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Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina
Year 5: June 1, 2004 – May 31, 2005

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ABSTRACT

Prior to the Wilmington Harbor Deepening Project, the Corps of Engineers initiated began a monitoring project that targeted potential upstream changes to wetlands along the Cape Fear River drainage. Individual monitoring components include 1) detailed water levels and salinity during each tidal cycle (365 days/year) at 12 stations along the major channel and tributaries, 2) flooding depth, duration, and salinity of floodwater at nine wetlands adjacent to river monitoring stations, 3) changes in the biogeochemistry of soils in these wetlands, 4) changes in animals (infauna and epifauna) associated with these wetlands, and 5) change in salt-sensitive vegetation. Stations were located along channels where slight changes in salinity of flooding depth would likely have the greatest impact. This report includes data collected from June 2004 through May 2005.

More than 1400 tide ranges were measured between June 1, 2004 and May 31, 2005 and comprise the database for water level comparisons. The existing database allows for analyses of changes in tidal amplitude as well as changes of ebb and flood duration. The correlation of tidal range from the base station at Ft Caswell with the predicted tidal range remained very good with the slopes of regressions higher than in 2003 and 2004, but comparable to previous years. Tidal ranges at estuarine stations were fairly constant, and higher than upstream stations. Water levels in the most upstream sites and the inner Town Creek station continued to be affected by discharge rates in the river or local drainage area. This reporting period was characterized by fewer high discharge events than in the 2002-2003 and 2003-2004 reporting periods, which was reflected in generally higher R^2 values for almost all stations this year compared to last year. Some significant differences in yearly mean tidal ranges between this reporting period and 2003-2004 were observed. Those that were observed occurred primarily in the most upstream mainstem stations. In general, tidal ranges at the three most upstream sites in the mainstem Cape Fear River and Northeast Cape Fear were significantly lower than the mean ranges reported for these stations during the first year of monitoring. Surprisingly, the same was observed for a station at the mouth of the river. The fact that mean tidal range observed at Ft Caswell was again significantly less than in Year 1 may complicate interpretation of the results, as this station was initially expected to be unimpacted by river widening activities. This difference may be part of a long-term harmonic that can be determined through an examination of the long-term database at the Corps station in Wilmington Harbor. As reported last year, mean monthly maximum water levels for this reporting period were not significantly different from the values reported for the previous monitoring period (2003-2004). And again, with the exception of one station, there was no significant difference in mean monthly minimum water level between this reporting period and last year. Comparisons of the regression slopes when tidal range at each site was regressed against the base station tidal range yielded

significant differences between this reporting period and the previous reporting period for all but four stations. When the slopes from this reporting period were compared to slopes calculated for Year 1 (2000-2001), all sites yielded a significant difference between years except for two sites.

At nine of the 12 monitoring stations, belt transects were established that extend perpendicular from the river to the upland edge. Each station contained six substations located from the river edge to the upland edge where the depth, duration, and salinity of floodwater were measured for two weeks in spring 2005 and fall 2004. More normal flow conditions did not result in lower flooding depths or frequency of flooding. Most substations flooded at least once a day. Saline water seldom accompanied tides that flooded upstream stations of the Cape Fear River during 2004-2005. Flooding of substations along the Northeast Cape Fear River, however, contained saline water at three of the four stations in fall and at two in spring. In fall, saline water flooded far into the interiors of associated wetlands. At one site on Town Creek, a small tributary of the lower estuary, saline water was found on the marsh during spring, but not fall.

Geochemical data was collected at nine stations along the Cape Fear River Estuary beginning winter 2000. Data presented in this report includes winter 2005 and summer 2004. The microbial modes of organic matter remineralization of the study sites range from sulfate reducing to methanogenic. Analysis of porewater chloride, sulfate, and methane was performed at six substations per station and at 6 sub-depths per substation. Samples were collected during winter and summer at eight sites and monthly within the estuary at Eagle Island. These data were used to classify the geochemical setting of each substation at each station as methanogenic, sulfate reducing, methanogenic with evidence of past sulfate reduction, and sulfate reducing with a non-seawater source of sulfate. The classifications were compared to the previous data for these sites. Understanding the current and past geochemical conditions examined during the past 5 ½ years will be necessary to separate potential change caused by the deepening of the Cape Fear River from natural fluctuations.

The geochemistry at Eagle Island was analyzed monthly and displayed a steady decrease in salinity from June of 2002 until June of 2003. Salinity slightly rebounded during the winter of 2004; however, it was still lower than previous years. The current winter (2005) had almost identical conditions as the previous winter of 2004 with the exception of a salinity peak in November. Although there was no obvious peak in salinity last year, this monthly pattern of salinity variation has been observed in previous years where peaks in salinity were observed during November and May. Because of the salinity pulse during November, several locations within Eagle Island that were converted to Methanogenic geochemical classifications for the first time during the previous year returned to Sulfate reducing this year..

Infaunal community patterns were determined at nine sites along the Cape Fear River, Northeast Cape Fear River, and Town Creek from 1999-2004. This period covered three major potential system-level impacts: a drought in 2001-2002, a period of recovery and relatively higher freshwater input late in 2003 and in 2004, as well as the initiation of channel deepening construction in 2001-2002. Diversity was generally lowest in 2000 and species richness was generally highest in 2004 for six out of nine stations. However, there were no consistent patterns for either diversity or richness among the remaining years. Multidimensional Scaling Analysis indicated that 2002 and 2003 represented distinct community assemblages based on species similarity compared to 1999-2001. These two years were separated from each other, but more dramatic was a separation of these two years from the previous three years of sampling. As part of the 2004 report we identified a shift in species dominance related primarily to increasing drought impacts and subsequent recovery in 2003. Many sites initially dominated by tidal freshwater and oligohaline species shifted toward dominance by oligohaline-mesohaline polychaetes in 2002. The highest mean abundances or second highest mean abundance among major taxonomic groupings and functional groups for all but a few sites was found in 2004. Dominance patterns varied among sites, but in general oligochaetes and insect taxa were the most abundant taxa at most sites in 2004.

The temporal and spatial patterns of recruiting epibenthos are closely related to changes in the physical environment and to changes in available prey organisms. In order to evaluate long-term trends of epibenthos related to channel widening activities against the background of natural inter-annual variability, the composition and abundance of epibenthos (primarily juvenile fish and crustaceans) that utilize the shallow tidal marshes and wetlands along the Cape Fear River estuary was determined at the same stations where benthic collections were made. The distribution and abundance of this group of organisms is affected by the distribution and species composition of the benthic infauna that are their primary food source. Epibenthic organisms are indicators of community stability (or instability), generally responding in short time scales to changes in physical conditions and/or to changes in resources. Since many of the juvenile fish species are commercially important, detecting patterns that may indicate impacts to future year class structure is important to biologists and resource managers

Seasonal fluctuations and among year variations in species distribution patterns and relative dominance were compared from fall 1999 through spring 2005. Previous years found species patterns consistent with developing drought conditions in 2001 and 2002. In 2004-2005, drop trap and Breder trap data indicate significant annual and site differences. Evaluation of species richness by season found that 2004 and/or 2005 spring sampling periods tended to have significantly higher species richness measures, but this did not continue in fall. Analysis of total abundance showed a high degree of variation among years for each of the three tributaries. Highest total abundances were recorded for most sites in the main-stem Cape Fear and North East Cape Fear tributaries during spring 2005. *Leiostomus xanthurus, Lagodon rhomboids,* and *Paralichthys* sp. dominated spring 2004 and 2005.

There was a rebound of the dominant plant species at most of the sensitive herbaceous vegetation sampling stations. This follows hydrologic events that included salinity incursions at most stations followed a year later by freshwater flooding generated in the Cape Fear River and Northeast Cape Fear River watersheds from precipitation events. Two stations, Rat Island and Black River, did not follow this pattern. Vegetation at Rat Island has continued in its trajectory from forest swamp to brackish marsh because of continual exposure to saline water at high tide. The Black River Station vegetation was not killed by a salinity event, but by prolonged flooding of fresh water. Recovery from flooding has not taken place since most of the plant material was killed and/or removed by continual flooding during the extreme flooding of 2003.

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EXECUTIVE SUMMARY

Prior to the initiation of the Wilmington Harbor Deepening Project, the Wilmington District of the U.S. Army Corps of Engineers, established a monitoring plan that targeted potential upstream change to wetlands along the Cape Fear River drainage. Potential impacts were identified by an Environmental Impact Study that preceded dredging work. Monitoring reported here was directed toward the primary impact identified as significant by the EIS, i.e. an increase of as much as three inches in flooding by saline water within predominantly fresh water wetlands. Scientists at the University of North Carolina at Wilmington were contracted to monitor a series of variables identified within an early scope of work. The study design allows the excursion of each tidal wave to be followed as it moves up the estuary, past the City of Wilmington, and into the Lower River and associated wetlands. Important biological, physical, and geological indicators are monitored at permanent stations. Individual monitoring components include 1) water levels and salinity at 12 stations along the major channel and tributaries, 2) flooding depth, salinity, and duration at nine wetlands adjacent to river monitoring stations, 3) changes in the biogeochemistry of soils in these wetlands, 4) changes in animals associated with these wetlands, and 5) changes in salt-sensitive vegetation.

Measurement of water levels in the main channel of the Cape Fear River, the Northeast Cape Fear River, and Town Creek continue to provide data necessary to determine impacts associated with the Wilmington Harbor Deepening Project. Differences between the high and low points of each tide, referred to as ranges in this report, can be followed upstream from the base station at Ft Caswell to any individual upstream station. Comparisons of the relationship of each tide range at the mouth to each station upstream before and after channel modifications will provide the statistical testing mechanism to examine whether the project has impacted adjacent wetland communities. This report includes data collected from June 2004 through May 2005.

More than 1,400 tide ranges were measured between June 1, 2004 and May 31, 2005. The correlation of tidal range from the base station at Ft Caswell with the predicted tidal range remained very good. Tidal ranges within the estuary were fairly constant, including the lowermost of the upstream stations, and were higher than tidal ranges measured at most upstream stations. Water levels in the most upstream sites and the inner Town Creek station continued to be affected by discharge rates upstream. This reporting period was characterized by fewer high discharge events than in the 2002-2003 and 2003-2004 reporting periods. Some significant differences in yearly mean tidal ranges between this reporting period and 2003-2004 were observed. Those that were observed occurred primarily in the most upstream mainstem Cape Fear River stations. In general, tidal range at the three most upstream sites in the mainstem and Northeast Cape Fear were significantly lower than the mean ranges reported for these stations during the first year of monitoring. The mean tidal range observed Ft Caswell was again significantly less than in Year 1. The mean monthly maximum water levels for this reporting period were not significantly different from the values reported for the previous monitoring period (2003-2004). With the exception of one station, there was no significant difference in mean monthly minimum water level between this reporting period and last year. Comparisons of the regression slopes when tidal range at each site was regressed against P1 tidal range yielded significant differences between this reporting period and the previous reporting period for all but four stations. When the slopes from this reporting period were compared to slopes calculated for Year 1 (2000-2001), all sites except two yielded a significant difference between years.

Flooding of wetlands adjacent to the river was measured along nine wetland transects associated with monitoring stations. Each transect contained six substations where the depth, salinity of water, and duration of flooding was measured for two weeks in spring and fall. Complete data sets were generated for both fall 2004 and spring 2005 sampling seasons. Marshes and swamps continued to flood on most high tides despite lower flow rates upstream. There were few tides along the mainstem of the Cape Fear River that flooded adjacent swamps with saline water during the monitoring period. Flooding of substations along the Northeast Cape Fear River, however, contained saline water at three of the four stations in fall and at two in spring. In fall, saline water flooded far into the interiors of associated wetlands. At one site on Town Creek, a small tributary of the lower estuary, saline water was found on the marsh during spring, but not fall.

Geochemical data was collected at nine stations along the Cape Fear River Estuary beginning winter 2000. Sulfate is an important component of seawater and is converted into toxic hydrogen sulfide under anoxic conditions typical of organic rich waterlogged soils. A change from fresh floodwater to even slightly saline water can eliminate fauna and flora living in these soils. From a geochemical standpoint, a change from methane generating wetland soil to a sulfide generating system demonstrates that saline water has penetrated into the soil and is a good predictor of a large scale community change that will eventually follow. Analysis of pore water chloride, sulfate, and methane was performed at six substations per station and at 6 sub-depths per substation. Samples were collected during winter 2005 and summer 2004 at eight sites and monthly at one site to examine more detailed temporal variations. These data were used to classify the geochemical setting of each substation at each station as methanogenic, sulfate reducing, methanogenic with evidence of past sulfate reduction, and sulfate reducing with a non-seawater source of sulfate. Classifications were compared to the previous data for these sites. Understanding the current and past geochemical conditions examined during the past 5 ½ years will be necessary to separate potential change caused by the deepening of the Cape Fear River from natural fluctuations.

There was a steady decrease in salinity from June of 2002 until June of 2003 at the station monitored monthly. Salinity rebounded slightly during winter 2004; however, it was still lower than previous years. Winter 2005 had almost identical conditions as the previous winter with the exception of a salinity peak in November. Although there was no obvious peak in salinity last year, this monthly pattern of salinity variation has been observed in previous years where peaks in salinity were observed during November and May. Because of the salinity pulse during November, several locations within Eagle Island that were converted to methanogenic geochemical classifications for the first time during the previous year returned to Sulfide generating soils this year..

Patterns of diversity and abundance of the infaunal community at nine sites distributed among the Cape Fear River, Northeast Cape Fear River, and Town Creek has been followed from 1999-2004. This period included three, major, potential system-level impacts: a developing drought in 2001-2002, a period of recovery and relatively higher freshwater input late in 2003 and in 2004, as well as the initiation of channel deepening construction in 2001-2002. Diversity was generally lowest in 2000 and species richness was generally highest in 2004 for six of the nine sites. However, there were no consistent patterns for either diversity or richness among the remaining years. Statistical analyses found that 2002 and 2003 represented distinct community assemblages based on species similarity. These two years separated from each other, but more dramatic was a separation of these two years from the previous three years of sampling. A historic drought shifted many stations dominated by insect larvae and other freshwater taxa towards dominance by saline loving species such as polychaetes in 2002.

The temporal and spatial patterns of recruiting fish, shrimp, and crabs are closely related to changes in the physical environment and to changes in prey organisms. Epibenthic organisms are indicators of community stability (or instability), generally responding in short time scales to changes in physical conditions and/or to changes in resources. Since many of the juvenile fish species are commercially important, detecting patterns that may indicate impacts to future year class structure is important to biologists and resource managers.

Seasonal fluctuations and among year variations in species distribution patterns and relative dominance were compared from fall 1999 through spring 2005. Previous findings indicated changes in species patterns consistent with developing drought conditions in 2001 and 2002. There were significant annual and station differences. Evaluation of species richness by season show that 2004 and/or 2005 spring but not fall sampling periods tended to have significantly higher species richness. Total abundance was highly variable among years for each of the three tributaries. Highest total abundances were recorded for most sites in the main-stem Cape Fear and Northeast Cape Fear tributaries during spring 2005. *Leiostomus xanthurus*, *Lagodon rhomboides* and *Paralichthys* sp. dominated spring 2004 and 2005.

There was a rebound of most salt-sensitive plant species at most of the sensitive stations. This follows hydrologic events that included salinity incursions at most stations followed a year later by freshwater flooding generated in the Cape Fear River and Northeast Cape Fear River watersheds from precipitation events.

Two stations did not follow this pattern. Vegetation at Rat Island continues a trend from forest swamp to brackish marsh. There was a loss of sensitive vegetation at the most upstream station on the mainstem Cape Fear River as well that was not caused by saline water, but by extensive flooding the previous year. Vegetative recovery has not occurred because most plant material was killed and/or removed by extensive and persistent flooding.

1.0 STATION OPERATION

1.1 Summary

Measurement of water levels in the main channel of the Cape Fear River, the Northeast Cape Fear River, and Town Creek continue to provide the data necessary to determine the impact associated with the widening and deepening project. Differences between the high and low points of each tide, referred to as ranges in this report, can be followed upstream from the base station at Ft Caswell (P1) to any individual station. Differences between stations with respect to tidal range, time to high or low tide, length of low and high tides were also determined. Comparisons of these variables before and after channel modifications will provide the statistical testing mechanism to examine whether the project has impacted adjacent wetlands. In addition, the absolute elevation of floodwater when related to measurements of water levels at marsh/swamp substations allows the determination of both flood duration and flood depth for any tide. This report includes data collected from June 2004 through May 2005. During this period, problems of communication with instruments or minor instrument malfunction were solved as they occurred. As was the case in previous monitoring years, each tide has been examined for each station and a determination made as to whether the data collected are reliable. The general locations of all stations are shown in Figure 1.1-1. Table 1.1-1 provides a general summary of data loss that affects statistical analysis for present and future comparisons.

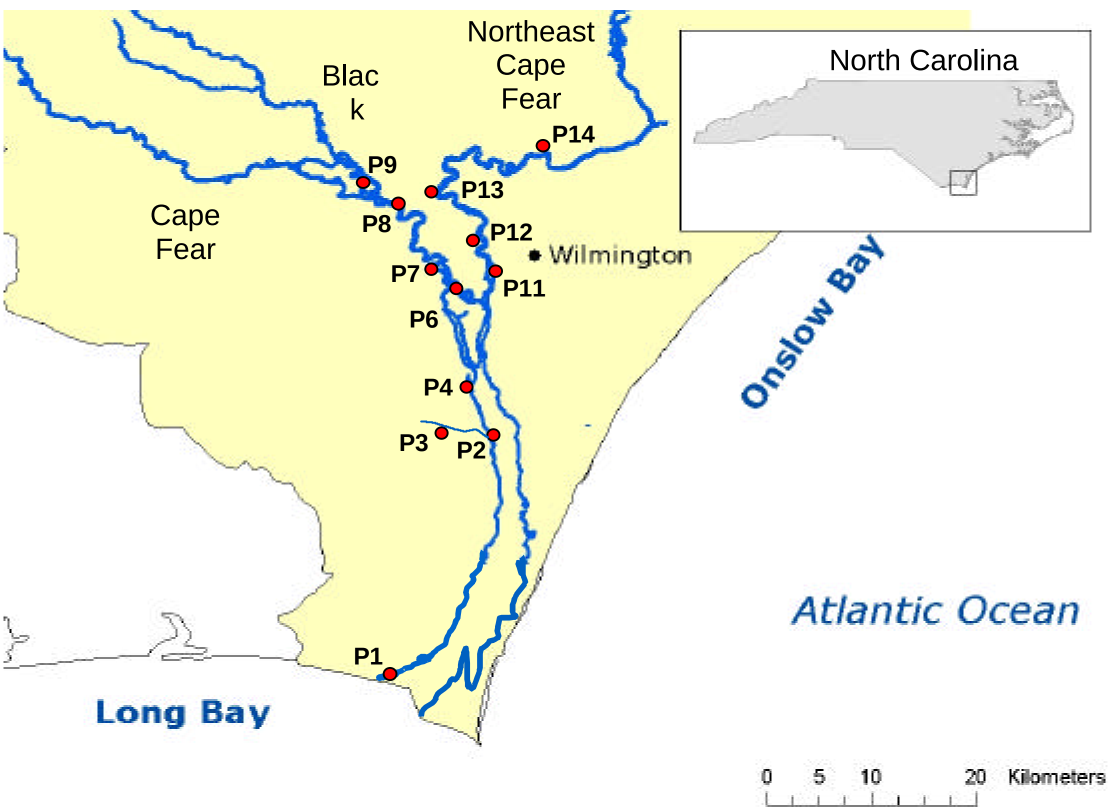


Figure 1.1-1. Location of permanent stations on the Cape Fear River estuary and tributaries.

Table 1.1-1. Percentages of tides unavailable for analysis and reasons for loss. Detailed descriptions of "loss" categories are listed in Section 1.2 above.

Station	% Loss At Station P1	% QA/QC	% Under-ranging Events	% Absence of Data	% Freezing	% Mechanical Errors	Total % Lost Tides
P1	N/A	0	0	0	0	10.2	10.2
P2	10.2	0.1	1.0	0	0	4.4	15.7
P3	10.2	0	0	0	0	0.6	10.8
P4	10.2	0	0	0	0	0	10.2
P6	10.2	0	0	0.1	0	0	10.3
P7	10.2	0	4.1	0	0	0.6	14.9
P8	10.2	0.3	0	2.3	0	9.2	22.0
P9	10.2	0.5	0	0	0.1	0.8	11.6
P11	10.2	0.6	1.0	1.1	0	1.4	14.3
P12	10.2	0.3	0	0	0	1.8	12.3
P13	10.2	0.2	0	0	0	4.0	14.4
P14	10.2	0	0	2.0	0	1.1	13.3

1.2 Methodology

Water level was sampled by a UNIDATA shaft-encoded water level recorder housed in an aluminum stilling well at 1-second intervals. A UNIDATA Starlogger logged the average, maximum and minimum values every 3 minutes. Conductivity and temperature were sampled by a UNIDATA conductivity instrument and recorded by the Starlogger every 3 minutes. Data were downloaded to a PC housed in the laboratory every 2 weeks via modem. In instances when the modem had not functioned properly, technicians on site downloaded data loggers using a laptop. Preliminary data quality review consists of visually reviewing data for major problems (e.g. float hang-ups in the stilling well, data transmission errors, large jumps/shifts in water level, loss of data) within 2-3 days of download. This process is done so that any major problems identified can be rectified quickly. Data are then compiled into files each of which contains 1 month of data for each station. Data files are then sorted at 6 minutes intervals and the resulting data set is stored for subsequent data analysis. As in previous reporting periods, the terms used to describe general mechanisms through which data are lost or compromised are defined below:

Loss at Station P1: Because the response of each variable upstream (Figure 1.1-1) is related to the base station at Ft Caswell (P1), the loss of a variable from P1 during a particular tide means that there is no means of comparison with other stations. Reasons for data loss at P1 as well as other stations are: 1) QA/QC Procedure, which refers to tides that were removed from the data set when measurements coincided with QA/QC and equipment maintenance procedures. In these instances, recorded water levels were inaccurate due to cleaning the water level float, removing/replacing the water level recorder, replacing the beaded cable, or performing a field reset when in-situ observations of water level were inconsistent with water levels reported by the data logger, 2) Under ranging events refers to tides that were removed from the data set when the actual water level fell below the elevation of the stilling well cap. In these instances, the instruments were unable to detect the minimum water level, 3) Absence of Data refers to tides that were lost when the data were not recorded by the data logger or were not transmitted properly via the modem or PC download process, 4) Freezing of surface water in the stilling well prohibited the float from following the rise and fall of the tides and these tides were removed, and 5) Mechanical Errors refer to tides removed from the data set during the data review process because of likely mechanical malfunction. Mechanical malfunctions were suspected when the plotted data exhibited misshapen curves, large jumps, and flat lines (i.e. hang-ups).

1.3 Ft Caswell (P1)

Ft Caswell is the most important station because this station experiences amplitude changes that are essentially oceanic tides. All upstream water levels are related to this station. This station functioned well during the reporting period. The total percentage of lost tides at this station from June 2004 to May 2005 (10.2%) was slightly higher than losses reported for the previous reporting period (8.0%). Data collected at this station still show irregularities in the shape of the water level curves periodically; however, the lack of a smooth curve usually does not affect the reported minimum and maximum water level values (i.e. reported tidal range). Episodic wind events disrupted water level several times during the year. A temporary problem with the water level battery resulted in a loss of 30 tides during mid October 2004. Biofouling continues to be a minor problem for the conductivity (salinity) probe, especially when larvae are recruiting into the estuary. Monthly QA/QC checks and cleaning of probes and the well interior, however, limits and corrects these problems when they occur. Corrosion of the beaded cable also affects data quality; therefore, cable integrity is assessed each month and the cable replaced when necessary.

1.4 Town Creek Mouth (P2)

Water level curves at this station are not always as smooth as would be expected, although maximum and minimum water levels correspond well with P1. This site seems to be affected by passing ships/boats which compromise the quality of data in some instances. One major problem over the sampling period was a faulty scheme program resulting in 58 tides lost at the end of December 2004 and extending to January 2005. Further, minor problems existed with extreme weather events and QA/QC visits. Water relatively high in salinity at this site continues to affect the conductivity probe resulting in monthly cleaning. During monthly QA/QC procedure a filter is inserted into the conductivity probe to reduce biofouling.

1.5 Inner Town Creek (P3)

This station generally experiences few problems and continues to generate smooth tidal curves. Lost tides for this station were due largely to minor mechanical problems which resulted in a loss of fewer than 1% of total tides.

1.6 Corps Yard (P4)

NOAA operates the tidal gauge at this site and data are available at their website after curve-smoothing procedures are applied. The UNCW conductivity/salinity gauges located at this site have operated with only a few problems over the reporting period. During both Feb 2005 and May 2005 the microloggers were replaced due to readings that failed QA/QC protocols.

1.7 Eagle Island (P6)

With the exception of a mechanical error that occurred during the passage of Hurricane Charlie, there have been few problems at this site.

1.8 Indian Creek (P7)

This DCP and associated stilling well was originally set higher than others along the Cape Fear River making under ranging events problematic at the site. The stilling well was lengthened, although, the under ranging problem continued during the 2004-2005 sampling period (4.1% of total tides). Fewer than 1% of the tides at this site were lost due to mechanical errors.

1.9 Dollisons Landing (P8)

Data loss of 18 tides occurred at the beginning of June 2004 due to the DCP being shot during the Memorial Day weekend. Water level jumps and QA/QC corrections posed a problem during this reporting period, resulting in several lost tides. This problem likely arose from issues with low voltage of the DCP internal battery. The voltage problem also caused several mechanical failures and loss of tide data (approximately 9.2% of total tides) in March, April, and May 2005.

1.10 Black River (P9)

This site experienced few operational difficulties during this monitoring period. Tide data loss occurred as a result of abrupt shifts in water level jumps that lead to mechanical failure. Unscheduled QA/QC maintenance visits to this site were required to correct the problem. The total loss of tidal data was still low with fewer than 2% of total tides lost.

1.11 Smith Creek (P11)

Under ranging events continued to be a problem at this site resulting in a loss of 1% of total tides. Under ranging frequency, however, has decreased since the previous year. Water level jumps continued to plague this station during June, July, and August 2004, which required several unscheduled QA/QC visits to reset the water level recorder. The entire system was removed on July 9, 2004 for a laboratory test resulting in a loss of 17 tides. Following a series of bench tests, the starlogger and the water level instruments were replaced. Afterwards, the system worked well with only two additional water level jumps during August 2004. A few mechanical errors also occurred resulting in a 1.4% loss of tidal data.

1.12 Rat Island (P12)

This site experienced some tide loss resulting from water level jumps and subsequent QA/QC visits required to correct the problem. Further, some mechanical problems resulted in loss of water level data. The total tide loss for this site was approximately 2% of total tides.

1.13 Fishing Creek (P13)

This site had more mechanical problems during this sampling period as compared to the 2003-2004 period. The solar panel was stolen on August 26, 2004 resulting in a loss of 32 tides. The theft continued to be a problem throughout the reporting period, and manual downloading of data on station was required on numerous occasions. Additional mechanical errors were also observed resulting in further loss of 39 tides. These errors were the consequence of either extreme weather events or DCP electronic failure.

1.14 Prince George Creek (P14)

There have been few problems at this site with respect to water level. The primary exception was a problem with the internal water level battery which ultimately had to be replaced. The only other issues throughout the monitoring period were a few mechanical problems associated with severe weather conditions.

2.0 MONUMENT AND STATION SURVEY VERIFICATION

2.1 Summary

When data suggest that a permanent change of either a subsite or DCP occurs surveys are used to determine if an actual change, sinking or rising, has occurred. No problems were noted during the reporting period.

3.0 RIVER AND WATER LEVEL/SALINITY MONITORING

3.1 Summary

More than 1,400 tide ranges measured between June 1, 2004 and May 31, 2005 comprise the database for water level comparisons during this monitoring period (Appendix A). The existing database allows for analyses of changes in tidal amplitude as well as changes of ebb and flood duration. The correlation of tidal range from the base station at Ft Caswell with the predicted tidal range remained very good with the slope of the regression being higher than in 2003 and 2004, but comparable to previous years. Tidal ranges within the estuary were fairly constant, including the lowermost of the upstream stations, and were higher than tidal ranges measured at most upstream stations. Water levels in the most upstream sites and the inner Town Creek station continued to be affected by discharge rates in the river. This reporting period was characterized by fewer high discharge events than in the 2002-2003 and 2003-2004 reporting periods, which was reflected in generally higher R^2 values for almost all stations this year compared to last year. Some significant differences in yearly mean tidal ranges between this reporting period and 2003-2004 were observed. Those that were observed occurred primarily in the most upstream mainstem stations. In general, tidal range at the three most upstream sites in the mainstem and Northeast Cape Fear were significantly lower than the mean ranges reported for these stations during the first year of monitoring. The same was observed for site P1. The observation that mean tidal range observed at P1 (Ft Caswell) is again significantly less than in Year 1 continues to complicate interpretation of the results as this station was initially expected to be unimpacted by river widening activities. As was the pattern reported last year, mean monthly maximum water levels for this reporting period were not significantly different from the values reported for the previous monitoring period (2003-2004). And again, with the exception of station P11, there was no significant difference in mean monthly minimum water level between this reporting period and last year. Comparisons of the regression slopes when tidal range at each site was regressed against P1 tidal range yielded significant differences between this reporting period and the previous reporting period for all stations except P3, P4, P6, and P11. When the slopes from this reporting period were compared to slopes calculated for Year 1 (2000-2001), all sites yielded a significant difference between years except for site P3 and P14.

The mean high tide lag times measured during this reporting period generally increased for all stations compared to those measured in 2003-2004. The low tide lag times did not show such a consistent pattern. In the estuary and the Northeast Cape Fear, low tide lag times decreased, while lag times were observed to both increase and decrease for the mainstem stations. The duration of the ebb tide continues to exceed the duration of flood at most stations from P4 upriver as in previous monitoring periods. Flood and ebb durations show little change from mean durations reported in 2003-2004 for most stations (less than 3% change for both flood and ebb durations). P2 showed the greatest change in mean flood and ebb durations. At this site, mean flood duration decreased from the 2003-2004 value by 3.75% and ebb duration increased by 3.4 %. The relationship between tidal range at Ft Caswell and other stations differed from station to station, but was generally related to distance from the ocean and freshwater flow. Fewer high discharge events in 2004-2005 resulted in a reduction in variability of the tidal ranges observed during this monitoring period.

In general, mean tidal range decreased at upstream stations. With the exception of sites P8 and P9, the mean tidal range for every station in the main river was not significantly different this year from the mean tidal range reported in 2003-2004. At stations P8 and P9, mean tidal range increased relative to the mean reported in last year's monitoring period. When the mean tidal ranges for the current year were compared to those reported for Year 1 (2000-2001), only stations P3 and P7 exhibited means that were not significantly different. This result is consistent with the previous reporting period. At present, our observations are inconclusive and somewhat inconsistent with the expected effects of dredging. It is apparent that that our results have been complicated by the existence of both lower, drought-induced water levels and extreme flooding in the system over the last 3 years and that additional types of data analyses may be necessary to conclusively evaluate the effects of channel modification on tidal attributes. Further, the precise timing of significant deepening or realignment activities will be needed to correlate changes in tidal range among stations with dredging activities. Further, the data suggest that the limited data set available for Year 1 (October-May), may be affecting the results of the statistical analyses.

In 2000-2001, salinity did not exceed 1 ppt at stations upstream of Eagle Island on the Cape Fear River because of the continuous release of freshwater upstream. In 2001-2002, upstream releases in the Cape Fear River had been reduced and salinities as high as 3.5 ppt were measured at P8 while salinities exceeding 14 ppt were measured at Fishing Creek, 8 miles north of Point Peter in the Northeast Cape Fear River. In 2002-2003, maximum salinities reported for these sites were 5.8 ppt and 16.4 ppt, respectively, and were measured in summer 2002 when drought conditions still existed in the region. This year, a period of more typical flow conditions in the river, maximum salinities for P8 and P13 were 0.2 ppt and 8.6 ppt., respectively.

3.2 Database

Water level, conductivity, and temperature data collected at DCP stations from June 2004 through May 2005 are incorporated in this report. This year's database includes approximately 1,400 tides of sufficient quality to be used in the analyses of each of the 11 DCP stations. Specific problems associated with each station have been described in Section 1 of this report. Table 1.1-1 summarizes the percentage of tides unavailable for analysis due to the various reasons cited above.

3.3 Data Analyses Methods

Maximum, minimum, and mean water level and conductivity/ temperature were recorded every 3 minutes. The final data set used for analyses consists of 3-minute averages of water level and conductivity collected every 6 minutes. The 6-minute means were plotted after each two-week interval and the resulting curves visually inspected by a senior analyst for quality control purposes. Suspect data, such as outliers or data points that deviate from a smooth curve, were discarded. Unreliable data, such as those collected during periods of mechanical malfunction, equipment maintenance, under-ranging events, and freezing events, were also removed. The remaining data were then filtered to extract the maximum and minimum water levels associated with each tidal event. For this report, a tidal event consists of one high water/low water pair.

The high and low water values contained in the final data set were used to determine the mean tidal range and to compute tidal lags between sites. The mean tidal range was computed from the difference in water level between each high and low tide event for each station. As was the case in the previous reporting period, the mean tidal ranges measured during this reporting period were significantly different ($P<0.05$) than the means reported during the first year of monitoring (2000-2001) at all stations except stations P3 and P7. Except for station 1 (base station) where the mean has decreased, significant increases in mean water level occurred at stations lower in the estuary (stations 2, 4, 6, and 11) and decreased at stations located further upstream (stations 8, 9, 13, and 14). It is important to note, however, that the Year 1 reporting period only included the period of October to May and all subsequent period have included a complete calendar year.

Monthly mean tidal ranges, maximum/minimum water level and maximum/minimum salinity values for each station are given in Table 3.3-1. Yearly mean tidal ranges and standard deviation are given in Figure 3.3-1. A Wilcoxon rank-sum test was used to compare yearly means for each station and significant differences ($P<0.05$) denoted by asterisks in Figure 3.3-1. A summary of statistical analyses of mean annual water level comparisons for each of the 11 DCP stations are shown in Table 3.3-2. Yearly mean tidal ranges were compared using Tukey-Kramer highest significant difference ($p<0.05$). Table 3.3-3 shows a summary of statistical tests for yearly data collected at the 11 DCP stations. Also shown are yearly differences in the slopes of the best-fit lines generated by regressing each tidal range for each station on the corresponding tidal range for P1.

Tidal lags were determined by measuring the difference in time for high (or low) tide at 2 different stations as described in the Year 1 report. All tidal lags were calculated relative to station P1 and are being used to evaluate the impact of dredging on the propagation of the tidal wave upriver. Mean tidal range, flood duration, ebb duration and tidal lags for each station are given in Table 3.3-4. During this reporting period, high tide lag values increased at all stations relative to last year's values with the exception of station P11. This pattern is consistent with the high tide lag observation reported in 2003-2004. Both increases and decreases in low tide lag were noted among stations relative to the 2003-2004 values. During this reporting period, mean flood durations decreased at the stations lower in the estuary (stations 1, 2, and 3), but increased at all other stations. Flood and ebb durations varied little from those values reported in the last monitoring period (<2%) except for stations P2 and P12 (Table 3.3-4). Yearly comparisons of mean monthly maximum and minimum water levels collected at the 11 DCP stations are summarized in Table 3.3-5.

3.4 Upstream Tidal Effects

Stations upstream of Point Peter are influenced more by river flow in both branches of the Cape Fear Estuary than downstream stations. Estuarine stations, P1, P2, and P4, are considered separately from upstream stations and from each other.

3.41 Ft Caswell (P1) and Outer Town Creek (P2)

The tidal ranges observed at the Ft Caswell base station show good agreement with the predicted tides for the area (Figure 3.41-1). When observed tidal ranges are regressed against the predicted tidal ranges, the R^2 value is similar to those documented in previous reports. The slope, however, is steeper than in 2003-2004, but consistent to that reported for Years 1 through 3. The mean tidal range at P1 was significantly lower than the mean reported for Years 1 and 2, but not different from Years 3 and 4 (Table 3.3-2, Figure 3.3-1). The mean tidal range at the Outer Town Creek (P2) site was significantly higher than the range reported for Year 1 but was not significantly different from the mean reported in the previous reporting period. Further, both the mean monthly maximum and minimum water levels were significantly different from those reported for the Year 1 monitoring period (Table 3.3-5). As seen in Figure 3.41-2, the tidal range at P2 is strongly and positively correlated with observed tidal ranges at P1. The slope of the P1 versus P2 regression for this monitoring period was significantly higher ($p<0.0002$) than

Table 3.3-1. Monthly maximum, minimum, and range of salinity values for each station. Monthly maximum, minimum, and range of water level for each station are also given. All water levels are relative to NAVD88 with the exception of P4 (USACE yard), which is relative to MSL.

		Salinity (ppt)			Water Level (ft)		
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P1	Jun-04	34.0	6.7	27.3	3.00	-3.80	6.80
	Jul-04	33.8	6.1	27.7	3.06	-3.78	6.84
	Aug-04	32.0	1.8	30.2	3.01	-4.61	7.62
	Sep-04	28.5	3.5	25.0	3.02	-3.64	6.66
	Oct-04	32.0	4.7	27.3	2.83	-3.25	6.08
	Nov-04	31.4	4.9	26.5	2.57	-3.94	6.51
	Dec-04	31.9	4.1	27.8	2.47	-4.79	7.26
	Jan-05	30.5	5.4	25.1	2.76	-4.23	6.99
	Feb-05	31.6	11.6	20.0	3.32	-3.95	7.27
	Mar-05	33.2	7.7	25.5	2.30	-5.39	7.69
	Apr-05	29.4	12.3	17.1	2.56	-3.94	6.50
	May-05	34.0	13.4	20.6	3.12	-3.72	6.84
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P2	Jun-04	26.5	2.1	24.4	3.55	-2.78	6.33
	Jul-04	17.7	0.3	17.4	3.57	-2.96	6.53
	Aug-04	16.7	0.1	16.6	3.86	-2.67	6.53
	Sep-04	11.2	0.0	11.2	3.83	-2.42	6.25
	Oct-04	30.0	0.8	29.2	4.26	-2.35	6.61
	Nov-04	21.8	0.7	21.1	3.59	-2.56	6.15
	Dec-04	9.0	0.4	8.6	3.53	-2.59	6.12
	Jan-05	18.6	1.6	17.0	3.85	-2.60	6.45
	Feb-05	13.3	1.3	12.0	4.00	-2.49	6.49
	Mar-05	9.9	0.1	9.8	3.93	-2.45	6.38
	Apr-05	12.3	0.1	12.2	3.86	-2.86	6.72
	May-05	13.9	0.1	13.8	3.85	-2.85	6.70
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P3	Jun-04	12.7	1.3	11.4	2.02	-1.89	3.91
	Jul-04	13.0	0.0	13.0	2.31	-2.32	4.63
	Aug-04	13.5	0.0	13.5	2.33	-2.13	4.46
	Sep-04	6.5	0.0	6.5	2.62	-1.44	4.06
	Oct-04	19.8	0.1	19.7	2.19	-1.87	4.06
	Nov-04	11.7	0.1	11.6	1.81	-2.19	4.00
	Dec-04	6.2	0.1	6.1	1.72	-2.56	4.28
	Jan-05	9.9	0.0	9.9	1.97	-2.23	4.20
	Feb-05	9.9	0.0	9.9	2.13	-2.20	4.33
	Mar-05	5.3	0.1	5.2	2.11	-2.40	4.51
	Apr-05	5.2	0.0	5.2	2.23	-2.10	4.33
	May-05	10.7	0.0	10.7	2.27	-1.81	4.08
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P4	Jun-04	14.0	2.3	11.7	3.11	-3.27	6.38
	Jul-04	12.7	2.2	10.5	3.11	-3.34	6.45
	Aug-04	14.9	0.1	14.8	3.38	-3.10	6.48
	Sep-04	8.4	0.1	8.3	3.27	-3.04	6.31
	Oct-04	15.9	0.5	15.4	3.63	-3.02	6.65
	Nov-04	16.9	1.3	15.6	2.93	-3.35	6.28
	Dec-04	11.6	0.5	11.1	2.90	-3.87	6.77
	Jan-05	11.5	0.4	11.1	3.18	-3.71	6.89
	Feb-05	12.8	0.4	12.4	3.31	-3.05	6.36
	Mar-05	12.3	0.1	12.2	3.31	-3.89	7.20
	Apr-05	9.7	0.1	9.6	3.53	-3.21	6.74
	May-05	11.7	0.9	10.8	3.52	-3.30	6.82
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P6	Jun-04	16.7	0.1	16.6	3.27	-2.77	6.04
	Jul-04	13.6	0.0	13.6	3.55	-2.56	6.11
	Aug-04	11.0	0.0	11.0	3.25	-2.95	6.20
	Sep-04	6.3	0.0	6.3	3.31	-2.84	6.15
	Oct-04	14.7	0.1	14.6	3.56	-2.76	6.32

Table 3.3-1. (continued)

		Salinity (ppt)			Water Level (ft)		
	Nov-04	15.4	0.0	15.4	2.88	-2.99	5.87
	Dec-04	9.1	0.0	9.1	2.88	-3.09	5.97
	Jan-05	8.3	0.0	8.3	3.04	-3.00	6.04
	Feb-05	10.8	0.1	10.7	3.13	-2.99	6.12
	Mar-05	5.9	0.0	5.9	3.68	-2.95	6.63
	Apr-05	6.4	0.0	6.4	4.00	-2.52	6.52
	May-05	10.7	0.1	10.6	3.29	-2.71	6.00
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P7	Jun-04	0.1	0.0	0.1	2.92	-2.37	5.29
	Jul-04	0.1	0.1	0.0	3.00	-2.34	5.34
	Aug-04	1.8	0.0	1.8	3.28	-2.27	5.55
	Sep-04	0.1	0.0	0.1	3.38	-2.02	5.40
	Oct-04	0.1	0.0	0.1	3.54	-2.12	5.66
	Nov-04	0.2	0.0	0.2	3.05	-2.20	5.25
	Dec-04	0.1	0.1	0.0	3.06	-2.19	5.25
	Jan-05	0.1	0.0	0.1	3.16	-2.21	5.37
	Feb-05	0.1	0.0	0.1	3.38	-2.18	5.56
	Mar-05	0.1	0.0	0.1	3.46	-2.18	5.64
	Apr-05	0.1	0.0	0.1	3.39	-2.16	5.55
	May-05	0.1	0.0	0.1	3.41	-2.27	5.68
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P8	Jun-04	0.1	0.1	0.0	2.49	-2.41	4.90
	Jul-04	0.1	0.0	0.1	2.53	-2.62	5.15
	Aug-04	0.1	0.0	0.1	2.85	-2.34	5.19
	Sep-04	0.1	0.1	0.0	3.04	-2.03	5.07
	Oct-04	0.1	0.0	0.1	3.32	-1.79	5.11
	Nov-04	0.2	0.1	0.1	2.93	-2.22	5.15
	Dec-04	0.1	0.1	0.0	2.85	-2.15	5.00
	Jan-05	0.1	0.0	0.1	2.99	-2.02	5.01
	Feb-05	0.1	0.0	0.1	3.29	-2.11	5.40
	Mar-05	0.1	0.0	0.1	3.30	-1.54	4.84
	Apr-05	0.1	0.0	0.1	3.45	-1.60	5.05
	May-05	0.1	0.1	0.0	3.16	-1.58	4.74
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P9	Jun-04	0.1	0.0	0.1	2.86	-1.83	4.69
	Jul-04	0.1	0.1	0.0	2.89	-1.80	4.69
	Aug-04	0.1	0.0	0.1	2.98	-1.93	4.91
	Sep-04	0.2	0.0	0.2	3.72	-0.72	4.44
	Oct-04	0.1	0.1	0.0	2.73	-0.54	3.27
	Nov-04	0.1	0.1	0.0	3.27	-1.69	4.96
	Dec-04	0.1	0.1	0.0	3.42	-1.75	5.17
	Jan-05	0.1	0.0	0.1	2.93	-1.73	4.66
	Feb-05	0.1	0.0	0.1	3.05	-1.99	5.04
	Mar-05	0.1	0.0	0.1	3.14	-1.49	4.63
	Apr-05	0.1	0.0	0.1	3.09	-1.27	4.36
	May-05	0.1	0.1	0.0	3.16	-1.50	4.66
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P11	Jun-04	14.5	0.5	14.0	3.89	-2.27	6.16
	Jul-04	12.6	0.3	12.3	3.21	-3.16	6.37
	Aug-04	13.0	0.0	13.0	3.29	-2.75	6.04
	Sep-04	9.1	0.0	9.1	3.26	-2.71	5.97
	Oct-04	13.7	0.1	13.6	3.49	-2.74	6.23
	Nov-04	15.5	0.2	15.3	3.05	-2.93	5.98
	Dec-04	10.2	0.1	10.1	2.98	-3.12	6.10
	Jan-05	9.5	0.1	9.4	3.25	-3.04	6.29
	Feb-05	10.7	0.1	10.6	3.40	-2.65	6.05
	Mar-05	12.0	0.0	12.0	3.34	-3.23	6.57
	Apr-05	9.9	0.1	9.8	3.56	-2.64	6.20
	May-05	11.1	0.1	11.0	3.67	-2.74	6.41
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P12	Jun-04	12.4	0.1	12.3	2.77	-2.90	5.67
	Jul-04	12.4	0.1	12.3	2.90	-2.60	5.50
	Aug-04	11.1	0.0	11.1	3.13	-2.15	5.28
	Sep-04	5.8	0.0	5.8	2.87	-2.42	5.29

Table 3.3-1. (continued)

Site	Month	Salinity (ppt)			Water Level (ft)		
	Oct-04	13.9	0.1	13.8	3.00	-2.51	5.51
	Nov-04	14.5	0.1	14.4	2.52	-2.88	5.40
	Dec-04	8.8	0.1	8.7	2.40	-3.44	5.84
	Jan-05	8.6	0.1	8.5	2.62	-3.00	5.62
	Feb-05	10.9	0.1	10.8	2.77	-2.75	5.52
	Mar-05	10.5	0.0	10.5	2.83	-3.21	6.04
	Apr-05	8.6	0.0	8.6	3.00	-2.76	5.76
	May-05	9.8	0.1	9.7	2.97	-2.84	5.81
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P13	Jun-04	6.1	0.1	6.0	2.36	-2.38	4.74
	Jul-04	3.6	0.0	3.6	2.41	-2.38	4.79
	Aug-04	4.5	0.0	4.5	2.41	-2.08	4.49
	Sep-04	No Data	No Data	No Data	2.86	-1.79	4.65
	Oct-04	8.6	0.0	8.6	2.87	-1.81	4.68
	Nov-04	4.3	0.1	4.2	2.33	-2.45	4.78
	Dec-04	0.4	0.1	0.3	2.17	-2.81	4.98
	Jan-05	1.9	0.0	1.9	2.37	-2.48	4.85
	Feb-05	2.6	0.1	2.5	2.54	-2.41	4.95
	Mar-05	0.9	0.1	0.8	2.62	-2.58	5.20
	Apr-05	0.4	0.1	0.3	2.77	-2.21	4.98
	May-05	0.3	0.0	0.3	2.69	-2.34	5.03
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P14	Jun-04	0.1	0.1	0.0	1.81	-1.84	3.65
	Jul-04	0.1	0.1	0.0	1.91	-1.76	3.67
	Aug-04	0.1	0.0	0.1	2.27	-1.69	3.96
	Sep-04	0.1	0.0	0.1	2.44	-0.92	3.36
	Oct-04	0.2	0.0	0.2	2.24	-1.33	3.57
	Nov-04	0.1	0.1	0.0	1.97	-1.85	3.82
	Dec-04	0.1	0.1	0.0	1.76	-2.15	3.91
	Jan-05	0.1	0.1	0.0	1.96	-1.91	3.87
	Feb-05	0.1	0.0	0.1	2.12	-1.93	4.05
	Mar-05	0.1	0.1	0.0	2.21	-1.92	4.13
	Apr-05	0.1	0.0	0.1	2.28	-1.53	3.81
	May-05	0.1	0.0	0.1	2.19	-1.51	3.70

Table 3.3-1. (continued)

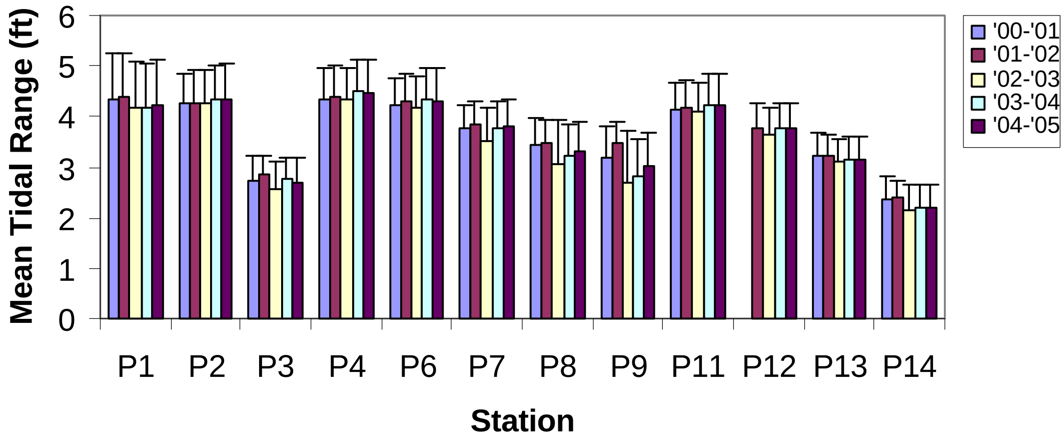


Figure 3.3-1. Mean water level for each station for all monitoring years. All water levels are relative to NAVD88 with the exception of P4 (USACE yard), which is relative to MSL. Error bars show one standard deviation. Significant differences between yearly means ($p<0.05$) for one or more monitoring periods are shown in Table 3-3.2.

Table 3.3-2. Summary of statistical analyses of mean annual water level comparisons for each of the 11 DCP stations. Yearly mean tidal ranges were compared using Tukey-Kramer highest significant difference ($p<0.05$). Asterisks denote where significant differences occurred among years. Years with different letter superscripts were significantly different. No data (NA) were available for Year 1 for station P12.

Station	Significant	Effect (Year)
P1	*	1^{a} 2^{a} 3^{b} 4^{b} 5^{b}
P2	*	1^{a} 2^{ab} 3^{a} 4^{b} 5^{b}
P3	*	1^{ad} 2^{b} 3^{c} 4^{a} 5^{d}
P4	*	1^{a} 2^{a} 3^{a} 4^{b} 5^{b}
P6	*	1^{a} 2^{b} 3^{a} 4^{b} 5^{b}
P7	*	1^{a} 2^{b} 3^{c} 4^{a} 5^{ab}
P8	*	1^{a} 2^{a} 3^{b} 4^{c} 5^{d}
P9	*	1^{a} 2^{b} 3^{c} 4^{d} 5^{e}
P11	*	1^{ab} 2^{ac} 3^{b} 4^{c} 5^{c}
P12	*	NA 2^{a} 3^{b} 4^{a} 5^{a}
P13	*	1^{a} 2^{a} 3^{b} 4^{c} 5^{c}
P14	*	1^{a} 2^{a} 3^{b} 4^{bc} 5^{c}

Table 3.3-3. Summary of statistical tests for yearly data collected at the 11 DCP stations. Yearly means of tidal ranges were compared. Also shown are yearly differences in the slopes of the best-fit lines generated by regressing each tidal range for each station on the corresponding tidal range for P1. These were compared using analysis of covariance. NS indicates no significant difference at $P<0.05$. Asterisks denote significant differences between years and p values are given. N/A indicates insufficient data to complete analyses.

	Regression Slope					
Station	Y1/Y2	Y1/Y3	Y1/Y4	Y3/Y4	Y1/Y5	Y4/Y5
	---	---	---	---	---	---
P2	*(<0.0001)	NS	NS	* (0.0011)	* (<0.0001)	* (0.0002)
P3	* (<0.0001)	NS	* (0.0227)	NS	NS	NS
P4	NS	NS	* (<0.0001)	* (<0.0001)	* (<0.0001)	NS
P6	NS	NS	* (<0.0001)	* (<0.0001)	* (<0.0001)	NS
P7	*(0.0247)	NS	* (0.0064)	* (0.0007)	* (<0.0001)	* (0.0133)
P8	NS	NS	NS	NS	* (0.0005)	* (0.0002)
P9	NS	NS	* (0.0001)	* (<0.0001)	* (0.0020)	* (<0.0001)
P11	NS	NS	* (<0.0001)	* (<0.0001)	* (<0.0001)	NS
P12	N/A	N/A	N/A	NS	N/A	* (0.0010)
P13	NS	NS	NS	NS	* (<0.0001)	* (<0.0001)
P14	* (0.0088)	NS	* (<0.0001)	* (0.0002)	NS	* (<0.0001)

Table 3.3-4. Summary of tidal data generated from data collection platforms (DCP) at 11 stations along the Cape Fear River and tributaries. Values in italicized parenthesis are the percent change between the current monitoring interval and the previous reporting period. Positive values indicate an increase and negative values a decrease. ND indicates that a change was not measurable. N/A indicates that data were insufficient to measure a reliable change. Mean lag times for the previous reporting period are also given in parentheses for both high and low tide.

Station Number	Mean Tidal Range (ft)	Mean Flood Duration (hr) *(% change)*	Mean Ebb Duration (hr) *(%change)*	Mean High Tide Lag From P1 (hr) ('03-'04 lag time)	Mean Low Tide Lag From P1 (hr) ('03-'04 lag time)
P1	4.22 ± 21.73%	6.30 *(-0.79)*	6.11 *(+1.33)*	N/A	N/A
P2	4.35 ± 16.01%	5.65 *(-3.75)*	6.75 *(+3.37)*	1.33 (1.27)	1.97 (2.05)
P3	2.70 ± 17.35%	6.2 *(-1.59)*	6.18 *(+2.15)*	2.97 (2.92)	2.98 (2.95)
P4	4.46 ± 15.29%	5.71 *(+1.06)*	6.70 *(-0.74)*	1.62 (1.32)	2.21 (2.14)
P6	4.29 ± 15.44%	5.87 *(+1.21)*	6.53 *(-0.31)*	2.12 (2.00)	2.55 (2.57)
P7	3.79 ± 14.33%	5.78 *(+0.52)*	6.58 *(-0.30)*	2.55 (2.45)	3.02 (3.07)
P8	3.32 ± 16.83%	5.82 *(+1.22)*	6.58 *(-0.60)*	3.17 (2.85)	3.63 (3.47)
P9	3.03 ± 21.23%	5.78 *(+0.52)*	6.61 *(-0.30)*	3.33 (3.27)	3.63 (3.88)
P11	4.22 ± 14.63%	5.82 (+1.57)	6.57 (0.00)	2.13 (2.15)	2.58 (2.75)
P12	3.75 ± 14.16%	5.87 (+1.22)	6.53 (-1.36)	2.53 (2.4)	2.91 (2.97)
P13	3.16 ± 13.98%	6.00 (+3.09)	6.40 (-3.03)	3.10 (2.92)	3.38 (3.47)
P14	2.21 ± 19.18%	5.91 (+1.55)	6.48 (-1.52)	4.13 (4.00)	4.50 (4.53)

Table 3.3-5. Yearly comparisons of mean monthly maximum and minimum water levels collected at the 11 DCP stations. Significant differences were identified using a Wilcoxon Rank Sum test. NS indicates no significant difference at P <0.05. Asterisks denote significant differences between years and p values are given. N/A indicates insufficient data to complete analyses. Additional yearly comparisons are available in previous reports.

	Mean Monthly Maximum WL		Mean Monthly Minimum WL	
Station	Yr1/Yr5	Yr4/Yr5	Yr1/Yr5	Yr4/Yr5
P1	NS	NS	NS	NS
P2	*(0.0007)	*(0.0224)	*(0.0034)	NS
P3	NS	NS	*(0.0054)	NS
P4	NS	NS	NS	NS
P6	*(0.0278)	NS	*(0.0010)	NS
P7	*(0.0185)	NS	*(0.0005)	NS
P8	NS	NS	*(0.0308)	NS
P9	*(0.0228)	NS	*(0.0004)	NS
P11	*(0.0043)	NS	*(0.0252)	*(0.0047)
P12	N/A	NS	N/A	NS
P13	*(0.0087)	NS	*(0.0372)	NS
P14	NS	NS	NS	NS

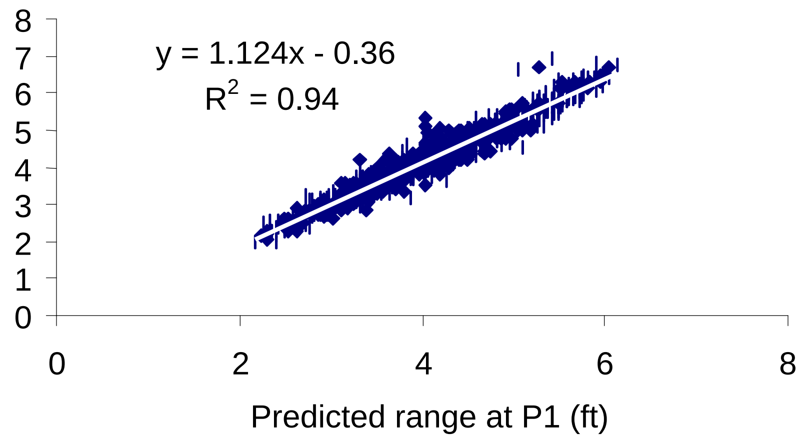


Figure 3.41-1. Plot of predicted tidal range at P1 relative to measured tidal range at P1 for June 2004 to May 2005.

