DEPARTMENT OF THE ARMY
CHICAGO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
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APR 2 0 2007

Technical Services Division
Hydraulic and Environmental Engineering Branch

«Title» «FirstName» «LastName»
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Dear «Title» «LastName»,

In accordance with Illinois EPA water pollution control permit number 2001-EA-4691 issued December 7, 2001 routine water quality monitoring data was collected at Chicago Area Confined Disposal Facility, Calumet Harbor, Illinois during April, July, and October 2006. The Monitoring Report for this routine non-dredge event data is enclosed. Note that a new permit has been received, and the Confined Disposal Facility is now operating under permit number 2006-EA-0864. Should you have any questions concerning the enclosed report, please contact Mr. Jay Semmler, Chief, Hydraulics and Environmental Engineering Section at telephone line (312) 846-5500.

Sincerely,

Steve E. Hungness

STEVE E. HUNGNESS
Chief, Operations
Technical Support Section

Enclosures
Identical Letters sent to:
Linda Holst, USEPA
Anthony J. Ianello, Illinois Regional Port District
Dan Injerd, IDNR
Alan Keller, IEPA
John Rogner, USFWS
Leeann Tomas, Chicago Park District
Bruce Yurdin, IEPA

TS-DH-E 16 Apr 07
TS-DH 4/16/07
TS-C-T (Hungness) 4/20/07

WATER QUALITY MONITORING REPORT
FOR
ROUTINE MONITORING EVENTS
AT
CHICAGO AREA CONFINED DISPOSAL FACILITY
FOR THE WATER YEAR
2006

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS, CHICAGO DISTRICT
111 NORTH CANAL STREET
CHICAGO, ILLINOIS 60606

April 2007

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1 Purpose

The purpose of this report is to analyze and summarize the water quality data from samples collected at the Chicago Area Confined Disposal Facility (Chicago CDF) and at the Calumet River and Harbor by the U.S. Army Corps of Engineers (USACE), Chicago District, during the Water Year 2006 monitoring period from October 2005 to October 2006. The report includes data from routine monitoring events that were conducted on April 26, July 18 and October 11 of 2006, and it provides discussions of the sampling procedures, laboratory testing and data quality for these events. The trimester routine monitoring events are conducted to determine if the Chicago CDF is having an adverse impact on water quality in the Calumet River or Harbor. This monitoring was conducted under permit number 2001-EA-4691 issued December 7, 2001; the monitoring and reporting are consistent with that permit. Future monitoring and reporting will be conducted as required in permit number 2006-EA-0864 issued November 9, 2006.

2 Background

The Chicago Area CDF is a diked facility for the disposal and containment of contaminated dredged materials from deep-draft (18 feet or greater) federal navigation projects in Chicago, Illinois, particularly the Calumet River federal project. The Chicago CDF was constructed between 1982–1984, and it is located at the mouth of the Calumet River (Figure 1). The Chicago CDF was constructed by, and is operated and maintained by, the USACE, Chicago District, under authority of the River and Harbor Act of 1970 (Public Law 91-611, Section 123). The Chicago Regional Port Authority and the Chicago Park District have adjoining interests for this project. The facility is roughly triangular in shape, it has a surface area of approximately 43 acres, and it has a capacity of about 1.3 million cubic yards of dredged material. As shown in Table 1, the total amount of dredged sediment that has been placed into the facility since its inception is about 1,038,100 cubic yards. This table also shows that the Chicago CDF has been used for ten different dredging and disposal events, each of which used mechanical dredging operations.

Table 1: Historical Dredging and Disposal Events for Chicago Area CDF

Year of Disposal Operation	Location of Dredging	Volume of Dredged Material	Dredging By
Oct. – Dec. 1984	Calumet River	100,000 yd^3	USACE
July – Sept. 1985	Calumet River	108,000 yd^3	USACE
May – June 1986	Chicago Harbor & Chicago River	62,000 yd^3	USACE
April – June 1989	Calumet River	70,000 yd^3	USACE
May 1991	Calumet River	3,100 yd^3	KCBX Terminals Co.
December 1994	Calumet River	62,000 yd^3	USACE
Aug. 2000 – Apr. 2001	Calumet River & Harbor Breakwater	206,000 yd^3	USACE
Sept. – Dec. 2001	Calumet Harbor	291,000 yd^3	USACE
June 2002	Calumet River Obstruction Removal	1,000 yd^3	USACE
Sept. – Dec 2003	Calumet River	135,000 yd^3	USACE
Total		1,038,100 yd^3	

3 Sampling and Analytical Procedures

3.1 Water Quality Monitoring Plan

USACE obtained its water pollution control permit (in compliance with the Section 401 certification requirements of the Clean Water Act (CWA)) for the Chicago CDF from the Illinois Environmental Protection Agency (IEPA) under Permit # 2001-EA-4691. This permit was issued on December 7, 2001 and it was valid until December 1, 2006 (Appendix A); a subsequent permit issued November 9, 2006 covers future monitoring and reporting activities. Under "Special Condition 2," the permit stipulated that the monitoring shall be conducted in accordance with the Corps of Engineers report entitled "Water Quality Monitoring at the Chicago Area Confined Disposal Facility, Calumet Harbor, IL". Thus, this water quality monitoring report was integrated into the permit to provide details of the current monitoring plan including the routine monitoring, as well as the more rigorous monitoring, that is conducted during dredging events. The report also gives the rationale for transitioning from the previous to the current monitoring plan. For more detail on the analytical procedure, the recent scope of work (SOW) for Analysis of Water Samples at Chicago Area CDF, dated March 2006, may also be referenced (Appendix B).

3.1.1 Current Routine Monitoring

As explained in the above referenced permit, the sampling frequency has been three times per year for routine monitoring, and the approximate dates for the monitoring events are March – May, June – August and September – December. For the year 2006 these three routine monitoring events were conducted on April 26, July 18, and October 11, 2006.

3.2 Sampling Locations for Routine Monitoring Events

The sampling locations for routine monitoring events at the Chicago CDF are shown in Figure 2. The samples were collected from the following five distinctly different sampling environments for each of the routine monitoring events:

(a) Background – three background samples are collected from Lake Michigan about 1000 feet away from the dike (BACK-001, BACK-002, BACK-003)
(b) Near-Dike – three composite samples are collected in Calumet Harbor near the edge of the dike (ND-COMP-001, ND-COMP-002, ND-COMP-003)
(c) Calumet River – three samples are collected from the Calumet River; downstream, next to, and upstream of the filter cell effluent discharge point (RIV-001, RIV-002, RIV-003)
(d) CDF Pond – three samples are collected from within the CDF pond (CDF-001, CDF-002, CDF-003)
(e) Landing Wells – one sample is collected from each of the monitoring wells in the Iroquois Landing area (CH-18-81, CH-19-81, CH-20-81)

The background samples are collected far enough away from the CDF so detected concentrations provide baseline contaminant levels in Calumet Harbor. The near-dike samples are three-part composite samples that are collected in Calumet Harbor near the edge of the CDF dike wall. If the near-dike samples have parameter concentrations

significantly higher than the respective concentrations in the background samples, then the CDF may be having an impact on the water quality in Calumet Harbor.

During dredging and disposal events, the volume contained within the CDF is reduced in proportion to incoming sediment and water volume by pumping water out of the CDF settling basin. This water is subsequently passed through a filter cell and discharged into the Calumet River. To monitor the effluent from the filter cell, river samples are collected upstream, adjacent to, and downstream of the filter cell effluent discharge point during dredging and disposal operations. The sampling locations in the Calumet River are also monitored for routine monitoring events for comparison purposes, and to reduce data variations that may occur due to changes in the sampling locations.

The CDF pond samples give an indication of quality of the water that is in contact with sediments in the CDF. It depends on the parameter, but one might expect the CDF pond samples to have higher concentrations when compared to near-dike or background samples. Lastly, the landing well data provides an indication of groundwater quality adjacent to the CDF. It should be noted that a geotechnical investigation of the land area adjacent to the CDF and the landing wells, performed prior to CDF construction, revealed that the soil was largely composed of fill containing municipal and industrial wastes, intermixed with silt, sand and clay (Reference 3). Industrial and municipal wastes included slag, cinders, ash, and foundry sand from the nearby steel mills as well as coal, wood, iron, and miscellaneous trash.

3.3 Laboratory Analyses for Water Quality Samples

The target parameters for routine monitoring events and the required detection limits for year 2006 are shown in Table 2. The target parameters include three metals, three nutrients, and two general water quality parameters. The parameters were selected based on historical results to provide a standardized and informative data set (Appendix A).

For the April, July, and October sampling events the laboratory analyses were conducted by Trace Analytical Laboratories, Muskegon, Michigan. The Scope of Work provided to Trace Analytical Laboratories for analytical testing is included as Appendix B. The Standard Operating Procedure (SOP) checklist is included as Appendix C.

Table 2: Detection Limits for Routine Monitoring Parameters

Parameter	Required Detection Limit
Chromium (total)	0.005 mg/L
Manganese (total)	0.005 mg/L
Zinc (total)	0.005 mg/L
Total Phosphorus	0.005 mg/L
Ammonia as Nitrogen	0.01 mg/L
Total Kjeldahl Nitrogen	0.2 mg/L
Total Suspended Solids	5 mg/L
Total Dissolved Solids	5 mg/L
PH	1.0 – 14.0

4 Routine Water Quality Monitoring Events, Water Year 2006

4.1 Water Quality Data

The field pH and temperature values for all three 2006 sampling events are provided in Table 3 below. The table provides the minimum and maximum pH and temperature values recorded for each location group for each sampling event. The analytical data for the April 26, July 18, and October 11, 2006 monitoring events are provided on the attached compact disk (Appendices D, E, and F), and these data are summarized in Tables 4A, 4B, and 4C, respectively. These tables provide the concentrations in mg/L for each of the target parameters at the fifteen sampling stations, as well as the reporting limits achieved by the laboratory for each of the parameters. Parameter samples reported as "<" (detection limit) in Tables 4A, 4B, and 4C were designated as non-detect. It should be noted that mean values calculated for the statistical analysis did not include these designated samples.

