

*Protecting Our Water Environment*



*Metropolitan Water Reclamation District of Greater Chicago*

***MONITORING AND RESEARCH  
DEPARTMENT***

***REPORT NO. 13-24***

***CONTINUOUS DISSOLVED OXYGEN MONITORING  
IN CHICAGO AREA WADEABLE STREAMS  
DURING 2012***

***July 2013***

**Metropolitan Water Reclamation District of Greater Chicago**

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**CONTINUOUS DISSOLVED OXYGEN MONITORING  
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DURING 2012**

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## **DISCLAIMER**

Mention of proprietary equipment and chemicals in this report does not constitute endorsement by the District.

## INTRODUCTION

The District began monitoring the Chicago Area Waterway System with continuous dissolved oxygen monitors in 1998. The initial project involved monitoring the Chicago River System and later expanded into the Calumet River System. The Continuous Dissolved Oxygen Monitoring (CDOM) Program was developed to identify reaches of the waterways where the dissolved oxygen (DO) concentrations were below the DO standards established by the Illinois Pollution Control Board (IPCB). In 2005 the CDOM Program expanded again and started monitoring the Chicago area wadeable streams.

Low DO levels can be caused by a multitude of sources including low gradient streams, dams, combined sewer overflow (CSO), stormwater runoff, wastewater effluents, thermal discharges, respiration, decomposition, and chemical reactions. Illinois streams that are found to not meet the state DO standards are placed on the 303(d) list of impaired waters by the Illinois Environmental Protection Agency (IEPA, 2012).

To better understand the DO concentrations in the wadeable streams within the Chicago area, monitoring locations were chosen to measure DO levels above and below discharges, impoundments, and major confluences. Wadeable sites were chosen within the Chicago River System, Upper Des Plaines River System, and Calumet River System.

One monitoring location is on the North Branch of the Chicago River. This location is upstream of the North Branch Dam. The North Branch watershed encompasses 113 square miles and is located both in Lake and Cook Counties (Ogata, 1975).

Four monitoring locations are in the Upper Des Plaines River System. One site is on the Upper Des Plaines River and three sites are in Salt Creek. The entire Des Plaines River watershed covers approximately 700 square miles and originates in Wisconsin. The river within the District's jurisdiction flows southward through a highly urbanized area from the Lake-Cook County line to Highway 171, at which point it flows southwestward, parallel and adjacent to the Chicago Sanitary and Ship Canal, to Lockport (Schmeelk, et al., 1979). Salt Creek is a tributary to the Des Plaines River and their confluence is located in the town of Lyons. The Salt Creek watershed encompasses approximately 150 square miles originating with the confluence of several small streams west of Palatine, Illinois (Polls et al., 1979).

One monitoring location is in the Calumet River System on the Little Calumet River. The Little Calumet River basin is located in northeastern Illinois and northwestern Indiana. The watershed drains an area of 242 square miles, 151.2 square miles of which are in Illinois (Northeastern Illinois Planning Commission, 1981).

This report covers the monitoring results for the period January 1, 2012, through December 31, 2012, for wadeable streams in the Chicago River System, Upper Des Plaines River System, and Calumet River System.

## MONITORING STATIONS

### Locations and Descriptions

The CDOM Program supplies the District with water quality data throughout the year for both the wadeable streams and deep-draft waterways within its jurisdiction. The CDOM stations are shown in Figure 1. Descriptions of the wadeable CDOM stations are listed in Table 1.

### Designated Uses

The IPCB has assigned water uses for specific water bodies within the state of Illinois. The waterways described in this wadeable CDOM report are all designated as General Use Waters.

### Water Quality Standards

The IPCB has established water quality standards for DO in General Use Waters. In General Use Waters, the DO shall not be less than 3.5 mg/L at any time and shall meet a 4.0 mg/L daily minimum averaged over seven days and shall meet a 5.5 mg/L daily mean averaged over 30 days from August through February. In General Use Waters, the DO shall not be less than 5.0 mg/L at any time and shall meet a 6.0 mg/L daily mean averaged over seven days from March through July. For this report, we have selected the any time standard when calculating percent compliance.



FIGURE 1: 2012 CONTINUOUS DISSOLVED OXYGEN MONITORING STATIONS

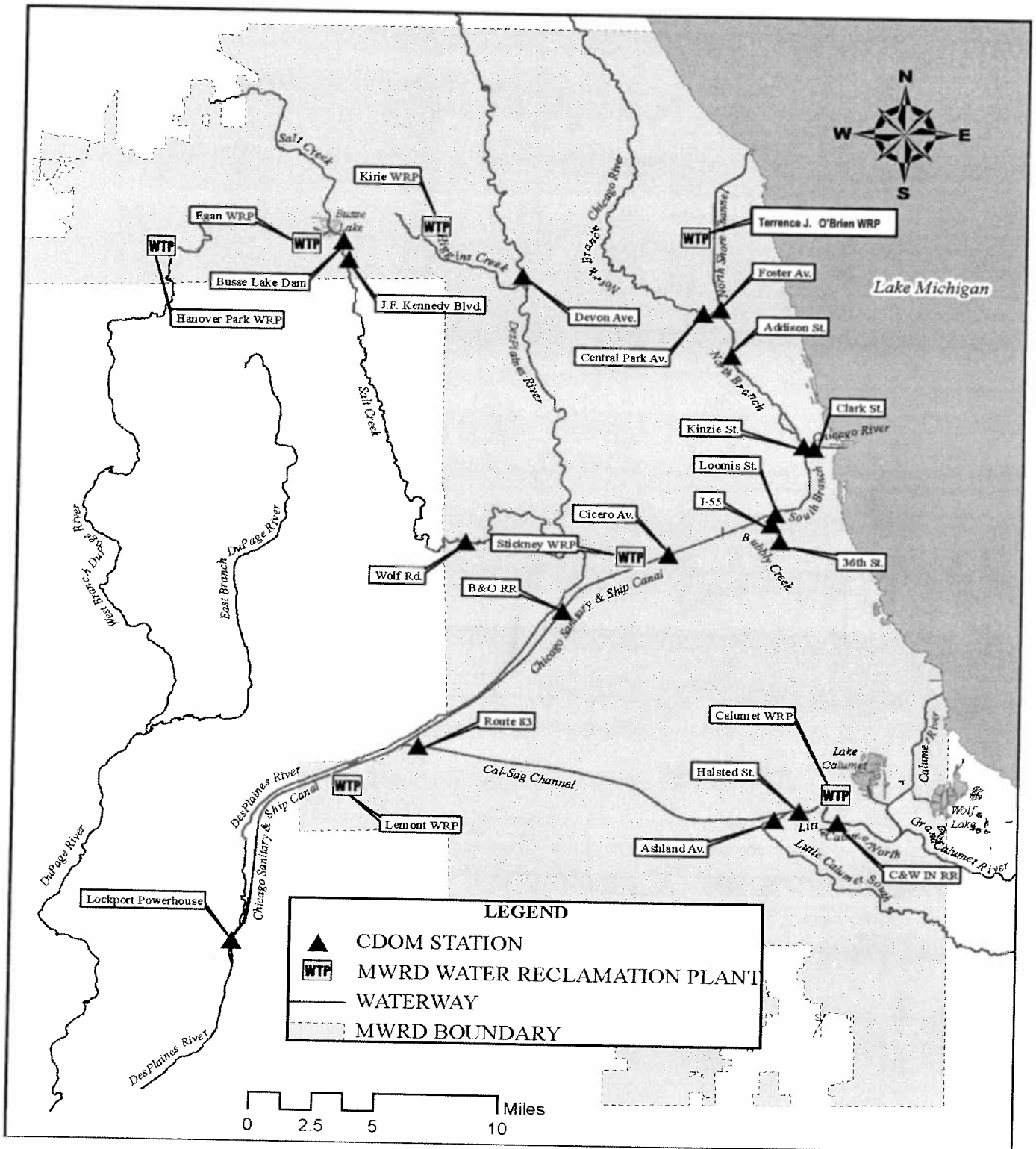


TABLE 1: WADEABLE STREAM CONTINUOUS DISSOLVED OXYGEN  
MONITORING STATIONS DURING 2012

Monitoring Station	Waterway	Description of Monitoring Station
<u>Chicago River System</u>		
Central Park Avenue	North Branch Chicago River	0.8 mile above junction with North Shore Channel, water quality monitor on northeast side of Central Park Avenue bridge, 2-4 inches from stream bed.
<u>Des Plaines River System</u>		
Devon Avenue	Des Plaines River	0.7 mile above junction with Willow Creek, water quality monitor on northwest side of Devon Avenue bridge, 2-4 inches from stream bed.
Busse Lake Dam	Salt Creek	0.1 mile above Egan WRP outfall, water quality monitor on bike path bridge support, downstream of Busse Woods South Dam, in center of creek, 2-4 inches from stream bed.
J.F. Kennedy Boulevard	Salt Creek	0.8 mile below Egan WRP outfall, water quality monitor on southeast side of J.F. Kennedy Boulevard bridge, 2-4 inches from stream bed.

