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Little Venice Water Quality Monitoring Project

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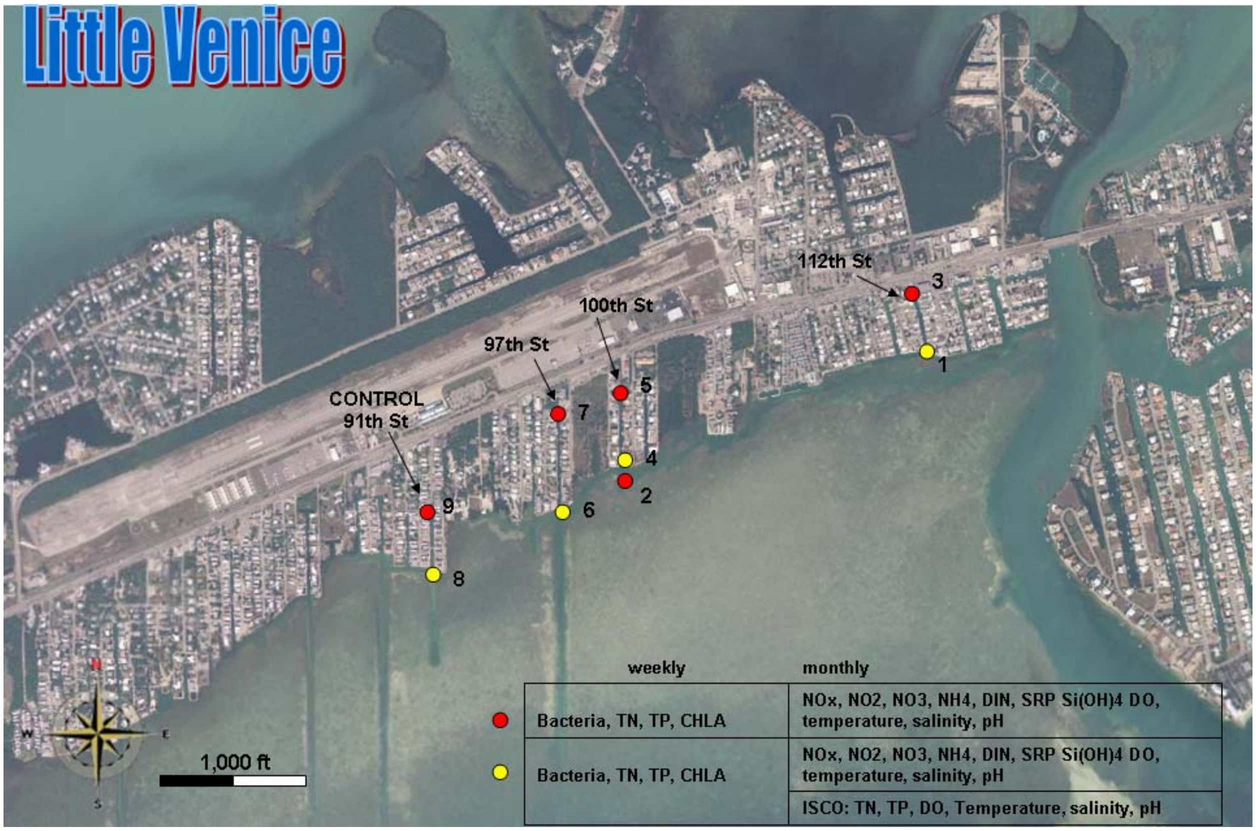
Little Venice Water Quality Monitoring Project

FDEP Contract SP 635

Final Report



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Little Venice Water Quality Monitoring Project
FDEP Contract Number SP 635

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Little Venice Water Quality Monitoring Project

FDEP Contract Number SP 635

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EXECUTIVE SUMMARY

The objective of the Little Venice project is to detect changes in water quality as a function of remediation activities, and includes two phases. Phase I sampling (2001- 2003) was prior to remediation while Phase II (2005-2007) is the post-remediation stage sampling. The initial experimental design was conceptually developed as a Before–After Control-Impact Design with multiple sites. Observations and sampling have been performed in three remedied canals (112th St., 100th St. and, 97th St. canals), in one canal lacking remedial actions (91st St. canal) and a nearshore site for comparison purposes (Fig. 1). Phase I was executed from May 23, 2001 to Dec. 15, 2003; Phase II began June 15, 2005, after the construction of the wastewater collection system was mostly completed.

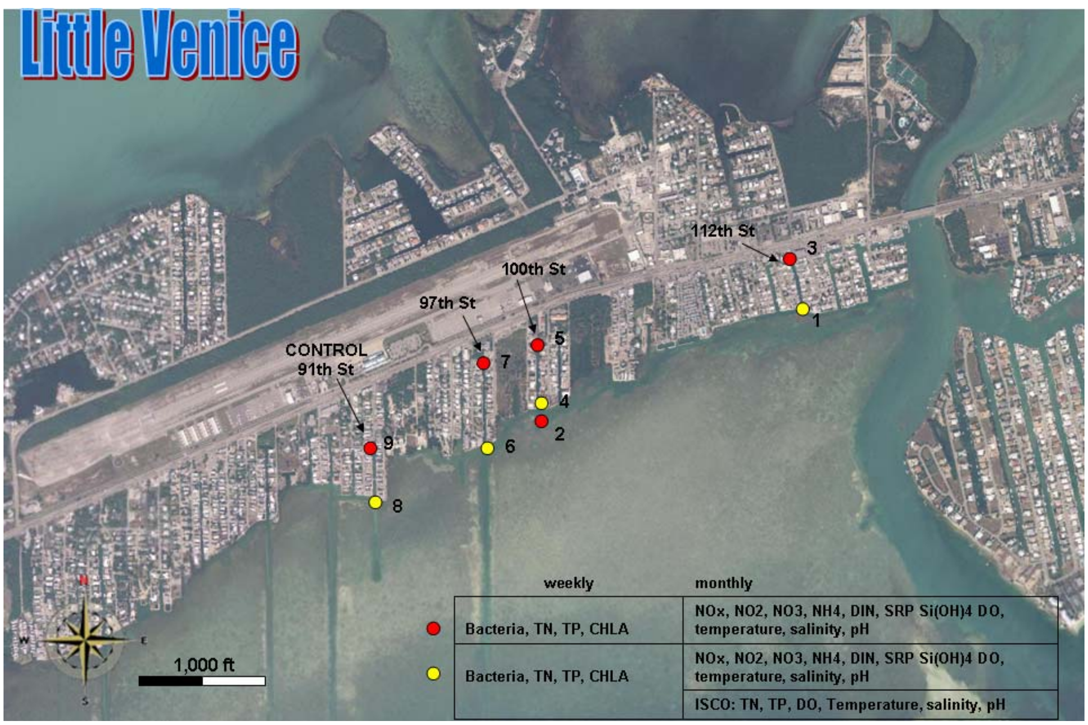

Figure 1. Little Venice Subdivision area in Marathon Key; sampling stations are shown. ISCO sampling is only performed bimonthly at yellow coded sites.

At a regional scale, natural water quality in the Little Venice area is the result of the dynamic interplay of complex natural settings with a man-modified landscape where driving processes are not constant but subject to trends and cycles of diverse periodicity and intensity. Marine currents exert an important influence on the distribution, character and interactions of water masses. The Florida Keys are highly interconnected by local and oceanic circulation patterns including Atlantic, Gulf and continental waters which in turn result in water quality diversity, both in time and space. At the local scale, the interaction is among water masses moving though Vaca Cut and along shore, ocean waters, runoff, ground waters and seepage from onsite sewage disposal systems. Water quality may be influenced with residence time in the canals and abundance of organic debris on their bottoms.

This report includes cumulative water quality and bacteriological data from the 9 selected stations within the Little Venice subdivision. Water was collected weekly for bacteriological analysis and enumeration of fecal coliforms and *Enterococci*. Field parameters collected weekly at both the surface and bottom of the water column at each station include salinity, temperature, and dissolved oxygen (DO). Water quality parameters monitored weekly at each station included total nitrogen (TN), total phosphorus (TP), and chlorophyll *a* (CHLA). Water samples were analyzed by the SERC laboratory using standard methodology outlined in our Quality Assurance Plan. Monthly grab samples from each site were analyzed for the full suite of nutrients including ammonium, nitrate, nitrite, soluble reactive phosphate, silicate, and total organic carbon. In addition, monthly deployments of ISCO autosamplers at two sites were programmed to collect 12 samples per day over a 2 day period, to be analyzed for TN and TP. Datasondes accompanied the autosamplers and measured and logged temperature, salinity, DO, and pH on an hourly basis.

Bacterial count distribution along the year corresponded to both climatic conditions and site location. The heads of the canals had significantly greater bacterial numbers than did the mouths. This was true for both fecal coliform and *Enterococci*. Bacterial counts were also higher during the summer months. The FL State standard for single counts of fecal coliforms in Class III Marine waters is 800 CFU/100ml; the EPA recommended standard for *Enterococci* is 104 CFU/100ml. During Phase I, 5 of 1152 fecal coliform observations (0.43%) exceeded the FL State standard and 60 *Enterococci* counts (5.2%) exceeded the recommended EPA level. One year into Phase II, fecal coliform exceedances were not statistically different than Phase I (5 of 503, or 0.99%). During phase II, *Enterococci* counts exceeded the recommended level 16 times (3.18%) but also were not statistically significant than during Phase I. When considering all bacterial counts, all stations from the head of the canals experienced statistically significant declines in fecal coliform counts, including the 91st St canal. There were no significant changes for *Enterococci* during this period of record.

State of Florida Rule 62-302.530, for Class III marine waters, specifies that DO "shall never be less than 4.0 mg l^{-1}". During Phase I, 57.4% and 67.1 % of surface and bottom water measurements exceeded (were lower) than the State standard. For Phase II, DO exceedances in surface waters were not significantly different (61.9%), but were significantly greater for bottom waters (79.6%). On a diurnal scale, daily temperature fluctuation is the controlling factor on DO concentration.

During Phase II, TN decreased significantly in all canals. Concurrent with this TN decline was an increase in TP concentrations. The result was a normalization of the TN:TP ratio to that of more balanced condition.

The Florida impaired water rule states that an estuary is impaired if the annual mean CHLA concentration is greater than 11 µg l^{-1}. Annual mean CHLA concentrations for all canals were well below FL State standards during both Phase I (1.33 µg l^{-1}) and Phase II (2.46 µg l^{-1}), however, the overall increase during Phase II was statistically significant.

To put these changes in perspective, we need to look at the larger picture of regional water quality. Salinity in all canals increased significantly between Phase I and Phase II. Freshwater diversion from OSDS sources probably had no impact on this increase. Instead, we believe that salinity variations in the canals were mostly controlled by tidal flushing processes, which was in turn influenced by regional salinity patterns. The regional salinity patterns are influenced by precipitation, terrestrial runoff, and large-scale oceanic and Gulf currents which convey coherent water masses both onshore from the south and from the north through Keys passes. In addition, the period of 2005-06 was characterized as being impacted by numerous hurricanes and storm surges, which clearly modified the coastal water conditions.

Due to the diurnal and seasonal fluctuations and the partial regional control on the behavior of water quality monitoring parameters, we continue to develop statistically sound criteria for data handling and interpretation as well as for outlining operative guidelines. From results to date, we have found that the optimum sampling time for detecting maximum groundwater impacts in Little Venice is in the late morning. The ISCO Station 10 (mouth of 112th St. canal) renders the most adequate data for such purposes. Using this information we note that, 97% of the time, our weekly grab sampling has been performed during these optimum morning hours. Nevertheless, from experience in the overall region, water quality variables change frequently and even reverse, so long-trend monitoring is the surest way towards understanding of the behavior of these coastal ecosystems.

ACKNOWLEDGEMENTS

We thank all of our many field personnel, laboratory technicians, and data support staff for their diligence and perseverance in this ongoing program, especially Amanda Dean, Danielle Mir, Cristina Pisani, and Pete Lorenzo. This project was possible due to funding by the Florida Department of Environmental Protection (Contract No. SP-635). This report is contribution #T-337 of the Southeast Environmental Research Center at Florida International University.

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BACKGROUND

Since the early 1980's several Florida counties began monitoring beaches and canals for *Enterococci* (EC) and fecal coliforms bacteria (FC), because elevated concentrations of these bacteria were believed to be strongly correlated with the presence of human pathogens. Onsite disposal systems (OSDS) and injection wells are known to be a source of microbial contamination of groundwater (Keswick, 1984). Because the groundwaters and surface waters are very closely linked in the Keys, it is not surprising that fecal coliform bacteria are common in canals and boat basins (FDER, 1987).

The Little Venice neighborhood was selected in the Monroe County Sanitary Wastewater Master Plan as the first phase of wastewater improvements for the Marathon area because of the large concentration of cesspools and inadequate septic systems, small average size of lots, high development density, and known water quality problems in the canals in the area. Little Venice includes the ocean side area of Vaca Key from Vaca Cut (east) to 94th Street (west), Marathon, FL. The Little Venice Service Area includes ~540 Equivalent Development Units (Fig. 1).

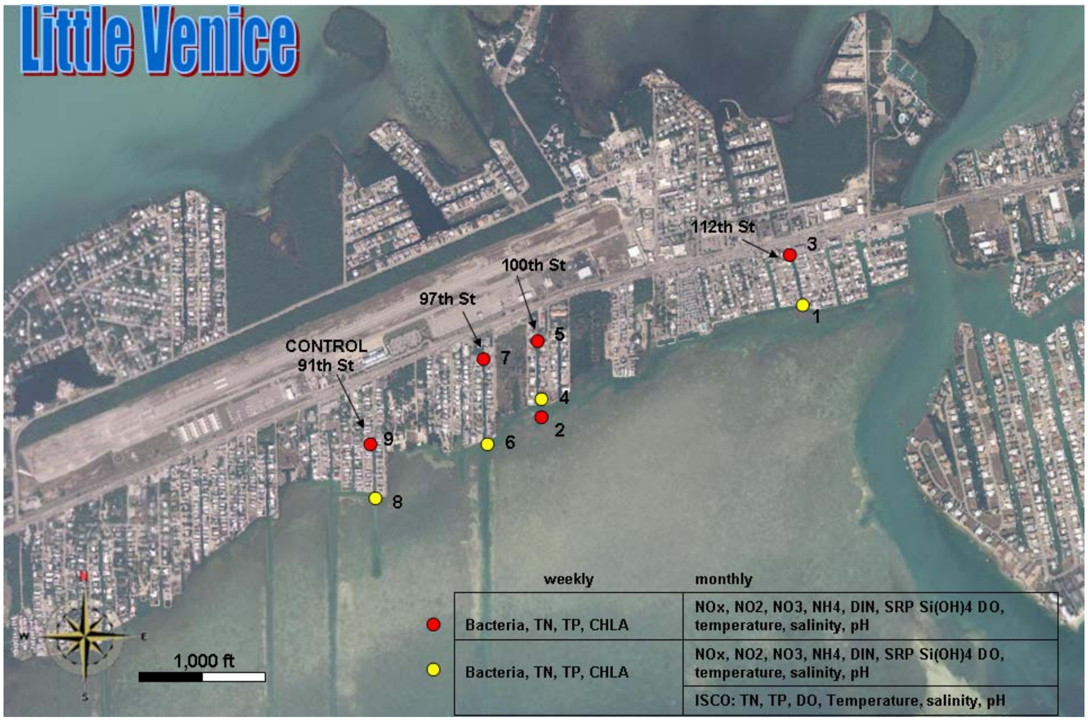

Figure 1. Little Venice Subdivision area in Marathon Key; sampling stations are shown. ISCO sampling is only performed bimonthly at yellow coded sites.

Water quality in the 89^{th} – 91^{st} Street canals was thoroughly studied in 1984-1985 as part of the Florida Department of Environmental Regulation's Monitoring Study (FDER, 1987). That study demonstrated significant nutrient enrichment of the canals, high Chlorophyll-a content, and high coprostanol concentrations in sediments. Coprostanol is a break-down product of cholesterol and has been used as an indicator of fecal contamination.

During year 2004 the Little Venice Service Area received a low-pressure, vacuum wastewater collection system to convey wastewater to a central treatment plant. The treatment plant produces effluents that meet or exceed the current advanced wastewater treatment (AWT) standards of 5:5:3:1 (BOD5, TSS, TN, TP) and uses a Class V injection well for disposal of treated wastewater. Central collection and treatment of wastewater removes a substantial portion of nutrient loading into the canals by removing the sources of wastewater (septic tanks and cesspits).

The objective of the Little Venice Monitoring project is to detect changes in water quality as a function of remediation activities. The initial experimental design was conceptually developed as a Before–After Control-Impact Design with multiple sites (BACI; Eberhardt, 1976; Stewart-Oaten et al., 1986) and includes two phases. Phase, I from year 2001 to year 2003, corresponds to the pre-remediation stage, and Phase II, which began in 2005 after the construction of the wastewater collection system, is the post-remediation phase. Four canals within the Little Venice Service Area were selected for study (Fig. 1). The first canal is a connected "U-shaped" canal system located at 112^{th} Street, lined with single-family residences that were constructed prior to 1970. A high percentage of those residences had inadequate sewage treatment systems. The second canal is located adjacent to 100^{th} Street and the third one is located adjacent to 97^{th} Street. Both are dead-end canals that are lined with single-family houses and mobile homes. Many of these residences had poorly functional septic systems or cesspits. Finally, the 91^{st} Street canal has been selected as a reference canal not subjected to remediation measures. It is located west and outside the Little Venice Service Area.

Regional scope

Under a regional scope, natural water quality in the Little Venice area is the result of the dynamic interplay of an already complex natural setting with a man made landscape, where neither natural nor anthropogenic driving processes are constant. On the contrary, they are subjected to trends, seasonal changes and cycles of diverse periodicity and amplitude. The climate in South Florida is subtropical, with little temperature variation along the year but well defined wet (summer/fall) and dry (winter/spring) seasons (Lee et al., 2003). Storms are frequent during the wet season, eventually reaching extreme rain, winds and surge levels. Marine currents exert an important influence on the distribution, character and interactions of water masses (Fig. 2). The south Florida coastal region is bordered by strong, large-scale oceanic boundary currents (the Loop Current/Florida Current System) which link local coastal waters to Gulf of Mexico and Atlantic waters and even far upstream river sources (i.e. Mississippi River), especially by conveying coherent water masses contained within evolving eddy systems. Eddy formation, trapping of Loop Current waters on the shelf break and onshore transport are the proposed mechanisms by which Loop Current waters are transported onto the shelf (Fig. 3; IMARS 2006).

Furthermore, wind driven southward coastal flows commonly advect low salinity water plumes coming from the Everglades to western Florida Bay and the Keys reef tract (Lee et al., 2001a, 2001b). In turn, flow direction through the Keys passages vary along the year, with southward flows predominating in winter and spring (dry season); north-northwest flows in the summer (wet season), and southwest flow towards the Tortugas in the fall (wet season) (Nuttle et al., 2003)

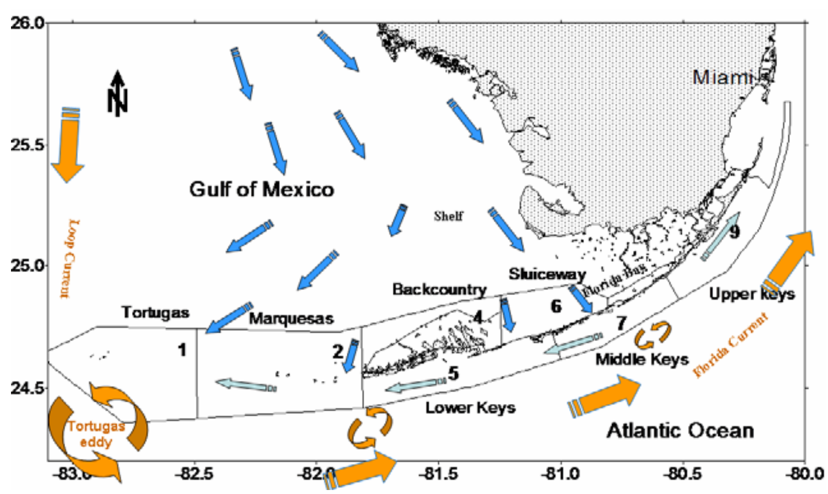

Figure 2. Current circulation patterns in southwest Florida coasts (modified after Lee et al. 2003)

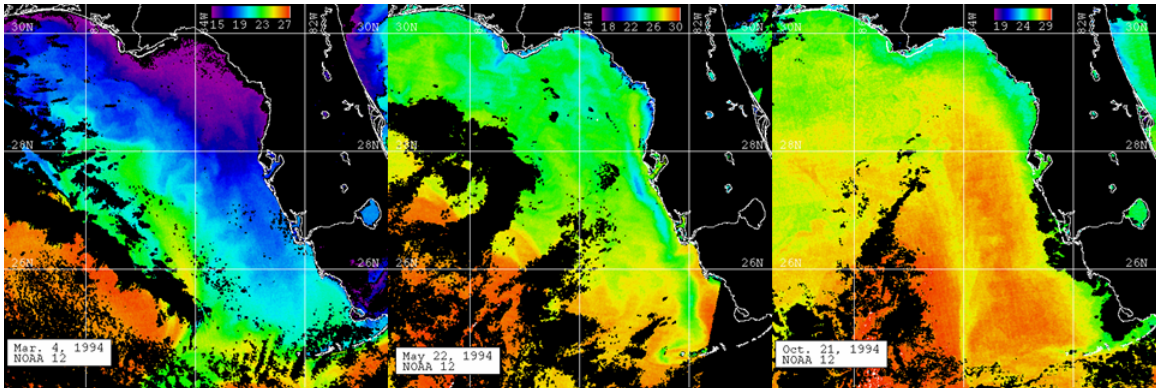

Figure 3. Surface Sea Temperature images showing transport of Gulf of Mexico waters onto the SW Florida shelf. March 4, trapping of eddy onto the shelf break and wind induced transport of Loop current waters onto the shelf. May 22, a narrow band of upwelling (blue) appears along the coast with a maximum just off Tampa Bay. Oct 21, the shelf responds to large scale storm wind forcing by forming along-shore jets (USF 2006)

This interaction between Atlantic, Gulf and continental waters affect biotic and abiotic processes in South Florida ecosystems, leading to even more complex responses, which in turn result in water quality diversity, both in time and space (Fig. 4). Regional monitoring of the Florida Keys National Marine Sanctuary allowed the grouping of water quality types into 8 clusters (Fig. 5), where the bulk of the stations fall into 6 large clusters (1, 3, 5, 6, 7, and 8) which describe a gradient of water quality. The more relevant groups to the present study are clusters 3, 5 and 7, for which the overall nutrient gradient, from highest to lowest concentrations is 7>5>3, suggesting that this gradient is due to progressive mixing between a nutrient-poor marine end member and a nutrient-rich terrestrial-derived end member (Boyer & Briceño, 2006).

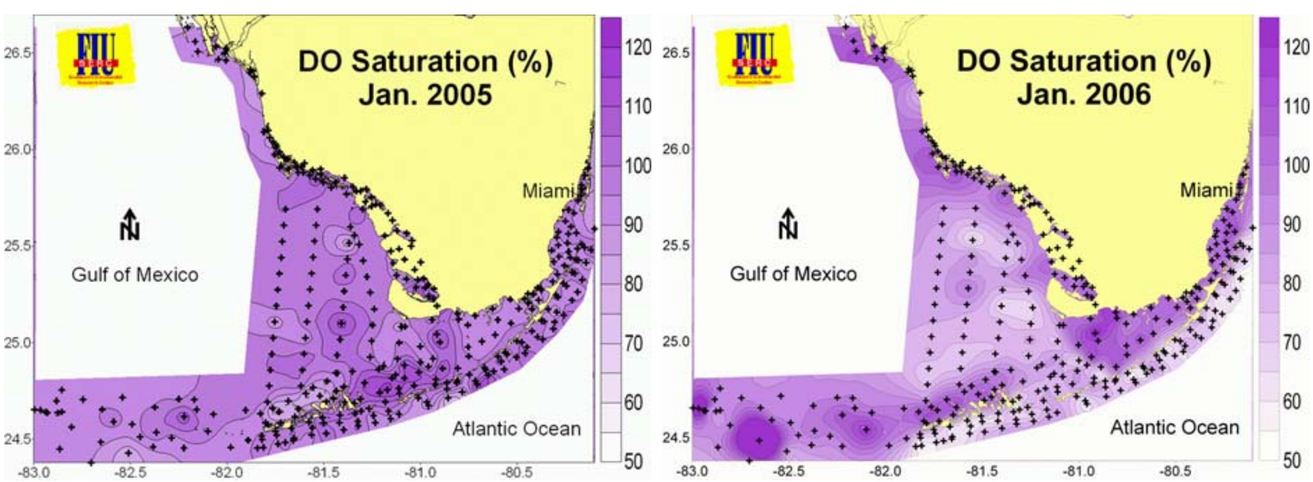

Figure 4. Distribution of DO % saturation values in South Florida coastal waters. (Boyer and Briceño, 2006; http://serc.fiu.edu/wqmnetwork/)

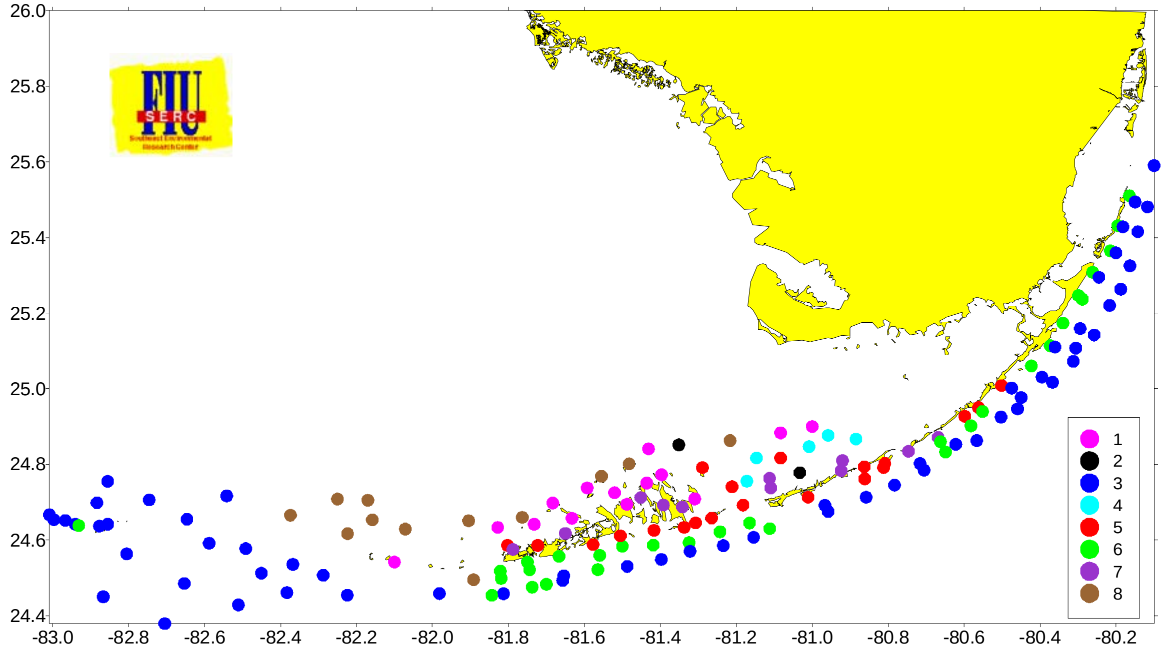

Figure 5. Results of cluster analysis showing station membership in distinct water quality groups (Boyer and Briceño, 2006).

Local scope

At the local scale, the interaction is among water masses moving across Vaca Cut and along shore, ocean waters, runoff, ground waters and seepage from cesspits. Water quality changes with residence time in the canals, which in turn varies according to canal geometry (i.e. straight versus U-shaped), canal seaward extension (i.e. 97th St. canal), bottom topography, accumulation of organic debris (Fig. 6) and tide and wind intensities, among other factors. These organic-rich debris pools, where bacteria thrive, are stirred back and forth during tides and are incorporated in the water column (Fig. 6).

SAMPLING PROGRAM

The sampling program consisted of two phases. Phase I was conducted for 2.5 years prior to the initiation of operation of the central sewage treatment system to establish pre-remediation conditions in the canals within the service area. Phase II is being conducted for two years after initiation of the central sewage treatment system and will document changes in water quality and sediment chemistry of the canals. Four canals within the Little Venice Service Area were selected for sampling (Figure 1). Canal 1 is a "U-shaped" canal system located at 112th Street. This canal receives better tidal flushing than other canals within the Service Area because of the flow-through design and the relatively short length. The 112th St. canal is lined with single-family residences that were constructed prior to 1970. Canal 2 is located adjacent to 100th Street and Canal 3 is located adjacent to 97th Street. Both 100th St. and 97th St. canals are dead-end canals that are lined with single-family houses and mobile homes. Many of these residences had inadequate sewage treatment systems. The 91st Street canal (Canal 4) has been selected as a reference canal and is located outside the Little Venice Service Area.

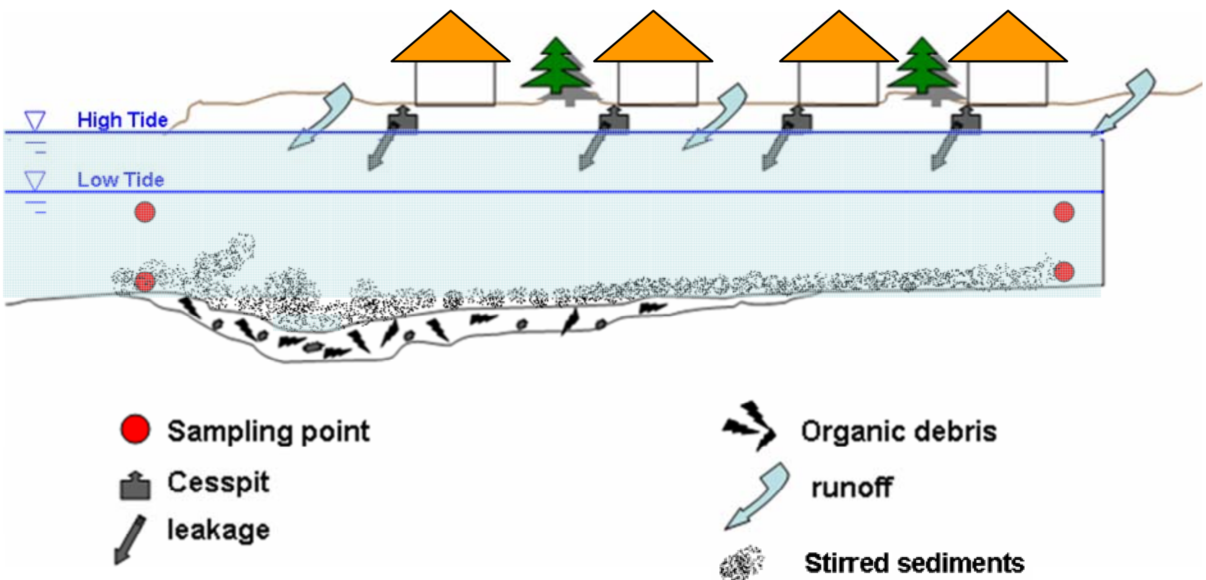

Figure 6. Schematic cross-section of a canal.

Weekly Canal Sampling

Nine sampling stations were chosen for this project: two per canal plus a nearshore site (Fig. 1). Stations were located at the mouth and head of each canal and the nearshore station (Sta. 2) which was located ~100 m offshore the 100th St. canal. Surface and bottom measurements of salinity (practical salinity units), temperature (ºC), and dissolved oxygen (DO, mg l^{-1}) were performed at each station on a weekly basis. Duplicate water samples were collected in mid-channel at 20cm below the surface. Water samples were also collected just below the surface for bacteriological analysis. To ensure that we captured the greatest potential terrestrial inputs, sampling was performed on the lowest low tide whenever possible. For Phase

I, sampling commenced May 23, 2001 and ended Dec. 15, 2003. Phase II sampling began June 14, 2005 and is continuing.

Monthly Diurnal Sampling (ISCO)

Although optimal conditions to capture potential terrestrial inputs occurs during lowest low tide, due to logistical reasons no systematic sampling was performed to exactly match those conditions. To overcome this handicap, each month we deployed two ISCO autosamplers at rotating sites, which were programmed to collect 12 samples per day over a two day period. Hydrolab or YSI datasondes accompanied the ISCO autosamplers and were programmed to measure and log temperature, salinity, DO, and pH on an hourly basis. This resulted in diurnal profiles of physical and chemical variables associated with tidal cycles and precipitation events.

LABORATORY ANALYSIS

Nutrient Analysis.

Water samples were analyzed for total nitrogen (TN), total phosphorus (TP), and chlorophyll *a* (CHLA, $\mu g\ l^{-1}$) by the SERC laboratory using standard methodology outlined in our Quality Assurance Plan. The ISCO water samples were analyzed only for TN and TP. Once a month, grab samples from each site were analyzed for the full suite of nutrients including ammonium (NH_4^+), nitrate + nitrite (NO_x^-), nitrite (NO_2^-), silicate ($Si(OH)_4$), soluble reactive phosphate (SRP), and total organic carbon (TOC). Some parameters were not measured directly, but calculated by difference. Nitrate (NO_3^-) was calculated as NO_x^- - NO_2^-, dissolved inorganic nitrogen (DIN) was calculated as NO_x^- + NH_4^+, and total organic nitrogen (TON) was defined as TN - DIN. All variables are reported in mg l^{-1} unless specified otherwise. The SERC Laboratory is a NELAP certified by the Florida Department of Health.

Bacteriological Analysis

Water samples were collected as above and transported to SYNAGRO for enumeration of fecal coliform (SM 9222D) and *Enterococci* (EPA 1600). All samples were kept at 4 ºC and tested within 6 hours of sampling. The SYANGRO lab is NELAP certified by the Florida Department of Health.

DATA ANALYSIS

Data distributions of water quality variables are reported as box-and-whiskers plots and time series. The box-and-whisker plot is a powerful statistic as it shows the median, range, the data distribution as well as serving as a graphical, nonparametric ANOVA. The center horizontal line of the box is the median of the data, the top and bottom of the box are the 25_{th} and 75_{th} percentiles (quartiles), and the ends of the whiskers are the 5_{th} and 95_{th} percentiles. The notch in the box is the 95% confidence interval of the median. When notches between boxes do not overlap, the medians are considered significantly different. Outliers ($<5_{th}$ and $>95_{th}$ percentiles) were sometimes excluded from the graphs in order to reduce visual compression. Differences in variables were also tested between groups using the nonparametric Mann-Whitney test (comparable to the *t*-test) with significance set at $p<0.05$.

Observations and sampling were performed in the four selected canals and a nearshore site (Station 2) which was located ~100 m offshore the 100^{th} St. canal. The 97^{th} St. canal, together with the nearshore site was selected for comparison purposes. The initial experimental design was conceptually developed as a Before–After Control-Impact Design with multiple sites (BACI; Eberhardt, 1976; Stewart-Oaten et al., 1986). This design allows the application of traditional Before-After methods (BA; Green, 1979; Smith, 2002) where the data are treated as independent samples and are compared using diverse statistics (i.e. two-sample test, F-tests). BACI also allows us to use variations of such methodology (Eberhardt, 1976; Smith, 2002), where differences and ratios of measured parameters, between the control sites and remedied sites are used.

BACI statistical methods test whether differences in before-and-after conditions of the treated canals are different than before-and-after conditions in the control canal. The overall assumption is that significant differences between treatment and control are due to remediation activity, although causal inference is difficult to determine in this highly variable system. To help explain the inherent variability, the influences of several driving factors are explored, among them: precipitation, wind, and tides.

Traditional time-series analysis will be performed on the data sequences once the second year of Phase II is concluded. Additionally, Cumulative Rate of Variation (CRV) and Cumulative Rate of Variation Difference methods (CRVD) will be used for analysis of the times-series. CRV and CRVD are graphical techniques, similar to CumSum time-series analysis, useful for unraveling the structure of time-series (Briceño and Callejon, 2006; submitted to ASLO Methods). This extensive data analysis is presented here in a preliminary fashion as definitive results will have to wait until an additional full year of data is collected and incorporated in the final report.

RESULTS

Bacteriological Analysis

The head of the canals have greater bacterial numbers than the mouth (Fig. 7) as would be expected because of tidal mixing with offshore waters. Figures 8-16 show bacterial counts (colony forming units, CFU) for the canal and reference stations for the complete period of record by month and year. Most stations displayed a similar pattern with maxima centered about July-September and December-January, a persistent minimum in March-May and a more subdued minimum in November. These maxima seem to respond to climatic conditions (rainy season in June-September) and peak visitor period (December-February). On the other hand, the minima may be due to dryer conditions in March-May and October-November which diminish runoff and seepage contributions to the canals.

The FL State standard for single counts of fecal coliforms in Class III-Marine waters is 800 CFU/100ml and the EPA recommended standard for *Enterococci* is 104 CFU/100ml. Considering all sites, prior to remediation 5 out of 1152 observations of fecal coliforms counts (0.43%) exceeded the FL State standard and 60 *Enterococci* counts (5.2%) exceeded the recommended EPA level (Table 1). One year of post remediation observations (503) indicate that fecal coliforms surpassed the standard 5 times (0.99%) while *Enterococci* counts exceeded the recommended level only 16 times (3.18%), but these changes were not statistically significant between Phases. Comparable results are obtained for the remedied canals as a separated group and even for the 91st St. Canal alone (Sta. 8 and 9) as shown in Table 1.

The overall changes are not evident when only percent exceedances or means and median values for FC and EC are compared for pre- and post-remediation, perhaps due to the non-normal distribution of FC and EC samples. The perspective is rather different when the whole data set is tested with Mann-Whitney non-parametric test, which indicates that FC in the whole data set decreased significantly after remediation ($p<0.0001$). Furthermore, FC counts at all canal heads and at the mouth of Canal 112th St.. (Sta. 1) also experienced significant decreases ($p<0.05$). Changes for EC are non-significant, except for a slight but significant increase at the offshore site (Sta. 2, $p=0.003$).

