

Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

Status of Chicago Area Waterway System Use Attainability Analysis Hearings Before the Illinois Pollution Control Board



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Presentation Overview

- UAA Process
- Timeline
- Studies Conducted to Inform Process
- ALU
 - IEPA Proposal
 - MWRD Proposal
 - Current Status
- Recreational Use
 - IEPA Proposal
 - IPCB Final Order
 - Current Status

Use Attainability Analysis

- 40 CFR 131.3(g): *Use attainability analysis is a structured scientific assessment of the factors affecting the attainment of the use which may include physical, chemical, biological and economic factors as described in § 131.10(g).*
- 40 CFR 131.10(j): *A State must conduct a use attainability analysis as described in 131.3(g) whenever:*
 - (1) *The State designates or has designated uses that do not include the uses specified in section 101(a)(2) of the Act, or*
 - (2) *The State wishes to remove a designated use that is specified in section 101(a)(2) of the Act or to adopt subcategories of uses specified in 101(a)(2) of the Act which require less stringent criteria.*

Use Attainability Analysis (UAA) of the Chicago Area Waterway System (CAWS)

- Required by Clean Water Act if use is other than fishable/swimmable
- Consider physical, chemical, biological, and economic factors
- Commenced in 2002
- CAWS UAA
 - 20 Stakeholder meetings, 12 public meetings
 - District provided almost all of the data for UAA evaluation
 - District undertook several major projects suggested by IEPA
- Draft UAA released to stakeholders in February 2005
- IEPA proposal submitted Oct 2007 to IPCB docket R08-9
- Hearing commence January 2008 (50 days of hearings to date)
- IPCB splits R08-9 into Subdockets A-D in March 2010

UAA “Exception Factors”

“Wherever attainable” waters of the US must be “fishable, swimmable,” unless one of the following 6 factors applies:

- 1) Naturally occurring pollutant concentrations prevent attainment of use
- 2) Natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the use...
- 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
- 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 modification in a way that would result in the attainment of the use
- 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
- 6) Controls would result in widespread economic and social impact

District Studies that Informed the Process

CDOM Program
Commence

Kickoff September 5,
2002, Stakeholder
Process Initiated

*FC in CAWS, R&D 05-15

*Expert Review of Technology &
Probable Cost



1998

2000

2002

2003

2004

2005



Duflow Model
Development by
Marquette University
Commences

Ambient Water Quality
Monitoring Program

CSO Impact Report 05-1D

District Studies that Informed the Process

*Expert Review of 1986 Criteria

*TM-3WQ, End of Pipe Treatment CSO's

*IEPA Draft, October 2006

*TM-4WQ Supplemental Aeration in North & South Branch

*TM-5WQ Flow Augmentation in UNSC

*TM-6WQ Flow Augmentation & Supplemental Aeration Bubbly Creek

*Assessment of Environmental and Economic Impacts of Compliance with R08-9

*Recreational Risk Assessment Final Report

*Integrated DO Strategy Report

*USGS Sources of Bacteria

*UIC, 2010 CHEERS Reports

2006

2007

2008

2009

2010

•3-D Modeling Commenced

*TM-7WQ Develop Framework for Integrated Strategy for CAWS

*Risk Assessment Interim Dry Weather Report

*FC in CAWS, Dry & Wet Weather 04,05,06 R&D 07-79

Operating SEPA to Meet Proposed Stds

•Disinfection Costs Updated

*Bubbly Creek SOD Study

*Habitat Reports

IEPA Recommendation for Aquatic Life Use Designation & Criteria

- Aquatic Life Use relates to “fishable” goal of Clean Water Act. Water quality standards should identify aquatic life use potential and include criteria to protect it in the water body.
- IEPA’s UAA Finds Limitations to Aquatic Life Use in Chicago River Still Exist
 - IEPA invoked UAA Factors 3, 4, and 5 to explain limited use designations:
 - 3) Human caused (CSOs, contaminated sediments)
 - 4) Dams or other hydrologic modifications (flow completely controlled to maintain navigation and prevent flooding);
 - 5) Physical conditions related to natural water body features (channelized, steep banks, homogeneous substrate, commercial navigation, lack of cover/emergent vegetation)
- Findings
 - The CAWS have “unique habitat conditions.” “Such conditions are not reversible in the foreseeable future,” and prevent “maintaining a biological condition that meets the Clean Water Act’s Aquatic Life goal.

