WATER QUALITY MONITORING REPORT
FOR
ROUTINE MONITORING EVENTS
AT
CHICAGO AREA CONFINED DISPOSAL FACILITY
FOR THE WATER YEAR
2005

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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 Year 2005 monitoring period from October 2004 to October 2005. The report includes data from routine monitoring events that were conducted on April 27, July 25 and October 6 of 2005, 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.

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 most recent 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 is valid until December 1, 2006 (Appendix A). Under "Special Condition 2," the permit stipulates 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 more recent scope of work (SOW) for Analysis of Water Samples at Chicago area CDF, dated February 2005, may also be referenced (Appendix B).

3.1.1 Current Routine Monitoring

As explained in the above referenced permit, the sampling frequency is 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 2005 these three routine monitoring events were conducted on April 27, July 25, and October 6, 2005.

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 2005 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, Montgomery Watson Harza (MWH) subcontracted the laboratory analyses to Trace Analytical Laboratories, Muskegon, Michigan. The scope of work provided to MWH 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	0.01 mg/L
Ammonia as Nitrogen	0.01 mg/L
Total Kjeldahl Nitrogen	0.5 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 2005

4.1 Water Quality Data

The analytical data for the April 27, July 25, and October 6, 2005 monitoring events are provided in the attached compact disk, 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.

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 7.76 to 12.6 over the monitoring year. Both of these measurements were taken from 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 8.7°C in the CDF pond (April 2005 event) to a high of 28.1°C in the CDF pond for (July 2005 event).

Table 3: Field pH and Temperature Summary for Water Year 2005

Parameter	PH			PH		
Statistical Measure	Minimum			Maximum		
Sampling Event	April	July	October	April	July	October
Location Group		(Station)			(Station)	
Background	8.14	8.5	8.3	8.54	8.5	8.4
Near-dike	8.03	8.5	8.3	8.6	8.5	8.4
River	8.07	8.4	8.3	8.11	8.4	8.3
CDF	8.77	7.8	8.6	8.82	8.0	8.8
Landing wells	7.76	7.8	7.8	12.6	11.6	12.0

Parameter	Temperature (°C)			Temperature (°C)		
Statistical Measure	Minimum			Maximum		
Background	8.7	25.3	15.9	9.3	25.7	17.0
Near-dike	8.8	25.1	16.6	9.5	25.6	16.9
River	9.5	25.4	16.7	9.9	25.4	16.8
CDF	10.9	27.9	20.7	11.8	28.1	21.1
Landing wells	10.6	16.5	13.1	14.1	17.6	17.3

See field logs in Appendices D,E,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 not detected during the April sampling event, and there were only four (4) detections for total Cr during the other events. The highest detection of 0.01 mg/L was found in the CDF in October. The next highest detection of 0.008 mg/L was found in landing well CH-18-81 in July.

Table 4: Chicago Area CDF 2005 analytical water quality data

TABLE 4A 27-Apr-05 Chicago Area CDF Routine Monitoring Water Year 2005
Analytical lab = Trace Analytical Laboratory Inc., Muskegon, Michigan for MW

	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	0.011	<0.005	0.76	0.033	<0.010	160	10
BACK-002	<0.005	0.012	<0.005	0.62	0.025	<0.010	180	11
BACK-003	<0.005	0.019	0.008	1.1	0.034	0.035	240	8.0
ND-Comp-001	<0.005	0.021	0.007	<0.50	0.031	<0.010	190	12
ND-Comp-002	<0.005	0.007	0.006	0.92	0.033	<0.010	180	5.0
ND-Comp-003	<0.005	0.007	0.006	0.76	0.030	<0.010	180	5.0
RIV-001	<0.005	0.019	0.006	0.70	0.041	0.020	200	9.0
RIV-002	<0.005	0.016	0.005	1.0	0.038	<0.010	200	11
RIV-003	<0.005	0.056	0.007	1.0	0.036	<0.010	200	16
CDF-001	<0.005	0.170	0.025	2.0	0.025	1.0	510	45
CDF-002	<0.005	0.170	0.023	1.8	0.024	0.10	500	41
CDF-003	<0.005	0.160	0.020	<2.5*	0.017	0.093	490	31
CH-18-81	<0.005	0.046	0.010	1.5	0.70	0.037	520	35
CH-19-81	<0.005	0.078	0.008	4.3	2.8	0.058	510	27
CH-20-81	<0.005	0.380	0.008	<0.5	0.11	<0.010	960	12
Detection limit	<0.005	<0.005	<0.005	<0.50	<0.010	<0.010	<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 25-Jul-05 Chicago Area CDF Routine Monitoring Water Year 2005

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

	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	0.006	0.010	<0.50	0.021	<0.010	120	5.0
BACK-002	<0.005	<0.005	<0.005	<0.50	0.013	<0.010	150	<5.0
BACK-003	<0.005	<0.005	0.0098	<0.50	<0.010	<0.010	160	<5.0
ND-Comp-001	<0.005	0.006	0.077	<0.50	0.018	<0.010	110	5.0
ND-Comp-002	<0.005	<0.005	0.008	<0.50	0.012	<0.010	72	<5.0
ND-Comp-003	<0.005	<0.005	0.030	<0.50	0.026	<0.010	160	<5.0
RIV-001	<0.005	0.005	0.005	<0.50	<0.050*	<0.010	150	6.0
RIV-002	<0.005	0.006	0.008	<0.50	0.043	<0.010	140	<5.0
RIV-003	<0.005	0.007	0.010	<0.50	0.034	<0.010	170	6.0
CDF-001	0.007	0.270	0.077	1.0	0.073	0.094	550	66
CDF-002	0.006	0.320	0.069	1.1	0.058	0.089	570	140
CDF-003	<0.005	0.200	0.091	1.0	0.052	0.083	540	40
CH-18-81	0.008	0.230	0.200	3.30	3.0	0.093	590	270
CH-19-81	<0.005	0.300	0.410	5.40	6.0	0.097	500	100
CH-20-81	<0.005	0.410	0.090	<0.5	0.23	0.055	1000	17
Detection limit	<0.005	<0.005	<0.005	<0.50	<0.010	<0.010	10	<5.0

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

* Reporting limit was raised due to matrix interference

TABLE 4C 6-Oct-05 Chicago Area CDF Routine Monitoring Water Year 2005

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

	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	<0.005	<0.0050	0.58	0.044	<0.010	170	<5.0
BACK-002	<0.0050	<.0050	<.0050	<0.50	0.046	<0.010	170	<5.0
BACK-003	<0.0050	<0.0050	0.0061	0.54	0.046	<0.010	180	<5.0
ND-Comp-001	<0.0050	<0.0050	0.015	<0.50	0.050	<0.010	180	<5.0
ND-Comp-002	<0.0050	<0.0050	0.030	1.8	0.048	0.011	180	<5.0
ND-Comp-003	<0.0050	<0.0050	0.120	1.1	0.052	<0.010	180	<5.0
RIV-001	<0.0050	<0.0050	<0.0050	<0.50	0.11	0.012	180	<5.0
RIV-002	<0.0050	0.0050	<0.0050	<0.50	0.054	<0.010	180	<5.0
RIV-003	<0.0050	0.0052	0.0073	<0.50	0.06	<0.010	170	<5.0
CDF-001	0.010	0.34	0.10	2.8	0.23	0.32	530	74
CDF-002	<0.0050	0.20	0.027	2.4	0.12	0.095	550	55
CDF-003	<0.0050	0.20	0.030	1.7	0.099	0.058	540	48
CH-18-81	<0.0050	<0.0050	0.160	4.2	3.3	0.077	630	19
CH-19-81	<0.0050	0.018	0.018	7.6	7.1	0.041	500	40
CH-20-81	<0.0050	0.050	0.061	0.86	0.24	0.045	1000	<5.0
Detection limit	<0.0050	<0.0050	<0.0050	<0.50	<0.010	<0.010	<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 (0.410 mg/L) was measured in well sample CH-20-81 during the July 2005 event. The next highest Mn concentration (0.380 mg/L) was measured in the same well in April. The highest background concentration of Mn was measured at 0.019 mg/L in April, and the highest near-dike concentration was 0.021, also measured in April.