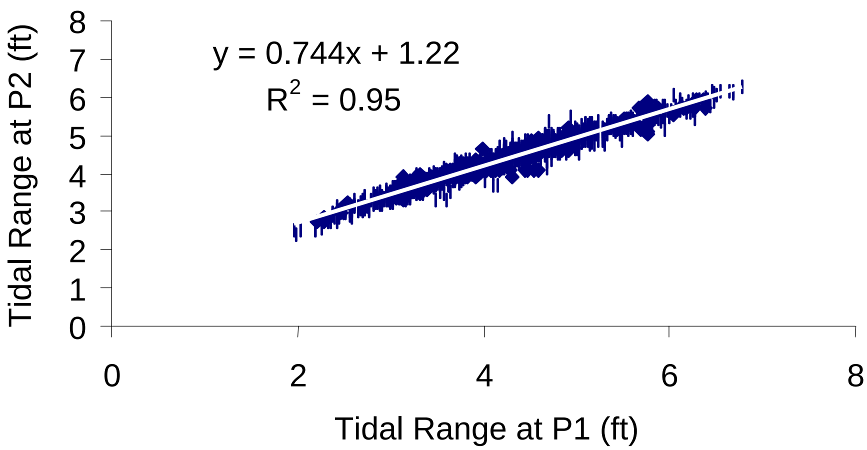


Figure 3.41-2. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Outer Town Creek (P2).

the slope reported during 2003-2004 reporting period (Table 3.3-3), and also significantly different from the slope measured in the first monitoring period ($p<0.0001$). This result is similar to Year 2 when a significant difference in the slopes of the regressions was also observed. No such difference in slope was observed between Years 3 and 4 (monitoring periods marked by drought and extended flooding, respectively) and Year 1. Possible explanations for the varying statistical results among years may be the reduced variability in tidal ranges at P2 during this year compared to Year 4 (R^2 = 0.86) and the effect of regional climatology (e.g. drought and flooding) on water levels and tidal fluctuation in the river. Another possibility, raised in the fiscal

Year 2003-2004 report, may be that the dredging and realignment of the offshore shipping channel has affected tidal ranges at P1. Nonetheless, the overall impact of climatologically driven events on water level remains much less than other up river sites.

The water level curve at P1 has remained generally symmetrical and continues to show less evidence of the time asymmetries (Table 3.3-3) measured at other stations. These asymmetries, as evidenced by the unequal flood and ebb durations shown in Table 3.3-3, begin at site P2 and continue up river to all monitoring sites. The duration of flooding tide at P2 decreased during this reporting period relative to the duration reported for both the 2003-2004 and 2002-2003 reporting periods. The ebb tide duration at P2 increased relative to the 2003-2004 reporting period, but was essentially the same as the ebb duration reported in 2002-2003. In contrast to the previous three reporting periods, the mean high tide lag between P2 and P1 increased and the mean low tide lag decreased. When coupled with the data presented in previous monitoring reports, the tidal lags show no consistent pattern and do not indicate a definitive change in the rate of the tidal wave propagation up-estuary.

3.42 Inner Town Creek (P3)

The mean tidal range observed at this site during this reporting period was approximately 1.5 feet less than the tidal range observed at the creek mouth (Table 3.3-4) and lower than the mean tidal ranges of all other sites except P14. The mean tidal range from June 2004 to May 2005 was significantly lower than the mean tidal range reported for June 2003 to May 2004. Interestingly, the mean tidal range at P3 during this reporting period is significantly different from the means of all other reporting periods except Year 1, but does not show a consistent pattern. This result is most likely due to the role of large runoff events, associated with localized precipitation events in the watershed, which reduce tidal range when they occur. (Figure 3.3-1 and Table 3.3-2). As reported previously, water level curves generated for this station and computed tidal ranges continue to exhibit a wide range of variability and to depend on flow conditions in the creek. Mean flood durations decreased during this reporting period relative to the previous reporting period while ebb durations have increased (Table 3.3-4). These results suggest the transition to a more symmetrical water level curve at this station for FY 2004-2005 compared to the previous reporting period.

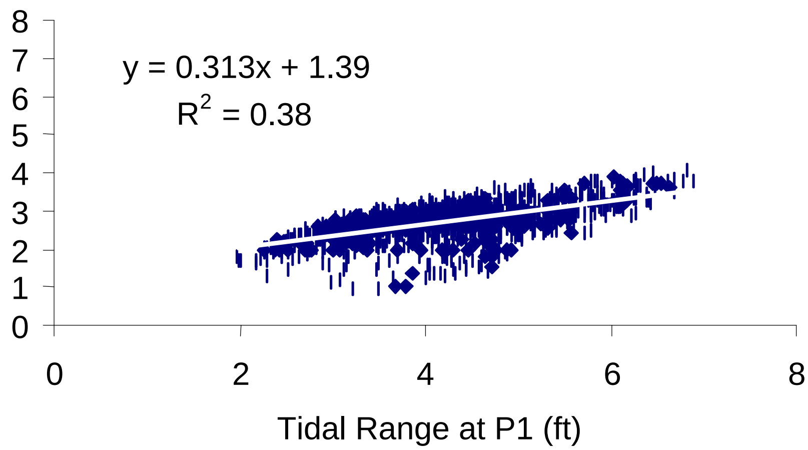


Figure 3.42-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Inner Town Creek (P3).

The correlation between tides at P3 and P1 this year was comparable to the value reported in FY2003-2004 and higher than that reported for the previous two monitoring periods (R^2 = 0.32 and R^2 = 0.26 for years 2 and 3, respectively). The slope of the P1 versus P3 regression for this monitoring period was not significantly different from the slope reported in 2003-2004 (Table 3.3-2). The slope also was not significantly different from the slope reported for Year 1 at this station.

3.43 Corps Yard (P4)

As was noted in the FY 2003-2004 reporting period, the mean tidal range observed at P4 again was significantly higher than the mean tidal range at the P1 base station (Figure 3.42-2). The mean tidal range during this reporting period was also significantly greater than the mean reported for Years 1, 2, and 3. The slope (0.716) of the P1/P4 regression was significantly greater than the slope reported for the first monitoring period (Table 3.3-3), but not significantly different from the slope reported last year. Water level curves generated for P4 continue to show a slight time asymmetry that does not occur at P1. The mean ebb and flood durations of 6.7 and 5.7 hours, respectively, have changed by 1% or less since the previous reporting periods. Both the mean high and low tide lags at this station, however, are greater than those reported in 2003-2004 but not as great as those reported for 2002-2003 (Table 3.3-4). These data suggest that the tidal wave is propagating more quickly upriver. Mean maximum and minimum water levels at this station are not significantly different from those reported in 2003-2004 or 2000-2001 (Table 3.3-5). Water levels at the Corps yard continue to be impacted by changes in river discharge, but to a much lesser degree than stations further upstream and to lesser degree than in 2003-2004.

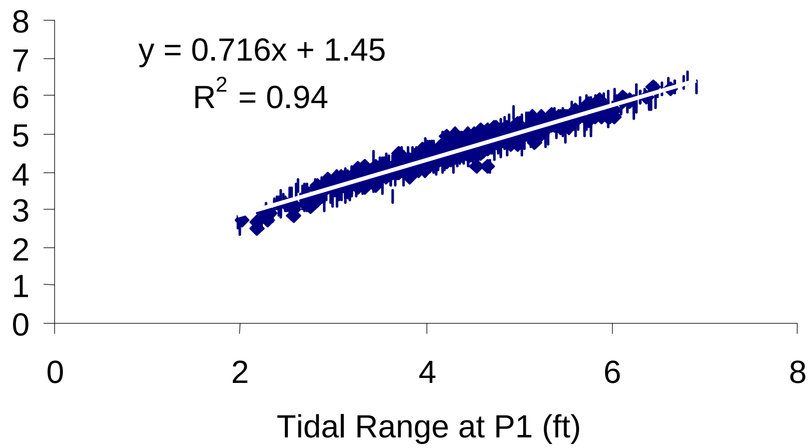


Figure 3.43-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and the Corps Yard station (P4).

3.44 Cape Fear River: Eagle Island (P6), Indian Creek (P7), Dollisons Landing (P8), and Black River (P9)

With the exception of P6, mean tidal ranges computed for mainstem river sites were lower than the mean determined for P1. During this reporting period, the mean tidal range for P6 was only 0.07 ft greater than the mean tidal range reported for P1. This reporting period, mean tidal range at P6 was less than the mean tidal range reported for P2 (Table 3.3-4). During the previous reporting period, the mean tidal range at P6 was identical to the mean reported at P2. Consistent with previous years, tidal range decreased with distance upriver (Table 3.3-4) with P9 exhibiting the lowest tidal range of these sites. The mean tidal ranges measured over this reporting period at the mainstem river sites were higher than in the previous reporting, with the exception of site P6 which decreased by 0.04-foot. The mean tidal ranges were significantly higher than those measured during the 2003-2004 reporting period at sites P8 and P9. At these sites, tidal range has consistently and significantly increased since the second year of monitoring; a period marked by extreme drought conditions and lower water levels in the river. With the exception of site P7, mean tidal ranges at all mainstem sites were significantly different from ranges reported for the first year of monitoring (Figure 3.3-1, Table 3.3-2). Mean tidal range at site P6 was significantly greater than the range reported for Year 1, while sites P8 and P9 exhibited mean ranges significantly lower than those reported for Year 1. These results are consistent with the results reported in FY 2003-2004. Neither the mean monthly maximum nor minimum water levels for these stations differed significantly from the values reported in 2003-2004 (Table 3.3-2). When compared to Year 1 values, however, mean monthly minimum values for all stations were significantly different from Year 1. The mean monthly maximum water levels were significantly different from Year 1 values for all sites except P8. In the previous reporting period, site P9 was the only station exhibiting a significant difference in mean monthly maximum water levels.

Figures 3.44-1 through 3.44-4 illustrate the relationship between tidal range at these Cape Fear River sites and tidal range at Ft Caswell. In general, tidal range at each upriver site is positively correlated with tidal range at the mouth, however, the degree of correlation decreases upriver. This pattern is consistent with previous reporting periods. The R^2 values at sites P6, P7, and P8 were much higher for this reporting period compared to both the 2002-2003 and 2003-2004 reporting periods. These data suggest fewer impacts associated with rainfall and runoff in the system. Of particular note is the R^2 value for P9 which increased from 0.11 and 0.10 in 2002-2003 and 2003-2004, respectively, to 0.32 during this reporting period. These results are consistent with river discharge reported in the mainstem (Figure 3.5-1) over the monitoring period which approximate the long-term, discharge mean. Comparisons of the regression slopes between years yielded significant differences at all sites with the exception of P6 (Table 3.3-3). For all sites that showed significant differences, slopes were steeper than in the previous reporting period. When regression slopes for this reporting period were compared to Year 1, significant differences existed for all sites.

The mainstem upriver sites continue to exhibit pronounced time asymmetries as shown in previous reports. The duration of flooding tide at these stations has increased slightly (by less than 2%) at all mainstem stations since the last reporting period (Table 3.3-4). In contrast, the duration of ebbing tide decreased by less the 0.75% at all stations. These results indicate an increase in time asymmetries for the mainstem stations. The mean high tide lag from P1 has increased at all stations relative to the lag times reported in 2003-2004, but have not returned to the values reported in 2002-2003. In contrast, the mean low tide lag decreased at P7, P8, and P9, but increased at P6. Further, the mean low tide lag for the two most upstream stations were identical (Table 3.3-4).

3.45 Northeast Cape Fear: Smith Creek (P11), Rat Island (P12), Fishing Creek (P13), and Prince George Creek (P14)

The mean tidal ranges computed for northeast Cape Fear sites over the current reporting period were not significantly different from those reported in 2003-2004 (Figure 3.3-1, Table 3.3-2). The mean tidal ranges at these sites for this reporting period, however, were significantly higher than the ranges reported in 2002-2003. The 2002-2003 reporting period was a period characterized by increased precipitation and discharge rates in the mainstem Cape Fear greater than those reported for the current monitoring period. For the two most upstream stations (Table 3.3-2), mean tidal ranges were significantly lower than the Year 1 values, but for the most downstream station (P11) the range was significantly greater than Year 1. Similar comparisons are unavailable for site P12 due to an incomplete data set at that station during the first year of monitoring. Mean tidal ranges for all of the Northeast Cape Fear River stations decrease upstream and continue to be lower than the mean determined for P1 with the exception of station P11, which, this year, had the same mean as station P1 (Table 3.3-3). With the exception of site P11, mean monthly minimum water levels for this reporting period were not significantly different than those reported during the previous reporting period (Table 3.3-5). This result is consistent with the two previous reporting periods. No significant difference in maximum water level was noted between this year and 2003-2004 for these stations. This pattern also was noted in the previous reporting period. All of the sites in the Northeast Cape Fear River continue to exhibit time asymmetries. Mean flood durations are shorter than ebb durations and the mean high tide lag relative to site P1 is less than the mean low tide lag (Table 3.3-4). During this

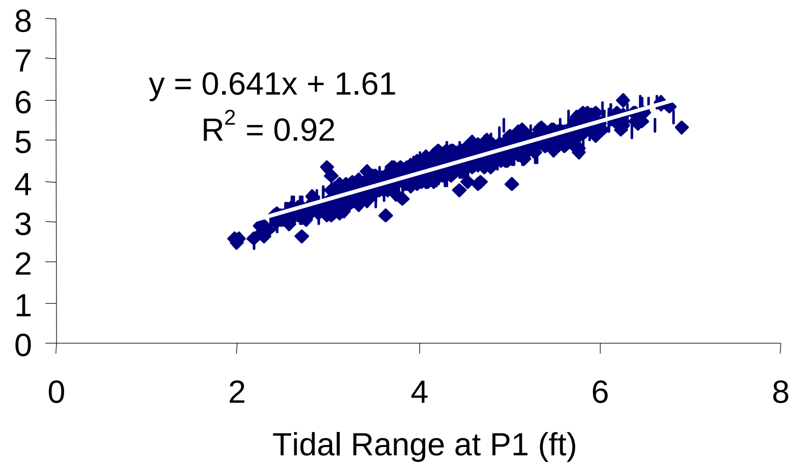


Figure 3.44-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Eagle Island (P6).

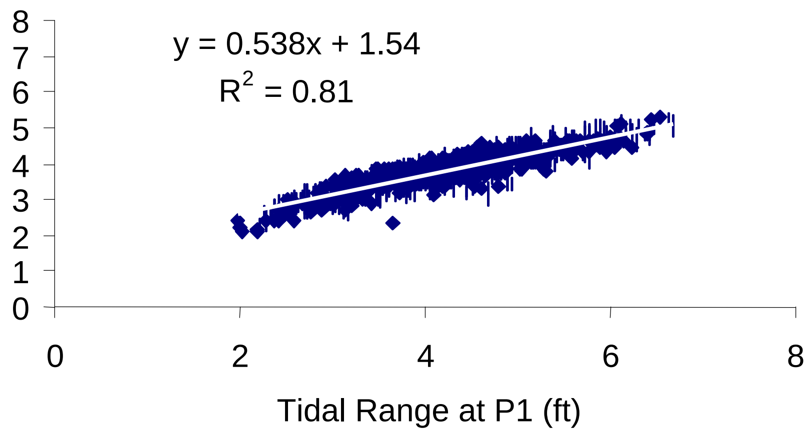


Figure 3.44-2**.** Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Indian Creek (P7).

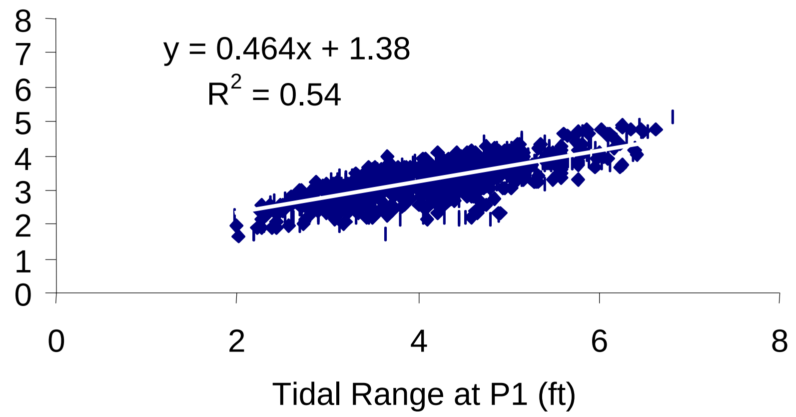


Figure 3.44-3. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Dollisons Landing (P8).

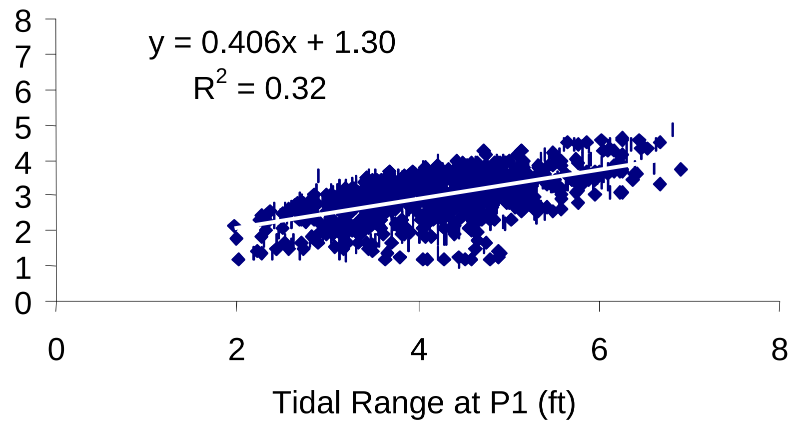


Figure 3.44-4. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Black River (P9).

monitoring period, mean flood duration increased at all sites. In most cases this increase was less than 2%, however, site P13 experienced an increase in mean flood duration of 3% above the duration reported in 2003-2004 (Table 3.3-4). The mean ebb durations for these stations did not change in a consistent manner. Sites P12 and P14 decreased by about 1.5%, while site P13 decreased by 3%. The mean ebb duration at site P11 did not change with respect to the duration reported in 2003-2004.

Tidal ranges at upstream stations in the Northeast Cape Fear are positively correlated with the tidal range at P1 (Figures 3.45-1 through 3.45-4). The mean tidal range at P14 on the Northeast Cape Fear River continues to be less than the mean range measured at P9, 12 mi from convergence on the Cape Fear River. Consistent with previous years, tidal ranges at stations P11 and P12 are more strongly correlated to tidal ranges observed at P1 than the tidal ranges at P13 and P14. Water levels at these upriver stations continue to be impacted strongly by other types of events; especially increased rainfall and upriver discharge as suggested by the lower R^2 values for the most upstream stations (Figures 3.5-1 and 3.5-2). Comparisons of the regression slopes between this reporting period and last year yielded no significant difference for site P11, but significant increases in slope for sites P12 and P13 and a significant decrease in slop for site P13 (Table 3.3-2). Significant differences in regression slope between this reporting period and 2000-2001 were also detected for sites P11 and P13. No Year 1 data were available for P12 with which to make a similar comparison.

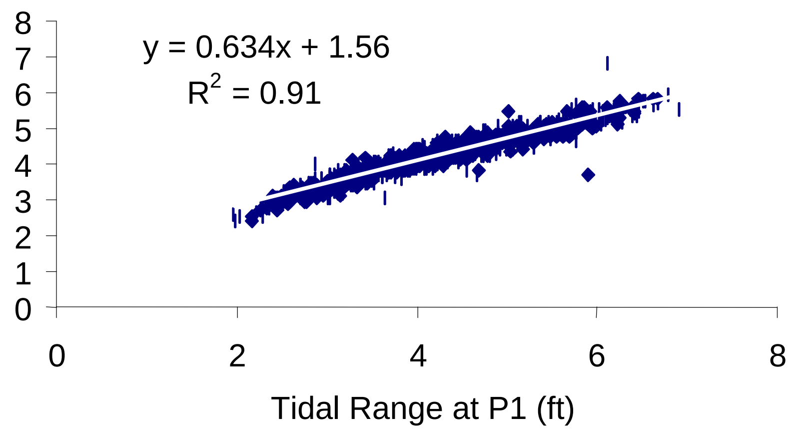


Figure 3.45-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Smith Creek (P11).

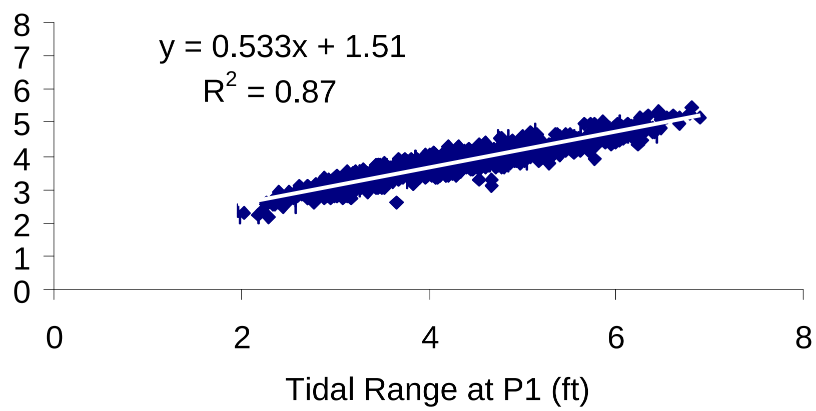


Figure 3.45-2. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Smith Creek (P12).

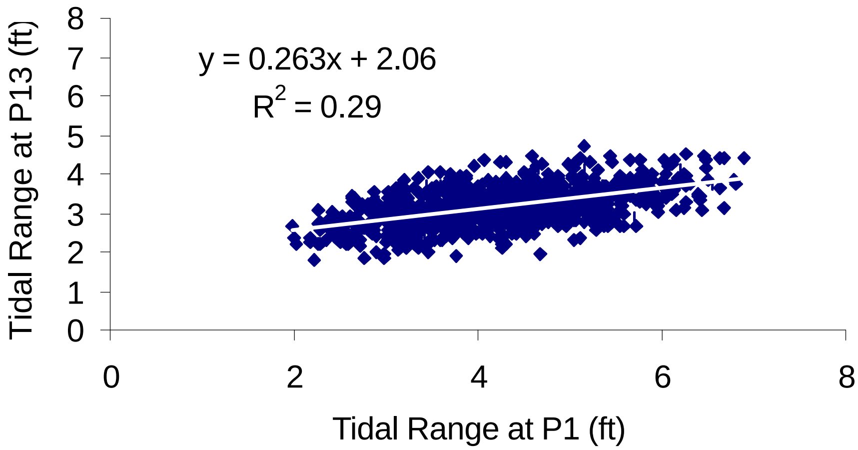


Figure 3.45-3. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Fishing Creek (P13).

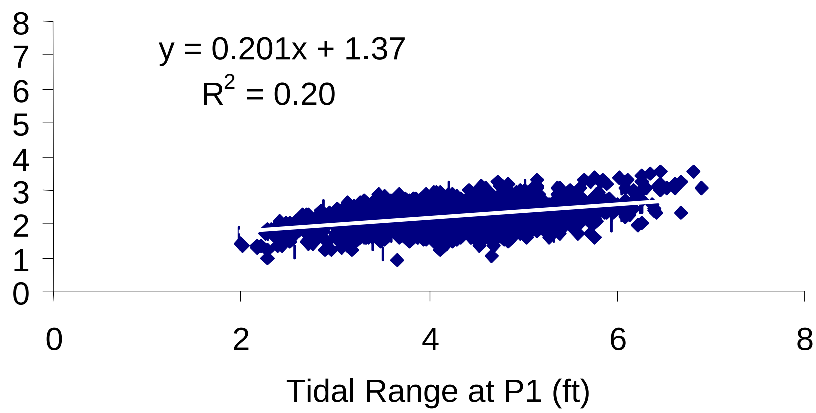


Figure 3.45-4. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Prince George Creek (P14).

3.5 Influence of Upstream Flow

Periods of lower, drought-induced water levels and extreme flooding in the system over the last 3 years have contributed to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. These effects are confounded by the shortened data set for Year 1 which included data collected from October to June, only, and covered a period when monthly river discharge was below the long-term average (~5,531 ft^3/s) reported by the USGS at Lock and Dam 1 on the Cape Fear mainstem (Figure 3.5-1). The discharge time series for the Northeast Cape Fear River is also provided this year (Figure 3.5-3) and shows that even though discharge rates in the Northeast Cape Fear River are much lower than in the mainstem, periods of increased discharge frequently occur. As discussed in last year's report, the higher tidal ranges observed for P1 for the first two monitoring periods may reflect these lower than average flows in the river, which have a tendency to produce higher tidal ranges. In contrast, the above average discharges recorded during monitoring Years 3 and 4, may explain the lower mean tidal ranges observed at P1 and other stations during those years. The Year 4 discharge data included fewer high flow events and more closely approximated mean conditions for the river (Figure 3.5-2) than the previous three years. This reporting period, for the first time, the mean discharge measured at Lock and Dam 1 is comparable to the 30 year mean discharge at that station (Figure 3.5-1). Thus, the tidal ranges and water levels reported this year are more likely to reflect baseline conditions than in any previous year of monitoring. Unfortunately, these data were collected after significant dredging activities had occurred.

The return to average river discharge in Year 4 and this reporting period, may help account for the high R^2 values reported for the last two years. The influence of discharge on water level and the return to more average conditions may also account for the significant differences in regression slope that existed between this year and the previous reporting period for the more upstream stations and the lack of significant difference for estuarine stations and the lowermost river stations. The upstream stations, (P7, P8, and P9 on the mainstem and P12, P13, and P14 on the Northeast Cape Fear), are more strongly influenced by runoff than estuarine stations or stations just above the estuary (e.g. P6 and P11). The lack of flooding, and presumably runoff, during this reporting period relative to the previous 2 reporting periods may also explain the lack of significant difference in mean monthly maximum and minimum water level between Year 4 and 5 at almost all sites.

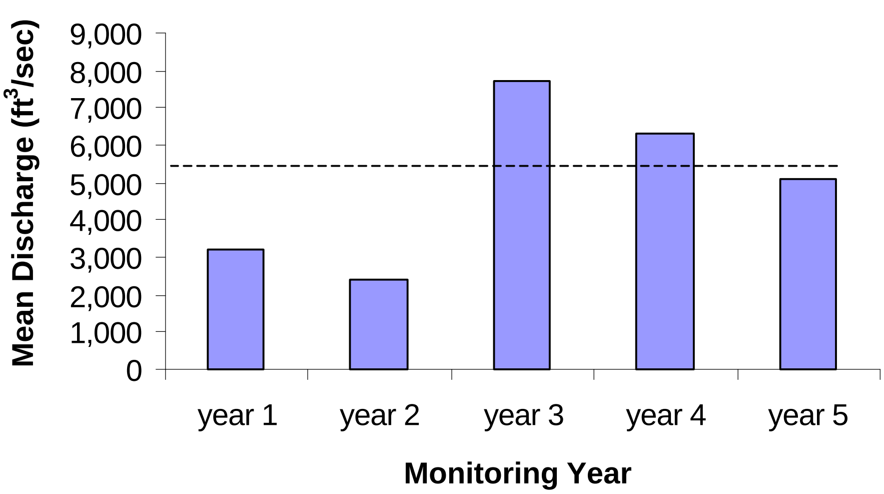


Figure 3.5-1. Mean discharge for each monitoring period. Monitoring Year 1 is October 2000 to May 2001; monitoring Year 2 in June 2001 to May 2002; monitoring Year 3 is June 2002 to May 2003; monitoring Year 4 is June 2003 to May 2004; and monitoring Year 5 is June 2004 to May 2005. The line denotes the long-term mean discharge for the Cape Fear River as measured at Lock 1 by a USGS gauging station.

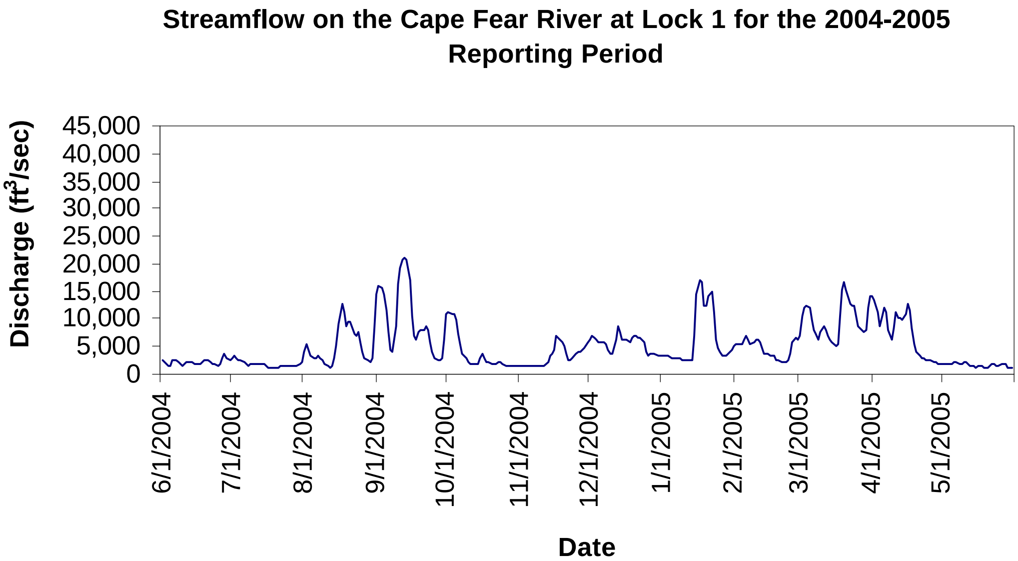


Figure 3.5-2. Plot showing discharge in the Cape Fear River at Lock 1 for the current monitoring period. Data available at http://nwis.waterdata.usgs.gov/nc/nwis site number 02105769.

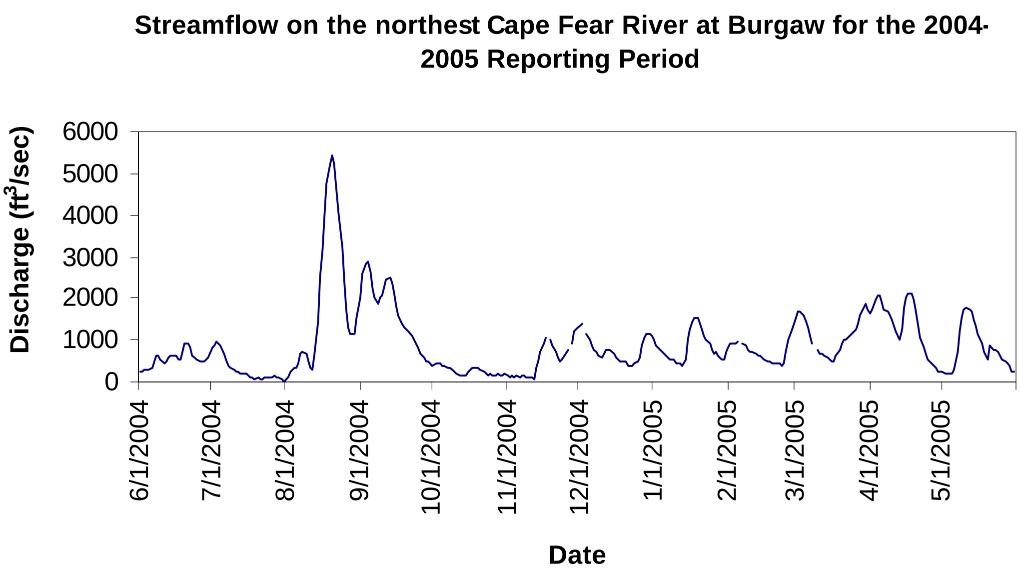


Figure 3.5-3. Plot showing discharge in the Northeast Cape Fear River at Burgaw for the current monitoring period. Data available at http://nwis.waterdata.usgs.gov/nc/nwis site number 02108566.

4.0 MARSH/SWAMP FLOOD AND SALINITY LEVELS

4.1 Summary

Complete data sets were generated for both fall 2004 and spring 2005 sampling seasons. More normal flow conditions did not result in lowered flooding rates for substations, which generally flooded during most high tides. Substations adjacent to DCPs on the mainstem of the Cape Fear River, experienced very few salinity incursions during the monitoring period. Flooding of substations along the Northeast Cape Fear River, however, contained saline water at three of the four stations in fall and at two in spring. In fall, saline water flooded far into the interiors of associated wetlands. At one site on Town Creek, a small tributary of the lower estuary, saline water was found on the marsh during spring, but not fall.

4.2 Data Base

A full, two-week water level collection was made for each of the 54 substations in fall 2004 and spring 2005 (Tables 4.2-1 and 4.2-2). Data sets were complete with only one substation at P11 in spring 2005 lost. Prior to deployment, a number of instruments could not pass QA/QC checks and were determined to be unreliable. These were replaced. Salinity data for the same two-week period, measured through conductivity, were also complete during both seasons (Tables 4.2-3 and 4.2-4).

4.3 Marsh/Swamp Flooding

The same general pattern of surface flooding found during previous years (Hackney et al. 2002a, 2002b, 2003, and 2005) was generally repeated, even though two of the previous years (2001-2003) were characterized by extreme flooding or drought, suggesting that tidal flooding is normal for these wetlands. This reporting year was characterized as near normal (see Section 3.0), i.e. no extreme events. As a consequence, substations at all nine sites flooded with nearly the same frequency as past reporting years (see Section 4.5 for inter-annual comparisons). The same among-station pattern emerged again this year with P7, Indian Creek, flooded less frequently with less water, while the same within station pattern also occurred. Substations located closest to uplands flooded least (Tables 4.2-1 and 4.2-2).

4.4 Water Salinity in Marshes and Swamps

The more normal river flow pattern noted this reporting year in Section 3.0 provides a better perspective on the impact of salt water to wetlands adjacent the DCP stations than years when extreme flow or drought occurred. During fall 2004, flow rates on the main stem of the Cape Fear River were elevated, but generally below 20,000 cu ft/sec (Figure 3.5-2). As a consequence, no saline water was detected (Table 4.2-3) at any substation within these four stations (P6-P9), even though P6 is near the confluence of the Brunswick and Northeast Cape Fear Rivers. There was regular rainfall along the lower river as evidenced by fresh conditions in Town Creek (Table 4.2-3). Local rainfall within the Coastal Plain drainage of the Northeast

Table 4.2-1. Flooding frequency, duration, depth, and actual water level of marsh/swamp substations during fall 2004. Actual water level is calculated using the maximum depth and marsh/swamp surface elevation relative to NAVD88 datum.

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
P3	1	Fall 04	9/10/2004	9/24/2004	26/27	8.5	2.5	0.66	1.8
	2	Fall 04	9/10/2004	9/24/2004	21/27	8.8	2.5	0.83	1.7
	3	Fall 04	9/10/2004	9/24/2004	26/27	9.1	2.5	0.52	2.0
	4	Fall 04	9/10/2004	9/24/2004	26/27	8.8	2.8	1.49	1.3
	5	Fall 04	9/10/2004	9/24/2004	26/27	7.8	2.5	0.99	1.5
	6	Fall 04	9/10/2004	9/24/2004	26/27	6.7	2.5	3.31	-0.8
P6	1	Fall 04	9/1/2004	9/15/2004	26/27	6.9	3.2	0.76	2.4
	2	Fall 04	9/1/2004	9/15/2004	23/27	5.4	3.1	1.56	1.5
	3	Fall 04	9/1/2004	9/15/2004	27/27	6.0	3.2	0.85	2.4
	4	Fall 04	9/1/2004	9/15/2004	26/27	5.4	3.1	1.13	2.0
	5	Fall 04	9/1/2004	9/15/2004	26/27	4.7	3.4	1.92	1.5
	6	Fall 04	9/1/2004	9/15/2004	22/27	5.4	3.0	1.74	1.3
P7	1	Fall 04	9/15/2004	9/29/2004	25/27	6.5	3.5	1.76	1.7
	2	Fall 04	9/15/2004	9/29/2004	19/27	5.7	3.5	2.23	1.3
	3	Fall 04	9/15/2004	9/29/2004	18/27	5.8	3.5	2.26	1.2
	4	Fall 04	9/15/2004	9/29/2004	16/27	5.7	3.6	2.43	1.2
	5	Fall 04	9/15/2004	9/29/2004	14/27	5.5	3.2	2.31	0.9
	6	Fall 04	9/15/2004	9/29/2004	14/27	5.7	3.5	2.37	1.1
P8	1	Fall 04	9/29/2004	10/13/2004	20/27	6.6	3.3	2.14	1.2
	2	Fall 04	9/29/2004	10/13/2004	25/27	5.1	3.4	1.54	1.9
	3	Fall 04	9/29/2004	10/13/2004	26/27	5.8	3.4	1.46	1.9
	4	Fall 04	9/29/2004	10/13/2004	20/27	5.4	3.3	1.98	1.3
	5	Fall 04	9/29/2004	10/13/2004	12/27	4.5	3.2	2.24	1.0
	6	Fall 04	9/29/2004	10/13/2004	7/27	4.9	3.1	2.38	0.7
P9	1	Fall 04	10/4/2004	10/18/2004	25/27	8.1	3.3	0.58	2.7
	2	Fall 04	10/4/2004	10/18/2004	26/27	6.6	3.2	2.21	1.0
	3	Fall 04	10/4/2004	10/18/2004	18/27	5.5	3.1	1.22	1.9
	4	Fall 04	10/4/2004	10/18/2004	14/27	5.6	3.1	2.06	1.0

Table 4.2-1. (continued)

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
	5	Fall 04	10/4/2004	10/18/2004	7/27	5.2	3.2	2.20	1.0
	6	Fall 04	10/4/2004	10/18/2004	12/27	5.8	3.2	1.92	1.3
P11	1	Fall 04	10/18/2004	11/4/2004	24/27	6.1	3.3	1.44	1.9
	2	Fall 04	10/18/2004	11/4/2004	25/27	5.2	3.4	1.82	1.6
	3	Fall 04	10/18/2004	11/4/2004	21/27	5.4	3.2	1.76	1.4
	4	Fall 04	10/18/2004	11/4/2004	22/27	5.4	3.3	1.85	1.5
	5	Fall 04	10/18/2004	11/4/2004	21/27	5.4	3.2	1.91	1.3
	6	Fall 04	10/18/2004	11/4/2004	21/27	5.3	3.3	2.04	1.3
P12	1	Fall 04	11/1/2004	11/15/2004	25/27	5.8	2.7	0.90	1.8
	2	Fall 04	11/1/2004	11/15/2004	11/27	5.5	2.7	1.62	1.1
	3	Fall 04	11/1/2004	11/15/2004	11/27	6.5	2.7	2.00	0.7
	4	Fall 04	11/1/2004	11/15/2004	11/27	6.8	2.7	1.90	0.8
	5	Fall 04	11/1/2004	11/15/2004	7/27	5.9	2.6	2.08	0.5
	6	Fall 04	11/1/2004	11/15/2004	4/27	6.5	2.6	2.44	0.2
P13	1	Fall 04	11/5/2004	11/19/2004	16/27	7.7	2.3	1.43	0.9
	2	Fall 04	11/5/2004	11/19/2004	23/27	5.9	2.3	1.08	1.2
	3	Fall 04	11/5/2004	11/19/2004	27/27	5.9	2.4	0.75	1.7
	4	Fall 04	11/5/2004	11/19/2004	27/27	6.7	3.3	1.00	2.3
	5	Fall 04	11/5/2004	11/19/2004	27/27	6.5	2.3	1.21	1.1
	6	Fall 04	11/5/2004	11/19/2004	6/27	6.8	2.3	1.64	0.7
P14	1	Fall 04	10/22/2004	11/5/2004	27/27	8.7	2.5	0.70	1.8
	2	Fall 04	10/22/2004	11/5/2004	26/27	7.4	2.4	0.87	1.5
	3	Fall 04	10/22/2004	11/5/2004	25/27	7.5	2.3	1.08	1.2
	4	Fall 04	10/22/2004	11/5/2004	22/27	7.6	2.3	1.22	1.1
	5	Fall 04	10/22/2004	11/5/2004	22/27	7.3	2.4	1.28	1.1
	6	Fall 04	10/22/2004	11/5/2004	18/27	7.4	2.2	1.49	0.7

Table 4.2-2. Flooding frequency, duration, depth, and actual water level of marsh/swamp substations during spring 2005. Actual water level is calculated using the maximum depth and marsh/swamp surface elevation relative to NAVD88 datum.

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
P3	1	Spr 05	4/28/2005	5/12/2005	26/27	6.0	2.3	0.66	1.6
	2	Spr 05	4/28/2005	5/12/2005	27/27	5.8	2.2	0.83	1.4
	3	Spr 05	4/28/2005	5/12/2005	26/27	6.4	2.0	0.52	1.5
	4	Spr 05	4/28/2005	5/12/2005	26/27	6.5	2.3	1.49	0.8
	5	Spr 05	4/28/2005	5/12/2005	25/27	5.7	2.1	0.99	1.1
	6	Spr 05	4/28/2005	5/12/2005	18/27	6.2	4.4	3.31	1.1
P6	1	Spr 05	4/12/2005	4/26/2005	26/27	6.4	3.3	0.76	2.5
	2	Spr 05	4/12/2005	4/26/2005	26/27	6.0	3.2	1.56	1.6
	3	Spr 05	4/12/2005	4/26/2005	26/27	6.6	3.1	0.85	2.3
	4	Spr 05	4/12/2005	4/26/2005	26/27	5.7	3.1	1.13	2.0
	5	Spr 05	4/12/2005	4/26/2005	25/27	4.9	3.3	1.92	1.4
	6	Spr 05	4/12/2005	4/26/2005	19/27	5.2	3.0	1.74	1.3
P7	1	Spr 05	3/22/2005	4/5/2005	26/27	6.1	3.5	1.76	1.7
	2	Spr 05	3/22/2005	4/5/2005	15/27	5.2	3.7	2.23	1.5
	3	Spr 05	3/22/2005	4/5/2005	16/27	6.1	3.4	2.26	1.1
	4	Spr 05	3/22/2005	4/5/2005	16/27	5.7	3.5	2.43	1.1
	5	Spr 05	3/22/2005	4/5/2005	15/27	6.0	3.5	2.31	1.2
	6	Spr 05	3/22/2005	4/5/2005	12/27	7.2	3.5	2.37	1.1
P8	1	Spr 05	4/5/2005	4/19/2005	23/27	5.5	3.3	2.14	1.2
	2	Spr 05	4/5/2005	4/19/2005	27/27	6.5	3.3	1.54	1.8
	3	Spr 05	4/5/2005	4/19/2005	27/27	6.9	3.4	1.46	1.9
	4	Spr 05	4/5/2005	4/19/2005	22/27	5.0	3.2	1.98	1.2
	5	Spr 05	4/5/2005	4/19/2005	20/27	4.9	3.3	2.24	1.1
	6	Spr 05	4/5/2005	4/19/2005	14/27	4.7	3.2	2.38	0.8
P9	1	Spr 05	4/19/2005	5/3/2005	27/27	7.1	2.7	0.58	2.1
	2	Spr 05	4/19/2005	5/3/2005	24/27	5.3	2.6	2.21	0.4
	3	Spr 05	4/19/2005	5/3/2005	12/27	4.8	2.5	1.22	1.3
	4	Spr 05	4/19/2005	5/3/2005	7/27	5.8	2.6	2.06	0.5
	5	Spr 05	4/19/2005	5/3/2005	5/27	5.5	2.6	2.20	0.4
	6	Spr 05	4/19/2005	5/3/2005	1/27	7.6	2.4	1.92	0.5
P11	1	Spr 05	3/29/2005	4/12/2005	25/27	5.0	3.7	1.44	2.3
	2	Spr 05	3/29/2005	4/12/2005	21/27	4.8	3.6	1.82	1.8
	3	Spr 05	3/29/2005	4/12/2005	ND	ND	ND	ND	ND
	4	Spr 05	3/29/2005	4/12/2005	19/27	4.8	3.3	1.85	1.5
	5	Spr 05	3/29/2005	4/12/2005	19/27	4.5	3.1	1.91	1.2
	6	Spr 05	3/29/2005	4/12/2005	19/27	5.0	3.3	2.04	1.3

Table 4.2-2. (continued)

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
P12	1	Spr 05	5/9/2005	5/23/2005	26/27	5.8	2.9	0.90	2.0
	2	Spr 05	5/9/2005	5/23/2005	15/27	5.4	2.9	1.62	1.3
	3	Spr 05	5/9/2005	5/23/2005	8/27	4.6	2.9	2.00	0.9
	4	Spr 05	5/9/2005	5/23/2005	3/27	5.7	2.8	1.90	0.9
	5	Spr 05	5/9/2005	5/23/2005	4/27	5.5	2.9	2.08	0.8
	6	Spr 05	5/9/2005	5/23/2005	3/27	3.6	2.9	2.44	0.5
P13	1	Spr 05	3/1/2005	3/15/2005	19/27	6.4	2.4	1.43	1.0
	2	Spr 05	3/1/2005	3/15/2005	23/27	5.5	2.4	1.08	1.3
	3	Spr 05	3/1/2005	3/15/2005	25/27	5.8	2.5	0.75	1.8
	4	Spr 05	3/1/2005	3/15/2005	27/27	6.2	3.5	1.00	2.5
	5	Spr 05	3/1/2005	3/15/2005	25/27	4.8	2.4	1.21	1.2
	6	Spr 05	3/1/2005	3/15/2005	9/27	4.0	2.3	1.64	0.7
P14	1	Spr 05	3/2/2005	3/16/2005	26/27	6.6	2.2	0.70	1.5
	2	Spr 05	3/2/2005	3/16/2005	27/27	4.8	2.1	0.87	1.2
	3	Spr 05	3/2/2005	3/16/2005	25/27	5.0	2.0	1.08	0.9
	4	Spr 05	3/2/2005	3/16/2005	23/27	4.2	2.0	1.22	0.8
	5	Spr 05	3/2/2005	3/16/2005	21/27	3.1	2.0	1.28	0.7
	6	Spr 05	3/2/2005	3/16/2005	14/27	5.5	1.7	1.49	0.2

ND = No data available.

Table 4.2-3. Summary of salinity data from nine substations collected along the Cape Fear River and its tributaries in fall 2004.

Station Number	Station Name	Substation Number	Fall 2004 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P3	Town Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P6	Eagle Island	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P7	Indian Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P8	Dollisons Landing	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P9	Black River	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P11	Smith Creek	1	<1 - 14	22/27
		2	<1 - 15	22/27
		3	<1 - 4	27/27
		4	<1 - 13	22/27
		5	<1 - 12	22/27
		6	<1 - 12	22/27
P12	Rat Island	1	<1 - 13	14/27
		2	<1 - 11	9/27
		3	<1- 10	5/27
		4	<1 - 9	3/27
		5	<1 - 8	1/27
		6	<1	0/27

Table 4.2-3. (continued)

Station Number	Station Name	Substation Number	Fall 2004 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P13	Fishing Creek	1	<1 - 5	5/27
		2	<1 - 3	2/27
		3	<1 - 4	2/27
		4	<1 - 3	4/27
		5	<1 - 2	1/27
		6	<1	0/27
P14	Prince George	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27

Table 4.2-4. Summary of salinity data from nine substations collected along the Cape Fear River and its tributaries in spring 2005.

Station Number	Station Name	Substation Number	Fall 2003 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P3	Town Creek	1	<1 - 6	15/27
		2	<1 - 5	13/27
		3	<1 - 5	13/27
		4	<1 - 3	8/27
		5	<1 - 2	2/27
		6	<1 - 2	1/27
P6	Eagle Island	1	<1 - 3	5/27
		2	<1 - 2	2/27
		3	<1 - 2	1/27
		4	<1 - 1	0/27
		5	<1	0/27
		6	<1	0/27
P7	Indian Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P8	Dollisons Landing	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27

Table 4.2-4. (continued)

Station Number	Station Name	Substation Number	Fall 2003 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P9	Black River	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P11	Smith Creek	1	<1 - 1	0/27
		2	<1 - 1	0/27
		3	<1 - 2	6/27
		4	<1 - 2	5/27
		5	<1 - 1	0/27
		6	<1 - 1	0/27
P12	Rat Island	1	<1 - 6	8/27
		2	<1 - 4	3/27
		3	<1- 1	0/27
		4	<1- 2	4/27
		5	<1	0/27
		6	<1	0/27
P13	Fishing Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P14	Prince George	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27

Cape Fear River provided more flow in fall than spring (Figure 3.5-3), but saline water remained a part of the normal flood water at three (P11, P12, and P13) of the four stations. All substations at P11 were flooded by saline water almost every tide, (22/27), a fact reflected in the soil biogeochemistry (see Section 5.0). Saline water as high as 15 ppt flooded the surface (Table 4.2-3). Upstream at P12, saline water flooded all but the substation farthest from the river with water almost as saline. However, substations at this station are located on a long belt transect and saline water did not reach substation 6, adjacent to wetlands where seepage water dominates. Note that floodwater as high s 13 ppt flooded substation 1 along the river's edge on 14 of 27 tides. Vegetation at this substation now consists totally of salt tolerant species (see Section 8.0). At substations where woody, freshwater vegetation is dead or dying, maximum salinities of 10-11 ppt were recorded on at least one occasion and flooding by saline water was a common event (Table 4.2-3). Wetlands adjacent to P13 are forested, but showing some signs of salt stress. While this stress may have resulted from high levels of saline water delivered to these wetlands during the drought of 2001-2002, there continue to be saline water intrusions on the site (Table

4.2-3). The degree to which saline water affects woody vegetation is reflected in the degree to which soils respond, which is examined in Section 5.0. The most upstream station, P14, is the only station on the Northeast Cape Fear River that did not experience saline water on the wetlands during fall 2004.

Spring 2005 conditions in the mainstem Cape Fear River were similar with respect to flow rate (Figure 3.5-2), but lower than fall flows in the Northeast Cape Fear River (Figure 3.5-3). Saline conditions (6 ppt maximum) occurred in Town Creek about half of the tides at most substations (Table 4.2-4). All stations continued to be relatively fresh on the mainstem of the river, except at P6 were a few saline incursions occurred. Similarly, saline water was found more frequently on wetland substations along the Northeast Cape Fear River (Table 4.2-4).

4.5 Inter-Annual Variation

Since the study began flood duration has largely increases over initial conditions (Table 4.5-1). Beginning in fall 2001 flooding duration increased at 27, 19, 37, 32, 32, 37, and 29 of the 54 substations. At the same time, the maximum salinity measured at individual substations has generally decreased (Table 4.5-2).

Table 4.5-1. Deviation of flood duration over time. Values in parentheses are negative.

Station	Subsite	**Initial Avg. Tidal Duration (hrs.) (Spr. 2000-Spr.2001)**	Deviation from Initial							
			Fall 2001	Spring 2002	Fall 2002	Spring 2003	Fall 2003	Spring 2004	Fall 2004	Spring 2005
P3	1	**6.3**	(0.6)	0.1						

Table 4.5-1. (continued)

+1.3
+0.8
+1.7
(0.4)
2.2
(0.3)
2
6.0
(0.7)
(0.7)
+1.2
+0.8
+1.5
(0.5)
2.8
(0.2)
3
6.0
0.2
(0.0)
+1.9
1.3
+1.9
(0.2)
3.1
0.4
4
6.8
(0.8)
(1.7)
+1.7
+0.5
+1.0
(1.9)
2.2
(0.3)
5
6.2
(0.2)
(1.4)
+0.9
+0.4
(0.4)
(0.4)
1.6
(0.5)
6
4.7
+2.8
(0.2)
+1.6
+0.4
+0.9
+1.8
2.0
1.5

Table 4.5-1. (continued)

P6

1	2	3	4	5
8.6	**5.4**	**6.1**	**5.6**	**5.0**
(1.7)	+1.1	+0.4	+0.8	+0.1
(2.2)	+0.3	(0.5)	(0.1)	(0.0)
(0.3)	+0.8	(0.1)	+0.1	+0.9
(1.9)	(0.0)	+0.5	+0.1	+0.2
(0.7)	(0.2)	+0.3	+0.6	(0.0)
(3.2)	+0.6	(1.0)	(0.7)	(0.4)
1.7	-	(0.1)	0.2	(0.3)
(2.2)	0.6	0.5	0.1	(0.1)

Table 4.5-1. (continued)

6
4.5
(0.1)
(0.1)
+0.5
+0.2
(0.1)
+0.4
(0.9)
0.7

P7

1
5.0
+1.6
+0.6
+1.3
+2.2
+0.2
+0.1
1.5
1.1
2
2.8
+3.2
+3.4
+1.2
+3.7
+1.7
+2.9
2.9
2.4
3
3.2
+2.9
+2.8
+0.7
+2.9
+0.8
+2.5
2.6
2.9
4
4.0
+2.1
+1.5
+0.8
+1.6
+0.2
+0.9
1.7
1.7

Table 4.5-1. (continued)

Station		
Subsite	5	6
Initial Avg. Tidal Duration (hrs.) (Spr. 2000-Spr.2001)	**2.0**	**3.9**
Deviation from Initial		
Fall 2001	+4.2	+2.1
Spring 2002	+2.5	+1.4
Fall 2002	+4.1	+2.4
Spring 2003	+3.9	+2.1
Fall 2003	+2.7	+1.1
Spring 2004	+3.4	+0.6
Fall 2004	3.5	1.8
Spring 2005	4.0	3.3

Table 4.5-1. (continued)

P8

1
4.8
(0.3)
+0.4
+0.1
(1.1)
+0.6
(1.2)
1.8
0.7

2
5.8
(0.9)
(0.2)
+0.2
(0.7)
(0.0)
(1.4)
(0.7)
0.7

3
5.7
(0.1)
(0.9)
(0.0)
(0.2)
+0.2
(0.7)
0.1
1.2

4
4.8
(0.6)
+0.5
+0.3
(0.4)
+0.6
+0.2
0.6
0.2

5
4.2
(0.2)
+1.2
+0.1
(0.5)
+0.8
+0.8
0.3
0.7

Table 4.5-1. (continued)

	6
	3.5
	(0.1)
	+1.5
	+0.8
	+0.1
	+2.1
	+1.6
	1.4
	1.2
P9	
	1
	8.5
	(0.5)
	(2.2)
	(2.1)
	(1.6)
	(0.3)
	(1.8)
	(0.4)
	(1.4)
	2
	6.0
	+1.2
	(1.7)
	(0.6)
	(1.2)
	(0.1)
	(0.9)
	0.6
	(0.7)
	3
	4.2
	+1.5
	+1.7
	+0.5
	(0.6)
	(0.4)
	+0.4
	1.3
	(0.6)
	4
	5.8
	+0.3
	+0.2
	(0.4)
	(1.3)
	(1.0)
	(0.4)
	(0.2)
	-

Table 4.5-1. (continued)

5
5.7
+0.2
(1.4)
(0.2)
(1.2)
(1.3)
+0.2
(0.5)
(0.2)

6
5.8
+0.4
(1.2)
(0.6)
(0.9)
(1.0)
(1.6)
-
1.8

P11

1
5.0
+1.0
+0.1
+1.3
+1.5
+0.9
+0.3
1.1
-

2
3.9
+1.5
+0.3
+1.0
+1.5
+1.4
+1.0
1.3
0.9

3
5.2
+0.9
(0.0)
+0.2
+0.8
+0.3
+0.1

Table 4.5-1. (continued)

0.2
-

4
5.4
(0.1)
(0.2)
+0.7
+0.2
+0.2
+0.6
-
(0.6)

5
5.1
+0.3
(0.1)
+0.3
+0.7
+0.1
+0.2
0.3
(0.6)

6
5.2
(0.2)
(0.5)
+0.5
(0.3)
0.0
+0.8
0.1
(0.2)

P12

1
6.3
+0.7
(0.1)
+0.8
(0.5)
(0.7)
+0.2
(0.5)
(0.5)

2
4.9
+0.3
(0.2)
(0.1)
+1.2

Table 4.5-1. (continued)

+0.6
+1.2
0.6
(0.5)
3
4.7
+0.9
(0.2)
+1.7
(0.4)
-
+1.2
1.8
(0.1)
4
4.9
(0.2)
+0.1
+0.6
+0.8
+2.0
+0.3
1.9
0.8
5
6.1
+0.3
(0.6)
+0.2
(0.1)
(0.3)
(1.0)
(0.2)
(0.6)
6
5.4
+2.0
(0.6)
(0.3)
+1.4
+2.2
+1.4
(1.1)
(1.8)

P13

1
5.6
+1.9
+1.6

Table 4.5-1. (continued)

+1.2
0.0
+0.9
+1.8
2.1
0.8
2
5.8
(1.1)
(0.8)
+0.4
+0.6
+0.2
(0.6)
0.1
(0.3)
3
6.2
(0.9)
(0.9)
+0.1
+0.5
+0.9
(0.1)
(0.3)
(0.5)
4
7.9
(1.8)
(1.1)
(2.5)
(0.9)
(0.6)
(0.9)
(1.2)
(1.7)
5
5.9
(0.3)
+0.1
(0.9)
(0.3)
(0.1)
(0.1)
0.6
(1.1)
6
4.3
(2.1)
0.0
(0.3)
(0.6)
+0.3
+0.1
2.5
(0.3)

Table 4.5-1. (continued)

P14

1	2	3	4	5
7.9	**7.4**	**6.8**	**6.5**	**5.6**
(1.4)	(2.7)	(0.5)	(0.6)	(0.1)
(2.7)	(2.3)	(1.5)	(1.7)	(0.9)
+0.2	(1.2)	(0.3)	+0.4	(0.2)
+0.9	+0.6	+0.4	+0.1	+0.8
(0.3)	(0.7)	(0.2)	(0.4)	+0.1
0.8	(1.3)	+0.1	+0.1	(0.2)
0.8	-	0.7	1.1	1.7
(1.3)	(2.6)	(1.3)	(2.3)	(2.5)

Table 4.5-1. (continued)

6
6.0
+0.9
(0.4)
(0.0)
(0.5)
+0.2
(0.4)
1.4
(0.5)

SUM

-18.0
-29.0
-10
-14.875
-8.8
-20.3
47.8
2.4

Table 4.5-2. Deviation of maximum salinities from initial values from 2001-2005.