TABLE 1 (Continued): WADEABLE STREAM CONTINUOUS DISSOLVED OXYGEN MONITORING STATIONS DURING 2012

Monitoring Station	Waterway	Description of Monitoring Station
<u>Des Plaines River System (Continued)</u>		
Wolf Road	Salt Creek	8.0 miles above junction with Des Plaines River, water quality monitor on northwest side of Wolf Road bridge, 2-4 inches from stream bed.
<u>Calumet River System</u>		
Ashland Avenue	Little Calumet River	0.5 mile above junction with Calumet-Sag Channel, water quality monitor attached to east side of Ashland Avenue bridge, 1 foot from stream bed

## MATERIALS AND METHODS

### Water Quality Monitor

The continuous water quality monitors (monitor) used to collect these data were manufactured by YSI Incorporated (YSI) of Yellow Springs, Ohio. The DO was measured hourly using the YSI Model 6920 or Model 6600 monitor. In order to protect and safeguard the monitors from marine navigation and vandalism, the monitors were deployed in the field in stainless steel pipes. Installation designs resulted in a fixed length of pipe at each location with multiple 2-inch circular openings on the submerged end to allow sufficient flow of water through the pipe. Each monitor housing was vertically mounted on the side of a bridge abutment with an access hatch on the top end to allow for periodic monitor exchange.

The District personnel retrieved each monitor from the field following 14 days of continuous monitoring. Prior to retrieval, a water sample was collected next to the protective housing for DO analysis using the Winkler method for subsequent comparison with the monitor results. An additional monitor, that had been previously calibrated and serviced in the laboratory, was then deployed to replace the retrieved monitor. The retrieved monitors were returned to the laboratory for data downloading, exterior cleaning, servicing, and calibration of the DO sensors. The monitors were temporarily stored in holding tanks containing tap water for subsequent deployment during the following week.

### Data Management and Review

Hourly DO data were directly exported electronically from individual monitors to a specially designed Oracle<sup>®</sup> database for data processing and storage. All DO data were carefully reviewed for accuracy.

The review process included the following:

1. Comparing the grab sample DO concentration measured in the field with the DO concentration recorded by the respective monitor retrieved in the field (DO rejection criteria = difference greater than 2.0 mg/L).
2. Comparing the last hourly DO concentration measured by the monitor retrieved in the field with the first hourly DO concentration recorded by a deployed monitor that replaced it. (DO rejection criteria = difference greater than 2.0 mg/L).
3. Comparing a DO concentration measured in a laboratory holding tank and a DO concentration recorded by a monitor after retrieval from the field (DO rejection criteria = difference greater than 1.0 mg/L).

Criterion 3 would entail rejection of all hourly readings; criteria 1 and 2 may or may not result in rejection of all readings. Incidents of equipment malfunction would also entail rejection of data.

After careful review of the DO data, weekly summary statistics (mean, minimum, maximum, and percent observations above DO standard) and individual graphs for each monitoring station showing hourly DO concentrations versus time were prepared.

### **Verification of Representative Data**

During the spring, summer, and fall of 2012, cross-sectional DO surveys were conducted in the Chicago River System, Calumet River System, and Des Plaines River System to determine if the DO concentration at a fixed continuous monitoring location represented the DO concentrations across the waterway. The DO concentrations were measured directly with a monitor at multiple locations and depths. The cross-sectional DO measurements were taken in the center of the waterway and at the right and left side of the flow from a bridge. DO measurements were recorded at up to three depths for each location including just above the bottom of the stream bed, three feet below the surface, and at the surface. If the overall depth was less than four feet, only a bottom and surface measurement was recorded, and if the overall depth was less than one foot, only a surface measurement was recorded.

## RESULTS

The annual minimum, maximum, and mean DO concentrations measured at all six stations during 2012 are shown in Table 2.

The number and percent of measured DO concentrations rejected and removed from the Oracle<sup>®</sup> database following review during 2012 are summarized in Table 3.

The number and percent of DO concentrations above the applicable IPCB DO standard for each waterway during 2012 are presented in Table 4. The DO data shown in Table 4 do not include the DO concentrations rejected during the data review.

Table 5 shows the percent distribution of DO concentrations from <1.0 mg/L to >5.0 mg/L at the seven monitoring stations during 2012. The current national one-day minimum dissolved oxygen criterion for adult life stages of fish is 3.0 mg/L (USEPA, 1986).

Individual graphs showing hourly DO concentrations at each monitoring station are indicated in Figure 2 through Figure 7.

Weekly DO summary statistics during 2012 are presented for each monitoring station in Appendix A, Tables A-1 through A-6.

Summary statistics for dissolved oxygen measurements made during cross-sectional surveys are shown in Appendix Table A-7. The results from the cross-sectional surveys clearly showed that the differences across the waterway were generally minimal (coefficient of variation < 10 percent).

### **Dissolved Oxygen Fluctuations**

DO concentrations fluctuate seasonally and daily in the aquatic environment. Oxygen is more soluble in cold water than warm water, a trend that can typically be seen in annual DO graphs where the colder months have higher mean DO concentrations than the warmer months. Daily DO fluctuation can be caused by aquatic plant and algae photosynthesis during daylight hours and respiration during the night. Photosynthesis results in higher DO, while plant respiration depletes DO. Slower moving canals absorb less oxygen from the atmosphere than faster moving streams and rivers. Thermal loads from sources such as used cooling water can increase the temperature of the waterway, thereby lowering DO. Other deficiencies of DO can occur when materials that exhibit an oxygen demand are introduced into a waterway. These materials enter a waterway most often through wastewater treatment effluents, CSOs, stormwater run-off, and directly from wildlife and plants. This is most evident during heavy rainstorms that result in CSO events containing untreated waste and stormwater. More information on CSOs can be found on the District website at [www.mwr.org](http://www.mwr.org).

TABLE 2: MINIMUM, MAXIMUM, AND MEAN HOURLY DISSOLVED OXYGEN CONCENTRATIONS DURING 2012<sup>1</sup>

Monitoring Station	Waterway	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
<u>Chicago River System</u>				
Central Park Avenue	North Branch Chicago River	3.1	16.2	8.7
<u>Des Plaines River System</u>				
Devon Avenue	Des Plaines River	2.8	15.8	9.2
Busse Lake Dam	Salt Creek	0.0	14.4	8.8
J.F. Kennedy Boulevard	Salt Creek	0.3	14.4	7.7
Wolf Road	Salt Creek	0.2	16.6	9.3
<u>Calumet River System</u>				
Ashland Avenue	Little Calumet River	0.4	14.8	7.9

<sup>1</sup>Dissolved oxygen was measured hourly using a YSI Model 6920 or Model 6600 continuous water quality monitor.

TABLE 3: NUMBER AND PERCENT OF DISSOLVED OXYGEN VALUES NOT MEETING ACCEPTANCE CRITERIA DURING 2012<sup>1</sup>

Monitoring Station	Waterway	Number of DO Values Rejected	Percent of DO Values Rejected
<u>Chicago River System</u>			
Central Park Avenue	North Branch Chicago River	1,011	12 <sup>2</sup>
<u>Des Plaines River System</u>			
Devon Avenue	Des Plaines River	1,419	16 <sup>3</sup>
Busse Lake Dam	Salt Creek	674	8 <sup>4</sup>
J.F. Kennedy Boulevard	Salt Creek	673	8 <sup>5</sup>
Wolf Road	Salt Creek	1,372	16 <sup>6</sup>
<u>Calumet River System</u>			
Ashland Avenue	Little Calumet River	1,628	19 <sup>7</sup>

<sup>1</sup>Dissolved oxygen was measured hourly using a YSI Model 6920 or Model 6600 continuous water quality monitor. DO values were rejected based on quality control check and/or operational problems with monitor.

<sup>2</sup>4/4-18/2012 monitor failed criteria 1 and 2. 4/18-5/2/2012, 10/7-31/2012 monitor failed criteria 3.

<sup>3</sup>1/1-11/2012, 5/16-30/2012, 12/17-31/2012, monitor failed criteria 3. 8/8-23/2012 equipment failure.

<sup>4</sup>5/2-16/2012 monitor failed criteria 1 and 2. 7/25-8/8/2012 monitor failed criteria 3.

<sup>5</sup>1/25-2/8/2012, 3/7-21/2012 monitor failed criteria 3.

<sup>6</sup>7/2-24/2012 equipment failure. 10/17-11/15/2012 monitor failed criteria 3.

<sup>7</sup>7/6-18/2012, 10/10-24/2012 monitor failed criteria 1 and 3. 8/15-29/2012 monitor failed criteria 3. 11/21-27/2012 equipment failure.