Figure 3C shows the highest zinc (Zn) concentration (0.410 mg/L) was measured in well CH-19-81 during the July 2005 event. The next highest was 0.2 mg/L in the CH-18-81 well, also in July. The highest measured background concentration of Zn was 0.010 mg/L, in July. The highest near-dike values were 0.120 and 0.077, measured in October and July respectively.

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 (7.6 and 5.4 mg/L) were measured in landing well CH-19-81 during the October and July 2005 events, respectively. The highest near-dike concentration for TKN was 1.8 mg/L, in October. The highest background concentration for TKN was 1.1 mg/L, in April.

Figure 3E shows that the highest two ammonia nitrogen concentrations (7.1 and 6.0 mg/L) were measured in landing well CH-19-81 during the October and July 05 events, respectively. In comparison, the CDF pond, river and near-dike samples ranged from non-detect to 0.23 mg/L, and the highest background concentration for ammonia was 0.046 mg/L, measured in October.

As observed in Figure 3F, the highest phosphorus concentration (1.0 mg/L) was measured in the CDF pond during April 2005 event. The river and near-dike samples had phosphorous concentrations that were 0.020 mg/L or less. The highest phosphorous concentration detected in a background sample was 0.035 mg/L, in April 2005.

4.1.4 Solids

The monitoring results for Total Dissolved Solids and Total Suspended Solids are shown in Figures 3G and 3H, respectively. The highest TDS measurement was 1000 mg/L in well CH-20-81, for July and October, and the highest background measurement for TDS was 240 mg/L, measured in April.

Figure 3H shows that the highest Total Suspended Solids concentration of 270 mg/L was measured in well sample CH-18-81 in July. The next highest TSS sample was collected from the CDF in July (140 mg/L). Background samples did not exceed 11 mg/L during any of the sampling events.

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 result from CDF-003 during the April 05 sampling event is listed as < 2.5 mg/L although the required reporting limit was lower (0.50 mg/L). This reporting limit was raised because the sample had to be diluted, due to matrix interference. This was noted in the laboratory QC narrative and flagged in the results summary. Secondly, the RIV 001 test sample for Ammonia for the July 05 sampling event was diluted, raising the detection limit from 0.01 mg/L to 0.05 mg/L. Both raised reporting limits were accepted in the DQA. The data from the three events was determined to be acceptable and suitable for its intended purpose and objectives.

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) (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 2005 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.

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 a student's t-distribution to assess whether there is a statistically significant difference between the means of two independent sample groups. 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 differences 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 2005, the statistical comparisons for the five sampling environments and eight parameters are summarized in Table 5. 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).

The statistical comparison for manganese (Mn) indicated that samples collected during the April event in the CDF were significantly higher than the background, near-dike and river results (Table 5). In July there was a significantly higher CDF result compared to the river, and Mn samples from the well environment were found to be higher than the river as well. No conclusions were made about Mn for October.

As seen in Table 5, the statistical comparison for zinc (Zn) concludes that water in the CDF environment during the April sampling event was significantly higher in Zn than near-dike, landing well and river environments. The Zn concentrations in the well environment were also found to be significantly higher than the near-dike environment. In July, the mean Zn concentration in the wells was found to be significantly higher than the river environment.

4.5.2 Nutrients

Statistical comparison for the nutrients TKN, ammonia and phosphorus; revealed that for the April event, the near-dike and river samples were higher in ammonia than the CDF. Also, the river was found to be significantly higher in ammonia than the near-dike location. This suggests that a source of nutrients to the river environment other than the CDF, such as nearby biological activity, was present in April that could also be impacting the near dike environment. For the July event, the only significant difference in nutrients identified by the statistical analysis was a higher mean concentration of ammonia in the CDF when compared to the river. For the October event, statistical comparison indicated that mean ammonia concentration in the near dike samples was statistically significantly higher than background. Although this statistical comparison is a resourceful scientific tool for analyzing and making inferences based on the available data, further investigation is still required to determine the importance of the results. The actual data for the October event shows the mean concentrations for the near dike and background samples were 0.050 mg/L and 0.045 mg/L, respectively, and the difference between these mean values is only 0.005 mg/L. The means are statistically significantly different due to their low standard deviations (0.00200 for near dike and 0.00115 for background). It should be noted that ammonia is a measure of the nitrogen components of biological origin, so the ammonia concentration is expected to be higher for regions where the biological activity is more intense. Consequently, it is plausible that some pronounced biological activity along the lakeside dike face during October might have slightly elevated the ammonia concentration in comparison to the open water background. Overall, in this particular instance, the statistical comparison between the mean ammonia

concentrations in the near dike and background environments appears to be of limited value and does not indicate any adverse impact.

4.5.3 Solids

In April, TDS results for the river environment were found to be significantly higher than the near-dike environment. In April, July and October 2005, there were significantly higher TDS values at the CDF compared to near-dike, river and background environments. Also in April, July and October the well environment was significantly higher in TDS than the background, near-dike and river areas.

In April significantly higher TSS levels were found in the CDF compared to background, near-dike and river locations. For TSS in July and October there was either insufficient data or the null hypothesis was accepted.

Table 5: Chicago Area CDF Year 2005 Routine Water Quality Parameter Statistical Comparison Summary

Water Quality Parameter	April 2005		July 2005		October 2005	
	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	BACK	CDF	RIV	--	--
	CDF	NDC	CH	RIV	--	--
	CDF	RIV	--	--	--	--
Zinc	CDF	NDC	CDF	RIV	--	--
	CDF	RIV	--	--	--	--
	CH	NDC	--	--		
	CDF	CH	--	--	--	--
TKN	--	--	--	--	--	--
NH_3	NDC	CDF	CDF	NDC	NDC	BACK
	RIV	NDC	--	--	--	--
	RIV	CDF	--	--	--	--
Phosphorus	--	--	--	--	--	--
TDS	CDF	BACK	CDF	BACK	CDF	BACK
	CDF	NDC	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	NDC	--	--	--	--
TSS	CDF	BACK	--	--	--	--
	CDF	NDC	--	--	--	--
	CDF	RIVER	--	--	--	--

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 #7044) is maintained by the National Oceanographic and Atmospheric Administration (NOAA) and the water level monitoring station 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 references 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 0.29 feet. The daily mean pond surface water levels in the CDF ranged from 1.22 ft above LWD, to 0.45 ft below LWD. The daily mean Calumet Harbor water elevation ranged from 1.53 ft above LWD to 1.2 ft below LWD. The average daily mean water level was 0.36 ft above LWD for the Calumet Harbor, and 0.63 above LWD for the CDF. Piezometric data collected from landing wells CH-18-81 (CH 1), CH-19-81 (CH 2), and CH-20-81 (CH 3) for each monitoring event is presented in Table 6 along with 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 6 references Lake Michigan Low Water Datum, which is 576.8 feet above mean water level at Father Point Quebec International Great Lakes Datum1955.