	BEFORE		AFTER	
All Sites	FC	EC	FC	EC
Events	1152	1152	503	503
Exceedances	5	60	5	16
% Exceedances	**0.43**	**5.21**	**0.99**	**3.18**
All Canals	FC	EC	FC	EC
Events	1024	1024	449	449
Exceedances	5	60	5	16
% Exceedances	**0.49**	**5.86**	**1.11**	**3.56**
Remedied Canals	FC	EC	FC	EC
Events	768	768	337	337
Exceedances	4	44	4	13
% Exceedances	**0.52**	**5.73**	**1.19**	**3.86**
91st St Canal	FC	EC	FC	EC
Events	256	256	112	112
Exceedances	1	16	1	3
% Exceedances	**0.39**	**6.25**	**0.89**	**2.68**

Table 1. BACI comparison of FC and EC exceedances in Little Venice area for All Sites, All Canals (excluding Station 2), Remedied Canals (excluding 97th St. Canal), and 91th St. control Canal. These exceedances changes from Phase I to Phase II are not statistically significant at the $p<0.05$ level (Mann-Whitney non-parametric test).

The general assumption that traditional fecal indicators do not occur in natural environments (soil or water) and are only supplied from fecal material has been suggested to be erroneous (Byappanahalli 2000; Fujioka 1999; Hardina and Fujioka 1991; Solo-Gabriele et al. 2000). These bacteria occur in soils and riparian sediments and perhaps as epiphytic microflora on terrestrial plants. Furthermore, residual bacteria survive for months in dried algae and readily grow upon rehydration. Therefore, immediate remediation results for fecal coliforms and *Enterococci* may be masked by their regrowth in organic-rich (nutrient-rich) debris on the canal bottom (Fig. 6) or supplied by alternative sources as runoff, especially from storm action.

If we take into consideration that year 2005 was a record-breaking hurricane year and that the storms affected coastal water quality by increasing nutrient and bacteria-rich runoff contribution (Solo-Gabrielle et al., 2000), the non-significant changes in bacterial exceedances in Little Venice waters may in fact indicate an improvement in water quality. Monitoring data from 2006, a rather storm-free year, will eventually shed some light on this issue.

Nutrient Analysis

Results for nutrient analysis are presented as Box-and-Whisker plot in Figures 17 to 36 and as time-series in Appendix 1. NO_x^- pattern (Fig. 17) is driven primarily by NO_3^- concentration (Fig. 18) and both show anomalously high values in September and December 2005, perhaps as a consequence of hurricanes Katrina (August 2005) and Wilma (October 2005). Both NO_2^- (Fig. 19) and NH_4^+ (Fig. 20) behave similarly showing higher concentrations from June to December, perhaps controlled by the rainy season. High values for NO_3^- and NH_4^+ in August and September 2005 may be due to disturbances caused by hurricane Katrina.

TN (Fig. 21) and TON (Fig. 23) have consistently decreased from Phase I to Phase II. However, such a decrease was observed in all sampling sites, including the offshore site (Sta. 2). Furthermore, this sustained decreasing trend has been observed in Little Venice since 2003 as shown in Figure 37. When considering TN time-series at each station (Fig. 38.) a common baseline is observed on which local variations are superimposed; this also supports the hypothesis of regional control on TN concentrations.

Opposite to TN, TP values were higher for Phase II (Fig. 24), and a long-term increasing trend was observed in all stations (Fig. 39). This behavior may indicate that TN and TP values are affected by regional phenomena rather than being the unique result of local variations within Little Venice. These variables exhibited statistically significant differences ($p<0.0001$) between pre- and post-remediation when analyzed with non-parametric Mann-Whitney tests (Table 2 and Appendix 2). To corroborate the existence of these regional trends similar Mann-Whitney tests were performed on the whole Florida Keys National Marine Sanctuary (FKNMS) database, confirming the TN decrease and TP increase in the region ($p<0.0001$).

There are no nutrient standards for Florida marine waters. However, State of Florida Rule 62-02.300(13), F.A.C. states that “particular consideration shall be given to the protection from nutrient enrichment of those presently containing very low nutrient concentrations: less than 0.3 milligrams per liter total nitrogen or less than 0.04 milligrams per liter total phosphorus.” Prior to remediation (Table 3), out of 1205 TN determinations, 657 (54.5%) exceeded the 0.3 mg l^{-1} benchmark; and out of 1205 TP determinations 18 (1.5%) exceeded the 0.04 mg l^{-1} threshold. For Phase II, out of 421 TN determinations, 115 (27.3%) exceeded the 0.3 mg l^{-1} benchmark. For TP, out of 421 determinations, 11 (2.6%) exceeded the 0.04 mg l^{-1}

threshold. Decreases in TN exceedances are statistically significant for all stations, either as a group or individually (Table2). TP changes in exceedances are not statistically significant.

		SIGNIFICANT DECREASE				SIGNIFICANT INCREASE			
Station	Site	TN	TON	TN-EX	TN:TP	TP	CHLA	SAL-S	SAL-B
Station 1	112 St mouth	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Station 2	100 St offshore	<0.0001	0.0049	0.0394	<0.0001	<0.0001	<0.0001	<0.0001	
Station 3	112 St head	<0.0001		0.0031	<0.0001	0.0187	<0.0001	<0.0001	<0.0001
Station 4	100 St mouth	<0.0001	0.014	0.0235	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Station 5	100 St head	<0.0001		0.0036	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Station 6	97 St mouth	<0.0001	0.0384	0.0270	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Station 7	97 St head	0.0003		0.0039	<0.0001	0.0002	0.0066	<0.0001	<0.0001
Station 8	91 St mouth	<0.0001	0.0011	0.0002	<0.0001	0.0002	0.0007	<0.0001	<0.0001
Station 9	91 St head	0.0006	0.0261	0.0009	<0.0001	0.0028	0.0399	<0.0001	<0.0001
All Stations		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Table 2. Level of significance from Mann-Whitney tests, for changes in Little Venice water quality from Phase I to Phase II. (TN= Total Nitrogen; TON= Total Organic Nitrogen; TN-EX= TN exceedances above 0.3 mg l^{-1}; TN:TP= ratio)

Soluble reactive phosphorous (SRP) showed seasonal variations and ample dispersion of values in August, September and December 2005 (Fig. 25), perhaps as a result of storms. Chlorophyll *a* (CHLA) concentrations were significantly higher ($p<0.0001$) during Phase II (Table 2). There seems to be an increasing concentration gradient from East to West with the highest values in the control canal (91st St.. canal; Fig. 40). During Phase I, 26 out of 1196 observations showed CHLA values above 11 ug l^{-1} (2.2%); for Phase II, 22 out 440 observations exceeded the 11 ug l^{-1} level (5.0%). These exceedances were restricted to the heads of 100th St., 97th St. and 91st St. canals and the mouth of 100th St. canal. There are no statistically significant differences between exceedances in Phase I and those in Phase II.

TOC is rather constant, notably for the period January-May, and displays similar values for pre- and post-remediation stages (Fig. 27). There was an increase in variance from June and extreme values especially on August 30, 2005, five days after Hurricane Katrina made landfall in South Florida and moved over Florida Bay. Silica showed a maximum centered about August with largest variability from June to November, perhaps caused by storms (Fig. 28). This was more evident in August 2005, after Hurricane Katrina, but there are also high concentrations in December 2005.

Surface and bottom salinity (Sal-S and Sal-B) have very similar distribution throughout the year (Fig.s 29 and 30) with a minimum centered about January and higher values around June. There was a significant increase in salinity in the post-remediation stage together with anomalously high values in August 2005, perhaps due to influx of Central Florida Bay waters driven by Hurricane Katrina. The lowest salinities occurred at the head of 97th St. canal (Sta. 7).

Surface DO data (Fig. 31) show similar patterns for pre- and post-remediation stages, except that location of maxima and minima are offset. Phase I maximum occurs in November while for Phase II there is a principal maximum in January and another one, not so prominent in November. Phase I minimum is centered in June-August while Phase II minimum is in July. Bottom DO (DO-B) trends (Fig. 32) resemble those of surface DO. Temperature for surface and bottom waters showed the same seasonal pattern, with a minimum in January and a maximum in August. This was perhaps one of the most important parameters controlling DO concentrations.

State of Florida Rule 62-302.530, for Class III marine waters, specifies that DO "shall never be less than 4.0" mg l^{-1}. Prior to remediation (Table 4), out of 1162 determinations for surficial DO, 667 (57.4%) exceeded the 4.0 mg l^{-1} benchmark; and out of 1084 determinations for bottom DO, 727 (67.1%) exceeded the 4.0 mg l^{-1} threshold. For Phase II, out of 412 determinations for surficial DO, 255 (61.9%) exceeded the 4.0 mg l^{-1} benchmark; and out of 394 determinations for bottom DO, 292 (74.1%) exceeded the 4.0 mg l^{-1} threshold. DO-B exceedances are statistically significant (p=0.0381).

	BEFORE				AFTER			
Station 1 - 112th St Canal Mouth	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	128	128	135	135	126	126	131	131
# exceedances	68	84	60	0	79	100	66	5
% exceedances	53	66	44	0	63	79	50	4
Station 2 - Offshore 110th St Canal	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	130	55	135	135	126	104	131	131
# exceedances	26	12	52	0	70	93	62	5
% exceedances	20	22	39	0	56	89	47	4
Station 3 - 112th St Canal Head	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	130	128	135	135	126	126	131	131
# exceedances	77	89	77	10	88	101	66	8
% exceedances	59	70	57	7	70	80	50	6
Station 4 - 110th St Canal Mouth	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	130	130	135	135	126	126	131	131
# exceedances	72	87	64	0	87	99	66	5
% exceedances	55	67	47	0	69	79	50	4
Station 5 - 110th St Canal Head	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	130	130	135	135	126	126	131	131
# exceedances	94	108	81	0	88	102	70	8
% exceedances	72	83	60	0	70	81	53	6
Station 6 - 91 St Canal Mouth	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	131	130	135	135	126	126	131	131
# exceedances	78	72	69	0	92	97	70	5
% exceedances	60	55	51	0	73	77	53	4
Station 7 - 91st St Canal Head	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	131	131	135	135	126	126	131	131
# exceedances	103	114	95	0	97	107	77	11
% exceedances	79	87	70	0	77	85	59	8
Station 8 - 97th St Canal Mouth	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	131	131	134	134	126	126	131	131
# exceedances	72	59	75	0	87	97	64	6
% exceedances	55	45	56	0	69	77	49	5
Station 9 - 97th St Canal Head	**DO-S**	**DO-B**	**TN**	**TP**	**DO-S**	**DO-B**	**TN**	**TP**
Totals	131	130	135	135	126	126	131	131
# exceedances	85	109	86	8	87	108	68	13
% exceedances	65	84	64	6	69	86	52	10

Table 3. Exceedances for DO, TN and TP before and after remediation for individual stations.

		DO-S	DO-B	TN	TP	CHLA
PHASE I	Sampling Events	1162	1084	1205	1205	1196
	Exceedances	667	727	657	18	26
	% Exceedances	**57.4%**	**67.1%**	**54.5%**	**1.5%**	**2.2%**
PHASE II	Sampling Events	412	394	421	421	440
	Exceedances	255	292	115	11	22
	% Exceedances	**61.9%**	**74.1%**	**27.3%**	**2.6%**	**5.0%**

Table 4. Exceedances for the overall Little Venice area. Dissolved Oxygen in surface and bottom waters (DO-S and DO-B respectively), Total Nitrogen (TN), Total Phosphorous (TP), and chlorophyll *a* (CHLA)

Monthly Diurnal Sampling

Each month two ISCO autosamplers were deployed at rotating sites to explore diurnal variability in TN and TP by collecting 12 samples per day over a two day period. Additionally, Hydrolab or YSI datasondes accompanied the ISCO autosamplers and were programmed to measure and log temperature, salinity, DO, and pH on an hourly basis. This resulted in diurnal profiles of physical and chemical variables useful for exploring relationships with tidal cycles and climatic events. Figure 41 shows the relationships between depths (proportional to tidal plus wind intensity changes), temperature, DO and salinity for a selected YSI run at ISCO Sta. 11 (mouth of 100^{th} St. Canal). As expected, tidal cycles are very regular and their frequency doubles that of temperature, DO, and salinity cycles. DO variations are highly correlated with temperature changes ($r = 0.867$; $p<0.0001$) driven by daily sunlight cycles; salinity was also significantly correlated with temperature ($r=0.508$; $p<0.0001$), although there was a better correlation with a combination of temperature and depth (multiple linear correlation $r=0.623$; $p<0.0001$). DO values increased steeply during morning hours and decay slowly during the night as a function of biological cycles of productivity in the water mass. These results (Fig. 41) clearly document the diurnal variability of the monitoring parameters and emphasize the impact of sample collection schedule within these cycles on the magnitude of measurements used for monitoring. Results for all ISCO runs are presented in Appendix 3

Theoretically, low DO concentrations, high TN and TP values, and low salinities would indicate poor water quality conditions, perhaps induced by anthropogenic sources. From the combination of all available ISCO analytical results and YSI data, we calculated the frequency of events when optimum conditions to detect such potential man-derived influences (maximum TP and TN; minimum DO and salinity) were matched. It was performed for each sampling time and station. Results in Figure 42 indicate that morning hours render the highest probabilities. Using this information we note that, 97% of the time, our weekly grab sampling was performed during these optimum morning hours. Additionally, we have calculated the overall efficiency of ISCO Stations for rendering results matching optimum sampling conditions (Fig. 43). Results indicate that Station 10 (mouth of 112th St. Canal) is the most efficient. Nevertheless, from experience in the overall region, water quality variables change frequently and even reverse, so long-trend monitoring is the surest way towards understanding of the behavior of these coastal ecosystems.

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FIGURES

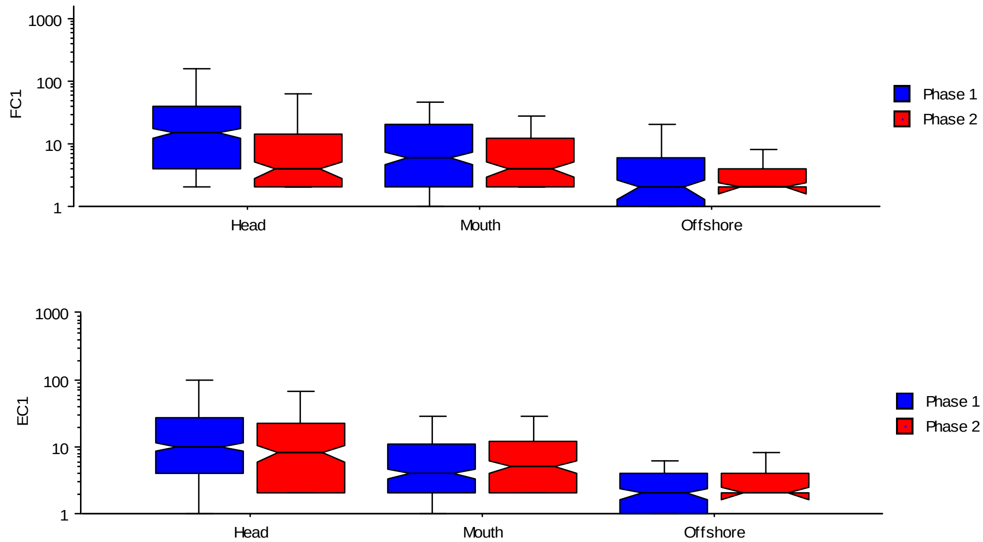


Figure 7. Distribution of FC and EC counts in the canals and offshore

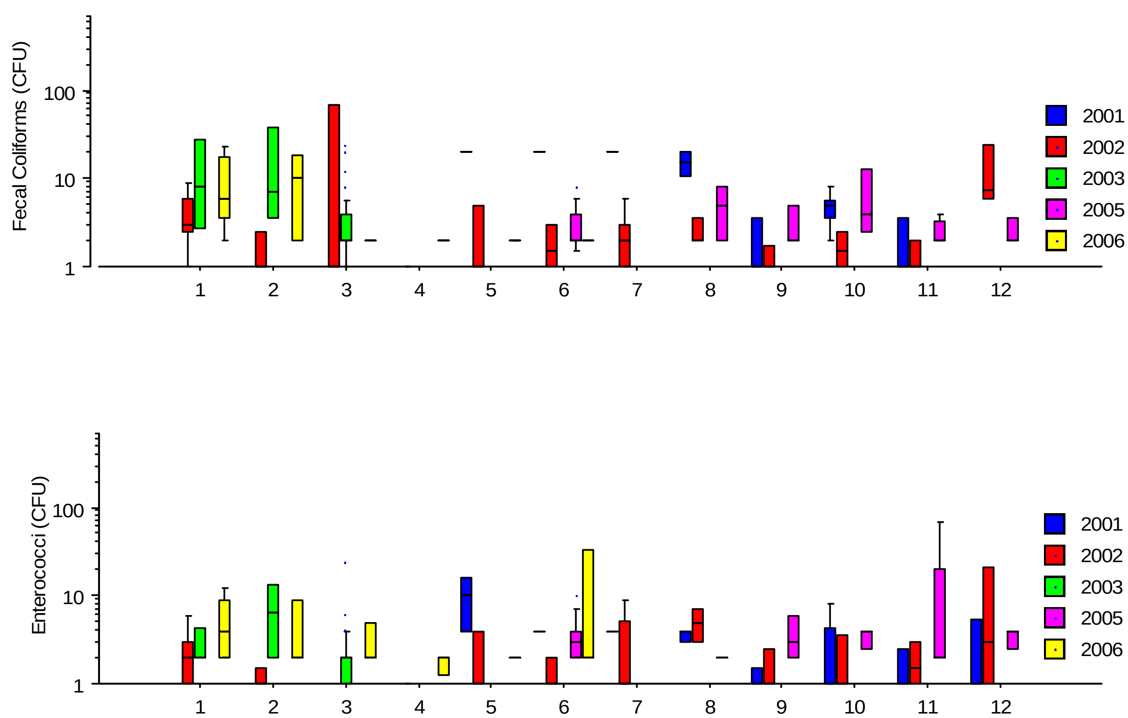


Figure 8. Station 2 – Nearshore of the 100th Street Canal. This is the offshore reference station

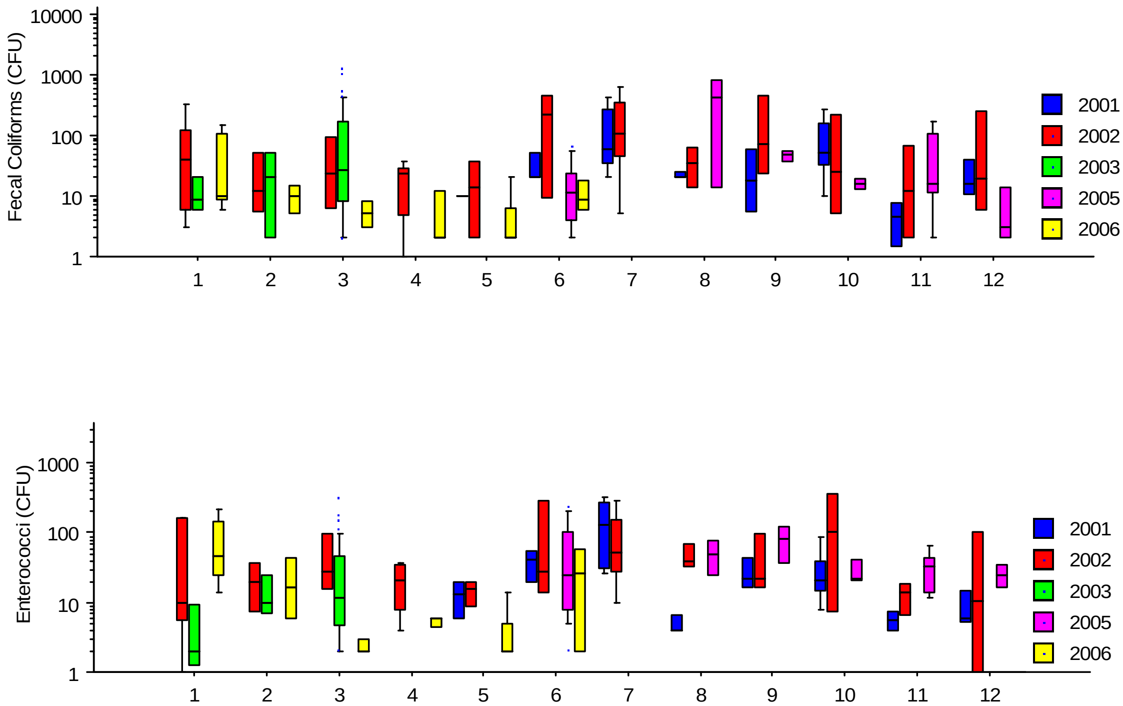


Figure 9. Station 1 Mouth of 112th Street Canal

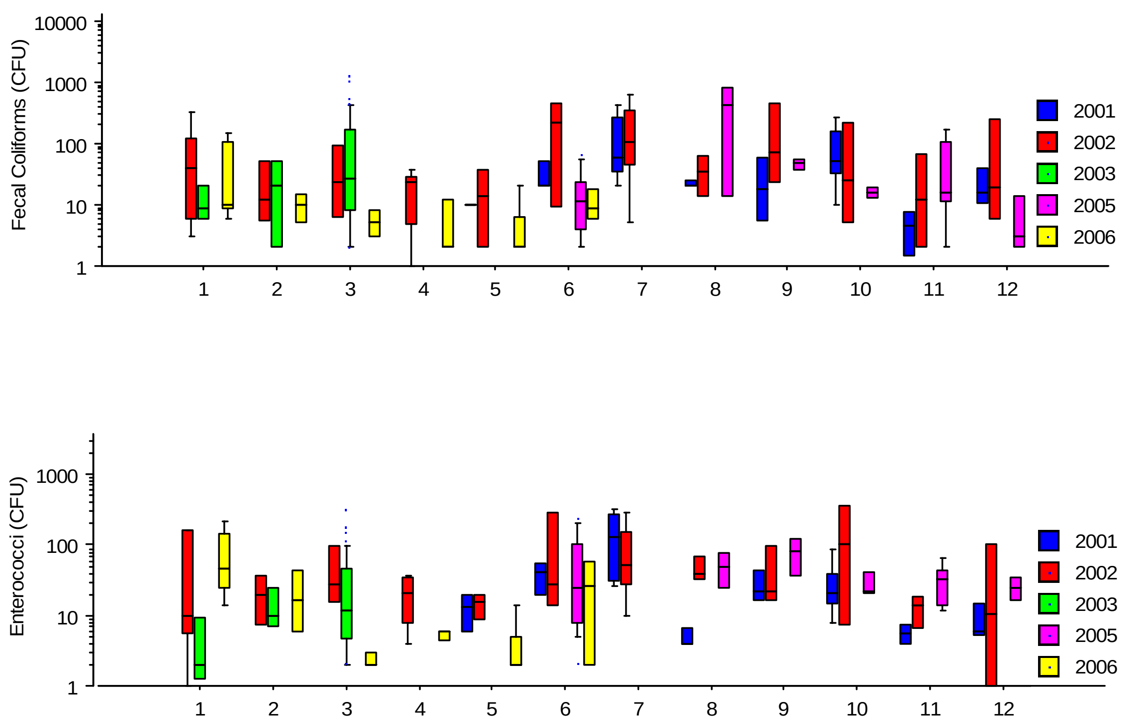


Figure 10. Station 3 – Head of the 112th Street Canal

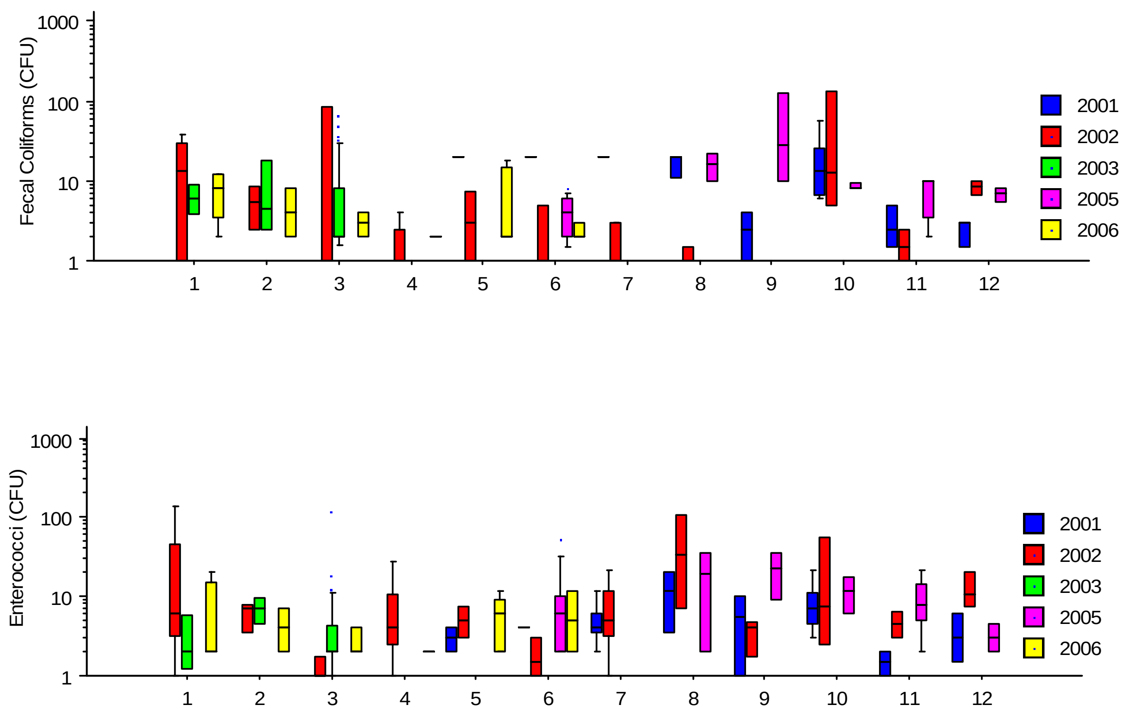


Figure 11. Station 4 – Mouth of the 100th Street Canal

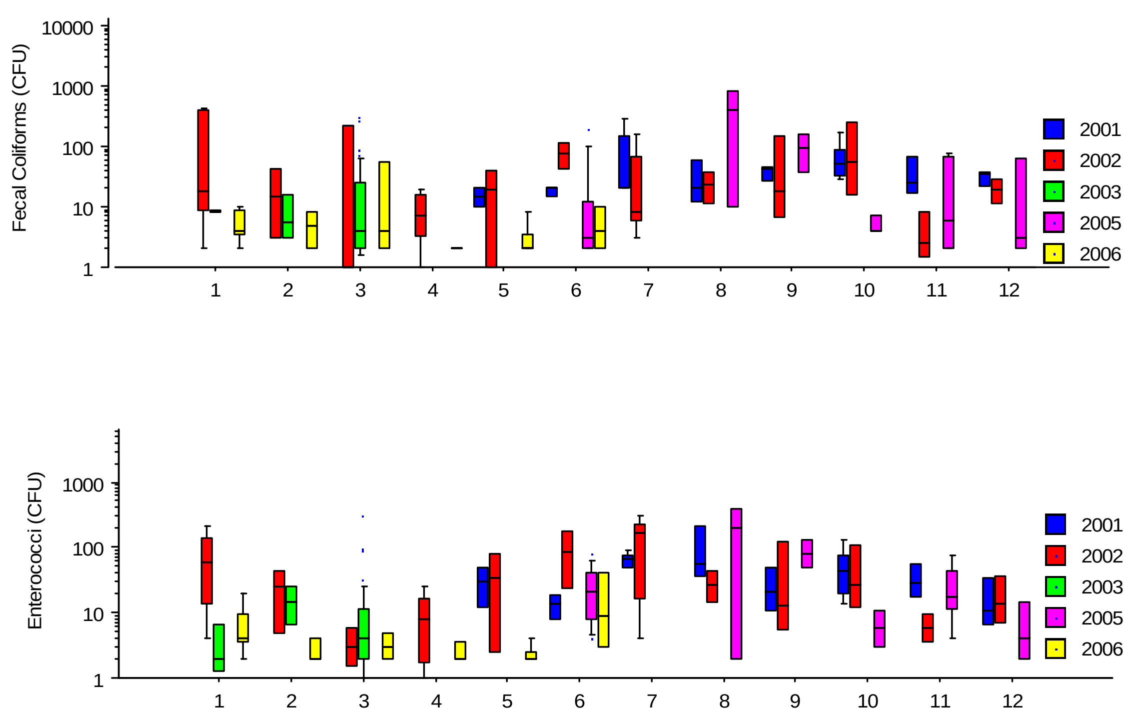


Figure 12. Station 5 – Head of the 100th Street Canal

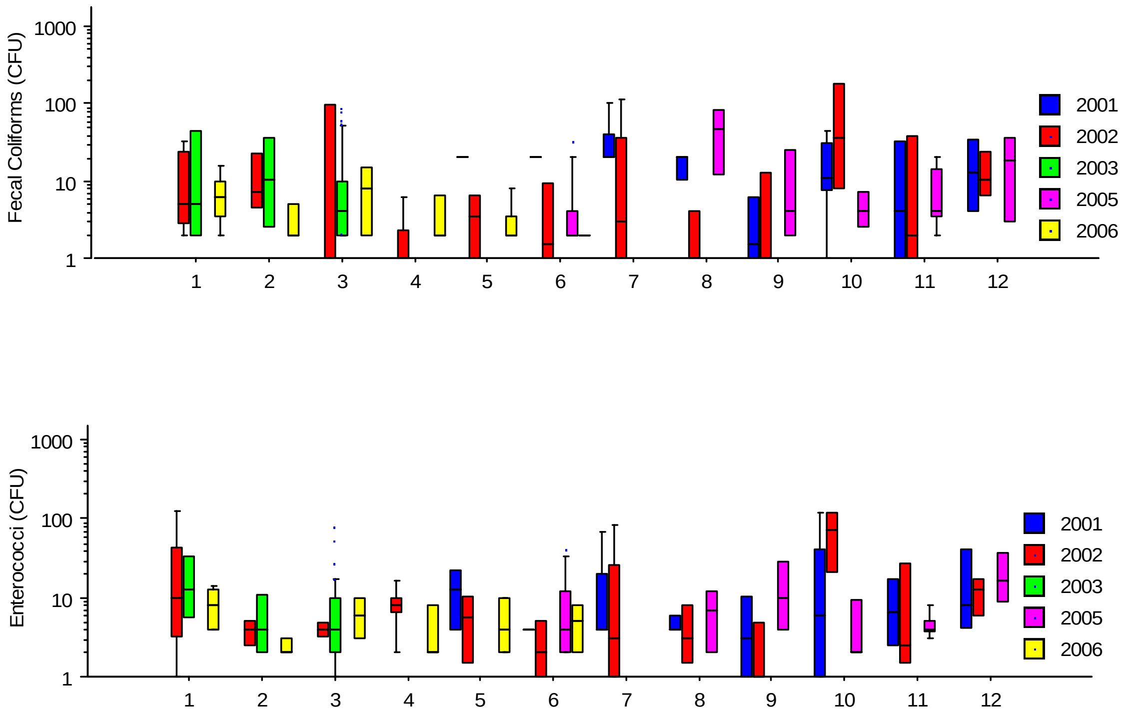


Figure 13. Station 6 – Mouth of the 97th Street Canal

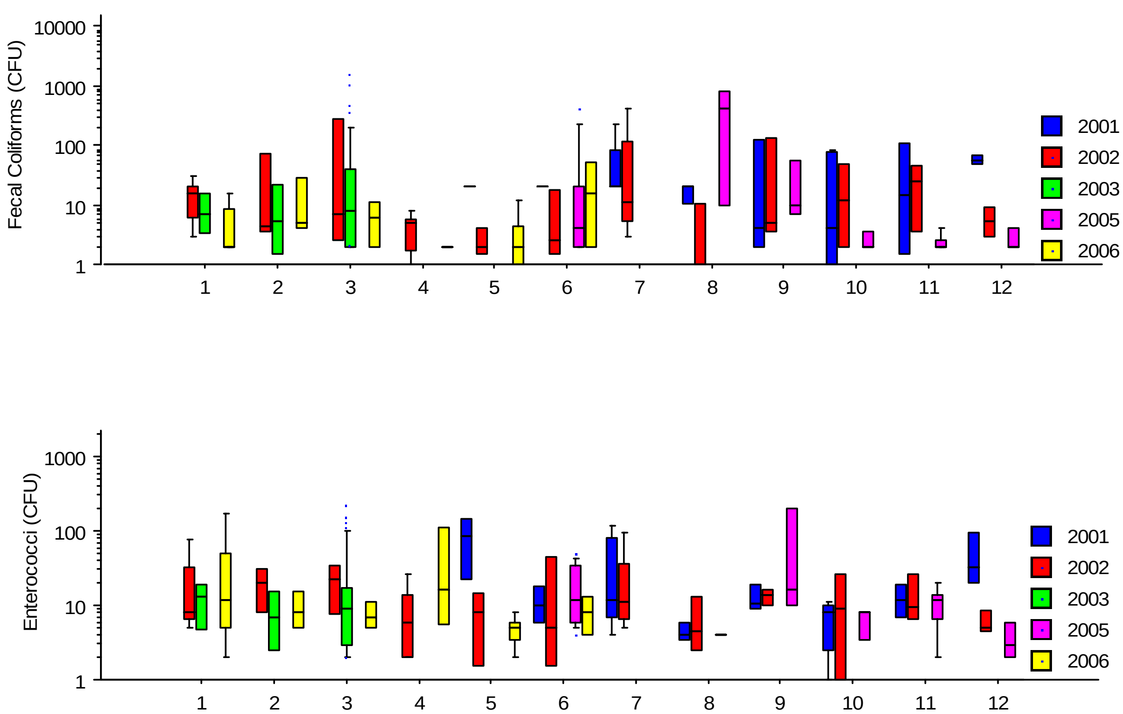


Figure 14. Station 7 – Head of the 97th Street Canal

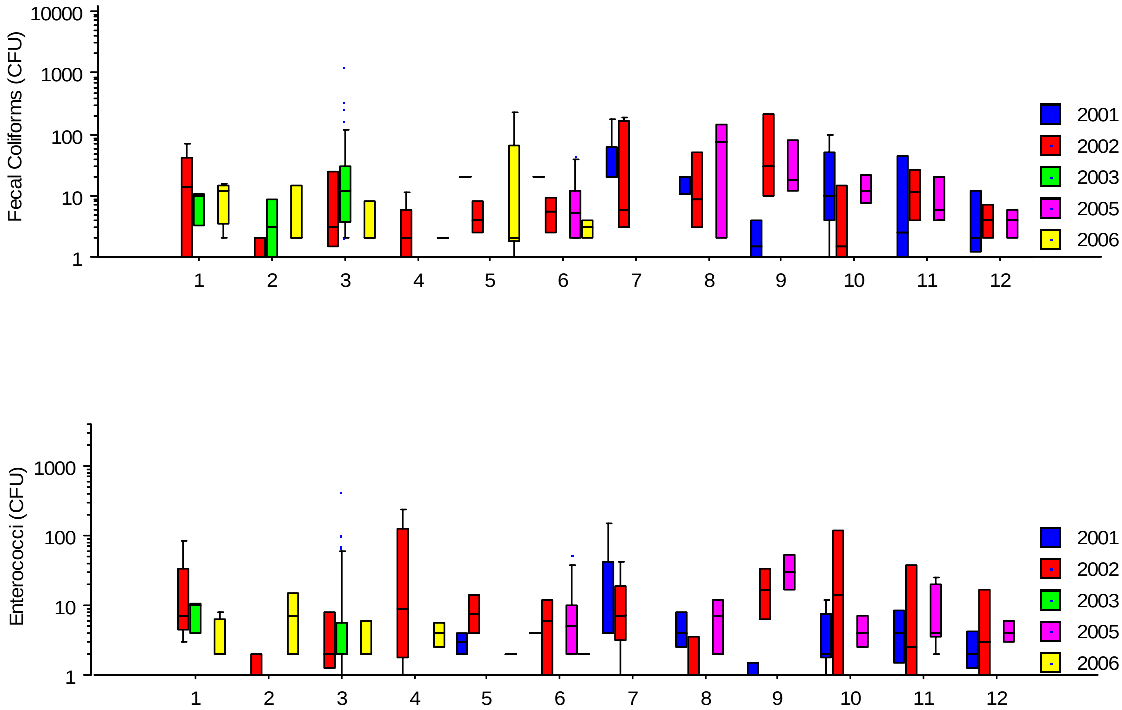


Figure 15. Station 8 – Mouth of the 91st Street Canal

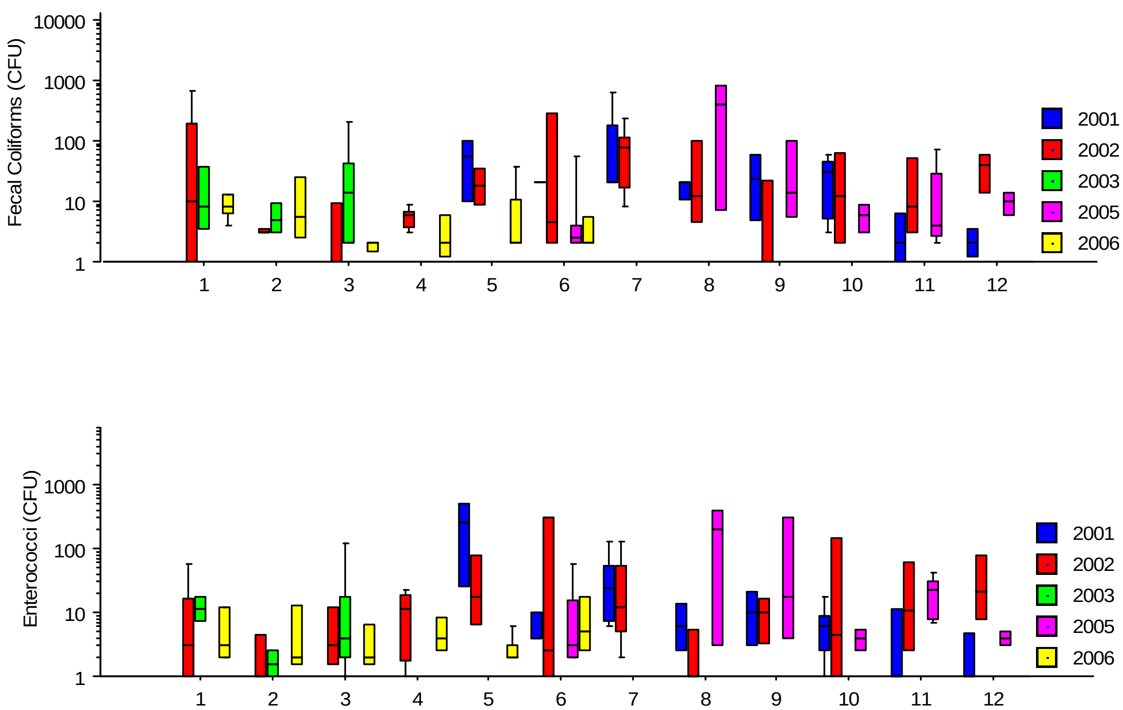


Figure 16. Station 9 – Head of the 91st Street Canal

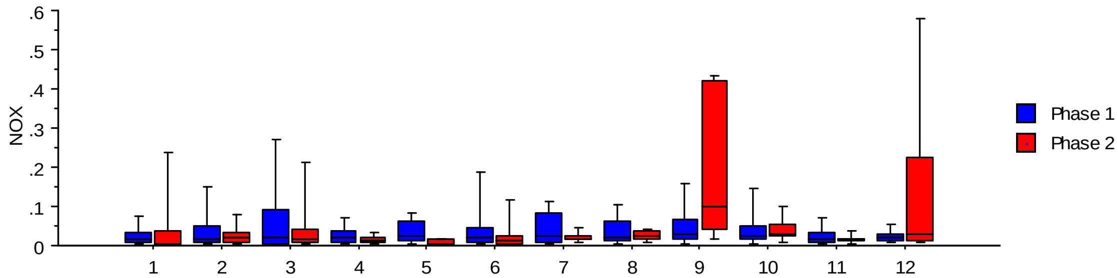


Figure 17. Box-and-whisker plot of NOx for all sites, grouped by month and phase

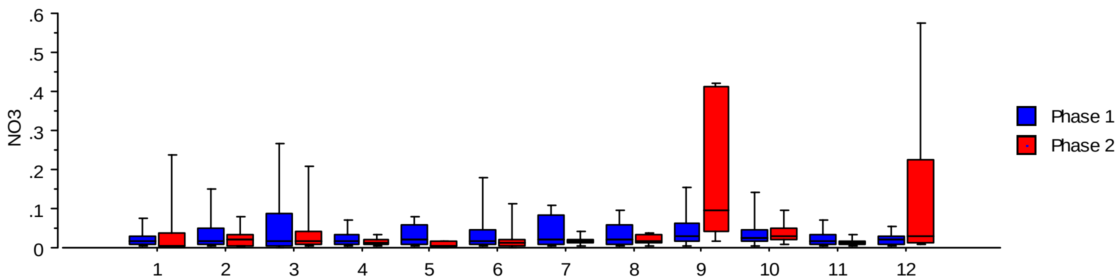


Figure 18. Box-and-whisker plot of NO_3 for all sites, grouped by month and phase