TABLE 4: NUMBER AND PERCENT OF DISSOLVED OXYGEN VALUES MEASURED ABOVE THE ILLINOIS POLLUTION CONTROL BOARD'S WATER QUALITY STANDARD DURING 2012<sup>1</sup>

Monitoring Station	Waterway	IPCB DO Standard	Number of DO Values	Number Above Standard	Percent Above Standard
<u>Chicago River System</u>					
Central Park Avenue	North Branch Chicago River	3.5-5.0 <sup>2</sup>	7,773	7,261	93
<u>Des Plaines River System</u>					
Devon Avenue	Des Plaines River	3.5-5.0 <sup>2</sup>	7,365	7,035	96
Busse Lake Dam	Salt Creek	3.5-5.0 <sup>2</sup>	8,110	7,030	87
J.F. Kennedy Boulevard	Salt Creek	3.5-5.0 <sup>2</sup>	8,111	7,410	91
Wolf Road	Salt Creek	3.5-5.0 <sup>2</sup>	7,412	7,052	95
<u>Calumet River System</u>					
Ashland Avenue	Little Calumet River	3.5-5.0 <sup>2</sup>	7,156	6,328	88

<sup>1</sup>Dissolved oxygen was measured hourly using a YSI Model 6920 or Model 6600 continuous water quality monitor.

<sup>2</sup>IPCB general use DO standard is 5.0 mg/L from March through July and 3.5 mg/L for the balance of the year.

TABLE 5: PERCENT OF DISSOLVED OXYGEN VALUES IN  
SELECTED RANGES DURING 2012

Monitoring Station	Waterway	Percent of DO Values in Range (mg/L) <sup>1</sup>					
		0-<1	1-<2	2-<3	3-<4	4-<5	≥5
<u>Chicago River System</u>							
Central Park Avenue	North Branch Chicago River	0	0	0	1	7	92
<u>Des Plaines River System</u>							
Devon Avenue	Des Plaines River	0	0	<1	1	6	94
Busse Lake Dam	Salt Creek	2	2	3	4	5	84
J.F. Kennedy Boulevard	Salt Creek	<1	1	2	2	5	90
Wolf Road	Salt Creek	1	<1	<1	<1	3	95
<u>Calumet River System</u>							
Ashland Avenue	Little Calumet River	<1	<1	3	6	9	82

<sup>1</sup> Percentages greater than one are rounded to nearest whole number.

FIGURE 2: DISSOLVED OXYGEN CONCENTRATION MEASURED HOURLY AT CENTRAL PARK AVENUE ON THE NORTH BRANCH CHICAGO RIVER FROM JANUARY 1, 2012, THROUGH DECEMBER 31, 2012

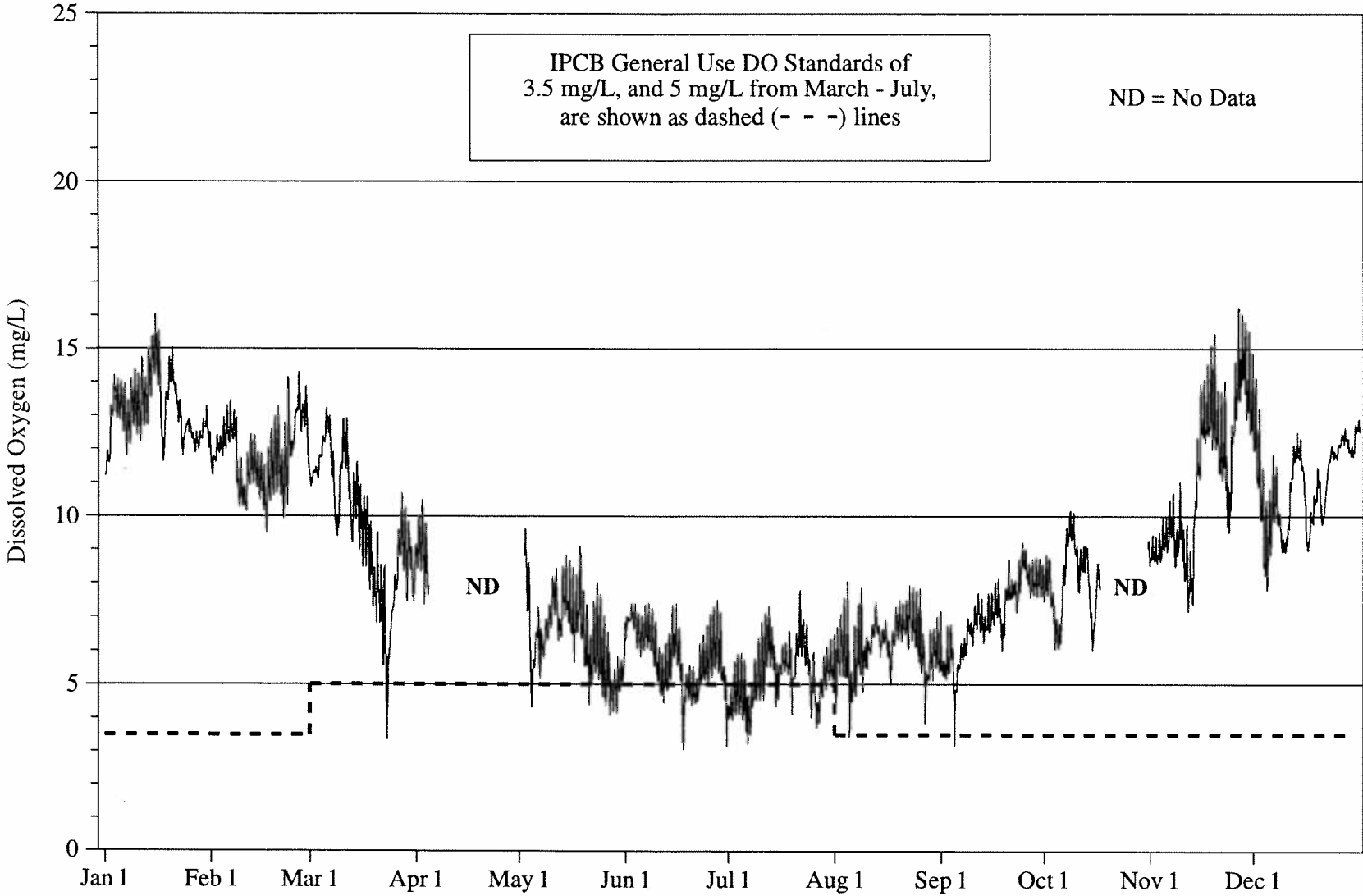


FIGURE 3: DISSOLVED OXYGEN CONCENTRATION MEASURED HOURLY AT DEVON AVENUE ON THE DES PLAINES RIVER FROM JANUARY 1, 2012, THROUGH DECEMBER 31, 2012

