

# **Operating the Sidestream Elevated Pool Aeration Stations to Meet the Proposed Water Quality Standards on the Calumet-Sag Channel**

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# Purpose of Project

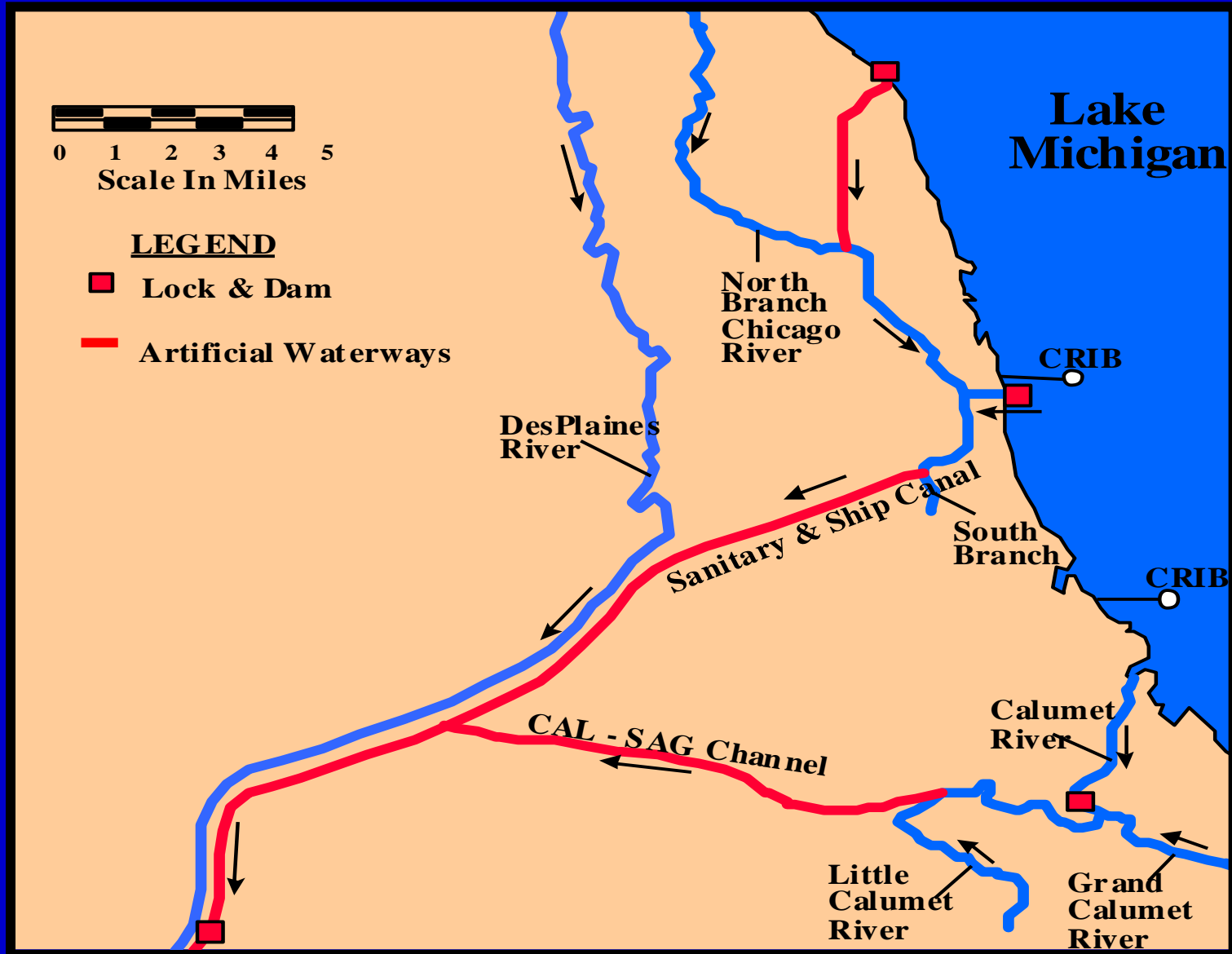
- October 26, 2007, IEPA presented proposed water quality standards for the Chicago Area Waterway System to the Illinois Pollution Control Board.
- Dissolved oxygen (DO) standards more stringent than current standards for the Calumet-Sag Channel (CSC)
- Can existing Sidestream Elevated Pool Aeration (SEPA) stations provide enough supplemental DO to meet proposed standards?