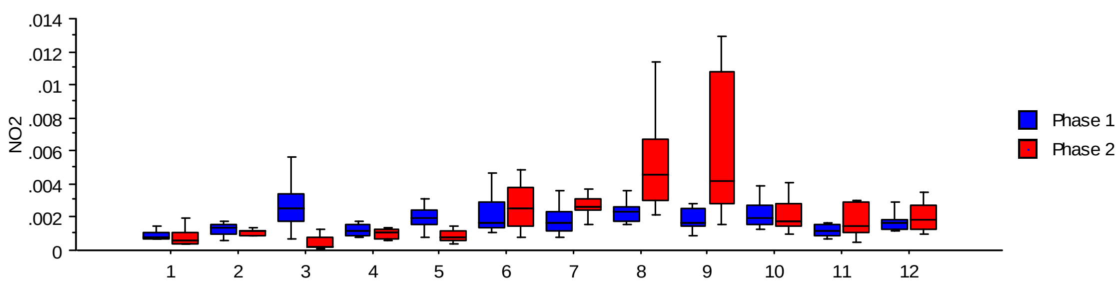


Figure 19. Box-and-whisker plot of NO_2 for all sites, grouped by month and phase

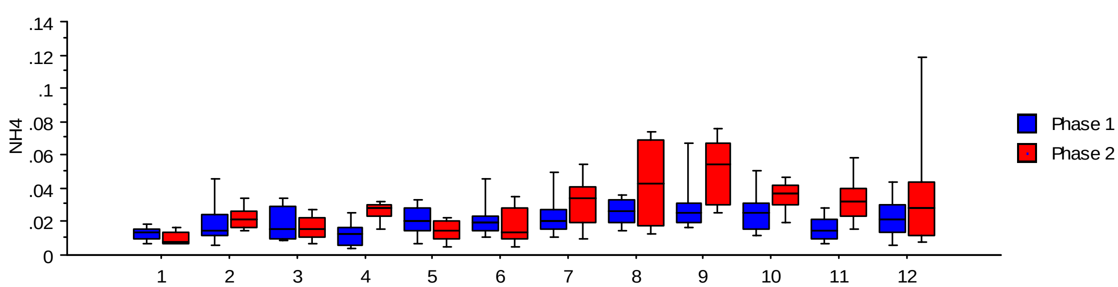


Figure 20. Box-and-whisker plot of NH_4 for all sites, grouped by month and phase

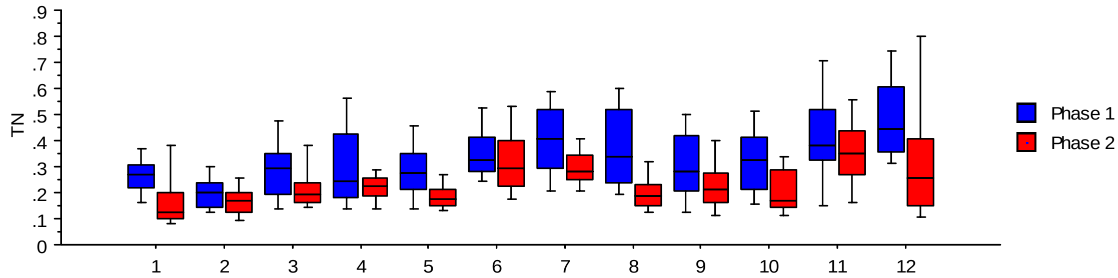


Figure 21. Box-and-whisker plot of TN for all sites, grouped by month and phase

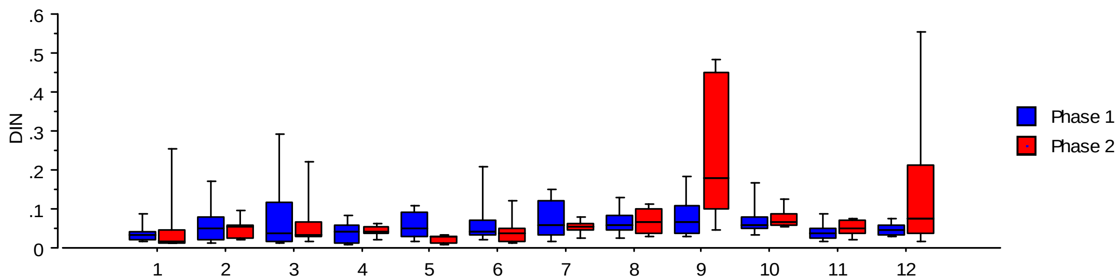


Figure 22. Box-and-whisker plot of DIN for all sites, grouped by month and phase

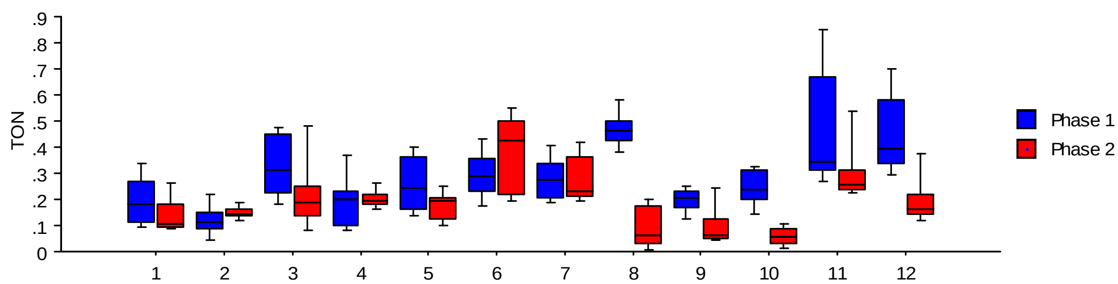


Figure 23. Box-and-whisker plot of TON for all sites, grouped by month and phase

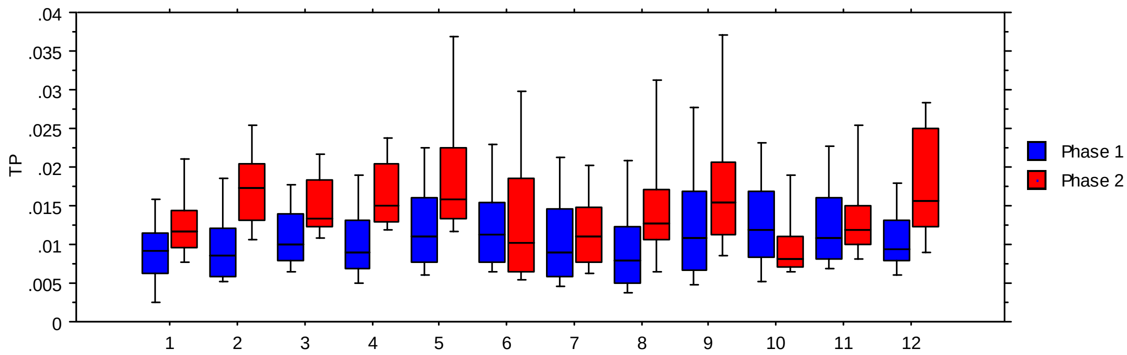


Figure 24. Box-and-whisker plot of TP for all sites, grouped by month and phase

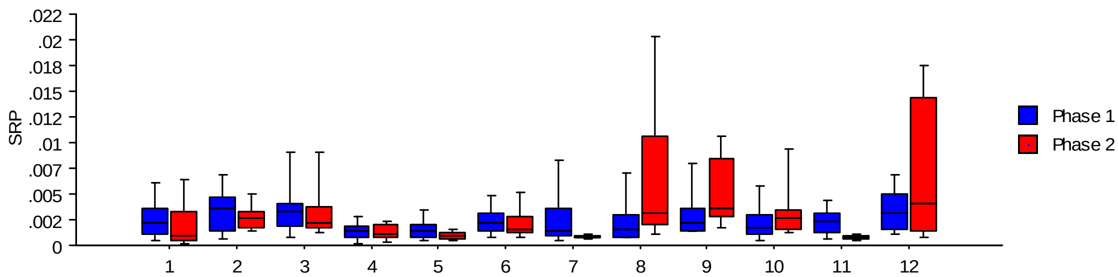


Figure 25. Box-and-whisker plot of SRP for all sites, grouped by month and phase

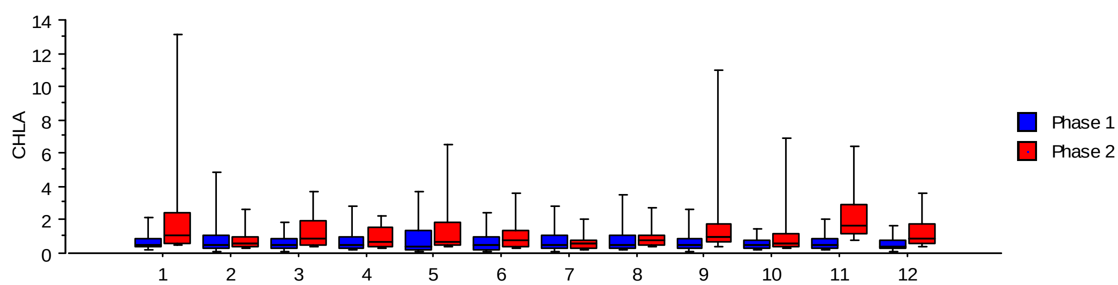


Figure 26. Box-and-whisker plot of CHL-a for all sites, grouped by month and phase

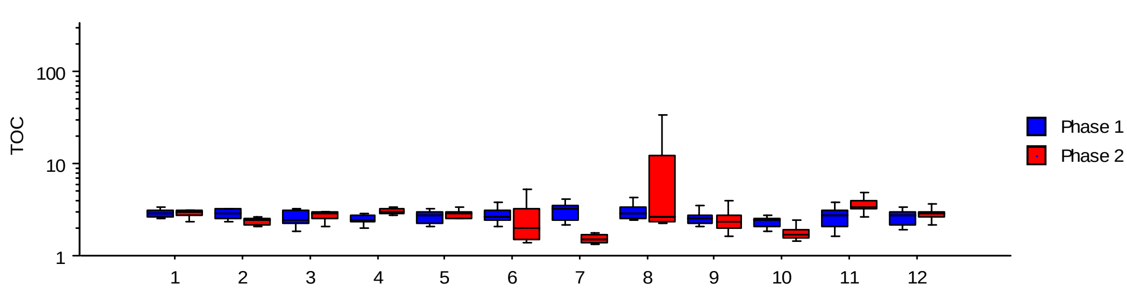


Figure 27. Box-and-whisker plot of TOC for all sites, grouped by month and phase

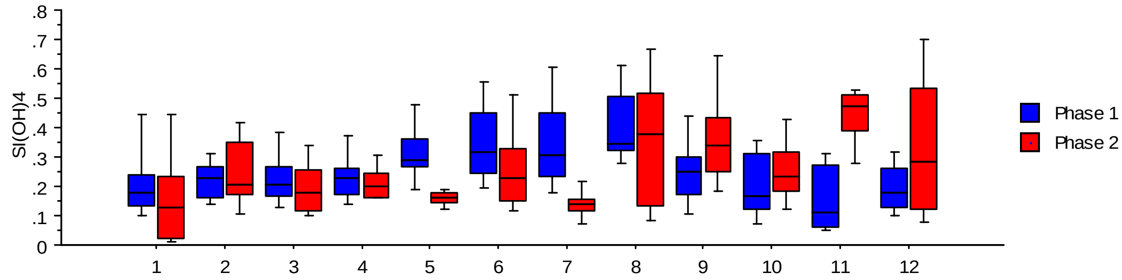


Figure 28. Box-and-whisker plot of $Si(OH)_4$ for all sites, grouped by month and phase

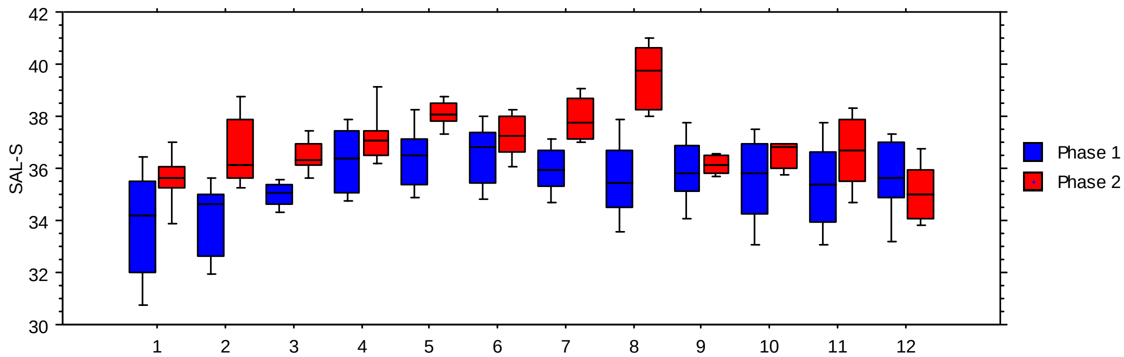


Figure 29. Box-and-whisker plot of surface salinity for all sites, grouped by station and year

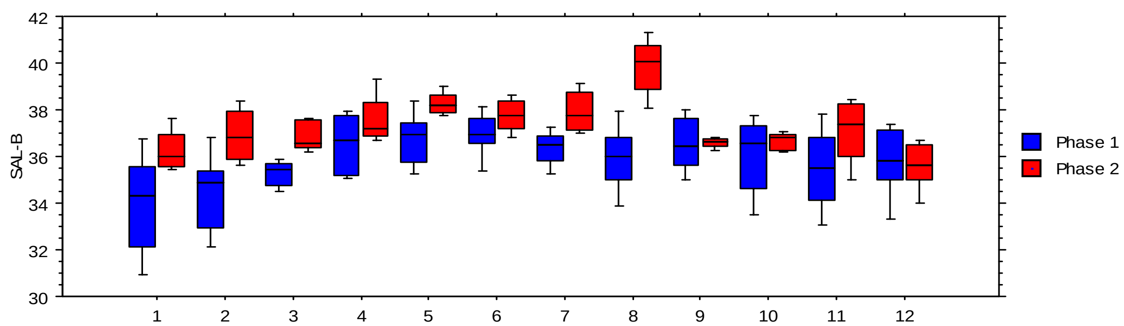


Figure 30. Box-and-whisker plot of bottom salinity for all sites, grouped by station and year

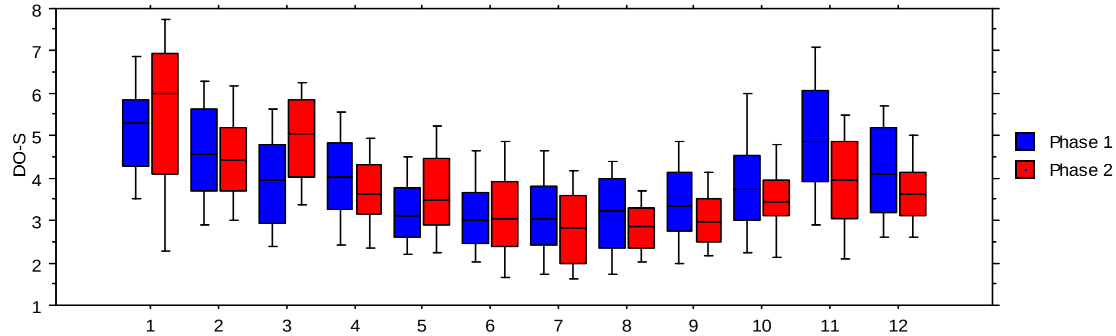


Figure 31. Box-and-whisker plot of surface DO for all sites, grouped by station and year

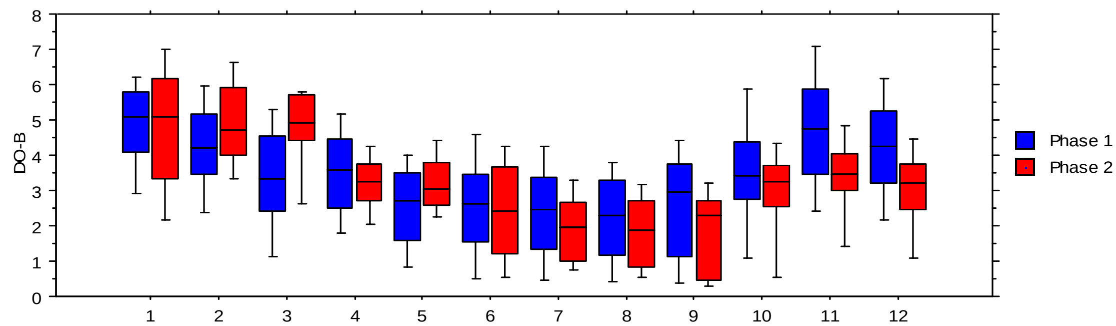


Figure 32. Box-and-whisker plot of bottom DO for all sites, grouped by station and year

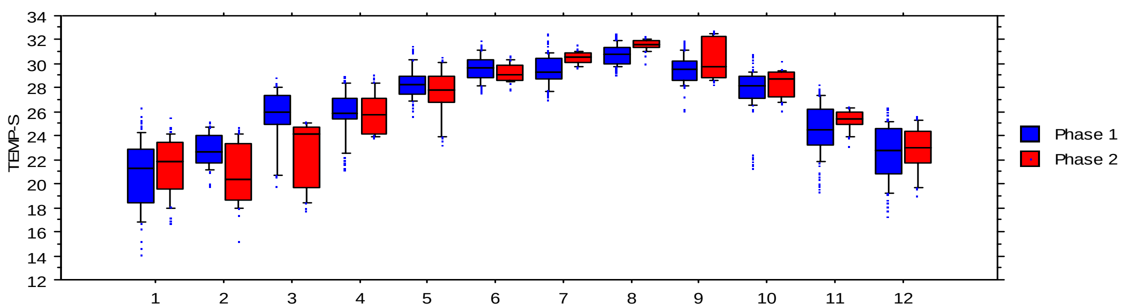


Figure 33. Box-and-whisker plot of surface temperature for all sites, grouped by station and year

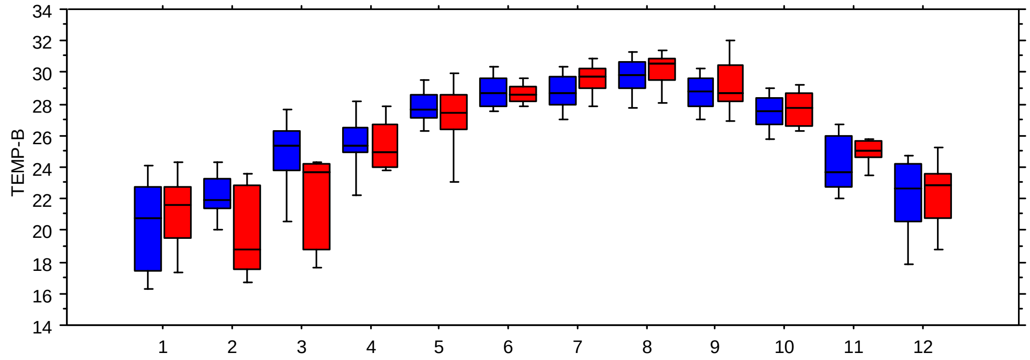


Figure 34. Box-and-whisker plot of surface temperature for all sites, grouped by station and year

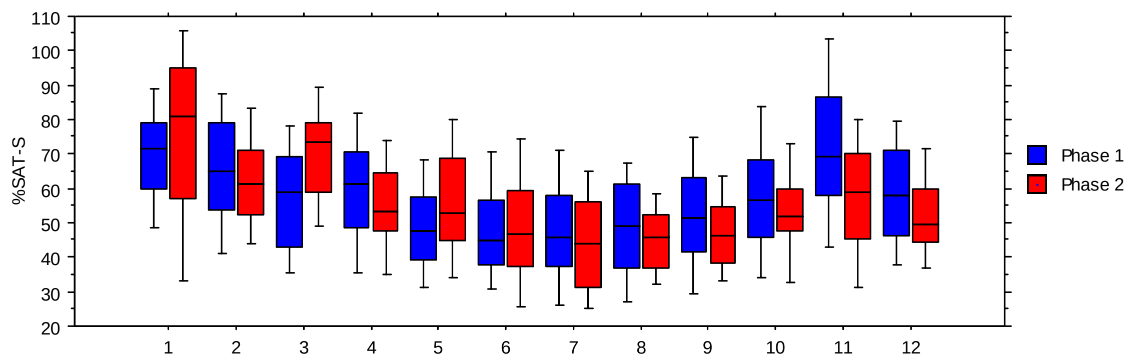


Figure 35. Box-and-whisker plot of % DO saturation in surface waters for all sites, grouped by station and year

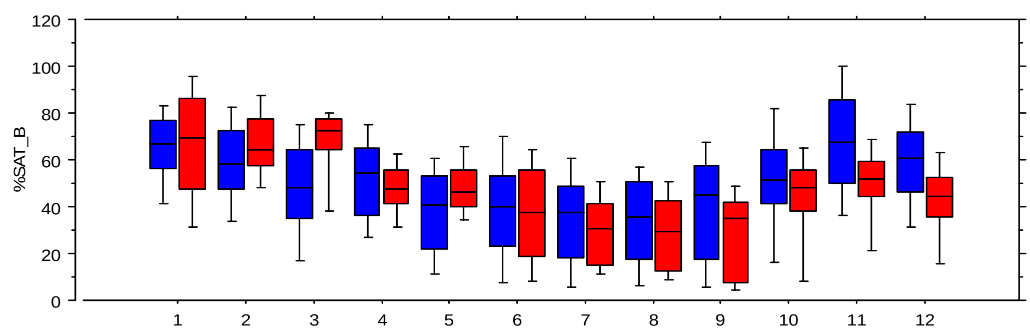


Figure 36. Box-and-whisker plot of % DO saturation in bottom waters for all sites, grouped by station and year.

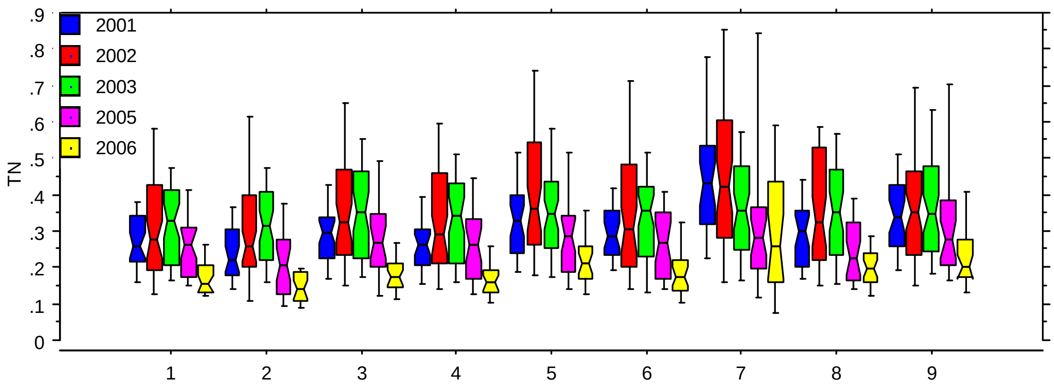


Figure 37. Box-and-whisker plot of TN for all sites, grouped by station and year

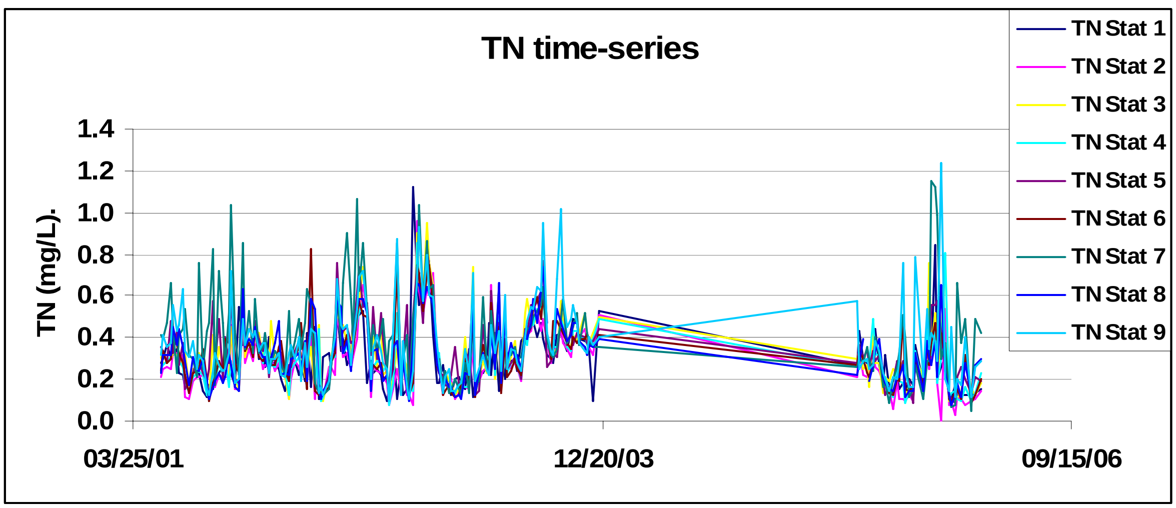


Figure 38. Time-series for TN for each Station. Notice the development of a common baseline.

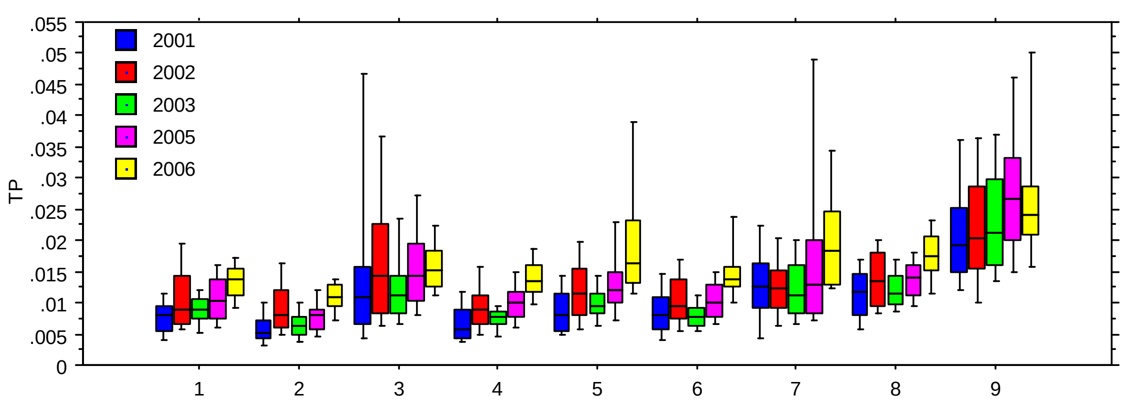


Figure 39. Box-and-whisker plot of TP for all sites, grouped by station and year

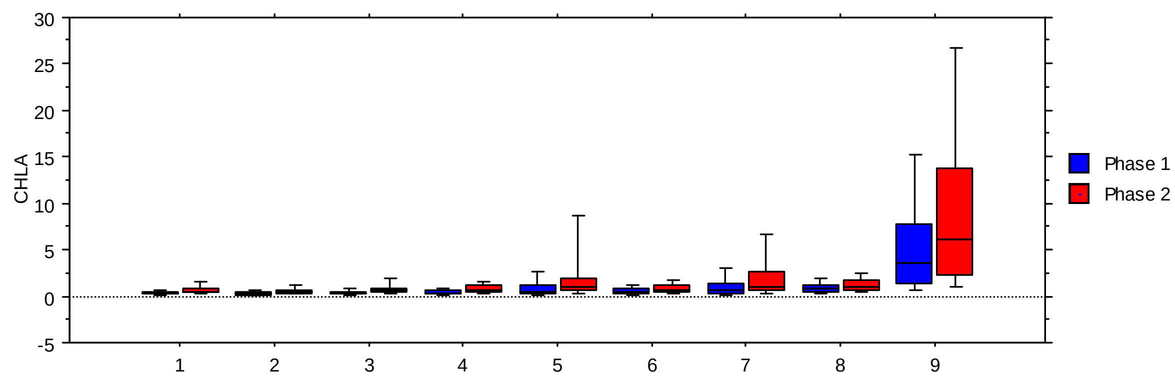


Figure 40. Box-and-whisker plot of Chlorophyll-a grouped by station and year

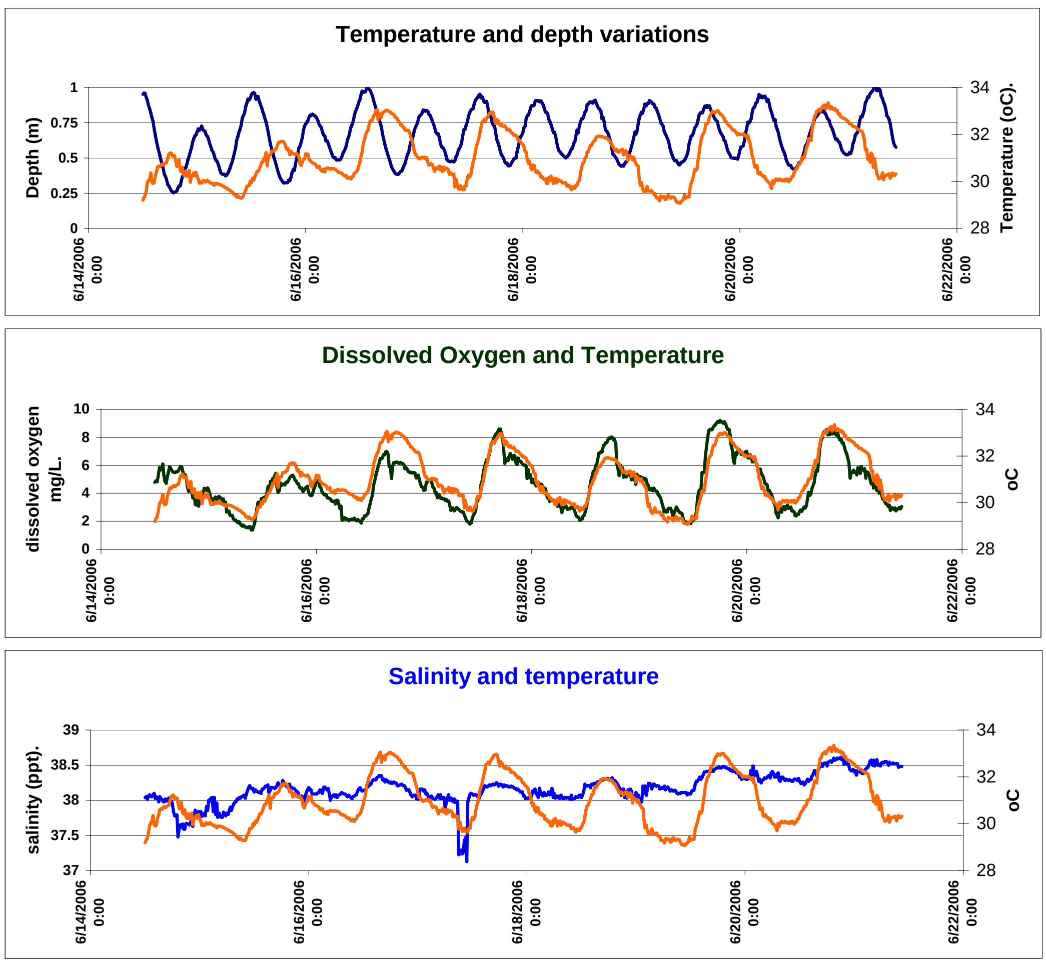


Figure 41. YSI datasondes results for Run 188 at ISCO Station 11 (100th St mouth station). Note Comparison with depth measurements.

