



Stream Response to Phosphorus Reduction at the MWRDGC's Egan Water Reclamation Plant

2010 Illinois Water Conference

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Introduction

USEPA guidance in 2000 urged establishment of predictive relationships between nutrients and algae

Illinois EPA prompted research initiative with Council on Food and Agricultural Research (CFAR)

Uncertainty concerning appropriate nutrient standards for Illinois prompted MWRDGC to initiate Phosphorus (P) reduction demonstration project at the John E. Egan WRP (Egan).

Using filtration and ferric chloride, Egan effluent P was reduced to <0.5 mg/L



Objectives

Determine effects of P reduction at Egan WRP on downstream water quality

Explore possible effects in the paradigm:

Phosphorus → Algae → DO

Observe any subsequent effects of this paradigm shift on stream biota

Other research projects

- Effects on plant operation and solids production

- Effects on biosolids characteristics



P Reduction Demonstration Project Background Info

Egan WRP

Located in Schaumburg, IL

Design capacity of 30 MGD

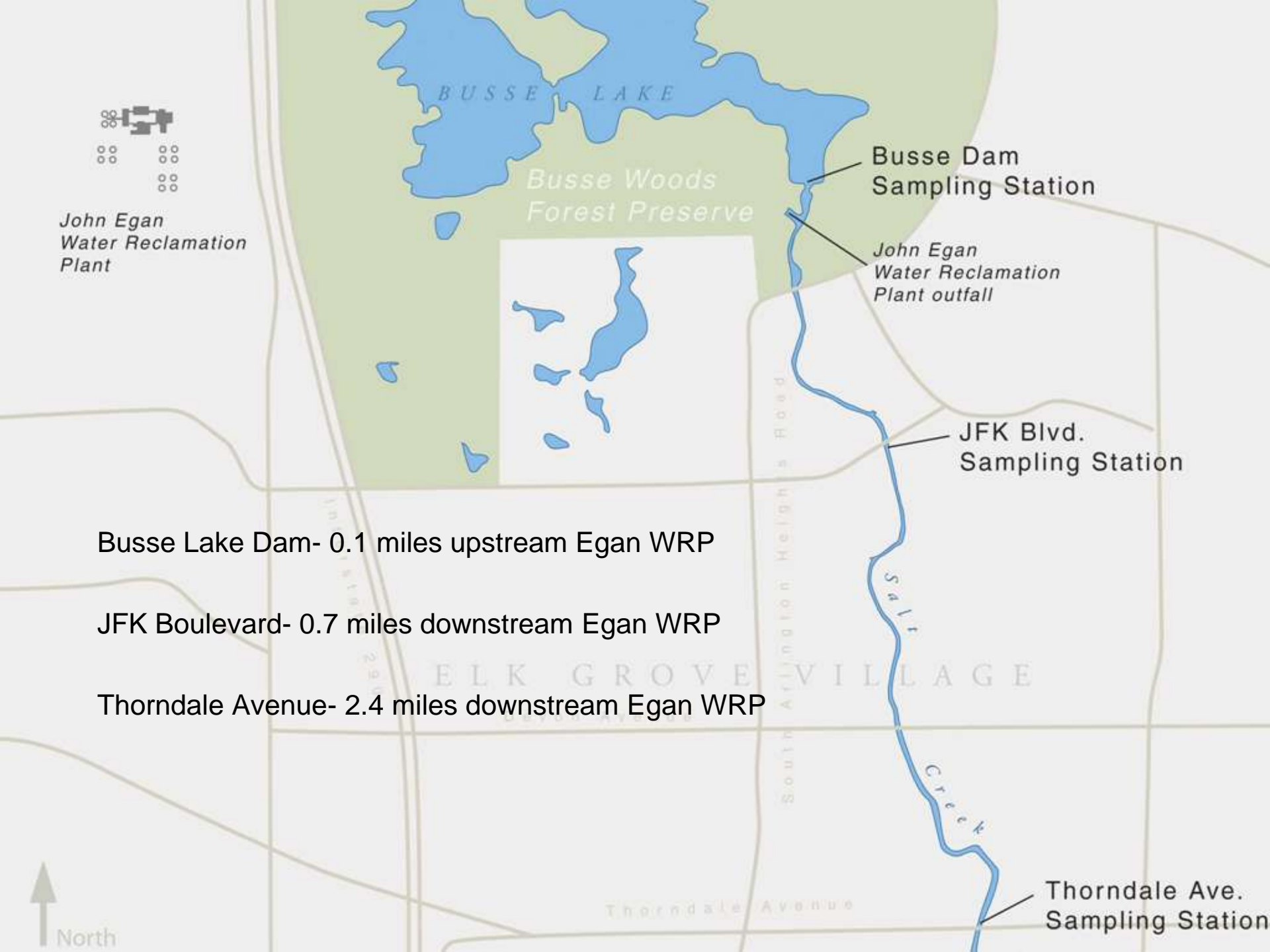
Discharges into Salt Creek

Salt Creek

General Use waterway in Northeast Illinois

Drainage area of about 150 mi²

Effluent dominated



John Egan
Water Reclamation
Plant

Busse Dam
Sampling Station

John Egan
Water Reclamation
Plant outfall