The analytical results are also shown graphically in Figures 3A-3H. Each figure shows a bar graph of the concentrations of a given target parameter by date for all fifteen of the sampling stations. The sampling stations are subdivided into (a) Background Samples (Back-001, 002, 003), (b) Near-Dike Samples (ND-Comp-001, 002, 003) (c) River Samples (Riv-001, 002, 003), (d) CDF Pond Samples (CDF-001, 002, 003), and (e) Landing Well Samples (CH-18-81, CH-19-81, CH-20-81). For each of the stations three concentrations are given, which correspond to the three monitoring events, along with the reporting limit achieved by the laboratory. If no concentration appears on the bar graph, the analyte was non-detectable for that event and sample.

A USACE Chicago District report from April 2006 titled "Chicago Area Confined Disposal Facility Data Analysis 1984 through 2005" (Appendix G) provides analysis of data collected from the beginning of the project through 2005 showing trends for the parameters tested. The report includes a discussion of the data and a trend analysis for those data. Also included in the report are comparative descriptives by parameter which give the mean value for each parameter at each location over time. The mean values for metals, nutrients, and solids are given below in Tables 5, 6, and 7, respectively. The location "near CDF" in the trend analysis report corresponds to the location "near dike" in this report.

Tables 5, 6, and 7 contain water year 2006 mean values, water year 2006 standard deviations, and mean values from the trend analysis report (Appendix G) for metals, nutrients, and solids respectively. The values are presented by parameter and location. The mean values for water year 2006 were compared to the values contained in the trend analysis report. For the purposes of evaluating the consistency of the data, it was assumed that the data were normally distributed. In normally distributed data, about 95% of the values are within two standard deviations from the mean. When the water year 2006 mean was within two standard deviations of the mean in the trend analysis, no further investigation was conducted. Any 2006 mean that was more than two standard deviations above the corresponding trend analysis mean is discussed below.

4.1.1 pH and Temperature

The field logs with pH and temperature measurements are provided in Appendices D, E, and F. Table 3 provides a summary of these measurements where pH ranged from 7.0 to 11.8 over the monitoring year. Both limits were measured in the landing wells. Historically, the pH values have been particularly high for landing well CH-19-81, and a possible cause for this is the presence of waste or slag material in the adjacent soil. The water temperature readings ranged from a low of 10.5°C at sample location Near-Dike 008 (April 2006 event) to a high of 29.3°C in the CDF pond (July 2006 event).

Table 3: Field pH and Temperature Summary for Water Year 2006

Parameter	PH			PH		
Statistical Measure	Minimum			Maximum		
Sampling Event	April	July	October	April	July	October
Location Group		(Station)			(Station)	
Background	7.7 (003)	8.0 (003)	7.99 (001)	8.0 (001)	8.2 (001 & 002)	8.02 (002)
Near-dike	7.9 (003)	8.1 (005, 006, 009)	7.90 (008)	8.0 (all but 003)	8.2 (all but 005, 006, 009)	7.97 (001)
River	7.9 (all)	8.1 (all)	7.93 (001 & 002)	7.9 (all)	8.1 (all)	7.94 (003)
CDF	8.3 (003)	8.3 (002)	8.36 (003)	8.4 (001 & 002)	8.5 (001)	8.39 (001)
Landing wells	7.8 (CH-18)	7.0 (CH-18)	7.19 (CH-20)	11.8 (CH-19)	11.5 (CH-19)	11.5 (CH-19)
Parameter	Temperature (ºC)			Temperature (ºC)		
Statistical Measure	Minimum			Maximum		
Background	10.7 (001)	22.5 (001)	15.8 (002)	11.1 (002)	23.5 (003)	16.1 (003)
Near-dike	10.5 (008)	22.8 (001 & 002)	16.0 (009)	11.5 (002)	23.0 (009)	16.2 (004, 005, 007)
River	12.1 (001)	22.7 (003)	16.1 (002 & 003)	12.2 (002 & 003)	22.8 (001 & 002)	16.2 (001)
CDF	15.0 (003)	29.0 (002 & 003)	13.4 (001)	16.2 (001)	29.3 (001)	13.9 (003)
Landing wells	11.6 (CH-18)	15.0 (CH-19)	13.4 (CH-20)	14.0 (CH-20)	18.7 (CH-18 & CH-19)	17.3 (CH-18)

See field logs in Appendices D, E, and F for additional detail.

4.1.2 Metals

The monitoring results for total chromium (Cr), manganese (Mn), and zinc (Zn) are shown in Figures 3A, 3B, and 3C respectively. Cr was only detected five (5) times during the sampling events. The highest detection of 0.0085 mg/L was found in the CDF in July. The next highest detection of 0.006 mg/L was found at RIV-003 in April and in landing well CH-18-81 in July. Due to the inadequate number of values recorded above the detection limit, no mean was calculated for the Cr values in either this report or the trend analysis report (Appendix G).

Table 4: Chicago Area CDF 2006 Analytical Water Quality Data

TABLE 4A 26-Apr-06 Chicago Area CDF Routine Monitoring Water Year 2006

Analytical lab = Trace Analytical Laboratory Inc., Muskegon, Michigan

	Chromium (mg/L)	Manganese (mg/L)	Zinc (mg/L)	TKN (mg/L)	Ammonia (mg/L)	Phosphorus (mg/L)	TDS (mg/L)	TSS (mg/L)
BACK-001	<0.005	0.01	<0.005	<0.75*	0.066	<0.005	190	10
BACK-002	<0.005	0.0059	<0.005	<0.75*	0.052	<0.005	190	7.0
BACK-003	<0.005	<0.005	<0.005	<0.75*	0.013	<0.005	190	5.0
ND-Comp-001	<0.005	0.007	<0.005	<0.75*	0.047	<0.005	200	<5.0
ND-Comp-002	<0.005	0.0055	0.0072	<0.75*	0.034	<0.005	190	<5.0
ND-Comp-003	<0.005	<0.005	0.031	<0.75*	0.048	0.014	190	5.0
RIV-001	<0.005	0.018	<0.005	<0.75*	0.046	0.0063	250	8.0
RIV-002	<0.005	0.035	<0.005	<0.75*	0.11	<0.005	270	6.0
RIV-003	0.006	0.032	0.006	<0.75*	0.068	0.01	260	14
CDF-001	<0.005	0.36	0.048	2.2	0.084	0.15	570	82
CDF-002	<0.005	0.38	0.02	1.4	0.05	0.098	570	38
CDF-003	<0.005	0.3	0.016	1.2	0.05	0.076	560	23
CH-18-81	0.0055	0.11	0.1	1.4	0.4	0.087	590	94
CH-19-81	<0.005	0.033	0.023	5.5	4.7	0.02	550	15
CH-20-81	<0.005	0.32	0.071	<0.75*	0.36	0.024	750	7.0
Detection limit	<0.005	<0.005	<0.005	<0.20	<0.010	<0.005	<5.0	<5.0

Parameter samples reported as "< Detection limit" for a given compound were not detected.

* Reporting limit was raised due to matrix interference

TABLE 4B 18-Jul-06 Chicago Area CDF Routine Monitoring Water Year 2006

Analytical lab = Trace Analytical Laboratory Inc., Muskegon, Michigan

	Chromium (mg/L)	Manganese (mg/L)	Zinc (mg/L)	TKN (mg/L)	Ammonia (mg/L)	Phosphorus (mg/L)	TDS (mg/L)	TSS (mg/L)
BACK-001	<0.005	0.0054	0.0086	0.71	0.042	0.0063	130	5
BACK-002	<0.005	<0.005	0.26	0.72	0.053	0.01	140	<5.0
BACK-003	<0.005	<0.005	<0.005	0.74	0.041	0.0079	140	<5.0
ND-Comp-001	<0.005	<0.005	0.014	0.8	0.039	<0.005	160	<5.0
ND-Comp-002	<0.005	<0.005	0.012	0.64	0.036	0.0055	160	<5.0
ND-Comp-003	<0.005	<0.005	0.015	0.92	0.04	0.0059	180	<5.0
RIV-001	<0.005	0.0053	<0.005	0.6	0.05	<0.005	170	5
RIV-002	<0.005	0.0061	0.01	0.35	0.044	0.0056	160	<5.0
RIV-003	<0.005	0.0054	0.0091	0.23	0.044	0.0055	160	<5.0
CDF-001	0.0085	0.37	0.11	2.3	0.084	0.2	550	120
CDF-002	<0.005	0.31	0.039	2	0.1	0.15	530	54
CDF-003	<0.005	0.26	0.03	1.5	0.07	0.14	540	44
CH-18-81	0.006	0.19	0.28	2.5	0.73	0.12	590	120
CH-19-81	<0.005	0.31	0.013	5.8	5.1	0.049	540	52
CH-20-81	<0.005	0.058	0.13	0.6	0.22	0.033	860	<5.0
Detection limit	<0.005	<0.005	<0.005	<0.20	<0.010	<0.005	<5.0	<5.0

Parameter samples reported as "< Detection limit" for a given compound were not detected.

TABLE 4C 11-Oct-06 Chicago Area CDF Routine Monitoring Water Year 2006

Analytical lab = Trace Analytical Laboratory Inc., Muskegon, Michigan

	Chromium (mg/L)	Manganese (mg/L)	Zinc (mg/L)	TKN (mg/L)	Ammonia (mg/L)	Phosphorus (mg/L)	TDS (mg/L)	TSS (mg/L)
BACK-001	<0.0050	0.0068	0.016	0.66	0.05	<0.005	180	6
BACK-002	<0.0050	0.0063	0.013	0.26	0.037	0.006	190	<5.0
BACK-003	<0.0050	<0.0050	0.015	0.4	0.04	<0.005	170	<5.0
ND-Comp-001	<0.0050	0.0067	0.011	0.35	0.042	0.015	180	<5.0
ND-Comp-002	<0.0050	0.0058	0.015	0.64	0.04	<0.005	180	7
ND-Comp-003	<0.0050	0.0065	0.037	0.32	0.038	0.0067	180	<5.0
RIV-001	<0.0050	0.0088	0.012	0.36	0.047	0.0064	180	5
RIV-002	<0.0050	0.0077	0.0068	0.18	0.06	0.0087	190	<5.0
RIV-003	<0.0050	0.0076	0.0076	0.33	0.063	0.0095	200	<5.0
CDF-001	0.0051	0.19	0.048	3.6	0.14	0.08	480	76
CDF-002	<0.0050	0.16	0.038	1.8	0.089	0.066	480	54
CDF-003	<0.0050	0.16	0.038	2.3	0.069	0.075	480	53
CH-18-81	<0.0050	0.17	0.026	1.9	0.7	0.06	610	91
CH-19-81	<0.0050	0.042	0.028	3.1	2	0.029	530	31
CH-20-81	<0.0050	0.25	0.057	1.2	0.21	0.076	1100	5
Detection limit	<0.0050	<0.0050	<0.0050	<0.20	<0.010	<0.005	<5.0	<5.0

Parameter samples reported as "< Detection limit" for a given compound were not detected.