Station	Subsite	Initial Avg. Max Salinities (ppt) (Sum. 2000-Spr.2001)	Deviation from Initial							
			Fall 2001	Spring 2002	Fall 2002	Spring 2003	Fall 2003	Spring 2004	Fall 2004	Spring 2005
P3	1	**8.0**	+11.0	-7.0	+13.0	-8.0	0.0	-7.0	-8.0	-5.0
	2	**8.7**	+10.3	-8.7	+10.3	-8.7	-5.7	-8.7	-8.7	-3.7
	3	**9.3**	+9.7	-9.3	ND	-9.3	-2.3	-9.3	-9.3	-4.3
	4	**6.3**	+10.7	-5.3	-0.3	-6.3	-0.3	-5.3	-6.3	-3.3
	5	**4.5**	+9.5	-2.5	+7.5	-4.5	+1.5	-4.5	-4.5	-2.5
	6	**4.0**	+10.0	-3.0	+2.0	-4.0	+2.0	-4.0	-4.0	2.0
P6	1	**9.7**	+5.3	-4.7	-0.7	-9.7	-0.7	-3.7	-9.7	-6.7
	2	**9.3**	+2.7	-9.3	+3.7	ND	-1.3	-4.3	-9.3	-7.3
	3	**11.0**	+2.0	-7.0	1.0	ND	-4.0	-8.0	-11.0	-9.0
	4	**9.3**	+1.7	-7.3	-4.3	ND	-3.3	-7.3	-9.3	-6.3
	5	**4.0**	+3.0	-4.0	+2.0	-3.0	-2.0	+1.0	-4.0	-3.0
	6	**3.5**	+2.5	-1.5	+3.5	-3.5	-1.5	-3.5	-3.5	-2.5
P7	1	**0.0**	+5.0	0.0	+2.0	ND	0.0	0.0	0.0	0.0
	2	**0.0**	+1.0	+3.0	+1.0	0.0	0.0	0.0	0.0	0.0
	3	**0.0**	+1.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0
	4	**0.0**	0.0	0.0	+2.0	0.0	0.0	0.0	0.0	0.0
	5	**0.0**	0.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0
	6	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P8	1	**0.3**		-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	0.3
	2	**0.0**	0.0	+2.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P9	1	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	4	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	5	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	6	**0.0**	0.0	0.0	0.0	0.0	ND	0.0	0.0	0.0
P11	1	**6.7**	+7.3	-3.7	+11.3	-6.7	-0.7	-3.7	7.3	-5.7
	2	**7.7**	+4.3	-4.7	+3.3	-7.7	-1.7	-4.7	7.3	-6.7
	3	**7.7**	+7.3	-2.7	+1.3	-7.7	-2.7	-4.7	-3.3	-5.7
	4	**6.3**	+8.7	-3.3	+6.7	-6.3	-1.3	-3.3	6.7	-4.3
	5	**5.7**	+8.3	-2.7	+12.3	-4.7	-1.7	-3.7	6.3	-4.7
	6	**1.5**	+11.5	+1.5	+16.5	+0.5	+3.5	-0.5	10.5	-0.5
P12	1	**5.0**	+6.0	-3.0	+7.0	-5.0	-2.0	+6.0	+8.0	+1.0
	2	**4.0**	+6.0	-3.0	+8.0	-3.0	-4.0	+3.0	7.0	0.0

Table 4.5-2. (continued)

Station	Subsite	Initial Avg. Max Salinities (ppt) (Sum. 2000-Spr.2001)	Deviation from Initial Fall 2001	Spring 2002	Fall 2002	Spring 2003	Fall 2003	Spring 2004	Fall 2004	Spring 2005
	3	**3.0**	+9.0	-2.0	+8.0	-1.0	-3.0	+2.0	7.0	2.0
	4	**2.3**	+8.7	+0.7	+8.7	-1.3	-2.3	+0.7	6.7	0.3
	5	**0.0**	+10.0	+1.0	+11.0	+1.0	0.0	+3.0	8.0	0.0
	6	**0.0**	+2.0	+1.0	+7.0	+2.0	+1.0	0.0	0.0	0.0
P13	1	**4.3**	+4.7	-4.3	-2.3	-4.3	-4.3	-4.3	0.7	-3.3
	2	**2.7**	+8.3	-2.7	-0.7	-2.7	-2.7	-2.7	0.3	-1.7
	3	**2.3**	+6.7	-2.3	-0.3	-1.3	-2.3	-2.3	1.7	-1.3
	4	**3.7**	+4.3	-3.7	-1.7	-2.7	-3.7	-3.7	-0.7	-2.7
	5	**3.0**	+4.0	-3.0	-1.0	-3.0	-3.0	-3.0	-1.0	-2.0
	6	**1.0**	0.0	-1.0	0.0	-1.0	-1.0	-1.0	0.0	-1.0
P14	1	**0.0**	+2.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0
	2	**0.0**	+2.0	+1.0	+1.0	0.0	0.0	0.0	0.0	0.0
	3	**0.0**	+2.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0
	4	**0.0**	+2.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0
	5	**0.0**	+2.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0
	6	**0.0**	+1.0	0.0	+1.0	0.0	0.0	0.0	0.0	0.0
		Total Change	0.0	-112.0	-10.7	-115.7	-57.8	-103.5	-7.4	-87.6

5.0 MARSH/SWAMP BIOGEOCHEMISTRY

5.1 Summary

Geochemical data was collected at nine stations along the Cape Fear River Estuary beginning winter 2000. Data from the winters of 2000-2004 and the summers of 2000-2003 was presented in the previous annual reports for this project (CZR Incorporated 2001; Hackney et al. 2002a, 2002b, 2003, 2005). Data presented in the current report includes winter 2005 and summer 2004. The microbial modes of organic matter remineralization of the study sites range from sulfate reducing to methanogenic. Analysis of porewater chloride, sulfate, and methane was performed at six substations per station and at 6 sub-depths per substation. Samples were collected during winter and summer at eight sites and monthly at P6 (Eagle Island). These data were used to classify the geochemical setting of each substation at each station as methanogenic (M), sulfate reducing (SR), methanogenic with evidence of past sulfate reduction (MPSR), and sulfate reducing with a non-seawater source of sulfate (SRNS). The classifications were compared to the previous data for these sites. Understanding the current and past geochemical conditions examined during the past 5 ½ years will be necessary to separate potential change caused by the deepening of the Cape Fear River from natural fluctuations.

Station P6's (Eagle Island) geochemistry was analyzed monthly and displayed a steady decrease in salinity from June of 2002 until June of 2003. The salinity slightly rebounded during the winter of 2004, however, it was still lower than previous years. The current winter (2005)

Table 4.5-2. (continued)

had almost identical conditions as the previous winter of 2004 with the exception of a salinity peak in November. Although there was no obvious peak in salinity last year (Hackney et al.

2005), this monthly pattern of salinity variation has been observed in previous years where peaks in salinity were observed during November and May (Hackney et al. 2002a, 2002b, 2003). Because of the salinity pulse during November, several locations within Eagle Island that were converted to M geochemical classifications for the first time during the previous year returned to SR this year.

5.2 Geochemical Theory and Classification

Porewater sampling of the metabolic products of sulfate reducing and methanogenic bacteria help establish the frequency and duration of organic soil inundation by tidal water carrying ocean-derived salt versus inundation by fresh water. Changes in flooding frequency have a more significant impact if salts from seawater enter the pore space of wetland sediments. In the presence of sufficient seawater sulfate, organic matter is remineralized via sulfate reducing bacteria in anaerobic environments generating hydrogen sulfide. In freshwater environments, organic matter is usually remineralized via methanogens that generate methane as a byproduct. In the presence of high levels of sulfate from seawater, methanogens are replaced by sulfate reducing bacteria and methanogenesis is inhibited. Hydrogen sulfide is toxic and limits both plants and animal species that do not have a behavioral or physiological mechanism to tolerate this bacterial metabolite. Thus, a shift in remineralization pathway can lead to different communities of plants and animals.

Chloride concentrations are a direct measure of salinity as it occurs in a constant proportion in seawater and has no substantial sinks or sources in wetland sediments. Therefore, the term salinity used in the biogeochemistry section of this report will refer to salinity based on measured chloride concentrations.

Chloride and sulfate concentrations are in a constant ratio in seawater (approximately 20:1). Unlike sulfate, which can decrease due to sulfate reduction, there are no common removal mechanisms (biotic or abiotic) for chloride from seawater. Therefore, chloride concentrations can be used as an indicator of the amount of sulfate originally supplied to a site by seawater. Changes in the ratio of chloride to sulfate are an indicator of sulfate reduction. In the presence of sulfate reduction, methanogenic bacteria are out competed and methane production is inhibited. Therefore, low concentrations of methane are another indicator of sulfate reduction. When sulfate concentrations decrease sufficiently, sulfate-reducing bacteria are no longer able to function and methane production dominates. Thus, a sulfate reducing threshold concentration can be identified in sulfate concentration versus depth profiles, where sulfate concentrations no longer decrease with increasing depth and methane concentrations increase. Data from all nine marsh/swamp stations of the present study place the level where the shift occurs at approximately 300 µM sulfate. This corresponds to sulfate being supplied by salinities of approximately 0.4 parts per thousand.

Using this sulfate reducing threshold (300 µM sulfate), stations and substations were classified as sulfate reducing or methanogenic. Methanogenic substations that had a chloride to sulfate ratio significantly greater than seawater (>30:1) were classified as methanogenic sites with evidence of past sulfate reduction. Sulfate reducing sites with ratios less than seawater (5:1) were classified as sulfate reducing with a non-seawater source of sulfate. The four main classifications are: 1) sulfate reducing (SR), 2) methanogenic (M), 3) methanogenic with evidence of past sulfate reduction (MPSR) and sulfate reducing with a non-seawater source of sulfate (SRNS). Changes in these classifications will be used to determine changes in biogeochemical setting associated with river dredging, drought, or other factors.

5.3 Geochemical Methodology

Biogeochemical monitoring was established in close proximity to shallow water well/conductivity/temperature substations. Six substations are distributed along the length of each of nine monitoring belt transects with number one near the river or channel and number 6 adjacent to uplands. Substations are roughly perpendicular to the segment of the stream along which they have been established. Sampling devices, peepers, are constructed of thick acrylic with wells (1-cm deep grooves) located at six different depths that sample 1, 6, 11, 16, 21, and 26 cm below the soil surface. Semipermeable membranes allow methane, sulfate, and chlorine to equilibrate with distilled water in wells. Peepers are inserted into the substrate and left for 1 week, which is ample time for equilibration. Peepers have been shown to be reliable collection devices for these types of dissolved substances (Hesslein 1976). The concentrations of all parameters are determined after removing samples from peeper cells with a syringe equipped with a needle. Sulfate and chloride concentrations are stable under oxic conditions and can be stored in serum vials until analysis. Sulfate and chloride concentrations are determined with an ion chromatograph (Hoehler et al. 1994). Salinity is calculated from the chloride concentrations of the equilibrated peeper chamber water based on the constant ratio of chloride to total dissolved salts in seawater. Samples for porewater methane analysis are prepared by extraction of porewater methane into an inert helium headspace within a gas-tight syringe. The headspace gas is then injected into a gas chromatograph equipped with a flame ionization detector (Kelley et al. 1995) for quantitative determination of methane concentration.

Porewater is collected and analyzed at all 54 substations in all nine transect stations during mid-summer and mid-winter, the coldest and warmest parts of the year. This provides data during periods of maximum and minimum bacterial metabolism. In addition, porewater is collected from the Eagle Island station (P6) every month using the same procedures. This station represents a transition between saline and fresh-dominated stations. In addition, the six substations represent the same transition along a different scale, well-flooded to less flooded.

5.4 Eagle Island (P6) Annual Cycles of Sulfate, Chloride, and Methane

Prior to the spring of 2003, Eagle Island had been classified primarily as SR and MPSR classification because both methanogenesis and sulfate reduction occur at this station (CZR Incorporated 2001; Hackney et al. 2002a; 2002b, 2003). The occurrence of methanogenic geochemical classifications increased during the spring of 2003 and continued through the summer of 2004. Following the pulse of salinity during November 2004, many sites returned to SR classification at the near-shore stations and eventually at all locations by spring 2005. Eagle

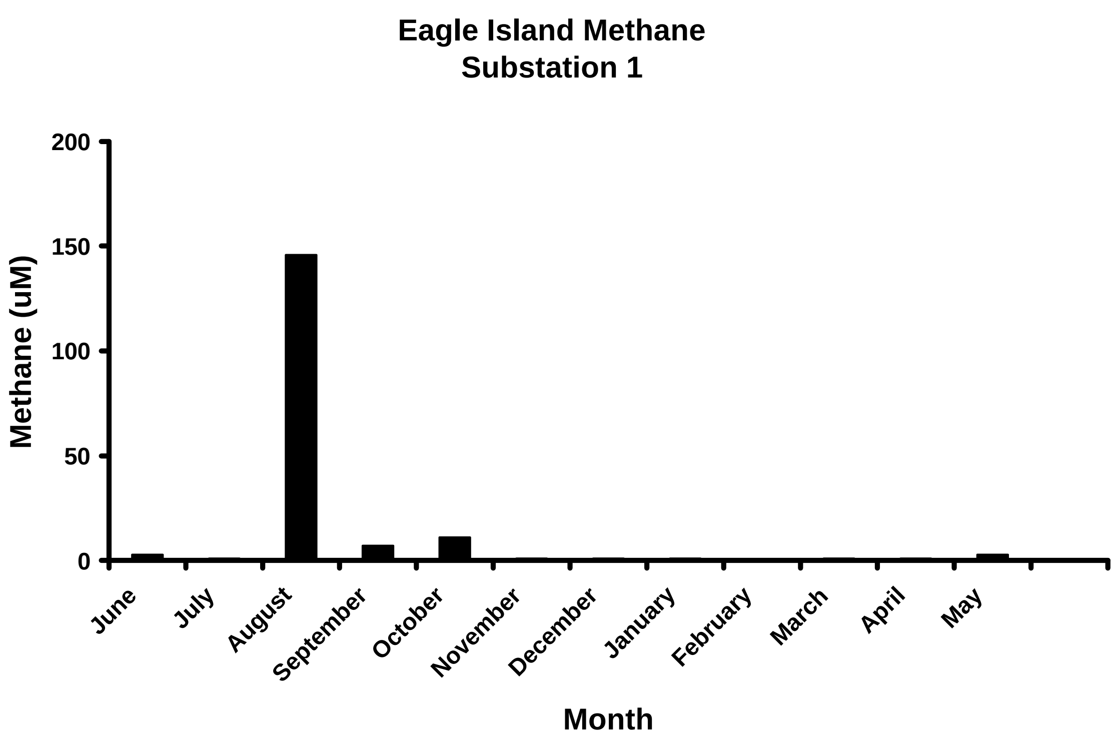
Island's general classifications are based on the following observations: 1) Methane is present at depth in all substations, but is often at very low concentrations at the surface during times of high sulfate input (Figure 5.4-1), 2) Sulfate concentrations range from below the sulfate reducing threshold of 300 µM indicating methane production, to as high as 6000 µM indicating sufficient sulfate to drive sulfate reduction (Figure 5.4-2) and, 3) The ratios of sulfate to chloride range from those found in seawater to ratios indicating a depletion of sulfate due to sulfate reduction (Figure 5.4-3).

Salinity input to Eagle Island varies during the year. Generally the salinity is higher during summer months when the flow rate of the river is lower, however, an input of salt and a corresponding shift in classification was observed during November of 2000, 2001 and 2004 (Figure 5.4-4) and May of 2001 and 2002 (Hackney et al. 2002a, 2002b, 2003, 2005). These events overshadowed seasonal trends and dominated geochemical conditions during these years (Hackney et al. 2002; 2002a, 2002b, 2003, 2005). During the winter of 2003 and summer of 2002, the pattern of salinity variations was different (Hackney et al. 2003). Instead of salinity peaks during November and May, the salinity steadily decreased from the summer of 2002 until the spring of 2003. The November pulse of salinity observed during the current year resulted in a shift towards SR classifications leading into the spring of 2005 (Table 5.4-1).

Salinities at the near-shore station S1 were approximately 10-15 ppt. during the summer of 2002 (Hackney et al. 2003). By November 2002 they had dropped below 0.5 ppt and remained there until the fall of 2003 (Hackney et al. 2005) when there was a slight increase with salinity values approaching 1 ppt. With the exception of low salinity values in February and April, the salinities though the winter of 2004 remained at approximately 1 ppt. At the beginning of the current report year (June 2004), salinities at S1 were approximately 2 ppt and steadily decreased to approximately 0.1 ppt through October S1 (Figure 5.4-4). A sharp increase in salinity reaching values greater than 8 ppt was observed in November. Salinities rapidly decreased and varied between approximately 0.1 -2 ppt throughout the rest of the study period. At the most inland station S6, the salinities dropped from about 8 ppt. during the summer of 2002 to below 0.5 ppt. by March of 2003 (Hackney et al. 2003). They have remained at approximately 0.1 ppt. through the winter and spring of 2004 and throughout the current report year.

Sulfate concentrations at Eagle Island essentially paralleled salinity trends (Figure 5.4-2). Sulfate concentrations at S1 during November approached the 8,000-10,000 uM values seen during the summer of 2002 prior to the drop in salinity (Hackney et el. 2003). Sulfate values at S6 remained low throughout the current study period staying close to sulfate reducing threshold values (Figure 5.4-2).

Prior to the decrease in salinity that began during the fall of 2002, the majority of classifications were SR and MPSR (CZR Incorporated 2001; Hackney et al. 2002a, 2002b, 2003). During the previous report (Hackney et al. 2005) the majority of sites were methanogenic due to continued fresh conditions with only a few sub-stations having SR classifications primarily resulting from the slight rebound in salt input which began during the winter of 2004. Geochemical classifications of Eagle Island during the current report period show the expected trend for a system experiencing an input of salinity during November. Starting with near-shore


Eagle Island Methane
Substation 1
Methane (uM)
200
150
100
50
0
June
July
August
September
October
November
December
January
February
March
April
May
Month

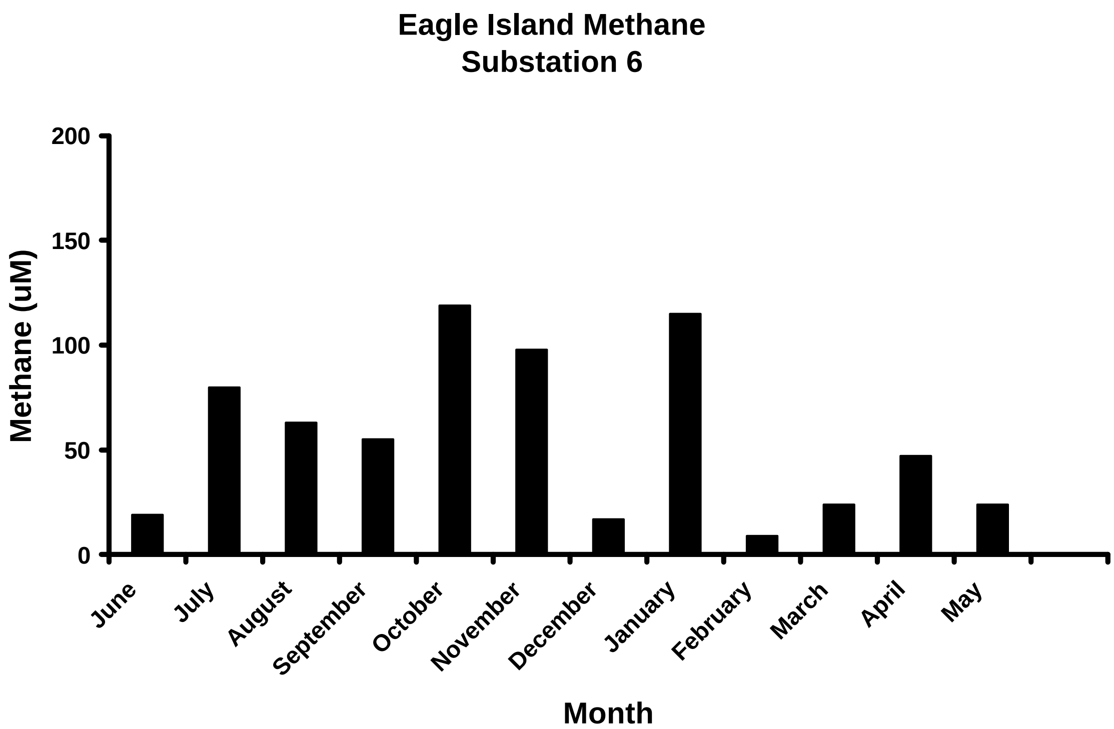
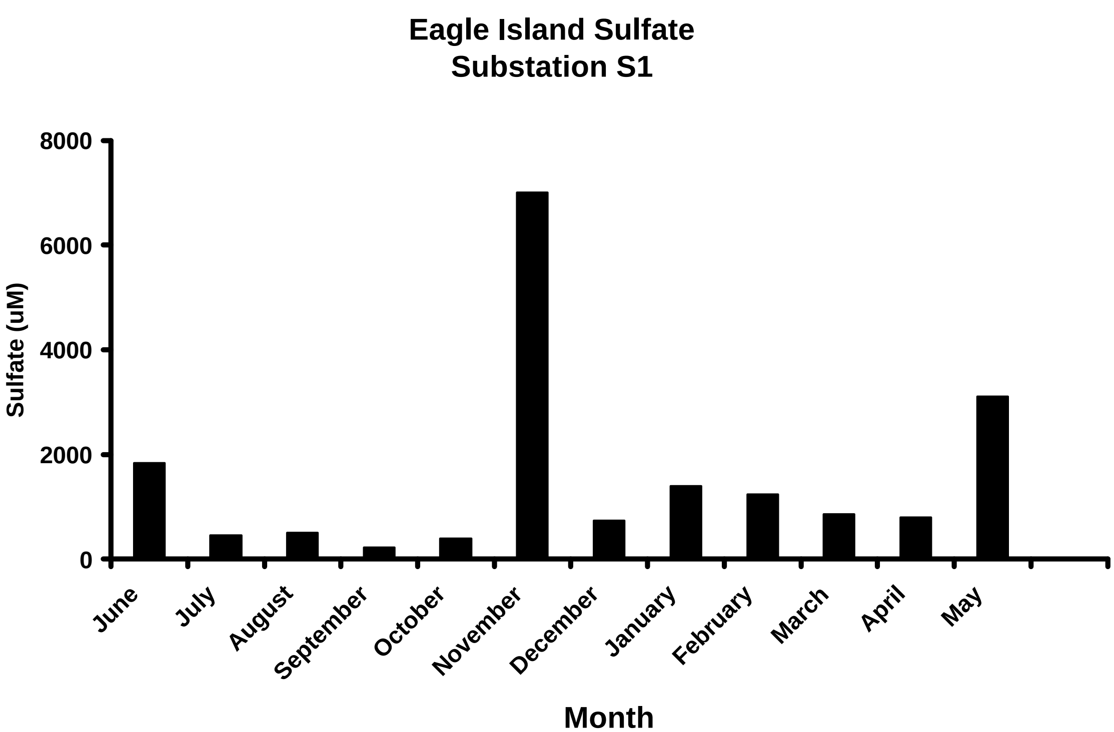


Figure 5.4-1. Methane concentrations of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows most upland site (S6).



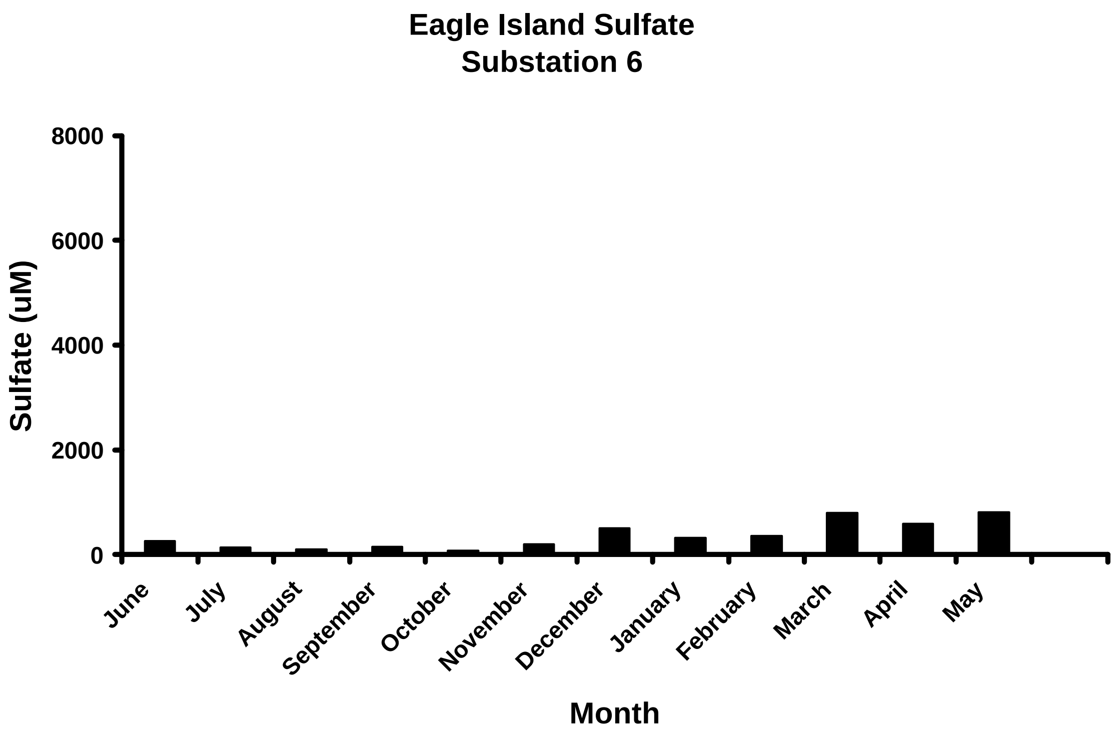
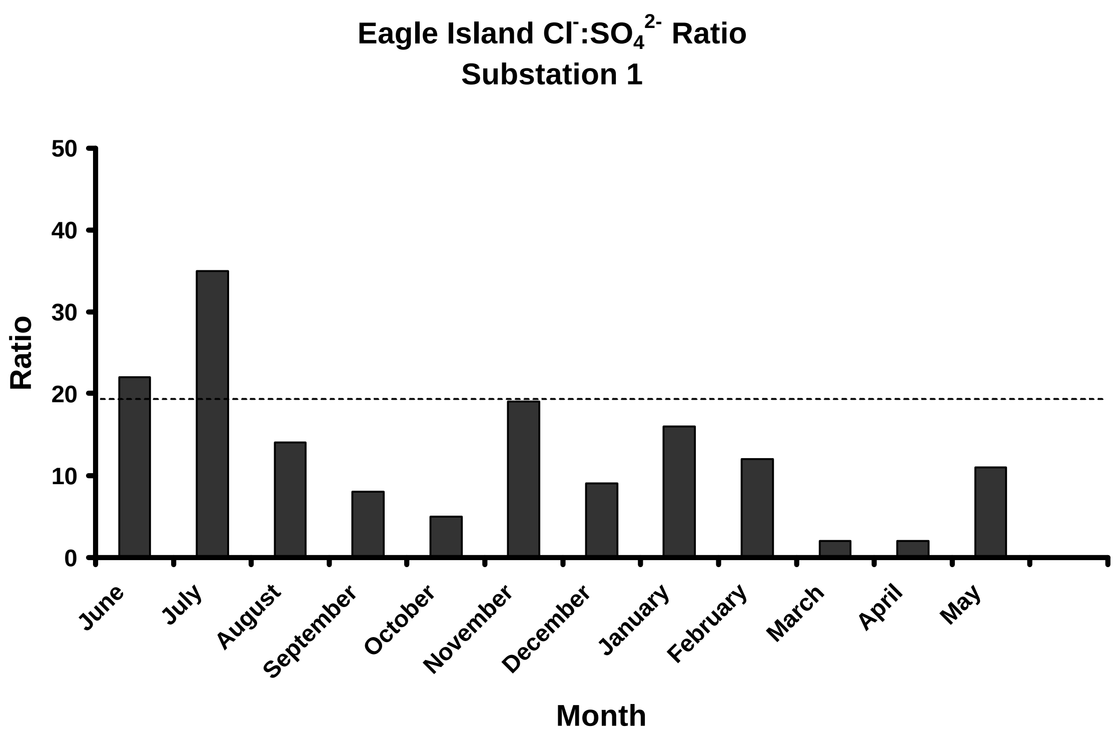


Figure 5.4-2. Sulfate concentrations of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows most upland site (S6).



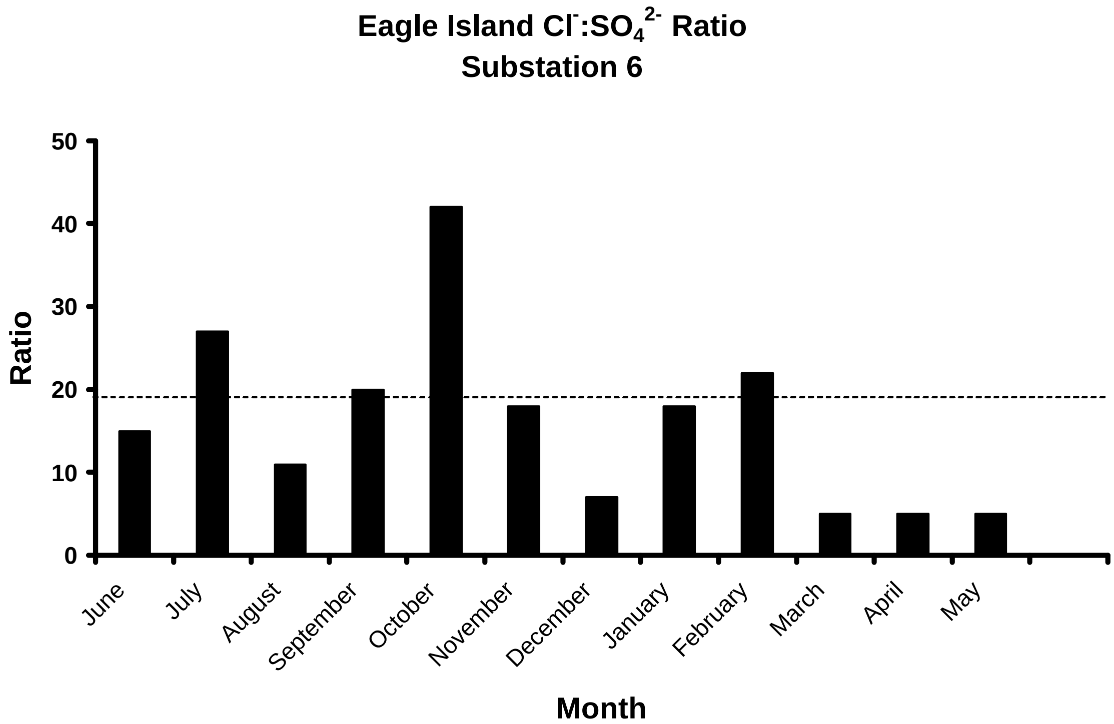
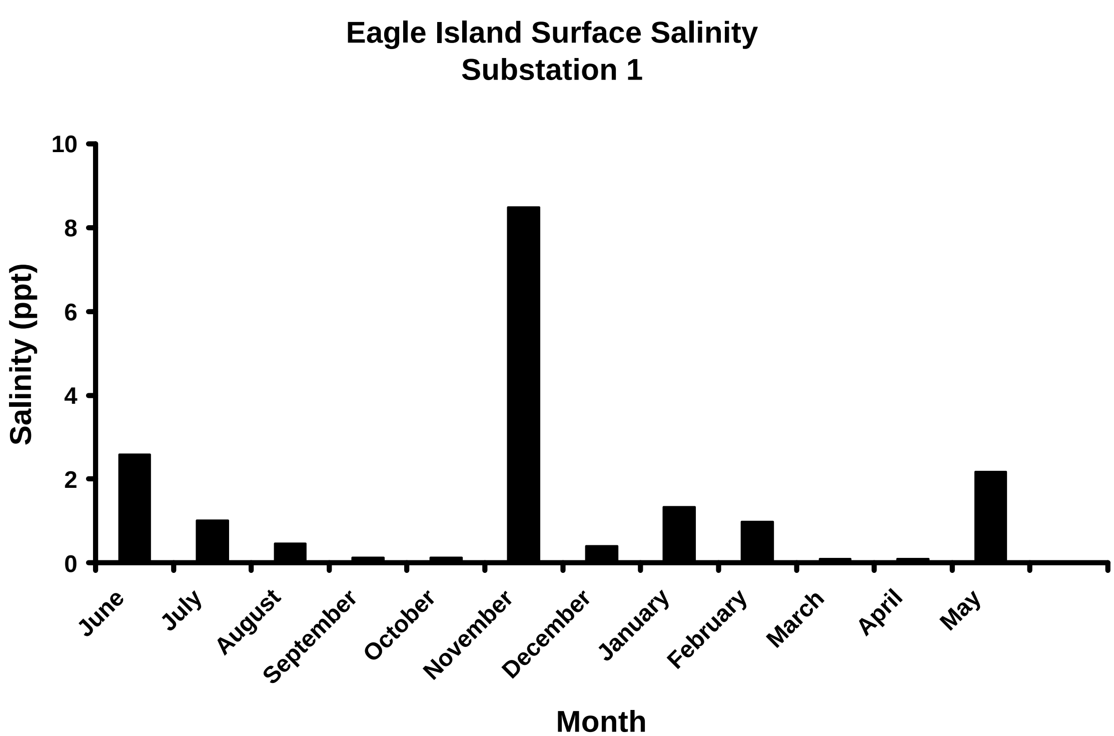


Figure 5.4-3. Chloride to sulfate ratios of Eagle Island porewaters vs. month. Dashed line shows ratio for seawater. Top shows nearshore site (S1) and bottom shows most upland site (S6).



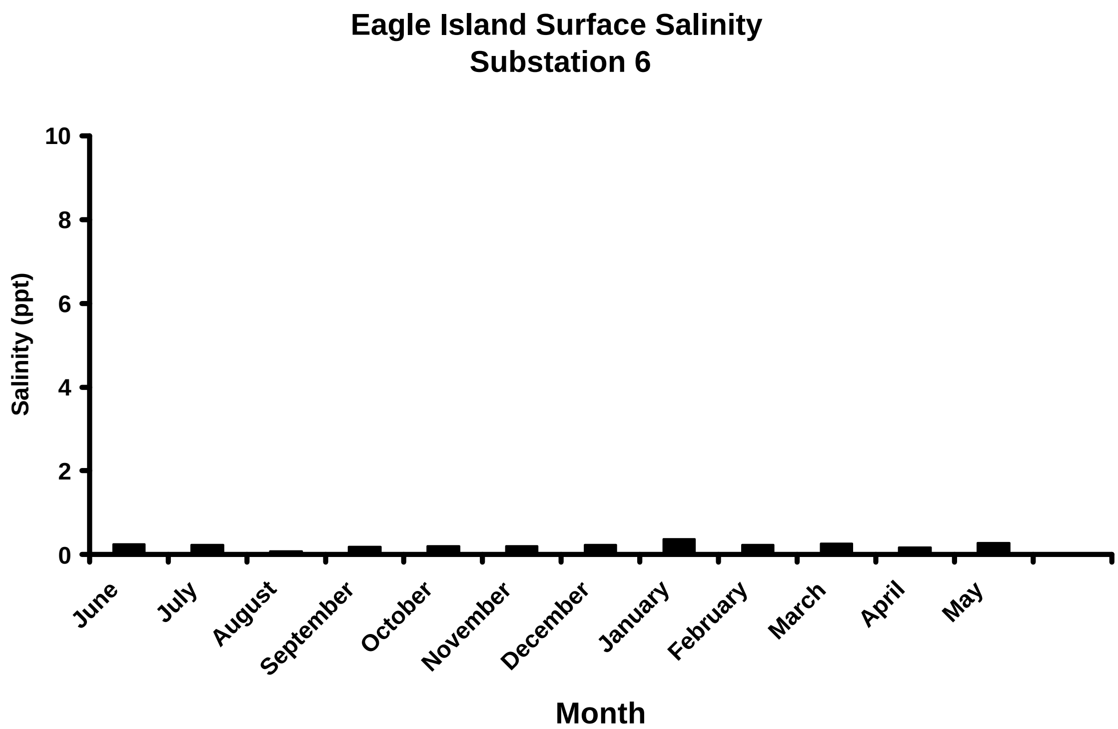


Figure 5.4-4. Salinities of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows most upland site (S6).

Table 5.4-1. Eagle Island (P6) Geochemical Classifications by month. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Sites	June 04	July	August	September	October	November	December	January	February
S1-1	II	II	II	I	II*	II	II	II	II
S1-2	II	II	II	I	II	II	II	II	II
S1-3	II	I*	II	I	I*	II	II	II	II
S1-4	I*	I*	II	I*	I*	II	II	II	II
S1-5	I*	I*	I*	I*	I*	II	II	II	II
S1-6	I*	I*	I*	I*	I	I*	I	II	II
S2-1	II	I*	I*	I*	I*	II	II	II	II
S2-2	I*	I*	I*	I*	I*	II	II	II	II
S2-3	I*	I*	I*	I*	I*	II	II	II	II
S2-4	I*	I*	I*	I*	I*	II	II	I*	II
S2-5	I*	I*	I*	I*	I*	II	II	I*	II
S2-6	I*	I*	I*	I*	I*	II	II	I*	II
S3-1	II	II	I*	I	I	II	II	II	II
S3-2	II	I*	I*	I	I*	II	II	II	II
S3-3	I*	I*	I*	I*	I*	II	II	II	II
S3-4	I*	I*	I*	I*	I*	II	II	II	II
S3-5	I*	I*	I*	I*	I*	II	II	II	II
S3-6	I*	I*	I*	I*	I*	I*	II	I*	II
S4-1	I*	I*	I*	I	I*	II	I*	II	I*
S4-2	I*	I*	I*	I*	I*	I*	I*	I*	I*
S4-3	I*	I*	I*	I*	I*	I*	I*	I*	I*
S4-4	I*	I*	I*	I*	I*	I*	I*	II	I*
S4-5	I*	I*	I*	I*	I*	I*	I*	I*	I*
S4-6	I*	I*	I*	I	I*	I*	I*	I*	I*
S5-1	II	I	I	I*	I	II	II	II	I*
S5-2	II	I*	I*	I*	I*	I*	I	II	I*
S5-3	I*	I*	I*	I*	I*	I*	I*	I	I*
S5-4	I*	I*	I*	I*	I*	I*	I*	I	I*
S5-5	I*	I*	I*	I*	I	I*	II	I*	I*
S5-6	I*	I*	I*	II	I	I*	II*	I	I*
S6-1	I	I	I	I	I*	I	II	II	II
S6-2	I	I	I	I*	I	I*	I	I	I
S6-3	I	I*	I*	I*	I	I*	I*	I	I
S6-4	I	I	I*	I*	I	I*	I	I	I*
S6-5	I	I	I*	I*	I	I*	I	I	I
S6-6	I	II	I	I*	I	I*	I	I	I*

Table 5.4-1. (continued)

Sites	March	April	May
S1-1	II*	II*	II
S1-2	II*	II*	II
S1-3	II*	II*	II
S1-4	II*	II*	II
S1-5	II	II*	II
S1-6	II	II	II
S2-1	II	II	II
S2-2	II	II	II
S2-3	II	II	II
S2-4	II	II	II
S2-5	II	II	II
S2-6	II	II	II
S3-1	II	II	II
S3-2	II	II	II
S3-3	II	II	II
S3-4	II	II	II
S3-5	II	I*	II
S3-6	II	II	II
S4-1	II	II	II
S4-2	II	II	II
S4-3	II	II	II
S4-4	II	II	II
S4-5	II	II	II
S4-6	II	II	II
S5-1	II*	II	II
S5-2	II	II	II
S5-3	II	II	II
S5-4	II	II	II
S5-5	II	II	II
S5-6	II	II	II
S6-1	II	II*	II
S6-2	II	II	II*
S6-3	II	II	II
S6-4	II	II	II
S6-5	II	II	---
S6-6	II	II	II

stations, classifications shifted to SR. By May 2005, all locations had been converted to SR classifications (Table 5.4-1).

The chloride to sulfate ratios ($Cl^-:SO_4^{2-}$) reflect the salinity variations observed during the current year (Figure 5.4-3). At S1, the ratios were below that expected for seawater most of the year indicating that the sulfate present was likely from oxidation of H_2S rather than re-supply from seawater. During June and July signs of sulfate reduction were evident with ratios greater than seawater. During November values were the same as seawater indicating the high input of seawater sulfate. For Eagle Island substation 6, where salinities and sulfate supply was low, the ratios display a variable pattern with values indicating H_2S oxidation and seawater as a source of the sulfate.

Methane concentrations at Eagle Island were lower at the creek bank locations compared to the uplands (Figure 5.4-1). Higher salinities at the creek bank locations result in inhibition of methanogenesis at these sites while fresher conditions in the uplands are conducive to methanogenesis. With the exception of a dramatic decrease in methane at S1 in December, following the peak in salinity and sulfate in November, methane variations do not appear to show any distinct seasonal variations during this project year.

5.5 Marsh/Swamp Transect Stations, Geochemistry, Annual Variability

The following section compares the geochemistry of substations from the previous years 2000-2001 (Hackney et al. 2002a), 2001-2002 (Hackney et al. 2002b), 2002-2003 (Hackney et al. 2003) and 2003-2004 (Hackney et al. 2005) to the current year. The current report includes the winter of 2005 and the summer of 2004.

5.51 Town Creek (P3)

Town Creek is the most seaward station monitored for geochemistry. Average winter porewater salinities increased steadily throughout the first four years of this study [winter 2000 = 0.8 $\pm$ 0.4 ppt; winter 2001 = 1.4 $\pm$ 0.8 ppt (Hackney et al. 2002a); winter 2002 = 3.8 ppt $\pm$ 1.9 (Hackney et al. 2002b); winter 2003 = 7.2 $\pm$ 4.9 ppt. (Hackney et al. 2003]. Porewater salinities during the winter of 2003 reached values as high as 17 ppt, roughly twice the highest winter salinities ever observed. (Hackney et al. 2003). During the winter 2004 there was a dramatic shift towards lower salinity conditions (Hackney et al. 2005). Salinities ranged from approximately 0.5 ppt to 3.0 ppt whereas during the previous winter of 2003 the majority of the salinities were greater than 3 ppt (Hackney et al. 2003). In the first 4 winters, the majority of geochemical classifications were SR (Hackney et al. 2002a, 2002b, 2003). During the winter of 2004, geochemical classifications reflected the lower salinities with the majority of substations having MPSR conditions indicating a lack of re-supply of sulfate to the porewaters after depletion. Salinities were slightly higher during the current winter (2005) compared to 2004, but were still relatively low (1-3 ppt, Table 5.51-1). The slightly higher salinities resulted in some 2004 winter MPSR classifications being converted to SR.

The average summer salinities showed no obvious changes over the first 3 years of summer data [summer 2000 = 4.3 ± 1.7 (Hackney et al. 2002a); summer 2001 = 3.4 ± 0.8 (Hackney et al. 2002b); summer 2002 = 4.8 ± 2.2 (Hackney et al. 2003)]. Average porewater salinities were always higher during the summer compared to the winter reflecting the general trend towards higher winter freshwater river flow. Salinities during the summer of 2003 ranged from approximately 0.4 ppt to 3.0 ppt (Hackney et al. 2005) in contrast to the previous summer 2002 where the majority of salinities were greater than 3.0 ppt (Hackney et al. 2003). Summer 2003 classifications reflected the fresher conditions with the majority of sites having MPSR conditions for the first time (Hackney et al. 2005). During the current summer of 2004 salinities were slightly higher, ranging from 2-5 ppt (Table 5.51-1), resulting in some MPSR classifications being converted to SR.

Methane concentrations were lower during the current summer (2004) compared to the previous summer (2003) reflecting the increase in salinity and inhibition of methanogenesis (Table 5.51-4). During the current winter (2005) sites that experienced higher salinities than the previous year (S1, S3, and S6) had decreases in methane concentrations as well.

5.52 Indian Creek (P7)

Porewaters of Indian Creek were essentially fresh during the winters of 2000, 2001, and 2002, with highest salinities never reaching above 0.2 ppt. (Hackney et al. 2002a, 2002b). Winter porewater salinities increased substantially at this station during the winter of 2003 with salinities as high as 1.3 ppt at the near shore substation S1 and averaged 0.4 ± 0.3 ppt at substations 1, 2, 3, and 4 combined (Hackney et al. 2003). The upland substations 5 and 6 were still fresh and likely not influenced as much by tidal flood waters. During the winter of 2004, salinities returned to low values with only 2 substations reaching values above 0.2 ppt (Hackney et al. 2005). Classifications were generally MP and MPSR, similar to the winters of 2000, 2002, and 2003 but not as fresh as the winter of 2001 where all classifications were M (Table 5.51-3). Only substation S1 had sulfate concentrations sufficient to sustain sulfate reduction (Table 5.52-1). The current winter of 2005 was very fresh and similar to the winter of 2001. Salinities were generally less than 0.05 ppt. (Table 5.51-1) and all classifications were M except for a single MPSR (Table 5.51-3).

An increase in salinity was observed during the summer of 2002 (Hackney et al. 2003). During the previous 2 summers, the majority of the substations had values below 0.5 ppt. (Hackney et al. 2002a, 2002b). During the summer of 2002 most values at the non-upland substations had salinities in the 2.0 ppt range clearly showing an increase in salinity. The following summer of 2003 had all but 3 substations sub-depths with salinities below 0.2 ppt indicating very low salinity conditions for this site. For the first time, this site had all methanogenic summer classifications with the majority being M and only a few MPSR (Hackney et al. 2005). Salinities during the current summer of 2004 were slightly higher ranging from 0.05-0.13 ppt. (Table 5.51-1). Classifications reflected the slightly higher salinities with some M classifications converted to MPSR (Table 5.51-2).

Table 5.51-1. Salinity of Sites. Salinity in parts per thousand calculated from chloride concentrations in porewaters. A --- indicates no data.

Station	Substation	Depth (cm)	Salinity	
			Summer 2004	Winter 2005
Town Creek P3	1	1	4.25	1.67
	1	6	4.27	2.60
	1	11	4.68	2.62
	1	16	4.52	2.69
	1	21	4.00	2.61
	1	26	3.44	2.93
	2	1	5.27	1.92
	2	6	4.95	2.86
	2	11	4.86	3.20
	2	16	4.48	1.49
	2	21	3.83	3.61
	2	26	3.53	3.49
	3	1	4.45	0.94
	3	6	3.40	1.10
	3	11	3.48	1.11
	3	16	2.61	1.49
	3	21	3.35	2.15
	3	26	4.00	3.01
	4	1	2.39	1.42
	4	6	2.68	2.05
	4	11	2.70	2.17
	4	16	2.52	2.22
	4	21	2.36	2.42
	4	26	2.15	2.65
	5	1	1.27	0.63
	5	6	1.87	0.86
	5	11	2.37	0.93
	5	16	2.49	1.02
	5	21	2.53	1.28
	5	26	2.51	1.48
	6	1	1.95	1.20
	6	6	2.39	1.62
	6	11	3.03	2.06
	6	16	3.51	2.38
	6	21	3.59	2.86
	6	26	3.50	3.21
Eagle Island P6	1	1	1.01	1.33
	1	6	1.94	1.44
	1	11	1.91	1.38
	1	16	1.90	1.12
	1	21	2.08	0.95
Eagle Island (continued)	1	26	1.93	0.82
	2	1	1.73	1.43
	2	6	1.58	1.41
	2	11	1.57	1.38

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2004	Winter 2005
	2	16	1.49	1.29
	2	21	1.42	1.26
	2	26	1.32	1.24
	3	1	1.63	1.07
	3	6	1.55	1.17
	3	11	1.77	1.19
	3	16	1.88	1.09
	3	21	1.69	1.06
	3	26	1.55	0.89
	4	1	1.04	0.81
	4	6	1.17	1.22
	4	11	1.18	1.18
	4	16	1.19	1.56
	4	21	1.25	0.90
	4	26	1.19	1.64
	5	1	0.55	0.25
	5	6	0.64	0.46
	5	11	0.63	0.74
	5	16	0.65	0.47
	5	21	0.60	0.50
	5	26	0.59	0.51
	6	1	0.23	0.37
	6	6	0.20	0.20
	6	11	0.20	0.20
	6	16	0.20	0.21
	6	21	0.18	0.21
	6	26	0.20	0.21
Indian Creek P7	1	1	0.13	0.04
	1	6	0.08	0.05
	1	11	0.09	---
	1	16	0.12	---
	1	21	0.12	0.09
	1	26	0.12	0.12
	2	1	0.10	0.04
	2	6	0.07	0.04
	2	11	0.06	0.04
	2	16	0.07	0.05
	2	21	0.06	0.05
	2	26	0.07	0.05
	3	1	0.05	0.03
Indian Creek (continued)	3	6	0.05	0.04
	3	11	0.05	0.04
	3	16	0.07	0.03
	3	21	0.08	0.04
	3	26	0.10	0.04
	4	1	0.05	0.04
	4	6	0.04	0.03
	4	11	0.04	0.03

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2004	Winter 2005
	4	16	0.05	0.04
	4	21	0.04	0.04
	4	26	0.05	0.05
	5	1	0.04	0.03
	5	6	0.03	0.03
	5	11	0.03	0.02
	5	16	0.03	0.03
	5	21	0.03	0.02
	5	26	0.03	0.03
	6	1	0.02	0.02
	6	6	0.03	0.02
	6	11	0.02	0.02
	6	16	0.03	0.02
	6	21	0.01	0.02
	6	26	0.02	0.07
Dollisons Landing P8	1	1	0.05	0.05
	1	6	0.04	0.04
	1	11	0.04	0.04
	1	16	0.04	0.06
	1	21	0.04	0.05
	1	26	0.04	0.05
	2	1	0.04	0.05
	2	6	0.04	0.05
	2	11	0.03	0.05
	2	16	0.04	0.05
	2	21	0.04	0.06
	2	26	0.04	0.05
	3	1	0.04	0.04
	3	6	0.04	0.05
	3	11	0.04	0.04
	3	16	0.04	0.04
	3	21	0.04	0.07
	3	26	0.04	0.04
	4	1	0.04	0.04
	4	6	0.04	0.04
	4	11	0.04	0.05
Dollisons Landing (continued)	4	16	0.03	0.04
	4	21	0.04	0.04
	4	26	0.04	0.04
	5	1	0.08	0.10
	5	6	0.08	0.11
	5	11	0.08	0.11
	5	16	0.07	0.12
	5	21	0.08	0.11
	5	26	0.07	0.11
	6	1	0.11	0.11
	6	6	0.11	0.12
	6	11	0.11	0.11

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2004	Winter 2005
	6	16	0.12	0.11
	6	21	0.13	0.10
	6	26	0.14	0.09
Black River P9	1	1	0.04	0.06
	1	6	0.04	0.05
	1	11	0.04	0.05
	1	16	0.04	0.05
	1	21	0.04	0.05
	1	26	0.04	0.06
	2	1	0.03	0.05
	2	6	0.03	0.04
	2	11	0.03	0.04
	2	16	0.04	0.04
	2	21	0.04	0.05
	2	26	0.04	0.05
	3	1	0.03	0.04
	3	6	0.04	0.05
	3	11	0.03	0.05
	3	16	0.03	0.04
	3	21	0.03	0.05
	3	26	0.03	0.05
	4	1	0.03	0.04
	4	6	0.03	0.04
	4	11	0.03	0.02
	4	16	0.02	0.04
	4	21	0.02	0.04
	4	26	0.02	0.04
	5	1	0.01	0.05
	5	6	0.01	0.05
	5	11	0.02	0.05
	5	16	0.03	0.05
	5	21	0.01	0.05
Black River (continued)	5	26	0.03	0.04
	6	1	---	0.05
	6	6	0.02	0.06
	6	11	0.01	0.04
	6	16	0.02	0.03
	6	21	0.02	0.03
	6	26	0.02	0.04
Smith Creek P11	1	1	7.45	4.30
	1	6	7.73	4.52
	1	11	7.65	4.63
	1	16	6.36	4.46
	1	21	5.62	4.11
	1	26	5.63	4.55
	2	1	6.15	4.21
	2	6	7.77	4.37
	2	11	7.15	4.16

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2004	Winter 2005
	2	16	6.67	4.21
	2	21	5.99	4.33
	2	26	5.45	3.96
	3	1	7.33	4.47
	3	6	7.53	4.58
	3	11	7.52	5.07
	3	16	6.77	5.30
	3	21	5.87	5.85
	3	26	4.79	5.97
	4	1	6.60	4.33
	4	6	8.04	5.06
	4	11	8.24	4.93
	4	16	6.96	5.19
	4	21	6.32	5.27
	4	26	5.59	4.91
	5	1	0.01	2.81
	5	6	0.02	3.34
	5	11	0.01	3.17
	5	16	0.01	3.53
	5	21	0.01	3.39
	5	26	0.01	3.75
	6	1	5.15	2.11
	6	6	5.88	2.33
	6	11	6.17	2.42
	6	16	5.91	2.47
	6	21	5.63	2.44
	6	26	5.41	2.61
Rat Island	1	1	1.30	1.16
P12	1	6	1.14	1.44
	1	11	1.11	1.54
	1	16	1.08	1.53
	1	21	0.93	1.60
	1	26	0.99	1.60
	2	1	2.28	0.77
	2	6	1.42	0.80
	2	11	1.43	0.92
	2	16	1.25	1.01
	2	21	1.12	1.11
	2	26	0.96	1.13
	3	1	0.02	1.51
	3	6	2.99	1.52
	3	11	3.14	1.51
	3	16	3.19	1.21
	3	21	2.61	1.56
	3	26	2.68	1.62
	4	1	0.85	0.74
	4	6	0.86	0.91

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2004	Winter 2005
	4	11	0.80	1.01
	4	16	0.80	1.17
	4	21	0.75	1.31
	4	26	0.83	1.30
	5	1	0.47	1.00
	5	6	0.55	1.16
	5	11	0.66	1.27
	5	16	0.75	1.30
	5	21	0.86	1.29
	5	26	0.89	1.25
	6	1	0.15	0.22
	6	6	0.17	0.20
	6	11	0.20	0.26
	6	16	0.17	0.30
	6	21	0.19	0.45
	6	26	0.23	0.50
Fishing Creek P13	1	1	0.07	0.08
	1	6	0.08	0.08
	1	11	0.10	0.15
	1	16	0.11	0.07
	1	21	0.16	0.07
	1	26	0.18	0.08
	2	1	0.06	0.13
	2	6	0.06	0.14
Fishing Creek (continued)	2	11	0.07	0.07
	2	16	0.06	0.15
	2	21	0.07	0.17
	2	26	0.06	0.19
	3	1	0.18	0.18
	3	6	0.19	0.14
	3	11	0.27	0.18
	3	16	0.24	0.21
	3	21	0.26	0.23
	3	26	0.27	0.23
	4	1	0.07	0.09
	4	6	0.07	0.10
	4	11	0.08	0.09
	4	16	0.09	0.10
	4	21	0.09	0.09
	4	26	0.09	0.09
	5	1	0.05	0.09
	5	6	0.05	0.07
	5	11	0.05	0.08
	5	16	0.05	0.06
	5	21	0.06	0.07
	5	26	0.06	0.06
	6	1	0.02	0.05
	6	6	0.02	0.04

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2004	Winter 2005
	6	11	0.02	0.04
	6	16	0.02	0.04
	6	21	0.02	0.03
	6	26	0.02	0.07
Prince George P14	1	1	0.05	0.03
	1	6	0.05	0.06
	1	11	0.05	0.06
	1	16	0.05	0.06
	1	21	0.05	0.06
	1	26	0.05	0.05
	2	1	0.05	0.04
	2	6	0.05	0.04
	2	11	0.00	0.05
	2	16	0.05	0.05
	2	21	0.05	0.06
	2	26	0.06	0.06
	3	1	0.05	0.05
	3	6	0.05	0.06
	3	11	0.05	0.06
	3	16	0.05	0.05
Prince George (continued)	3	21	0.05	0.06
	3	26	0.05	0.06
	4	1	0.05	0.06
	4	6	0.05	0.05
	4	11	0.05	0.06
	4	16	0.06	0.06
	4	21	0.06	0.05
	4	26	0.05	0.06
	5	1	0.05	0.06
	5	6	0.04	0.06
	5	11	0.04	0.06
	5	16	0.05	0.06
	5	21	0.04	0.07
	5	26	0.04	0.06
	6	1	0.03	0.06
	6	6	0.03	0.05
	6	11	0.03	0.02
	6	16	0.03	0.05
	6	21	0.02	0.04
	6	26	0.02	0.04

Table 5.51-2. Classification of Sites Summer. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004
Town Creek P3	1	1	II	II	II	I*	II
	1	6	II	II	II	I*	I*
	1	11	II	II	II	I*	I*
	1	16	II	II	II	I*	I*
	1	21	II	II	II	I*	I*
	1	26	I*	II	II	I*	I*
	2	1	II	II	II	II	II
	2	6	II	II	II	II	I
	2	11	II	II	I*	II	I
	2	16	II	II	I*	II	I
	2	21	II	II	I*	I*	I*
	2	26	II	II	I*	II	I
	3	1	II	II	II	I*	II
	3	6	II	II	II	I*	II
	3	11	II	II	II	I*	II
	3	16	II	II	II	I*	I*
	3	21	II	II	II	I*	I*
	3	26	II	II	II	I*	I*
	4	1	II	II	II	I	II
	4	6	II	II	II	I*	II
	4	11	II	II	II	I*	II
	4	16	II	II	II	I*	II
	4	21	II	II	II	I*	II
	4	26	II	II	II	I*	II
	5	1	II	II	I*	I*	I*
	5	6	II	II	II	I*	I*
	5	11	II	II	II	I	I*
	5	16	II	II	II	I*	I*
	5	21	II	II	II	I*	I*
	5	26	II	II	II	I*	I*
	6	1	II	II	II	I	II
	6	6	II	II	II	I*	I*
	6	11	II	II	II	I*	I*
	6	16	II	II	II	I*	I*
	6	21	II	II	II	I*	I*
	6	26	I*	II	II	I*	I*
Eagle Island P6	1	1	II	II	II	I	II
	1	6	II	II	II	ns	II
	1	11	II	II	II	ns	I*
Eagle Island (continued)	1	16	II	II	II	I*	I*
	1	21	II	II	II	I*	I*
	1	26	II	II	I*	I*	I*