JFK Blvd.
Sampling Station

Busse Lake Dam- 0.1 miles upstream Egan WRP

JFK Boulevard- 0.7 miles downstream Egan WRP

Thorndale Avenue- 2.4 miles downstream Egan WRP



Thorndale Ave.
Sampling Station







P Reduction Demonstration Project Methodology

Water parameters

Continuous DO, Temp, pH, TSS, VSS, turbidity, BOD₅, CBOD₅, COD, TP, Ortho-P, NH₄-N, NO₃-N, NO₂-N, and chlorophyll a

Sediment chemistry

TS, TVS, TP, TKN, NH₄-N, NO₃-N+NO₂-N

Biology

Fish

Benthic Invertebrates



P Reduction Demonstration Project Methodology (continued)

Water Sampling Schedule

December-March 1x/month

April-November 2x/month

4 consecutive days after rain event (3-4 per year)

Sediment and Biological Sampling

Once each summer

Sampling Years

Pre- P reduction sampling during 2005-6

***Ferric Chloride dosing began February 5, 2007

Post- P reduction sampling during 2007-8



P Reduction Demonstration Project Phosphorus Results

Upstream of Egan at Busse Dam

	2005	2006	2007	2008
Mean P (mg/L)	0.25	0.18	0.11	0.10
Range P (mg/L)	<0.05-3.15	<0.05-0.87	0.06-0.36	0.04-0.35

Egan Effluent daily 24-hour composite samples

	2005	2006	2007	2008
Mean P (mg/L)	3.26	3.72	0.35	0.43
Range P (mg/L)	0.98-5.87	0.92-8.22	0.06-1.77	0.14-1.38



P Reduction Demonstration Project Phosphorus Results (continued)

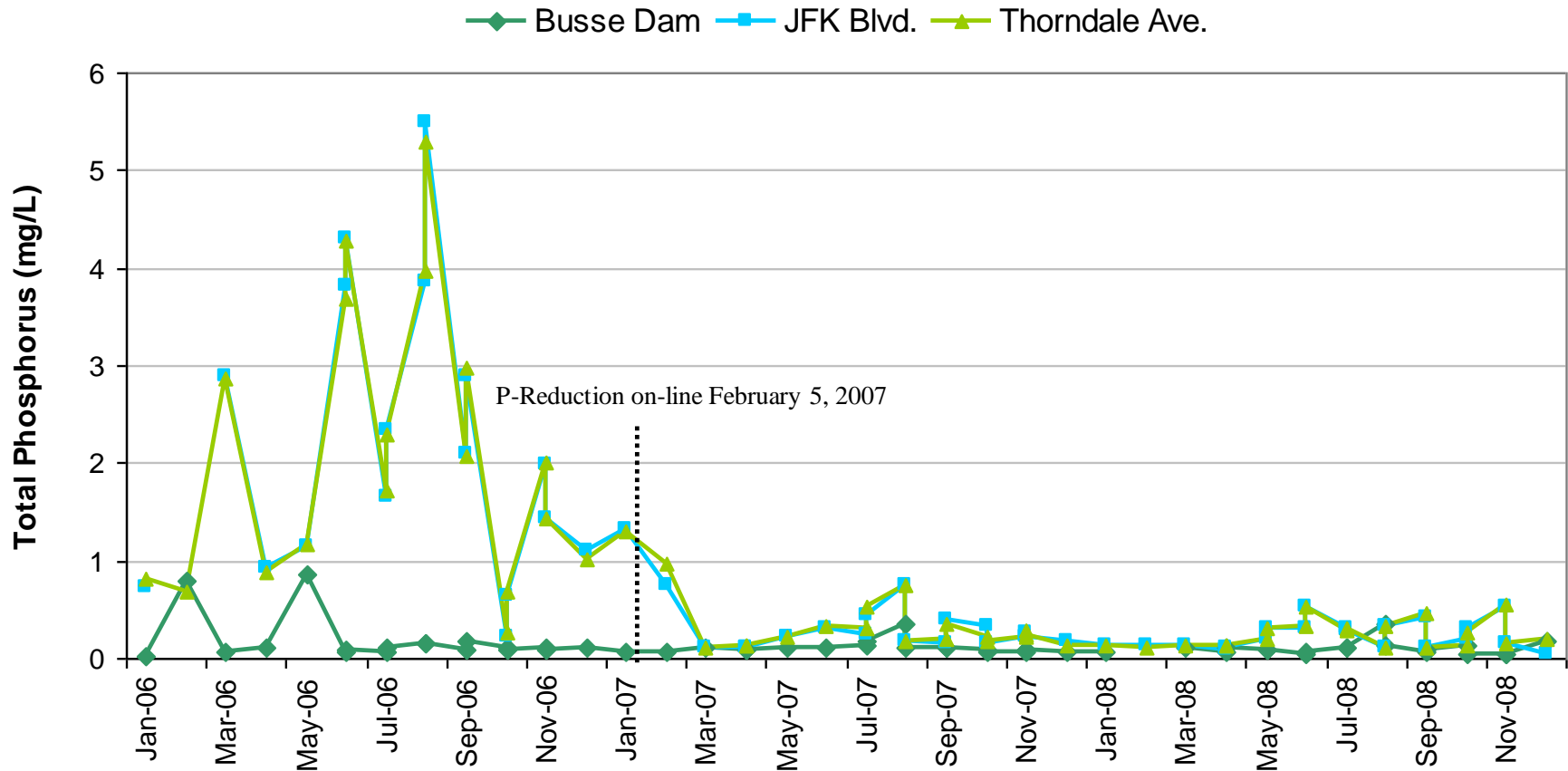
Downstream of Egan at JFK Blvd.

