sewer overflows (CSOs) and the hydrologic nature of the waterway.

North Shore Channel (Upper and Lower)

Dissolved oxygen was the water quality parameter of concern in the upper NSC with levels falling below the 6 mg/L water quality screening criteria over 50% of the time. The low D.O. levels are most likely attributable to low flow stagnant conditions, coupled with CSO input and storm water discharges. Dissolved oxygen in this reach often takes several days to recover, depending on the severity of the event, the amount of the discretionary lake diversion and other factors.

CSOs are the likely cause for the elevated bacteria levels in the upper NSC and occasionally, back flow from the North Side WRP will contribute to the bacterial contamination of this reach. The bacteria data shows that on average, the bacteria levels in the upper NSC can support a limited contact recreation (*E. coli* < 1030 cfu). However, caution would have to be exercised during and following a wet-weather event. The lower NSC flow is dominated by the non-disinfected effluent from the North Side WRP which contains elevated levels of bacteria exceeding limited recreation contact (*E. coli* <1030) and recreational navigation (*E. coli* >1030 and < 2740 cfu) water quality screening criteria.

Dissolved zinc was the only metal that exceeded water quality screening criteria greater than 10% of the time. Total silver was the next highest (8%) and the remaining other General Use water quality constituents met or slightly exceeded the water quality screening criteria.

Chicago River System

Dissolved oxygen levels in the North Branch fell below the 6 mg/L standard over 50% of the time from Fullerton Avenue to Kinzie Street, fell below the 5 mg/L standard 18% of the time in this reach.

D.O. levels in the Chicago River are good and only fell below the 6 mg/L standard about 5% of the time. In the South Branch the D.O. levels are comparable to the North Branch, with poorest D.O. occurring in the South Fork, where even the 4 mg/L level was not met approximately 45% of the time. The South Fork is a stagnant waterbody that receives no flow unless the Racine Avenue Pump Station is discharging. The pump station discharges combined sewer overflow to the South Fork, which is high in oxygen demanding material, as well as bacteria, solids and floatables. The percent of time dissolved oxygen levels dropped below water quality screening criteria in the upper Chicago River system were significantly greater during CSO impacted periods.

In the CSSC, dissolved oxygen levels fell below the 6 mg/L water quality screening criteria more than 55% of the time, with the 5 mg/L and the 4 mg/L not being met 32% and 12% of the time, respectively.

Bacteria levels in the upper and lower North Branch exceed the limited contact recreation water and recreational water quality screening criteria. Bacteria levels begin to meet recreational navigation criteria at Grand Avenue in Chicago. Bacteria levels in the Chicago River and South Branch met the limited contact recreation water quality screening criteria a significant portion of the time, including the South Fork. However, CSO overflows can cause bacteria levels to rise dramatically above proposed standards. Downstream of the Stickney WRP, the bacteria levels in the CSSC exceed water quality screening criteria for both limited contact recreation and recreational navigation. Bacteria levels decline in a downstream fashion from the Stickney WRP, and become acceptable for recreational navigation at Route 83, and meets water quality screening criteria for limited contact recreation by the time it reaches the Lockport Powerhouse and Dam.

In the North Branch, the Chicago River and South Branch (including the South Fork), total silver, dissolved nickel, dissolved zinc were the only metals that exceeded water quality screening criteria greater than 5% of the time. Ammonia levels in the North Branch, South Branch and South Fork exceeded water quality screening criteria 5% of the time. In the CSSC, ammonia, total silver, pH and temperature exceeded water quality screening criteria more than 5% of the time. Most other water quality constituents met or slightly exceeded the water quality screening criteria. Water quality dramatically improved downstream of the Stickney WRP discharge into the CSSC. Water temperatures in the CSSC were above water quality screening criteria just downstream of the Midwest Generation's Crawford Station (above Cicero

Avenue). Water temperatures downstream of the Crawford Station exceeded water quality temperature screening criteria approximately 15% of the time. Greater exceedences of the temperature water quality screening criteria occurred during the winter time period (December through March). Water temperatures declined significantly downstream of the Stickney WRP discharge to the CSSC. Water temperatures increased again downstream of the Midwest Generation's Will County Station, with the water quality temperature screening criteria being exceeded 3% of the time. Exceedences of the water quality screening criteria for temperature at this location was greatest during the winter period.

Calumet River System

Dissolved oxygen levels in the Calumet System varied for each waterway reach. Dissolved oxygen challenges were most significant in the Grand Calumet River, followed by the Calumet-Sag Channel. Dissolved oxygen levels in the Grand Calumet River fell below the 6 mg/L screening criteria approximately 47% of the time, with the 5 mg/L and 4 mg/L screening criteria not being met 27% and 19%of the time, respectively. The D.O. levels in the Calumet-Sag Channel fell below the 6 mg/L and the 5 mg/L water quality screening criteria, 34% and 12% of the time, respectively. Dissolved oxygen levels in the Calumet-Sag Channel for the most part were consistently above 4 mg/L. The lowest exceedence of the dissolved oxygen screening level criteria was in Lake Calumet and the Calumet River. Both of these waterbodies for the most part are above the O'Brien Lock and Dam, and the Calumet River has a direct connection with Lake Michigan. The D.O. levels in the Little Calumet River were significantly higher than the levels observed in the Calumet-Sag Channel. The 6 mg/L screening criteria was not met 16% of the time, while the 5 mg/L and the 4 mg/L screening criteria were not met 5% and 2%, respectively.

Bacteria levels in the Calumet-Sag Channel for the most part met screening level criteria for limited contact recreation. The Little Calumet River (west), downstream of the Calumet WRP did not meet the water quality screening criteria for limited contact recreation, however this reach does meet the water quality screening criteria for recreational navigation. The Little Calumet River (east) met the water quality screening criteria for limited contact recreation. Lake Calumet also meets the water quality screening criteria for limited contact recreation.

As in other parts of CAWS, pH, total silver, dissolved nickel, and dissolved zinc were the metal parameters of concern. The remaining other water quality constituents met or slightly exceeded the water quality screening criteria.

Numerous innovative treatment systems (e.g. side-stream elevated pooled aeration (SEPA) structures, TARP) have been placed in CAWS to help alleviate water quality problems. However, even with this technology in place, there are still areas of water quality impairment, particularly as it relates to dissolved oxygen and temperature. In those reaches where dissolved oxygen levels cannot meet General Use standards, even after treatment technologies have been implemented, a site-specific standard may be more appropriate.

Since the MWRDGC does not disinfect at the three major water reclamation plants in the CAWS, bacteria levels will always remain high and prevent the attainment of limited contact recreation in selected reaches of the waterways. Detailed studies of *E. coli* levels in the waterways, particularly during wet-weather events, would provide a better picture of the extent of bacterial contamination and how they affect the attainment of recreational opportunities.

Sediments

Contaminated sediments reside in many reaches of CAWS and it is important to identify how sediment quality characterizations would influence the use designation decision making process in terms of the goals for the CAWS UAA. Although contaminated sediments are an important consideration in evaluating the health of a water resource, the goal of this UAA is to determine whether sediment conditions in threaten attainment of a use. Barge traffic and dredging in the CAWS can re-suspend these sediments, preventing the attainment of a recreational use category.

The sediment data primarily consisted of chemical parameters, with little or no information regarding the bacteria levels in the sediments. Since there is little data on how sediment contamination may impact recreational activities, it will not be evaluated in this UAA.

From an aquatic life use designation perspective, contaminated sediments from a chemical perspective can limit the diversity of benthic organisms as well as influence the risk associated with fish consumption. As a result, sediment toxicity can secondarily constrain attainment of an aquatic life use designation. The current procedures for evaluating sediment toxicity includes bioassay analysis, for which there was little data to evaluate.

Recreational

Recreational uses of waters are more likely to occur in areas where there are higher densities of people living and working along the river, and this is true for CAWS. Recreational use by non-motorized boats (e.g. canoes, kayaks) in the Chicago River System was common in the lower North Shore Channel, upper North Branch, Chicago River and South Branch. Power boating was also common in these reaches as well, including the lower North Branch. Fishing was the most common potential contact activity observed along the shoreline in these reaches. The Chicago River and sections of the North Branch and South Branch are host to a variety water-based events (e.g. Friends of Chicago River Annual Flatwater Classic), and many school-based groups, as well as environmental organizations use the waterways for educational purposes.

In the South Fork, power boating was the dominant activity, but was only observed a limited number of time (n=5). In the CSSC, the dominant recreational use was power boating. Along the Cal-Sag Channel, power boating and fishing were the dominant activities observed. Jet skiing and water skiing occurred infrequently. Wading was observed, but it was primarily associated with launching boats. At the Villages of Alsip and Worth, the estimated number of launches at their boat launch facilities was 7,000 and 4,000 launches per season, respectively. Other boating activities that occur in this segment include the annual Poker Fun Run and limited canoeing. In the Grand Calumet, the only observed activity was fishing, where as in the Little Calumet River power boating and fishing were the dominant activities. The Little Calumet River is host to many marinas whose livelihood depends upon the power boat uses of this waterway. Recreational uses observed in the Calumet River include fishing and power boating. The dominant activity occurring in Lake Calumet was fishing, both from shore and boat.

Biological

With the availability of biological data characterizing macroinvertebrate and fish populations in CAWS, these more direct measures of aquatic life conditions were given precedence in evaluating aquatic life use attainment or water quality conditions in a given reach. Biological data collected over the last 25 years, and particularly from the 1992 – 2002 time period, indicates that the waterways contain a diverse assemblage of fish and macroinvertebrates that are dominated by pollution tolerant organisms. Dramatic improvements in the fish community structure has occurred since the 1970's, however fish species like common carp, bluntnose minnow, goldfish, and alewife numbers and biomass tend to dominate CAWS. Game fish, such as largemouth bass and bluegill have seen a dramatic increase in numbers since the MWRDGC has been collecting data and now are commonly pursued by local anglers.

Fish sampling with electroshocking

Due to the lack of habitat data for the fish collection locations in CAWS, a study was conducted by USEPA and IEPA to evaluate the aquatic habitats within CAWS. The data showed that the aquatic habitats were rated from very poor to fair, with most of the reaches having habitat unable to support a diverse aquatic community. Since most of the waterways are man-made and were created primarily for conveyance of wastewater and navigation, little attention was given to fish habitat during their construction in the early 1900's. However, this does not preclude the potential for these waterways to achieve high uses if modifications can be made to improve fish and macroinvertebrate habitat.

1.5 Proposed Use Designations for the CAWS

Since CAWS comprises a large area with diverse conditions, the waterways were broken up into fourteen different reach segments. Reach segments were defined to have breakpoints at critical locations that contribute to their unique characteristics based upon, physical morphology, water quality and quantity, flow, chemical and biological properties. The proposed use designations and water quality standards to protect the uses of the waters in the open channels that flow through the Chicago metropolitan area apply to the following CAWS reaches:

- Upper North Shore Channel- Wilmette Lift Station to North Side WRP
- Lower North Shore Channel- North Side WRP to the confluence with the North Branch Chicago River
- Upper North Branch Chicago River- Confluence with NSC to North Avenue Turning Basin
- Lower North Branch Chicago River- North Avenue Turning Basin to confluence with Chicago River
- Chicago River- Chicago Control Works to confluence with North Branch and South Branch Chicago Rivers
- South Branch Chicago River- Confluence with the Chicago River to confluence with Chicago Sanitary Ship Canal
- South Fork (Bubbly Creek)- Racine Avenue Pump Station to confluence with South Branch Chicago River
- Chicago Sanitary Ship Canal and Collateral Channel- Confluence with South Branch Chicago River to Lockport Powerhouse
- Calumet-Sag Channel- Confluence with Little Calumet River to confluence with Chicago Sanitary Ship Canal
- Little Calumet River West- Calumet WRP to confluence with Calumet-Sag Channel
- Little Calumet River East- O'Brien Lock and Dam to Calumet WRP
- Grand Calumet River- Illinois State Line to confluence with Little Calumet River
- Calumet River
- Lake Calumet

Proposed Use Designations

The six factors that the state must take into consideration when conducting a UAA in order to demonstrate that the attainment of a CWA goal use is not feasible, was specifically included in stakeholder involvement process. The CAWS UAA differs from most UAAs in that improving conditions are prompting a potential use upgrade for most reaches rather than the typical scenario where existing conditions are not supporting a currently regulated designated use and are prompting consideration of a use downgrade. In either case, the criteria are still applicable. In the case where a use upgrade is being considered the criteria were applied in evaluating the feasibility of potential future use designations rather than one that is already in place. The approach is consistent with the intent of the UAA process and the CWA goals.

The data clearly shows that more than one of the six criteria prevent the attainment of a high quality biological community in CAWS. Good quality aquatic habitat in CAWS is limited and the waterways would need to undergo major habitat restoration to improve the fish and macroinvertebrate assemblages. The recreational use data demonstrate that secondary contact forms of recreation (e.g. kayaking, canoeing, fish and recreational boating) are occurring in the waterways and these uses need to be protected. The physical and institutional limitations, along with periodic impairments to water quality from CSOs and stormwater in CAWS, prevent the attainment of primary contact recreation (e.g. swimming) over the next ten years.

The integrated assessment of the physical, chemical, biological, and waterway use conditions in CAWS have resulted in recommendations documented herein for revised use classifications and water quality standards. Based upon the review of data for CAWS, five use designation sub-categories are being proposed to protect aquatic life and recreational uses in CAWS. The recreational and aquatic life use sub-categories and the applicable water quality standards and criteria proposed for CAWS include the following:

Warm-Water Aquatic Life

- ***General Warm-Water Aquatic Life (GWAL)*** - These waters are capable of supporting a year-round balanced, diverse warm-water fish and macroinvertebrate community. The fish community is characterized by the presence of a significant proportion of native species, including mimic shiner, spotfin shiner, brook stickleback, longnose dace, hornyhead chub, smallmouth buffalo, rock bass and smallmouth bass. Water quality standards as identified in 35 Ill. Adm. Code Part 302, Subpart B: Sections 302.201 – 302.213 or more appropriate standards based upon recent guidance shall be applied to protect the GWAL use designation.

- ***Modified Warm-Water Aquatic Life (MWAL)*** - These waters are presently not capable of supporting and maintaining a balanced, integrated, adaptive community of a warm-water fish and macroinvertebrate community due to significant modifications of the channel morphology, hydrology and physical habitat that may be recoverable. These waters are capable of supporting and maintaining communities of native fish and macroinvertebrates that are moderately tolerant and may include desired sport fish species such as channel catfish, largemouth bass, bluegill, and black crappie. Water quality standards as identified in 35 Ill. Adm. Code Part 302, Subpart B: Sections 302.201 – 302.213 or more appropriate standards based upon recent guidance shall be applied to protect the MWAL use designation.

- ***Limited Warm-water Aquatic Life (LWAL)*** - These waters are incapable of sustaining a balanced and diverse warm-water fish and macroinvertebrate community due to irreversible modifications that result in poor physical habitat and stream hydrology. Such physical modifications are of long-duration (i.e. twenty years or longer) and may include artificially constructed channels consisting of vertical sheet-pile, concrete and rip-rap walls designed to support commercial navigation and the conveyance of stormwater and wastewater. Hydrological modifications include locks and dams that artificially control water discharges and levels. The fish community is comprised of tolerant species, including central mudminnow, golden shiner, white sucker, bluntnose minnow, yellow bullhead and green sunfish. These waters shall allow for fish passage. Water quality standards as identified in 35 Ill. Adm. Code Part 302, Subpart B: Sections 302.201 – 302.213 or more appropriate standards based upon recent guidance or habitat limitations shall be applied to protect the LWAL use designation. On a parameter-by-parameter basis, General Use water quality criteria may be modified to protect the existing aquatic life use designation.

Water Recreation

- ***Limited Contact Recreation*** – These waters shall protect for incidental or accidental body contact during which the probability of ingesting appreciable quantities of water is minimal including: recreational boating (kayaking, canoeing, jet skiing) and any limited contact incident to shoreline activity, such as wading and fishing. Protection requires the attainment of 30-day geometric mean 1030 cfu E. coli standard based on 10 illnesses per thousand contacts. These limited- body contact recreation criteria shall apply only during the defined recreational period of March 1 through November 30.

- ***Recreational Navigation*** – These waters shall protect for non-contact activities including, but not limited to pleasure boating and commercial boating traffic operations. Protection would require attainment of a 30-day geometric mean 2740 cfu E. coli standard is based on 14 illnesses per thousand contacts. These recreational navigation criteria shall apply only during the defined recreational period of March 1 through November 30.

1.6 Proposed CAWS Reach Use Designations

In developing use designations for CAWS reaches, stakeholders were asked how they perceived each reach of the waterway should be designated. This discussion occurred at the end of each meeting in which the physical, chemical, biological, and water way use data were presented for selected reaches. Stakeholders were asked to take into consideration uses that are anticipated within the next ten years and the feasibility of restoration actions that might be required to attain such a designation. The recommended use designations as defined above for the fourteen waterway reaches are shown in **Tables 1-1 and 1-2**.

Table 1-1
Recommended Use Designations for the NSC and Chicago River System

Proposed Designated Use	Upper NSC	Lower NSC	Upper North Branch Chicago River	Lower North Branch Chicago River	Chicago River	South Branch Chicago River	Bubbly Creek
Limited Contact Recreation	◆	◆	◆	◆	◆	◆	◆
Recreational Navigation							
General Use Warm-Water Aquatic Life							
Modified Warm-Water Aquatic Life	◆	◆	◆				
Limited Warm-water Aquatic Life				◆	◆	◆	◆

Table 1-2
Recommended Use Designations for the CSSC and Calumet System

Proposed Designated Use	CSSC	Grand Calumet	Lake Calumet	Calumet River	Little Calumet East	Little Calumet West	Cal-Sag Channel
Limited Contact Recreation		◆	◆	◆	◆	◆	◆
Recreational Navigation	◆						
General Use Warm-Water Aquatic Life							
Modified Warm-water Aquatic Life		◆	◆		◆	◆	◆
Limited Warm-water Aquatic Life	◆			◆			

1.7 Strategic Plan

The Strategic Plan sets the overall priorities and associated goals and strategies for CAWS. It is based on the long-term vision shared by many of the stakeholders in the Chicago area. It does not provide an exhaustive list of all the strategies to achieve water quality goals, nor does it provide a complete summary of accomplishments to date. The plan is designed to be concise and include only essential information to support the strategic goals. The intended audiences are governmental agencies, environmental organizations, the general public, and specific constituent groups. The plan incorporates strategies to address the attainment of each of the use designations for the Chicago area waterway reaches through selected management options. **Table 1-3** identifies management options to address impairments that prevent the attainment of a proposed designated use in a given waterway reach.

The management alternatives were reviewed with the UAA stakeholder group and the public and discussions took place on how each of these management alternatives would be implemented, the responsible agency or organization(s) and the potential costs for implementing each management alternative. The goals, objectives and strategies for implementing the management alternatives for aquatic life and recreational use designations are discussed with specific goals, objectives and strategies. As the water-based recreational and aquatic life opportunities continue to expand in CAWS it is imperative that these uses be protective and where possible enhanced so that the waterway system can become truly the "second shoreline" for the City of Chicago and the surrounding communities. The following strategies are being recommended to ensure a safer environment for water-based recreation and enhancing aquatic communities in CAWS.

Limited Contact Recreation

The number of recreational boaters utilizing the Chicago waterways is increasing and the added emphasis from the City of Chicago in embracing the Chicago waterways as the City's "second-shoreline" continues to encourage more users. At this time no governmental agency or environmental organization is supporting the use of the waterways for primary contact recreation (i.e. swimming) because of the physical limitations and the safety hazards. However, many Chicagoans are taking to the waterways to kayak, canoe, power boat and fish, and such uses need to be protected through appropriate water quality standards.

Goal

Protect recreational users and improve the existing water quality in the Chicago area waterways to support limited contact recreation.

Objective

Work closely with MWRDGC, the City of Chicago and other CAWS communities to control site-specific point sources of bacterial pollution and develop a plan to address Combined Sewer Overflows (CSO) events until the remaining portions of TARP come on line.

Table 1-3
Proposed Management Strategies to Address New Use Sub-categories in CAWS.

Management Alternatives	Upper NSC	Lower NSC	Upper North Branch Chicago River	Lower North Branch Chicago River	Chicago River	South Branch Chicago River	Bubbly Creek	CSSC	Calumet-Sag Channel	Little Calumet East	Little Calumet West	Grand Calumet	Calumet River	Lake Calumet
Flow Augmentation to Address Low Dissolved Oxygen Levels	◆						◆							
Aeration to Address Low Dissolved Oxygen Levels	◆		◆	◆		◆	◆	◆	◆	◆	◆			
Instream Habitat Enhancement to Improve Fish Communities	◆	◆	◆	◆			◆			◆				◆
Sediment Removal to Improve Aquatic Life Conditions							◆			◆		◆		
Disinfection to Protect for Water Recreation	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆			

Strategies

a) Conduct engineering studies to determine the costs of disinfection at the Stickney, Calumet and North Side WRPs.

b) Determine the costs for implementing CAWS-wide disinfection of MWRDGC and surrounding community CSOs.

c) Conduct an economic analysis of implementing water quality improvements to protect recreational uses in the CAWS.

d) Prepare a construction schedule for the implementation of disinfection at the North Side, Stickney and Calumet WRPs to meet appropriate bacteria criteria.

e) Conduct detailed *E. coli* sampling in the CAWS during dry-weather and wet-weather periods (using various rainfall events) to determine the nature and extent of bacterial contamination from CSOs.

f) Develop a phased approach to the disinfection at the three WRPs. Evaluate the impacts during the recreation season and success of each of the facility to meet water quality standards in lieu of on-going sources of contamination, i.e. CSOs and stormwater runoff. Disinfect the North Side WRP first, while MWRDGC evaluates if water quality over a two-year period (including dry and wet weather events) to determine if water quality criteria are being met.

g) Require MWRDGC and surrounding communities to treat their CSOs to reduce or eliminate bacterial loading to the waterways during wet weather events, bearing in mind commitments to complete TARP.

h) Evaluate the feasibility of wet-weather exclusions in the water quality standards

i) Conduct a detailed engineering review of the Chicago area "sewershed" to evaluate the feasibility of maximizing the use of the TARP system for CSO pollution control, as opposed to solely flow capture mechanisms during wet weather events.

j) Continue to educate the public on the environmental hazards in the waterways and implement the CSO notification plan.

k) Develop additional data to determine the nature and extent of pathogens residing in the sediment since sediments can be a reservoir to harmful bacteria and could prevent the attainment of a designated use when disturbed sediments are re-suspended.

Recreational Navigation

Many portions of CAWS are still used by commercial barge traffic and recreational pleasure boats. The heavy uses occur on the CSSC and in the Calumet System. The exposure to high levels of bacteria from these uses is minimal, but water quality standards need to be in place to protect against accidental exposure (i.e. worker falling into the water; splashing water).

Goal

Protect commercial and recreational users of the waterways from accidental exposure to high levels of bacteria.

Objective

Identify treatment technologies that can be implemented at the Calumet and Stickney WRP to achieve a lower level bacterial quality in the effluent during the recreational time period March 1 through November 30.

Strategies

a) Prepare a construction schedule for the implementation of disinfection at the Stickney and Calumet WRPs to meet appropriate bacteria criteria.

b) Require the City of Chicago and surrounding communities to treat their CSOs to reduce or eliminate bacterial loading to the waterways during wet weather events.

c) Require MWRDGC and surrounding communities to treat their CSOs to reduce or eliminate bacterial loading to the waterways during wet weather events, bearing in mind that commitments to complete TARP.

d) Evaluate the feasibility of wet-weather exclusions in the water quality standards.

e) Conduct a detailed engineering review of the Chicago area “sewershed” to evaluate the feasibility of maximizing the use of the TARP system for CSO pollution control, as opposed to solely flow capture mechanisms during wet weather events

f) Continue to educate the public on the environmental hazards in the waterways and implement the CSO notification plan.

g) Develop additional data to determine the nature and extent of pathogens residing in the sediment since sediments can be a reservoir to harmful bacteria and could prevent the attainment of a designated use when disturbed sediments are re-suspended.

General Warm-water Aquatic Life

None of the Chicago area waterway reaches possessed the necessary characters to support a GWAL use designation. The primary constraints to preventing the attainment of this use were the lack of suitable habitat to support a diverse fish and macroinvertebrate community.

Goal

Create favorable habitat in selected reaches of CAWS to support a diverse aquatic and wildlife community. Ensure water quality is sufficient to support a viable and productive fish and macroinvertebrate community.

Objective

To upgrade selected reaches in the Chicago area waterways to GWAL through habitat enhance and water quality improvement.

Strategies

a) Develop a stakeholder group to study habitat issues

b) Develop a habitat restoration plan and guidelines for the waterway reaches

c) Determine the costs for implementing temperature control at the Midwest Generation Crawford and Will County power generating stations

d) Conduct engineering studies to determine the costs of flow augmentation in the Upper North Shore Channel and the South Fork

e) Conduct an economic analysis of implementing water quality improvements for aquatic life in the CAWS

f) Identify areas for potential restoration that could allow the waterbody to achieve a high aquatic life designated use. These could include selected areas on the NSC, North Branch Chicago River, South Fork (Bubbly Creek), the Little Calumet River, Grand Calumet River and Lake Calumet.

g) Conduct "watershed" D.O. modeling to determine areas and degree of dissolved oxygen impairment

h) Install appropriate in-stream or side-stream aeration devices in those areas not meeting D.O. criteria

i) Create flow augmentation in the upper reaches of the NSC and the South Fork to create a flow regime that will enhance D.O. levels

j) Remove contaminated sediments from the South Fork, Collateral Channel and the Grand Calumet River

k) Review and modify where necessary MWRDGC's pretreatment program to eliminate unconventional parameters (e.g. silver).

l) Conduct additional studies on fish in CAWS to determine if endocrine disruptors are having an impact on the fish community

m) Develop a comprehensive educational outreach program for the general public and local governmental agencies

n) Explore and implement a combination of pretreatment and best management practices to reduce levels of non-conventional pollutants (e.g. silver)

Modified Warm Water Aquatic Life

Most of the Chicago area waterways have been designated this use classification as a result of significant modifications to channel morphology, hydrology and physical habitat that may be reversible to some extent.

Goal

Create favorable habitat and favorable water quality conditions at selected locations in the waterways to support a diverse aquatic and wildlife community.

Objective

Identify those areas where habitat enhancement is feasible and develop a long term plan to implement habitat improvements in the Chicago area waterways. Eliminate water quality impairments through Best Management Practices or Best Practicable Technology.

Strategies

a) Develop a stakeholder group to study habitat issues and form a technical team to evaluate aquatic habitat restoration technologies applicable in a high urbanized environment

b) Identify areas for potential restoration such as in the turning basins at on the North and South Branch, the inner harbor area of the Chicago River; slip channels on the CSSC and the South Branch, and the stretch of river between Cicero Avenue and Harlem Avenue on the CSSC

c) Construct in-stream aquatic habitat in the non-navigable portions of CAWS (e.g. Christmas tree "reefs") to provide habitat for warm-water fish

d) Explore and implement a combination of pretreatment and best management practices to reduce levels of non-conventional pollutants (e.g. silver)

e) Install in-stream and side-stream aeration where necessary to ensure surface water quality standards are met.

Limited Warm Water Aquatic Life

Selected reaches of CAWS have been designated LWAL due to irreversible modifications that result in poor physical habitat and stream hydrology. The Chicago River as it flows through the city has been highly developed and the existing structures will not be modified or removed to accommodate aquatic life habitat improvements. The CSSC and the Calumet River are deep-draft channels that have steep walls, are heavily industrialized in the upper reaches and are host to significant numbers of large commercial barge vessels and recreational pleasure boats.

Goal

Maintain water quality to meet general use standards, where attainable, and allow for navigation and fish passage.

Objective

To ensure D.O. and temperature criteria are met, and if unattainable, identify a treatment alternative to increase D.O. levels and reduce temperature levels.

Strategies

a) Evaluate the feasibility of aerating and lowering temperature in selected areas in the CSSC

b) Monitor D.O. levels and temperature in the CSSC

c) Develop site-specific water quality standards for D.O. and temperature to support existing fish communities

d) Continue with MWRDGC's water quality, fish and macroinvertebrate sampling program throughout CAWS

Section 2
Introduction

2.1 Project Overview

The IEPA is conducting a UAA for CAWS to determine the existing and potential uses for the waterways. This project will assess the factors limiting the potential uses and evaluate whether or not those factors can be controlled through appropriate technology and regulation. The focus of the UAA is on the Calumet and Chicago River basin waterway reaches which are for the most part currently classified by the IPCB as Secondary Contact and Indigenous Aquatic Life use. Three CAWS reaches are designated General Use waterways, which were upgraded relatively recently without undergoing the rigors of a UAA. The UAA excludes the reach of the Lower Des Plaines River currently being evaluated through a separate UAA. A complete listing of Secondary Contact and General Use waterways that are addressed by CAWS UAA are provided in Section 3.0.

The Chicago area is home to a large and diverse series of waterways, many of which have been man-made in order to facilitate water flow away from Lake Michigan to protect drinking water and recreational uses. The waterways are used for commercial and recreational purposes by people across Cook and neighboring counties, the state of Illinois and the Midwest. The Chicago area waterways have experienced many changes throughout the last 100 years. There have been dramatic improvements in water quality and shoreline development in the last 25 years. The City of Chicago, MWRDGC, Cook County, USEPA, IEPA, industries and local environmental organizations (e.g. Friends of the Chicago River, LMF, Sierra Club) all have a vested interest in the future of the Chicago area waterways and have participated as valuable stakeholders in the UAA. Their wisdom, vision, dreams, and aspirations for CAWS have been taken into consideration in this UAA. Without stakeholder input, the challenges would have been much greater, if not impossible, in preparing a final strategic plan for the waterways.

The UAA studied the recreational uses of the NBCR.

As evident by the number of stakeholders who participated in the UAA process, there is intense interest in the outcome of the UAA with stakeholders advocating many competing uses and visions for the future, not one more important than the other. In the detailed analyses conducted to determine the perception of how the Chicago area waterways should be used, Paul Gobster and Lynne Westphal (1998) concluded in their report "*People and the River: Perception and Use of Chicago Waterways for Recreation"* that fishing, canoeing, kayaking, rowing, commercial navigation, parks and trails, excursion boat operations and the aesthetic quality of a river are important uses to Chicagoans. This UAA will focus on existing and potential uses that are occurring in the waterway now and that are expected to occur over the next ten years. The UAA will result in a recommended management strategy to protect the existing and potential uses with appropriate water quality standards, while at the same time being cognizant of the economic and social costs to area citizens. This will be achieved by creatively developing new use designations (sub-categories) for CAWS to replace the General and Secondary Contact uses currently in place.

Like the water quality challenges faced in the last 100years, Chicagoans can tackle the challenges that face them now and in the future, by providing a healthy and safe water environment for enjoying recreation and conducting business. The reversal of the Chicago and Calumet Rivers was a major engineering accomplishment that provided a safer environment for the citizens of the Chicago area and helped protect a critical global resource in Lake Michigan. Now they face a new challenge: tapping the amenity potential of a waterway system that gave the city life a century ago. Just as the foresight and guidance of past leaders helped turn Chicago into a world-class city, today's government and environmental organization leaders have a vision of a greener Chicago. In the last 25 years tremendous progress has been made in improving water quality in the CAWS by upgrading and improving MWRDGC's three major wastewater reclamation plants that make up the bulk of the flow in the waterways and controlling CSO through the Tunnel and Reservoir Project. Through the leadership of environmental organizations, like the Friends of the Chicago River, Lake Michigan Federation and the Sierra Club, they have invested time and effort in helping keeping the waterways clean and educating the public on the benefits of the waterways. Additionally, the City of Chicago and area communities have implemented projects to make their surroundings environmentally and aesthetically friendly.

> *…our water resources are vulnerable to pollution, waste and other forms of misuse, and we must never take them for granted. We have a responsibility to protect, conserve and manage our water wisely to help improve the quality of life for ourselves and future generations.*
>
> *Mayor Richard Daley*
> *Clean Water Agenda*

2.2 Use Attainability Analysis

A UAA is a structured scientific assessment of the factors that prevent the attainment of uses ("fishable/swimmable") specified in Section 101(a)(2) of the CWA. The Act requires states to conduct a UAA if waters of the state are not able to support the protection and propagation of fish, shellfish, and wildlife for primary contact recreational uses. Alternatively, in the case of the CAWS UAA where recent water quality improvements have occurred, IEPA wishes to examine the present Secondary Contact and Indigenous Aquatic Life designated sections. These investigations will determine whether a use upgrade for balanced aquatic life and contact recreation are attainable and whether relatively recent upgrades of the General Use reaches of the CAWS were appropriate.

Designated uses are those uses specified in state water quality standards for each of the waterway reaches whether or not they are being attained. **Existing uses** are those uses attained on or after November 28, 1975, whether or not they are included in the water quality standards. Once a state has designated a use or uses for a given waterway, then water quality criteria need to be developed to protect such uses.

The basis for creating use designations for waterways is in the CWA which states it is the national goal for waterways to be "fishable and swimmable". In Illinois there are two major use designations that apply to the CAWS (35 Ill. Adm. Code 303): General Use and Secondary Contact and Indigenous Aquatic Life. The General Use water quality standards, comply with CWA goals in that they protect aquatic life, wildlife, agricultural use, secondary contact , most industrial uses and safeguard the aesthetic quality of the aquatic environment. Primary contact uses are protected for all General Use waters whose physical configuration permits such use (35 Ill. Adm. Code 302.202). Illinois defines **primary contact** as any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing.

Secondary Contact and Indigenous Aquatic Life use standards are intended for those waters not suited for general use activities, but which are appropriate for all secondary contact uses and are capable of supporting indigenous aquatic life limited only by the physical configuration of the body of water, characteristics and origin of the water and the presence of contaminants in amounts that do not exceed the water quality standards listed in 35 Ill. Adm. Code 302 Subpart D. **Secondary contact** means any recreational or other water use in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial and recreational boating (e.g. canoeing and kayaking) and any limited contact incident to shoreline activity.

Since the Secondary Contact use class does not meet CWA goals of "fishable/ swimmable", the State must conduct a UAA in order to justify any deviation from a General Use designation. Specifically, a State must conduct a UAA as described in 40 CFR 131.10(j) whenever:

- The State designates or has designated uses that do not include the uses specified in Section 101(a)(2) of the Act, or
- The State wishes to remove a designated use or adopt subcategories of uses specified in Section 101(a)(2) of the Act which require less stringent criteria.

Those factors that the state must take into consideration when conducting a UAA in order to demonstrate that attaining the designated use is not feasible include one or more of the following six factors:

- Naturally occurring pollutant concentrations preventing the attainment of the use
- Natural, ephemeral, intermittent or low flow conditions or water levels preventing the attainment of the use, unless these conditions may be offset by the discharge of a sufficient volume of effluent, (may be used for determining aquatic life use, but may not be used solely to determine recreational use).
- Human caused conditions or sources of pollution preventing the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place.
- Dams, diversions or other types of hydrologic modifications precluding the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modifications in such a way that would result in the attainment of the use.
- Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses, (may be used for determining aquatic life use, but may not be used solely to determine recreational use).
- Controls more stringent than those required by Sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact.

The economic and social impact of the management decisions in the UAA will not be presented in this report. MWRDGC is in the process of collecting engineering and cost estimate data to determine the costs for upgrading the three main wastewater reclamation plants for disinfection and the potential for instream aeration and flow augmentation. The City of Chicago is conducting an investigation to develop costs for controlling major city owned CSOs and Midwest Generation is evaluating the cost of upgrading their facilities to address temperature concerns in the Chicago Sanitary Ship Canal. It is anticipated that once this information is made available to IEPA (summer 2005), then the state would revise the UAA to include the economic and social impact analysis.

Recreational Use Survey on Cal-Sag Channel helped develop UAA data.

UAA Process

After the Water Quality Standards Regulations were revised in 1983 (54 Federal Register 51400), the UAA was made the standard procedure through which states gather and analyze data and document decision processes to resolve questions about site-specific attainability of designated use classes. USEPA does not insist that the published UAA guidelines (USEPA, 1983a, 1984a, b, 1994) are followed. However, any process that a state develops to address attainability issues must be sufficient to meet the intent of the UAA guidelines. Since the State of Illinois has no formal procedures for conducting a UAA, the guidelines used for this evaluation generally follow those outlined in "*A Suggested Framework for Conducting UAAs and Interpreting Results*" by Michael and Moore (1997) for the Water Environment Federation, and the USEPA's "*Water Quality Standards Handbook*" (USEPA 1994). Both guidance documents state that the physical, chemical and biological factors affecting the attainment of a use are to be evaluated through a water body survey and assessment.

The assessment should answer the following four questions:

1. What are the aquatic use(s) currently being achieved in the water body?

2. What are the causes of any impairment of the aquatic uses?

3. What are the aquatic use(s) that can be attained based on the physical, chemical and biological characteristics of the water body?

4. What are the socioeconomic impacts to the community?

These questions are typically answered through the following approaches:

- Define the objectives and scope of the assessment

- Gather and analyze existing data

- Select evaluation approach that will address the objectives

- Select a reference body for comparison analyses, If applicable

- Conduct the evaluation

- Integrate the data and prepare a management strategy for the waterway, which includes recommendations about the attainment of the selected uses.

After the UAA has been completed, IEPA will at a minimum provide the public with the opportunity to comment on the revised use designations and supporting water quality criteria. Once comments have been received and a final report has been prepared, IEPA will present their recommendations to the Illinois Pollution Control Board in the form of proposed regulations. The IPCB will hold hearings and solicit comments before final rulemaking on the new water quality standards.

2.3 Objectives of the UAA

The purpose of CAWS UAA is to evaluate existing conditions including waterway use practices and anticipated future uses to determine if use classification revisions are warranted, particularly to protect the anticipated expansion of recreational activity occurring in the waterways. The IEPA wishes to examine the present Secondary Contact and Indigenous Aquatic Life portions of CAWS to evaluate whether a use upgrade for balanced aquatic life and contact recreation are achievable and whether a downgrade of the General Use reaches are appropriate.

An upgrade to balanced aquatic life and contact recreation use designations may conflict with important existing uses, such as navigation, wastewater and stormwater management. It is the intent of the UAA, through stakeholder involvement, to consider these potential conflicts while developing criteria for uses that would meet or approach aquatic life protection and primary contact recreational uses ("fishable/swimmable") required by the Clean Water Act (CWA). If the statutory CWA uses are not attainable, the UAA will define the most optimal attainable use for each water body.

The objectives of the study, as specified by IEPA, include:

- Review and evaluation of the last five to ten years of environmental data to determine the physical, chemical, and biological conditions of the waterway, recommending additional data gathering activities and coordinating the generation and evaluation of additional data as may be necessary to accomplish the objectives

- Identification and characterization of the types, causes and sources of major stressors on the system including potential use impairments identified in the agency's most recent CWA Section 303(d) List

- Assessment of available water quality and habitat management options for eliminating or reducing system stressors

- Determination of the potential to achieve and maintain use classification other than existing classifications

- Development of recommended use designations and associated water quality standards to achieve the highest attainable uses consistent with CWA goals and Chapter 2 of USEPA's Water Quality Standards Handbook (40 CFR 131.10)

"I am hopeful that the end result of the UAA will be better education and protection for people and better habitat and wildlife in the Evanston, Wilmette, Skokie area as well as up and down the Chicago river and its tributaries."
Ross Richards, concerned citizen, Wilmette, Illinois

- Providing expert testimony before the IPCB in support of use designation changes

- Establishment and coordination of stakeholder involvement in the UAA process

The final UAA report will outline the process/approach utilized to determine the attainable use classifications for CAWS. The report will consist of the following chapters:

- **Section 3.0 - Existing Conditions of the Chicago Area Waterways** – Describes the existing conditions of CAWS including the physical characteristics, water quality impairments, limiting factors, recreational uses, major facilities and current National Pollution Discharge Elimination System (NPDES) permit holders.

- **Section 4.0 - Characterizations of Waterway Reaches** – Characterizes current water quality, biological and recreational use conditions in the waterways including spatial and temporal analysis using statistical and quantitative methods.

- **Section 5.0 - Proposed Use Classifications and Water Quality Standards for CAWS** – Outlines recommended use classifications for the segments of CAWS and water quality standards to protect those uses.

- **Section 6.0 - Strategic Plan Development** - Provides the framework for identifying recommended actions necessary to achieve desired use designations. The plan will also identify actions to address stressors that may be preventing attainment of applicable water quality standards designed to protect those uses.

2.4 References

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Section 3
Existing Conditions in the Chicago Area Waterways

3.1 System Description

The purpose of this section is to describe the attributes about the Chicago Area Waterways that pertain to existing and potential conditions of selected reaches. The primary focus of the UAA is on the Calumet and Chicago River basin waterway reaches currently classified by the Illinois Pollution Control Board (IPCB) as Secondary Contact and Indigenous Aquatic Life and selected General Use waterways. Three CAWS reaches are General Use, upgraded relatively recently without undergoing the rigors of a UAA (**Figure 3-1**). The CAWS UAA addresses the following waterways defined by 35 Ill. Adm. Code 303.441:

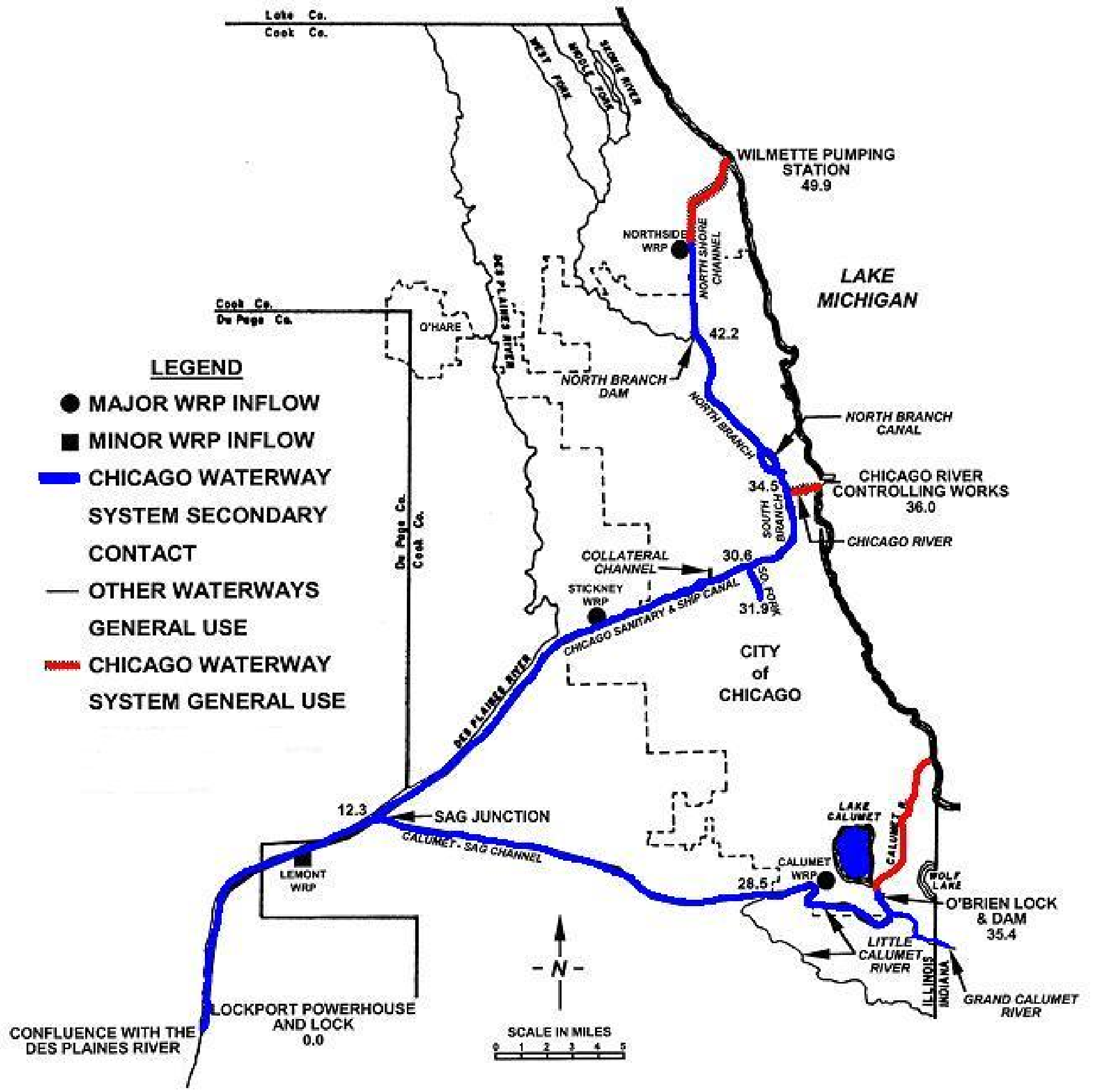
Secondary Contact and Indigenous Aquatic Life

- North Shore Channel (NSC) downstream of the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) North Side Water Reclamation Plant (WRP)
- North Branch Chicago River (NBCR) from its confluence with the North Shore Channel to its confluence with the South Branch
- Chicago Sanitary and Ship Canal (CSSC)
- South Branch of the Chicago River (SBCR)South Fork (Bubbly Creek)
- Calumet-Sag Channel
- The Little Calumet River from its junction with the Grand Calumet River to the Calumet-Sag Channel
- The Grand Calumet River (GCR)
- The Calumet River, except the 6.8 mile segment extending from the O'Brien Locks and Dam to Lake Michigan
- Lake Calumet

General Use

- North Shore Channel upstream of the MWRDGC North Side WRP
- Chicago River
- Calumet River upstream (lakeside) of O'Brien Lock

Figure 1-1
Chicago Area Waterway System (CAWS)



Figured provided by MWRDGC and modified by CDM

CAWS consists of 78 miles of man-made canals and modified river channels which provide for drainage of urban storm water runoff, treated municipal wastewater effluent and support commercial navigation. The waterways also support recreational boating, fishing, streamside recreation and aquatic habitat for wildlife. Approximately 75 percent of the waterway length consists of man-made canals where no waterway existed previously. The remainder is natural streams that have been deepened, straightened and/or widened. The flow is artificially controlled by four hydraulic structures managed by MWRDGC. The level of water in the waterways can be lowered in the anticipation of a storm event to provide additional storage for flood control. Wastewater effluent makes up approximately 70 percent of the annual flow going through the Lockport Lock and Dam facility.

CAWS watershed is approximately 740 square miles and is composed of the Chicago River and the Calumet River sub-watersheds. The Chicago River system, which consists of 55 miles of waterways, includes the Chicago River, the CSSC, the North Branch, the North Branch Canal, the NSC, the South Branch, and the South Fork of the South Branch. The Calumet system, which is 23 miles in length, includes the Calumet-Sag Channel (Cal-Sag), the Little Calumet River the GCR, the Calumet River and Lake Calumet. Characterization of the existing water quality, biology and habitat of the Chicago and Calumet River systems are described below. Distances provided in the following reach descriptions are measured from the Lockport Powerhouse Lock and Dam Facilities.

3.1.1 Chicago River System

3.1.1.1 Chicago Sanitary Ship Canal

The CSSC extends upstream its the confluence with the Des Plaines River (near Lockport) to the South Damen Avenue/I-55 bridge, for a distance of 31.1 miles. The CSSC was created in 1900 to transport human waste and industrial pollutants away from Lake Michigan, which was accomplished through a flow reversal of the Chicago River (Solzman 1998, Lanyon 2000). In addition to its primary purpose of transporting waste downstream of Chicago, the CSSC was constructed to provide a commercial navigation conduit between the Great Lakes and the Mississippi River. The river serves as a primary passage for the transport of sand and gravel, coal, cement, fuel oils and other industrial materials (FCR 2000).

Chicago's Sanitary Ship Canal serves as a conduit to the Mississippi River.

The seven day low flow in a ten year period (7Q10) is approximately 1,050 cubic feet per second (cfs) at it's confluence with the Cal-Sag Channel. Downstream of the Lockport Lock and Dam the 7Q10 is 1,317 cfs. According to Illinois 2004 305(b) report, the CSSC is potentially impaired by polychlorinated biphenyls (PCBs) in fish tissue, ammonia (unionized), low D.O., total nitrogen, oil and grease, total phosphorus.

Potential sources of impairment include flow regulation/modification, municipal point sources, CSO, urban runoff during storm events, channelization and hydro-modification.

The man made channel has many different shapes and sizes. The alignment is generally straight, with the exception of four bends. The 1.1 mile reach downstream of the Lockport Powerhouse and Locks (LP&L) is 10-feet deep and 200-feet wide. The reach upstream of the LP&L varies from 20- to 27-feet deep. The 2.4 mile reach immediately upstream of the LP&L varies from 160- to 300-feet wide and consists of a vertical concrete wall on the east bank and a combination of vertical dock walls and steep rockfill embankments on the west bank. The next 14.6 miles are 160-feet wide with vertical concrete or rock walls. The remaining portion has a trapezoidal shape, 220-feet wide, with steep earth or rock side slopes. The widest point in the CSSC is at the North Avenue turning basin at 800 feet (MWRDGC 2003). Additionally, several areas of this reach have vertical dock walls (Illinois EPA 2002). Near Kedzie Avenue is the Collateral Channel which is a former navigation slip to the Sanitary Ship Canal. At the head end of this channel is a large CSO owned by the City of Chicago.

The CSSC is dominated by industrial and commercial land uses. MWRDGC, which is the largest land-owner in the area, leases a majority of the canal edge land to industrial users. There are no pedestrian paths adjacent to the waterway due to the heavy industrial nature of the canal. Open space is limited in nearby residential areas. Hazardous, steep banks limit access and heavy barge traffic limits recreational opportunities on the waterway (City of Chicago 1999). However, in the upper reaches of the CSSC, the Chicago Park District has proposed a canoe launch area between Pulaski and Kedzie Roads, and proposed motorized boat launch near Kedzie, in one of the side-slips to the channel (City of Chicago 1999). Just downstream of the South Branch turning basin and near the proposed new Chicago Sun-Times building, the City of Chicago is proposing to build a half-mile river edge path and create areas for bank fishing. Recreational small-boating is limited and dangerous in the CSSC as the wakes from the large commercial and recreational boats can create hazardous paddling conditions. In the event of a capsize, the paddler would have an extremely difficult time getting out of the water due to the steep banks.

Stickney WRP is the largest WWTP in the world.

MWRDGC's largest wastewater treatment plant, the Stickney WRP, discharges to the CSSC in Cicero, Illinois. The plant accommodates approximately 507 acres, and has an average design flow of 1.2 billion gallons per day (bgd) and a design maximum flow of 1.4 bgd, making it reportedly the largest wastewater treatment facility in the world. The Stickney plant provides secondary wastewater treatment for more than 2 million people in a 260 square mile area. The Stickney WRP effluent is not disinfected.

Situated on the lower reaches of the CSSC near Lemont, Illinois, is the MWRDGC's Lemont WRP. The plant's average design flow is 3.4 mgd, with a maximum design flow 4 mgd. The Lemont WRP provides secondary treatment of wastewater for approximately 12,000 people in a service area that includes 21 square miles. Similar to the Stickney WRP upstream, the Lemont WRP effluent is not disinfected.

Just upstream of the Stickney WRP, are two coal-fired power plants, the Fisk and Crawford Generation Stations and downstream of the Stickney WRP is the Will County Generating Station near Romeoville, Illinois. The stations are owned by Midwest Generation, a subsidiary to Edison Mission Energy and withdraw and discharge water from the CSSC for cooling purposes. Their cooling water intake structures have helped screen out floatables and in some cases entrapped nuisance fish species (e.g. round goby). Other industrial facilities along the CSSC contribute cooling water and some stormwater runoff. They include scrap metal recyclers, cement mixers, sand/gravel, processors and bulk material handlers.