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	2	1	II	II	II	I	I*
	2	6	II	II	II	I	I*
	2	11	II	II	II	I	I*
	2	16	II	I*	II	I	I*
	2	21	II	I*	II	I*	I*
	2	26	II	I*	I*	I*	I*
	3	1	I*	II	II	I*	II
	3	6	I*	I*	II	I*	I*
	3	11	I*	I*	II	I*	I*
	3	16	I*	I*	II	I*	I*
	3	21	I*	I*	II	I*	I*
	3	26	I*	I*	II	I*	I*
	4	1	II	II	I*	I*	I*
	4	6	II	I*	I*	I*	I*
	4	11	II	I*	I*	I*	I*
	4	16	II	I*	I*	I*	I*
	4	21	II	I*	I*	I*	I*
	4	26	I*	I*	I*	I*	I*
	5	1	II	I*	II	I*	I
	5	6	I*	I*	II	I*	I*
	5	11	II	I*	I*	I*	I*
	5	16	I*	I*	I*	I*	I*
	5	21	I*	I*	I*	I*	I*
	5	26	I*	I*	I*	I*	I*
	6	1	II	I*	II	I	I
	6	6	I*	I*	II	I	I
	6	11	---	I*	II	I	I*
	6	16	II	I*	II	I*	I
	6	21	I*	I*	II	I*	I
	6	26	I*	I*	I*	I*	II
Indian Creek P7	1	1	II	II	II	I	II
	1	6	II	II	II	I*	I
	1	11	II	II	II	I*	I
	1	16	II	II	II	I*	I*
	1	21	II	II	II	I*	I*
	1	26	I	I*	II	I*	I*
	2	1	I	II	II	I	I
	2	6	I	I	II	I*	I
	2	11	I	I	II	I	I*
	2	16	I	I*	II	I*	I*
Indian Creek (continued)	2	21	I	I*	II	I*	I*
	2	26	I	I	II	I*	I*
	3	1	II	II	I*	I	I
	3	6	II	I	I*	I	I
	3	11	I	I*	I*	I	I
	3	16	I	I	I*	I	I*
	3	21	II	I	I*	I	I*

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	3	26	I	II	I*	I*	I*
	4	1	I	I	II	I	I
	4	6	II	I	II	I	I*
	4	11	II	I	II	I	I
	4	16	I	I	II	I	I*
	4	21	I	I	II	I	I*
	4	26	I	I	II	I	I*
	5	1	II	I	I*	I	I
	5	6	I	I	I*	I	I
	5	11	II	I	I*	I	I
	5	16	II	---	I*	I	I
	5	21	I	I*	I*	I	I
	5	26	I	I	I*	I	I
	6	1	II	---	I	I	I
	6	6	I	---	I	I	I
	6	11	I	I	I	I	I
	6	16	I	I	I	I	I
	6	21	I	---	I	I	I
	6	26	II	I	I	I	I
Dollisons	1	1	I		II	I	I
Landing P8	1	6	II*	II	II	I	I
	1	11	II*	II	I	I	I
	1	16	II*	II	I	I	I
	1	21	II	I	II	I	I*
	1	26	II	I	I	I	I*
	2	1	II*	II	I	I	I
	2	6	II	I	I*	I	I
	2	11	I	II	I*	I*	I
	2	16	I	I*	I*	I*	I
	2	21	I	II	I*	I*	I
	2	26	I	I	I*	I*	I
	3	1	II	I	I	I	I
	3	6	I		I*	I	I
	3	11	I	I	I*	I*	I
	3	16	I	I	I*	I	I*
	3	21	I	I	I*	I*	I
Dollisons	3	26	I	II	I*	I	I
Landing	4	1	I	I	II*	I	I
(continued)	4	6	I	I	I	I	I
	4	11	I	II	I*	I	I*
	4	16	I	I	ns	I	I
	4	21	I	II	I*	I	I
	4	26	I	II	I*	I*	I
	5	1	I	I	I	I	I
	5	6	I	I	I	I	I*
	5	11	I	I	I*	I	I*
	5	16	I	I*	I*	I	I*

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	5	21	I	II	I*	I	I*
	5	26	I	II	I*	I	I*
	6	1	I	I	I	I	I*
	6	6	I	I*	I	I	I*
	6	11	I	I*	I*	I	I*
	6	16	I	I*	I*	I	I*
	6	21	I	I	I*	I	I*
	6	26	I	I	I*	I	I*
Black River P9	1	1	I	---	I*	I	I
	1	6	---	---	I*	I	I
	1	11	I	---	I	I	I*
	1	16	I	---	II*	I	I*
	1	21	II	---	I*	I	I
	1	26	I	II	I*	I	I*
	2	1	I	I*	I*	I	I
	2	6	I	I*	I*	I	I
	2	11	I	I	I*	I	I
	2	16	I	I	II*	I	I
	2	21	I	I	I	I	I
	2	26	I	I*	I*	I	I
	3	1	I	II	I*	I	I
	3	6	I	II*	I*	I	I
	3	11	I	I	I	ns	I
	3	16	I	I	II*	I	I
	3	21	I	I	I	I	I*
	3	26	I	I	I	I	I*
	4	1	I	II	I*	I	II
	4	6	II	II*	I	I	I
	4	11	I	II	II*	I	I
	4	16	I	I	II*	I	I*
	4	21	I	I	II*	I	I
	4	26	I	I	II*	ns	I
Black River (continued)	5	1	II*	II*	I	I	I
	5	6	II	II	I	I	I
	5	11	I	II	II*	I	I
	5	16	I	I	II*	I*	I
	5	21	II	I	II*	I	I*
	5	26	II	I	I	I	I*
	6	1	II*	---	I	I	
	6	6	II*	II	II*	I	I
	6	11	II*	I	II*	I	I
	6	16	I	I*	II*	I	I
	6	21	I	I	I	I	I
	6	26	I	I	I	I	I
Smith Creek P11	1	1	II	II	II	II	II
	1	6	II	I*	II	II	II
	1	11	---	II	II	II	II

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	1	16	II	II	II	II	II
	1	21	---	II	II	II	I
	1	26	---	II	II	II	I
	2	1	II	II	II	II*	II
	2	6	---	I*	II	II	II
	2	11	II	II	II	II	II
	2	16	II	II	II	II	II
	2	21	II	II	II	II	II
	2	26	II	II	II	II	II
	3	1	II	II	II	II	II
	3	6	II	II	II	I*	II
	3	11	II	II	II	I*	II
	3	16	II	II	II	II	I
	3	21	II	II	II	I*	I*
	3	26	II	II	II	II	I
	4	1	II	II	II	II	II
	4	6	II	II	II	II	II
	4	11	II	II	II	II	II
	4	16	II	II	II	II	I
	4	21	II	II	II	II	
	4	26	II	II	II	II	I
	5	1	II	I*	II	ns	I
	5	6	II	II	II	II	I
	5	11	II	II	II	II	I
	5	16	II	II	II	II	I
	5	21	II	II	II	II	I
	5	26	II	II	II	II	I
	6	1	II	II	II	I	II
Smith Creek (continued)	6	6	II	I*	II	I	II
	6	11	II	I*	II	I*	II
	6	16	II	I*	II	II	I
	6	21	II	---	II	II	II
	6	26	II	II	II	II	II
Rat Island P12	1	1	II	II	II	I	I*
	1	6	II	II	II	I	II
	1	11	II	II	II	I	I*
	1	16	II	II	II	I	I*
	1	21	II	II	II	I*	I*
	1	26	I	II	II	I*	I*
	2	1	II	I*	II	I	II
	2	6	II	I*	II	II	II
	2	11	II	I*	II	II	I
	2	16	II	II	II	II	I
	2	21	II	II	I*	I*	I*
	2	26	I*	---	II	I*	I*
	3	1	II	II	II	I	I
	3	6	II	I	II	I	II

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	3	11	II	I	II	I	II
	3	16	II	I	II	I	II
	3	21	II	I*	II	I	II
	3	26	II	I*	II	I	II
	4	1	II	I*	II	I	II
	4	6	I*	II	II	I	II
	4	11	I*	I*	II	I	I*
	4	16	II	I*	II	I*	II
	4	21	II	I*	I*	I*	II
	4	26	I*	I*	I*	I*	II
	5	1	II	I	II	I*	I*
	5	6	II	I	II	I*	I*
	5	11	I	I*	II	I*	I*
	5	16	II	I*	II	I*	I*
	5	21	II	I*	II	I*	I*
	5	26	I*	I*	II	I*	I*
	6	1	I	---	II	II	I
	6	6	I	I	II	II	II
	6	11	I	I	II	I*	I
	6	16	I	I*	II	I*	I
	6	21	I	I	II	I*	I
	6	26	I	I	II	I*	I*

Fishing Creek P13	1	1	II	---	II	I	I
	1	6	II	---	II	I	I
	1	11	II	I*	II	I	I*
	1	16	II	II	II	I	I*
	1	21	II	I*	II	I	I*
	1	26	I*	II	II	I	I*
	2	1	II	I	II	I	I*
	2	6	II	I	II	I	I*
	2	11	II	I	II	I	I*
	2	16	II	II	II	I	I*
	2	21	II	II	II	I	I*
	2	26	I*	II	II	I	I*
	3	1	II	II	II	I	I*
	3	6	I	I*	II	I	I*
	3	11	II	I*	II	I	I*
	3	16	II	I*	II	I	I*
	3	21	II	II	II	I*	I*
	3	26	I	I*	II	I*	I*
	4	1	I	I	II	I	I
	4	6	I	II	II	I	I
	4	11	I	I	II	I	I*
	4	16	I	I	II	I	I*

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	4	21	I	I	II	I	I*
	4	26	I	I	NS	I	I*
	5	1	II	I	II	II	I
	5	6	II	I	II	I	I
	5	11	II	I	II	I	I
	5	16	II	I	II	I	I
	5	21	II	II	II	I*	I*
	5	26	II	I	II	I	I
	6	1	I	II	II	I	I
	6	6	II*	I	I	II*	I
	6	11	I	I	I	I	I
	6	16	II	II	I	I	I
	6	21	I	I*	I	I	I
	6	26	I	I	I	I	I
Prince George P14	1	1	I	I	II	I	I
	1	6	I	I	II	I	I
	1	11	I	I*	II	I	I
	1	16	I	I	II	I	I
	1	21	I	I	I*	I	I
	1	26	I	I*	I*	I	I
Prince George (continued)	2	1	I	I	II	I*	I
	2	6	I	I	II	I*	I
	2	11	I	I	II	I*	I
	2	16	I	I	I*	I*	I
	2	21	I	I*	I*	I*	I
	2	26	I	I*	I*	I*	I
	3	1	I	I	II	I	I
	3	6	I	II*	II	I	I
	3	11	I	I	II	I	I
	3	16	I	I*	II	I	I
	3	21	I	I	I*	I	I
	3	26	I	I	I*	I	I
	4	1	I	I	II	I	I
	4	6	I	I	II	I*	I
	4	11	I*	I	II	I*	I
	4	16	I	I	II	I*	I
	4	21	I	I	I*	I*	I*
	4	26	I	I	I*	I*	I*
	5	1	I	II	II	I	I
	5	6	II	II	II	I	I
	5	11	I	I	II	I	I
	5	16	I	I	II	I	I
	5	21	I	I	II	I	I
	5	26	I	I*	I*	I	I
	6	1	I	I	I	I	I
	6	6	I	I	II	I	I
	6	11	I	I	I*	I	I

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	6	16	I	I	I*	I	I
	6	21	I	I	I*	I	I
	6	26	I	II	I*	I	I

Table 5.51-3. Classification of Sites Winter. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
Town Creek P3	1	1	---	II	II	II	I	II
	1	6	---	II	II	II	I*	II
	1	11	---	II	II	II	I*	II
	1	16	---	I*	II	II	I*	II
	1	21	---	I*	II	I*	I*	II
	1	26	I*	I*	II	I*	I*	II
	2	1	II	II	II	II	I*	II
	2	6	II	II	II	I*	I*	II
	2	11	I*	II	II	I*	I*	I*
	2	16	I	II	II	I*	I*	II
	2	21	I*	II	II	I*	I*	I*
	2	26	I*	II	II	II	I*	I*
	3	1	II	I	II	II	II	II
	3	6	I	II	II	II	I	II
	3	11	I	II	II	II	I*	II
	3	16	I*	I*	II	II	I*	II
	3	21	I*	II	II	II	I*	II
	3	26	I*	II	II	II	I*	II
	4	1	I	II	II	II	II	II
	4	6	I*	I*	II	II	I*	II
	4	11	II	I*	II	II	I*	I*
	4	16	II	I*	II	II	I*	II
	4	21	II	II	II	II	I*	II
	4	26	II	II	II	II	II	II
	5	1	---	II	II	II	I	II
	5	6	I	II	II	II	I	II
	5	11	I	II	II	II	I*	II
	5	16	II	II	II	II	I*	II
	5	21	---	II	II	II	I*	II
	5	26	II	II	II	II	II	II
	6	1	II	II	II	II	II	II
	6	6	II	II	II	II	I*	II
	6	11	II	II	II	II	I*	II
	6	16	II	II	II	II	I*	II
	6	21	II	II	II	II	I*	I*
	6	26	II	II	II	II	I*	II
Eagle Island P6	1	1	---	II	II	II	II	II
	1	6	---	II	II	II	II	II
	1	11	---	II	II	II	II	II

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	1	16	I	II	II	I	II	II
	1	21	I	II	II	I	II	II
	1	26	I*	II	II	I*	II	II
	2	1	I	II	II	II	II	II
	2	6	I	II	II	II	II	II
	2	11	---	II	II	II	II	II
	2	16	---	II	II	II	I*	I*
	2	21	I	II	II	II	I*	I*
	2	26	I	II	II	II	I*	I*
	3	1	I	II	II	II	II	II
	3	6	---	II	II	II	II	II
	3	11	I*	II	II	II	II	II
	3	16	I*	I*	II	II	II	II
	3	21	I*	II	II	I*	I*	II
	3	26	II	II	II	I*	I*	I*
	4	1	I	II	II	II	II	II
	4	6	I*	II	II	I*	I*	I*
	4	11	I*	II	II	I*	I*	I*
	4	16	II	I*	II	I*	I*	II
	4	21	I*	II*	II	I*	I*	I*
	4	26	I*	II	II	I*	I*	I*
	5	1	I	II	II	II	II	II
	5	6	I*	II	I*	I*	II	II
	5	11	I	II	I*	I*	II	I
	5	16	I*	II	I*	I*	II	I
	5	21	I*	II	II	I*	I	I*
	5	26	I*	II	I*	I*	II	I
	6	1	I	I*	I*	II	II	II
	6	6	I*	I*	I*	I*	II	I
	6	11	I	I*	I*	I*	I	I
	6	16	I	I*	I*	I*	I	I
	6	21	I	I*	I*	I*	I	I
	6	26	I	I*	I*	I*	I	I
Indian Creek P7	1	1	I	I	I	I	I	I
	1	6	I	I	I	II*	II*	I
	1	11	I	I	I	II	II*	
	1	16	---	I	I	II	II*	0
	1	21	I	I	I	II	I	I
	1	26	I	I	I	II	I	I*
Indian Creek (continued)	2	1	I	I	I*	I*	I	I
	2	6	I	I	I*	I*	I	I
	2	11	I	I	I*	I*	I	I
	2	16	I	I	I*	I*	I*	I
	2	21	I*	I	I*	I*	I*	I
	2	26	I*	I	I*	I*	I*	I
	3	1	I	I	I	I*	I	I

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	3	6	I*	I	I	I*	I	I
	3	11	I*	I	I*	I*	I*	I
	3	16	I	I	I*	I*	I*	I
	3	21	I*	I	I*	I*	I	I*
	3	26	I	I	I*	I*	I	I
	4	1	I	I	I	I	I	I
	4	6	I	I	I	I*	I	I
	4	11	I	I	I	I*	I*	I
	4	16	I*	I	I	I*	I*	I
	4	21	I*	I	I	I*	I*	I
	4	26	I	I	I	I*	I*	I
	5	1	I	I	I	NS	I	I
	5	6	I	I	I	I	I	I
	5	11	I	I	I	I	I	I
	5	16	I*	I	I	I	I	I
	5	21	I	I	I	I	I	I
	5	26	I*	I	I	I	I	I
	6	1	I	I	I	I	I	I
	6	6	I	I	I	I	I	I
	6	11	I	I	I	I	I	I
	6	16	I	I	I	I	I	I
	6	21	I	I	I	I	I	I
	6	26	II*	I	I	I	I	I
Dollisons	1	1	---	II*	I	I	I	I
Landing P8	1	6	I	II*	II*	I	II	I
	1	11	II	II*	II*	I	II	I
	1	16	I	II*	II*	I	I	I
	1	21	I*	II	II*	I	I	I
	1	26	II*	II*	I	I	I	I
	2	1	---	I	I	I	I	I
	2	6	---	I	I	I	I	I
	2	11	II	I	I	I	I	I
	2	16	II	I	I	I	II*	I
	2	21	I	I	I	I*	II*	I
	2	26	I	I	I	I	I	I
Dollisons	3	1	II	I	I	I	I	I
Landing	3	6	I	I	I	I	I	I
(continued)	3	11	II*	II*	I	I	I	I
	3	16	I	II*	I	I	I	I
	3	21	II	I	I	I	II*	I
	3	26	I	I	I	I	I	I
	4	1	II	I	I	I	I	I
	4	6	I	I	I	I	I	I
	4	11	I*	I	I	I	I	I
	4	16	---	I	I	I	I	I
	4	21	---	I	I	I	I	I

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	4	26	I	I	I	I*	I	I
	5	1	I	I	I	I	I	I
	5	6	II	I	I	I	I	I*
	5	11	---	I	I	I	I	I*
	5	16	II	I	I	I	I	I*
	5	21	I	II*	I	I	I	I*
	5	26	II	I	I	I	II*	I
	6	1	I*	I	I	I	I	I
	6	6	I	I	I	I	I	I*
	6	11	II*	I	I*	I	I	I*
	6	16	II	I	I	I*	I	I
	6	21	---	I	I	I	I	I
	6	26	I	I	I	I	I	I*
Black River P9	1	1	---	I	I	I*	II	I
	1	6	I	I	I	I	II	I
	1	11	I	I	I	I	I	I
	1	16	I	I	I	I	I	I
	1	21	I	II	I	I	I	I
	1	26	I*	II	I	I	I	I
	2	1	I	II*	I	I	I	I
	2	6	I	II*	I	I	I	I
	2	11	I	I	I	I	I	I
	2	16	I*	I	I	I	I	I
	2	21	I	II	I	I	I	I
	2	26	I	I	I	I*	I	I
	3	1	I	II*	I	I	I	I
	3	6	I	II*	I	I	I	I
	3	11	I	II*	I	I	I	I
	3	16	I	I	I	I	I	I
	3	21	I	II	I	I	I	I
	3	26	I	II*	I	I	I	I
Black River (continued)	4	1	I	II*	I	I	I	I
	4	6	I*	I	I	I	I	I
	4	11	I*	II*	I	I	I	I
	4	16	I*	II*	I	I	I	I
	4	21	I*	II*	I	I	I	I
	4	26	I*	II*	I	I	I	I
	5	1	I*	II*	I	I	I	I
	5	6	I	II*	I	I	I	I
	5	11	I	II*	I	I*	I	I
	5	16	I*	II*	I	I*	I	I
	5	21	I*	II*	I*	I	I	I
	5	26	I*	II*	I	I*	I	I
	6	1	I	I	I	I	I	I
	6	6	I	I	I	I	I	I
	6	11	I*	I	I	I	I	I

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	6	16	I*	I	I	I	I	I
	6	21	I	II*	I	I	I	I
	6	26	I	II*	I	I	I	I
Smith Creek P11	1	1	I	II	II	II	II	II
	1	6	I*	I*	II	II	II	II
	1	11	---	II	II	II	II	II
	1	16	I*	II	II	II	II	II
	1	21	I*	II	II	II	II	II
	1	26	---	II	II	II	II	II
	2	1	II	II	---	II	II	II
	2	6	I*	II	II	II	II	II
	2	11	I*	II	II	II	II	II
	2	16	I*	II	II	II	II	II
	2	21	I*	II	II	II	II	II
	2	26	---	II	II	II	II	II
	3	1	---	II	II	II	II	II
	3	6	I*	II	II	II	II	II
	3	11	I*	II	II	II	II	II
	3	16	I*	II	II	II	II	II
	3	21	I*	II	II	II	II	II
	3	26	I*	II	II	II	II	II
	4	1	I	II	II	II	II	II
	4	6	II	I	II	II	II	I*
	4	11	II	II	II	II	II	I*
	4	16	II	II	II	II	II	I*
	4	21	II	II	II	II	II	I*
	4	26	II	II	II	II	II	II
Smith Creek (continued)	5	1	II	II	II	II	II	II
	5	6	II	II	II	II	II	II
	5	11	I*	II	II	II	II	II
	5	16	I*	II	II	II	I*	I*
	5	21	I*	II	II	II	I*	I*
	5	26	---	II	II	II	I*	I*
	6	1	---	II	II	II	II	II
	6	6	---	II	II	II	II	II
	6	11	---	II	II	II	II	II
	6	16	---	II	II	II	I*	II
	6	21	---	II	II	II	II	II
	6	26	---	II	II	II	II	II
Rat Island P12	1	1	---	II	II	II	II	II
	1	6	---	II	II	II	II	II
	1	11	I*	II	II	II	II	II
	1	16	I*	II	II	II	II	II
	1	21	I*	II	II	II	I*	II
	1	26	I*	II	II	II	II	II
	2	1	I*	II	II	II	II	II

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	2	6	I*	I	II	II	II	II
	2	11	I*	II	II	II	II	II
	2	16	I*	II	II	II	II	II
	2	21	I*	II	II	II	II	II
	2	26	I*	II	II	II	II	II
	3	1	II	II	II	II	II	II
	3	6	I	II	II	II	II	II
	3	11	I*	II	II	II	II	II
	3	16	I	II	II	II	II	I
	3	21	I	II	II	II	I	II
	3	26	I	II	II	II	I*	I
	4	1	I*	II	II	II	II	II
	4	6	I*	I*	II	II	II	I
	4	11	I*	I*	II	II	II	I
	4	16	I*	I*	II	I*	I	I*
	4	21	I*	I*	II	I*	I	I*
	4	26	I*	I*	II	II	I	I*
	5	1	I	II	II	II	I*	I*
	5	6	I	I*	I	II	I*	I*
	5	11	I	I*	II	II	II	II
	5	16	I	I*	II	II	I*	II
	5	21	I	I*	I*	II	I*	II
	5	26	I	I*	I*	II	I*	II
Rat Island (continued)	6	1	I	I	---	II	II*	II*
	6	6	I	I	---	II	II*	II*
	6	11	I	I	II	II	II*	II*
	6	16	I	II	II	II	II	II
	6	21	I	I	II	II	I	II
	6	26	I	I	II	II	I	I*
Fishing Creek P13	1	1	II	II	I	I	I	I
	1	6	II	II	I	I	I	I
	1	11	I	II	II	II*	I	I*
	1	16	I	II	II	II*	II*	I
	1	21	I	II	II	II*	I	I
	1	26	I	II	II	II*	I	I
	2	1	---	II	I	II*	I	I*
	2	6	I	II	II	I	I	I*
	2	11	I	II	II	I	I	I
	2	16	I	I	II	I	I	I*
	2	21	I*	I	II	I	I	I*
	2	26	I*	I	II	I*	I*	I*
	3	1	I	I	II	I*	I*	II
	3	6	I	I	II	II	I*	I
	3	11	I*	I	II	I*	I*	I*
	3	16	I	I	II	I*	I*	I*
	3	21	I*	I	II	I*	I*	I*

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	3	26	I	II	II	I*	I*	I*
	4	1	II*	II	II	I	I	I
	4	6	I	II	II	II	I	I
	4	11	I	II	II	II	I	I
	4	16	I	II	II	II	I	I
	4	21	I	I	II	II	I	I
	4	26	I	I	II	II	I	I
	5	1	I	I	---	I	I	I
	5	6	I	I	II	I	I	I
	5	11	I	I	II	I	I	I
	5	16	I	I	II	I	I	I
	5	21	I	I	I*	I*	I	I
	5	26	I	I	---	I*	I	I
	6	1	II	I	I	I	I	I
	6	6	I*	I	I*	I	I	I
	6	11	II	I	I	I	I	I
	6	16	---	I	I	I	I	I
	6	21	II	I	I	I	I	I
	6	26	I	I	I	I	I	I
Prince George P14	1	1	I	II*	II*	NS	I	I
	1	6	I	I	II*	II*	I	I
	1	11	I	I	II	II*	I	I
	1	16	I	I	II	II*	I	I
	1	21	I	I	II	II*	I	I
	1	26	I	I	II*	II*	I	I
	2	1	I	I	II*	I	I	I
	2	6	I	I	II*	I	I*	I
	2	11	I	I	II*	I	I*	I
	2	16	I	II	II*	I	I*	I
	2	21	I	I*	II*	I	I*	I*
	2	26	I*	I	II	I	I*	I
	3	1	II	I	II*	NS	I	I
	3	6	II	I	II*	II*	I	I
	3	11	I	I	II	I	I	I
	3	16	I	I	II*	I	I	I
	3	21	I	I	II	I	I*	I
	3	26	I	I	II	I	I*	I*
	4	1	I	I	II*	I	I	I
	4	6	I	II*	II*	I	I	I*
	4	11	I	I	II	I*	I*	I*
	4	16	I	I	II*	I*	I*	I*
	4	21	I	I	II	I*	I*	I
	4	26	I	I	II	I*	I*	I*
	5	1	I	I	II	II*	I	I
	5	6	I	I	II*	I	I*	I
	5	11	I	I	II	I	I	I

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Winter 2000	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	5	16	I	II	II	I	I*	I
	5	21	I	I	II	I	I	I*
	5	26	I	I	II	I	I	I
	6	1	II*	II	II*	II*	I	I
	6	6	I	I	II	II*	I	I
	6	11	I	I	II	II*	I	I
	6	16	I	I	II	II*	I	I*
	6	21	I	I	I	II*	I	I
	6	26	I	I	I	I	I	I*

Table 5.51-4. Methane Concentrations of Sites. Porewater methane concentrations are µM.

			Methane	
Station	**Substation**	**Depth (cm)**	**Summer 2004**	**Winter 2005**
Town Creek	1	1	211	1
P3	1	6	299	15
	1	11	253	19
	1	16	257	21
	1	21	242	22
	1	26	257	25
	2	1	78	14
	2	6	146	119
	2	11	113	276
	2	16	128	263
	2	21	132	272
	2	26	119	315
	3	1	28	5
	3	6	221	51
	3	11	183	127
	3	16	247	129
	3	21	295	231
	3	26	193	245
	4	1	1	130
	4	6	60	289
	4	11	107	278
	4	16	170	---
	4	21	180	383
	4	26	198	390
	5	1	176	16
	5	6	171	97
	5	11	133	225
	5	16	181	304
	5	21	258	394
	5	26	185	382
	6	1	8	7
	6	6	262	74
	6	11	209	182
	6	16	251	156
	6	21	187	230
	6	26	202	173

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2004	Winter 2005
Eagle Island	1	1	1	1
P6	1	6	32	13
	1	11	153	142
	1	16	308	243
	1	21	349	332
	1	26	315	221
	2	1	169	97
	2	6	218	100
	2	11	190	109
	2	16	203	183
	2	21	197	208
	2	26	241	173
	3	1	7	5
	3	6	230	13
	3	11	227	31
	3	16	350	92
	3	21	277	160
	3	26	284	199
	4	1	156	104
	4	6	258	174
	4	11	290	208
	4	16	320	163
	4	21	362	254
	4	26	374	292
	5	1	21	18
	5	6	48	29
	5	11	136	169
	5	16	209	254
	5	21	196	301
	5	26	197	161
	6	1	80	115
	6	6	165	186
	6	11	187	198
	6	16	144	299
	6	21	202	344
	6	26	157	214

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane Summer 2004	Methane Winter 2005
Indian Creek P7	1	1	0	2
	1	6	2	1
	1	11	26	---
	1	16	37	---
	1	21	72	23
	1	26	114	63
	2	1	229	25
	2	6	231	114
	2	11	270	121
	2	16	209	142
	2	21	197	149
	2	26	138	102
	3	1	134	9
	3	6	186	85
	3	11	231	48
	3	16	210	111
	3	21	202	130
	3	26	216	98
	4	1	248	8
	4	6	155	62
	4	11	194	95
	4	16	198	129
	4	21	284	61
	4	26	267	97
	5	1	225	4
	5	6	244	25
	5	11	260	24
	5	16	203	39
	5	21	278	33
	5	26	217	20
	6	1	83	1
	6	6	63	1
	6	11	54	1
	6	16	136	5
	6	21	138	6
	6	26	161	54

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane Summer 2004	Methane Winter 2005
Dollisons	1	1	53	7
Landing P8	1	6	148	22
	1	11	206	64
	1	16	196	77
	1	21	272	123
	1	26	171	143
	2	1	162	106
	2	6	190	117
	2	11	218	138
	2	16	164	90
	2	21	194	88
	2	26	153	112
	3	1	63	55
	3	6	96	65
	3	11	94	62
	3	16	128	49
	3	21	114	69
	3	26	117	74
	4	1	154	153
	4	6	241	234
	4	11	301	264
	4	16	321	261
	4	21	254	131
	4	26	209	95
	5	1	123	15
	5	6	166	38
	5	11	130	62
	5	16	215	101
	5	21	163	120
	5	26	254	153
	6	1	2	31
	6	6	30	111
	6	11	53	140
	6	16	161	141
	6	21	149	171
	6	26	246	194

Table 5.51-4. (continued)

			Methane	
Station	**Substation**	**Depth (cm)**	**Summer 2004**	**Winter 2005**
Black River	1	1	108	89
P9	1	6	230	204
	1	11	273	240
	1	16	262	321
	1	21	223	310
	1	26	114	210
	2	1	87	2
	2	6	674	3
	2	11	154	9
	2	16	135	6
	2	21	133	10
	2	26	157	21
	3	1	3	3
	3	6	21	36
	3	11	271	64
	3	16	237	44
	3	21	247	61
	3	26	108	83
	4	1	230	15
	4	6	273	186
	4	11	128	299
	4	16	161	364
	4	21	243	455
	4	26	256	517
	5	1	2	21
	5	6	4	85
	5	11	94	122
	5	16	144	144
	5	21	159	150
	5	26	117	133
	6	1	---	38
	6	6	154	197
	6	11	198	287
	6	16	209	280
	6	21	203	288
	6	26	34	---

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2004	Winter 2005
Smith Creek	1	1	4	1
P11	1	6	74	10
	1	11	83	41
	1	16	122	80
	1	21	193	117
	1	26	264	219
	2	1	2	8
	2	6	21	79
	2	11	32	121
	2	16	49	144
	2	21	53	216
	2	26	113	199
	3	1	4	248
	3	6	35	275
	3	11	202	336
	3	16	142	361
	3	21	178	413
	3	26	149	370
	4	1	1	311
	4	6	3	435
	4	11	232	584
	4	16	318	395
	4	21	343	491
	4	26	291	323
	5	1	---	1
	5	6	---	5
	5	11	---	205
	5	16	---	358
	5	21	---	339
	5	26	---	391
	6	1	0	130
	6	6	1	103
	6	11	5	59
	6	16	74	44
	6	21	17	94
	6	26	192	160

Table 5.51-4. (continued)

			Methane	
Station	**Substation**	**Depth (cm)**	**Summer 2004**	**Winter 2005**
Rat Island	1	1	188	45
P12	1	6	222	86
	1	11	176	129
	1	16	172	115
	1	21	210	107
	1	26	165	108
	2	1	11	3
	2	6	137	5
	2	11	131	16
	2	16	166	40
	2	21	152	39
	2	26	166	55
	3	1	1	363
	3	6	23	472
	3	11	80	385
	3	16	65	488
	3	21	168	438
	3	26	150	443
	4	1	7	10
	4	6	130	162
	4	11	258	297
	4	16	328	442
	4	21	382	463
	4	26	283	632
	5	1	155	72
	5	6	349	140
	5	11	265	166
	5	16	304	162
	5	21	272	134
	5	26	181	113
	6	1	241	8
	6	6	195	14
	6	11	237	65
	6	16	231	164
	6	21	258	271
	6	26	257	236

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane Summer 2004	Methane Winter 2005
Fishing Creek P13	1	1	2	0
	1	6	57	0
	1	11	138	0
	1	16	256	0
	1	21	245	2
	1	26	175	4
	2	1	130	36
	2	6	147	119
	2	11	205	169
	2	16	215	207
	2	21	229	235
	2	26	183	162
	3	1	123	2
	3	6	140	35
	3	11	141	105
	3	16	160	151
	3	21	203	196
	3	26	167	183
	4	1	4	2
	4	6	55	26
	4	11	80	54
	4	16	139	59
	4	21	172	84
	4	26	190	59
	5	1	2	1
	5	6	2	5
	5	11	46	11
	5	16	124	31
	5	21	178	27
	5	26	185	17
	6	1	25	1
	6	6	18	14
	6	11	15	7
	6	16	20	19
	6	21	21	14
	6	26	21	7

Table 5.51-4. (continued)

			Methane	
Station	**Substation**	**Depth (cm)**	**Summer 2004**	**Winter 2005**
Prince George P14	1	1	1	---
	1	6	22	14
	1	11	97	15
	1	16	160	40
	1	21	155	106
	1	26	205	160
	2	1	179	78
	2	6	231	223
	2	11	---	244
	2	16	304	263
	2	21	262	277
	2	26	219	113
	3	1	91	2
	3	6	136	2
	3	11	202	21
	3	16	221	122
	3	21	303	181
	3	26	265	223
	4	1	153	52
	4	6	173	172
	4	11	219	197
	4	16	179	176
	4	21	180	52
	4	26	156	160
	5	1	40	9
	5	6	84	50
	5	11	115	77
	5	16	157	84
	5	21	165	---
	5	26	148	142
	6	1	2	6
	6	6	273	86
	6	11	261	89
	6	16	295	156
	6	21	296	284
	6	26	239	283

Table 5.52-1. Sulfate Concentrations of Sites. Porewater sulfate concentrations are µM. A --- indicates no data.

Station	Substation	Depth (cm)	Sulfate	
			Summer 2004	Winter 2005
Town Creek P3	1	1	396	784
	1	6	168	491
	1	11	138	396
	1	16	129	330
	1	21	108	392
	1	26	82	319
	2	1	1949	1159
	2	6	281	683
	2	11	144	275
	2	16	105	441
	2	21	84	212
	2	26	135	72
	3	1	2660	933
	3	6	1241	469
	3	11	1281	308
	3	16	156	438
	3	21	88	384
	3	26	185	343
	4	1	1415	549
	4	6	1296	371
	4	11	1049	279
	4	16	850	492
Town Creek (continued)	4	21	594	367
	4	26	337	375
	5	1	268	653
	5	6	140	586
	5	11	87	413
	5	16	210	469
	5	21	111	360
	5	26	176	408
	6	1	1083	863
	6	6	201	670
	6	11	211	416
	6	16	142	357
	6	21	211	285
	6	26	180	379
Eagle Island P6	1	1	455	1293
	1	6	716	1519
	1	11	193	1557
	1	16	30	1092
	1	21	12	883
Eagle Island (continued)	1	26	64	659
	2	1	258	528
	2	6	106	469
	2	11	69	390

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2004	Winter 2005
	2	16	56	239
	2	21	70	159
	2	26	37	224
	3	1	1287	1305
	3	6	270	1322
	3	11	167	1205
	3	16	43	577
	3	21	70	315
	3	26	117	162
	4	1	143	412
	4	6	120	277
	4	11	66	197
	4	16	64	311
	4	21	49	185
	4	26	74	124
	5	1	296	519
	5	6	155	422
	5	11	102	169
	5	16	69	137
	5	21	51	113
	5	26	43	175
	6	1	133	327
	6	6	114	185
	6	11	68	279
	6	16	144	207
	6	21	167	173
	6	26	379	154
Indian Creek	1	1	306	285
P7	1	6	148	299
	1	11	53	---
	1	16	35	---
	1	21	14	215
	1	26	16	61
	2	1	63	97
	2	6	44	46
	2	11	19	66
	2	16	33	60
	2	21	22	95
	2	26	29	103
	3	1	33	93
Indian Creek	3	6	25	55
(continued)	3	11	37	71
	3	16	27	26
	3	21	26	18
	3	26	31	25
	4	1	42	91
	4	6	21	77
	4	11	25	55

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2004	Winter 2005
	4	16	24	64
	4	21	16	59
	4	26	13	78
	5	1	25	97
	5	6	28	94
	5	11	33	85
	5	16	20	64
	5	21	22	50
	5	26	31	61
	6	1	41	88
	6	6	38	96
	6	11	28	89
	6	16	51	78
	6	21	30	78
	6	26	33	194
Dollisons Landing P8	1	1	57	284
	1	6	55	221
	1	11	33	80
	1	16	37	190
	1	21	17	99
	1	26	18	74
	2	1	59	72
	2	6	42	65
	2	11	35	65
	2	16	45	69
	2	21	40	77
	2	26	43	48
	3	1	45	48
	3	6	25	99
	3	11	23	31
	3	16	19	32
	3	21	21	48
	3	26	26	30
	4	1	41	49
	4	6	27	45
	4	11	16	55
Dollisons Landing (continued)	4	16	22	63
	4	21	22	83
	4	26	23	90
	5	1	56	57
	5	6	35	37
	5	11	34	32
	5	16	30	48
	5	21	32	50
	5	26	21	39
	6	1	27	69
	6	6	25	30
	6	11	18	31

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2004	Winter 2005
	6	16	22	102
	6	21	24	72
	6	26	36	43
Black River P9	1	1	29	139
	1	6	22	128
	1	11	20	169
	1	16	12	169
	1	21	28	145
	1	26	16	166
	2	1	78	217
	2	6	24	177
	2	11	17	153
	2	16	26	130
	2	21	28	112
	2	26	54	103
	3	1	271	164
	3	6	202	111
	3	11	31	63
	3	16	23	75
	3	21	17	82
	3	26	13	49
	4	1	327	156
	4	6	271	101
	4	11	18	58
	4	16	10	44
	4	21	12	37
	4	26	5	45
	5	1	197	275
	5	6	118	216
	5	11	15	213
	5	16	17	210
	5	21	5	205
Black River (continued)	5	26	9	55
	6	1	---	296
	6	6	142	187
	6	11	19	198
	6	16	15	205
	6	21	15	194
	6	26	14	233
Smith Creek P11	1	1	5691	3181
	1	6	4626	3095
	1	11	3914	1344
	1	16	1233	1174
	1	21	292	1715
	1	26	201	1570
	2	1	2865	2726
	2	6	1291	2429
	2	11	1477	1861

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate Summer 2004	Sulfate Winter 2005
	2	16	2180	1688
	2	21	2205	1193
	2	26	1954	959
	3	1	4698	770
	3	6	1621	1143
	3	11	522	845
	3	16	140	304
	3	21	104	1464
	3	26	84	837
	4	1	3834	639
	4	6	3229	261
	4	11	848	18
	4	16	195	262
	4	21	0	146
	4	26	124	365
	5	1	114	1858
	5	6	85	797
	5	11	40	742
	5	16	15	136
	5	21	42	278
	5	26	32	259
	6	1	3016	350
	6	6	2264	507
	6	11	1564	730
	6	16	282	687
	6	21	891	633
	6	26	1309	843
Rat Island	1	1	278	1580
P12	1	6	311	657
	1	11	139	417
	1	16	101	330
	1	21	62	330
	1	26	195	453
	2	1	1603	1033
	2	6	511	1031
	2	11	192	898
	2	16	85	747
	2	21	78	676
	2	26	136	638
	3	1	27	371
	3	6	2624	312
	3	11	2789	309
	3	16	2795	298
	3	21	2244	337
	3	26	2239	180
	4	1	765	330
	4	6	730	256

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2004	Winter 2005
	4	11	280	242
	4	16	519	287
	4	21	303	272
	4	26	355	162
	5	1	191	250
	5	6	88	274
	5	11	82	309
	5	16	77	346
	5	21	93	334
	5	26	94	375
	6	1	154	1002
	6	6	348	1089
	6	11	186	848
	6	16	138	509
	6	21	126	341
	6	26	111	228
Fishing Creek	1	1	122	200
P13	1	6	51	264
	1	11	26	64
	1	16	22	234
	1	21	16	222
	1	26	12	221
	2	1	25	54
	2	6	25	37
Fishing Creek	2	11	14	231
(continued)	2	16	26	20
	2	21	20	27
	2	26	17	30
	3	1	25	417
	3	6	19	116
	3	11	29	57
	3	16	19	48
	3	21	14	51
	3	26	14	53
	4	1	88	132
	4	6	76	134
	4	11	37	96
	4	16	24	85
	4	21	34	82
	4	26	20	94
	5	1	97	134
	5	6	79	112
	5	11	67	123
	5	16	49	88
	5	21	21	82
	5	26	33	95
	6	1	89	124
	6	6	87	126

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2004	Winter 2005
	6	11	95	101
	6	16	85	120
	6	21	82	105
	6	26	85	143
Prince George P14	1	1	195	33
	1	6	95	134
	1	11	54	168
	1	16	35	168
	1	21	52	134
	1	26	30	115
	2	1	40	74
	2	6	36	40
	2	11	3	26
	2	16	44	26
	2	21	30	30
	2	26	40	31
	3	1	70	67
	3	6	57	109
	3	11	33	93
	3	16	30	69
Prince George (continued)	3	21	30	40
	3	26	27	22
	4	1	78	60
	4	6	37	23
	4	11	55	20
	4	16	37	14
	4	21	29	43
	4	26	26	1
	5	1	80	92
	5	6	59	53
	5	11	43	40
	5	16	45	38
	5	21	40	1
	5	26	34	36
	6	1	130	41
	6	6	60	33
	6	11	32	20
	6	16	62	22
	6	21	28	40
	6	26	40	24

5.53 Dollisons Landing (P8)

Winter porewaters at Dollisons Landing have been essentially fresh with only a few substation sub-depths with sulfate concentrations able to support sulfate reduction,

Table 5.52-1. (continued)

mainly during the winter of 2000 (Hackney et al. 2002a). Since the winter of 2000 the site has remained relatively fresh. During the winters of 2000 and 2001, the site had porewater salinities in the 0.1 to 0.3 ppt range (Hackney et al. 2002a). During the winters of 2002, 2003 and 2004, the salinities were essentially below 0.1 ppt. (Hackney et al. 2002b, Hackney et al. 2003, Hackney et al. 2005), continuing the low salinity conditions. Salinities during the current winter of 2005 were saltier in the uplands (Table 5.51-1) making this year the saltiest since 2000; several M classifications shifted to MPSR (Table 5.51-3).

Salinities during thee summer (2003) (Hackney et al. 2005) were all at or below 0.05 ppt. resulting in the lowest salinities observed at this site since the projects inception. For the first time all substations had methanogenic conditions (Hackney et al. 2005). The majority of substations had M classifications and only a few had MPSR classifications. During the current summer of 2004, conditions were slightly saltier in the uplands resulting in several M classifications converted to MPSR (Table 5.51-2). Conditions were slightly fresher nearer to the river with a few SR classifications converted to M.

5.54 Black River (P9)

Winter porewaters of the Black River station continues to display fresh conditions that have been observed since the winter of 2002. All substations were methanogenic during the previous winter of 2004 except for the two surface sub-depths at substation S1 (Hackney et al. 2005). During the previous two winters (2002, 2003) a few of the substations were MPSR classifications, however none were MPSR classifications during the winter 2004 suggesting slightly fresher conditions. Salinities remained low with the majority of values below 0.04 ppt (Hackney et al. 2005). During the current winter of 2005, salinities remained in the same range (0.02-0.06 ppt., Table 5.51-1). All classifications were M reflecting these low salinity conditions.

Summer 2004 salinities were similar to the winter 2005 values and ranged from approximately 0.01- 0.04 ppt (Table 5.51-1). On the basis of classifications and salinities, the previous summer of 2003 was the freshest summer since monitoring began for this site with all M classifications and only one MPSR. All locations were methanogenic during the current summer with mostly M classifications and a few MPSR (Table 5.51-2). The higher instances of MPSR in the current summer indicate slightly saltier conditions.

5.55 Smith Creek (P11)

Porewater salinities during the winter at Smith Creek showed a steady increase from 2000 (Hackney et al, 2002a) to 2002 (Hackney et al. 2002b). However, salinities during the winter of 2003 [av. = 4.4 $\pm$ 1.1 ppt; (Hackney et al. 2003)] and 2004 [av. = 3.3 $\pm$ 1.1 ppt; (Hackney et al. 2005)] were lower than the winter of 2002 [(av. = 7.2 $\pm$ 2.1 ppt; (Hackney et al. 2002b)]. The slightly fresher conditions during winter of 2004 were reflected in the classifications, which for the first time since the winter of 2000 show a few substations with methanogenic (MPSR) conditions (Hackney et al. 2005). The current winter of 2005 is similar to the previous winter of 2004 with the exception of a few more MPSR classifications (Table 5.51-3) indicating slightly fresher conditions.

The current summer of 2004 salinities range from 5-8 ppt. (Table 5.51-1) with the exception of S5 which displayed very fresh conditions (0.01-0.02 ppt.). These salinities are higher than those observed during the summer of 2003 (0.1-4 ppt., Hackney et al. 2005) but are not as high as previous years which have reached values as high as 14 ppt. Similarly to previous summer of 2003, the current summer showed some MPSR classifications whereas the majority of classifications were SR during the previous summers (Table 5.51-2).

5.56 Rat Island (P12)

Vegetation along this transect is strongly transitional, from saline tolerant species near the river to salt intolerant species toward the upland boundary. Porewater salinity reflects the gradient with higher salinity at substations near the river and fresher conditions toward the uplands. Winter salinities steadily increased from 2000-2002 (Hackney et al. 2002a, 2002b) with the winter of 2003 showing a dramatic salinity increase in upland sites for the first time (Hackney et al. 2003). Average substation S6 salinities were never above 0.2 ppt but were 2.7 $\pm$ 0.2 ppt during the winter of 2003, representing more than a ten fold increase. The salinities during the winter of 2004 returned to lower values similar to those observed during winters of 2001-2002 with the majority of salinities at the upland sites below 0.3 ppt (Hackney et al. 2005). Winter classifications reflected the lower salinities with several upland sites returning to methanogenic conditions (Table 5.51-3). The current winter was similar to the previous one (2004) but conditions were slightly saltier in the uplands with some M classifications converted to MPSR and some MPSR classifications converted to SR (Table 5.51-3).

A similar pattern was observed during the summer of 2002. Previous average salinities at near-shore station S1 were always below 2 ppt (Hackney et al. 2002a, 2002b) however, during the summer of 2002 the average value at substation S1 was 6.3 $\pm$ 0.7 ppt (Hackney et al. 2003). Salinities at upland substation 6 increased as well during the summer of 2002. Average salinities at this upland site (1.9 $\pm$ 0.2 ppt, Hackney et al. 2003) increased almost tenfold from previous average salinities (0.2 + 0.1 ppt, Hackney et al. 2002a, 2002b). The salinities during the previous summer of 2003 were lower than that of the summer of 2002 with the majority of salinities below 0.4 ppt. (Hackney et al. 2005). On the basis of classifications, the summer of 2003 was the freshest observed during this project. All but 5 substations were methanogenic (Hackney et al. 2005) whereas during the second freshest summer (2001), 10 substations had sulfate reducing conditions (Hackney at al. 2002). Conditions during the current summer (2004) were slightly saltier than last summer in most stations except S6 which was slightly fresher (Table 5.51-1). Several classifications shifted from M and MPSR to SR as a result of increased salinity while a few MPSR classifications converted to M in the uplands.

5.57 Fishing Creek (P13)

The winter porewater salinities at Fishing Creek displayed a peak during the winter of 2002 (Hackney et al. 2002b) and returned to values similar to the winters of 2000 and 2001 (Hackney et al. 2002a) during the winter of 2003 (Hackney et al. 2003). Salinities of approximately 1 ppt. were observed during the winter of 2002 (Hackney et el., 2002b). During the winter of 2003 salinities were all less than 0.5 ppt (Hackney et al. 2003). Winter 2004 salinities displayed a freshening trend with all salinities below 0.1 ppt except for substation 3 (Hackney et al. 2005). On the basis of classifications, the winter of 2004 was the freshest on record with only one site having sulfate concentrations high enough to maintain sulfate reduction (Hackney et al. 2005). The lowest salinity winter (winter 2000) prior to this winter had 6 sub-depths with sulfate reducing conditions. The current winter (2005) was essentially the same as the previous one (2004) with essentially no change in salinity (0.03-0.2 ppt., Table 5.51-1) or classification (Table 5.51-3).

Porewater salinities measured during the summer of 2002 were the highest ever obtained for Fishing Creek since the beginning of the project with values of approximately 5-7 ppt. at the near-bank substation, 3 ppt at the mid substations, and essentially fresh conditions at the upland stations (Hackney et al. 2003). Porewater salinities during the summer of 2003 were the lowest observed during the project for

Fishing Creek with values less than 0.1 ppt at the near-bank substation, less than 0.5 ppt at the mid substations (Hackney et al. 2005). Summer 2003 classifications reflected the fresher conditions with all but 2 sub-depths with methanogenic conditions. In previous summers at least 1/3 of the sub-depths were sulfate reducing (Table 5.51-2). Salinities during the current summer of 2004 were still relatively fresh but slightly saltier than the previous fresh summer of 2003. Several M classifications were converted to MPSR (Table 5.51-2) indicating that the spring was saltier than the previous spring of 2003. However, there were no SR classifications such as those observed during the saltier summers of 2000-2002.

5.58 Prince George Creek (P14)

Winter salinities peaked during the winter (2002) and decreased during the winters of 2003-2004. Salinities during the winter (2003) ranged from 0.05 to 0.26 ppt (Hackney et al. 2003) while salinities for the winter of 2004 were all below 0.1 ppt. (Hackney et al. 2005). For the first time all substation sub-depths were methanogenic (Hackney et al. 2005). Conditions during the current winter of 2005 were similar to last winter with salinities ranging from 0.02-0.07 ppt. (Table 5.51-2). No sites had sulfate concentrations able to support sulfate reduction due to lower chloride (Table 5.58-1) and salinities levels (Table 5.51-1).

Summer salinities peaked during 2002 and returned to lower salinity values last summer (2003). Summer 2002 salinity values were approximately 1 ppt (Hackney et al. 2003), roughly twice previous values (Hackney et al. 2002a, 2002b). The majority of summer (2003) values were below 0.04 ppt. (Hackney et al. 2005). Salinities during the current year were slightly lower (Table 5.51-1) than the previous summer of 2003. Prior to the summer of 2002, summer geochemical classifications were essentially all (M). Due to the increase in salinity at this site during the summer 2002, the majority of substations were converted to (SR) (Table 5.51-2). None of the classifications from the previous summer (2003) or the current summer (2004) are sulfate reducing and are similar to the previous summers of 2000 and 2001. The slightly fresher conditions during the current summer are reflected in the classifications where only 2 of the classifications are MPSR while the remainder are MP. During the previous year the majority of classifications were MP but there were more MPSR classification due to slightly higher salinities.

5.6 Interannual comparisons

Change of geochemical classification over time is an ideal mechanism for determining future community change. Patterns of variations for the current year and previous years follow.

Year 1 (winter 2000, 2001, summer 2000):

During the first year of the project general geochemical classifications were established for the sites in order to compare with future conditions. In the first report

Table 5.58-1. Chloride Concentrations of Sites. Chloride concentrations of porewaters in µM.

Station	Substation	Depth (cm)	Chloride	
			Summer 2004	Winter 2005
Town Creek	1	1	66377	26112
P3	1	6	66651	40552
	1	11	73130	40988
	1	16	70606	42002
	1	21	62465	40813
	1	26	53672	45856
	2	1	82375	30056
	2	6	77378	44720
	2	11	75885	50056
	2	16	69939	23262
	2	21	59906	56480
	2	26	55169	54534
	3	1	69513	14706
	3	6	53193	17194
	3	11	54324	17316
	3	16	40812	23289
	3	21	52294	33563
	3	26	62474	47064
	4	1	37342	22203
	4	6	41909	32038
	4	11	42146	33847
	4	16	39431	34669
	4	21	36939	37795
	4	26	33592	41437
	5	1	19842	9794
	5	6	29191	13464
	5	11	37000	14481
	5	16	38877	15947
	5	21	39571	19970
	5	26	39187	23184
	6	1	30538	18717
	6	6	37418	25389
	6	11	47344	32147
	6	16	54783	37194
	6	21	56065	44704
	6	26	54748	50212

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2004	Winter 2005
Eagle Island	1	1	15809	20757
P6	1	6	30335	22502
	1	11	29812	21522
	1	16	29654	17442
	1	21	32498	14783
	1	26	30095	12753
	2	1	26989	22290
	2	6	24756	21999
	2	11	24512	21507
	2	16	23349	20147
	2	21	22230	19690
	2	26	20688	19314
	3	1	25407	16701
	3	6	24277	18340
	3	11	27594	18571
	3	16	29403	17026
	3	21	26415	16553
	3	26	24244	13895
	4	1	16188	12609
	4	6	18209	19119
	4	11	18466	18385
	4	16	18525	24323
	4	21	19503	14025
	4	26	18555	25599
	5	1	8616	3845
	5	6	9972	7173
	5	11	9788	11514
	5	16	10124	7381
	5	21	9322	7823
	5	26	9157	8045
	6	1	3606	5843
	6	6	3172	3067
	6	11	3168	3080
	6	16	3083	3317
	6	21	2799	3226
	6	26	3105	3332

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2004	Winter 2005
Indian Creek	1	1	2003	702
P7	1	6	1181	781
	1	11	1459	---
	1	16	1805	---
	1	21	1904	1385
	1	26	1939	1878
	2	1	1571	635
	2	6	1123	659
	2	11	887	701
	2	16	1051	744
	2	21	953	726
	2	26	1091	820
	3	1	858	537
	3	6	735	651
	3	11	824	651
	3	16	1088	521
	3	21	1285	565
	3	26	1506	703
	4	1	824	617
	4	6	667	543
	4	11	653	540
	4	16	740	622
	4	21	697	653
	4	26	721	800
	5	1	600	431
	5	6	506	413
	5	11	497	389
	5	16	462	446
	5	21	500	334
	5	26	476	482
	6	1	306	308
	6	6	394	362
	6	11	236	317
	6	16	515	286
	6	21	230	293
	6	26	265	1116

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride Summer 2004	Chloride Winter 2005
Dollisons Landing P8	1	1	785	725
	1	6	561	701
	1	11	598	646
	1	16	582	888
	1	21	548	720
	1	26	628	754
	2	1	591	794
	2	6	596	757
	2	11	512	711
	2	16	587	778
	2	21	658	875
	2	26	671	728
	3	1	590	687
	3	6	627	758
	3	11	587	627
	3	16	588	600
	3	21	618	1026
	3	26	621	685
	4	1	555	604
	4	6	556	568
	4	11	570	720
	4	16	521	593
	4	21	548	572
	4	26	619	553
	5	1	1254	1520
	5	6	1238	1757
	5	11	1182	1711
	5	16	1169	1798
	5	21	1212	1654
	5	26	1152	1673
	6	1	1794	1707
	6	6	1682	1831
	6	11	1721	1696
	6	16	1906	1649
	6	21	2050	1506
	6	26	2142	1380

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2004	Winter 2005
Black River	1	1	694	931
P9	1	6	629	730
	1	11	611	835
	1	16	583	810
	1	21	629	849
	1	26	665	903
	2	1	545	707
	2	6	488	630
	2	11	520	656
	2	16	565	668
	2	21	599	743
	2	26	624	738
	3	1	498	665
	3	6	601	725
	3	11	501	785
	3	16	496	691
	3	21	517	705
	3	26	512	744
	4	1	392	594
	4	6	521	624
	4	11	454	310
	4	16	359	668
	4	21	349	557
	4	26	378	610
	5	1	168	788
	5	6	228	779
	5	11	297	762
	5	16	432	723
	5	21	200	763
	5	26	434	663
	6	1	---	851
	6	6	303	870
	6	11	188	590
	6	16	282	419
	6	21	322	507
	6	26	342	682

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2004	Winter 2005
Smith Creek	1	1	116396	67247
P11	1	6	120762	70551
	1	11	119511	72358
	1	16	99391	69695
	1	21	87850	64264
	1	26	88032	71159
	2	1	96024	65838
	2	6	121368	68343
	2	11	111778	64936
	2	16	104271	65735
	2	21	93533	67631
	2	26	85232	61813
	3	1	114528	69836
	3	6	117659	71543
	3	11	117425	79197
	3	16	105763	82761
	3	21	91668	91441
	3	26	74781	93248
	4	1	103060	67721
	4	6	125648	79000
	4	11	128757	77012
	4	16	108793	81033
	4	21	98778	82348
	4	26	87395	76768
	5	1	201	43904
	5	6	277	52187
	5	11	102	49608
	5	16	160	55161
	5	21	101	53037
	5	26	145	58551
	6	1	80513	32931
	6	6	91873	36353
	6	11	96357	37818
	6	16	92343	38657
	6	21	87993	38074
	6	26	84459	40766

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2004	Winter 2005
Rat Island	1	1	20318	18071
P12	1	6	17883	22498
	1	11	17333	24066
	1	16	16859	23921
	1	21	14608	25010
	1	26	15489	25067
	2	1	35651	12086
	2	6	22226	12568
	2	11	22352	14331
	2	16	19542	15748
	2	21	17426	17327
	2	26	14959	17628
	3	1	251	23551
	3	6	46768	23688
	3	11	49085	23543
	3	16	49888	18902
	3	21	40723	24311
	3	26	41895	25314
	4	1	13298	11492
	4	6	13382	14244
	4	11	12530	15854
	4	16	12484	18260
	4	21	11657	20498
	4	26	13005	20279
	5	1	7301	15684
	5	6	8613	18200
	5	11	10372	19829
	5	16	11790	20298
	5	21	13464	20194
	5	26	13874	19573
	6	1	2299	3447
	6	6	2601	3150
	6	11	3133	4106
	6	16	2731	4661
	6	21	2930	6996
	6	26	3654	7820

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2004	Winter 2005
Fishing Creek	1	1	1150	1321
P13	1	6	1284	1223
	1	11	1511	2278
	1	16	1708	1086
	1	21	2425	1155
	1	26	2794	1174
	2	1	925	1956
	2	6	979	2189
	2	11	1031	1101
	2	16	943	2381
	2	21	1034	2588
	2	26	961	2988
	3	1	2809	2796
	3	6	2955	2207
	3	11	4152	2805
	3	16	3696	3272
	3	21	3985	3586
	3	26	4241	3539
	4	1	1155	1376
	4	6	1086	1517
	4	11	1181	1387
	4	16	1366	1568
	4	21	1410	1383
	4	26	1401	1482
	5	1	828	1448
	5	6	785	1145
	5	11	794	1172
	5	16	849	996
	5	21	893	1031
	5	26	977	979
	6	1	348	814
	6	6	351	687
	6	11	386	565
	6	16	346	665
	6	21	278	468
	6	26	278	1097

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2004	Winter 2005
Prince George	1	1	779	448
P14	1	6	736	960
	1	11	736	931
	1	16	752	910
	1	21	825	904
	1	26	796	809
	2	1	764	674
	2	6	800	689
	2	11	63	735
	2	16	830	705
	2	21	829	1005
	2	26	959	875
	3	1	774	809
	3	6	743	889
	3	11	746	972
	3	16	787	831
	3	21	753	977
	3	26	740	981
	4	1	837	943
	4	6	832	852
	4	11	853	925
	4	16	867	891
	4	21	903	771
	4	26	846	886
	5	1	715	877
	5	6	691	893
	5	11	683	909
	5	16	728	883
	5	21	597	1136
	5	26	601	1014
	6	1	447	903
	6	6	528	847
	6	11	485	327
	6	16	420	761
	6	21	375	693
	6	26	290	698

which included the winters of 2000, 2001 and the summer of 2000 (Hackney et al, 2002), three of these stations were primarily sulfate reducing year-round (P3 - Town Creek, P12 - Rat Island, and P11- Smith Creek) two were primarily methanogenic year round (P8 - Dollisons Landing, and P14 - Prince George) and four exhibited mixed conditions with sulfate reduction typically dominating the geochemistry during the summer and methanogenesis dominating during the winter (P7- Indian Creek , P9 - Black River, P12 - Rat Island, P13 - Fishing Creek) (Hackney et al. 2002).