	2005	2006	2007	2008
Mean P (mg/L)	2.76	2.20	0.29	0.24
Range P (mg/L)	0.88-4.64	0.22-5.49	0.10-0.76	0.05-0.54

Downstream of Egan at Thorndale Ave.

	2005	2006	2007	2008
Mean P (mg/L)	2.51	2.12	0.30	0.24
Range P (mg/L)	<0.05-4.45	0.27-5.30	0.10-0.97	0.11-0.56

P Reduction Demonstration Project Phosphorus Results (continued)

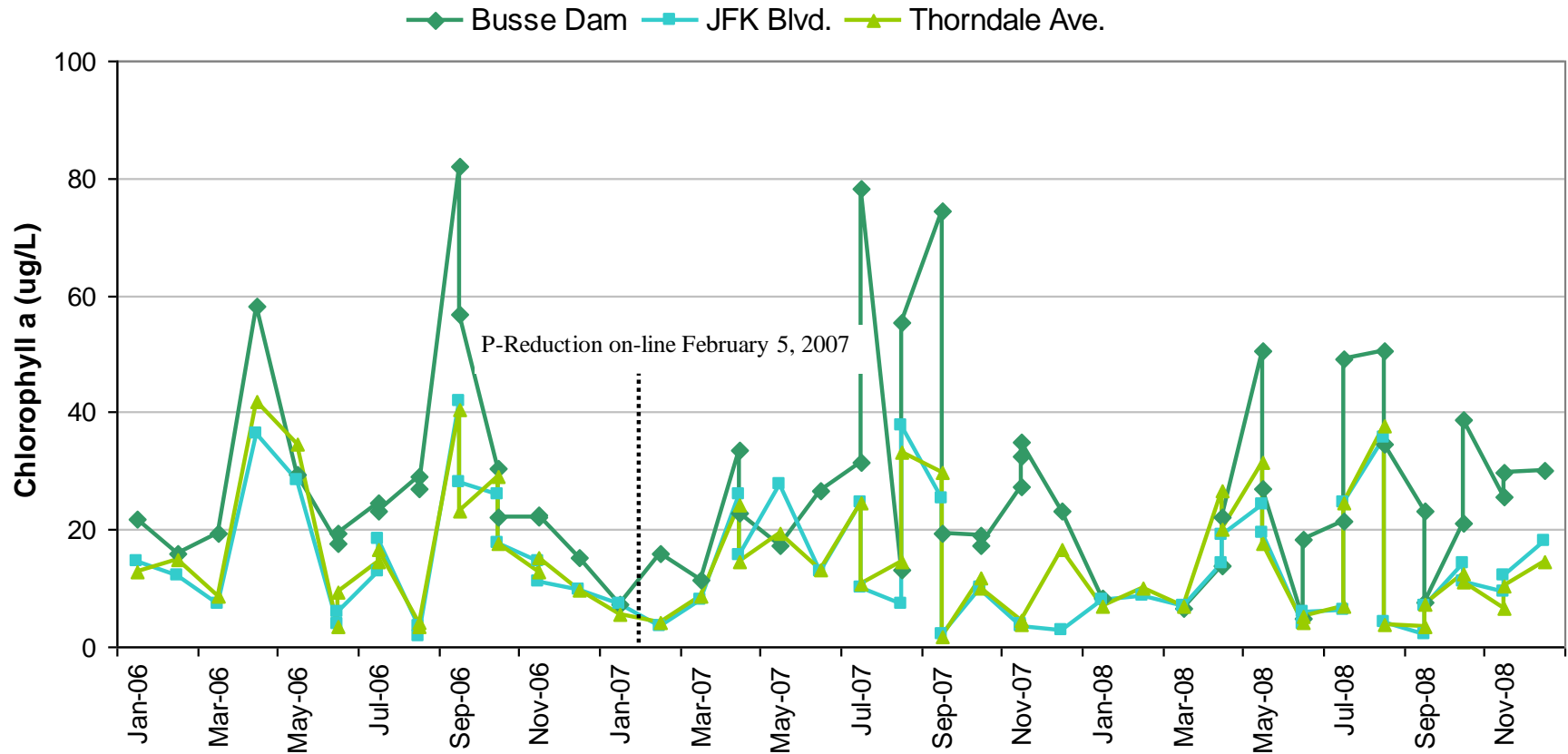


P Reduction Demonstration Project Chlorophyll *a* Results



Location		Chlorophyll <i>a</i> (µg/L)			
		2005 (pre)	2006 (pre)	2007 (post)	2008 (post)
Busse Dam	Mean	29	30	31	25
	Range	7-63	15-82	11-78	5-51
JFK Blvd.	Mean	10	16	13	13
	Range	3-29	2-42	2-38	2-36
Thorndale	Mean	11	17	14	13
	Range	3-34	3-42	2-33	4-38