Proposed Aquatic Life Uses



Chicago Area Waterway System Aquatic Life Use A

March – Nov: **5.0 mg/L**

Dec – Feb: **3.5 mg/L**
7-day mean of min: **4.0 mg/L**

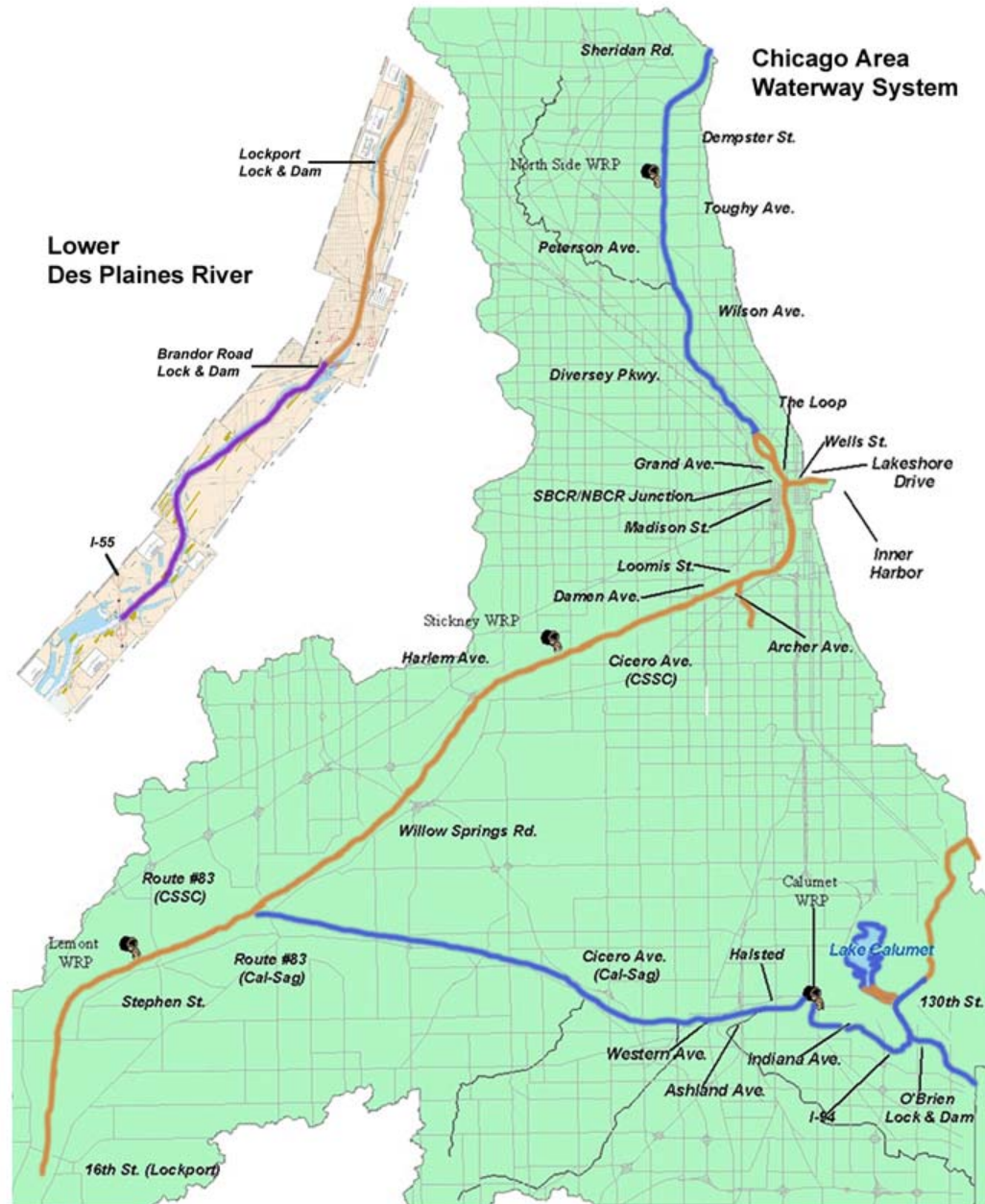


Chicago Area Waterway System Aquatic Life Use B

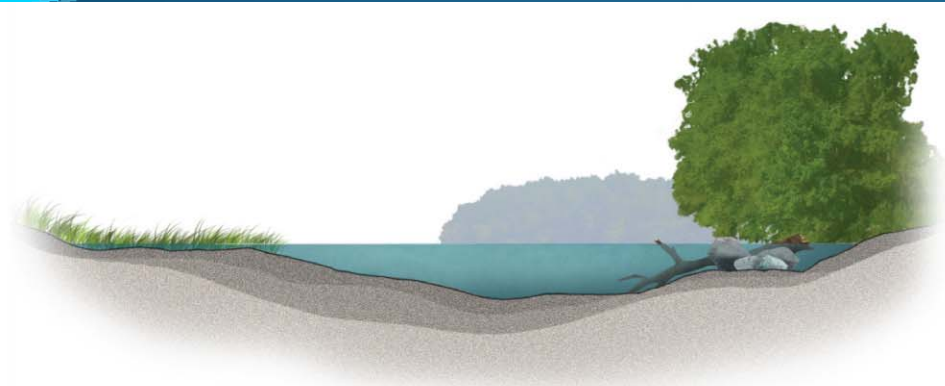
Minimum: **3.5 mg/L**
7-day mean of min: **4.0 mg/L**