It can be observed in Figure 3B that total Mn levels were generally higher in the CDF and landing wells than they were in the near-dike and river samples. The highest Mn concentration (0.38 mg/L) was measured in the CDF during the April 2006 event. The next highest Mn concentration (0.37 mg/L) was also measured in the CDF and occurred in July. The highest background concentration of Mn was measured at 0.01 mg/L in April, and the highest near-dike concentration was 0.007 mg/L, also measured in April. No mean values for Mn at any location were more than two standard deviations above the values in the trend analysis report.

Figure 3C shows the highest zinc (Zn) concentration (0.28 mg/L) was measured in well CH-18-81 during the July 2006 event. The next highest concentration was 0.26 mg/L from BACK-002 also in July. The next highest measured background concentration of Zn was 0.016 mg/L in October. The highest near-dike value was 0.037 mg/L, measured in October. No mean values for Zn at any location were more than two standard deviations above the values in the trend analysis report.

Table 5. Mean Concentrations of Metals by Location

	WY 2006 Mean		WY 2006 STDEV		Trend Analysis Mean	
Location	Manganese	Zinc	Manganese	Zinc	Manganese	Zinc
Background	0.00688	0.06252	0.00182	0.11043	0.00834	0.01300
Near CDF	0.00630	0.01589	0.00063	0.00971	0.00805	0.03033
River	0.01399	0.00858	0.01173	0.00223	0.01758	0.02518
In CDF	0.27667	0.04300	0.08874	0.02746	0.12245	0.04187
CH-18	0.15667	0.13533	0.04163	0.13063	0.20640	0.08418
CH-19	0.12833	0.02133	0.15739	0.00764	0.15922	0.06808
CH-20	0.20933	0.08600	0.13565	0.03874	0.12273	0.04503

4.1.3 Nutrients

The monitoring results for microbiological nutrients including Total Kjeldahl Nitrogen (TKN), ammonia nitrogen, and total phosphorus are shown in Figures 3D, 3E, and 3F respectively. As shown in Figure 3D, the two highest TKN concentrations were 5.8 mg/L measured in landing well CH-19-81 in July and 5.5 mg/L measured in the same well in April. The highest near-dike concentration for TKN was 0.92 mg/L in July. The highest background concentration for TKN was 0.74 mg/L also in July. No mean values for TKN at any location were more than two standard deviations above the values in the trend analysis report.

Figure 3E shows that the highest three ammonia nitrogen concentrations were all measured in landing well CH-19-81; 5.1 mg/L in July, 4.7 mg/L in April, and 2 mg/L in October. In comparison, the CDF pond, river and near-dike samples all fell at or below 0.14 mg/L. The highest background concentration for ammonia was 0.066 mg/L measured in October. No mean values for ammonia at any location were more than two standard deviations above the values in the trend analysis report.

As observed in Figure 3F, the highest phosphorus concentration of 0.2 mg/L was measured in the CDF pond during the July 2006 event. The next highest phosphorus concentration of 0.15 mg/L was also measured in the CDF pond, once in April and once in July. The river and near-dike samples had phosphorous concentrations that were 0.015 mg/L or less. The highest phosphorous concentration detected in a background sample was 0.01 mg/L in July 2006. No mean values for phosphorus at any location were more than two standard deviations above the values in the trend analysis report.

Table 6. Mean Concentrations of Nutrients by Location

	WY 2006 Mean			WY 2006 STDEV			Trend Analysis Mean		
Location	TKN	Ammonia	Phosphorus	TKN	Ammonia	Phosphorus	TKN	Ammonia	Phosphorus
Background	0.5817	0.0438	0.0076	0.2016	0.0146	0.0018	0.3748	0.0343	0.01219
Near CDF	0.6117	0.0404	0.0094	0.2390	0.0046	0.0047	0.5131	0.0722	0.02145
River	0.3640	0.0580	0.0074	0.1508	0.0222	0.0019	0.5012	0.1027	0.02312
In CDF	2.0333	0.0858	0.1150	0.7124	0.0266	0.0466	1.4400	0.3989	0.08012
CH-18	1.9333	0.6100	0.0890	0.5508	0.1825	0.0300	2.8816	1.6243	0.09716
CH-19	4.8000	3.9333	0.0327	1.4799	1.6862	0.0148	5.9076	5.3141	0.04464
CH-20	0.9000	0.2633	0.0443	0.4243	0.0839	0.0278	0.4801	0.1520	0.04608

4.1.4 Solids

The monitoring results for Total Dissolved Solids and Total Suspended Solids are shown in Figures 3G and 3H respectively. TDS and TSS levels were generally higher in the CDF and landing wells than they were in the near-dike and river samples. The highest TDS measurement was 1100 mg/L in well CH-20-81 in October. The highest background measurement for TDS was 190 mg/L measured in all three samples for April, as well as once in October. The mean TDS concentration in the CDF was more than two standard deviations above the CDF mean in the trend analysis report (Table 7). This is not unexpected based on the quality of the sediment and decreasing volume of water contained in the CDF. The water quality in the CDF has been becoming relatively worse as shown in the trend analysis (Appendix G). The mean TDS concentration in well CH-19 was also more than two standard deviations above the corresponding mean in the trend analysis report (Table 7). This could be due to the type of fill in the adjacent soil; it is not due to the CDF as the wells are located up gradient from the CDF and are therefore not influenced by it.

Figure 3H shows that the highest Total Suspended Solids concentration of 120 mg/L was measured in both the CDF and landing well CH-18-81 in July. The highest near dike TSS concentration was 7 mg/L collected in October. Background samples did not exceed 10 mg/L during any of the sampling events. No mean values for TSS at any location were more than two standard deviations above the values in the trend analysis report.

Table 7. Mean Concentrations of Solids by Location

	WY 2006 Mean		WY 2006 STDEV		Trend Analysis Mean	
Location	TDS	TSS	TDS	TSS	TDS	TSS
Background	168.8889	6.60	25.22	2.07	172.6737	7.89
Near CDF	180.0000	6.00	13.23	1.41	171.1067	6.58
River	204.4444	7.60	43.91	3.78	236.1867	10.35
In CDF	528.8889	60.44	38.87	28.65	374.5467	31.02
CH-18	596.6667	101.67	11.55	15.95	606.5600	149.17
CH-19	540.0000	32.67	10.00	18.56	506.9200	54.68
CH-20	903.3333	6.00	178.98	1.41	994.6400	6.66

4.2 Quality Assurance/Quality Control (QA/QC)

The purpose of the data collection and analyses is to determine if the CDF is operating effectively by preventing pollutants from entering the Calumet River or Harbor. Data quality objectives include reviewing enough data for bias and precision to determine if it is accurate. This is done by reviewing the laboratory quality control reports for conformance with the scope of work requirements. Data quality assessments were written for the three monitoring events and are included along with the final laboratory and QA/QC reports in Appendices D, E and F. Holding time preservation requirements were met for all samples. Temperature preservation requirements were acceptable for all sampling events.

All reporting limits were met or were otherwise acceptable. Specifically, the TKN reporting limit from the April 06 sampling event is listed as 0.75 mg/L although the required reporting limit was lower (0.2 mg/L). This reporting limit was raised because the Trace wet chemistry laboratory had difficulty meeting the TKN reporting limit specified in the SOW. The laboratory agreed to take corrective action before the next sampling event. This was noted in the DQA and flagged in the above results summary. For the July and October sampling events, the laboratory detection limit for TKN was 0.1 mg/L which is lower than the SOW required limit. Secondly, it should be noted that originally the laboratory detection limits for TDS and TSS in April exceeded those required in the SOW, but after the laboratory was notified, the data was regenerated with the correct detection limits for TDS and TSS. The revised reporting limit and the amended results were accepted in the April DQA.

For the July sampling event, there was a low % recovery of the MS and MSD samples for the TKN parameter. Due to this the TKN measurements for two of the samples (Back-001 and CH-18-81) were considered to be estimates and a slight bias for all TKN results to be lower than the actual concentration was indicated. However, the TKN data were acceptable for the data objectives and the data package was accepted in the July DQA.

The data from the three events was determined to be acceptable and suitable for its intended purpose and objectives. All three data packages were recommended for acceptance in the corresponding DQA.

4.3 Statistical Analysis

One of the goals of the monitoring plan is to generate a statistically analyzable data set for each monitoring event. To reiterate, during each routine sampling event three samples are collected from different locations within each of the five distinct sampling environments to meet this goal: (1) the background water of Calumet Harbor (BACK), (2) near-dike harbor composites (ND-Comp), (3) Calumet River (RIV), (4) CDF pond (CDF), and (5) landing wells (CH) (See Figure 2). A statistical analysis is then performed on the water quality results that are provided by the analytical laboratory. Appendices D, E, and F contain the statistical analyses for the April, July, and October 2006 sampling events respectively. For each sampling event these program tables summarize the concentration data and statistical analysis for each of the eight water quality parameters including chromium, manganese, zinc, TKN, ammonia, phosphorus, total dissolved solids, and total suspended solids. These data are added to the trend analysis dataset required by IEPA; these three events were not included in the recent trend analysis, however future analysis and reporting will be as required in the 2006 permit.