P Reduction Demonstration Project Chlorophyll *a* Results (continued)

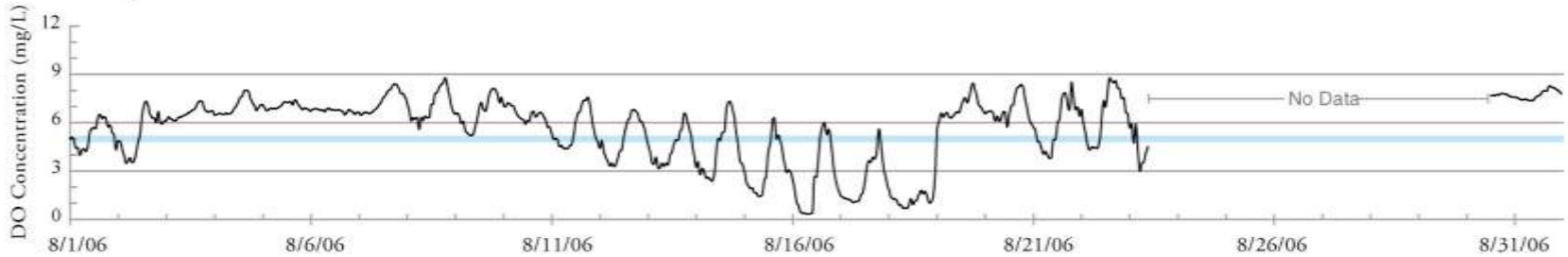




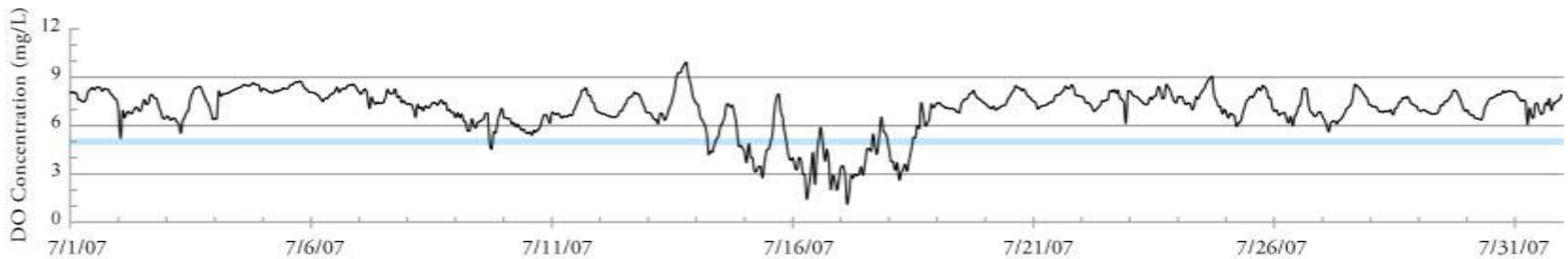
Continuous DO Comparison During Summer Months in 2006, 2007, and 2008