Floatable material collected on the intakes screens of the Midwest Generation's Crawford Station.

The CSSC, near Romeoville also is home to the Aquatic Nuisance Species Barrier Project. A temporary electric field barrier has been placed in one location in the CSSC to prevent the upstream migration of aquatic nuisance species (e.g. Asian carp) into Lake Michigan. Under the 1996 National Invasive Species Act (Section 1202), the United States Army Corps of Engineers (USACE) was authorized to design and construct a demonstration project to investigate the feasibility of preventing nuisance species from entering the Sanitary Ship Canal via the Des Plaines River (and the Mississippi River system). After numerous meetings and inputs by federal, state and local entities, it was decided that an electrical barrier would hold the most promise in preventing the upward migration of nuisance species. The electrical barrier has been in place for approximately 3 years and seems to be successful in deterring the nuisance species from entering the Sanitary Ship Canal. However, this barrier also prevents also prevents the movement of many native fish from moving into and out of CAWS. A second permanent barrier will be installed and operational in 2005 or 2006.

3.1.1.2 South Branch Chicago River


The South Branch looking north

The waterway transitions into the SBCR approximately 31.2 miles upstream of the LP&L. The South Branch ends at the junction of the Chicago River and the NBCR. Generally, the 4.5 mile long segment follows its original course. There is a short reach relocated in 1928 to eliminate a major bend. The South Branch consists of vertical dock walls throughout most of its length. It varies from 200- to 250-feet wide and 15- to 20-feet deep (Illinois EPA 2002). There are three former navigation slips off the South Branch near Ashland Avenue. This stretch of river, which runs through Chicago's Chinatown, is mainly commercial and industrial. However, several abandoned areas have grown up with pioneer vegetation. The neighborhoods surrounding this reach have one of the lowest amounts of open space per capita (Gobster and Westphal 1998).

The only water quality impairment listed in the state's 2004 305(b) report is from PCBs, which are contributing to fish consumption advisory. The source of PCBs in the sediments is unknown at this time.

Recreational amenities located along the South Branch include Ping Tom Park where there is access for fishing and three marine launch sites, including Cowley's Marina, Skokie Marine Corporation, and South Branch Marina. The River City Marina located just south of the Loop, contains approximately 50 recreational boat slips. The Rezmer Development Group is requesting the City of Chicago approve their plans for 5,000 residential units to be located on 62 acres along the SBCR. A river walk will be developed along with this planned development. The City of Chicago is also planning to develop canoe launch sites at Chinatown Park and Western Avenue.

3.1.1.3 South Fork of the South Branch

The South Fork (Bubbly Creek), which is 1.3 miles long, flows into the South Branch. The channel varies from 100- to 200-feet wide and 3- to 13-feet deep. The majority of the bank consists of steeply sloped earth or rock materials. However, there are several sections with vertical dock walls (Illinois EPA 2002).

Land-use along the canal is dominated by industrial and commercial uses. There is limited open space within nearby residential areas. Vacant land is often heavily contaminated. Land uses and barge and commercial traffic limit recreational use of the waterways (City of Chicago 1999). The South Fork is primarily a stagnant side-channel to the SBCR, as the original creek has been mostly filled in. Currently, there is virtually no natural flow into the system. Most flow occurs when the MWRDGC Racine Avenue Pumping Station is discharging combined sewer overflow to the

South Fork. The flow coming from this pumping station is high in oxygen demanding compounds as well as floatable materials (e.g. sanitary waste products).

Racine Avenue Pumping Station provides flow for the South Branch when it discharges.

The headwaters of the South Fork use to be the site of the Union Stock Yards from the late 1800s until closing in 1971. The South Fork was also the recipient of large amounts of slaughterhouse and rendering waste. As a result, the sediments in the South Fork are heavily contaminated from old by-products of the stockyards, plus organic matter originating from the Racine Avenue pump station (Hill 2000).

The South Fork is impaired by high pH, low dissolved oxygen and total phosphorus (IEPA 2004). The primary cause of impairments is from CSOs along the South Fork, with the majority of the flow coming from the Racine Avenue Pump station.

Limited recreational activities occur in this reach, but at the confluence with the SBCR, the South Chicago Rowing Center has a small boat launch. Additionally, the City of Chicago is planning to build a canoe launch at the Illinois and Michigan Canal Origins Park on Bubbly Creek and develop a pull-over and drop-off point for canoes on Ashland Avenue (City of Chicago 1999). Bank fishing is also common at the confluence with the SBCR. Just north of the South Fork, between West 34th and 32nd streets is Bridgeport Village, a new single-family residential development. This is one of many new developments that are being constructed along the Chicago River area. Many of these developments are creating river walks to connect the waterways to the people.

3.1.1.4 Chicago River

The Chicago River begins at the junction of the North and South Branch, ends at the Chicago River Controlling Works (CRCW) and is 1.5 miles in length. The Chicago River is 200-feet wide west of Michigan Avenue and up to 250-feet wide east of there. It has vertical concrete and sheet pile side-walls throughout its length. It is 20-feet deep at the west end and 26-feet deep at the east end. The river alignment is generally straight with three bends near Michigan Avenue, Orleans and State Streets (Illinois EPA 2002). The banks are developed with high-rise office, residential buildings, and open space that consist of hardscape plazas and cafes. The Chicago River, as it flows through the City, is one of the most visible aspects of the city that separates it from the highways and majestic buildings that adorn the Lake Michigan skyline. To many Chicagoans, it is commonly referred to as the City's "second shoreline." Segments of the river are bordered by a riverwalk and recreational boating and fishing are becoming increasingly popular with locals and visitors to the City (Gobster and Westphal 1998). The amount of open space along the river is limited, and the City has plans to increase the number of public plazas along the river. Recreational navigation boating occurs in the Chicago River, with the many excursion boats motoring up and down the downtown waterway. In addition to the excursion boats, the Chicago University Rowing Team, through the Chicago River Rowing and Paddling Center (at the old Coast Guard Station) uses the river in the early morning hours for training. Friends of the Chicago River host several waterway recreational events each year, many of them taking place in the Chicago River as it flows through downtown. Several commercial canoe rental and launch facilities such as Chicago River Canoe and Kayak and Chicagoland Canoe Base, cater to locals and tourists within the city. Marina City located under the building complex locally known as the "corncobs" provides recreational slips for pleasure boats. Light commercial barge traffic occurs in the Chicago River.

The Chicago River is often seen as the City's second shoreline.

In addition to boating and sightseeing, many Chicagoans use the Chicago River for angling. The area between Michigan Avenue and Columbus Drive is popular with fisherman, with a variety of gamefish species being caught (Gobster and Westphal 1998).

As discussed previously, the Chicago River is currently designated General Use, but on occasion the flow in the NBCR will enter into the Chicago River when the force of the discretionary diversion and lock flow is not sufficient to overcome a density current found in the Chicago River (personal communication, Lanyon 2003). This can cause the bacteria standard for this reach of the waterway to be exceeded. Currently, the United States Geological Survey (USGS) is conducting studies to better understand the effects of the density currents in the Chicago River and how they affect river flow in and out of the CRCW. Between the period of November and April, no discretionary diversion water is withdrawn from Lake Michigan through the Chicago River Controlling Works.

3.1.1.5 North Branch Chicago River

The NBCR within the CAWS, is 7.7 miles long, and stretches from the junction of the Chicago River and South Branch, up to the North Branch Dam at the NSC junction. The river follows its original course for a distance of 5.1 miles from the junction of the Chicago River and South Branch, although the channel has been deepened and widened in this area. The width of this reach varies from 150- to 300-feet with a depth between 10- to 15-feet. In several reaches, the banks consist of vertical dock walls in various states of disrepair. Throughout the remaining 2.6 miles, the channel has been either straightened or relocated into straight segments with steep earthen side slopes. The width is generally 90-feet with a depth in the center of the channel of approximately 10-feet (Illinois EPA 2002). This reach of the river consists of a mix of commercial, industrial, residential and park land/open space. It is one of the few stretches with homes bordering the river. However, many of the homes (approximately 41) along the Ravenswood section of the NBCR have built docks and

The NBCR provides many areas for urban kayakers.

structures on land that belongs to MWRDGC and through these structures homeowners have access to the waterway (Chicago Tribune, 2003). Currently, the MWRDGC is evaluating their legal options to have these structures removed or require the homeowner to obtain permits and pay an annual fee.

Many of the neighborhoods have taken an active interest in enhancing banks of the NBCR, particularly the communities at Ravenswood and Lathrop. Along with residential homeowners, some commercial businesses and industries have conducted stream improvement activities.

MWRDGC owns, manages and controls several facilities in the NBCR. These include the Webster Avenue aeration station, which is used to increase D.O. levels in the waterway and the North Branch pumping station near Lawrence Avenue. The Lawrence Avenue pumping station discharges CSO flow to the NBCR when the TARP tunnels are full.

Water quality impairments listed in the state's 2004 305(b) report for the North Branch are silver, total nitrogen, D.O., total dissolved solids, chlorides, physical habitat alterations, total suspended solids, aldrin, iron, flow alterations, oil and grease, PCBs, and hexachlorobenzene. Potential causes for impairment include municipal point sources, combined sewer overflow, urbanrunoff/stormwater, hydro-modification, channelization, habitat modification, bank or shoreline modification, highway maintenance and runoff, contaminated sediments and flow regulation.

Recreational activities in the NBCR include fishing, canoeing, kayaking and some power boating. The Lincoln Park Boat Club and the Chicago Union Rowing and Paddling Foundation share a boat launch facility near the North Avenue turning basin at the end of the Federal Navigable Waterway. The City of Chicago would like to enhance the existing facility with a boat storage and marina that would allow for motorized and canoe boat launches. Non-motorized boat facilities are also available at Clark Park, a ten-acre passive recreation area along the NBCR.

The NBCR is a favorite spot for fisherman, kayakers and children.

The Friends of the Chicago River hold their annual Chicago River Flatwater Classic and other events in the lower reaches of the NBCR. The Annual Chicago Chase rowing regatta is also held here. West River Park, where the NBCR meets the NSC, is a favorite spot for fishing and other shoreline activities (e.g. wading). The City of Chicago has plans to build a boat ramp from Argyle Street to the canoe launch in West River Park. The City also plans to build a ramp from Albany Street to the canoe launch on the upper North Branch and develop a water-edge portage path between these two canoe launches. At the dam structure in West River Park, the City has plans to rebuild the waterfall and create a safe run for small craft over the structure (City of Chicago 1999). Along with these improvements, the City plans to improve aquatic habitat in the river adjacent to West River Park. In addition to river access at West River Park, the City plans to encourage river access with new developments that would be constructed between Lawrence Avenue and Chicago Avenue. There are also several boat mooring structures associated with some restaurants and condominium complexes.

3.1.1.6 North Branch Channel

The North Branch Channel, which is an alternate route around Goose Island, is 1 mile long. The channel was constructed in the 1870s and connects around to the North Avenue turning basin and forms the east side of Goose Island. The channel has a straight alignment with a width that varies from 80- to 120-feet and a depth from 4- to 8-feet (Illinois EPA 2002). The fenced off banks offer limited access to the river in this reach with shoreline recreational uses restricted to some fishing and river viewing from bridges. While there is some natural vegetation along the banks, the majority of riparian land consists of commercial and industrial buildings (Gobster and Westphal 1998). A small marina is on Goose Island, but it is primarily limited to putting in recreational boats for storage and launching them in early-summer. A major residential conversion of the former Montgomery Ward building is taking place, with 298 residential units being planned. This development is immediately adjacent to the North Branch Channel and opposite of Goose Island. As stated previously, many of these residential developments are bringing people closer to river where land prices are more affordable than Lake Michigan development shoreline activities.

3.1.1.7 North Shore Channel

The NSC begins at the North Branch Dam in West River Park and extends upstream for 7.7 miles, ending at the MWRDGC Wilmette Harbor and Diversion structure. Unlike the rest of CAWS reaches, the NSC carries two use designations. The reach of this waterway above the MWRDGC Northside WRP is designated by the State of Illinois as General Use, whereas, the section of the NSC downstream of the Northside WRP is designated as Secondary Contact and

The North Shore Channel carries two use designations.

Indigenous Aquatic Life. The General Use portion of this waterway receives CSO and overflows from storm sewers. Most of the time this segment of the NSC experiences periods of no or little flow as a result of reduced discretionary diversion from Lake Michigan (personal communication, Dick Lanyon, MWRDGC 2003). The lack of flow creates a stagnant situation, resulting in D.O. levels falling below Illinois water quality standards and General Use bacteria standards.

The NSC is a man-made channel and is generally straight except for four bends. From each bank, it has about a 10- to 15-foot wide submerged shelf which transitions into a steep earthen side slope. It has a width of approximately 90-feet and a center depth that varies from 5- to 10-feet (Illinois EPA 2002). The narrow riparian corridor in the reach is mostly park land, which is owned by MWRDGC and managed in some locations by the City of Evanston, and the Village of Skokie and Wilmette. The riparian area has many older trees, picnic facilities, parks, a few launches for non-motorized boats some paved trails. Recreational uses include shore activities such as walking, fishing, biking, jogging, and nature exploration (Gobster and Westphal 1998).

North Side WRP discharges to the North Shore Channel near Howard Street.

The Northside WRP discharges to the NSC near Howard Street. The average design flow from this facility is 333 mgd, with a maximum design flow of 450 mgd. The plant provides wastewater treatment for approximately 1,300,000 people in the North Chicago area. This plant provides the primary flow for the NSC downstream of Howard Avenue. The flow from the North Side WRP creates a backwater area upstream of the facility and occasionally provides a flow of wastewater upstream to Lake Michigan during extreme wet-weather conditions. Approximately 16 reversals have occurred at the Wilmette pump station since 1985 and they have ranged in magnitude from 9 to 774 million gallons (MWRDGC 2004). Just downstream of the North Side WRP is the Devon Avenue Instream Aeration Station.

This aeration station helps aerate the NSC when DO levels fall below the water quality standard, as measured by a DO probe at the North Branch Pumping Station. According to the IEPA 2004 305(b) report, the NSC is impacted by zinc, nickel, total nitrogen, dissolved oxygen, total phosphorus, PCBs, fecal coliforms, flow alterations, physical habitat limitations and excess algal growth. Causes of impairment include CSOs, municipal point sources, stormwater runoff, flow regulation at Wilmette, hydro-modification of the waterway and channelization.

Like other portions of the CAWS, the NSC provides habitat for belted-kingfishers, warblers, beavers, black-crown night herons and various types of water turtles. The black-crowned night heron, a common resident in CAWS was placed on the Illinois endangered species list in 1977 due to their limited numbers throughout the state. The herons are protected under the Migratory Bird Treaty Act of 1918 and the Illinois Wildlife Code of 1971. The Evanston Ecology Center has a dock on the NSC, but it is not open to the public. However, the Chicago River Aquatic Center will use it for launching rowing boats (Gobster and Westphal 1998). Near Oakton Avenue the New Trier High School Rowing Club, Northwestern University and North Park College utilize the boat launching facilities at the Skokie Boat Dock Rowing Center.

3.1.2 Calumet River System

3.1.2.1 Calumet-Sag Channel

The Calumet-Sag Channel extends upstream from the Cal-Sag - CSSC junction for 16.2 miles to the Little Calumet River. The route for this channel generally follows the original route of Stony Ford Creek. The man-made channel consists of a trapezoidal shape that is 225-feet wide and approximately 10-feet deep. In some sections, the north bank has a vertical wall. The alignment is generally straight with three bends (Illinois EPA 2002). The Palos-Sag Forest Preserves, one of the largest contiguous open spaces in Northeastern Illinois, exists along the banks of the channel. There is a nearly continuous narrow band of cottonwood, willow, and box elder trees along each bank of the reach. The trees create a screen that blocks views of residential and industrial land uses from the waterway, although canopy and instream cover are sparse across much of the length of the channel. The Cal-Sag is used primarily by commercial barge vessels and recreational power boats (Gobster and Westphal 1998; Moore et al. 1998).

MWRDGC has three SEPA stations along the Cal-Sag to maintain the DO levels in the waterway. The SEPA stations are discussed in greater detail in Section 3.7. The cities of Alsip and Worth have constructed public boat launch facilities for recreational vehicles on the Cal-Sag. The launches are located on land leased by MWRDGC to the respective city. They are used heavily on summer weekends by power boats and to a much lesser extent, jet ski users. Canoes and kayak activity is very limited on the Cal-Sag due to the heavy boat traffic by commercial and recreational boats. The steep solid walls of the channel create a "bath-tub' affect (boat wake bouncing of the walls) which could cause small non-motorized boats to capsize. Additionally, the high walls and limited access points along much of the channel make it difficult for a capsized boater to get out of the waterway safely.

The Cal-Sag channel is used primarily by commercial barge and recreational vessels.

The 7Q10 for the Cal-Sag is 259 cfs and suffers from low dissolved oxygen, PCBs, and physical habitat impairment. Causes of impairment are from CSOs, industrial sources, municipal point sources, urban stormwater runoff, hydro-modification, channelization, habitat modification, removal of riparian vegetation, and contaminated sediments (IEPA 2004). The navigational channel is dredged periodically for maintenance and the barge traffic contributes to the re-suspension of bottom sediments.

The 43-acre peninsula between the Cal-Sag and the Little Calumet River will potentially be developed with 400 upscale riverfront homes. The plans include developing 11 acres of MWRDGC land as natural animal habitat and five acres of Blue Island City land along the Little Calumet River for a marina (The Star, 2004).

3.1.2.2 Little Calumet River

The Little Calumet River North Leg, which is 6.9 miles in length, begins at about Ashland Avenue and ends near the O'Brien Lock and Dam. The Little Calumet River has been altered from its natural condition. It has been deepened, widened and there are several changes in alignment including the construction of one full 180° bend. The width varies from 250-to 350-feet and the depth in the center on the channel is approximately 12-feet. The majority of the channel banks are earthen side slopes with a few reaches of vertical dock walls (Illinois EPA, 2002). Land use along this reach includes heavy industry, with some open space and forest preserve areas nearby. Other uses include active commercial and recreational boating, and limited shoreline fishing due to the lack of access points and open space (Gobster and Westphal 1998). Numerous facilities line the Little Calumet just downstream of the O'Brien Lock and Dam including boat launches, taverns and restaurants. In addition to these, there are many private docks and boat launches along the Little Calumet River.

The marinas and taverns on Little Calumet River provide services for active recreational boaters.

The Little Calumet River (north leg) has a 7Q10 flow of 20 cfs just downstream of its confluence with the Grand Calumet River. The Illinois 2004 305(b) report identifies the Little Calumet River (north leg) as being impaired by PCBs and mercury, which result in fish consumption advisory for this reach. The reach is also impaired by iron, dissolved oxygen, flow alterations, physical habitat alterations

MWRDGC's Calumet WRP is situated near the Little Calumet River's Acme Bend. It has an average design flow of 354 mgd and a maximum design flow of 430 mgd. The service area for this facility is approximately 300 square miles and provides wastewater treatment for approximately 1.2 million people. MWRDGC also operates

SEPA Station Number 2 on the north side of the Little Calumet River near Indiana Avenue. It is the smallest of the five SEPA stations on the Calumet System.

3.1.2.3 Grand Calumet River

The GCR in Illinois flows into the Little Calumet River just downstream of the O'Brien Lock and Dam. The river originates in Indiana and flows through Illinois for approximately 3 miles before it empties into the Little Calumet River. The GCR is very shallow, with the average depth around 2-feet (personal communication with Rob Sulski, IEPA). The GCR contains heavily contaminated sediments that originated from the industrial complexes and CSOs in Indiana.

The riparian vegetation along the Grand Calumet River provides excellent habitat for many species.

Recreational activity on the Grand Calumet is extremely limited due to the shallow depths observed in the river. The riparian vegetation along the river provide excellent habitat for many species of birds and mammals. The black-crowned night heron is common in this stretch of the river. Fishing is common along the banks at the confluence of the Grand Calumet and the Little Calumet River, where a sunken boat and barge partially blocks the entrance into the Grand Calumet.

3.1.2.4 Calumet River

The Calumet River extends upstream of the Grand Calumet River, through the O'Brien Lock and Dam and ends Calumet Harbor in Lake Michigan. The river is approximately 8 miles in length, with an average width of 450-feet. The river flow was diverted in the early 20th-century to prevent pollution from entering Lake Michigan. The flow from the Calumet River is directed now to the Calumet-Sag Channel via the Little Calumet River and GCR. The Calumet River has been heavily dredged to support barge operations and the industries that are found along the banks. Numerous slips and turning basins are present to accommodate the commercial barge traffic. The average depth in the channel is 27-feet, but the

The design of SEPA #1 along the Calumet River included a six acre heron rookery.

actual navigation depths may vary due to the fluctuations in the level of Lake Michigan. Numerous domestic and hazardous waste landfills surround the Calumet River. The channel banks consist of sheet-pile, concrete walls and rip-rap. Very little riparian vegetation exists along the Calumet River, except in the vicinity of the landfills. In addition to accommodating barge traffic, the Calumet River provides access to Lake Michigan for recreational boaters. Small non-motorized boat recreation is very limited due to the hazardous conditions created by the heavy barge traffic and the limited access points for canoes and kayaks.

MWRDGC's SEPA Station Number 1 is located on the north side of the Calumet River near Torrance Avenue. It is the second smallest SEPA station on the Calumet System and is adjacent to a six acre heron rookery. Water quality impairments as identified in the Illinois 2004 305(b) report indicates the Calumet River is impaired by PCBs, silver, high pH, total phosphorus, fecal coliform bacteria. Potential sources of impairment include industrial point sources, CSOs, and urban runoff during storm events

3.1.2.5 Lake Calumet

Lake Calumet located approximately 15 miles south of the City of Chicago is the last remaining vestige of a large glacial lake that existed 13,500 years ago (Ross, et. al). The Lake Calumet area was originally surrounded by a series of marshes in the South Chicago area. As early as the mid 1800s, the marsh area underwent extensive industrial development. A majority of the land throughout these marshes was bought up by the railroad industries including the Pullman Palace Car Company, who took benefit of the cheap land prices. Continued economic development brought in numerous other support industries, including steel mills and residential development. The Calumet area also became the dumping grounds for municipal and industrial waste and many Superfund sites can be found in and around the historical footprint of Lake Calumet. The lake is still threatened by these legacy landfills, through residual contamination in the lake sediments and man-made modifications (e.g. filling in of the lake). However, many local citizens have banded together to help preserve what is remaining of Lake Calumet and its surrounding wetlands.

Lake Calumet is a remnant of what was a vast wetland complex in the South Chicago area.

Access to Lake Calumet is very limited and access by boat is only through the Chicago Park District launch on Lake Michigan and through the O'Brien Lock and Dam on the Calumet River. The Illinois International Port District controls much of the activities occurring in Lake Calumet.

3.1.3 Tributaries of CAWS

There are several tributary streams that contribute flow to CAWS. These include the Little Calumet River South Leg, the North Branch above the North Branch Dam and numerous small watersheds along the Cal-Sag Channel (e.g. I&M Canal, Mill Creek and Tinley Creek). In addition, there are numerous small directly contributing areas along CAWS, including areas served by storm sewers, parking lots, street ends, and rooftop drains.

3.1.4 Lockport Powerhouse and Lock

The Lockport Powerhouse and Lock is the main outlet control for CAWS. All flow from CAWS discharges from the CSSC into the Lower Des Plaines River just north of the City of Joliet. The confluence of the Canal and the Des Plaines River is 1.1 miles downstream of the Lockport Powerhouse and Lock. This reach is the upper end of the Brandon Road navigation pool.

Lockport Powerhouse and Lock is the main outlet control for CAWS.

3.1.5 Pollutant Sources and Existing Controls

More than 70 percent of the annual flow in CAWS is from the discharge of treated municipal wastewater effluent from the four MWRDGC WRPs discussed previously. The Hammond Sanitary District in Indiana and the Thorn Creek Basin Sanitary Treatment Works, also contribute treated domestic and industrial waste effluents to CAWS via the GCR and the Little Calumet River South Leg.

3.1.6 Navigation and Leakage

This source consists of discharge that supports navigation in the operation of locks and leakage through structures and walls separating Lake Michigan and CAWS. Navigation flows are seasonal and dependent on the level of Lake Michigan because flow through the structure is by gravity only. Leakage has been reduced through repair of gates and construction of new walls. USGS reported the average annual discharge downstream of the three diversion facilities for the 2001 water year as 80 cfs at the Wilmette Controlling Structure, 217 cfs at the O'Brien Lock and Dam and 312 cfs at the CRCW. Leakage at the CRCW has been substantially reduced due to repairs to the lock and turning basing walls during the low Lake Michigan levels in the summer of 2000. **Table 3-1** details the average annual and monthly maximum and minimum flows at each of the diversion facilities for 2001 calendar year.

Table 3- 1
Delineation of Flow Characteristics at Each Diversion Facility Located on the CAWS

Facility	Navigation			Lockage			Leakage		
	Average Annual	Monthly Maximum	Monthly Minimum	Average Annual	Monthly Maximum	Monthly Minimum	Average Annual	Monthly Maximum	Monthly Minimum
WPS	0	0	0	0	0	0	0	0	0
CRCW	20.5	81.7	0	10.1	26.3	0.1	12.1	18.8	9.1
OL&D	29.1	113	0	17.4	36.3	2.5	6.8	10.1	4.4

All flows reported in cfs
WPS - Wilmette Pumping Structure
CRCW – Chicago River Controlling Works
OL&D - O'Brien Lock and Dam

3.1.7 Storm Runoff

Numerous storm sewers discharge to CAWS from several municipalities and IDOT drainage facilities. Forty-one municipalities within MWRDGC's jurisdictional area have applied for NPDES Phase II permits. In addition, MWRDGC reports eight major expressway outfalls to CAWS. These stormwater systems contribute to the pollutant load to the waterways by collecting and directing overland flow which may contain high levels of bacteria, oils, nutrients, pesticides, herbicides, high suspended solids and oxygen-demanding compounds.

Approximately 246 permitted CSOs discharge into CAWS.

3.1.8 CSO

Combined sewer systems are sewers that are designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. During dry weather periods combined sewer systems in CAWS transport all of their wastewater to one of MWRDGCs water reclamation plants, where it is treated and then discharged to the river. During wet-weather periods the wastewater volume in a combined sewer system can exceed the capacity of the sewer system and the existing TARP tunnels. For this reason, combined sewer systems are designed to overflow occasionally and discharge diluted excess wastewater directly to a waterbody. The CSOs contribute to water quality degradation by introducing high levels of bacteria from raw sewage, suspended sediment loading and oxygen demanding substances. CSOs are regulated under the federal National Pollutant Discharge Elimination System (NPDES) permit program and the CWA. IEPA administers the program and permits the CSOs within CAWS. Approximately 307 permitted CSOs discharge into the CAWS, with the dominant contributions coming from those permitted by the City of Chicago, MWRDGC and the City of Evanston. Table 3-2 on the following page identifies the number of CSOs in CAWS.

Table 3-2 Number of CSOs in CAWS

Permit Number	Permittee Name	City	Number
	Chicago River System		
IL0036536	Evanston CSO	Evanston	14
IL0069981	Wilmette-Greenleaf CSO	Wilmette	1
IL0028088	MWRDGC North Side WRP CSO	Chicago	9
IL0045012	Chicago CSO	Chicago	231
IL0028053	MWRDGC Stickney WRP CSO	Chicago	19
IL0039551	MWRDGC Lemont WRP CSO	Chicago	2
	Calumet River System		
IL0045063	Calumet Park CSO	Calumet Park	1
IL0044881	Calumet City	Calumet City	7
IL0028061	MWRDGC Calumet WRP CSO	Chicago	15
IL0052442	Blue Island CSO	Blue Island	4
IL0045098	Riverdale CSO	Riverdale	4

Source: USEPA: Communities with Combined Sewer Systems. Sep 2002.

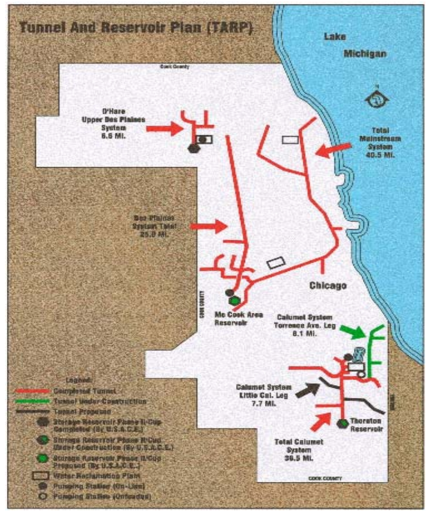
Five of the CSOs are from major MWRDGC pumping stations (IEPA 2002). MWRDGC's ongoing TARP Project was implemented to alleviate the polluting effects of CSOs and to provide relief from local flooding by providing holding capacity for 18 billion gallons of combined sewage in its tunnels and reservoirs until it can be pumped to the WRP for full treatment. Although TARP is scheduled for completion in 2014, significant benefits have already been realized. It is estimated that since the first of the tunnels went online in 1985 until 2001, more than 578 billion gallons of CSOs have been captured and conveyed to the WRPs for full treatment. Since TARP went online, the waterways have seen an increase in both fish population and diversity of species present. Basement and street flooding have also been reduced and fewer floodwater discharges to Lake Michigan have occurred. To date, more than $2 billion have been spent on the project.

MWRDGC has implemented a CSO notification program for CAWS and other surrounding communities are in the process of implementing their own program. The purpose of the program is to notify the public when overflow events occur that may impact designated uses in the waterways.

3.1.9 Industrial Sources

The three major private industrial NPDES permit holders, defined as facilities that discharge greater than 10 mgd to CAWS, include Midwest Generation, Corn Products Corp and ACME Steel. Potential pollutant waste streams from the plants include cooling water and waste streams generated during product processing. The NPDES permit reporting limits and compliance schedule for each is discussed later in this section.

3.1.10 TARP



The TARP is designed to reduce CSOs from the combined sewers into CAWS. TARP consists of tunnels and reservoirs which intercept CSOs and hold them until the stored wastewater can be pumped to the treatment plants for full treatment. TARP's purpose is to eliminate water pollution and flooding across Cook County, which originates from combined sewer areas. The tunnels were designed to catch the dirtiest "first flush" portion of the CSO from entering the river and the reservoirs were intended for flood control. TARP capture lessens the need for river and the combined sewage contained therein, reversals to Lake Michigan, a not uncommon, pre-TARP method of flood control. **Table 3-3** on the following page depicts the number of reversals that have occurred to Lake Michigan since 1985. Once completed, TARP will consist of 120 miles of tunnels and 15.65 billion gallons of reservoir storage (MWRDGC 2000; AquaNova and Hey and Associates 2003), collecting the flow from 307 sewer overflow points.

3.1.11 SEPA and In-stream Aeration System Stations

D.O. levels in the CAWS are historically low due to point and nonpoint sources and low instream velocities. SEPA and Instream Aeration System Stations (IASS) were designed and installed to enhance the water quality of portions of the Calumet-Sag Channel, the Little Calumet River, North Shore Channel and the North Branch Chicago River by adding oxygen directly into the waterways. There are five SEPA stations along Calumet River system and two IASSs along in the Chicago River system. The SEPA station concept involves pumping a portion the stream water into an elevated pool above the channel. The water then cascades over a series of weirs to create waterfalls that adds oxygen to the waterway. The IASSs rely on the use of submerged porous spargers to drive air directly into the river. The program goal has been to eliminate the need to build costly advanced treatment plants to meet water quality standards on CAWS (MWRDGC 2003; Butts, Shackleford, and Bergerhouse 2000).

SEPA #5 at Cal-Sag/Sanitary Ship Canal is enhancing water quality.

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Table 3-3
Reversals to Lake Michigan 1985-2003 (million gallons)

Date	O'Brien Lock/Dam	Chicago River Controlling Works	Wilmette	Total Volume
3/4/85			153.3	153.3
8/6/85			58.0	58.0
10/3/86			53.0	53.0
8/13-14/87		986.0	871.0	1957.0
8/25-26/87			18.0	18.0
9/3-4/89			52.0	52.0
5/9-10/90		208.0	289.0	497.0
8/17-18/90			9.5	9.5
11/27-28/90	224.0	86.0	154.0	464.0
7/17-18/96	1032.0	519.0		1551.0
2/20-22/97	1458.0	1947.0	774.0	4179.0
8/16-17/97		402.0	157.0	559.0
6/13/99			9.7	9.7
8/2/01		883.1	139.9	1023.0
8/31/01			75.3	75.3
10/13/01			90.7	90.7
8/22/02		1296.4	455.4	1751.8

3.1.12 Lake Michigan Discretionary Diversion Program

In the late 1800s, the flow of the Chicago and Calumet Rivers into Lake Michigan resulted in severe pollution and public health consequences. In response, the Illinois State Legislature created the Chicago Sanitary District in 1889 (now MWRDGC) to solve the pollution issues. The Sanitary District, starting with the CSSC, constructed a system of conveyances and control structures to reverse the flow directions of the Chicago and Calumet Rivers away from the lake. Flow in the rivers was maintained by diverting large amounts of Lake Michigan water into the rivers.

Later, the District constructed a second canal, the NSC, which extends from Lake Michigan at Wilmette to the NBCR. The amount of flow diverted from Lake Michigan into the NSC is regulated by the Wilmette Controlling Structure. Finally, the Calumet-Sag Channel was constructed to carry sewage from South and East Chicago to the CSSC. The O'Brien Lock and Dam, which is located on the Calumet River, regulates the flow of Lake Michigan waters into the Calumet-Sag Channel.

During the 1920 and 1930s the discretionary diversion program changed significantly due to lawsuits filed by the Great Lakes states seeking to restrict the loss of Lake Michigan water to CAWS. In 1975, the total Illinois allotment for lake withdrawal became 3,200 cfs. The 3,200 amount includes about 2,400 to 2,600 cfs which, after domestic consumption and treatment, enters CAWS as wastewater effluent. The remaining 600 to 800 cfs of lake withdrawal enters CAWS directly through the controlling structures for the purposes of water quality enhancement (dilution) and navigation maintenance (AquaNova and Hey and Associates 2003).

The USACE, through provisions of the U.S. Supreme Court Decree (Wisconsin et al. vs. Illinois et al) 388 U.S. 426, 87 S. Ct. 1774 (1967) as modified by 449 U.S. 48, 101 S. Ct. 557 (1980) has authority to monitor and measure the amount of diversionary flow coming from Lake Michigan in Illinois. The MWRDGC is responsible for managing the sluice gates that allow flow into CAWS. Discretionary diversion is seasonal and scheduled such that most of the diversion flow occurs during the warm weather, low flow, months of June through October. Presently and continuing through 2014, an annual average of 270 cfs of the diversion is intended for improvement of water quality. In 2015, the annual average discretionary diversion amount will be reduced to 101 cfs. However, an additional 35 cfs will continue to be allocated to the MWRDGC for navigational purposes. This additional amount is required to restore the water level to that required for navigation immediately following wet-weather related draw-downs of CAWS, necessary for flood control purposes (IEPA 2002).

3.2 Chicago River Programs and Projects

3.2.1 Chicago River Corridor Development Plan

In 1993, the City Space Program was initiated by the City of Chicago to improve the quality of life for Chicagoans, particularly children and youth. The City of Chicago, Chicago Park District and Forest Preserve District of Cook County developed City Space jointly. It is an intergovernmental initiative, which sets open space development goals, policies and priorities. Two-hundred specific projects to increase open spaces in Chicago, including neighborhood parks, community gardens, river trails, nature preserves and new lakefront parks. The Greenways Project, which strives to increase greenway acreage along inland waterways, is described in the following paragraphs (Chicago 2001).

Ping Tom Park along the South Branch is part of the Greenways Project.

3.2.2 Greenways Project

The Greenways Project encourages businesses and neighborhood groups to work with local governments to propose Greenways along inland waterways and abandoned rail corridors through intergovernmental collaboration and land donations. Capital projects incorporated as Greenways projects are derived from the 1998 Chicago River Corridor Development Plan and landscape improvements initiated as part of the River Greening Program.

The River Corridor Plan was designed to establish a river edge park and walkway through downtown and a continuous greenway along the north and south branches of the Chicago River. The City created zoning policies that require new riverside developments to provide public access and landscaping in preparation for the eventual expansion of the riverwalk along the river's entire length. Completed projects include the West River Park Waterfall located at the junction of the North Branch and the NSC and the Lathrop Homes Riverwalk along the North Branch, just north of Diversey (Chicago 2001).

3.2.3 A Vision for Lake Calumet

Lake Calumet was once one of the largest wetland complexes in the Midwest, supporting a diversity of plant and animal life. Today, after 120 years of industrialization, pollution and waste disposal, the area is altered and bares little resemblance to its original condition. Area organizations, such as the Lake Calumet Vision Committee, the LMF and the Southeast Environmental Task Force have a new vision for the area that includes restoration of natural areas and renewed recreational opportunities within Lake Calumet. The new vision is the first attempt to strike a balance between the area's economy and its environment, to provide jobs, re-invigorate neighborhoods, and nurture its remaining complex of rare natural areas (Chicago 2002, Pallasch 2002). The Lake Calumet area and associated wetlands are host to the largest breeding colony of Illinois endangered black-crowned night heron (Landing 1986).

The Chicago Department of Planning and Development's Calumet Land Use Plan recommends 3,000 acres for industrial redevelopment and 3,000 acres for the Calumet Open Space Reserve. The Calumet Area Ecological Management Strategy, prepared jointly by the Chicago Department of Environment (CDOE) and the Illinois Department of Natural Resources (IDNR), is the framework which will provide a unified strategy for land managers to rehabilitate their respective parcels within the Calumet Open Space Reserve. Parcels that have key ecological significance will be those targeted with the long-term goal of enhancing them individually and in relation to each other (Chicago 2002; Pallasch 2002).

Each Calumet project involves intensive collaboration between a large number of government agencies, industry, environmental group representatives and local residents. They require coordination among a range of different property owners, including IDNR, Waste Management, Inc., MWRDGC and Illinois International Port District. Ultimately, IDNR will be a major property owner for several of the open space parcels within the area (Chicago 2002; Pallasch 2002).

3.3 NPDES Permits issued in the CAWS

There are 12 facilities within CAWS that have discharge rates greater than 10 mgd. A brief summary of the permit information, including facility flow rates and compliance violations, for these facilities are included in **Table 3-4** (USEPA 2003).

Table 3-4 NPDES Permits in the CAWS

Facility Name	Permit #	Receiving Water	Issued Date	Expiration Date	Flow Capacity (MGD)
MWRDGC Calumet WRP	IL0028061	LCR	1/22/2002	2/28/2007	354
MWRDGC North Side STP	ILL028088	NSC	1/22/2002	2/28/2007	333
MWRDGC Stickney WRP	IL0028053	CSSC	1/22/2002	2/28/2007	1200
Midwest Generation, LLC-Crawford	IL0002186	CSSC	4/24/2000	4/30/2005	356.8
Midwest Generation, LLC-Fisk	IL0002178	SBCR	4/24/2000	4/30/2005	241.2
Corn Products International	IL0041009	CSSC	3/28/1996	3/31/2001	60
Thorn Creek Basin S.D.	IL0027723	Thorn Creek	9/29/1995	9/30/2000	15.94
Hammond Municipal STP	IN0023060	GCR	1/24/1999	6/30/1999	37.8
NSSD Clavey Road STP	IL0030171	Skokie River	9/17/2001	8/31/2006	17.8
ACME Steel Co.-Riverdale	IL0002119	LCR	9/14/1999	9/30/2004	10.7

3.4 Existing Uses and Water Quality Standards

As described earlier in this section, CAWS consists of primarily Secondary Contact and Indigenous Aquatic Life designated uses with three areas only being designated as General Use water ways.

3.4.1 Waterways Listed as Secondary Contact and Indigenous Aquatic Life

To protect these secondary contact waterways, the State of Illinois has adopted water quality standards that are appropriate for all secondary contact uses (35 Ill. Adm. Code 302 Subpart D). Such standards are contained in Table 3-5 and as follows:

Unnatural Sludge - Waters will be free from unnatural sludge or bottom deposits, floating debris, visible oil, odor, unnatural plant or algal growth, or unnatural color or turbidity.

pH - pH will be within the range of 6.0 to 9.0 except for natural causes.

Temperature - Temperature will not exceed 34°C (93°F) more than 5 percent of the time, or 37.8°C (100°F) at any time.

Cyanide - Total cyanide will not exceed 0.10 mg/l.

Substances Toxic to Aquatic Life - Any substance toxic to aquatic life not listed in Section 302.407 shall not exceed one half of the 96-hour median tolerance limit (96-hour TL_m) for native fish or essential fish.

D.O. – Dissolved oxygen shall not be less than 4.0 mg/l at any time except that the Calumet-Sag Channel shall not be less than 3.0 mg/1 at any time.

Bacteria Levels - There are no fecal coli form or *E. coli* standards for Secondary Contact waterways.

Table 3-5
Numeric Water Quality Standards for Illinois Secondary Contact and Indigenous Aquatic Life Waterways (35 Ill. Adm. Code 302.400)

Parameter	Concentration (mg/L)
Ammonia Un-ionized (as N*)	0.1
Arsenic (total	1.0
Barium (total)	5.0
Cadmium (total)	0.15
Chromium (total hexavalent)	0.3
Chromium (total trivalent)	1.0
Copper (total)	1.0
Cyanide (total)	0.10
Fluoride (total)	15.0
Iron (total)	2.0
Iron (dissolved)	0.5
Lead (total)	0.1
Manganese (total)	1.0
Mercury (total)	0.0005
Nickel (total)	1.0
Oil, fats and grease	15.0**
Phenols	0.3
Selenium (total)	1.0
Silver	1.1
Zinc (total)	1.0
Total Dissolved Solids	1500

*For purposes of this section the concentration of un-ionized ammonia is computed by the following equation:

$$U = \frac{N}{[0.94412(1 + 10^{x}) + 0.0559]} \quad \text{where:}$$

$$X = 0.09018 + \frac{2729.92}{(T + 273.16)} - pH$$

U = Concentration of un-ionized ammonia as N in mg/L
N = Concentration of ammonia nitrogen as N in mg/L
T = Temperature in degrees Celsius

**Oil shall be analytically separated into polar and non-polar components if the total concentration exceeds 15 mg/L. In no case shall either of the components exceed 15 mg/L (i.e., 15 mg/L polar materials and 15 mg/L non-polar materials).

3.4.2 General Use Waterways

CAWS has three waterways that are classified as General Use including the:

- NSC from the North Side WRP up to Lake Michigan
- Chicago River from the CRCW to the junction of the NBCR
- Calumet River from the O'Brien Lock and Dam to Lake Michigan

Although there are other General Use waterbodies (e.g. Little Calumet River, South Leg, and NBCR upstream of the confluence with NSC) they are not to be addressed in this UAA.

Illinois Title 35: Part 302, Subpart B in the water quality standards contains general use water quality standards which must be met for the three waterbodies being evaluated in this UAA. The General Use standards will protect these waters for aquatic life, wildlife, agricultural use, most industrial uses and ensure the aesthetic quality of the State's aquatic environment. Primary contact uses are protected for all General Use waters whose physical configuration permits such use. The following General Use water quality standards have been adopted and promulgated by the State of Illinois to protect those waterbodies that are General Use:

Offensive Conditions - Waterbodies designated for General Uses will be free from sludge or bottom deposits, floating debris, visible oil, odor, plant or algal growth, color or turbidity of other than natural origin.

pH - will be within the range of 6.5 to 9.0 except for natural causes.

D.O. - D.O. will not be less than 6.0 mg/l during at least 16 hours of any 24 hour period, nor less than 5.0 mg/l at any time.

Radioactivity - Gross beta concentrations will not exceed 100 picocuries per liter (pCi/l) and radium 226 and strontium 90 will not exceed 1 and 2 pCi/l, respectively.

Other Toxic Substances - General use waters will be free from any substances or combination of substances in concentrations toxic or harmful to human health, or to animal, plant and aquatic life.

Bacteria Levels - During the months May through October, based on a minimum of five samples taken over not more than a 30 day period, fecal coli form will not exceed a geometric mean of 200 per 100 ml, nor will more than 10 percent of the samples during any 30 day period exceed 400 per 100 ml in those waters that presently support or have the physical characteristics to support primary contact and flow through or adjacent to parks or residential areas.

Those areas that are unsuited to support primary contact uses because of physical, hydrologic or geographic configuration and are located in areas unlikely to be frequented by the public on a routine basis are exempt from the above criteria.

Temperature - There shall be no abnormal temperature changes that may adversely affect aquatic life unless caused by natural conditions. The normal daily and seasonal temperature fluctuations which existed before the addition of heat due to other than natural causes shall be maintained. The maximum temperature rise above natural temperatures shall not exceed 2.8°C (5°F). In addition, the water temperature at representative locations in the main river shall not exceed the maximum limits in **Table 3-6** during more than one percent of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature at such locations exceed the maximum limits in Table 3-6 by more than 1.7°C (3°F).

Table 3-6
Temperature Limits for Illinois General Use Waterways

Month	°C	°F	Month	°C	°F
Jan.	16	60	July	32	90
Feb.	16	60	Aug.	32	90
March	16	60	Sept.	32	90
April	32	90	Oct.	32	90
May	32	90	Nov.	32	90
June	32	90	Dec.	16	60

Total Ammonia Nitrogen - Total ammonia nitrogen must in no case exceed 15 mg/L. The total ammonia nitrogen acute, chronic, and sub-chronic standards are determined by the following equations:

1) The acute standard (AS) is calculated using the following equation:

$$AS = \frac{0.411}{1 + 10^{7.204-pH}} + \frac{58.4}{1 + 10^{pH-7.204}}$$

2) The chronic standard (CS) is calculated using the following equations:

A) During the Early Life Stage Present period:
When water temperature is less than or equal to 14.51°C:

$$CS = \left\{\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right\}(2.85)$$

When water temperature is above 14.51°C:

$$CS = \left\{\frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}}\right\}\left(1.45*10^{0.028*(25-T)}\right)$$

Where T = Water Temperature, degrees Celsius

B) During the Early Life Stage Absent period, as defined in subsection (e) of this Section:

When water temperature is less than or equal to 7°C:

$$CS = \left\{ \frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}} \right\} \left(1.45 * 10^{0.504}\right)$$

~~When water temperature is greater than 7°C:~~

When water temperature is greater than 7°C:

$$CS = \left\{ \frac{0.0577}{1+10^{7.688-pH}} + \frac{2.487}{1+10^{pH-7.688}} \right\} \left(1.45 * 10^{0.028(25-T)}\right)$$

Where T = Water Temperature, degrees Celsius

3) The sub-chronic standard is equal to 2.5 times the chronic standard.

Tables 3-7, 3-8 and **3-9** describe the water quality constituents assigned to protect General Use waterbodies.

Table 3-7
Numeric Water Quality Standards for Illinois General Use Waterways to Protect Aquatic Organisms 35 Ill. Adm. Code 302.208(e)

Parameter	Acute Standard (µg/L)	Chronic Standard (µg/L)
Arsenic (trivalent, dissolved)	360 X 1.0*=360	190 X 1.0*=190
Cadmium (dissolved)	exp[A+Bln(H)] X {1.138672-[(lnH)(0.041838)]}*, where A=-2.918 and B=1.128	exp[A+Bln(H)] X {1.101672-[(lnH)(0.041838)]}*, where A=-3.490 and B=0.7852
Chromium (hexavalent, total)	16	11
Chromium (trivalent, dissolved)	exp[A+Bln(H)] X 0.316*, where A=3.688 and B=0.8190	exp[A+Bln(H)] X 0.860*, where A=1.561 and B=0.8190
Copper (dissolved)	exp[A+Bln(H)] X 0.960*, where A=-1.464 and B=0.9422	exp[A+Bln(H)] X 0.960*. where A=-1.465 and B=0.8545
Cyanide	22	5.2
Lead (dissolved)	exp[A+Bln(H)] X {1.46203-[(lnH)(0.145712)]}*, where A=-1.301 and B=1.273	exp[A+Bln(H)] X {1.46203-[(lnH)(0.145712)]}*, where A=-2.863 and B=1.273
Mercury (dissolved)	2.6 X 0.85*=2.2	1.3 X 0.85*=1.1
Nickel (dissolved)	exp[A+Bln(H)] X 0.998*, where A=0.5173 and B=0.8460	exp[A+Bln(H)] X 0.997*, where A=-2.286 and B=0.8460
TRC	19	11

Parameter	Acute Standard (µg/L)	Chronic Standard (µg/L)
Zinc (dissolved)	exp[A+Bln(H)] X 0.978*, where A=0.9035 and B=0.8473	Exp[A+Bln(H)] X 0.986*, where A=-0.8165 and B=0.8473
Benzene	4200	860
Ethylbenzene	150	14
Toluene	2000	600
Xylene(s)	920	360

where: µg/L = microgram per liter,
exp[x] = base natural logarithms raised to the x- power,
ln(H) = natural logarithm of Hardness and
* = conversion factor multiplier for dissolved metals

Table 3-8
Numeric Water Quality Standards in Illinois General Us Waterways for the Protection of Human Health 35 Ill. - Adm. - Code 302.208(f)

Parameter	Unit	Standard
Mercury	µg/L	0.012
Benzene	µg/L	310

where:
µg/L = micrograms per liter

Table 3-9
Numeric Water Quality Standards 35 Ill. Adm. Code Part 302-208(g)

Parameter	Unit	Standard
Barium (total)	mg/L	5.0
Boron (total)	mg/L	1.0
Chloride (total)	mg/L	500
Fluoride	mg/L	1.4
Iron (dissolved)	mg/L	1.0
Manganese (total)	mg/L	1.0
Phenols	mg/L	0.1
Selenium (total)	mg/L	1.0
Silver (total)	µg/L	5.0
Sulfate	mg/L	500
Total Dissolved Solids	mg/L	1000

where:
mg/L = milligram per liter
µg/L = microgram per liter

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Section 4
Characterization of Waterway Reaches

4.1 Methodology

CAWS UAA process required an evaluation of the existing physical, chemical, and biological conditions to support the determination of the most appropriate use classifications for the waterways. This section describes the approach used to evaluate CAWS such that all the critical elements of a UAA were addressed, including how the study area was segmented and what data was used to evaluate existing and potential conditions. Monthly Stakeholder Advisory Committee (SAC) meetings were held to present the analysis of available data and solicit recommendations on use classifications and associated water quality standards and on UAA direction in general.

4.1.1 Reach Definitions

Since the waterways comprise a large area with diverse conditions, the study area was divided into reach segments allowing for more site specific analysis. Reach segments were defined to have break points at critical locations that contribute to their unique characteristics so that each reach was fairly homogeneous with regard to it's physical, chemical, and biological properties. **Figure 4-1** shows these reaches geographically and **Table 4-1** provides a summary description of reach breakpoints.

