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IEPA ATTACHMENT NO. W

June 4, 2007

Mr. Rob Sulski
Illinois Environmental Protection Agency
9511 West Harrison Street
Des Plaines, Illinois 60016

Dear Mr. Sulski:

Subject: Chicago Area Waterways Use Attainability Analysis Draft Standards

This letter is a follow-up to our March 23, 2007, letter to the Illinois Environmental Protection Agency regarding the subject matter. The Metropolitan Water Reclamation District of Greater Chicago (District) would like to amend our comments in the attachment to the March 23, 2007, letter. In Item 14, we state that the Chicago Sanitary and Ship Canal (CSSC) downstream of California Avenue, including the Collateral Channel, should be added to the list of noncontact recreation waters. We would like to rescind this comment. We agree with the January 18, 2007, draft water quality standards in which the CSSC is designated as nonrecreational waters.

As you requested, we enclose the effluent temperatures, with associated statistics, for the North Side, Calumet and Stickney Water Reclamation Plants for the years 2001 through 2006 (Tables 1 through 3).

You also requested that we determine the aqueous carbon dioxide concentration in the waterway. The District determines alkalinity, pH and water temperature, among other parameters, at our ambient water quality monitoring (AWQM) sites. The carbonate alkalinity concentration is determined by potentiometric titration to endpoint pH. To determine the aqueous carbon dioxide concentration, we assume that all alkalinity consists of HCO_3^- , CO_3^{2-} and OH^- , which overestimates the carbonate concentration because it ignores other sources of alkalinity. We used relations provided in *Water Quality* (Tchobanoglou, G. and Schroeder, E., Addison-Wesley Publishing, 1985), to compute H_2CO_3^* . The following equations were used:

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$$\text{Alkalinity (mole/liter)} = [\text{HCO}_3^-] + [\text{CO}_3^{2-}] + [\text{OH}^-] \quad (1)$$

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Div. Water Pollution Control
Field Operations
Section - Reg. 2

Subject: Chicago Area Waterways Use Attainability Analysis Draft Standards

$$\frac{[\text{H}^+][\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3^*]} = K_1 \quad (2)$$

$$\frac{[\text{H}^+][\text{CO}_3^{2-}]}{[\text{HCO}_3^-]} = K_2 \quad (3)$$



$$[\text{HCO}_3^-] = \frac{[\text{Alkalinity}] - [\text{OH}^-]}{1 + K_2 / [\text{H}^+]} \quad (5)$$

Solving Equation 3 for $[\text{HCO}_3^-]$ and substituting into Equation 1 gives Equation 5, which was used to determine $[\text{HCO}_3^-]$. Equation 2 was then used to compute $[\text{H}_2\text{CO}_3^*]$. The equilibrium constants, K_1 and K_2 , are a function of temperature and are provided below.

Carbonate Equilibrium Constants as a Function of Temperature

T °C	K_1 (moles/liter)	K_2 (moles/liter)
05	3.02×10^{-7}	2.75×10^{-11}
10	3.46×10^{-7}	3.24×10^{-11}
15	3.80×10^{-7}	3.72×10^{-11}
20	4.17×10^{-7}	4.17×10^{-11}
25	4.47×10^{-7}	4.68×10^{-11}

Given this approach, we have computed the H_2CO_3^* as a function of pH and temperature for the AWQM stations throughout the Chicago Area Waterways (CAWs). Tables 4 and 5 show the locations and associated parameters for instances when the H_2CO_3^* exceeded 100 mg/L during 2005 and 2006, respectively. We will be happy to provide you with each computed value throughout the CAWs.

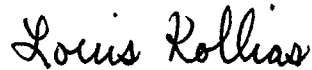
Tables 6 and 7, also enclosed, show the sampling locations and dates when the sample pH was below 6.5 for 2005 and 2006, respectively.

Subject: Chicago Area Waterways Use Attainability Analysis Draft Standards

We have also included chloride concentrations and associated statistics for all of the AWQM stations in the CAWs for 2005 and 2006. Tables 8 and 9 show the basic statistics for chloride concentrations throughout the waterways in 2005 and 2006, respectively. Table 10 shows the data combining 2005 and 2006 chloride concentrations. Tables 11 and 12 show the dates and chloride concentration for all AWQM data collected in 2005 and 2006, respectively.

Should you have any questions or need clarification regarding these enclosures, please contact Dr. Catherine O'Connor at (708) 588-4116.

Very truly yours,



Louis Kollias
Director
Research and Development

LK:lmf
Enclosures
cc: Granato
O'Connor
Abedin

TABLE 1: BASIC STATISTICS OF TEMPERATURE (°F) IN THE
 OUTFALL OF STICKNEY WATER RECLAMATION PLANT (WRP)
 DURING 2001 THROUGH 2006

Period	Observation	Minimum	Percentile			Mean	Maximum
			25 th	50 th	75 th		
January 1-31	186	45.1	50.7	52.5	54.3	52.6	62.4
February 1-29*	169	44.8	48.6	52.3	53.6	51.6	61.5
March 1-31	186	45.5	50.4	52.5	54.0	52.3	58.5
April 1-15	90	47.5	52.7	55.1	57.0	55.0	63.5
April 16-30	90	53.8	56.8	58.7	60.8	58.8	64.8
May 1-15	90	52.5	59.2	61.5	63.3	61.1	72.3
May 16-31	96	55.8	60.4	64.0	65.9	63.7	76.6
June 1-15	90	58.8	63.5	66.3	72.5	67.6	82.2
June 16-30	90	64.0	67.8	70.1	74.5	70.9	84.0
July 1-31	186	67.6	71.6	73.7	79.0	75.2	85.8
August 1-31	186	68.0	72.5	74.8	80.6	76.5	85.8
September 1-15	89	69.6	72.9	74.3	79.3	76.0	85.8
September 16-30	89	65.3	70.3	72.7	76.5	73.5	85.8
October 1-15	90	60.3	66.4	69.3	73.2	69.8	85.8
October 16-31	96	58.6	64.0	66.1	69.4	66.8	76.1
November 1-30	180	54.7	61.3	62.8	66.2	63.7	76.1
December 1-31	186	49.6	54.1	57.4	59.9	57.1	66.6

*Included data for February 29 of 2004.