Table 6: Chicago Area CDF Well, Pond, and Harbor Water Level Comparison 2004

	Elevation Expressed in Feet above Lake Michigan Low Water Datum			Remarks
Location/Date	27 Apr 05	25 Jul 05	06 Oct 05	For this report
CH-18-81	2.46	1.96	1.36	(CH 1)*
CH-19-81	3	1.5	1.3	(CH 2)*
CH-20-81	4.37	3.37	3.37	(CH 3)*
CDF Pond	0.57	0.82	0.28	Daily Mean USGS**
Calumet Harbor	0.567	0.574	.098	Daily Mean NOAA***

* Designation in Statistical Summary Tables in Appendices D-F
** 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 27, July 25 and October 6 of 2005 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 2005. 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 nitrogen, 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 2005.

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) U.S. Army Corps of Engineers, Scope of Work for Analysis of Water Samples for Chicago Area Confined Disposal Facility Monitoring. 28 February 2005.

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

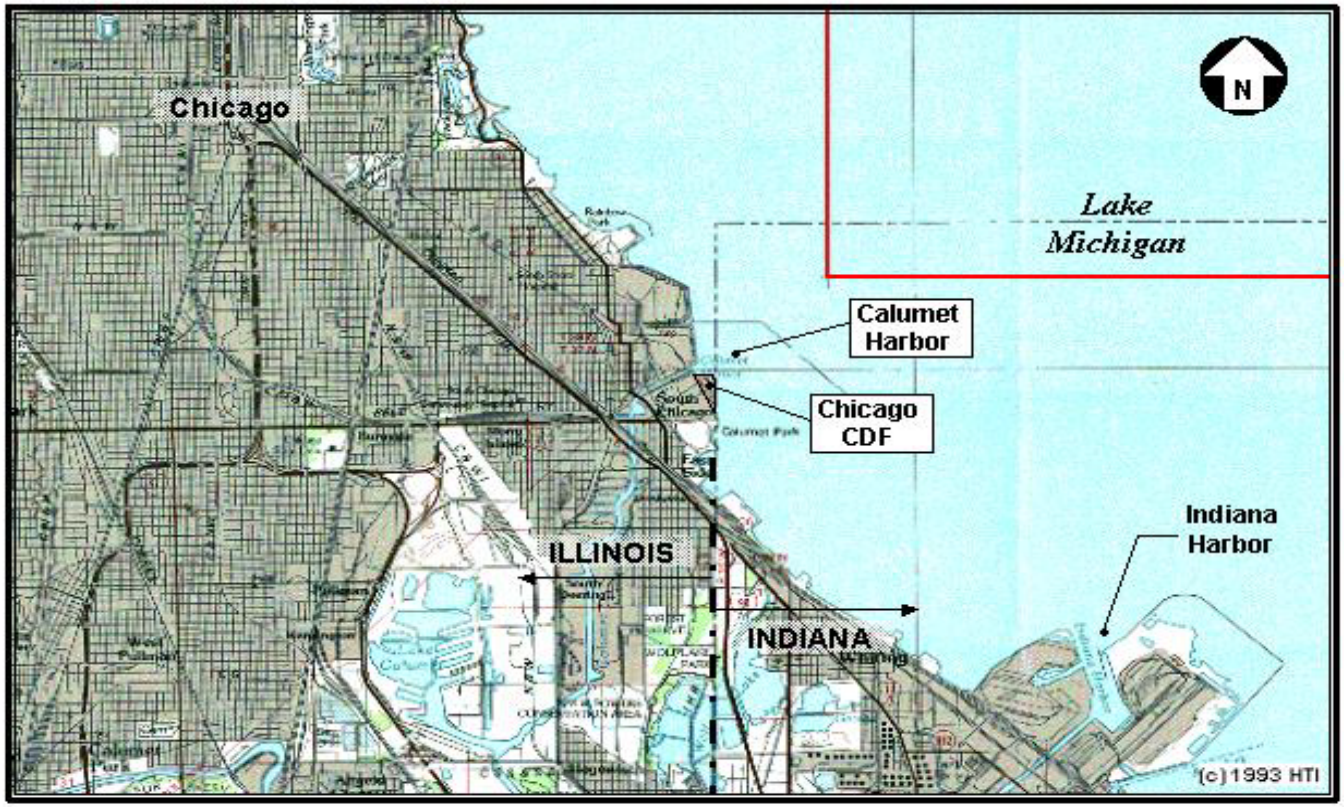

Figure 1: Location of Chicago Area CDF and Calumet Harbor

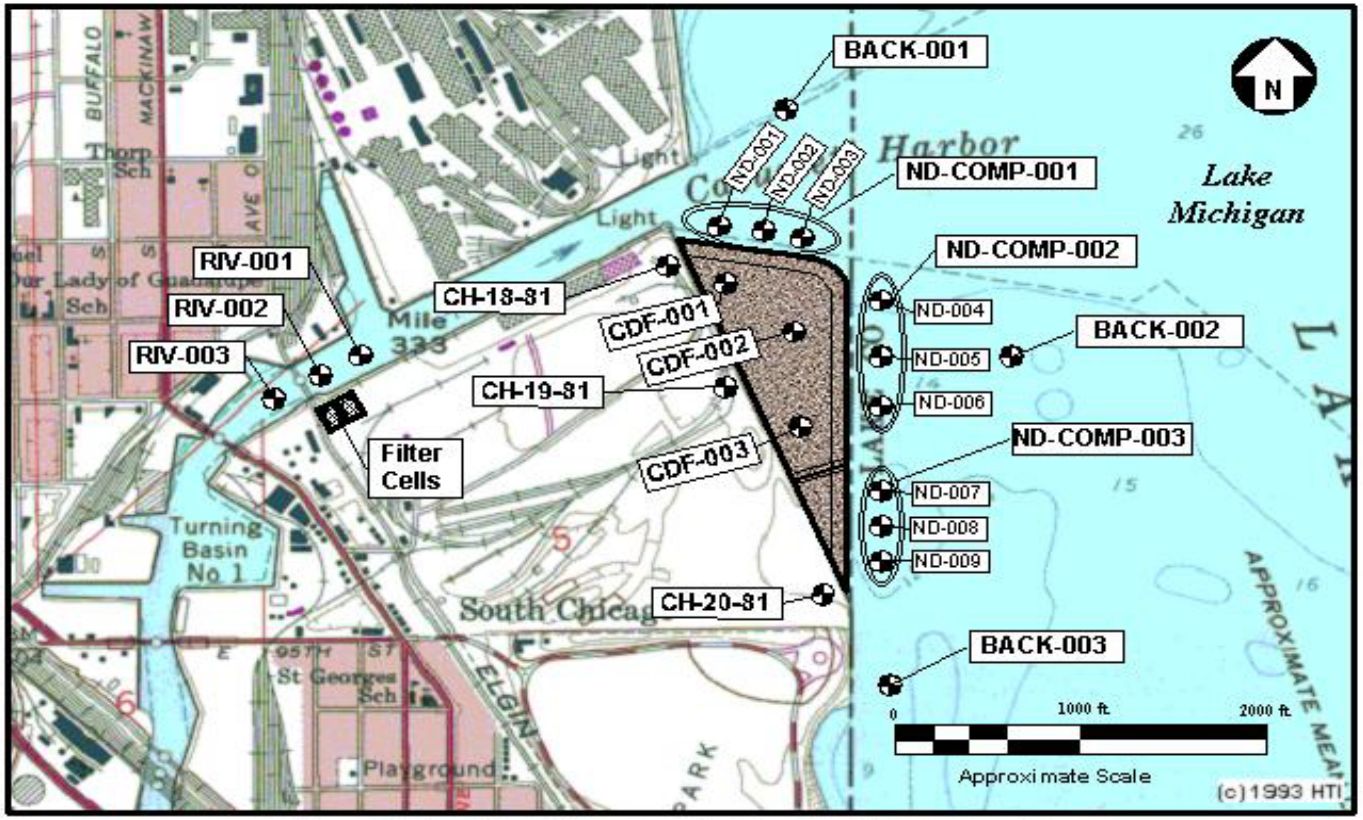

Figure 2: Sampling Locations for Routine Monitoring Events

Figure 3A: 2005 Chicago CDF Total Chromium

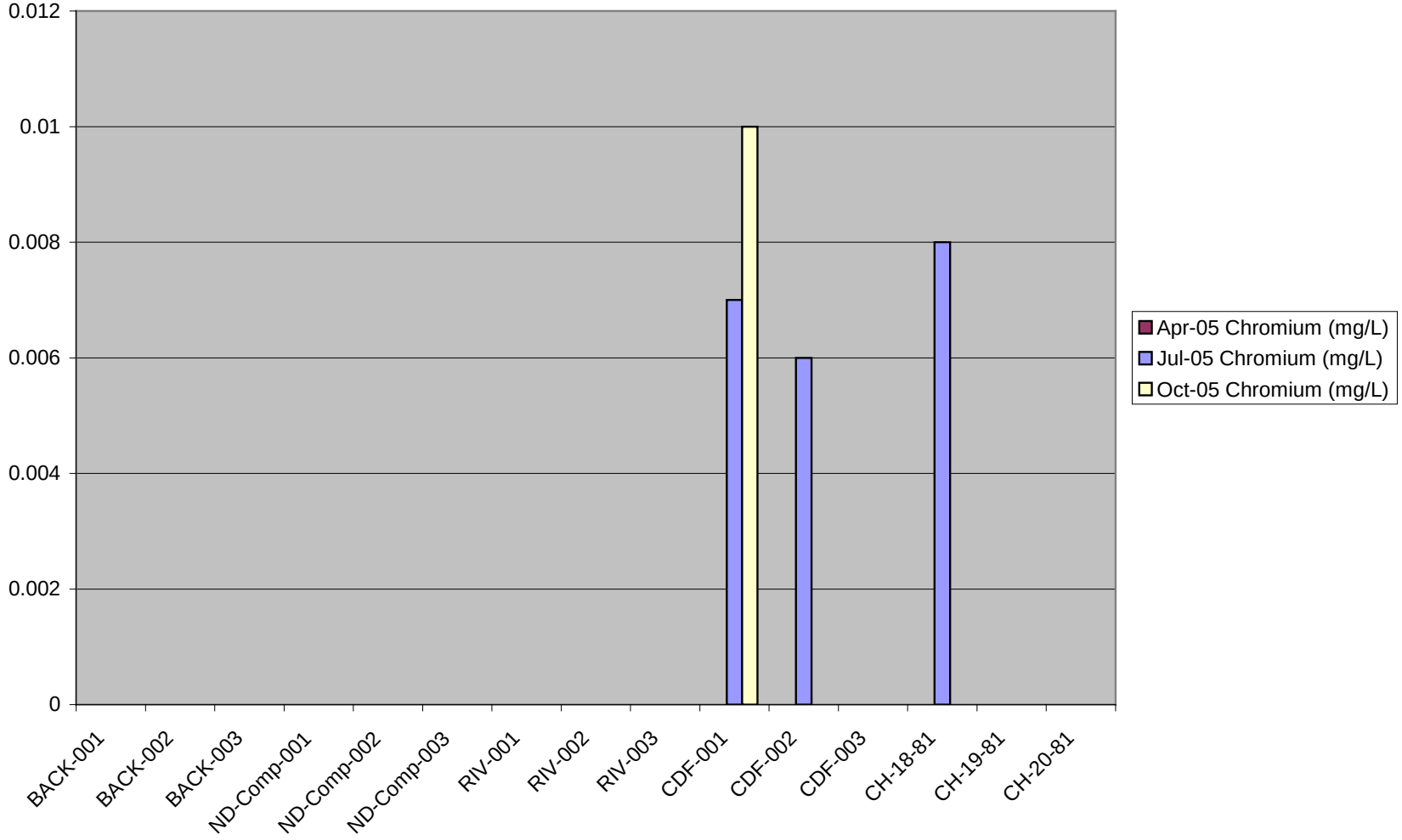

Figure 3B: 2005 Chicago CDF Total Manganese