The statistical analysis summarizes completeness, count, degrees of freedom (df), mean, sample standard deviation, and sample variance for each of the eight water quality parameters in each of the five sampling environments. If one or more of the water quality parameter concentration results is below the reporting limit, or if no data are obtained for a given parameter in a given sampling environment, the estimated or absent concentrations are not used in the statistical comparison. These estimated or absent data values are labeled as not applicable (N/A) in the statistical analysis spreadsheet. Completeness indicates whether three data values were present for a particular sampling environment. If less than three data values are present, the completeness is described as being “incomplete”, whereas “OK” indicates that three values are present for the analysis. The count displays the number of data values that are present for the analysis. The degree of freedom is simply one whole number below the count. The mean is computed when either two or three data values are present. Finally, the sample variance and sample standard deviation are not calculated, nor is the statistical comparison performed, unless all three sample values are present, thus providing a complete dataset.

The statistical comparison is performed using a parametric statistical test method known as an independent two-sample t-test. This test method employs Student’s t-distribution to assess whether there is a statistically significant difference between the means of two independent sample groups of small sample size. The declaration that a statistically significant difference does not exist between the means of the two sample groups is referred to as the “null hypothesis (H_0)”. Hence, if a comparison indicates that there is no statistically significant difference between the means of two sample groups, then the null hypothesis is declared true and the comparison is labeled *"OK"*. Conversely, if the comparison indicates a significant difference between the means of two sample groups does exist, then the null hypothesis is declared false and the comparison is labeled *"Reject H_0"*. If the two population means are exactly the same and both sample populations have a variance of zero, a division by zero error is indicated.

It is important to note that if the null hypothesis is concluded to be true, it does not imply any statistically significant similarity between the two sample groups. This only indicates that there was not enough evidence to reject the null hypothesis. Significant statistical similarities may or may not exist when the null hypothesis is concluded to be true and additional evidence, robust test methods, and analyses are required in order to reach a statistically based conclusion. The statistical comparison used in this report is most informative for cases when the null hypothesis is rejected, because it is based on sufficient evidence. Thus, inferences concerning the results of the statistical comparison were only made for cases in which the null hypothesis was rejected.

4.4 Results of Statistical Analysis

One of the primary goals of the statistical analysis program is to provide an indication of whether the Chicago CDF has affected the water quality in the Calumet River or Harbor. Such an impact may be indicated, for example, if there is a statistically significant difference between the means of the contaminant concentrations in the near-dike samples (ND-Comp-XXX) and background water samples (BACK-XXX). Moreover, if the mean of the near-dike samples is greater than the mean of the background samples, this might suggest that the water outside the CDF dike wall was affected by seepage of contaminants from the CDF pond.

For the current monitoring period, which includes the sampling events of April, July, and October of 2006, the statistical comparisons for the five sampling environments and eight parameters are summarized in Table 8. This table only provides information regarding the statistical comparisons that were complete and had all three data values present for each of the compared sampling environments. In addition, the table only provides information for cases in which the null hypothesis was rejected, indicating that a significant difference existed between the means of the two sample groups. For cases where the null hypothesis was rejected the higher mean value was identified and placed into the appropriate column in the table.

4.5 Discussion of Results

4.5.1 Metals

Due to a high number of sample results below the reporting limit for all sampling events, a statistical comparison was not conducted for the chromium water quality parameter (Tables 4A, 4B, and 4C). This is consistent with the long term monitoring results; chromium has consistently been non-detectable in most samples.

The statistical comparison for manganese (Mn) indicated that samples collected during the April event in the CDF were significantly higher than the river results (Table 8). In July the CDF result was again significantly higher compared to the river. In October the CDF results were significantly higher than those for both the near-dike and river sampling environments. Additionally, the results for the river were significantly higher than the near-dike results in October.

As seen in Table 8, no conclusions were made regarding zinc (Zn) for either the April or July sampling events. However, the statistical comparison for October concludes that water in the CDF environment was significantly higher in Zn than the background and river environments. Also, the background and landing well Zn concentrations were found to be significantly higher than the river environment results in October.

4.5.2 Nutrients

The statistical comparison for Total Kjeldahl Nitrogen (TKN) shows no conclusion for the April sampling event. In July the CDF result was significantly higher than background, near-dike, and river environments. Additionally, both the background and near-dike results were significantly higher than the river results in July. For October the CDF results were again significantly higher than background, near-dike, and river environments. The landing well TKN concentrations were significantly higher than the background, near-dike, and river environments this month as well.

Table 8 shows that for the April sampling event, no conclusion was made regarding ammonia concentrations. However in July, the CDF results were significantly higher than the background, near-dike, and river environments. Also the river ammonia concentrations were significantly higher than those of the near-dike environment. In October both the CDF and river samples were significantly higher in ammonia than the near-dike environment.

In April, there were no conclusions about phosphorus concentrations. For the July event the only significant differences were higher mean concentrations of phosphorus in the CDF when compared to both the background and landing well environments. The CDF and landing well results for phosphorus were significantly higher than the river in October.

4.5.3 Solids

In April, July, and October TDS results for the CDF were found to be significantly higher than background and river environments. Additionally, in April and July the CDF results were significantly higher than the near-dike environment. Again in April, July, and October the landing well results had significantly higher TDS values compared to background, near-dike, and river. Also in April and July, the river results were significantly higher than background. Finally, in April the river had significantly higher results compared to near-dike and in July the near-dike environment has significantly higher TDS values than background.

This statistical comparison is a useful scientific tool for analyzing and making inferences based on available data, however further investigation is still required to determine the importance of the results. The near-dike environment was only statistically significantly higher than background once, for the July TDS results. However, for the July TDS results the river was also statistically significantly higher than background. It is possible that there is some other source of TDS in the drainage area of the river and near the retaining wall, such as the geology of the area and associated weathering and dissolution of soil and rocks. These processes could elevate the TDS results at these areas and not affect the open water background measurements.

There was either insufficient data or the null hypothesis was accepted for TSS comparing all sampling environments for all sampling events.

Table 8: Chicago Area CDF Year 2006 Routine Water Quality Parameter Statistical Comparison Summary

Water Quality Parameter	April 2006		July 2006		October 2006	
	Sampling Environment With Higher Mean Value	Sampling Environment With Lower Mean Value	Sampling Environment With Higher Mean Value	Sampling Environment With Lower Mean Value	Sampling Environment With Higher Mean Value	Sampling Environment With Lower Mean Value
Chromium	--	--	--	--	--	--
Manganese	CDF	RIV	CDF	RIV	CDF	NDC
	--	--	--	--	CDF	RIV
	--	--	--	--	RIV	NDC
Zinc	--	--	--	--	CDF	BACK
	--	--	--	--	CDF	RIV
	--	--	--	--	BACK	RIV
	--	--	--	--	CH	RIV
TKN	--	--	CDF	BACK	CDF	BACK
	--	--	CDF	NDC	CDF	NDC
	--	--	CDF	RIV	CDF	RIV
	--	--	BACK	RIV	CH	BACK
	--	--	NDC	RIV	CH	NDC
	--	--	--	--	CH	RIV
NH_3	--	--	CDF	BACK	CDF	NDC
	--	--	CDF	NDC	RIV	NDC
	--	--	CDF	RIV	--	--
	--	--	RIVER	NDC	--	--
Phosphorus	--	--	CDF	BACK	CDF	RIV
	--	--	CDF	CH	CH	RIV
TDS	CDF	BACK	CDF	BACK	CDF	BACK
	CDF	NDC	CDF	NDC	CDF	RIV
	CDF	RIV	CDF	RIV	CH	BACK
	CH	BACK	CH	BACK	CH	NDC
	CH	NDC	CH	NDC	CH	RIV
	CH	RIV	CH	RIV	--	--
	RIV	BACK	RIV	BACK	--	--
	RIV	NDC	NDC	BACK	--	--
TSS	--	--	--	--	--	--

Comments:
BACK = Background Samples
NDC = Near CDF Dike Composite Samples
RIV = Calumet River Samples
CDF = CDF Pond Samples
CH = Landing Well Samples
This table summarizes the two-sample t-test statistical method comparisons, which were only performed on complete data sets. This table only provides information on comparisons for which the null hypothesis was rejected, indicating a statistically significant difference between the means of the two sampling environments being compared.

5 Water Level Data

The water level in Calumet Harbor and in the Chicago CDF is continuously measured at two nearby gage stations. The water level monitoring station at Calumet Harbor (Station ID 9087044) is maintained by the National Oceanographic and Atmospheric Administration (NOAA) and the water level monitoring station (Station #414340087313901) within the CDF pond is maintained by the U.S. Geological Survey (USGS). Daily mean elevations in Calumet Harbor and in the CDF pond were compared using this data. Data are given in feet and reference the Lake Michigan Low Water Datum (LWD). Figure 4 demonstrates that daily mean water surface elevations in the CDF varied less, but were generally higher than levels in the Calumet Harbor. The average annual daily mean difference between Calumet Harbor and the CDF was 0.30 feet. The daily mean pond surface water levels in the CDF ranged from 1.13 ft above LWD to 0.45 ft below LWD. The daily mean Calumet Harbor water elevation ranged from 0.89 ft above LWD to 1.2 ft below LWD. The average daily mean water level was 0.09 ft above LWD for the Calumet Harbor and 0.37 ft above LWD for the CDF. Piezometric data collected from landing wells CH-18-81, CH-19-81, and CH-20-81 for each monitoring event are presented in Table 9 along with the daily mean water level at the Calumet Harbor and the CDF for each sampling date.

The NOAA Calumet Harbor gage data and the Chicago Area CDF pond data in Figure 4 and Table 9 reference Lake Michigan Low Water Datum, which is 577.5 feet above mean water level at Father's Point Quebec International Great Lakes Datum 1985.