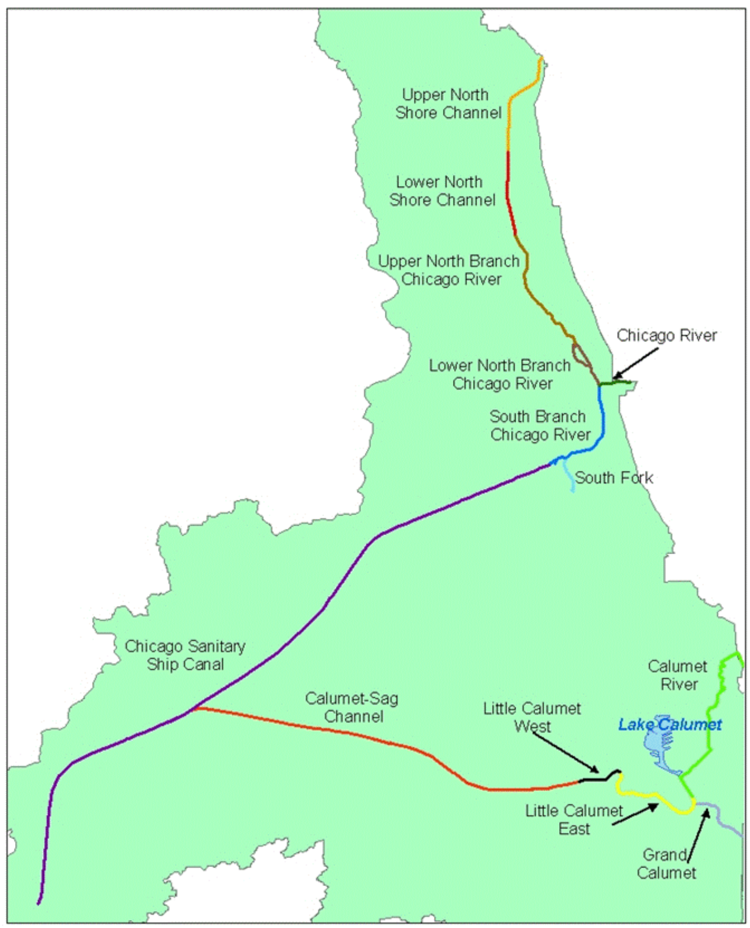


Figure 4-1 - UAA Reach Segmentation was defined to have break points at critical locations.

Table 4-1
Reach Segmentation

Segment	Description
Upper NSC	Wilmette Pump Station to North Side WRP
LNSC	North Side WRP to confluence with NBCR
Upper NBCR	Confluence with NSC to North Avenue Turning Basin
Lower NBCR	North Avenue Turning Basin to Confluence with Chicago River
Chicago River	Chicago Control Works to confluence with North Branch and SBCR
SBCR	Confluence with the Chicago River to confluence with CSSC at the Damen Avenue / I-55 bridge
South Fork	Racine Avenue Pumping Station to Confluence with SBCR
CSSC	Confluence with the SBCR at the Damen Avenue / I-55 bridge to Lockport Powerhouse
Calumet-Sag Channel	Confluence with Little Calumet to confluence with CSSC
Little Calumet River (West)	Calumet WRP to confluence with Calumet Sag Channel
Little Calumet River (East)	O'Brien Lock and Dam to Calumet WRP
GCR	Illinois state line to confluence with Little Calumet River
Lake Calumet	Lake Calumet
Calumet River	Lake Michigan to the O'Brien Locks and Dam

4.1.2 Data Acquisition and Gaps

UAA process required the analysis of physical, chemical, and biological data to characterize existing conditions and assess use classifications. Since the waterways were monitored extensively over the past decade by various agencies, the UAA utilized these resources and only collected additional field data to fill significant and high priority data gaps.

Numerous agencies as listed in **Table 4-2** and the public-at-large were solicited to provide relevant data in the following categories, collected over the past five years, from January 1, 1998 to December 31, 2002.

- Water Quality
- Biological
- Aesthetics
- Waterway Use
- Sediment Chemistry
- Habitat
- Hydrological and Meteorological
- Mapping/GIS

Table 4-2
Agencies Solicited for Data Acquisition

MWRDGC	City of Chicago
IEPA	Northeastern Illinois Planning Commission
USEPA	Illinois Department of Natural Resources
U.S. Army Corps of Engineers	Midwest Generation
U.S. Geological Survey	Fish and Wildlife Service
Illinois State Water Service	Illinois State Geological Survey
Friends of the Chicago River	National Weather Service
LMF	Local marinas

Water Quality Data

From a water quality perspective, UAA focused heavily on bacteria and DO for the characterization of attainable uses and therefore emphasized developing a comprehensive dataset of these and related parameters; including nutrients, solids, oxygen demand, water temperature, and photosynthesis related measures. Water quality data characterizing priority and 303d listed pollutants was also a consideration. Specific water quality constituents of concern for UAA and requested from potential data providers are listed in **Table 4-3**. Requests were made for all water quality data collected in-stream and for point and non-point sources for the parameters listed in Table 1 within CAWS over the past five years (1998 through 2002).

Table 4-3
UAA Water Quality Parameters of Concern

D.O.	Chromium (Trivalent)
Ammonia Nitrogen (total)	Biological Oxygen Demand
Chromium (Hexavalent)	Un-ionized Ammonia
Bacteria (E. coli, fecal coliforms, total coliforms)	Copper
Nitrate Nitrogen	Chlorophyll-a
Cyanide	Oil and Grease
Algal Biomass	Fluoride
Aldrin	Nitrogen (all forms)
Iron (Total)	Phosphorus (all forms)
Iron (Dissolved)	Endrin µg/L
Water Temperature	Lead
Total DDT	PH
Manganese	Total Chlordane
Total Organic Carbon	Mercury
Methoxychlor	Total Suspended Solids
Nickel	Toxaphene
Dissolved Solids	Phenols
Heptachlor	Arsenic
Selenium	Heptachlor epoxide
Barium	Silver
Lindane	Boron
Sulfate	Parathion
Cadmium	Total Residual Chlorine
2,4-D	Chloride
Zinc	Silver
Chromium (Total)	Dieldrin

Sediment Data

Although UAA focused primarily on bacteria and DO in the water column in assessing use attainability, sediment bound pollutants and their potential impact on in-stream water quality and aquatic life populations were also considered. As a result, all available sediment chemistry and volume data collected in CAWS study area over the past five years (1998 through 2002) was requested, including sediment oxygen demand (SOD) measurements and sediment toxicity testing.

Biological, Habitat, and Aesthetics Data

Biological and habitat data were an important resource in assessing aquatic life use designations. As a result, all fish survey, benthic/macro-invertebrate, habitat, aesthetics and toxicity data collected in CAWS study area over the past ten years (1993 through 2002) was requested from each potential data provider. Specific parameters of interest are listed in **Table 4-4**, including calculated metrics and indicies when available.

Table 4-4
UAA Habitat, Biological and Aesthetics Parameters of Concern

Fish Species	Fish Tissue
Benthic/Macro-invertebrate Species	Toxicity testing (inc. WET)
Algal	Macrophytes
Phytoplankton	Ichthyoplankton
Riparian Survey	Substrate classification
Canopy Cover	Floatables/Film/Oil/Grease
Odor	Color/Clarity/Turbidity
Debris/Obstructions/Hazards (surface/sub-surface)	

Hydrologic and Meteorological Data

Hydrologic and meteorological data was collected to provide insight into the impact of wet weather and CSO discharges on DO and bacteria conditions in the waterway. UAA requested hydrologic data characterizing in-stream as well as point and nonpoint sources, including flow, velocity, and elevation measurements. Meteorological data requests included rainfall, air temperature, solar radiation, and cloud cover. **Table 4-5** provides a complete list of hydrologic and meteorological parameters requested over the past five years (1998 through 2002).

Table 4-5
Hydrology/Meteorological Parameters of Concern

Flow Volume	Flow Velocity
Stage Elevation	Precipitation
Air Temperature	Solar Radiation
Cloud Cover	Evaporation Rate

Waterway Use Data

Evaluations of how CAWS is being used for both recreational and commercial purposes were a critical component of UAA. As a result, we requested all qualitative and quantitative data that might support characterization of existing and projected uses of the waterways, including any measures of use intensity, frequency, and duration.

GIS Data

GIS data was utilized to support UAA mapping needs, including presentation of sampling, waterway characterization, and use classification results. **Table 4-6** outlines the project's GIS data needs and information requested.

Table 4-6
GIS Data Needs

Base map - roads, political boundaries, waterways…	Sampling locations/coordinates
Point sources locations (Outfalls [CSO or SW], WWTP discharges, SEPA locations, NPDES permits…)	Recreational features (boat launches, marinas, canoe liveries…)
Land use (existing and future)	Aerial photography
Digital Elevation Models (DEMs)	

Data Gaps

Once the data was compiled and logged into the database management system an assessment of data gaps was performed. Specifically the following types of data listed in **Table 4-7** were lacking and important to the development of the UAA process.

Table 4-7
Data Gaps

Waterway use	Habitat
Sediment toxicity	Lake Calumet
E.coli bacteria, particularly characterizing wet weather, non-point sources and CSO loadings.	

To fill the critical need for waterway use data, the project conducted numerous surveys of the waterways as described in Section 4.1.3.1 of this report. The habitat data gaps were filled by USEPA and IEPA who funded and coordinated a habitat assessment of critical locations as described in Section 4.1.3.5. IEPA similarly conducted water quality sampling in Lake Calumet. Additional sediment toxicity data was not collected and the project relied on the positive correlation between *E.coli* and fecal coliform bacteria to confirm findings from limited instream *E.coli* data. Additionally, by the completion of the study in 2004, the MWRD provided nearly two more years of instream *E.coli* data that is included in the final assessment of use classifications for CAWS. The wet weather, CSO, and non-point source bacteria loading data gap was not filled and initial plans to develop a water quality model for bacteria were abandoned as a result. Since the lack of available data significantly limited the cost/benefit of a water quality model, the analysis of available instream bacteria data was used to make use classification recommendations.

4.1.3 Data Assessment

For the purposes of this UAA the past five years of data were used for characterizing existing conditions and the next ten years was set as the time frame for consideration of future uses and potential changes with regard to physical, biological and chemical conditions in the waterways. The TARP Reservoir, for example, will have substantial effects on water quality in the waterways, but will not be completed within the next ten years. As a result, although TARP Reservoir plans have been considered with this UAA, the focus is on addressing pre TARP Reservoir conditions. The past five years were defined as 1998-2002 based on data acquisition at the on-set of the UAA in 2002, but newer critical data was acquired and included as necessary. In cases where limited data was available for the past five years or where it was important to evaluate historical trends, as with fish community data, data collected prior to 1998 was included in data assessments.

4.1.3.1 Recreation and Navigation Uses

Since UAA process requires the designation of use classifications and associated water quality standards that protect attainable uses, the waterway use data gap needed to be filled to satisfy a basic requirement of the study. As a result, recreation and navigation use surveys were conducted for all reaches in the study area. Waterway use data was collected using four methods. First, SAC, other significant stakeholders, and all pubic meeting attendees were asked to provide any quantitative data characterizing waterway use. Second, a post card survey soliciting information from marinas along the waterways was conducted. Third, a letter was sent to all municipalities and other public entities adjacent to or owning land along CAWS, soliciting all ongoing or near future (10 years) development plans that might affect uses in and along the waterways. The forth approach was to travel each reach of the waterway by boat. During these field visits, waterway use activities and access points were recorded.

The postcard survey involved weekly questionnaires sent to marinas along CAWS during the recreational season. Participation was encouraged using a monetary incentive for the number of postcards returned. Postcard questions included:

- At what marina are you operating?
- How many boats were launched during the past week?
- In the past week, have you observed swimming, fishing water skiing, jet skiing, power boating, wading, kayaking, canoeing, or playing at stream bank on the waterway you are located on?
- How often in the last week have you observed swimming, wading, or stream bank playing activities?

Field surveys of the waterways were conducted during the recreational season from July through October 2003. Several stakeholders contributed to the effort with the field observation teams including:

- IEPA
- LMF
- MWRDGC
- CDM
- USEPA

Each reach was surveyed at least once, with some reaches surveyed twenty times (includes MWRDGC and USEPA visits). Field teams counted the number of times the following recreational categories were observed, including logging the relative location and documenting with photographs when appropriate:

- Swimming, diving or jumping
- Wading
- Fishing
- Skiing or tubing
- Canoeing, sculling or kayaking
- Power boating

The results of both surveys were summarized by calculating a frequency distribution of observed activities, including the total count for activity category and the percent of the total observed activities it comprised. Survey results are presented by stream segment in Sections 4.5 through 4.8.

The waterway use data served a critical role in the UAA process, particularly for recommending recreational use classifications. Since the UAA process dictates protecting attainable uses by designating appropriate use classifications, waterway use data was evaluated to determine routine uses for each reach. Use statistics were presented to SAC at monthly meetings, where results were discussed to ensure that the data was in alignment with perceived uses and to identify any concern that the data did not represent anticipated future uses which UAA should consider. The timeframe for consideration of future uses was defined as the next ten years.

4.1.3.2 Water Quality

The past five years of available water quality data were evaluated using a use attainment screening approach that identified CAWS reach segments currently attaining clean water act goals. Instream water quality data was compared to General Use and Secondary Contact and Indigenous Aquatic Life water quality criteria to determine whether recent water quality conditions justified a use upgrade. Section 3.4.2 includes a listing of the applicable General Use Water Quality Standards. Since USEPA's latest draft bacteria guidance recommends using *E.coli* bacteria as the indicator organism rather than fecal coliform as currently regulated for General Use designated water bodies, UAA bacteria screening criteria were established consistent with the more recent guidance as recommended by USEPA based on protecting recreational uses identified as existing uses in CAWS. These criteria are further detailed in Section 5, but in summary an *E.coli* geometric mean criteria of 1000 cfu/100mL was used as the screening criteria for limited contact recreation and a geometric mean of 2470 cfu/100mL for recreational navigation. The use attainment screening approach identified constituents of concern that are limiting attainment of clean water act goals and/or potential use designations developed through UAA. The use attainment screening results were presented at monthly stakeholder meetings along with waterway use, sediment quality and biological conditions and are presented in Section 4.2-4.5.

Water quality data from several agencies was used to characterize existing water quality conditions in the waterways, however, MWRDGC's continuous D.O. and temperature monitoring and monthly grab sampling programs provided by far the most comprehensive data set. Continuous monitoring included hourly measurements recorded throughout the year at 36 locations in CAWS UAA study area as shown in **Figure 4-2**. Monthly grab samples analyzed for conventional water quality constituents and metals were collected at 25 different locations in the UAA study area and are also shown in Figure 4-2. Some sampling locations included on maps and graphs are not in the UAA study area, but are included to help assess their potential influence on water quality in the study area.

In addition, water quality results were analyzed along with meteorological and point and non-point source loading data to help understand conditions affecting water quality. The map shown in **Figure 4-3** identifies the location of instream aeration stations and significant point source inputs such as water reclamation plants, CSO pumping stations and power generating facilities. The impacts of wet weather and CSO discharges were evaluated using rainfall data from Midway and O'Hare airports and discharge volume data provided by the MWRD for the CSO pumping stations. The pumping station discharges to the waterways when the TARP CSO capture system is near capacity. Changes in dissolved oxygen concentrations were assessed in response to rainfall and/or CSO discharge events using continuous time series (hourly) plots of rainfall, DO and temperature data for 36 stations distributed throughout the waterways. Similar assessments were made using monthly grab *e.coli* bacteria data.

Since MWRDGC WRP discharge makes up the majority of flow in the waterways, effluent water quality data was also compared to water quality screening criteria to help understand potential WRP influences. In the case of bacteria, screening criteria followed USEPA's recent guidance to use *E. coli* rather than fecal coliform as explained further in Section 5. Since MWRDGC effluent samples are analyzed for fecal coliform and not *E.coli* bacteria, for this screening level comparison *E. coli* concentrations were predicted from weekly fecal coliform results using *E. coli/*fecal coliform ratios developed by MWRDGC (MWRDGC, Report No. 04-10, Estimation of the *E. coli* To Fecal Coliform Ratio in Wastewater Effluents and Ambient Waters of the MWRDGC, July 2004).

In cases where water quality screening criteria are dependent on multiple parameters, such ammonia being dependent on pH and temperature or dissolved metals being dependent on water hardness, actual corresponding measurements taken at the same time and location were applied when available. Fortunately, the MWRDGC sampling program usually included the data necessary to make these determinations. In cases where a different procedure was followed it is so noted with the presentation of results in Sections 4.2-4.5. For example, temperature data was not provided with the WRP effluent data so ammonia criteria comparisons were applied using only to the non-temperature dependent formula for temperatures less than 14.51°C. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any

Figure 4-2 - Monitoring Stations

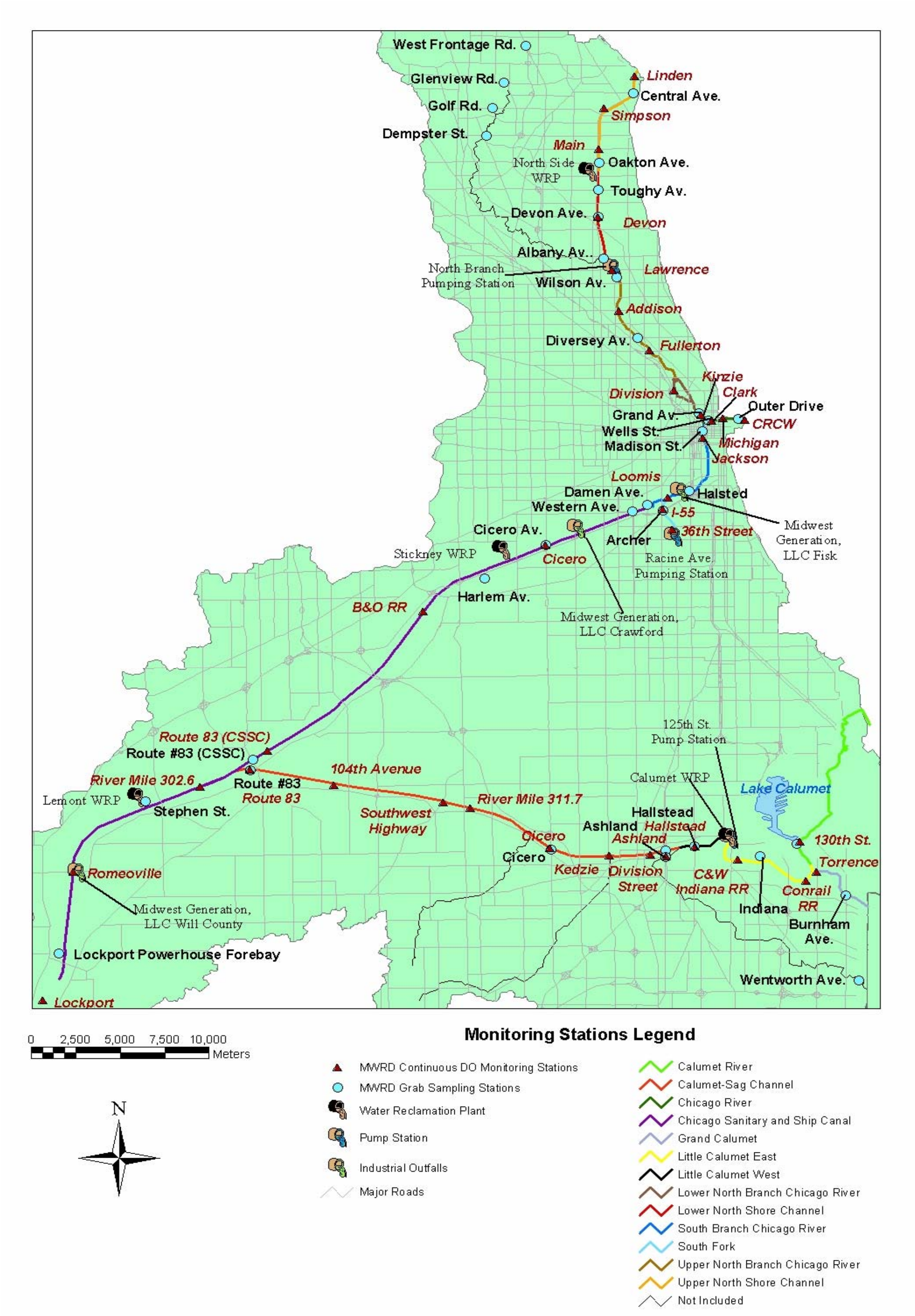
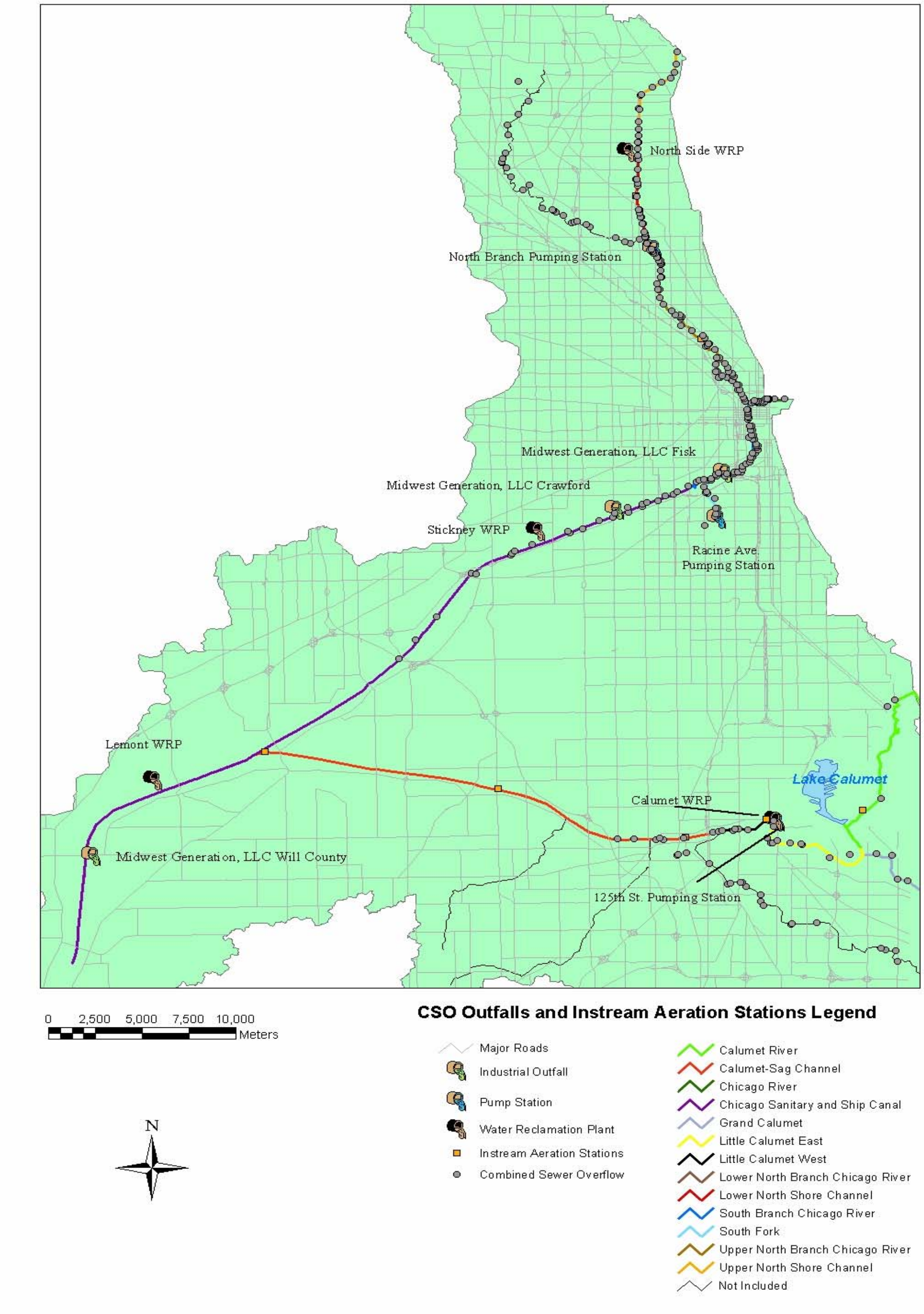


Figure 4-3 - CSO Outfalls and Instream Aeration Stations Legend



period of at least four days. *E.coli* bacteria calculations were similarly calculated as data representing five samples collected over 30 days was not available.

4.1.3.3 Sediment Quality

Since there are no regulated sediment quality standards for CAWS, two sediment quality criteria guidelines were used to evaluate sediment data in CAWS as described in **Table 4-8**. Both guidelines are based on two concentration thresholds that predict the likelihood of toxicity to benthic organisms. **Figure 4-4** illustrates the increase of potential impact with increasing concentrations. In both studies, the guidelines were developed based on correlating sediment chemistry data with sediment toxicity results. The actual concentration thresholds are listed in **Table 4-9**.

Table 4-8
UAA Sediment Quality Criteria Guidelines Applied

Author	Agency/Publication	Sensitive Benthic Organism Toxicity Threshold	Probable Benthic Organism Toxicity Threshold
Long and Morgan [1]	National Oceanic and Atmospheric Administration (1990)	Effect Range – Low (ER-L)	Effect Range – Median (ER-M)
MacDonald [2]	Archives of Environmental Contamination and Toxicology (2000)	TEC	Probable effects concentration (PEC) -

[1] Long, E.R., and L. G. Morgan. 1990. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. National Oceanic and Atmospheric Administration. Seattle, Washington.

[2] MacDonald, D.D., C.G. Ingersoll and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. Toxicol.* 39: 20-31.

The guidelines are intended and were used as a screening tool to identify potential problem areas and constituents. More accurate characterizations of risk and/or bioavailability should be based on site specific sediment toxicity data such as bioassays. Since there was limited sediment toxicity data available for CAWS, accurate reach by reach characterization were not possible.

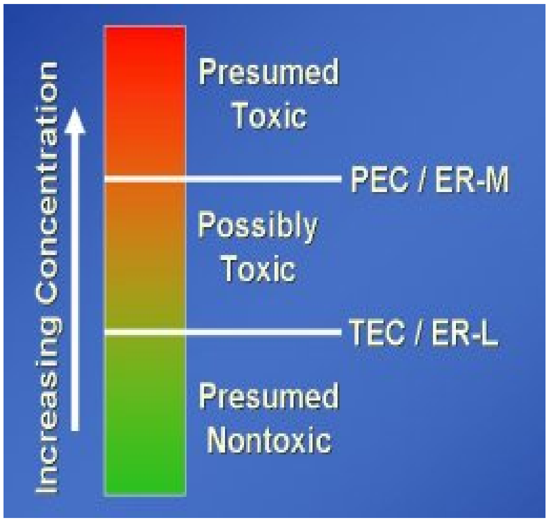


Figure 4-4 - Sediment Toxicity Thresholds

Table 4-9
Sediment Quality Guideline Concentration Thresholds

Parameter	TEC (ppm)	PEC (ppm)	ER-L (ppm)	ER-M (ppm)
Antimony			2	25
Cadmium	0.99	5	5	9
Chromium	43.4	111	80	145
Copper	31.6	149	70	390
Lead	35.8	128	35	110
Mercury	0.18	1.1	0.15	1.3
Nickel	22.7	49	30	50
Silver			1	2.2
Zinc	121	459	120	270
Total PAHs	1.61		4	35
Total PCBs	0.0598		0.05	0.4

In terms of the goals for CAWS UAA, it is important to identify how sediment quality characterizations should influence the use designation decision making process. Although contaminated sediments are an important consideration in evaluating the health of a water resource, the goal of UAA is to determine whether conditions threaten attainment of a use. Since contaminated sediments do not pose a significant risk of illness to recreationists, particularly for partial body contact activities like boating, sediment quality results were not included as criteria in determining use attainment for recreation.

From an aquatic life use designation perspective, contaminated sediments can certainly limit the diversity of benthic organisms as well as influence the risk associated with fish consumption. As a result, sediment toxicity can secondarily constrain attainment of an aquatic life use designation. With the availability of biological data characterizing macro-invertebrate and fish populations in CAWS, these more direct measures of aquatic life conditions were given precedence in evaluating aquatic life use attainment. Sediment chemistry data was used to help understand cause and effect relationships that may be driving biological and/or water quality conditions in a given reach.

With sediment chemistry and toxicity data only serving as a support tool rather than a determinant in assigning use designations, the collection of additional sediment toxicity data to better understand bioavailability was not judged to be a high priority data gap for UAA. As a result, additional data collection was not planned or conducted. **Table 4-10** itemizes the sediment chemistry data obtained from various stakeholder agencies in the data acquisition process. Sampling locations are shown in **Figure 4-5**. Since sediment studies are generally less frequent than water quality, to get a more complete assessment of all reaches, data from the last twelve years was utilized (1990-2002).

Figure 4-5 - Sediment Sampling Stations Legend

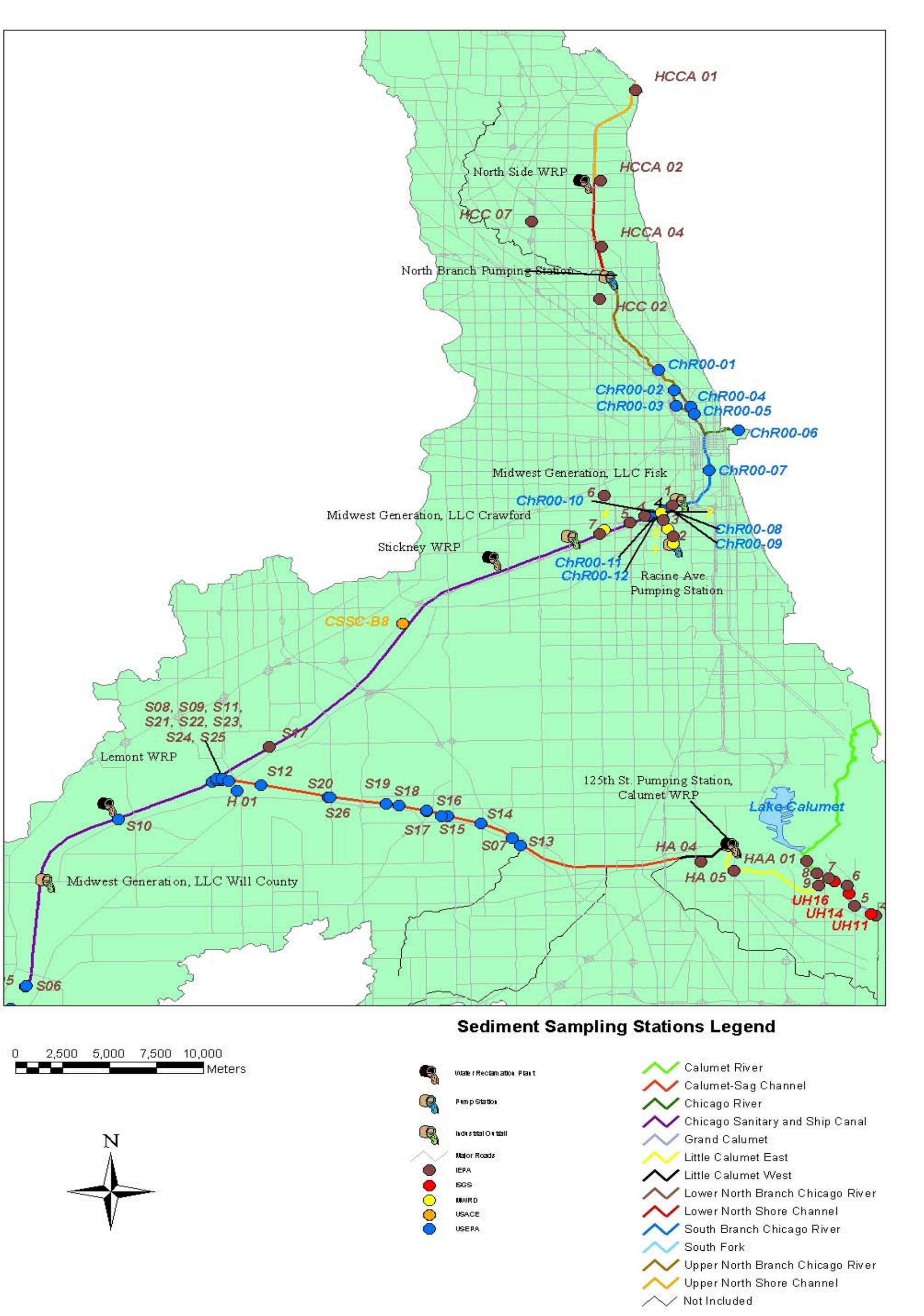


Table 4-10
Sediment Quality Studies included in UAA Assessment

Data Provider	Reaches	Year
MWRD	South Branch, Collateral Channel	1995
MWRD	Upper North Branch	1992
IEPA / MWRD	South Branch/Fork, CSSC, Collateral Channel	1994-5
IEPA	Grand Calumet	1997
IEPA	Calumet System, North Branch, NSC	1999, 2001
IEPA	Lake Calumet	2000
USEPA	Chicago River System, CSSC , Cal-Sag Channel	2000, 2001
ISGS	Grand Calumet	1991

4.1.3.4 Biological Conditions

The health of an aquatic community is an important parameter in determining whether the CWA goals of "fishable and swimmable" are being met for the propagation of fish and shellfish. The aquatic community includes fish, macroinvertebrates (i.e. bugs that live in streams and lakes), algae and aquatic vegetation. The wealth of biological data to evaluate ecological integrity of the waterways comes from the fish and macroinvertebrates collected in the Chicago area waterways by various governmental agencies. Biological health for the fish and macroinvertebrate communities are measured by indices, consisting of a variety of metrics (e.g. number of native species, number of sensitive species, etc) and have wide use with regulatory agencies across the United States. Illinois, Ohio, and other Midwest states in USEPA Region V commonly use these indices to help develop both narrative and numerical biological criteria to protect aquatic life use designations. Narrative criteria are general in nature and typically state that a waterway is to be "free from" a certain harmful or noxious substance (e.g. free from oil and grease, odor producing materials…etc.). Narrative criteria can also include language such as "waterways are dominated by fish species such as green sunfish, largemouth bass…etc." Numerical criteria are estimations of concentrations of chemicals and degrees of aquatic life toxicity allowable in a waterway without adversely impacting the water body's designated uses. Typically these criteria include acute (short-term exposure) and chronic (long-term exposure) criteria.

As stated previously, the objectives of the CWA are the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. To accomplish that objective, the act aimed to attain a level of water quality that "provides for the protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water" by 1983 and to eliminate the discharge of pollutants into navigable waters by 1985. Since the implementation of the CWA, much of the development in determining "attainment" has been focused on chemical criteria. Some states, like Ohio have implemented biological criteria in their water quality standards. These criteria are useful in determining if the biological integrity of a waterbody is being achieved.

Biological criteria are developed to evaluate cumulative biotic responses to exposure to contaminants or other stressors (e.g. habitat alterations) and have been useful in measuring attainment of designated aquatic life uses. Biological criteria can be narrative or numerical and are usually based upon the comparison to a reference reach or similar water body that receives little impact from human activities. However, due to the uniqueness of CAWS, there are not any waterways in Illinois that could serve as a suitable reference area. Like the federally maintained navigation channels in CAWS, the Cuyahoga River Ship Channel in Cleveland shares similar characteristics such as vertical sheet piled walls, deep dredged channels, used by large commercial vessels and has limited contact recreation (e.g. rowing, jet skiing) use occurring in the channel. Water quality studies (OEPA 1999) conducted for Cuyahoga River Ship Channel indicates that the fish and macroinvertebrate communities are substantially degraded and the potential for recovery is limited due to the irretrievable human induced conditions.

Numerous states have developed biological criteria and many are in the process of developing aspects of biological assessments that will support future development of biological criteria. The State of Illinois is currently conducting biological monitoring to evaluate biological conditions within state waterbodies, but are not developing biological criteria at this time. Since there are no biological criteria under the state's General Use standards to determine the attainment of a waterbody to meet biological integrity, and there is no suitable reference waterbody for CAWS, the attainment of a given reach will be based on the "existing best condition" observed in the waterways. This approach will be discussed in greater detail in Section 5.

Biocriteria and water quality standards to protect for aquatic life in CAWS may include both numeric and narrative criteria. Narrative biological criteria can be reflective of the dominant fish species for a given use designation, based upon the biological expectation of the waterway. In this UAA, numerical biological criteria were used for screening purposes and are defined as the IBI score for fish. The macroinvertebrate communities will be included as part of the aquatic life use designation based upon this MBI as used by the State of Illinois in the 305b waterbody attainment report.

The IBI was first developed by Karr (1981) to assess small warm water streams in Illinois and consists of 12 metrics that reflect fish species richness and composition, number and abundance of key species, trophic structure and function, and the condition of the fish. Each metric either receives a score of 1, 3 and 5 depending upon how it relates to a similar waterbody (reference stream) that has little human influence. A score of 5 means a particular metric is very similar to that of a reference water, and a metric score of 1 means that metric departs significantly from the reference condition.

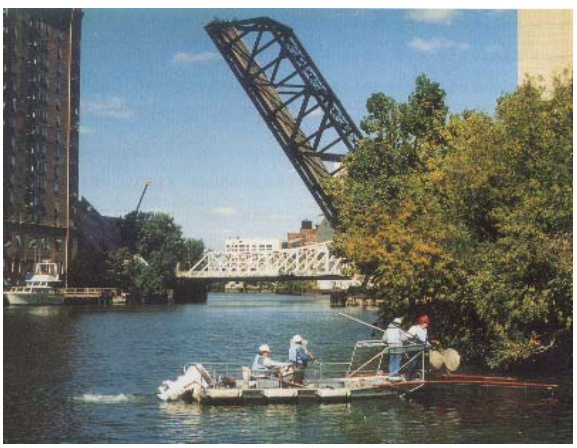
The IBI has now become the standard, by which the biological integrity of a fish community can be evaluated, and many states have modified the IBI to fit their particular ecoregion, and some states have included the IBI in their water quality standards. In this UAA, a range of IBI scores using the Ohio Boatable IBI metrics (OEPA 1987) was be used to define the use designations for a waterway reach. The State of Illinois does not have an approved approach to evaluate fish communities in large, deep waterways, and therefore, the Ohio IBI boatable approach was used as a guide or expectation as to what the use designation could support in terms of fish community structure in CAWS.

Biological Data Set

MWRDGC has collected over 25 years worth of biological data from CAWS. The primary focus has been on collecting fish and to a much lesser extent, macroinvertebrate data in conjunction with their water quality monitoring program. The biological data set used in this UAA includes fish and macroinverterbrate data collected at selected locations between 1993 and 2002 (**Figure 4-6**). In addition to these data sets, biological data collected by IDNR was also included in this evaluation. Habitat analysis was conducted in April 2004 by and IEPA.

Fish

MWRDGC collects fish from 20 different locations within CAWS, and the sites are sampled at least twice a year between 1974 and 2004. The fish community was sampled using a 230-volt alternating current boat-mounted electorshocking unit, and the length of channel shocked was approximately 400 meters. One pass was made on a channel side, and then repeated for fifty meters (MWRDGC 1998). Sampling is conducted downstream, from the upstream boundary of the sampling reach along one side of the channel (MWRDGC 1998). Shocked fish were netted, brought on aboard, identified, enumerated, weighed and measured. Additional notes were made of any deformities or abnormalities on the fish.



MWRDGC's electroshocking crew collected fish from 20 different locations within CAWS.

Once measurements are completed, the fish were typically released back into the waterway. However, some specimens were retained and brought back to the laboratory for further analysis, or if field identification was not possible.

Fish data was analyzed using a variety of metrics, with the primary metric being the Ohio Boatable IBI (OEPA 1987). **Table 4-11** outlines the IBI metrics used for evaluating the fish data collected by MWRDGC.

Figure 4-6 - Biological Sampling Stations

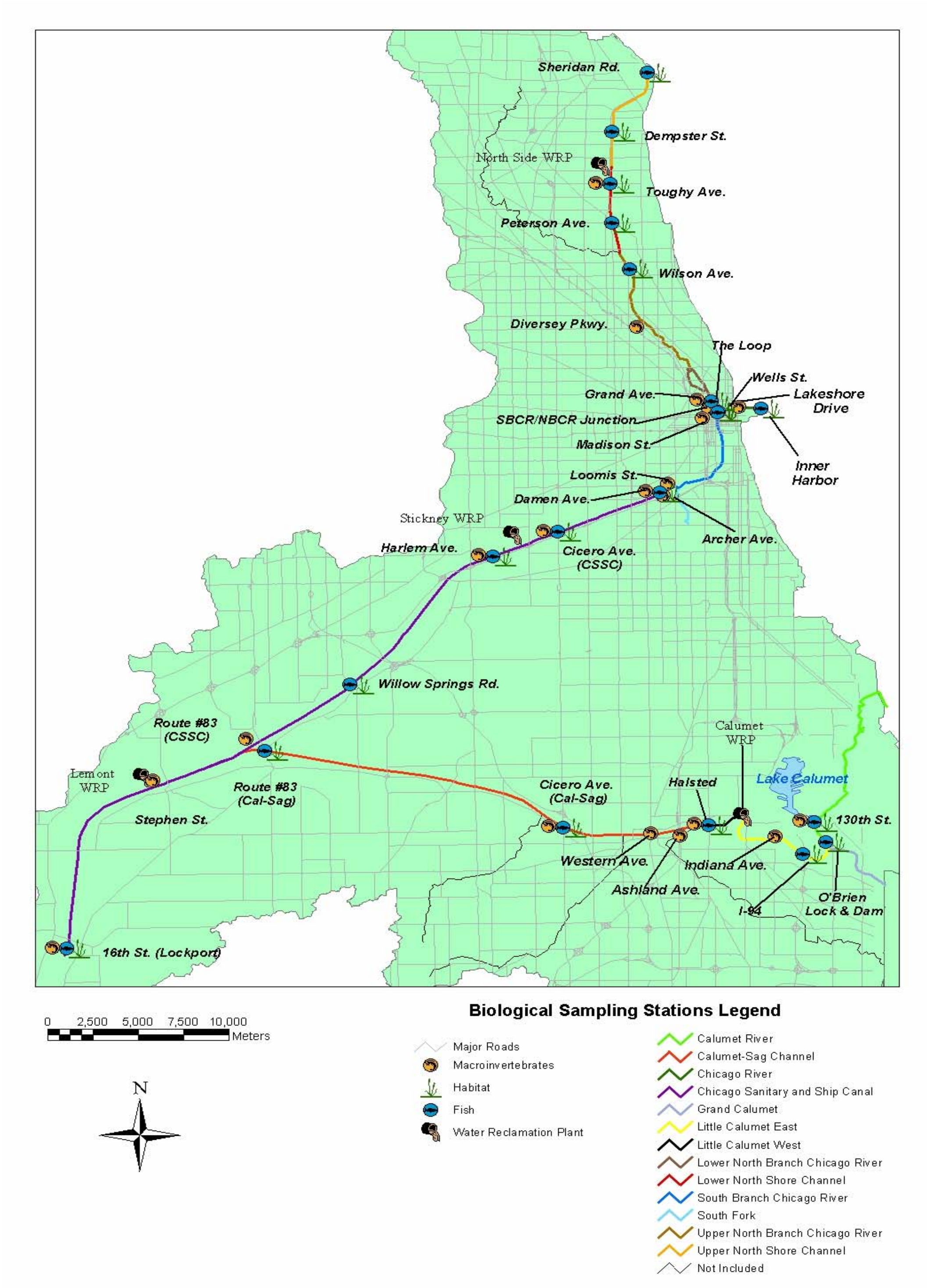


Table 4-11
Ohio EPA IBI Metrics and Scoring Criteria for Boatable Sites

Category	Metric	Scoring		
		5	3	1
Species Composition				
	Total Species	>20	10 - 20	<10
	% Round-bodied Suckers	>38	19 - 38	<19
	Number of Sunfish Species	>3	2 - 3	<2
	Number of Sucker Species	>5	3 - 5	<3
	Number of Intolerant Species	>3	2 - 3	<2
	% Tolerant Species	<15	15 - 27	>27
Trophic Composition				
	% Omnivores	<16	16 – 28	>28
	% Insectivores	>54	27 – 54	<27
	% Top Carnivores	>10	5 – 10	<5
Fish Condition				
	% Lithophils (clean gravel and cobble spawners)			
	< 600 sq miles	>50	25 – 50	<25
	> 600 sq miles	Varies with drainage area		
	% DELT Anomalies	<0.5[a]	0.5 – 3.0[b]	>3.0
	Fish Numbers[c]	<200	200 - 450	>450

[a] or>1 individual at sites with <200 total fish
[b] or>2 individuals at sites with <200 total fish
[c] excludes tolerant species; special scoring procedures are used when relative numbers are less than 200/0.3 km

Macroinvertebrates

In 2001, MWRDGC began a benthic sampling program as an additional component of the evaluation of biological resources within their service area. Macroinvertebrate data were collected at established stations in the NBCR, SBCR, CSSC, Cal-Sag Channel and the Calumet River. Additional data was collected from the nearby Des Plaines River. In addition to these data, macroinvertebrate data were collected by MWRDGC 1989, 1990 and 1991 (MWRDGC 1990, 1991, and 1992). Since the pre-1992 data are beyond the ten year time line used for data evaluation in the UAA, they were not used to determine use attainability. They are however, useful for trend and comparison analysis.

Data were collected in 2001 and 2002 from 35 stations within the Chicago area waterways. Sampling was conducted by MWRDGC laboratory staff using a combination of Ponar grabs and Hester-Dendy (HD) artificial substrate samplers at each sampling station. Three HD samplers were placed near the shoreline in the littoral zone and the mid-channel of the waterway (MWRDGC 2004). The total plate surface area of each HD sample plates was 0.031 m^2. The HD samplers were deployed between 30 - 60 days during the summer months.

In conjunction with the retrieval of the HD samplers, two ponar grab samples were collected using a petite ponar (PP) dredge. Each ponar sample consisted of three grabs within 30- to 50-feet of the HD samples. All three grabs were combined in the field to form one sample. The PP dredge samples a surface area of approximately 6-inches by 6-inches.

Macroinvertebrate samples were brought back to MWRDGC's laboratory, bugs were separated out and preserved in 70 percent isopropanol solution, and sent to EA Engineering, Science and Technology, Incorporated. EA then identified the macroinvertebrates to the lowest taxonomic level possible and enumerated. In addition to collecting species abundance information, represented chironomids were examined for a variety of head capsule deformities (MWRDGC 2004). A high percentage of deformities in specimens may indicate severe water quality problems.

In addition to the data collected by the MWRDGC, the IDNR collected macroinvertebrate data from selected locations in the waterways over a thirty year period. Macroinvertebrate data were collected from one location on the Sanitary and Ship Canal from 1974 through 1992 at Division Street, at Route 83 on the Cal-Sag Channel from 1978 to 1992; and four locations on the NSC and the NBCR (Oakton Ave, Peterson Ave, Lawrence Ave and Argyle Street) in 2001. Macroinvertebrates were collected using HD samplers.

Metrics used to evaluate the health of the macroinverbrate community included relative abundance, total species richness, emphemeroptera+plecoptera+trichopertera (EPT) taxa, dominant taxa composition, percent chironomid head capsule deformities and the MBI. The State of Illinois uses the MBI as a method to rapidly assess the biological condition of a stream. The MBI is a modification of the Hilsenhoff Biotic Index (HBI), and is based upon the pollution tolerance for an individual species. The MBI is an average of tolerance ratings weighted by species abundance, as defined in this formula:

$$MBI = \sum \frac{(n_i t_i)}{N}$$

Where n_i is the number of individuals in each taxon, t_i is the tolerance rating assigned to that taxon and N is the total number of individuals in the sample.

The MBI scores range from 0 to 11, with the lower scores being reflective of higher quality water.

Habitat

Good quality habitat is fundamental to the existence of a diverse aquatic community as it provides feeding, breeding and rearing areas for resident and migratory fish and macroinvertebrate species. A survey of the aquatic habitat at 20 of the MWRDGC's fish sampling locations was performed. Not only would this information categorize the habitat types, but also would provide useful information on what habitat features are limiting and could be corrected in a restoration effort to improve the fish community at that location or at other sites in the Chicago waterway system.

To address the lack of physical habitat data, and to understand what other stressors (excluding water quality/quantity) could prevent the full attainment of the fish community in CAWS, the USEPA solicited the services of the Center for Applied Bioassessment and Biocriteria (CABB) to conduct habitat analysis using the Ohio Qualitative Habitat Evaluation Index (QHEI) procedures. The State of Ohio uses a tiered approach to defining aquatic life uses in its water quality standards (Rankin 2004). This approach assumes the following:

Mixture of sheet pile bank and overhanging vegetation in the SBCR

- Not all streams have the same capability to support aquatic life,
- Some streams have been so irretrievably altered to support flood control and drainage that they cannot support the same diverse aquatic community found in minimally impacted waters, and
- Some of the difference in aquatic communities are due to natural features unique to a particular ecoregion.

The aquatic life warmwater use designations in Ohio include:

- Exceptional Warmwater Habitat (EWH) - reflective of high quality streams,
- Warmwater Habitat (WWH) - most Ohio streams fit into this category,
- Modified Warmwater Habitat (MWH) - assigned to streams and rivers that have had extensive and irretrievable physical habitat modifications,
- Limited Resource Waters (LRW) - restricted to streams that cannot meet MWH use due to extremely limited habitat conditions resulting from natural factors or anthropogenic origin, and
- Limited Warmwater Habitat (LWH) - currently being phased out by Ohio EPA, and only served as temporary use designation for those waterways receiving point discharges that were unable to meet water quality standards.

The Ohio tiered aquatic life use designations were considered and compared when conducting the habitat evaluation of CAWS. **Table 4-12** shows the habitat attributes measured during this evaluation.

Ed Rankin from CABB, to conducted habitat analyses of CAWS with the assistance of representatives from USEPA Region V and IEPA. Habitat data were collected from March 29 through April 3 and collected at 23 sites in the Chicago area waterways, with focus on the 20 MWRDGC fish sampling locations (Rankin 2004).

Table 4-12
Metrics and Scoring Ranges for Ohio QHEI

Metric	Scoring Ranges
Substrate	20 points total
Type	0 – 20
Quality	-5 - 3
Instream Cover	20 points total
Type	0 – 9
Amount	1 - 11
Channel Quality	20 points total
Sinuosity	1 – 4
Development	1 – 7
Channelization	1 – 6
Stability	1 - 3
Riparian/Erosion	10 points total
Width	0 – 4
Floodplain Quality	0 – 3
Bank Erosion	1 - 3
Pool – Riffle	20 points total
Max Depth	0 – 6
Current Available	-2 – 4
Pool Morphology	0 – 2
Riffle/Run Depth	0 – 4
Riffle/Run Substrate Stability	0 – 2
Riffle Embeddedness	-1 - 2
Gradient	0 – 10 points
Total Score	0 – 100 points

Table 4-13 summarizes QHEI range of values describing the general ability of the habitat to support aquatic life. Habitat analysis was also conducted on the Lower Des Plaines River below Lockport to serve as a "reference" comparison site to validate the scoring for CAWS sites.

4.1.4 Stakeholder Process

An important component of the UAA process is to involve the stakeholders who have a vested interest in the management decisions being made for CAWS. Effective and rewarding stakeholder involvement comes not from just holding public hearings, but providing a forum for identifying public concerns and values, developing consensus of the vested parties, and producing efficient and effective solutions through an open and interactive process.

Table 4-13
Narrative Ranges of the QHEI Based on a General Ability of that Habitat to Support Aquatic Life

>=75 - Excellent
60-74 - Good
46-59 - Fair
30-45 - Poor
<30 - Very Poor

At the start of the UAA process, IEPA solicited input from various potential stakeholders to determine their level of involvement and if interested, who would be there representative. Approximately 15-25 stakeholders formed SAC, which participated in "monthly" stakeholder meetings. These meetings were extremely important as they were an open forum for stakeholders to express their concerns, share data, and provide valuable input to management decisions for the waterway reaches they were concerned about. The following is a list of stakeholders who were routinely at the stakeholder meetings:

- USEPA, Region V
- IEPA
- MWRDGC
- City of Chicago
- USACE
- Illinois International Port District
- Friends of the Chicago River
- LMF
- Environmental Law and Policy Center/Sierra Club
- Prairie Rivers Network
- Southeast Environmental Task Force
- Midwest Generation
- Chemical Industry Council of Illinois
- Corn Products
- Illinois Environmental Regulatory Group
- Illinois River Carriers Association

In addition to the stakeholder meetings, IEPA conducted public meetings twice per year throughout the Chicago area. These meetings were held in Evanston, downtown Chicago, the Palos Heights area, and the Southeast Chicago area. The purpose of the meetings were to inform and update the public on the UAA process and solicit the concerns and recommendations they may have regarding the uses occurring in the Chicago are waterways.