Busse Lake Dam monitoring station

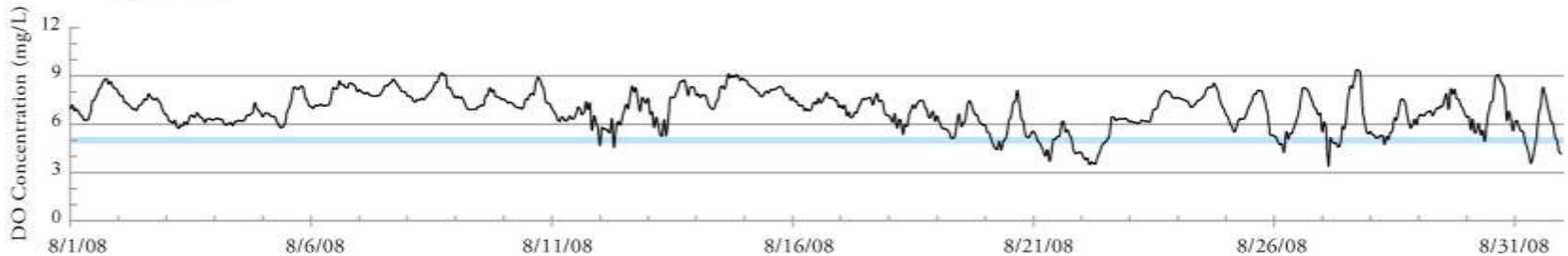
August 2006



July 2007



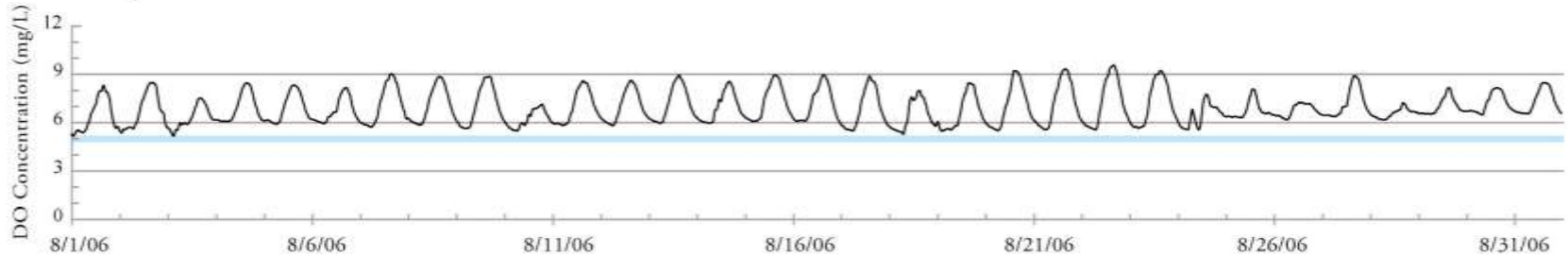
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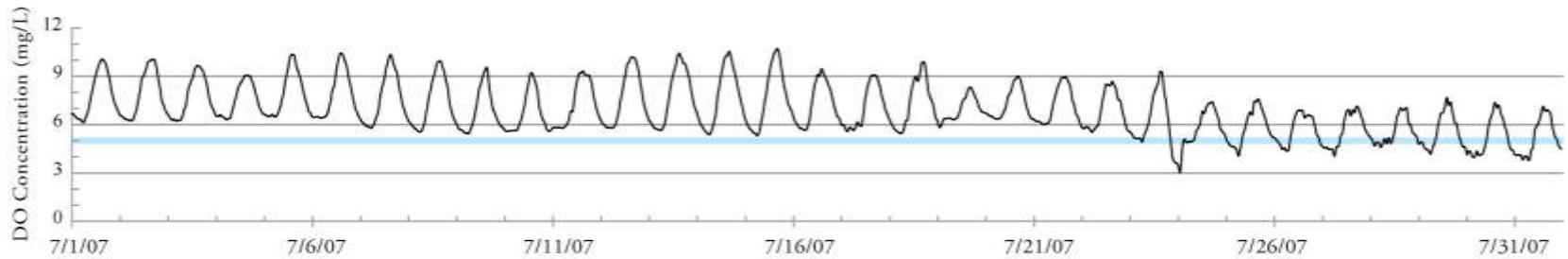
Continuous DO Comparison During Summer Months in 2006, 2007, and 2008