Table 9: Chicago Area CDF Well, Pond, and Harbor Water Level Comparison 2006

	Elevation Expressed in Feet above Lake Michigan Low Water Datum		
Location/Date	26 Apr 06	18 Jul 06	11 Oct 06
CH-18-81	2	2	2.1
CH-19-81	2.7	2	3.7
CH-20-81	3.8	3.8	4.3
CDF Pond*	0.52	0.64	0.54
Calumet Harbor**	0.04	0.57	.02

* Data taken from gage in CDF pond by USGS Urbana

** Data taken from NOAA web site

6 Conclusion

This report presents the results of the water quality data that was collected on April 26, July 18 and October 11 of 2006 at the Chicago Area CDF. The purpose of this report is to analyze and summarize the water quality data to determine if the Chicago CDF had an adverse impact on the water quality of the Calumet River or Harbor during the Water Year 2006. In accordance with the IEPA permit, samples were acquired from five different sampling environments that included background samples for a baseline comparison and near-dike, river, CDF pond and landing well samples. The samples were analyzed for metals (chromium, manganese, and zinc), nutrients (Total Kjeldahl Nitrogen, ammonia, and phosphorus), and Total Dissolved and Total Suspended Solids. Based on an analysis of the water quality data, it appears that the Calumet River and Harbor was not adversely impacted by the Chicago CDF during 2006.

References

(1) Illinois Environmental Protection Agency, Water Pollution Control Permit Number 2001-EA-4691, Chicago District, Corps of Engineers, Chicago Area Confined Disposal Facility. 07 December 2001.

(2) Illinois Environmental Protection Agency, Water Pollution Control Permit Number 2006-EA-0864, Chicago District, Corps of Engineers, Chicago Area Confined Disposal Facility. 09 November 2006.

(3) U.S. Army Corps of Engineers, Scope of Work for Analysis of Water Samples for Chicago Area Confined Disposal Facility Monitoring. 23 March 2006.

(4) U.S. Army Corps of Engineers, Design Analysis: Calumet Harbor, Illinois Chicago Area Confined Disposal Facility Volumes I and II. January 1982.

(5) U.S. Army Corps of Engineers, Chicago District, Chicago Area Confined Disposal Facility Data Analysis 1984 through 2005. April 2006.