Upper Dresden Island Pool



Natural River

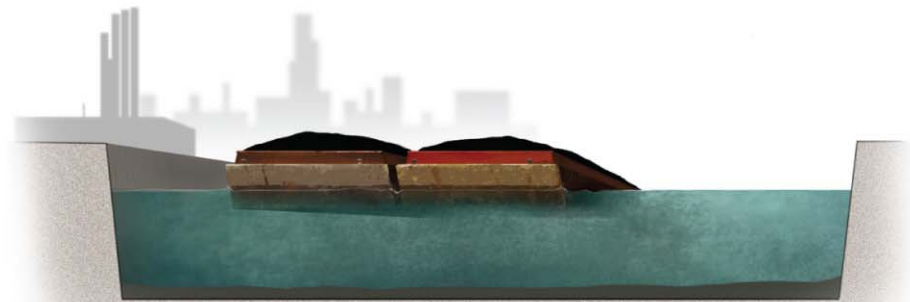


Storm water filtered by the flood plain before replenishing the river, resulting in fewer contaminants and less bank erosion.

Differing depths, widths, flow velocities, and bends. This variety supports diverse biotic assemblage. Shallow areas allow light to penetrate for aquatic plant growth, which provides shelter and feeding area for fish.

Variable sediment particles support diverse aquatic invertebrates. Coarse sediments more stable.

Chicago Area Waterway System

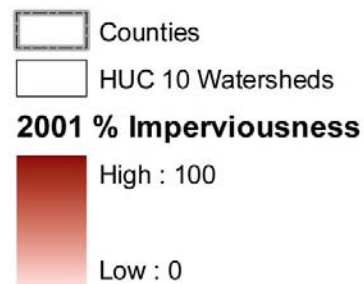


Little or no vegetated riparian zone. Combined and storm sewers convey and discharge storm water directly to river through outfalls.

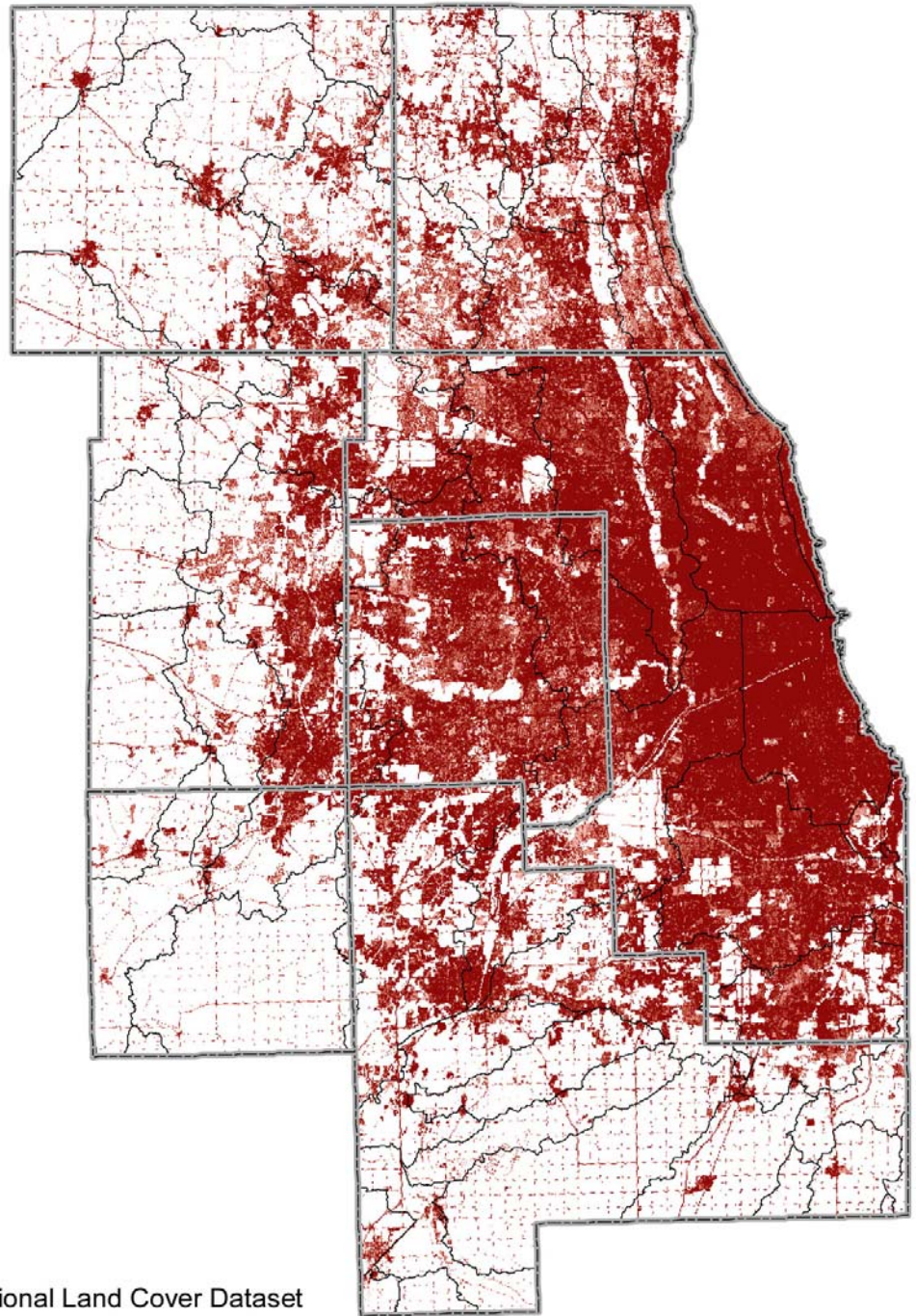
Channelized basins have few shallow areas, relatively constant width and low flow velocity, with few bends. Aquatic plant growth and fish shelter minimal. Lack of riffles and pools limit more sensitive biota.