JFK Boulevard monitoring station

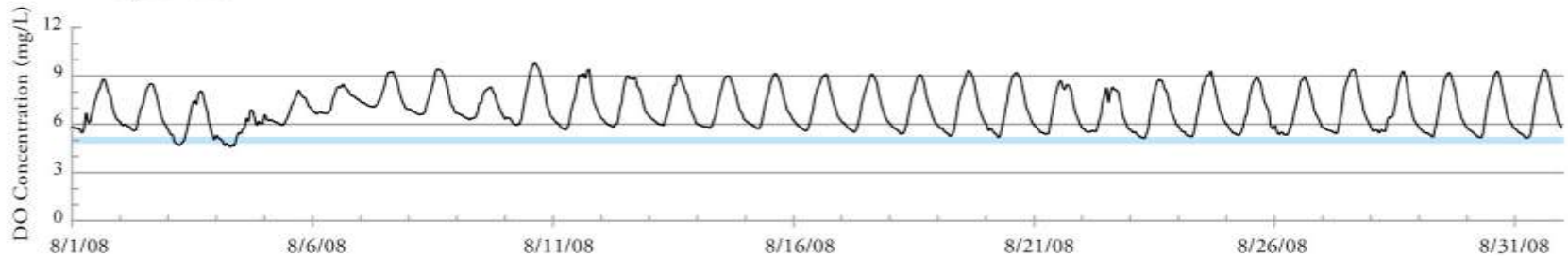
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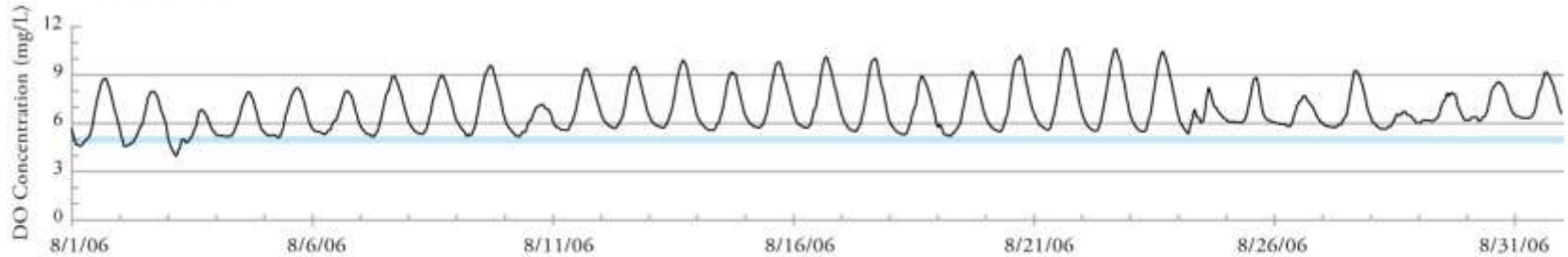
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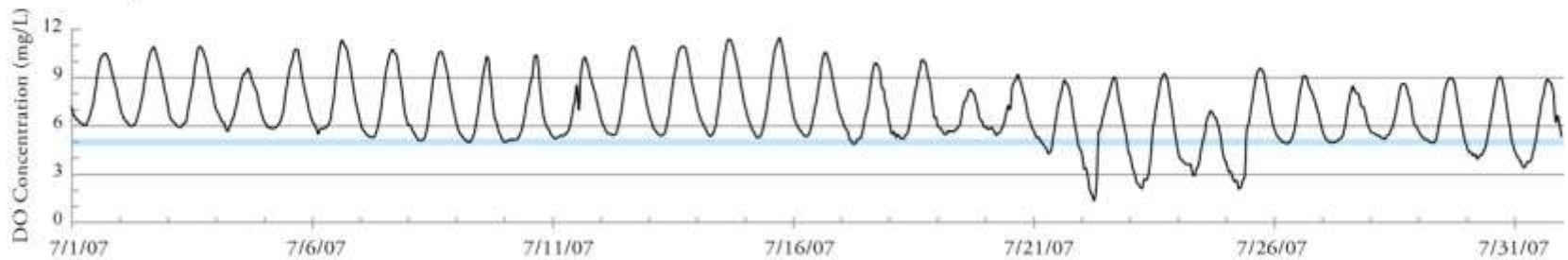
Continuous DO Comparison During Summer Months in 2006, 2007, and 2008