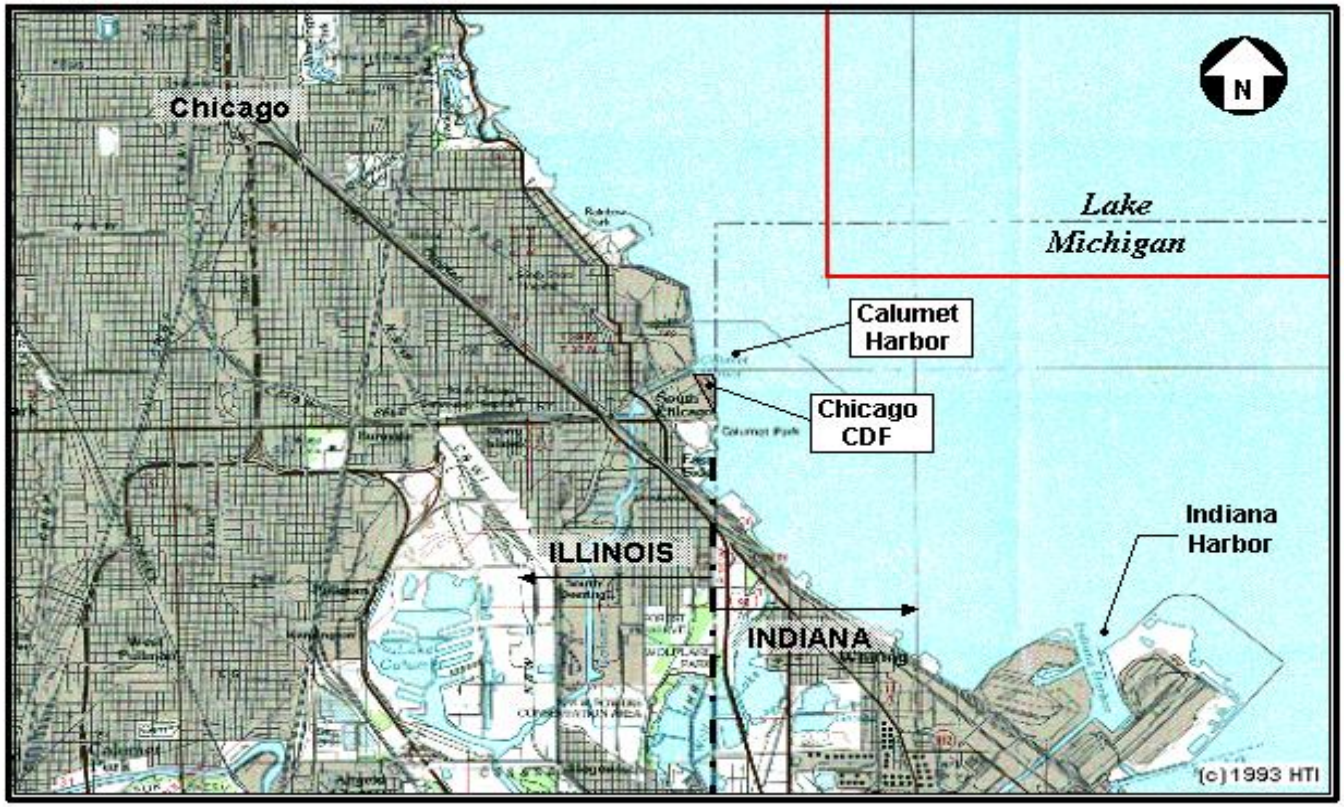


Figure 1: Location of Chicago Area CDF and Calumet Harbor

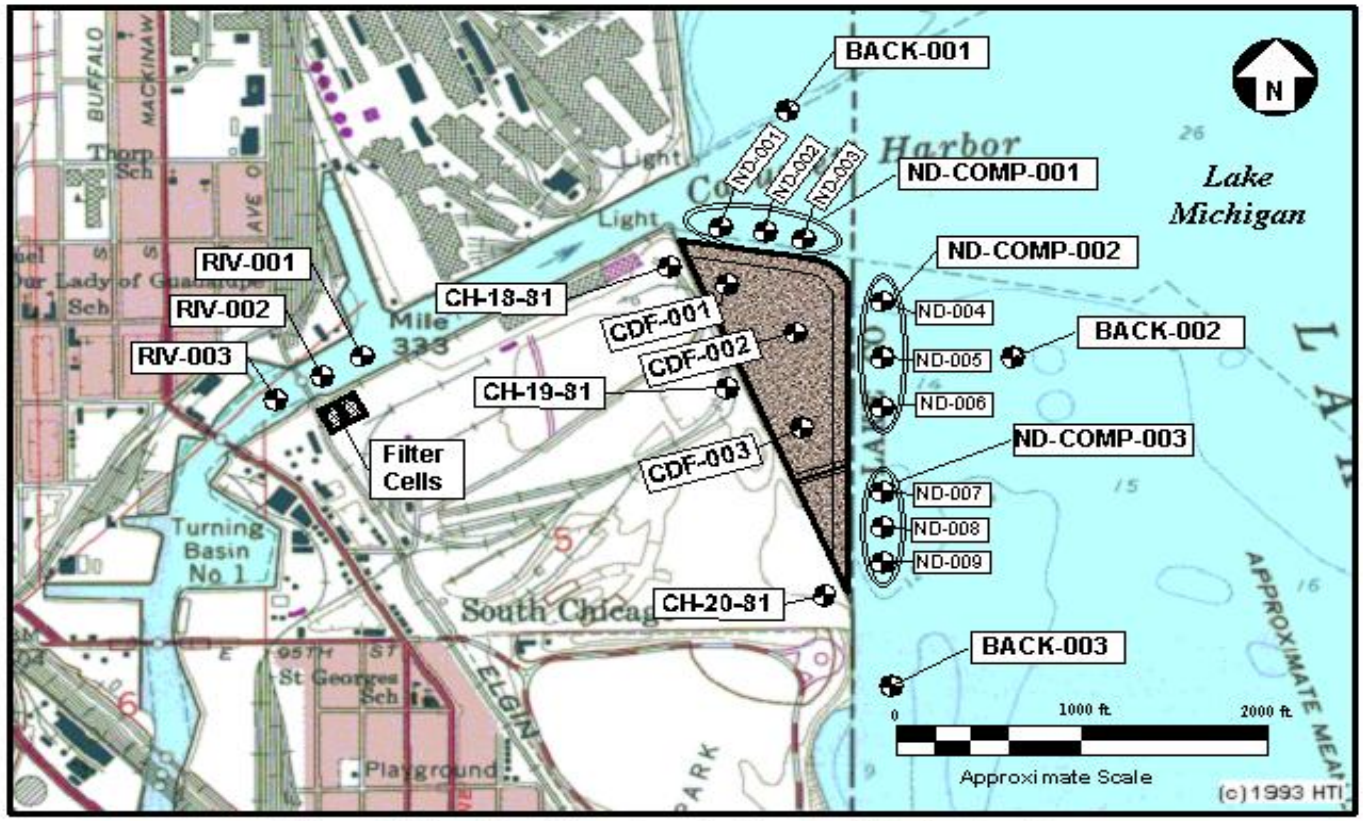


Figure 2: Sampling Locations for Routine Monitoring Events

Figure 3A: 2006 Chicago CDF Total Chromium

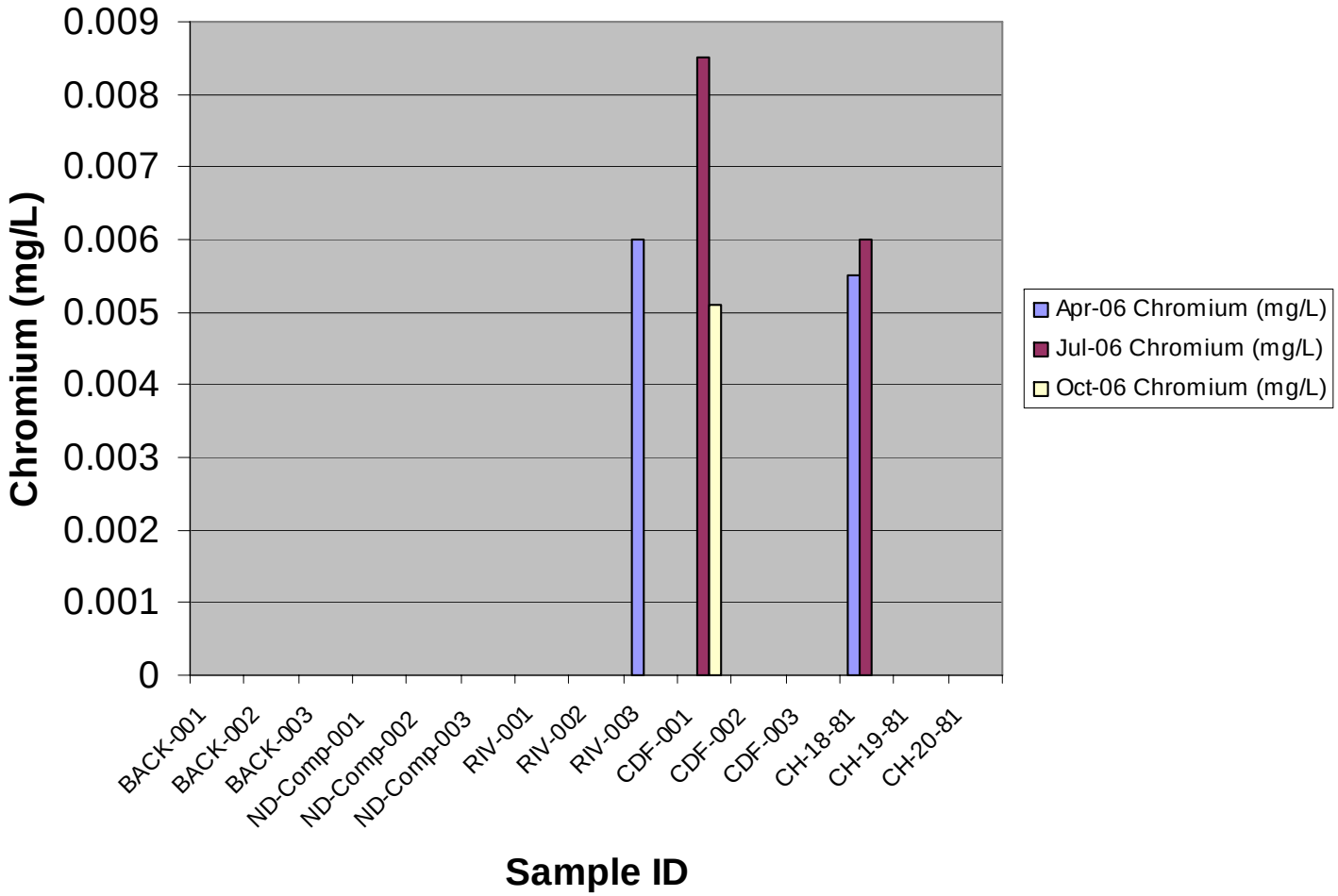


Figure 3B: 2006 Chicago CDF Total Manganese

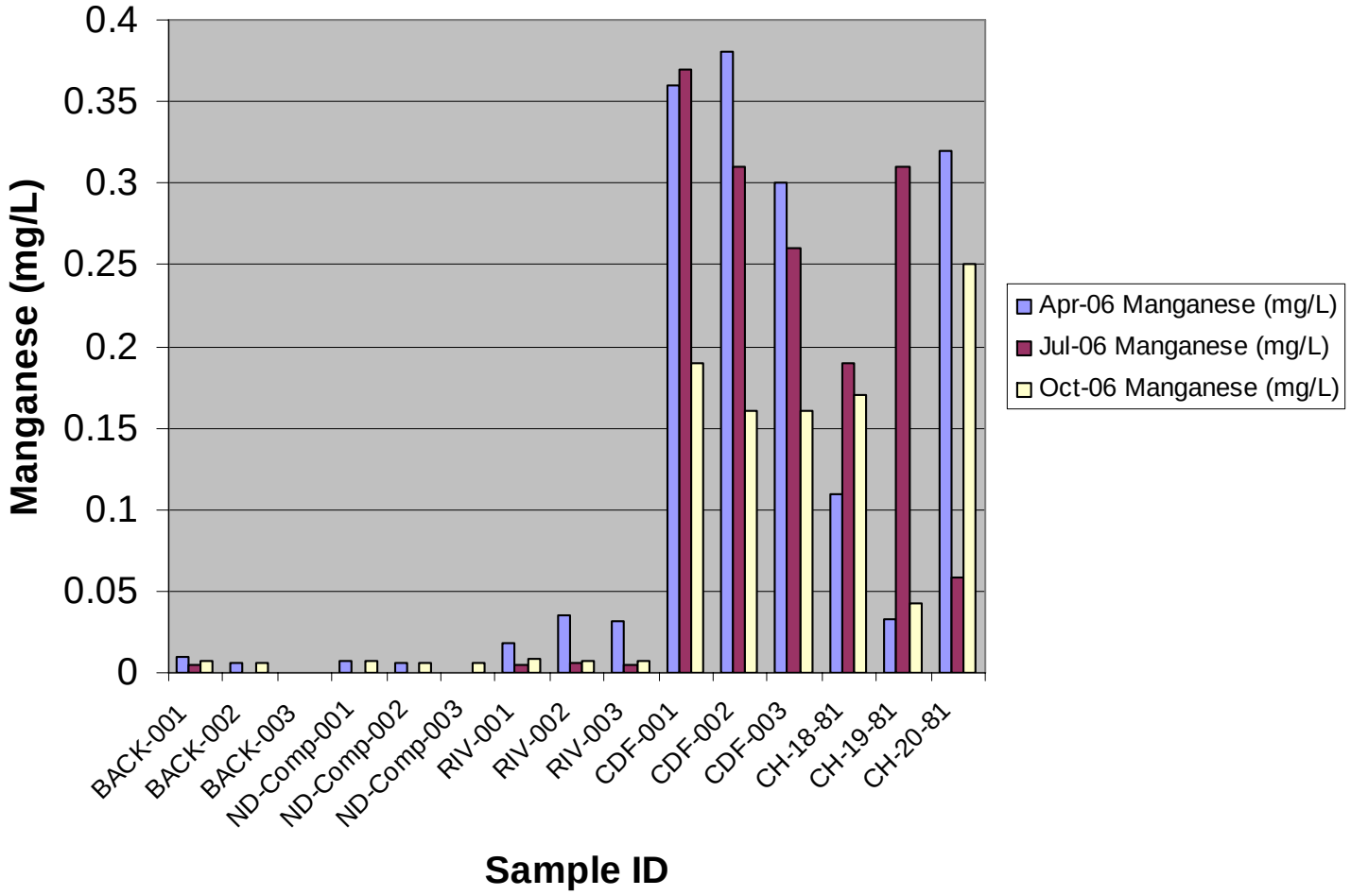
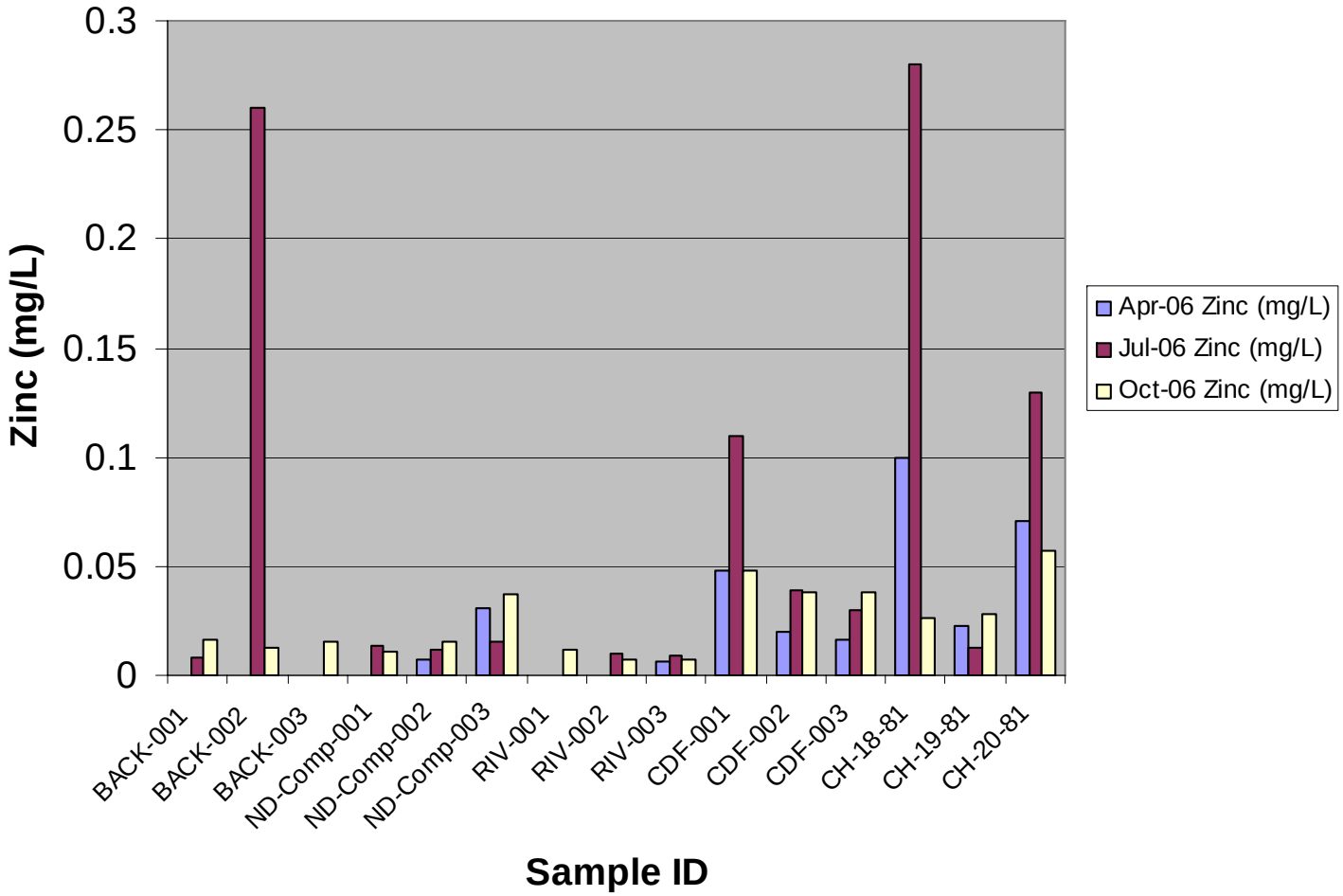