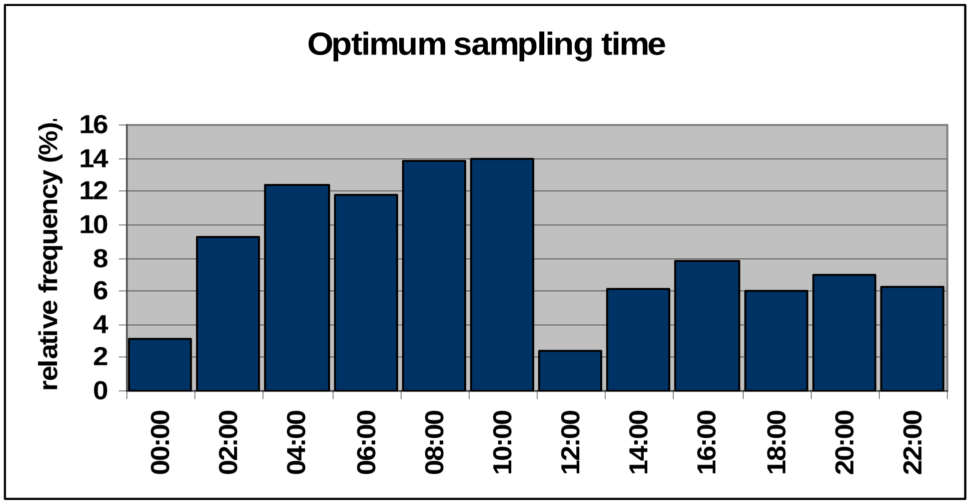


Figure 42. Percentage of events when sampling is closest to optimum conditions (maximum TP and TN, and minimum DO and salinity) to detect potential man-induced effects in water quality

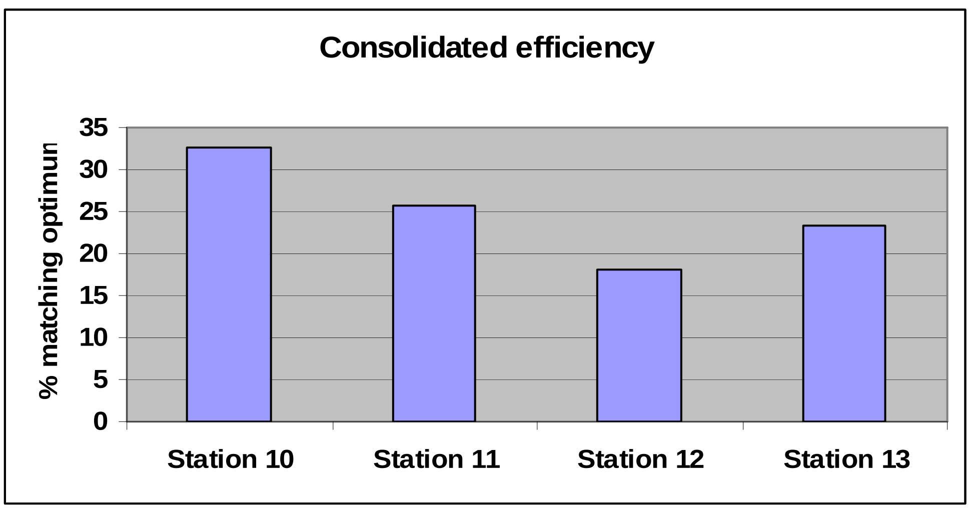
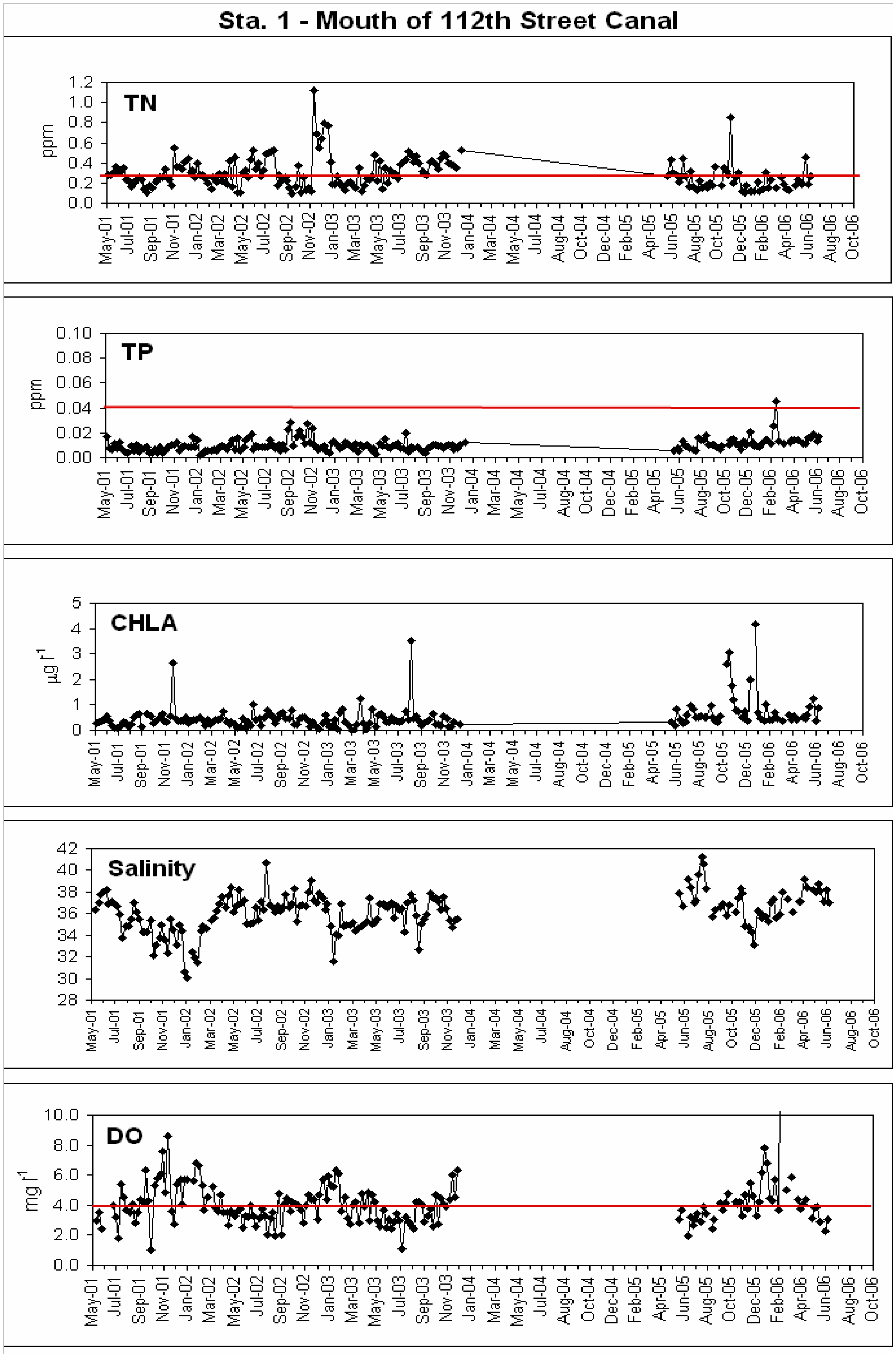
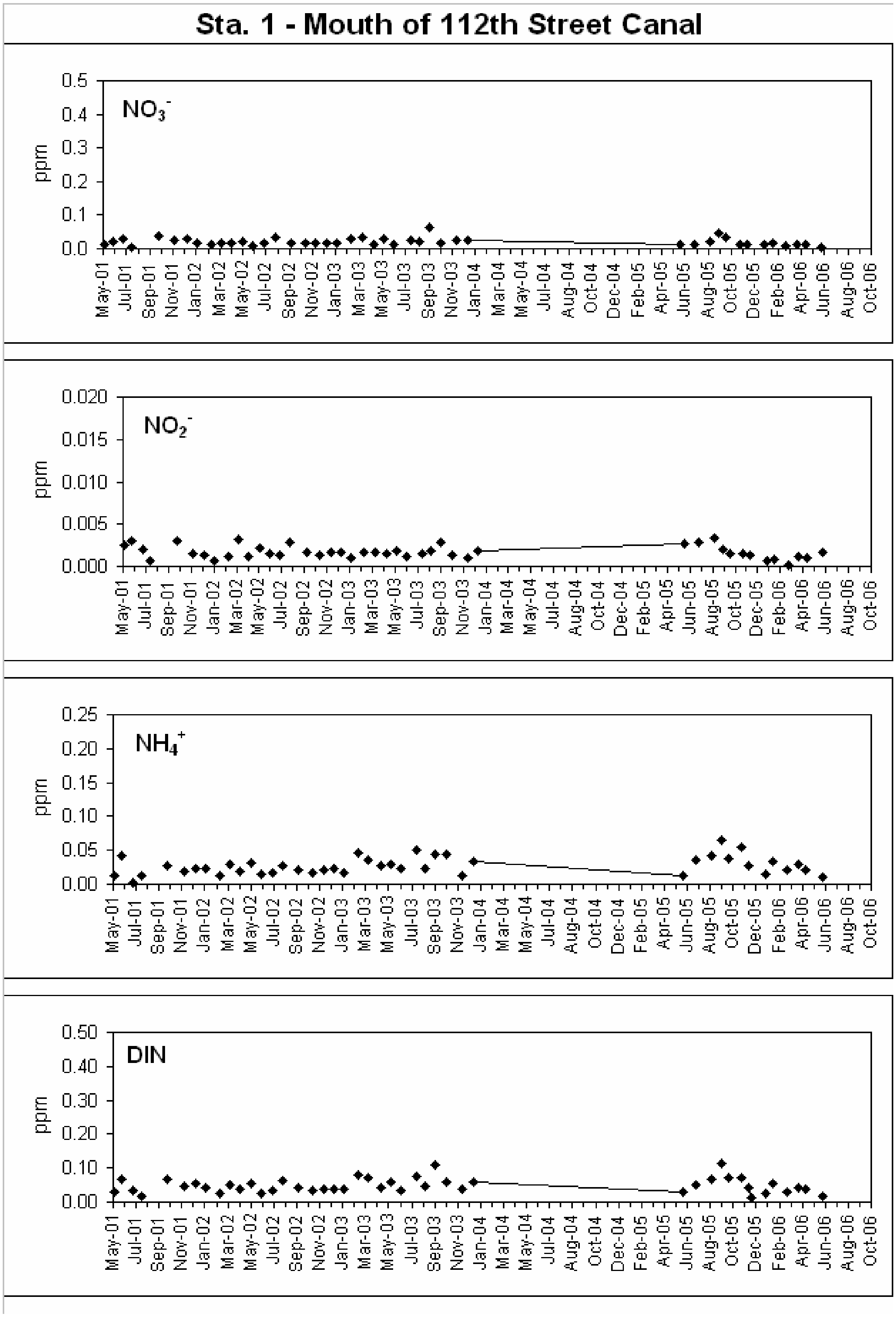


Figure 43. Overall efficiency of ISCO stations to render results matching optimum conditions for detecting potential man-induced effects in water quality.

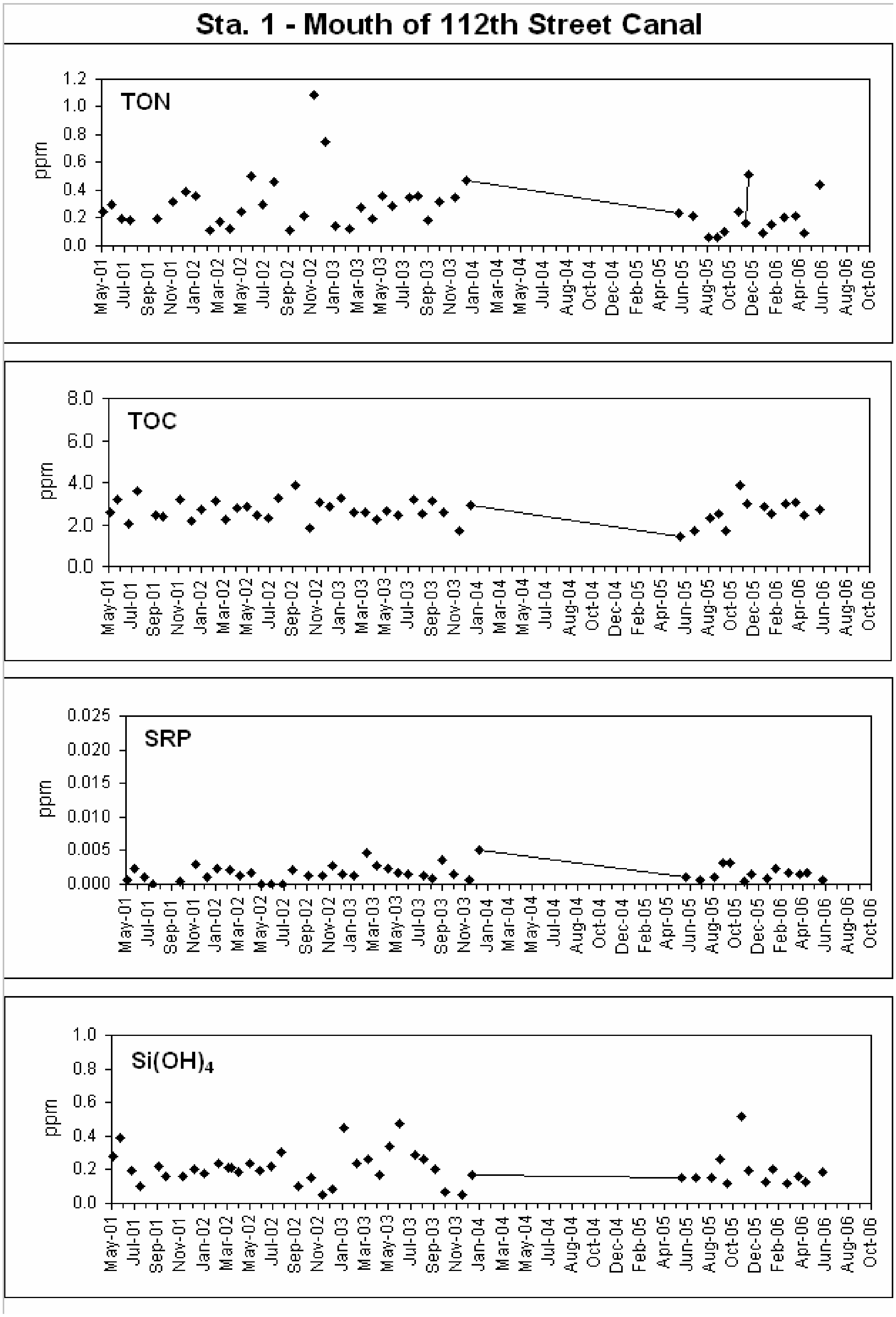
APPENDIX 1

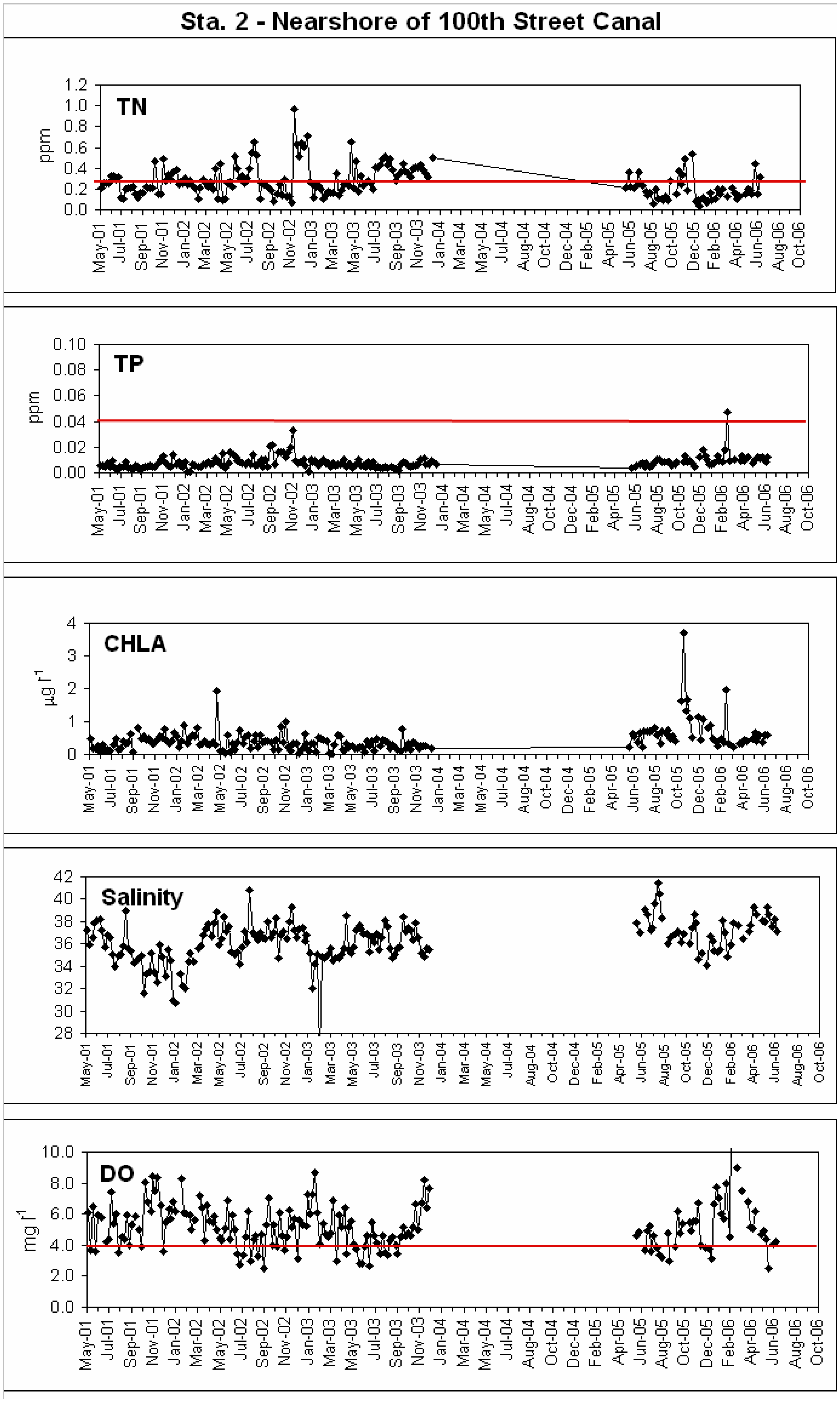
Time-series Diagrams for all variables

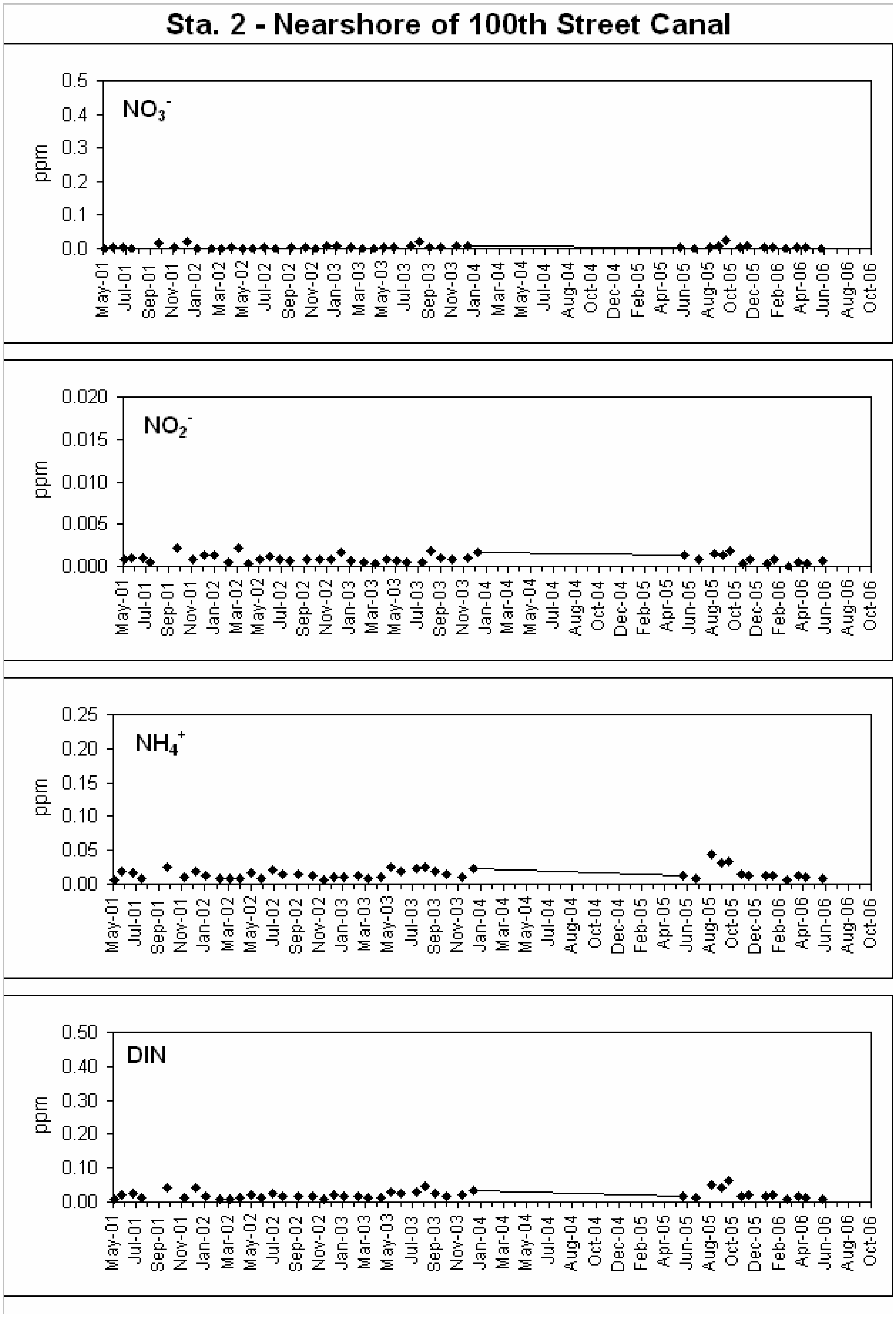

Sta. 1 - Mouth of 112th Street Canal
TN
ppm
1.2
1.0
0.8
0.6
0.4
0.2
0.0
TP
ppm
0.10
0.08
0.06
0.04
0.02
0.00
CHLA
µg l-1
5
4
3
2
1
0
Salinity
42
40
38
36
34
32
30
28
DO
mg l-1
10.0
8.0
6.0
4.0
2.0
0.0
May-01
Jul-01
Sep-01
Nov-01
Jan-02
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06



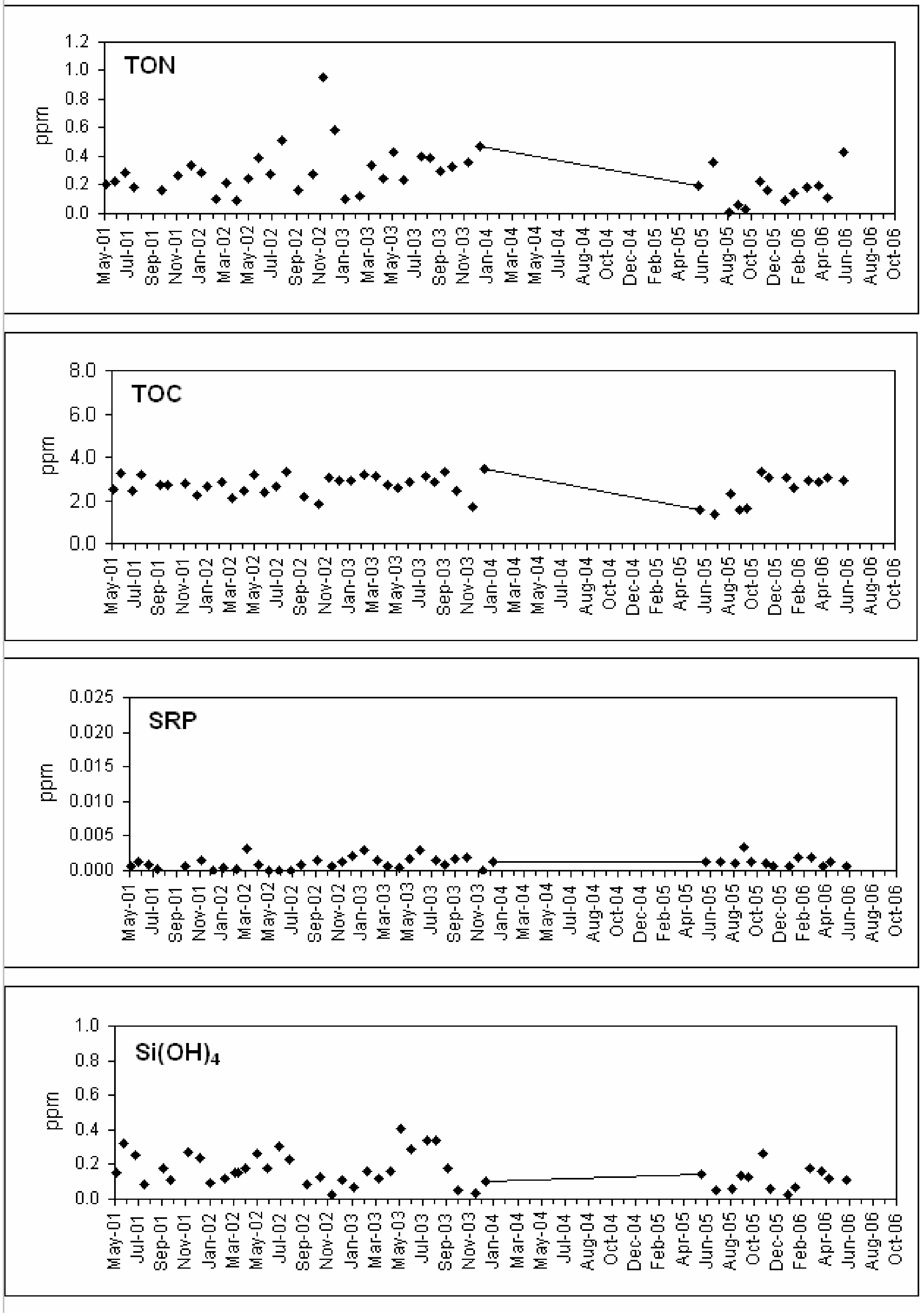
Sta. 1 - Mouth of 112th Street Canal
NO_3^-
NO_2^-
NH_4^+
DIN
ppm
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06

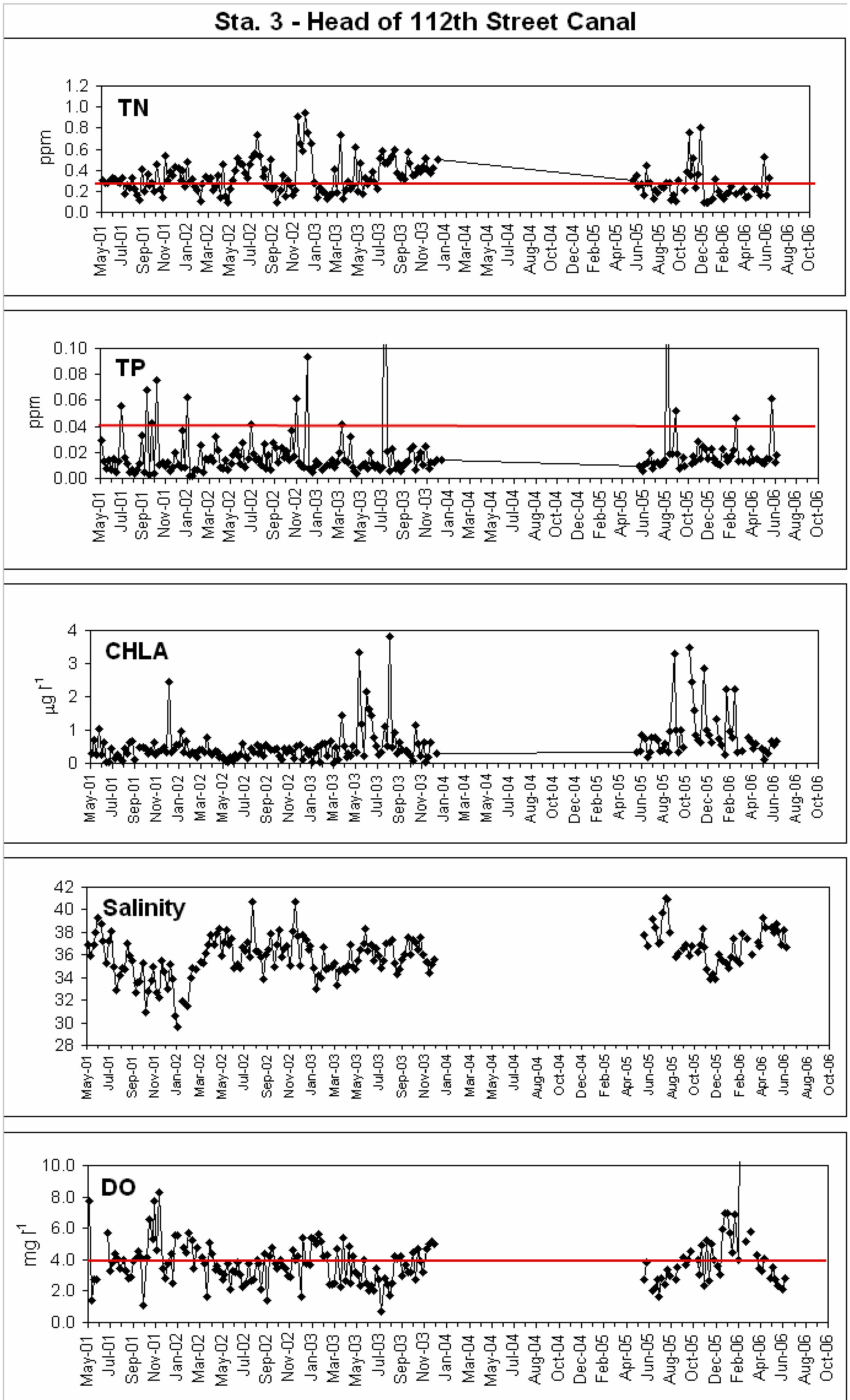

Sta. 1 - Mouth of 112th Street Canal
TON
TOC
SRP
Si(OH)4
ppm
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06

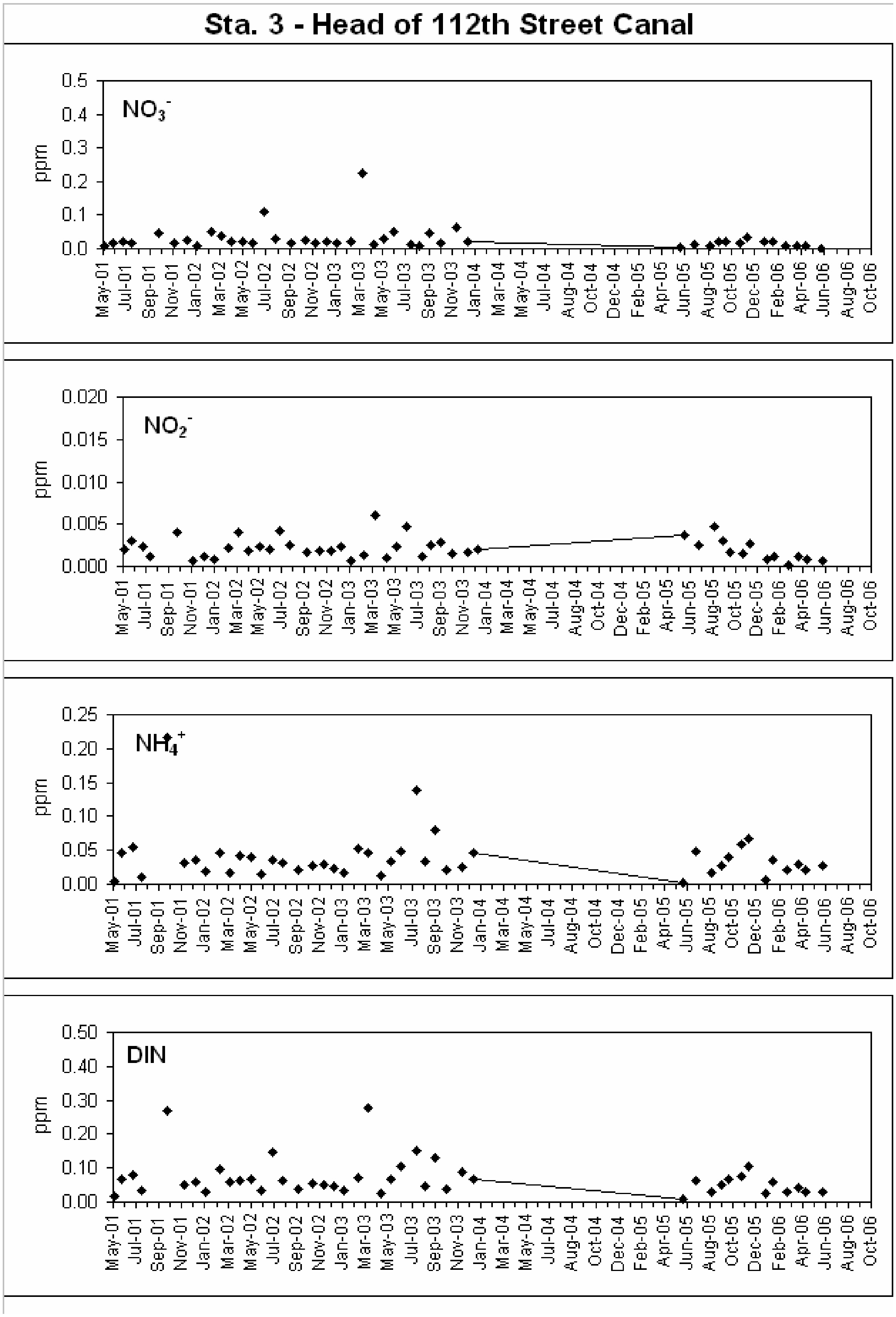

Sta. 2 - Nearshore of 100th Street Canal
TN
ppm
TP
ppm
CHLA
µg l-1
Salinity
DO
mg l-1


Sta. 2 - Nearshore of 100th Street Canal
NO3-
NO2-
NH4+
DIN
ppm
May-01
Jul-01
Sep-01
Nov-01
Jan-02
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06

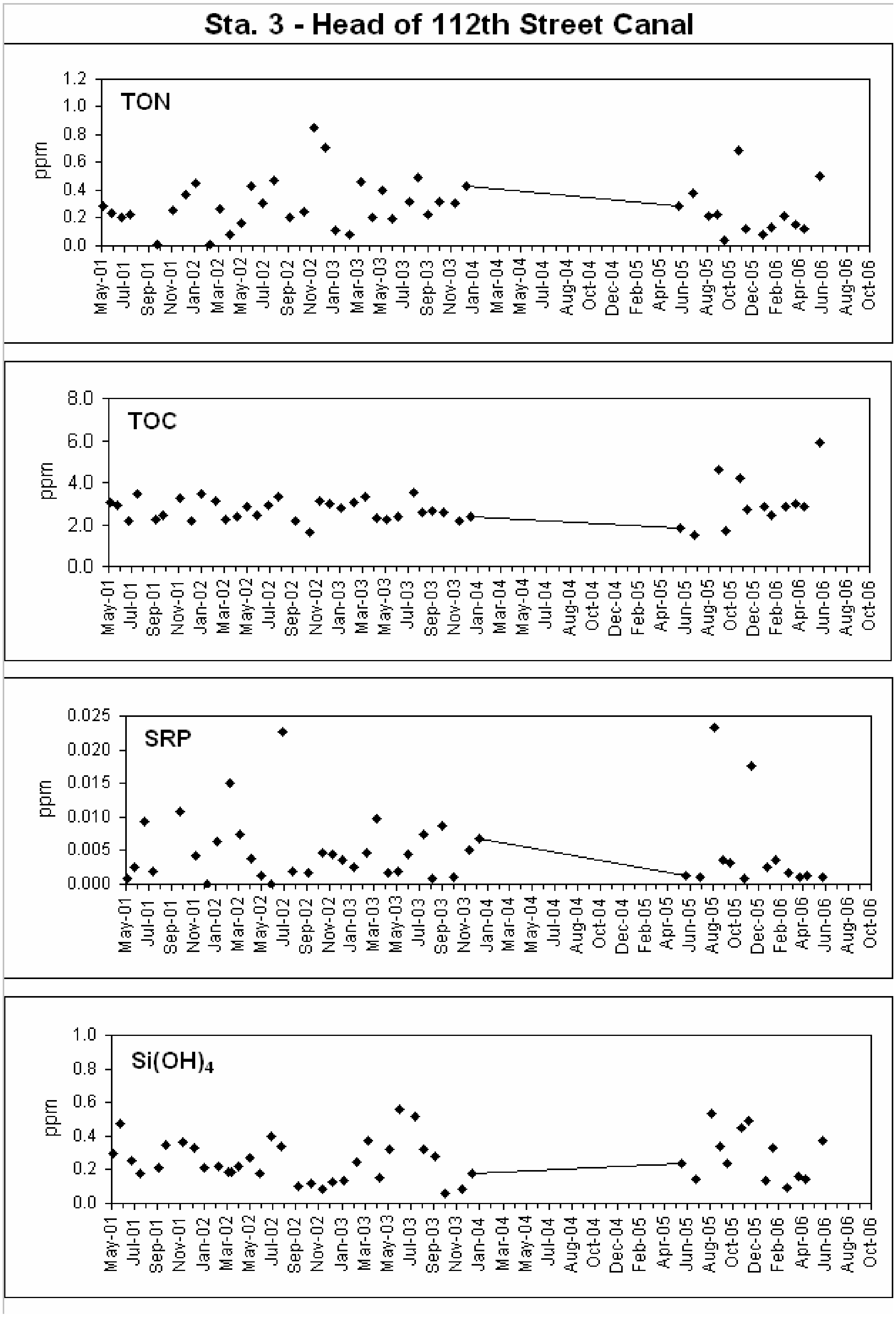
Sta. 2 - Nearshore of 100th Street Canal

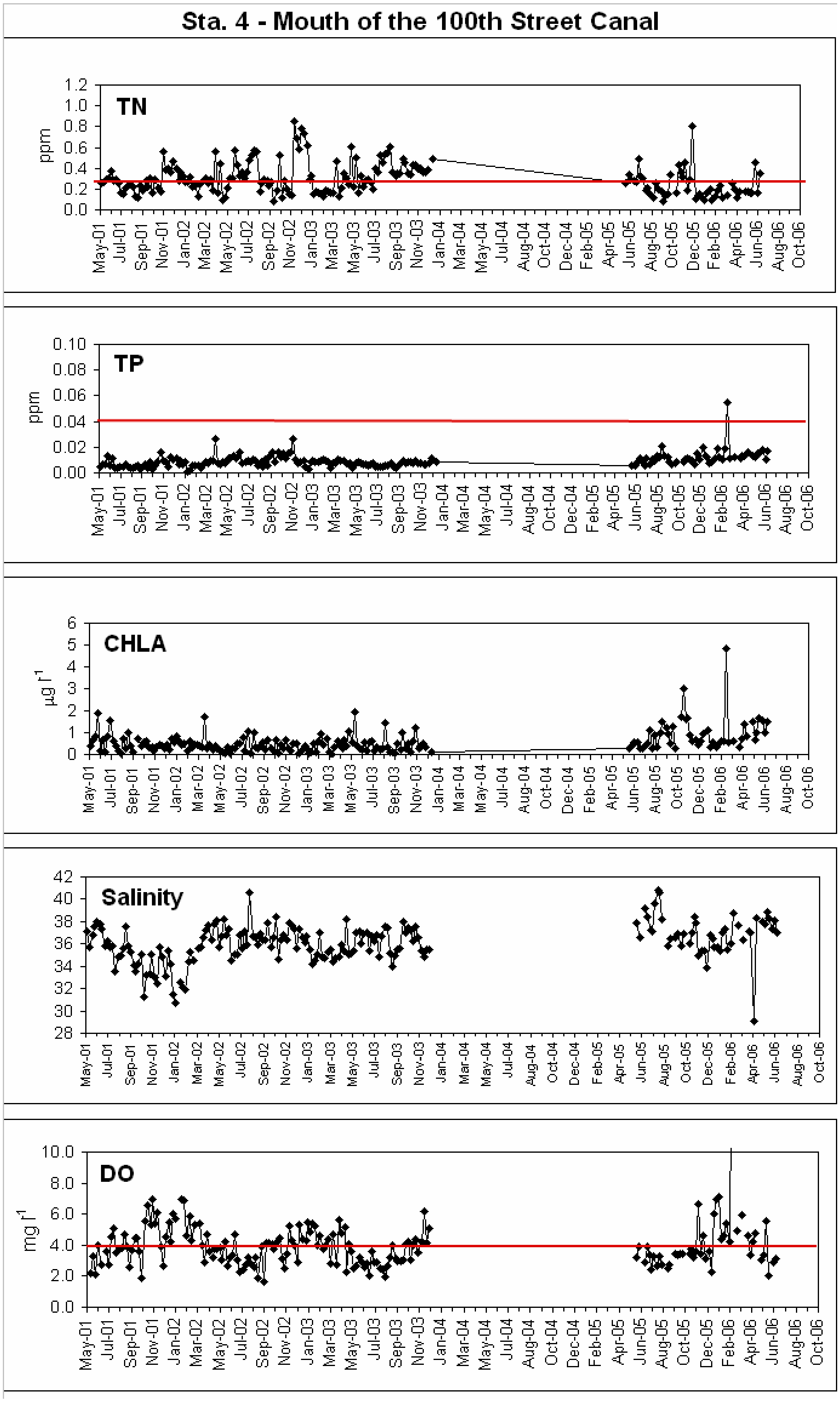


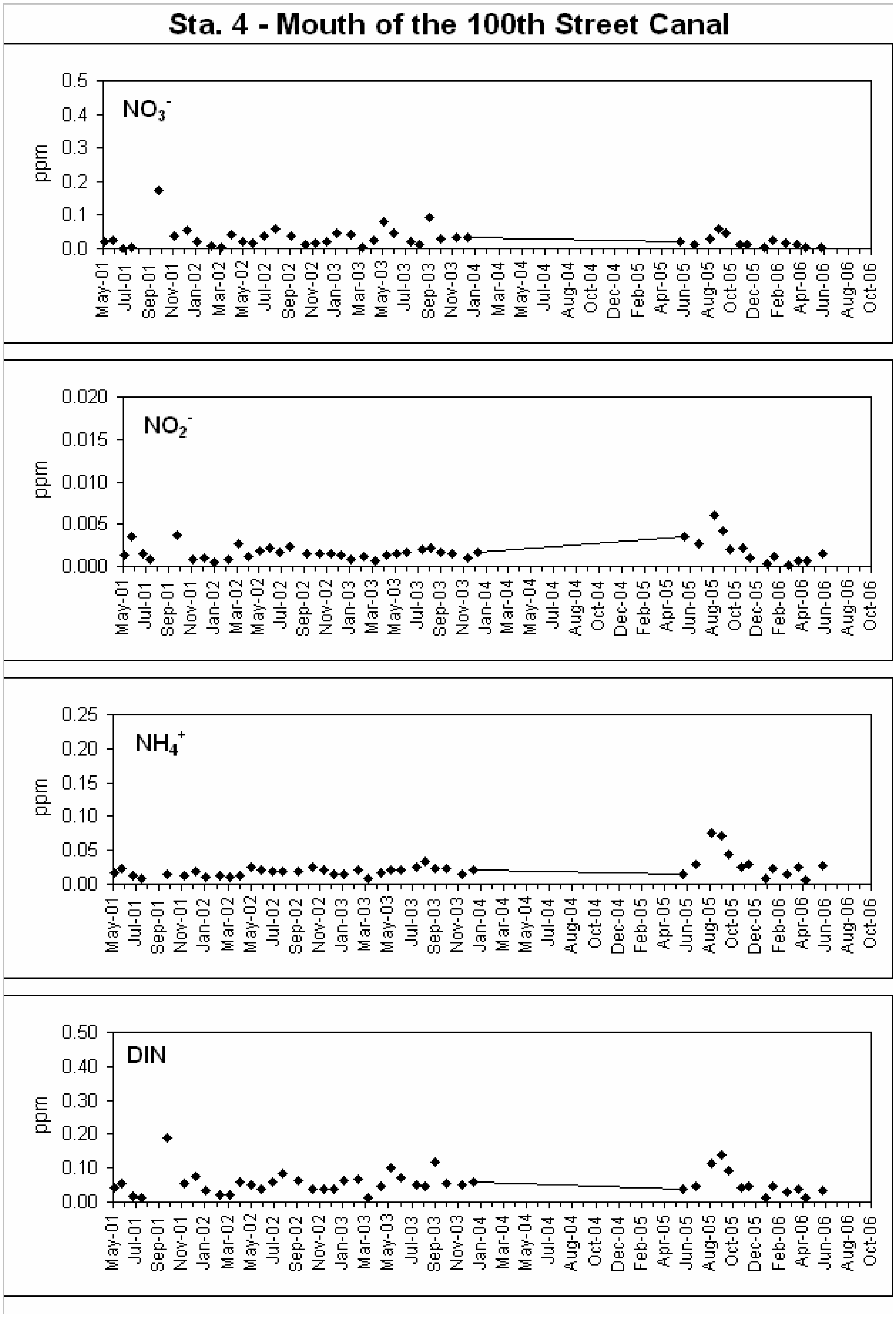

Sta. 3 - Head of 112th Street Canal
TN
ppm
TP
ppm
CHLA
µg l-1
Salinity
DO
mg l-1
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06