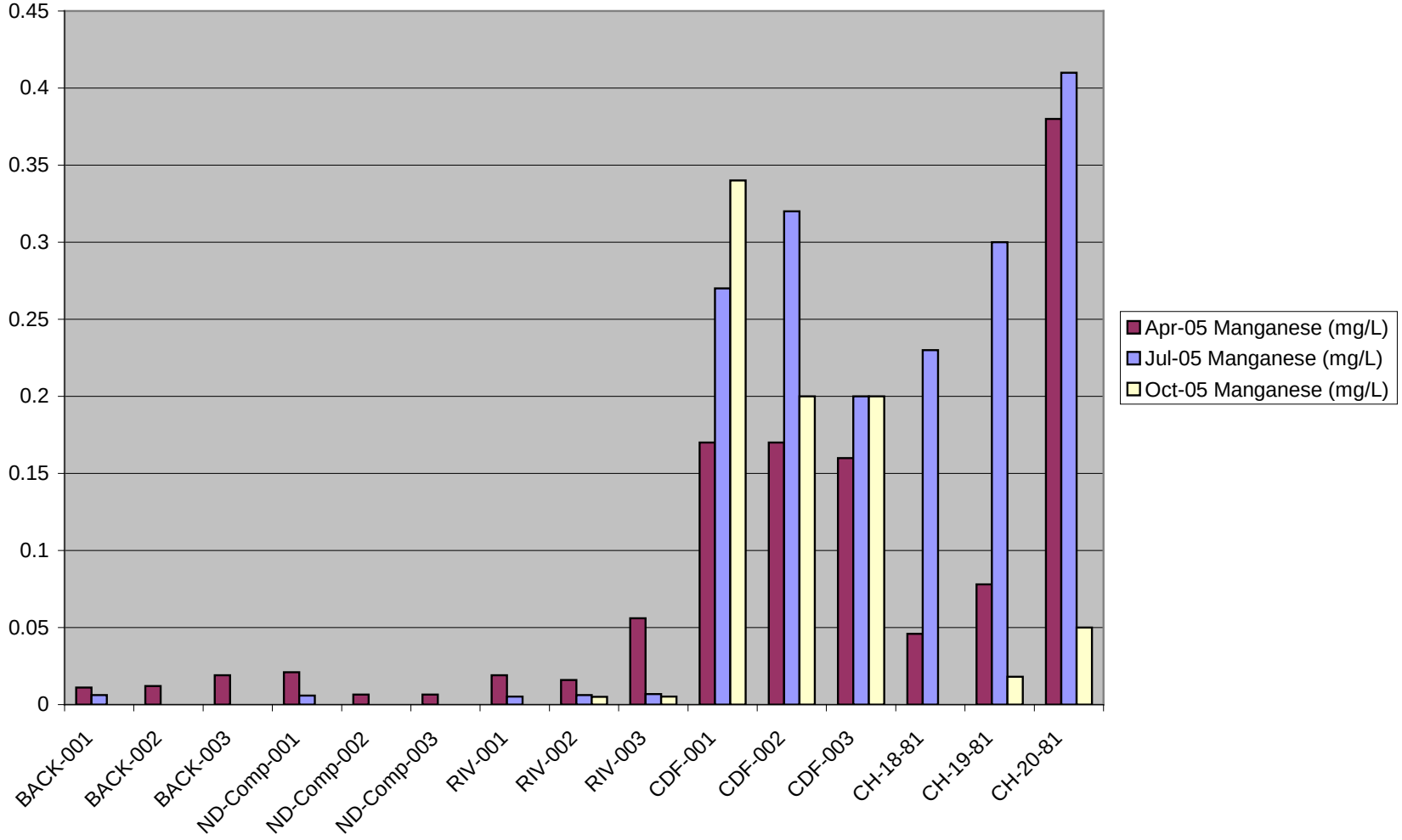

Figure 3C: 2005 Chicago CDF Total Zinc

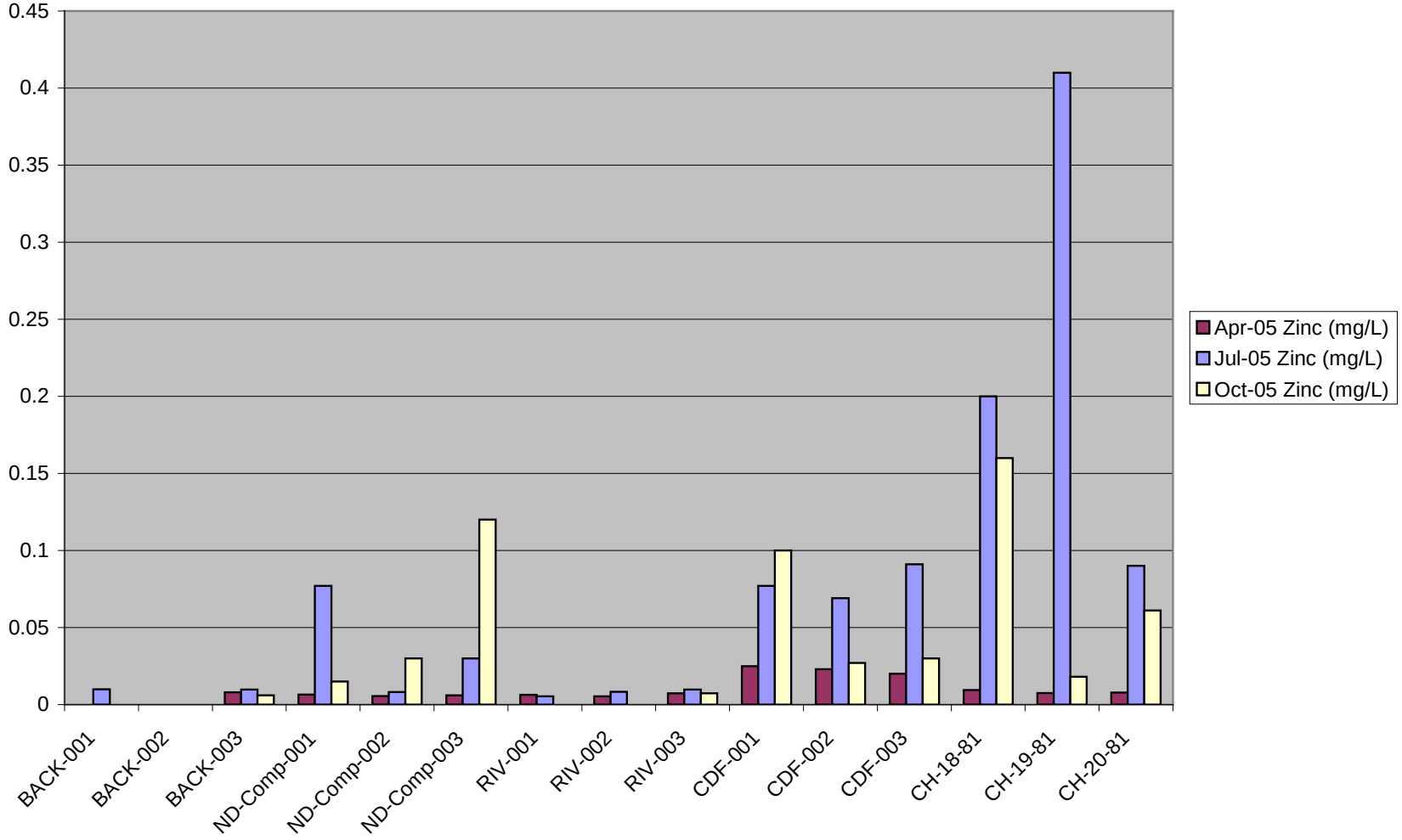

Figure 3D: 2005 Chicago CDF TKN

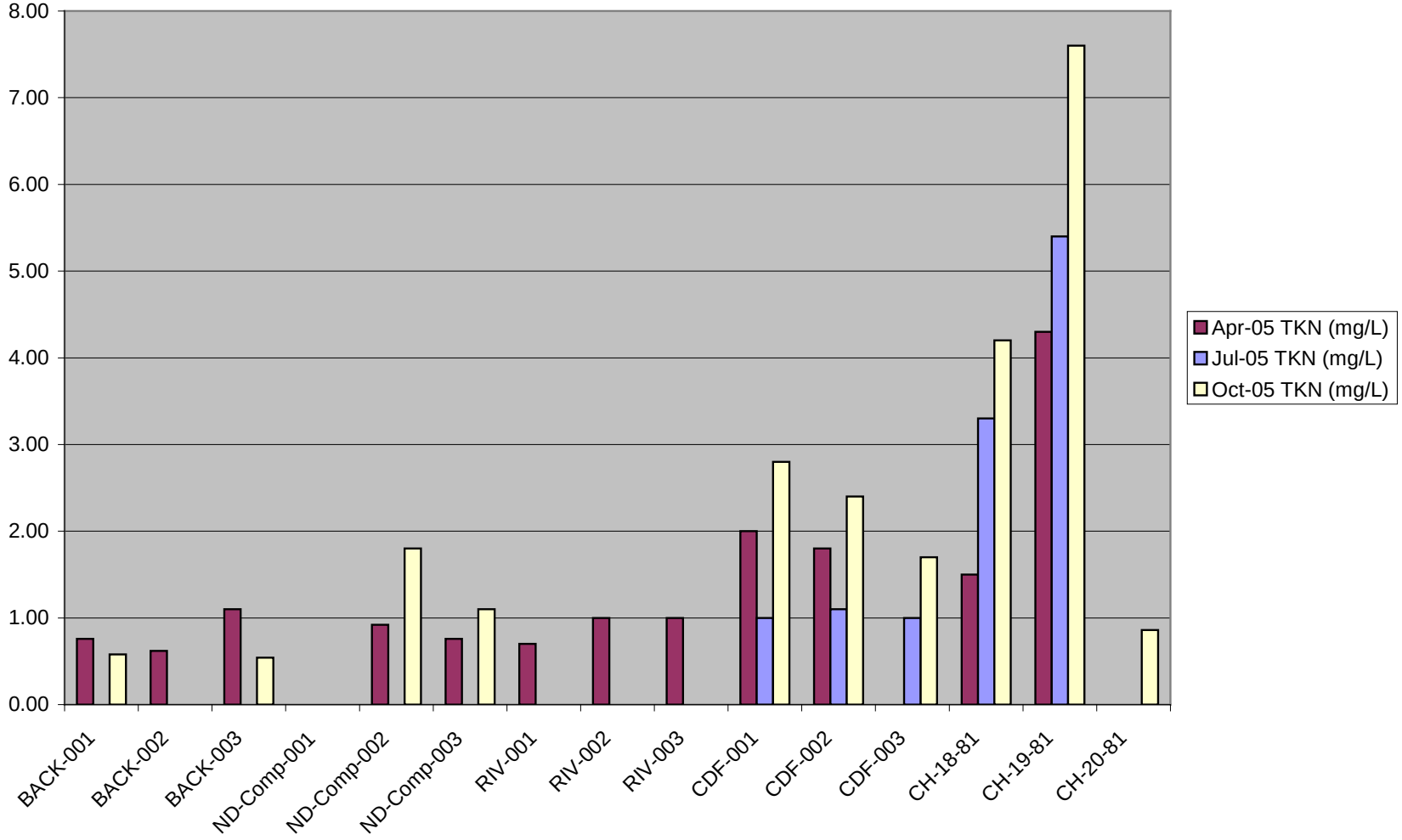

Figure 3E: 2005 Chicago CDF Ammonia

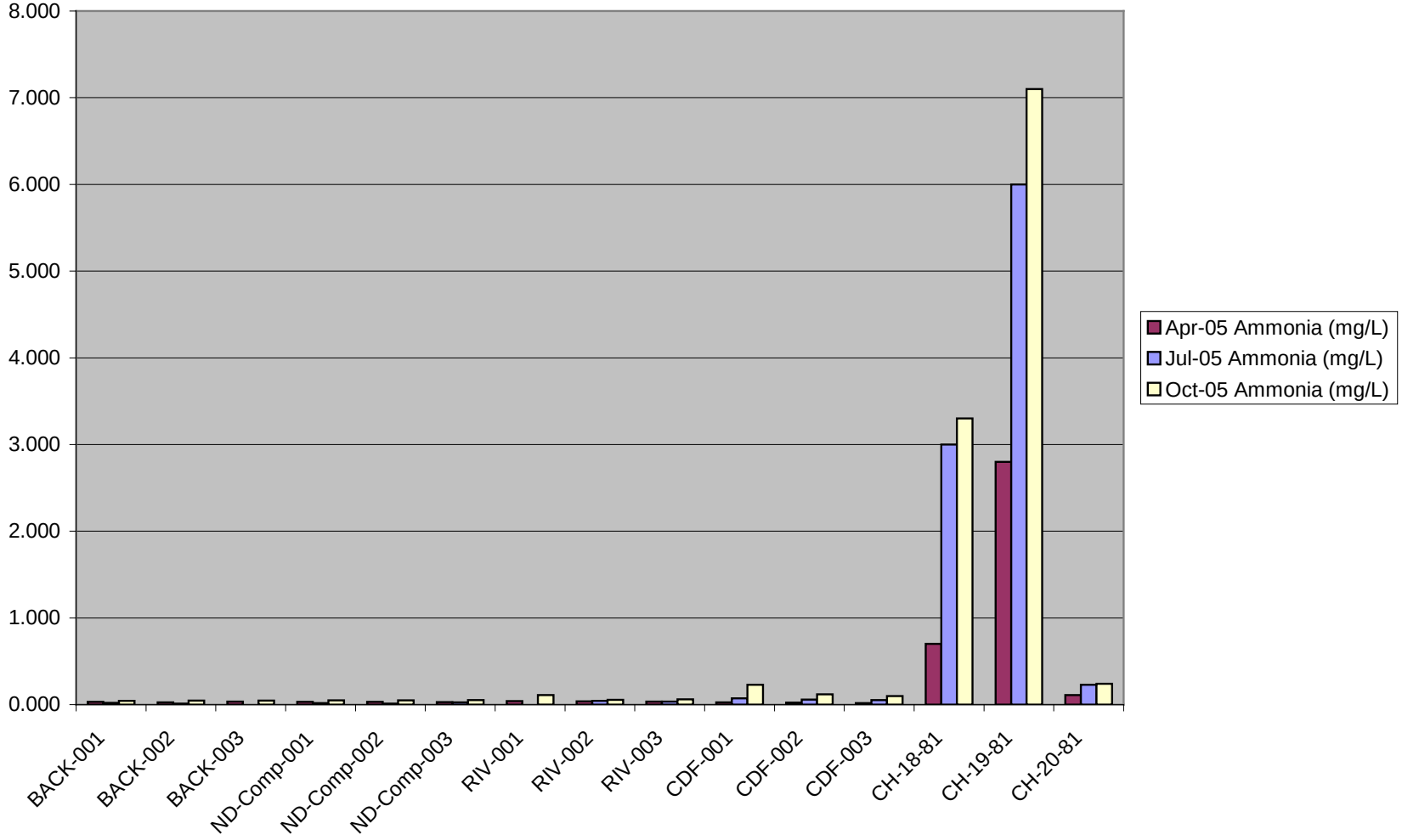

Figure 3F: 2005 Chicago CDF Phosphorus