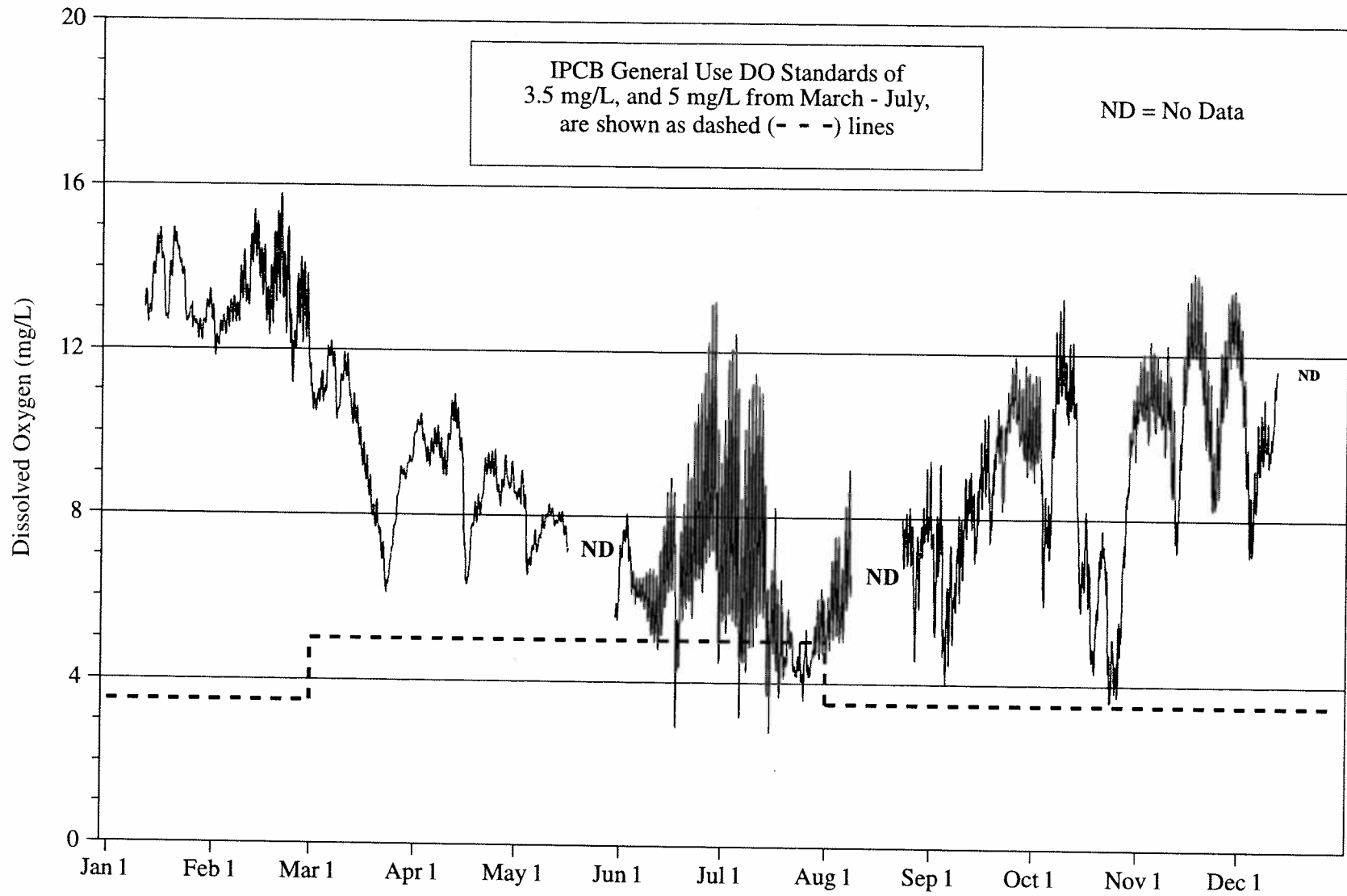


FIGURE 4: DISSOLVED OXYGEN CONCENTRATION MEASURED HOURLY AT BUSSE LAKE DAM ON SALT CREEK FROM JANUARY 1, 2012, THROUGH DECEMBER 31, 2012

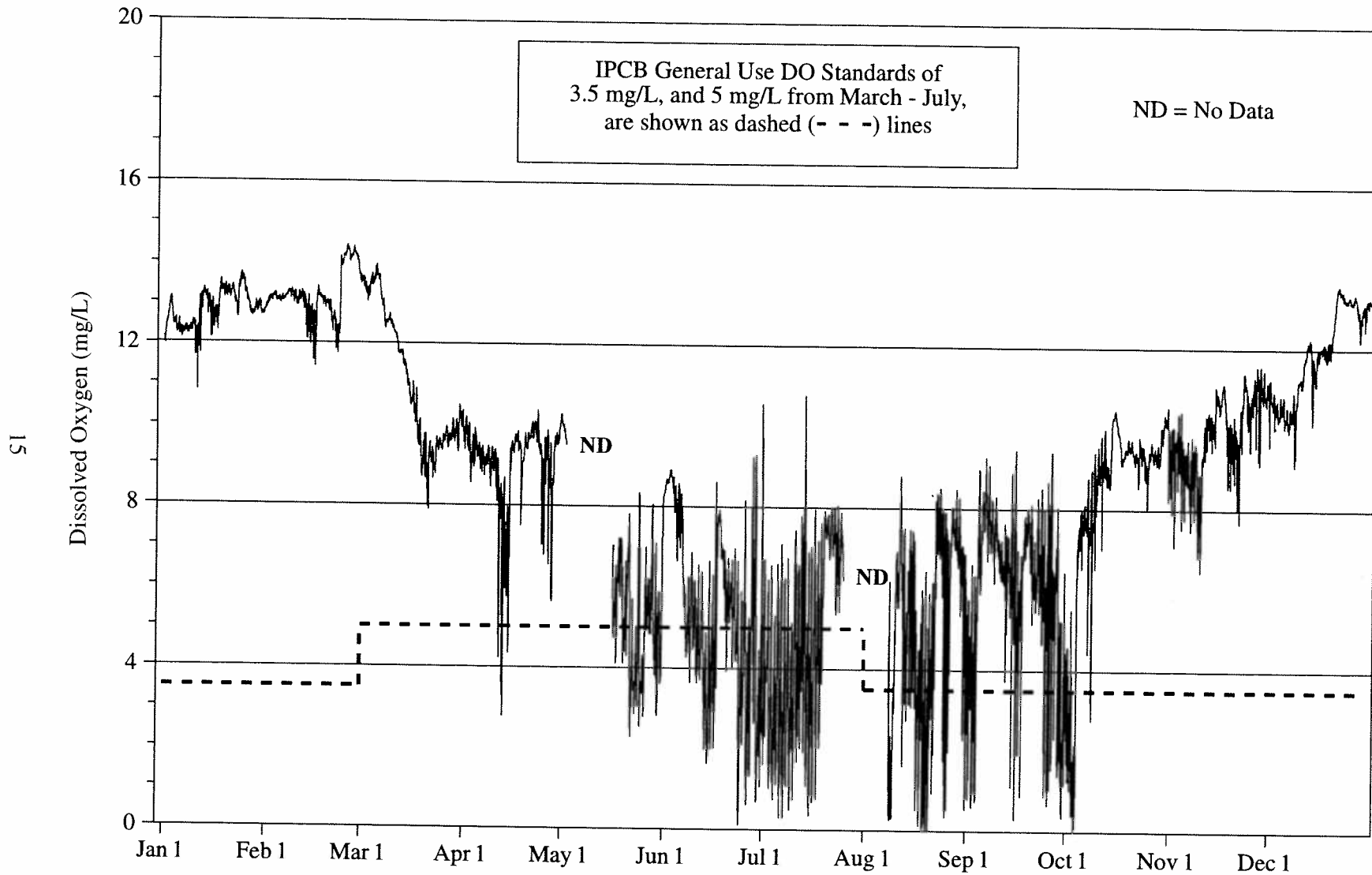


FIGURE 5: DISSOLVED OXYGEN CONCENTRATION MEASURED HOURLY AT J. F. KENNEDY BOULEVARD ON SALT CREEK FROM JANUARY 1, 2012, THROUGH DECEMBER 31, 2012

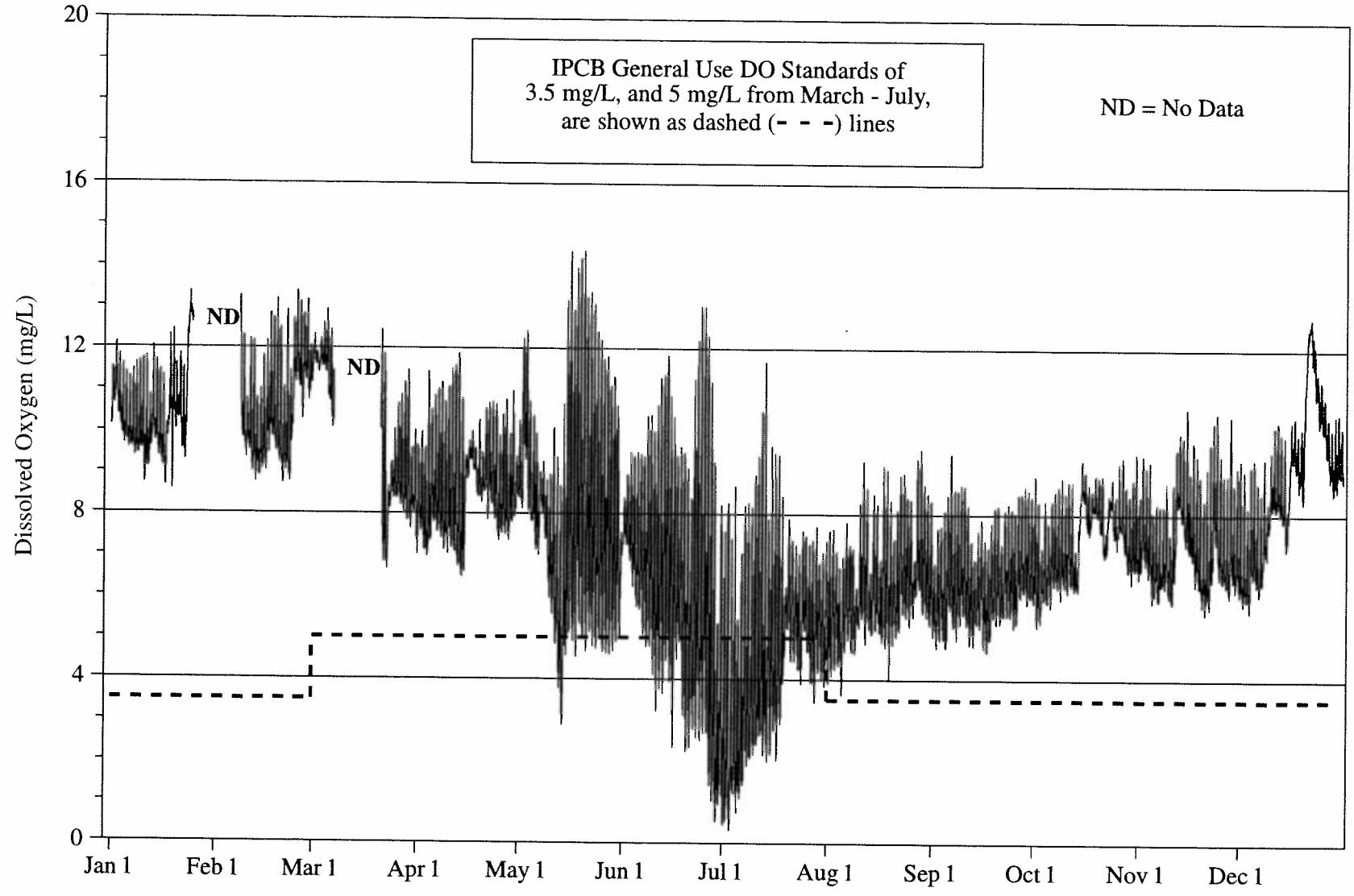


FIGURE 6: DISSOLVED OXYGEN CONCENTRATION MEASURED HOURLY AT WOLF ROAD ON SALT CREEK FROM JANUARY 1, 2012, THROUGH DECEMBER 31, 2012