Health Advisory for CAWS

On a parallel track with the UAA, representatives from USEPA-Region V, IEPA, the Illinois Department of Public Health, MWRDGC, the City of Chicago, and Cook County participated in the development of a health advisory pamphlet and warning sign that would be distributed and posted throughout the Chicago area. The pamphlet describes how to use the waterways safely considering the physical constraints of the channels and harmful bacteria in the water. The above agencies will distribute the pamphlets and MWRDGC is in the process of posting their property along the waterways with health advisory signs. The City of Chicago and Chicago Park District are in the process of developing similar signs for posting on City property that are adjacent to the waterways.

4.2 North Shore Channel System (Upper and Lower)

The NSC begins at the MWRDGC Wilmette Control Structure and ends at the North Branch Dam in West River Park. It is divided into two segments, upper and lower, with the MWRDGC North Side WRP as the break point. The total length of both segments is 7.7 miles. The channel consists of earthen side slopes with an average width and depth of 90-feet and 5- to 10-feet, respectively. The channel's riparian land use includes parks and a few commercial lots. The narrow channel has good vegetative overhang and habitat for various fish, bird, and turtle species. Its current use designation is Secondary Contact downstream of the MWRDGC North Side WRP and General Use upstream of the plant.

NSC upstream of the North Side WRP

4.2.1 Recreation and Navigation Uses

Recreation and navigation use surveys of the NSC were conducted for fourteen days between June 24, 2003 and October 1, 2003 by IEPA, CDM, MWRD, USEPA and LMF. The teams counted the number of times each category of recreational use was observed as summarized in **Table 4-14**.

Table 4-14
Activity Observed on NSC

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	0	0%
Skiing or Tubing	0	0%
Wading	1	1%
Canoeing, Sculling or Kayaking	16	21%
Fishing	57	73%
Power Boating	4	5%

Observed uses on the NSC were wading, fishing, canoeing/kayaking, and power boating. No commercial navigation was observed. The following additional recreation related information is noted in the record:

- Three canoe launches—two from Oakton and Ladd Arboretum, and one at Lincoln Village;
- The Woodlands Academy, Loyola Academy, North Park College, Northwestern University and New Trier High School Rowing Club report recreational use from mid-March to November at the Oakton & NSC launch;
- The Evanston Ecology Center reported canoe launches in 2002 and 2003 at 837 and 896, respectively;
- Recreational use was reported at Skokie Park District Dock and Fishing Pier;
- One private dock; and,
- Several events taking place on the channel, including: River Rescue Day, canoe trips, and the Environmental Schools Network.

4.2.2 Water Quality

The water quality of the UNSC is heavily influenced by the amount of Lake Michigan discretionary diversion allowed at Wilmette, since it comprises the majority of flow in this reach. The Lower NSC starts at the MWRDGC North Side WRP whose average annual flow rate is 431 cfs (MWRDGC, 2001) and makes up the majority of the average flow in the reach. During wet weather, numerous CSOs discharge along the entire length of both the Upper and Lower NSC reaches. There is also an instream aeration station at Devon Avenue on the Lower NSC. These features are all identified on the monitoring location and CSO outfall maps in Section 4.1.

Water Quality conditions were evaluated using the use attainment screening approach described in Section 4.1. In general, screening criteria were aligned with existing General Use Water Quality Standards criteria as the benchmark for achieving clean water act goals. Bacteria screening criteria is the exception, where thresholds were set using USEPA's latest draft bacteria guidance which differs from the current General Use criteria. For reference, Illinois General Use Water Quality Standards are included in Section 3.4.2. In all cases screening criteria exactly match UAA recommended water quality criteria presented in Section 5.

4.2.2.1 Dissolved Oxygen

Figure 4-7 shows the percent of the time dissolved oxygen (D.O). levels did not meet water quality screening criteria. The Upper NSC suffers from low D.O. levels much of the time. These conditions may be attributed to frequent low flow conditions coupled with periodic surges of CSO and storm water discharges. D.O. in this reach often takes several days to recover, depending on the severity of the event, the amount of discretionary lake diversion occurring and other factors. **Figure 4-8** on the following page demonstrates this D.O. response at Simpson Street after a large rain event in August 2002.

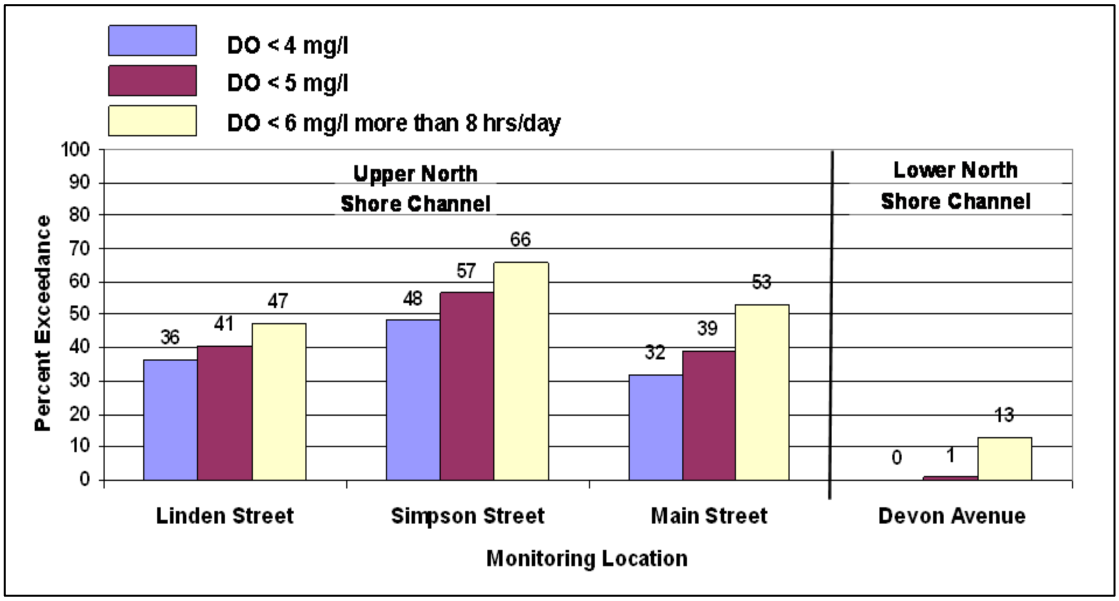


Figure 4-7 - The Percent Time D.O. Levels Did Not Meet Proposed Water Quality Criteria

The MWRDGC conducted a study of the effects of waterway operation on D.O. levels during the period of July 10 through October 31, 2001 concluding that when discretionary diversion at the Wilmette Control Structure was interrupted, the D.O. downstream at Linden, Simpson, and Main Streets on the NSC dramatically decreased below the 5.0 mg/L D.O. screening criterion. The duration of the time for recovery of D.O. levels and especially the magnitude of the decrease in D.O. were much greater at Simpson and Main Streets compared to Linden Street. This condition may be attributable to the higher oxygen demand further downstream. (MWRD 2002).

The one D.O. monitoring station on the LNSC at Devon Avenue almost always stayed above the 5 mg/L screening criterion during the past five years and 13 percent of the time dropped below 6 mg/L for more than 8 hours/day. The wet weather D.O. response at Devon Avenue is much less severe than along the UNSC as shown in **Figure 4-9**. The North Side WRP effluent flow that dominates this reach helps dampen the CSO impact seen on the UNSC. Generally, the times D.O. stayed below 6 mg/L for appreciable lengths of time were during warmer summer months, particularly following larger rain events when CSOs likely occurred.

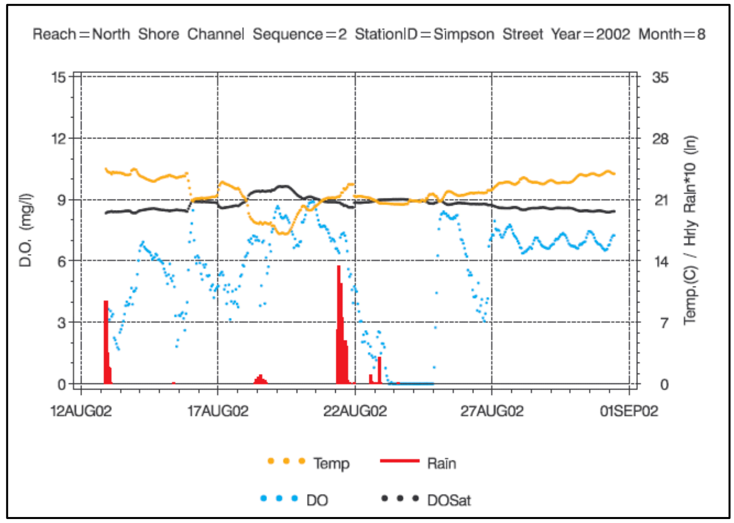


Figure 4-8 - D.O. Response at Simpson Street After a Large Rain Event in August 2002

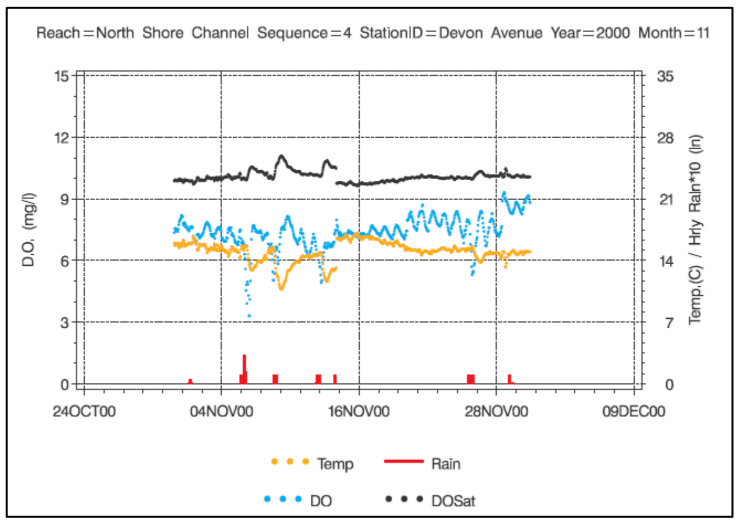


Figure 4-9 - D.O. Response at Devon Avenue After a Large Rain Event in November 2000

The Devon Avenue monitoring station is 1.2 miles downstream of the North Side WRP and 0.1 miles upstream of a diffused instream aeration station (MWRDGC, 2002). D.O. levels in the North Side WRP effluent ranged from 5.3 – 9 mg/L and averaged 7.25 mg/L as calculated from daily D.O. measurements provided by MWRDGC collected in the years 2000 through 2002.

4.2.2.2 Temperature

Water temperature in the NS is recorded continuously at the same locations as D.O. Linden Street, Simpson Street, Main Street and Devon Avenue. Temperatures during the last five years exceeded screening criteria less than one percent of the time at Main Street and Devon Avenue and never exceeded criteria during that period at the Linden and Simpson Street stations, indicating that water temperature is not a significant concern in this reach.

4.2.2.3 Bacteria

Bacteria concentrations in the NSC can be characterized using the four instream grab sampling locations, two each on the Upper and Lower channels. Using the limited contact recreation and recreational navigation water quality screening criteria of 1030 and 2470 cfu/100ml, respectively, the frequency distribution for *E.coli* at each station from March through November are shown in **Figure 4-10**. Each station is labeled with the number of samples included in the distribution. **Figure 4-11** shows the March through November *E.coli* geometric mean for each station.

CSOs along the Upper NSC, also shown in Figures 4-10 and 4-11, are the likely cause for elevated *E.coli* levels exceeding 2470 cfu/100 ml at Central and Oakton Avenues. There are also numerous CSOs on the LNSC, which combined with the undisinfected discharge from the North Side WRP result in concentrations over 2470 most of the time (100% at Devon Ave.). The Albany Avenue station shown on the map is on the North Branch just upstream of the confluence with the NSC and is not in the UAA study area. It is included for reference only.

4.2.2.4 Metals and Other Constituents

All constituents analyzed by the grab sampling station are shown in **Table 4-15. Figures 4-12** and **4-13** show the percent of time metals and other pollutant concentrations exceeded water quality screening criteria at the four grab sampling locations along the NSC. Constituents that never exceeded water quality criteria are not shown. The number of samples taken for each constituent with an exceedance at all grab sampling stations is shown in **Table 4-16**. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any period of at least four days. Details of pH exceedances are shown in **Table 4-17**. Only stations with pH exceedances are shown.

4.2.2.5 Water Reclamation Plant Effluent

Since the North Side WRP is the primary source of flow in the LNSC, effluent concentrations were also compared to water quality screening criteria. Since MWRDGC effluent water quality is regulated through their NPDES permit, this assessment does not represent discharge compliance and is only intended to provide a perspective regarding the relationships between an important point source and instream conditions. **Table 4-18** describes the percent of the time effluent concentrations exceeded water quality screening criteria in the past five years. Parameters that never exceeded the criteria are not listed. All constituents analyzed by water treatment plant are shown in **Table 4-19.** The number of samples taken for each constituent with an exceedance at all treatment plants is shown in **Table 4-20**. Details of pH exceedances at wastewater treatment plants are shown in **Table 4-21**. Only treatment plants with pH exceedances are shown.

Figure 4-10 - *E.coli* Bacteria Frequency Distribution for March through November

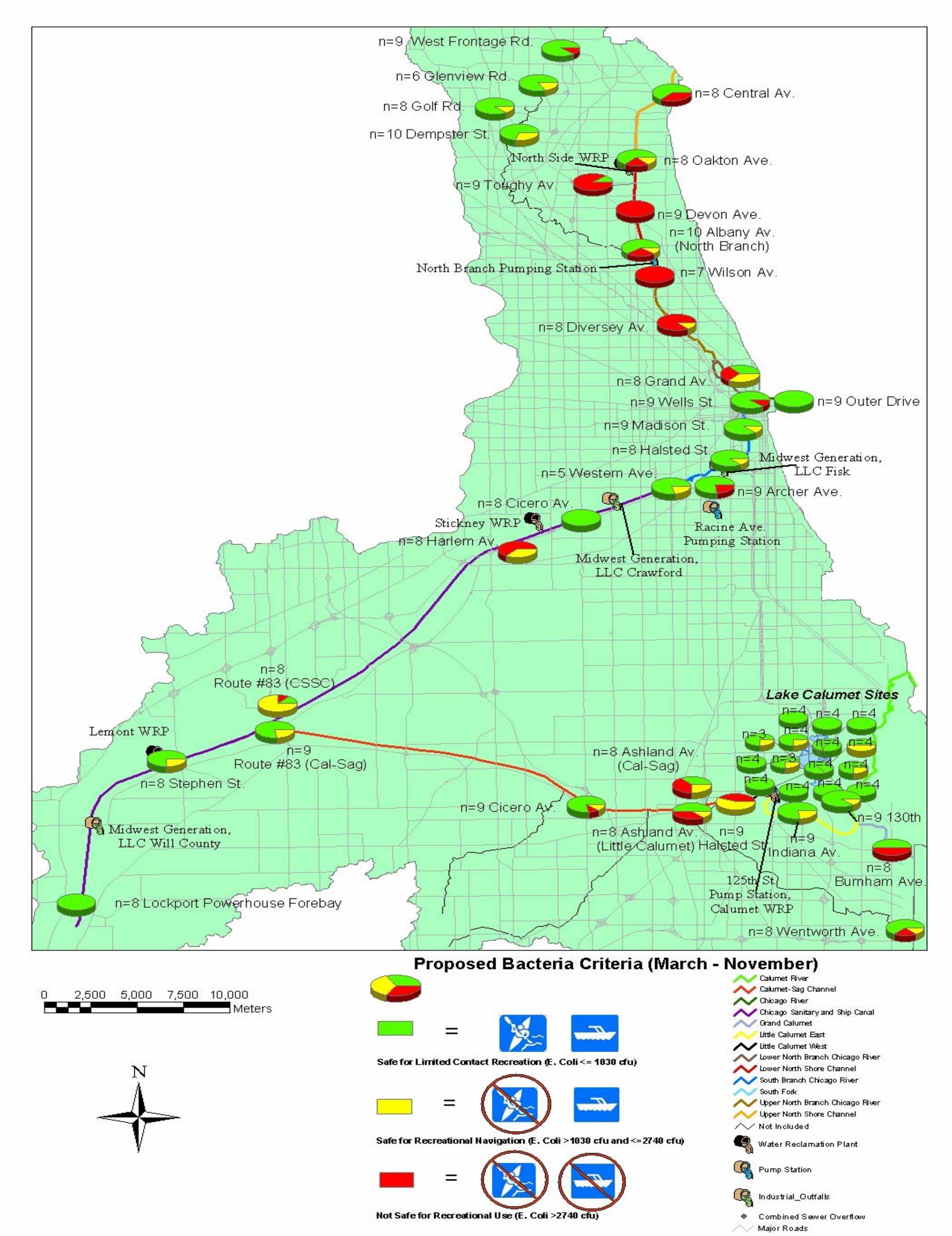


Figure 4-11 - E. coli Geometric Mean Concentrations for March through November

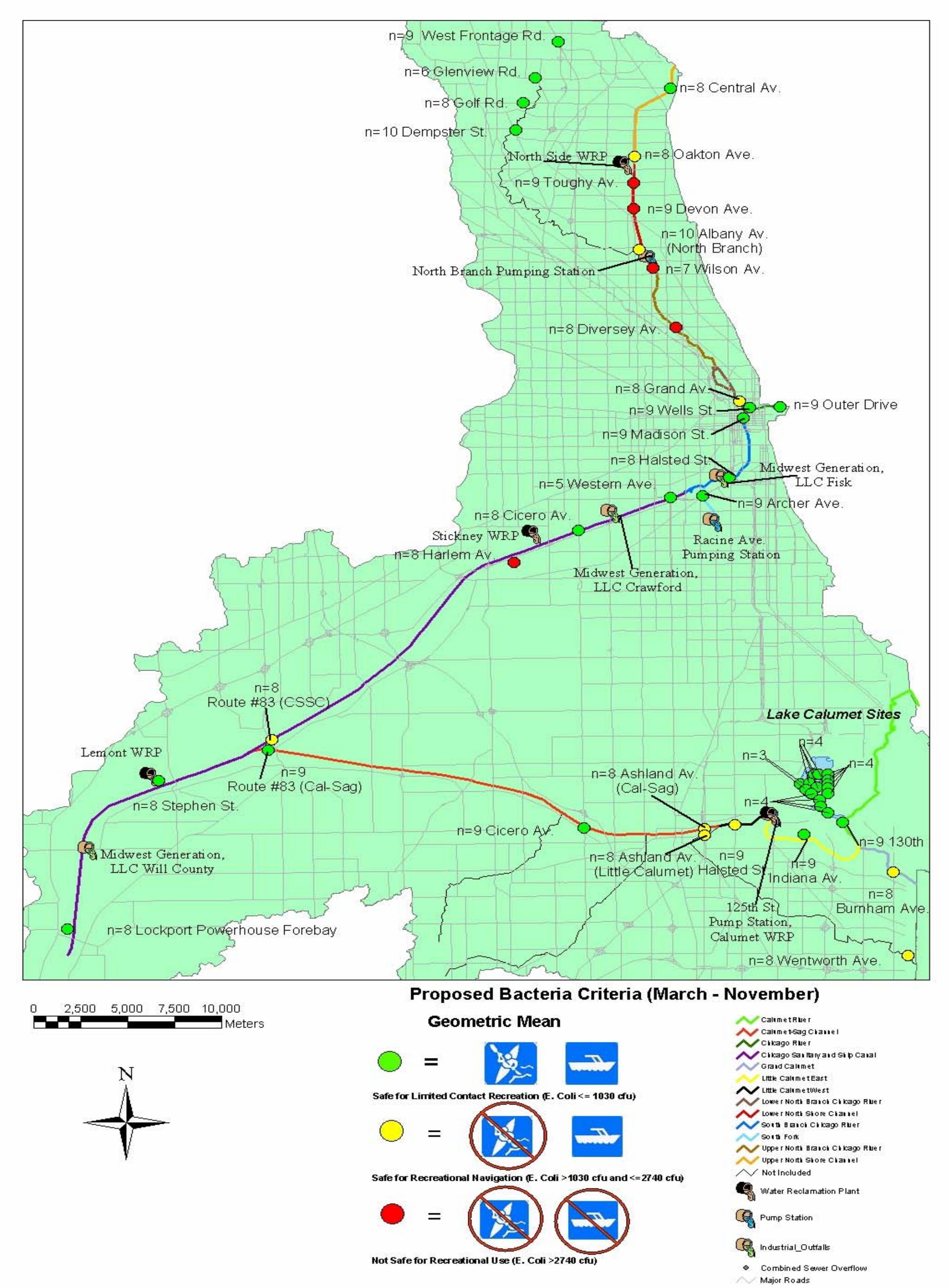


Table 4-15
Constituents Analyzed at CAWS Grab Sampling Sites

Constituents			
Temperature	Flouride	Iron	Dissolved Copper
pH	Silver	Lead	Dissolved Chromium
Ammonia Total	Arsenic	Nickel	Dissolved Iron
Total Dissolved Solids	Barium	Manganese	Dissolved Lead
Phenol	Boron	Mercury	Dissolved Nickel
Sulfate	Cadmium	Selenium	Dissolved Mercury
Fats, Oils and Greases	Copper	Dissolved Arsenic	Dissolved Zinc
Cyanide (Total)	Chromium	Dissolved Cadmium	Zinc
Cyanide (WAD)	Chromium +6		

Notes:
1. Temperature, pH, Ammonia Total were not taken at Grand Calumet Station 86
2. Fats, Oils and Greases were not taken at Chicago River Station 100, Upper North Branch Station 96, Upper North Shore Channel Stations 35 and 102
3. Only Temperature, pH and Ammonia Total were taken at Lake Calumet
4. Dissolved Arsenic, Dissolved Cadmium, Dissolved Copper, Dissolved Chromium, Chromium +6, Dissolved Lead, Dissolved Nickel, Dissolved Mercury and Dissolved Zinc were not measured at South Branch Station 40

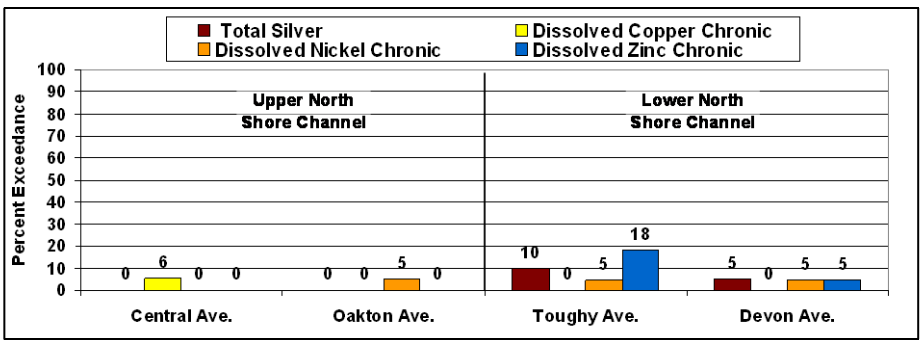


Figure 4-12 - Percent of the Time Metal Concentrations Exceeded Water Quality Screening Criteria

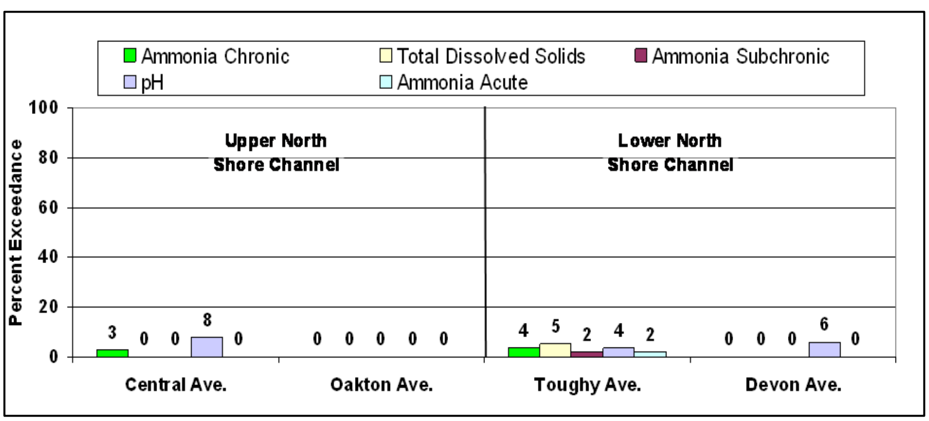


Figure 4-13 - Percent of the Time Other Pollutant Concentrations Exceeded Water Quality Screening Criteria

Table 4-16
Number of Samples for Exceeding Constituents at CAWS Grab Sampling Stations

Reach	Station	Location	pH	Ammonia Total	Total Dissolved Solids	Phenol	Cyanide (WAD)	Flouride	Silver	Dissolved Copper	Dissolved Nickel	Manganese	Dissolved Zinc
Cal Sag	43	Route #83	80	76	59	NE	NE	58	59	NE	NE	NE	NE
Cal Sag	58	Ashland Ave.	72	68	55	NE	NE	55	55	NE	NE	NE	NE
Cal Sag	59	Cicero Ave.	80	75	59	NE	NE	59	59	NE	NE	NE	NE
Calumet River	55	130th St.	73	NE	NE	NE	NE	NE	57	NE	22	NE	NE
Chicago River	74	Outer Drive	57	NE	NE	NE	NE	NE	NE	NE	NE	NE	22
Chicago River	100	Wells St.	NE	NE	NE	NE	NE	NE	19	NE	NE	NE	NE
CSSC	41	Harlem Ave.	58	58	59	NE	NE	NE	59	NE	NE	NE	NE
CSSC	42	Route #83	58	58	59	NE	NE	NE	59	NE	NE	NE	22
CSSC	48	Stephen St.	57	NE	58	NE	NE	NE	58	NE	NE	NE	22
CSSC	75	Cicero Ave.	NE	NE	NE	NE	NE	NE	60	NE	22	NE	22
CSSC	92	Lockport Powerhouse Forebay	146	146	153	NE	152	NE	154	NE	NE	154	96
CSSC	107	Western Ave.	21	NE	22	NE	NE	NE	22	NE	NE	NE	22
Grand Calumet	86	Burnham Ave.	NE	NE	NE	NE	NE	NE	59	NE	24	NE	NE
Little Calumet East	56	Indiana Ave.	74	71	NE	NE	NE	NE	55	NE	NE	NE	NE
Little Calumet West	76	Halsted St.	81	NE	59	59	59	59	59	NE	22	NE	22
Lower North Branch	46	Grand Ave.	NE	57	60	NE	NE	NE	60	NE	NE	NE	22
Lower NSC	36	Touhy Ave.	54	54	60	NE	NE	NE	60	NE	22	NE	22
Lower NSC	101	Devon Ave.	17	NE	NE	NE	NE	NE	21	NE	22	NE	22
South Branch	39	Madison St.	58	58	60	NE	NE	NE	60	NE	NE	NE	22
South Branch	40	Damen Avenue	31	31	32	NE	NE	NE	32	NE	NE	NE	NE
South Branch	108	Halsted St.	20	20	NE	NE	NE	NE	21	NE	NE	NE	NE
South Fork	99	Archer Ave.	21	21	NE	NE	NE	NE	22	NE	NE	NE	22
Upper North Branch	37	Wilson Ave.	54	54	60	NE	NE	NE	60	NE	22	NE	NE
Upper North Branch	73	Diversey Ave.	54	54	60	NE	60	NE	60	NE	22	NE	22
Upper North Branch	96	Albany Ave.	25	NE	30	NE	NE	NE	30	NE	NE	NE	NE
Upper NSC	35	Central Ave	38	37	NE	NE	NE	NE	NE	18	NE	NE	NE
Upper NSC	102	Oakton Ave.	NE	NE	NE	NE	NE	NE	NE	NE	21	NE	NE

NE is no exceedance

Table 4-17
Statistics for pH Samples at CAWS Grab Sampling Sites with pH Measurements that have Exceeded Standards

Reach	Station	Location	Mean pH	Minimum pH	Maximum pH	Number of Samples	% of pH Samples Exceeding General Use Standard	% of pH Samples Exceeding Secondary Use Standard
South Branch	39	Madison St.	7.59	6.7	9.5	58	3.45	3.45
South Branch	40	Damen Ave	7.77	6	9.79	31	12.90	9.68
CSSC	41	Harlem Ave	7.48	6.55	9.4	58	1.72	1.72
CSSC	42	Route #83	7.47	6.5	9.05	58	1.72	1.72
Cal Sag	43	Route #83	7.45	6	9.65	80	10.00	5.00
CSSC	48	Stephen St.	7.51	6.8	9.11	57	1.75	1.75
Calumet River	55	130th St.	7.94	6.4	9.55	73	5.48	4.11
Little Calumet East	56	Indiana Ave	7.91	6.7	10.09	74	6.76	6.76
Cal Sag	58	Ashland Ave	7.58	6	9.62	72	5.56	4.17
Cal Sag	59	Cicero Ave	7.49	5.1	9.71	80	8.75	6.25
Chicago River	74	Outer Drive	7.85	6.8	9.73	57	1.75	1.75
Little Calumet West	76	Halsted St.	7.51	5	9.06	81	4.94	3.70
CSSC	92	Lockport Powerhouse Forebay	7.22	5.3	8.7	146	2.74	2.74
South Fork	99	Archer Ave	7.08	5.1	8.4	21	9.52	4.76
CSSC	107	Western Ave	7.08	6.3	7.9	21	14.29	0.00
South Branch	108	Halsted St.	7.15	6.2	8.1	20	5.00	0.00
Upper NSC	35	Central Ave	8.09	7.1	9.33	38	7.89	7.89
Upper NSC	36	Touhy Ave	7.47	6	9.3	54	3.70	1.85
Upper North Branch	37	Wilson Ave	7.51	6.4	9.18	54	5.56	3.70
Upper North Branch	73	Diversey Ave	7.47	6.4	10.16	54	9.26	5.56
CSSC	75	Cicero Ave	7.51	6.1	9.69	59	8.47	5.08
Upper North Branch	96	Albany Ave.	7.64	6.2	8.5	25	4.00	0.00
Lower NSC	101	Devon Ave	7.19	6.4	7.9	17	5.88	0.00

Table 4-18
North Side WRP Effluent Water Quality Screening Summary

Parameter	% Exceedance of Use Attainment Screening Criteria**	
Ammonia (Chronic*)	0.617 %	
Total Silver	1.5 %	
D.O.	3 %	
	Limited Contact Recreation	Recreational Navigation
*E.coli****	99 %	98 %

* Since water temperature was not available, the chronic ammonia criterion for water temperatures <14.51°C was used because it is not temperature dependant.

** Effluent was compared to use attainment screening criteria and does not represent discharge compliance.

*** *E.coli* concentrations estimated using EC/FC ratio of 0.84 (MWRDGC, 2004)

Table 4-19
Parameters Analyzed at CAWS Wastewater Treatment Plants

Constituent	North	Stickney	Lemont	Calumet
pH	X	X	X	X
Dissolved Oxygen	X	X	X	X
Ammonia	X	X	X	X
Flouride	X	X	X	X
Phenol	X	X	X	X
Fecal Coliform	X	X	X	X
Sulfate	X	X		
Total Cyanide	X	X	X	X
Arsenic	X	X	X	X
Barium	X	X	X	X
Cadmium	X	X	X	X
Chromium	X	X	X	X
Copper	X	X	X	X
Iron	X	X	X	X
Dissolved Iron	X	X	X	X
Lead	X	X	X	X
Manganese	X	X	X	X
Mercury	X	X	X	X
Nickel	X	X	X	X
Selenium	X	X	X	X
Silver	X	X	X	X
Zinc	X	X	X	X
Chromium 6+	X	X	X	X
WAD Cyanide	X	X		
Temperature		X		X
Unionized Ammonia		X		
Fats, Oils and Greases				X

Table 4-20
Number of Samples for Exceeding Constituents at CAWS Wastewater Treatment Plants

WWTP	Number of samples						
	Dissolved Oxygen	Ammonia	Fecal Coliform	Silver	pH	Flouride	Iron
North	1095	972	261	1824	NE	NE	NE
Stickney	NE	NE	261	1825	730	NE	NE
Lemont	729	730	261	1826	730	226	1826
Calumet	730	NE	262	NE	NE	NE	NE

NE is no exceedance

Table 4-21
Statistics for pH Samples at CAWS Wastewater Treatment Plants with pH Measurements that have Exceeded Standards

WWTP	Mean pH	Minimum pH	Maximum pH	Number of Samples	% of pH Samples Exceeding General Use Standard	% of pH Samples Exceeding Secondary Use Standard
Stickney	6.7	6.1	7.4	730	14.66	0
Lemont	7.4	6.4	7.9	730	0.14	0

4.2.2.6 Constituents of Concern

Table 4-22 shows the water quality use attainment screening constituents of concern for the NSC. The maximum percent exceedance that any sampling location in the reach exceeded screening criteria in the past five years is identified. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any period of at least four days. *E.coli* bacteria calculations were similarly calculated as data representing five samples collected over 30 days was not available.

Table 4-22
NSC Water Quality Constituents of Concern

Parameter	Upper North Shore Channel	Lower North Shore Channel
Dissolved Oxygen	66	13
Temperature	0.3	0.8
*E.Coli**	37.5 / 37.5	100 / 100
Total Silver		10.0
Dissolved Copper Chronic	5.6	
Dissolved Nickel Chronic	4.8	4.5
Dissolved Zinc Chronic		18.2
Ammonia Chronic	2.7	3.7
Ammonia Subchronic		1.9
Ammonia Acute		1.9
Total Dissolved Solids		5.0
pH	7.9	5.9

Maximum percent exceedance at any sampling location in reach

0% (green) | <=10% (yellow) | >10 and <=25% (orange) | >25% (red)

* Limited Contact Recreation / Recreational Navigation

4.2.3 Sediment Quality

There was limited sediment quality data available for the NSC, but a recent surface sediment study conducted in 2001 by IEPA at five locations shown in Figure 4-5 provides a suitable synopsis of existing conditions. Metals analyses results were compared to the TEC and PEC thresholds developed by MacDonald and described in Section 4.1.3.3 (MacDonald 2000). As a reminder, the TEC represents the concentration level where toxic effects may start occurring, particularly for sensitive benthic organisms and the PEC represents the concentration level where toxic effects are probable for both sensitive and tolerant benthic organisms. **Table 4-23** summarizes locations where these thresholds were exceeded for heavy metals.

Table 4-23
NSC Surface Sediments Summary

Station	Exceeded TEC	Exceeded PEC
1 – NSC mouth	Copper, Zinc, Lead	Lead
2 – Central St.	Copper, Lead, Mercury and Zinc	
3 - Green Bay Rd.	Cadmium, Copper, Lead, Nickel, Zinc	
4 - Dempster St.	Cadmium, Copper, Lead and Zinc	
HCCA 04 - Peterson Ave.	Copper, Cadmium, Lead	

Sediment oxygen demand (SOD) data was available for one study conducted by MWRDGC in the Fall and Winter of 2001 that included two locations in the UNSC. SOD is a measure of how much oxygen bottom sediments consume from the water column to decompose organic materials. SOD values in the vicinity of a municipal sewage outfall typically range from 2 to 10 $g/m^2/day$ and average approximately 4 $g/m^2/day$. (Thomann 1987) The SOD measured at Simpson Street was 3.89 $g/M^2/day$ and at Main Street 1.85 $g/M^2/day$.

4.2.4 Biological Assessment

4.2.4.1 Fish

Fish sampling in the NSC was conducted at four MWRDGC locations:

- Sheridan Road in Wilmette
- Dempster Street in Skokie
- Touhy Avenue in Lincolnwood
- Peterson Avenue in Chicago

Thirty-two species of fish (excluding hybrids) were captured in the NSC from 1993 to 2002, with the dominant fish species being alewife, gizzard shad, bluntnose minnow and common carp (**Table 4-24**). Dominant game fish species included largemouth bass and bluegill. The greatest diversity (22 species) was observed at Sheridan Road, just downstream of the Wilmette Water Controlling Structure on Lake Michigan. Pescitelli, et. al. (2001) collected ten species in 1999 at the confluence of NSC and NBCR. Eight of the ten species were native fish with the dominant fish being gizzard shad and largemouth bass. The dominant non-native species was the common carp.

Fish diversity tended to fluctuate on a yearly basis, with some species being more dominant in one year, and not the rest (e.g. large number of spottail shiners captured in 1997 and not in other years). Temporally, species diversity showed a dramatic decline in the NSC from 1993 to 2002 (**Figure 4-14)**. The IBI scores for Sheridan Road (**Figure 4-15**) tended to be higher than the three downstream sampling locations. The higher the IBI score, the more diverse and healthy the fish community is for that section of a stream.

Figure 4-14 - Temporal Trend in Species Diversity in the North Shore Channel 1993 - 2002

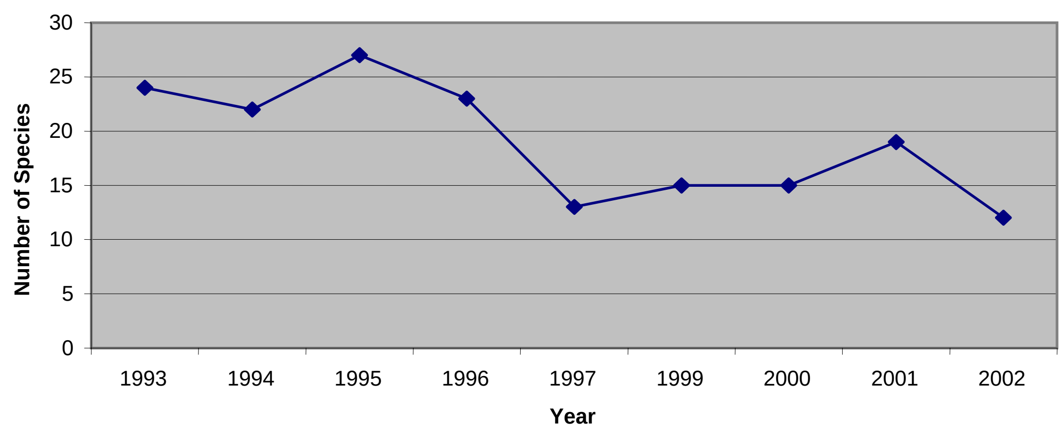
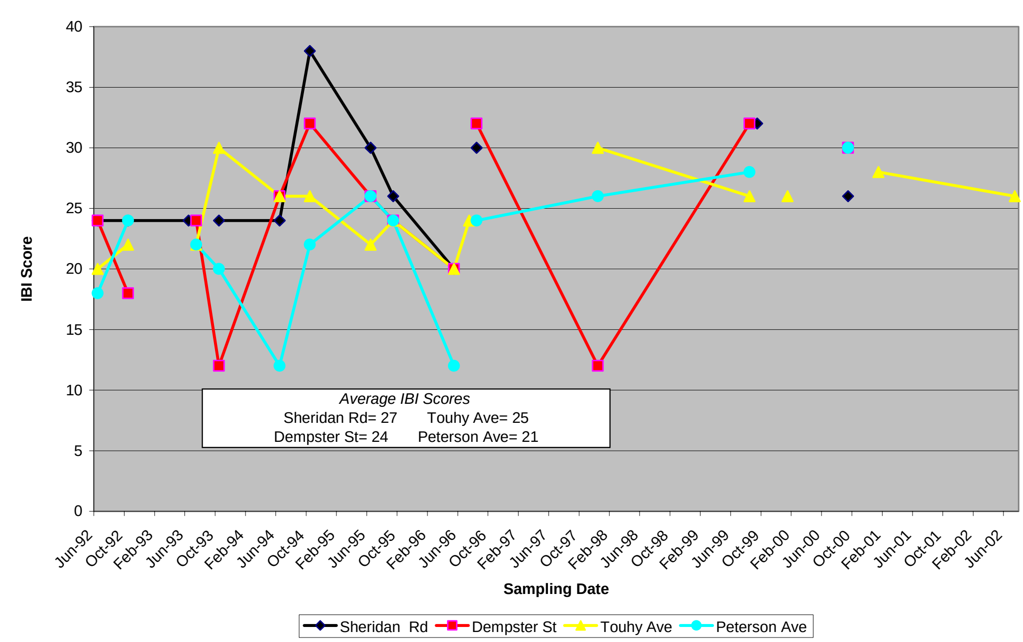


Table 4-24 - Species Richnes and Relative Abundance of Fish Species in the North Shore Channel 1993 - 2002- All Sampling Locations

	Relative Abundance (%)								
Fish Species	1993	1994	1995	1996	1997	1999	2000	2001	2002
Clupeidae: Herrings, Shads, Sardines, and allies									
Alosa pseudoharengus - alewife	12.2	7.1	3.1	3.5					
Dorosoma cepedianum - gizzard shad	28.3	0.5	26.5	65.1		66.7	70.8	59.6	38.1
Cyprinidae: Minnows and Carps									
Carassius auratus - goldfish	2.2	5.3	10.9	3.9	0.5	0.9	2.0	0.9	2.0
Cyprinus carpio - common carp	0.9	2.7	3.7	1.2	0.5	2.2	1.2	3.9	27.2
Notemigonus crysoleucas - golden shiner	1.6	3.3	2.3	0.9	2.5	0.2	0.4	1.5	11.6
Notropis hudsonius - spottail shiner	2.7	7.1	0.6	0.3	30.2			0.3	
Pimephales notatus - bluntnose minnow	38.9	40.3	5.2	1.0	9.5	0.2	0.4	2.2	
Pimephales promelas - fathead minnow	1.8	0.5			0.5			0.1	
Carp x goldfish	1.2	2.9	5.2	1.5	0.5	0.9	0.2	0.1	
Catostomidae: Suckers									
Catostomus commersoni - white sucker	0.5	0.2	1.1	0.3				0.3	
Cobitidae									
Misgurnus anguillicaudatus - Oriental weatherfish			0.2						
Ictaluridae: Catfishes									
Ameiurus melas - black bullhead	0.6	1.5	1.1	1.5		1.1	0.6		
Ameiurus natalis - yellow bullhead		0.2	0.2	0.1					1.4
Ictalurus punctatus - channel catfish						0.1	0.8	0.1	0.7
Esocidae: Pikes									
Esox americanus - grass pickerel			0.2						
Esox lucius - northern pike				0.1					
Umbridae: Mudminnows									
Umbra limi - central mudminnow			0.2						
Salmonidae: Salmonides									
Oncorhynchus mykiss - rainbow trout			0.5						
Oncorhynchus tshawytscha - chinook salmon	0.1			0.1					
Salmo trutta - brown trout	0.1	0.1	0.2						
Gasterosteidae: Sticklebacks and Tubesnouts									
Culaea inconstans - brook stickleback									
Gasterosteus aculeatus - threespine stickleback	0.4			0.3					
Pungitius pungitius - ninespine stickleback			0.2			0.1			
Centrarchidae: Sunfishes and Freshwater Basses									
Ambloplites rupestris - rock bass	0.2	0.6	0.3	0.2				1.9	0.7
Lepomis cyanellus - green sunfish	2.9	6.4	4.0	1.8	8.5	0.7	0.8	3.7	
Lepomis gibbosus - pumpkinseed	0.6	2.6	1.1	0.3		2.1	3.3	1.2	2.0
Lepomis humilis - orangespotted sunfish	0.1	0.5	0.6		0.5			0.4	
Lepomis macrochirus - bluegill	2.0	9.4	8.8	5.9	44.2	11.9	4.7	10.6	2.0
Micropterus salmoides - largemouth bass	1.6	8.3	22.8	11.0	1.0	10.6	13.5	11.4	10.2
Pomoxis nigromaculatus - black crappie	0.3	0.2	0.8			1.7	0.8	1.2	3.4
Pumpkinseed x Bluegill hybrid	0.1	0.2	0.2	0.1					
Green sunfish x Bluegill hybrid		0.2	0.3	0.1	0.5		0.2	0.1	
Green sunfish x Pumpkinseed hybrid	0.2			0.1	1.0		0.2	0.3	
Percidae: Perches and Darters									
Perca flavescens - yellow perch	0.5		0.2	0.4					
Percichthyidae: Temerate Perches									
Morone americana - white perch									0.7
Cichlidae									
Oreochromis niloticus - nile tilapia						0.5			
Total Number of Species	24	22	27	23	13	15	15	19	12

Figure 4-15. IBI Scores for NSC Fish Sampling Locations 1992 - 2002



4.2.4.2 Macroinvertebrates

Macroinvertebrates are a group of animals without backbones that are large enough to see without a microscope. They are an important link in the aquatic food chain of the Chicago waterway system. In a typical Illinois stream, the energy stored by plants is available to animal life either in the form of leaves that fall in the water or in the form of algae that grows on the stream bottom, all of which are consumed by macroinvertebrates and detritivores (organisms that eat decaying matter, e.g. bacteria). The macroinvertebrates in turn, are a source of energy for larger animals such as fish. Most bottom-dwelling macroinvertebrates cannot survive in contaminated water and enriched sediments. However, many species can survive or even thrive in polluted water. In a healthy stream, the benthic community will include a variety of pollution-sensitive macroinvertebrates, while in an unhealthy stream, there may be only a few types of non-sensitive and tolerant macroinvertebrates present. The macroinvertebrate data collected by MWRDGC (MWRDGC 2004) and the data

Taxa richness at each location ranged from two to seventeen organisms including Tubificid (sludge worm).

provided by IEPA (Essig 2004) showed 31 species of macroinvertebrates were found at five sampling locations in the NSC (**Table 4-25**).

Taxa richness at each of these locations ranged from two to seventeen organisms, with Touhy Avenue having the highest diversity (17) of macroinvertebrates.

These data were samples collected using the Hester-Dendy (HD) artificial substrate samplers and the PP dredge. Whereas the HD samplers will allow colonization both by drifting macroinvertebrates and sediment-dwelling organisms, the dredge will typically sample only those organism that live in the sediment. The most dominant sediment-dwelling organism was Oligochaeta, a tubificid worm that lives within the specialized tubes they secrete. With their heads positioned at the bottom of the tubes, the worms extend their tails and wave them in the water column to induce aerated water downward where the D.O. is absorbed into the body. The red-color observed in the tubificids is due to the very high concentrations of hemoglobin, which allows them to exist in oxygen-poor waters. The tubificids are usually indicative of poor water quality conditions and usually exist in large number in waters dominated by wastewater. The second dominant macroinvertebrate group was the dipterans (flies), which are generally indicative of degraded water quality conditions when they make up a high percentage of the sample.

The MBI scores for the HD sampling data ranged from 7.1 at Touhy Avenue to 9.2 at Oakton Street, and the PP dredge MBI scores ranged from 9.8 to 10. As stated previously, the MBI score ranges from zero to eleven, with the lower MBI score reflecting a population comprised of more pollution sensitive organisms (high quality), while the higher score indicates a predominance of species known to occur in severely polluted waters. The high MBI scores for the NSC indicate that this stretch of water way is severely degraded with respect to the structure of the macroinvertebrate community. EPT taxa scored one at Touhy Avenue, and zero at the other 4 sites along the NSC. EPT Index is the sum of species in the Orders Emphemeroptera (mayflies), Trichopertera (caddisflies) and Plecoptera (stoneflies). The EPT Index normally increases with improved water quality and is reflective of insect groups that are considered to be pollution sensitive.

Table 4-25. NSC: Macroinvertebrate Taxa Richness, Density (HD) and PP number/meter2), Percent Relative Abundance (RelAbu) and MBI Score (MWRDGC 2001, 2002; IEPA 2001 Data Sets

Species	Central Rd.				Oakton St.				Touhy Ave.				Peterson Ave.		Foster Ave.			
	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	HD	RelAbu	PP	RelAbu
COELENTERATA																		
Hydra													18.00	0.98				
PLATYHELMINTHES																		
Dugesia trigrina													673					
Turbellaria									12,561.9	20.55	3,100.3	0.63			4126.30	16.44	179.40	0.68
ANNELLIDA																		
Oligochaeta	999.3	67.76	37,957.2	99.89	16,210.5	80.86	149,274.0	99.81	35,016.1	57.29	481,387.1	97.84	317.00	17.23	16684.60	66.48	25656.50	97.28
Hirudinea																		
Helobdella															17.90	0.07		
Helobdella stagnalis	17.9	1.21	7.2	0.02	3.0	0.01												
Mooreobdella microstoma					1.0	0.00												
Isopoda																		
Caecidotea	102.3	6.94	14.4	0.04					53.8	0.09	7.2	0.00			71.80	0.29		
Amphipoda																		
Gammarus fasciatus	93.3	0.06	7.2	0.02					143.5	0.23	71.8	0.01			340.90	1.36	143.50	0.54
INSECTA																		
Tricoptera																		
Cyrnellus fratermus									17.9	0.03								
Cheumatopsyche									3.6	0.01								
Diptera																		
Chironomidae					17.9	0.09					5,310.7	1.08					358.80	1.36
Ablabesmyia mallochi			7.2	0.02														
Procladius			7.2	0.02			287.1	0.19										
Thienemannimyia grp.									3.6	0.01								
Cricotopus bicinctus grp.									495.2	0.81	129.2	0.03						
Cricotopus sylvestris grp.									21.5	0.04	50.2	0.01						
Nanocladius											93.3	0.02	41.00	2.23				
Nanocladius distinctus									1,521.4	2.49			16.00	0.87	215.30	0.86		
Nanocladius crassicornus/rectinervis	3.6	0.24																
Chironomus					9.0	0.04												
Dicrotendipes neomodestus					2,024.0	10.10			3.6	0.01			445.00	24.18				
Dicrotendipes simpsoni	213.5	14.48			1,759.1	8.77			10,017.9	16.39	323.0	0.07	90.00	4.89	3516.30	14.01		
Glyptotendipes					8.0	0.04			391.1	0.64			16.00	0.87	35.90	0.14		
Parachironomus	3.6	0.24			14.0	0.07			699.7	1.14	1,557.3	0.32	205.00	11.14				
Polypedilum flavum	3.6	0.24							3.6	0.01								
Polypedilum illinoense									71.8	0.12								
Paratanytarsus	32.3	2.19																
GASTROPODA																		
Ferrissia													1.00	0.05	89.70	0.36		
Menetus dilatatus									89.7	0.15			18.00	0.98				
Physella					2.0													
PELECYPODA																		
Dressiena polymorpha	5.4																35.9	
Taxa Richness	10.0		6.0		10.0		2.0		17.0		10.0		11.0		9.0		5.0	
Total Number of Individuals	1,474.8		38,000.4		20,048.5		149,561.1		61,115.9		492,030.1		1,840.0		25,098.7		26,374.1	
MBI	8.5		10.0		9.2		10.0		7.1		9.9		7.3		7.6		9.8	

4.2.4.3 Habitat Assessment

Based upon the habitat survey results conducted by Rankin (2004) the NSC had poor to fair habitat conditions. The limiting factors for this site were:

- Predominance of silty-muck and sand substrate
- Severe embeddedness
- Limited flow in the UNSC
- Channelized nature of the waterway
- Limited instream cover and structure

The assessment concluded the NSC could potentially support an assemblage of tolerant organisms, and those species reflective of high quality substrates and structure would be absent or in limited numbers.

Table 4-26 shows those habitat attributes that define the reach of the waterway from Sheridan Road to Peterson Avenue. Sheridan Road fish sampling location had the highest QHEI score, reflecting improving conditions when compared to the other NSC sites. This location is located closes to the Lake Michigan and may receive some positive input in terms of better water quality. Overall, the NSC had poor to fair habitat, primarily associated with the lack of flow or current, little instream habitat, and poor substrate. According to Rankin (2004), aquatic potential of the NSC would support a Modified Warmwater Channelized (MWH-C) aquatic life use.