TABLE 2: BASIC STATISTICS OF TEMPERATURE (°F) IN THE
 OUTFALL OF **NORTHSIDE** WATER RECLAMATION PLANT (WRP)
 DURING 2001 THROUGH 2006

Period	Observation	Minimum	Percentile			Mean	Maximum
			25 th	50 th	75 th		
January 1-31	186	45.0	49.0	52.0	53.0	51.5	57.0
February 1-29*	169	43.0	48.0	50.0	52.0	50.1	55.0
March 1-31	186	46.0	49.0	51.0	53.0	50.9	57.0
April 1-15	90	46.0	51.0	53.5	56.0	53.4	65.0
April 16-30	90	51.0	54.0	56.0	59.0	56.5	62.0
May 1-15	90	50.0	55.0	58.5	61.0	58.1	64.0
May 16-31	96	54.0	57.5	60.5	63.0	60.4	67.0
June 1-15	90	57.0	59.0	62.5	67.0	63.0	70.0
June 16-30	90	60.0	63.0	66.5	69.0	66.1	78.0
July 1-31	186	63.0	67.0	70.0	73.0	69.9	79.0
August 1-31	186	65.0	69.0	71.0	74.0	71.7	78.0
September 1-15	90	67.0	69.0	71.5	75.0	71.8	77.0
September 16-30	90	63.0	66.0	69.5	74.0	69.7	75.0
October 1-15	86	50.0	63.0	66.0	70.0	65.9	78.0
October 16-31	96	43.0	59.0	63.0	66.0	61.9	69.0
November 1-30	180	54.0	60.0	61.0	63.0	61.2	67.0
December 1-31	186	49.0	54.0	56.0	58.0	55.9	60.0

*Included data for February 29 of 2004.

TABLE 3: BASIC STATISTICS OF TEMPERATURE (°F) IN THE
 OUTFALL OF CALUMET WATER RECLAMATION PLANT (WRP)
 DURING 2001 THROUGH 2006

Period	Observation	Minimum	Percentile			Mean	Maximum
			25 th	50 th	75 th		
January 1-31	185	44.6	50.0	50.0	51.8	50.1	53.6
February 1-29*	169	44.6	48.2	48.2	50.0	48.6	51.8
March 1-31	186	46.4	48.2	50.0	50.0	49.3	53.6
April 1-15	90	48.2	50.0	51.8	53.6	51.8	55.4
April 16-30	90	50.0	53.6	55.4	55.4	54.5	57.2
May 1-15	90	53.6	55.4	55.4	57.2	56.3	62.6
May 16-31	96	53.6	57.2	59.0	59.0	58.5	62.6
June 1-15	90	59.0	59.0	60.8	62.6	61.4	64.4
June 16-30	90	60.8	62.6	64.4	64.4	64.1	68.0
July 1-31	186	64.4	66.2	68.0	69.8	67.8	71.6
August 1-31	186	66.2	68.0	69.8	71.6	69.8	71.6
September 1-15	90	66.2	68.0	69.8	71.6	69.6	71.6
September 16-30	90	64.4	66.2	68.0	68.0	67.7	71.6
October 1-15	90	60.8	64.4	65.3	66.2	65.5	69.8
October 16-31	96	59.0	62.6	62.6	62.6	62.6	68.0
November 1-30	180	53.6	57.2	59.0	60.8	59.2	66.2
December 1-31	186	50.0	51.8	53.6	55.4	53.6	59.0

*Included data for February 29 of 2004.

TABLE 4: CONCENTRATION OF TEMPERATURE, pH, ALKALINITY, AND H₂CO₃*
 FOR H₂CO₃* ≥ 100 mg/L
 IN THE CHICAGO AREA WATERWAYS (CAW) IN 2005

Location	Date	Temp °F	pH	Alk	H ₂ CO ₃ * -- mg/L --
59 Cicero Avenue, Calumet Sag Channel	01/24/05	3.0	6.5	204	132.4
75 Cicero Avenue, Chicago Sanitary & Ship Canal	08/15/05	32.3	6.1	117	127.5
92 Lockport Forebay, Chicago Sanitary & Ship Canal	08/29/05	31.7	6.1	121	109.7
92 Lockport Forebay, Chicago Sanitary & Ship Canal	09/12/05	29.9	6.0	119	152.4
56 Indiana Avenue, Little Calumet River	09/26/05	21.7	5.7	105	284.0
76 Halsted Street, Little Calumet River	09/26/05	22.1	5.5	118	517.6
57 Ashland Avenue, Little Calumet River	09/26/05	23.6	5.5	123	515.2
58 Ashland Avenue, Calumet Sag Channel	09/26/05	19.2	5.0	127	1888.2
76 Halsted Street, Little Calumet River	10/24/05	15.9	6.2	139	118.9
36 Touhy Avenue, North Shore Channel	11/14/05	15.7	6.2	123	123.6
101 Foster Avenue, North Shore Channel	11/14/05	14.6	6.3	120	105.1
75 Cicero Avenue, Chicago Sanitary & Ship Canal	11/21/05	19.1	6.2	121	105.9
92 Lockport Forebay, Chicago Sanitary & Ship Canal	11/21/05	14.8	6.1	124	172.2
52 Wentworth Avenue, Little Calumet River	12/27/05	3.1	6.1	195	318.0
59 Cicero Avenue, Calumet Sag Channel	12/27/05	6.9	5.8	136	386.2
43 Route 83, Calumet Sag Channel	12/27/05	5.0	6.2	141	182.6