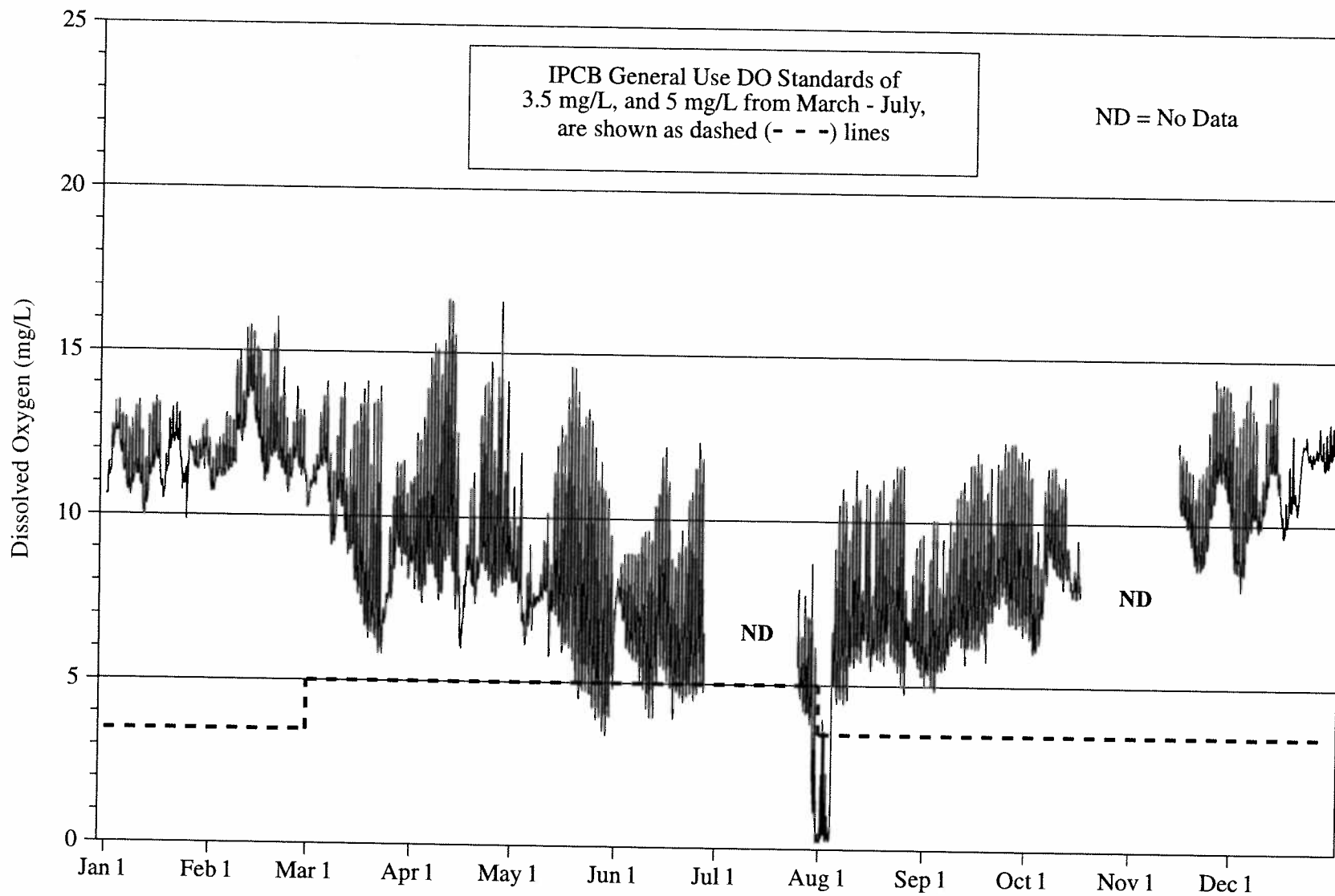
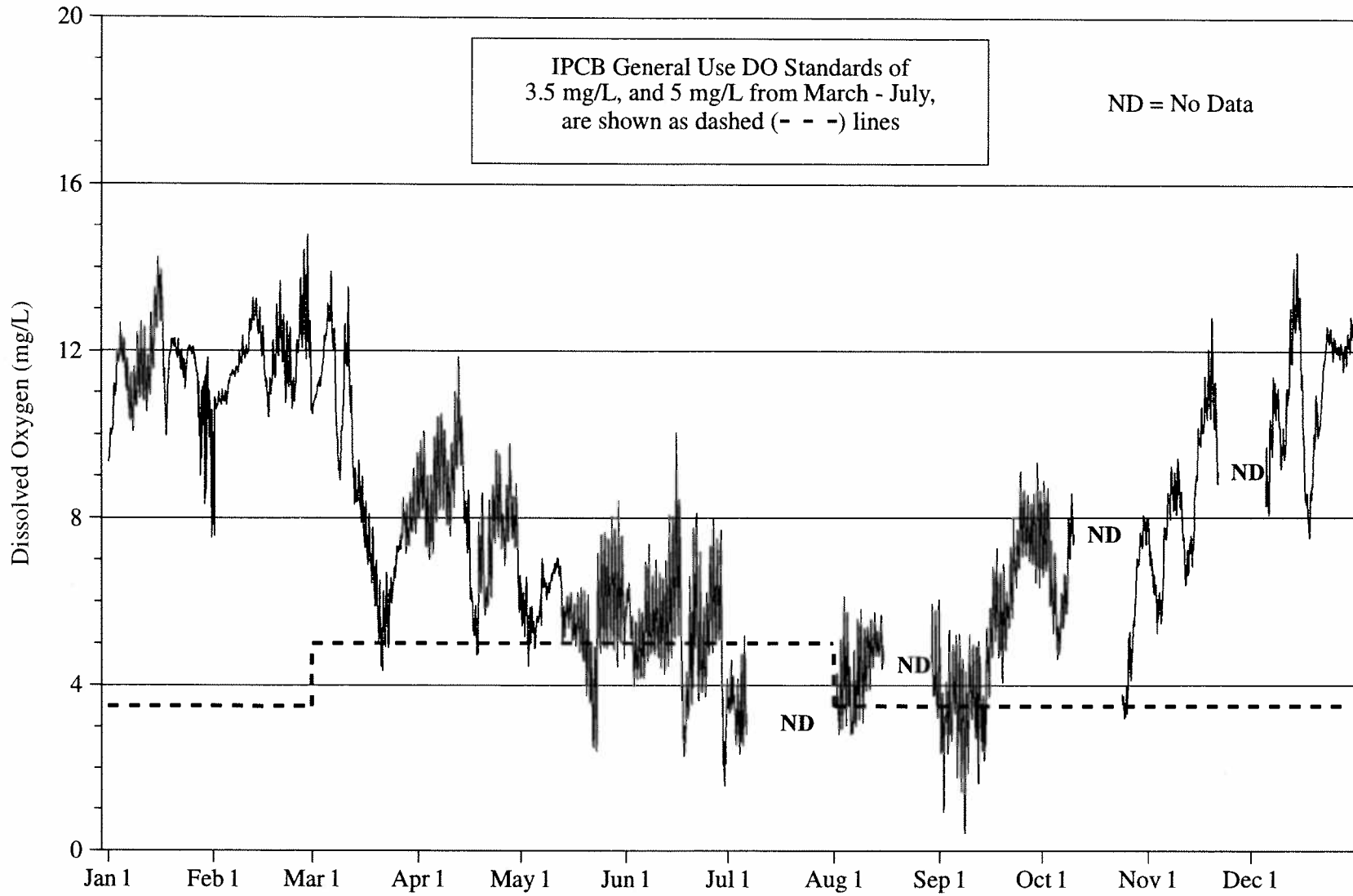