Significant habitat improvements (e.g. creating meanders, shallow shorelines) would have to be made to improve community structure for both fish and macroinvertebrates and will be discussed in greater detail in Section 6.

Table 4-26
QHEI Scores for North Shore Channel Sampling Locations

Site Description	QHEI Score
Upstream/Downstream of Sheridan Road	54
Upstream of Dempster Street	47.5
Downstream of Touhy Avenue	40.0
Downstream of Peterson Avenue	49.5

4.2.5 IEPA Letter Response Request

As part of this UAA study, IEPA requested from communities along the North Shore Channel if they had any plans for instream habitat improvements or the development of swimming areas. The cities that responded did not have any long-range plans for development in the North Shore Channel.

4.3 Chicago River System

The Chicago River System includes the North Branch, South Branch, the Chicago River and the South Fork of the South Branch (Bubbly Creek). Its total length is approximately 16 miles.

The North Branch originates at its junction with the Chicago River and the South Branch and ends at the North Branch Dam. It is divided into two segments, upper and lower. The junction of these segments is at the Diversey Parkway Bridge. The upper and lower segment lengths are 2.7 miles and 5 miles, respectively. The North Branch Canal adds an additional mile to the North Branch. The upper segment channel consists of earthen side slopes with an average width and depth of 90-feet and 10-feet, respectively. The lower segment channel consists of vertical concrete and steel walls with an average width and depth of 150- to 300-feet and 10- to 15-feet, respectively. The upper segment's riparian land use includes a mix of commercial, industrial, residential, parks and open space. The upper segment has a continuous band of dense vegetation along the banks, which provides habitat for a variety of fish, birds, and turtles. The lower segment's riparian land use includes a mix of industrial, commercial and residential uses. The lower segment has limited aquatic life around bridges and piers. The North Branch Canal's channel consists of vertical steel walls with an average width and depth of 80- to 120-feet and 4- to 8-feet, respectively. The canal's riparian land use includes a mix of industrial/ commercial and limited natural vegetation. The canal has limited aquatic life around bridges. The North Branch's current use designation is Secondary Contact.

The Chicago River begins at the junction of the North and South Branch, and ends at the CRCW. It is 1.5 miles in length. The channel consists of vertical concrete and sheet pile side-walls with an average width and depth of 200- to 250-feet and 20- to 26-feet, respectively. The channel's riparian land use is limited with segments bordered by riverwalk. Its current use designation is General Use.

The South Branch begins at the Chicago River and the North Branch confluence and ends at the Damen Avenue/I-55 bridge. It has a total length of 4.5 miles. The channel consists of vertical dock walls with an average width and depth of 200- to 250-feet and 15- to 20-feet, respectively. The channel's riparian land use is mainly commercial and industrial. There is limited pioneer vegetation in abandoned lots. Aquatic habitat is limited to areas under bridges. The South Branch's current use designation is Secondary Contact.

The South Fork (Bubbly Creek) flows into the South Branch of the Chicago River near Damen Avenue. It has a total length of 1.3 miles. The channel consists of steeply sloped earth or rock and several locations have vertical dock walls. This reach has an average width and depth of 100- to 200-feet and 3- to 13-feet, respectively. The channel's riparian land use is dominated by industrial and commercial uses, although there is an upscale single family home development being constructed. The South Fork's current use designation is Secondary Contact.

4.3.1 Recreation and Navigation Uses

North Branch

Recreation and navigation use surveys of the North Branch were conducted for 16 days from June 17, 2003 through October 1, 2003 by IEPA, CDM, MWRD, USEPA, and LMF. The teams counted the number of times various recreational uses were observed as summarized in **Table 4-27**.

Table 4-27
Recreational Activities on North Branch

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	0	0%
Skiing or Tubing	2	1%
Wading	7	2%
Canoeing, Sculling or Kayaking	130	40%
Fishing	80	25%
Power Boating	105	32%

The observed uses on the North Branch were skiing, tubing, wading, canoeing, kayaking, fishing and power boating. Small craft commercial navigation was observed downstream of Addison Street where the USACE maintains the channel. The following addition recreation related activities are noted in the record.

- One boat launch at Clark Park;
- Multiple private docks;
- Canoes and kayaks stored individually at various locations;
- Chicago Chase Rowing Regatta – The Chicago Union Rowing and Paddling Foundation estimates 400 users in 2003 and 300 in 2204 at Wolf's Point (Lake Street)/North Avenue Bridge;
- Canoes and kayaks available for rental - The Chicago River Canoe & Kayak Rental estimates that during the 2001, 2002, 2003 and 2004 (only through August 2004) recreational seasons 200, 3000, 5000 and 5000, respectively, users launched at Skokie and Clark Park;

- The Lincoln Park Boat Club and Chicago Union Rowing and Paddling Foundation use North Avenue Boat House at Le Moyne & Magnolia at the North Avenue Turning Basin;

- The Chicago Union Rowing and Paddling Foundation proposed canoe access at Lawrence/North Ave./22nd St. and estimate 80 users between February 21, 2004 and November 7, 2004; and,

- Several events taking place on the river, including: River Rescue Day, canoe trips, Environmental Schools Network, Flatwater Classic, Restoration/ Beautification Projects. The Friends of Chicago River estimate that the UCAN canoe trips included 40, 462 and 433 users in 2002, 2003 and 2004, respectively; their field trips included 300, 210 and 260 users in 2002, 2003 and 2004, respectively; the Flatwater Classic included 731, 785, and 797 users in 2002, 2003, and 2004, respectively; and 740, 745 and 760 users in 2002, 2003 and 2004, respectively, for River Rescue Day.

Chicago River Reach

Recreation and navigation use surveys of the Chicago River were conducted for 14 days between June 24, 2003 and September 7, 2003 by IEPA, CDM and MWRD. The teams counted the number of times various recreational uses were observed as summarized in **Table 4-28**.

Table 4-28
Recreational Activities on Chicago River

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	0	0%
Skiing or Tubing	0	0%
Wading	0	0%
Canoeing, Sculling or Kayaking	0	0%
Fishing	2	6%
Power Boating	29	94%

The observed uses on the Chicago River were fishing and power boating. Commercial navigation was observed in areas where the USACE maintains the channel. Other recreational uses contained in the record include:

- Boat locking measured by the USACE was 17,372, 18,268 and 15,009 vessels in 2001, 2002, and 2003, respectively;

- Dragon Boat Races (sculling) by the Michigan Dragon Boat Association on July 24, 2004;

- Water Trails (kayaking) by the Chicago Area Sea Kayakers Association at the Chicago Locks;

- Sculling observed by the Chicago River Rowing & Paddling Association;
- Friends of Chicago River estimate their proposed canoe access along the Chicago River will be 1,000 users in 2004;
- The Chicago River Schools Network estimate their proposed canoe access on the Chicago River System will be 10,000 users year round;
- The Chicago River Rowing and Paddling Center held an Open House and Learn to Row Day for the on June 12, 2004;
- Several events taking place on the river, including: Canoe trips and Flatwater Classic. The Friends of Chicago River estimate that the UCAN canoe trips included 46 and 32 users in 2002 and 2004, respectively; the Flatwater Classic included 731, 785, and 797 users in 2002, 2003, and 2004, respectively.

South Branch Reach

Recreation and navigation use surveys of the South Branch were conducted for 15 days between June 24, 2003 and October 1, 2003 by IEPA, CDM, MWRD, USEPA and LMF. The teams counted the number of times various recreational uses were observed. For further study of the uses of the river, postcard surveys were sent to and returned from: River City Marina, South Branch Marina, Crowley's, and Chicago Yacht Club. The results of the survey complimented the observed uses of the river. **Table 4-29** summarizes the teams' observations and postcard surveys and quantifies the amount of activity observed on the South Branch:

Table 4-29
Activities on South Branch of Chicago River

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	0	0%
Skiing or Tubing	5	3%
Wading	0	0%
Canoeing, Sculling or Kayaking	10	6%
Fishing	66	39%
Power Boating	89	52%

The observed uses on the South Branch were skiing, canoeing, kayaking, fishing and power boating. Commercial navigation was observed in areas where the USACE maintains the channel. The UAA record notes that the following activities occur:

- South Chicago Rowing Center, St. Ignatius High School and University of Chicago estimate that 40, 50 and 30 users, respectively, launch from Lock/Fuller, Bridgeport, Chicago;

- The Chicago Youth Rowing Club and Kenwood Academy launch from mid-March to mid-November from the Lock/Fuller, Bridgeport, Chicago launch; and,

- Several events taking place on the river, including: River Rescue Day and canoe trips. The Friends of Chicago River estimate that the UCAN canoe trips included 64 and 32 users in 2002 and 2004, respectively; and their field trips included 120 users in 2002; and 220, 220 and 240 users in 2002, 2003 and 2004, respectively, for River Rescue Day.

South Fork Reach

Recreation and navigation use surveys of South Fork were conducted on July 15, 2003 by IEPA and CDM. The teams counted the number of times various recreational uses were observed as summarized in **Table 4-30**.

Table 4-30
Activities on South Fork

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	0	0%
Skiing or Tubing	0	0%
Wading	0	0%
Canoeing, Sculling or Kayaking	0	0%
Fishing	0	0%
Power Boating	5	100%

The observed uses on South Fork were power boating. Commercial navigation was observed in areas where the USACE maintains the channel. The UAA record notes that the following activities occur:

- The Chicago Youth Rowing Club and Kenwood Academy launch from mid-March to mid-November from the Lock/Fuller, Bridgeport, Chicago launch; and,

- Several events taking place on the river, including: River Rescue Day and canoe trips. The Friends of Chicago River estimate that the field trips included 80 users in 2002; and 30, 30 and 30 users in 2002, 2003 and 2004, respectively, for River Rescue Day Canoe trips

4.3.2 Water Quality

The Chicago River System includes the waterways that flow through the downtown Chicago area. The Chicago River proper receives fresh Lake Michigan water diversion into the system. Significant influences on water quality in this series of reaches includes an instream aeration station at Webster Avenue, the North Branch Pumping Station at Lawrence Avenue, the Racine Avenue Pumping Station that discharges into the South Fork, the Fisk Midwest Generation power generating facility on the South Branch, and numerous CSOs along all reaches. These features are identified on the monitoring location (Figure 4-2) and CSO outfall maps (Figure 4-3) in Section 4.1.

Water Quality conditions were evaluated using the use attainment screening approach described in Section 4.1. In general, screening criteria were aligned with existing General Use Water Quality Standards criteria as the benchmark for achieving clean water act goals. Bacteria screening criteria is the exception, where thresholds were set using USEPA's latest draft bacteria guidance which differs from the current General Use criteria. For reference, Illinois General Use Water Quality Standards are included in Section 3.4.2. In all cases screening criteria exactly match UAA recommended water quality criteria presented in Section 5.

4.3.2.1 Dissolved Oxygen

There are twelve continuous D.O. monitoring stations in the Chicago River system. **Figure 4-16** illustrates the percent of the time D.O. levels fell below water quality screening criteria from 1998 to 2002. The Chicago River clearly contributes water with higher D.O. content to the system whereas

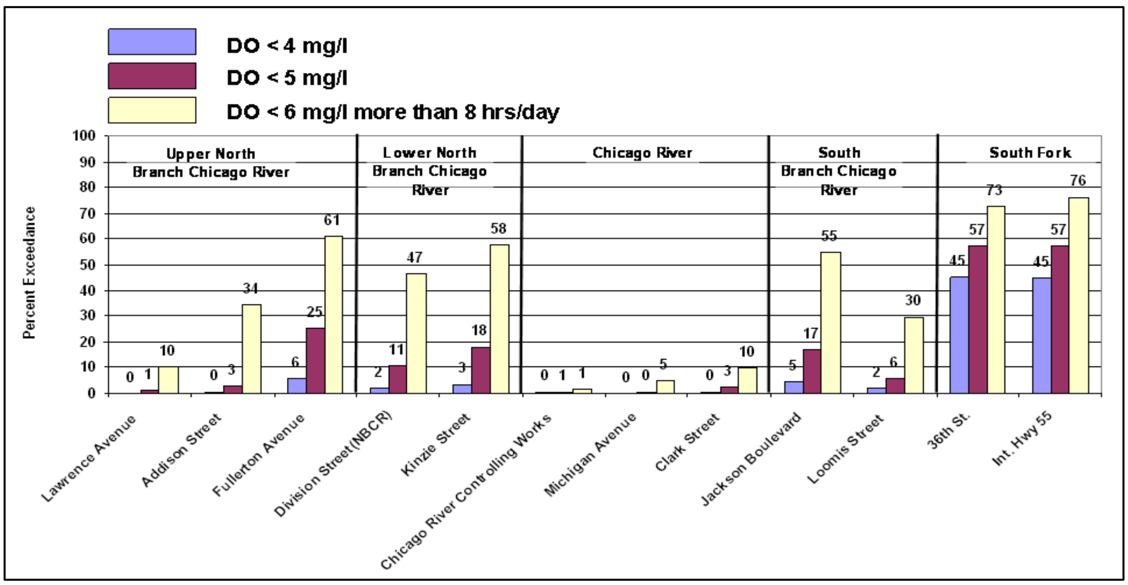


Figure 4-16 - Percent of Time D.O. Levels Fell Below Water Quality Screening Criteria for the Chicago River from 1998 to 2002

water from the South Fork of the South Branch typically is depressed below screening criteria. The South Fork, generally has minimal flow except when the Racine Avenue Pumping Station is discharging combined sewage. The 6 mg/L screening criterion for at least 16 hours per day is difficult to maintain along the North Branch.

Water quality impacts resulting from the North Branch Pumping Station CSO were evaluated using 2000-2002 volume and duration data provided by MWRDGC. Continuous time series D.O. data was flagged six hours prior to pumping and up to 36 hours after in order to demonstrate impacts. **Figure 4-17** shows that the percent of time D.O. levels dropped below water quality screening criteria in the North Branch was significantly greater during CSO impacted periods. A review of time series plots shows significant wet weather D.O. sags at Lawrence Avenue just downstream of the pumping station. Lawrence Avenue's D.O. levels typically recovered quickly, but the depressed D.O. levels became more severe moving downstream with low D.O. lasting for extended periods of time at Kinzie Street. In August 2000 and 2001 fish kills were reported on the North Branch. The impact of CSO discharges, particularly when the TARP system nears capacity and the Lawrence Avenue and Racine Avenue Pumping Stations are forced to discharge to the North Branch and South Fork of the South Branch, are described in detail by the MWRDGC in a draft report titled "Effects of Waterway Operations on D.O. in CAWS from Wilmette to Lockport during the period July 10 through October 31, 2001" (MWRD 2002). During this period the study showed that storm events that did not trigger the North Branch pumping station to discharge resulted in decreased D.O. at Addison and Kinzie Streets, but not below screening criteria. The report concludes that the severity D.O. depression from wet weather is generally more a function of the available storage capacity of the TARP at the beginning of the storm rather than the amount of rainfall.

4.3.2.2 Temperature

Water temperature in the Chicago River System is recorded continuously at the same twelve locations as D.O.. Temperatures during the last five years exceeded screening criteria less than one percent of the time from Lawrence Avenue to Division Street on the North Branch, at Clark Street on the Chicago River and at I-55 on the South Fork. On the South Branch at Loomis Street, downstream of the Midwest Generation Fisk power generating facility, temperature screening criteria were exceeded an average of 2.2 percent of the time in the past five years. All other locations in the Chicago System never exceeded criteria over the past five years.

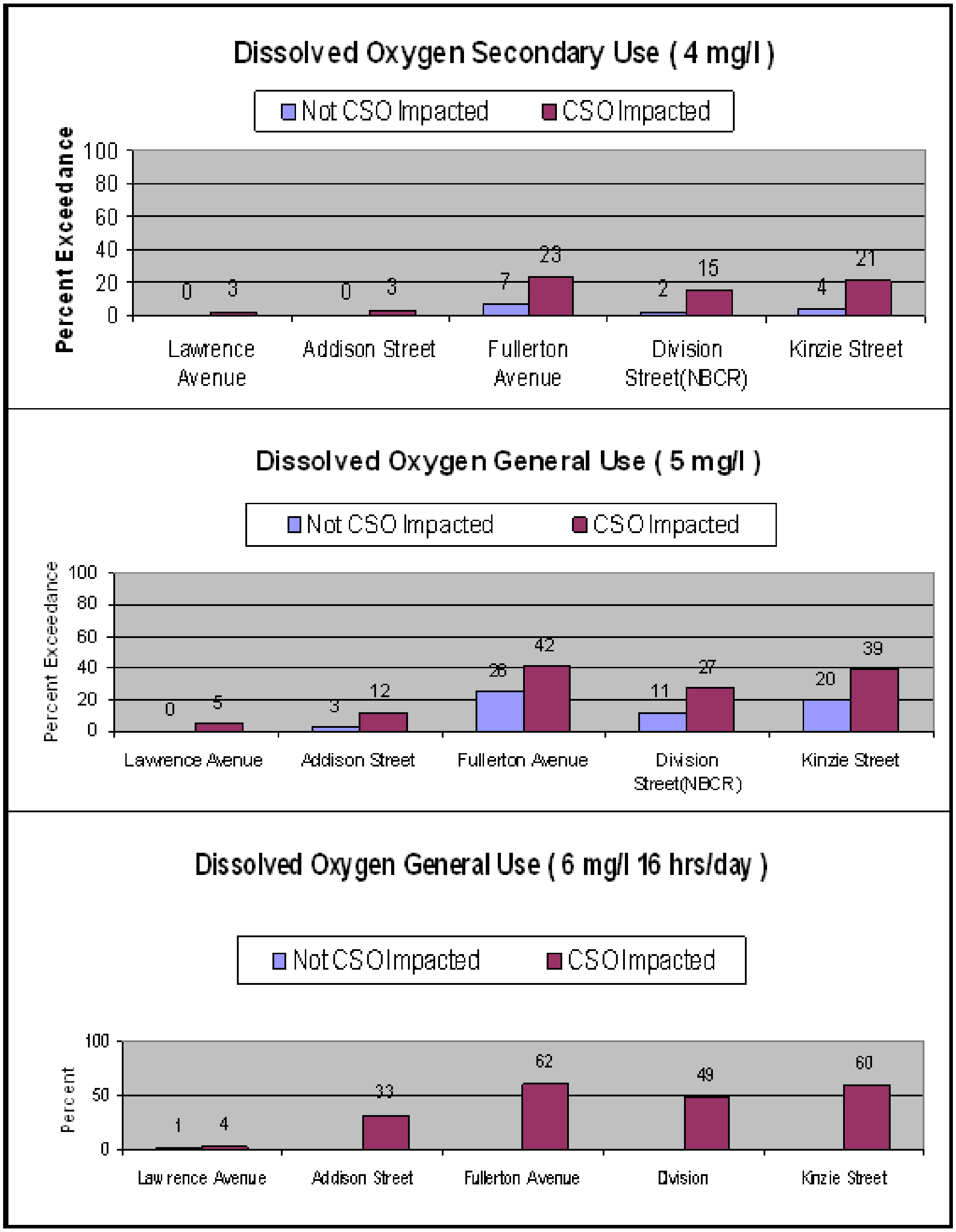


Figure 4-17 - Percent of the Time D.O. Levels Dropped Below Water Quality Screening Criteria in the North Branch During CSO Impacted and Non-CSO Periods

4.3.2.3 Bacteria

Bacteria concentrations in the Chicago River System were evaluated using data from the eight monthly grab sampling locations operated by MWRDGC. The frequency distribution for *E.coli* results from March through November at each station using the limited contact recreation and recreational navigation water quality screening criteria of 1030 and 2470 cfu/100ml, respectively are shown in Figure 4-10. The number of samples included in each distribution is labeled for each station. The *E.coli* geometric mean concentrations for each station are shown in Figure 4-11. The Upper North Branch at Wilson Avenue is clearly still influenced by the non disinfected effluent from the North Side WRP. The Albany sampling location shown on the map is located on the North Branch outside the UAA study area just upstream of the confluence with the NSC and is included for reference purposes. Conditions improve steadily moving downstream particularly past the confluence with the Chicago River where conditions at Outer Drive show concentrations less than 1030 cfu/100 ml 100% of the time in the past five years. The South Fork adds an additional bacterial load with concentrations above 2740 cfu/100ml 22 percent of the time.

4.3.2.4 Metals and Other Constituents

All constituents analyzed by grab sampling station are shown in Table 4-14**. Figures 4-18** and **4-19** show the percent of time that metals and other pollutant concentrations exceeded water quality screening criteria at the nine grab sampling locations in the Chicago River System. Constituents that never exceeded the criteria are not shown. The number of samples taken at for each constituent with an exceedance at all grab sampling stations is shown in Table 4-16. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any period of at least four days. Details of pH exceedances are shown in Table 4-17. Only stations with pH exceedances are shown.

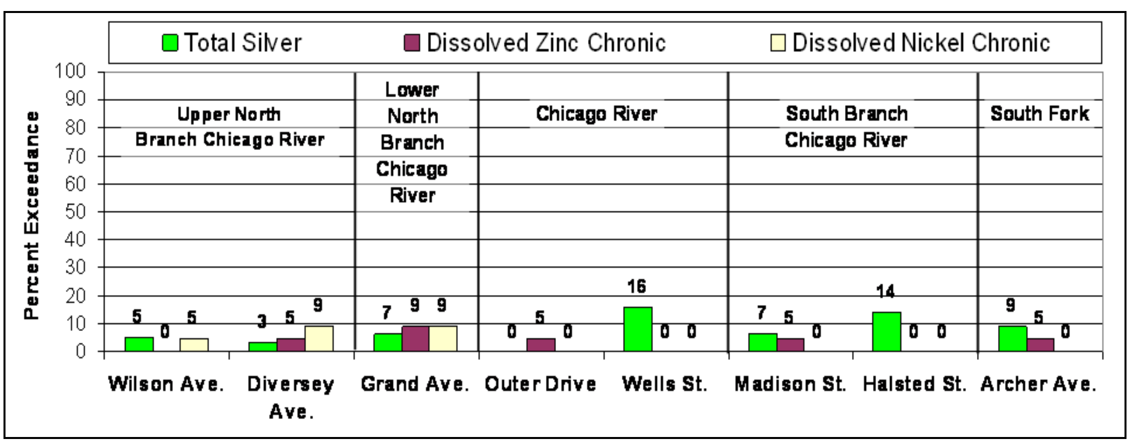


Figure 4-18 - Percent of time metal concentrations exceeded water quality screening criteria in the Chicago River System

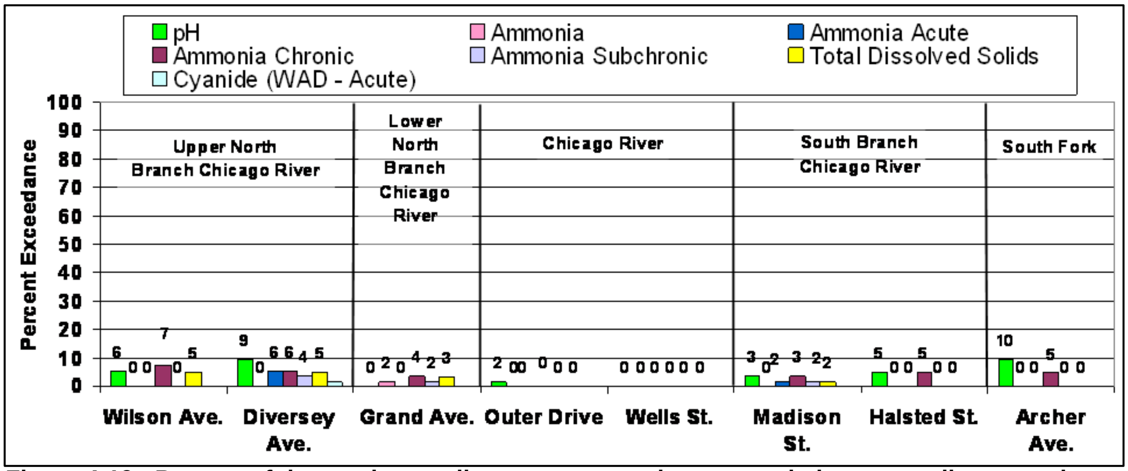


Figure 4-19 - Percent of time various pollutant concentrations exceeded water quality screening criteria in the Chicago River System

4.3.2.5 Constituents of Concern

Table 4-31 summarizes the water quality use attainment screening constituents of concern for the Chicago River System. The maximum percent exceedance that any sampling location in the reach exceeded water quality screening criteria in the past five years is identified. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any period of at least four days. *E.coli* bacteria calculations were similarly calculated as data representing five samples collected over 30 days was not available.

4.3.3 Sediment Quality

Several agencies identified in Table 4-10 collected sediment data in the Chicago River System over the past 12 years. **Table 4-32** provides a screening level summary of conditions in the reaches that comprise the Chicago River System based on a comparison with the TEC and PEC thresholds developed by MacDonald and the Long and Morgan Effects Range Low (ER-L) and Effects Range Median (ER-M) described in Section 4.1.3.3. As a reminder, the TEC represents the concentration level where toxic effects may start occurring, particularly for sensitive benthic organisms, and the PEC represents the concentration level where toxic effects are probable for both sensitive and tolerant benthic organisms. Generally, sediment quality worsens in the Upper North Branch from upstream to downstream. Chicago River sediments are relatively cleaner, but still exceeded quality guidelines for some metals as noted in Table 4-32. Compared to conditions in the South Branch and in the CSSC, South Fork sediments were not as contaminated with non-conventional pollutants as repudiated.

Table 4-31
Chicago River System Water Quality Constituents of Concern

Parameter	Upper North Branch	Lower North Branch	Chicago River	South Branch	South Fork
Dissolved Oxygen	61	58	10	55	76
Temperature	0.3	0.1	0.1	2.2	0.2
*E.Coli**	100 / 100	62.5 / 25	11 / 11	12.5 / 0	22 / 22
Total Silver	5.0	6.7	15.8	14.3	9.1
Dissolved Nickel Chronic	9.1	9.1			
Dissolved Zinc Chronic	4.5	9.1	4.5	4.5	4.5
Total Ammonia		1.8			
Ammonia Chronic	7.4	1.9		5	4.8
Ammonia Subchronic	3.7	1.9		1.7	
Ammonia Acute	5.6			1.7	
Total Dissolved Solids	5.0	3.3		1.7	
Cyanide (WAD) Chronic	1.7				
pH	1.7		1.8	5	9.5

Maximum percent exceedance at any sampling location in reach

0%   <=10%   >10 and <=25%   >25%

* Limited Contact Recreation / Recreational Navigation

Table 4-32
Chicago River System Surface Sediment Quality Summary

Reach	Exceeded TEC or ER-L	Exceeded PEC or ER-M
Upper North Branch	Cadmium, Chromium, Copper, Lead, Zinc, Mercury, Nickel, Silver, PCBs, PAHs	Cadmium, Chromium, Copper, Lead, Zinc, Mercury, Nickel, Silver, PCBs, PAHs
Lower North Branch	Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, PCBs, PAHs	Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, PCBs, PAHs
Chicago River	Cadmium, Copper, Zinc, Lead, Mercury, PCBs, PAHs	Lead, Mercury, PCBs, PAHs
South Branch	Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, PCBs, PAHs	Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, PCBs, PAHs
South Fork	Chromium, Cadmium, Nickel, Copper, Lead, Mercury, Zinc	Copper, Lead, Mercury, Zinc

Sediment oxygen demand (SOD) data was available for one study conducted by MWRDGC in the Fall and Winter of 2001 that included five locations in the Chicago River System. SOD is a measure of how much oxygen bottom sediments consume from the water column to decompose organic materials. SOD values in the vicinity of a municipal sewage outfall typically range from 2 to 10 g/m^2/day and average approximately 4 g/m^2/day. (Thomann 1987) **Table 4-33** shows the results of SOD measurements conducted on Chicago River System sediments in 2001.

Table 4-33
Chicago River System SOD Measurements

SOD sampling location	SOD (g/m²/day) at 20°C
Upper North Branch at Belmont	3.1
Lower North Branch at Grand Avenue	1.8
Chicago River at LaSalle	0.77
South Branch at Congress	1.93
South Branch at Halstead	3.32

4.3.4 Biological Assessment

4.3.4.1 Fish

North Branch

Fish sampling in the North Branch was conducted at two MWRDGC locations in Chicago:

- Wilson Avenue
- Grand Avenue

Twenty-five species of fish (excluding hybrids) were captured in the North Branch l from 1993 to 2002, with the dominant fish species being common carp, gizzard shad, and goldfish (**Table 4-34**). Dominant game fish species included largemouth bass, green sunfish and bluegill. The greatest species diversity (19 species) was observed at Wilson Avenue, just downstream of the confluence with the NSC. Like the North Shore Channel, species diversity showed a dramatic decline in the North Branch from 1993 to 2002 (**Figure 4-20**). IBI scores tended be higher at the Wilson Avenue sampling location with IBI scores ranging from 14 to 32 (**Figure 4-21**), where as the IBI scores for Grand Avenue ranged from 16 to 28. IBI scores for both locations fluctuated on a yearly basis but no temporal trend could be identified.

Chicago River

Between 1993 and 2002 twenty-seven species of fish (excluding hybrids) were collected at four different locations in the Chicago River as it flows through downtown. The four sites were:

- Inner harbor area near the old Coast Guard station
- Loop area near the North and South Branch confluence
- Lake Shore Drive (2002 only)
- Wells Street (2002 only)

Table 4-34 Species Richnes and Relative Abundance of Fish Species in the North Branch 1993 - 2002, all Sampling Locations

	Relative Abundance (%)									
Fish Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Amiidae: Bowfins										
Amia calva - bowfin		0.44								
Clupeidae: Herrings, Shads, Sardines, and allies										
Alosa pseudoharengus - alewife	3.14	3.51								
Dorosoma cepedianum - gizzard shad	13.45	1.32	29.01	10.33	9.26		50.00	10.26	24.19	21.43
Cyprinidae: Minnows and Carps										
Carassius auratus - goldfish	14.80	17.98	9.56	10.00	1.85		1.37	3.85	4.30	7.14
Cyprinus carpio - common carp	21.52	29.39	12.97	11.67	27.78		9.25	20.51	38.17	42.86
Notemigonus crysoleucas - golden shiner	4.93	16.23	2.05	2.67					0.54	
Notropis atherinoides - emerald shiner	0.90			1.00					1.08	
Notropis hudsonius - spottail shiner		2.63	0.34							
Pimephales notatus - bluntnose minnow	6.73	0.44			3.70				2.69	
Carp x goldfish	7.17	6.58	2.73	0.33	3.70		1.03	5.13	0.54	3.57
Catostomidae: Suckers										
Catostomus commersoni - white sucker	1.35	2.19	1.37						1.08	
Cobitidae										
Misgurnus anguillicaudatus - Oriental weatherfish		0.44								
Ictaluridae: Catfishes										
Ameiurus melas - black bullhead	0.45	0.44		0.33						
Ameiurus natalis - yellow bullhead							0.34	1.28	0.54	
Ictalurus punctatus - channel catfish								1.28		
Salmonidae: Salmonides										
Salvelinus fontinalis - brook trout				0.33						
Gasterosteidae: Sticklebacks and Tubesnouts										
Gasterosteus aculeatus - threespine stickleback				20.67						
Centrarchidae: Sunfishes and Freshwater Basses										
Ambloplites rupestris - rock bass				0.33				1.28	1.08	
Lepomis cyanellus - green sunfish	13.45	2.19	3.41	2.33	5.56		7.19	15.38	6.45	
Lepomis gibbosus - pumpkinseed	0.45	0.44		0.33			0.68		1.08	7.14
Lepomis humilis - orangespotted sunfish			0.34		1.85		1.03	1.28		
Lepomis macrochirus - bluegill	6.28	6.58	10.58	16.67	40.74		18.49	25.64	5.38	
Micropterus salmoides - largemouth bass	4.48	7.02	27.30	23.00	5.56		10.62	14.10	10.75	3.57
Pomoxis nigromaculatus - black crappie		1.32	0.34						0.54	
Green sunfish x Bluegill hybrid	0.45									
Percichthyidae: Temperate Perches										
Morone americana - White Perch	0.45	0.88							1.61	14.29
Total Number of Species	16	18	12	14	9	0	10	11	16	7

Figure 4-20. Temporal Trend in Species Diversity for North Branch 1993 - 2002

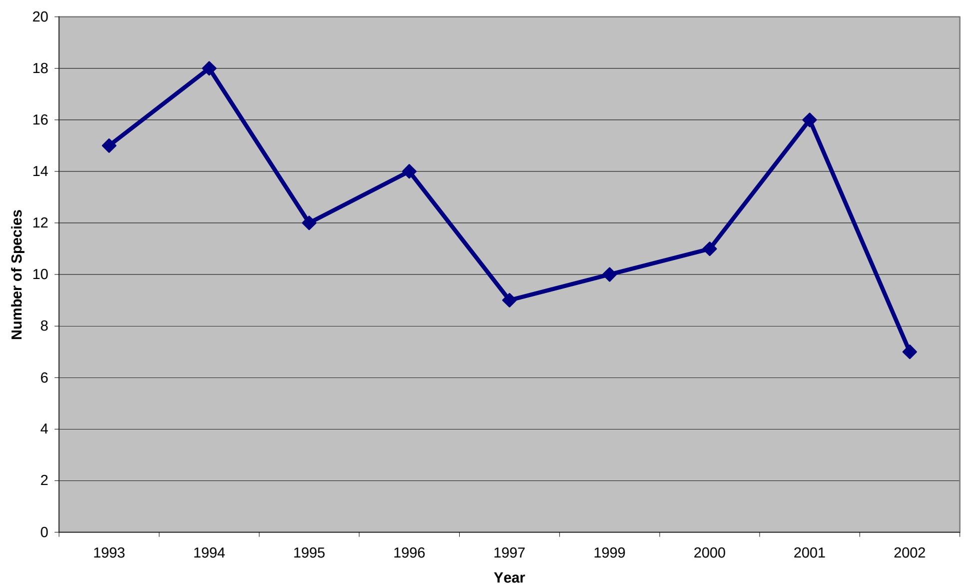
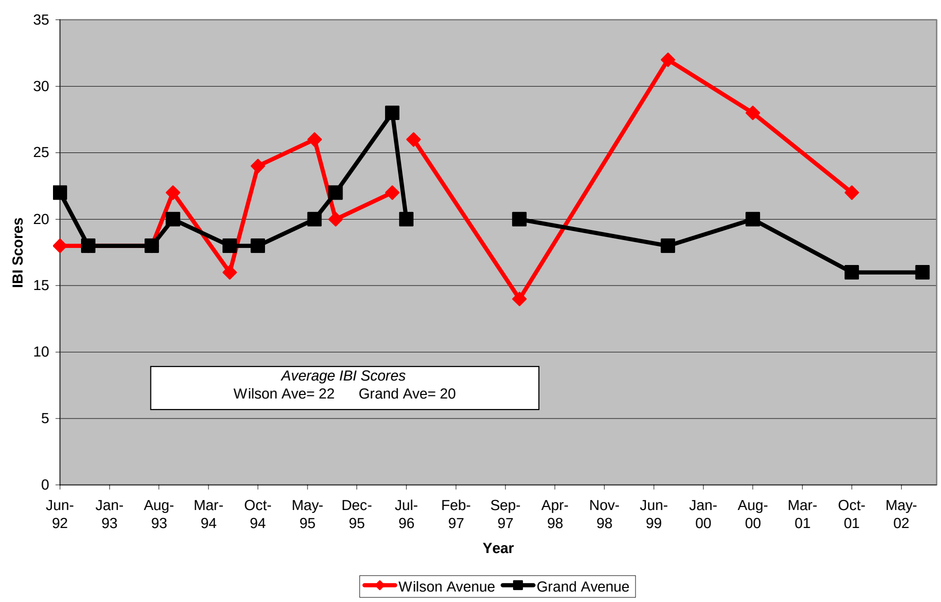


Figure 4-21. IBI Scores for North Branch Fish Sampling Locations 1992 - 2002



Dominant fish species included gizzard shad, common carp, bluntnose minnow and goldfish (**Table 4-35**). Abundant game species included: rock bass, largemouth bass and bluegill. The largest diversity of fish (19) was observed at the Inner Harbor location, which is adjacent to the CRCW on Lake Michigan. As was observed in the North Branch, species richness showed a decreasing trend from 1993 to 2002 ago River (**Figure 4-22**).

IBI values for the Inner Harbor area ranged from 14 to 36, while in the Loop area, the IBI values ranged from 12 to 24 (**Figures 4-23**). The large difference may be attributed to the better water quality in the Inner Harbor area, slightly better habitat and the periodic ingress of lake species during lockage and lake diversion. Game fish diversity was greatest in the Inner Harbor area.

South Branch and South Fork

Twenty species of fish (excluding hybrids) were collected at one location in the South Branch as it flows out of Chicago. The sampling location was at the junction of the South Branch and the North Branch. MWRDGC also conducted sampling at Archer Avenue on the South Fork (Bubbly Creek).

South Branch looking north.

Dominant fish species included goldfish, common carp, bluntnose minnow and emerald shiner (**Table 4-36**). Abundant game species included: rock bass, largemouth bass and bluegill. Four species of fish were collected in Bubbly Creek in 2002, and they include: common carp (4), gizzard shad (9), emerald shiner (2) and largemouth bass (3).

No distinct trend in species richness could be ascertained over the last 10 years (**Figure 4-24**) for the South Branch. The IBI values have slightly increased over the last ten years, but remain very similar to the North Branch (**Figure 4-25**). The South Branch has similar habitat characteristics as the lower North Branch and the Loop area of the Chicago River. The channel is primarily sheet-piled and concrete-lined, with little instream habitat. Limited habitat in the form of overhanging vegetation and instream structure occurs near the confluence with Bubbly Creek. South Branch channel significantly widens at the turning basin just above the Sanitary Ship Canal.

Table 4-35
Species Richness and Relative Abundance of Fish Species in the Chicago River 1993 – 2002 all Sampling Locations

	Relative Abundance (%)								
Fish Species	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2002**
Clupeidae: Herrings, Shads, Sardines, and allies									
Alosa pseudoharengus - alewife	1.28		1.63	0.37					
Dorosoma cepedianum - gizzard shad	59.46		1.63	10.45	3.61	5.14	6.78	40.54	49.37
Cyprinidae: Minnows and Carps									
Carassius auratus - goldfish	7.69	7.99	7.72	7.09	4.82		3.39	4.05	1.90
Cyprinus carpio - common carp	14.26	16.86	28.86	30.60	3.61	2.77	27.97	22.97	22.78
Notemigonus crysoleucas - golden shiner		0.30							
Notropis atherinoides - emerald shiner				6.72					6.96
Notropis hudsonius - spottail shiner				1.12	1.20				
Pimephales notatus - bluntnose minnow	2.08	3.85		0.37	9.64	20.95	3.39		
Carp x goldfish	1.12	0.59	2.03	1.12					
Catostomidae: Suckers									
Ictiobus niger - black buffalo	0.16								
Ictaluridae: Catfishes									
Ameiurus melas - black bullhead	0.16	2.07	0.81			0.40			
Esocidae: Pikes									
Esox lucius - northern pike								1.35	
Salmonidae: Salmonides									
Oncorhynchus mykiss - rainbow trout				0.75					
Salmo trutta - brown trout		0.30							
Atherinidae:Silversides									
Labidesthes sicculus - brook silverside				0.37					
Gasterosteidae: Sticklebacks and Tubesnouts									
Gasterosteus aculeatus - threespine stickleback	0.16			5.60					
Centrarchidae: Sunfishes and Freshwater Basses									
Ambloplites rupestris - rock bass	4.81	13.91	7.72	10.07	7.23	9.49	19.49	6.76	
Lepomis cyanellus - green sunfish	2.24	4.14	0.81	0.75	2.41	0.40	5.08		0.63
Lepomis gibbosus - pumpkinseed	0.16	1.78		1.12		2.77	0.85	1.35	3.80
Lepomis gulosus - warmouth						0.40			0.63
Lepomis humilis - orangespotted sunfish	0.16								
Lepomis macrochirus - bluegill	3.21	13.91	4.07	4.10	63.86	36.76	12.71		2.53
Micropterus dolomieu - smallmouth bass	0.80	1.78	1.63	0.37			0.85		1.27
Micropterus punctulatus - spotted bass									
Micropterus salmoides - largemouth bass	1.44	31.36	42.68	18.28	3.61	18.18	16.95	21.62	8.86
Pomoxis nigromaculatus - black crappie						2.77	2.54	1.35	0.63
Green sunfish x Bluegill hybrid	0.32	0.30	0.41	0.37					
Pumpkinseed x Bluegill hybrid		0.30							
Perca flavescens - Yellow Perch		0.30		0.37					
Sciaenidae: Coakers and Drums									
Aplodinotus grunniens - freshwater drum	0.16								
Percichthyidae: Temperate Perches									
Morone americana - White Perch	0.32	0.30							0.63
Total Number of Species	**19**	**17**	**12**	**19**	**9**	**11**	**11**	**8**	**12**

Figure 4-22. Temporal Trend in Species Diversity in the Chicago River 1993 - 2002

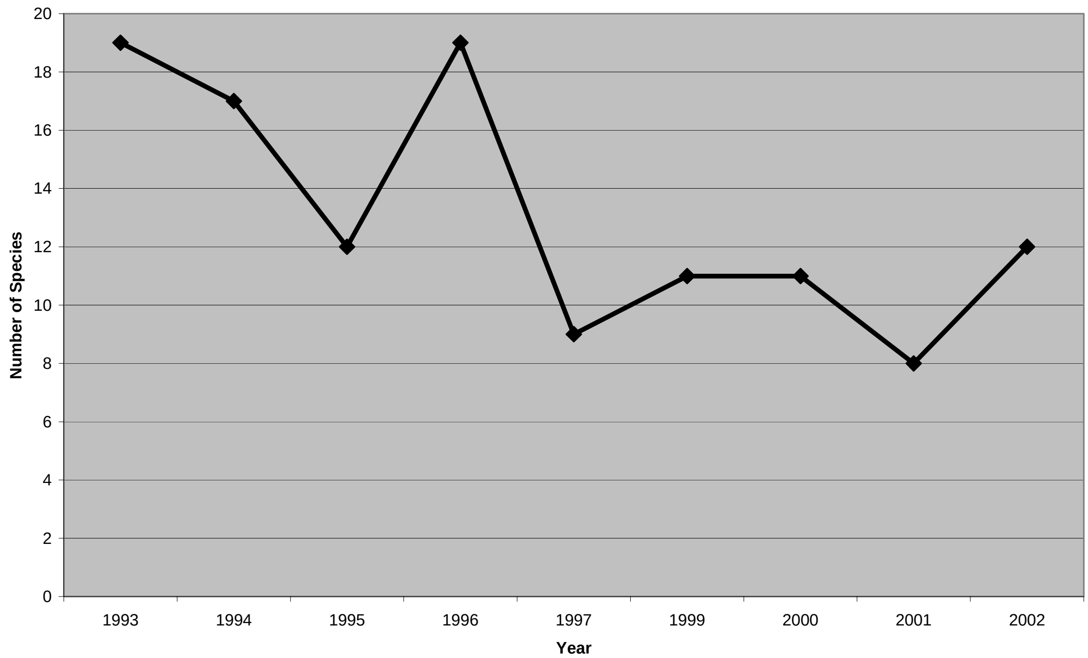


Figure 4-23. IBI Scores for Selected Fish Sampling Locations in the Chicago River

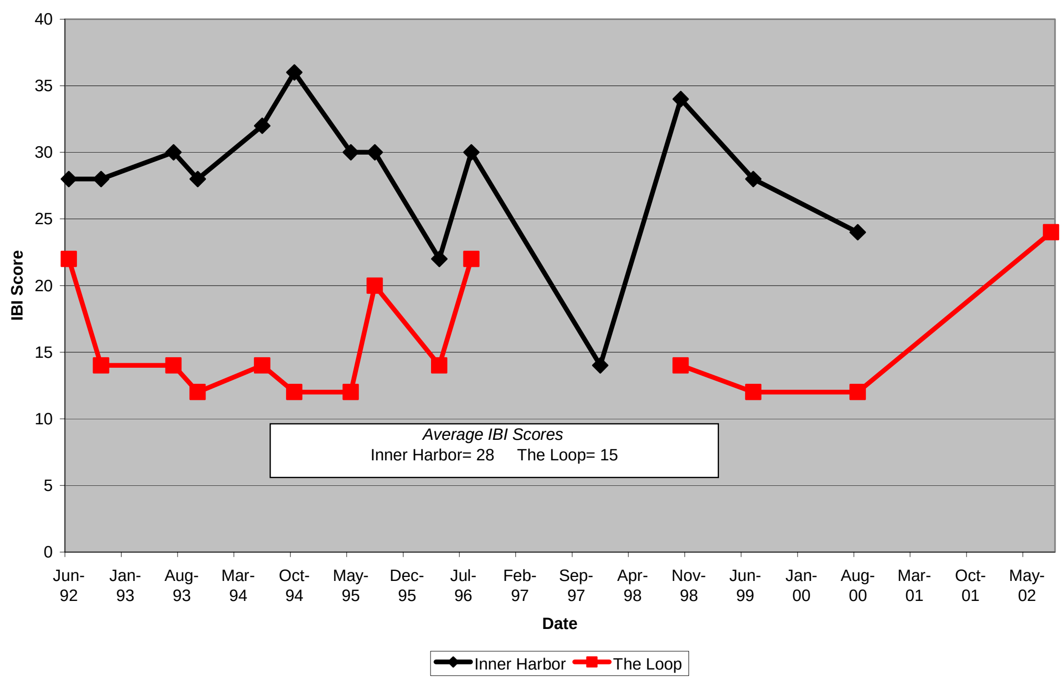


Table 4-36 Species Richnes and Relative Abundance of Fish Species in the South Branch 1993 - 2000

	Relative Abundance (%)						
Fish Species	1993	1994	1995	1996	1997	1999	2000
Clupeidae: Herrings, Shads, Sardines and allies							
Alosa pseudoharengus - alewife	5.48			2.65			0.47
Dorosoma cepedianum - gizzard shad			1.30	0.88	4.48	11.32	29.44
Cyprinidae: Minnows and Carps							
Carassius auratus - goldfish	30.14	24.42	19.48	13.27	5.97	1.89	0.93
Cyprinella spiloptera - spotfin shiner							1.40
Cyprinus carpio - common carp	36.30	48.84	49.35	33.63	4.48	39.62	20.09
Notemigonus crysoleucas - golden shiner							0.47
Notropis atherinoides - emerald shiner				15.93			34.11
Notropis hudsonius - Spottail shiner					1.49		
Pimephales notatus - bluntnose minnow	8.90	6.98			11.94		0.47
Carp x goldfish	4.79	1.16	3.90	2.65			0.93
Catostomidae: Suckers							
Ictiobus niger - Black Buffalo	0.68						
Gasterosteidae: Sticklebacks and Tubesnouts							
Gasterosteus aculeatus - Threespine stickleback				12.39			
Centrarchidae: Sunfishes and Freshwater Basses							
Lepomis cyanellus - green sunfish	4.79	6.98			1.49	1.89	0.93
Lepomis gibbosus - pumpkinseed	0.68			0.88		1.89	1.40
Lepomis macrochirus - bluegill	2.74	1.16				16.98	3.27
Green sunfish x Bluegill		1.16	1.30	0.88	65.67		
Ambloplites rupestris -Rock Bass	0.68	1.16	1.30	0.88		5.66	
Micropterus dolomieu - smallmouth bass							0.93
Micropterus salmoides - largemouth bass	2.05	6.98	23.38	15.93	4.48	20.75	3.27
Lepomis humilis - Orangespotted Sunfish	0.68						
Percichthyidae: Temperate Perches							
Morone americana - White Perch	1.37	1.16					
Sciaenidae: Croakers Drums							
Aplodinotus grunniens - Freshwater Drum	0.68						1.87
Total Number Species	14	10	7	11	8	8	15

Figure 4-24. Temporal Trend in Fish Species Diversity in the South Branch 1993 - 2000

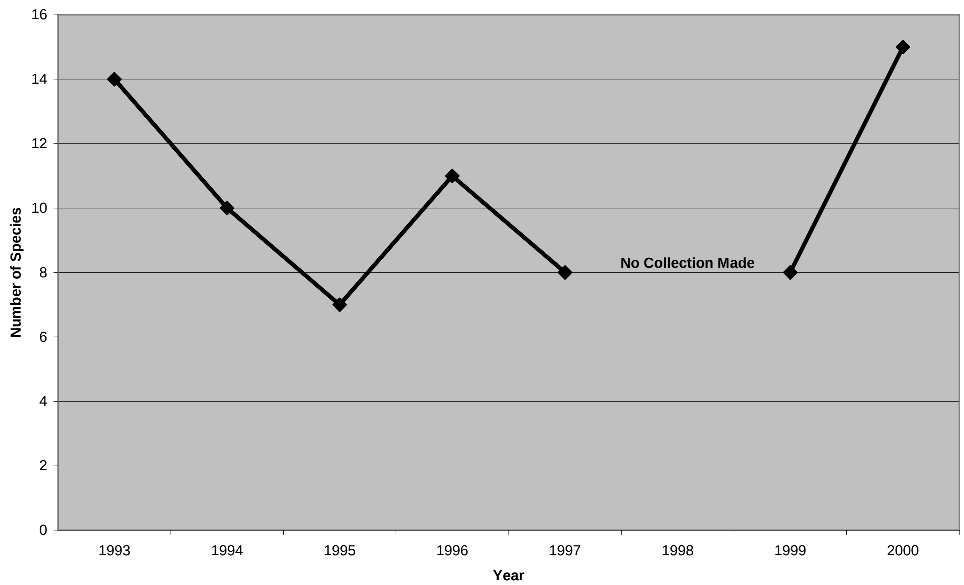
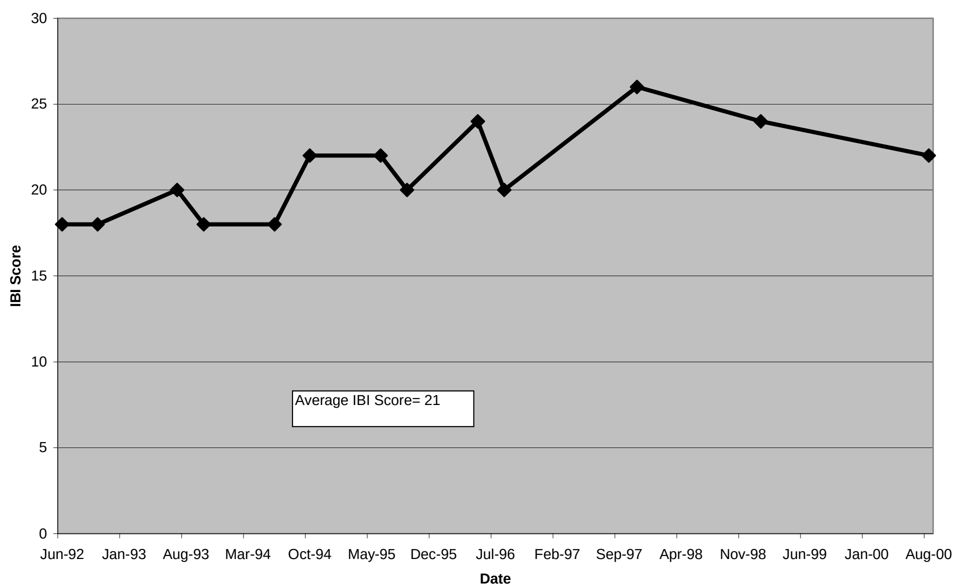


Figure 4-25. IBI Scores of SBCR/NBCR Fish Sampling Location 1993 - 2000



4.3.4.2 Macroinvertebrates

North Branch

MWRDGC and IEPA sampled macroinvertebrates at seven locations in the North Branch.