# Presentation Overview

- **Background**
  - Description of Chicago Area Waterways (specifically CSC)
  - Current and Proposed Standards for CSC
  - SEPA Station Information
- **Investigation Set-up**
- **Results**
  - SEPA Station Performance
  - Factors Affecting Performance
  - Environmental Impacts of Meeting New Standards
- **Summary**

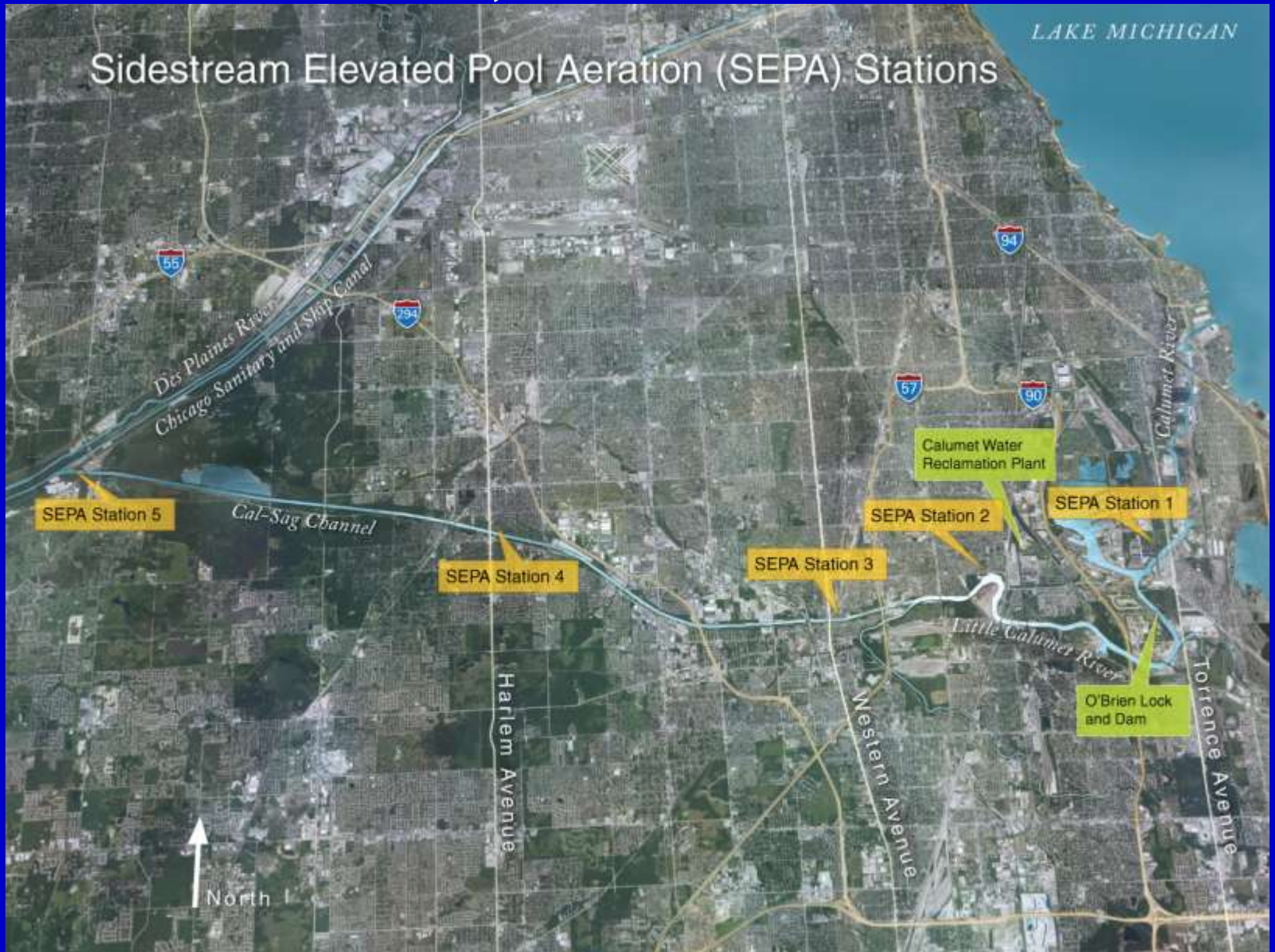
# Background

## Chicago Area Waterways



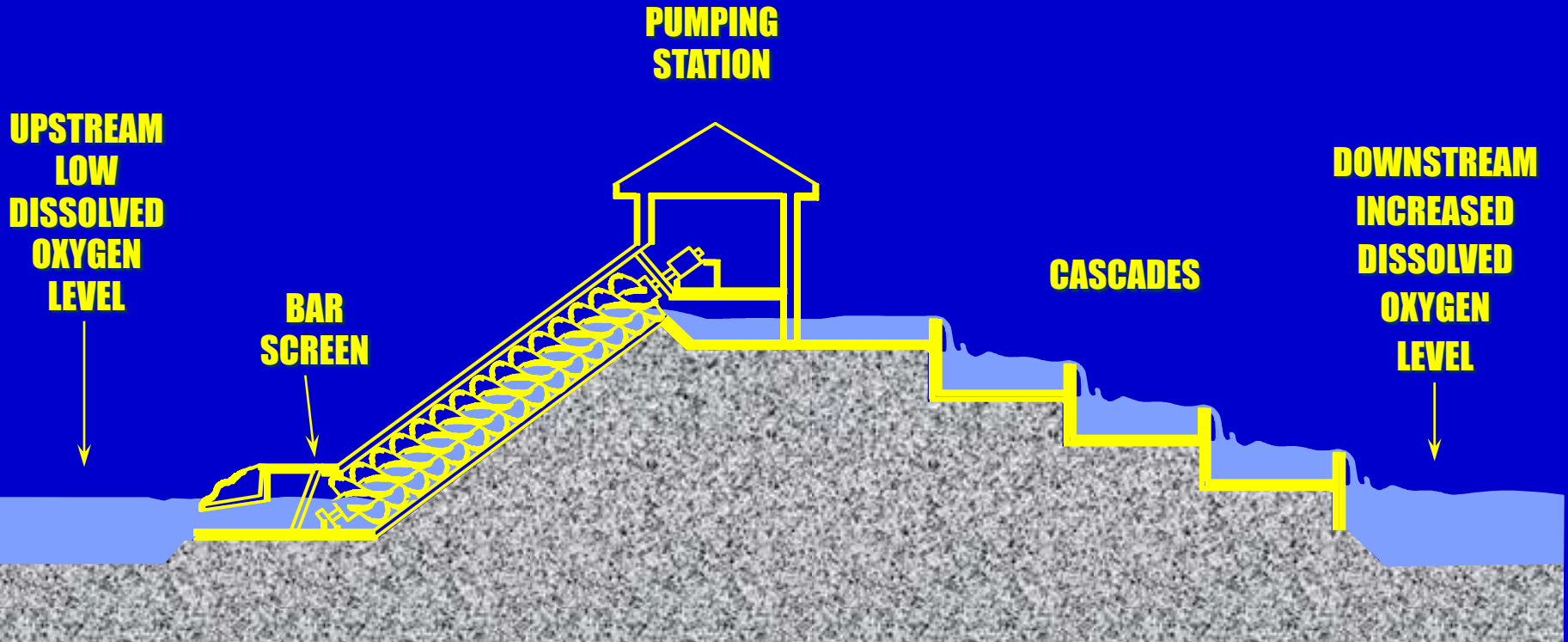
# Background

## CSC, SEPA Stations



# Background

## SEPA Stations



SEPA Station 3: 4 pumps, practical max – 3 pumps/245.7 MGD

SEPA Station 4: 4 pumps, practical max – 3 pumps/232.8 MGD

SEPA Station 5: 5 pumps, practical max – 4 pumps/297.6 MGD

# Background

## SEPA Stations



# Background

## Current and Proposed Standards for CSC

Waterway	Current Year-Round	Proposed	
		March-July	August-February
CSC	3.0 mg/L	5.0 mg/L anytime	3.5 mg/L anytime, 4.0 mg/L as daily minimum