Figure 3C: 2006 Chicago CDF Total Zinc



Figrure 3D: 2006 Chicago CDF TKN

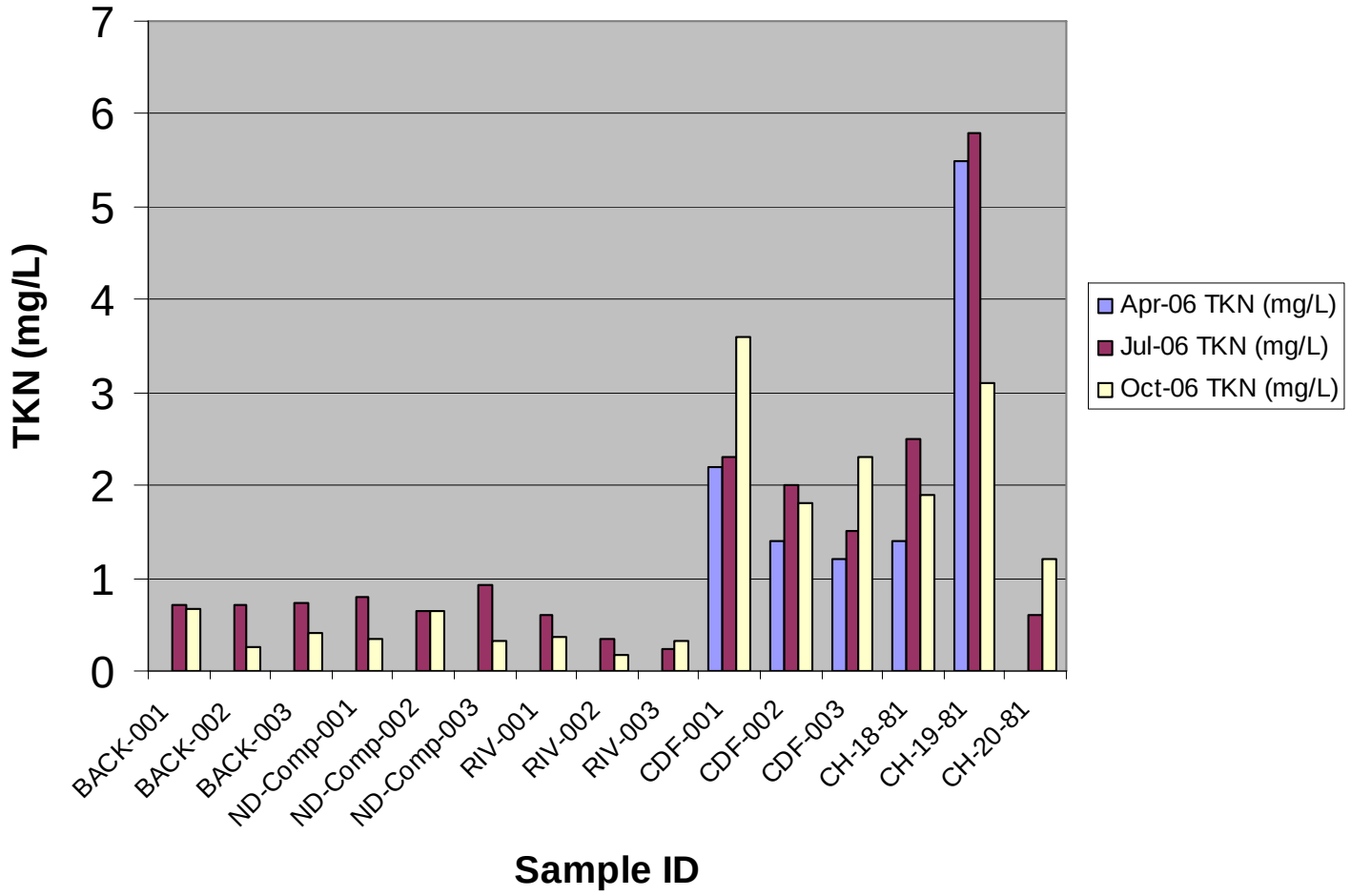


Figure 3E: 2006 Chicago CDF Ammonia

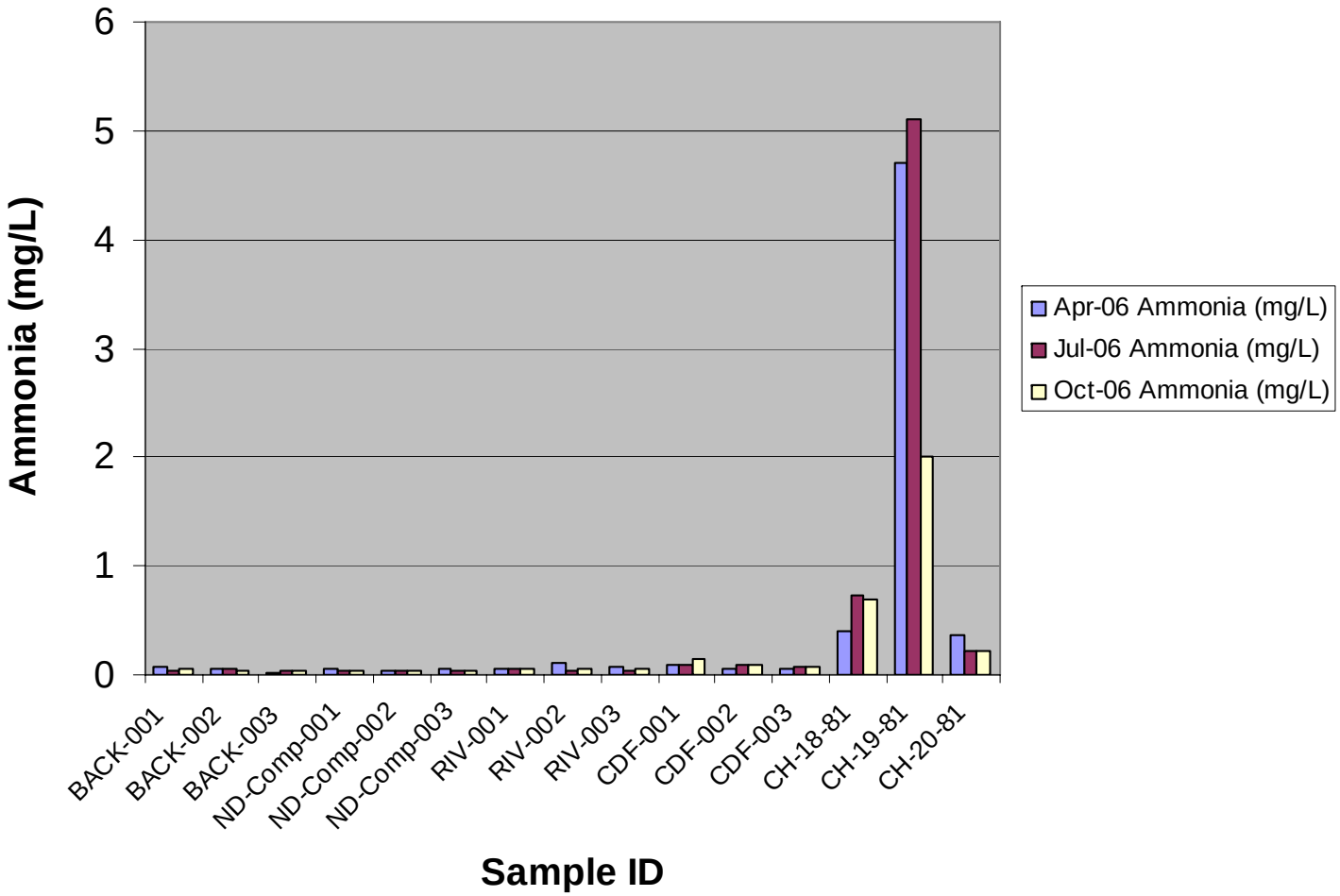


Figure 3F: 2006 Chicago CDF Phosphorus

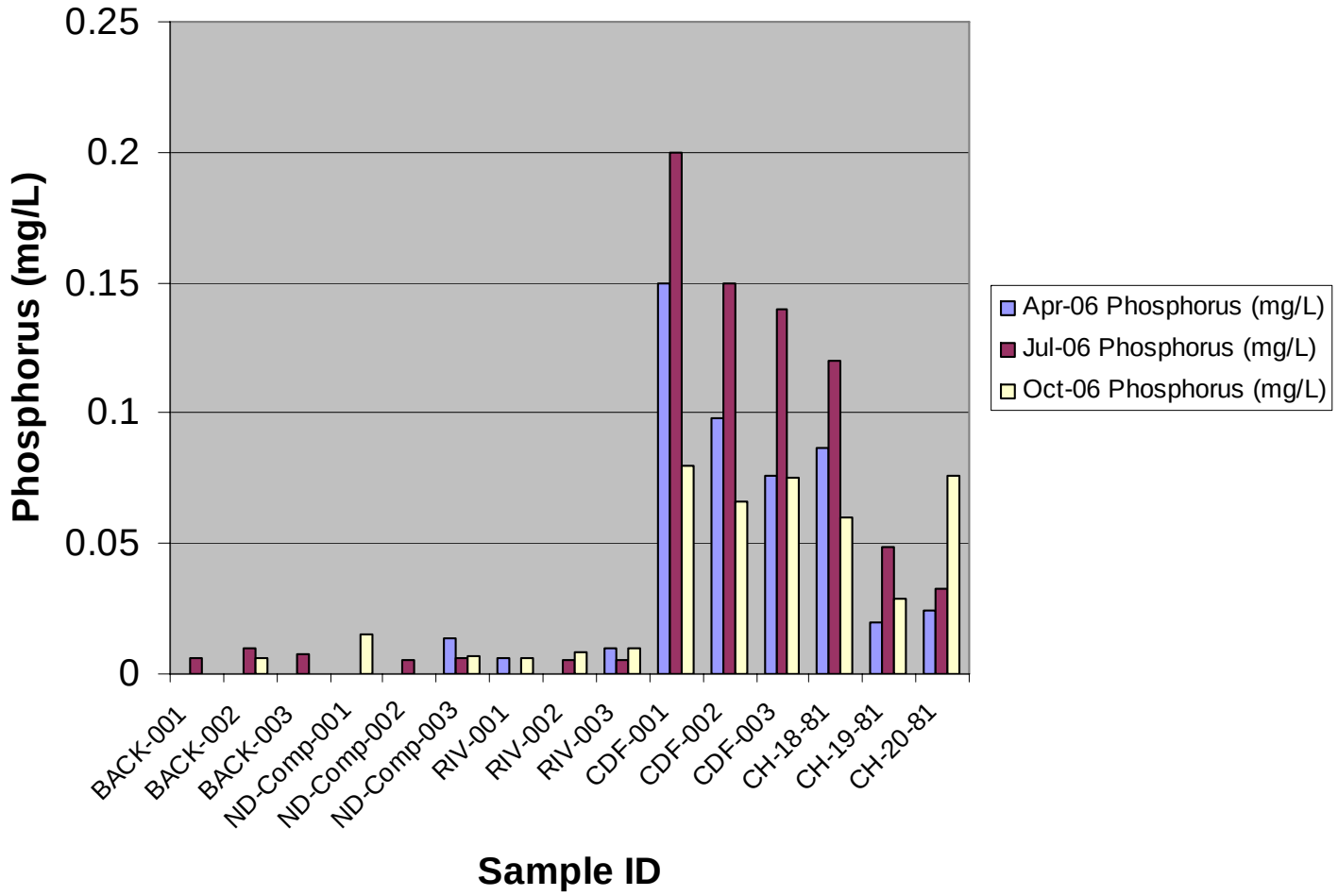