Homogenous fine sediment deposits dominate. More likely enriched with contaminants.

Realities of the System: Impervious Surfaces



Imperviousness from 2001 National Land Cover Dataset



Chicago Area Waterway System Combined Sewer Overflows



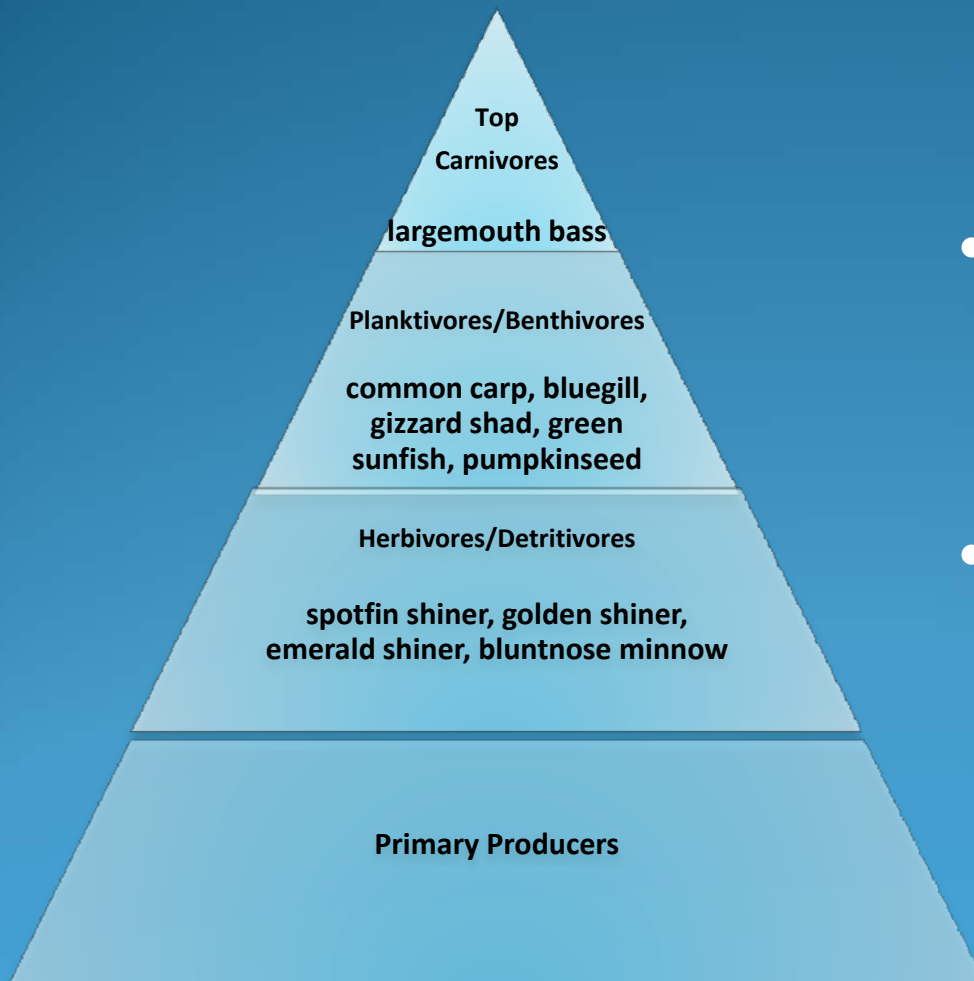
Habitat Assessment of the CAWS

- Assess physical habitat characteristics
- Develop Habitat index specific to the CAWS
- Habitat Index & fish data used to assess relative importance of physical habitat compared to other WQ factors
- Navigation also found to be limiting aquatic life uses
- Assess if the feasible habitat improvements could lead to improvements in the fish community

Findings of Habitat Improvement Report Relative to Dissolved Oxygen

- Habitat factors explain most variation in fish
- DO less important factor than physical habitat (changing DO levels will not positively impact aquatic life)
- Making feasible changes in CAWS habitat is unlikely to improve fish community significantly
- Goal should be to protect current fish assemblage – more stringent DO standards will not make any difference in aquatic community
- Goal to have sustainable populations of game fish species that can tolerate permanent habitat features in the CAWS, e.g. Largemouth bass and other sunfish

The current fish community consists of a select group of tolerant or moderately tolerant species



- These fish represent 92% of the total number (25,493) of fish collected in the CAWS from 2001 to 2008.
- Less than 2% of the total fish collected were intolerant.