TABLE 5: CONCENTRATION OF TEMPERATURE, pH, ALKALINITY, AND H₂CO₃*
 FOR H₂CO₃* ≥ 100 mg/L
 IN THE CHICAGO AREA WATERWAYS (CAW) IN 2006

Location	Date	Temp °F	pH	Alk	H ₂ CO ₃ * -- mg/L --
101 Foster Avenue, North Shore Channel	01/09/06	6.4	6.3	149	143.4
75 Cicero Avenue, Chicago Sanitary & Ship Canal	01/17/06	13.6	6.3	140	122.7
41 Harlem Avenue, Chicago Sanitary & Ship Canal	01/17/06	11.4	6.2	129	142.3
92 Lockport Forebay, Chicago Sanitary & Ship Canal	01/17/06	13.6	6.1	129	171.1
52 Wentworth Avenue, Little Calumet River	01/23/06	3.5	6.3	185	190.3
59 Cicero Avenue, Calumet Sag Channel	01/23/06	5.6	6.3	162	145.5
43 Route 83, Calumet Sag Channel	01/23/06	3.0	6.3	175	180.1
92 Lockport Forebay, Chicago Sanitary & Ship Canal	01/30/06	12.0	5.9	147	275.4
73 Diversey Parkway, North Branch Chicago River	02/14/06	5.8	6.0	141	252.7
46 Grand Avenue, North Branch Chicago River	02/14/06	8.3	6.0	149	267.0
42 Route 83, Chicago Sanitary & Ship Canal	04/17/06	15.0	6.0	135	220.3
48 Stephen Street, Chicago Sanitary & Ship Canal	04/17/06	13.0	6.0	151	246.4

TABLE 6: CONCENTRATION OF TEMPERATURE, pH, ALKALINITY, AND H₂CO₃*
 FOR pH < 6.5
 IN THE CHICAGO AREA WATERWAYS (CAW) IN 2005

Location	Date	Temp °F	pH	Alk	H ₂ CO ₃ * -- mg/L --
100 Wells Street, Chicago River	08/15/05	24.0	6.4	107	64.8
39 Madison Street, South Branch Chicago River	08/15/05	23.5	6.5	108	51.9
75 Cicero Avenue, Chicago Sanitary & Ship Canal	08/15/05	32.3	6.1	117	127.5
41 Harlem Avenue, Chicago Sanitary & Ship Canal	08/15/05	28.8	6.5	112	48.6
86 Burnham Avenue, Grand Calumet River	08/22/05	22.7	6.4	175	98.9
92 Lockport Forebay, Chicago Sanitary & Ship Canal	08/29/05	31.7	6.1	121	109.7
92 Lockport Forebay, Chicago Sanitary & Ship Canal	09/12/05	29.9	6.0	119	152.4
56 Indiana Avenue, Little Calumet River	09/26/05	21.7	5.7	105	284.0
76 Halsted Street, Little Calumet River	09/26/05	22.1	5.5	118	517.6
57 Ashland Avenue, Little Calumet River	09/26/05	23.6	5.5	123	515.2
58 Ashland Avenue, Calumet Sag Channel	09/26/05	19.2	5.0	127	1888.2
36 Touhy Avenue, North Shore Channel	10/10/05	17.6	6.4	117	66.1
101 Foster Avenue, North Shore Channel	10/10/05	18.0	6.3	117	85.2
76 Halsted Street, Little Calumet River	10/24/05	15.9	6.2	139	118.9
57 Ashland Avenue, Little Calumet River	10/24/05	10.5	6.5	105	58.0
58 Ashland Avenue, Calumet Sag Channel	10/24/05	14.9	6.4	138	81.7
102 Oakton Street, North Shore Channel	11/14/05	12.5	6.3	116	99.3
36 Touhy Avenue, North Shore Channel	11/14/05	15.7	6.2	123	123.6
101 Foster Avenue, North Shore Channel	11/14/05	14.6	6.3	120	105.1
75 Cicero Avenue, Chicago Sanitary & Ship Canal	11/21/05	19.1	6.2	121	105.9
41 Harlem Avenue, Chicago Sanitary & Ship Canal	11/21/05	16.4	6.2	106	99.4
92 Lockport Forebay, Chicago Sanitary & Ship Canal	11/21/05	14.8	6.1	124	172.2
52 Wentworth Avenue, Little Calumet River	12/27/05	3.1	6.1	195	318.0
59 Cicero Avenue, Calumet Sag Channel	12/27/05	6.9	5.8	136	386.2
43 Route 83, Calumet Sag Channel	12/27/05	5.0	6.2	141	182.6

TABLE 7: CONCENTRATION OF TEMPERATURE, pH, ALKALINITY, AND H₂CO₃*
 FOR pH < 6.5
 IN THE CHICAGO AREA WATERWAYS (CAW) IN 2006

Location	Date	Temp °F	pH	Alk	H ₂ CO ₃ * -- mg/L --
36 Touhy Avenue, North Shore Channel	01/09/06	5.3	6.5	158	98.2
101 Foster Avenue, North Shore Channel	01/09/06	6.4	6.3	149	143.4
92 Lockport Forebay, Chicago Sanitary & Ship Canal	01/09/06	12.7	6.5	152	82.1
75 Cicero Avenue, Chicago Sanitary & Ship Canal	01/17/06	13.6	6.3	140	122.7
41 Harlem Avenue, Chicago Sanitary & Ship Canal	01/17/06	11.4	6.2	129	142.3
92 Lockport Forebay, Chicago Sanitary & Ship Canal	01/17/06	13.6	6.1	129	171.1
52 Wentworth Avenue, Little Calumet River	01/23/06	3.5	6.3	185	190.3
59 Cicero Avenue, Calumet Sag Channel	01/23/06	5.6	6.3	162	145.5
43 Route 83, Calumet Sag Channel	01/23/06	3.0	6.3	175	180.1
92 Lockport Forebay, Chicago Sanitary & Ship Canal	01/30/06	12.0	5.9	147	275.4
73 Diversey Parkway, North Branch Chicago River	02/14/06	5.8	6.0	141	252.7
46 Grand Avenue, North Branch Chicago River	02/14/06	8.3	6.0	149	267.0
42 Route 83, Chicago Sanitary & Ship Canal	04/17/06	15.0	6.0	135	220.3
48 Stephen Street, Chicago Sanitary & Ship Canal	04/17/06	13.0	6.0	151	246.4