Figure 3G: 2006 Chicago CDF Total Dissolved Soilds

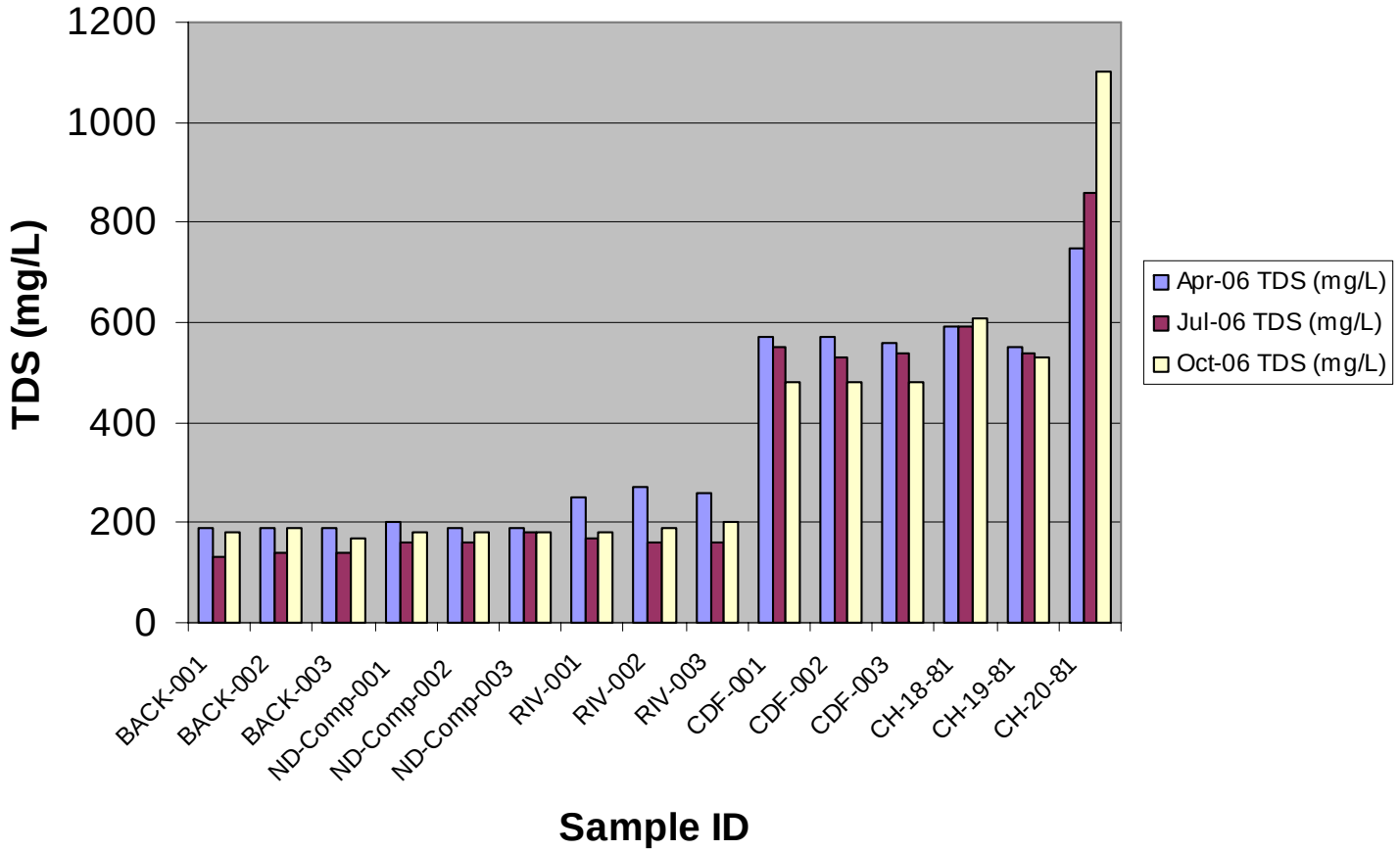


Figure 3H: 2006 Chicago CDF Total Suspended Solids

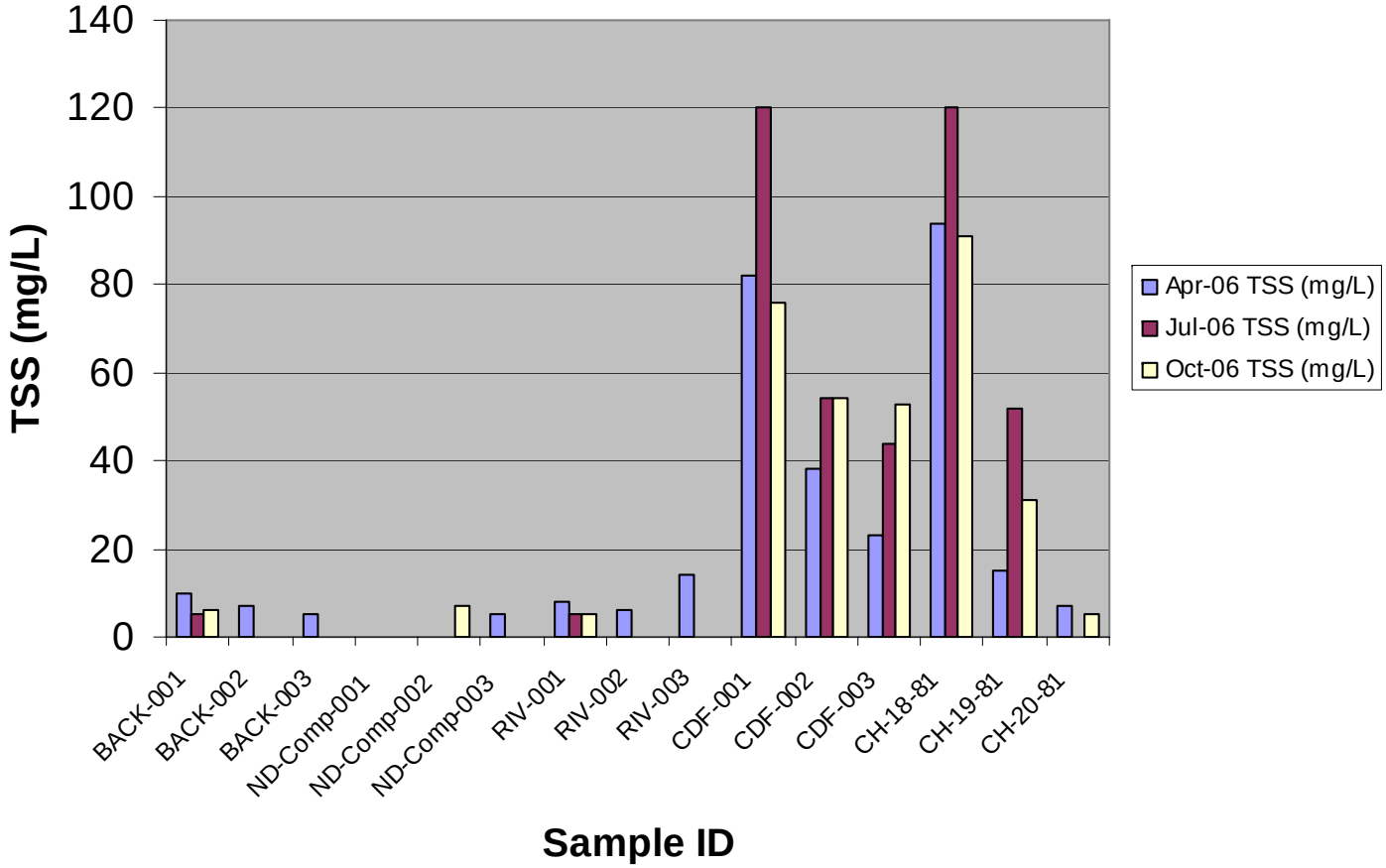


Figure 4: Daily Mean Water Levels in Calumet Harbor and Chicago Area CDF