Habitat Evaluation and Improvement Study Results

Reach	CAWS Habitat Index Score	Potential Index Score After Habitat Improvement
Upper North Shore Channel	75	80
Lower North Shore Channel	60	71
Upper North Branch Chicago River	49	58
Lower North Branch Chicago River	47	56
Chicago River	45	45
South Branch Chicago River	34	47
Bubbly Creek	37	48
Chicago Sanitary and Ship Canal	34	43
Cal-Sag Channel	37	44
Little Calumet River	52	57

District-Proposed Aquatic Life Use Categories

- Modified Warm Water Aquatic Life Waters (Category 1)
- Limited Warm Water Aquatic Life Waters (Category 2)
- Severely Limited Aquatic Life Waters (Category 3)

Summary of Factors Affecting Use Designations

Factor	Category 1	Category 2	Category 3
PRIMARY			
Habitat Index Score	49-75	34-47	
SECONDARY			
Habitat features	Reaches with earthen banks Some in-stream cover Reaches with lower depths Commercial navigation generally low	Generally lack earthen banks, in-stream cover, and lower depth reaches Most commercial navigation in Category 2 Waters	Stagnant flow conditions during dry weather
Sediment quality	Majority were non-toxic	Majority in some Category 2 Waters were toxic	Majority were toxic
Differences in fish community	*CPUE Largemouth Bass = 11.9 CPUE Bluegill = 7.2	CPUE Largemouth Bass = 3.9 CPUE Bluegill = 3.8	

*CPUE = Catch Per Unit Effort

Comparison of Segment Categories for Aquatic Life Uses

Segment	IEPA (Oct. 2007)	District (May, 2011)
North Shore Channel (NSC)	A	1
Upper North Branch Chicago River (UNBCR)	A	1
Lower North Branch Chicago River (LNBCR)	B	2
North Branch Canal (NBC)	-	3
Chicago River (CR)	B	2
South Branch Chicago River (SBCR)	B	2
Bubbly Creek (BC)		3
Chicago Sanitary and Ship Canal (CSSC)	B	2
Calumet River (CaIR) from Lake MI to Torrence Av	B	1
Calumet River (CaIR) from Torrence to GCR/LCR	A	
Lake Calumet (LC)	A	1
Lake Calumet Connecting Channel (LCCC)	B	2
Grand Calumet River (GCR)	A	3
Little Calumet River North (LCRN)	A	1
Calumet-Sag Channel (CSC)	A	2
Side channels & boat slips (unspecified)	-	3

Differences between District and IEPA proposals shown in red

Basis for Proposed District DO Criteria

- Other highly modified urban waters have DO criteria in the range of 1.5 – 2.0 mg/L
 - Milwaukee River
 - Ohio Cuyahoga River Ship Channel
 - Houston Ship Channel
 - Patapsco River
- USEPA DO Criteria Document
 - Acute DO limit for adult life stages is 3.0 mg/L
- Current Illinois General Use DO Standard
 - Minimum of 3.5 mg/L for acute protection of aquatic life

Selection of DO Criteria Levels

- Proposed criteria are more stringent than what is needed to *support the existing biotic communities* in these segments
- District is maintaining Illinois EPA's minimum DO criterion (during dry weather)
 - Category 1
 - District proposes daily minimum DO standard of 4.0 mg/L
 - Category 2
 - District proposes daily minimum DO standard of 3.5 mg/L
 - Category 3
 - Narrative criteria to protect against odors and to protect limited ecological functions and biotic assemblages

Comparison of DO Criteria Proposals

Category	IEPA		District
	Minimum (mg/L)	7-Day Mean of Minima (mg/L)	Minimum (mg/L)
A or 1	5.0 (Mar-Jul) 3.5 (Aug-Feb)	4.0 (Aug-Feb)	4.0
B or 2	3.5	4.0	3.5
3	-	-	Narrative

District proposal includes a Wet Weather Limited Aquatic Life Use standard that supersedes the criteria above during some defined wet weather impacted periods

“Early Life Stage Present” Requirement

- Limited physical and modified hydrologic conditions will not support spawning of sensitive fish species that require higher DO
- No evidence that these species are spawning or could spawn due to habitat limitations
- If early life stages of more tolerant fish are present, they do not need higher DO
 - Example: Juvenile largemouth bass can tolerate DO of 2.0 mg/L or periodic hypoxic exposure