Year 2 (winter 2002, summer 2001):

In the second report which included the summer of 2001 and the winter of 2002 (Hackney et al. 2002ab), two Northeast Cape Fear River sites, Prince George (P14) and Fishing Creek (P13), displayed a dramatic change in winter classification from methanogenic in the winters of 2000 and 2001 to sulfate reducing in the Winter of 2002 resulting from an increase in salinity. The other two sites on the Northeast Cape Fear River, Rat Island (P12) and Smith Creek (P11), also showed signs of increased salinity although their general classification did not change. Rat Island (P12) had several methanogenic classifications converted to sulfate reducing. Smith Creek (P11), which was already a sulfate reducing system, recorded higher salinities in porewaters.

The summer geochemical classifications on the Cape Fear River showed the opposite trend with evidence of a slight freshening of the porewaters. Changes in classifications of the Cape Fear River sites were not as dramatic as those observed on the Northeast Cape Fear River. The general trend for Cape Fear River sites was a slight freshening of the porewaters in winter 2002 and saltier conditions in summer 2001 compared to the data contained in the previous report. Town Creek (P3), which is located below the confluence of the Northeast Cape Fear River and the Cape Fear River, displayed a similar trend as that of the Cape Fear River sites with slightly saltier conditions during the summer and slightly fresher conditions during the winter.

Year 3 (winter 2003, summer 2002):

The increases in porewater salinities observed during previous summers continued through the summer of 2002 in the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, and Smith Creek). Due to the continued increase in summer salinities, all four sites were classified as sulfate reducing geochemical classifications for the first time. With the exception of Smith Creek, which already had a sulfate reducing geochemical classification, this was the first time the upper Northeast Cape Fear sites have had a summertime sulfate reducing geochemical classifications. A similar increase in summertime porewater salinity was noted in the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island) while the sites further upstream on the Cape Fear River (Black River, Dollisons Landing) had peak salinities occurring during the previous summer (2001). The salinities of Town Creek, the only site below the City of Wilmington monitored for geochemical classification, showed no obvious change in summer porewater salinity.

With the exception of Town Creek, which is below the city of Wilmington, and the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island) all sites had lower winter porewater salinities than previous winters. For the upper Cape Fear River sites (Black River, Dollisons Landing), the winter conditions continued to show a steady decrease since 2000. The fresher conditions did not cause a shift in geochemical classification for these sites since they were already methanogenic. In the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, Smith Creek), winter (2003) porewater salinities returned to lower values after peaking during the previous winter (2002). The decrease in salinities for the more seaward stations (Rat Island and Smith Creek) was not enough to convert these systems from sulfate reducing geochemical classification. For the upstream stations (Fishing Creek, Price George), several substations that were converted to sulfate reducing during the previous winter returned to methanogenic geochemical classification during the winter (2003). Porewater salinities of Town Creek, Indian Creek, and Eagle Island increased during the winter (2003). The changes in geochemical classifications were relatively small for these sites with only slight changes towards higher salinity classifications.

Year 4 (winter 2004, summer 2003):

Low salinity conditions characterize the current project year, summer 2003 and winter 2004. In general, all sites experienced conditions that would be considered low salinity on the basis of previous winters and summers. Several sites had conditions that were the lowest in salinity since the project started. For the most seaward station, Town Creek, both the winter and summer were the freshest on record. The Cape Fear River sites (Indian Creek, Dollisons Landing, and Black River) had a relatively low salinity winter and a summer that was the freshest observed during this project. While all Northeast Cape Fear River sites had relatively fresher conditions during the current year, there was more variability in the extent to which they experienced low salinities. Fishing Creek had the freshest winter and summer on record, Prince George had the freshest winter on record, and Rat Island had the freshest summer on record. Smith Creek had fresh conditions during both the summer and winter, but not the freshest on record.

Year 5 (current year winter 2005, summer 2004):

Low salinity conditions characterize the current project year, summer 2004 and winter 2005. In general, all sites experienced conditions that would be considered low salinity on the basis of previous winters and summers. However, conditions were not as fresh as the previous year. Five stations experienced slightly saltier conditions during the current summer (2004) compared to last summer (Town Creek, Indian Creek, Black River, Smith Creek, and Fishing Creek) while Prince George experienced slightly fresher conditions. The remainder of sites either had no change or a mix of fresher and saltier conditions within the site. Two stations experienced slightly saltier conditions during the current winter (2005) compared to last winter (Town Creek and rat Island) while Indian Creek experienced slightly fresher conditions. Five sites were essentially the same as the previous winter (Eagle Island, Black River, Smith Creek, Fishing Creek and Prince George) and Dollisons Landing had both saltier and fresher conditions with the site.

The remaining eight stations were sampled twice each year, during summer and winter. The patterns of variations for the current year and previous years follow.

Year 1 (winter 2000, 2001, summer 2000):

During the first year of the project general geochemical classifications were established for the sites in order to compare with future conditions. In the first report which included the winters of 2000, 2001 and the summer of 2000 (Hackney et al. 2002), three of these stations were primarily sulfate reducing year-round (P3 - Town Creek, P12 - Rat Island, and P11- Smith Creek) two were primarily methanogenic year round (P8 - Dollisons Landing, and P14 - Prince George) and four exhibited mixed conditions with sulfate reduction typically dominating the geochemistry during the summer and methanogenesis dominating during the winter (P7- Indian Creek , P9 - Black River, P12 - Rat Island, P13 - Fishing Creek) (Hackney et al. 2002).

Year 2 (winter 2002, summer 2001):

In the second report which included the summer of 2001 and the winter of 2002 (Hackney et al. 2003a), two Northeast Cape Fear River sites, Prince George (P14) and Fishing Creek (P13), displayed a dramatic change in winter classification from methanogenic in the winters of 2000 and 2001 to sulfate reducing in the Winter of 2002 resulting from an increase in salinity. The other two sites on the Northeast Cape Fear River, Rat Island (P12) and Smith Creek (P11), also showed signs of increased salinity although their general classification did not change. Rat Island (P12) had several methanogenic classifications converted to sulfate reducing. Smith Creek (P11), which was already a sulfate reducing system, recorded higher salinities in porewaters.

The summer geochemical classifications on the Cape Fear River showed the opposite trend with evidence of a slight freshening of the porewaters. Changes in classifications of the Cape Fear River sites were not as dramatic as those observed on the Northeast Cape Fear River. The general trend for Cape Fear River sites was a slight freshening of the porewaters in winter 2002 and saltier conditions in summer 2001 compared to the data contained in the previous report. Town Creek (P3), which is located below the confluence of the Northeast Cape Fear River and the Cape Fear River, displayed a similar trend as that of the Cape Fear River sites with slightly saltier conditions during the summer and slightly fresher conditions during the winter.

Year 3 (winter 2003, summer 2002):

The increases in porewater salinities observed during previous summers continued through the summer of 2002 in the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, and Smith Creek). Due to the continued increase in summer salinities, all four sites were classified as sulfate reducing geochemical classifications for the first time. With the exception of Smith Creek, which already had a sulfate reducing geochemical classification, this was the first time the upper Northeast Cape Fear sites have had a summertime sulfate reducing geochemical classifications. A similar increase in summertime porewater salinity was noted in the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island) while the sites further upstream on the Cape Fear River (Black River, Dollisons Landing) had peak salinities occurring during the previous summer (2001). The salinities of Town Creek, the only site below the City of Wilmington monitored for geochemical classification, showed no obvious change in summer porewater salinity.

With the exception of Town Creek, which is below the city of Wilmington, and the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island) all sites had lower winter porewater salinities than previous winters. For the upper Cape Fear River sites (Black River, Dollisons Landing), the winter conditions continued to show a steady decrease since 2000. The fresher conditions did not cause a shift in geochemical classification for these sites since they were already methanogenic. In the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, Smith Creek), winter (2003) porewater salinities returned to lower values after peaking during the previous winter (2002). The decrease in salinities for the more seaward stations (Rat Island and Smith Creek) was not enough to convert these systems from sulfate reducing geochemical classification. For the upstream stations (Fishing Creek, Price George), several substations that were converted to sulfate reducing during the previous winter returned to methanogenic geochemical classification during the winter (2003). Porewater salinities of Town Creek, Indian Creek, and Eagle Island increased during the winter (2003). The changes in geochemical classifications were relatively small for these sites with only slight changes towards higher salinity classifications.

Year 4 (current year, winter 2004, summer 2003):

Low salinity conditions characterize the current project year, summer 2003 and winter 2004. In general, all sites experienced conditions that would be considered low salinity on the basis of previous winters and summers. Several sites had conditions that were the lowest in salinity since the project started. For the most seaward station, Town Creek, both the winter and summer were the freshest on record. The Cape Fear River sites (Indian Creek, Dollisons Landing, and Black River) had a relatively low salinity winter and a summer that was the freshest observed during this project. While all Northeast Cape Fear River sites had relatively fresher conditions during the current year, there was more variability in the extent to which they experienced low salinities. Fishing Creek had the freshest winter and summer on record, Prince George had the freshest winter on record, and Rat Island had the freshest summer on record. Smith Creek had fresh conditions during both the summer and winter, but not the freshest on record.

Changes in site classifications can be found in Tables 5.6-1 and 5.6-2. Comparisons are made to the summer of 2000 and the winter of 2001.

Table 5.6-1. Changes in site classifications. A + sign indicates Transition to a higher salinity classification (i.e. M to MPSR, MPSR to SR). A – sign indicates a transition to fresher conditions (i.e. SR to MPSR, MPSR to M). Comparisons are made to the summer of 2000 and the winter of 2001.

Station	**Substation**	**Depth (cm)**	**Summer 2001**	**Summer 2002**	**Summer 2003**	**Summer 2004**
Town Creek	1	1			-	
P3	1	6			-	-
	1	11			-	-
	1	16			-	-
	1	21			-	-
	1	26	+	+		
	2	1				
	2	6				-
	2	11		-		-
	2	16		-		-
	2	21		-	-	-
	2	26		-		-
	3	1			-	
	3	6			-	
	3	11			-	
	3	16			-	-
	3	21			-	-
	3	26			-	-
	4	1			-	
	4	6			-	
	4	11			-	
	4	16			-	
	4	21			-	
	4	26			-	
	5	1		-	-	-
	5	6			-	-
	5	11			-	-
	5	16			-	-
	5	21			-	-
	5	26			-	-
	6	1			-	
	6	6			-	-
	6	11			-	-
	6	16			-	-
	6	21			-	-
	6	26	+	+		
Eagle Island	1	1			-	
P6	1	6				
	1	11				-

Table 5.6-1. (continued)

Station	Substation	Depth (cm)	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	1	16			-	-
	1	21			-	-
	1	26		-	-	-
	2	1			-	-
	2	6			-	-
	2	11			-	-
	2	16	-		-	-
	2	21	-		-	-
	2	26	-	-	-	-
	3	1	+	+		+
	3	6		+		
	3	11		+		
	3	16		+		
	3	21		+		
	3	26		+		
	4	1		-	-	-
	4	6	-	-	-	-
	4	11	-	-	-	-
	4	16	-	-	-	-
	4	21	-	-	-	-
	4	26				
	5	1	-		-	-
	5	6		+		
	5	11	-	-	-	-
	5	16				
	5	21				
	5	26				
	6	1	-		-	-
	6	6		+	-	-
	6	11				
	6	16	-		-	-
	6	21		+		-
	6	26				+
Indian Creek P7	1	1			-	
	1	6			-	-
	1	11			-	-
	1	16			-	-
	1	21			-	-
	1	26	+	+	+	+
	2	1	+	+		
Indian Creek (continued)	2	6		+	+	
	2	11		+		+
	2	16	+	+	+	+
	2	21	+	+	+	+
	2	26		+	+	+
	3	1		-	-	-
	3	6	-	-	-	-

Table 5.6-1. (continued)

Station	**Substation**	**Depth (cm)**	**Summer 2001**	**Summer 2002**	**Summer 2003**	**Summer 2004**
	3	11	+	+		
	3	16		+		+
	3	21	-	-	-	-
	3	26	+	+	+	+
	4	1		+		
	4	6	-		-	-
	4	11	-		-	-
	4	16		+		+
	4	21		+		+
	4	26		+		+
	5	1	-	-	-	-
	5	6		+		
	5	11	-	-	-	-
	5	16		-	-	-
	5	21	+	+		
	5	26		+		
	6	1		-	-	-
	6	6				
	6	11				
	6	16				
	6	21				
	6	26	-	-	-	-
Dollisons Landing P8	1	1		+		
	1	6				-
	1	11				-
	1	16				-
	1	21	-		-	-
	1	26	-	-	-	-
	2	1				-
	2	6	-	-	-	-
	2	11	+	+	+	
	2	16	+	+	+	
	2	21	+	+	+	
	2	26		+	+	
	3	1	-	-	-	-
	3	6		+		
Dollisons Landing (continued)	3	11		+	+	
	3	16		+		+
	3	21		+	+	
	3	26	+	+		
	4	1				
	4	6				
	4	11	+	+		+
	4	16				
	4	21	+	+		
	4	26	+	+	+	
	5	1				

Table 5.6-1. (continued)

Station	Substation	Depth (cm)	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	5	6				+
	5	11		+		+
	5	16	+	+		+
	5	21	+	+		+
	5	26	+	+		+
	6	1				+
	6	6	+			+
	6	11	+	+		+
	6	16	+	+		+
	6	21		+		+
	6	26		+		+
Black River P9	1	1		+		
	1	6				
	1	11				+
	1	16				+
	1	21		-	-	-
	1	26	+	+		+
	2	1	+	+		
	2	6	+	+		
	2	11		+		
	2	16				
	2	21				
	2	26	+	+		
	3	1	+	+		
	3	6		+		
	3	11				
	3	16				
	3	21				+
	3	26				+
	4	1	+	+		+
	4	6		-	-	-
	4	11	+			
Black River (continued)	4	16				+
	4	21				
	4	26				
	5	1				-
	5	6		-	-	-
	5	11	+			
	5	16			+	
	5	21	-		-	-
	5	26	-	-	-	-
	6	1				
	6	6				-
	6	11				-
	6	16	+			
	6	21				
	6	26				

Table 5.6-1. (continued)

Station	Substation	Depth (cm)	Summer 2001	Summer 2002	Summer 2003	Summer 2004
Smith Creek	1	1				
P11	1	6	-			
	1	11				
	1	16				
	1	21				
	1	26				
	2	1				
	2	6				
	2	11				
	2	16				
	2	21				
	2	26				
	3	1				
	3	6			-	
	3	11			-	
	3	16				-
	3	21			-	-
	3	26				-
	4	1				
	4	6				
	4	11				
	4	16				-
	4	21				
	4	26				-
	5	1	-			-
	5	6				-
	5	11				-
	5	16				-
Smith Creek	5	21				-
(continued)	5	26				-
	6	1			-	
	6	6	-		-	
	6	11	-		-	
	6	16	-			-
	6	21				
	6	26				
Rat Island	1	1			-	-
P12	1	6			-	
	1	11			-	-
	1	16			-	-
	1	21			-	-
	1	26	+	+	+	-
	2	1	-		-	
	2	6	-			
	2	11	-			-
	2	16				-
	2	21		-	-	-

Table 5.6-1. (continued)

Station	Substation	Depth (cm)	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	2	26		+		
	3	1			-	-
	3	6	-		-	
	3	11	-		-	
	3	16	-		-	
	3	21	-		-	
	3	26	-		-	
	4	1	-		-	
	4	6	+	+	-	+
	4	11		+	-	
	4	16	-		-	
	4	21	-	-	-	
	4	26				+
	5	1	-		-	-
	5	6	-		-	-
	5	11	+	+	+	+
	5	16	-		-	-
	5	21	-		-	-
	5	26		+		
	6	1		+	+	
	6	6		+	+	+
	6	11		+	+	
	6	16	+	+	+	
	6	21		+	+	
Rat Island (cont'd)	6	26		+	+	+
Fishing Creek	1	1			-	-
P13	1	6			-	-
	1	11	-		-	-
	1	16			-	-
	1	21	-		-	-
	1	26	+	+	-	
	2	1	-		-	-
	2	6	-		-	-
	2	11	-		-	-
	2	16			-	-
	2	21			-	-
	2	26	+	+	-	
	3	1			-	-
	3	6	+	+		+
	3	11	-		-	-
	3	16	-		-	-
	3	21			-	-
	3	26	+	+	+	+
	4	1		+		
	4	6	+	+		
	4	11		+		+
	4	16		+		+

Table 5.6-1. (continued)

Station	Substation	Depth (cm)	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	4	21		+		+
	4	26				+
	5	1	-			-
	5	6	-		-	-
	5	11	-		-	-
	5	16	-		-	-
	5	21			-	-
	5	26	-		-	-
	6	1	+	+		
	6	6				-
	6	11				
	6	16		-	-	-
	6	21	+			
	6	26				
Prince George P14	1	1		+		
	1	6		+		
	1	11	+	+		
	1	16		+		
	1	21		+		
	1	26	+	+		
Prince George (continued)	2	1		+	+	
	2	6		+	+	
	2	11		+	+	
	2	16		+	+	
	2	21	+	+	+	
	2	26	+	+	+	
	3	1		+		
	3	6		+		
	3	11		+		
	3	16	+	+		
	3	21		+		
	3	26		+		
	4	1		+		
	4	6		+	+	
	4	11	-	+		-
	4	16		+	+	
	4	21		+	+	+
	4	26		+	+	+
	5	1	+	+		
	5	6			-	-
	5	11		+		
	5	16		+		
	5	21		+		
	5	26	+	+		
	6	1				
	6	6		+		
	6	11		+		

Table 5.6-1. (continued)

Station	Substation	Depth (cm)	Summer 2001	Summer 2002	Summer 2003	Summer 2004
	6	16		+		
	6	21		+		
	6	26	+	+		

Table 5.6-2. Changes in site classifications. A + sign indicates Transition to a higher salinity classification (i.e. M to MPSR, MPSR to SR). A – sign indicates a transition to fresher conditions (i.e. SR to MPSR, MPSR to M). Comparisons are made to the summer of 2000 and the winter of 2001.

Station	**Substation**	**Depth (cm)**	**Winter 2001**	**Winter 2002**	**Winter 2003**	**Winter 2004**	**Winter 2005**
Town Creek P3	1	1					
	1	6					
	1	11					
	1	16					
	1	21		+			+
	1	26				-	-
	2	1			-	-	-
	2	6	+	+			
	2	11	+	+	+	+	+
	2	16	+	+			
	2	21	+	+	+		
	2	26	-				
	3	1	+	+	+		+
	3	6	+	+	+	+	+
	3	11		+	+		+
	3	16	+	+	+		+
	3	21	+	+	+		+
	3	26	+	+	+	+	+
	4	1		+	+		+
	4	6	-			-	-
	4	11	-			-	
	4	16				-	
	4	21					
	4	26					
	5	1	+	+	+		+
	5	6	+	+	+	+	+
	5	11				-	
	5	16					
	5	21					
	5	26					
	6	1				-	
	6	6				-	
	6	11				-	
	6	16				-	-
	6	21				-	
	6	26					
Eagle Island P6	1	1					
	1	6					
	1	11	+	+		+	+

Table 5.6-2. (continued)

Station	Substation	Depth (cm)	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	1	16	+	+		+	+
	1	21	+	+		+	+
	1	26	+	+	+	+	+
	2	1	+	+	+	+	+
	2	6					
	2	11					
	2	16	+	+	+	+	+
	2	21	+	+	+	+	+
	2	26	+	+	+	+	+
	3	1					
	3	6	+	+	+	+	+
	3	11		+	+	+	+
	3	16	+	+			+
	3	21			-	-	-
	3	26	+	+	+	+	+
	4	1	+	+			
	4	6	+	+			
	4	11	-		-	-	
	4	16		+			
	4	21	+	+			
	4	26	+	+	+	+	+
	5	1	+			+	+
	5	6	+	+	+	+	
	5	11	+			+	-
	5	16	+	+		-	
	5	21	+			+	-
	5	26	+	+	+	+	+
	6	1				+	-
	6	6	+	+	+		
	6	11	+	+	+		
	6	16	+	+	+		
	6	21	+	+	+		
	6	26					
Indian Creek P7	1	1					
	1	6			+		
	1	11					
	1	16			+		
	1	21			+		+
	1	26		+	+		

Station	Substation	Depth (cm)	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
Indian Creek (continued)	2	1		+	+		
	2	6		+	+		
	2	11		+	+	+	
	2	16	-				-
	2	21	-				-
	2	26			+		
	3	1	-	-		-	-

Table 5.6-2. (continued)

Station	Substation	Depth (cm)	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	3	6	-				-
	3	11		+	+	+	
	3	16	-			-	
	3	21		+	+		
	3	26					
	4	1			+		
	4	6			+	+	
	4	11	-	-			-
	4	16	-	-			-
	4	21			+	+	
	4	26					
	5	1					
	5	6					
	5	11	-	-	+	-	-
	5	16					
	5	21	-	-	+	-	-
	5	26					
	6	1					
	6	6					
	6	11					
	6	16					
	6	21					-
	6	26					
Dollisons Landing P8	1	1				+	
	1	6			-		-
	1	11					
	1	16	+		-	-	-
	1	21					-
	1	26					
	2	1					
	2	6	-	-	-	-	-
	2	11	-	-	-		-
	2	16			+		
	2	21					
	2	26	-	-	-	-	-
Dollisons Landing (continued)	3	1					
	3	6					-
	3	11					
	3	16	-	-	-		-
	3	21					
	3	26	-	-	-	-	-
	4	1					
	4	6	-	-	-	-	-
	4	11					
	4	16					
	4	21			+		

Table 5.6-2. (continued)

Station	Substation	Depth (cm)	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	4	26					
	5	1	-	-	-	-	-
	5	6					
	5	11	-	-	-	-	-
	5	16					+
	5	21	-	-	-		-
	5	26	-	-	-	-	-
	6	1					+
	6	6					-
	6	11	-	-	-	-	-
	6	16					
	6	21					+
	6	26					
Black River P9	1	1				+	
	1	6					
	1	11					
	1	16	+				
	1	21	+	-	-	-	-
	1	26					
	2	1					
	2	6					
	2	11	-	-	-	-	-
	2	16	+				
	2	21			+		
	2	26					
	3	1					
	3	6					
	3	11					
	3	16	+				
	3	21					
	3	26					
Black River (continued)	4	1	-	-	-	-	-
	4	6		-	-	-	-
	4	11		-	-	-	-
	4	16		-	-	-	-
	4	21		-	-	-	-
	4	26		-	-	-	-
	5	1					
	5	6			+		
	5	11		-		-	-
	5	16			-	-	-
	5	21		-		-	-
	5	26					
	6	1					
	6	6	-	-	-	-	-
	6	11	-	-	-	-	-

Table 5.6-2. (continued)

Station	Substation	Depth (cm)	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	6	16					
	6	21					
	6	26	+	+	+	+	+
Smith Creek P11	1	1		+	+	+	+
	1	6					
	1	11	+	+	+	+	+
	1	16	+	+	+	+	+
	1	21					
	1	26					
	2	1	+	+	+	+	+
	2	6	+	+	+	+	+
	2	11	+	+	+	+	+
	2	16	+	+	+	+	+
	2	21					
	2	26					
	3	1	+	+	+	+	+
	3	6	+	+	+	+	+
	3	11	+	+	+	+	+
	3	16	+	+	+	+	+
	3	21	+	+	+	+	+
	3	26	+	+	+	+	+
	4	1	-				-
	4	6					-
	4	11					-
	4	16					-
	4	21					
	4	26					
Smith Creek (continued)	5	1					
	5	6	+	+	+	+	+
	5	11	+	+	+		
	5	16	+	+	+		
	5	21					
	5	26					
	6	1					
	6	6					
	6	11					
	6	16					
	6	21					
	6	26					
Rat Island P12	1	1					
	1	6	+	+	+		+
	1	11	+	+	+	+	+
	1	16	+	+	+		+
	1	21	+	+	+	+	+
	1	26	+	+	+	+	+
	2	1	-	+	+	+	+

Table 5.6-2. (continued)

Station	Substation	Depth (cm)	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	2	6	+	+	+	+	+
	2	11	+	+	+	+	+
	2	16	+	+	+	+	+
	2	21	+	+	+	+	+
	2	26					
	3	1	+	+	+	+	+
	3	6	+	+	+	+	+
	3	11	+	+	+	+	
	3	16	+	+	+		+
	3	21	+	+	+	+	
	3	26	+	+	+	+	+
	4	1		+	+	+	-
	4	6		+	+	+	-
	4	11		+		-	
	4	16		+		-	
	4	21		+	+	-	
	4	26	+	+	+	+	+
	5	1	+		+	+	+
	5	6	+	+	+	+	+
	5	11	+	+	+	+	+
	5	16	+	+	+	+	+
	5	21	+	+	+	+	+
	5	26			+		+
Rat Island	6	1			+		+
(continued)	6	6		+	+		+
	6	11	+	+	+	+	+
	6	16		+	+		+
	6	21		+	+		+
	6	26		-	-	-	-
Fishing Creek	1	1		-	-	-	-
P13	1	6	+	+			+
	1	11	+	+			
	1	16	+	+			
	1	21	+	+			
	1	26					
	2	1	+	+			+
	2	6	+	+			
	2	11		+			+
	2	16	-	+	-	-	
	2	21	-	+			
	2	26		+	+	+	+
	3	1		+	+	+	
	3	6	-	+			
	3	11		+	+	+	+
	3	16	-	+			
	3	21	+	+	+	+	+

Table 5.6-2. (continued)

Station	Substation	Depth (cm)	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	3	26					-
	4	1	+	+	+		
	4	6	+	+	+		
	4	11	+	+	+		
	4	16		+	+		
	4	21		+	+		
	4	26					
	5	1		+			
	5	6		+			
	5	11		+			
	5	16		+	+		
	5	21			+		
	5	26	-	-	-	-	-
	6	1	-		-	-	-
	6	6	-	-	-	-	-
	6	11					
	6	16	-	-	-	-	-
	6	21					
	6	26					
Prince George P14	1	1					
	1	6		+			
	1	11		+			
	1	16		+			
	1	21					
	1	26					
	2	1				+	
	2	6				+	
	2	11	+			+	
	2	16	+			+	+
	2	21	-	+	-		-
	2	26	-			-	-
	3	1	-			-	-
	3	6		+			
	3	11					
	3	16		+		+	
	3	21		+		+	+
	3	26					
	4	1					+
	4	6		+	+	+	+
	4	11			+	+	+
	4	16		+	+	+	
	4	21		+	+	+	+
	4	26		+			
	5	1				+	
	5	6		+			
	5	11	+	+		+	

Table 5.6-2. (continued)

Station	Substation	Depth (cm)	Winter 2001	Winter 2002	Winter 2003	Winter 2004	Winter 2005
	5	16		+			+
	5	21		+			
	5	26					-
	6	1		+			
	6	6		+			
	6	11		+			+
	6	16					
	6	21					+
	6	26					

6.0 BENTHIC INFAUNAL COMMUNITIES

6.1 Summary

This report summarizes infaunal community patterns at 9 sites distributed among the Cape Fear River, Northeast Cape Fear River, and Town Creek from 1999-2004. This period covered three major potential system-level impacts: a developing drought in 2001-2002, a period of recovery and relatively higher freshwater input late in 2003 and in 2004, as well as the initiation of channel widening construction in 2001-2002. Diversity was generally lowest in 2000 and species richness was generally highest in 2004 for six out of nine sites. However, there were no consistent patterns for either diversity or richness among the remaining years. Multidimensional Scaling Analysis indicated that 2002 and 2003 represented distinct community assemblages based on species similarity compared to 1999-2001. These 2 years separated from each other, but more dramatic was a separation of these 2 years from the previous 3 years of sampling. As part of the 2004 report we identified a shift in species dominance related primarily to increasing drought impacts (many sites initially dominated by tidal freshwater and oligohaline species shifted toward dominance by oligohaline-mesohaline polychaetes in 2002) and subsequent recovery in 2003. 2004 showed the highest mean abundances or second highest mean abundance among major taxonomic groupings and functional groups for all but a few sites. Dominance patterns varied among sites but in general oligochaetes and insect taxa were the most abundant taxa at most sites in 2004.

6.2 Background

As part of the U.S. Army Corps of Engineers project to deepen and widen the Cape Fear River shipping channel from the mouth of the river to Wilmington Harbor, benthic infaunal communities have been monitored at stations predicted to have the greatest potential impacts. The focus of this sampling effort is on the fringing wetlands that border the river and represent critical habitat and nursery areas for a number of commercially and ecologically important taxa. Changes in the composition and abundance of organisms living within or directly on the sediments of the fringing marsh (infauna) may result from changes in salinity, flow, and tidal currents. Benthic infaunal community patterns integrate environmental changes at a specific site over time. Most infauna have limited post-larval mobility or dispersal, with abundances at a site reflecting a combination of recruitment patterns and site-specific processes. Infauna may be relatively long-lived, with lifespans of months to years for some taxa, and they occupy intermediate trophic positions, consuming detrital or planktonic food sources and being prey for larger fish and decapods. As a result, the infaunal community present in an area represents cumulative impacts of varying environmental factors over a several month period. Changes in the composition of the infaunal community in response to changing environmental conditions may occur more slowly than for more motile organisms that can migrate to optimal locations. However, changes in this group may also have fundamental importance for local ecosystem functioning because of their key position in nearshore estuarine food webs.

While many benthic species are resilient to short-term disturbances, long-term change associated with fluctuations in water quality, changes in tidal inundation or amplitude, changes in current flow or local hydrology, or changes in salinity regime and other physical factors may alter species composition and abundance. These physical changes impact the infaunal community through direct mortality, reduced dispersal, food web alteration, and impacts related to increased stress e.g. reduced feeding, competition. The monitoring effort reported here is designed to detect changes in the infaunal communities at selected sites that may be coincident with the timing of deepening of the Cape Fear River shipping channel. We hope to be able to distinguish potential long-term changes related to these anthropogenic impacts from year-to-year variability related to climatic fluctuations. Current working hypotheses are: 1) Changes in salinity and/or tidal amplitude and/or inundation period will lead to changes in intertidal and shallow subtidal benthic community composition. 2) If alterations of the Cape Fear River shipping channel significantly change estuarine flow characteristics, a change in community composition and function reflecting altered recruitment patterns may follow.

Polychaetes, oligochaetes, amphipods, and insect larvae are the dominant taxonomic groups of the Cape Fear estuary. Polychaetes and amphipods tend to dominate mesohaline sites in the river, while oligochaetes and insects dominate oligohaline sites, although this pattern may shift among years and site-specific responses vary with taxonomic composition. The relative importance of specific species that dominate a site changes along the estuarine gradient from polyhaline to oligohaline and tidal freshwater conditions. As noted in previous evaluations of the Cape Fear River estuary, both bivalves and gastropods have conspicuously low abundances in estuarine portions of the river both in the intertidal and subtidal habitats (Mallin et. al. 1999 and 2001). Infaunal groups demonstrate a variety of reproductive, dispersal, and functional strategies that can directly relate to timing and magnitude of their response to shifting environmental conditions. Polychaetes (segmented worms bearing specialized appendages) are common throughout the estuary and are generally the numerically dominant taxa in euhaline to mesohaline environments. Polychaetes have a variety of living modes including free-living, burrowing, and sedentary forms. Burrowing and tube-dwelling species dominate in most of the intertidal and shallow subtidal areas and are common prey for fish, shrimp, and crabs. Oligochaetes are another group of segmented worms that generally lack specialized appendages, have a burrowing habit, and exhibit direct development. Direct development in this group often results in locally dense patches and the ability to respond quickly to local environmental changes. Their deeper burrowing habit often makes them less available as a prey resource for fish and decapods than tube-dwelling polychaetes or amphipods. Amphipods are a diverse group of brooding crustaceans. This group can exhibit explosive population growth under optimal conditions, and serves as a critical food resource in fringing wetlands during at least certain time periods. Although many are free-living or pelagic, a large proportion of estuarine amphipods are tube builders that can be highly mobile over small spatial scales and may quickly colonize disturbed habitats. Insect larvae are among the most numerous and diverse groups that inhabit the oligohaline and tidal freshwater regions of the estuary, but are generally absent from lower mesohaline and more saline areas. Insect larvae exploit virtually every habitat type in the upper estuary and are distinct from other groups in having aerial dispersal. However, many insects are very sensitive to salt intrusions and are indicators of changing salinity conditions. Like other infaunal groups, this group includes of a number of life strategies including surface tube-dwelling and free-living species that would be susceptible to predation especially by juvenile fish that recruit into the system heavily in the spring and to a lesser extent in the fall of each year.

6.3 Methodology

Infaunal core samples were collected at nine stations along the Cape Fear River estuarine gradient. Three benthic stations are located in Town Creek (P2 at the mouth of Town Creek, P3A and P3B inner Town Creek), three stations in the main stem Cape Fear above the city of Wilmington (P6- Eagle Island, P7- Indian Creek, and P8- Dollisons Landing), and three stations in the Northeast Cape Fear River (P11- Smith Creek, P12- Rat Island, and P13- Fishing Creek). These stations are the same as those being monitored for epifauna patterns (Section 7.0) and represent a subset of those stations being monitored for changes in physical factors that may be causal for possible biotic changes (including tidal elevation, inundation, and biogeochemical composition among other variables).

Infaunal core samples (10 cm diameter X 15 cm deep) were collected at two upper intertidal subsites and two lower intertidal subsites at each station. These subsites are fixed stations that were originally marked (and positions recorded using GPS) in 1999. Three replicate core samples were collected within a one-meter area around these points. Core samples are collected at all stations in June of each year. All samples are fixed in a 10% formalin solution (~4% formaldehyde), with rose Bengal dye added, later sieved through a 500 micron screen to remove excess sediment, and preserved in 50% isopropanol. All organisms are separated from the remaining sediment by sorting under a dissecting microscope and identified to lowest reasonable taxon, in most cases this is genus or species.

The major deepening efforts for the Cape Fear River channel began in winter 2001. The current report summarizes data from infaunal samples taken through June 2004, and represents background conditions (pre-dredging; 1999-2001) and possible initial impacts related to the actual sediment removal activities (2002-2004). Full effects of the deepening project cannot be assessed until 2-3 years of post-dredging data are available to compare to pre-dredging conditions. However, interim community patterns at each site over the 5 years of sampling were assessed by examining patterns of species diversity, species richness, species dominance, and community similarity as described by multi-dimensional scaling. Per site diversity was calculated using the Shannon-Weiner Diversity Index and was compared along with per site species richness among sites and years. To assess patterns of species dominance over time, all species comprising at least 5% of the total fauna at a site on a given sampling date were recorded. Community similarity was compared among site/year combinations using the ANOSIM and multidimensional scaling data analysis procedures of the PRIMER statistical package (Clarke and Gorley 2001). These procedures examine community similarity based on a Bray-Curtis Similarity matrix. All species were included in this analysis and abundances were square root transformed to reduce dominating effects on analyses by common taxa. Abundances of major taxonomic groups (polychaetes, oligochaetes, amphipods and insects) and major functional guilds (sedentary/tube dwellers, surface/mobile taxa, deep burrowing taxa, and surface burrowing taxa) were compared among years separately for each site using analysis of variance. Abundances were log-transformed before analyses to meet assumptions of homogeneity of variances.

6.4 Faunal Patterns

While four locations (two high intertidal and two low intertidal substations) where sampled at each station, mean total abundances for all infaunal species present (at a given station) are given by tidal position. In order to more easily compare the relative abundance and shift in composition between tidal positions and among years, abundance data is presented in three year blocks by tidal position and only for taxa that were present at that site/substation combination. Tables 6.4-1a through 6.4-1d represent the mouth of Town creek (P2) located in the mesohaline region of the Cape Fear River, while Tables 6.4-2a through 6.4-2d and Tables 6.4-3a through 6.4-3d represent the two inner Town Creek sites, P3A and P3B respectively. Shifts in species composition and relative abundance are evident in the main stem Cape Fear sites Eagle Island station (P6) (Tables 6.4-4a through 6.4-4d), Indian Creek (P7) (Tables 6.4-5a through 6.4-5d), and Dollisons Landing (P8) (Tables 6.4-6a through 6.4-6d). Most of these individual species shifts follow major taxonomic changes (see below), though there was considerable species replacement among years within a guild or higher taxonomic grouping. Mean abundances for the three Northeast Cape Fear River stations, Smith Creek (P11) (Tables 6.4-7a through 6.4-7d), Rat Island (P12) (Tables 6.5-8a through 6.4-8d), and Fishing Creek (P13) (Tables 6.4-9a through 6.4-9d) also show a high degree of variability among years, generally following the shifts in major guild or taxonomic groups.

ANOVA comparisons of among-year abundances for major taxonomic groups and functional guilds show generally greater abundances of insect larvae in most sites (8 of 9) in 2003 and/or 2004 compared to at least certain earlier years (Table 6.4-12) – a period coincident with the lessoning of the drought as well as ongoing channel widening. Insect larvae as a group are generally less common with increasing salinity in the estuary. Oligochaetes showed significant patterns less often, but were also more abundant in 2004 or 2003 during 5 of 7 years when significant among year trends were detected. This group also tends to be more abundant in lower salinities, though high numbers are characteristic of certain mesohaline to euhaline marsh conditions. Polychaetes showed a more mixed pattern, with no detectable among year differences at 5 sites, greater abundance in drought years at P2, a more saline site often dominated by mesohaline polychaetes, and greater abundance in 2004 at 2 oligohaline/tidal freshwater sites. Functional guild changes paralleled these patterns, with among-year variations in surface /mobile reflecting their dominance by insect larvae and certain amphipods in sites where significant among year variations in this functional group occurred, deep burrowers reflecting the patterns for oligochaetes at most sites and sedentary/tube builders reflecting mixed effects of polychaetes (especially *Streblospio* and *Maranzellaria*) and certain tube-dwelling amphipods (Table 6.4-12).

More pronounced than variations in abundance of taxonomic groups was their relative composition. Insect larvae and certain amphipods were among the dominant taxa at several sites during both 1999 and 2003 (Tables 6.4-1 through 6.4-9). However, in 1999 the dominant insect larvae were *Bezzia/Palpomyia* at one site, *Parandalia* at one site, and *Procladius* at another site. The dominant amphipods were *Gammarus* spp. In 2003 the dominant insect larvae were *Polypedilium* at 6 sites, *Dicrotendipes* at 3 sites and *Cryptochironomus* and *Paratindipes* at 1 site each. Where amphipods dominated, *Corophium* was usually the most common genera in 2003 samples. As noted in last year's progress report, 2002 was distinguished by greater dominance of several polychaete species, consistent with a drought signature, and decline of insects at most sites. Variations in abundances of less common taxa are also apparent among years for most sites (Tables 6.4-1 through 6.4-9).

Species richness and diversity exhibited significant variation among years and sites with 2004 representing distinct pattern for both measures compared to previous years (ANOVA; $p<0.0001$; Tables 6.4-10 and 6.4-11). Diversity decreased in 2004 from downstream to upstream sites for all three tributaries: Town Creek (P2-P3b), the mainstem Cape Fear (P6-P8), and Northeast Cape Fear sites (P11-P13). Among year comparison for each site shows highest diversity for 2004 for six of the nine sites (Table 6.4-11). Though patterns for among years prior to 2004 are not as strong, diversity was generally lowest in 2000 compared to other years, with 2000 representing the lowest or second lowest period for diversity in 8 of the 9 sites. Species richness was highest in 2004 with no clear pattern among years prior to 2004 (Figure 6.4-1).

Analysis of community similarity and the associated graphical representation of those patterns, multidimensional scaling (MDS), are increasingly being used to discriminate infaunal community patterns among years or sites. We compared community assemblages among years and sites and found the strongest patterns related to among year differences (Table 6.4-10; ANOSIM: $R=0.724$; $p<0.001$). Two patterns were most apparent with first involving strong differences between 2002/2003 (both circled) and previous years. Although there is a gradient among the 1999-2001 samples (indicated with 1999 samples graphing lower on the y-axis and grading into 2000 and then 2001 samples moving up the y-axis), these sites do not differentiate strongly from each other. However, there is a clear break between these earlier samples and the later 2 years. The second pattern is a difference between 2002 and 2003 samples. Although MDS does not have specific factors associated with each axis, the differences along the y-axis are consistent with salinity (lower salinity years lower on the y-axis, higher salinity higher on the y-axis); while the x-axis separation is dominated by the 2002/2003 split from earlier sample years. Differences among sites were not strong relative to among-year patterns.

Table 6.4-1a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected on the Town Creek mouth site (P2) during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Town Creek mouth (P 2)		
High Intertidal	**June 99**	**June 00**	**June 01**
amphipod sp.	0.17(0.17)	0.5(0.23)	0(0)
Bezzia/palpomia	0.5(0.5)	0(0)	0(0)
juv. Bivalve	1.0(0.37)	0.5(0.29)	0(0)
Boccardiella sp.	0(0)	26.5(18.62)	0(0)
Cassidimidea lunifrons	0.17(0.17)	0.5(0.5)	0(0)
Chironomid larvae	0(0)	0.25(0.25)	0(0)
Corophium acherasicum	0(0)	0(0)	12.5(8.72)
Corophium acutum	0(0)	0(0)	7.75(7.75)
Corophium lacustre	0(0)	4.25(0.85)	0(0)
Corophium sp.	0.17(0.17)	0(0)	11.75(7.81)
Cyathura polita	0(0)	0.75(0.75)	0(0)
Dicrotendipes sp.	2.0(0.93)	1.0(1.0)	0.25(0.25)
Eteone heteropoda	0(0)	1.0(0.41)	0(0)
Eteone sp.	0(0)	0.25(0.25)	0(0)
Gammarus sp.	0(0)	0.75(0.48)	0(0)
Gammarus tigrinus	0(0)	2.25(2.25)	0(0)
Hobsonia florida	3.67(2.01)	3.0(2.68)	0.5(0.5)
insect pupae	0(0)	0.25(0.25)	0(0)
insect sp.	0.17(0.17)	0(0)	0.25(0.25)
Nereidae sp.	0(0)	0(0)	0.25(0.25)
Laeonereis culveri	0.17(0.17)	0(0)	0(0)
Marenzellaria virdis	1.67(1.67)	0(0)	0(0)
Nereis falsa	0(0)	1.25(1.25)	0(0)
Nereis riisei	0.67(0.49)	0(0)	0(0)
Nereis succinea	0(0)	0.25(0.25)	1.5(0.96)
Oligochaete	36.5(11.55)	8.75(6.79)	2.25(1.31)
Owenia sp.	0.17(0.17)	0(0)	0(0)
Palaemonetes pugio	0.17(0.17)	0(0)	0(0)
Parandalia sp.	1.0(0.63)	0(0)	0.5(0.29)
Polydora ligni	12.17(10.83)	0.25(0.25)	0.25(0.25)
Polydora socialis	5.5(4.11)	0(0)	3.25(3.25)
Polypedilum sp.	1.5(0.72)	0.3(0.3)	0(0)
Streblospio benedicti	0.83(0.31)	0.75(0.25)	0.25(0.25)
Tanais sp.	0.33(0.33)	0(0)	16.75(9.46)

Table 6.4-1b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected on the Town Creek mouth site (P2) during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Town Creek mouth (P 2)		
High Intertidal	**June 02**	**June 03**	**June 04**
Bezzia/palpomia	2.0(2.0)	2.5(0.86)	3.5(2.06)
juv. Bivalve	0(0)	0.25(0.25)	1(0.58)
Boccardiella sp.	0.25(0.25)	0.75(0.48)	18.75(6.97)
Capitellidae sp.	0.25(0.25)	0(0)	0(0)
Cassidimidea lunifrons	0(0)	0.5(0.5)	2(1.35)
Caulleriella killariensis	0(0)	0.25(0.25)	0(0)
Corophium lacustre	0(0)	0.5(0.29)	28.25(9.28)
Corophium sp.	0(0)	0(0)	2(2)
Crangonyx psudogracilis	0.25(0.25)	0(0)	0(0)
Curculionidae sp.	0(0)	0(0)	1.5(1.19)
Cyathura polita	0(0)	0(0)	4.5(3.84)
Dicrotendipes lobus	0(0)	0(0)	22.0(17.64)
Dicrotendipes nervosus	0(0)	0(0)	0.25(0.25)
Dicrotendipes sp.	0(0)	7.5(6.85)	1.5(1.5)
Dipolyudora ligni	0(0)	0(0)	2.0(1.08)
Dolichopodidae sp.	0(0)	0(0)	0.25(0.25)
Fabriciola sp.	37.0(37.0)	0(0)	0(0)
Fabriciola trilobata	5.75(5.42)	0(0)	0.25(0.25)
Flabelligeridae sp.	0(0)	0(0)	0.25(0.25)
Gammarus sp.	0.25(0.25)	0(0)	0.25(0.25)
juv. Gastropod	0(0)	0(0)	0.25(0.25)
Hageria rapax	0(0)	0.25(0.25)	5.0(4.67)
Hobsonia florida	0(0)	0.5(0.5)	11.25(4.27)
Marenzellaria virdis	0(0)	0(0)	0.5(0.29)
Megalops	0(0)	0(0)	1.5(0.65)
Mite	0(0)	0(0)	1.0(0.71)
Notophilia sp.	0(0)	0(0)	0.25(0.25)
Orchestia uhleri	0.75(0.75)	0(0)	0.25(0.25)
Parandalia sp.	2.75(1.11)	0(0)	4.75(2.93)
Polydora ligni	0.75(0.48)	0(0)	0(0)
Polydora socialis	0.25(0.25)	0(0)	0(0)
Polypedilum sp.	0(0)	13.5(11.51)	0.5(0.29)
Streblospio benedicti	8.25(4.77)	0(0)	0(0)
Tanytarus sp.	0(0)	0.75(0.75)	0(0)
Tipulidae sp.	0(0)	0(0)	0.25(0.25)
Tubificidae sp.	2.25(1.93)	2.75(1.55)	52.5(27.52)
Tubificoides heterochaetus	0.5(0.5)	0(0)	0(0)
Uca minax	0.25(0.25)	0(0)	0.25(0.25)
Uca sp.	0.25(0.25)	0(0)	0(0)

Table 6.4-1c. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected on the Town Creek mouth site (P2) during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Town Creek mouth (P 2)		
Low Intertidal	**June 99**	**June 00**	**June 01**
amphipod sp.	0.17(0.17)	0.25(0.25)	0(0)
Belanus improvisus	0(0)	0(0)	4.8(4.8)
juv. Bivalve	0(0)	0.25(0.25)	0(0)
Boccardiella sp.	0(0)	16.5(5.17)	0(0)
Capitella capitata	0(0)	0(0)	0.2(0.2)
Collembola sp.	0.17(0.17)	0(0)	0(0)
Corophium sp.	0(0)	0.25(0.25)	0.2(0.2)
Corophium lacustre	0(0)	2.5(1.19)	0(0)
Dicrotendipes sp.	0(0)	0.5(0.5)	0(0)
Edotea (*muntosa*)	0.17(0.17)	0(0)	0(0)
Gammarus sp.	0(0)	0.25(0.25)	0.2(0.2)
Gammarus tigrinus	0.33(0.33)	0(0)	0.2(0.2)
Hobsonia florida	0.83(0.83)	4.0(2.74)	0(0)
Laeonereis culveri	0.17(0.17)	0(0)	0(0)
Mediomastus ambiseta	1.17(0.83)	0(0)	0(0)
Mediomastus sp.	1.67(0.99)	0(0)	0(0)
Melita nitida	0(0)	0.5(0.5)	0.2(0.2)
Nemertean	0.17(0.17)	0(0)	0(0)
Nereis acuminata	0(0)	0.25(0.25)	0(0)
Neanthes succinea	0(0)	1.25(0.95)	0.2(0.2)
Oligochaete	4.83(2.21)	2.5(1.19)	0.2(0.2)
Parandalia sp.	2.5(0.85)	1.0(0.71)	0.8(0.37)
Paraprionospio pinnata	0.17(0.17)	0(0)	0(0)
Polydora ligni	0.83(0.83)	1.5(1.5)	0(0)
Streblospio benedicti	3.0(1.69)	0(0)	1.6(1.03)
Syllidae sp.	0.17(0.17)	0(0)	0(0)
Tanais sp.	0(0)	0.25(0.25)	0(0)
Tubificoides heterochaetus	0(0)	0(0)	0.2(0.2)

Table 6.4-1d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected on the Town Creek mouth site (P2) during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-sites for high low intertidal areas.