TABLE 8: BASIC STATISTICS OF CHLORIDE CONCENTRATION
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Obs	Minimum	Mean	Maximum
	----- mg/L -----			
35 Central Street, North Shore Channel	8	12	35	177
102 Oakton Street, North Shore Channel	12	12	135	394
36 Touhy Avenue, North Shore Channel	12	54	150	455
101 Foster Avenue, North Shore Channel	13	62	165	574
37 Wilson Avenue, North Branch Chicago River	12	67	209	643
73 Diversey Parkway, North Branch Chicago River	12	67	196	421
46 Grand Avenue, North Branch Chicago River	12	70	186	553
74 Lake Shore Drive, Chicago River	10	13	62	250
100 Wells Street, Chicago River	12	16	109	286
39 Madison Street, South Branch Chicago River	12	49	156	344
108 Loomis Street, South Branch Chicago River	10	35	158	295
99 Archer Avenue, South Fork South Branch Chicago River	10	39	150	288
40 Damen Avenue, Chicago Sanitary & Ship Canal	12	35	153	306
75 Cicero Avenue, Chicago Sanitary & Ship Canal	12	35	156	312
41 Harlem Avenue, Chicago Sanitary & Ship Canal	12	56	162	320
42 Route 83, Chicago Sanitary & Ship Canal	11	75	170	395
48 Stephen Street, Chicago Sanitary & Ship Canal	11	83	164	307
92 Lockport Forebay, Chicago Sanitary & Ship Canal	52	3	181	671
49 Ewing Avenue, Calumet River	11	12	38	81
55 130th Street, Calumet River	11	25	75	149
86 Burnham Avenue, Grand Calumet River	10	53	137	185
56 Indiana Avenue, Little Calumet River	9	27	82	176
76 Halsted Street, Little Calumet River	12	60	174	467
52 Wentworth Avenue, Little Calumet River	11	27	140	245
57 Ashland Avenue, Little Calumet River	11	76	205	506
58 Ashland Avenue, Calumet Sag Channel	12	68	180	401
59 Cicero Avenue, Calumet Sag Channel	12	66	171	324
43 Route 83, Calumet Sag Channel	11	1	144	274

TABLE 9: BASIC STATISTICS OF CHLORIDE CONCENTRATION
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Obs	Minimum	Mean	Maximum
	----- mg/L -----			
35 Central Street, North Shore Channel	9	13	37	144
102 Oakton Street, North Shore Channel	12	13	90	186
36 Touhy Avenue, North Shore Channel	12	60	116	184
101 Foster Avenue, North Shore Channel	12	72	134	319
37 Wilson Avenue, North Branch Chicago River	12	78	145	215
73 Diversey Parkway, North Branch Chicago River	12	68	140	213
46 Grand Avenue, North Branch Chicago River	12	69	154	250
74 Lake Shore Drive, Chicago River	11	13	64	149
100 Wells Street, Chicago River	12	13	89	217
39 Madison Street, South Branch Chicago River	12	43	125	234
108 Loomis Street, South Branch Chicago River	12	56	143	284
99 Archer Avenue, South Fork South Branch Chicago River	7	47	110	227
40 Damen Avenue, Chicago Sanitary & Ship Canal	12	48	137	290
75 Cicero Avenue, Chicago Sanitary & Ship Canal	12	45	136	339
41 Harlem Avenue, Chicago Sanitary & Ship Canal	12	70	146	240
42 Route 83, Chicago Sanitary & Ship Canal	12	69	151	254
48 Stephen Street, Chicago Sanitary & Ship Canal	12	77	152	257
92 Lockport Forebay, Chicago Sanitary & Ship Canal	51	80	158	306
49 Ewing Avenue, Calumet River	11	15	44	81
55 130th Street, Calumet River	11	30	83	135
86 Burnham Avenue, Grand Calumet River	11	119	155	223
56 Indiana Avenue, Little Calumet River	11	28	98	150
76 Halsted Street, Little Calumet River	11	73	153	390
52 Wentworth Avenue, Little Calumet River	11	82	122	159
57 Ashland Avenue, Little Calumet River	11	109	174	351
58 Ashland Avenue, Calumet Sag Channel	11	78	161	440
59 Cicero Avenue, Calumet Sag Channel	11	5	155	428
43 Route 83, Calumet Sag Channel	11	76	150	310