Thorndale Avenue monitoring station

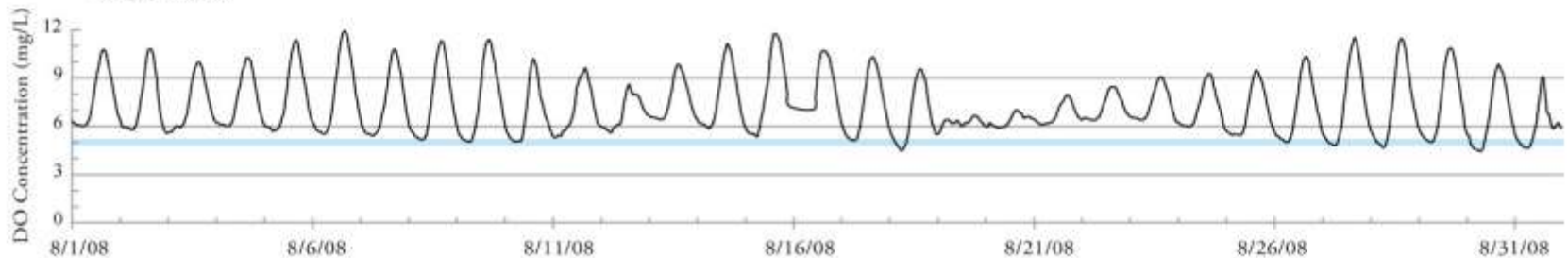
August 2006



July 2007



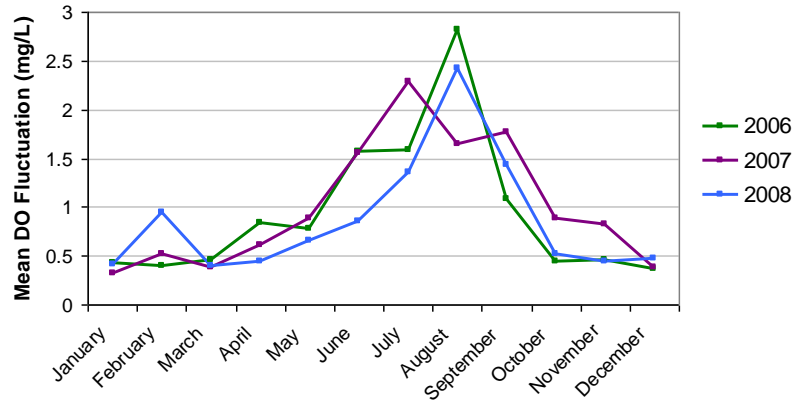
August 2008



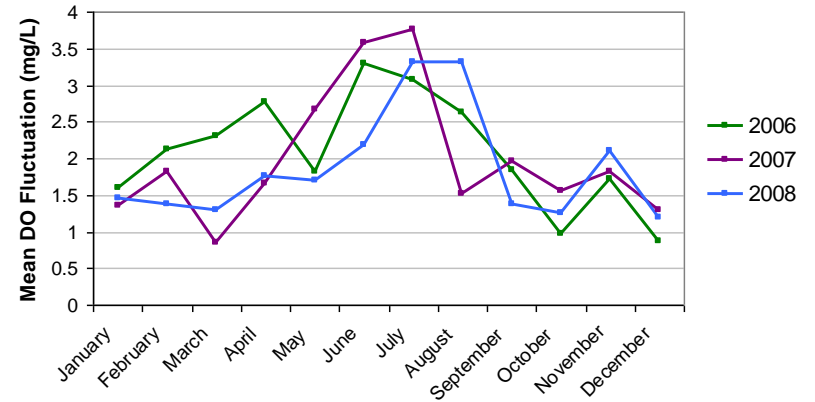


Mean Monthly DO Fluctuation Before (2006) and After (2007, 2008) P Reduction

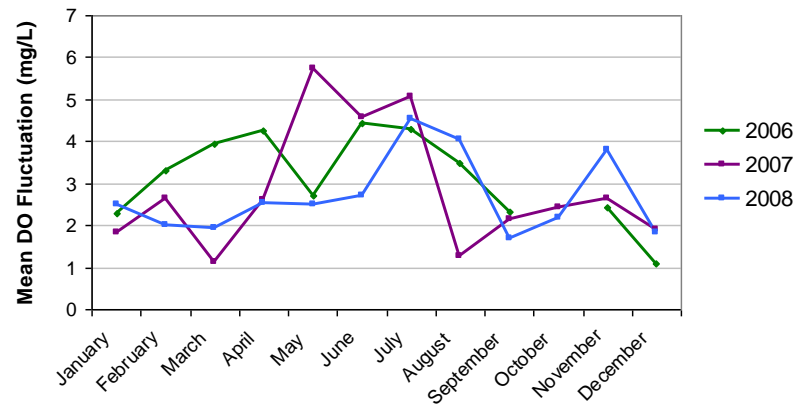
Busse Dam



JFK



Thorndale



P Reduction Demonstration Project

Sediment Chemistry Results

Busse Dam

YEAR	CREEK LOCATION	TP (mg/kg)
2005	side	84
	center	141
2006	side	46
	center	94
2007	side	4
	center	6
2008	side	251
	center	189

JFK

YEAR	CREEK LOCATION	TP (mg/kg)
2005	side	218
	center	222
2006	side	37
	center	11
2007	side	382
	center	705
2008	side	338
	center	424

Thorndale

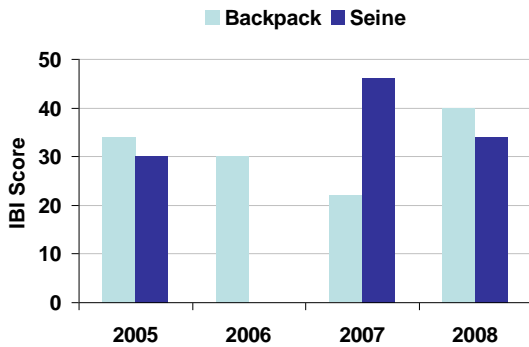
YEAR	CREEK LOCATION	TP (mg/kg)
2005	side	1,202
	center	460
2006	side	11
	center	42
2007	side	336
	center	557
2008	side	113
	center	218



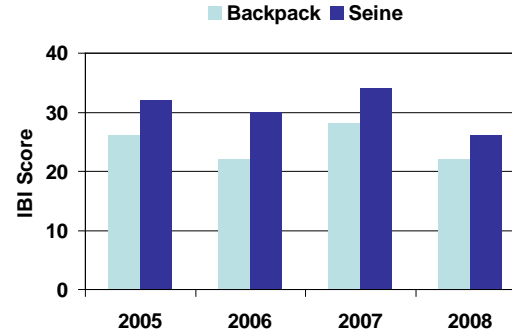
P Reduction Demonstration Project Fish Results