7-day mean of daily minima standard

- Minimum criterion of 4.0 mg/L will protect Category 1 waters
- EPA's criterion is intended to protect fish communities from predictable consistent daily low DO concentrations that may occur due to diurnal DO fluctuations
 - Diurnal DO fluctuations rarely occur in deep draft waters in the CAWS
 - Low DO is unpredictable, infrequent (at most stations), and transient based on weather conditions
 - Fish are able to avoid the low DO areas caused by wet weather events as evidenced by rare fish kill events
- Standard is not necessary to support the existing biotic community and would not likely improve the community

Basis for Wet-Weather Limited Use Designation

- DO levels are significantly reduced for up to a week in certain reaches
- Existing biotic community appears to tolerate these conditions (no fish kills except for extremely rare occurrences)
- Criteria cannot be met during and for periods after wet weather events
- District is proposing a trigger be established to determine when wet weather limited use applies
- Limited use would apply when: (1) precipitation is more than 0.25 inch; (2) depression of DO below criteria occur during the wet weather event; and (3) DO was above criteria before the event

The Wet Weather Limited Use (WWLU) Trigger

Rainfall (inches)	Time After Day of “Trigger” to Apply WWLU Designation
<0.25 to 0.49	2 Days
0.5 to 1.0	4 Days
> 1.0	6 Days

- In lieu of criteria sources would be subject to appropriate operational requirements set forth in applicable permits (for sources such as MS4s) or Long-term Control Plans (for CSOs)
- The dissolved oxygen criteria would apply all other times

Estimated Cost of Technologies to Meet IEPA Versus District Proposed DO Standards for the CAWS

	IEPA Proposal	District Proposal
Number Supplemental Aeration Stations	28	2
Number Flow Augmentation Stations	3	1
Total Capital Cost	\$594,300,000	\$54,300,000
Annual O&M Cost	\$3,900,000	\$530,000
Total Present Worth Cost	\$669,900,000	\$64,600,000

Level 5 cost estimate using DUFLOW water quality model for 100% compliance. Provided by AECOM

District Financial Impact

- Current capital program at \$2.3B
- Priority for TARP and existing Capital Improvement Plan
- Non-Referendum Bond Authority Limited
- Annual tax levy limited
- Additional energy required

Recent Activities

IPCB hearings on May 16-18, 2011

District testimony on

- LimnoTech Habitat Reports
- District proposal for CAWS uses and standards
- Costs to achieve IEPA versus District proposed DO standards

Current Status and Future Direction for Aquatic Life Use Subdockets

- More Aquatic Life Use Designation (Subdocket C) hearings on June 27 and August 15-17
- District currently formulating draft regulatory language to more clearly convey its proposed aquatic life use standards to IPCB
- Several parties have motion before IPCB to stay hearings in Subdocket D scheduled for October 25-27 until first order of rulemaking is issued in Subdocket C
- IPCB would like to complete hearings for all Subdockets of the CAWS UAA by the end of 2011

IEPA-Proposed Recreational Uses

October, 2007

- **Incidental Contact Recreation**: Human contact with water is incidental and the probability of ingesting appreciable quantities of water is minimal (fishing and paddling)
- **Non-Contact Recreation and Non-Recreational**: Human contact with the water is unlikely, such as pass through commercial navigation, and where physical or hydrologic configurations make direct human contact unlikely or dangerous.
- No water quality criteria for bacteria
- Effluent bacteria limit of 400 Fecal coliform/100 mL (WRPs to Disinfect)