TABLE 10: BASIC STATISTICS OF CHLORIDE CONCENTRATION
IN THE CHICAGO AREA WATERWAYS (CAW) FOR 2005 AND 2006 COMBINED

Location	Obs	Minimum	Mean	Maximum
	----- mg/L -----			
35 Central Street, North Shore Channel	17	12	36	177
102 Oakton Street, North Shore Channel	24	12	112	394
36 Touhy Avenue, North Shore Channel	24	54	133	455
101 Foster Avenue, North Shore Channel	25	62	150	574
37 Wilson Avenue, North Branch Chicago River	24	67	177	643
73 Diversey Parkway, North Branch Chicago River	24	67	168	421
46 Grand Avenue, North Branch Chicago River	24	69	170	553
74 Lake Shore Drive, Chicago River	21	13	63	250
100 Wells Street, Chicago River	24	13	99	286
39 Madison Street, South Branch Chicago River	24	43	141	344
108 Loomis Street, South Branch Chicago River	22	35	150	295
99 Archer Avenue, South Fork South Branch Chicago River	17	39	133	288
40 Damen Avenue, Chicago Sanitary & Ship Canal	24	35	145	306
75 Cicero Avenue, Chicago Sanitary & Ship Canal	24	35	146	339
41 Harlem Avenue, Chicago Sanitary & Ship Canal	24	56	154	320
42 Route 83, Chicago Sanitary & Ship Canal	23	69	160	395
48 Stephen Street, Chicago Sanitary & Ship Canal	23	77	158	307
92 Lockport Forebay, Chicago Sanitary & Ship Canal	103	3	169	671
49 Ewing Avenue, Calumet River	22	12	41	81
55 130th Street, Calumet River	22	25	79	149
86 Burnham Avenue, Grand Calumet River	21	53	146	223
56 Indiana Avenue, Little Calumet River	20	27	91	176
76 Halsted Street, Little Calumet River	23	60	164	467
52 Wentworth Avenue, Little Calumet River	22	27	131	245
57 Ashland Avenue, Little Calumet River	22	76	189	506
58 Ashland Avenue, Calumet Sag Channel	23	68	171	440
59 Cicero Avenue, Calumet Sag Channel	23	5	163	428
43 Route 83, Calumet Sag Channel	22	1	147	310

TABLE 11: CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
35 Central Street, North Shore Channel	06/13/05	12
"	07/11/05	12
"	08/08/05	12
"	09/12/05	12
"	10/10/05	13
"	05/09/05	16
"	11/14/05	24
"	04/11/05	177
102 Oakton Street, North Shore Channel	08/08/05	12
"	10/10/05	12
"	06/13/05	13
"	07/11/05	13
"	09/12/05	13
"	05/09/05	19
"	11/14/05	79
"	03/14/05	204
"	12/12/05	234
"	02/14/05	304
"	04/11/05	324
"	01/10/05	394
36 Touhy Avenue, North Shore Channel	08/08/05	54
"	10/10/05	55
"	09/12/05	58
"	07/11/05	68
"	06/13/05	79
"	11/14/05	83
"	05/09/05	99
"	02/14/05	121
"	04/11/05	153
"	03/14/05	200
"	01/10/05	376
"	12/12/05	455
101 Foster Avenue, North Shore Channel	09/12/05	62
"	10/10/05	62
"	08/08/05	64
"	07/11/05	72
"	11/14/05	84
"	06/13/05	88
"	06/13/05	88
"	05/09/05	100

TABLE 11 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
101 Foster Avenue, North Shore Channel (Continued)	04/11/05	154
"	03/14/05	221
"	02/14/05	260
"	01/10/05	322
"	12/12/05	574
37 Wilson Avenue, North Branch Chicago River	09/12/05	67
"	10/10/05	71
"	08/08/05	73
"	07/11/05	84
"	11/14/05	99
"	06/13/05	104
"	05/09/05	122
"	04/11/05	197
"	03/14/05	325
"	02/14/05	361
"	01/10/05	365
"	12/12/05	643
73 Diversey Parkway, North Branch Chicago River	09/12/05	67
"	10/10/05	71
"	08/08/05	74
"	07/11/05	90
"	11/14/05	92
"	06/13/05	107
"	05/09/05	125
"	04/11/05	187
"	12/12/05	337
"	01/10/05	370
"	03/14/05	412
"	02/14/05	421
46 Grand Avenue, North Branch Chicago River	09/12/05	70
"	08/08/05	73
"	10/10/05	82
"	07/11/05	92
"	06/13/05	105
"	11/14/05	105
"	05/09/05	133
"	04/11/05	213
"	12/12/05	249
"	03/14/05	260
"	02/14/05	297

TABLE 11 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
46 Grand Avenue, North Branch Chicago River (Continued)	01/10/05	553
74 Lake Shore Drive, Chicago River	10/17/05	13
"	09/19/05	14
"	08/15/05	15
"	06/20/05	16
"	07/18/05	16
"	05/16/05	24
"	11/21/05	35
"	04/18/05	63
"	02/22/05	176
"	03/21/05	250
100 Wells Street, Chicago River	07/18/05	16
"	08/15/05	20
"	06/20/05	21
"	09/19/05	24
"	10/17/05	30
"	05/16/05	57
"	11/21/05	74
"	04/18/05	141
"	03/21/05	172
"	02/22/05	212
"	12/19/05	251
"	01/18/05	286
39 Madison Street, South Branch Chicago River	07/18/05	49
"	09/19/05	51
"	10/17/05	56
"	08/15/05	63
"	06/20/05	83
"	11/21/05	104
"	05/16/05	115
"	04/18/05	181
"	03/21/05	270
"	02/22/05	274
"	01/18/05	284
"	12/19/05	344
108 Loomis Street, South Branch Chicago River	09/19/05	35
"	10/17/05	54
"	07/18/05	56
"	08/15/05	74
"	11/21/05	94

TABLE 11 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
108 Loomis Street, South Branch Chicago River (Continued)	04/18/05	185
"	12/19/05	254
"	03/21/05	262
"	02/22/05	276
"	01/18/05	295
99 Archer Avenue, South Fork South Branch Chicago River	09/19/05	39
"	07/18/05	54
"	10/17/05	56
"	06/20/05	73
"	11/21/05	97
"	05/16/05	122
"	04/18/05	205
"	03/21/05	279
"	12/19/05	283
"	02/22/05	288
40 Damen Avenue, Chicago Sanitary & Ship Canal	09/19/05	35
"	07/18/05	54
"	10/17/05	57
"	06/20/05	70
"	08/15/05	72
"	11/21/05	96
"	05/16/05	124
"	04/18/05	180
"	03/21/05	271
"	02/22/05	279
"	12/19/05	298
"	01/18/05	306
75 Cicero Avenue, Chicago Sanitary & Ship Canal	09/19/05	35
"	10/17/05	54
"	08/15/05	55
"	07/18/05	58
"	06/20/05	74
"	11/21/05	99
"	05/16/05	114
"	04/18/05	181
"	12/19/05	281
"	02/22/05	297
"	03/21/05	309
"	01/18/05	312
41 Harlem Avenue, Chicago Sanitary & Ship Canal	09/19/05	56