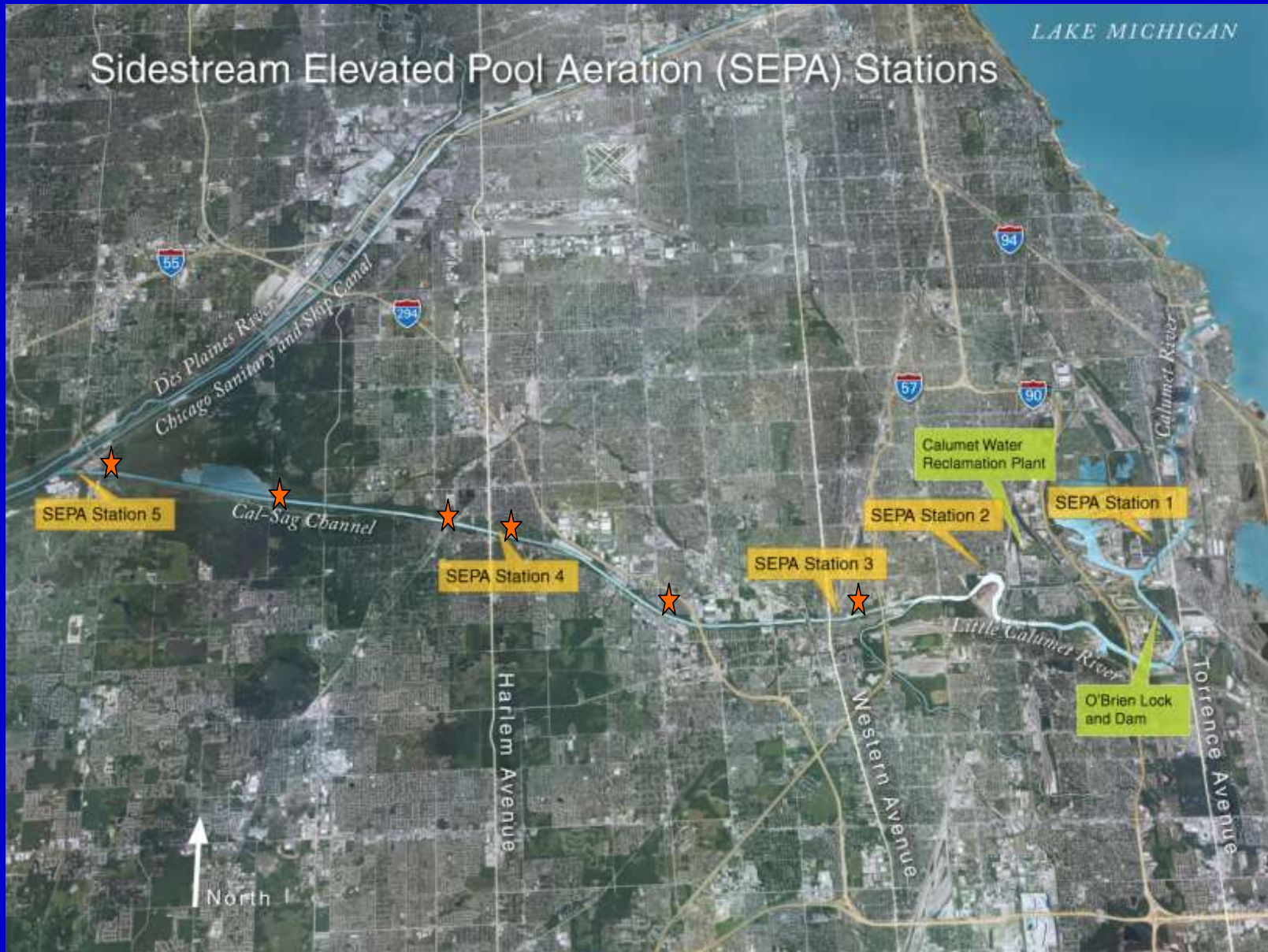


# Experimental Set-Up

- Four Events
  - Event 1, Spring: 5/1/2008 to 5/21/2008
  - Event 2, Early Summer: 7/10/2008 to 7/31/2008
  - Event 3, Summer: 8/11/2008 to 8/22/2008
  - Event 4, Early Fall: 9/22/2008 to 10/3/2008
- Pump Operation Set Points Adjusted
- Monitoring Station Locations
  - 6 stations along the CSC
  - 3 stations along the Chicago Sanitary and Ship Canal (CSSC)
- Water Quality Monitoring
  - DO, temperature, and conductivity
  - Continuous monitors – hourly measurement
  - YSI Model 6920 or Model 6600
  - Data downloaded weekly and reviewed for quality assurance according to the existing CDOM program (86% data recovery rate)