Proposed Recreational Uses

Primary Contact

2nd Order June 16, 2011

Incidental Contact

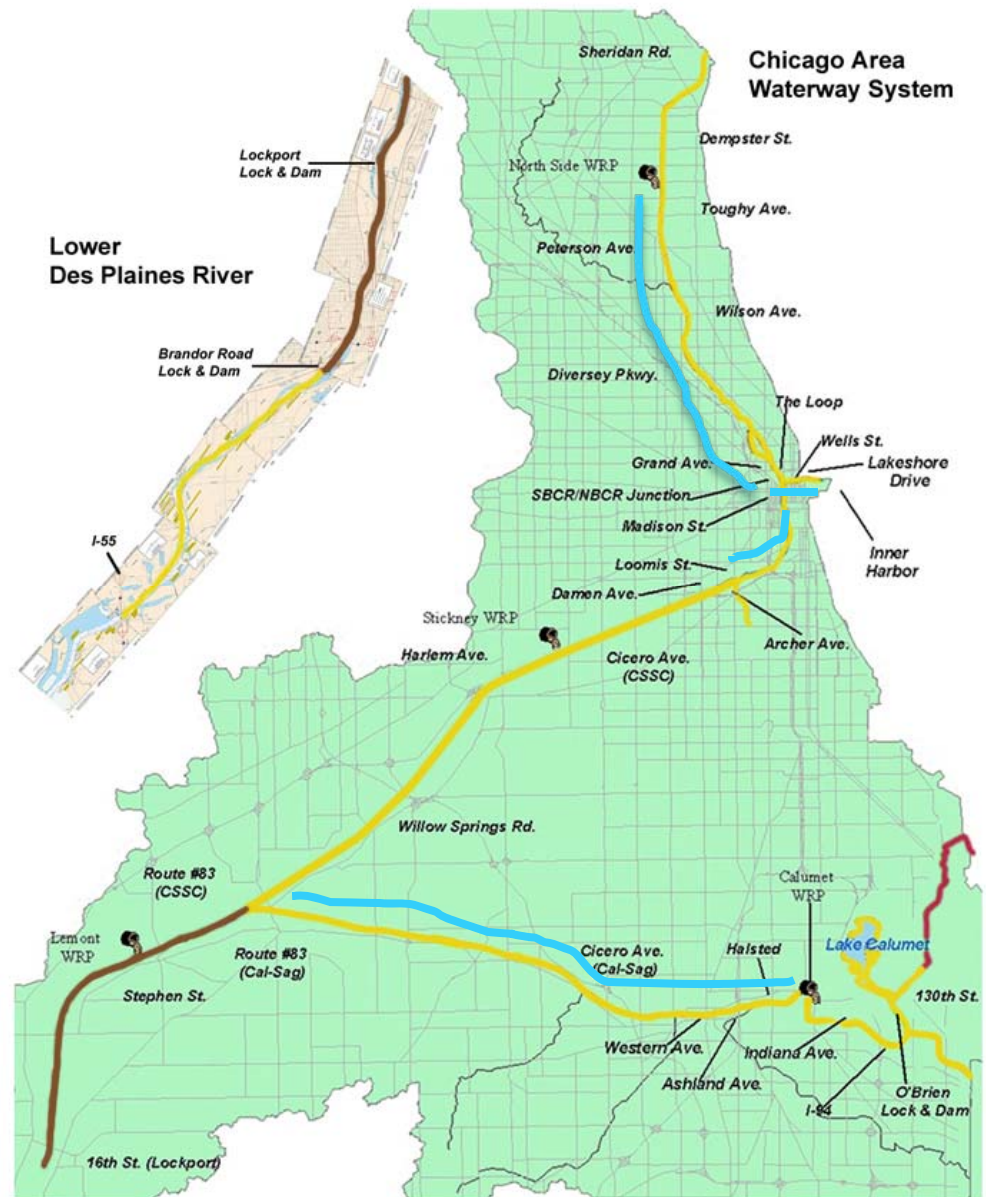
is where the probability of ingestion of water is unlikely

Non-Contact

is where human contact with water is unlikely

Non-Recreational

is where no recreational boating is likely



Research Projects/Public Health Studies

- Engineering study to evaluate disinfection technologies and estimate cost of implementation
- Characterize fecal coliform content of CAWs during dry and wet weather conditions
- Engineering study to evaluate feasibility and estimate cost of capturing and treating CAWs CSOs
- Conduct expert review of USEPA criteria for developing secondary contact recreation bacteria standards for CAWs
- Conduct assessment of microbial risk of recreating on CAWs with and without effluent disinfection
- Conduct epidemiological study to determine the incidence of illness among recreators that are exposed to the CAWS through secondary contact recreational activities.

Studies to Inform Disinfection

- **Expert Review USEPA's Water Quality Criteria for Bacteria (1986): Application to Secondary Contact Recreation**
 - EPA 1986 criteria not suitable for effluent dominated waters
 - Recommendation: perform a risk assessment, epi study
- **Risk Assessment – 2005, 2006**
- **Epidemiology Study (CHEERS) 2007 - 2009**

Microbial Risk Assessment of the CAWS

- Evaluated the human health impact of disinfecting versus not disinfecting effluents from three large (250 to 800 mgd) plants.
 - Determine the risk of gastrointestinal illnesses from exposure to pathogens from incidental contact recreation during dry and wet weather.
 - Pathogens (viruses, protozoa, bacteria) and indicator microorganisms (fecal coliform, *E. coli*, Enterococci) were measured upstream, downstream, and at the outfalls of each plant.
 - Canoeing, pleasure boating, and fishing were assessed. Exposure parameters and pathogen concentrations were combined in a probabilistic analysis to derive projected health risk distributions.
 - Pathogen concentrations very low and incidental contact recreation results in low probability of developing gastrointestinal illness.
-
- Study concluded that effluent disinfection would have virtually no effect on overall risk

The Chicago waterway microbial risk assessment study shows no elevated health risk to boaters, fishermen and paddlers

Results

WHAT IS THE CURRENT RISK OF ILLNESS?