TABLE 11 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
41 Harlem Avenue, Chicago Sanitary & Ship Canal (Continued)	08/15/05	74
"	10/17/05	80
"	07/18/05	85
"	06/20/05	99
"	11/21/05	114
"	05/16/05	130
"	04/18/05	188
"	12/19/05	263
"	03/21/05	268
"	01/18/05	269
"	02/22/05	320
42 Route 83, Chicago Sanitary & Ship Canal	09/19/05	75
"	10/17/05	89
"	07/18/05	90
"	08/15/05	90
"	06/20/05	109
"	11/21/05	112
"	05/16/05	139
"	04/18/05	196
"	03/21/05	288
"	01/18/05	289
"	02/22/05	395
48 Stephen Street, Chicago Sanitary & Ship Canal	09/19/05	83
"	08/15/05	87
"	10/17/05	89
"	07/18/05	94
"	06/20/05	116
"	11/21/05	119
"	05/16/05	149
"	04/18/05	205
"	01/18/05	268
"	02/22/05	283
"	03/21/05	307
92 Lockport Forebay, Chicago Sanitary & Ship Canal	06/27/05	3
"	09/06/05	64
"	09/12/05	65
"	10/03/05	65
"	09/19/05	67
"	09/26/05	67
"	08/22/05	75

TABLE 11 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
92 Lockport Forebay, Chicago Sanitary & Ship Canal (Continued)	08/15/05	82
"	08/29/05	82
"	10/17/05	86
"	10/24/05	90
"	08/08/05	91
"	10/10/05	94
"	07/25/05	97
"	07/18/05	99
"	07/05/05	100
"	08/01/05	100
"	07/11/05	101
"	10/31/05	103
"	11/14/05	116
"	11/28/05	119
"	06/13/05	120
"	11/07/05	120
"	11/21/05	121
"	06/20/05	122
"	12/05/05	139
"	05/23/05	145
"	05/16/05	148
"	06/06/05	152
"	05/31/05	160
"	01/03/05	175
"	05/09/05	190
"	05/02/05	191
"	04/18/05	196
"	04/25/05	196
"	12/12/05	201
"	12/27/05	223
"	04/11/05	224
"	04/04/05	238
"	01/18/05	254
"	12/19/05	271
"	03/14/05	275
"	02/22/05	277
"	02/28/05	277
"	03/07/05	282
"	03/28/05	288
"	03/21/05	296

TABLE 11 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
92 Lockport Forebay, Chicago Sanitary & Ship Canal (Continued)	01/24/05	351
"	02/14/05	364
"	02/07/05	382
"	01/10/05	591
"	01/31/05	671
49 Ewing Avenue, Calumet River	09/26/05	12
"	06/27/05	14
"	08/22/05	14
"	07/25/05	17
"	10/24/05	23
"	05/23/05	26
"	11/28/05	43
"	12/27/05	53
"	04/25/05	61
"	03/28/05	71
"	02/28/05	81
55 130th Street, Calumet River	09/26/05	25
"	08/22/05	27
"	10/24/05	27
"	07/25/05	33
"	11/28/05	43
"	12/27/05	55
"	06/27/05	65
"	05/23/05	127
"	03/28/05	132
"	02/28/05	140
"	04/25/05	149
86 Burnham Avenue, Grand Calumet River	10/24/05	53
"	11/28/05	73
"	08/22/05	114
"	09/26/05	119
"	06/27/05	155
"	03/28/05	162
"	05/23/05	166
"	04/25/05	170
"	07/25/05	171
"	02/28/05	185
56 Indiana Avenue, Little Calumet River	09/26/05	27
"	08/22/05	33
"	10/24/05	33

TABLE 11 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
56 Indiana Avenue, Little Calumet River (Continued)	07/25/05	44
"	11/28/05	59
"	06/27/05	84
"	12/27/05	120
"	02/28/05	168
"	03/28/05	176
76 Halsted Street, Little Calumet River	09/26/05	60
"	08/22/05	69
"	07/25/05	93
"	10/24/05	108
"	06/27/05	109
"	11/28/05	126
"	05/23/05	152
"	04/25/05	176
"	02/28/05	203
"	03/28/05	230
"	12/27/05	290
"	01/24/05	467
52 Wentworth Avenue, Little Calumet River	10/24/05	27
"	08/22/05	66
"	11/28/05	90
"	05/23/05	142
"	09/26/05	142
"	03/28/05	147
"	07/25/05	159
"	02/28/05	166
"	04/25/05	176
"	06/27/05	176
"	12/27/05	245
57 Ashland Avenue, Little Calumet River	08/22/05	76
"	10/24/05	107
"	09/26/05	124
"	07/25/05	149
"	11/28/05	170
"	05/23/05	186
"	06/27/05	222
"	04/25/05	225
"	02/28/05	239
"	03/28/05	257
"	12/27/05	506

TABLE 11 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2005

Location	Date	Concentration (mg/L)
58 Ashland Avenue, Calumet Sag Channel	08/22/05	68
"	09/26/05	78
"	07/25/05	94
"	10/24/05	111
"	06/27/05	118
"	11/28/05	127
"	05/23/05	157
"	04/25/05	185
"	02/28/05	209
"	03/28/05	224
"	12/27/05	384
"	01/24/05	401
59 Cicero Avenue, Calumet Sag Channel	08/22/05	66
"	09/26/05	66
"	07/25/05	102
"	10/24/05	107
"	06/27/05	122
"	11/28/05	124
"	05/23/05	162
"	04/25/05	188
"	02/28/05	215
"	03/28/05	253
"	12/27/05	318
"	01/24/05	324
43 Route 83, Calumet Sag Channel	06/27/05	1
"	09/26/05	63
"	08/22/05	80
"	10/24/05	91
"	07/25/05	92
"	11/28/05	133
"	05/23/05	172
"	04/25/05	205
"	02/28/05	231
"	03/28/05	247
"	12/27/05	274