- Argyle Street
- Dempster Street
- Lawrence Avenue
- Diversey Parkway
- Grand Avenue
- Albany Avenue

Stenacron sp.

Table 4-37 shows the species richness and associated MBI score for both HD and PP dredge sampling methods. Fifty-seven species of macroinvertebrates were collected in the Secondary Contact section of the North Branch. Species richness was highest at Dempster Street (25 species) and Albany Avenue (25 species). Dominant species included oligochaeta, *Turbellari*a, the isopod *Caecidotea* and chironomids. The cnidarian *Hydra* was present in significant numbers at Dempster Street. *Polypedilum* was the dominant dipeteran collected in the river. Some members of this genus are the only insect definitely known to endure cryptobiosis(animal's metabolism has come to a virtual standstill) and survive drying to <3 percent moisture (Schwarz 1994). The mayfly *Stenacro*n was collected at four sites in the North Branch with the highest density being observed at Albany Avenue operation of the study area. The EPT taxa richness index at Albany Avenue was one, while the other sampling locations had an EPT taxa index of zero.

Chicago River

MWRDGC sampled macroinvertebrates at two locations in the Chicago River during 2002.

- Lakeshore Drive
- Wells Street

Table 4-38 shows the species richness and associated MBI score for both HD and PP dredge sampling methods. Twenty-two species of macroinvertebrates were collected in the South Branch. Species richness was highest at Lakeshore Drive (18 species) and Wells Street (12 species). Dominant taxa included Oligochaeta, the amphipod *Gammarus fasciatus*, dipterans including *Cricotopus bicinctus* and *Polypedilum halterale*. Zebra mussels (*Dressiena polymorpha*) were also dominant at this site. The Chicago

Table 4-37 North Branch: Macroinvertebrate Taxa Richness, Density (HD) and PP number/meter2), Percent Relative Abundance (RelAbu) and MBI Score (MWRDGC 2001, 2002; IEPA 2001Data Sets)

Species	Argyle St.				Dempster St.				Lawrence Ave.		Wilson Avenue				Diversey Pkwy.				Grand Avenue				Albany Avenue			
	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu
COELENTERATA																										
Hydra	7.0	2.5			1,026.2	17.3			2.0	0.6		0.0			53.8	0.5			1.8				1.8		14.4	0.1
PLATYHELMINTHES																										
Turbellaria					1,279.2	21.6				0.0	2,296.4	11.7	215.3		915.0	8.6			1,051.3	2.7	7.2	0.0	2,554.7	16.7		
ECTOPROCTA																										
Plumatella										0.0		0.0									7.2	0.0				
ANNELLIDA																										
Oligochaeta	68.0	24.5	10,729.1	100.0	979.5	16.5			39.0	12.6	16,424.5	83.7	36,026.7	1.0	8,442.8	79.3	124,371.1	99.5	35,541.8	90.5	58,073.4	99.6	132.8	0.9	688.9	4.9
Hirudinea																										
Helobdella															17.9	0.2										
Helobdella stagnalis																			1.8	0.0			3.6	0.0		
Helobdella triserialis					25.1	0.4																			28.7	0.2
Placobdella																							1.8	0.0		
Mooreobdella microstoma															35.9	0.3	71.8	0.1					3.6	0.0	1,449.7	10.4
CRUSTACEA																										
Caecidotea	4.0	1.4			1,115.9	18.8	50.2	0.7	2.0	0.6	376.7	1.9			287.0	2.7			91.5	0.2			11,837.1	77.3	1,119.6	8.0
Amphipoda																										
Gammarus fasciatus															53.8	0.5			231.4	0.6						
INSECTA																										
Ephemeroptera																										
Stenacron	84.0	30.3			19.7	0.3			2.0	0.6													145.3	0.9		
Odonata																										
Argia	1.0	0.4			105.8	1.8																				
Corixidae																							1.8	0.0		
Trichoptera																										
Cheumatopsyche					236.8	4.0																	23.4	0.2	28.7	0.2
Hydropsyche									1.0																	
Hydropsyche betteni					1.8	0.0																	10.8	0.1		
Hydroptila																							14.4	0.1		
Coleoptera																										
Stenelmis							35.9	0.5																		
Stenelmis crenata grp.					10.8	0.2																				
Diptera																										
Chironomidae													215.3	0.0			574.1	0.5	1,004.7	2.6	114.8	0.2				
Procladius					19.7	0.3	839.7	11.8													64.6	0.1	1.8	0.0		
Thienemannimyia grp.							86.1	1.2															134.5	0.9	14.4	0.1
Corynoneura	3.0	1.1																								
Cricotopus bicinctus grp.									4.0	1.3													10.8	0.1	57.5	0.4
Cricotopus sylvestris grp.					7.2	0.1			4.0	1.3									9.0	0.0						
Nanocladius	12.0	4.3							20.0	6.5																
Nanocladius distinctus	18.0	6.5			44.9	0.8			102.0	33.0					17.9				9.0	0.0			39.5	0.3		
Nanocladius crassicornus/rectinervis					25.1	0.4																	17.9	0.1		
Rheocricotopus robacki	3.0	1.1							16.0	5.2													32.3	0.2		

Species 	Argyle St.				Dempster St.				Lawrence Ave.		Wilson Avenue				Diversey Pkwy.				Grand Avenue				Albany Avenue			
	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu
Thienemanniella xena									28.0	9.1																
Thienemanniella similis	8.0	2.9																								
Chironomus							78.9	1.1											159.7	0.4						
Cryptochironomus					12.6	0.2	28.7	0.4																		
Dicrotendipes neomodestus	41.0	14.8			57.4	1.0	251.2	3.5	28.0	9.1													44.9	0.3	244.1	1.8
Dicrotendipes simpsoni					107.6	1.8	172.2	2.4	4.0	1.3	484.4				753.5	7.1			1,099.7	2.8			1.8	0.0		
Glyptotendipes					10.8	0.2									53.8	0.5			9.0	0.0	14.4	0.0				
Parachironomus	3.0	1.1							28.0	9.1									34.1	0.1					7.2	0.1
Paracladopelma					5.4	0.1																				
Polypedilum fallax grp.																							1.8	0.0		
Polypedilum flavum					93.3	1.6	86.1	1.2															91.5	0.6	14.4	0.1
Polypedilum illinoense	9.0	3.2			17.9	0.3	14.4	0.2	28.0	9.1													84.3	0.6	57.4	0.4
Polypedilum scalaenum grp.	12.0	4.3			705.1	11.9	5,246.1	73.8															114.8	0.7	344.5	2.5
Stenochironomus							14.4	0.2																		
Micropsectra																							1.8	0.0		
Paratanytarsus																									14.4	0.1
Tanytarsus glabrescens grp.																									14.4	0.1
Tanytarsus guerlus grp.					7.2	0.1																				
GASTROPODA																										
Amnicola																									43.1	0.3
Ferrissia	4.0	1.4									35.9	0.2			17.9	0.2										
Menetus dilatatus																			12.6	0.0					14.4	0.1
Physella																									14.4	0.1
PELECYPODA																										
Corbicula fluminea																					7.2					
Pisidium					1.8		136.4	1.9													28.7				9,458.8	67.8
Pisidium compressum					3.6	0.1																			28.7	0.2
Pisidium nitidum							71.8	1.0																	287.1	2.1
Dressiena polymorpha									1.0	0.3																
Taxa Richness	15.0		1.0		25.0		14.0		16.0		5.0		3.0		11.0		3.0		14.0		8.0		25.0		21.0	
Total Number of Individuals	277.0		10,729.1		5,920.4		7,112.1		309.0		19,617.9		36,457.3		10,649.3		125,017.0		39,257.4		58,317.5		15,308.8		13,944.8	
MBI	5.8		10.0		6.4		6.3		4.9		9.4		10.0		9.2		10.0		9.6		10.0		6.0		5.7	

Table 4-38 Chicago River: Macroinvertebrate Taxa Richness, Density (HD) and PP number/meter2), Percent Relative Abundance (RelAbu) and MBI Score (MWRDGC 2001, 2002; Data Set)

Species 	Lake Shore Drive				Wells Street			
	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAb
COELENTERATA								
Hydra	3.6	0.4						
ECTOPROCTA								
Plumatella	1.8	0.2						
ANNELLIDA								
Oligochaeta	256.5	28.4	7,951.7	98.4	2,086.5	92.1	2,504.6	99.7
Gammarus fasciatus	502.3	55.7			95.1	4.2		
INSECTA								
Trichoptera								
Cheumatopsyche	1.8	0.2						
Hydroptila	1.8	0.2						
Diptera								
Ablabesmyia mallochi					3.6	0.2		
Cricotopus bicinctus grp.	19.7	2.2						
Chironomus	9.0	1.0	7.2	0.1	10.8	0.5		
Cladopelma	9.0	1.0						
Cricotopus sylvestris grp.	5.4	0.6						
Heterotrissocladius	1.8	0.2						
Nanocladius distinctus			7.2	0.1	1.8	0.1		
Cryptochironomus	1.8	0.2						
Dicrotendipes neomodestus	3.6	0.4			1.8	0.1		
Dicrotendipes simpsoni	9.0	1.0			43.1	1.9		
Glyptotendipes	7.2	0.8			1.8	0.1		
Microchironomus					1.8	0.1		
Parachironomus	16.1	1.8			10.8	0.5		
Polypedilum halterale grp.	32.3	3.6	21.5	0.3	5.4	0.2		
Xenochironomus xenolabis					1.8	0.1		
PELECYPODA								
Dressiena polymorpha	19.7	2.2	93.3	1.2			7.2	0.3
Taxa Richness	18		5		12		2	
Total Number of Individuals	902.4		8,080.9		2,264.3		2,511.8	
MBI	5.5		9.9		9.5		10.0	

River and the Chicago Sanitary Ship Canal have served as the primary conduit for zebra mussels and other exotics to the Mississippi River and the Gulf of Mexico. The EPT taxa richness at Lake Shore Drive was two, while Wells Street had an EPT taxa richness of zero.

MBI scores for the HD sampling data ranged from 5.5 at Lake Shore Drive to 9.5 at Wells Street, and the PP dredge MBI scores ranged from 9.9 to 10, respectively.

South Branch and South Fork
MWRDGC and IEPA sampled macroinvertebrates at two locations in the South Branch and at one location on the South Fork during 2002.

- Madison Street
- Loomis Street
- Archer Avenue (South Fork only)

Table 4-39 shows the species richness and associated MBI score for both HD and PP dredge sampling methods. Twenty-three species of macroinvertebrates were collected in the South Branch. Species richness was highest at Madison Street (19 species) and Wells Street (16 species). Dominant taxa included Oligochaeta, the amphipod *Gammarus fasciatus*, dipterans including *Dicrotendipes simpsoni* and *Nanocladius distinctus*. Zebra mussels (*Dressiena polymorpha*) were also dominant in the South Branch. The EPT taxa richness at the two sampling sites was one at Madison Street and zero at Loomis Street.

MBI scores for the HD sampling data set was 7.3 at Madison Avenue and 6.9 at Loomis Street, and the PP dredge MBI scores ranged from 7.1 to 9.8, respectively.

4.3.4.3 Habitat Assessment

North Branch
The habitat survey conducted by Rankin (2004) for the North Branch had poor to fair aquatic life potential in the reach downstream of the NSC confluence, while downstream habitat below Grand Avenue were rated low. **Table 4-40** summarizes the habitat attributes for this reach. Rankin (2004) characterized this section of the North Branch similar to Ohio's Limited Resource Water aquatic life use (lowest quality). He further characterized the lower reach as not having habitat to support sensitive species, but capable of supporting fish species that are accustomed to open water environments. The upper portion of the North Branch had some shallow water areas and provided more edge habitat and structure than the downstream section.

Table 4-39
South Branch: Macroinvertebrate Taxa Richness, Density (HD) and PPPonar (PP) number/meter2), Percent Relative Abundance (RelAbu) and MBI Score (MWRDGC 2001, 2002; Data Sets)

Species	Madison Street				Loomis Street			
	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu
COELENTERATA								
Hydra	7.2	0.1			1.8	0.0		
PLATYHELMINTHES								
Turbellaria	638.7	10.3	57.4	1.5	1,289.9	27.2		
ANNELLIDA								
Oligochaeta	2,073.9	33.6	1,586.0	41.9	2,036.2	43.0	2,913.7	94.6
Helobdella stagnalis					1.8	0.0		
Helobdella triserialis	17.9	0.3			9.0	0.2		
CRUSTACEA								
Caecidotea	504.1	8.2	7.2	0.2	134.6	2.8		
Amphipoda								
Gammarus fasciatus	134.6	2.2			80.7	1.7		
INSECTA								
Ephemeroptera								
Stenacron	1.8	0.0						
Odonata								
Argia					5.4	0.1		
Trichoptera								
Potamyia flava					5.4	0.1		
Diptera								
Procladius			7.2	0.2			43.1	1.4
Nanocladius distinctus	78.9	1.3			1,153.6	24.3		
Dicrotendipes neomodestus			14.4	0.4				
Dicrotendipes simpsoni	2,544.0	41.2	21.5	0.6			7.2	0.2
Glyptotendipes	17.9	0.3			5.4	0.1		
Polypedilum halterale grp.	17.9	0.3						
Polypedilum illinoense	17.9	0.3	7.2	0.2	12.6	0.3	7.2	0.2
Polypedilum scalaenum grp.	14.4	0.2						
GASTROPODA								
Menetus dilatatus	71.8	1.2						
PELECYPODA								
Corbicula fluminea							71.8	2.3
Musculium transversum			7.2	0.2				
Pisidium nitidum			7.2	0.2				
Dressiena polymorpha	32.3	0.5	2,066.9	54.6	1.8	0.0	35.9	1.2
Taxa Richness	15.0		10.0		13.0		6.0	
Total Number of Individuals	6,173.3		3,782.2		4,738.2		3,078.9	
MBI	7.3		7.1		6.9		9.8	

Table 4-40
QHEI Scores for the North Branch

Site Description	QHEI
Wilson Avenue	42
Grand Avenue	26

The upper section of the North Branch could support a more permanent assemblage of fish and aquatic life, but mostly by fish who can adapt to a variety of conditions and are tolerant to water pollution. The higher QHEI scores reflect the improved habitat conditions in this reach of the North Branch. The aquatic potential for the upper reach would be equivalent to the Ohio Modified Warmwater-Channelized aquatic life use.

Chicago River

The habitat survey conducted by Rankin (2004) for the Chicago River had very poor aquatic life potential in the river as it flows through the heart of Chicago. His findings revealed that the Chicago River had the most limited habitat of all surveyed sites in the Chicago area waterways. Limiting habitat features included:

- Channelization of the waterway
- No sinuosity (no meanders)
- No instream cover, mostly sheet-pile walls
- No riffles or fast current

The only positive feature of the Chicago River was the water depths greater than 15-inches, which are a week attribute for big rivers (**Table 4-41**). There is very limited riparian vegetation along the shoreline and the channel consist primarily of concrete bulkhead walls and sheet pile. The heart of Chicago's business district borders the Chicago River leaving practically no instream habitat for aquatic life. Rankin (2004) compared the Chicago River as being functionally similar to the Cuyahoga River ship canal in Cleveland.

Table 4-41
QHEI Scores for the Chicago River

Site Description	QHEI
Inner Harbor	28
Loop Area	22.5
Chicago River Junction with NBCR/SBCR	28

South Branch
The South Branch was not analyzed for habitat conditions, however, the South Branch is very similar to the lower reaches of the North Branch and would carry the same aquatic life potential (i.e. modified warmwater-channelized). The South Fork is also similar to the South Branch, but has more overhanging vegetation on the channel's south bank. Cursory analysis from the recreational use survey indicated that the waterway is limited by severe channelization, silting sediments and lack of instream structure.

4.3.5 IEPA Letter Response Request

As part of this UAA study, IEPA requested from communities along the North Branch and the Chicago River system if they had any plans for instream habitat improvements or the development of swimming areas. The cities that responded did not have any plans for improvements to the waterways.

4.4 CSSC Reach

The CSSC begins at its confluence with the Des Plaines River (near Lockport) and ends at the Damen Avenue I-55 bridge. It has a total length of 31.1 miles. The canal consists of vertical concrete walls and steep rockfill embankments with an average width and depth of 200- to 300-feet and 27-to 50-feet, respectively. The canal's riparian land use is dominated by industrial and commercial use. Its aquatic habitat is limited to areas under bridges and piers. Its current use designation is Secondary Contact.

4.4.1 Recreation and Navigation Uses

Recreation and navigation use surveys of the CSSC were conducted for 28 days between June 17, 2003 and August 28, 2003 by IEPA and MWRD. The teams counted the number of times various recreational uses were observed as summarized in **Table 4-42**.

Table 4-42
Recreation Activities Observed on the CSSC

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	0	0%
Skiing or Tubing	0	0%
Wading	0	0%
Canoeing, Sculling or Kayaking	1	2%
Fishing	23	37%
Power Boating	38	61%

Observed uses on the CSSC were canoeing, kayaking, fishing and power boating. Commercial navigation was observed in areas where the USACE maintains the channel. The team also observed the following notable activities:

- The Chicago Youth Rowing Club and Kenwood Academy launch from mid-March to mid-November from the Lock/Fuller, Bridgeport, Chicago launch; and,
- The City of Chicago conducts student activities (field trips, studies, survey) at Western Avenue;
- A boat launch will be constructed in 2004-2005 at Western Avenue by the Chicago Park District; and,
- The Friends of Chicago River estimates 80, 35 and 35 users in 2002, 2003 and 2004, respectively, for River Rescue Day.

4.4.2 Water Quality

The CSSC is comprised principally of upstream flow from the Chicago River system and WRP effluent from the Stickney plant. Stickney's average annual flow rate is 1200 cfs (MWRDGC 2001). Midwest Generation's Crawford power generating facility is along the CSSC and utilizes the majority of CSSC flow for cooling water resulting in a significant thermal input to the system. Downstream of its confluence with Cal-Sag Channel, the Lemont WRP discharges into CSSC with an average annual flow rate of 3.4 cfs (MWRDGC 2001). Downstream further at Romeoville is Midwest Generation's Will County power generating facility which contributes another thermal input to the CSSC. These and other features are identified on the monitoring location and CSO outfall maps in Section 4.1.

Water Quality conditions were evaluated using the use attainment screening approach described in Section 4.1. In general, screening criteria were aligned with existing General Use Water Quality Standards criteria as the benchmark for achieving clean water act goals. Bacteria screening criteria is the exception, where thresholds were set using USEPA's latest draft bacteria guidance which differs from the current General Use criteria. For reference, Illinois General Use Water Quality Standards are included in Section 3.4.2. In all cases screening criteria exactly match UAA recommended water quality criteria presented in Section 5.

4.4.2.1 D.O.

MWRDGC operates seven continuous D.O. monitors along the CSSC. **Figure 4-26** summarizes the percent of the time water quality screening criteria are exceeded at each location from 1998 to 2002. The D.O. levels are fairly consistent in this reach with the exception of relatively higher concentrations just downstream of the Stickney WRP. The Stickney WRP effluent over the past five years had an average D.O. content of 8.6 mg/L, whereas the average D.O. concentration 1.9 miles upstream at Cicero was 5.29 mg/L. For reference, the average D.O. at the next downstream station, B&O Central Railroad, was 6.37 mg/L.

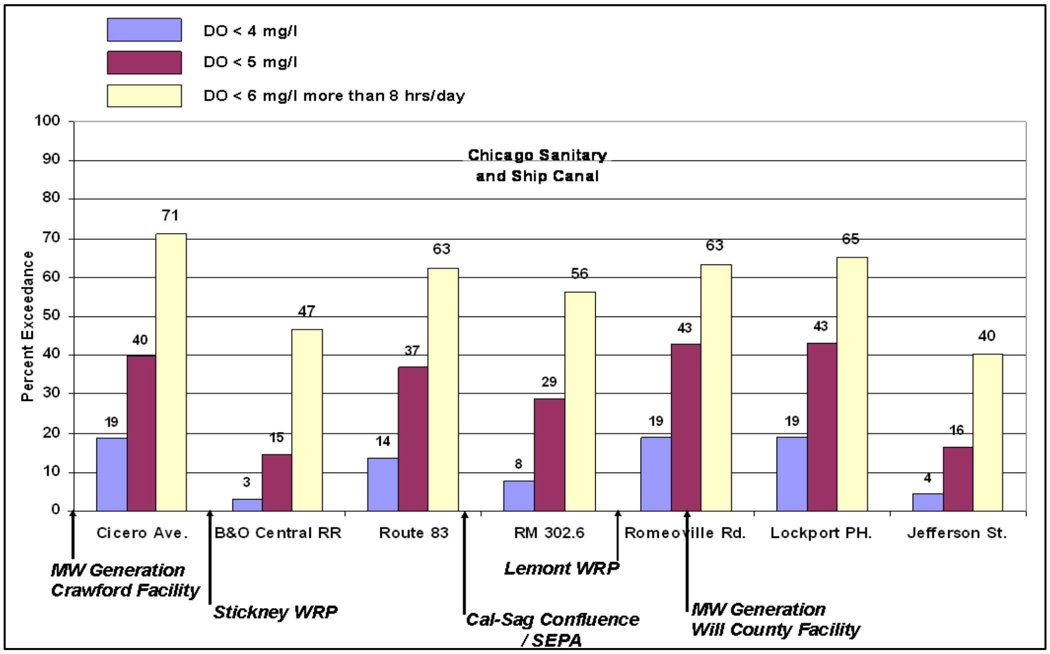


Figure 4-26 - Percent of the Time D.O. Levels Fell Below Water Quality Screening Criteria for the CSSC from 1998 to 2002

The difference in average temperature between the Cicero and B&O Central Railroad stations was 2.6°C. Higher temperatures decrease the amount of oxygen that can dissolve in water. This difference in average temperature, results in approximately a 0.5 mg/L difference in D.O. saturation. Although thermal inputs from the upstream Midwest Generation facility can contribute to lower D.O. content, an analysis of the continuous time series data for D.O., water temperature, D.O. saturation, and rainfall show that wet weather impacts resulting in discharges from the Racine Avenue Pumping Station and the many upstream CSOs are the primary factor contributing to appreciable D.O. sags. **Figures 4-27** and **4-28** on the following page demonstrate this effect.

Although not appreciable, it is noteworthy that D.O. conditions improve downstream of the confluence with the Cal-Sag Channel where a SEPA station is located. However, further downstream at Romeoville D.O. conditions revert back to slightly worse than what they were upstream of the confluence. Warmer water temperatures resulting from Midwest Generation's Will County Facility likely contribute to lower D.O. in this section.

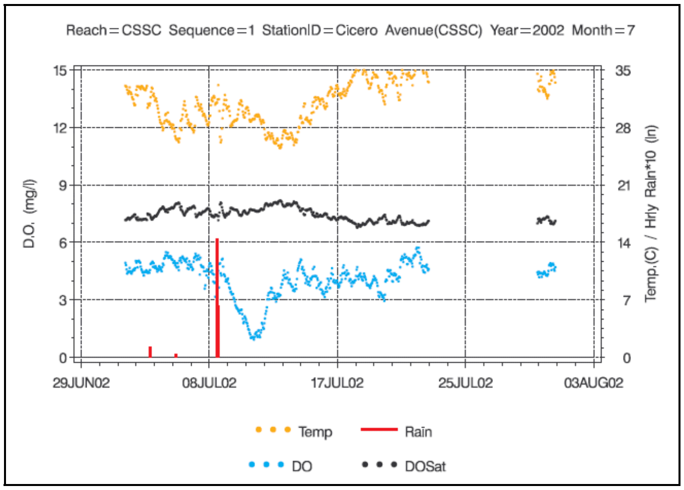


Figure 4-27 - D.O. Wet Weather Response at Cicero Avenue on the CSSC

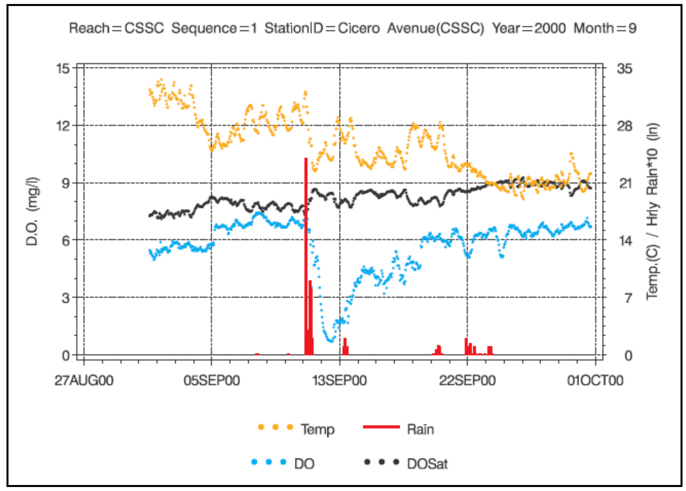


Figure 4-28 - D.O. Wet Weather Response at Cicero Followed by Warm Water Temperatures

4.4.2.2 Temperature

Water temperature in the CSSC is recorded continuously at the same seven locations as D.O. Temperatures during the last five years exceeded water quality screening criteria less than one percent of the time from B&O Central Railroad to Romeoville Road. Water temperatures at Cicero Avenue and Lockport Powerhouse exceeded criteria an average of 15 percent and 3 percent of the time, respectively. Cicero Avenue is one mile downstream from the Midwest Generation Crawford power generating station's cooling water discharge and Lockport is the nearest station downstream of the Will County generating facility. **Figure 4-29** shows box and whisker plots of temperature data collected over the past five years at the seven monitoring locations on the CSSC. The shaded region of the box represents the range from the 25th percentile to the 75th and the connected asterisks show the mean temperature for each station. Since temperature screening criteria differ by season, data are tabulated from April through November and December through March separately with the corresponding criteria shown as red reference lines. In each case the lower criterion (32°C and 16°C) is not to be exceeded more than ten percent of the time and the upper criterion (33.7°C and 17.7°C) is never to be exceeded. Exceedances at Cicero and Lockport are more common in the winter months of December through March. At Cicero in the winter, temperatures exceed 16°C (60°F) more than 25 percent of the time. The water quality standard allows for a 10 percent exceedance.

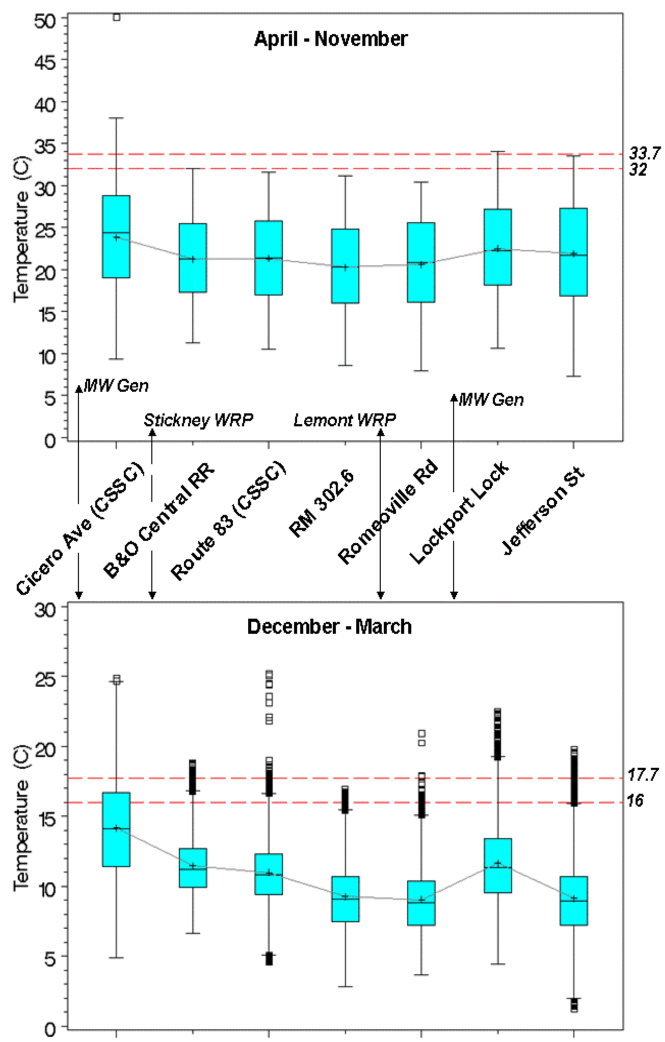


Figure 4-29 - Temperature Data Collected Over the Past Five Years

4.4.2.3 Bacteria

Bacteria concentrations in the CSSC can be characterized using data from the seven instream grab sampling locations. The frequency distribution for *E.coli* results from March through November at each station using limited contact recreation and recreational navigation water quality screening criteria of 1030 and 2470 cfu/100ml, respectively are shown in Figure 4-10. The number of samples included in the distribution is also labeled for each station. Figure 4-11 shows the *E.coli* geometric mean concentrations. The influence of non-disinfected wastewater entering at the Stickney WRP is evident as is the die off as the water moves down the CSSC.

4.4.2.4 Metals and Other Constituents

All constituents analyzed by grab sampling station are shown in Table 4-15**. Figures 4-30** and **4-31** show the percent of the time that metals and other pollutant concentrations exceeded water quality screening criteria at the seven grab sampling locations along the CSSC. Constituents that never exceeded criteria are not shown.

The number of samples taken for each constituent with an exceedance at all grab sampling stations is shown in Table 4-16. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any period of at least four days. Details of pH exceedances are shown in Table 4-17. Only stations with pH exceedances are shown.

4.4.2.5 WRP Effluent

Since the Stickney WRP is a primary source of flow in the CSSC, effluent concentrations were also compared to water quality screening criteria. This assessment does not represent discharge compliance and is only intended to provide a perspective regarding the relationships between an important point source and instream conditions.

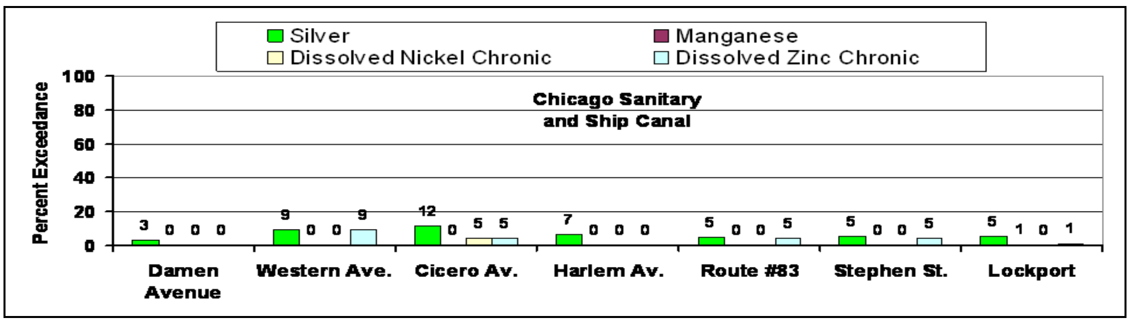


Figure 4-30 - Percent of the Time Metal Concentrations Exceeded Water Quality Screening Criteria in the CSSC

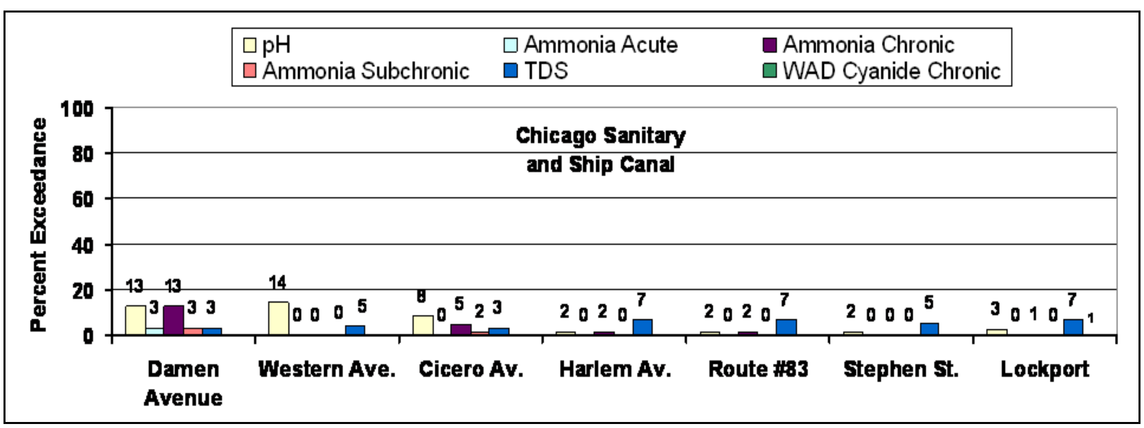


Figure 4-31 - Percent of the Time Various Pollutant Concentrations Exceeded Water Quality Screening Criteria in the CSSC

Table 4-43 describes the percent of the time effluent concentrations exceeded water quality screening criteria in the past five years at the Stickney WRP. Parameters that never exceeded the criteria are not listed. All constituents analyzed by the water treatment plant are shown in Table 4-19**.** The number of samples taken for each constituent with an exceedance at all treatment plants is shown in Table 4-20. Details of pH exceedances at wastewater treatment plants are shown in Table 4-21. Only treatment plants with pH exceedances are shown.

The Lemont WRP discharges into the CSSC downstream of the confluence with the Cal-Sag Channel and has an average annual flow rate of 3.4 cfs (MWRDGC 2001). **Table 4-44** below describes the percent of the time effluent concentrations exceeded water quality screening criteria in the past five years at this facility.

Table 4-43
Stickney WRP Effluent Water Quality Screening Summary

Parameter	% Exceedance of Water Quality Screening Criteria*	
pH	15%	
Total Silver	13%	
	Limited Contact Recreation	Recreational Navigation
*E.coli***	100%	96%

* Effluent was compared to water quality screening criteria and does not represent discharge compliance.
** *E.coli* concentrations estimated using EC/FC ratio of 0.84 (MWRD, 2004)

Table 4-44
Lemont WRP Effluent Water Quality Screening Summary

Parameter	% Exceedance of Water Quality Screening Criteria**	
pH	0.17%	
D.O.	0.8%	
Ammonia* (Acute)	0.1%	
Ammonia* (Chronic)	2.2%	
Fluoride	0.9%	
Iron	0.4%	
Total Silver	1.0%	
	Limited Contact Recreation	Recreational Navigation
*E.coli****	99%	93%

* Since water temperature was not available, the chronic ammonia criterion for water temperatures <14.51°C was used because it is not temperature dependant. Acute and chronic percent exceedances are shown.
** Effluent was compared to water quality screening criteria and does not represent discharge compliance.
*** *E.coli* concentrations estimated using EC/FC ratio of 0.84 (MWRDGC, 2004)

4.4.2.6 Constituents of Concern

Table 4-45 shows the water quality use attainment screening constituents of concern for the CSSC. The maximum percent exceedance that any sampling location in the reach exceeded water quality screening criteria in the past five years is identified. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any period of at least four days. *E.coli* bacteria calculations were similarly calculated as data representing five samples collected over 30 days was not available.

Table 4-45
Chicago Sanitary and Ship Canal Water Quality Constituents of Concern

Parameter	CSSC
Dissolved Oxygen	71
Temperature	14.6
*E.Coli**	100 / 62.5
Total Silver	11.7
Total Manganese	0.6
Dissolved Nickel	4.5
Dissolved Zinc	9.1
Ammonia Chronic	12.9
Ammonia Subchronic	3.2
Ammonia Acute	3.2
Total Dissolved Solids	7.2
Cyanide (WAD) Chronic	0.7
pH	14.3

Maximum percent exceedance at any sampling location in reach

0% (green) **<=10%** (yellow) **>10 and <=25%** (orange) **>25%** (red)

* Limited Contact Recreation / Recreational Navigation

4.4.3 Sediment Quality

Several agencies collected sediment data in the CSSC over the past 5-10 years that were identified in Section 4.1. **Table 4-46** summaries concentrations compared to sediment quality guidelines using the TEC and PEC thresholds developed by MacDonald and the Long and Morgan ER-L and ER-M described in Section 4.1.3.3. (MacDonald 2000) As a reminder, the TEC represents the concentration level where toxic effects may start occurring, particularly for sensitive benthic organisms and the PEC represents the concentration level where toxic effects are probable for both sensitive and tolerant benthic organisms. Metal concentrations generally increase going downstream on the CSSC, with the exception of lead.

Table 4-46
CSSC Surface Sediment Quality Summary

Reach	Exceeded TEC or ER-L	Exceeded PEC or ER-M
CSSC	Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, PCBs, PAHs	Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc, PCBs, PAHs
Collatoral Channel	Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc	Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc

Sediment oxygen demand (SOD) data was available for one study conducted by MWRDGC in the Fall and Winter of 2001 that included three locations along the

CSSC. SOD is a measure of how much oxygen bottom sediments consume from the water column to decompose organic materials. SOD values in the vicinity of a municipal sewage outfall typically range from 2 to 10 $g/m^2/day$ and average approximately 4 $g/m^2/day$. (Thomann 1987) Measurements performed on sediments at Cicero, I-55, and Lockport were 1.71, 3.64, and 2.71 $g/m^2/day$ respectively.

4.4.4 Biological Assessment

4.4.4.1 Fish

Chicago Sanitary Ship Canal

Fish sampling in the CSSC was conducted at five MWRDGC locations in Chicago:

- Damen Avenue
- Cicero Avenue
- Harlem Avenue
- Willow Springs
- Lockport (16th Street)

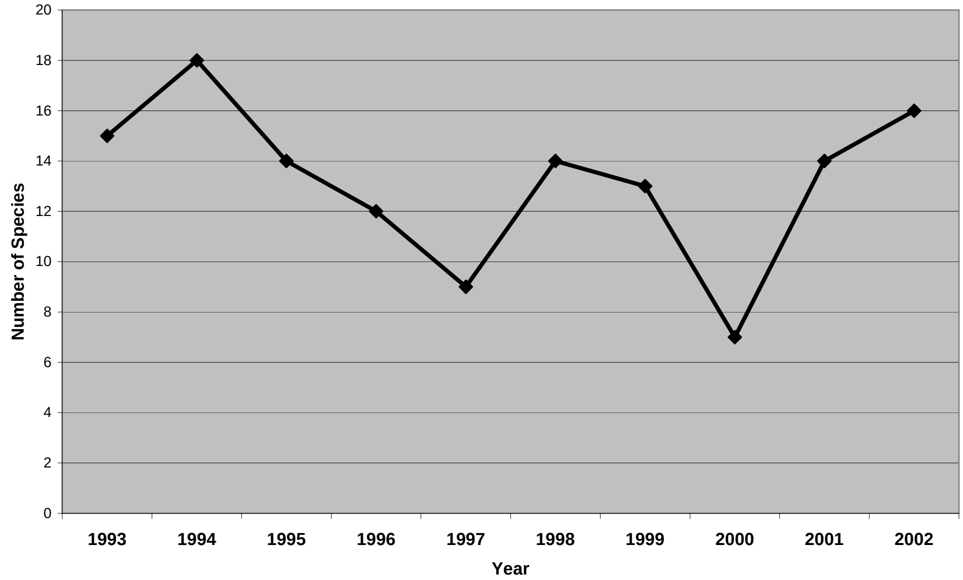
Twenty-seven species of fish (excluding hybrids) were captured in the CSSC from 1993 to 2002, with the dominant fish species being common carp, gizzard shad, goldfish, and bluntnose minnow (**Table 4-47**). Dominant game fish species included largemouth bass, pumpkinseed and bluegill.

The greatest species diversity (19 species) was observed at Cicero Avenue, with lowest diversity being at Damen Avenue. Species diversity showed a general decline in the 1990's, and began to rebound in 2001 (**Figure 4-32**). IBI scores ranged from 12 to 24 and were fairly uniform throughout the CSSC (**Figure 4-33**). The median IBI score for the CSS fish sampling sites was 18.

Table 4-47 Species Richnes and Relative Abundance of Fish Species in the CSSC 1993 - 2002, All Sampling Locations

	Percent Abundance (%)									
Fish Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Clupeidae: Herrings, Shads, Sardines, and allies										
Alosa pseudoharengus - alewife		0.18								
Dorosoma cepedianum - gizzard shad	34.46	3.70	12.02	30.58	14.21	14.17	43.52	43.78	44.48	31.60
Cyprinidae: Minnows and Carps										
Carassius auratus - goldfish	8.85	10.04	12.31	4.69	0.55	1.35			0.57	0.84
Cyprinella spiloptera - spotfin shiner							0.15		0.28	1.01
Cyprinus carpio - common carp	14.33	23.50	49.26	49.03	68.31	16.69	20.12	46.59	38.24	32.10
Notemigonus crysoleucas - golden shiner	1.25	0.53	0.74		0.55	1.18				3.70
Notropis atherinoides - emerald shiner	0.08	0.09	0.15		0.55		0.30		0.85	2.52
Notropis hudsonius - spottail shiner	0.23	0.09								
Notropis volucellu s - mimic shiner						0.17				
Pimephales notatus - bluntnose minnow	34.93	31.69	8.01	0.49	2.19	60.88	29.51		3.97	6.72
Pimephales promelas - fathead minnow	3.13	25.70	1.63			0.67	0.30			
Carp x goldfish	0.78	0.88	1.48	1.29	0.55			0.40	0.85	0.17
Catostomidae: Suckers										
Catostomus commersoni - white sucker							0.45			
Erimyzon oblongus - creek chubsucker	0.08									
Ictaluridae: Catfishes										
Ameiurus melas - black bullhead	0.16	0.18	0.15			0.17		0.80		
Ameiurus natalis - yellow bullhead			0.30	0.16			0.15	0.80	0.28	1.01
Ictalurus punctatus - channel catfish									0.28	0.67
Umbridae: Mudminnows										
Umbra limi - central mudminnow		0.09								
Poeciliidae: Live-bearers										
Gambusia affinis - mosquitofish		0.09				0.17			0.57	8.74
Gasterosteidae: Sticklebacks and Tubesnouts										
Gasterosteus aculeatus - threespine stickleback				1.13						
Moronidae: Temperate Basses										
Morone chrysops - white bass							0.15			
Morone mississippiensis - yellow bass	0.47									
Centrarchidae: Sunfishes and Freshwater Basses										
Lepomis cyanellus - green sunfish	0.16	0.35	1.48	0.32	1.09	0.34	0.15		1.42	0.84
Lepomis gibbosus - pumpkinseed		0.18	0.30	0.65		0.34	2.53	4.42	6.52	7.73
Lepomis macrochirus - bluegill	0.23	0.09	0.45	1.78		2.02	0.30		1.13	1.18
Micropterus salmoides - largemouth bass	0.86	2.55	11.72	9.55	12.02	1.69	2.38	3.21	0.57	1.01
Pomoxis nigromaculatus - black crappie		0.09		0.32						
Pumpkinseed x Bluegill hybrid						0.17				
Sciaenidae: Coakers and Drums										
Aplodinotus grunniens - freshwater drum										0.17
Total Number of Species	15	18	14	12	9	14	13	7	14	16

Figure 4-32. Temporal Trend in Fish Species Diversity in the CSSC 1993 - 2002



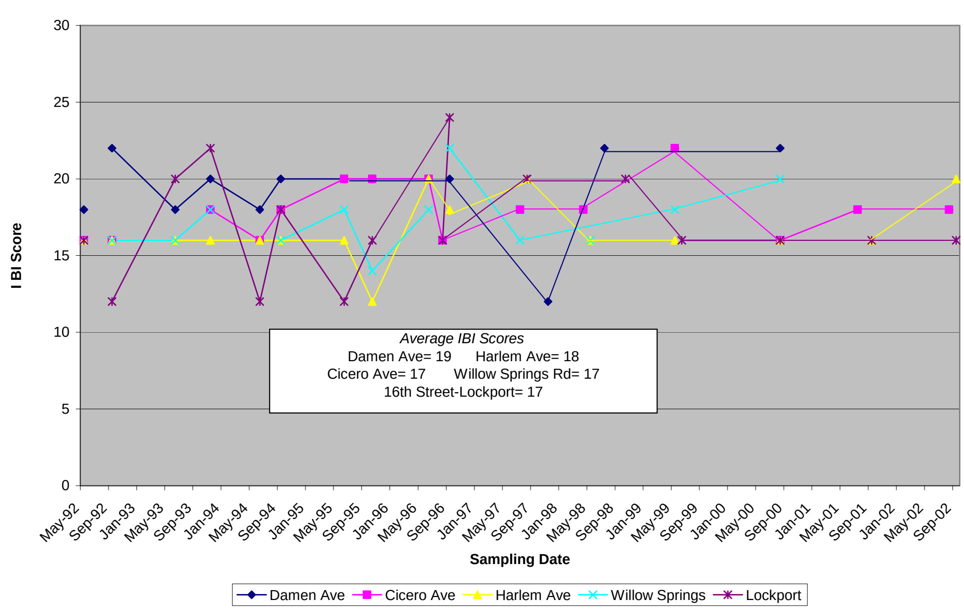
4.4.4.2 Macroinvertebrates

MWRDGC sampled macroinvertebrates at six locations in the CSSC during 2001 and 2002.

- Damen Avenue
- Cicero Avenue
- Harlem Avenue
- Route 83
- Stephen Street
- Lockport (16th Street)

Table 4-48 shows the relative abundance, species richness and associated MBI score for both HD and PP dredge sampling methods. Thirty-four species of macroinvertebrates were collected in the CSSC. Species richness was highest at the Lockport sampling location (19 species). Dominant taxa included Turbelleria, oligochaeta, the amphipod *Gammarus fasciatus*, dipterans including *Dicrotendipes simpsoni* and *Nanocladius distinctus*. The Asiatic clam, *Corbicula fluminea* and the zebra mussel (*Dressiena polymorpha*) were the dominant pelecypod in the CSSC. The EPT taxa richness of three at the Lockport sampling location. The EPT Index consisted of three caddisflies: *Cynellus fratermus*, *Cheumatopsyche* and *Hydropsyche*.

Figure 4-33. IBI Scores for Fish Sampling Locations on the CSSC 1992 - 2002



MBI scores for the HD sampling data ranged from 8.6 at Lockport to 9.7 at Cicero Avenue, and the PP dredge MBI scores ranged from 7.3 at Stephen Street to 10 at Damen Avenue. The high MBI scores are reflective of a poor macroinvertebrate community in the CSSC.

4.4.4.3 Habitat

Ranken's (2004) habitat evaluation showed that the CSSC instream habitat ranged from poor to very poor. The habitat at Lockport, Romeoville and Willow Springs Road was canal-like with steep sides and little functional cover for fish (**Table 4-49**). Limiting factors for the CSSC include:

- Silty substrates
- Poor substrate material
- Little instream cover
- Channelization
- No sinuosity

The stretch of waterway between Harlem and Cicero avenues had some shoreline shallows that provided suitable habitat to support a slightly better community than found in the remainder of the CSSC channel (Rankin 2004). Rankin categorized the Harlem to Cicero Street section as modified Warm Water Habitat-Channelized, while the other portions of the CSSC were considered a Limited Resource Waterway according to Ohio EPA's classification system.

4.4.5 IEPA Letter Response Request

As part of this UAA study, IEPA requested from communities along the CSSC if they had any plans for instream habitat improvements or the development of swimming areas. There were no responses back to IEPA from the municipalities contacted.

4.5 Calumet System

The Calumet System consists of the Calumet-Sag Channel (Cal-Sag), the east and west segments of the LCR North Leg, the GCR, the Calumet River and Lake Calumet. The total segment length is 26.2 miles.

The Cal-Sag extends upstream from the junction of the Cal-Sag and the CSSC and ends at the LCR. It has a total length of approximately 16.2 miles. The channel consists of trapezoidal rock banks and has an average width and depth of 225-feet and 10-feet, respectively with portions of the north bank being concrete wall. The riparian area of the channel is lined with dense trees and a small portion is comprised of commercial and industrial land. Aquatic life has refuge along some banks of the channel where the rock walls have crumbled. Its current use designation is Secondary Contact.

Table 4-48
CSSC: Macroinvertebrate Taxa Richness, Density (HD) and PP number/meter2), Percent Relative Abundance (RelAbu) and MBI Score (MWRDGC 2001, 2002 Data Sets)

Species	Damen Avenue				Cicero Avenue				Harlem Avenue				Route 83		Stephen Street		Lockport			
	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	PP	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu
COELENTERATA																				
Hydra	1.8	0.0							17.9	0.0							861.1	3.6		
PLATYHELMINTHES																				
Turbellaria	830.6	12.2	7.2	0.0	317.5	1.1			5,956.2	8.2	1,090.9	1.7	14.4	3.2	50.2	30.4	1,867.6	7.9	21.5	0.0
ECTOPROCTA																				
Plumatella									1.8	0.0	7.2	0.0								
ANNELLIDA																				
Oligochaeta	4,861.9	71.2	26,338.2	99.4	26,666.6	93.0	3,286.9	97.0	60,513.1	83.4	61,719.1	96.6	416.2	93.5	21.5	13.0	16,803.0	70.6	92,219.8	97.8
Hirudinea																				
Glossiphoniidae															14.4	8.7	17.9	0.1		
Helobdella triserialis	1.8	0.0																		
Helobdella stagnalis																	17.9	0.1		
Mooreobdella microstoma																	1.8	0.0		
CRUSTACEA																				
Isopoda																				
Caecidotea	7.2	0.1							35.9	0.0			7.2	1.6						
Amphipoda		0.0																		
Gammarus fasciatus	91.5	1.3							215.3	0.0	215.3	0.3					1,279.1	5.4	114.8	0.0
INSECTA																				
Odonata																				
Somatochlora	1.8	0.0																		
Trichoptera																				
Cyrnellus fratermus																	17.9	0.1		
Cheumatopsyche																			71.8	0.1
Hydropsyche																	9.0	0.0		
Diptera																				
Ablabesmyia janta					35.9	0.1			21.5	0.030							179.4	0.8		
Ablabesmyia mallochi													7.2	1.6						
Clinotanypus																	14.4	0.1		
Procladius	3.6	0.1	7.2	0.000			43.1	1.3											968.8	1.0
Tanypus																				
Thienemannimyia grp.					17.9	0.1														
Cricotopus sylvestris grp.									53.8	0.1										
Nanocladius distinctus					179.4	0.6			89.7	0.1							448.5	1.9	466.5	0.5
Chironomus							7.2	0.2			71.8	0.1								
Glyptotendipes			71.8	0.3											14.4	0.1				
Dicrotendipes simpsoni	1,024.4	15.0			1,381.4	4.8			5,611.8	0.1	358.8	0.6					1,962.7	8.3	322.9	0.3
Parachironomus			7.2	0.0			14.4	0.4	53.8	0.1										
Polypedilum flavum					17.9	0.1											1.8	0.0		
Polypedilum illinoense											143.5	0.2								
Polypedilum scalaenum grp.											14.4	0.0								
GASTROPODA																				
Ferrissia											244.0	0.4					9.0	0.0		
Menetus dilatatus					23.3	0.1														
Physella					17.9	0.1														
PELECYPODA																				
Corbicula fluminea			71.8	0.3	30.5	0.1	35.9	1.1							7.2	0.0	292.4	1.2	150.7	0.2
Dressiena polymorpha															57.4	0.3	1.8	0.0		
Taxa Richness	9.0		6.0		10.0		5.0		11.0		9.0		4.0		6.0		17.0		8.0	
Total Number of Individuals	6,824.6		26,503.4		28,688.3		3,387.5		72,570.8		63,865.0		445.0		165.1		23,785.3		94,336.8	
MBI	8.8		10.0		9.7		9.9		9.3		9.9		9.7		7.3		8.6		9.9	

Table 4-49
QHEI Scores for the CSSC

Site Description	QHEI
Damen Avenue	32
Cicero Avenue	33.5
Harlem Avenue	38.5
Willow Springs Road	40.5
16th Street- Lockport	40.5
Romeoville	27

The LCR begins at Ashland Avenue and ends at the GCR. It has a total length of about 6.9 miles. For the purpose of the UAA, it is divided into two segments: the east reach, upstream of the Calumet WRP effluent; and the west reach downstream of the Calumet WRP. The river consists of earthen side slope with a few reaches that have dock walls. It has an average width of 250- to 350-feet and average depth of 12-feet. The LCR has a semi-continuous band of shoreline vegetation that provides habitat near the channel side. The river's riparian land use includes heavy industrial and commercial facilities, marinas, forest preserves and some additional limited open space.