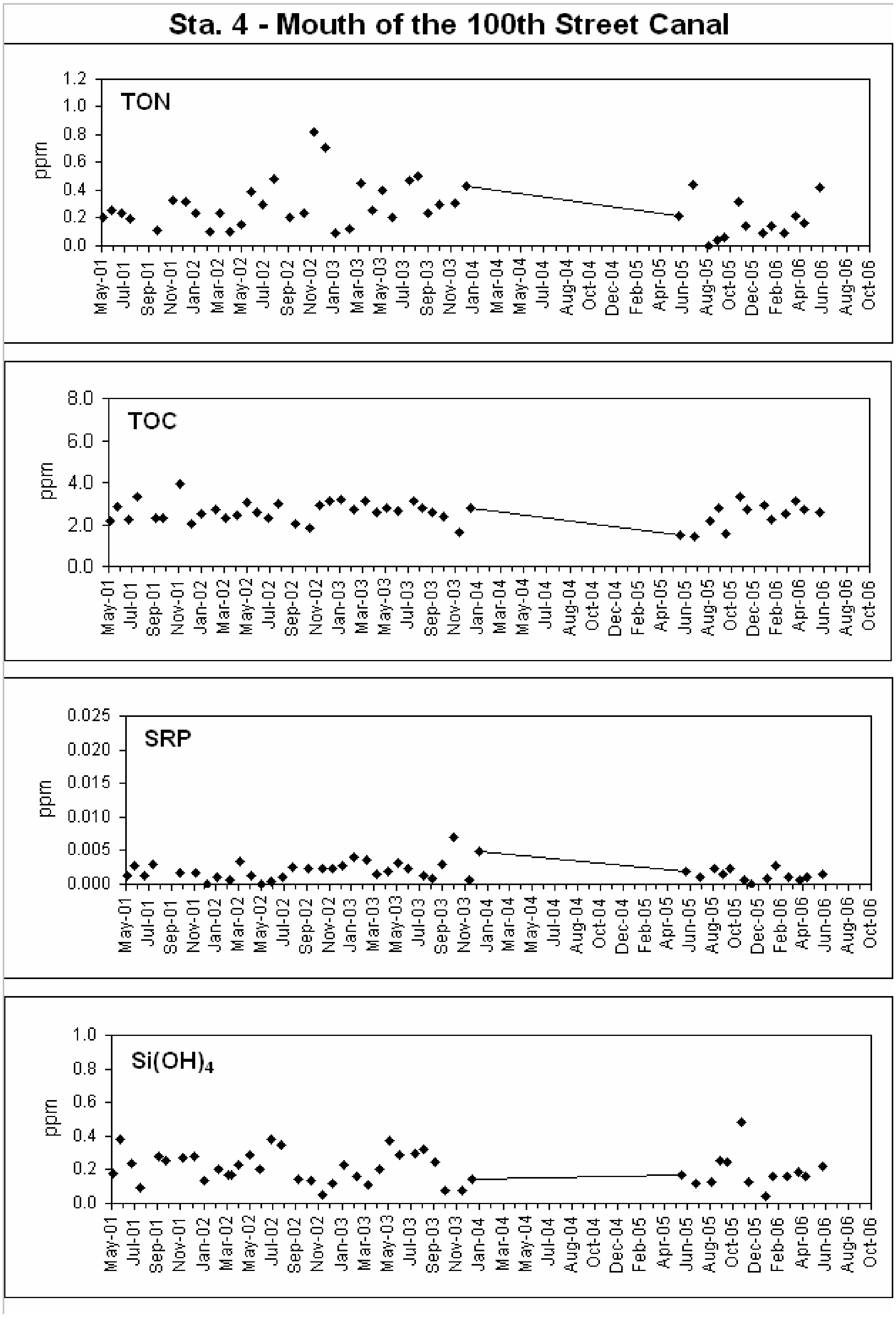
Sta. 3 - Head of 112th Street Canal
NO3-
NO2-
NH4+
DIN
ppm
0.0 0.1 0.2 0.3 0.4 0.5
0.000 0.005 0.010 0.015 0.020
0.00 0.05 0.10 0.15 0.20 0.25
0.00 0.10 0.20 0.30 0.40 0.50
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06


Sta. 3 - Head of 112th Street Canal
TON
ppm
1.2
1.0
0.8
0.6
0.4
0.2
0.0
TOC
ppm
8.0
6.0
4.0
2.0
0.0
SRP
ppm
0.025
0.020
0.015
0.010
0.005
0.000
Si(OH)$_4$
ppm
1.0
0.8
0.6
0.4
0.2
0.0
May-01
Jul-01
Sep-01
Nov-01
Jan-02
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06

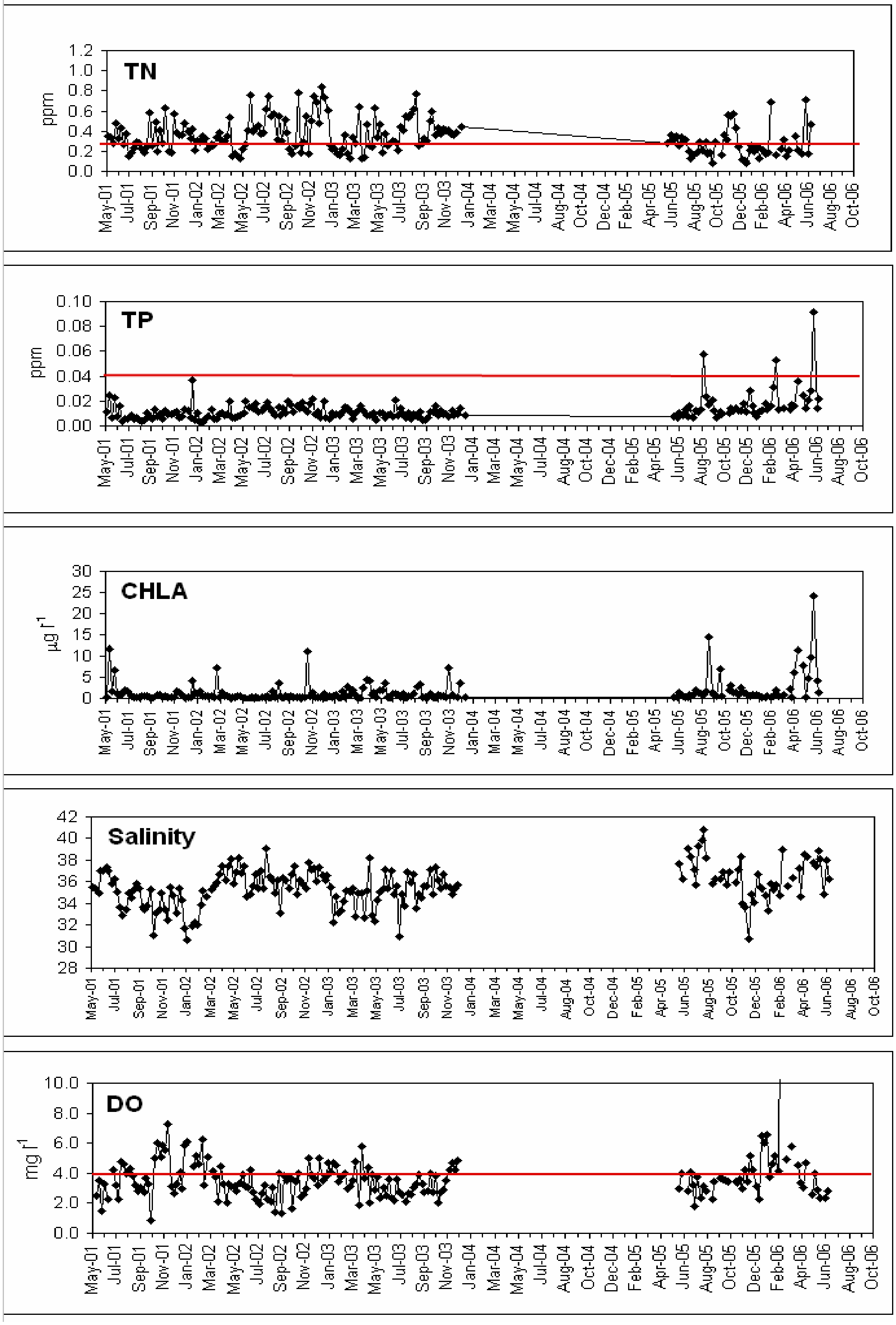

Sta. 4 - Mouth of the 100th Street Canal
TN
ppm
1.2
1.0
0.8
0.6
0.4
0.2
0.0
TP
0.10
0.08
0.06
0.04
0.02
0.00
CHLA
μg l-1
6
5
4
3
2
1
0
Salinity
42
40
38
36
34
32
30
28
DO
mg l-1
10.0
8.0
6.0
4.0
2.0
0.0
May-01
Jul-01
Sep-01
Nov-01
Jan-02
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06

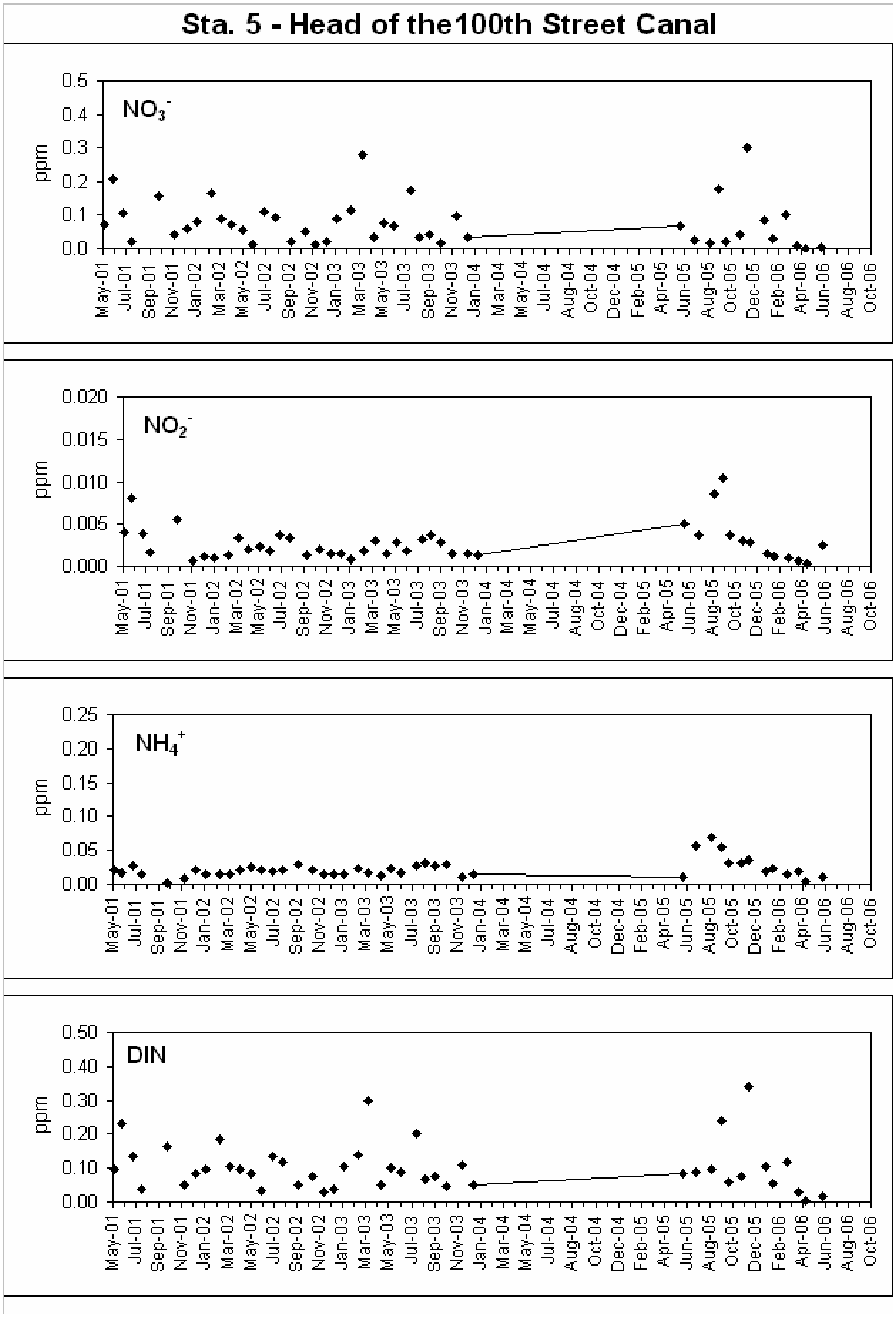


Sta. 4 - Mouth of the 100th Street Canal
NO3-
NO2-
NH4+
DIN
ppm
0.0 0.1 0.2 0.3 0.4 0.5
0.000 0.005 0.010 0.015 0.020
0.00 0.05 0.10 0.15 0.20 0.25
0.00 0.10 0.20 0.30 0.40 0.50
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06

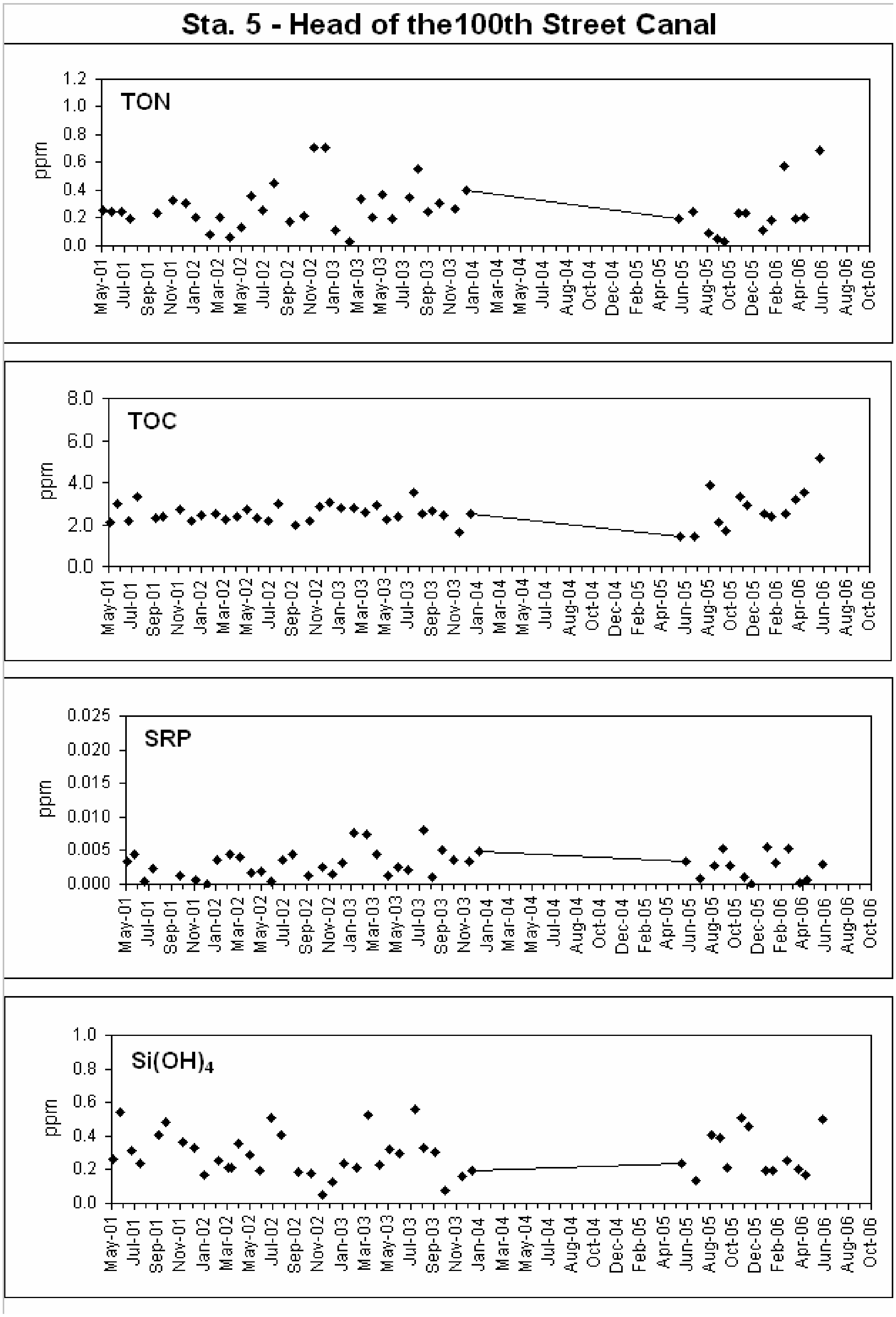

Sta. 4 - Mouth of the 100th Street Canal
TON
TOC
SRP
Si(OH)4
ppm
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06

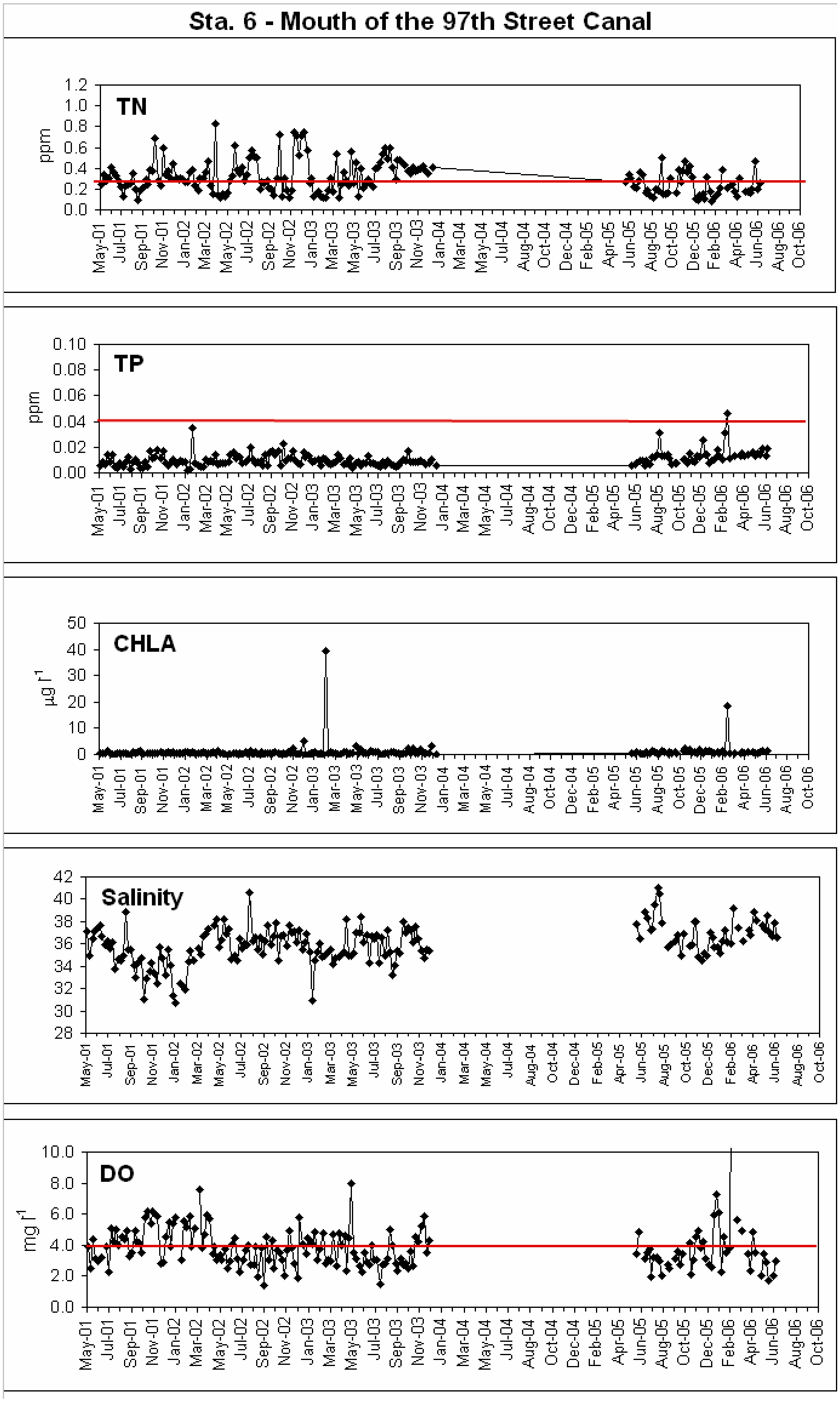
Sta. 5 - Head of the100th Street Canal

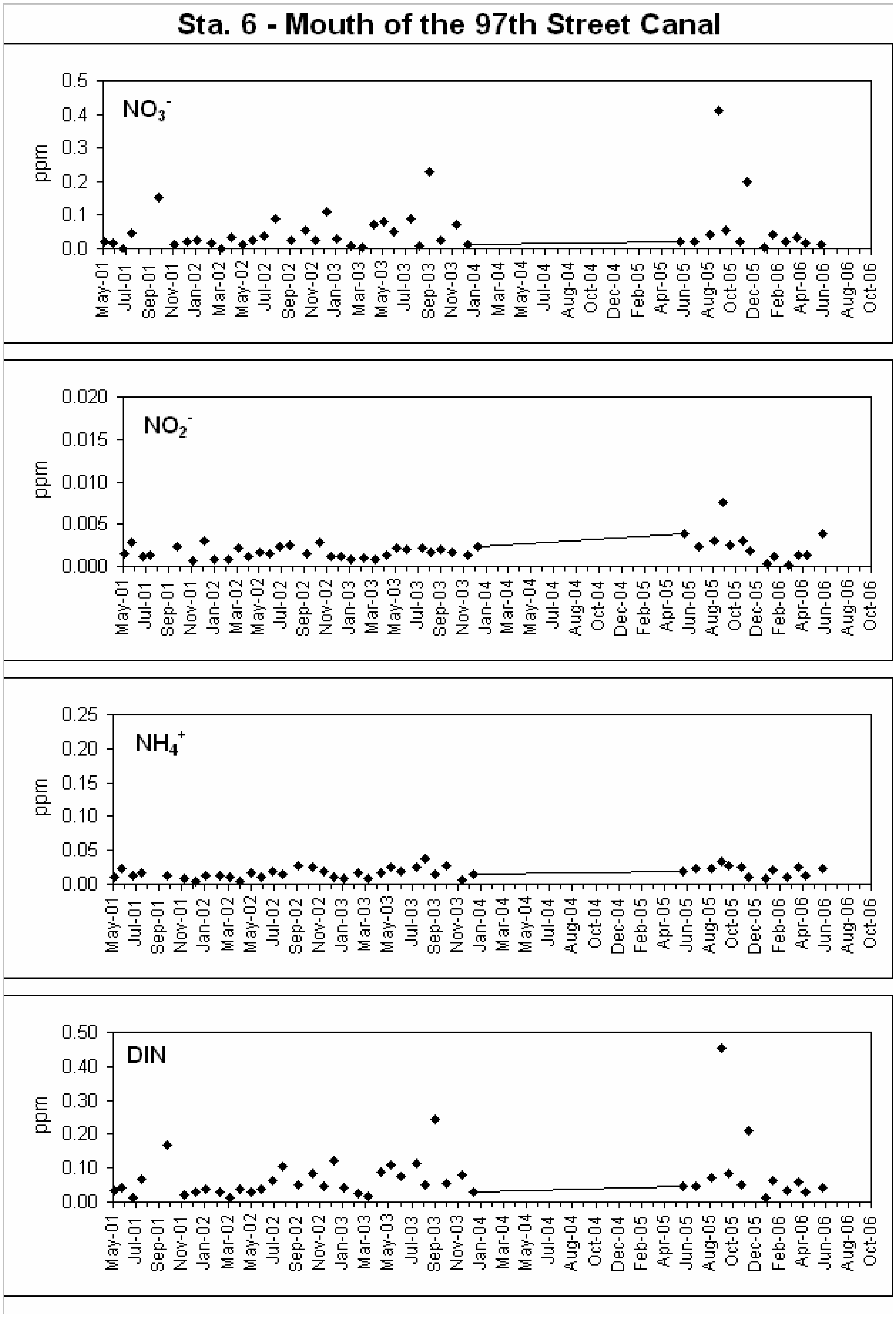


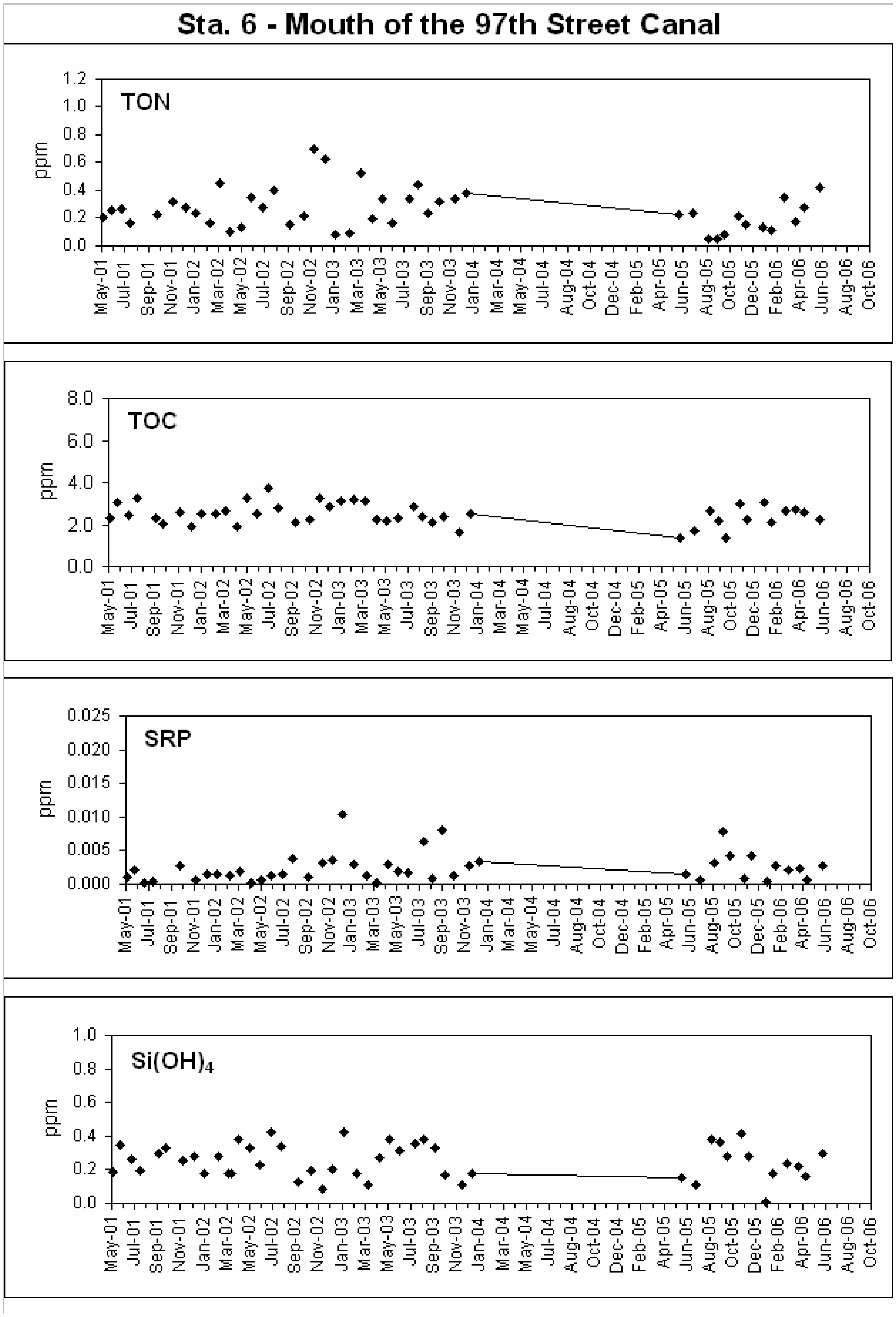


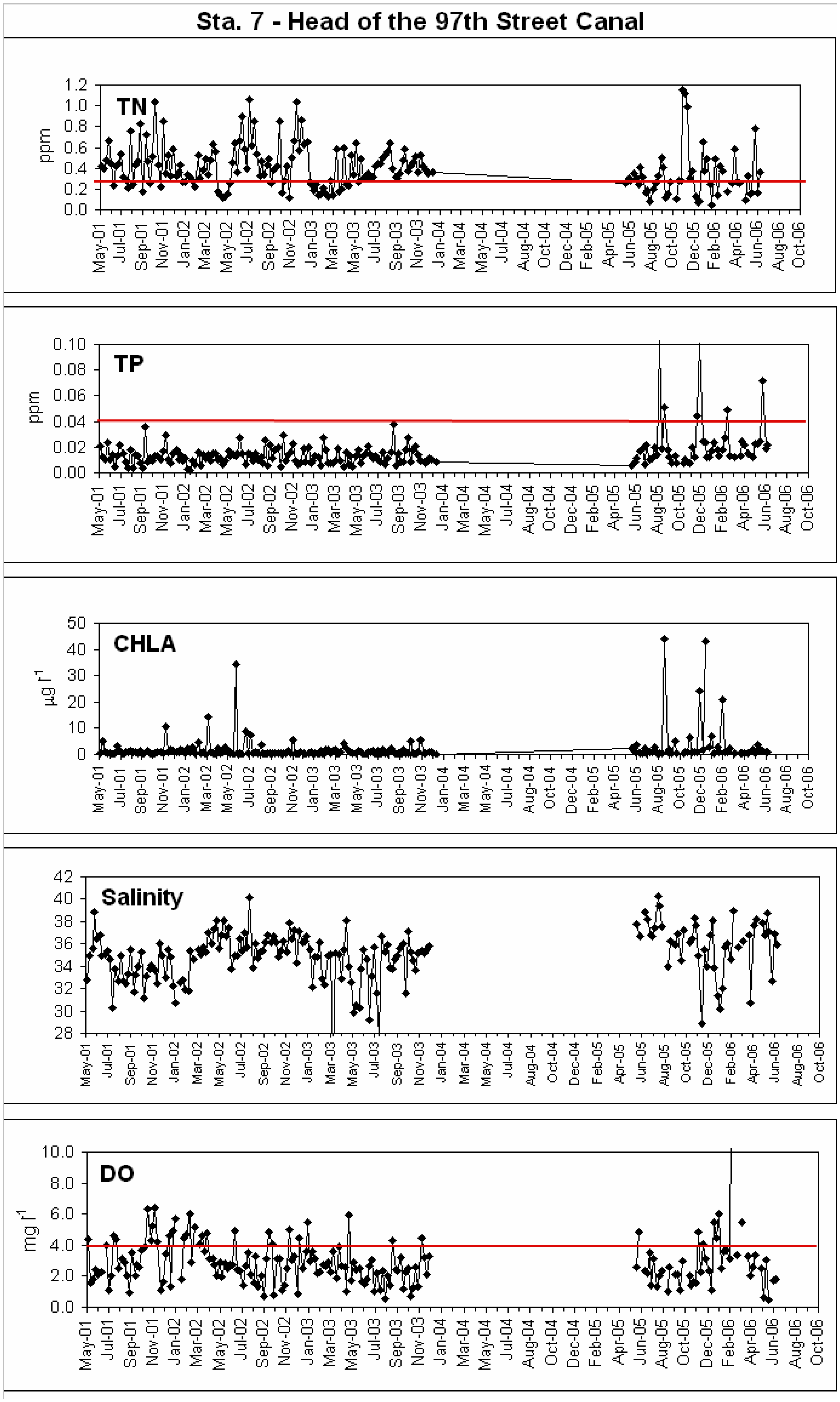
Sta. 5 - Head of the100th Street Canal
NO3-
NO2-
NH4+
DIN
ppm

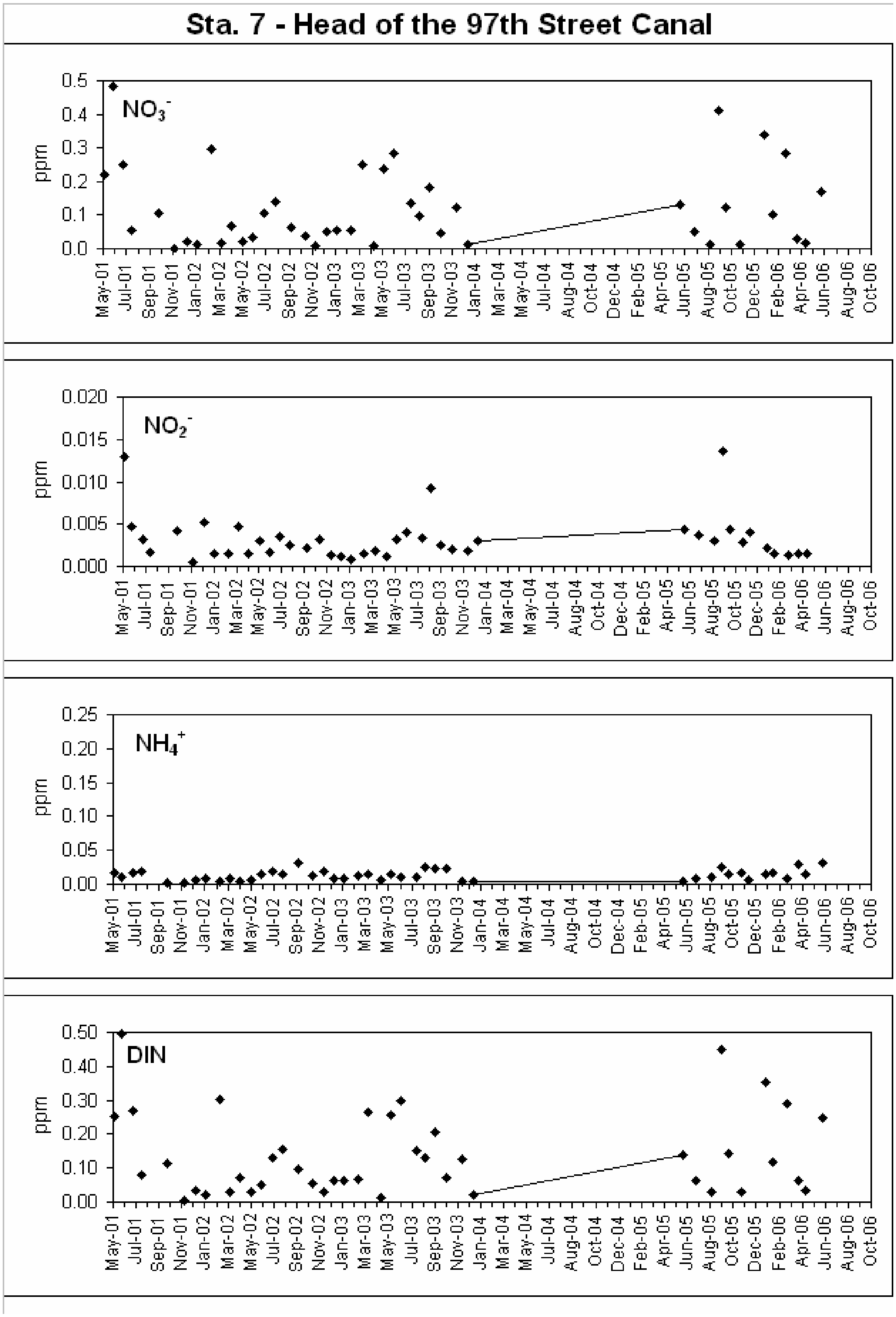

Sta. 5 - Head of the100th Street Canal
TON
TOC
SRP
Si(OH)4
ppm
May-01
Jul-01
Sep-01
Nov-01
Jan-02
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06