FIGURE 7: DISSOLVED OXYGEN CONCENTRATION MEASURED HOURLY AT ASHLAND AVENUE ON THE LITTLE CALUMET RIVER FROM JANUARY 1, 2012, THROUGH DECEMBER 31, 2012

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APPENDIX A

WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS AT ALL  
WADEABLE STREAM MONITORING STATIONS DURING 2012

TABLE A-1: WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT CENTRAL PARK AVENUE ON THE  
 NORTH BRANCH CHICAGO RIVER DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
01/01/12 - 01/01/12	24	11.2	11.9	11.5
01/02/12 - 01/08/12	168	11.6	14.2	13.1
01/09/12 - 01/15/12	168	12.2	16.0	13.9
01/16/12 - 01/22/12	168	11.6	15.5	13.6
01/23/12 - 01/29/12	168	11.8	13.0	12.4
01/30/12 - 02/05/12	168	11.2	13.3	12.2
02/06/12 - 02/12/12	168	10.1	13.5	11.6
02/13/12 - 02/19/12	168	9.5	13.0	11.2
02/20/12 - 02/26/12	168	9.9	14.3	12.1
02/27/12 - 03/04/12	168	10.9	13.9	12.0
03/05/12 - 03/11/12	168	9.4	13.2	11.6
03/12/12 - 03/18/12	168	7.8	11.6	10.0
03/19/12 - 03/25/12	167	3.4	9.5	7.1
03/26/12 - 04/01/12	168	7.5	10.7	8.9
04/02/12 - 04/08/12	58	7.4	10.5	8.9
04/09/12 - 04/29/12		NO DATA		
04/30/12 - 05/06/12	110	4.3	9.6	6.7
05/07/12 - 05/13/12	168	5.2	8.5	6.9
05/14/12 - 05/20/12	168	5.5	9.1	7.1
05/21/12 - 05/27/12	168	4.1	8.0	5.7
05/28/12 - 06/03/12	168	4.2	7.4	6.0
06/04/12 - 06/10/12	168	4.9	7.4	6.3
06/11/12 - 06/17/12	168	3.1	7.4	5.6
06/18/12 - 06/24/12	168	3.7	6.8	5.1
06/25/12 - 07/01/12	167	3.2	7.5	5.5
07/02/12 - 07/08/12	168	3.2	5.9	4.6
07/09/12 - 07/15/12	167	4.3	7.3	5.7
07/16/12 - 07/22/12	168	4.1	7.8	5.9
07/23/12 - 07/29/12	168	3.7	6.8	5.1
07/30/12 - 08/05/12	168	3.4	8.1	5.6
08/06/12 - 08/12/12	168	4.7	7.9	6.1
08/13/12 - 08/19/12	168	5.0	7.5	6.4
08/20/12 - 08/26/12	168	4.8	7.9	6.6
08/27/12 - 09/02/12	168	3.9	7.2	5.7

TABLE A-1 (Continued): WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT CENTRAL PARK AVENUE ON THE  
 NORTH BRANCH CHICAGO RIVER DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
09/03/12 - 09/09/12	168	3.2	7.0	5.8
09/10/12 - 09/16/12	168	6.2	8.0	7.0
09/17/12 - 09/23/12	168	6.0	8.7	7.5
09/24/12 - 09/30/12	168	7.5	9.2	8.2
10/01/12 - 10/07/12	167	6.0	9.7	7.6
10/08/12 - 10/14/12	168	6.4	10.2	8.7
10/15/12 - 10/21/12	58	6.0	8.6	7.4
10/22/12 - 10/28/12		NO DATA		
10/29/12 - 11/04/12	110	8.5	10.0	9.0
11/05/12 - 11/11/12	168	7.2	11.0	9.3
11/12/12 - 11/18/12	168	7.3	15.1	11.4
11/19/12 - 11/25/12	168	9.5	15.4	12.2
11/26/12 - 12/02/12	168	9.9	16.2	13.5
12/03/12 - 12/09/12	168	7.8	11.9	9.8
12/10/12 - 12/16/12	168	8.9	12.5	10.8
12/17/12 - 12/23/12	168	9.1	12.1	10.6
12/24/12 - 12/30/12	168	11.7	12.7	12.1
12/31/12 - 12/31/12	24	12.6	12.9	12.7

TABLE A-2: WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT DEVON AVENUE ON THE  
 DES PLAINES RIVER DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
01/01/12 - 01/08/12		NO DATA		
01/09/12 - 01/15/12	109	12.6	14.9	13.7
01/16/12 - 01/22/12	168	12.7	14.9	14.0
01/23/12 - 01/29/12	168	12.2	13.9	12.7
01/30/12 - 02/05/12	168	11.8	13.5	12.7
02/06/12 - 02/12/12	168	12.6	15.4	13.6
02/13/12 - 02/19/12	168	12.4	15.4	13.9
02/20/12 - 02/26/12	168	11.2	15.8	13.3
02/27/12 - 03/04/12	168	10.5	14.1	11.6
03/05/12 - 03/11/12	168	10.3	12.2	11.4
03/12/12 - 03/18/12	168	8.3	11.3	9.8
03/19/12 - 03/25/12	167	6.1	8.4	7.3
03/26/12 - 04/01/12	168	7.7	10.3	9.1
04/02/12 - 04/08/12	168	9.2	10.5	9.8
04/09/12 - 04/15/12	168	7.1	10.9	9.7
04/16/12 - 04/22/12	168	6.3	9.5	8.0
04/23/12 - 04/29/12	168	8.2	9.6	8.9
04/30/12 - 05/06/12	168	6.6	9.1	7.9
05/07/12 - 05/13/12	168	7.1	8.3	7.8
05/14/12 - 05/20/12	58	7.1	8.1	7.7
05/21/12 - 05/27/12		NO DATA		
05/28/12 - 06/03/12	109	5.5	8.1	7.0
06/04/12 - 06/10/12	168	5.1	6.9	6.1
06/11/12 - 06/17/12	168	2.9	9.0	6.3
06/18/12 - 06/24/12	168	4.4	11.0	7.3
06/25/12 - 07/01/12	168	4.5	13.2	8.4
07/02/12 - 07/08/12	168	3.2	12.5	7.4
07/09/12 - 07/15/12	168	2.8	11.5	7.0
07/16/12 - 07/22/12	168	3.7	8.2	5.0
07/23/12 - 07/29/12	168	3.6	6.0	4.6
07/30/12 - 08/05/12	168	4.6	7.6	5.7
08/06/12 - 08/12/12	58	5.0	9.2	6.8
08/13/12 - 08/19/12		NO DATA		
08/20/12 - 08/26/12	85	5.9	8.3	7.4

TABLE A-2 (Continued): WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT DEVON AVENUE ON THE  
 DES PLAINES RIVER DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
08/27/12 - 09/02/12	168	4.6	9.4	7.2
09/03/12 - 09/09/12	168	4.0	9.3	6.3
09/10/12 - 09/16/12	168	6.5	10.4	8.4
09/17/12 - 09/23/12	168	7.4	11.1	9.4
09/24/12 - 09/30/12	168	9.1	11.9	10.5
10/01/12 - 10/07/12	168	5.9	12.6	9.1
10/08/12 - 10/14/12	168	6.4	13.4	10.7
10/15/12 - 10/21/12	167	4.3	8.2	6.2
10/22/12 - 10/28/12	168	3.6	8.6	5.5
10/29/12 - 11/04/12	168	8.5	12.3	10.5
11/05/12 - 11/11/12	168	8.6	12.2	10.6
11/12/12 - 11/18/12	168	7.2	14.0	11.0
11/19/12 - 11/25/12	168	8.2	13.7	10.5
11/26/12 - 12/02/12	168	10.3	13.6	12.0
12/03/12 - 12/09/12	168	7.1	10.9	9.1
12/10/12 - 12/16/12	58	9.3	11.6	10.4
12/17/12 - 12/31/12		NO DATA		