	Town Creek mouth (P 2)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Balanus improvisus	0(0)	0(0)	1.0(0.71)
juv. Bivalve	0.29(0.18)	0(0)	0.5(0.29)
Chironomus sp.	0(0)	0.5(0.5)	0(0)
Corophium sp.	0(0)	0(0)	0.25(0.25)
Cyclaspis varians	0.14(0.14)	0(0)	0(0)
Edotea triloba	0(0)	0(0)	0.25(0.25)
Eteone heteropoda	0.71(0.42)	0(0)	0(0)
Gammarus sp.	0.14(0.14)	0(0)	0(0)
Haustoridae sp.	0(0)	0(0)	0.25(0.25)
Hobsonia florida	0(0)	0.25(0.25)	0.25(0.25)
Mediomastus ambiseta	2.86(2.54)	0(0)	0(0)
Mediomastus sp.	4.29(2.3)	0.25(0.25)	0.25(0.25)
Mucrogammarus mucronata	0.14(0.14)	0(0)	0(0)
Neanthes succinea	0.14(0.14)	0(0)	1.25(0.95)
Parandalia sp.	2.43(1.49)	0(0)	0.75(0.25)
Polydora ligni	0.43(0.43)	0(0)	0(0)
Porcladius sp.	0(0)	0.75(0.25)	0(0)
Spisula solidessima	0.29(0.18)	0(0)	0(0)
Streblospio benedicti	54.29(11.27)	0(0)	0(0)
Tubificoides heterochaetus	0.86(0.7)	0(0)	3.25(1.31)
Tubificidae sp.	0(0)	0.25(0.25)	0.25(0.25)

Table 6.4-2a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3A upper Town Creek sites during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Town Creek inner a (P3A)		
High Intertidal	**June 99**	**June 00**	**June 01**
Bezzia/*palpomia*	0(0)	0(0)	0.4(0.24)
juv. Bivalve	0.17(0.17)	0(0)	0(0)
Cassidimidea lunifrons	0(0)	0(0)	1.0(0.32)
Collembola sp.	0.33(0.21)	0(0)	0(0)
Dolichopodid larvae	0(0)	3.75(1.38)	0.6(0.4)
Dolichopus sp.	1.83(0.6)	0(0)	0.2(0.2)
Elasmopus sp.	0(0)	0.25(0.25)	0(0)
Eukiefferiella sp.	0(0)	0(0)	1.8(1.56)
Gammarus tigrinus	0.33(0.33)	0(0)	0(0)
Hemipodus roseus	0(0)	0.5(0.5)	0.4(0.24)
insect pupae	0.17(0.17)	0(0)	0(0)
insect sp.	0.17(0.17)	0(0)	0(0)
insect sp.b	0.17(0.17)	0(0)	0(0)
insect sp. g	0.33(0.33)	0(0)	0(0)
juv. Nereid	0(0)	0.25(0.25)	0(0)
Laeonereis culveri	0.67(0.67)	0.5(0.5)	0(0)
Lumbriculidae sp.	0(0)	0(0)	0.2(0.2)
Mite	0.17(0.17)	0(0)	0(0)
Oligochaete	36.67(24.02)	42.0(12.81)	9.6(3.98)
Orchestia sp.	0(0)	0(0)	0.8(0.58)
Orchestia uhleri	0(0)	0(0)	0.4(0.4)
Polypedilum sp.	0(0)	0.25(0.25)	0(0)
Procladius sp.	0(0)	0.25(0.25)	0(0)
Solenopsis sp	0(0)	0(0)	0.2(0.2)
Tubificidae sp.	0(0)	0(0)	2.4(2.4)
Uca minax	0.17(0.17)	0(0)	0(0)
Uca pugilator	0.5(0.34)	0(0)	0(0)
Uca pugnax	0.17(0.17)	0(0)	0(0)
Uca sp.	0(0)	0.25(0.25)	0(0)

Table 6.4-2b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3A upper Town Creek sites during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Town Creek inner a (P3A)		
High Intertidal	**June 02**	**June 03**	**June 04**
Acarina	0.17(0.17)	0(0)	0(0)
Apedilum sp.	0(0)	0(0)	0.5(0.5)
Bezzia/palpomia	0.17(0.17)	0.75(0.47)	0.25(0.25)
juv. Bivalve	0.17(0.17)	0(0)	0(0)
Cassidimidea lunifrons	0(0)	1.25(0.63)	4.0(0.91)
Collembola sp.	8.67(7.09)	0(0)	1.25(0.48)
Corophium volutator	0(0)	0(0)	0.75(0.48)
Chironomidae sp.	0(0)	0.25(0.25)	0(0)
Cryptochironomous sp.	0(0)	0.5(0.5)	0(0)
Cyathura (madelinae)	0(0)	0.25(0.25)	0(0)
Cyathura polita	0(0)	0.25(0.25)	1.5(1.19)
Dicrotendipes sp.	0.17(0.41)	0(0)	0(0)
Dicrotendipes (lobus)	0.17(0.17)	0(0)	0(0)
Dolichopodid larvae	0(0)	0.25(0.25)	0(0)
Enchytraeidae sp.	0(0)	0.25(0.25)	0(0)
Lumbriculidae sp.	0(0)	0.75(0.75)	0.75(0.75)
Megalops	0.17(0.17)	0.25(0.25)	0.25(0.25)
Mite	0(0)	0(0)	0.25(0.25)
Nais sp	0(0)	0.25(0.25)	0(0)
Olivella sp.	0.17(0.17)	0(0)	0(0)
Orchestia sp.	0(0)	0(0)	0.5(0.29)
Orchestia uhleri	0.17(0.17)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	4.0(1.58)
Polypedilum sp.	0(0)	3.5(2.36)	0(0)
Polypedilum sp.	0(0)	0(0)	0.25(0.25)
Spionidae sp.	0.17(0.17)	0(0)	0(0)
Streblospio benedicti	0.17(0.17)	0(0)	0(0)
Tabanus sp	0(0)	0.5(0.5)	0.25(0.25)
Tubificoides heterochaetus	0(0)	0(0)	0.5(0.5)
Tubificidae sp.	6.67(3.26)	6.0(0.25)	26.25(5.76)
Uca minax	0(0)	0(0)	0.5(0.29)
Uca sp.	0.33(0.21)	0.25(0.25)	0(0)

Table 6.4-2c. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3A upper Town Creek sites during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Town Creek inner a (P3A)		
Low Intertidal	**June 99**	**June 00**	**June 01**
Ampharetidae sp.	0.17(0.17)	0(0)	0(0)
Amphipoda sp.	0.67(0.33)	0.25(0.25)	0(0)
Bezzia/*palpomi*a	0(0)	0(0)	0.2(0.2)
juv. Bivalve	0.17(0.17)	0(0)	0(0)
Cassidisca lunifrons	0.17(0.17)	0(0)	0.2(0.2)
Cyathura polita	0(0)	0(0)	0.4(0.4)
Dolichopodid larvae	0(0)	0.25(0.25)	0(0)
Gammarus plumosa	0.17(0.17)	0(0)	0(0)
Eukiefferiella sp.	0(0)	0(0)	0.4(0.4)
Gammarus tigrinus	2.67(2.12)	0(0)	0(0)
gastropod juv.	0.17(0.17)	0(0)	0(0)
Hobsonia florida	3.17(1.33)	0(0)	0.6(0.4)
Hydrophilidae larvae	0(0)	0.25(0.25)	0(0)
Insect pupae	0.17(0.17)	0(0)	0(0)
insect larva b	0.17(0.17)	0(0)	0(0)
Marenzellaria virdis	0.33(0.33)	0(0)	0(0)
Mediomastus ambiseta	0.17(0.17)	0(0)	0(0)
Mediomastus califoriensis	0.17(0.17)	0(0)	0(0)
Munna sp.	0.17(0.17)	0(0)	0(0)
Oligochaete	5.0(3.85)	83.0(35.67)	12.4(3.91)
Orchestia sp.	0(0)	0(0)	0.2(0.2)
Polydora ligni	0.17(0.17)	0(0)	0(0)
Polydora sp.	0.17(0.17)	0(0)	0(0)
Polypedilum sp.	1.0(0.37)	0(0)	0(0)
Procladius sp.	2.5(0.34)	0(0)	0(0)
Streblospio benedicti	0.17(0.17)	0(0)	0.2(0.2)
Tanytarsus sp.	0.5(0.34)	0(0)	0(0)
Uca pugilator	0.17(0.17)	0(0)	0(0)
Uca sp.	0.17(0.17)	0(0)	0(0)

Table 6.4-2d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3A upper Town Creek sites during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Town Creek inner a (P3A)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Boccardiella sp.	0.33(0.21)	0(0)	0(0)
Cassidisca lunifrons	0(0)	0.5(0.29)	0.25(0.25)
Collembola sp.	0.33(0.21)	0(0)	21.0(7.15)
Corophium volutator	0(0)	0.25(0.25)	0.5(0.5)
Cryptochironomous sp	0(0)	0.25(0.25)	0(0)
Cyathura (madelinae)	0(0)	0.5(0.29)	0(0)
Dolichopodid larvae	0(0)	0(0)	4.25(1.11)
Georthocladius sp.	0(0)	0(0)	0.5(0.5)
Hobsonia florida	0(0)	0.5(0.29)	0(0)
insect larva b	0(0)	0(0)	?
Laeonereis culveri	0(0)	0(0)	0.25(0.25)
Lumbriculidae sp.	0(0)	0(0)	13.5(13.5)
Megalops	0(0)	0(0)	0.25(0.25)
Melita nitida	0.17(0.17)	0(0)	0(0)
Mite	0(0)	0(0)	4.75(1.25)
Monopylephores sp.	0.17(0.17)	0(0)	0(0)
Neanthes succinea	0(0)	0(0)	0.25(0.25)
Polypedilum sp.	0(0)	1.5(1.19)	0(0)
Streblospio benedicti	1.67(1.12)	0(0)	0(0)
Tanytarsus sp.	0(0)	0.25(0.25)	0(0)
Tubificidae sp.	4.5(1.34)	2.0(1.08)	44.5(15.44)
Tubificoides heterochaetus	0.67(0.33)	0(0)	0(0)

Table 6.4-3a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3B upper Town Creek sites during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Town Creek inner b (P3B)		
High Intertidal	**June 99**	**June 00**	**June 01**
juv. Bivalve	0.4(0.24)	0(0)	0(0)
juv. Nereidae	0(0)	0.25(0.25)	0(0)
Cassidimidea lunifrons	0(0)	0(0)	0.6(0.24)
Collembola sp.	0.4(0.24)	0(0)	0(0)
Corophium volutator	0(0)	0(0)	0.4(0.2)
Dolichopodid larvae	0(0)	0.5(0.5)	0.4(0.24)
Dolichopus sp	0.4(0.4)	0(0)	0.2(0.2)
Eukiefferiella sp.	0(0)	0(0)	0.2(0.2)
*Hobsonia flori*da	0(0)	0(0)	0.8(0.8)
insect larva c	0.4(0.24)	0(0)	0(0)
Laeonereis culveri	0(0)	0.25(0.25)	0(0)
Marenzellaria virdis	0.2(0.2)	0(0)	0(0)
Munna sp.	0.2(0.2)	0(0)	0(0)
Nereidae sp.	0(0)	0.75(0.75)	0(0)
Oligochaete	16.4(6.24)	27.3(6.8)	3(1.84)
Orchestia sp.	0.2(0.2)	0.25(0.25)	4.2(3.95)
Orchestia uhleri	0(0)	0.75(0.48)	0.2(0.2)
Polypedilum sp.	0(0)	0.25(0.25)	0(0)
Streblospio benedicti	0(0)	0(0)	0.2(0.2)
Tubificidae sp.	0(0)	0(0)	1.0(1.0)
Uca sp.	0.2(0.2)	0(0)	0(0)

Table 6.4-3b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3B upper Town Creek sites during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Town Creek inner b (P3B)		
High Intertidal	**June 02**	**June 03**	**June 04**
juv. Bivalve	0(0)	0.25(0.25)	0(0)
Ablabesmyia sp.	0(0)	2(2)	0(0)
Apedilum sp.	0(0)	0(0)	0.5(0.5)
Axarus sp.	0(0)	2.5(2.5)	0(0)
Bezzia/palpomyia	0.8(0.58)	0.25(0.25)	1.5(0.65)
Boccardiella sp A	0(0)	0.25(0.25)	0(0)
Cassidimidea lunifrons	0(0)	0.5(0.5)	0.75(0.25)
Chrysops sp.	0(0)	0(0)	0.5(0.5)
Collembola sp.	0.2(0.2)	0.25(0.25)	1.0(0.58)
Corophium lacustre	0(0)	1.25(0.95)	0(0)
Corophium volutator	0(0)	1.25(0.95)	0.25(0.25)
Cryptochironomous sp.	0(0)	0.25(0.25)	0(0)
Cyathura (madelinae)	0(0)	0.25(0.25)	0(0)
Cyathura polita	0(0)	0(0)	1.0(0.5)
Dero sp.	0(0)	0.25(0.25)	0(0)
Dicrotendipes sp.	0(0)	2.5(2.5)	0(0)
Diptera sp.	0.2(0.2)	0.25(0.25)	0(0)
Dolichopodid larvae	0(0)	0(0)	0.5(0.5)
Enchytraeidae sp.	3.0(3.0)	0(0)	0(0)
Ephydridae sp.	0(0)	0(0)	2.0(1.41)
Erioptera sp.	0(0)	0(0)	0.25(0.25)
juv. Gastropod	0(0)	0(0)	0.25(0.25)
*Hobsonia flori*da	0.2(0.2)	0(0)	0.25(0.25)
Hydrothassa sp.	0.2(0.2)	0(0)	0(0)
Megalops	0(0)	0(0)	0.25(0.25)
Parametriocnemus sp.	0(0)	0(0)	1.25(0.48)
Paratendipes sp.	0(0)	0(0)	0.75(0.48)
Platyhelminthes sp.	0(0)	0.25(0.25)	0(0)
Polypedilum sp.	0(0)	2.5(2.18)	0.25(0.25)
Procladius sp.	0(0)	1(1)	0(0)
Streblospio benedicti	0.4(0.4)	0(0)	0(0)
Tabanus sp.	0(0)	0(0)	1.25(1.25)
Tanytarsus sp.	0(0)	0.25(0.25)	0(0)
Tubificidae sp.	0.8(0.58)	8(4.74)	16.5(1.71)
Uca mixax	0(0)	0(0)	0.5(0.5)

Table 6.4-3c. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3B upper Town Creek sites during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Town Creek inner b (P3B)		
Low Intertidal	**June 99**	**June 00**	**June 01**
Amphipoda sp.	0.33(0.21)	(0)	0(0)
Cassidisca lunifrons	0.17(0.17)	0(0)	0(0)
Corophium acutum	0(0)	0(0)	0.25(0.25)
Corophium lacustre	0(0)	0(0)	0.5(0.5)
Cyathura polita	0(0)	0.5(0.29)	0(0)
Dicrotendipes sp.	0.17(0.17)	0(0)	0(0)
Dolichopodid larvae	0(0)	0.25(0.25)	0.25(0.25)
Gammarus sp.	0.17(0.17)	0(0)	0(0)
Gammarus lawrencianus	0.83(0.83)	0(0)	0(0)
Gammarus tigrinus	1.83(1.83)	0(0)	0(0)
Heteromastus filiformis	0.17(0.17)	0(0)	0(0)
Hobsonia florida	2.5(0.89)	0(0)	0.25(0.25)
insect sp. a	0(0)	0.25(0.25)	0(0)
insect pupae	0(0)	0(0)	0.25(0.25)
Laeonereis culveri	0(0)	0.25(0.25)	0(0)
Marenzellaria virdis	0.17(0.17)	0(0)	0(0)
Marinogammarus sp.	0.17(0.17)	0(0)	0(0)
Mite	0(0)	0(0)	0.25(0.25)
Munna sp.	0.5(0.34)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.25(0.25)
Nimbocera sp.	0.5(0.5)	0(0)	0(0)
Oligochaete	4.83(2.36)	39.3(13.9)	10.5(3.23)
Polydora sp.	0.33(0.33)	0(0)	0(0)
Polydora ligni	0(0)	0(0)	0.25(0.25)
Polypedilum sp.	0.67(0.49)	0(0)	0(0)
Procladius sp.	0.5(0.34)	0(0)	0(0)
Tharyx sp.	0(0)	0(0)	0.25(0.25)

Table 6.4-3d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3B upper Town Creek sites during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Town Creek inner b (P3B)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Apedilum sp.	0(0)	0(0)	0.25(0.25)
Cassidisca lunifrons	0.2(0.2)	0(0)	2.0(2.0)
Chironomidae sp.	0(0)	0.25(0.25)	0(0)
Collembola sp.	0.2(0.2)	0(0)	13.5(6.54)
Coelotanypus sp.	0(0)	0.25(0.25)	0(0)
Corophium volutator	0(0)	0(0)	9.0(5.70)
Cryptochironomous sp.	0(0)	0.25(0.25)	0(0)
Cyathura polita	0.8(0.8)	0(0)	1.5(0.87)
Dicrotendipes sp.	0.2(0.2)	0(0)	0(0)
Dolichopodid larvae	0(0)	0(0)	1.25(1.25)
Enchytraeidae sp.	0(0)	0(0)	1.0(1.0)
Gammarus sp.	0.4(0.4)	0(0)	0(0)
Gastropoda sp.	0(0)	0.25(0.25)	0(0)
Goeldichironomus sp.	0(0)	0(0)	0.25(0.25)
Laeonereis culveri	0(0)	0(0)	4.25(3.33)
Limnodrilus hoffmeisteri	0(0)	1.75(1.75)	0(0)
Lumbriculidae sp.	0(0)	0(0)	0.25(0.25)
Melita dentata	0.2(0.2)	0(0)	0(0)
Mite	0(0)	0(0)	4.75(2.43)
Polydora socialis	0.4(0.4)	0(0)	0(0)
Polypedilum sp.	0(0)	1.5(0.96)	0(0)
Procladius sp.	0(0)	4.5(2.6)	0(0)
Rhithropanapeus harisii	0.2(0.2)	0(0)	0(0)
Stictochironomus sp.	0(0)	0.25(0.25)	0(0)
Streblospio benedicti	3.6(1.03)	0(0)	0(0)
Tubificidae sp.	6.6(2.01)	1.75(0.63)	50.25(29.71)
Tubificoides heterochaetus	0.8(0.58)	0.5(0.5)	0(0)
Uca minax	0(0)	0(0)	0.75(0.48)

Table 6.4-4a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at the lowest main-stem Cape Fear site P6 during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Eagle Island (P6)		
High Intertidal	**June 99**	**June 00**	**June 01**
Bezzia/*palpomia*	0.6(0.24)	0.25 (0.25)	0(0)
juv. Bivalve	0.2(0.2)	0(0)	0(0)
juv. Gastropod	0.2(0.2)	0(0)	0(0)
Cassidisca lunifrons	1(1)	0(0)	0(0)
Collembola sp.	1.6(0.75)	0(0)	0(0)
Curculionidae sp.	0.4(0.4)	0(0)	0(0)
Cyathura (*madelinae*)	0.4(0.4)	0(0)	0(0)
Cyathura polita	0.8(0.58)	0(0)	0(0)
Dolichopodid larvae	0(0)	0(0)	1(0.41)
Dolichopus sp.	0.8(0.8)	0(0)	0(0)
Eukiefferiella (*claripennis*)	0.2(0.2)	0(0)	0(0)
Hemipodus roseus	0.8(0.8)	0(0)	1.75(0.85)
insect larva c	0.2(0.2)	0(0)	0(0)
insect sp. h	1(1)	0(0)	0(0)
insect sp. I	0.4(0.4)	0(0)	0(0)
Laeonereis culveri	3.2(2.03)	2.5(1.66)	0(0)
Marrenzellaria virdis	0(0)	0.25(0.25)	0(0)
Namalycastis abiuma	0(0)	1(0.41)	0(0)
Oligochaete	9.6(4.84)	9.5(2.9)	6(4.06)
Orchestia uhleri	1(0.55)	0(0)	0(0)
Orchestia sp.	1.2(0.97)	0(0)	0(0)
Procladius sp.	0.2(0.2)	0(0)	0(0)
Syphidae	0(0)	0(0)	0.25(0.25)
Uca minax	0(0)	0(0)	0.25(0.25)
Uca pugilator	0.4(0.4)	0(0)	0(0)
Uca pugnax	0(0)	0(0)	0.25(0.25)
Uca sp.	0.2(0.2)	0(0)	0(0)

Table 6.4-4b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at the lowest main-stem Cape Fear site P6 during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Eagle Island (P6)		
High Intertidal	**June 02**	**June 03**	**June 04**
Bezzia/palpomia	0.5(0.29)	6.75(4.01)	4.0(0.91)
juv. Bivalve	0(0)	0(0)	0.25(0.25)
juv. Gastropod	0(0)	0.25(0.25)	0(0)
Cassidinidea lunifrons	0(0)	0(0)	0.5(0.5)
Chrysops sp.	0.25(0.25)	1(1)	0(0)
Collembola sp.	1(0.41)	1.75(0.63)	0.75(0.25)
Curculionidae sp.	0(0)	0(0)	0.5(0.5)
Cyathura polita	0(0)	0(0)	1.0(0.58)
Delphacidae sp.	0(0)	0.25(0.25)	0(0)
Dero sp.	0(0)	0.25(0.25)	0(0)
Diptera sp.	0(0)	0.75(0.48)	0(0)
Dolichopodid larvae	0.25(02.5)	1(0.58)	1.0(0.41)
Enchytraeidae sp.	0.25(0.25)	0(0)	0(0)
Endochironomus sp.	0(0)	0(0)	0.25(0.25)
Ephydridae sp.	0(0)	0(0)	0.25(0.25)
Laeonereis culveri	1(0.58)	0(0)	0(0)
Lumbriculidae sp.	2.25(2.25)	0(0)	0(0)
Microvelia sp.	0(0)	0.25(0.25)	0(0)
Mite			0.5(0.29)
Monopylephorus irroratus	0(0)	4(3.67)	0(0)
Nereidae sp.	0(0)	0.5(0.5)	0(0)
Orchestia uhleri	0.25(02.5)	0(0)	0(0)
Orthocladinae sp.	0(0)	0(0)	0.25(0.25)
Parametriocnemus sp.	0(0)	0(0)	1.0(1.0)
Paratendipes sp.	0(0)	0.25(0.25)	0(0)
Polypedilum sp.	0(0)	0.25(0.25)	0(0)
Sabellaria vulgaris Beauforteasis	0(0)	0.25(0.25)	0(0)
Sthenelais sp. A	0(0)	0.25(0.25)	0(0)
Tubificidae sp.	1.5(0.29)	19.75(6.34)	14.25(3.86)
Tubificoides heterochaetus	0(0)	0.25(0.25)	1.0(1.0)
Uca minax	0.25(0.25)	0(0)	0(0)
Uca sp.	1(0.41)	0(0)	0(0)

Table 6.4-4c. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at the lowest main-stem Cape Fear site P6 during June 1999, 2000, 2001. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Eagle Island (P6)		
Low Intertidal	**June 99**	**June 00**	**June 01**
amphipod sp.	0.8(0.58)	0(0)	0.4(0.4)
Bezzia/palpomia	0.6(0.4)	0(0)	0.2(0.2)
juv. Bivalve	0.6(0.4)	0(0)	0(0)
Cassidisca lunifrons	1(0.77)	0(0)	0(0)
Collembola sp.	0.2(0.2)	0(0)	0(0)
Cyathura polita	5.0(5.0)	0(0)	0(0)
Dolichopus sp.	0.2(0.2)	0(0)	0(0)
Eukiefferiella (*claripennis*)	0.4(0.4)	0(0)	0(0)
Gammarus daiberi	0.2(0.2)	0(0)	0.2(0.2)
gastropod juv.	0.4(0.24)	0(0)	0(0)
Hobsonia florida	0.2(0.2)	0(0)	0(0)
insect pupae	1.8(1.11)	0(0)	0(0)
insect sp.	0.2(0.2)	0(0)	0(0
Maranzellaria virdis	0(0)	2(0.91)	3.8(1.16)
Melita sp.	1.0(1.0)	0(0)	0(0)
Mite sp.	0.2(0.2)	0(0)	0(0)
Munna sp.	1.0(1.0)	0(0)	0(0)
Nemertean	0(0)	0(0)	0(0)
Oligochaete	49.6(18.89)	3.5(1.94)	1(0.55)
Polydora socialis	2.6(2.6)	0(0)	0(0)
Polypedilum sp.	0.4(0.4)	0(0)	0(0)
Procladius sp.	0.6(0.6)	0(0)	0(0)
Uca sp.	0.4(0.4)	0(0)	0(0)

Table 6.4-4d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at the lowest main-stem Cape Fear site P6 during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Eagle Island (P6)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Americhelidium americanum	0(0)	0(0)	0.25(0.25)
Bezzia/*palpomia*	0(0)	0.25(0.25)	0.5(0.29)
juv. Bivalve	0(0)	0(0)	0.25(0.25)
Capitellidae sp.	0.2(0.2)	0(0)	0(0)
Coelotanypus sp.	0(0)	0.75(0.75)	0(0)
Collembola sp.	0(0)	0(0)	2.0(2.0)
Dipolyudora sp.	0(0)	0(0)	0.25(0.25)
Dolichopodidae sp.	0(0)	0(0)	0.25(0.25)
Gammarus sp.	0(0)	0(0)	0.25(0.25)
Maranzellaria virdis	0(0)	0(0)	4.75(2.63)
Nemertean	0.4(0.4)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0.25(0.25)
Parandalia sp.	0.4(0.24)	0.25(0.25)	0(0)
Pectinaria gouldii	0.2(0.2)	0(0)	0(0)
Polydora sp.	0.2(0.2)	0(0)	0(0)
Polypedilum sp.	0(0)	0.5(0.29)	1.5(1.5)
Streblospio benedicti	0.4(0.4)	0(0)	0(0)
Sirosperma sp.	0(0)	0.25(0.25)	0(0)
Tubificidae sp.	0(0)	1.75(0.25)	10.0(5.29)
Tubificoides heterochaetus	3.8(2.33)	0(0)	0.5(0.29)

Table 6.4-5a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P7 on the main-stem Cape Fear during June 1999, 2000, 2001. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Indian Creek (P7)		
High Intertidal	**June 99**	**June 00**	**June 01**
Bezzia/*palpomia*	0.2(0.2)	0(0)	0.17(0.17)
juv. Bivalve	0(0)	0.2(0.2)	0.17(0.17)
*Cassidisca luni*frons	0(0)	0(0)	1(0.52)
Celina sp.	0.2(0.2)	0(0)	0(0)
Chironomus sp.	0(0)	0(0)	0.17(0.17)
Chrysops sp.	0.2(0.2)	0(0)	0(0)
Collembola sp.	0.4(0.24)	1.2(0.8)	0(0)
Corophium acherasicum	0(0)	0(0)	0.17(0.17)
Corophium sp.	0(0)	0(0)	0.5(0.5)
Corophium volutator	0(0)	0(0)	0.67(0.67)
Cryptochironomus sp.	0.2(0.2)	0(0)	0(0)
Cyathura (*madelinae*)	0.4(0.4)	0(0)	0(0)
*Cyathura poli*ta	0(0)	0.2(0.2)	3.67(1.02)
Dolichopodid larvae	0(0)	1.6(0.24)	0.5(0.5)
Dolichopus sp.	1.6(0.51)	0(0)	0.5(0.5)
*Gammarus diabe*ri	0(0)	0(0)	4(4)
Gammarus sp.	0(0)	0(0)	0.67(0.67)
gastropod juv.	0.2(0.2)	0(0)	0(0)
Hobsonia florida	0(0)	0(0)	0.17(0.17)
insect larvae	0(0)	0.4(0.4)	0(0)
insect pupae	0.2(0.2)	0(0)	0(0)
insect sp.	0(0)	0(0)	0.67(0.49)
Isopod sp.	0(0)	0(0)	0.17(0.17)
Lirceus sp.	1.4(1.2)	0(0)	0.67(0.67)
Lumbriculidae sp.	7.4(3.33)	0(0)	0.33(0.21)
Micropsectra sp.	0.8(0.37)	0(0)	0(0)
Microtendipes (rydalensis group)	0(0)	0(0)	0(0)
Mite	0(0)	0.2(0.2)	0(0)
Oligochaete	52.2(15.47)	64.2(23.7)	20.17(10.29)
Omisus sp.	0(0)	0(0)	1.83(1.83)
Orchestia (plantesis)	0.2(0.2)	0(0)	0(0)
Orchestia sp.	0(0)	0(0)	0.17(0.17)
Orchestia uhleri	0.6(0.6)	0(0)	0(0)
Paratendipes sp.	0(0)	0(0)	1.83(1.64)
Polypedilum sp.	0(0)	0(0)	0.17(0.17)
Pristinella sp.	0.4(0.4)	0(0)	0(0)
Spirosperma carolinensis	0(0)	0(0)	0.83(0.83)
Tabanus sp.	0.2(0.2)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	3.17(2.01)
Tubificoides heterochaetus	0.2(0.2)	0(0)	0(0)
Uca pugilator	0.4(0.4)	0(0)	0(0)
Uca sp.	0(0)	0(0)	0.33(0.33)

Table 6.4-5b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P7 on the main-stem Cape Fear during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Indian Creek (P7)		
High Intertidal	**June 02**	**June 03**	**June 04**
Bezzia/*palpomia*	0(0)	2.25(1.03)	0(0)
juv. Bivalve	0(0)	2(0.82)	0.25(0.25)
*Cassidisca lun*ifrons	0(0)	0.25(0.25)	0.75(0.75)
Collembola sp.	0.17(0.17)	0(0)	0.5(0.29)
Cryptochironomus sp.	0(0)	1(0.58)	0(0)
Cyathura (*madelinae*)	0(0)	0.25(0.25)	0(0)
Enchytraeidae sp.	0(0)	0(0)	0.25(0.25)
Erioptera sp.	0(0)	0(0)	3.75(1.75)
Georthocladius sp.	0(0)	0(0)	0.25(0.25)
Hargeria rapax	0(0)	0(0)	0.25(0.25)
Hobsonia florida	0.17(0.17)	0(0)	0(0)
Limnodrilus hoffmeisteri	0(0)	11.5(3.75)	0(0)
Lumbriculidae sp.	0.17(0.17)	0(0)	17.25(6.7)
Megalops	0(0)	0(0)	0.25(0.25)
Microtendipes (rydalensis group)	0(0)	0.25(0.25)	0(0)
Mite	0(0)	0(0)	1.0(0.71)
Nemertea	0(0)	0.5(0.5)	0(0)
Oligochaete	0(0)	0.5(0.5)	0(0)
Orchestia uhleri	0(0)	0(0)	0.25(0.25)
Parametriocnemus sp.	0(0)	0(0)	0.5(0.5)
Peloscolex sp.	0(0)	0(0)	5.50(3.57)
Polypedilum sp.	0(0)	6.75(2.84)	0.25(0.25)
Sirosperma sp.	0(0)	1(0.58)	0(0)
Spionidae sp.	0.17(0.17)	0(0)	0(0)
Staphylinidae	0.17(0.17)	0(0)	0(0)
Stictochironomus sp.	0(0)	0.25(0.25)	0(0)
Tabanus sp.	0(0)	0.3(0.3)	0(0)
Tanytarsus sp.	0(0)	0(0)	0.5(0.5)
Tubificidae sp.	24.5(5.36)	104(30.6)	13.75(3.57)
Uca sp.	0(0)	104(30.6)	0(0)

Table 6.4-5c. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P7 on the main-stem Cape Fear during June 1999, 2000, 2001. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Indian Creek (P7)		
Low Intertidal	**June 99**	**June 00**	**June 01**
Batea cathariensis	0(0)	0(0)	0.17(0.17)
juv. Bivalve	0.6(0.4)	0.25(0.25)	0(0)
Bezzia/Palpomyia	0.2(0.2)	0(0)	0(0)
Cassidisca lunifrons	0.6(0.24)	0(0)	0(0)
Chironomus sp.	0.2(0.2)	0(0)	0(0)
Crab megalopae	0.2(0.2)	0(0)	0(0)
Cryptochironomous sp.	0.6(0.6)	0(0)	0(0)
Cyathura polita	0(0)	0.5(0.29)	0.67(0.49)
Cyathura (*madelinae*)	0.4(0.24)	0(0)	0(0)
Dispio unicata	0(0)	0.25(0.25)	0(0)
Dolichopodid larvae	0(0)	0.25(0.25)	0.67(0.67)
Dolichopus sp.	0.2(0.2)	0(0)	0(0)
Gammarus daiberi	0.2(0.2)	0(0)	0(0)
Gammarus tigrinus	0.6(0.4)	0(0)	0(0)
gastropod juv.	1.0(0.45)	0(0)	0(0)
insect larvae	0(0)	0(0)	0.33(0.33)
insect pupae	0.4(0.24)	0(0)	0(0)
insect species	0(0)	0(0)	0.33(0.21)
insect sp. a	0.4(0.24)	0(0)	0(0)
Isochaetides sp.	0(0)	0(0)	0.5(0.5)
Isopoda (unknown)	0(0)	0.25(0.25)	0(0)
Laeonereis culveri	0(0)	0.25(0.25)	0(0)
Limnodrilus hoffmeisteri	0(0)	0(0)	0.5(0.5)
Lumbriculidae sp.	0(0)	0(0)	0.83(0.54)
Oligochaete	17.8(4.55)	64(19.63)	46.83(25.24)
Orchestia sp.	0(0)	0(0)	0.17(0.17)
Paratendipes sp.	0.2(0.2)	0(0)	0(0)
Polypedilum sp.	1.0(1.0)	1.25(0.48)	0.33(0.33)
Procladius sp.	0.2(0.2)	0(0)	0(0)
Spionidae sp.	0(0)	0.25(0.25)	0(0)
Spirosperma carolinensis	0(0)	0(0)	0.33(0.33)
Tubificidae sp.	0(0)	0(0)	8.5(5.38)

Table 6.4-5d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P7 on the main-stem Cape Fear during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Indian Creek (P7)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Arcteonais lomondi	0(0)	0.4(0.24)	0(0)
Aulodrilus pluriseta	0(0)	0.2(0.2)	0(0)
juv. Bivalve	0.17(0.17)	0.4(0.4)	0.25(0.25)
Bezzia/Palpomyia	0.17(0.17)	3.8(2.58)	1.75(0.48)
Cassidisca lunifrons	0(0)	0(0)	0.5(0.5)
Chironomidae sp.	0(0)	0.2(0.2)	0(0)
Chironomus sp.	0(0)	0.2(0.2)	0(0)
Chrysops sp.	0(0)	0(0)	0.25(0.25)
Cladotanytarsus sp.	0(0)	0.4(0.4)	0(0)
Coelotanypus sp.	0.17(0.17)	2(1.05)	0(0)
Collembola	0(0)	0(0)	0.5(0.29)
Corophium volutator	0(0)	0.2(0.2)	0(0)
Cryptochironomous sp.	0(0)	2(0.89)	0.75(0.25)
Cryptotendipes sp.	0(0)	0.4(0.4)	0(0)
Cyathura polita	0(0)	0(0)	0.25(0.25)
Dero sp.	0(0)	0.8(0.8)	0(0)
gastropod juv.	0(0)	0(0)	0.25(0.25)
Limnodrilus hoffmeisteri	0(0)	2.8(1.16)	0(0)
Megalops	0(0)	0(0)	0.25(0.25)
Mite	0(0)	0(0)	0.25(0.25)
Parametriocnemus sp.	0(0)	0(0)	0.25(0.25)
Paratendipes sp.	0(0)	0(0)	1.0(1.0)
Peloscolex sp.	0(0)	0(0)	0.25(0.25)
Polypedilum sp.	0(0)	2(0.84)	0.75(0.75)
Procladius sp.	0(0)	1.6(0.4)	0(0)
Saetheria sp.	0(0)	0.2(0.2)	0(0)
Tanytarsus sp.	0(0)	0.4(0.24)	0(0)
Tubificidae sp.	11.0(3.34)	48.2(6.85)	24.5(3.23)

Table 6.4-6a Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P8 on the main-stem Cape Fear during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Dollisons Landing (P8)		
High Intertidal	**June 99**	**June 00**	**June 01**
Bezzia/palpomia	0.33(0.33)	0.75 (0.25)	0.33(0.21)
juv. Bivalve	11.17(4.32)	23.5(8.51)	5.17(1.82)
Coleoptera larvae	0.33(0.33)	0(0)	0(0)
Collembola sp.	1.5(0.43)	6.5(2.53)	0.33(0.21)
Dolichopodid larvae	0(0)	6.5(2.33)	0.67(0.49)
Dolichopus sp.	2.17(.75)	0(0)	0(0)
Gammarus tigrinus	1.33(1.33)	0(0)	0(0)
gastropod juv.	0.5(0.34)	0(0)	0(0)
Hydaticus larvae	0.33(0.21)	0(0)	0(0)
Hydrobia sp.	0(0)	0(0)	0.17(0.17)
Hydrophilidae larvae	0(0)	0.25(0.25)	0(0)
Insect larvae	0(0)	0(0)	1.33(0.88)
insect pupae	0(0)	0(0)	0.83(0.31)
insect sp. a	0(0)	0(0)	0(0)
insect sp. b	0(0)	0(0)	0.5(0.5)
insect sp. C	0(0)	0(0)	0.17(0.17)
insect sp. D	0(0)	0(0)	0.33(0.33)
insecta sp.	0.17(0.17)	0(0)	0.17(0.17)
Lumbriculidae sp.	5(2.89)	2(2)	0(0)
Micropsectra sp.	3.17(3.17)	0(0)	0(0)
Mite	0.17(0.17)	0(0)	0(0)
Nemertea	0(0)	0(0)	0.33(0.21)
Notomierus capricornis	0.17(0.17)	0(0)	0(0)
Oligochaete	73.5(14.07)	180.25(37.14)	44.17(11.32)
Orchestia sp.	0(0)	0(0)	5.5(1.57)
Orchestia uhleri	3.5(1.48)	2.5(1.5)	0(0)
Paratendipes sp.	0(0)	5.75(2.69)	0(0)
Polypedilum sp.	0.17(0.17)	2.75(2.43)	0.17(0.17)
Rheotanytarsus sp.	0.33(0.33)	0.5(0.5)	0(0)
Stratiomya sp.	0.17(0.17)	0(0)	0(0)
Tabanus sp.	0(0)	0(0)	0.17(0.17)
Tanais sp.	0(0)	0(0)	0.17(0.17)
Tanytarsus sp.	1(1)	7.5(2.99)	0.17(0.17)
Tubificoides heterochaetus	0.17(0.17)	0(0)	0(0)
Uca pugilator	0.17(0.17)	0.5(0.5)	0(0)
Uca pugnax	0(0)	0(0)	0.17(0.17)

Table 6.4-6b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P8 on the main-stem Cape Fear during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-sites for high intertidal areas.

	Dollisons Landing (P8)		
High Intertidal	**June 02**	**June 03**	**June 04**
Bezzia/palpomia	0(0)	0(0)	1.0(0)
juv. Bivalve	0.6(0.4)	2(1.15)	18.5(1.16)
Branchiura sowerbyi	0(0)	0.25(0.25)	0(0)
Cassidisca lunifrons	0.4(0.24)	0(0)	0(0)
Coelotanypus sp.	0(0)	0.25(0.25)	0(0)
Collembola sp.	0(0)	0(0)	0.75(0.75)
Cryptochironomus sp.	0(0)	0.25(0.25)	0(0)
Cyathura polita	0.6(0.4)	0(0)	0(0)
Dero sp.	0(0)	0.25(0.25)	0(0)
Dolichopodid larvae	0.4(0.4)	0.5(0.5)	0(0)
Enchytraeidae sp.	0(0)	0.25(0.25)	0.75(0.75)
Erioptera sp.	0(0)	0(0)	1.5(1.19)
Fabriciola trilobata	0(0)	0(0)	0.75(0.75)
Limnodrilus hoffmeisteri	0(0)	1.0(0.71)	0(0)
Lumbriculidae sp.	1.4(0.75)	0.25(0.25)	4.0(2.83)
Neanthes succinea	0(0)	0.25(0.25)	0(0)
Nemertea	0(0)	0.25(0.25)	0(0)
Omisus sp.	0.6(0.6)	0(0)	0(0)
Orchestia sp.	0.2(0.2)	0(0)	0(0)
Orchestia uhleri	1 (1)	0(0)	0.590.5)
Oribatei sp.	0.2(0.2)	0(0)	0(0)
Parametriocnemus sp.	0(0)	0(0)	0.25(0.25)
Paratendipes sp.	0.2(0.2)	1.5(1.19)	0.75(0.48)
Peloscolex sp.	0(0)	0(0)	0.75(0.48)
Pericoma sp.	0(0)	0(0)	3.0(1.22)
Polypedilum sp.	0.2(0.2)	3(1.41)	0(0)
Sirosperma sp.	0(0)	0.25(0.25)	0(0)
Tanytarsus sp.	0(0)	0(0)	1.75(1.03)
Tipula sp.	0.2(0.2)	0(0)	0.5(0.5)
Tipulidae sp.	0(0)	0(0)	0.75(0.48)
Tubificidae sp.	19.4(9.14)	128(39.51)	63.25(16.14)
Tubificoides heterochaetus	1(1)	0.25(0.25)	0(0)

Table 6.4-6c. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P8 on the main-stem Cape Fear during June 1999, 2000, 2001. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Dollisons Landing (P8)		
Low Intertidal	**June 99**	**June 00**	**June 01**
Bezzia/palpomia	0.33(0.33)	0(0)	0.33(0.21)
juv. Bivalve	1.67(0.56)	5.75(4.46)	1.83(0.31)
Cassidisca lunifrons	0.83(0.83)	0(0)	0(0)
Collembola sp.	0.17(0.17)	0.25(0.25)	1(1)
Corophium acherasicum	0(0)	0(0)	3.33(0.99)
Corophium sp.	0(0)	0(0)	0.17(0.17)
crab megalopae	0.17(0.17)	0(0)	0(0)
Cryptochironomous sp.	0.33(0.33)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	1.5(0.56)
Cyathura (*madelinae*)	0.67(0.67)	0.75(0.75)	0(0)
Dolichopodid larvae	0(0)	0.75(0.25)	0.67(0.33)
Dolichopus sp.	1(0.82)	0(0)	0(0)
Gammarus tigrinus	1.5(1.15)	0(0)	0(0)
gastropod juv.	0.17(0.17)	0.5(0.5)	1(0.68)
insect pupae	0(0)	0.25(0.25)	0(0)
insect sp.	0(0)	0(0)	0.17(0.17)
insect sp.b	0.17(0.17)	0(0)	0.17(0.17)
Isopoda (unknown)	0(0)	0(0)	0.83(0.65)
Limnodrilus hoffmeisteri	0(0)	0(0)	0(0)
Lumbriculidae sp.	3(1.61)	1.5(1.19)	0(0)
Micropsectra sp.	0.17(0.17)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.8(1)
Oligochaete	122.83(31.34)	103(16.91)	63(67.6)
Orchestia sp.	0(0)	0(0)	57(21.7)
Orchestia uhleri	0(0)	0.75(0.48)	0(0)
Paratendipes sp.	0.17(0.17)	1(0.58)	0(0)
Polypedilum haterale group	2.33(2.33)	0(0)	0(0)
Polypedilum sp.	1.33(0.56)	3(1.58)	2.5(2.4)
Pristinella sp.	0.67(0.67)	0(0)	0(0)
Procladius sp.	0(0)	0(0)	0.3(0.5)
Rheotanytarsus sp.	0.17(0.17)	0(0)	0(0)
Sirosperma sp.	0(0)	0(0)	0(0)
Tanytarsus sp.	0.33(0.33)	1(1)	0(0)
Tribelos sp.	0.33(0.33)	0(0)	0(0)

Table 6.4-6d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P8 on the main-stem Cape Fear during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-sites for low intertidal areas.

	Dollisons Landing (P8)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Apedilum sp.	0(0)	0(0)	0.75(0.75)
Armadillidium quadrifrons	0.25(0.25)	0(0)	0(0)
Bezzia/*palpomia*	0.75(0.48)	1(0.58)	0.25(0.25)
juv. Bivalve	0.25(0.25)	1(0.71)	0.25(0.25)
Branchiura sowerbyi	0(0)	1(0.71)	0(0)
Chironomus sp.	0(0)	0(0)	0.25(0.25)
Coelotanypus sp.	0.25(0.25)	0.75(0.48)	0(0)
Collembola sp.	0(0)	0(0)	3.75(3.09)
Cyathura polita	0.25(0.25)	0(0)	0(0)
Dolichopus sp.	0(0)	0.25(0.25)	0(0)
gastropod juv.	0.5(0.5)	0(0)	0.25(0.25)
Goeldichironomus sp.	0(0)	0(0)	0.5(0.5)
Limnodrilus hoffmeisteri	0(0)	6.25(5.92)	0(0)
Lumbriculidae sp.	0(0)	0(0)	5.0(2.61)
Megalops	0(0)	0(0)	0.25(0.25)
Micropsectra sp.	0.25(0.25)	0(0)	0(0)
Oligochaete	0(0)	0(0)	0.25(0.25)
Orthocladinae sp.	0(0)	0(0)	0.75(0.75)
Parametriocnemus sp.	0(0)	0(0)	0.25(0.25)
Paratendipes sp.	0(0)	0(0)	0.5(0.5)
Procladius sp.	0(0)	1(0.71)	0(0)
Sirosperma sp.	0(0)	0.25(0.25)	0(0)
Tipulidae sp.	0(0)	0(0)	0.75(0.75)
Tubificidae sp.	0(0)	0(0)	129.5(47.23)
Tubificoides sp.	6.5(2.06)	57.25(32.77)	0(0)
Uca minax	0(0)	0(0)	0.25(0.25)

Table 6.4-7a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P11 on the NE Cape Fear River during June 1999, 2000, 2001. The means presented here represent the combination of two sub-site for high intertidal areas at each station.

	Smith Creek (P11)		
High Intertidal	**June 99**	**June 00**	**June 01**
amphipod sp.	0(0)	0(0)	0.25(0.25)
Bezzia/*palpomia*	0(0)	0(0)	0.5(0.5)
juv. Bivalve	0.25(0.25)	0(0)	0(0)
Boccardiella sp.	0(0)	1.25(1.25)	0(0)
Cassidisca lunifrons	1(0.71)	0.25(0.25)	1.25(0.48)
Chironomus sp.	0.5(0.5)	0(0)	0(0)
Curculionidae sp.	0.75(0.75)	0(0)	0(0)
Cyathura madelina	0(0)	0.25(0.25)	0(0)
Dicrotendipes lobus	1(1)	0(0)	0(0)
Dicrotendipes nirvosus	0.5(0.5)	0(0)	0(0)
Dicrotendipes sp.	0(0)	1(0.71)	0.5(0.29)
Edotea triloba	0(0)	0(0)	0.25(0.25)
Gammarus diaberi	0(0)	0(0)	0.25(0.25)
Gammarus tigrinus	0(0)	0.25(0.25)	0(0)
Gammarus mucronatus	0.25(0.25)	0(0)	0(0)
Hobsonia florida	7.5(4.33)	0(0)	3.25(1.11)
Insect larvae (Elimidae)	0(0)	0.25(0.25)	0(0)
insect pupae	1(1)	0.25(0.25)	0(0)
Insect sp.	1.25(1.25)	0(0)	0(0)
Megalopae (Uca)	0(0)	0(0)	0.25(0.25)
Nereidae sp.	0(0)	0(0)	1(0.71)
Oligochaete	10.5(3.69)	14.25(7.7)	1.75(0.85)
Paratendipes sp.	0(0)	0.25(0.25)	0(0)
Polydora ligni	0.25(0.25)	0(0)	0(0)
Polydora socialis	0.25(0.25)	0(0)	0(0)
Polydora sp.	0(0)	0(0)	0.25(0.25)
Polypedilium sp.	0.5(.5)	0.25(0.25)	0.5(0.5)

Table 6.4-7b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P11 on the NE Cape Fear River during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-site for high intertidal areas at each station.

	Smith Creek (P11)		
High Intertidal	**June 02**	**June 03**	**June 04**
Apedilum sp.	0(0)	0(0)	1.4(0.87)
Bezzia/palpomia	0.5(0.29)	0.25(0.25)	4.8(2.37)
juv. Bivalve	0(0)	0(0)	0.2(0.2)
Chironomus sp.	0(0)	0(0)	3.2(2.06)
Collembola	0(0)	0(0)	0.6(0.24)
Cladotanytarsus sp.	0(0)	0.25(0.25)	0(0)
Cricotopus sp.	0(0)	0(0)	0.2(0.2)
Cryptochironomus sp.	0(0)	1.75(1.44)	0.6(0.6)
Cyathura madelina	0.25(0.25)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	0.8(0.58)
Dicrotendipes sp.	0.25(0.25)	0(0)	0(0)
Dolichopodidae sp.	0(0)	0(0)	0.4(0.24)
Gammarus sp.	1.5(1.5)	0(0)	0(0)
Goeldichironomus holoprasinus	0(0)	0(0)	1.6(1.6)
Insect larvae (Elimidae)	0(0)	0(0)	0.6(0.6)
Insect sp.	0.5(0.5)	0(0)	0(0)
Laeonereis culveri	0.5(0.5)	0(0)	0.6(0.6)
Megalops	0.25(0.25)	0(0)	0(0)
Neanthes succinea	0(0)	0(0)	0.6(0.6)
Nematoda	0(0)	0(0)	3.4(1.12)
Nemertea	0.25(0.25)	0(0)	0(0)
Orchestia uhleri	0(0)	0(0)	0.2(0.2)
Polypedilium sp.	0(0)	3.75(1.49)	2.0(1.26)
Stictochironomus sp.	0(0)	0.25(0.25)	0(0)
Streblospio benedicti	0.75(0.49)	0(0)	0(0)
Tanytarsus sp.	0(0)	0(0)	0.2(0.2)
Tipulidae sp.	0(0)	0(0)	0.6(0.4)
Tubificidae sp.	9.75(8.76)	4.75(2.59)	13.4(5.55)
Tubificidae heterochaetus	1(0.71)	0.75(0.48)	0(0)
Tubificoides heterochaetus	0(0)	0(0)	2.0(2.0)
Uca sp.	0(0)	0.25(0.25)	0(0)

Table 6.4-7c. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P11 on the NE Cape Fear River during June 1999, 2000, 2001. The means presented here represent the combination of two sub-site for low intertidal areas at each station.

	Smith Creek (P11)		
Low Intertidal	**June 99**	**June 00**	**June 01**
amphipod sp.	0.2(0.2)	0(0)	0(0)
Boccardiella sp.	0(0)	0(0)	0.17(0.17)
Corophium acherasicum	0(0)	0(0)	0.33(0.33)
Corophium sp.	0(0)	0(0)	0.33(0.33)
crab megalopae	0.2(0.2)	0(0)	0(0)
Cryptochironomous (*fulvens*)	0.2(0.2)	0(0)	0(0)
Gammarus tigrinus	0.6(0.4)	0(0)	0(0)
Hobsonia florida	0.6(0.24)	0(0)	0.33(0.21)
Laeonereis culveri	0(0)	0(0)	5(4.43)
Marenzellaria virdis	1(0.77)	3.75(1.93)	22.83(5.72)
nemertea	0.2(0.2)	0(0)	0.5(0.22)
Nereidae	0(0)	0(0)	7(2.5)
Oligochaete	3.6(1.86)	0.25(0.25)	7.5(4.63)
Polypedilum sp.	0.4(0.4)	0.5(0.5)	1.67(0.61)
Tubificoides heterochaetus	6.2(6.2)	0(0)	1.5(1.31)

Table 6.4-7d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P11 on the NE Cape Fear River during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-site for low intertidal areas at each station.

	Smith Creek (P11)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Armadillidium vulgare	0(0)	0.33(0.33)	0(0)
Axarus sp.	0(0)	3.67(1.52)	0(0)
Bivalve sp.	0.2(0.2)	1.17(0.4)	0(0)
Bivalvia juv. sp.	0(0)	0(0)	0.25(0.25)
Cladotanytarsus sp.	0(0)	0.5(0.5)	0(0)
Collembola sp.	0(0)	0.17(0.17)	0(0)
Cryptochironomous sp.	0(0)	2(0.58)	0(0)
Cyathura (madelinae)	0(0)	0.17(0.17)	0(0)
Cyathura polita	0(0)	0.17(0.17)	0.25(0.25)
Diplopoda (millipede)	0(0)	0.17(0.17)	0(0)
Eteone heteropoda	0.2(0.2)	0(0)	0(0)
Laeonereis culveri	0.2(0.2)	0(0)	0(0)
Marenzellaria virdis	0(0)	12.17(3.51)	51.5(6.85)
nemertea	0.2(0.2)	0(0)	0(0)
Parandalia sp. A	0.2(0.2)	0.17(0.17)	0(0)
Paratanytarsus sp.	0(0)	0.5(0.5)	0(0)
Pentatomidae	0.2(0.2)	0(0)	0(0)
Polypedilum sp.	0(0)	3(0.93)	1.75(1.11)
Procladius sp.	0(0)	1.33(1.33)	0(0)
Streblospio benedicti	2.0(1.38)	0(0)	0(0)
Tanytarsus sp.	0(0)	0.17(0.17)	0(0)
Tubificidae sp.	0.4(0.4)	1.17(1.17)	0(0)
Tubificoides heterochaetus	30.4(18.98)	6.5(2.86)	3.5(1.71)

Table 6.4-8a. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P12 on the NE Cape Fear River during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-site for high intertidal areas at each station.

	Rat Island (P12)		
High Intertidal	**June 99**	**June 00**	**June 01**
Bezzia/palpomia	1.8(0.37)	0(0)	0.25(0.25)
Cassidisea lunifrons	0.2(0.2)	0.25(0.25)	0.25(0.25)
Collembola sp.	0.2(0.2)	1(0.41)	0(0)
Corophium (*lacustre*)	0.2(0.2)	0(0)	0(0)
Cricotopus sp.	0.2(0.2)	0(0)	0(0)
Dicrotendipes sp.	0(0)	0(0)	0.25(0.25)
Dispio unicata	0(0)	0.25(0.25)	0(0)
Dolichopodid larvae	0(0)	0.25(0.25)	0.75(0.75)
Dolichopus sp.	0.6(0.4)	0(0)	0(0)
Donacia sp.	0.2(0.2)	0(0)	0(0)
gastropod juv.	0.2(0.2)	0(0)	0(0)
Heterothissocladius sp.	0(0)	0.25(0.25)	0(0)
Hydrobia sp.	0(0)	0.25(0.25)	0(0)
Insect sp.	0(0)	0(0)	0.75(0.48)
insect sp. g	0.4(0.4)	0(0)	0(0)
insect sp. h	1.2(1.2)	0(0)	0(0)
insect sp. f	0(0)	0(0)	0(0)
Laeonereis culveri	1.4(0.51)	0.25(0.25)	0(0)
Lumbriculid sp.	0(0)	0.25(0.25)	0(0)
Mite	0(0)	0(0)	0.25(0.25)
Monopylephorus irroratus	1(1)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.25(0.25)
Nereidae sp.	0(0)	0(0)	0.25(0.25)
Nereidae sp.	0(0)	0.25(0.25)	0(0)
Ocypode quadrata	0.2(0.2)	0(0)	0(0)
Oligochaete	47.8(15.93)	30(9.61)	13.25(7.11)
Orchestia uhleri	0.2(0.2)	0.5(0.29)	0(0)
Polypedilium sp.	0(0)	0(0)	0.5(0.5)
Pristinella sp.	0.2(0.2)	0(0)	0(0)
Spiophanes bombyx	0(0)	0.25(0.25)	0(0)
Uca minax	0.2(0.2)	0(0)	0(0)
Uca pugilator	0.2(0.2)	0(0)	0(0)
Uca sp.	0(0)	0(0)	0(0)

Table 6.4-8b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P12 on the NE Cape Fear River during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-site for high intertidal areas at each station.

	Rat Island (P12)		
High Intertidal	**June 02**	**June 03**	**June 04**
Bezzia/*palpomia*	1.4(0.93)	0.6(0.24)	0.5(0.29)
Cassidisea lunifrons	0.4(0.4)	0(0)	0.25(0.25)
Coleoptera sp.	0(0)	0(0)	0.25(0.25)
Collembola sp.	0(0)	0(0)	0.75(0.48)
Corophium volutator	0(0)	0(0)	0.25(0.25)
Cyathura polita	0(0)	0(0)	0.75(0.25)
Delphacidae sp.	0(0)	0.2(0.2)	0.5(0.5)
Diptera sp.	0(0)	0.2(0.2)	0(0)
Dolichopodidae sp.	0.2(0.2)	0.4(0.24)	1.0(0.41)
Donacia sp.	0.2(0.2)	0(0)	0(0)
Donaciinae sp.	0.2(0.2)	0(0)	0(0)
Endochironomus sp.	0(0)	0.2(0.2)	0(0)
Ephydra sp.	0(0)	0(0)	0.5(0.5)
Ephydridae	0(0)	0(0)	0.25(0.25)
Gammarus sp.	0.2(0.2)	0(0)	0(0)
gastropod juv.	0(0)	0(0)	0.25(0.25)
Hemiptera sp.	0(0)	0.2(0.2)	0(0)
Mesomelia mulsanti	0.2(0.2)	0(0)	0.5(0.5)
Monopylephorus irroratus	0(0)	0.4(0.4)	0.25(0.25)
Neanthes succinea	0(0)	0(0)	0.25(0.25)
Orchestia uhleri	0(0)	0(0)	0.25(0.25)
Orthocladinae sp.	0(0)	0.2(0.2)	0(0)
Parametriocnemus sp.	0(0)	0(0)	3.75(1.49)
Paratandipes sp.	0(0)	0.2(0.2)	0(0)
Polypedilium sp.	0(0)	1.8(1.11)	0.5(0.29)
Streblospio benedicti	0(0)	0.2(0.2)	0(0)
Tubificidae sp.	3.2(1.16)	17.6(4.15)	55.25(10.06)
Uca minax	0(0)	0(0)	0.5(0.29)
Uca sp.	0.4(0.4)	0(0)	0(0)

Table 6.4-8c. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P12 on the NE Cape Fear River during June 1999, 2000, 2001. The means presented here represent the combination of two sub-site for low intertidal areas at each station.

	Rat Island (P12)		
Low Intertidal	**June 99**	**June 00**	**June 01**
amphipod sp. B	0.2(0.2)	0(0)	0(0)
Axarus sp.	0(0)	0(0)	0(0)
Bezzia/*palpomia*	0.2(0.2)	0(0)	0(0)
Boccardiella sp.	0(0)	0(0)	12.5(12.5)
Collembola sp.	0(0)	0(0)	0.5(0.5)
Corophium acherasicum	0(0)	0(0)	1.0(1.0)
Gammarus tigrinus	0.2(0.2)	0(0)	0(0)
juv. Gastropod	0(0)	0(0)	0.25(0.25)
Insect sp.	0(0)	0.25(0.25)	0(0)
insect larvae	0(0)	0.25(0.25)	0(0)
Lumbriculid sp.	0(0)	1.75(1.44)	0(0)
Mediomastus sp.	0.2(0.2)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.5(0.5)
Oligochaete	1.6(0.51)	7.25(4.4)	2.75(1.49)
Paracladopelma sp.	0.2(0.2)	0(0)	0(0)
Polydora ligni	0.2(0.2)	0(0)	0(0)
Polydora sp.	0.2(0.2)	0(0)	0(0)
Polypedilum sp.	0.2(0.2)	0(0)	0(0)

Table 6.4-8d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P12 on the NE Cape Fear River during June 2002, 2003 and 2004. The means presented here represent the combination of two sub-site for low intertidal areas at each station.

	Rat Island (P12)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Ablabesmyia sp.	0(0)	0.2(0.71)	0(0)
Apedilum sp.	0(0)	0(0)	2.75(2.75)
Axarus sp.	0(0)	0.75(0.75)	0(0)
Boccardiella sp.	7.6(4.43)	0.75(0.48)	0(0)
Cassidinidea lunifrons	0(0)	0.75(0.48)	0(0)
Chironomidae sp.	0(0)	0(0)	0.25(0.25)
Chironomus sp.	0(0)	0(0)	1.0(1.0)
Chyrsops sp.	0(0)	0.25(0.25)	0(0)
Collembola sp.	0(0)	0(0)	0.75(0.49)
Crangonyx sp.	0.4(0.4)	0(0)	0(0)
Cricotopus sp.	0(0)	0.5(0.5)	0(0)
Cryptochironomus sp.	0(0)	0.75(0.75)	0(0)
Dicrotendipes lucifer	0(0)	0.25(0.25)	0(0)
Dicrotendipes sp.	0(0)	1.75(1.75)	0(0)
Dolichopodidae sp.	0(0)	0(0)	0.25(0.25)
Edotea juv sp.	0.2(0.2)	0(0)	0.25(0.25)
Enchytraeidae sp.	0(0)	0.25(0.25)	0(0)
Gammarus sp.	0(0)	0.25(0.25)	0(0)
Goeldichironomus holoprasinus	0(0)	0(0)	0.25(0.25)
Goeldichironomus sp.	0(0)	0(0)	3.25(2.36)
Hobsonia florida	0.4(0.4)	0.25(0.25)	0(0)
Laeonereis culveri	0.4(0.4)	0(0)	0(0)
Marenzellaria viridis	0(0)	0(0)	0.75(0.48)
Megalops	0.2(0.2)	0(0)	0(0)
Naididae sp.	0(0)	0.25(0.25)	0(0)
Nereis lamellosa	0.2(0.2)	0(0)	0(0)
Polydora socialis	0.2(0.2)	0(0)	0(0)
Polypedilum sp.	0(0)	3.75(1.11)	0(0)
Procladius sp.	0(0)	0.25(0.25)	0(0)
Rhithropanopeus harrisii	0.2(0.2)	0(0)	0(0)
Spiophanes bombyx	0.2(0.2)	0(0)	0(0)
Streblospio benedicti	0.8(0.58)	0(0)	0(0)
Tanypodinae sp.	0(0)	1.25(1.25)	0(0)
Tubificidae sp.	1.8(1.36)	0.5(0.29)	0.25(0.25)
Tubificoides heterochaetus	0.4(0.4)	6.75(3.90)	0.75(0.75)

Table 6.4-9a. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P13 on the NE Cape Fear River during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-site for high intertidal areas at each station.

	Fishing Creek (P13)		
High Intertidal	**June 99**	**June 00**	**June 01**
Bezzia/palpomyia	0(0)	0(0)	0.2(0.2)
juv. Bivalve	0(0)	0.75(0.48)	0(0)
Collembola sp.	0.2(0.2)	0(0)	0.8(0.8)
Cyathura polita	0.2(0.2)	0(0)	0(0)
Dolichopodid larvae	0(0)	0.5(0.5)	0.2(0.2)
Dolichopus sp.	0.4(0.24)	0.75(0.75)	0(0)
Halipldae sp.	0.2(0.2)	0(0)	0(0)
Helophorus linearis	0(0)	0(0)	0.2(0.2)
Hydrobia sp.	0(0)	0.25(0.25)	0(0)
Insect sp.	0(0)	0(0)	0.4(0.4)
insect pupae	0.2(0.2)	0(0)	0.2(0.2)
Laeonereis culveri	0.4(0.24)	2(1.08)	0(0)
Lumbriculid sp.	1.4(1.4)	0.5(0.29)	18.4(18.4)
Mediomastus sp.	0.2(0.2)	0(0)	0(0)
Megalopae (Uca)	0(0)	0(0)	0.2(0.2)
Namalycastis sp.	0(0)	0(0)	0.2(0.2)
Oligochaete	29.4(6.9)	11(3.72)	37.2(14.04)
Orchestia sp.	0(0)	0(0)	0.4(0.24)
Orchestia uhleri	0(0)	0(0)	0.2(0.2)
Paratendipes sp.	0(0)	0.5(0.5)	0.6(0.4)
Polichopodidae sp.	0(0)	0(0)	0.2(0.2)
Polypedilium sp.	0.6(0.4)	0(0)	0.4(0.24)

Table 6.4-9b. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P13 on the NE Cape Fear River during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-site for high intertidal areas at each station.