Sta. 6 - Mouth of the 97th Street Canal
TN
ppm
TP
ppm
CHLA
µg l-1
Salinity
DO
mg l-1
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06

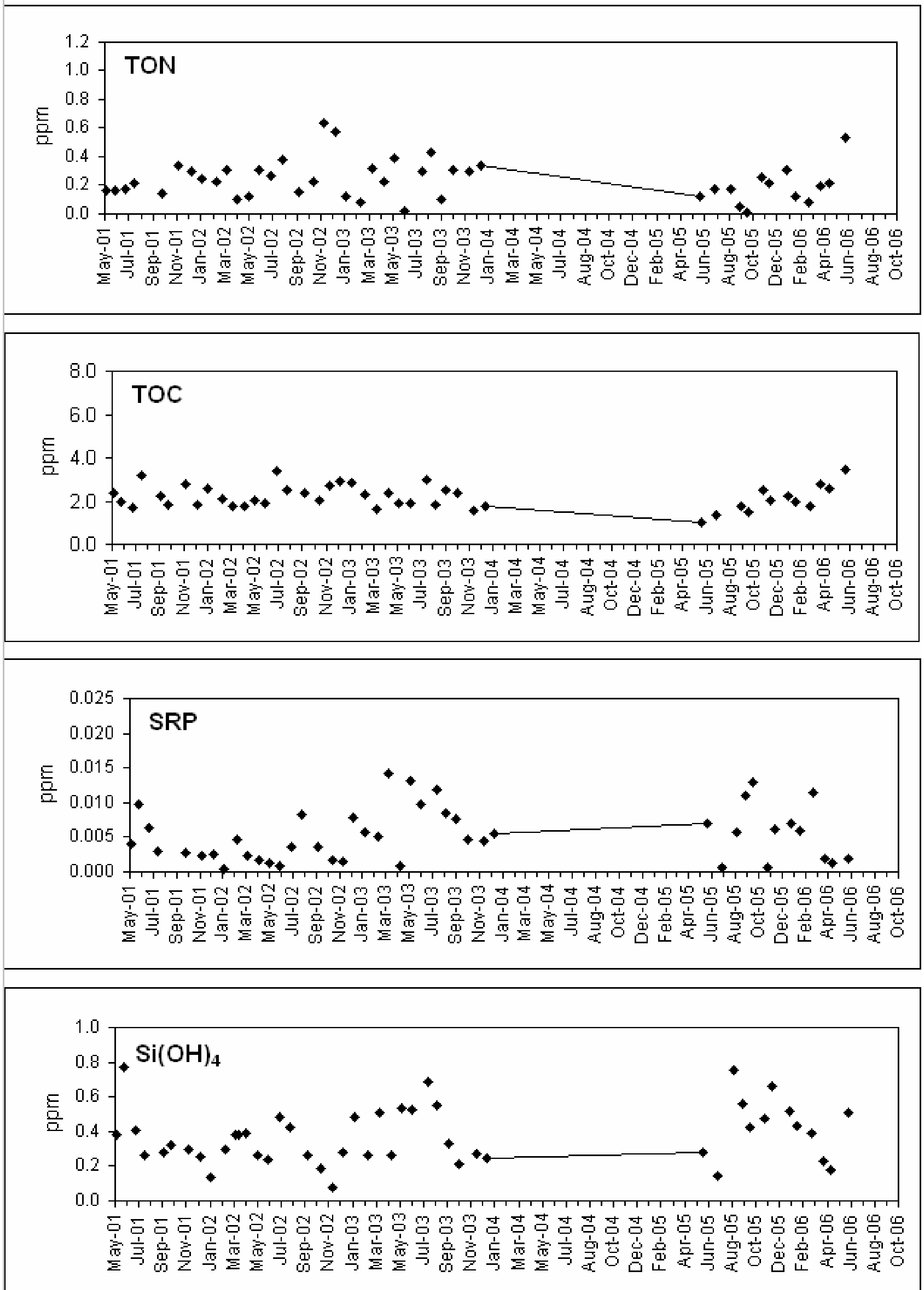

Sta. 6 - Mouth of the 97th Street Canal
NO3-
NO2-
NH4+
DIN
ppm
May-01
Jul-01
Sep-01
Nov-01
Jan-02
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06


Sta. 6 - Mouth of the 97th Street Canal
TON
TOC
SRP
Si(OH)4
ppm
May-01
Jul-01
Sep-01
Nov-01
Jan-02
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
May-03
Jul-03
Sep-03
Nov-03
Jan-04
Mar-04
May-04
Jul-04
Aug-04
Oct-04
Dec-04
Feb-05
Apr-05
Jun-05
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06

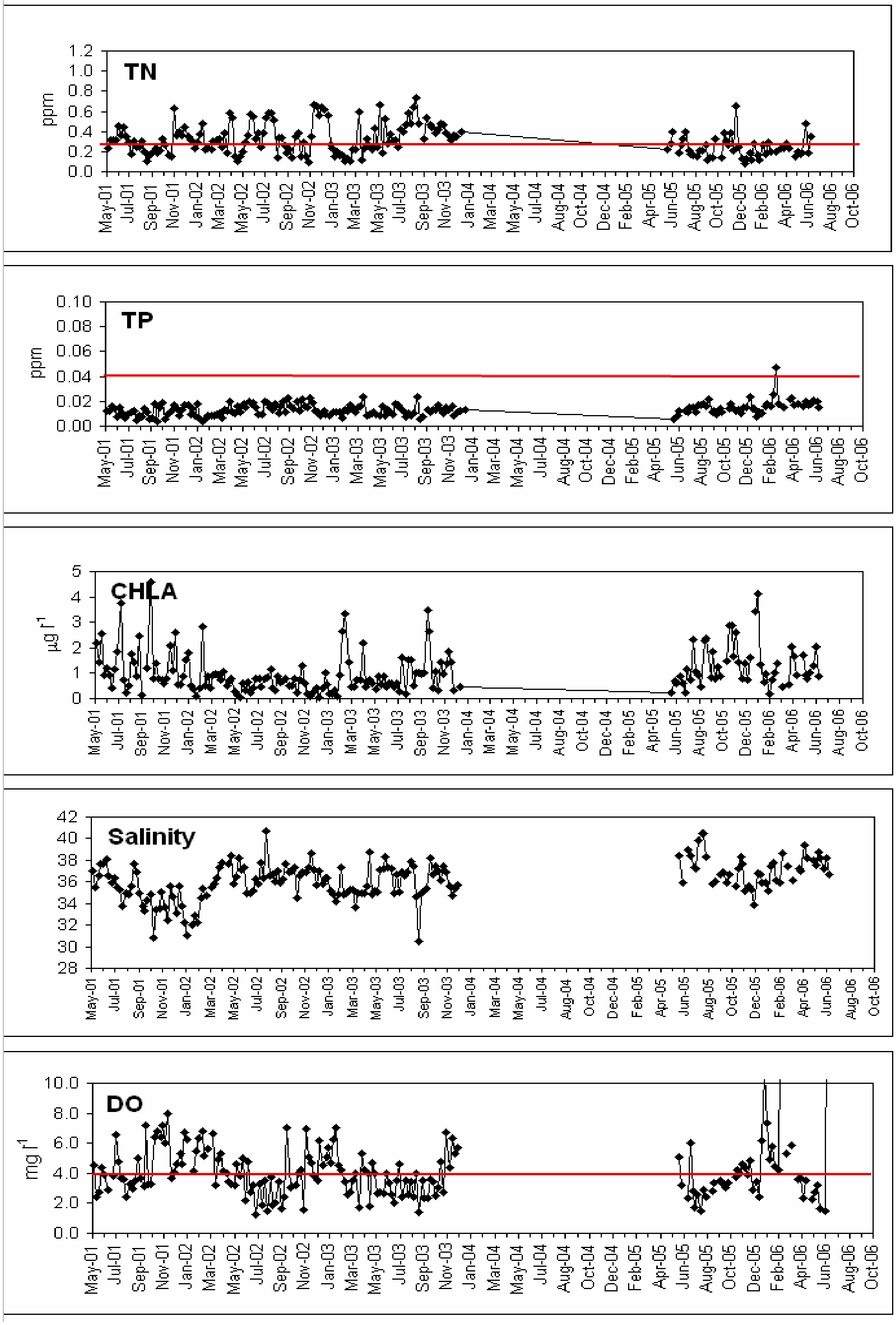

Sta. 7 - Head of the 97th Street Canal
TN
ppm
TP
ppm
CHLA
µg l-1
Salinity
DO
mg l-1
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06

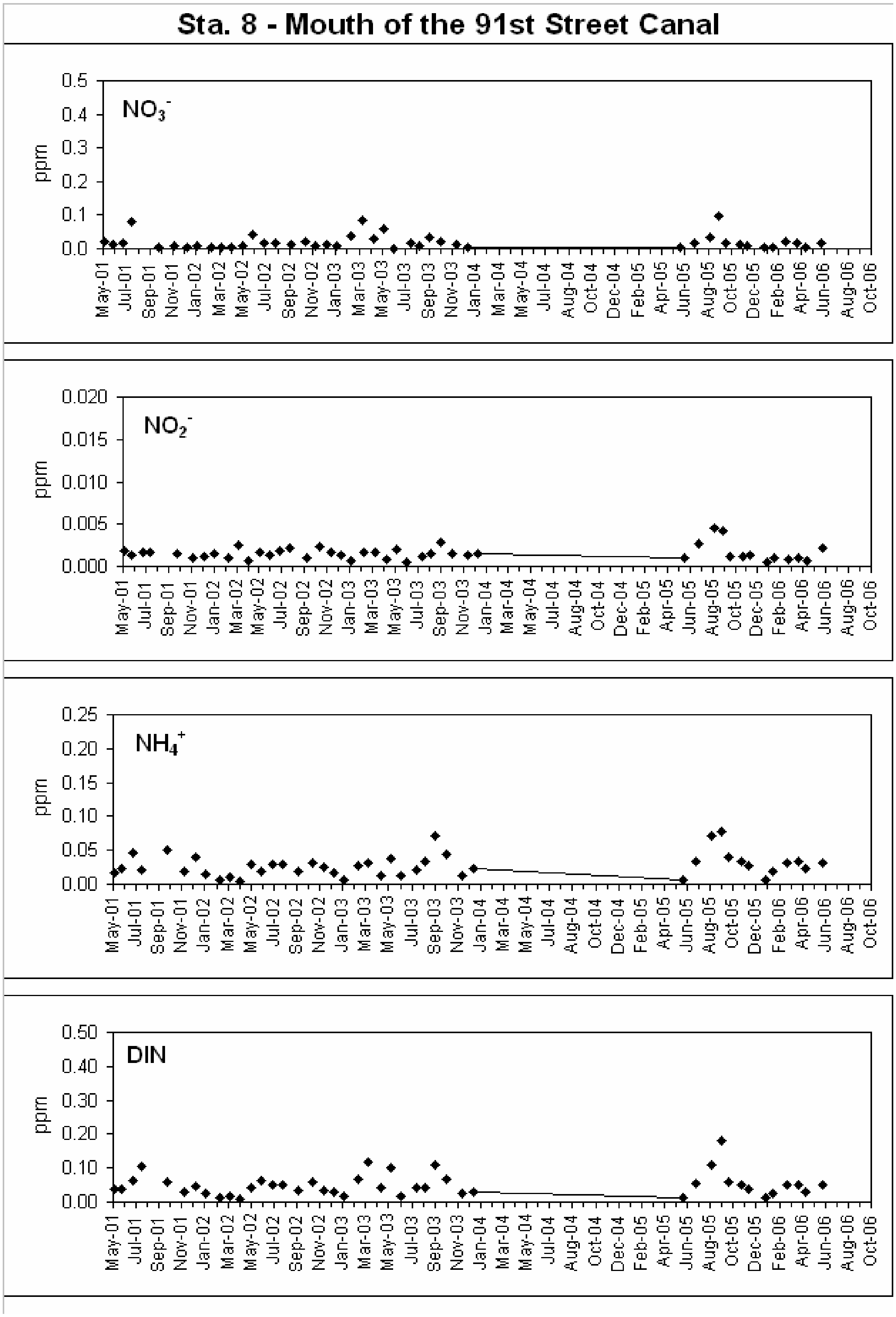

Sta. 7 - Head of the 97th Street Canal
NO3-
NO2-
NH4+
DIN
ppm
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06

Sta. 7 - Head of the 97th Street Canal

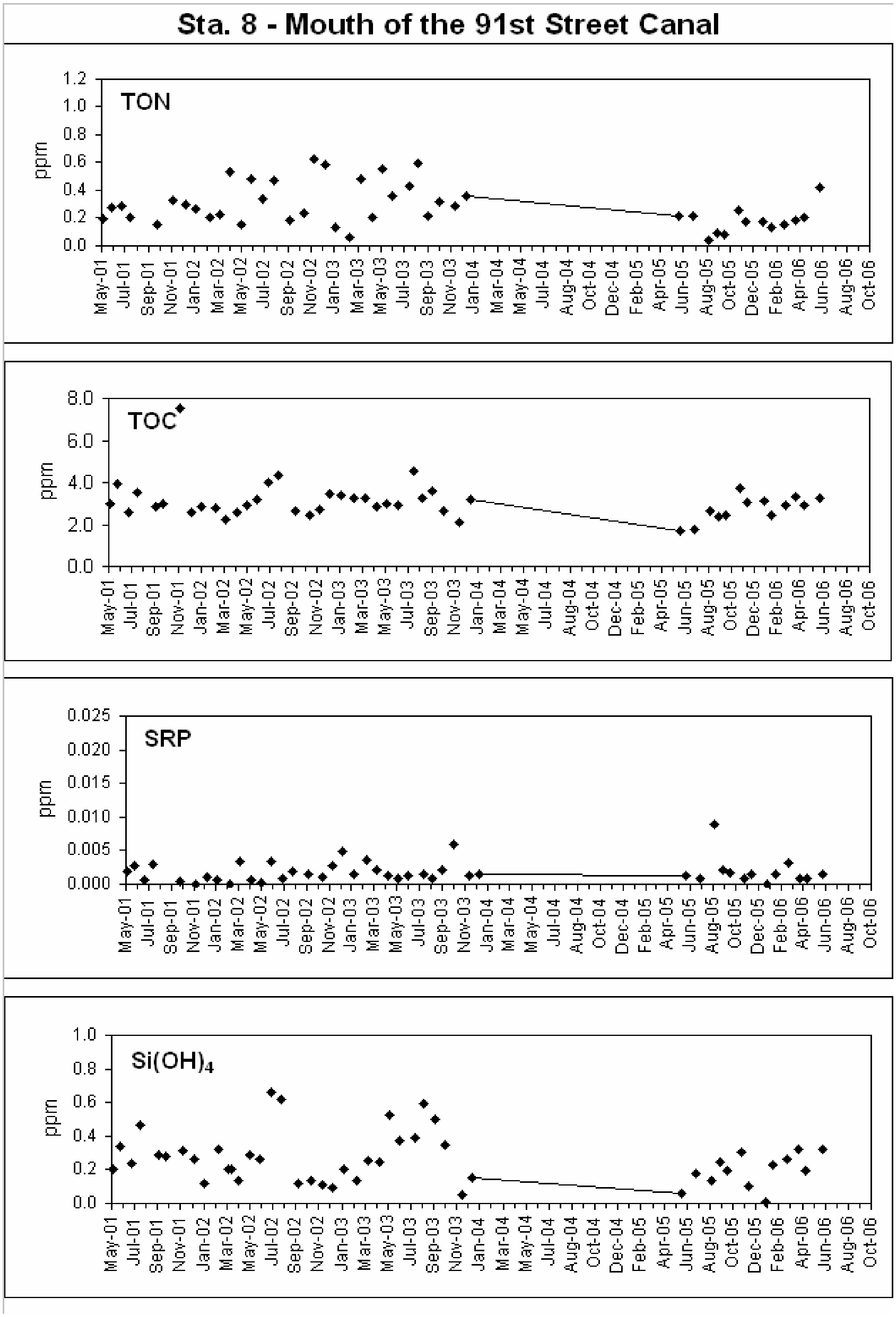


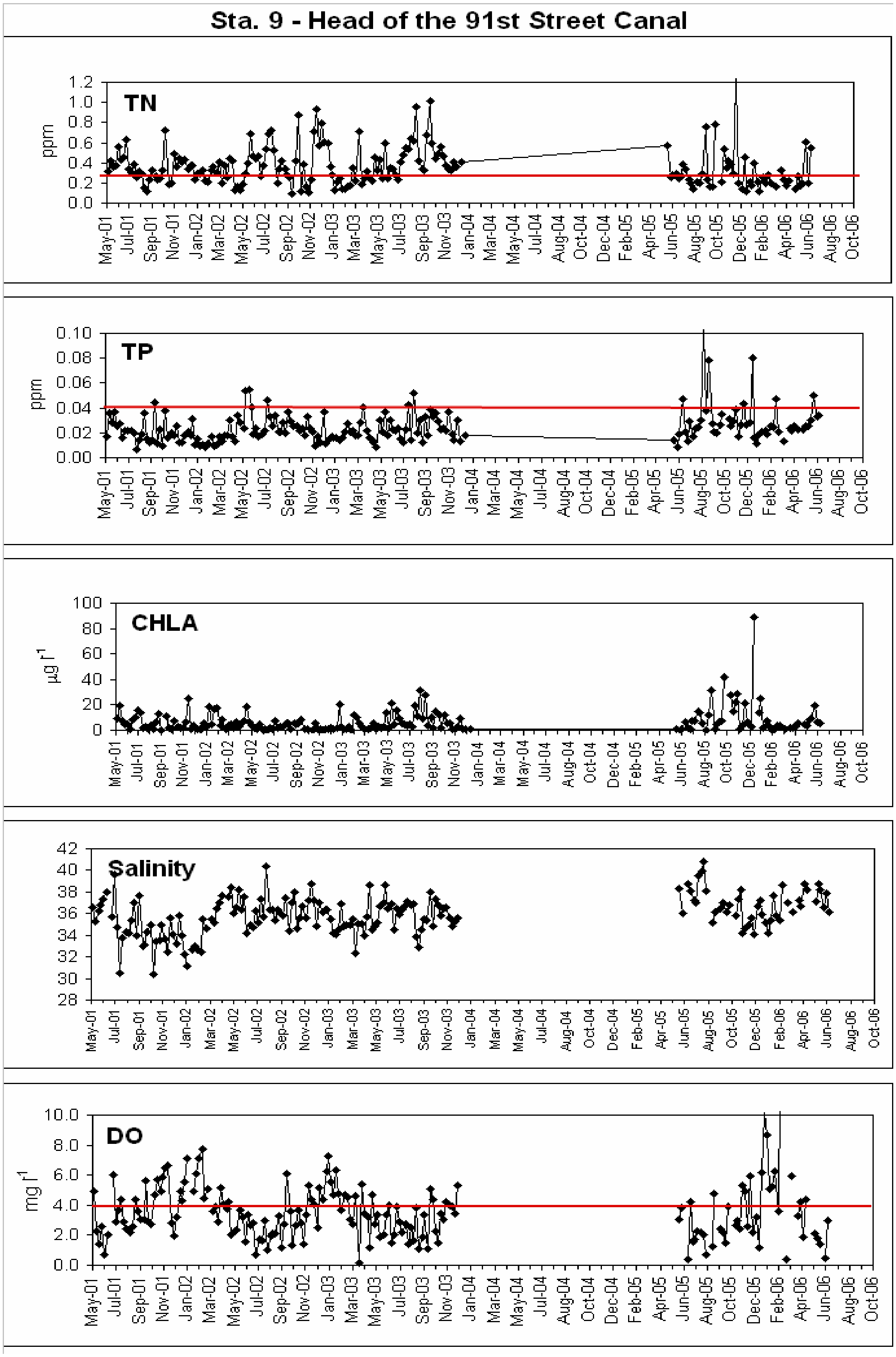
Sta. 8 - Mouth of the 91st Street Canal

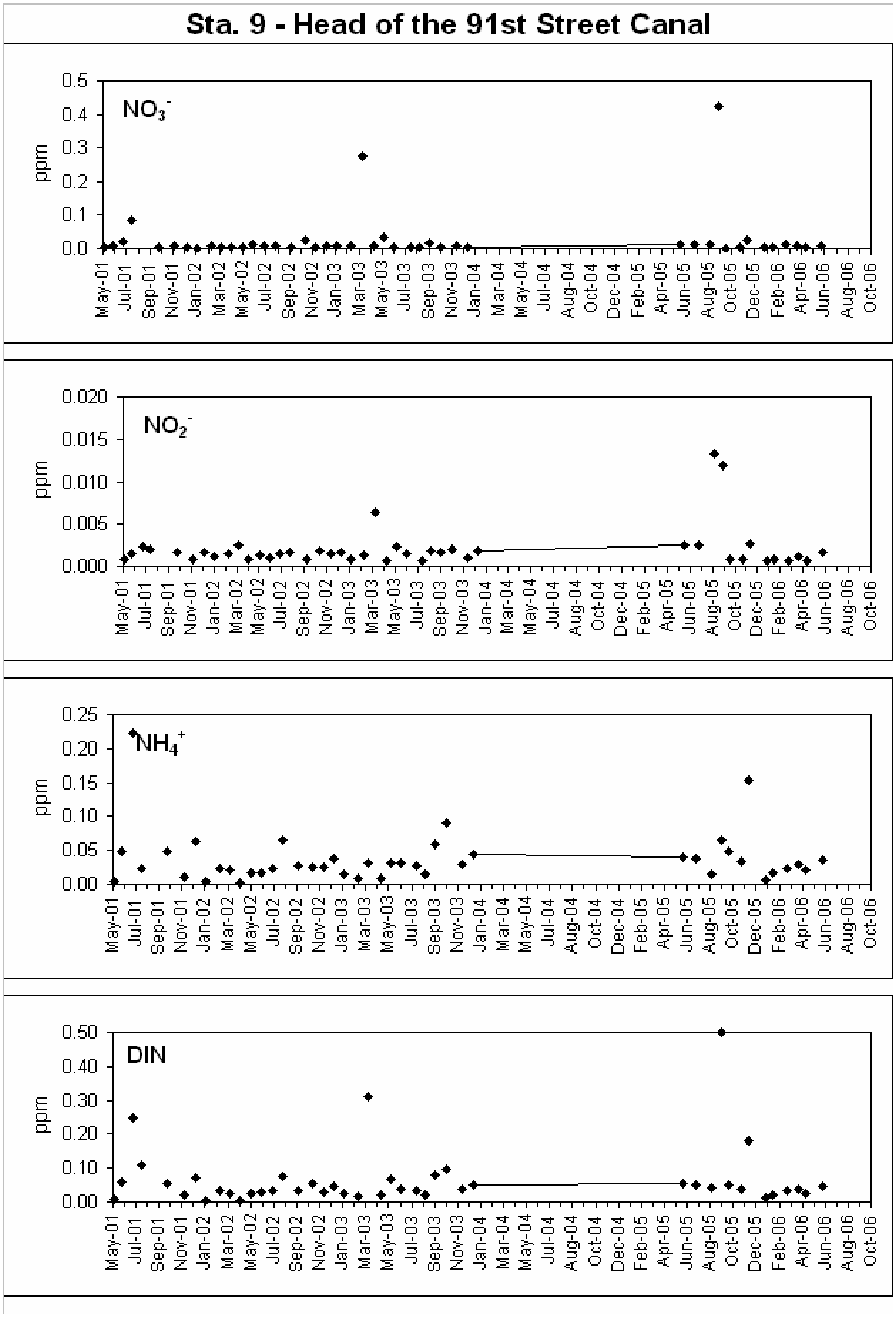


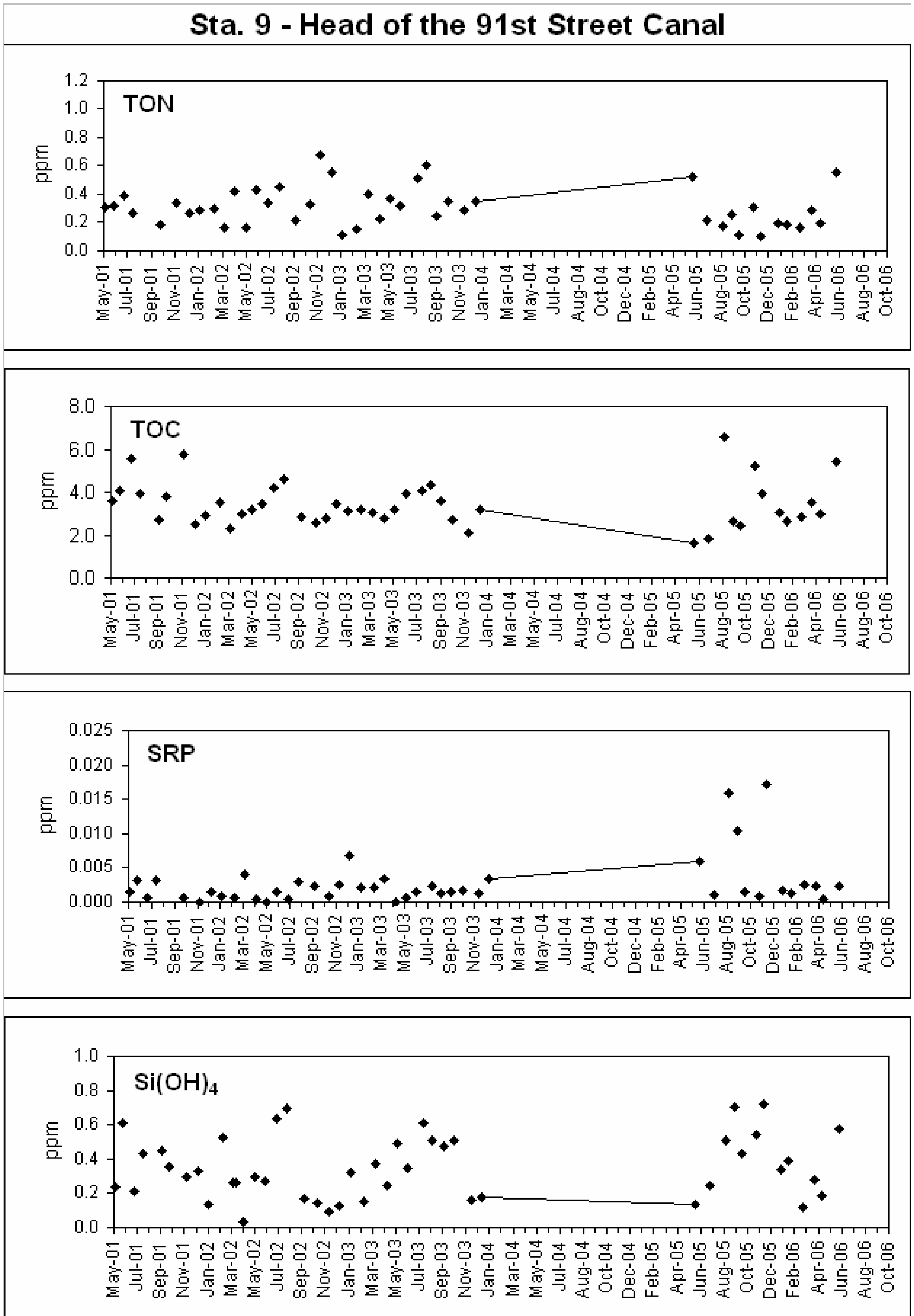


Sta. 8 - Mouth of the 91st Street Canal
NO3-
NO2-
NH4+
DIN
ppm


Sta. 8 - Mouth of the 91st Street Canal
TON
ppm
1.2
1.0
0.8
0.6
0.4
0.2
0.0
TOC
ppm
8.0
6.0
4.0
2.0
0.0
SRP
ppm
0.025
0.020
0.015
0.010
0.005
0.000
Si(OH)4
ppm
1.0
0.8
0.6
0.4
0.2
0.0
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06


Sta. 9 - Head of the 91st Street Canal
TN
ppm
TP
ppm
CHLA
μg l-1
Salinity
DO
mg l-1
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06


Sta. 9 - Head of the 91st Street Canal
NO3-
ppm
0.5
0.4
0.3
0.2
0.1
0.0
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06
NO2-
ppm
0.020
0.015
0.010
0.005
0.000
NH4+
ppm
0.25
0.20
0.15
0.10
0.05
0.00
DIN
ppm
0.50
0.40
0.30
0.20
0.10
0.00


Sta. 9 - Head of the 91st Street Canal
TON
ppm
0.0 0.2 0.4 0.6 0.8 1.0 1.2
TOC
ppm
0.0 2.0 4.0 6.0 8.0
SRP
ppm
0.000 0.005 0.010 0.015 0.020 0.025
$Si(OH)_4$
ppm
0.0 0.2 0.4 0.6 0.8 1.0
May-01 Jul-01 Sep-01 Nov-01 Jan-02 Mar-02 May-02 Jul-02 Sep-02 Nov-02 Jan-03 Mar-03 May-03 Jul-03 Sep-03 Nov-03 Jan-04 Mar-04 May-04 Jul-04 Aug-04 Oct-04 Dec-04 Feb-05 Apr-05 Jun-05 Aug-05 Oct-05 Dec-05 Feb-06 Apr-06 Jun-06 Aug-06 Oct-06

APPENDIX 2

RESULTS FROM MANN-WHITNEY NON-PARAMETRIC TEST. SIGNIFICANCE LEVEL SET AT p=0.05

TABLE 2-1. Mann-Whitney test for All Stations. Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for NH4
Grouping Variable: PHASE

U	13563.000
U Prime	19080.000
Z-Value	-2.654
P-Value	.0079
Tied Z-Value	-2.654
Tied P-Value	.0079
# Ties	2

1315 cases were omitted due to missing values.

Mann-Whitney Rank Info for NH4
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	279	52623.000	188.613
Phase 2	117	25983.000	222.077

1315 cases were omitted due to missing values.

Mann-Whitney U for TN
Grouping Variable: PHASE

U	170453.000
U Prime	380232.000
Z-Value	-12.007
P-Value	<.0001
Tied Z-Value	-12.007
Tied P-Value	<.0001
# Ties	7

49 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1205	1106847.000	918.545
Phase 2	457	275106.000	601.982

49 cases were omitted due to missing values.

Mann-Whitney U for TON
Grouping Variable: PHASE

U	9642.000
U Prime	23280.000
Z-Value	-6.526
P-Value	<.0001
Tied Z-Value	-6.526
Tied P-Value	<.0001
# Ties	0

1314 cases were omitted due to missing values.

Mann-Whitney Rank Info for TON
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	279	62340.000	223.441
Phase 2	118	16663.000	141.212

1314 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE

U	187205.000
U Prime	363480.000
Z-Value	-10.089
P-Value	<.0001
Tied Z-Value	-10.089
Tied P-Value	<.0001
# Ties	276

49 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1205	913820.000	758.357
Phase 2	457	468133.000	1024.361

49 cases were omitted due to missing values.

TABLE. 2-1. All stations continuation…

Mann-Whitney U for CHLA
Grouping Variable: PHASE

U	177630.000
U Prime	359374.000
Z-Value	-10.588
P-Value	<.0001
Tied Z-Value	-10.588
Tied P-Value	<.0001
# Ties	274

66 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1196	893436.000	747.020
Phase 2	449	460399.000	1025.388

66 cases were omitted due to missing values.

Mann-Whitney U for SAL-S
Grouping Variable: PHASE

U	139402.500
U Prime	354430.500
Z-Value	-13.270
P-Value	<.0001
Tied Z-Value	-13.271
Tied P-Value	<.0001
# Ties	370

117 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1173	827953.500	705.843
Phase 2	421	443261.500	1052.878

117 cases were omitted due to missing values.

Mann-Whitney U for SAL-B
Grouping Variable: PHASE

U	107724.000
U Prime	300276.000
Z-Value	-13.646
P-Value	<.0001
Tied Z-Value	-13.646
Tied P-Value	<.0001
# Ties	331

248 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1088	700140.000	643.511
Phase 2	375	370776.000	988.736

248 cases were omitted due to missing values.

Mann-Whitney U for DO-B X
Grouping Variable: PHASE

U	198503.000
U Prime	228593.000
Z-Value	-2.074
P-Value	.0381
Tied Z-Value	-2.587
Tied P-Value	.0097
# Ties	2

233 cases were omitted due to missing values.

Mann-Whitney Rank Info for DO-B X
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1084	786573.000	725.621
Phase 2	394	306408.000	777.685

233 cases were omitted due to missing values.

TABLE. 2-1. All stations continuation…

Mann-Whitney U for TN-EX
Grouping Variable: PHASE

U	184641.500
U Prime	322663.500
Z-Value	-8.321
P-Value	<.0001
Tied Z-Value	-9.621
Tied P-Value	<.0001
# Ties	2

85 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1205	1049278.500	870.771
Phase 2	421	273472.500	649.578

85 cases were omitted due to missing values.

Mann-Whitney U for TN:TP
Grouping Variable: PHASE

U	128538.000
U Prime	377142.000
Z-Value	-15.021
P-Value	<.0001
Tied Z-Value	-15.021
Tied P-Value	<.0001
# Ties	0

87 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1204	1102552.000	915.741
Phase 2	420	216948.000	516.543

87 cases were omitted due to missing values.

TABLE. 2-2. Mann-Whitney test for 112th St Canal mouth (Station 1). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for TN
Grouping Variable: PHASE

U	170453.000
U Prime	380232.000
Z-Value	-12.007
P-Value	<.0001
Tied Z-Value	-12.007
Tied P-Value	<.0001
# Ties	7

49 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1205	1106847.000	918.545
Phase 2	457	275106.000	601.982

49 cases were omitted due to missing values.

Mann-Whitney U for TON
Grouping Variable: PHASE

U	9642.000
U Prime	23280.000
Z-Value	-6.526
P-Value	<.0001
Tied Z-Value	-6.526
Tied P-Value	<.0001
# Ties	0

1314 cases were omitted due to missing values.

Mann-Whitney Rank Info for TON
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	279	62340.000	223.441
Phase 2	118	16663.000	141.212

1314 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE

U	187205.000
U Prime	363480.000
Z-Value	-10.089
P-Value	<.0001
Tied Z-Value	-10.089
Tied P-Value	<.0001
# Ties	276

49 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1205	913820.000	758.357
Phase 2	457	468133.000	1024.361

49 cases were omitted due to missing values.

Mann-Whitney U for CHLA
Grouping Variable: PHASE

U	177630.000
U Prime	359374.000
Z-Value	-10.588
P-Value	<.0001
Tied Z-Value	-10.588
Tied P-Value	<.0001
# Ties	274

66 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1196	893436.000	747.020
Phase 2	449	460399.000	1025.388

66 cases were omitted due to missing values.

TABLE. 2-2. 112th St Canal mouth (Station 1) continuation…

Mann-Whitney U for SAL-S
Grouping Variable: PHASE

U	139402.500
U Prime	354430.500
Z-Value	-13.270
P-Value	<.0001
Tied Z-Value	-13.271
Tied P-Value	<.0001
# Ties	370

117 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1173	827953.500	705.843
Phase 2	421	443261.500	1052.878

117 cases were omitted due to missing values.

Mann-Whitney U for SAL-B
Grouping Variable: PHASE

U	107724.000
U Prime	300276.000
Z-Value	-13.646
P-Value	<.0001
Tied Z-Value	-13.646
Tied P-Value	<.0001
# Ties	331

248 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1088	700140.000	643.511
Phase 2	375	370776.000	988.736

248 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE

U	184641.500
U Prime	322663.500
Z-Value	-8.321
P-Value	<.0001
Tied Z-Value	-9.621
Tied P-Value	<.0001
# Ties	2

85 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1205	1049278.500	870.771
Phase 2	421	273472.500	649.578

85 cases were omitted due to missing values.

Mann-Whitney U for TN:TP
Grouping Variable: PHASE

U	128538.000
U Prime	377142.000
Z-Value	-15.021
P-Value	<.0001
Tied Z-Value	-15.021
Tied P-Value	<.0001
# Ties	0

87 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE

	Count	Sum Ranks	Mean Rank
Phase 1	1204	1102552.000	915.741
Phase 2	420	216948.000	516.543

87 cases were omitted due to missing values.

TABLE. 2-3. Mann-Whitney test for Offshore Station (Station 2). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1788.000
U Prime	4912.000
Z-Value	-4.860
P-Value	<.0001
Tied Z-Value	-4.860
Tied P-Value	<.0001
# Ties	1

6 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13957.000	104.157
Phase 2	50	3063.000	61.260

6 cases were omitted due to missing values.

Mann-Whitney U for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	92.000
U Prime	311.000
Z-Value	-2.817
P-Value	.0049
Tied Z-Value	-2.817
Tied P-Value	.0049
# Ties	0

146 cases were omitted due to missing values.

Mann-Whitney Rank Info for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	31	807.000	26.032
Phase 2	13	183.000	14.077

146 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2071.000
U Prime	4629.000
Z-Value	-3.980
P-Value	<.0001
Tied Z-Value	-3.980
Tied P-Value	<.0001
# Ties	9

6 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	11116.000	82.955
Phase 2	50	5904.000	118.080

6 cases were omitted due to missing values.

Mann-Whitney U for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1417.000
U Prime	5100.000
Z-Value	-5.841
P-Value	<.0001
Tied Z-Value	-5.841
Tied P-Value	<.0001
# Ties	12

8 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	10328.000	77.654
Phase 2	49	6325.000	129.082

8 cases were omitted due to missing values.

TABLE. 2-3. Offshore Station (Station 2) continuation…

Mann-Whitney U for SI(OH)4
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	130.000
U Prime	299.000
Z-Value	-2.061
P-Value	.0393
Tied Z-Value	-2.061
Tied P-Value	.0393
# Ties	1

144 cases were omitted due to missing values.

Mann-Whitney Rank Info for SI(OH)4
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	33	860.000	26.061
Phase 2	13	221.000	17.000

144 cases were omitted due to missing values.

Mann-Whitney U for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1604.500
U Prime	4375.500
Z-Value	-4.665
P-Value	<.0001
Tied Z-Value	-4.665
Tied P-Value	<.0001
# Ties	22

14 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	130	10119.500	77.842
Phase 2	46	5456.500	118.620

14 cases were omitted due to missing values.