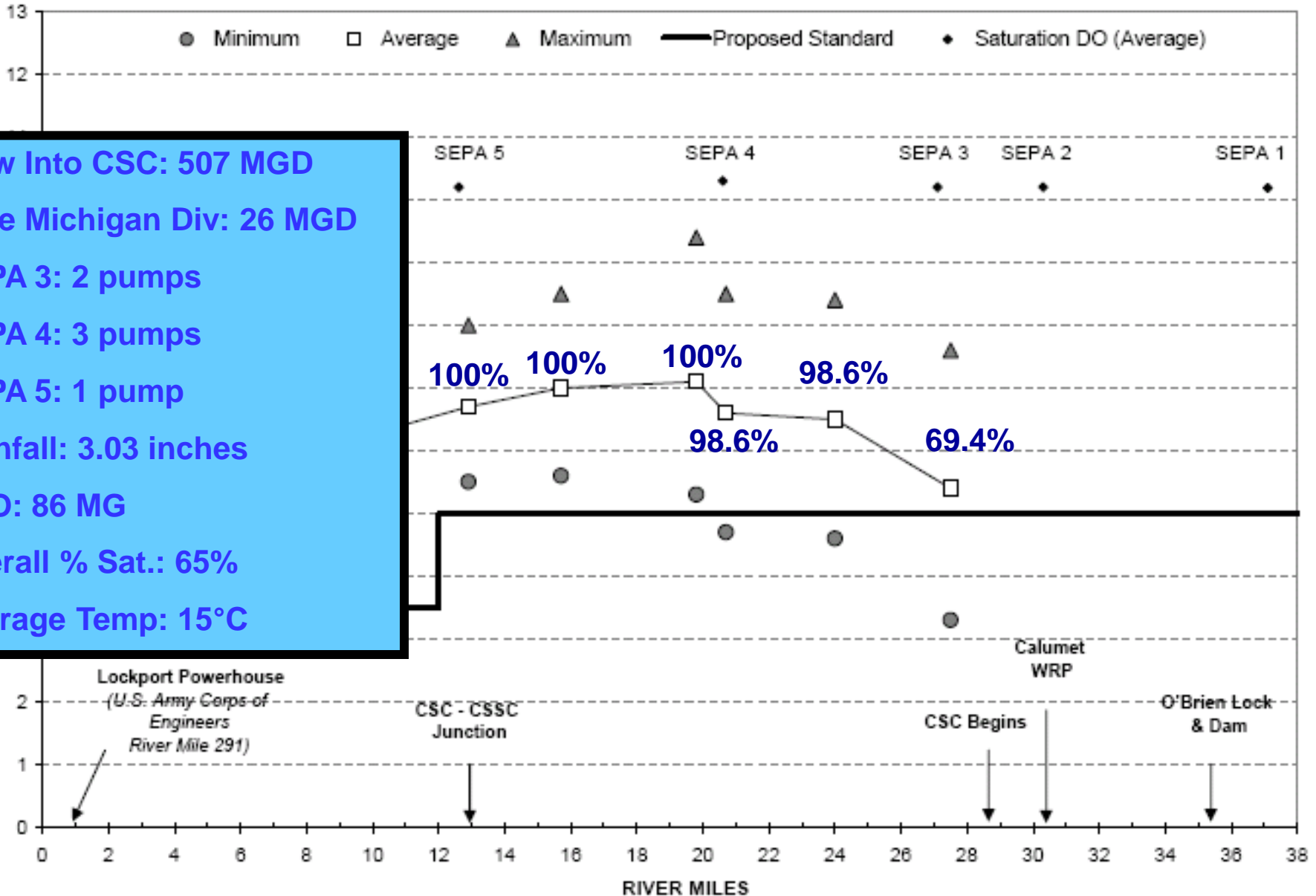
# Experimental Set-Up

## Monitoring Stations



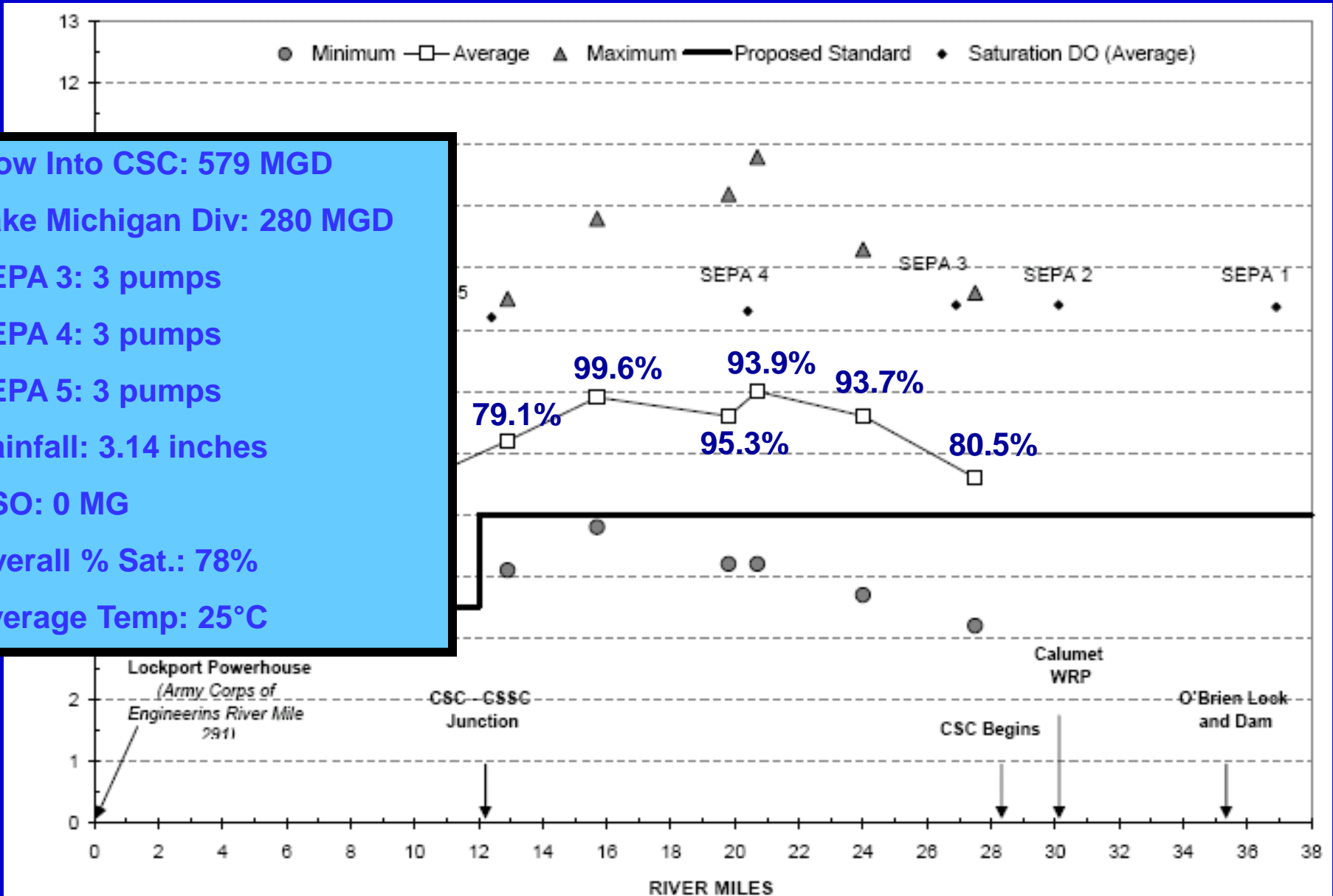
# Results

## Event 1 (Spring) – DO