The GCR in Illinois flows into the LCR just downstream of the O'Brien Lock and Dam. Its length is three miles with an average depth of 2-feet. The GCR has riparian vegetation along its banks which provides habitat for many species of birds and mammals. Its current use designation is General Use.

Lake Calumet is approximately 15 miles south of the City of Chicago. The Calumet River extends upstream of the O'Brien Lock and Dam to Calumet Harbor in Lake Michigan. The river is approximately 8 miles in length, with an average width of 450-feet. The average depth in the channel is 27-feet, but the actual navigation depths may vary due to the fluctuations in the level of Lake Michigan. The channel banks consist of sheet-pile, concrete walls and rip-rap. Very little riparian vegetation exists along the Calumet River, except in the vicinity of the landfills located north of the banks. Its current use designation is General Use.

4.5.1 Recreation and Navigation Uses

Grand Calumet

Recreation and navigation use surveys of Grand Calumet were conducted on August 13, 2003 by IEPA and CDM. The teams counted the number of times various recreational uses were observed as summarized in **Table 4-50**. The only observed use on the Grand Calumet was fishing and the only observed fishing location was at the mouth of the river.

Table 4-50
Observed Activities on Grand Calumet

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	0	0%
Skiing or Tubing	0	0%
Wading	0	0%
Canoeing, Sculling or Kayaking	0	0%
Fishing	2	100%
Power Boating	0	0%

Other notable activities on the Grand Calumet include:

- Little Calumet River Trail/Calumet Park Trail Loop at East 130th Street and Indiana State Line; and,
- Proposed canoe and power boat dock at East 142nd Street in 2004.

Little Calumet River

Recreation and navigation use surveys of the Little Calumet River were conducted for 11 days between June 18, 2003 and August 27, 2003 by IEPA, CDM, MWRD and LMF. The teams counted the number of times various recreational uses were observed. For further study of the uses of the river, postcard surveys were sent to and returned from: Pier 11, Lake Calumet Boat Club, and Skipper's Marina. The result of the survey complimented the observed uses of the river as summarized in **Table 4-51**.

Table 4-51
Observed Activities Little Calumet River

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	1	0%
Skiing or Tubing	6	3%
Wading	6	3%
Canoeing, Sculling or Kayaking	0	0%
Fishing	145	64%
Power Boating	68	30%

Observed uses on the Little Calumet River were swimming, diving, skiing, tubing, wading, fishing and power boating. Commercial navigation was observed in areas where the USACE maintains the channel. The UAA record also contains the following notable activities:

- Numerous private boat launches;

- Numerous marinas;
- Poker Fun Run;
- Canoe trips;
- Marinas;
- Lincoln Park Juniors Crew launches at Ashland Avenue;
- Little Calumet Canoe Access at Ashland Avenue/Princeton Avenue; and,
- Little Calumet North Bank Trail at South Indiana Avenue/Beaubien Woods/East 130th Street.

Cal-Sag Channel (Cal-Sag)
Recreation and navigation use surveys of the Cal-Sag were conducted for 17 days between June 25, 2003 and August 28, 2003 by the IEPA, CDM, MWRD and LMF. The teams counted the number of times recreational uses were observed as summarized in **Table 4-52**.

Table 4-52
Observed Recreational Activities on Cal-Sag Channel

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	1	0%
Skiing or Tubing	7	3%
Wading	6	3%
Canoeing, Sculling or Kayaking	0	0%
Fishing	69	34%
Power Boating	119	59%

Observed uses on the Cal-Sag were swimming, diving, skiing, tubing, wading, fishing and power boating. Commercial navigation was observed in areas where the USACE maintains the channel. The UAA record also includes the following notable activities:

- Two boat launches - The Village of Alsip estimates 7,000 launches per season and the Village of Worth estimates 4,000 launches per season;
- Poker Fun Run; and,
- Recreational use at Little Calumet River North Bank Trail at South Peoria Street.

Lake Calumet
Recreation and navigation use surveys of Lake Calumet were conducted on July 6, 2003 and August 27, 2003 by IEPA, CDM, and LMF. The teams counted the number of times recreational uses were observed as summarized in **Table 4-53.** The

observed use on Lake Calumet was fishing. In addition, the Chicago Dept. of Environment estimates that the Canoe Lake Calumet Event launched 14, 13 and 11 canoes on June 7, 2003, August 16, 2003 and June 13, 2004, respectively, from Stony Island Avenue on the north side of the Lake Calumet Shipping Canal.

Table 4-53
Observed Recreational Activities on Lake Calumet

Observed Activity	Count of Observed Activities	% of Total Observed Activities
Swimming, Diving or Jumping	0	4%
Skiing or Tubing	0	0%
Wading	0	0%
Canoeing, Sculling or Kayaking	0	0%
Fishing	9	100%
Power Boating	0	0%

Calumet River

Recreation and navigation use surveys of the Calumet River were not conducted due to the dangers of traveling the area. However, fishing, power boating and commercial navigation were observed.

4.5.2 Water Quality

The influences on the Calumet System's water quality are diverse. Some fresh Lake Michigan water is allowed to enter the system at the O'Brien Locks. The Grand Calumet brings water from the Indiana border, and one major and several minor tributaries enter the Cal-Sag Channel. There are a number of CSOs along these reaches and five SEPA stations. The MWRDGC Calumet WRP and 125 Street Pumping Station enter the system at the upstream end of the Little Calumet River West/East breakpoint. The WRP discharges an average annual flow rate of 417 cfs (MWRDGC, 2001). Some of these features are identified on the monitoring location and CSO outfall maps in Section 4.1.

Water Quality conditions were evaluated using the use attainment screening approach described in Section 4.1. In general, screening criteria were aligned with existing General Use Water Quality Standards criteria as the benchmark for achieving clean water act goals. Bacteria screening criteria is the exception, where thresholds were set using USEPA's latest draft bacteria guidance which differs from the current General Use criteria. For reference, Illinois General Use Water Quality Standards are included in Section 3.4.2. In all cases screening criteria exactly match UAA recommended water quality criteria presented in Section 5.

4.5.2.1 Dissolved Oxygen

There are twelve continuous D.O. monitoring locations in the Calumet system. **Figure 4-34** shows the percent of the time levels fell below water quality screening criteria from 1998 to 2002. Little Calumet (South) data shown in the chart is not in the UAA study area but is included for reference only. Lake Calumet data shown in the chart was collected by IEPA during sampling surveys conducted in 1999, 2000, and 2004. The

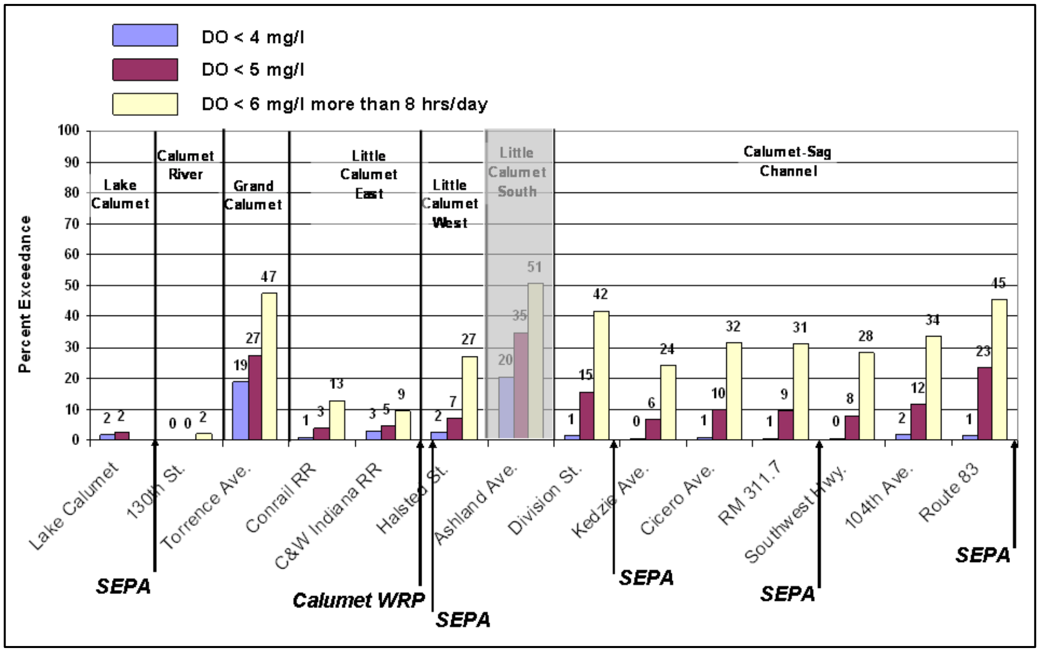


Figure 4-34 - Percent of the time D.O. levels fell below water quality screening criteria

Calumet River clearly contributes water with higher D.O. content whereas the Grand Calumet does not meet the 6 mg/L level for at least 16 hours per day almost half the time. Both contribute to the Little Calumet (East) reach which has relatively few deviations from water quality criteria. Conditions deteriorate in the Little Calumet (West) downstream of the Calumet WRP and worsen further downstream at Division Street which is downstream of the confluence with the Little Calumet South Leg. Although not in the UAA study area, the Ashland Avenue station is shown in the chart to recognize the condition of water entering from this tributary and its impact on D.O. at Division Street. Levels stay fairly steady in the rest of the Cal-Sag until Route 83 where conditions may be influenced by the CSSC.

4.5.2.2 Temperature

None of the twelve continuous temperature monitoring locations in the Calumet System recorded levels above screening criteria over the past five years.

4.5.2.3 Bacteria

Bacteria concentrations in the Calumet System were evaluated based on the seven instream grab sampling locations operated by MWRDGC and IEPA sampling conducted in Lake Calumet in 2004. The map at right shows the IEPA 2004 Lake Calumet sampling locations (**Figure 4-35**). The frequency distribution for *E.coli* results from March through November at each station for limited contact recreation and recreational navigation water quality screening criteria of 1030 and 2470 cfu/100ml, respectively are shown in Figure 4-10. Figure 4-11 shows the *E.coli* geometric mean at each station. The influence of non-disinfected wastewater entering from the Calumet WRP at the upstream end of the Little Calumet (West) reach is evident. The Little Calumet South Leg also contributes a significant bacteria load. The bacteria concentrations decline fairly quickly as one moves down the Cal-Sag. At Cicero, *E.coli* concentrations are less then 1030 cfu/100ml more than 75 percent of the time.

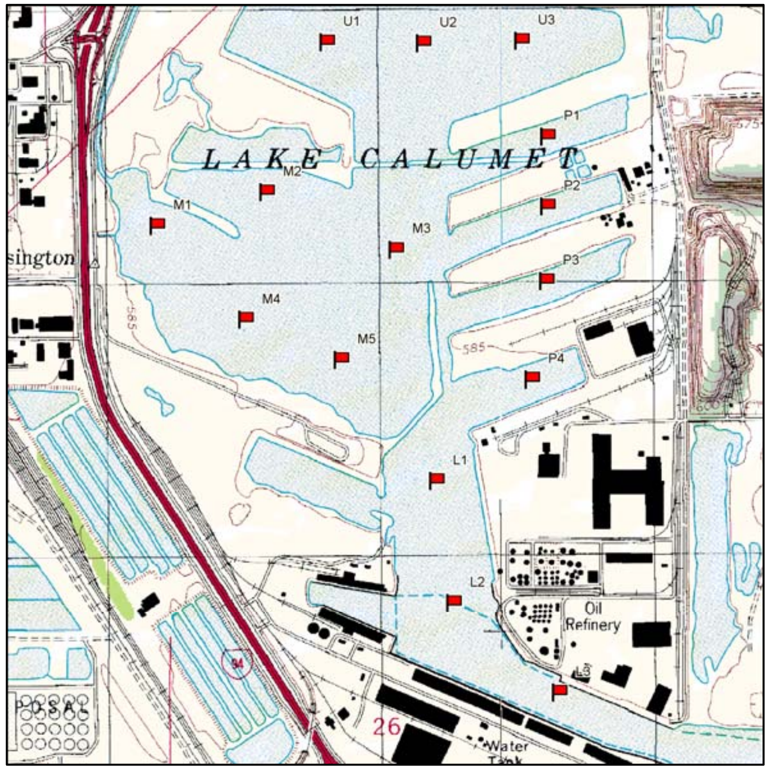


Figure 4-35 - 2004 IEPA Lake Calumet sampling locations

4.5.2.4 Metals and Other Constituents

All constituents analyzed by grab sampling station are shown in Table 4-15**. Figures 4-36** and **4-37** show the percent of the time that metals and other pollutant concentrations exceeded water quality screening criteria at the seven monthly grab sampling locations operated by MWRDGC in the Calumet System. The data shown for Lake Calumet was collected by IEPA in 1999, 2000, and 2004. MWRDGC's monthly sampling program does not include Lake Calumet. Constituents that never exceeded screening criteria are not shown. The number of samples taken at for each constituent with an exceedance at all grab sampling stations are shown in Table 4-16. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any period of at least four days. Details of pH exceedances are shown in Table 4-17. Only stations with pH exceedances are shown.

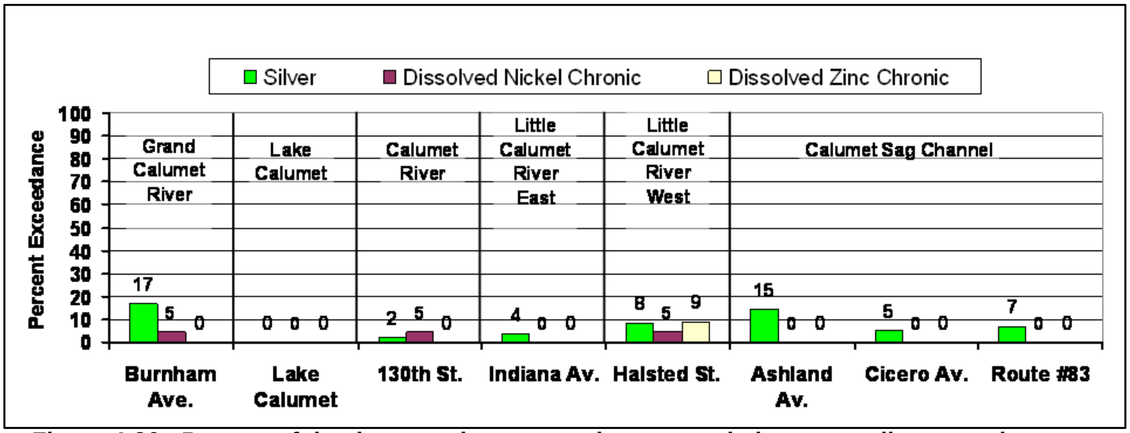


Figure 4-36 - Percent of the time metal concentrations exceeded water quality screening criteria in the Calumet River System

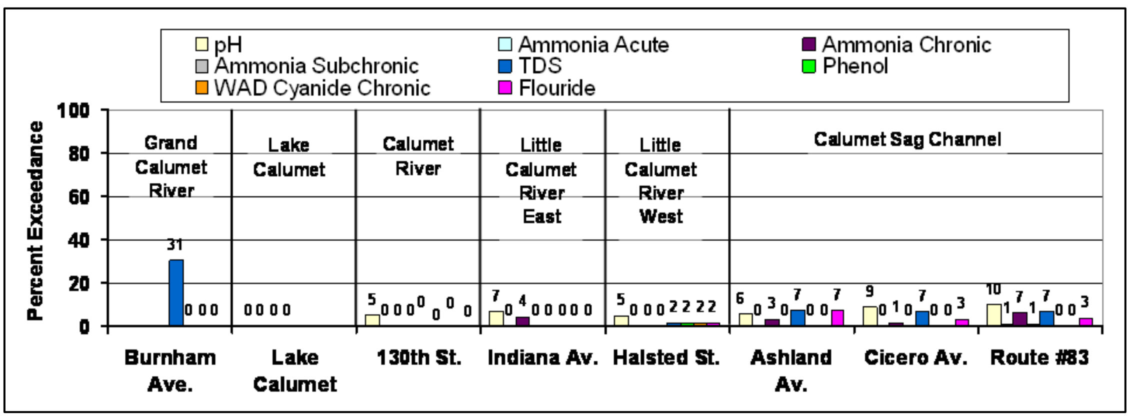


Figure 4-37 - Percent of the time various pollutant concentrations exceeded water quality screening criteria in the Calumet River System

4.5.2.5 WRP Effluent

Since the Calumet WRP is a primary source of flow in the Little Calumet (West) reach and the Cal-Sag, Calumet plant effluent concentrations were also compared to water quality screening criteria in order to help characterize the influence of this important point source. Note that this assessment does not represent discharge compliance and is only intended to provide a perspective regarding the relationships between an important point source and instream conditions. **Table 4-54** describes the percent of the time effluent concentrations exceeded water quality screening criteria in the past five years. Constituents that never exceeded screening criteria are not listed. All constituents analyzed by the water treatment plant are shown in Table 4-19**.** The number of samples taken for each constituent with an exceedance at all treatment plants are shown in Table 4-20. Details of pH exceedances at wastewater treatment plants are shown in Table 4-21. Only treatment plants with pH exceedances are shown.

Table 4-54
Calumet WRP Effluent Water Quality Screening Summary

Parameter	% Exceedance of Water Quality Screening Criteria	
D.O.	0.1%	
	Limited Contact Recreation	Recreational Navigation
*E.coli***	99%	91%

* Effluent was compared to water quality screening criteria and does not represent discharge compliance.
** *E.coli* concentrations estimated using EC/FC ratio of 0.84 (MWRD, 2004)

4.5.2.6 Constituents of Concern

Table 4-55 summarizes the water quality use attainment screening constituents of concern for the Calumet System and lists the maximum percent that any sampling location in the reach exceeded water quality screening criteria in the past five years. Chronic metals screening was calculated based on instantaneous monthly grab samples rather than the arithmetic average of at least four consecutive samples collected over any period of at least four days. *E.coli* bacteria calculations were similarly calculated as data representing five samples collected over 30 days was not available.

Table 4-55
Calumet System Water Quality Constituents of Concern

Parameter	Grand Calumet	Lake Calumet	Calumet River	Little Calumet River East	Little Calumet River West	Cal Sag Channel
Dissolved Oxygen	47	2.5	2	13	27	45
*E.Coli**	50 / 50	100 / 0	11 / 0	22 / 0	100 / 24	62.5 / 37.5
Total Silver	17		1.8	3.6	8.5	14.5
Dissolved Nickel	4.5		4.5		4.5	
Dissolved Zinc					9.1	
Ammonia Chronic				4.2		6.6
Ammonia Subchronic						1.3
Ammonia Acute						1.3
Total Dissolved Solids	30.5				1.7	7.3
Cyanide (WAD) Chronic					1.7	
pH			5.5	6.8	4.9	10.0
Phenol					1.7	
Flouride					1.7	7.3

Maximum percent exceedance at any sampling location in reach

0% **<=10%** **>10 and <=25%** **>25%** **No data**

* Limited Contact Recreation / Recreational Navigation

4.5.3 Sediment Quality

Several agencies identified in Table 4-10 collected sediment data in the Calumet System over the past 5 to10 years. **Table 4-56** provides a summary of conditions in the Calumet System reaches. The data was compared against the TEC and PEC thresholds developed by MacDonald and the Long and Morgan ER-L and ER-M as described in Section 4.1.3.3. Grand Calumet concentrations were generally substantially higher than the rest of the Calumet System. Within the Grand Calumet, concentrations at the downstream end were generally lower than further upstream. In general, Cal-Sag sediment quality is better than that of the Little Calumet. Lake Calumet results are based on one sample collected by IEPA in June 2000.

Table 4-56
Calumet System Surface Sediment Quality Summary

Reach	Exceeded TEC or ER-L	Exceeded PEC or ER-M
Grand Calumet	Mercury, Cadmium, Chromium, Copper, Lead, Nickel, Zinc	Cadmium, Chromium, Copper, Lead, Nickel, Zinc
Calumet River	Cadmium, Chromium, Copper, Lead, Mercury, Zinc, PCBs	Copper, Lead, Zinc, PCBs
Lake Calumet		
Little Calumet (East)	Cadmium, Chromium, Mercury, Nickel, Zinc, PCBs, Copper, Lead	Copper, Lead
Little Calumet (West)	Mercury, Cadmium, Chromium, Copper, Lead, Nickel, Zinc, PCBs	Cadmium, Chromium, Copper, Lead, Nickel, Zinc, PCBs
Cal-Sag Channel	Chromium, Copper, Nickel, Cadmium, Lead, Zinc	Cadmium, Lead, Zinc

Sediment oxygen demand (SOD) data was available for one study conducted by MWRDGC in the Fall and Winter of 2001 that included six locations in the Calumet System. SOD is a measure of how much oxygen bottom sediments consume from the water column to decompose organic materials. SOD values in the vicinity of a municipal sewage outfall typically range from 2 to 10 $g/m^2/day$ and average approximately 4 $g/m^2/day$. (Thomann, 1987) **Table 4-57** shows the results of SOD measurements conducted on Calumet System sediments in 2001.

Table 4-57
Calumet System SOD Measurements

SOD sampling location	SOD ($g/m^2/day$) at 20°C
LCR (East) at Conrail	0.59
LCR (East) at Indiana Avenue	1.25
LCR (West) at Halstead	1.14
Cal-Sag at Division	1.07
Cal-Sag at Southwest Hwy.	0.8
Cal-Sag at Route 83	0.63

4.5.4 Biological Assessment

4.5.4.1 Fish

Cal-Sag

MWRDGC collected fish from the Cal-Sag at two primary locations:

- Cicero Avenue
- Route 83

The fish community in the Cal-Sag was also sampled at SEPA Stations 3, 4 and 5; upstream and downstream at SEPA Stations 3 and 4; and upstream at SEPA Station 5.

This work was done in the late 1990's with an intended purpose of evaluating the response of the fish community to improvements in water quality after the SEPA stations came on line.

Twenty-six fish species were collected between 1993- 2002 at all the sampling locations identified in **Table 4-58**. Species diversity was fairly uniform between the Cicero Avenue and Route 83 sampling locations with the dominant species consisting of gizzard shad, common carp, emerald shiner and bluntnose minnow. Common game fish included green sunfish, bluegill, pumpkinseed and largemouth bass. The fish assemblage in the Cal-Sag was very similar to the rest of the Chicago River systems, with the exception that more emerald shiners were captured in the Cal-Sag.

Table 4-58 Species Richnes and Relative Abundance of Fish Species in the Cal-Sag 1993 - 2002

	Percent Abundance Per Year (%)									
Fish Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Clupeidae: Herrings, Shads, Sardines, and allies										
Dorosoma cepedianum - gizzard shad	17.71	19.70	4.55	52.29	11.33	47.78	26.02	5.63	48.03	18.97
Cyprinidae: Minnows and Carps										
Carassius auratus - goldfish	3.13	3.03	2.42	1.00			0.88	1.99	0.79	1.15
Cyprinus carpio - common carp	19.27	46.97	23.33	12.57	14.38	13.33	27.78	20.53	18.11	8.62
Notemigonus crysoleucas - golden shiner	0.52		0.30		0.44					
Notropis atherinoides - emerald shiner	0.52		20.91	15.86	52.29	13.33	4.97	36.09	4.72	16.67
Notropis hudsonius - spottail shiner					0.22					
Pimephales notatus - bluntnose minnow	3.65	3.03	2.42	3.43	3.49	12.78	11.99	6.95	5.51	23.56
Pimephales promelas - fathead minnow	1.04	1.52		0.43	0.22					2.87
Semotilus atromaculatus - creek chub	0.52							0.33	0.79	
Carp x goldfish	2.60		0.61		0.65		0.58	0.33		
Catostomidae: Suckers										
Catostomus commersoni - white sucker			1.52	2.43	0.44		0.88	0.33		
Ictaluridae: Catfishes										
Ameiurus melas - black bullhead				0.29			0.29			
Ameiurus natalis - yellow bullhead		1.52					0.29	0.33	0.79	0.57
Ictalurus punctatus - channel catfish			1.21	0.14	0.65		2.63	0.33		
Umbridae: Mudminnows										
Umbra limi - central mudminnow					0.22					
Gasterosteidae: Sticklebacks and Tubesnouts										
Gasterosteus aculeatus - threespine stickleback				0.29						
Moronidae: Temperate Basses										
Morone mississippiensis - yellow bass	0.52		0.61	1.43	0.22	0.56	2.92	11.26		
Centrarchidae: Sunfishes and Freshwater Basses										
Ambloplites rupestris - rock bass							0.29			
Lepomis cyanellus - green sunfish	21.35	10.61	7.88	3.71	5.23	10.00	4.97	3.97	3.94	5.17
Lepomis gibbosus - pumpkinseed			0.91		0.22					1.15
Lepomis gulosus - warmouth				0.14						
Lepomis macrochirus - bluegill	23.44	10.61	6.06	2.86	3.49	0.56	2.34	0.99	0.79	0.57
Micropterus dolomieu - smallmouth bass			0.30	0.29	0.44			0.33		
Micropterus salmoides - largemouth bass	5.73	3.03	26.67	2.57	5.66	1.11	7.60	7.95	16.54	17.82
Pomoxis nigromaculatus - black crappie				0.14						
Green sunfish x Bluegill hybrid				0.14		0.56	0.29	0.33		
Sciaenidae: Coakers and Drums										
Aplodinotus grunniens - freshwater drum			0.30					0.33		1.72
Percichthyidae: Temperate Perches										
Morone americana - White Perch					0.44		5.26	1.99		1.15
Total Number of Species	13	9	16	18	18	9	17	18	10	13

Species richness ranged from nine to 18 from 1993 to 2002 (**Figure 4-38**), varying over the years. IBI scores generally increased at the Cicero Avenue sampling location from 12 to 24 and decreased at the Route 83 sampling location from 22 to 18 (**Figure 4-39**).

Figure 4-38. Temporal Trend in Fish Species Diversity in the Calumet-Sag Channel 1993 - 2002

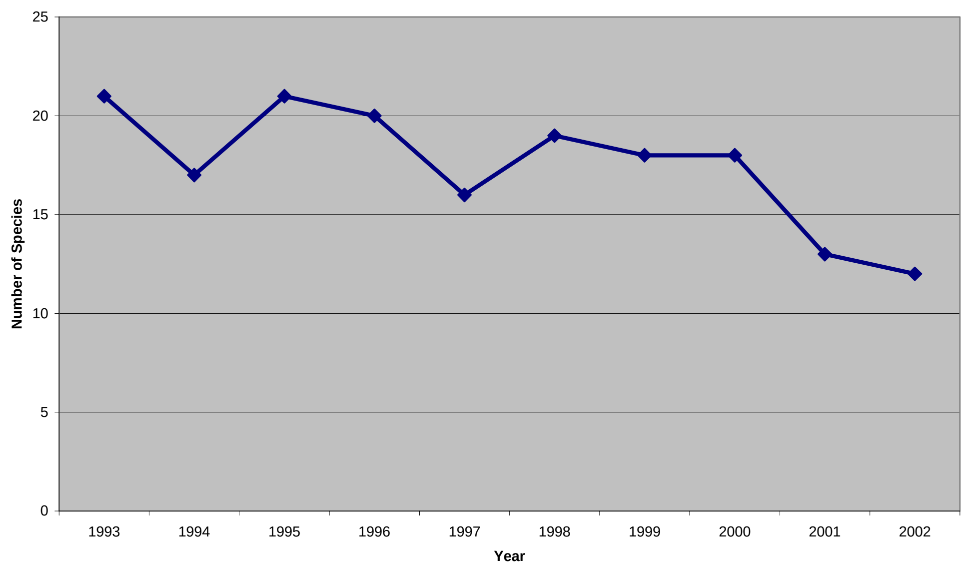
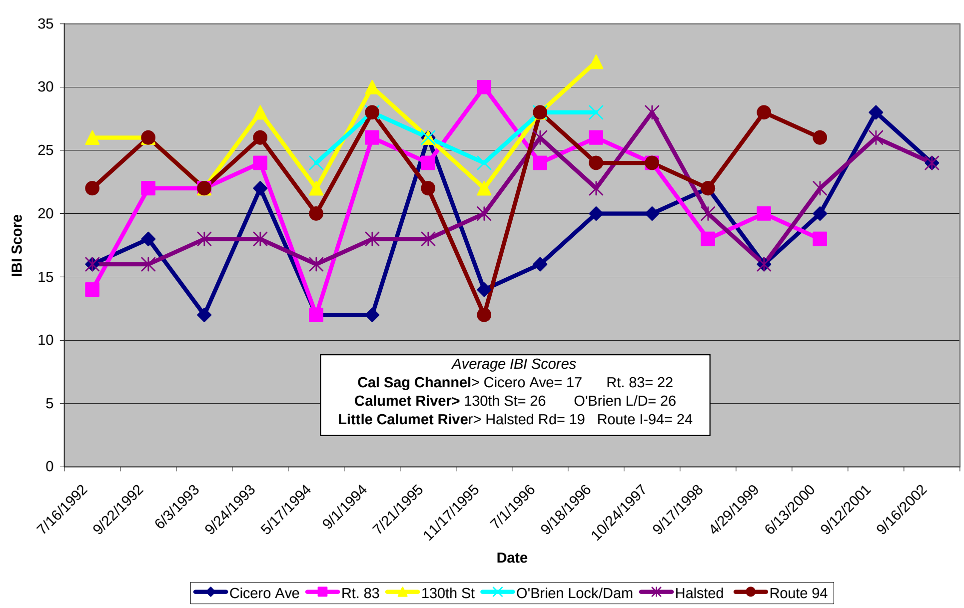


Figure 4-39. IBI Scores for Fish Sampling Locations for the Calumet System 1992 - 2002



Calumet River

MWRDGC collected fish from the Calumet River from two primary locations:

- 130th Street
- O'Brien Lock and Dam

The fish community in the Calumet River was also sampled upstream and downstream of SEPA Station 1. The work was done in the late 1990s to evaluate the response of the fish community to improvements in water quality after the SEPA stations came on line.

Thirty-two species of fish were collected between 1993- 2002 at the sampling locations identified in **Table 4-59**. Dominant species were gizzard shad, common carp, emerald shiner and bluntnose minnow. Common game fish included green sunfish, pumpkinseed, bluegill, smallmouth bass and largemouth bass. As with the Cal-Sag, more emerald shiners were captured in the Calumet River than in the other Chicago waterways. Also, more smallmouth bass were captured in the Calumet River than in any other parts of the Chicago River System.

Species richness decreased from 21 to 12 from 1993 to 2002 (**Figure 4-40**). IBI Scores increased from 22 to 32 at the 130th Street sampling location over three years (1993 to 1996) and ranged from 24 to 28 over two years (1994 to 1996) at the O'Brien Lock and Dam location Figure 4-39.

Figure 4-40. Temporal Trend in Fish Species Diversity in the Calumet River 1993 - 2002

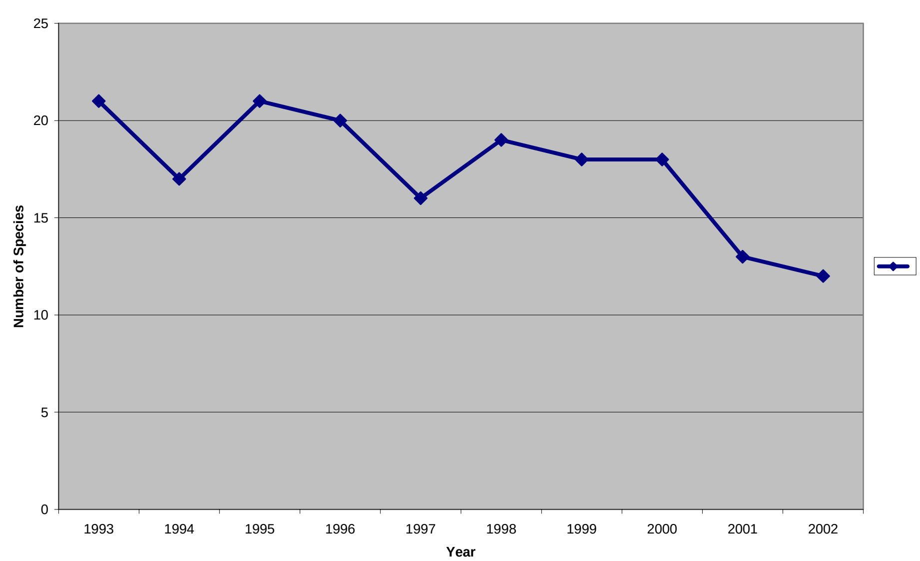


Table 4-59 Species Richnes and Relative Abundance of Fish Species in the Calumet River 1993 - 2002

	Percent Abundance (%)									
Fish Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Clupeidae: Herrings, Shads, Sardines, and allies										
Alosa pseudoharengus - alewife	0.37						0.22	2.37		
Dorosoma cepedianum - gizzard shad	39.44	10.11	10.93	29.81	2.20	38.70	63.68	31.19	47.13	15.33
Cyprinidae: Minnows and Carps										
Carassius auratus - goldfish	0.56	1.80	0.91	0.21		0.21	0.22			
Ctenopharyngodon idella - grass carp									0.64	
Cyprinus carpio - common carp	2.41	2.47	4.37	10.35	3.96	6.49	5.25	2.71	7.64	5.75
Notemigonus crysoleucas - golden shiner	2.41	1.12		0.31		0.21				
Notropis atherinoides - emerald shiner	1.48	0.22	2.37	15.73	0.88	25.73	9.41	10.85	9.55	
Pimephales notatus - bluntnose minnow	15.56	37.08	34.97	14.80	67.25	7.11	1.09	12.88	3.18	55.17
Pimephales promelas - fathead minnow	0.19		0.18							
Carp x Goldfish	0.19	0.22				0.21				
Ictaluridae: Catfishes										
Ictalurus punctatus - channel catfish						0.21				
Ameiurus melas - black bullhead			0.18							
Catostomidae: Suckers										
Carpiodes cyprinus - quillback				0.10		0.21	0.22	0.34	0.64	
Catostomus commersoni - white sucker	0.56	1.80	2.19	1.24	0.22	0.63	1.09	1.69		0.77
Esocidae: Pikes										
Esox americanus - grass pickerel			0.18							
Salmonidae: Salmonides										
Oncorhynchus mykiss - rainbow trout					0.22					
Oncorhynchus tshawytscha - chinook salmon									0.64	
Gasterosteidae: Sticklebacks and Tubesnouts										
Gasterosteus aculeatus - threespine stickleback l							0.44			
Moronidae: Temperate Basses										
Morone mississippiensis - yellow bass						0.63				
Morone chrysops - white bass								0.68		
Striped bass x White bass hybrid				0.10						
Centrarchidae: Sunfishes and Freshwater Basses										
Ambloplites rupestris - rock bass	0.37	0.67	1.09	0.93	0.44	1.88	1.09	3.05	1.91	1.92
Lepomis cyanellus - green sunfish	5.37	3.15	1.64	1.14	1.54	1.67	1.09	6.78		0.77
Lepomis gibbosus - pumpkinseed	4.81	3.60	3.10	1.55	2.20	1.26	1.53	2.71		0.38
Lepomis humilis - orangespotted sunfish			0.18		0.22					
Lepomis macrochirus - bluegill	4.26	1.57	6.74	3.00		3.14	1.75	5.08	0.64	1.15
Micropterus dolomieu - smallmouth bass	0.19	0.67	5.10	4.55	0.66	5.65	2.63	5.42	11.46	5.75
Micropterus salmoides - largemouth bass	19.07	33.71	21.31	14.18	11.65	5.65	9.19	12.20	14.65	11.11
Pomoxis annularis - white crappie	0.19				0.22					
Pomoxis nigromaculatus - black crappie		0.22	0.18	0.31	0.22			0.34		
Green sunfish x Pumpkinseed hybrid	0.19							0.34		
Green sunfish x Bluegill hybrid			0.18	0.10	7.69	0.21	0.22			
Percidae: Perches and Darters										
Perca flavescens - yellow perch	0.37									
Aplodinotus grunniens - freshwater drum	0.93		0.36	0.10				0.34	0.64	0.38
Percichthyidae: Temperate Perches										
Morone americana - White Perch	1.11	0.90	0.73	1.24			0.44	1.02	1.27	
Gobiesocidae: Gobies										
Neogobius melanostomus - Round goby		0.67	3.10	0.21	0.44	0.21	0.44			1.53
Total Number of Species	21	17	21	20	16	19	18	18	13	12

LCR
MWRDGC collected fish from the LCR from two primary locations:

- Halsted Street - Little Calumet (West)
- Route I-94 - Little Calumet (East)

The fish community in the Calumet River was also sampled upstream and downstream of SEPA Stations 2 and 4;. The work was done in the late 1990s to evaluate the response of the fish community to improvements in water quality after the SEPA stations came on line.

Twenty-nine fish species were collected between 1993- 2002 at the sampling locations identified in **Table 4-60**. Dominant species were gizzard shad, common carp, emerald shiner and bluntnose minnow. Common game fish included pumpkinseed, bluegill and largemouth bass. More golden shiners were caught in the Little Calumet River than in the Cal-Sag channel or the Calumet River. As with the other branches of the Calumet River system, more emerald shiners were captured in this section of the waterway section as compared to the Chicago River System.

Species richness generally rose over 1993 to 2000 (**Figure 4-41**) from 16 to 24. Richness decreased from 2000 to 2002, from 24 to 17. At the Halsted Street location, IBI Scores overall increased from 18 to 24 from 1993 to 2002, but showed declines from 1998 to 2000, and went as low as 16 in 1999. IBI scores at Route 94 ranged from 12 to 28, fluctuating up and down over the 1993 to 2004 sampling period (Figure 4-39).

Figure 4-41. Temporal Trend in Fish Species Diversity in the Little Calumet River 1993 - 2002

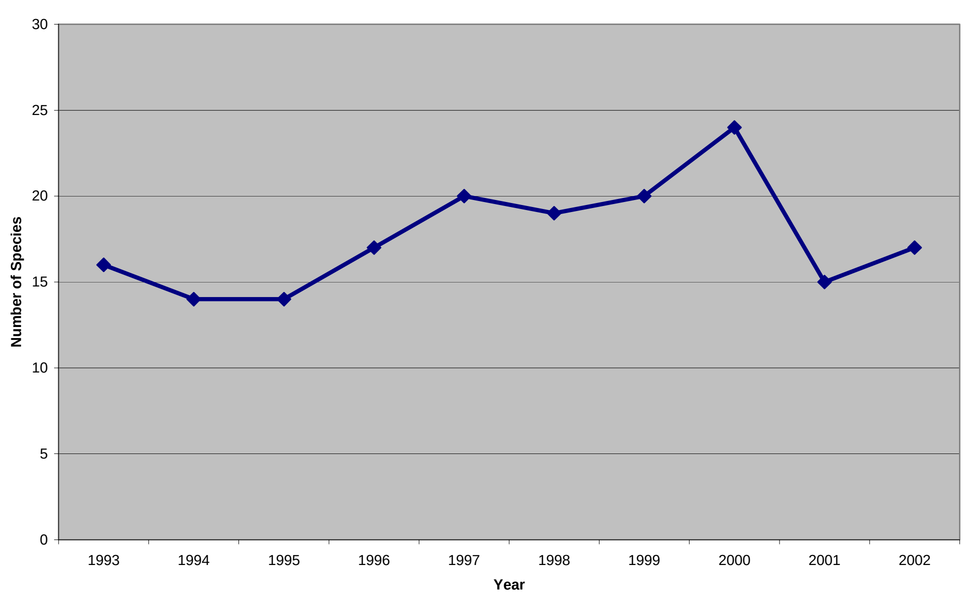


Table 4-60 Species Richnes and Relative Abundance of Fish Species in the Little Calumet River 1993 - 2002

	Percent Abundance (%)									
Fish Species	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Clupeidae: Herrings, Shads, Sardines, and allies										
Alosa chrysochloris - skipjack herring										0.61
Alosa pseudoharengus - alewife	1.34		0.63		0.27			2.61		
Dorosoma cepedianum - gizzard shad	71.84	22.26	42.50	55.76	25.60	35.29	43.41	31.74	29.05	20.25
Cyprinidae: Minnows and Carps										
Carassius auratus - goldfish	7.09	19.93	2.50	1.82	0.53	1.55	2.44	0.87	3.33	0.61
Cyprinus carpio - common carp	6.51	12.29	15.94	7.39	6.13	14.86	11.71	16.96	18.57	21.47
Notemigonus crysoleucas - golden shiner	3.07	1.00	3.44	1.09	0.27	1.24	0.49	0.43		0.61
Notropis atherinoides - emerald shiner	1.15	8.97	7.50	14.55	31.73	10.22	15.85		0.95	3.68
Notropis hudsonius - spottail shiner					0.53	0.31	0.24	0.87		
Pimephales notatus - bluntnose minnow	0.77	4.98	0.94	4.24	18.93	9.60	4.15	1.74	0.95	2.45
Pimephales promelas - fathead minnow	0.19			0.24	0.27			0.43		
Carp x goldfish	0.19	2.66	2.19	0.48	0.27	0.31	0.24	0.43		
Catostomidae: Suckers										
Catostomus commersoni - white sucker	0.77	0.33	0.31	0.61	0.53	0.62	0.98	2.17		6.13
Erimyzon oblongus - creek chubsucker								1.74		
Ictaluridae: Catfishes										
Ameiurus melas - black bullhead	0.19						0.24			
Ameiurus natalis - yellow bullhead					0.27		0.73	1.30	1.90	
Ictalurus punctatus - channel catfish						0.31	0.24			
Noturus gyrinus - tadpole madtom								0.43		
Salmonidae: Salmonides										
Oncorhynchus mykiss - rainbow trout								0.87		
Gasterosteidae: Sticklebacks and Tubesnouts										
Gasterosteus aculeatus - threespine stickleback				0.12						
Moronidae: Temperate Basses										
Morone mississippiensis - yellow bass		0.33		1.21	0.80	0.31	0.73		2.38	0.61
Centrarchidae: Sunfishes and Freshwater Basses										
Lepomis cyanellus - green sunfish	0.19	0.33	1.25	0.97	3.73	0.62	0.73	5.65	1.90	1.23
Lepomis gibbosus - pumpkinseed	1.34	9.30	7.81	6.55	3.47	4.02	3.90	5.65	3.33	12.27
Lepomis humilis - orangespotted sunfish								0.87		
Lepomis macrochirus - bluegill	0.38	1.00	2.50	0.73	0.53	6.19	1.95	13.48	6.19	3.07
Micropterus dolomieu - smallmouth bass					0.27		0.73		0.48	1.23
Micropterus salmoides - largemouth bass	2.49	5.98	5.63	2.30	4.53	6.19	8.54	7.83	24.29	19.02
Pomoxis nigromaculatus - black crappie				0.12				0.43		
Pumpkinseed x Bluegill hybrid						0.31		0.43		
Green sunfish x Bluegill hybrid							0.24	0.43		
Sciaenidae: Coakers and Drums										
Aplodinotus grunniens - freshwater drum						0.31			1.43	2.45
Percichthyidae: Temperate Perches										
Morone americana - White Perch	2.49	10.63	6.88	1.82	0.80	5.57	2.44	1.74	4.76	3.07
Gobiesocidae: Gobies										
Neogobius melanostomus - Round goby					0.53	2.17		0.87	0.48	1.23
Total Number of Species	16	14	14	17	20	19	20	24	15	17

Lake Calumet

IEPA collected fish from Lake Calumet from 1990 to 1996. **Table 4-61** shows the total number of species ranged from 8 to 12. Dominant species included gizzard shad and carp, and game species included pumpkinseed, bluegill and largemouth bass.

4.5.4.2 Macroinvertebrates

MWRDGC and IEPA sampled macroinvertebrates at six locations in the Calumet River system:

- Ashland Avenue
- Indiana Avenue
- Western Avenue
- 130th Street
- Halsted Street
- Cicero Avenue

Table 4-61. Species Richness and Relative Abundance of Fish Species in Lake Calumet, 1990-1996

	Relative Abundance (%)		
Fish Species	**1990**	**1992**	**1996**
Clupeidae: Herrings, Shads, Sardines, and allies			
Dorosoma cepedianum - gizzard shad	31.6	37.8	94.2
Cyprinidae: Minnows and Carps			
Cyprinus carpio - common carp	12.7	14.1	1.3
Notemigonus crysoleucas - golden shiner	0.6	0.9	
Notropis atherinoides - emerald shiner		1.8	0.2
Pimephales notatus - bluntnose minnow		2.6	0.2
Shiner sp.	0.6		
Carp X Goldfish hybrid	0.6		
Ictaluridae: North American Freshwater Catfishes			
Ictalurus punctatus - channel catfish	1.3	0.2	
Moronidae: Temperate basses			
Morone americana - White Perch		15.4	
Morone mississippiensis - yellow bass	10.8		
Centrarchidae: Sunfishes and Freshwater Basses			
Lepomis cyanellus - green sunfish	2.5	0.4	
Lepomis gibbosus - pumpkinseed	7.6	9.0	1.2
Lepomis macrochirus - bluegill	6.3	5.9	1.0
Micropterus salmoides - largemouth bass	17.1	11.0	1.8
Pomoxis nigromaculatus - black crappie			0.2
Pumpkinseed X Green sunfish hybrid	1.9		
Percidae: Perches and Darters			
Perca flavescens - yellow perch	1.9		
Sciaenidae: Coakers and Drums			
Aplodinotus grunniens - freshwater drum	4.4	0.9	
Total Number of Species	12	12	8

Table 4-62 shows the species richness and associated MBI score for both HD and PP dredge sampling methods. Fifty-three taxa of macroinvertebrates were collected.

HD sampling showed species diversity was highest at Ashland, Halsted and Cicero Avenues, with taxa richnesses of 23, 22 and 24, respectively. The lowest diversity, with a taxa richness of 8.0, was at Indiana Avenue. Of the PP samples, the highest taxa richness was at 130th Avenue, with 17 and the lowest were at Halsted Street and Cicero Avenue, with taxa richnesses of 7 and 8, respectively.

Oligachaetes, *Gammarus*, and *Dicrotendipes* were dominant at 130th Street, Halsted Street, and Cicero Avenue. Gastropods and zebra mussels were also numerous at Halsted Street and Cicero Avenue. Dipterans were dominant at Ashland, Indiana and Western Avenues.

MBI scores for the HD sampling data ranged from 5.2 at Indiana Avenue to 7.0 at 130th Street. PP dredge MBI scores ranged from 9.5 at 130th Street to 9.9 at Halsted Street and Cicero Avenue.

4.5.5 Habitat Assessment

Cal-Sag Channel

Based upon the habitat survey results conducted by Rankin (2004) the Cal-Sag Channel had fair habitat conditions. Limestone rubble and coarse materials were left behind during channel construction along the littoral areas. The littoral habitat is also found along most of the shoreline. The limiting factors for this site were:

- Predominance of silty-muck and sand substrate
- Channelation
- No sinuosity
- Little Instream cover
- Deep center region
- Lack of flow

Important positive attributes included substrates, shoreline structure and maximum depth. The Cal-Sag Channel was recommended as a MWH-C Category by Ohio's standards (Rankin, 2004).

Table 4-62. Calumet System: Macroinvertebrate Taxa Richness, Density (HD) and PP number/meter2), Percent Relative Abundance (RelAbu) and MBI Score (MWRDGC 2001, 2002; IEPA 2001Data Sets)

Species	Ashland Avenue		Indiana Avenue		Western Avenue		130 th St.				Halsted				Cicero Ave.			
	HD	RelAbu	HD	RelAbu	HD	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu	HD	RelAbu	PP	RelAbu
COELENTERATA																		
Hydra							179.4	0.1	7.2	0.1	1,435.2	2.9			1,901.6	7.9	7.2	
PLATYHELMINTHES																		
Dugesia tigrina											6.0							
Turbellaria									7.2	0.1	2,709.0	5.5	279.9	2.2	179.4	0.7		
ECTOPROCTA																		
Plumatella							1.8	0.0								0.0		
ANNELLIDA																		
Oligochaeta	1.0	0.4					1,991.4	1.1	4,485.4	84.7	1,776.1	3.6	12,458.6	96.8	4,366.5	18.1	33,342.6	95.7
Hirudinea																		
Mooreobdella microstoma											17.9	0.0						
CRUSTACEA																		
Isopoda																		
Caecidotea	1.0	0.4							114.8	2.2	35.9	0.1			26.9	0.1		
Amphipoda																		
Gammarus fasciatus	16.0	6.6	41.0	22.5	13.0	7.1	1,273.8	0.7	57.4	1.1	2,170.8	4.4	35.9	0.3	1,829.9	7.6	79.0	0.2
Hyalella azteca	3.0	1.2			7.0	3.8												
INSECTA																		
Ephemeroptera																		
Baetis															1.0			
Odonata																		
Argia	6.0	2.5									35.9	0.1			26.9	0.1		
Enallagma					1.0	0.5												
Trichoptera																		
Cyrnellus fratermus	1.0	0.4	107.0	58.8			37.7	0.0			35.9	0.1			35.9	0.1		
Diptera																		
Chironomidae													7.2	0.1				
Ablabesmyia janta							179.4	0.1	7.2		89.7	0.2			7.2			
Ablabesmyia monilis															2.0			
Ablabesmyia rhampe	2.0	0.8			1.0	0.5												
Ablabesmyia mallochi							17.9	0.0							89.7	0.4		
Clinotanypus									7.2	0.1								
Coelotanypus									21.5	0.4								
Procladius	1.0	0.4							64.6	1.2							868.4	
Hayesomyia senata	2.0	0.8			1.0	0.5												
Nanocladius sp.																		
Nanocladius crassicornus/rectinervis	1.0	0.4																
Nanocladius distinctus	26.0	10.7					17.9	0.0			287.0	0.6			688.9	2.9	35.9	0.1
Nanocladius spinipienus	1.0	0.4																
Chironomus							179.4	0.1	7.2	0.1								
Cryptochironomus			1.0	0.5	22.0	12.1			43.1	0.8								
Cricotopus sp	4.0	1.6	1.0	0.5							1.0	0.0						
Cricotopus bicinctus grp.	81.0	33.3			1.0	0.5					7.0	0.0			11.0			
Dicrotendipes sp	6.0	2.5	6.0	3.3	90.0	49.5												
Dicrotendipes lucifer	20.0	8.2	4.0	2.2	25.0	13.7									32.3	0.1		
Dicrotendipes neomodestus	6.0	2.5	1.0	0.5		0.0									32.3	0.1		
Dicrotendipes simpsoni	1.0	0.4			28.0	15.4	681.7	0.4			2,511.6	5.1	21.5	0.2	5,816.2	24.1	21.5	0.1
Glyptotendipes			21.0	11.5	3.0	1.6	35.9	0.0			107.7	0.2			68.1	0.3		
Microchironomus									7.2	0.1								
Parakiefferiella sp.																		
Paratanytarsus sp.																		
Parachironomus tenuicaudatus											1.0	0.0						
Polypedium flavum															1.0			
Polypedium illinoense	56.0	23.0			2.0	1.1									4.0			
Polypedilum halterale grp.									7.2	0.1								
Polypedilum scalaenum grp.									21.5	0.4								
Rheocricotopus robacki	2.0	0.8																
Tanytarsus glabrascens															1.0			
GASTROPODA																		
Amnicola									7.2	0.1								
Ferrissia	4.0	1.6								0.0	197.3	0.4			53.8	0.2		
Menetus dilatatus	1.0	0.4								0.0	1,076.4	2.2			35.9	0.1		
Bithynia tantaculata	1.0	0.4			2.0	1.1				0.0	1,076.4	2.2			35.9	0.1		
Physella										0.0	17.9							
PELECYPODA																		
Corbicula fluminea										0.0	43.1	0.1					380.3	1.1
Pisidium compressum									14.4	0.3			50.2	0.4				
Dressiena polymorpha							180,193.7	97.5	416.3	7.9	35,486.2	72.2	14.4	0.1	8,871.5	36.8	122.0	0.4
Taxa Richness	23.0		8.0		13.0		12.0		17.0		22.0		7.0		24.0		8.0	
Total Number of Individuals	243.0		182.0		196.0		184,790.0		5,296.6		49,125.0		12,867.7		24,118.9		34,856.9	
MBI	6.6		5.2		6.1		7.0		9.5		6.8		9.9		6.7		9.9	

Calumet River

Rankin's (2004) habitat evaluation classified the two sites of the Calumet River as fair and poor. Limiting factors for the Calumet River include:

- Silty substrates
- Little instream cover
- No sinuosity
- Overall embeddedness
- No fast current

Positive habitat attributes included riffle development, moderate cover, depth, and boulder and cobble substrates (**Table 4-63)**. However, mixed silt-sand surrounding coarser substrates near the O'Brien Lock and Dam limited the habitat functionality. The Calumet River was recommended as a MWH-C Category by Ohio's standards (Rankin, 2004).