Mann-Whitney U for DO-B X
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	148.500
U Prime	1309.500
Z-Value	-5.816
P-Value	<.0001
Tied Z-Value	-6.728
Tied P-Value	<.0001
# Ties	2

109 cases were omitted due to missing values.

Mann-Whitney Rank Info for DO-B X
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	54	1633.500	30.250
Phase 2	27	1687.500	62.500

109 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2422.000
U Prime	3742.000
Z-Value	-2.165
P-Value	.0304
Tied Z-Value	-2.651
Tied P-Value	.0080
# Ties	2

10 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	12787.000	95.425
Phase 2	46	3503.000	76.152

10 cases were omitted due to missing values.

TABLE. 2-3. Offshore Station (Station 2) continuation…

Mann-Whitney U for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1418.000
U Prime	4700.000
Z-Value	-5.417
P-Value	<.0001
Tied Z-Value	-5.417
Tied P-Value	<.0001
# Ties	0

11 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	13611.000	102.338
Phase 2	46	2499.000	54.326

11 cases were omitted due to missing values.

TABLE. 2-4. Mann-Whitney test for 112th St Canal head (Station 3). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for NOX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	106.000
U Prime	297.000
Z-Value	-2.457
P-Value	.0140
Tied Z-Value	-2.457
Tied P-Value	.0140
# Ties	0

146 cases were omitted due to missing values.

Mann-Whitney Rank Info for NOX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	31	793.000	25.581
Phase 2	13	197.000	15.154

146 cases were omitted due to missing values.

Mann-Whitney U for NO3
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	106.000
U Prime	297.000
Z-Value	-2.457
P-Value	.0140
Tied Z-Value	-2.457
Tied P-Value	.0140
# Ties	0

146 cases were omitted due to missing values.

Mann-Whitney Rank Info for NO3
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	31	793.000	25.581
Phase 2	13	197.000	15.154

146 cases were omitted due to missing values.

Mann-Whitney U for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2000.000
U Prime	4834.000
Z-Value	-4.354
P-Value	<.0001
Tied Z-Value	-4.354
Tied P-Value	<.0001
# Ties	1

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13879.000	103.575
Phase 2	51	3326.000	65.216

5 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2651.500
U Prime	4182.500
Z-Value	-2.352
P-Value	.0187
Tied Z-Value	-2.352
Tied P-Value	.0187
# Ties	8

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	11696.500	87.287
Phase 2	51	5508.500	108.010

5 cases were omitted due to missing values.

TABLE. 2-4. 112th St Canal head (Station 3) continuation…

Mann-Whitney U for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1715.000
U Prime	4935.000
Z-Value	-5.042
P-Value	<.0001
Tied Z-Value	-5.042
Tied P-Value	<.0001
# Ties	6

7 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	10626.000	79.895
Phase 2	50	6210.000	124.200

7 cases were omitted due to missing values.

Mann-Whitney U for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1860.500
U Prime	4296.500
Z-Value	-4.019
P-Value	<.0001
Tied Z-Value	-4.019
Tied P-Value	<.0001
# Ties	19

12 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	131	10506.500	80.202
Phase 2	47	5424.500	115.415

12 cases were omitted due to missing values.

Mann-Whitney U for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1784.500
U Prime	4278.500
Z-Value	-4.170
P-Value	<.0001
Tied Z-Value	-4.170
Tied P-Value	<.0001
# Ties	25

14 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	129	10169.500	78.833
Phase 2	47	5406.500	115.032

14 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2234.000
U Prime	4064.000
Z-Value	-2.961
P-Value	.0031
Tied Z-Value	-3.419
Tied P-Value	.0006
# Ties	2

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13109.000	97.828
Phase 2	47	3362.000	71.532

9 cases were omitted due to missing values.

TABLE. 2-4. 112th St Canal head (Station 3) continuation…

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2234.000
U Prime	4064.000
Z-Value	-2.961
P-Value	.0031
Tied Z-Value	-3.419
Tied P-Value	.0006
# Ties	2

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13109.000	97.828
Phase 2	47	3362.000	71.532

9 cases were omitted due to missing values.

Mann-Whitney U for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1954.000
U Prime	4344.000
Z-Value	-3.867
P-Value	.0001
Tied Z-Value	-3.867
Tied P-Value	.0001
# Ties	0

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13389.000	99.918
Phase 2	47	3082.000	65.574

9 cases were omitted due to missing values.

TABLE 2-5. Mann-Whitney test for 100th St Canal mouth (Station 4). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for NH4
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	119.000
U Prime	284.000
Z-Value	-2.122
P-Value	.0338
Tied Z-Value	-2.122
Tied P-Value	.0338
# Ties	0

146 cases were omitted due to missing values.

Mann-Whitney Rank Info for NH4
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	31	615.000	19.839
Phase 2	13	375.000	28.846

146 cases were omitted due to missing values.

Mann-Whitney U for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2063.000
U Prime	4771.000
Z-Value	-4.160
P-Value	<.0001
Tied Z-Value	-4.160
Tied P-Value	<.0001
# Ties	0

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13816.000	103.104
Phase 2	51	3389.000	66.451

5 cases were omitted due to missing values.

Mann-Whitney U for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	106.000
U Prime	297.000
Z-Value	-2.457
P-Value	.0140
Tied Z-Value	-2.457
Tied P-Value	.0140
# Ties	0

146 cases were omitted due to missing values.

Mann-Whitney Rank Info for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	31	793.000	25.581
Phase 2	13	197.000	15.154

146 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1504.500
U Prime	5329.500
Z-Value	-5.876
P-Value	<.0001
Tied Z-Value	-5.876
Tied P-Value	<.0001
# Ties	8

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	10549.500	78.728
Phase 2	51	6655.500	130.500

5 cases were omitted due to missing values.

TABLE. 2-5. 100th St Canal mouth (Station 4) continuation…

Mann-Whitney U for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1580.000
U Prime	5070.000
Z-Value	-5.465
P-Value	<.0001
Tied Z-Value	-5.465
Tied P-Value	<.0001
# Ties	11

7 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	10491.000	78.880
Phase 2	50	6345.000	126.900

7 cases were omitted due to missing values.

Mann-Whitney U for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1714.000
U Prime	4443.000
Z-Value	-4.502
P-Value	<.0001
Tied Z-Value	-4.503
Tied P-Value	<.0001
# Ties	24

12 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	131	10360.000	79.084
Phase 2	47	5571.000	118.532

12 cases were omitted due to missing values.

Mann-Whitney U for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1671.500
U Prime	4438.500
Z-Value	-4.596
P-Value	<.0001
Tied Z-Value	-4.596
Tied P-Value	<.0001
# Ties	25

13 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	130	10186.500	78.358
Phase 2	47	5566.500	118.436

13 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2449.000
U Prime	3849.000
Z-Value	-2.265
P-Value	.0235
Tied Z-Value	-2.649
Tied P-Value	.0081
# Ties	2

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	12894.000	96.224
Phase 2	47	3577.000	76.106

9 cases were omitted due to missing values.

TABLE. 2-5. 100th St Canal mouth (Station 4) continuation

Mann-Whitney U for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1301.000
U Prime	4997.000
Z-Value	-5.979
P-Value	<.0001
Tied Z-Value	-5.979
Tied P-Value	<.0001
# Ties	0

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	14042.000	104.791
Phase 2	47	2429.000	51.681

9 cases were omitted due to missing values.

TABLE. 2-6. Mann-Whitney test for 100th St Canal head (Station 5). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2068.000
U Prime	4766.000
Z-Value	-4.145
P-Value	<.0001
Tied Z-Value	-4.145
Tied P-Value	<.0001
# Ties	1

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13811.000	103.067
Phase 2	51	3394.000	66.549

5 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1785.500
U Prime	5048.500
Z-Value	-5.013
P-Value	<.0001
Tied Z-Value	-5.013
Tied P-Value	<.0001
# Ties	5

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	10830.500	80.825
Phase 2	51	6374.500	124.990

5 cases were omitted due to missing values.

Mann-Whitney U for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2056.000
U Prime	4594.000
Z-Value	-3.974
P-Value	<.0001
Tied Z-Value	-3.974
Tied P-Value	<.0001
# Ties	5

7 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	10967.000	82.459
Phase 2	50	5869.000	117.380

7 cases were omitted due to missing values.

Mann-Whitney U for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1870.500
U Prime	4286.500
Z-Value	-3.986
P-Value	<.0001
Tied Z-Value	-3.986
Tied P-Value	<.0001
# Ties	27

12 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	131	10516.500	80.279
Phase 2	47	5414.500	115.202

12 cases were omitted due to missing values.

TABLE. 2-6. 100th St Canal head (Station 5) continuation…

Mann-Whitney U for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1462.000
U Prime	4648.000
Z-Value	-5.291
P-Value	<.0001
Tied Z-Value	-5.292
Tied P-Value	<.0001
# Ties	26

13 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	130	9977.000	76.746
Phase 2	47	5776.000	122.894

13 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2250.500
U Prime	4047.500
Z-Value	-2.907
P-Value	.0036
Tied Z-Value	-3.363
Tied P-Value	.0008
# Ties	2

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13092.500	97.705
Phase 2	47	3378.500	71.883

9 cases were omitted due to missing values.

Mann-Whitney U for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1307.000
U Prime	4991.000
Z-Value	-5.960
P-Value	<.0001
Tied Z-Value	-5.960
Tied P-Value	<.0001
# Ties	0

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	14036.000	104.746
Phase 2	47	2435.000	51.809

9 cases were omitted due to missing values.

TABLE. 2-7. Mann-Whitney test for 97th St Canal mouth (Station 6). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2115.000
U Prime	4719.000
Z-Value	-4.000
P-Value	<.0001
Tied Z-Value	-4.000
Tied P-Value	<.0001
# Ties	1

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13764.000	102.716
Phase 2	51	3441.000	67.471

5 cases were omitted due to missing values.

Mann-Whitney U for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	121.000
U Prime	282.000
Z-Value	-2.071
P-Value	.0384
Tied Z-Value	-2.071
Tied P-Value	.0384
# Ties	0

146 cases were omitted due to missing values.

Mann-Whitney Rank Info for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	31	778.000	25.097
Phase 2	13	212.000	16.308

146 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1903.000
U Prime	4931.000
Z-Value	-4.652
P-Value	<.0001
Tied Z-Value	-4.652
Tied P-Value	<.0001
# Ties	10

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	10948.000	81.701
Phase 2	51	6257.000	122.686

5 cases were omitted due to missing values.

Mann-Whitney U for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2061.000
U Prime	4589.000
Z-Value	-3.958
P-Value	<.0001
Tied Z-Value	-3.958
Tied P-Value	<.0001
# Ties	6

7 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	10972.000	82.496
Phase 2	50	5864.000	117.280

7 cases were omitted due to missing values.

TABLE. 2-7. 97th St Canal mouth (Station 6) continuation…

Mann-Whitney U for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1617.500
U Prime	4492.500
Z-Value	-4.775
P-Value	<.0001
Tied Z-Value	-4.775
Tied P-Value	<.0001
# Ties	27

13 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	130	10132.500	77.942
Phase 2	47	5620.500	119.585

13 cases were omitted due to missing values.

Mann-Whitney U for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1626.500
U Prime	4389.500
Z-Value	-4.651
P-Value	<.0001
Tied Z-Value	-4.651
Tied P-Value	<.0001
# Ties	18

15 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	128	9882.500	77.207
Phase 2	47	5517.500	117.394

15 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2465.500
U Prime	3832.500
Z-Value	-2.212
P-Value	.0270
Tied Z-Value	-2.562
Tied P-Value	.0104
# Ties	2

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	12877.500	96.101
Phase 2	47	3593.500	76.457

9 cases were omitted due to missing values.

Mann-Whitney U for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1471.000
U Prime	4827.000
Z-Value	-5.429
P-Value	<.0001
Tied Z-Value	-5.429
Tied P-Value	<.0001
# Ties	0

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13872.000	103.522
Phase 2	47	2599.000	55.298

9 cases were omitted due to missing values.

TABLE. 2-8. Mann-Whitney test for 97th St Canal head (Station 7). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2236.000
U Prime	4598.000
Z-Value	-3.629
P-Value	.0003
Tied Z-Value	-3.629
Tied P-Value	.0003
# Ties	1

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13643.000	101.813
Phase 2	51	3562.000	69.843

5 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2203.000
U Prime	4631.000
Z-Value	-3.730
P-Value	.0002
Tied Z-Value	-3.730
Tied P-Value	.0002
# Ties	3

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	11248.000	83.940
Phase 2	51	5957.000	116.804

5 cases were omitted due to missing values.

Mann-Whitney U for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2458.000
U Prime	4192.000
Z-Value	-2.715
P-Value	.0066
Tied Z-Value	-2.715
Tied P-Value	.0066
# Ties	4

7 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	11369.000	85.481
Phase 2	50	5467.000	109.340

7 cases were omitted due to missing values.

Mann-Whitney U for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1747.000
U Prime	4410.000
Z-Value	-4.394
P-Value	<.0001
Tied Z-Value	-4.394
Tied P-Value	<.0001
# Ties	24

12 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	131	10393.000	79.336
Phase 2	47	5538.000	117.830

12 cases were omitted due to missing values.

TABLE. 2-8. 97th St Canal head (Station 7) continuation…

Mann-Whitney U for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1483.500
U Prime	4626.500
Z-Value	-5.220
P-Value	<.0001
Tied Z-Value	-5.220
Tied P-Value	<.0001
# Ties	22

13 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	130	9998.500	76.912
Phase 2	47	5754.500	122.436

13 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2256.500
U Prime	4041.500
Z-Value	-2.888
P-Value	.0039
Tied Z-Value	-3.464
Tied P-Value	.0005
# Ties	2

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13086.500	97.660
Phase 2	47	3384.500	72.011

9 cases were omitted due to missing values.

Mann-Whitney U for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1496.000
U Prime	4802.000
Z-Value	-5.348
P-Value	<.0001
Tied Z-Value	-5.348
Tied P-Value	<.0001
# Ties	0

9 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13847.000	103.336
Phase 2	47	2624.000	55.830

9 cases were omitted due to missing values.

TABLE. 2-9. Mann-Whitney test for 91th St Canal mouth (Station 8). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1945.000
U Prime	4705.000
Z-Value	-4.322
P-Value	<.0001
Tied Z-Value	-4.322
Tied P-Value	<.0001
# Ties	1

7 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	13616.000	102.376
Phase 2	50	3220.000	64.400

7 cases were omitted due to missing values.

Mann-Whitney U for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	75.000
U Prime	328.000
Z-Value	-3.254
P-Value	.0011
Tied Z-Value	-3.254
Tied P-Value	.0011
# Ties	0

146 cases were omitted due to missing values.

Mann-Whitney Rank Info for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	31	824.000	26.581
Phase 2	13	166.000	12.769

146 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2136.500
U Prime	4513.500
Z-Value	-3.722
P-Value	.0002
Tied Z-Value	-3.722
Tied P-Value	.0002
# Ties	8

7 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	11047.500	83.064
Phase 2	50	5788.500	115.770

7 cases were omitted due to missing values.

Mann-Whitney U for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2238.000
U Prime	4412.000
Z-Value	-3.404
P-Value	.0007
Tied Z-Value	-3.404
Tied P-Value	.0007
# Ties	5

7 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	11149.000	83.827
Phase 2	50	5687.000	113.740

7 cases were omitted due to missing values.

TABLE. 2-9. 91th St Canal mouth (Station 8) continuation…

Mann-Whitney U for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1580.000
U Prime	4530.000
Z-Value	-4.900
P-Value	<.0001
Tied Z-Value	-4.900
Tied P-Value	<.0001
# Ties	29

13 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	130	10095.000	77.654
Phase 2	47	5658.000	120.383

13 cases were omitted due to missing values.

Mann-Whitney U for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1529.000
U Prime	4534.000
Z-Value	-5.024
P-Value	<.0001
Tied Z-Value	-5.024
Tied P-Value	<.0001
# Ties	22

14 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	129	9914.000	76.853
Phase 2	47	5662.000	120.468

14 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1961.500
U Prime	4289.500
Z-Value	-3.791
P-Value	.0002
Tied Z-Value	-4.387
Tied P-Value	<.0001
# Ties	2

10 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	13200.500	99.252
Phase 2	47	3089.500	65.734

10 cases were omitted due to missing values.

Mann-Whitney U for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1424.000
U Prime	4694.000
Z-Value	-5.397
P-Value	<.0001
Tied Z-Value	-5.397
Tied P-Value	<.0001
# Ties	0

11 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	133	13605.000	102.293
Phase 2	46	2505.000	54.457

11 cases were omitted due to missing values.

TABLE. 2-10. Mann-Whitney test for 91th St Canal head (Station 9). Significant differences ($p<0.05$) between Phase 1 and Phase 2

Mann-Whitney U for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2299.000
U Prime	4535.000
Z-Value	-3.435
P-Value	.0006
Tied Z-Value	-3.435
Tied P-Value	.0006
# Ties	0

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13580.000	101.343
Phase 2	51	3625.000	71.078

5 cases were omitted due to missing values.

Mann-Whitney U for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	115.000
U Prime	288.000
Z-Value	-2.225
P-Value	.0261
Tied Z-Value	-2.225
Tied P-Value	.0261
# Ties	0

146 cases were omitted due to missing values.

Mann-Whitney Rank Info for TON
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	31	784.000	25.290
Phase 2	13	206.000	15.846

146 cases were omitted due to missing values.

Mann-Whitney U for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2444.000
U Prime	4390.000
Z-Value	-2.990
P-Value	.0028
Tied Z-Value	-2.990
Tied P-Value	.0028
# Ties	5

5 cases were omitted due to missing values.

Mann-Whitney Rank Info for TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	11489.000	85.739
Phase 2	51	5716.000	112.078

5 cases were omitted due to missing values.

Mann-Whitney U for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2648.000
U Prime	3952.000
Z-Value	-2.055
P-Value	.0399
Tied Z-Value	-2.055
Tied P-Value	.0399
# Ties	1

8 cases were omitted due to missing values.

Mann-Whitney Rank Info for CHLA
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	132	11426.000	86.561
Phase 2	50	5227.000	104.540

8 cases were omitted due to missing values.

TABLE. 2-10. 91th St Canal head (Station 9) continuation…

Mann-Whitney U for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1697.000
U Prime	4237.000
Z-Value	-4.305
P-Value	<.0001
Tied Z-Value	-4.305
Tied P-Value	<.0001
# Ties	18

15 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-S
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	129	10082.000	78.155
Phase 2	46	5318.000	115.609

15 cases were omitted due to missing values.

Mann-Whitney U for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1530.000
U Prime	4404.000
Z-Value	-4.871
P-Value	<.0001
Tied Z-Value	-4.871
Tied P-Value	<.0001
# Ties	27

15 cases were omitted due to missing values.

Mann-Whitney Rank Info for SAL-B
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	129	9915.000	76.860
Phase 2	46	5485.000	119.239

15 cases were omitted due to missing values.

Mann-Whitney U for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	2065.000
U Prime	4099.000
Z-Value	-3.335
P-Value	.0009
Tied Z-Value	-3.871
Tied P-Value	.0001
# Ties	2

10 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN-EX
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

	Count	Sum Ranks	Mean Rank
Phase 1	134	13144.000	98.090
Phase 2	46	3146.000	68.391

10 cases were omitted due to missing values.

Mann-Whitney U for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

U	1723.000
U Prime	4441.000
Z-Value	-4.457
P-Value	<.0001
Tied Z-Value	-4.457
Tied P-Value	<.0001
# Ties	0

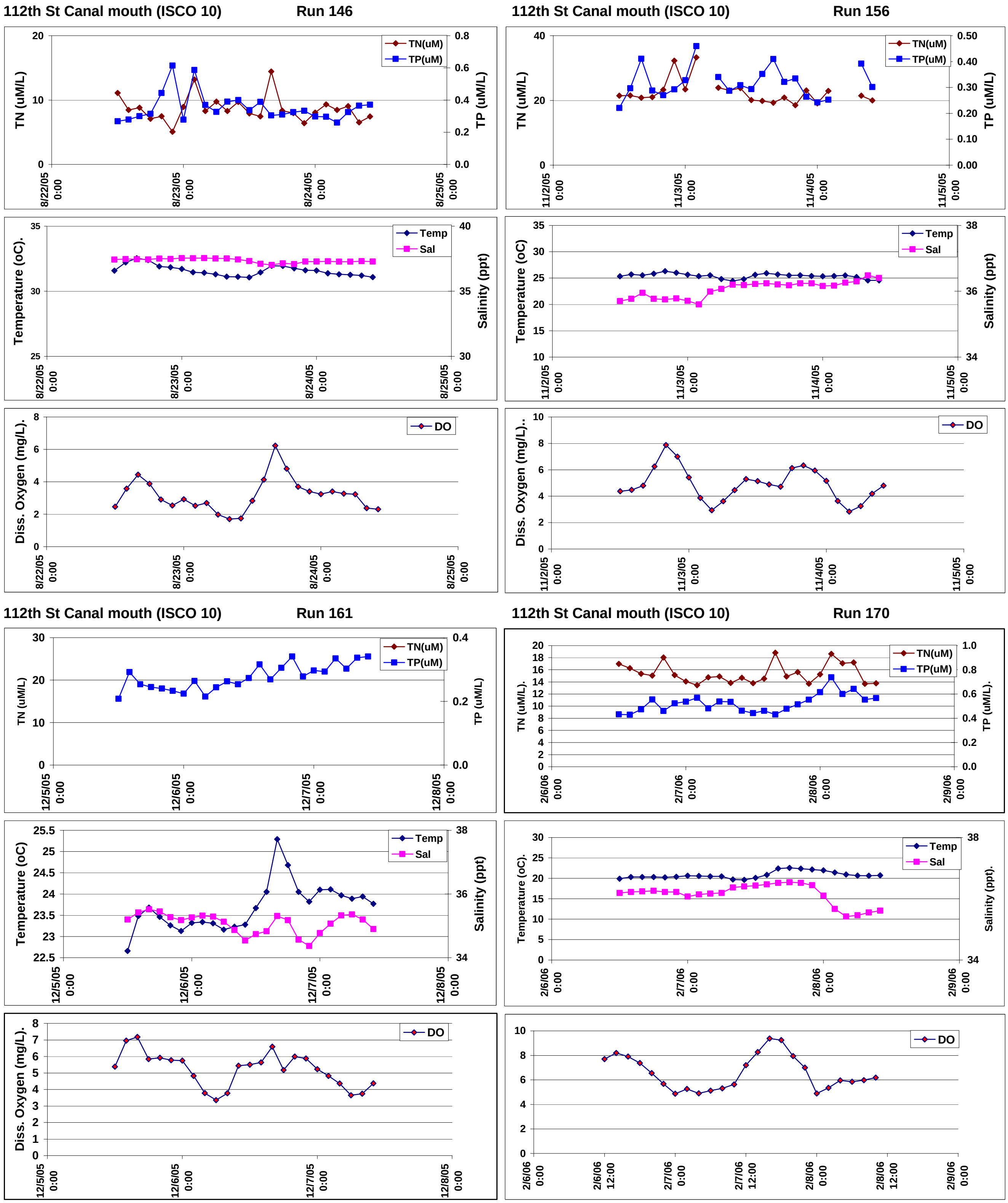
10 cases were omitted due to missing values.

Mann-Whitney Rank Info for TN:TP
Grouping Variable: PHASE
Inclusion criteria: Criteria 1 from Data (imported)

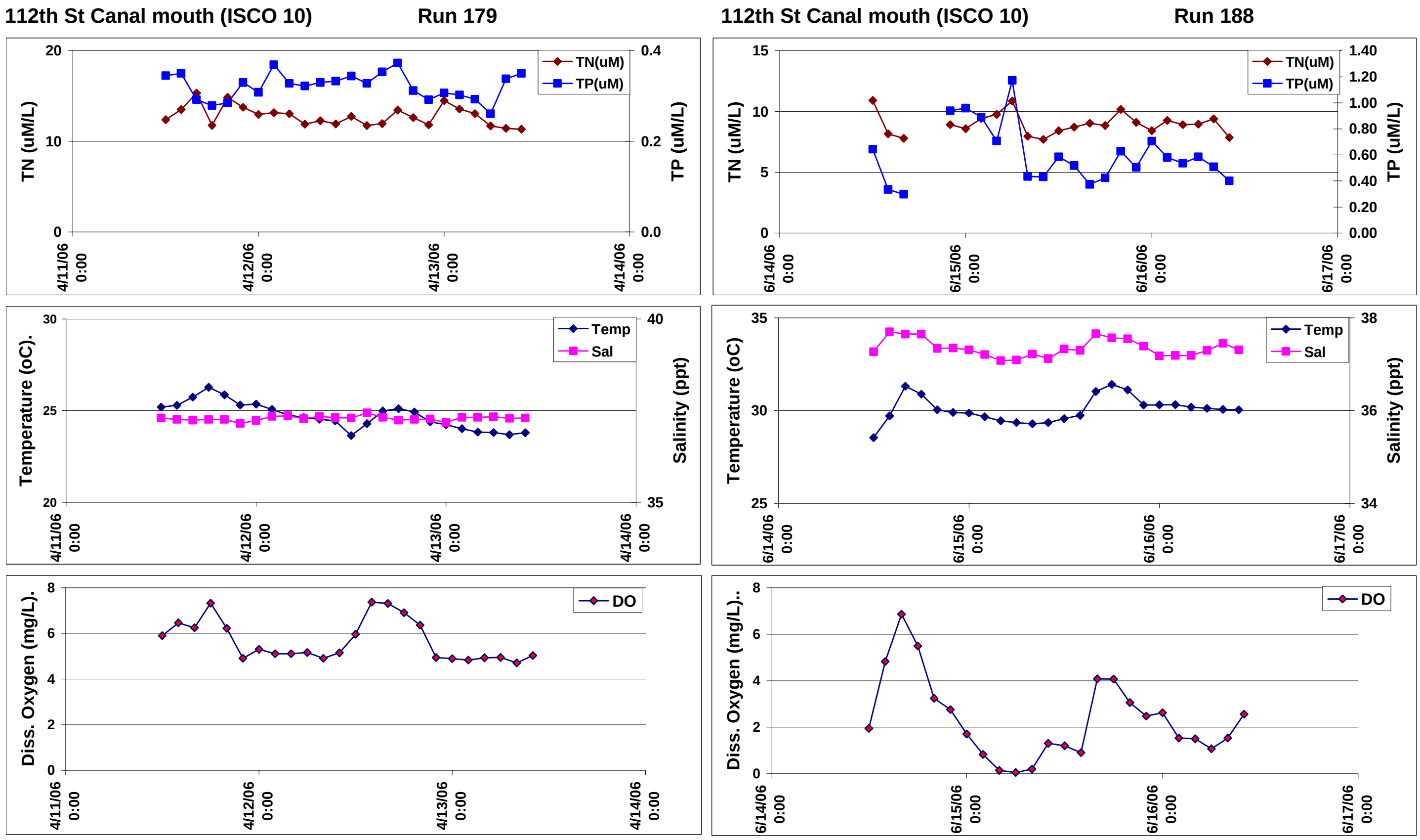
	Count	Sum Ranks	Mean Rank
Phase 1	134	13486.000	100.642
Phase 2	46	2804.000	60.957

10 cases were omitted due to missing values.

APPENDIX 3
TIME-SERIES FOR ISCO AND YSI RESULTS

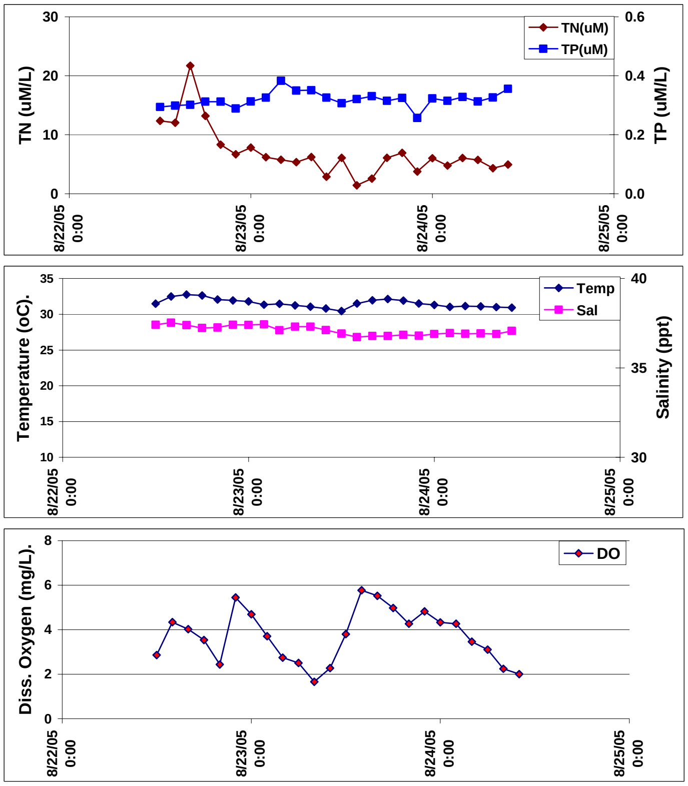


Appendix 3, Figure 3-1. Time-series for ISCO results at 112th St. Canal mouth.

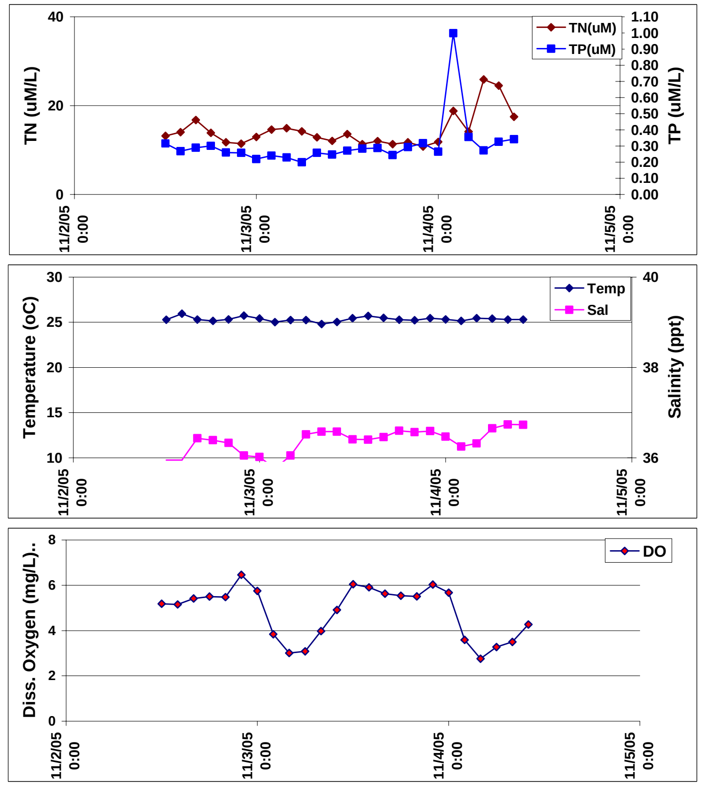


Appendix 3. Figure 3-1 cont. Time series for ISCO results for Station 10 (112th St Canal mouth)

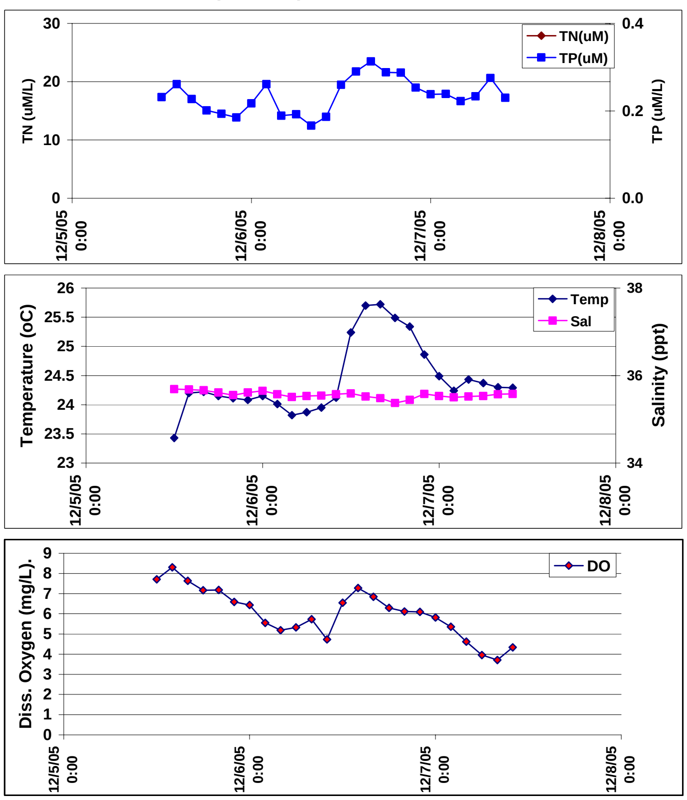
100th St Canal mouth (ISCO 11) Run 146



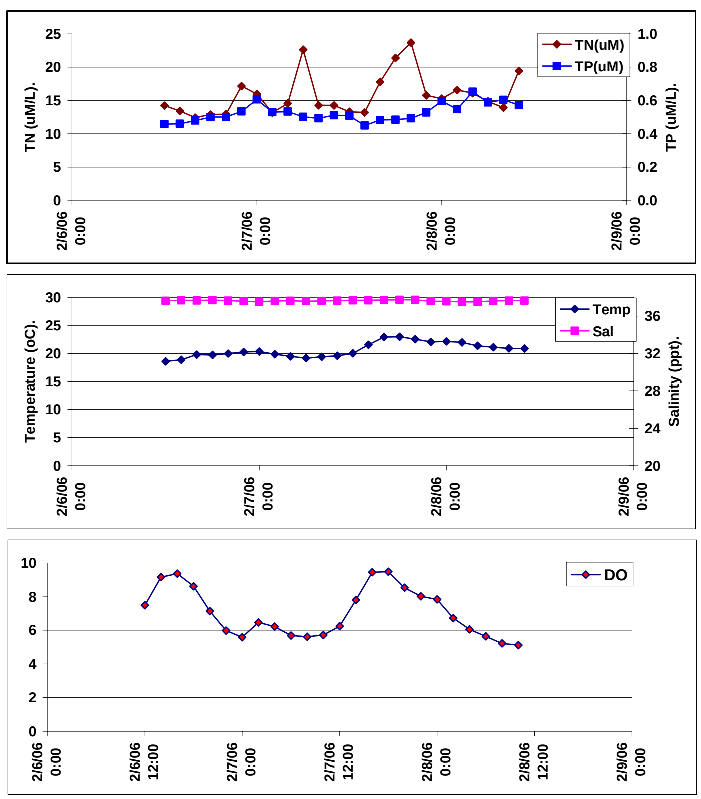
100th St Canal mouth (ISCO 11) Run 156



100th St Canal mouth (ISCO 11) Run 161

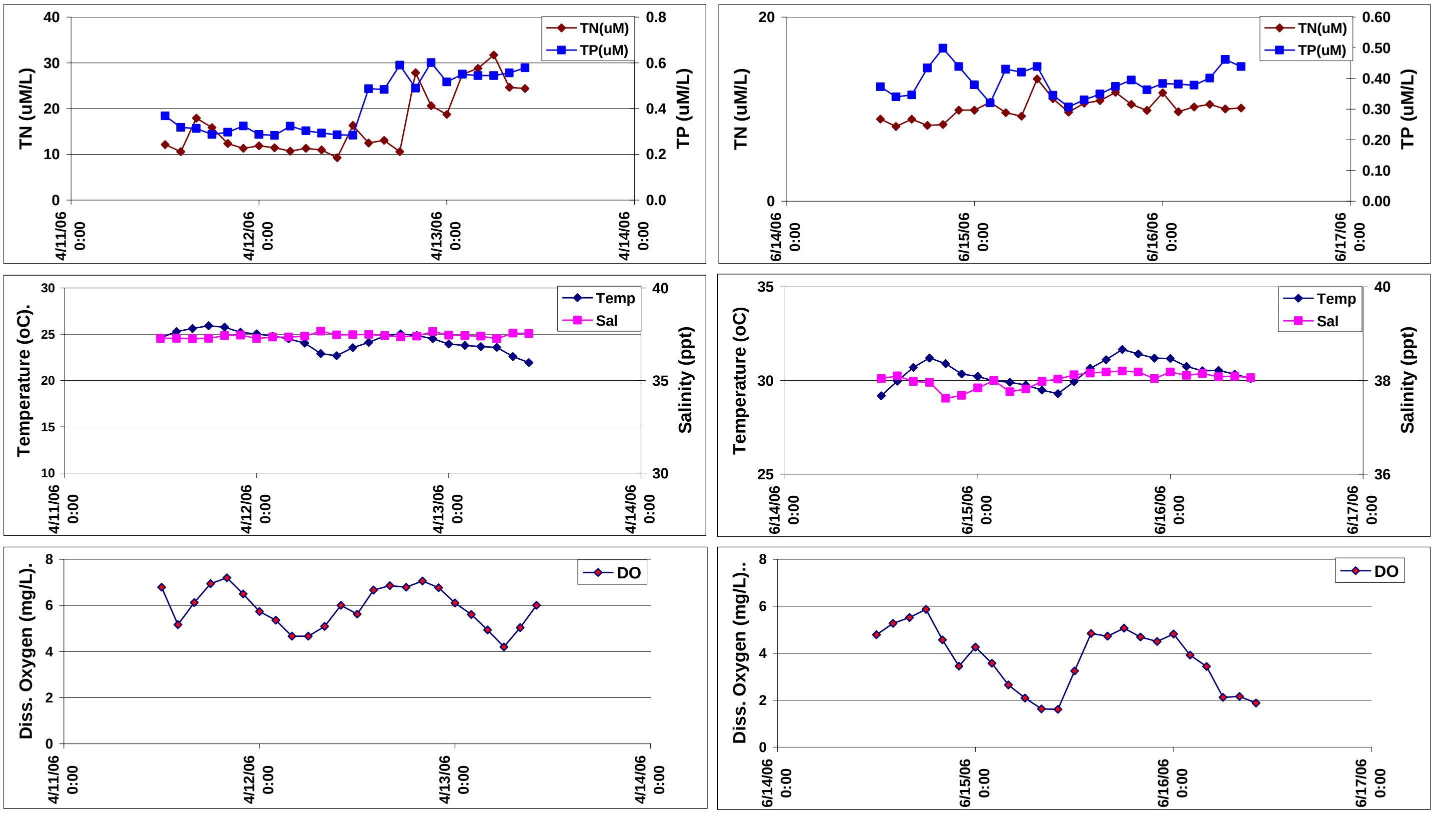


100th St Canal mouth (ISCO 11) Run 170



Appendix 3. Figure 3-2. Time-series for ISCO results at 100th St. Canal mouth.