Concentration



# Results

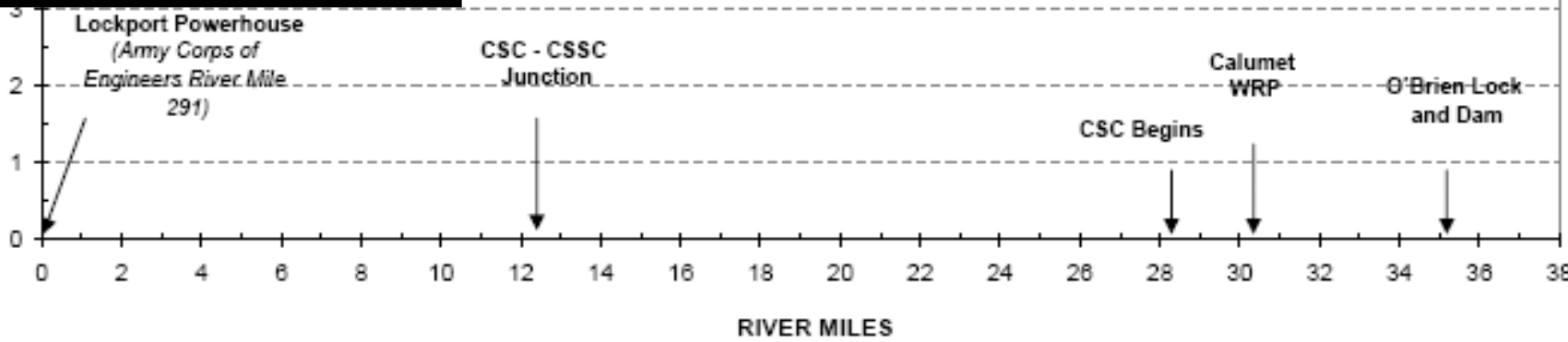
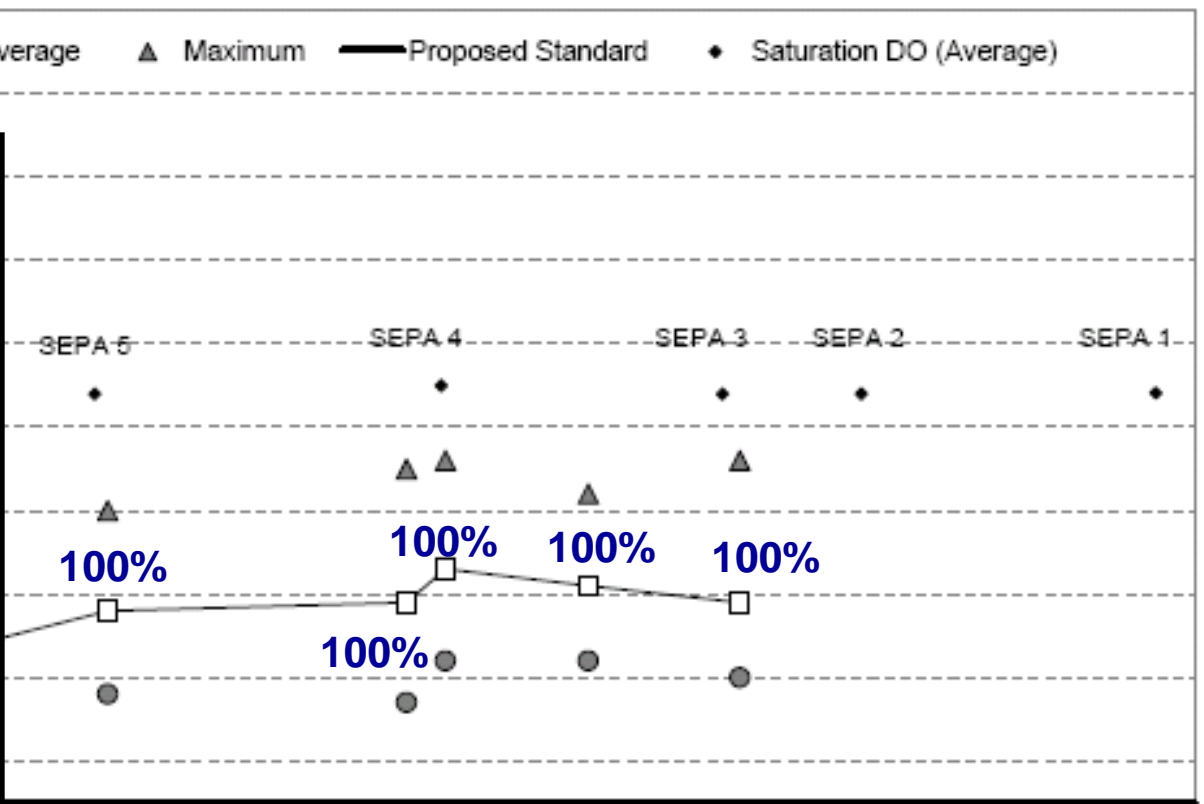
## Event 2 (Early Summer) – DO Concentration