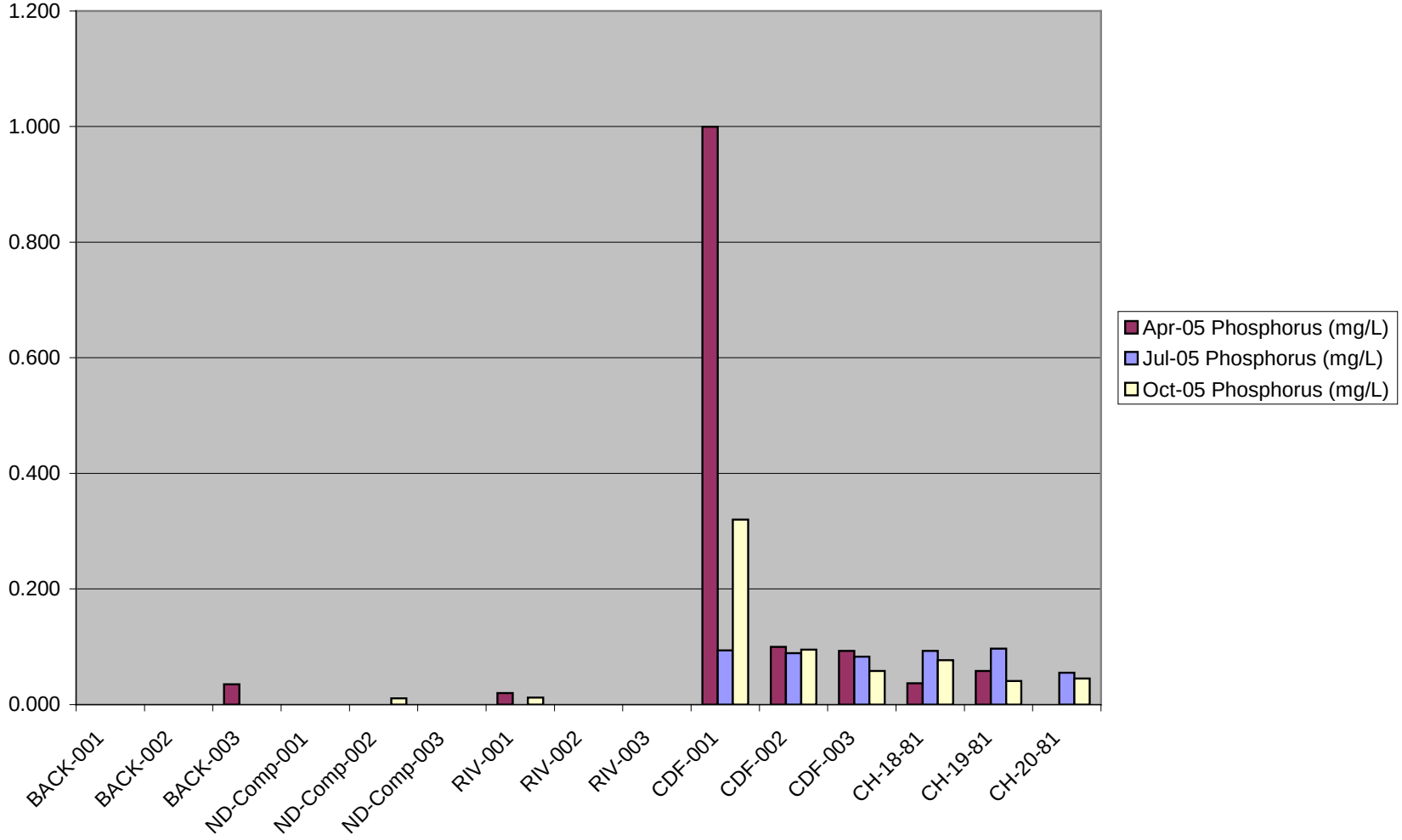

Figure 3G: 2005 Chicago CDF Total Dissolved Solids

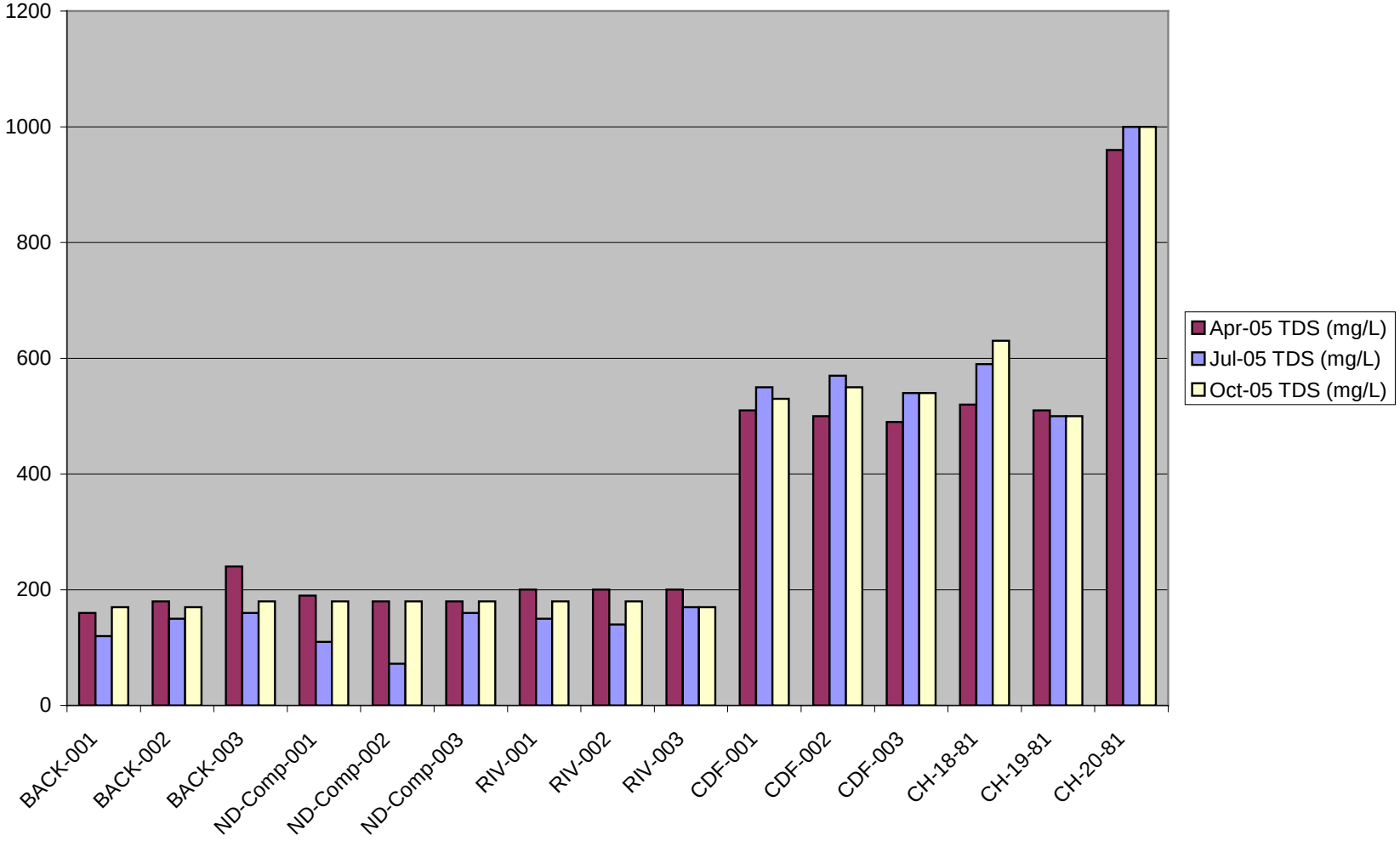

Figure 3H: 2005 Chicago CDF Total Suspended Solids

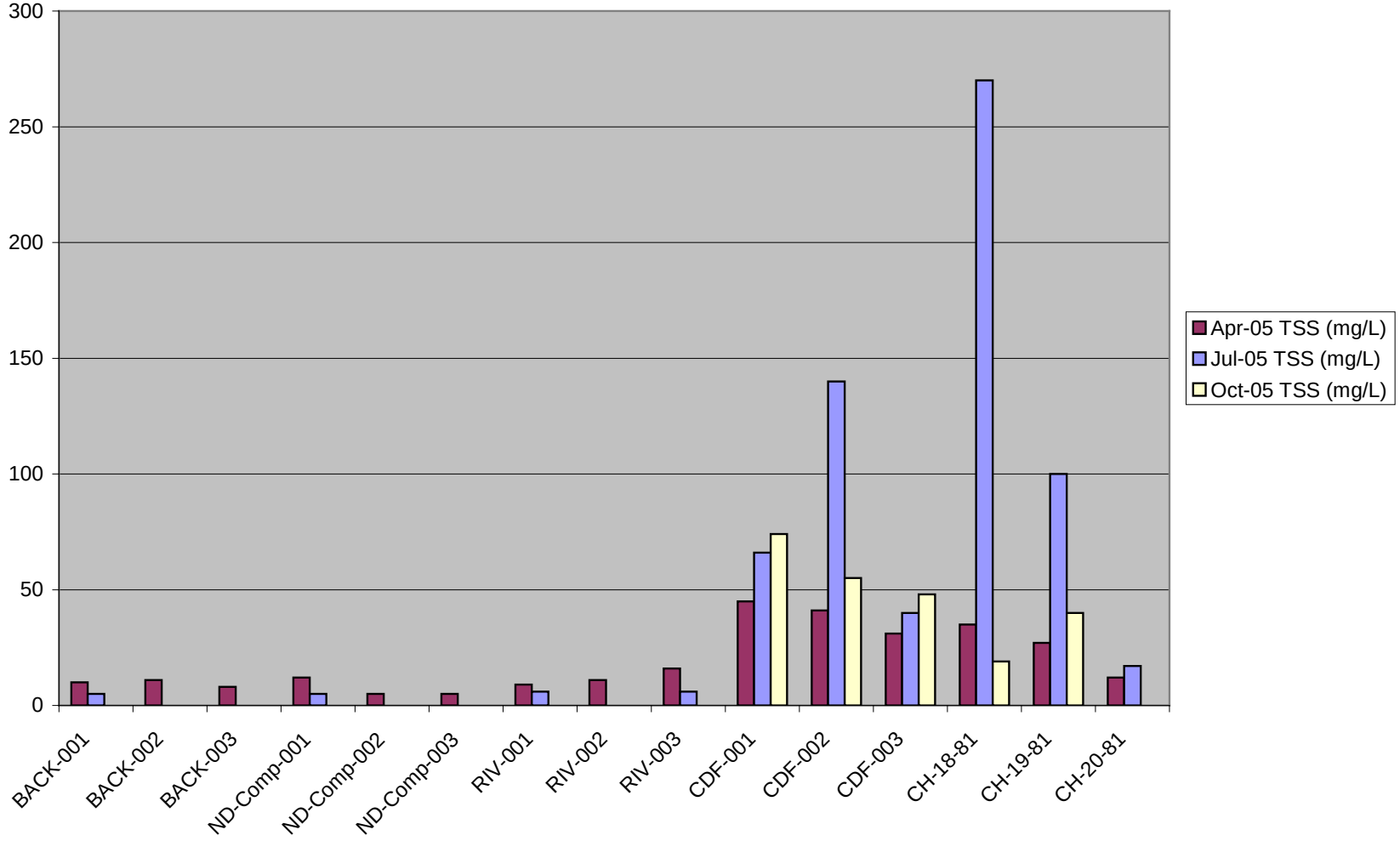
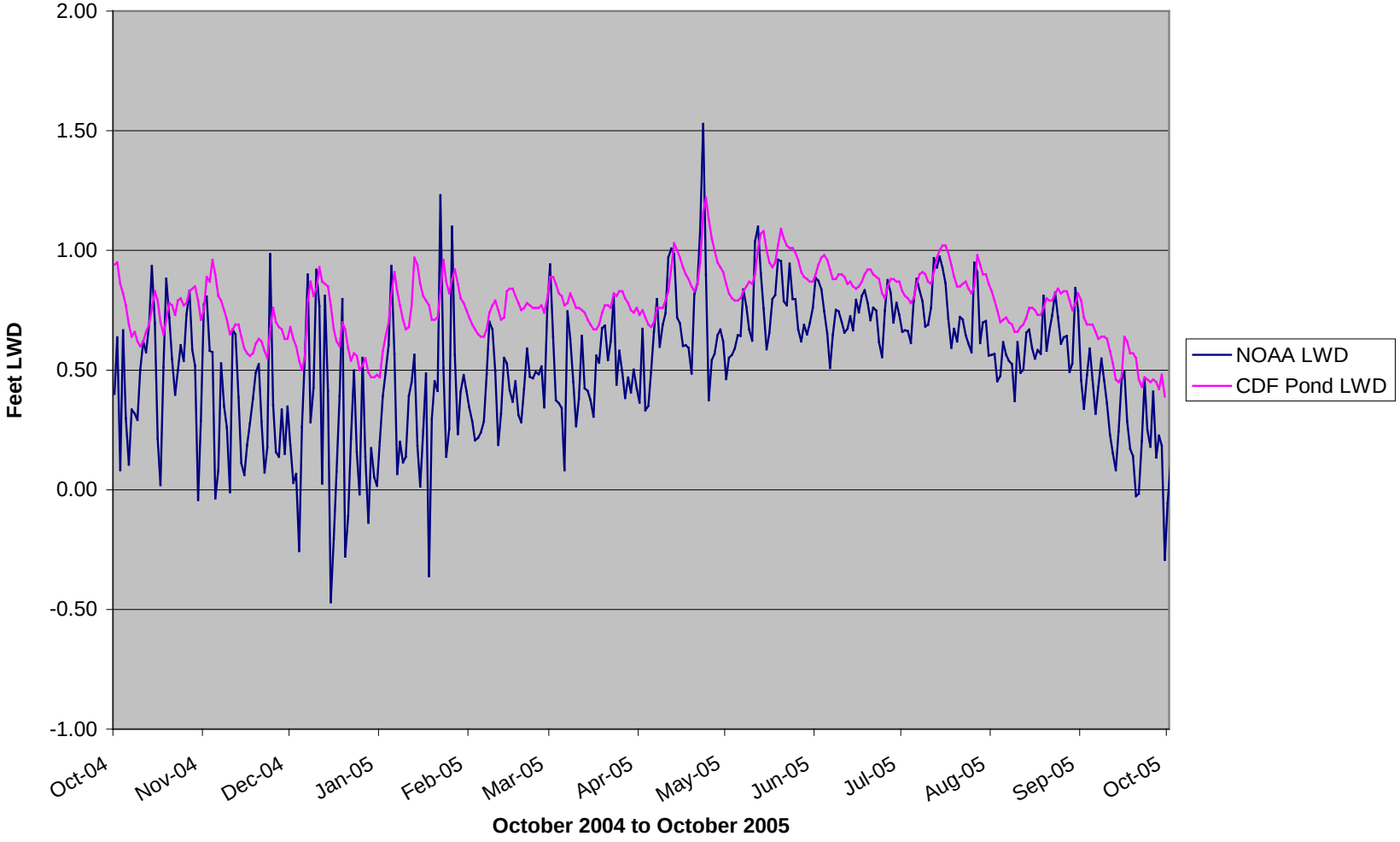
Figure 4: Daily Mean Water Levels in Calumet Harbor and Chicago Area CDF