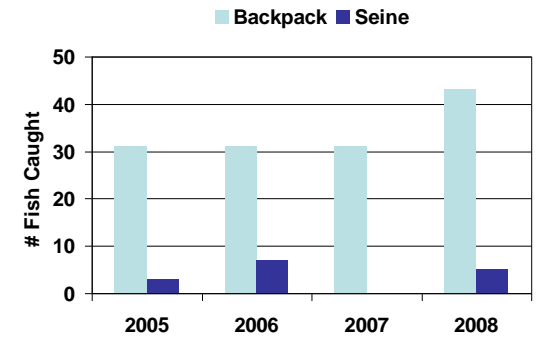
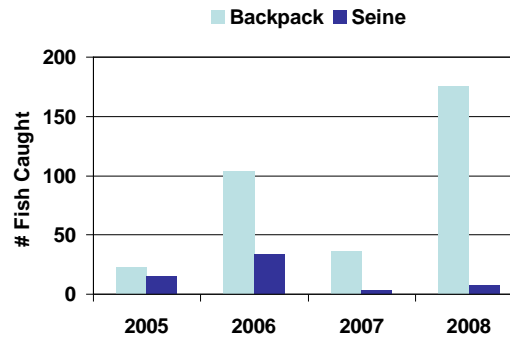
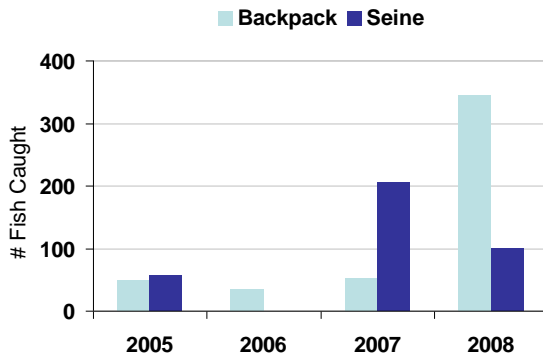
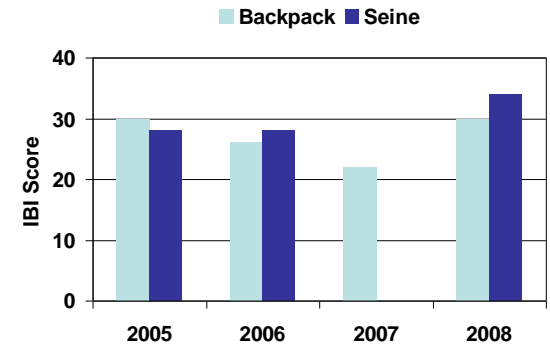
Busse Dam



JFK



Thorndale

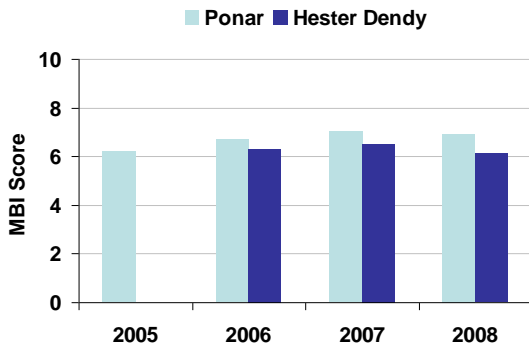


Higher IBI values are indicative of better water quality

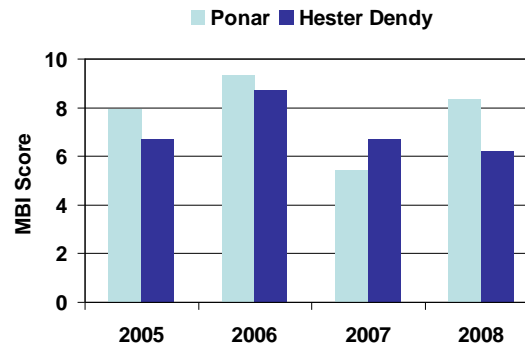
P Reduction Demonstration Project Benthic Invertebrate Results



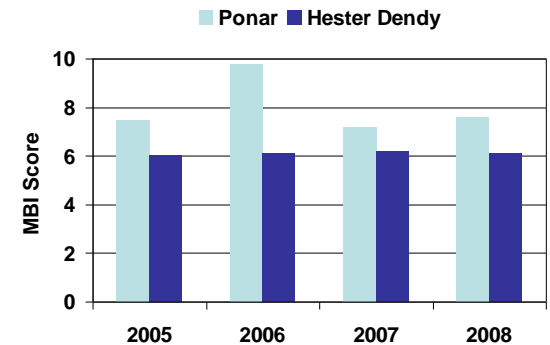
Busse Dam



JFK



Thorndale



Lower MBI values are indicative of better water quality



Cost

Major Costs

Design and Construction: \$800,000 - \$1M

Chemical (Ferric Chloride): \$450,000/yr

Additional Sludge Disposal: \$132,000/yr

These figures do not account for cost of additional biosolids processing and utilization

Another drawback of chemical P reduction is truck traffic for delivery: Egan required 1,700 g/d ferric chloride. Chemical delivery every 3 days for one of our relatively smaller WRPs (24MGD capacity)



Conclusions

Following P Reduction at Egan, there was:

Significant reduction in stream P concentrations at stations downstream of Egan

No significant effect on sestonic algae in Salt Creek

Diurnal fluctuations of similar magnitude recorded

Sediment P variable year to year and does not appear to be linked to P-reduction at Egan – Perhaps linked to discharge and scouring events

Similar fish and macroinvertebrate data as before P reduction

Protecting Our Water Environment



Metropolitan Water Reclamation District of Greater Chicago

QUESTIONS?

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