# Results

## Event 3 (Summer) – DO Concentration

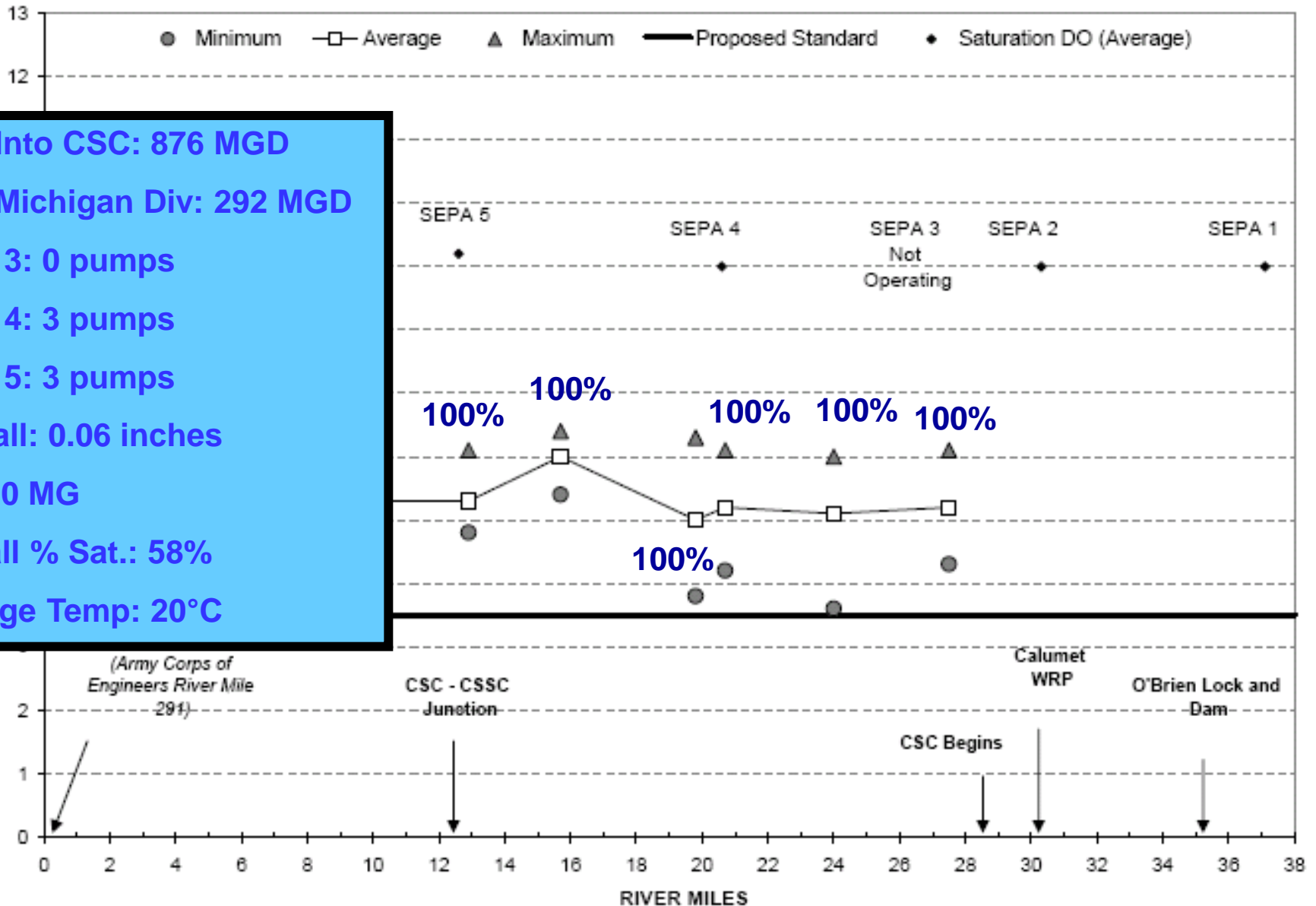
**Flow Into CSC: 640 MGD**  
**Lake Michigan Div: 419 MGD**  
**SEPA 3: 2 pumps**  
**SEPA 4: 2 pumps**  
**SEPA 5: 3 pumps**  
**Rainfall: 0.09 inches**  
**CSO: 0 MG**  
**Overall % Sat.: 71%**  
**Average Temp: 24°C**