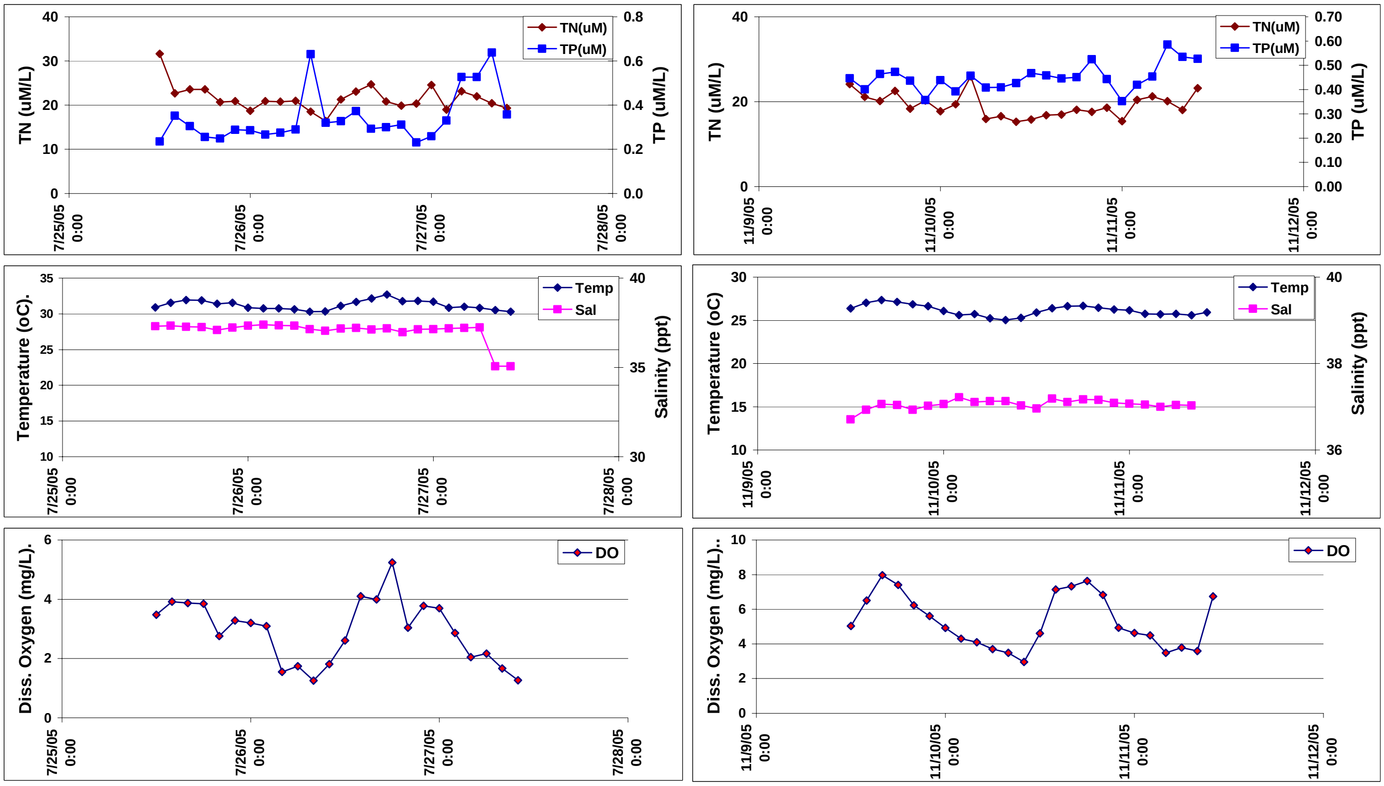
100th St Canal mouth (ISCO 11) Run 179 | 100th St Canal mouth (ISCO 11) Run 188



Appendix 3. Figure 3-2 cont. Time-series for ISCO results at 100th St. Canal mouth.

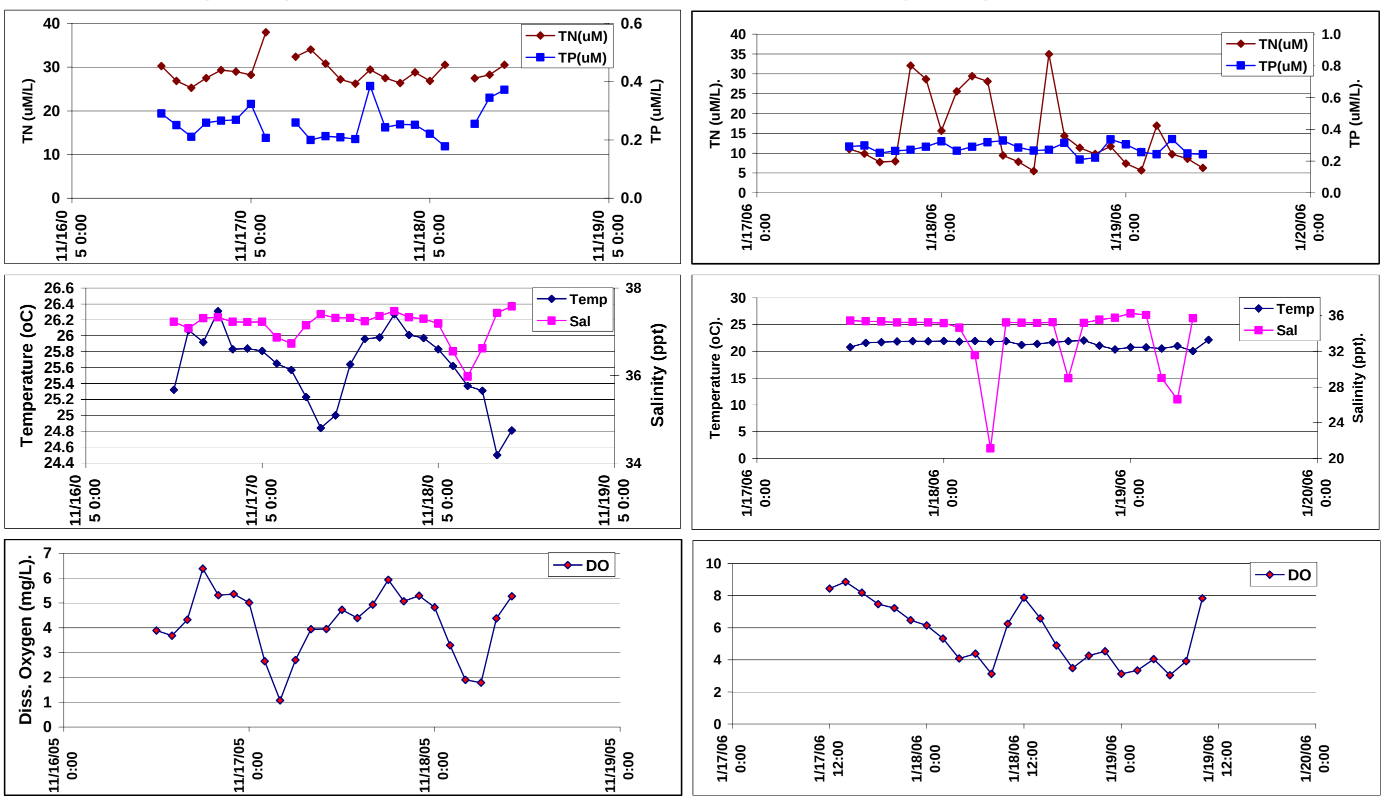
97th St Canal mouth (ISCO 12) Run 142

97th St Canal mouth (ISCO 12) Run 157

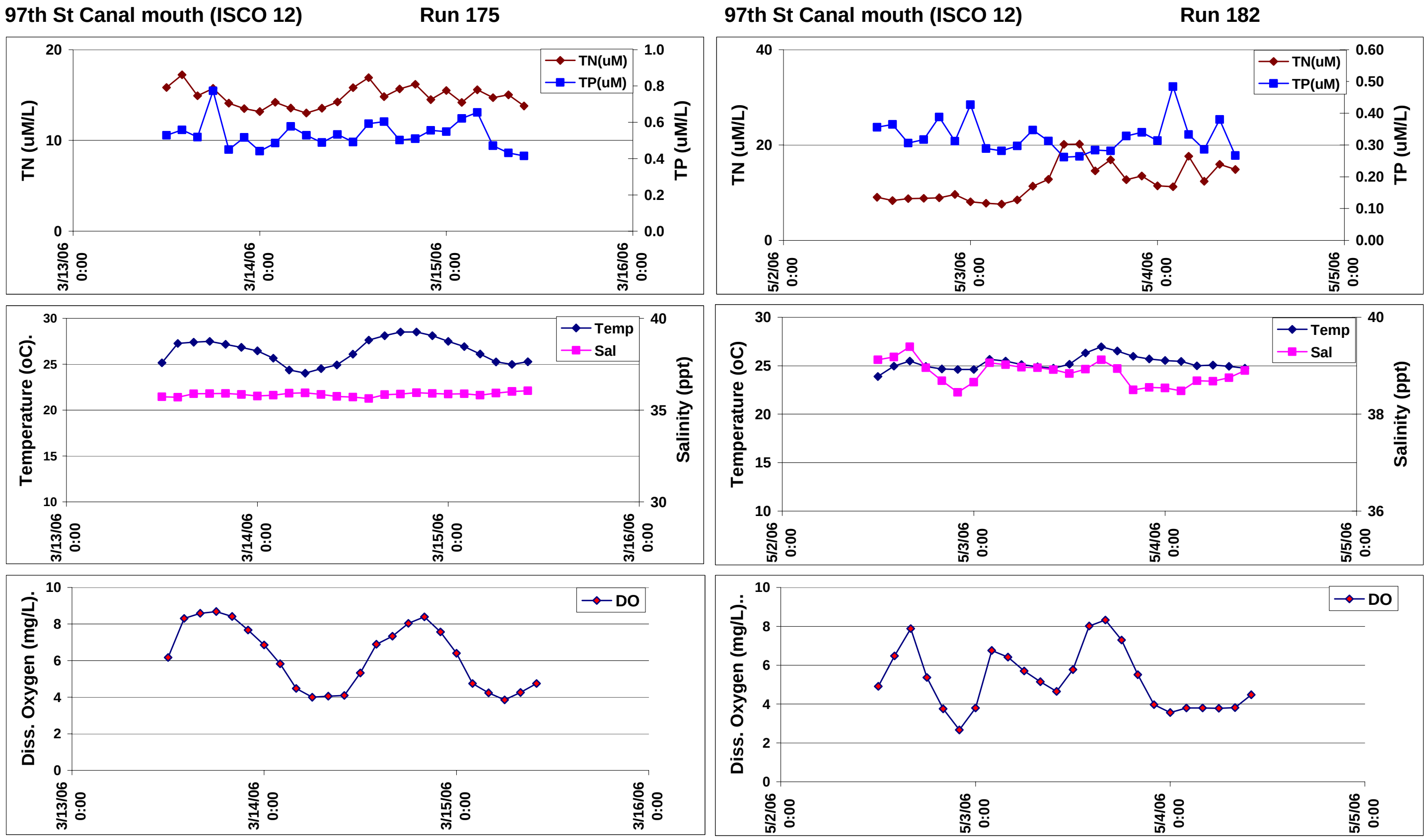


97th St Canal mouth (ISCO 12) Run 158

97th St Canal mouth (ISCO 12) Run 167

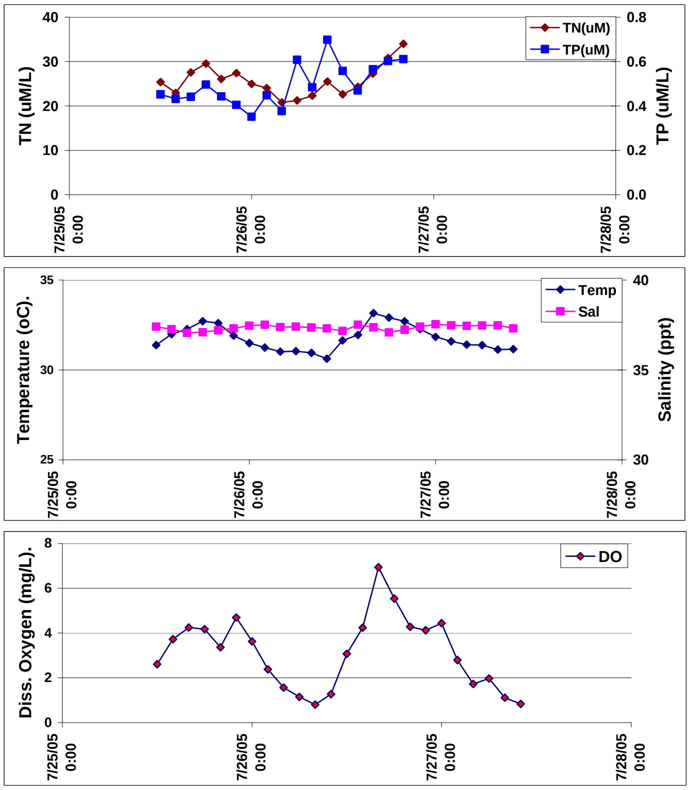


Appendix 3. Figure 3-3. Time-series for ISCO results at 97th St. Canal mouth.

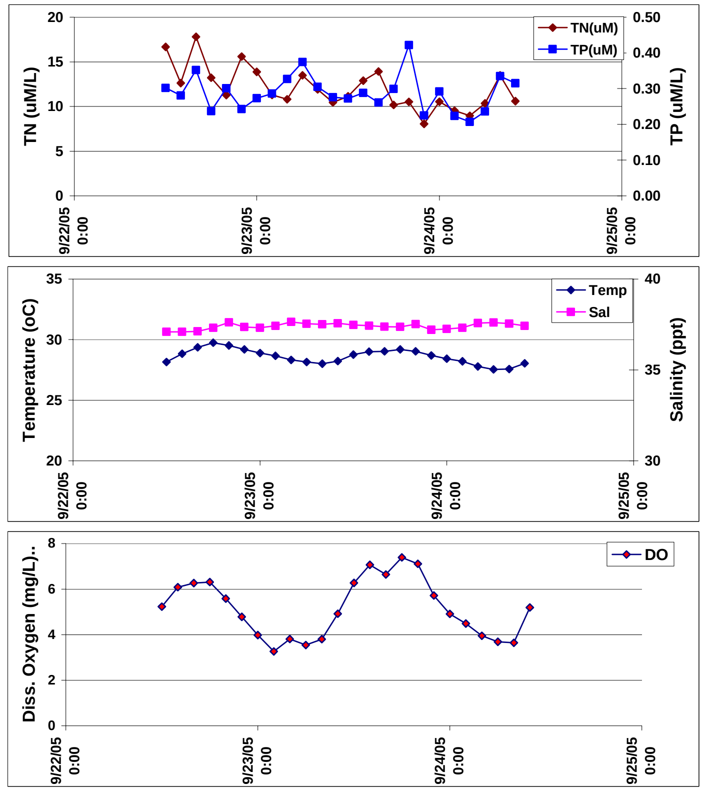


Appendix 3. Figure 3-3 cont. Time-series for ISCO results at 97th St. Canal mouth.

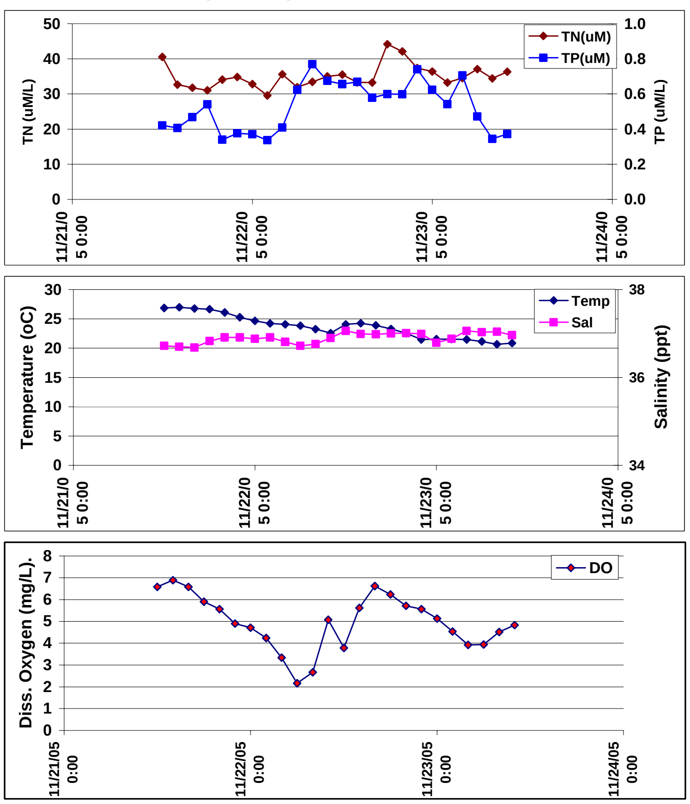
91th St Canal mouth (ISCO 13) Run 142



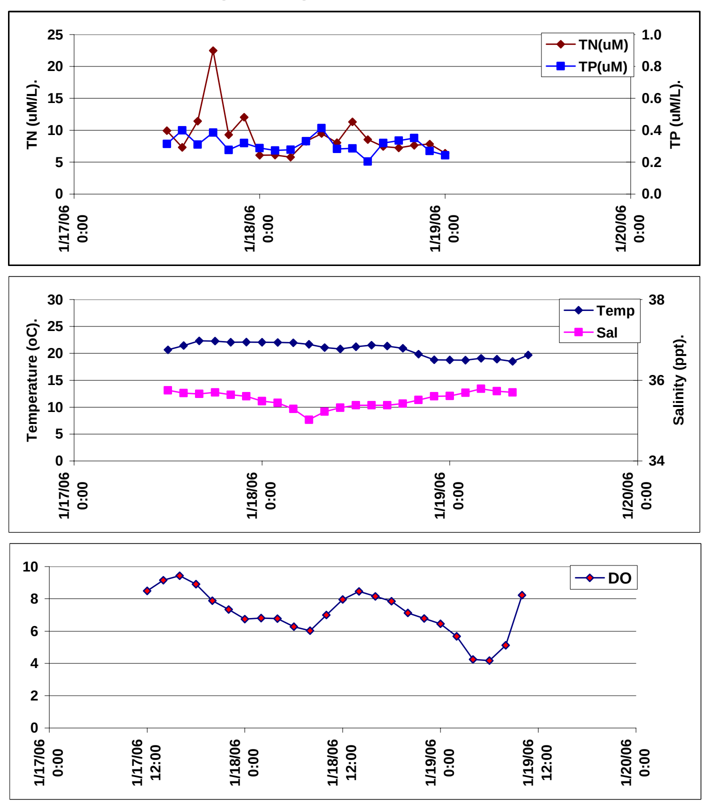
91th St Canal mouth (ISCO 13) Run 150



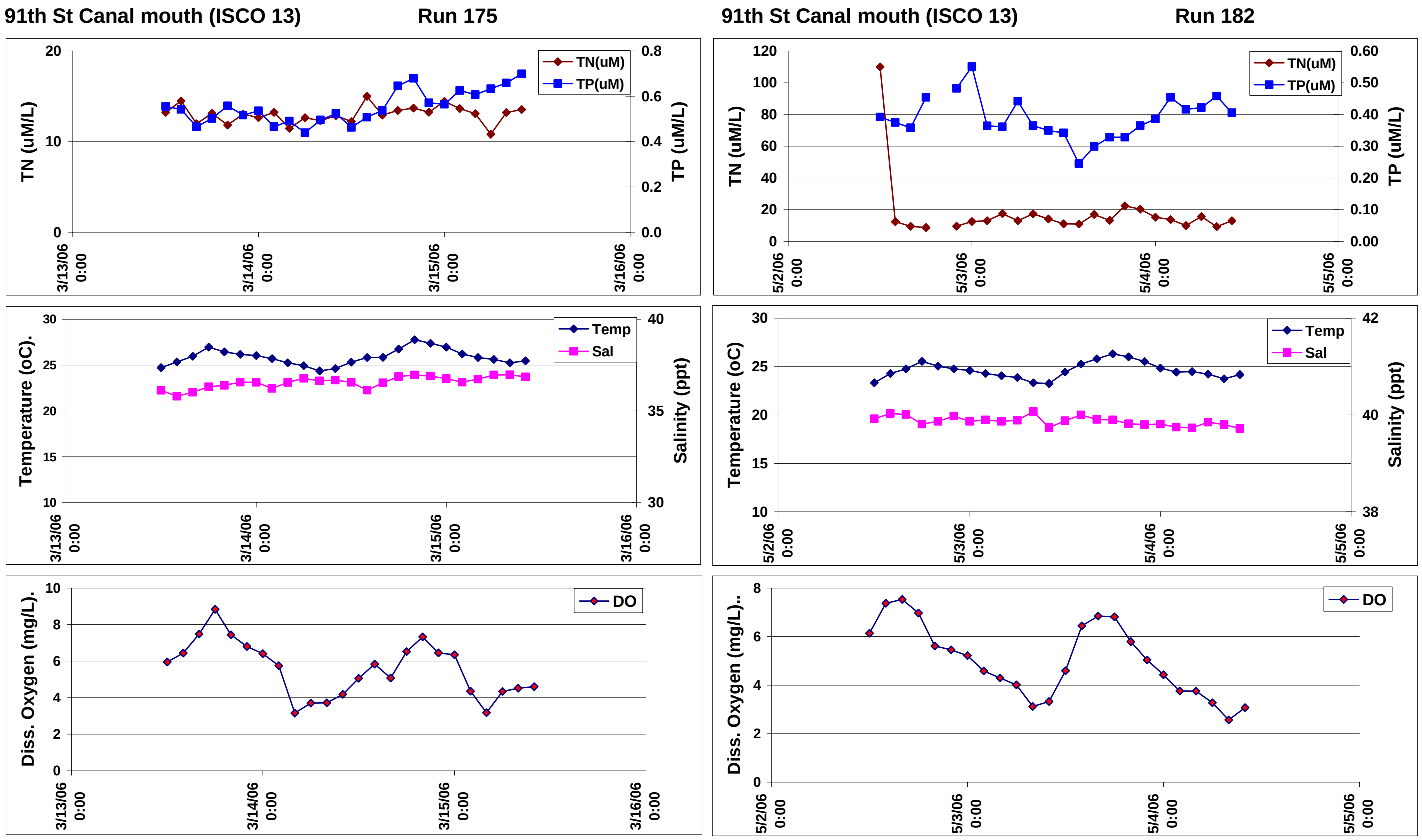
91th St Canal mouth (ISCO 13) Run 158



91th St Canal mouth (ISCO 13) Run 167



Appendix 3. Figure 3-4. Time-series for ISCO results at 91st St. Canal mouth.



Appendix 3. Figure 3-4 cont. Time-series for ISCO results at 91st St. Canal mouth.

APPENDIX 4
SUMMARY OF STATISTICS FOR ALL VARIABLES

	Fecal Coliforms (CFU), Total	Fecal Coliforms (CFU), Phase 1	Fecal Coliforms (CFU), Phase 2
Mean	33.045	37.343	22.629
Std. Dev.	103.957	109.861	87.254
Std. Error	2.578	3.238	4.004
Count	1626	1151	475
Minimum	1.000	1.000	1.000
Maximum	1520.000	1520.000	801.000
# Missing	0	0	0
Variance	10806.986	12069.431	7613.318
Coef. Var.	3.146	2.942	3.856
Range	1519.000	1519.000	800.000
Sum	53731.000	42982.000	10749.000
Sum Squares	19336887.000	15484930.000	3851957.000
Geom. Mean	7.593	8.552	5.693
Harm. Mean	3.373	3.363	3.397
Skewness	7.304	7.094	7.796
Kurtosis	68.544	66.422	64.933
Median	6.000	8.000	4.000
IQR	18.000	20.000	10.000
Mode	2.000	1.000	2.000
10% Tr. Mean	11.569	13.936	6.769
MAD	5.000	7.000	2.000

	Enterococci (CFU), Total	Enterococci (CFU), Phase 1	Enterococci (CFU), Phase 2
Mean	20.906	21.860	18.594
Std. Dev.	52.009	53.363	48.547
Std. Error	1.290	1.573	2.227
Count	1626	1151	475
Minimum	1.000	1.000	1.000
Maximum	607.000	607.000	576.000
# Missing	0	0	0
Variance	2704.898	2847.607	2356.799
Coef. Var.	2.488	2.441	2.611
Range	606.000	606.000	575.000
Sum	33993.000	25161.000	8832.000
Sum Squares	5106113.000	3824771.000	1281342.000
Geom. Mean	6.474	6.414	6.622
Harm. Mean	3.239	3.025	3.907
Skewness	5.931	5.604	6.922
Kurtosis	45.335	40.976	59.521
Median	5.000	5.000	5.000
IQR	13.000	14.000	10.000
Mode	2.000	1.000	2.000
10% Tr. Mean	9.108	9.325	8.551
MAD	4.000	4.000	3.000

	NOX, Total	NOX, Phase 1	NOX, Phase 2	NO3, Total	NO3, Phase 1	NO3, Phase 2
Mean	.046	.043	.052	.044	.042	.049
Std. Dev.	.078	.062	.108	.077	.061	.106
Std. Error	.004	.004	.010	.004	.004	.010
Count	396	279	117	396	279	117
Minimum	2.625E-4	.001	2.625E-4	0.000	0.000	2.030E-4
Maximum	.763	.486	.763	.759	.481	.759
# Missing	1268	927	341	1268	927	341
Variance	.006	.004	.012	.006	.004	.011
Coef. Var.	1.705	1.424	2.079	1.761	1.469	2.158
Range	.763	.485	.763	.759	.481	.759
Sum	18.190	12.110	6.080	17.364	11.598	5.766
Sum Squares	3.257	1.588	1.669	3.115	1.519	1.596
Geom. Mean	.020	.021	.018	•	•	.016
Harm. Mean	.009	.009	.007	•	•	.005
Skewness	4.234	3.181	3.963	4.294	3.206	4.047
Kurtosis	24.545	12.989	18.152	25.356	13.225	18.995
Median	.021	.022	.017	.019	.020	.015
IQR	.035	.039	.026	.035	.039	.025
Mode	•	•	•	0.000	0.000	•
10% Tr. Mean	.028	.030	.025	.026	.028	.023
MAD	.014	.015	.011	.013	.014	.010

	NH4, Total	NH4, Phase 1	NH4, Phase 2	DIN, Total	DIN, Phase 1	DIN, Phase 2
Mean	.024	.023	.028	.070	.067	.079
Std. Dev.	.022	.022	.021	.081	.065	.110
Std. Error	.001	.001	.002	.004	.004	.010
Count	396	279	117	397	279	118
Minimum	.002	.002	.002	.002	.002	.005
Maximum	.222	.222	.153	.769	.497	.769
# Missing	1268	927	341	1267	927	340
Variance	4.845E-4	.001	4.334E-4	.007	.004	.012
Coef. Var.	.900	.969	.752	1.151	.970	1.392
Range	.220	.220	.150	.767	.495	.764
Sum	9.681	6.444	3.237	27.899	18.568	9.331
Sum Squares	.428	.288	.140	4.551	2.395	2.156
Geom. Mean	.019	.018	.022	.048	.047	.048
Harm. Mean	.014	.014	.016	.033	.033	.032
Skewness	4.714	5.585	2.406	3.764	2.709	3.606
Kurtosis	33.894	42.784	10.014	20.140	9.723	15.330
Median	.020	.019	.024	.048	.049	.047
IQR	.016	.014	.021	.046	.046	.041
Mode	•	•	•	.033	•	•
10% Tr. Mean	.021	.020	.025	.054	.054	.054
MAD	.008	.007	.010	.021	.021	.019

	TON, Total	TON, Phase 1	TON, Phase 2	TP, Total	TP, Phase 1	TP, Phase 2
Mean	.272	.301	.205	.014	.012	.017
Std. Dev.	.161	.161	.139	.012	.012	.014
Std. Error	.008	.010	.013	3.063E-4	3.314E-4	.001
Count	397	279	118	1662	1205	457
Minimum	.004	.005	.004	.001	.001	.004
Maximum	1.083	1.083	.691	.284	.284	.161
# Missing	1267	927	340	2	1	1
Variance	.026	.026	.019	1.560E-4	1.323E-4	2.043E-4
Coef. Var.	.591	.536	.681	.918	.929	.848
Range	1.079	1.077	.687	.283	.283	.157
Sum	108.173	84.004	24.169	22.616	14.917	7.700
Sum Squares	39.759	32.533	7.226	.567	.344	.223
Geom. Mean	.222	.257	.157	.011	.010	.014
Harm. Mean	.137	.182	.087	.009	.008	.012
Skewness	1.265	1.318	1.351	8.907	12.053	4.815
Kurtosis	2.602	2.946	1.876	150.571	259.955	32.922
Median	.240	.277	.186	.011	.010	.013
IQR	.181	.168	.129	.008	.008	.008
Mode	•	•	•	•	.008	•
10% Tr. Mean	.256	.284	.187	.012	.011	.014
MAD	.088	.083	.067	.004	.004	.004

	SRP, Total	SRP, Phase 1	SRP, Phase 2	CHLA, Total	CHLA, Phase 1	CHLA, Phase 2
Mean	.003	.003	.003	1.660	1.333	2.528
Std. Dev.	.003	.003	.004	4.437	3.141	6.701
Std. Error	1.632E-4	1.743E-4	3.600E-4	.109	.091	.316
Count	378	263	115	1645	1196	449
Minimum	5.425E-5	5.425E-5	9.300E-5	-2.511E-4	-2.511E-4	.111
Maximum	.023	.023	.023	88.758	39.404	88.758
# Missing	1286	943	343	19	10	9
Variance	1.006E-5	7.986E-6	1.491E-5	19.690	9.866	44.899
Coef. Var.	1.099	.996	1.288	2.674	2.355	2.651
Range	.023	.023	.023	88.759	39.404	88.647
Sum	1.091	.746	.345	2729.889	1594.837	1135.052
Sum Squares	.007	.004	.003	36900.133	13916.097	22984.036
Geom. Mean	.002	.002	.002	•	•	1.012
Harm. Mean	.001	.001	.001	•	•	.671
Skewness	2.959	2.748	2.922	8.616	6.158	7.191
Kurtosis	11.588	11.321	9.408	115.395	49.177	70.448
Median	.002	.002	.002	.559	.477	.771
IQR	.002	.002	.002	.776	.654	1.114
Mode	•	•	•	.335	.335	•
10% Tr. Mean	.002	.002	.002	.759	.644	1.093
MAD	.001	.001	.001	.294	.263	.388

	TOC, Total	TOC, Phase 1	TOC, Phase 2	SI(OH)4, Total	SI(OH)4, Phase 1	SI(OH)4, Phase 2
Mean	2.874	2.753	3.172	.263	.264	.259
Std. Dev.	2.297	.679	4.136	.145	.137	.163
Std. Error	.114	.040	.382	.007	.008	.015
Count	405	288	117	414	297	117
Minimum	.992	1.538	.992	.009	.029	.009
Maximum	36.905	7.501	36.905	.774	.774	.754
# Missing	1259	918	341	1250	909	341
Variance	5.276	.461	17.109	.021	.019	.027
Coef. Var.	.799	.247	1.304	.552	.521	.628
Range	35.914	5.963	35.914	.764	.744	.745
Sum	1164.037	792.915	371.122	108.710	78.385	30.326
Sum Squares	5477.149	2315.352	3161.798	37.218	26.281	10.937
Geom. Mean	2.660	2.681	2.608	.221	.227	.207
Harm. Mean	2.546	2.615	2.391	.169	.187	.136
Skewness	12.112	1.930	7.013	.908	.863	.975
Kurtosis	163.867	9.364	50.527	.625	.691	.368
Median	2.666	2.684	2.639	.237	.249	.203
IQR	.806	.796	.996	.180	.169	.221
Mode	•	•	•	•	•	•
10% Tr. Mean	2.674	2.702	2.572	.249	.251	.244
MAD	.406	.391	.441	.088	.085	.078

	SAL-S, Total	SAL-S, Phase 1	SAL-S, Phase 2	SAL-B, Total	SAL-B, Phase 1	SAL-B, Phase 2
Mean	35.896	35.542	36.862	36.291	35.933	37.309
Std. Dev.	1.890	1.814	1.751	1.755	1.727	1.403
Std. Error	.047	.053	.084	.046	.052	.072
Count	1603	1173	430	1471	1088	383
Minimum	25.600	25.600	28.830	26.270	26.270	33.860
Maximum	41.430	40.800	41.430	42.360	42.360	41.510
# Missing	61	33	28	193	118	75
Variance	3.572	3.292	3.066	3.082	2.983	1.967
Coef. Var.	.053	.051	.048	.048	.048	.038
Range	15.830	15.200	12.600	16.090	16.090	7.650
Sum	57541.730	41690.900	15850.830	53384.043	39094.853	14289.190
Sum Squares	2071255.956	1485640.969	585614.986	1941889.545	1408028.600	533860.945
Geom. Mean	35.845	35.494	36.820	36.247	35.890	37.283
Harm. Mean	35.792	35.445	36.776	36.203	35.846	37.257
Skewness	-.609	-.748	-.606	-.604	-.783	.401
Kurtosis	1.730	1.897	2.414	2.231	2.420	.394
Median	35.980	35.560	36.895	36.520	36.085	37.190
IQR	2.178	2.063	2.100	2.028	1.950	1.915
Mode	•	•	•	35.800	35.800	•
10% Tr. Mean	35.992	35.661	36.902	36.374	36.058	37.254
MAD	1.090	1.080	1.065	1.030	.985	.950

	DO-S, Total	DO-S, Phase 1	DO-S, Phase 2	DO-B, Total	DO-B, Phase 1	DO-B, Phase 2
Mean	3.837	3.840	3.826	3.306	3.323	3.258
Std. Dev.	1.464	1.442	1.525	1.700	1.708	1.677
Std. Error	.037	.042	.074	.045	.052	.087
Count	1583	1162	421	1459	1084	375
Minimum	.130	.130	.380	.100	.100	.220
Maximum	10.730	8.680	10.730	10.060	9.060	10.060
# Missing	81	44	37	205	122	83
Variance	2.145	2.081	2.326	2.890	2.917	2.814
Coef. Var.	.382	.376	.399	.514	.514	.515
Range	10.600	8.550	10.350	9.960	8.960	9.840
Sum	6073.250	4462.650	1610.600	4823.917	3602.137	1221.780
Sum Squares	26692.913	19554.315	7138.598	20162.434	15129.445	5032.989
Geom. Mean	3.535	3.545	3.507	2.706	2.711	2.691
Harm. Mean	3.142	3.158	3.099	1.820	1.796	1.891
Skew ness	.570	.462	.823	.289	.241	.430
Kurtosis	.573	.147	1.499	-.062	-.200	.384
Median	3.670	3.700	3.600	3.300	3.336	3.170
IQR	1.890	1.890	1.860	2.245	2.315	2.010
Mode	3.500	3.500	•	3.800	•	•
10% Tr. Mean	3.761	3.774	3.723	3.263	3.286	3.196
MAD	.930	.945	.910	1.120	1.155	1.020

	TEMP-S, Total	TEMP-S, Phase 1	TEMP-S, Phase 2	TEMP-B, Total	TEMP-B, Phase 1	TEMP-B, Phase 2
Mean	26.704	26.888	26.202	26.037	26.218	25.522
Std. Dev.	3.678	3.537	3.999	3.606	3.470	3.928
Std. Error	.092	.103	.193	.094	.105	.201
Count	1598	1168	430	1471	1088	383
Minimum	13.970	13.970	15.160	14.430	14.430	15.690
Maximum	32.640	32.450	32.640	32.300	32.300	32.140
# Missing	66	38	28	193	118	75
Variance	13.529	12.508	15.992	13.006	12.041	15.427
Coef. Var.	.138	.132	.153	.139	.132	.154
Range	18.670	18.480	17.480	17.870	17.870	16.450
Sum	42672.290	31405.260	11267.030	38300.252	28525.152	9775.100
Sum Squares	1161107.571	859023.736	302083.836	1016337.950	760960.123	255377.827
Geom. Mean	26.426	26.632	25.877	25.762	25.964	25.196
Harm. Mean	26.123	26.348	25.530	25.458	25.682	24.843
Skew ness	-.726	-.849	-.422	-.777	-.864	-.532
Kurtosis	-.194	.077	-.677	-.058	.160	-.522
Median	27.675	27.930	26.095	26.980	27.125	25.740
IQR	5.430	4.975	5.790	5.108	4.755	5.345
Mode	29.700	•	•	26.800	•	•
10% Tr. Mean	27.029	27.227	26.454	26.381	26.556	25.808
MAD	2.425	2.150	2.945	2.330	2.115	2.760

	%SAT-S, Total	%SAT-S, Phase 1	%SAT-S, Phase 2	%SAT_B, Total	%SAT_B, Phase 1	%SAT_B, Phase 2
Mean	56.341	56.425	56.110	48.150	48.393	47.450
Std. Dev.	20.306	20.160	20.724	23.815	24.081	23.049
Std. Error	.511	.592	1.011	.624	.732	1.190
Count	1581	1161	420	1456	1081	375
Minimum	0.000	0.000	5.604	0.000	0.000	3.302
Maximum	147.349	121.257	147.349	149.647	128.963	149.647
# Missing	83	45	38	208	125	83
Variance	412.316	406.442	429.490	567.163	579.894	531.258
Coef. Var.	.360	.357	.369	.495	.498	.486
Range	147.349	121.257	141.745	149.647	128.963	146.345
Sum	89075.277	65509.147	23566.130	70106.699	52312.814	17793.886
Sum Squares	5670058.909	4167810.877	1502248.032	4200874.847	3157858.085	1043016.762
Geom. Mean	•	•	51.936	•	•	39.760
Harm. Mean	•	•	46.314	•	•	28.387
Skewness	.431	.341	.663	.162	.118	.299
Kurtosis	.603	.282	1.408	-.001	-.177	.608
Median	54.731	55.291	53.570	49.089	49.768	47.342
IQR	26.491	26.592	26.285	30.798	32.186	27.920
Mode	•	•	•	0.000	0.000	•
10% Tr. Mean	55.587	55.763	55.106	47.971	48.268	47.125
MAD	13.191	13.197	12.299	15.356	15.794	13.879