TABLE A-3: WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT BUSSE LAKE DAM ON  
 SALT CREEK DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
01/01/12 - 01/01/12	24	12.0	12.6	12.3
01/02/12 - 01/08/12	168	12.1	13.1	12.5
01/09/12 - 01/15/12	168	10.8	13.4	12.7
01/16/12 - 01/22/12	168	12.3	13.6	13.1
01/23/12 - 01/29/12	168	12.6	13.7	13.1
01/30/12 - 02/05/12	168	12.7	13.2	13.0
02/06/12 - 02/12/12	168	12.8	13.3	13.2
02/13/12 - 02/19/12	168	11.4	13.4	12.8
02/20/12 - 02/26/12	168	11.8	14.4	13.3
02/27/12 - 03/04/12	168	13.1	14.4	13.7
03/05/12 - 03/11/12	168	12.0	13.9	12.8
03/12/12 - 03/18/12	168	9.5	11.9	10.9
03/19/12 - 03/25/12	167	7.9	9.8	9.2
03/26/12 - 04/01/12	168	9.3	10.5	9.8
04/02/12 - 04/08/12	168	8.6	10.0	9.3
04/09/12 - 04/15/12	168	2.8	9.6	8.0
04/16/12 - 04/22/12	168	7.5	10.1	9.5
04/23/12 - 04/29/12	168	5.6	10.4	9.1
04/30/12 - 05/06/12	58	9.5	10.3	9.9
05/07/12 - 05/13/12		NO DATA		
05/14/12 - 05/20/12	109	4.1	7.2	5.8
05/21/12 - 05/27/12	168	2.3	8.3	4.7
05/28/12 - 06/03/12	168	2.8	8.9	6.7
06/04/12 - 06/10/12	168	3.6	8.6	6.3
06/11/12 - 06/17/12	168	1.6	8.6	4.5
06/18/12 - 06/24/12	168	0.1	7.7	5.4
06/25/12 - 07/01/12	168	0.6	10.6	4.0
07/02/12 - 07/08/12	168	0.3	7.1	3.3
07/09/12 - 07/15/12	168	0.4	10.8	4.1
07/16/12 - 07/22/12	168	0.7	8.0	5.9
07/23/12 - 07/29/12	59	5.4	8.1	6.7
07/30/12 - 08/05/12		NO DATA		
08/06/12 - 08/12/12	109	0.3	8.8	4.7
08/13/12 - 08/19/12	168	0.0	7.5	4.2

TABLE A-3 (Continued): WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT BUSSE LAKE DAM ON  
 SALT CREEK DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
08/20/12 - 08/26/12	168	0.0	8.5	5.2
08/27/12 - 09/02/12	168	0.5	8.5	5.9
09/03/12 - 09/09/12	167	0.8	9.3	6.9
09/10/12 - 09/16/12	168	0.3	9.5	6.2
09/17/12 - 09/23/12	168	0.9	8.5	6.7
09/24/12 - 09/30/12	168	0.4	9.4	4.7
10/01/12 - 10/07/12	168	0.0	8.8	4.9
10/08/12 - 10/14/12	168	2.8	10.2	8.6
10/15/12 - 10/21/12	168	9.1	10.5	9.6
10/22/12 - 10/28/12	168	8.0	9.8	9.2
10/29/12 - 11/04/12	168	7.1	10.5	9.5
11/05/12 - 11/11/12	168	6.5	10.1	8.8
11/12/12 - 11/18/12	168	8.6	11.1	10.3
11/19/12 - 11/25/12	168	7.7	11.4	10.1
11/26/12 - 12/02/12	168	9.1	11.6	10.8
12/03/12 - 12/09/12	168	9.1	11.2	10.4
12/10/12 - 12/16/12	168	10.1	12.2	11.6
12/17/12 - 12/23/12	168	11.7	13.6	12.6
12/24/12 - 12/30/12	168	12.2	13.4	13.1
12/31/12 - 12/31/12	24	13.1	13.3	13.2



TABLE A-4: WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT J. F. KENNEDY BOULEVARD ON  
 SALT CREEK DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
01/01/12 - 01/01/12	24	10.1	11.5	10.8
01/02/12 - 01/08/12	168	9.4	12.1	10.4
01/09/12 - 01/15/12	168	8.7	12.0	10.1
01/16/12 - 01/22/12	168	8.6	12.4	10.3
01/23/12 - 01/29/12	58	9.5	13.4	12.1
01/30/12 - 02/05/12		NO DATA		
02/06/12 - 02/12/12	110	9.0	13.3	10.4
02/13/12 - 02/19/12	168	8.8	13.2	10.2
02/20/12 - 02/26/12	168	8.7	13.4	10.7
02/27/12 - 03/04/12	168	10.3	13.2	11.7
03/05/12 - 03/11/12	58	10.1	12.9	11.3
03/12/12 - 03/18/12		NO DATA		
03/19/12 - 03/25/12	110	6.7	12.5	8.7
03/26/12 - 04/01/12	168	7.0	11.5	8.9
04/02/12 - 04/08/12	168	7.0	11.4	8.6
04/09/12 - 04/15/12	168	6.5	11.9	8.5
04/16/12 - 04/22/12	168	7.9	10.7	9.2
04/23/12 - 04/29/12	166	7.4	11.0	8.7
04/30/12 - 05/06/12	168	7.1	12.4	9.1
05/07/12 - 05/13/12	168	3.2	10.1	7.2
05/14/12 - 05/20/12	168	2.9	14.4	8.2
05/21/12 - 05/27/12	168	4.6	13.4	8.1
05/28/12 - 06/03/12	168	4.6	11.3	7.5
06/04/12 - 06/10/12	168	4.1	10.4	7.1
06/11/12 - 06/17/12	168	2.4	11.8	6.8
06/18/12 - 06/24/12	168	2.3	13.0	6.0
06/25/12 - 07/01/12	168	0.5	13.0	4.4
07/02/12 - 07/08/12	168	0.3	8.7	3.4
07/09/12 - 07/15/12	168	2.0	11.7	4.9
07/16/12 - 07/22/12	168	2.0	9.5	5.5
07/23/12 - 07/29/12	168	3.5	7.7	5.5
07/30/12 - 08/05/12	168	3.6	7.6	5.5
08/06/12 - 08/12/12	168	4.6	9.3	6.2
08/13/12 - 08/19/12	168	4.0	9.2	6.2

TABLE A-4 (Continued): WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT J. F. KENNEDY BOULEVARD ON  
 SALT CREEK DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
08/20/12 - 08/26/12	168	4.8	9.0	6.5
08/27/12 - 09/02/12	168	4.8	9.6	6.6
09/03/12 - 09/09/12	168	4.8	9.5	6.5
09/10/12 - 09/16/12	168	4.8	8.7	6.2
09/17/12 - 09/23/12	168	4.7	8.2	6.3
09/24/12 - 09/30/12	168	5.3	8.7	6.8
10/01/12 - 10/07/12	168	5.3	8.9	6.7
10/08/12 - 10/14/12	168	6.0	8.9	7.0
10/15/12 - 10/21/12	168	7.1	9.3	8.2
10/22/12 - 10/28/12	168	6.9	9.4	7.8
10/29/12 - 11/04/12	168	6.3	9.5	7.5
11/05/12 - 11/11/12	168	5.9	8.8	6.8
11/12/12 - 11/18/12	168	6.3	10.6	8.1
11/19/12 - 11/25/12	168	5.6	10.5	7.3
11/26/12 - 12/02/12	168	5.8	10.4	7.1
12/03/12 - 12/09/12	168	5.6	9.4	7.1
12/10/12 - 12/16/12	168	7.2	10.3	8.6
12/17/12 - 12/23/12	168	8.3	12.8	10.6
12/24/12 - 12/30/12	168	8.5	11.4	9.9
12/31/12 - 12/31/12	24	8.8	10.1	9.3

TABLE A-5: WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
AT WOLF ROAD ON  
SALT CREEK DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
01/01/12 - 01/01/12	24	10.6	11.6	11.0
01/02/12 - 01/08/12	168	10.6	13.5	11.9
01/09/12 - 01/15/12	168	10.0	13.6	11.5
01/16/12 - 01/22/12	168	10.5	13.4	11.9
01/23/12 - 01/29/12	168	9.9	12.7	11.6
01/30/12 - 02/05/12	168	10.7	13.1	11.6
02/06/12 - 02/12/12	168	11.3	15.8	13.0
02/13/12 - 02/19/12	168	11.0	15.6	12.9
02/20/12 - 02/26/12	168	10.7	16.1	12.1
02/27/12 - 03/04/12	168	10.3	13.2	11.4
03/05/12 - 03/11/12	168	9.1	14.1	11.2
03/12/12 - 03/18/12	168	6.7	14.1	9.6
03/19/12 - 03/25/12	167	5.8	13.9	8.0
03/26/12 - 04/01/12	168	7.5	11.7	9.5
04/02/12 - 04/08/12	168	7.4	15.3	10.1
04/09/12 - 04/15/12	168	6.0	16.6	10.3
04/16/12 - 04/22/12	168	6.4	14.0	8.8
04/23/12 - 04/29/12	168	7.6	16.6	10.1
04/30/12 - 05/06/12	167	6.1	12.0	8.1
05/07/12 - 05/13/12	168	5.8	11.4	7.9
05/14/12 - 05/20/12	168	5.0	14.6	9.0
05/21/12 - 05/27/12	168	3.9	13.3	7.6
05/28/12 - 06/03/12	168	3.4	10.9	7.0
06/04/12 - 06/10/12	168	4.3	9.6	6.9
06/11/12 - 06/17/12	168	4.0	12.2	7.3
06/18/12 - 06/24/12	168	3.9	11.5	6.7
06/25/12 - 07/01/12	58	4.7	12.3	7.2
07/02/12 - 07/22/12		NO DATA		
07/23/12 - 07/29/12	110	2.5	8.7	5.5
07/30/12 - 08/05/12	168	0.2	9.2	2.1
08/06/12 - 08/12/12	168	4.4	11.6	7.3
08/13/12 - 08/19/12	168	5.5	11.3	7.5
08/20/12 - 08/26/12	168	4.8	11.7	7.7
08/27/12 - 09/02/12	168	5.0	9.6	6.7