	Fishing Creek (P13)		
High Intertidal	**June 02**	**June 03**	**June 04**
Aricidea suecica	0.25(0.25)	0(0)	0(0)
Bezzia/palpomyia	0.75(0.75)	1(0.71)	3.75(1.18)
Cassidinidea lunifrons	0(0)	0(0)	0.75(0.48)
Chironomus sp.	0(0)	0(0)	0.25(0.25)
Collembola sp.	0(0)	0.5(0.5)	1.50(0.96)
Cyathura polita	0(0)	0.5(0.5)	0(0)
Dolichopodid larvae	0.25(0.25)	0(0)	0(0)
Dolichopodidae sp.	0(0)	0(0)	0.5(0.29)
Goeldichironomus sp.	0(0)	0(0)	0.25(0.25)
Insect sp.	0.25(0.25)	0(0)	0(0)
Laeonereis culveri	0.25(0.25)	0(0)	0.75(0.75)
Lumbriculid sp.	1(0.58)	0(0)	0.25(0.25)
Megalopae (Uca)	0(0)	0(0)	0.25(0.25)
Nereidae sp.	0.25(0.25)	0(0)	0(0)
Oribatei sp.	0.25(0.25)	0(0)	0(0)
Paratendipes sp.	0(0)	1(0.71)	3.75(0.85)
Polypedilium sp.	0(0)	5(1.22)	0.25(0.25)
Tubificidae sp.	2.75(2.43)	6.25(1.97)	60(11.37)

Table 6.4-9c. Mean (no. per 0.01 m^2) and (standard deviation) for all taxa collected at P13 on the NE Cape Fear River during June 1999, 2000, and 2001. The means presented here represent the combination of two sub-site for low intertidal areas at each station.

	Fishing Creek (P13)		
Low Intertidal	**June 99**	**June 00**	**June 01**
Bezzia/palpomia	0(0)	0(0)	0.25(0.25)
Chirodotea caeca	0.25(0.25)	0(0)	0(0)
Cryptochironomous (*fulvens*)	0.5(0.5)	0(0)	0(0)
Dolichopodid larvae	0(0)	0.25(0.25)	0(0)
Hobsonia florida	0(0)	0(0)	0.25(0.25)
insect pupae	0.25(0.25)	0(0)	0(0)
insect sp. d	0.25(0.25)	0(0)	0(0)
Insect sp. e	0.5(0.5)	0(0)	0(0)
larval fish	0.25(0.25)	0(0)	0(0)
Megalopa (Uca)	0(0)	0(0)	0.25(0.25)
Namalycastis sp.	0(0)	0.25(0.25)	0(0)
Oligochaete	34.25(11.13)	29.3(15.37)	8.25(4.97)
Polypedilum sp.	0.25(0.25)	1(0.71)	1.25(0.95)
Procladius sp.	0.75(0.48)	0(0)	0(0)

Table 6.4-9d. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P13 on the NE Cape Fear River during June 2002, 2003, and 2004. The means presented here represent the combination of two sub-site for low intertidal areas at each station.

	Fishing Creek (P13)		
Low Intertidal	**June 02**	**June 03**	**June 04**
Amphididae sp.	0(0)	0.2(0.2)	0(0)
Bezzia/palpomia	0.75(0.48)	0(0)	1.5(0.5)
Cassidimidea lunifrons	0.25(0.25)	0(0)	0(0)
Cryptochironomous sp.	0(0)	0.8(0.37)	1.0(1.0)
Diptera sp.	0(0)	0(0)	0.5(0.5)
Limnodrilus hoofmeisteri	0(0)	0.6(0.24)	0(0)
Laeonereis culveri	0.25(0.25)	0(0)	0(0)
Paratendipes sp.	0(0)	0(0)	1.0(1.0)
Polypedilum sp.	0(0)	0.8(0.2)	1.0(1.0)
Procladius sp.	0(0)	0.2(0.2)	0(0)
Tubificidae sp.	4(3.08)	5(2.65)	17.5(0.5)

Table 6.4-10. Among year comparison of species richness for the infaunal community.

Site	F (p)	SNK of F significant (high to low)
Smith Creek (P11)	3.78 (0.006)	03a 04a 01ab 99ab 02ab 00b
Rat Island (P12)	1.99 NS	
Fishing Creek (P13)	3.65 (0.0077)	04a 99b 03b 00b 01b 02b
Town Creek mouth (P2)	4.37 (0.0022)	04a 00ab 99b 02b 01b 03b
Inner Town Creek (P3a)	7.96 (0.0001)	04a 03b 02b 01b 00b
Inner Town Creek (P3b)	5.16 (0.0007)	04a 03b 99b 01b 02b 00b
Eagle Island (P6)	5.23 (0.0007)	99a 04ab 03abc 02bcd 01dc 00d
Indian Creek (P7)	16.61 (0.0001)	04a 03a 99a 01b 00bc 02c
Dollisons Landing (P8)	4.67 (0.0014)	04a 99a 00a 01a 03ab 02b

Table 6.4-11. Among year comparison of species diversity for the infaunal community.

Site	F (p)	SNK of F significant (high to low)
Smith Creek (P11)	3.31 (0.012)	03a 01a 04ab 99ab 02ab 00b
Rat Island (P12)	2.09 NS	
Fishing Creek (P13)	6.37 (0.0002)	04a 03a 02a 00a 99ab 01b
Town Creek mouth (P2)	8.07 (0.0001)	04a 00a 99a 03b 01b 02b
Inner Town Creek (P3a)	10.58 (0.0001)	04a 03a 02ab 01b 00c
Inner Town Creek (P3b)	5.55 (0.0004)	04a 03ab 99ab 02bc 01bc 00c
Eagle Island (P6)	2.95 (0.022)	04a 99a 03ab 02ab 01ab 00b
Indian Creek (P7)	11.69 (0.0001)	04a 99a 03a 01a 02b 00b
Dollisons Landing (P8)	1.15 NS	

Table 6.4-12. Guild and major taxa patterns by site among years.

Site	Taxa/guild	F(p)	SNK (high to low)
Smith Creek (P11)			
	INS	6.69(0.0001)	03a 04a 99b 01b 00b 02b
	OLI	0.62 NS	
	POL	3.40(0.01)	01a 04ab 03ab 99ab 00b 02b
	AMP	1.06 NS	
	DEC	0.36 NS	
	ISO	0.46 NS	
	BIV	3.96 (0.0065)	03a 04b 02b 99b 00b 01b
	GAS	…	
	ST	2.48 (0.044)	01a 04a 03a 99a 00a 02a
	SM	7.26 (0.0001)	03a 04ab 01bc 00c 99c 02c
	DB	0.62 NS	
	SB	12.60 (0.0001)	01a 02b 04b 03b 00b 99b
Rat Island (P12)			
	INS	5.74 (0.0003)	04a 03a 99ab 01b 00b 02b
	OLI	1.73 NS	
	POL	1.15 NS	
	AMP	0.47 NS	
	DEC	1.78 NS	
	ISO	1.11 NS	
	BIV	…	
	GAS	0.46 NS	
	ST	1.94 NS	
	SM	10.97 (0.0001)	04a 03a 01b 00b 99b 02b
	DB	1.75 NS	
	SB	1.57 NS	
Fishing Creek (P13)			
	INS	6.00 (0.0003)	04a 03ab 01bc 99bc 00bc 02c
	OLI	7.68 (0.0001)	04a 99a 01ab 00ab 03bc 02c
	POL	1.59 NS	
	AMP	2.34 NS	
	DEC	1.54 NS	
	ISO	1.11 NS	
	BIV	2.25 NS	
	GAS	1.03 NS	
	ST	1.65 NS	
	SM	6.48 (0.0001)	04a 03a 01b 00b 99b 02b
	DB	7.71 (0.0001)	04a 99a 01ab 00ab 03bc 02c
	SB	1.09 NS	

Table 6.4-12. (continued)

Site	Taxa/guild	F(p)	SNK (high to low)
Town Creek mouth (P2)			
	INS	2.11 NS	
	OLI	6.63 (0.0001)	04a 99a 00b 03b 02b 01b
	POL	10.46 (0.0001)	02a 00ab 99ab 04b 01c 03c
	AMP	5.74 (0.0003)	04a 00a 01a 02b 99b 03b
	DEC	2.88 (0.023)	04a 02b 99b 03b 00b 01b
	ISO	3.64 (0.0069)	04a 00b 03b 99b 02b 01b
	BIV	1.65 NS	
	GAS	1.22 NS	
	ST	3.21 (0.0136)	00a 02a 04ab 99ab 01ab 03b
	SM	3.31 (0.0116)	03a 04ab 99ab 00ab 01b 02b
	DB	5.56 (0.0004)	04a 99a 00ab 02b 03b 01b
	SB	2.79 (0.0267)	02a 99a 04a 01a 00a 03a
Inner Town Creek (P3A)			
	INS	6.11 (0.0006)	04a 03b 00b 02b 01b
	OLI	10.92 (0.0001)	00a 04a 01b 02bc 03c
	POL	0.97 NS	
	AMP	1.79 NS	
	DEC	1.34 NS	
	ISO	7.81 (0.0001)	04a 03a 01ab 02b 00b
	BIV	0.69 NS	
	GAS	0.69 NS	
	ST	2.87 (0.035)	04a 02ab 03ab 01ab 00b
	SM	5.65 (0.001)	04a 03b 00b 02b 01b
	DB	12.15 (0.0001)	04a 00a 01b 02bc 03c
	SB	2.48 NS	
Inner Town Creek (P3B)			
	INS	8.56 (0.0001)	04a 03a 99b 02b 01b 00b
	OLI	6.93 (0.0001)	00a 04a 99b 01b 03b 02b
	POL	1.30 NS	
	AMP	1.31 NS	
	DEC	4.51 (0.0091)	04a 02b 99b 03b 00b 01b
	ISO	2.37 NS	
	BIV	1.70 NS	
	GAS	0.97 NS	
	ST	3.74 (0.0061)	04a 02ab 99ab 01ab 03b 00b
	SM	6.96 (0.0001)	04a 03a 99b 00b 02b 01b
	DB	8.00 (0.0001)	00a 04a 99b 01b 03b 02b
	SB	1.28 NS	

Table 6.4-12. (continued)

Site	Taxa/guild	F(p)	SNK (high to low)
Eagle Island (P6)			
	INS	6.333 (0.0002)	04a 99a 03ab 02bc 01bc 00c
	OLI	3.95 (0.0046)	99a 04ab 03ab 00ab 02b 01b
	POL	1.28 NS	
	AMP	5.06 (0.0009)	99a 03b 01b 04b 02b 00b
	DEC	2.34 NS	
	ISO	3.16 (0.0156)	99a 04a 02a 03a 00a 01a
	BIV	2.31 NS	
	GAS	2.22 NS	
	ST	2.31 NS	
	SM	2.42 (0.0497)	99a 04a 03a 01a 02a 00a
	DB	3.97 (0.0045)	99a 04ab 03ab 00ab 02b 01b
	SB	1.45 NS	
Indian Creek (P7)			
	INS	14.65 (0.0001)	03a 04ab 99bc 00c 01c 02d
	OLI	5.84 (0.0002)	03a 00a 99ab 01ab 04b 02b
	POL	5.78 (0.0002)	04a 00b 02b 01b 03b 99b
	AMP	4.72 (0.0012)	01a 99ab 04b 03b 02b 00b
	DEC	1.21 NS	
	ISO	4.58 (0.0015)	01a 99ab 04b 00b 03b 02b
	BIV	2.33 NS	
	GAS	4.47 (0.0018)	99a 04b 02b 03b 00b 01b
	ST	1.45 NS	
	SM	8.17 (0.0001)	03a 01ab 00ab 04ab 99b 02c
	DB	5.14 (0.0006)	03a 00a 99ab 01ab 04ab 02b
	SB	1.24 NS	
Dollisons Landing (P8)			
	INS	6.67 (0.0001)	00a 04ab 99ab 01b 03b 02c
	OLI	12.79 (0.0001)	00a 99ab 04ab 03ab 01b 02c
	POL	8.65 (0.0001)	04a 01b 03b 02b 00b 99b
	AMP	8.20 (0.0001)	01a 99b 00bc 02bc 04bc 03c
	DEC	0.55 NS	
	ISO	1.60 NS	
	BIV	3.62 (0.0071)	00a 04ab 99ab 01ab 03b 02b
	GAS	0.64 NS	
	ST	4.16 (0.003)	00a 04ab 01ab 99ab 03bc 02c
	SM	5.44 (0.0004)	00a 04b 99b 03b 01b 02b
	DB	13.24 (0.0001)	00a 99ab 04ab 03ab 01b 02c
	SB	9.65 (0.0001)	01a 02b 00b 03b 04b 99b

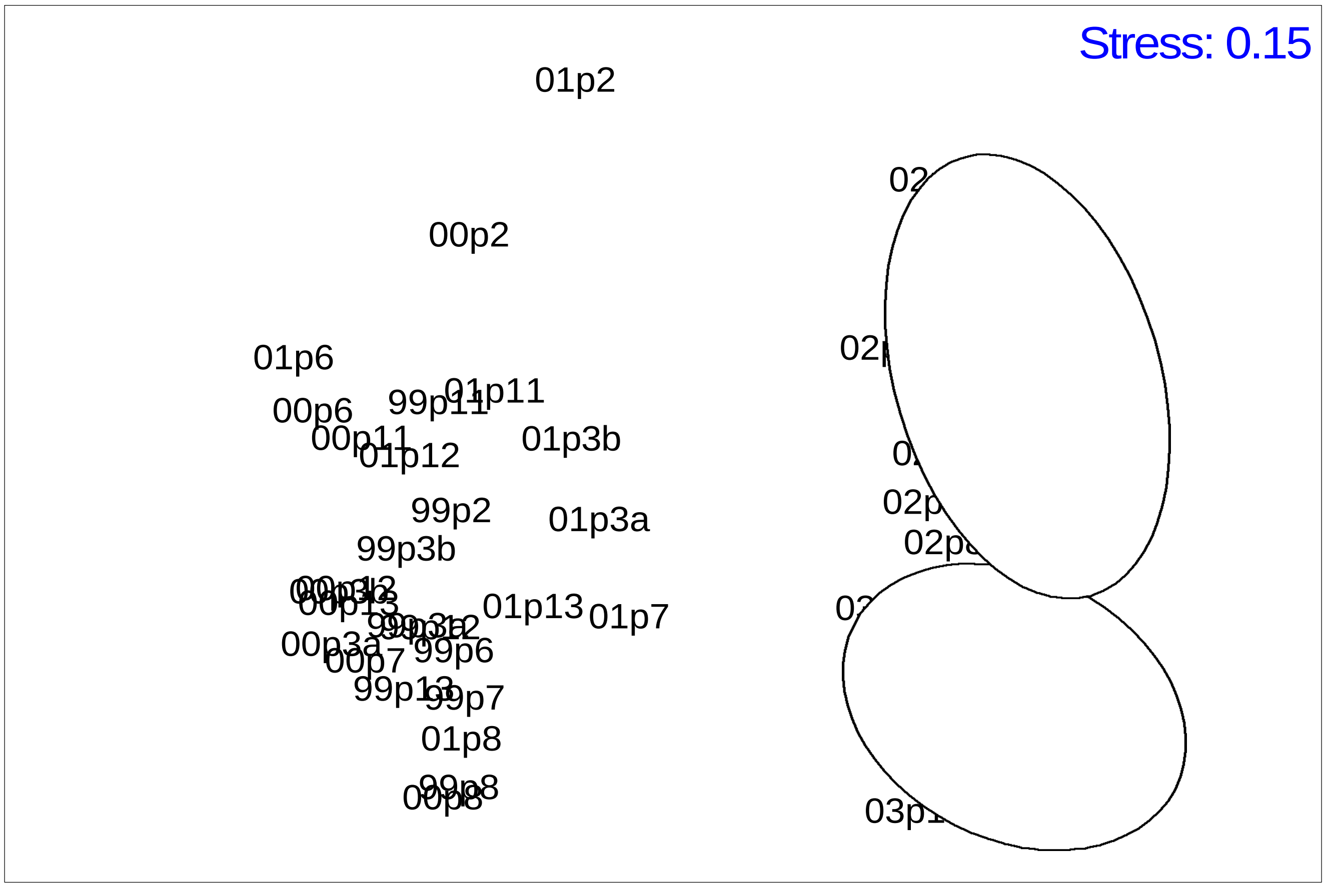


Figure 6.4-1. Multidimensional Scaling plot for infaunal community similarity. Samples are identified as year (99, 00, 01, 02, 03)/ site (p2, p3a. p3b, p6, p7, p8, p11, p12, p13) combinations. 2002 and 2003 samples are indicated within circles.

7.0 EPIBENTHIC STUDIES: DECAPODS AND EPIBENTHIC FISH

7.1 Summary

The temporal and spatial patterns of recruiting epibenthos are closely related to changes in the physical environment and to changes in prey organisms. In order to evaluate long-term trends of epibenthos related to channel widening activities against the background of natural inter-annual variability, the UNCW Benthic Ecology Lab has conducted a series of seasonal studies of the composition and abundance of epibenthos (primarily juvenile fish and crustaceans) that utilize the shallow tidal marshes and wetlands along the Cape Fear River estuary. The distribution and abundance of this group of organisms is affected by the distribution and species composition of the benthic infauna (Section 6) that are one of their primary food sources. Epibenthic organisms are indicators of community stability (or instability), generally responding in short time scales to changes in physical conditions and/or to changes in resources. Since many of the juvenile fish species are commercially important, detecting patterns that may indicate impacts to future year class structure is important to biologists and resource managers

Seasonal fluctuations and among year variations in species distribution patterns and relative dominance were compared from fall 1999 through spring 2005. Previous findings indicated changes in species patterns consistent with developing drought conditions in 2001 and 2002, though this period was also coincident with river widening construction. Our current analysis of drop trap data and Breder trap data indicate significant annual and site differences. Evaluation of species richness by season show that 2004 and/or 2005 spring sampling periods tended to have significantly higher species richness measures, but this did not hold for the fall sampling. Analysis of total abundance shows a high degree of variation among years for each of the three tributaries. Highest total abundances were recorded for most sites in the main-stem Cape Fear and North East Cape Fear tributaries during spring 2005. *Leiostomus xanthurus*, *Lagodon rhomboides* and *Paralichthys* sp. dominated spring 2004 and 2005.

7.2 Background

This study focuses on the epibenthic community utilizing the fringing marsh and swamp habitats across the estuarine gradient. This group of organisms may be sensitive to potential changes associated with shifts in salinity and/or tidal inundation. The sampling window for this monitoring effort is spring and fall, periods of high recruitment into the estuary (primary recruitment in the spring and a smaller pulse in the fall of the year, with differences in species composition between seasons). Areas sampled are the most prominent structural habitats within the upper Cape Fear estuarine system and provide both refuge and forage for epifaunal organisms. These habitats, primarily tidal wetlands and swamps, are critical in terms of providing refuge and foraging habitat for a number of commercially and environmentally important transient and resident species.

As part of the long-term project to monitor potential changes in the communities that depend on these habitats, we are examining the epibenthic community (primarily fish and decapods) found along the marsh and swamp boundary. Aside from resident fish and decapods, epibenthos include juveniles of transient fish, crabs and shrimp as well as larger snails, amphipods, and isopods. These organisms tend to be highly motile, are often able to utilize a variety of habitats, and may respond rapidly to environmental cues. Many species have larval stages that leave the upper estuary, making recruitment, and subsequent impacts on population levels, potentially responsive to changes in river hydrology. Examples of epibenthos in the Cape Fear system include important fisheries species such as the blue crab, *Callinectes sapidus*, the spot, *Leiostomus xanthurus*, flounder *Paralichthys dentatus*, and commercial shrimp, *Farfantepanaeus* sp. and *Litopanaeus* sp. Many epibenthos occupy critical intermediate trophic roles, being predators on benthos or plankton and prey for larger fish (e.g. grass shrimp, *Palaemonetes* spp., killifish, *Fundulus* spp., and bay anchovy, *Anchoa* sp.). Evaluation of epibenthos provides direct information on possible year class strength of target fishery and indicator species as well as indications of resource and ecosystem responses. Epibenthos may respond quickly to changing conditions because of their ability to move away from unfavorable conditions as well as their dependence on annual recruitment events.

Epibenthic taxa may represent indicators of ecosystem level changes for three reasons: 1) their motile lifestyles allows them to quickly respond to physical changes in the environment, 2) many of the species are juveniles that represent a critical “bottleneck” in year class strength that is sensitive to hydrodynamic factors affecting larval ingress, and 3) the intermediate trophic role of many epibenthos may lead to greater responsiveness to both changes in primary consumer abundances (e.g. benthos) and higher predator abundances. Changes in tidal amplitude or salinity regimes may be first detected as a change in the distribution of certain epifaunal organisms, including shifts in dominance at a site or along the upstream/ downstream gradient. Epifauna are sensitive to changes in many physical conditions and may show behavioral avoidance depending on the factor (i.e. rapid shift in dissolved oxygen, temperature or salinity). Conversely, they may show consistency on the longer temporal scale (i.e. timing of ingress/egress into the estuary and dominance patterns). For many epifauna, especially the juveniles of transient fish, a critical factor may be resource limitation. The presence of a consistent and abundant food resource (including benthic fauna) and refuge (structural habitat within the marsh system) are important for determining population levels and survivorship.

The objective of this section of the monitoring project is to evaluate long-term trends in abundance, species composition and habitat utilization of epibenthos and to detect shifts (if any) in these patterns concordant with river deepening activities and any associated physical changes. The primary objective of the first 2 years of sampling (fall 1999-spring 2001) was to establish a baseline for species composition and abundance patterns. The third and fourth year of monitoring represents a construction phase of the project and potential impact to hydrology may start to become apparent at this time, likewise potential impact to the faunal communities may also begin to be detected. Any potential long-term impacts of the river deepening project would be detected by comparison of patterns in multiple years after channel deepening has been completed to pre-construction and construction patterns. As with the benthic infaunal sampling, some of the potential impacts to these communities are similar to those predicted for rapid sea level rise and so may indicate long-term community changes expected in other systems over the next several decades.

There are three main working hypotheses associated with this study: 1) Shifts in salinity, tidal inundation, or tidal amplitude may cause shifts in the epibenthic community composition and/or abundance, 2) Changes in the benthic community resulting from the deepening and widening of the river channel may cause a trophic cascading effect that will change the dominance patterns and distribution of some epibenthic species, and 3) Hydrologic alterations may affect annual recruitment patterns into the estuary, especially for transient species.

7.3 Methodology

Marshes and boundary wetlands in the Cape Fear River estuary provide a variety of habitats, especially in the tidally influenced areas that have both intertidal and shallow subtidal edge habitats. We use two sampling methods, Breder traps and drop traps, to target fauna with different utilization patterns. Breder trap sampling targets bottom oriented organisms that utilize the intertidal marsh habitat during the period of inundation. Breder traps are a passive form of sampling that average use patterns over a several hour period. This method has the advantage of being reliably deployed among a variety of structures. Drop trap sampling targets those organisms that utilize the shallow subtidal or “edge” habitat. It is an instantaneous method that provides reliable estimates for both bottom oriented and pelagic species, with the advantage of allowing high replication but it is difficult to deploy within heavy structure.

Breder traps are used to sample small fish and crustaceans utilizing areas within the vegetated marsh or wooded swamp. The traps are constructed of clear acrylic (31 cm length X 16 cm height X 15 cm width). When submerged these traps are transparent and catch epibenthic fish and crustaceans passively, as they move into the tidal marshes. At each station traps are placed at three tidal heights; lower intertidal (near mean low water), mid intertidal (submerged ~1m depth at mean high water), and upper intertidal (submerged ~ 0.5m at mean high water). Two sets of five traps are set at each tidal height with the opening oriented toward the channel or downstream. The orientation of the traps is based on preliminary data that indicates this positioning is optimal for obtaining highest catches. Each trap is secured to the substrate to ensure it maintains proper orientation. All traps are set on the rising tide and traps are allowed to “fish” for two hours. This time period is based on previous work and represents a compromise between obtaining higher catches and reducing possible loss due to escape or to predation or cannibalism among organisms within the traps. All organisms caught are identified to lowest possible taxon and representative specimens are preserved for verification. All organisms caught are measured for total length. Breder trap sampling is conducted at 9 sites: P11, P12, and P13 in the mainstem Cape Fear River, P6, P7, and P8 in the Northeast Cape Fear, and P2 and 2 sites at P3 in Town Creek.

Drop traps sample those epibenthos utilizing the lower marsh edge or shallow subtidal regions adjacent to the marsh. The drop trap is an aluminum square that is 1m on a side and 1m high with mesh netting and floats attached to the top edge to prevent organisms from escaping. The trap is deployed from a boat using a large boom that suspends the trap 6-8 feet above the water surface. When the trap is released its weight drives it into the substrate and seals the bottom to prevent organisms from escaping beneath the trap (each drop is checked for an adequate bottom seal upon deployment to ensure that organisms cannot escape). Eighteen replicate drops are made in the shallow subtidal areas at each station. Replicate samples are taken at least 10m apart and at least 20 minutes is allowed between each sample. Once the trap is secured the contents are removed using a steel frame sweep net with a 2mm mesh. The trap is considered empty when five consecutive sweeps of the entire trap yield no organisms. All organisms caught are identified, enumerated, and measured (total length). Representatives of each species caught are preserved for verification. Drop sampling is conducted at the same sites as Breder trap sampling, except that the two P3 subsites are sampled as one site.

Drop trap and Breder trap sampling was conducted during the same time window for all stations. At least 24 hours separated the use of each method at a site. While breder traps were deployed on a single day per site, drop trap samples were collected over a 2-3 day period for each site. The collection of drop trap data over a multi-day sampling period gives a more accurate evaluate of the use of the subtidal areas adjacent to each site.

For this report, we present mean abundance of epibenthos for each station by year and season (reflecting seasonal variation in faunal abundances). To evaluate potential trends and community level responses, analyses for this report focus on differences in diversity and total fauna by season across years. Breder trap data was analyzed with year/site/season as main effects, along with the appropriate interactions, using an analysis of variance approach. Results of that analysis indicated strong interactions with season (reflecting differential recruitment patterns for different species), so the data was analyzed separately for each season (fall and spring). This analysis detected some interactions, however these interactions where attributed to sites with low abundances or no fauna captured during one or more sampling events. Data collected from drop trap sampling was also analyzed for community level responses, examining per sample species richness, total fauna abundance, and diversity by year/site/season. As with the Breder trap data, interactions related to site differences seem to reflect the patchy nature of the epibenthos and magnitude effects with some sites having very larges numbers of juvenile fish. Abundances of all fauna were log transformed before analyses to meet assumptions of non-heterogeneity of variances. For both Breder trap and drop trap data a 1-way Analysis of Variance was used to compare abundances among years at each site within a season type. Where significant year affects were found, an SNK test was used to distinguish among years.

7.4 Faunal patterns

After verification of all identifications, a total of 49 taxa have been collected using Breder traps since the initiation of this project in fall 1999. The mean abundance along with standard errors for each taxa by site/season/year is presented in Tables 7.4-1 through 7.4-9. Drop trap sampling collected a total of 84 taxa (Tables 7.4-10 through 7.4-17). While relative fish abundances, total fish abundance and species richness varied among sites (especially among tributaries), spring tended to have the highest total abundances and tended to be dominated by only a few taxa, although spring showed the highest measures of species richness indicating the presence of many rare taxa at this time. Based on the number of new species collected with each additional sampling season this community is near the apex of the cumulative species curve.

Diversity and total abundance showed both temporal and site differences for both Breder and drop trap methods (Tables 7.4-18 through 7.4-23). Peak total abundances were observed at 6 of 9 sites during spring 2004 and spring 2005. Breder traps showed a higher degree of variability among years (Tables 7.4-1 through 7.4-9). The increases observed for the 2004 and 2005 spring seasons tended to reflect strong recruitment of *Leiostomus xanthurus* (spot), Lagodon rhombiodes (pinfish), juvenile *Paralichthys* sp. (flounder) and a number of larval clupeidae. Comparison of diversity over the same time period showed peak diversity in the spring of 2004 and 2005 for Breder trap catches and peak diversity in spring 2004 for drop trap sampling for 4 out of 7 significant year differences. Other than this there were no other clear patterns for diversity.

Table 7.4-1a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P2 (Mouth of Town Creek).

	Fall 1999			**Fall 2000**			**Fall 2001**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)
Dormitator maculates	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0.30 (0.15)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.30 (0.21)	0.40 (0.22)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.70 (0.33)	0.90 (0.28)	0.60 (0.27)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)
Syngnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculates	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I insect	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-1b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P2 (Mouth of Town Creek).

	Fall 2002			Fall 2003			Fall 2004		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0.30 (0.15)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	010 (0.10)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)
Dormitator maculates	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	3.50 (0.82)	4.50 (1.18)	3.70 (1.68)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0.20 (0.13)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulates	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Palaemonetes pugio	0.60 (0.31)	0.80 (0.42)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0.40 (0.31)	0.60 (0.27)	0.50 (0.22)
Paralichthys lethostigma	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Syngnathidae	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculates	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I insect	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	1.5 (1.19)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0.80 (0.80)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-1c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P2 (Mouth of Town Creek).

	Spring 2000			Spring 2001			Spring 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0.10 (0.10)	0 (0)
Ctenogobius shufeldti	0.10 (0.10)	0.20 (0.13)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.10 (0.10)	0.10 (0.10)	0 (0)	0.20 (0.13)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Hirudinea	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomas xanthurus	9.90 (2.66)	5.00 (1.62)	5.30 (2.33)	0 (0)	0 (0)	0.50 (0.22)	1.00 (0.54)	0.50 (0.27)	0.30 (0.21)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Palaemonetes pugio	1.50 (0.43)	1.40 (0.52)	2.30 (1.04)	2.00 (0.82)	1.10 (0.53)	1.30 (0.68)	1.00 (0.45)	1.00 (0.47)	0.10 (0.10)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-1d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P2 (Mouth of Town Creek).

	Spring 2003			Spring 2004			Spring 2005		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.70 (0.33)	0.20 (0.13)	0.30 (0.15)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.22)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.40 (0.27)	0.30 (0.30)	0.10 (0.10)	0.40 (0.22)	0.40 (0.22)	0.10 (0.10)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0.10 (0.10)	0.30 (0.15)	0.20 (0.13)	1.00 (0.33)	0 (0)	0 (0)	0 (0)
Fudulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.30 (0.15)	0.20 (0.20)
Hirudinea	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)
Leiostomas xanthurus	0 (0)	0 (0)	0 (0)	2.60 (1.64)	2.20 (0.44)	1.40 (0.40)	2.10 (0.48)	3.30 (0.67)	2.90 (0.74)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.80 (0.44)	0.80 (0.51)	1.70 (0.96)	1.60 (0.67)	1.80 (0.36)	1.30 (0.50)	1.90 (0.41)	3.80 (0.57)	1.50 (0.43)
Paralichthys dentatus	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0.10 (0.10)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
U/I larval fish	0.20 (0.13)	0.80 (0.59)	0.10 (0.10)	0.30 (0.30)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-2a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P3A (Town Creek).

	Fall 1999			Fall 2000			Fall 2001		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Ctenogobius shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.80 (0.47)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.20 (.20)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0.40 (0.16)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.50 (0.31)	1.10 (0.41)	0.50 (0.31)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.70 (0.52)	0.40 (0.31)	0.50 (0.31)	0.30 (0.15)	0.40 (0.22)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.20 (0.20)	0.40 (0.22)	0.80 (0.25)	0 (0)	0.20 (0.20)	0.30 (0.21)	0.20 (0.20)	0.10 (0.10)	0 (0)

Table 7.4-2b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P3A (Town Creek).

	Fall 2002			Fall 2003			Fall 2004		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0.10 (0.10)	0.40 (0.22)	0.30 (0.15)	0.30 (0.21)	0 (0)
Farfantepenaeus aztecus	0.33 (0.33)	0.20 (0.13)	0.70 (0.50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.22 (0.15)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.70 (0.40)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.11 (0.11)	0.20 (0.20)	0.20 (0.20)	0.60 (0.50)	1.60 (0.85)	1.20 (0.57)	0 (0)	0 (0)	0.10 (0.10)
Gobiosoma sp.	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.33 (0.24)	0.80 (0.61)	0.90 (0.69)	0.20 (0.133)	0.40 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0.33 (0.17)	0.50 (0.31)	0.50 (0.40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-2c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P3A (Town Creek).

	Spring 2000			Spring 2001			Spring 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Ctenogobius shufeldti	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0.10 (0.10)	1.00 (0.54)	1.00 (0.89)	1.50 (0.82)	0.10 (0.10)	0.30 (0.15)	0.80 (0.51)
Gambusia affinis	0.10 (0.10)	0.50 (0.27)	0.50 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0.30 (0.21)	0.60 (0.43)	0.90 (0.69)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	1.50 (0.62)	2.10 (0.57)	2.00 (0.67)	0.10 (0.10)	1.40 (0.56)	1.80 (0.53)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	1.00 (0.30)	1.10 (0.48)

Table 7.4-2d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P3A (Town Creek).

	Spring 2003			Spring 2004			Spring 2005		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.90 (0.35)	0.80 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.20 (0.20)	0.50 (0.27)	0.89 (0.35)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.10 (0.10)	0.60 (0.34)	0 (0)	1.70 (0.86)	0.80 (0.29)	0 (0)	0.70 (0.52)	2.40 (1.48)	1.80 (0.92)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	1.30 (0.60)	1.50 (0.52)	2.70 (1.75)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0.70 (0.60)	0.70 (0.60	0 (0)	0.50 (0.40)	0.30 (0.21)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0 (0)	0.20 (0.13)	0.90 (0.55)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Uca minax	0.60 (0.31)	0.80 (0.29)	1.11 (0.31)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0.20 (0.20)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-3a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P3B (Town Creek).

	Fall 1999			**Fall 2000**			**Fall 2001**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.50 (0.22)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus confluentus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	1.00 (0.56)	0.20 (0.13)	1.00 (0.49)	0 (0)	0.30 (0.15)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	1.60 (0.40)	1.50 (0.76)	1.20 (0.59)	0.20 (0.13)	0.10 (0.10)	0.10 (0.10)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.50 (0.22)	0.20 (0.13)	0.40 (0.16)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-3b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P3B (Town Creek).

	Fall 2002			**Fall 2003**			**Fall 2004**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Cambaridae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.50 (0.50)	0.10 (0.10)	0 (0)	0 (0)
Farfantepenaeus aztecus	0.40 (0.22)	0.40 (0.27)	0.80 (0.51)	0.10 (0.10)	0.15 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus confluentus	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.10 (0.10)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.50 (0.40)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.10 (0.10)	0.80 (0.49)	0.90 (0.41)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	1.20 (0.49)	1.80 (0.61)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	1.10 (0.90)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-3c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P3B (Town Creek).

	Spring 2000			Spring 2001			Spring 2002		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)
Gambusia affinis	0.10 (0.10)	0.20 (0.13)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0.40 (0.31)	1.10 (0.67)	0.60 (0.40)	2.30 (0.83)	2.30 (1.04)	0.60 (0.34)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.10 (0.10)	0.10 (0.10)	1.20 (0.53)	0.30 (0.15)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.70 (0.26)	1.20 (0.49)	0.60 (0.34)	0.20 (0.13)	0.60 (0.40)	0.90 (0.50)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0.30 (0.15)	2.60 (0.73)

Table 7.4-3d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P3B (Town Creek).

	Spring 2003			Spring 2004			Spring 2005		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.30 (0.15)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.60 (0.27)	0 (0)	0.30 (0.21)	0.30 (0.21)	0 (0)
Dormitator maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox niger	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Fundulus heteroclitus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.30 (0.21)	0 (0)	0.20 (0.13)	0.90 (0.35)	0.20 (0.20)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	030 (0.15)	1.80 (0.92)	0.10 (0.10)	0.30 (0.21)	0.40 (0.22)	0.30 (0.21)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	0.10 (0.10)	0.30 (0.15)	0.80 (0.39)	0.20 (0.13)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)
Paralichthys dentatus	0.20 (0.20)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.30 (0.21)	0.10 (0.10)	0 (0)
Uca minax	0 (0)	0.80 (0.47)	1.40 (0.60)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0.20 (0.13)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-4a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P6 (Eagle Island).

	Fall 1999			Fall 2000			Fall 2001		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0.11 (0.11)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	1.00 (0.60)	0.80 (0.44)	0.20 (0.13)	1.90 (1.49)	1.40 (0.45)	2.89 (1.74)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I fish	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-4b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P6 (Eagle Island).

	Fall 2002			Fall 2003			Fall 2004		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	1.50 (0.50)	0.90 (0.55)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.40 (0.31)
Farfantepenaeus aztecus	0 (0)	0.90 (0.23)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.50)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.50 (0.22)	0.50 (0.31)	4.22 (4.10)	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0.50 (0.22)	0.20 (0.13)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sygnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.50 (0.22)	0 (0)	0.10 (0.10)	0 (0)
U/I fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-4c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P6 (Eagle Island).

	Spring 2000			Spring 2001			Spring 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.13)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0.30 (0.21)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0 (0)
Diving beetle	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.90 (0.59)	1.00 (0.89)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.20 (0.20)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0.20 (0.20)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)
Paralichthys dentatus	0.30 (0.30)	0.40 (0.22)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Uca pugnax	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0 (0)	0.60 (0.31)	0 (0)	0 (0)	0 (0)

Table 7.4-4d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P6 (Eagle Island).

	Spring 2003			Spring 2004			Spring 2005		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.30 (0.15)	0.50 (0.22)	0.10 (0.10)	0.50 (0.27)	0.90 (0.69)	0 (0)
Diving beetle	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.50 (0.27)	0.10 (0.10)	0.20 (0.13)	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.70 (0.21)	0.40 (0.27)	0.50 (0.27)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	8.70 (2.87)	14.30 (4.37)	32.90 (12.60)	5.30 (2.82)	11.4 (3.53)	9.3 (3.00)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.70 (0.40)	2.30 (1.08)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Paralichthys dentatus	2.30 (0.67)	1.80 (0.63)	0.80 (0.59)		0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.20 (0.20)	0 (0)	0.20 (0.13)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-5a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P7 (Indian Creek).

	Fall 1999			Fall 2000			Fall 2001		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.20 (0.13)	0 (0)
Dormitator maculatus	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropterus salmoides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.60 (0.34)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-5b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P7 (Indian Creek).

	Fall 2002			Fall 2003			Fall 2004		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Callinectes sapidus	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.50 (0.22)	0.10 (0.10)	0.40 (0.22)	0 (0)	0.10 (0.10)	0.20 (0.13)
Dormitator maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.40 (0.31)
Farfantepenaeus aztecus	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Gobiosoma sp.	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropterus salmoides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.11 (0.11)	1.56 (0.56)	0.56 (0.34)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.40 (0.31)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-5c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P7 (Indian Creek).

	Spring 2000			Spring 2001			Spring 2002		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Clupidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.40 (0.16)	1.10 (0.28)	4.33 (3.85)	0.40 (0.22)	0.60 (0.22)	0.30 (0.21)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.31)	0 (0)	0 (0)	0 (0)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	6.60 (2.35)	8.20 (3.57)	2.80 (0.66)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)
Paralichthys lethostigma	0 (0)	0.30 (0.15)	0.67 (0.44)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)

Table 7.4-5d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P7 (Indian Creek).

	Spring 2003			Spring 2004			Spring 2005		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Clupidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.70 (0.42)	0.70 (0.30)	0 (0)	1.00 (0.49)	0.70 (0.40)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.10 (0.10)	0 (0)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.10 (0.10)	3.00 (1.30)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.20 (2.09)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	1.60 (0.78)	0.90 (0.31)	1.10 (0.35)	0.40 (0.22)	1.10 (0.46)	0.50 (0.22)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.40 (0.16)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	1.20 (0.33)	0.70 (0.37)	0.50 (0.17)	0.10 (0.10)	0 (0)	0 (0)
Rhithropanopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0.10 (0.10)	0.33 (0.17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-6a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P8 (Dollisons Landing).

	Fall 1999			Fall 2000			Fall 2001		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Cambarus robustus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus confluentus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	1.0 (1.0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0.20 (0.13)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-6b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P8 (Dollisons Landing).

	Fall 2002			Fall 2003			Fall 2004		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Cambarus robustus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	1.10 (0.60)	0.50 (0.27)	0.20 (0.13)	0 (0)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus confluentus	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus diaphanus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.27)	1.60 (0.64)	2.20 (1.17)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.78 (0.66)	0.30 (0.21)	1.10 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)

Table 7.4-6c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P8 (Dollisons Landing).

	Spring 2000			Spring 2001			Spring 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Amphipoda	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.30 (0.15)	0.30 (0.21)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	1.00 (0.80)	0 (0)	0 (0)	0 (0)

Table 7.4-6d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P8 (Dollisons Landing).

	Spring 2003			Spring 2004			Spring 2005		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Amphipoda	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0.30 (0.15)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.60 (0.40)	0.50 (0.31)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.10 (0.10)	0.11 (0.11)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	1.20 (0.61)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-7a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P11 (Smith Creek).

	Fall 1999			Fall 2000			Fall 2001		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)
Ctenogobius shufeldti	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Dormitator maculatus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.27)	0.50 (0.22)	0.20 (0.13)
Fundulus heteroclitus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.30 (0.21)
Lepomis macrochirus	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.80)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphorus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.10 (0.10)	0.20 (0.13)	8.50 (4.17)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-7b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P11 (Smith Creek).

	Fall 2002			Fall 2003			Fall 2004		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	2.10 (0.85)	0.70 (0.40)	0.30 (0.21)	0.10 (0.10)	0 (0)	0.10 (0.10)
Dormitator maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	1.20 (0.70)	1.80 (0.61)	1.20 (0.36)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0.40 (0.16)
Lutjanus griseus	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Palaemonetes pugio	0.40 (0.31)	0.40 (0.22)	0.40 (0.16)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphorus plagiusa	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0.10 (0.10)	0 (0)	0.40 (0.40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-7c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P11 (Smith Creek).

	Spring 2000			Spring 2001			Spring 2002		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.10 (0.10)
Lagodon rhomboides	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	1.30 (0.76)	0.30 (0.21)	1.0 (0.39)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.61)	0.50 (0.22)	1.10 (0.60)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0.10 (0.10)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.16)	0.40 (0.31)	1.20 (0.63)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)

Table 7.4-7d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P11 (Smith Creek).

	Spring 2003			Spring 2004			Spring 2005		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.50 (0.67)	1.10 (0.46)	0.60 (0.31)
Leiostomus xanthurus	0 (0)	0.10 (0.10)	0 (0)	6.80 (2.08)	9.70 (3.85)	25.90 (11.83)	15.30 (5.11)	26.60 (8.71)	19.20 (4.62)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.33 (0.17)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0.89 (0.56)	0.10 (0.10)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)

Table 7.4-8a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P12 (Rat Island).

	Fall 1999			Fall 2000			Fall 2001		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Dormitator maculatus	0.60 (0.34)	0 (0)	0.40 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.10 (0.10)	0 (0)	0 (0)	0.40 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Syngnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0.20 (0.13)	0.10 (0.10)	0.10 (0.10)	0 (0)	1.70 (0.53)	0 (0)	0 (0)	0 (0)

Table 7.4-8b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P12 (Rat Island).

	Fall 2002			Fall 2003			Fall 2004		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.60 (0.43)	0.60 (0.40)	0.60 (0.31)	0.30 (0.15)	0.70 (0.26)	0 (0)
Dormitator maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0.30 (0.21)	0.30 (0.15)	0.89 (0.26)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0.44 (0.24)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Syngnathidae	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-8c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P12 (Rat Island).

	Spring 2000			Spring 2001			Spring 2002		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.30 (0.15)
Ctenogobius shufeldti	0.60 (0.31)	0.60 (0.31)	0.10 (0.10)	0 (0)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0.80 (0.49)	0 (0)	0 (0)	0.30 (0.21)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.20 (0.13)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Leiostomas xanthurus	0.20 (0.20)	0.20 (0.13)	0.10 (0.10)	0.50 (0.31)	0.60 (0.27)	0.80 (0.49)	0 (0)	0.20 (0.13)	0 (0)
Lepomis macrochirus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.30 (0.21)	0.50 (0.22)	0 (0)	1.00 (0.39)	0.50 (0.27)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0.30 (0.21)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)
Rhithropanopeus herbstii	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-8d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P12 (Rat Island).

	Spring 2003			Spring 2004			Spring 2005		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.22)	0.60 (0.22)	0.10 (0.10)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.90 (0.41)	0.55 (0.25)	0.90 (0.50)	0 (0)	0 (0)	0 (0)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6.20 (1.54)	3.30 (1.15)	2.90 (0.62)
Leiostomas xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	13.20 (3.03)	15.40 (5.68)	11.40 (8.63)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.67 (0.55)	1.60 (0.93)	3.50 (3.06)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)
Paralichthys dentatus	0.22 (0.15)	1.40 (1.09)	0.40 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Rhithropanopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.50 (0.98)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.81 (0.55)	1.50 (0.43)	0 (0)	0 (0)	0 (0)

Table 7.4-9a. Mean abundance (SE) for epibenthic fauna collected during fall (1999-2001) breder trap samples at station P13 (Fishing Creek).

	Fall 1999			Fall 2000			Fall 2001		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Dormitator maculatus	0.10 (0.10)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.60 (0.60)	0.30 (0.30)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0.40 (0.31)	0.40 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-9b. Mean abundance (SE) for epibenthic fauna collected during fall (2002-2003) breder trap samples at station P13 (Fishing Creek).

	Fall 2002			Fall 2003			Fall 2004		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.60 (0.34)	0.20 (0.13)	0.20 (0.13)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Dormitator maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)
Lutjanus griseus	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Palaemonetes pugio	0.30 (0.30)	0 (0)	0.40 (0.40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-9c. Mean abundance (SE) for epibenthic fauna collected during spring (2000-2002) breder trap samples at station P13 (Fishing Creek).

	Spring 2000			Spring 2001			Spring 2002		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.80 (0.42)	0.40 (0.22)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.30 (1.10)	0.60 (0.34)	0.20 (0.13)
Lepomis macrochirus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0.10 (0.10)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	0.60 (0.43)	0.80 (0.33)	0 (0)	0 (0)	0 (0)

Table 7.4-9d. Mean abundance (SE) for epibenthic fauna collected during spring (2003-2004) breder trap samples at station P13 (Fishing Creek).

	Spring 2003			**Spring 2004**			**Spring 2005**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0.70 (0.33)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.50 (0.50)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	1.30 (0.47)	1.00 (0.49)	1.50 (0.70)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.34)	0.20 (0.13)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	2.00 (1.31)	2.20 (1.04)	5.50 (2.87)	0.10 (0.10)	0.40 (0.31)	0.10 (0.10)
Lepomis macrochirus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0.20 (0.20)	0.40 (0.22)	0 (0)	0 (0)	0.10 (0.10)
Uca minax	0.20 (0.13)	0.40 (0.16)	0.90 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-10a. Mean abundance (SE) for epibenthic fauna collected in fall drop trap sampling at station P2 (Mouth of Town Creek).

	1999	2000	2001	2002	2003	2004
Alpheus heterochelis	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Anchoa mitchelli	0.44 (0.44)	0 (0)	1.39 (1.33)	0.28 (0.23)	0 (0)	5.22 (5.11)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anthinnae	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Bivalve	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0.17 (0.17)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.33 (0.14)	0.67 (0.23)	0.78 (0.42)	0.11 (0.11)	0 (0)	0.67 (0.40)
Ctenogobius shufeldti	0.44 (0.20)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.11 (0.08)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
Farfantepenaeus aztecus	0 (0)	0.17 (0.09)	0.17 (0.12)	3.50 (1.35)	0.44 (0.23)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Gerreidae	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.13)	0 (0)
Gobiesox punctulatus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Litopenaeus setiferus	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	1.00 (0.48)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.06 (0.06)
Menidia beryllina	0 (0)	0 (0)	0.39 (0.24)	0 (0)	0 (0)	0.22 (0.22)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.33 (0.24)	0 (0)
Menticirrhus saxatilis	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0.44 (0.27)	0 (0)	0 (0)	0.06 (0.06)
Mugil cephalus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Palaemonetes intermedius	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.27 (0.27)
Palaemonetes pugio	1.39 (0.88)	0.78 (0.61)	2.11 (0.81)	0.06 (0.06)	3.06 (0.73)	2.56 (1.25)
Panopeus herbstii	0.06 (0.06)	0.50 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Penaeid	0 (0)	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)
Rangia cuneata	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0.06 (0.06)	0 (0)	0.06 (0.06)	0.06 (0.06)	0 (0)	0.22 (0.10)
Sciaenidae sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Smphurus plagiusa	0 (0)	0 (0)	0 (0)	1.00 (0.44)	0.11 (0.11)	0 (0)
Syngnathid sp.	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Trachinotus falcatus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)

Table 7.4-10b. Mean abundance (SE) for epibenthic fauna collected in spring drop trap sampling at station P2 (Mouth of Town Creek).

	2000	**2001**	**2002**	**2003**	**2004**	**2005**
Alpheus heterochelis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anchoa mitchelli	0 (0)	0 (0)	2.00 (1.94)	0 (0)	0 (0)	0.11 (0.11)
Anguilla rostrata	0 (0)	0.06 (0.06)	0.28 (0.14)	0 (0)	0 (0)	0 (0)
Anthinnae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bivalve	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	21.67 (20.80)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.06 (0.06)	0.06 (0.06)	0.50 (0.15)	0.17 (0.09)	0.17 (0.09)	1.17 (0.40)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.22)
Ctenogobius shufeldti	0.17 (0.09)	0.06 (0.06)	0.11 (0.08)	0 (0)	0.06 (0.06)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	3.06 (2.37)	0 (0)	1.22 (0.75)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Gerreidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiesox punctulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.44 (0.23)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.13)
Leiostomus xanthurus	7.0 (2.41)	62.89 (40.60)	0.22 (0.17)	0 (0)	4.61 (1.39)	7.94 (2.11)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	5.61 (3.20)	1.28 (0.75)	1.39 (1.13)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	4.56 (4.38)	0.89 (0.35)	0 (0)
Menticirrhus saxatilis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	9.06 (1.89)	16.56 (4.12)	0 (0)	0.06 (0.06)
Mugil cephalus	0 (0)	1.39 (0.78)	0.89 (0.35)	0 (0)	0 (0)	0 (0)
Palaemonetes intermedius	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Palaemonetes pugio	5.56 (1.35)	20.22 (10.05)	37.94 (16.39)	1.33 (0.55)	1.33 (0.53)	16.22 (6.10)
Panopeus herbstii	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.11 (0.08)	0 (0)	0.11 (0.08)	0.17 (0.12)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	1.61 (0.57)	0.06 (0.06)	0.11 (0.08)
Penaeid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rangia cuneata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0.11 (0.11)
Sciaenidae sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma reticulatum	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Syngnathid sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trachinotus falcatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-11a. Mean abundance (SE) for epibenthic fauna collected in fall drop trap sampling at station P3 (Town Creek).

	1999	2000	2001	2002	2003	2004
Anchoa mitchelli	1.36 (0.63)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	14.33 (11.63)
Anguilla rostrata	0.06 (0.04)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.11 (0.10)	0 (0)	0.11 (0.08)	0 (0)	0.39 (0.18)	0.22 (0.10)
Cambarus robustus	(0.03) (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.53 (0.34)	0.33 (0.16)	0.17 (0.09)	0 (0)	1.22 (0.45)	2.89 (0.59)
Eucinostomus argenteus	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2.11 (1.02)
Evorthodus lyricus	0 (0)	0 (0)	0 (0)	0 (0)	2.44 (0.89)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	2.33 (0.67)	3.56 (2.05)	0 (0)
Fundulus heteroclitus	0.12 (.08)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0.06 (0.06)
Fundulus majalis	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.81 (0.72)	1.83 (0.62)	3.39 (1.72)	0.11 (0.08)	1.00 (0.58)	1.50 (0.78)
Gobionellus oceanicus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.56 (0.22)
Gobiosoma bosc	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.28 (0.14)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.09 (0.07)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
Menidia beryllina	0.06 (0.04)	0 (0)	0.06 (0.06)	0 (0)	2.89 (2.38)	0.22 (0.17)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0.78 (0.34)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis petersoni	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	1.39 (0.83)	0.56 (0.30)	0.17 (0.12)	2.11 (1.03)
Panopeus herbstii	0.06 (0.06)	0.17 (0.12)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 .06 (0.06)	0.06 (0.06)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0.56 (0.50)
Sesarma cinereum	0 (0)	0.28 (0.11)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sygnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Trinectes maculatus	2.14 (1.05)	0.06 (0.06)	0 (0)	0 (0)	0.06 (0.06)	0.06 (0.06)
Uca minax	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0.67 (0.61)
Uca pugnax	0.92 (0.47)	5.06 (0.96)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-11b. Mean abundance (SE) for epibenthic fauna collected in spring drop trap sampling at station P3 (Town Creek).

	2000	2001	2002	2003	2004	2005
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anguilla rostrata	0.09 (0.07)	0.28 (0.16)	0 (0)	0 (0)	0.06 (0.06)	0.06 (0.06)
Brevoortia tyrannus	0 (0)	0 (0)	4.00 (2.50)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.20 (0.11)	0.28 (0.16)	0.56 (0.27)	0 (0)	0.56 (0.22)	0.22 (0.13)
Cambarus robustus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.39 (0.33)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.39 (0.23)
Ctenogobius shufeldti	0.28 (0.12)	0.73 (0.39)	0.22 (0.17)	0 (0)	5.78 (1.79)	0.17 (0.12)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Evorthodus lyricus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	1.39 (1.16)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.11 (0.11)	0 (0)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	2.00 (1.28)	0.06 (0.06)	0.22 (0.13)	0 (0)	1.11 (0.54)	0 (0)
Lagodon rhomboides	0.34 (0.19)	0 (0)	0.22 (0.10)	0 (0)	0.11 (0.11)	1.39 (0.89)
Leiostomus xanthurus	0 (0)	0.28 (0.17)	0 (0)	0 (0)	36.39 (13.62)	31.22 (12.62)
Lepomis macrochirus	1.59 (1.70)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.06 (0.06)	0 (0)	4.33 (2.22)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	50.44 (21.43)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	2.89 (1.19)	0 (0)	0.06 (0.06)	0 (0)
Notropis petersoni	0 (0)	0.22 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0.17 (0.09)	7.17 (3.23)	0 (0)	10.39 (5.52)	3.94 (3.08)
Panopeus herbstii	0.06 (0.04)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.45 (0.16)	1.17 (0.59)	0 (0)	0.11 (0.08)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.44 (0.35)	0.22 (0.13)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Sesarma cinereum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Sygnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.31 (0.17)	0.39 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.50 (0.22)	0 (0)	2.28 (2.22)
Uca pugnax	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0.78 (0.46)	0 (0)	0.39 (0.39)	0 (0)

Table 7.4-12a. Mean abundance (SE) for epibenthic fauna collected in fall drop trap sampling at station P6 (Eagle Island).

	1999	2000	2001	2002	2003	2004
Anchoa mitchelli	0 (0)	1.00 (0.37)	0 (0)	0 (0)	0 (0)	9.72 (6.05)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0.22 (0.10)	0.06 (0.06)	0 (0)	0.06 (0.06)	0.39 (0.16)	0.33 (0.16)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Corbicula fluminea	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.06 (0.06)	0.22 (0.15)	0 (0)	0 (0)	1.61 (0.51)	0.33 (0.11)
Eucinostomus harengulus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.83 (0.35)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gerres cinereus	0 (0)	0.28 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)	0 (0)
Lepomis sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.09)
Menidia beryllina	0.11 (0.08)	0 (0)	0.17 (0.09)	0.72 (0.42)	0 (0)	0.28 (0.18)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	5.44 (3.28)	1.00 (1.00)	0 (0)	0 (0)	14.72 (8.95)
Panopeus herbstii	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.17)
Sesarma cinereum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Trinectes maculatus	0.44 (0.20)	0.11 (0.08)	0 (0)	0 (0)	0.50 (0.25)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	2.44 (1.72)	0 (0)	0 (0)

Table 7.4-12b. Mean abundance (SE) for epibenthic fauna collected in spring drop trap sampling at station P6 (Eagle Island).

	2000	2001	2002	2003	2004	2005
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anguilla rostrata	0 (0)	0.11 (0.08)	0.05 (0.05)	0.50 (0.25)	0.11 (0.08)	0 (0)
Callinectes sapidus	0 (0)	0.06 (0.06)	0.53 (0.18)	0.22 (0.10)	0.61 (0.18)	0.56 (0.25)
Clupeidae	0 (0)	0 (0)	0.21 (0.21)	0 (0)	0 (0)	37.78 (14.75)
Corbicula fluminea	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Ctenogobius shufeldti	0.11 (0.11)	0.11 (0.08)	0 (0)	0 (0)	1.78 (0.33)	0.67 (0.21)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0.32 (0.27)	0.06 (0.06)	0 (0)	0 (0)
Fundulus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Gerres cinereus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.11 (0.08)	0.39 (0.24)
Leiostomus xanthurus	0 (0)	1.72 (0.72)	1.00 (0.52)	0 (0)	25.61 (9.85)	2.50 (1.02)
Lepomis sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Menidia beryllina	0 (0)	20.83 (10.04)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.28 (0.28)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0.32 (0.32)	0 (0)	3.44 (2.55)	0 (0)
Mugil cephalus	0 (0)	0.22 (0.17)	0.16 (0.16)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	1.78 (0.60)	8.21 (2.52)	0.22 (0.13)	0.22 (0.13)	2.11 (0.82)
Panopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.17 (0.12)	1.17 (0.56)	0.11 (0.11)	0.44 (0.23)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0.26 (0.13)	10.83 (3.68)	11.00 (3.82)	1.06 (0.36)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.05 (0.05)	0 (0)	0.06 (0.06)	0.17 (0.17)
Sesarma reticulatum	0 (0)	0 (0)	0.05 (0.05)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.06 (0.06)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-13a. Mean abundance (SE) for epibenthic fauna collected in fall drop trap sampling at station P7 (Indian Creek).

	1999	2000	2001	2002	2003	2004
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.33 (0.14)	0 (0)
Callinectes sapidus	0.06 (0.06)	0 (0)	0.17 (0.09)	0 (0)	0.11 (0.07)	0.06 (0.06)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)	0 (0)
Ctenogobius shufeldti	0.06 (0.06)	0.28 (0.18)	0.22 (0.10)	0 (0)	2.11 (0.38)	1.17 (0.35)
Dorosoma cepedianum	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Dorosoma pretense	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox lucius	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Fundulus heteroclitus	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.06 (0.06)	0.17 (0.17)	0 (0)	0 (0)	0 (0)	0 (0)
Gerres cinereus	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus oceanicus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0.28 (0.23)	0 (0)	0.33 (0.28)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.28 (0.19)
Rangia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0.06 (0.06)	0.44 (0.15)	0 (0)	2.06 (0.60)	0.06 (0.06)
U/I juvenile fish	0 (0)	0.39 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)

Table 7.4-13b. Mean abundance (SE) for epibenthic fauna collected in spring drop trap sampling at station P7 (Indian Creek).