Total Expected Illnesses per 1,000 Exposures Using Estimates of Pathogen Concentrations^a

WITH NO DISINFECTION

Exposure Input ^b	Waterway		
	North Side	Stickney	Calumet
Dry Weather	0.36	1.28	0.10
Wet Weather	2.78	2.34	0.36
Combined Weather Samples	1.53	1.74	0.20

WITH DISINFECTION

	Waterway		
	North Side	Stickney	Calumet
No Disinfection	1.53	1.74	0.20
UV Irridation	1.32	1.48	0.17
Ozone	1.45	1.65	0.19
Chlorination	1.43	1.63	0.19

a Includes all primary gastrointestinal illnesses from estimated pathogenic *E. coli*, *Salmonella*, enteric viruses, adenoviruses, *Calicivirus*, *Giardia*, and *Cryptosporidium* expected from the waterway exposures.

b CAWS concentration inputs for the simulations were randomly selected (bootstrap sampled) from the sample data sets

Conclusions

The microbial health risks associated with non-swimming recreational practices on the CAWS are below the risk threshold that EPA applies to criteria for swimming.

Disinfection has virtually no effect on overall risk reduction.



Recipient of 2010 American Academy of Environmental Engineers Research Honor Award for the Excellence in Environmental Engineering & public health/environmental protection

CHICAGO WATERWAY EPIDEMIOLOGY RESEARCH

The Chicago Health Environmental Exposure and Recreation Study (CHEERS) was conducted by the University of Illinois – Chicago School of Public Health.

CHEERS is the first US Epidemiology study for fishing, paddling and motor boating conducted on the CAWS secondary contact water

Modeled after US EPA's National Epidemiological and Environmental Assessment of Recreational Water (NEEAR) study and the CHEERS was independently peer reviewed by selected USEPA, Academia, consultants, Center for Disease Control (CDC) personnel.

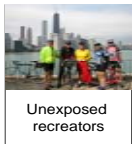
Study recruited 11,297 participants including recreators on the CAWS and General Use waters (such as Fox and Des Plaines Rivers, forest preserve lakes, Lake Michigan) over three recreation seasons from 2007 through 2009.



Illness Cases Compared with Non-Water Recreation (UNX) as the Reference Group

ILLNESS PER 1,000	Gastrointestinal	Eye Symptoms	Respiratory	Skin	Ear
CAWS	12.5	15.5*	-1.6	- 4.7	2.4
GUW	13.4	5.4	1.7	-11.1	1.6

**CAWS mild eye symptoms - comparable to GUW with hand washing adjusted analysis*



Unexposed
recreators



General use
recreators



CAWS
recreators

GUW: Lake Michigan, several small inland lakes (Busse, Crystal, Skokie Lagoons, Tampier, and others), and area rivers (Des Plaines, Fox, DuPage).

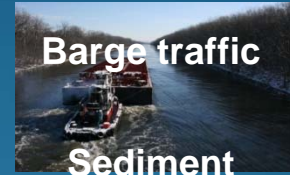
UNX: outdoor recreational activities that do not involve water (jogging, walking, cycling, playing sports). These individuals are recruited at locations and times that coincide with recruiting CAWS and GUW participants.

- Study found no difference in the disease risk to recreators between CAWS, where effluents are not disinfected and recreators in GUW where effluents are disinfected or where no effluent is discharged
- There was no relationship between high level of bacteria and occurrence of disease among people who recreated on the CAWS.
- The disease causing bacteria which are responsible for symptoms like vomiting or diarrhea among people who use the CAWS for recreation were not detected.

Sources of Bacteria



Storm water



Barge traffic

Sediment



CSO



North Shore Channel



WRP Effluent



Soil run-off,
tributaries



Wildlife

- Bacteria associated with fecal origins are present in the environment and are not unique to CAWS (USGS, 2010)

Status of Subdocket A

Recreational Use Designations

- Docket Closed and First Notice of Rulemaking was issued by IPCB in August 2010 (adopted IEPA's proposed uses)
- USEPA issues letter to IEPA on May 11, 2011 indicating intent to exercise discretionary authority to impose primary contact use designations on most of the CAWS
- IPCB Second Notice on Subdocket A (Recreational Uses) issued June 2, 2011 incorporated USEPA's recommendations and allows one week for comments.
- IPCB needs to complete JCAR review and issue final notice of rulemaking by August to comply with state statutes

Status of Subdocket B

Effluent Limitations (Recreational Criteria)

- Docket closed February 2011 IPCB deliberating on first notice of rulemaking
- USEPA May 2011 letter directs IEPA to establish protective water quality criteria for new primary contact use designation (not currently included in the subdocket)
- MWRD Board of Commissioners voted 8-1 to pursue disinfection at North Side, Calumet WRPs on June 7, 2011
 - Capital cost is \$240 million, \$26 million annual O&M
 - The District will hold public meetings to inform and hear from affected taxpayers and businesses
 - District has requested stay of first notice of rulemaking from IPCB in Subdocket B until meetings with public, IEPA and USEPA are conducted.