It should be noted that the rest of the Calumet River, north and east of SEPA 1 resembles the Chicago River. It is a deep draft shipping channel with no riparian vegetation, and vertical or near vertical sheet pile, concrete and rock walls.

Table 4-63
QHEI Scores for the Calumet System

Site Description	QHEI
Cal-Sag Channel Cicero Avenue	37.5
Cal-Sag Channel Route 83	42
Little Calumet River Halsted Road	48.5
Little Calumet River I-94	48.5
Calumet River 130th Street	47
Calumet River O'Brien Lock/Dam	43

LCR

Rankin's (2004) habitat evaluation classified the two sites of the Calumet River similarly as fair and both sites were similar. Limiting factors for the LCR include:

- Silty substrates
- Little sinuosity

- Overall embeddedness
- No fast current

Positive habitat attributes included riffle development, moderate cover, and maximum depth. The moderate cover was mostly low quality. The Calumet River should support MWH-C Category and may be able to support MWH-Impounded use, which includes more non-tolerant species according to Ohio's standards (Rankin, 2004).

Lake Calumet

Limited habitat studies have been conducted in Lake Calumet, and the area is generally off limits to shoreline fishing. However, boat fishing can be conducted in the lake, and access is via the Calumet River from Lake Michigan, or from the public and private boat launches on the other side of the O'Brien Lock/Dam.

Lake Calumet is the only inland lake in Illinois hydrologically connected to Lake Michigan via the Calumet River. Lake Calumet provides migratory bird habitat as well as feeding and spawning habitat fish species. Sections of the Lake Calumet shoreline have limited wetland systems that are dominated by canary reed grass (*Phragmites sp*.) and cat-tail (*Typha sp).* Lake Calumet currently hosts a number of Illinois state endangered bird species, including the black-crowned night-heron, the little blue heron, and the yellow-headed blackbird.

The southern portion of the lake consist of primarily deep-draft channels, while the northern portion of the lake is shallow (2-6 feet) with a clay bottom. Based upon site visits by IEPA and CDM, there were very little instream structure and emergent aquatic plants for fish habitat and foraging. Some of the slip channels on the eastern side of the lake contain rip-rap and debris material along the banks.

Although Lake Calumet has limited fish habitat, it has the potential through restoration efforts to provide diverse aquatic habitat for fish and wildlife. Aquatic habitat could be created to support many of Lake Michigan fish species, as well as many warm-water game species.

4.5.6 IEPA Letter Response Request

As part of this UAA study, IEPA requested from communities along the CSSC if they had any plans for instream habitat improvements or the development of swimming areas. There were no responses back to IEPA from the municipalities contacted.

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Section 5
Proposed Use Classifications and Water Quality Standards for CAWS Reaches

5.1 Approach

The integrated assessment of the physical, chemical, biological, and waterway use conditions in CAWS has resulted in recommendations documented herein for revised use classifications and water quality standards. The recommendations were developed using the UAA process approach described in Section 2.1 and through collaborative stakeholder involvement as described in Section 4.1. The assessment followed USEPA UAA guidelines (USEPA, 1983, 1984a, b,) and procedures outlined in both "*A Suggested Framework for Conducting UAAs and Interpreting Results*" by Michael and Moore (1997) for the Water Environment Federation, and the United States Environmental Protection Agency's "*Water Quality Standards Handbook*" (USEPA 1994). The six factors that the state must take into consideration when conducting a UAA in order to demonstrate that the attainment of a CWA goal use is not feasible, was specifically included in the stakeholder involvement process. The CAWS UAA differs from most UAAs in that improving conditions are prompting a potential use upgrade for most reaches rather than the typical scenario where existing conditions are not supporting an existing designated use and are prompting consideration of a use downgrade. In either case, the criteria are still applicable. In the case where a use upgrade is being considered the criteria were applied in evaluating the feasibility of potential future use designations rather than ones that are already in place. The approach is consistent with the intent of the UAA process and the CWA goals. Summarized below are the six factors including relevant discussion of specific circumstances and conditions affecting use attainment in various reaches of CAWS.

Factor 1- Naturally occurring pollutant concentrations prevent the attainment of the use

- Lake Calumet provides abundant habitat to support bird species, including waterfowl and gulls. Further, the stakeholders have expressed a desire to further promote wildlife use in Lake Calumet. Research has shown that levels of *E. coli* in lakes and streams are highly influenced by localized contamination by birds and may not always be reflective of man-made pollution, such as CSOs or sewage discharges (Hager 2001), (Fleming and Fraser 2001),(McLellan and Salmore 2003). Data collected by IEPA in the summer of 2004 indicate that *E. coli* levels (>126 cfu) were highest in the areas of active gull and waterfowl use and lowest in the areas of non-waterfowl use. High bacterial counts due to natural sources may prevent Lake Calumet from becoming a whole-body contact recreation waterbody.

Factor 2- **Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met**

- The upper reach of the North Shore Channel contains the Wilmette Controlling Structure. The structure is used to divert Lake Michigan water into the North Shore Channel to improve water quality in the channel and to provide navigational makeup for CAWS. On an annual basis, flow through this structure can range from 0 cfs to 115 cfs, depending upon the discretionary needs of MWRDGC. (Dick Lanyon, UAA Stakeholder Meeting Presentation June 24, 2003). Extended periods of low flow in the channel can create adverse water quality conditions (e.g. low dissolved oxygen) that can prevent the attainment of a higher aquatic life designated use.

Factor 3- **Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place**

- Most of the Chicago area has extensive residential, commercial and industrial development that has occurred on the waterways. Reducing or eliminating many of these structures (e.g. Chicago area buildings, bulkheads, sheet-piled walls, bridges) to attain a higher aquatic life use could cause significant and widespread economic and social hardship to the city's environment. The City of Chicago, has a long-term plan to develop parks and recreational facilities along the waterways, and is dependent upon the residential and commercial business to support the economic vitality of the city. Much of CAWS are man-made canals that were constructed to convey stormwater, wastewater and provide for navigation. These man-made canals have steep sides, are deep draft, and have very little shallow shoreline areas that provide adequate habitat for a high quality fishery. Such conditions prevent CAWS from attaining a high quality aquatic life use.

- Many of the physical features identified above also prevent primary contact recreation in the form of swimming. As discussed previously, CAWS was designed to support wastewater and stormwater conveyance and commercial navigation. Due to the many physical limitations to access the waterbodies, the access limitations placed upon most of the waterways by MWRDGC, the physical hazards in the waterways and the high use of commercial navigation traffic, the attainment of primary contact recreation is not feasible at this time. Additionally, no communities along CAWS have plans to establish recreational facilities along the waterways to support swimming. The attainment of secondary contact forms of recreation, like kayaking, canoeing, jet-skiing and recreational boating are not, for the most part, limited by human caused conditions and are attainable. Hand powered watercraft recreation is limited in some waterway reaches. Existing water quality conditions (high bacterial levels) can be corrected by implementing appropriate available technology.

*Factor 4***- Dams, diversions or other types of hydrologic modifications preclude the attainment of the use and it is not feasible to restore the water body to its original condition or to operate such modifications in such a way that would result in the attainment of the use**

- The flow in the Chicago area waterways are highly regulated and original flows were diverted through man-made canals to reduce contamination to Lake Michigan in the early 1900's. Additionally, the original waterbodies that make up the CAWS have been highly modified to support navigation, stormwater and wastewater conveyance and public use, and can not be restored to their original nature. These modifications along with flow regulation through the Wilmette controlling structure, Chicago River water controlling structure, O'Brien Lock and Dam and the Lockport Power House Lock/Dam prevent the attainment of a high quality aquatic life designated use. Improvements to water quality through various technologies, like re-aeration may not improve the fish communities due to the lack of suitable habitat to support the fish populations. Unless habitat improvements are made in areas like the CSSC, additional aeration may not result in the attainment of a higher aquatic life use.

- As discussed in Factor 3, the hydrologic modifications can affect the attainment of primary contact recreation due to the flow regimes in CAWS.

*Factor 5***- Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses, (may be used for determining aquatic life use, but may not be used solely to determine recreational use)**

- Chicago area waterways were artificially created to protect the health of the citizens of Chicago, save Lake Michigan from Chicago's waste, and developing a navigable link to the Gulf of Mexico, with little, if any consideration given to creating suitable aquatic habitat to support a diverse fish and macroinvertebrate community. According to the State of Illinois, the following Chicago area public bodies of water are navigable in their natural condition or were improved for navigation and opened to public use (TITLE 17: Conservation: Chapter I: Department of Natural Resources: Subchapter h: Water Resources: PART 3704: Regulation of Public Waters):

1) Lake Michigan
2) Chicago River: Main Branch
3) Chicago River: North Branch to North Shore Channel
4) Chicago River: South Branch
5) Chicago River: South Fork of South Branch
6) Chicago River: East and West Arms of South Fork of South Branch
7) Chicago River: West Fork of South Branch to Chicago Sanitary and Ship Canal
8) Calumet River
9) Lake Calumet and entrance channel to Calumet River
10) Grand Calumet River
11) Little Calumet River

Since these waterways are considered state and federal navigable waterways, they can be modified and dredged to meet navigable requirements. Modification and dredging can affect aquatic habitat (i.e., sediment and in-stream debris removal) that may naturally develop in these waterways. In CAWS, the re-suspension of potentially contaminated sediments from commercial and recreational activity can contribute to water quality impairment, as well as causing shoreline scouring and erosion. Since these waterways are maintained for navigational uses critical to the economic vitality of the City, the potential for dramatic improvements to create aquatic habitat to support a higher designated use would likely be unproductive, and would severely conflict with important navigational uses. Such conditions preclude the attainment of high quality aquatic life uses in CAWS.

***Factor 6*- Controls more stringent than those required by Sections 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact**

- Economic and social factors must be taken into consideration during the UAA process in proposing water quality criteria to protect proposed designated uses. In the case of those areas in the CAWS where a use designation may be lowered (i.e. Chicago River), it must be shown that the designation is necessary to accommodate important social and economic factors. IEPA is responsible for ascertaining where substantial and widespread economic and social impacts may occur as a result of the UAA. Factors IEPA must take into consideration include:

  i) Financial analysis of the necessary pollution controls and their economic impacts on publicly owned pollution control discharge facilities (e.g. wastewater plants, CSOs)

ii) The adverse impacts the affected community will bear if the entity is required to meet existing or proposed water quality standards

MWRDGC and Midwest Generation are conducting feasibility studies to determine the costs they would incur if they have to make modifications to their existing facilities to meet water quality criteria recommended in the UAA. This review will not be completed until mid-2005. Such information, along with potential impacts for upgrading the City of Chicago's CSOs to meet water quality standards needs to be considered in the overall economic evaluation. The UAA will address Factor 6 once the feasibility studies are completed.

Given that more than one of the six criteria is applicable, certain uses cannot be attained in CAWS. Factors 2, 3, 4 and 5 prevent the consistent attainment of a high quality aquatic life that would meet the goals of the CWA. Good quality aquatic habitat in CAWS is limited and the waterways would need to undergo major habitat restoration to improve the fish and macroinvertebrate assemblages. Despite the physical limitations observed in the CAWS, there are reaches that have experienced dramatic improvements in water quality since the original Secondary Contact and Indigenous Aquatic Life Use standards were established. Such improvements must be recognized through an upgrade in water quality standards where appropriate.

> *"…the physical patterns in these watersheds are very strong and will have a predominant influence on the types of assemblages one might expect" (Ranken 2004).*

The recreational use data demonstrate that secondary contact forms of recreation (e.g. kayaking, canoeing, fish and recreational boating) are occurring in the waterways and these uses need to be protected. The physical and institutional limitations, along with periodic impairments to water quality from CSOs and stormwater in CAWS, prevent the attainment of primary contact recreation (e.g. swimming) for the next ten years. Technological improvements in capturing CSOs and controlling stormwater runoff have improved water quality in CAWS. Local governments are making steady progress toward the reduction of overflows under USEPA's CSO policy. Most communities with CSOs are in the process of implementing basic control measures and funding the long term control measures by completing TARP.

5.2 Development of Use Designations and Water Quality Standards for the CAWS

Since the current regulatory framework in Illinois is limited to two use designations with limited flexibility for addressing unique water body characteristics, one goal IEPA established for the CAWS UAA was the development of recommended use designations and associated water quality standards to achieve the highest attainable uses consistent with CWA goals and Chapter 2 of United States Environmental Protection Agency's (USEPA) Water Quality Standards Handbook (40 CFR 131.10). Achieving this goal requires the development of use designations and a regulatory framework that flexibly adapts to the diverse nature of our water bodies. For instance, the two current use designations in Illinois, General Use and Secondary Contact and Indigenous Aquatic Life, collectively address aquatic life and recreational uses without providing the possibility that a water body may be suitable for one, but not the other. Creating sub use categories and designating them independent from one another is one way of making the framework more specific to local conditions and will aid in designating the highest attainable uses consistent with CWA goals. The development of the proposed designated uses for the CAWS utilized the experience of the Lower Des Plaines UAA which is in the process of finalizing regulatory language. The CAWS UAA also borrowed from other states in the Midwest that have implemented similar frameworks (e.g. Ohio).

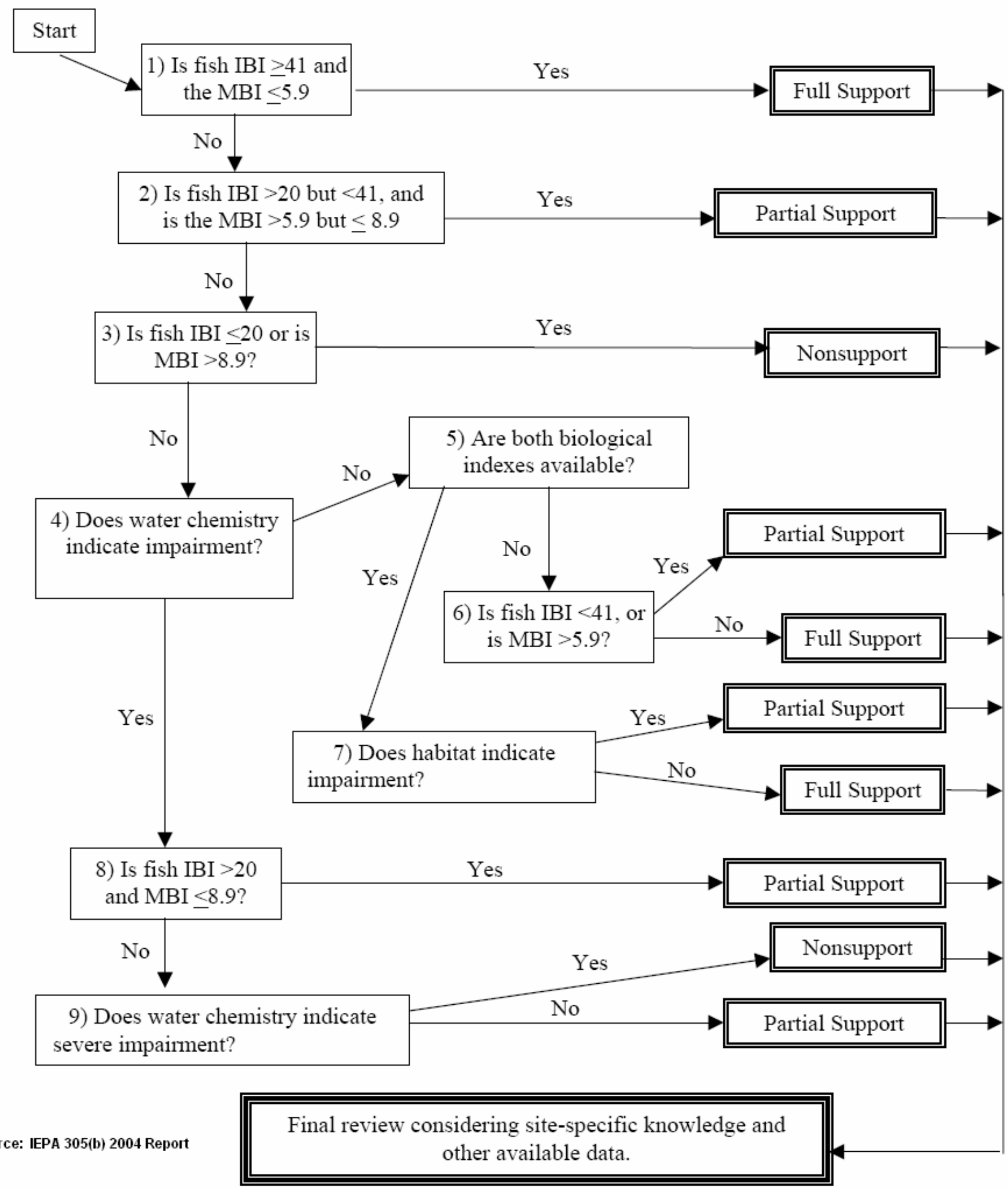
Aquatic Life Use Classifications

Since the General Use and Secondary Contact and Indigenous Aquatic Life use designations do not contain biological criteria or a limited discussion on how aquatic communities are protected in Illinois, this UAA has developed proposed aquatic life use designations that are specific to the Chicago Area Waterway System. The State of Illinois is in the process of developing biological criteria for streams and rivers and in the meantime has been evaluating biological integrity based upon a regional reference reach approach (IEPA 2004). IEPA uses habitat, water chemistry data and biological indices for fish and macroinvertebrates when determining the attainment of a water body under the states 305(b) reporting procedures **(Figure 5-1 on the following page)** (IEPA 2004). The narrative biological criteria used in the State's 305(b) report are not enforceable, but are used as a screening tool to assess the attainment of a specific waterbody to meet CWA goals. In this UAA, biological indices were used as screening tools to define the different use categories for aquatic life in CAWS. The CAWS UAA utilized the Ohio Boatable IBI and the Ohio QHEI as screening tools to determine the aquatic life use designations for the Chicago area waterways. Since the state has not developed an IBI methodology for large boatable waterways, it was agreed among stakeholders that Ohio's boatable methodology (Ohio EPA 1989) would be suitable for assessing biological integrity in CAWS. The Ohio boatable IBI approach was used in the recent Lower Des Plaines UAA (Aqua Nova 2003).

These indices are composed of measurements, or metrics, of the fish community and habitat found in CAWS. Metrics are measured attributes of the ecological community found in high quality or least impacted reference streams or rivers, and these reference waterbodies serve as "yardsticks" to measure biological health in similar or regional waterbodies.

Since the Chicago area waterways are a unique system of man-made canals and modified rivers, there are no regional high quality reference waterbodies that have similar characteristics as CAWS. The "yardstick" utilized in this UAA was selecting a

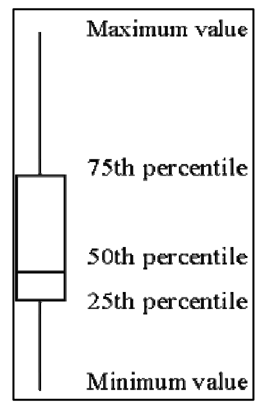
Figure 5-1
Flow Chart for Assessing Aquatic Life Use in Illinois Streams and Rivers



Source: IEPA 305(b) 2004 Report

site-specific reference site within CAWS that had a combination of good habitat and fish community structure, as defined by the QHEI and the IBI. This site potentially represents the optimal ecological conditions that are currently being attained in CAWS or could ever be attained without significant habitat modification. Although this approach differs than the regional IBI approach originally developed by Karr (1981) and modified by others (Fausch et. al 1984; Karr, et. al 1986; Ohio EPA 1989; Yoder 1989; Hughes 1995; Barbour et. al 1999, and, McIninch and Garman 2002), it does provide the best basis for which to measure biological potential in CAWS.

Figure 5-2 on the following page**,** shows the results of the IBI analysis for twenty fish sampling locations in CAWS. The whisker-box plots of the IBI represent all the fish data collected at MWRDGC's fish sampling locations from 1992 through 2002. Whisker box plots are a way of summarizing a distribution of IBI scores. By portraying the IBI values for more than one group next to each other, one can compare sampling sites in the dataset. The "box" in a box plot shows the median score as a line and the first (25th percentile) and third quartile (75th percentile) of the score distribution as the lower and upper parts of the box. The median is the score at the 50% percentile: half of all IBI values are scored higher than the median, and half are scored lower. The 25th percentile is the point at which 25% of the IBI values score lower (and 75% score higher). The 75th percentile is the point at which 75% of the IBI values score lower (and 25% score higher). The "whiskers" shown above and below the box represent the maximum and minimum observed scores.

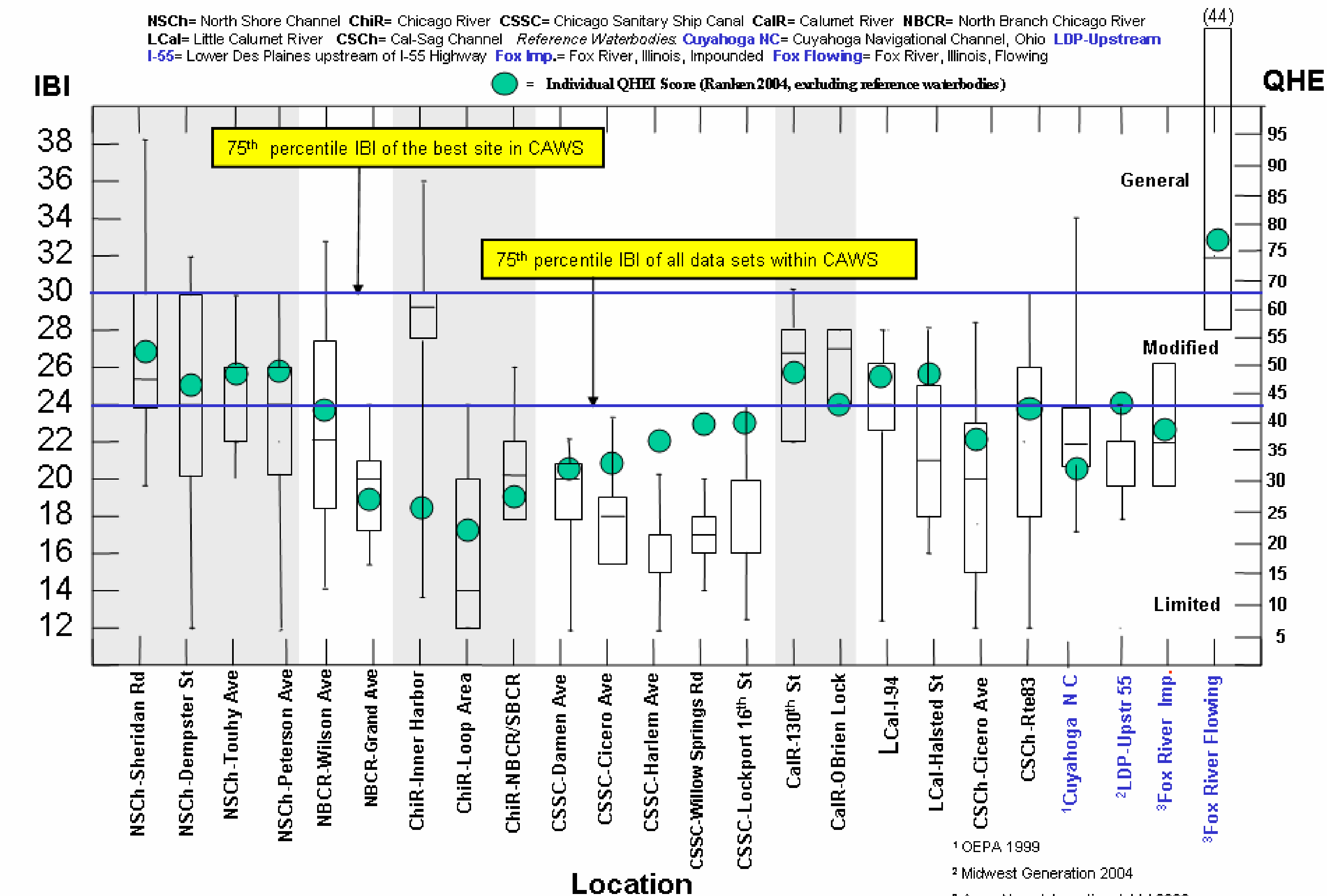


Whisker box plot definitions

The QHEI values (green round dots) shown in Figure 5-2 represent only one data point for the sampling that was conducted in March 2004. The QHEI data was collected at the MWRDGC fish sampling locations by USEPA's contractor. For comparison purposes, QHEI data for the Cuyahoga River Navigation Channel (CRNC), the Lower Des Plaines River (LDPR) (upstream of I-55), and the Fox River (flowing and impounded) were gathered from the literature. The CRNC and LDPR share similar biological and physical characteristics with selected reaches within CAWS.

Based upon existing water quality and biological data, along with existing and proposed uses, tiered aquatic life and recreational use designations are being proposed for CAWS. Tiered use designations allow for appropriately varying levels of protection according to the uses currently being attained and uses that could occur within the next ten years. Three tiered aquatic life use designations are being proposed for CAWS. They include General Warmwater Aquatic Life, Modified Warmwater Aquatic Life and Limited Warmwater Aquatic Life. The 75th percentile of the data set for the optimal site was used to set the upper boundary for a Modified Warmwater Aquatic Life use, while the 75th percentile of all IBI data for CAWS was

Figure 5-2. Use Designation Categories Defined by Whisker Box Plots of Ohio Boatable IBI Scores (1993 – 2002) vs. QHEI Scores (2004) for the Chicago Area Waterways and Reference Waterbodies



[1] OEPA 1999
[2] Midwest Generation 2004
[3] Aqua Nova International, Ltd 2003

used to set the lower boundary for this use classification. Sheridan Road in the North Shore Channel had the best overall IBI and QHEI scores for all sites in CAWS and was used to set the upper boundary for Modified Warmwater Aquatic Life. Using the 75th percentile of the IBI for the optimal site and the IBI for all sites has no immediate regulatory implication. This approach was used only as a screening method to delineate the aquatic communities based upon the fish community and the QHEI values. The use of the MBI was not included to screen and develop aquatic life use designations, due to the limited data set available for benthic macroinvertebrates in CAWS. The MBI was used, as discussed in Section 4, to describe the macroinvertebrate community structure for each of the waterway reaches in CAWS.

Recreational Use Classifications

In May 2002, USEPA published draft "Implementation Guidance for Ambient Water Quality Criteria for Bacteria" which will likely supersede the current "Ambient Water Quality Criteria for Bacteria – 1986 (USEPA, 2002; USEPA, 1986). The newer guidance was used in developing new recreational use classifications and associated water quality standards for CAWS. USEPA UAA Stakeholder Advisory Committee representatives affirmed that although the guidance is still in draft form, they strongly support its application to the UAA process at this time. The guidance includes recommendations for designating use categories as well as appropriate water quality criteria for each use type.

In terms of designating recreational use categories the guidance supports the CWA goals emphasizing that states "should designate primary contact recreation and adopt water quality criteria to support that use, unless shown to be unattainable…" Pursuant to 40 CFR 131.10(d) "At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limits required under sections 301(b) and 306 of the Act and cost-effective and reasonable best management practices for nonpoint source control." The option of adapting subcategories of recreational uses through a UAA is also discussed to "allow states and authorized tribes to better tailor the level of protection to the waterbody where it is needed most, while maintaining some protection for unanticipated recreation in waters where primary contact recreation is unattainable." Recreational uses can be removed if it can be shown that they are not an existing use as defined in 40 CFR 131.3(e): "E*xisting uses* are those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." Variations can include designation of intermittent, secondary or seasonal recreation uses.

In the case of the CAWS UAA, recreational use surveys showed that primary contact recreation (i.e.: swimming) was not an existing use in the waterways. The SAC reached consensus on this conclusion and further agreed that swimming was not an anticipated or desired use within the next ten years. As a result, one outcome of this UAA is to not recommend a primary contact recreation classification.

Recreational surveys did, however, show that significant secondary contact recreational activities were occurring in some reaches. Summarizing the results from

Section 4, kayaking, canoeing, sculling, power boating, and fishing were regularly observed. The UAA SAC developed two secondary contact subcategories designed to protect these uses: Limited Contact Recreation use and Recreational Navigation use. Limited Contact Recreation protects for incidental or accidental body contact, during which the probability of ingesting appreciable quantities of water is minimal, such as, recreational boating (kayaking, canoeing, jet skiing), and any limited contact incident to shoreline activity, such as wading and fishing. Recreational Navigation protects for non-contact activities including, but not limited to pleasure boating and commercial boating traffic operations. Stakeholders agreed that the recreation season extended from March 1 through November 30 and that these recreational uses only required protection during that period.

USEPA's draft bacteria guidance was also used as the basis for establishing water quality criteria protective of these new secondary use recreation subcategories. USEPA encourages the use of *E.coli* as the indicator organism in response to studies showing that it is a better means of protecting recreators from contracting gastrointestinal illness. Epidemiological studies that examined the relationship between *E.coli* bacteria and gastrointestinal illness in swimmers serve as the basis for recommended water quality criteria. The risk-based approach results in criteria recommendations for primary contact recreation with a specified illness rate no greater than 14 illnesses per 1000 swimmers (1.4%). However, USEPA suggests considering more conservative criteria based on 8 illnesses per 1000 or 0.8%. Additionally, both a geometric mean and single sample maximum criteria are recommended for primary contact recreation.

USEPA found that the epidemiological studies used to derive primary contact recreation criteria were not suitable for developing secondary contact criterion, but nonetheless believe that secondary contact waters should still be protected with numeric water quality criteria. USEPA as a result, suggests adopting criteria equal to 5 times that of the geometric mean component recommended for primary contact recreation using the illness rate no greater than 14 illnesses per 1000. A single sample maximum is not recommended for secondary contact. The majority UAA SAC reached consensus on establishing a Limited Contact Recreation water quality criteria of 1030 cfu/100 ml *E.coli* as a geometric mean based on 5 times the 10 illness per 1000 rate, and a Recreational Navigation criteria of 2470 cfu/100 ml, based on 5 times the 14 illness per 1000 rate.

5.3 Proposed CAWS Use Classifications and Water Quality Standards

The use designations and water quality standards to protect the beneficial uses of the waters in the open channels that flow through the Chicago metropolitan area apply to the following waterbodies:

- North Shore Channel from Lake Michigan to the confluence with the North Branch of the Chicago River
- North Branch of the Chicago River from it's confluence with the North Shore Channel to its confluence with the South Branch, including the North Branch Canal
- The Chicago River
- The South Branch of the Chicago River, including the South Fork and navigation slips
- The Chicago Sanitary Ship Canal, including the Collateral Channel
- Lake Calumet and Lake Calumet Entrance Channel
- The Calumet River from Lake Michigan to the confluence with the Grand Calumet River
- The Grand Calumet River
- The Little Calumet River from its junction with the Grand Calumet River to the Calumet-Sag Channel
- The Calumet-Sag Channel

Aquatic Life

Beneficial uses and the applicable sections of the 35IL Adm Code Part 302 include the following:

- ***General Warm-water Aquatic Life (GWAL)*** - These waters are capable of supporting a year-round balanced, diverse warm-water fish and macroinvertebrate community. The fish community is characterized by the presence of a significant proportion of native species, including mimic shiner, spotfin shiner, brook stickleback, longnose dace, hornyhead chub, smallmouth buffalo, rock bass and smallmouth bass. Water quality criteria as identified in 35IL Adm Code Part 302, Subpart B: Sections 302.201 – 302.213 or more appropriate standards based upon recent guidance shall be applied to protect the General Warm-water Aquatic Life use designation.

- ***Modified Warm-water Aquatic Life (MWAL)*** - These waters are presently not capable of supporting and maintaining a balanced, integrated, adaptive community of a warm-water fish and macroinvertebrate community due to significant modifications of the channel morphology, hydrology and physical habitat that may be recoverable. These waters are capable of supporting and maintaining communities of native fish and macroinvertebrates that are moderately tolerant, and may include desired sport fish species such as channel catfish, largemouth bass, bluegill, and black crappie. Water quality criteria as identified in 35IL Adm Code Part 302, Subpart B: Sections 302.201 – 302.213 or more appropriate standards based upon recent guidance shall be applied to protect the Modified Warm-water Aquatic Life use designation.

- ***Limited Warm-water Aquatic Life (LWAL)*** - These surface waters are not presently capable of sustaining a balanced and diverse warm-water fish and macroinvertebrate community due to irreversible modifications that result in poor physical habitat and stream hydrology. Such physical modifications are of long-duration (i.e. twenty years or longer) and may include artificially constructed channels consisting of vertical sheet-pile, concrete and rip-rap walls designed to support commercial navigation and the conveyance of stormwater and wastewater. Hydrological modifications include locks and dams that artificially control water discharges and levels. The fish community is comprised of tolerant species, including central mudminnow, golden shiner, white sucker, bluntnose minnow, yellow bullhead and green sunfish. These waters shall allow for fish passage. Water quality criteria as identified in 35IL Adm Code Part 302, Subpart B: Sections 302.201 – 302.213 or more appropriate standards based upon recent guidance or habitat limitations shall be applied to protect the Limited Warm-water Aquatic Life use designation. On a parameter-by-parameter basis, with consideration of economic factors, General Use water quality criteria may be modified to protect the existing aquatic life assemblages.

Recreational Use

- ***Limited Contact Recreation*** – The surface waters shall protect for incidental or accidental body contact, during which the probability of ingesting appreciable quantities of water is minimal, including recreational boating (kayaking, canoeing, jet skiing), and any limited contact incident to shoreline activity, such as wading and fishing. Protection would require attainment of 30-day geometric mean 1030 cfu *E. coli* standard[1] based on 10 illnesses per thousand contacts. Such limited contact recreation criteria shall apply only during the defined recreational period of March 1 through November 30.

- ***Recreational Navigation*** – These surface waters shall protect for non-contact activities including, but not limited to pleasure boating and commercial boating traffic operations. Protection would require attainment of a 30-day geometric mean 2740 cfu *E. coli* standard[2] is based on 14 illnesses per thousand contacts. Recreational Navigational criteria shall apply only during the defined recreational period of March 1 through November 30.

[1] *E. coli* standard 1030 per ml (MPN or MF) is based upon the thirty-day geometric mean of four or more sampling events representatively spread over a thirty-day period.
[2] *E. coli* standard 2740 per ml (MPN or MF) is based upon the thirty-day geometric mean of four or more sampling events representatively spread over a thirty-day period.

5.4 Proposed CAWS Reach Use Designations

In developing use designations for CAWS reaches, stakeholders were asked how they perceived each reach of the waterway designations. This discussion was held at the end of each meeting where the physical, chemical, biological, and waterway use data were presented for a group of reaches. Stakeholders were asked to take into consideration uses that are anticipated within the next 10 years and the feasibility of restoration actions that might be required to attain such a designation. Section 6 presents a summary of these restoration options proposed for each reach. Since feasibility studies will be required to evaluate the effectiveness and cost-benefit of these options, in the absence of that knowledge, stakeholders were encouraged to exercise optimism with their use designation recommendations consistent with IEPAs goal to achieve the highest attainable uses consistent with CWA goals. Tables 5-1 and 5-2 summarize the consensus of the SAC recommendations.

Table 5-1: Recommended Use Designations for the North Shore Channel and Chicago River System

Proposed Designated Use	Upper North Shore Channel	Lower North Shore Channel	Upper North Branch Chicago River	Lower North Branch Chicago River	Chicago River	South Branch Chicago River	Bubbly Creek
Limited Contact Recreation	◆	◆	◆	◆	◆	◆	◆
Recreational Navigation							
General Use Warm-Water Aquatic Life							
Modified Warm-Water Aquatic Life	◆	◆	◆				
Limited Warm-Water Aquatic Life				◆	◆	◆	◆

Table 5-2: Recommended Use Designations for the CSSC and Calumet System

Proposed Designated Use	CSSC	Grand Calumet	Lake Calumet	Calumet River	Little Calumet East	Little Calumet West	Cal-Sag Channel
Limited Contact Recreation		◆	◆		◆	◆	◆
Recreational Navigation	◆			◆			
General Use Warm-Water Aquatic Life							
Modified Warm-Water Aquatic Life		◆	◆		◆	◆	◆
Limited Warm-Water Aquatic Life	◆			◆			

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Section 6
Strategic Plan

The Chicago area waterways forms a complex hydrologic system of artificially created channels, modified rivers and open water areas. These waterways are the arteries that provide life and growth to the Chicago area and the nation as a whole. The system:

- Keeps wastewater from flowing into Lake Michigan
- Provides a navigational conduit to the Mississippi River
- Is a recreational source for fisherman and boaters
- Provides riparian habitat to wildlife, including a State endangered species
- Contributes to the aesthetic charm of downtown Chicago and surrounding communities

As the various reaches of the Chicago area waterways wind their way through the metropolitan Chicago area, they are also subject to threats from CSO, stormwater runoff, habitat degradation, sediment contamination, undisinfected wastewater effluent and flow regulation. These threats to water quality are currently being addressed by a concerted effort from USEPA, IEPA, local governmental agencies, environmental organizations, community groups and the public to ensure the public welfare is protected and that the goal of "fishable/swimmable" is achieved where possible.

Shared Commitment

MWRDGC has made significant improvements to their wastewater reclamation plants including investing large sums of money to understand the water quality dynamics of the system and contributing financially to the construction and implementation of the TARP system. Their role as the local agency to ensure the waterways are managed to support a variety of uses will take on new emphasis as the Chicago area moves ahead in this century.

MWRDGC and the City of Chicago are studying the CAWS system to reduce contaminants coming from CSOs.

MWRDGC and the City of Chicago is undertaking detailed studies to reduce the contaminants coming from their CSOs and to provide regional development strategies to enhance the waterways for recreational purposes. Friends of the Chicago River, The LMF, Sierra Club, Southeast Environmental Task Force and other groups have long supported the improvements in water quality in CAWS to provide viable aquatic ecosystems by providing healthy habitat for fish and wildlife, to protect human health, and to support economic and recreational activities.

These agencies and organizations have a shared vision of protecting the public, enhancing recreational opportunities, and decreasing environmental pollution through appropriate water quality targets. How these goals for the waterways are addressed vary with stakeholder interest. The purpose of the UAA is to develop appropriate use designations and applicable water quality standards for the Chicago area waterways that achieve the highest attainable use consistent with the CWA goals. This is to be accomplished through stakeholder involvement in identifying attainable uses and developing management strategies to correct any water quality deficiencies that may prevent the attainment of such uses.

6.1 Proposed Use Designations for the Chicago Area Waterways

The UAA process identified new water use designations for CAWS. The new use classifications are to replace the existing General Use and Secondary Contact and Indigenous Aquatic Life use designations that are currently in place for CAWS. The new aquatic life and recreational use designations are based upon: the existing and potential uses, those currently being attained and those that could be attained if limiting factors are rectified. The proposed water quality criteria to protect the proposed designated uses include those adopted and promulgated for General Use waterbodies in Illinois, with the exception of bacteria. Bacterial standards to protect the new recreational use categories will be based upon the concentration of *E. coli* in surface water. Currently the state uses the concentration of fecal coliforms in surface waters to protect General Use waterbodies. The USEPA is urging all states to update their bacteriological standards designed to protect surface waters for swimming and other forms of water recreation. IEPA is proposing to replace the current fecal coliform standard with an *E. coli* standard based on an EPA's 1986 recommended bacteria criteria.

During the stakeholder process, valid concerns were presented by several stakeholders regarding the level of effort and costs to provide disinfection to the Stickney, Calumet and North Side WRPs. These concerns include:

- The waterways will still being contaminated by CSOs and stormwater runoff, so why spend hundreds of millions of dollars to disinfect the three major WRPs.
- Expenditures to MWRDGC and resulting rate increases to the public to protect for a few users of the waterways, is not economically sound
- Current levels of risk and gastrointestinal illnesses rates are unknown among waterway users
- Other stakeholders have expressed concern about upgraded temperature standards

Addressing these issues should be included in any long term strategy for the CAWS.

Strategic Plan

The Strategic Plan sets the overall priorities and associated goals and strategies for CAWS. It is based on the long-term vision shared by many of the stakeholders in the Chicago area. It does not provide an exhaustive list of all the strategies to achieve water quality goals, nor does it provide a complete summary of accomplishments to date. The plan is designed to be concise and include only essential information and viable options to support the strategic actions that can be accomplished over roughly the next ten years. The intended audiences are governmental agencies, environmental organizations, general public and specific constituent groups. The plan incorporates strategies to address the attainment of each of the use designations for the Chicago area waterway reaches through selected management options. These options are subject to rigors of the six factors listed in 40 CFR 131.10(g). **Table 6-1** identifies management options to address impairments that prevent the attainment of a designated use in a given waterway reach.

The management alternatives were reviewed with and in most cases devised by, the UAA stakeholder group. Implementation strategies were discussed with the responsible agencies or organizations responsible for ensuring the management alternatives are acted upon. In the strategic plan for the CAWS, the goals, objectives and strategies for implementing the management alternatives for aquatic life and recreational use designations are discussed with specific goals, objectives and strategies. As the water-based recreational and aquatic life opportunities continue to expand in the CAWS it is imperative that these uses be protected and where possible enhanced so that the waterway system can become truly the “second shoreline” for the City of Chicago and the surrounding communities. The following strategies are being recommended to ensure a safer environment for water-based recreation and enhancing aquatic communities in CAWS.

6.2 Limited Contact Recreation

The number of recreational boaters utilizing the Chicago waterways is increasing and the added emphasis from the City of Chicago in embracing the Chicago waterways as the City’s “second-shoreline” continues to encourage more users. At this time no governmental agency or environmental organization is supporting the use of the waterways for primary contact recreation (i.e. swimming) because of the physical limitations and the safety hazards. However, many Chicagoans are taking to the waterways to kayak, canoe, power boat and fish and such uses need to be protected through appropriate water quality standards.

Goal

Protect recreational users and improve the existing water quality in the Chicago area waterways to support limited contact recreation.

Table 6-1
Proposed Management Strategies to Address New Use Sub-categories in CAWS.

Management Alternatives	Upper NSC	Lower NSC	Upper North Branch Chicago River	Lower North Branch Chicago River	Chicago River	South Branch Chicago River	Bubbly Creek	CSSC	Calumet-Sag Channel	Little Calumet East	Little Calumet West	Grand Calumet	Calumet River	Lake Calumet
Flow Augmentation to Address Low Dissolved Oxygen Levels	◆						◆							
Aeration to Address Low Dissolved Oxygen Levels	◆		◆	◆		◆	◆	◆	◆	◆	◆			
Instream Habitat Enhancement to Improve Fish Communities	◆	◆	◆	◆			◆			◆				◆
Sediment Removal to Improve Aquatic Life Conditions							◆			◆		◆		
Disinfection to Protect for Water Recreation	◆	◆	◆	◆	◆	◆	◆	◆	◆		◆			

Objective

Work closely with MWRDGC, the City of Chicago and other CAWS communities to control site-specific point sources of bacterial pollution and develop a plan to address CSO events until the remaining portions of TARP come on line.

Strategies

a) Conduct engineering studies to determine the costs of disinfection at the Stickney, Calumet and North Side WRPs

b) Determine the costs for implementing CAWS-wide disinfection of MWRDGC and surrounding community CSOs

c) Conduct an economic analysis of implementing water quality improvements to protect recreational uses in the CAWS

d) Prepare a construction schedule for the implementation of disinfection at the North Side, Stickney and Calumet WRPs to meet instream bacteria standards

e) Conduct detailed *E. coli* sampling in the CAWS during dry-weather and wet-weather periods (using various rainfall events) to determine the nature and extent of bacterial contamination from CSOs

f) Develop a phased approach to the disinfection at the three WRPs. Evaluate the impacts during the recreation season and success of each of the facilities to meet water quality standards in lieu of on-going sources of contamination, i.e. CSOs and stormwater runoff. Disinfect the North Side WRP first, while MWRDGC evaluates if water quality criteria are being met for a two-year period (including dry and wet weather events)

g) Require MWRDGC and surrounding communities to treat their CSOs to reduce or eliminate bacterial loading to the waterways during wet weather events, bearing in mind commitments to complete TARP

h) Evaluate the feasibility of wet-weather exclusions in the water quality standards

i) Conduct a detailed engineering review of the Chicago area "sewershed" to evaluate the feasibility of maximizing the use of the TARP system for CSO pollution control, as opposed to solely flow capture mechanisms during wet weather events.

j) Continue to educate the public on the environmental hazards in the waterways and implement the CSO notification plan.

k) Develop additional data to determine the nature and extent of pathogens residing in the sediment since sediments can be a reservoir to harmful bacteria and could prevent the attainment of a designated use when disturbed sediments are re-suspended

6.3 Recreational Navigation

Many portions of CAWS are still used by commercial barge traffic and recreational pleasure boats. The heavy uses occur on the CSSC and in the Calumet System. The exposure to high levels of bacteria from these uses is minimal, but water quality standards need to be in place to protect against accidental exposure (i.e. worker falling into the water and water splashing).

Tour Boat on the Chicago River

Goal

Protect commercial and recreational users of the waterways from accidental exposure to high levels of bacteria.

Objective

Identify treatment technologies that can be implemented at the Calumet and Stickney WRP to achieve a lower level bacterial quality in the effluent during the recreational time period March 1 through November 30.

Strategies

a) Prepare a construction schedule for the implementation of disinfection at the Stickney and Calumet WRPs to meet instream bacteria standards to protect from accidental exposure

b) Require the City of Chicago and surrounding communities to treat their CSOs to reduce or eliminate bacterial loading to the waterways during wet weather events

c) Require MWRDGC and surrounding communities to treat their CSOs to reduce or eliminate bacterial loading to the waterways during wet weather events, bearing in mind that commitments to complete TARP

d) Evaluate the feasibility of wet-weather exclusions in the water quality standards

e) Conduct a detailed engineering review of the Chicago area "sewershed" to evaluate the feasibility of maximizing the use of the TARP system for CSO pollution control, as opposed to solely flow capture mechanisms during wet weather events

f) Continue to educate the public on the environmental hazards in the waterways and implement the CSO notification plan.

g) Develop additional data to determine the nature and extent of pathogens residing in the sediment since sediments can be a reservoir to harmful bacteria and could prevent the attainment of a designated use when disturbed sediments are re-suspended.

6.4 General Warm-Water Aquatic Life

None of the Chicago area waterway reaches possessed the necessary characters to support a GWAL use designation. The primary constraints to preventing the attainment of this use were the lack of suitable habitat to support a diverse fish and macroinvertebrate community.

Goal

Create favorable habitat in selected reaches of CAWS to support a diverse aquatic and wildlife community. Ensure water quality is sufficient to support a viable and productive fish and macroinvertebrate community.

Objective

To upgrade selected reaches in the Chicago area waterways to GWA through habitat enhancement and water quality improvements

Strategies

a) Develop a stakeholder group to study habitat issues

b) Develop a habitat restoration plan and guidelines for the waterway reaches

c) Determine the costs for implementing temperature control at the Midwest Generation Crawford and Will County power generating stations

d) Conduct engineering studies to determine the costs of flow augmentation in the Upper North Shore Channel and the South Fork

e) Conduct an economic analysis of implementing water quality improvements for aquatic life in the CAWS

f) Identify areas for potential restoration that could allow the waterbody to achieve a high aquatic life designated use. These could include selected areas on the NSC, North Branch Chicago River, South Fork (Bubbly Creek), the Little Calumet River, Grand Calumet River and Lake Calumet.

g) Conduct "watershed" D.O. modeling to determine areas and degree of dissolved oxygen impairment

h) Install appropriate in-stream or side-stream aeration devices In those areas not meeting D.O. criteria

i) Create flow augmentation in the upper reaches of the NSC and the South Fork to create a flow regime that will enhance D.O. levels

j) Remove contaminated sediments from the South Fork, Collateral Channel and the Grand Calumet River

k) Review and modify where necessary MWRDGC's pretreatment program to eliminate unconventional parameters (e.g. silver)

l) Conduct additional studies on fish in CAWS to determine if endocrine disruptors are having an impact on the fish community

m) Develop a comprehensive educational outreach program for the general public and local governmental agencies

n) Explore and implement a combination of pretreatment and best management practices to reduce levels of non-conventional pollutants (e.g. silver)

6.5 Modified Warm Water Aquatic Life

Most of the Chicago area waterways have been designated this use classification as a result of significant modifications to channel morphology, hydrology and physical habitat that may be reversible to some extent.

Goal

Create favorable habitat and favorable water quality conditions at selected locations in the waterways to support a diverse aquatic and wildlife community.

Objective

Identify those areas where habitat enhancement is feasible and develop a long term plan to implement habitat improvements in the Chicago area waterways. Eliminate water quality impairments through Best Management Practices or Best Practicable Technology.

Strategies

a) Develop a stakeholder group to study habitat issues and form a technical team to evaluate aquatic habitat restoration technologies applicable in a high urbanized environment.

b) Identify areas for potential restoration such as in the turning basins on the North and South Branch, the inner harbor area of the Chicago River, slip channels on the CSSC and the South Branch and the stretch of river between Cicero Avenue and Harlem Avenue on the CSSC.

c) Construct in-stream aquatic habitat in the non-navigable portions of the CAWS (e.g. Christmas tree "reefs") to provide habitat for warm-water fish.

d) Explore and implement a combination of pretreatment and best management practices to reduce levels of non-conventional pollutants (e.g. silver).

e) Install in-stream and side-stream aeration where necessary to ensure surface water quality standards are met.

6.6 Limited Warm Water Aquatic Life

Selected reaches of CAWS have been designated LWAL due to irreversible modifications that result in poor physical habitat and stream hydrology. The Chicago River as it flows through the city has been highly developed and the existing structures will not be modified or removed to accommodate aquatic life habitat improvements. The CSSC and the Calumet River are deep-draft channels that have steep walls, are heavily industrialized in the upper reaches and are host to significant numbers of large commercial barge vessels and recreational pleasure boats.

Goal

Maintain water quality to meet general use standards, where attainable and allow for navigation and fish passage.

Objective

To ensure D.O. and temperature criteria are met, and if unattainable, identify a treatment alternative to increase D.O. levels and reduce temperature levels.

Strategies

a) Evaluate the feasibility of aerating and lowering temperature in selected areas in the CSSC

b) Monitor D.O. levels and temperature in the CSSC

c) Develop site-specific water quality standards for D.O. and temperature to support existing fish communities

d) Continue with MWRDGC's water quality, fish and macroinvertebrate sampling program throughout the CAWS