# Results

## Event 4 (Fall) – DO Concentration

**Flow Into CSC: 876 MGD**  
**Lake Michigan Div: 292 MGD**  
**SEPA 3: 0 pumps**  
**SEPA 4: 3 pumps**  
**SEPA 5: 3 pumps**  
**Rainfall: 0.06 inches**  
**CSO: 0 MG**  
**Overall % Sat.: 58%**  
**Average Temp: 20°C**



# Results

## DO Mass in CSC (Event 1)

### Average Daily Dissolved Oxygen Mass in the Calumet River System

During Event 1



### Average Daily Dissolved Oxygen Concentration in the Calumet River System

During Event 1



<sup>1</sup> DO concentration of Little Calumet River (South) measured 0.5 miles above junction with the Calumet-Sag Channel.

<sup>2</sup> DO concentration of Grand Calumet River measured 150 feet above junction with the Little Calumet River (North).

<sup>3</sup> No discretionary diversion during Event 1

# Results

## Electricity Usage and Estimation of Emissions

Event	SEPA 3 Operating (Additional)	SEPA 4 Operating (Additional)	Total Additional Pumps
1 Spring	2 (1)	3 (2)	3
2 Early Summer	3 (2)	3 (2)	4
3 Summer	2 (1)	2 (1)	2
4 Early Fall	0 (0)	3 (1)	1

Additional Pumps Operated at SEPAs 3 and 4	Estimated O <sub>2</sub> Transferred metric ton/day	Electricity Usage		Estimated Emissions <sup>2</sup>		
		MWh/day	No. of Homes per Day Electricity Can Power <sup>1</sup>	CO <sub>2</sub> metric ton/day	NO <sub>x</sub> metric ton/day	SO <sub>2</sub> metric ton/day
Event 1: 3 Additional Pumps	3.6	21.5	717	11.9	0.019	0.069
Event 2: 4 Additional Pumps	2.6	28.6	953	15.8	0.026	0.091
Event 3: 2 Additional Pumps	1.4	14.3	477	7.9	0.013	0.046
Event 4: 1 Additional Pump	1.1	7.2	240	4.0	0.007	0.023



# Summary

Parameter	Event 1 (5/1-5/21)	Event 2 (7/22-7/31)	Event 3 (8/11-8/22)	Event 4 (9/22-10/3)
Proposed Standard (mg/L)	5.0	5.0	3.5	3.5
Average Percent DO Values Above Proposed Standard (%)	96	90	100	100
Average DO Percent Saturation (%)	65	78	71	58
Average Temperature (°C)	15	25	24	20
Average Flow into CSC (MGD)	507	579	640	876
Average Lake Michigan Diversion (MGD)	26	280	419	292
Total Rainfall (Inches)	3.03	3.14	0.09	0.06
CSO Directly into CSC	Yes	No	No	No

# Summary

Parameter	Event 1 (5/1-5/21)	Event 2 (7/22-7/31)	Event 3 (8/11-8/22)	Event 4 (9/22-10/3)
Average O <sub>2</sub> Added by SEPA 3 and 4 (metric ton/day)	5.8	3.5	2.8	3.2
Total Additional Pumps Operated to Meet Proposed Standards	3	4	2	1
Average O <sub>2</sub> Transferred by Additional Pumps	3.6	2.6	1.4	1.1
Electricity Used by Additional Pumps	21.5	28.6	14.3	7.2
CO <sub>2</sub> Produced by Additional Pumps	11.9	15.8	7.9	4.0

# Conclusions

- Proposed standard not met 100% in Events 1 and 2 (spring and early summer)
- Operation of existing SEPA stations will not provide enough supplemental DO to meet the proposed DO standard 100% of the time
- Operating pumps at SEPA stations requires a significant amount of electricity and the electricity consumption has an associated economic and environmental cost.
- Operating more pumps does not necessarily mean more oxygen transfer. Temperature greatly affects SEPA station efficiency

# Thanks to....

- Mr. David Tank and staff from the Maintenance and Operation Department for operation of the SEPA stations according to study plan
- Industrial Waste Division who deployed and retrieved the water quality monitors
- Aquatic Ecology and Water Quality Section for data downloading and maintenance of monitors

**Questions?**