TABLE 12: CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
35 Central Street, North Shore Channel	07/10/06	13
"	08/14/06	13
"	10/09/06	13
"	09/11/06	14
"	06/12/06	15
"	05/08/06	19
"	11/13/06	38
"	04/10/06	62
"	03/13/06	144
102 Oakton Street, North Shore Channel	07/10/06	13
"	08/14/06	14
"	10/09/06	14
"	06/12/06	15
"	05/08/06	20
"	09/11/06	76
"	11/13/06	79
"	04/10/06	156
"	12/11/06	159
"	03/13/06	173
"	01/09/06	174
"	02/14/06	186
36 Touhy Avenue, North Shore Channel	08/14/06	60
"	07/10/06	70
"	09/11/06	82
"	06/12/06	88
"	10/09/06	104
"	11/13/06	111
"	05/08/06	113
"	03/13/06	119
"	01/09/06	150
"	04/10/06	150
"	02/14/06	161
"	12/11/06	184
101 Foster Avenue, North Shore Channel	09/11/06	72
"	07/10/06	75
"	08/14/06	87
"	10/09/06	104
"	06/12/06	111
"	11/13/06	112
"	03/13/06	115

TABLE 12 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
101 Foster Avenue, North Shore Channel (Continued)	05/08/06	123
"	01/09/06	149
"	02/14/06	164
"	12/11/06	175
"	04/10/06	319
37 Wilson Avenue, North Branch Chicago River	09/11/06	78
"	08/14/06	81
"	07/10/06	96
"	10/09/06	109
"	11/13/06	120
"	06/12/06	133
"	05/08/06	152
"	03/13/06	169
"	12/11/06	179
"	04/10/06	195
"	01/09/06	214
"	02/14/06	215
73 Diversey Parkway, North Branch Chicago River	08/14/06	68
"	09/11/06	75
"	07/10/06	83
"	10/09/06	109
"	06/12/06	110
"	11/13/06	118
"	05/08/06	151
"	12/11/06	159
"	03/13/06	190
"	04/10/06	197
"	02/14/06	211
"	01/09/06	213
46 Grand Avenue, North Branch Chicago River	08/14/06	69
"	11/13/06	94
"	07/10/06	95
"	09/11/06	97
"	10/09/06	111
"	06/12/06	118
"	05/08/06	161
"	12/11/06	178
"	03/13/06	205
"	04/10/06	216
"	02/14/06	249

TABLE 12 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
46 Grand Avenue, North Branch Chicago River (Continued)	01/09/06	250
74 Lake Shore Drive, Chicago River	08/21/06	13
"	09/18/06	13
"	07/17/06	14
"	06/19/06	15
"	05/15/06	20
"	11/20/06	35
"	04/17/06	62
"	10/16/06	116
"	12/18/06	130
"	03/20/06	143
"	01/17/06	149
100 Wells Street, Chicago River	09/18/06	13
"	07/17/06	14
"	08/21/06	14
"	06/19/06	19
"	10/16/06	24
"	05/15/06	63
"	11/20/06	82
"	04/17/06	115
"	02/21/06	137
"	03/20/06	172
"	12/18/06	194
"	01/17/06	217
39 Madison Street, South Branch Chicago River	08/21/06	43
"	07/17/06	46
"	09/18/06	53
"	10/16/06	55
"	06/19/06	60
"	05/15/06	119
"	11/20/06	121
"	04/17/06	154
"	02/21/06	186
"	12/18/06	200
"	03/20/06	233
"	01/17/06	234
108 Loomis Street, South Branch Chicago River	07/17/06	56
"	08/21/06	56
"	10/16/06	60
"	09/18/06	63

TABLE 12 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
108 Loomis Street, South Branch Chicago River (Continued)	06/19/06	79
"	05/15/06	108
"	11/20/06	120
"	04/17/06	175
"	12/18/06	211
"	01/17/06	227
"	03/20/06	276
"	02/21/06	284
99 Archer Avenue, South Fork South Branch Chicago River	08/21/06	47
"	07/17/06	53
"	09/18/06	58
"	10/16/06	65
"	11/20/06	121
"	01/17/06	200
"	12/18/06	227
40 Damen Avenue, Chicago Sanitary & Ship Canal	08/21/06	48
"	10/16/06	59
"	07/17/06	60
"	09/18/06	60
"	06/19/06	79
"	05/15/06	106
"	11/20/06	120
"	04/17/06	158
"	01/17/06	201
"	12/18/06	218
"	03/20/06	248
"	02/21/06	290
75 Cicero Avenue, Chicago Sanitary & Ship Canal	05/15/06	45
"	08/21/06	50
"	07/17/06	52
"	09/18/06	59
"	06/19/06	76
"	10/16/06	82
"	11/20/06	107
"	04/17/06	126
"	01/17/06	205
"	03/20/06	234
"	12/18/06	259
"	02/21/06	339
41 Harlem Avenue, Chicago Sanitary & Ship Canal	08/21/06	70

TABLE 12 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
41 Harlem Avenue, Chicago Sanitary & Ship Canal (Continued)	09/18/06	80
"	07/17/06	85
"	06/19/06	112
"	10/16/06	124
"	11/20/06	126
"	04/17/06	138
"	05/15/06	139
"	01/17/06	189
"	03/20/06	213
"	02/21/06	233
"	12/18/06	240
42 Route 83, Chicago Sanitary & Ship Canal	08/21/06	69
"	07/17/06	86
"	09/18/06	86
"	06/19/06	115
"	11/20/06	116
"	10/16/06	127
"	04/17/06	160
"	05/15/06	160
"	01/17/06	202
"	03/20/06	205
"	02/21/06	239
"	12/18/06	254
48 Stephen Street, Chicago Sanitary & Ship Canal	08/21/06	77
"	07/17/06	85
"	09/18/06	98
"	10/16/06	120
"	06/19/06	125
"	11/20/06	125
"	05/15/06	146
"	04/17/06	172
"	03/20/06	200
"	12/18/06	208
"	01/17/06	217
"	02/21/06	257
92 Lockport Forebay, Chicago Sanitary & Ship Canal	08/21/06	80
"	08/28/06	80
"	08/14/06	86
"	10/09/06	86
"	07/17/06	88