TABLE A-5 (Continued): WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT WOLF ROAD ON  
 SALT CREEK DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
09/03/12 - 09/09/12	167	4.9	10.1	7.0
09/10/12 - 09/16/12	168	5.7	12.1	8.2
09/17/12 - 09/23/12	168	5.8	11.8	8.5
09/24/12 - 09/30/12	168	6.6	12.4	9.1
10/01/12 - 10/07/12	168	6.0	12.0	8.2
10/08/12 - 10/14/12	168	7.8	11.7	9.2
10/15/12 - 10/21/12	57	7.7	9.5	8.2
10/22/12 - 11/11/12		NO DATA		
11/12/12 - 11/18/12	85	9.8	12.5	10.8
11/19/12 - 11/25/12	168	8.6	13.5	10.1
11/26/12 - 12/02/12	168	8.6	14.5	11.6
12/03/12 - 12/09/12	168	8.0	14.3	10.4
12/10/12 - 12/16/12	168	9.6	14.4	11.4
12/17/12 - 12/23/12	168	9.7	12.8	11.2
12/24/12 - 12/30/12	168	11.7	13.1	12.1
12/31/12 - 12/31/12	24	12.0	13.0	12.4

TABLE A-6: WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT ASHLAND AVENUE ON THE  
 LITTLE CALUMET RIVER DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
01/01/12 - 01/01/12	24	9.3	10.1	9.7
01/02/12 - 01/08/12	168	10.0	12.7	11.3
01/09/12 - 01/15/12	168	10.5	14.3	11.9
01/16/12 - 01/22/12	168	10.0	13.9	12.0
01/23/12 - 01/29/12	168	8.3	12.1	11.2
01/30/12 - 02/05/12	168	7.5	11.8	10.6
02/06/12 - 02/12/12	168	11.4	13.3	12.0
02/13/12 - 02/19/12	168	10.4	13.3	11.9
02/20/12 - 02/26/12	168	10.6	13.8	12.0
02/27/12 - 03/04/12	168	10.5	14.8	11.9
03/05/12 - 03/11/12	168	8.9	13.9	11.6
03/12/12 - 03/18/12	167	6.5	11.3	8.4
03/19/12 - 03/25/12	168	4.4	7.3	6.0
03/26/12 - 04/01/12	168	7.2	9.8	8.1
04/02/12 - 04/08/12	168	7.0	10.5	8.8
04/09/12 - 04/15/12	168	7.2	11.9	9.1
04/16/12 - 04/22/12	168	4.7	8.8	6.5
04/23/12 - 04/29/12	168	6.9	9.8	8.2
04/30/12 - 05/06/12	168	4.5	7.6	5.7
05/07/12 - 05/13/12	168	5.0	7.0	6.4
05/14/12 - 05/20/12	168	3.8	6.3	5.5
05/21/12 - 05/27/12	168	2.4	8.0	5.4
05/28/12 - 06/03/12	168	4.0	8.4	5.8
06/04/12 - 06/10/12	168	4.2	7.4	5.3
06/11/12 - 06/17/12	168	2.7	10.0	5.9
06/18/12 - 06/24/12	168	2.3	8.1	4.9
06/25/12 - 07/01/12	168	1.6	8.0	4.9
07/02/12 - 07/08/12	106	2.3	5.2	3.4
07/09/12 - 07/29/12		NO DATA		
07/30/12 - 08/05/12	110	2.8	6.1	4.0
08/06/12 - 08/12/12	168	2.9	5.8	4.4
08/13/12 - 08/19/12	58	4.4	5.7	5.0
08/20/12 - 08/26/12		NO DATA		
08/27/12 - 09/02/12	110	0.9	6.1	3.9

TABLE A-6 (Continued): WEEKLY DISSOLVED OXYGEN SUMMARY STATISTICS  
 AT ASHLAND AVENUE ON THE  
 LITTLE CALUMET RIVER DURING 2012

Monitoring Dates	Number of DO Values	DO Concentration (mg/L)		
		Minimum	Maximum	Mean
09/03/12 - 09/09/12	168	0.4	5.3	3.4
09/10/12 - 09/16/12	168	1.6	6.8	4.0
09/17/12 - 09/23/12	168	4.1	8.0	6.0
09/24/12 - 09/30/12	168	6.3	9.3	7.7
10/01/12 - 10/07/12	168	4.6	8.9	6.4
10/08/12 - 10/14/12	58	5.7	8.6	7.3
10/15/12 - 10/21/12		NO DATA		
10/22/12 - 10/28/12	110	3.2	7.0	4.7
10/29/12 - 11/04/12	168	5.2	8.1	6.9
11/05/12 - 11/11/12	168	5.7	9.4	8.0
11/12/12 - 11/18/12	168	6.4	12.1	9.0
11/19/12 - 11/25/12	62	8.8	12.8	10.6
11/26/12 - 12/02/12		NO DATA		
12/03/12 - 12/09/12	110	8.1	11.4	9.9
12/10/12 - 12/16/12	168	9.1	14.4	11.5
12/17/12 - 12/23/12	168	7.5	12.6	10.0
12/24/12 - 12/30/12	168	11.5	12.8	12.1
12/31/12 - 12/31/12	24	12.4	13.0	12.7

TABLE A-7: SUMMARY STATISTICS FOR DISSOLVED OXYGEN MEASUREMENTS  
MADE DURING CROSS-SECTIONAL SURVEYS IN 2012

Waterway, Station, and Date	Cross-Sectional DO Samples						
	Waterway Depth Range During Survey (feet)	N <sup>1</sup>	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Standard Deviation (mg/L)	Coefficient of Variation (%)
<u>North Branch Chicago River</u>							
<u>Central Park Avenue</u>							
05/15/2012	0.5 – 0.6	6	8.12	8.88	8.62	0.39	4.48
08/06/2012	0.1 – 0.5	5	6.60	7.00	6.76	0.19	2.84
10/01/2012	0.1 – 0.2	4	7.63	7.68	7.66	0.03	0.34
<u>Des Plaines River</u>							
<u>Devon Avenue</u>							
05/15/2012	1.0 – 2.2	6	7.46	7.85	7.63	0.14	1.86
08/06/2012	0.2 – 1.4	6	7.60	7.89	7.78	0.10	1.32
10/03/2012	0.8 – 1.8	5	8.33	8.41	8.37	0.04	0.43

TABLE A-7 (Continued): SUMMARY STATISTICS FOR DISSOLVED OXYGEN MEASUREMENTS  
MADE DURING CROSS-SECTIONAL SURVEYS IN 2012

Waterway, Station, and Date	Cross-Sectional DO Samples						
	Waterway Depth Range During Survey (feet)	N <sup>1</sup>	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Standard Deviation (mg/L)	Coefficient of Variation (%)
<u>Salt Creek</u>							
<u>Busse Lake Dam</u>							
05/15/2012	1.8 – 2.0	6	8.73	8.90	8.80	0.07	0.77
08/06/2012	1.9 – 2.2	6	7.60	7.89	7.78	0.10	1.32
10/03/2012	0.7 – 1.7	5	2.58	3.44	2.97	0.31	0.43
<u>J.F. Kennedy Boulevard</u>							
05/15/2012	0.1 – 1.3	6	10.20	11.11	10.71	0.41	3.84
08/06/2012	0.3 – 1.6	6	6.48	7.06	6.87	0.25	3.61
10/03/2012	0.1 – 1.3	4	6.14	6.32	6.24	0.09	1.40
<u>Wolf Road</u>							
05/15/2012	0.2 – 0.9	6	7.84	8.03	7.94	0.09	2.98
08/06/2012	0.5 – 2.0	6	6.03	6.34	6.20	0.14	2.19
10/03/2012	0.5 – 1.0	4	8.14	8.45	8.28	0.13	1.60



TABLE A-7 (Continued): SUMMARY STATISTICS FOR DISSOLVED OXYGEN MEASUREMENTS  
MADE DURING CROSS-SECTIONAL SURVEYS IN 2012

Waterway, Station, and Date	Cross-Sectional DO Samples						
	Waterway Depth Range During Survey (feet)	N <sup>1</sup>	Minimum (mg/L)	Maximum (mg/L)	Mean (mg/L)	Standard Deviation (mg/L)	Coefficient of Variation (%)
<u>Little Calumet River</u>							
<u>Ashland Avenue</u>							
05/10/2012	2.0 – 2.8	6	7.22	7.76	7.46	0.22	2.98
08/13/2012	1.2 – 2.2	6	5.05	5.20	5.12	0.05	1.04
10/11/2012	1.5 – 1.5	6	7.31	7.66	7.53	0.13	1.71

<sup>1</sup>Number of DO measurements made across transect during cross-sectional survey.