TABLE 12 (Continued): CHLORIDE CONCENTRATION DATA
 IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
92 Lockport Forebay, Chicago Sanitary & Ship Canal (Continued)	09/05/06	90
"	09/25/06	91
"	07/31/06	94
"	09/11/06	94
"	09/18/06	94
"	10/02/06	94
"	08/07/06	96
"	07/24/06	104
"	10/23/06	104
"	06/12/06	106
"	07/10/06	111
"	07/05/06	112
"	11/13/06	112
"	10/16/06	114
"	06/19/06	118
"	11/20/06	119
"	10/30/06	120
"	06/05/06	122
"	06/26/06	123
"	11/27/06	132
"	05/15/06	142
"	05/22/06	143
"	11/06/06	145
"	05/30/06	156
"	05/01/06	157
"	04/24/06	164
"	05/08/06	166
"	04/10/06	181
"	04/17/06	182
"	03/06/06	189
"	12/18/06	192
"	03/20/06	196
"	04/03/06	197
"	01/17/06	201
"	01/23/06	202
"	03/27/06	209
"	12/11/06	215
"	02/14/06	235
"	02/06/06	243
"	02/27/06	246

TABLE 12 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
92 Lockport Forebay, Chicago Sanitary & Ship Canal (Continued)	02/21/06	258
"	01/30/06	264
"	03/13/06	295
"	12/04/06	298
"	01/09/06	305
"	01/03/06	306
49 Ewing Avenue, Calumet River	08/28/06	15
"	07/24/06	18
"	06/26/06	19
"	09/25/06	26
"	05/22/06	39
"	10/23/06	42
"	02/27/06	53
"	04/24/06	53
"	03/27/06	58
"	11/27/06	80
"	01/23/06	81
55 130th Street, Calumet River	08/28/06	30
"	07/24/06	49
"	10/23/06	59
"	09/25/06	65
"	06/26/06	67
"	11/27/06	76
"	01/23/06	80
"	02/27/06	107
"	03/27/06	116
"	04/24/06	126
"	05/22/06	135
86 Burnham Avenue, Grand Calumet River	07/24/06	119
"	11/27/06	127
"	10/23/06	132
"	09/25/06	134
"	08/28/06	138
"	06/26/06	150
"	02/27/06	161
"	05/22/06	167
"	04/24/06	173
"	03/27/06	180
"	01/23/06	223
56 Indiana Avenue, Little Calumet River	08/28/06	28

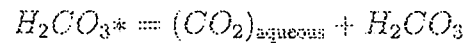
TABLE 12 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
56 Indiana Avenue, Little Calumet River (Continued)	07/24/06	54
"	09/25/06	57
"	10/23/06	74
"	06/26/06	95
"	11/27/06	104
"	03/27/06	126
"	02/27/06	127
"	04/24/06	128
"	05/22/06	138
"	01/23/06	150
76 Halsted Street, Little Calumet River	08/28/06	73
"	07/24/06	84
"	09/25/06	107
"	10/23/06	121
"	06/26/06	125
"	11/27/06	135
"	04/24/06	140
"	05/22/06	165
"	02/27/06	172
"	03/27/06	173
"	01/23/06	390
52 Wentworth Avenue, Little Calumet River	09/25/06	82
"	10/23/06	85
"	08/28/06	101
"	04/24/06	104
"	07/24/06	114
"	11/27/06	116
"	05/22/06	125
"	03/27/06	149
"	01/23/06	151
"	06/26/06	156
"	02/27/06	159
57 Ashland Avenue, Little Calumet River	10/23/06	109
"	09/25/06	111
"	08/28/06	118
"	07/24/06	137
"	04/24/06	138
"	11/27/06	150
"	05/22/06	157
"	06/26/06	192

TABLE 12 (Continued): CHLORIDE CONCENTRATION DATA
IN THE CHICAGO AREA WATERWAYS (CAW) DURING 2006

Location	Date	Concentration (mg/L)
57 Ashland Avenue, Little Calumet River (Continued)	02/27/06	224
"	03/27/06	224
"	01/23/06	351
58 Ashland Avenue, Calumet Sag Channel	08/28/06	78
"	07/24/06	89
"	09/25/06	109
"	10/23/06	115
"	06/26/06	126
"	11/27/06	136
"	04/24/06	143
"	05/22/06	169
"	02/27/06	181
"	03/27/06	183
"	01/23/06	440
59 Cicero Avenue, Calumet Sag Channel	07/24/06	5
"	08/28/06	81
"	09/25/06	110
"	10/23/06	117
"	06/26/06	126
"	11/27/06	137
"	04/24/06	144
"	05/22/06	168
"	02/27/06	190
"	03/27/06	198
"	01/23/06	428
43 Route 83, Calumet Sag Channel	08/28/06	76
"	07/24/06	86
"	09/25/06	98
"	10/23/06	99
"	11/27/06	128
"	04/24/06	133
"	06/26/06	144
"	05/22/06	166
"	03/27/06	184
"	02/27/06	225
"	01/23/06	310

$$\frac{[H^+][HCO_3^-]}{[H_2CO_3^*]} = K_1, \quad \frac{[H^+][CO_3^{2-}]}{[HCO_3^-]} = K_2$$



This is an α -century display $M = \begin{matrix} C & I & C' \\ C & \begin{pmatrix} I & O & O \\ b & I - B & O \\ O & a & I - a \end{pmatrix} \\ C' \end{matrix}$ matrix equation