	2000	2001	2002	2003	2004	2005
Anguilla rostrata	0.71 (0.34)	0.11 (0.11)	0 (0)	0.39 (0.28)	1.06 (0.41)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.22)
Ctenogobius shufeldti	0.29 (0.14)	0 (0)	0 (0)	0 (0)	1.72 (0.53)	0.22 (0.13)
Dorosoma cepedianum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Dorosoma pretense	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox lucius	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gerres cinereus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.35 (0.35)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	38.78 (21.08)	0 (0)
Menidia beryllina	0 (0)	0.28 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.28 (0.23)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0.28 (0.28)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.47 (0.29)	1.56 (0.56)	0 (0)	1.50 (0.48)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0.11 (0.08)	0 (0)	9.50 (2.14)	1.72 (0.40)
Rangia sp.	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0.61 (0.22)	0 (0)	0 (0)
U/I juvenile fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-14a. Mean abundance (SE) for epibenthic fauna collected in fall drop trap sampling at station P8 (Dollisons Landing).

	1999	2000	2001	2002	2003	2004
Alosa pseudoharengus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.11 (0.11)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0.11 (0.08)	0 (0)	0.06 (0.06)	0 (0)	2.56 (0.67)	1.00 (0.27)
Cyprinidae	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)
Dorosoma petenense	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Esox niger	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus harengulus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.10)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.22 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0 (0)
Lepomis gibbensis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.06 (0.06)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Notropis chalybaeus	2.94 (1.98)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis petersoni	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.06 (0.06)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Penaeid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithorpanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.06 (0.06)
Sesarma cinereum	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.17 (0.12)	0 (0)	0.11 (0.11)	0.06 (0.06)	4.00 (1.40)	0.28 (0.14)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	1.17 (0.74)	0 (0)	0 (0)
U/I larval fish sp B	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)
Uca pugnax	0 (0)	0.17 (0.12)	0.17 (0.09)	0 (0)	0 (0)	0 (0)

Table 7.4-14b. Mean abundance (SE) for epibenthic fauna collected in spring drop trap sampling at station P8 (Dollisons Landing).

	2000	2001	2002	2003	2004	2005
Anguilla rostrata	0 (0)	0.33 (0.18)	0.39 (0.14)	0.06 (0.06)	0.11 (0.08)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0.22 (0.10)	0 (0)	0.06 (0.06)	0 (0)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	69.78 (45.05)	7.94 (5.06)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	2.17 (0.62)	0.33 (0.11)
Cyprinidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox niger	0 (0)	0 (0)	0 (0)	0.12 (0.08)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Gambusia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.23)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis gibbensis	0 (0)	0 (0)	0 (0)	1.76 (1.76)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.61 (0.39)	0 (0)	0 (0)	0.12 (0.12)	0 (0)	0.11 (0.08)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis chalybaeus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis petersoni	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.11 (0.11)	0.06 (0.06)	0 (0)	1.35 (0.34)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	1.72 (0.40)	0.50 (0.25)
Penaeid	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)	0 (0)
Rhithorpanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma cinereum	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0.06 (0.06)	0.18 (0.13)	0 (0)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish sp B	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-15a. Mean abundance (SE) for epibenthic fauna collected in fall drop trap sampling at station P11 (Smith Creek).

	1999	2000	2001	2002	2003	2004
Anchoa mitchelli	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	1.94 (1.83)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0.06 (0.06)	0.50 (0.25)	0.17 (0.09)	0.22 (0.10)	0 (0)
Ctenogobius shufeldti	0.22 (0.13)	0 (0)	0.06 (0.06)	0 (0)	0.28 (0.16)	0.06 (0.06)
Eucinostomus argenteus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Gambusia holbrooki	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ictalurus furcatus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.78 (0.39)
Logodon rhomboides	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	1.89 (0.64)	0.83 (0.61)	0 (0)	0 (0)	0.22 (0.13)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	1.50 (1.44)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0.28 (0.28)	0.06 (0.06)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	1.56 (0.41)	0.17 (0.17)	0.17 (0.17)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0.83 (0.49)	6.28 (4.30)	3.56 (1.16)	0 (0)	0 (0)
Penaeus setiferus	0 (0)	1.89 (0.85)	0 (0)	0 (0)	0 (0)	0 (0)
Rangia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0.06 (0.06)	0.06 (0.06)	0.17 (0.12)	0 (0)	0.06 (0.06)	0 (0)
Sesarma cinereum	0 (0)	0.72 (0.38)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)
Trinectes maculatus	0.22 (0.17)	0.06 (0.06)	0 (0)	0 (0)	0.33 (0.14)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-15b. Mean abundance (SE) for epibenthic fauna collected in spring drop trap sampling at station P11 (Smith Creek).

	2000	2001	2002	2003	2004	2005
Anchoa mitchelli	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.39 (0.33)	0 (0)
Anguilla rostrata	0.33 (0.16)	0 (0)	0.06 (0.06)	0.11 (0.08)	0 (0)	0 (0)
Callinectes sapidus	0.11 (0.08)	0 (0)	1.17 (0.56)	0.28 (0.11)	0.72 (0.33)	0.26 (0.10)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.42 (0.69)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.16 (0.09)
Ctenogobius shufeldti	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0.72 (0.23)	0.05 (0.05)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0.28 (0.18)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0.33 (0.20)	0 (0)	0 (0)	0 (0)
Ictalurus furcatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.72 (0.50)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0.26 (0.13)
Leiostomus xanthurus	14.83 (9.79)	9.56 (2.30)	1.94 (0.60)	0.39 (0.23)	64.11 (14.63)	16.89 (4.91)
Litopenaeus setiferus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Logodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.22 (0.17)	1.0 (0.76)	0.06 (0.06)	0 (0)	0 (0)	0.05 (0.05)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	2.67 (1.11)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	1.89 (0.87)	0 (0)
Mugil cephalus	0 (0)	0.94 (0.79)	0.17 (0.12)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0.06 (0.06)	0.17 (0.09)	5.20 (2.38)	0.22 (0.13)	0.06 (0.06)	0.05 (0.05)
Paralichthys dentatus	1.17 (0.44)	0.06 (0.06)	0 (0)	16.11 (3.31)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0.28 (0.14)	0 (0)	14.78 (3.73)	1.53 (0.40)
Rangia sp.	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Sesarma cinereum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)

Table 7.4-16a. Mean abundance (SE) for epibenthic fauna collected in fall drop trap sampling at station P12 (Rat Island).

	1999	2000	2001	2002	2003	2004
Alosa aestivalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anchoa mitchilli	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0.11 (0.08)	0.56 (0.27)	0.06 (0.06)	0.11 (0.08)	0.22 (0.17)
Ctenogobius shufeldti	0.11 (0.08)	0.06 (0.06)	0.06 (0.06)	0 (0)	0.72 (0.40)	0.39 (0.16)
Gobionellus oceanicus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.28 (0.23)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.33 (0.23)	0 (0)	0 (0)	0.28 (0.19)
Palaemonetes pugio	0 (0)	1.22 (0.66)	1.56 (0.89)	0.33 (0.16)	0.11 (0.11)	0 (0)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0.06 (0.06)	0.22 (0.10)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma cinereum	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.22 (0.22)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	1.11 (0.54)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)

Table 7.4-16b. Mean abundance (SE) for epibenthic fauna collected in spring drop trap sampling at station P12 (Rat Island).

	2000	2001	2002	2003	2004	2005
Alosa aestivalis	0 (0)	0 (0)	0 (0)	0 (0)	2.56 (2.44)	0 (0)
Anchoa mitchilli	0 (0)	0 (0)	0 (0)	0 (0)	1.67 (1.05)	0 (0)
Anguilla rostrata	0 (0)	0.33 (0.28)	0 (0)	0 (0)	0.17 (0.12)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0.78 (0.26)	0 (0)	0.17 (0.09)	0.11 (0.08)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.39 (2.94)
Ctenogobius boleosoma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.28 (0.14)
Ctenogobius shufeldti	0.06 (0.06)	0.56 (0.23)	0 (0)	0 (0)	1.83 (0.69)	0.17 (0.12)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	1.22 (0.55)
Leiostomus xanthurus	0.11 (0.08)	0 (0)	17.56 (15.35)	0 (0)	16.94 (8.08)	33.11 (9.33)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	8.22 (4.56)	0 (0)
Menidia beryllina	0.17 (0.12)	0.39 (0.39)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)
Palaemonetes pugio	0.06 (0.06)	1.61 (0.93)	1.50 (0.41)	5.94 (2.60)	0 (0)	0.94 (0.61)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Paralichthys dentatus	0.17 (0.12)	0.33 (0.16)	0 (0)	11.44 (3.57)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	1.17 (0.68)	2.22 (1.19)	1.06 (0.30)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.11 (0.08)
Sesarma cinereum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0.11 (0.08)	0.06 (0.06)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)

Table 7.4-17a. Mean abundance (SE) for epibenthic fauna collected in fall drop trap sampling at station P13 (Fishing Creek).

	1999	2000	2001	2002	2003	2004
Alosa aestivalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0.28 (0.28)	0 (0)	0 (0)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Cambarus robustus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Ctenogobius shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	1.39 (0.74)	0.33 (0.18)
Dorosoma petenense	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Esox americanus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.33 (0.16)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0.33 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.39 (0.27)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.72 (0.46)	0 (0)	0 (0)	0.06 (0.06)
Menidia menidia	0 (0)	0 (0)	0 (0)	4.28 (2.51)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.44 (0.29)	0 (0)	0 (0)
Panopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Panopeus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Procambarus robostus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0.11 (0.11)	0.06 (0.06)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.89 (0.89)	0.11 (0.11)	0 (0)
Uca pugnax	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-17b. Mean abundance (SE) for epibenthic fauna collected in spring drop trap sampling at station P13 (Fishing Creek).

	2000	2001	2002	2003	2004	2005
Alosa aestivalis	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Anguilla rostrata	0.17 (0.17)	0.28 (0.14)	0 (0)	0.06 (0.06)	0.11 (0.08)	0.05 (0.05)
Callinectes sapidus	0 (0)	0.17 (0.12)	0.06 (0.06)	0 (0)	0.11 (0.08)	0.05 (0.05)
Cambarus robustus	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	7.05 (5.99)
Ctenogobius shufeldti	0.22 (0.15)	0.17 (0.09)	0.11 (0.08)	0 (0)	1.17 (0.40)	0.16 (0.09)
Dorosoma petenense	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox americanus	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.09)	7.32 (6.07)
Leiostomus xanthurus	0 (0)	0 (0)	0.11 (0.11)	0 (0)	27.22 (5.68)	1.26 (0.57)
Lepomis macrochirus	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	1.39 (0.97)	0.22 (0.22)	6.89 (6.54)	0 (0)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	7.28 (3.11)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Panopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Panopeus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.33 (0.16)	0.56 (0.23)	0 (0)	1.29 (0.50)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.56 (0.20)	1.47 (0.54)
Procambarus robostus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0.24 (0.14)	0 (0)	0 (0)
Trinectes maculatus	0.33 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-18a. Comparison on total abundances by years on log-transformed data from fall Breder trap samples.

Site	F(p)	SNK significance of F (high to low)
Smith Creek (P11)	6.24(.0001)	02a 99ab 03bc 01bc 04bc 00c
Rat Island (P12)	3.94(.0021)	00a 02b 99b 03b 04b 01b
Fishing Creek (P13)	4.74(.0004)	04a 99a 02ab 00b 03b 01b
Town Creek mouth (P2)	41.12(.0001)	02a 04b 00bc 01bc 99cd 03d
Town Creek inner (P3a)	4.25(.0011)	03a 02ab 01ab 00abc 99bc 04c
Town Creek inner (P3b)	20.08(.0001)	02a 00a 99b 03b 01b 04b
Eagle Island (P6)	4.16(.0014)	01a 03a 02a 00ab 04ab 99b
Indian Creek (P7)	3.44(.0054)	02a 04ab 03ab 99ab 01b 00b
Dollisons Landing (P8)	6.61(.0001)	04a 03ab 02ab 99bc 00c 01c

Table 7.4-18b. Comparison on total abundance by years on log-transformed data from spring Breder trap samples.

Site	F(p)	SNK significance of F (high to low)
Smith Creek (P11)	40.09(.0001)	05a 04b 02c 00c 03c 01c
Rat Island (P12)	30.03(.0001)	05a 03b 01b 04b 00b 02b
Fishing Creek (P13)	26.39(.0001)	04a 01b 03bc 05bc 00c
Town Creek mouth (P2)	26.60(.0001)	05a 00a 04a 01b 02b 03b
Town Creek inner (P3a)	1.56(NS)	
Town Creek inner (P3b)	6.44(.0001)	02a 05b 01bc 04bc 00bc 03c
Eagle Island (P6)	30.26(.0001)	04a 05a 03b 02b 01b 00b
Indian Creek (P7)	10.27(.0001)	01a 04b 05b 00b 03c 02c
Dollisons Landing (P8)	6.14(.0001)	01a 04a 05ab 00b 03b 02b

7.4-19a. Comparison of total faunal abundance by years on log-transformed data from fall drop trap samples.

Site	F(p)	SNK significance of F (high to low)
Smith Creek (P11)	4.84(.0005)	00a 01ab 02ab 03b 04b 99b
Rat Island (P12)	2.54(.033)	01a 00a 04ab 03ab 02ab 99b
Fishing Creek (P13)	3.64(.0046)	02a 03b 01b 04b 00b 99b
Town Creek mouth (P2)	1.90(NS)	
Town Creek inner (P3)	4.41(.0010)	04a 03ab 00ab 99b 02b 01b
Eagle Island (P6)	7.28(.0001)	04a 00ab 03bc 02bc 99c 01c
Indian Creek (P7)	9.80(.0001)	03a 04b 00b 01b 02b 99b
Dollisons Landing (P8)	9.74(.0001)	03a 04b 99bc 02bc 01c 00c

7.4-19b. Comparison of total faunal abundance by years on log-transformed data from spring drop trap samples.

Site	F(p)	SNK significance of F (high to low)
Smith Creek (P11)	15.63(.0001)	04a 05b 03b 01b 02bc 00c
Rat Island (P12)	10.20(.0001)	05a 03ab 04bc 02bc 01cd 00d
Fishing Creek (P13)	23.72(.0001)	04a 05b 01c 00c 03c 02c
Town Creek mouth (P2)	3.61(.0047)	02a 01ab 03ab 05ab 00b 04b
Town Creek inner (P3)	22.99(.0001)	02a 04a 05a 01b 00b 03c
Eagle Island (P6)	15.16(.0001)	04a 05ab 01b 02b 03b 00c
Indian Creek (P7)	40.87(.0001)	04a 03b 05b 01bc 00bc 02c
Dollisons Landing (P8)	12.77(.0001)	04a 05b 03b 02b 00b 01b

Table 7.4-20a. Comparison of species richness among years at each site, from fall breder trap sampling.

Site	F(p)	SNK significance of F (high to low)
Town Creek mouth (P2)	8.51(0.001)	02^{a} 01^{ab} 04^{ab} 99^{bc} 00^{bc} 03^{c}
Inner Town Creek (P3A)	3.61(0.03)	02^{a} 03^{ab} 01^{ab} 00^{ab} 99^{ab} 04^{b}
Inner Town Creek (P3B)	4.84(0.01)	02^{a} 00^{ab} 03^{b} 99^{b} 01^{b} 04^{b}
Eagle Island (P6)	3.94(0.02)	03^{a} 00^{ab} 01^{ab} 04^{ab} 02^{ab} 99^{b}
Indian Creek (P7)	NS	
Dollisons Landing (P8)	6.40(0.004)	03^{a} 02^{ab} 99^{ab} 04^{b} 00^{b} 01^{b}
Smith Creek (P11)	4.10(0.02)	02^{a} 99^{ab} 01^{ab} 04^{ab} 03^{ab} 00^{b}
Rat Island (P12)	NS	
Fishing Creek (P13)	7.44(0.002)	04^{a} 99^{ab} 02^{ab} 03^{bc} 00^{bc} 01^{c}

Table 7.4-20b. Comparison of species richness at each site from spring breder trap sampling.

Site	F(p)	SNK significance of F (high to low)
Town Creek mouth (P2)	3.84(0.02)	05^{a} 04^{a} 00^{a} 03^{a} 02^{a} 01^{a}
Inner Town Creek (P3A)	NS	
Inner Town Creek (P3B)	13.41(0.0001)	05^{a} 04^{b} 01^{b} 02^{b} 00^{b} 03^{c}
Eagle Island (P6)	NS	
Indian Creek (P7)	4.41(0.01)	05^{a} 04^{ab} 01^{ab} 00^{ab} 03^{b} 02^{b}
Dollisons Landing (P8)	1.20(0.0005)	04^{a} 01^{a} 00^{a} 03^{a} 05^{a} 02^{b}
Smith Creek (P11)	NS	
Rat Island (P12)	5.11(0.007)	01^{a} 05^{a} 00^{ab} 02^{ab} 03^{ab} 04^{b}
Fishing Creek (P13)	20.5(0.0001)	04^{a} 05^{a} 01^{b} 03^{b} 00^{c}

Table 7.4-21a. Comparison of diversity at each site from fall breder trap sampling.

Site	F(p)	SNK significance of F (high to low)
Town Creek mouth (P2)	6.38(0.004)	01^{a} 04^{a} 02^{a} 99^{ab} 00^{b} 03^{b}
Inner Town Creek (P3A)	5.27(0.008)	02^{a} 03^{ab} 00^{ab} 01^{ab} 99^{bc} 04^{c}
Inner Town Creek (P3B)	NS	
Eagle Island (P6)	6.15(0.004)	03^{a} 04^{ab} 00^{ab} 02^{bc} 01^{bc} 99^{c}
Indian Creek (P7)	NS	
Dollisons Landing (P8)	4.47(0.01)	03^{a} 99^{ab} 02^{b} 00^{b} 01^{b} 04^{b}
Smith Creek (P11)	NS	
Rat Island (P12)	NS	
Fishing Creek (P13)	4.99(0.01)	04^{a} 99^{ab} 02^{ab} 03^{b} 01^{b} 00^{b}

Table 7.4-21b. Comparison of diversity at each site from spring breder trap sampling.

Site	F(p)	SNK significance of F (high to low)
Town Creek mouth (P2)	4.09(0.02)	05^{a} 04^{a} 02^{a} 03^{a} 01^{a} 00^{a}
Inner Town Creek (P3A)	NS	
Inner Town Creek (P3B)	27.60(0.0001)	05^{a} 04^{b} 01^{b} 02^{c} 00^{c} 03^{d}
Eagle Island (P6)	NS	
Indian Creek (P7)	3.56(0.03)	05^{a} 04^{a} 01^{a} 00^{a} 02^{a} 03^{a}
Dollisons Landing (P8)	7.81(0.001)	04^{a} 01^{ab} 00^{bc} 03^{c} 02^{c} 05^{c}
Smith Creek (P11)	NS	
Rat Island (P12)	NS	
Fishing Creek (P13)	11.60(0.0009)	04^{a} 05^{ab} 01^{ab} 03^{b} 00^{c}

Table 7.4-22a. Comparison of species richness at each site from fall drop trap sampling.

Site	F(p)	SNK significance of F (high to low)
Town Creek mouth (P2)	2.47(0.03)	03^{a} 04^{ab} 02^{ab} 01^{ab} 00^{ab} 99^{b}
Inner Town Creek (P3)	6.76(0.0001)	04^{a} 03^{b} 00^{b} 99^{b} 01^{b} 02^{b}
Eagle Island (P6)	6.72(0.0001)	04^{a} 00^{ab} 03^{ab} 02^{bc} 99^{bc} 01^{c}
Indian Creek (P7)	6.50(0.0001)	03^{a} 04^{a} 01^{b} 00^{b} 02^{b} 99^{b}
Dollisons Landing (P8)	11.32(0.0001)	04^{a} 01^{ab} 00^{bc} 03^{c} 02^{c} 05^{c}
Smith Creek (P11)	5.18(0.0003)	00^{a} 01^{b} 03^{b} 02^{b} 04^{b} 99^{b}
Rat Island (P12)	NS	
Fishing Creek (P13)	NS	

Table 7.4-22b. Comparison of species richness at each site from spring drop trap sampling.

Site	F(p)	SNK significance of F (high to low)
Town Creek mouth (P2)	2.75(0.02)	02^{a} 05^{ab} 03^{ab} 00^{ab} 01^{b} 04^{b}
Inner Town Creek (P3)	14.90(0.0001)	02^{a} 04^{a} 05^{b} 01^{b} 00^{b} 03^{c}
Eagle Island (P6)	15.04(0.0001)	04^{a} 05^{ab} 01^{bc} 02^{bc} 03^{b} 00^{c}
Indian Creek (P7)	23.17(0.0001)	04^{a} 03^{b} 05^{bc} 00^{bc} 01^{bc} 02^{c}
Dollisons Landing (P8)	10.88(0.0001)	04^{a} 03^{b} 05^{b} 02^{b} 01^{b} 00^{b}
Smith Creek (P11)	7.74(0.0001)	04^{a} 02^{a} 05^{a} 03^{b} 00^{b} 01^{b}
Rat Island (P12)	7.71(0.0001)	05^{a} 04^{ab} 02^{ab} 03^{bc} 01^{bc} 00^{c}
Fishing Creek (P13)	15.05(0.0001)	04^{a} 05^{b} 01^{c} 00^{c} 03^{c} 02^{c}

Table 7.4-23a. Comparison of diversity by year for fall drop trap samples.

Site	F(p)	SNK significance of F (high to low)
Smith Creek(P11)	7.49(.0001)	00a 01b 02b 03b 04b 99b
Rat Island (P12)	3.01(.014)	01a 00ab 02ab 03ab 04ab 99b
Fishing Creek P(13)	1.04(NS)	
Town Creek mouth (P2)	2.63(.028)	03a 02ab 01ab 04ab 00ab 99b
Town Creek inner (P3)	5.56(.0001)	04a 03ab 00ab 03b 99b 01b
Eagle Island (P6)	3.16(.011)	04a 00a 03ab 02ab 99ab 01b
Indian Creek (P7)	4.95(.0004)	03a 00b 04b 01b 99b 02b
Dollisons Landing (P8)	6.63(.0001)	03a 04a 02b 99b 00b 01b

Table 7.4-23b. Comparison of diversity by year for spring drop trap samples.

Site	F(p)	SNK significance of F (high to low)
Smith Creek (P11)	5.93(.0001)	02a 04ab 05abc 00bc 03c 01c
Rat Island (P12)	3.03(.014)	02a 05a 04ab 03ab 01ab 00b
Fishing Creek(P13)	7.98(.0001)	04a 05a 01b 00b 03b 02b
Town Creek mouth(P2)	0.60(NS)	
Town Creek Inner (P3)	6.98(.0001)	02a 04ab 01ab 05b 00b 03c
Eagle Island (P6)	5.93(.0001)	04a 05a 01a 02a 03a 00b
Indian Creek(P7)	9.61(.0001)	04a 03b 00b 05b 01b 02b
Dollisons Landing (P8)	4.78(.0006)	04a 02b 05b 03b 01b 00b

8.0 SENSITIVE HERBACEOUS VEGETATION SAMPLING

8.1 Summary

There was a rebound of the dominant plant species at most of the sensitive herbaceous vegetation sampling stations. This follows hydrologic events that included salinity incursions at most stations followed a year later by freshwater flooding generated in the Cape Fear River and Northeast Cape Fear River watersheds from precipitation events (Hackney et al. 2005).

Some stations include Rat Island and Black River, did not follow this pattern. Vegetation at Rat Island has continued in its conversion from forest swamp brackish marsh. The Black River Station vegetation was not influenced by a salinity event, only prolonged flooding. Recovery from flooding has not taken place since most of the plant material was killed and/or removed by extensive and persistent flooding.

8.2 Introduction and Background

As a continuation of the Wilmington Harbor monitoring program in the Cape Fear River Estuary, seven stations are examined annually for plant species content and cover by sensitive herbaceous vegetation (Table 8.2-1). Each of the stations is subject to the semi-diurnal astronomical tides experienced within the lower Cape Fear River estuarine system. Six of the seven stations, during the years of the sampling, have experienced exposure to ocean-derived salt as well as freshwater tidal flooding. Ocean--derived salts have not been sampled at the Black River Station. Generalized vegetation zones along 50-meter wide transects at each station have been defined and described as a part of an earlier report (CZR Incorporated 2001). Methods and results of previous sampling and observations at these stations are covered in earlier reports (CZR Incorporated 2001, CZR Incorporated 2002, Hackney et al. 2002a, Hackney et al. 2002b, Hackney et al. 2003, Hackney et al. 2005).

Table 8.2-1. Locations, names and numbers of sensitive herbaceous vegetation monitoring stations in the Wilmington Harbor monitoring project, Cape Fear River Estuary, North Carolina.

Station Name	Stream Name	Station Number
Inner Town Creek	Town Creek	P3
Indian Creek	Cape Fear River	P7
Dollisons Landing	Cape Fear River	P8
Black River	Cape Fear River (near Black River)	P9
Rat Island	Northeast Cape Fear River	P12
Fishing Creek	Northeast Cape Fear River	P13
Prince George Creek	Northeast Cape Fear River	P14

8.3 Methodology

Data collection methods remain largely the same as those used during previous iterations of sensitive herbaceous vegetation sampling (CZR Incorporated 2002, Hackney et al. 2002a, Hackney et al. 2002b, Hackney et al. 2003, Hackney et al. 2005). Data for plant species presence and percent cover have been gathered from permanently variable-size plots and fixed-size plots.

Variable-size polygons have been sampled at five stations. Inner Town Creek (P3), Black River (P9), Rat Island (P12), Fishing Creek (P13), and Prince George Creek (P14) have been used to demonstrate yearly size, shape, and plant species cover variations within polygons. These variable-size plots have boundaries that delineate discrete sensitive herbaceous vegetation assemblages that continue to be easily recognized at this point in the project. Polygons with fixed, four-sided plots were originally chosen as representatives of larger, more widespread sensitive herbaceous vegetation assemblages at two stations, Indian Creek (P7) and Dollisons Landing (P8) (CZR Incorporated 2001).

During the second week of August, 2004, when herbaceous vegetation reached its full seasonal development, sensitive herbaceous sampling stations were visited. Polyvinyl chloride (PVC) stakes were added, moved, or removed in order to remark polygons. Each stake was renumbered and flagged as necessary. At each station plant species seen in each polygon were listed and their contributed cover percentages were recorded. Position data were recorded using GPS (Global Positioning System) instruments during the third week of January 2005 at each of the five stations. Details of the GPS data gathering process are covered in earlier reports (Hackney et al 2002a, Hackney et al. 2002b).

Field personnel responsible for and involved in gathering data for sensitive herbaceous vegetation and GPS have remained the same each year.

8.4 Sensitive Herbaceous Vegetation

The sampling period for sensitive herbaceous vegetation for the current year followed growing seasons in 2001, 2002, and 2003 during which unusual hydrologic events pulsed through the project area. A period of record-breaking regional drought in 2001 and 2002 was accompanied by profound salinity intrusions into usually freshwater portions of the Cape Fear River estuary. Drought was followed by record-breaking freshwater flooding through the Cape Fear River Estuary during which freshwater flushed all but the lowest portions of estuarine system. Flood events were attributed to abundant precipitation within contributing watersheds. By October and November of 2003, the hydrological extremes of the preceding years returned to more nearly normal flows (Hackney et al. 2005). The effects of these hydrological events on habitats and growth and distribution of sensitive herbaceous plant species can still be observed in tidal swamp forest communities.

Data covering sensitive herbaceous vegetation are presented below for each of the sampling stations (Tables 8.41-1 through 8.47-1). Polygon data are presented for baseline and current stations (Figures 8.41-1 through 8.47-1). Presentation of the GPS polygon data is now limited to baseline data (for year 2000) and data for the current year (2004) for greater clarity of presentation. Presentation of GPS data from interim years of sensitive herbaceous vegetation sampling are covered in previous reports (CZR Incorporated 2001, CZR Incorporated 2002, Hackney et al. 2002a, Hackney et al. 2002b, Hackney et al. 2003, Hackney et al. 2005) and will be referenced as needed in the current text. Data comparing measured areas (ft^2) of polygons through all years are now presented as a single table in Section 8.41, Inner Town Creek (Table 8.41-2).

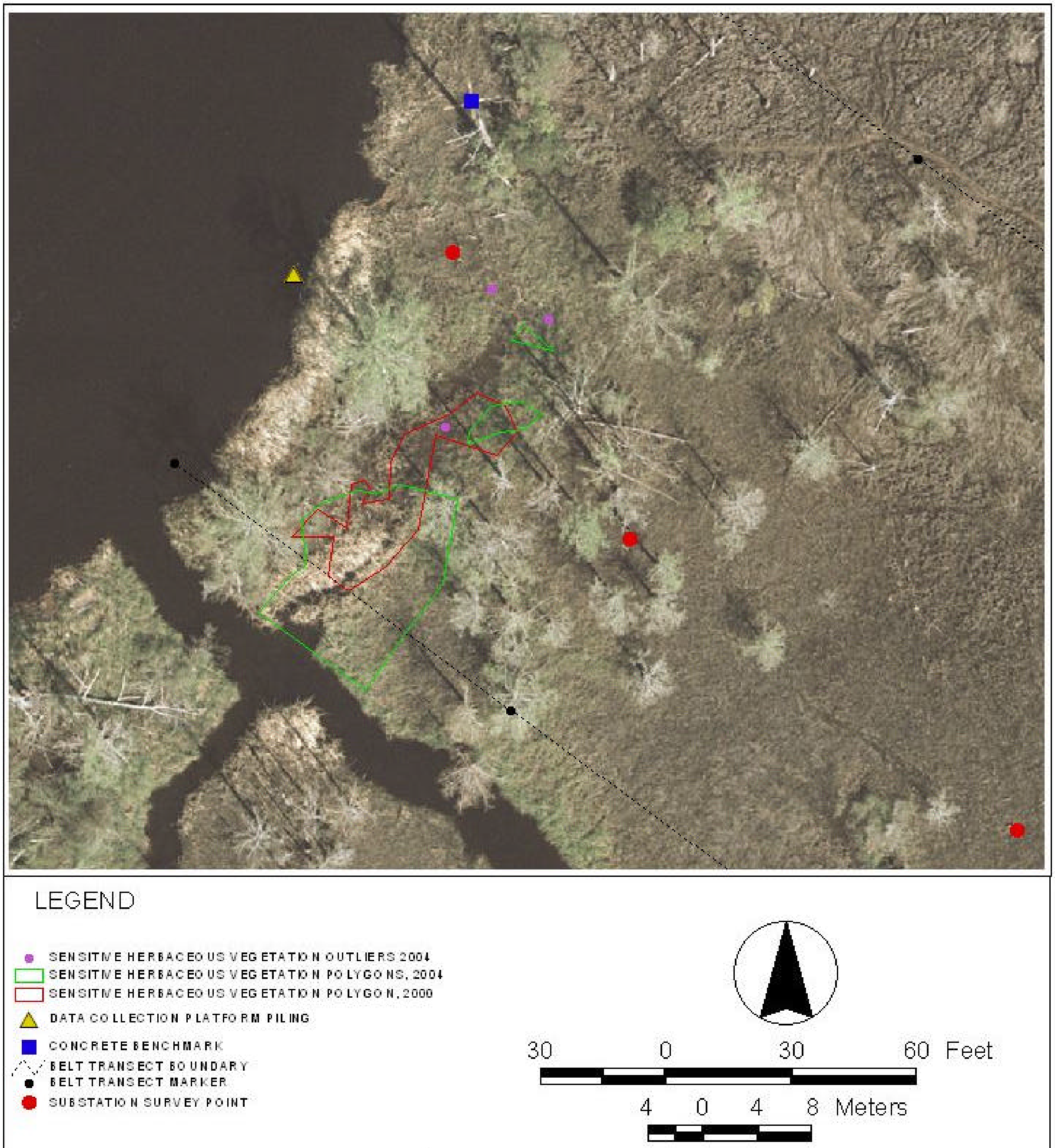
Additional variables considered important during collection and presentation of the data are discussed below for each station. Some of these variables include (1) changes of sensitive herbaceous species, (2) abrupt shifts in dominance of sensitive herbaceous species, (3) changes in cover contributions of sensitive herbaceous species within delineated polygons, (4) variations of shapes and sizes of polygons, and (5) habitat-related hydrological factors up to the sampling time in August.

8.41 Inner Town Creek

The subaerial extent of *Zizaniopsis miliacea*, the dominant sensitive herbaceous species being monitored at the Inner Town Creek site (P3), has continued to expand beyond the initial boundaries established during the 2000 monitoring (Figure 8.41-1). Additionally, as compared to the area established last year, the polygon has increased in area by more than 50 ft^2 and formed two additional polygons, outlier polygon B and outlier polygon C, to the northeast of the main (A) stand (Table 8.41-1 and see Hackney et al. 2003). These new polygons have a combined cover of nearly 140 ft^2, for a combined increase of nearly 200 ft^2. Sensitive herbaceous species data from outliers of the main polygon, separate polygons B and C, are presented below (Table 8.41-2).

This year the outliers have grown sufficiently that they could be treated as polygons. Additional outlier points established this year may be points from which to extend the boundaries of the polygon even further to the northeast in subsequent years. Further expansion of the main body (A) of the stand to the northwest is becoming apparent. This expansion, in particular, is away from locations where the habitat is currently considered optimum. Rhizomes of the plant seem to be invading a low tidal levee that parallels Town Creek on the west side of the sensitive herbaceous species polygon. The levee separates the polygon and a regularly flooded shelf along the creek. This levee once supported two cypress trees (*Taxodium ascendens*), now dead as a result of extended salt water flooding. West of the levee along the shelf is an additional stand of *Zizaniopsis miliacea* with intermixed stems of *Spartina cynosuroides*. Joining of these two stands may take place with erosion of the intervening levee.

Plant species found intermixed with *Zizaniopsis miliacea* within the polygons are, in part, the same as those seen in 2000, *Sagittaria lancifolia*, *Peltandra virginica*, and *Carex hyalinolepis* (Table 8.41-2). Additional species found in 2001 have continued to persist in the main polygon. The sudden change in cover of *Carex hyalinolepis* from



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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2000 AND 2004 AT STATION P3 (TOWN CREEK), WILMINGTON HARBOR MONITORING PROJECT, TOWN CREEK, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE:TOWNCR2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 30 FEB 2005	FIGURE 8.41-1

Table 8.41-1. Comparisons of areas (ft^2) of sensitive herbaceous vegetation polygons for years 2000, 2001, 2002, 2003 and 2004 at sensitive herbaceous vegetation monitoring stations, Wilmington Harbor monitoring project, Town Creek, North Carolina.

Station Name	Year 2000	Year 2001	Year 2002	Year 2003	Year 2004
Inner Town Creek A	710	1772.5	1311	1326	1378.69
Inner Town Creek B Outlier	--	--	--	--	91.44
Inner Town Creek C Outlier	--	--	--	--	47.93
Indian Creek	129.78	129.78	281.88[a]	281.88	281.88
Dollisons Landing	404.52	404.52	286.12[a]	286.12	286.12
Black River	431.00	1120.00	913.02	567.78	69.45
Rat Island	532.94	532.94	532.94	532.94	532.94
Fishing Creek	1522.20	1646.10	971.91	682.14	2613.60
Prince George Creek	3931.15	3669.31	5190.20	5265.43	5227.20

[a]Changes in area are caused by an artifact of shift to winter GPS data collection (Hackney et al. 2003).

Table 8.41-2. Comparisons of percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, 2002, 2003, and 2004 at the Inner Town Creek Station (P3), Wilmington Harbor monitoring project, Town Creek, North Carolina.

Species	Year r 2000	2001	2002	2003	2004
			Polygon A		
Zizaniopsis miliacea	70	60	20	50	60
Sagittaria lancifolia	5	20	5	10	10
Peltandra virginica	3	<1	<1	10	<1
Carex hyalinolepis	1	10	10	40	1
Typha latifolia	--	10	10	10	10
Schoenoplectus americanus	--	--	10	10	10
			Outlier Polygon B		
Zizaniopsis miliacea	--	--	--	--	10
Peltandra virginica	--	--	--	--	<1
Carex hyalinolepis	--	--	--	--	<1
Typha latifolia	--	--	--	--	10
Schoenoplectus americanus	--	--	--	--	<1
			Outlier Polygon C		
Zizaniopsis miliacea	--	--	--	--	20
Typha latifolia	--	--	--	--	10
Schoenoplectus americanus	--	--	--	--	<1

40% in 2003 to 1% 2004 is notable. Human rhizome damage or rhizome competition between *Zizaniopsis miliacea* and *Carex hyalinolepis* may be possible causes.

Sensitive herbaceous vegetation at Inner Town Creek continues to show signs of recovery from the 2002 season of inundation by high salinity water. Cover values for Zizaniopsis miliacea and Peltandra virginica are significantly higher than for last year. Three outlier clumps of Zizaniopsis miliacea have reappeared east of the main polygon where this species was dominant in 2000 and 2001 (Table 8.41-1, Figure 8.41-1). The relative sizes of the 2002 polygon and main 2003 polygon, however, are similar. The increase in cover by Carex hyalinolepis during 2003 may be attributable to proliferation of rhizomes of this species among the somewhat weakened rhizomes of Zizaniopsis miliacea. It is also possible the rhizomes of the two species were already mixed within the polygon and the diminished cover of last year's Zizaniopsis miliacea gave an advantage to a somewhat more tolerant Carex hyalinolepis.

It is difficult to predict a course of events at the Inner Town Creek sensitive herbaceous vegetation sample station. Coalescence of the entire local population of Zizaniopsis miliacea is a possibility. During the previous two years such an event did not seem possible since the plant was loosing ground to increasing salinity. Now the plant has begun increasing in cover following the suboptimum conditions that prevailed during active high salinity flooding. Rejuvenation of rhizome growth seems to have been promoted by subsequent freshwater flushing of the sediments. Perhaps release of rhizome competition combined with some unknown effect (s) of the salinity event was also responsible for renewed growth. Cover by Carex hyalinolepis and Peltandra virginica has declined since project inception. Interestingly, no new species have recruited to the site.

Vegetative reproductive strategies of Zizaniopsis miliacea include culm fasciculation. This process results in the proliferation of one or more node/internode complexes that readily disarticulate in wind from the tops of growing culms and act as propagula. These propagula fall to or float from the site, spreading genetically identical material. This process was noted this year. Last year there subaerial reproductive efforts were limited to spring flowering tops that died before setting seed. This year browning and spotting of some Zizaniopsis miliacea leaves was noted. The highest salinities occurred near sampling time. According to preliminary summary data salinities of 12-13.50 ppt occurred in June, July and August.

8.42 Indian Creek

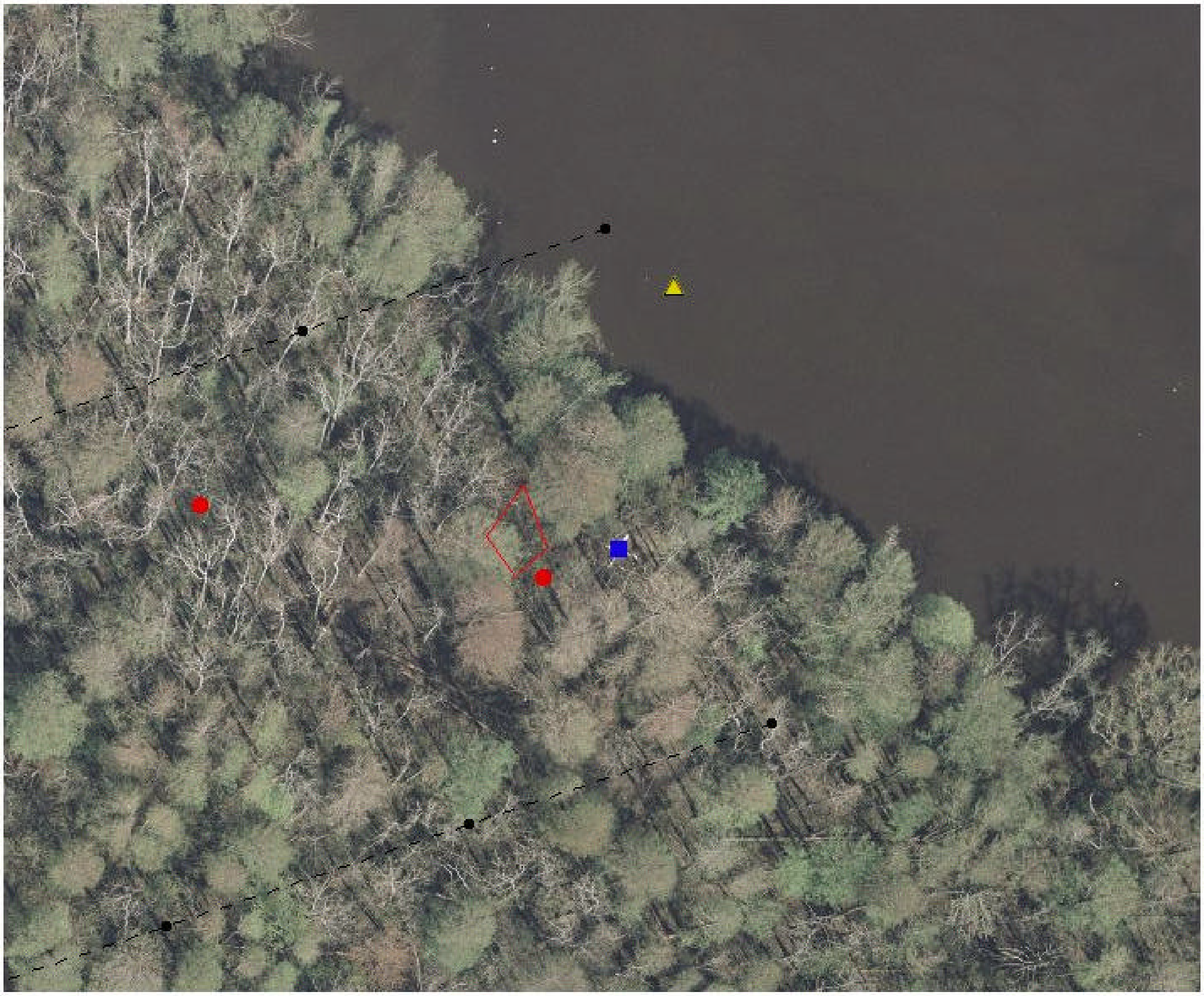
As in previous years the sensitive herbaceous vegetation polygon at Indian Creek is a simple four-sided figure marked by flagged trees located at each corner (Figure 8.42-1). No actual polygon size changes have occurred since the 2000 (Table 8.42-1). Apparent changes are an artifact of GPS data collection under two differing conditions (Hackney et al. 2002b).

Saururus cernuus has rebounded from rhizome material following the salinity event, but many other species noted originally have not reappeared. The decrease in competition from other species may have been responsible for the rapid increase in cover by *Saururus cernuus* this year to a cover value greater than originally noted in 2000. *Polygonum punctatum*, not observed for the last two growing seasons, was noted again this year. *Commelina virginica* was not noted this year. Two new species were noted, *Hymenocallis* floridana and *Cinna arundinacea*.

The polygon is still sparsely covered following the salinity event and the subsequent flooding. *Impatiens capensis*, an annual and therefore not a sensitive herbaceous species, has at least temporarily seeded to the area. It contributed a 20-percent cover value within the polygon and is often a species of disturbed hydric soils. *Toxicodendron radicans*, a woody vine dependent upon hummocks for growth in swamp forests and therefore also not a sensitive herbaceous species, was first seen this year, possibly favored by disturbance in the polygon.

Disturbance has come in three forms at the Indian Creek polygon. There was perturbation by salinity spiking followed by flooding. With loss of cover and the effects of higher-than-normal tides a small rivulet was noted last year in the center of the polygon. Continued erosion through the center of the polygon has been responsible for additional soil changes and redistribution of habitat space. As predicted last year, these changes have already begun to favor a new set of species. It has become apparent that, at least at this station, the direct results of salinity events do not necessarily result directly in loss of cover by one set of species and an attainment of cover by a new set of species. Several, or many, intermediate transitional stages may be manifested first.

There are no indications of damage or change to woody vegetation in and around the polygon at Indian Creek. Changes were observed in the herb layer only. Recent data indicate only very slight increases in river water salinity values along the Cape Fear River at Indian Creek since last year (Hackney et al. 2005 and data from June, July, and August 2004).



LEGEND

- SENSITIVE HERBACEOUS VEGETATION POLYGON
- DATA COLLECTION PLATFORM PILING
- CONCRETE BENCHMARK
- BELT TRANSECT BOUNDARY
- BELT TRANSECT MARKER
- SUBSTATION SURVEY POINT

100 0 100 Feet

20 0 20 Meters

DAVID M. DUMOND ECOLOGICAL SERVICES AND CONSULTING 225 CHEYENNE TRAIL WILMINGTON, NC 28409 PHONE (910)799-0363	SENSITIVE HERBACEOUS VEGETATION POLYGON FROM YEAR 2003 AT STATION P7 (INDIAN CREEK), WILMINGTON HARBOR MONITORING PROJECT, CAPE FEAR RIVER, NORTH CAROLINA WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: INDIANC2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 30 FEBRUARY 2005	FIGURE 8.42-1

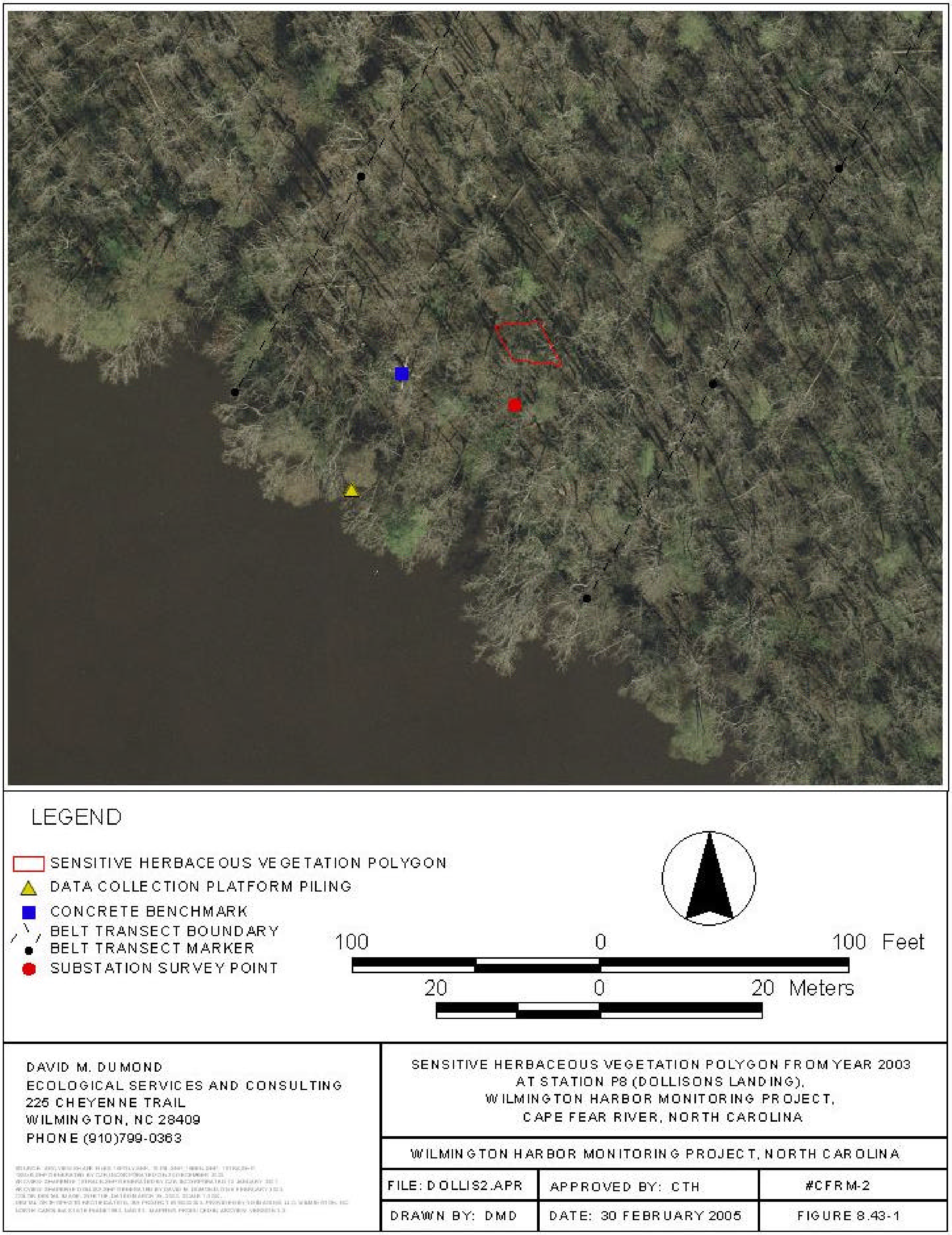
Table 8.42-1. Comparisons of percent cover contributions by sensitive herbaceous species in the sampling polygon at the Indian Creek Station (P7), Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Species			**Year**		
	2000	**2001**	**2002**	**2003**	**2004**
Saururus cernuus	2	1	--	2	20
Polygonum arifolium	2	10	--	1	1
Cicuta maculata	5	2	<1	2	1
Polygonum punctatum	<1	<1	--	--	<1
Commelina virginica	<1	2	1	<1	--
Carex crinita var. *brevicrinus*	<1	<1	10	--	--
Carex hyalinolepis	<1	2	--	1	<1
Symphyotrichum elliottii	<1	--	--	--	--
Triadenum walteri	<1	<1	--	--	--
Lycopus virginicus	<1	--	--	--	--
Galium sp.	<1	--	--	--	--
Phanopyrum gymnocarpum	--	<1	2	1	1
Peltandra virginica	--	--	<1	--	--
Boehmeria cylindrica	--	<1	--	--	--
Polygonum virginianum	--	--	--	1	--
Chasmanthium latifolium	--	--	--	1[a]	--
Hymenocallis floridana	--	--	--	--	<1
Cinna arundinacea	--	--	--	--	<1

[a]Possible misidentification. Species may have been *Cinna arundinacea*.

8.43 Dollisons Landing

The polygon at Dollisons Landing is also a fixed, four-sided figure marked by flagged trees at the corners with essentially no changes in shape on the ground since the beginning of the project (Figure 8.43-1). Data for current GPS locations of the corners were recollected during the winter of 2002 during leafless canopy conditions. The position of this polygon is shown in Figure 8.43.1. Cover data from all years for the sensitive herbaceous vegetation polygon are presented below (Table 8.43.1).


LEGEND
SENSITIVE HERBACEOUS VEGETATION POLYGON
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNDARY
BELT TRANSECT MARKER
SUBSTATION SURVEY POINT
100
0
100 Feet
20
0
20 Meters
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SENSITIVE HERBACEOUS VEGETATION POLYGON FROM YEAR 2003
AT STATION P8 (DOLLISONS LANDING),
WILMINGTON HARBOR MONITORING PROJECT,
CAPE FEAR RIVER, NORTH CAROLINA
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA
FILE: DOLLIS2.APR
APPROVED BY: CTH
#CFRM-2
DRAWN BY: DMD
DATE: 30 FEBRUARY 2005
FIGURE 8.43-1

As at Indian Creek, *Saururus cernuus* growth seems to have been enhanced following the salinity event, recovery, and subsequent flooding. Ocean derived salt has not been a factor in this reach of the Cape Fear River during the 2004 growing season (Hackney et al. 2005 and data from June, July, and August 2004). Numerous other species have not recovered since only five of the species originally occurring at this site in 2000 also appeared in 2004. Three species have appeared again this year after being absent last year. One of these, *Boehmeria cylindrica*, may be characterized as being somewhat weedy in nature, often thriving in some wet soils, following disturbance. *Murdannia keisak* and *Bidens* sp., annuals are considered sensitive herbaceous species, have appeared in the polygon for the first time this year. *Smilax rotundifolia*, a woody vine, was also present for the first time.

Table 8.43-1. Comparisons of percent cover contributions by sensitive herbaceous species in the sampling polygon at the Dollisons Landing Station (P8), Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Species			**Year**		
	2000	**2001**	**2002**	**2003**	**2004**
Saururus cernuus	30	20	35	10	40
Polygonum arifolium	10	25	3	--	--
Boehmeria cylinidrica	<1	--	<1	--	1
Rumex verticillatus	<1	--	2	--	<1
Cicuta maculata	2	--	2	--	<1
Carex sp.	1	--	--	--	--
Polygonum punctatum	1	1	3	--	--
Peltandra virginica	2	1	3	1	<1
Carex crinita	<1	2	--	--	--
Dulichium arundinaceum	<1	--	--	--	--
Triadenum walteri	<1	--	--	--	--
Eryngium aquaticum	--	3	1	<1	--
Pontederia cordata	--	<1	--	<1	--
Hymenocallis crassifolia[a]	--	--	<1	<1	<1
Alternanthera philoxeroides	--	--	<1	--	--
Proserpinaca palustris	--	--	--	--	<1
Ipomoea sp. (?)	--	--	--	--	<1

[a]Name change from 2003 does not represent a species change.

No changes in the general health of woody species at the Dollisons Landing Station were noted.

8.44 Black River

The Black River Station was not impacted by ocean-derived salt during the salinity events of the 2002. However, continued use of *Ludwigia palustris* as a definitive sensitive herbaceous species at the

Black River Station is questionable (Table 8.44-1, Table 8.41-1, Figure 8.44-1). Comparisons between polygon configurations for 2001, 2002, and 2003 may be reviewed in an older report (Hackney et al. 2005).

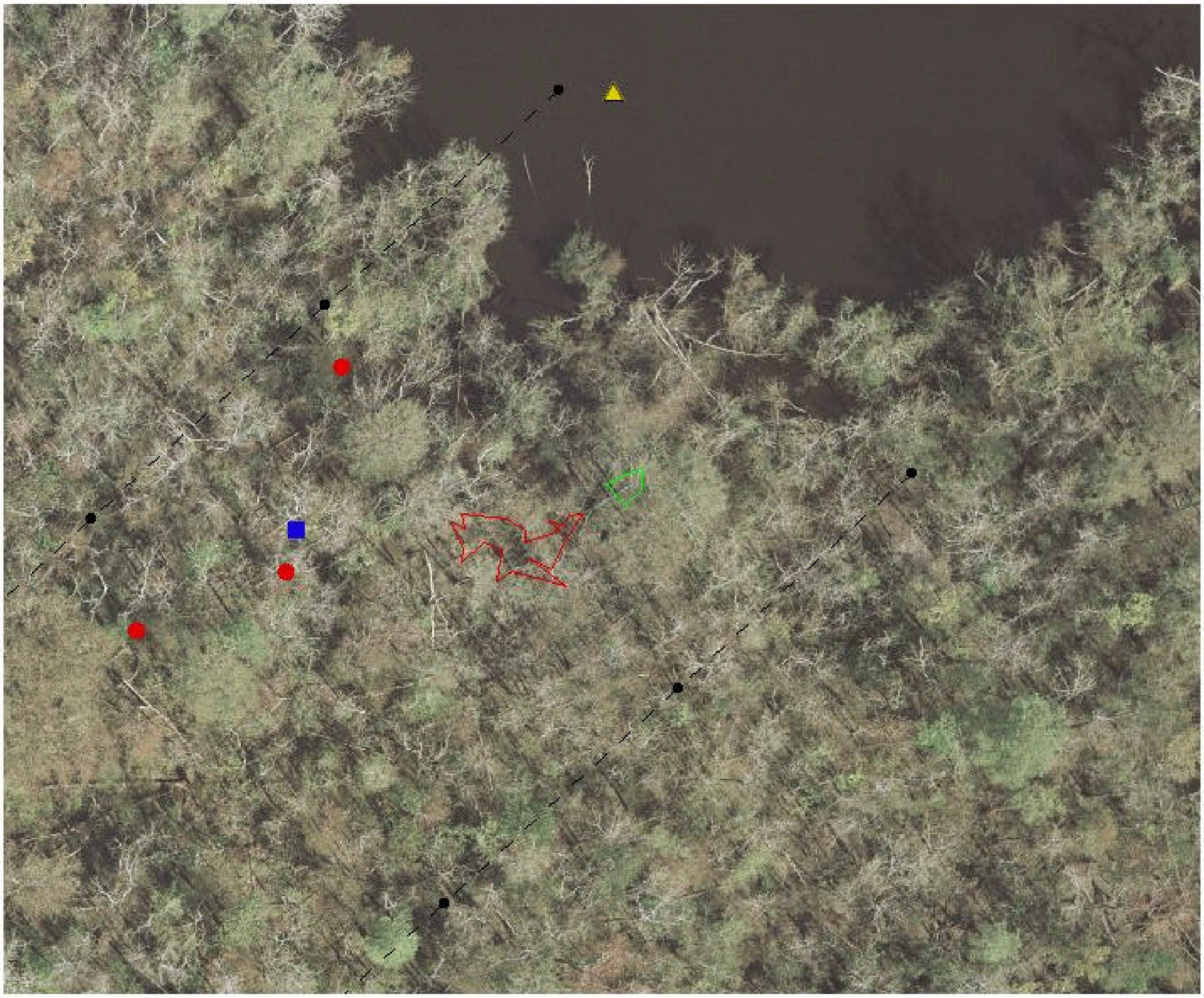
The boundary of the polygon marking *Ludwigia palustris* has been considerably reduced this year due to the effects of flooding. The future value of this species as a salt sensitive species may be compromised by its sensitivity to prolonged freshwater flooding. This species has basically disappeared from previous polygons as a result of flooding. Following the extended flooding of 2003 (Hackney et al. 2005) it appeared to be sensitive to anaerobic conditions, to undergo fragmentation, and then to subsequently die or be washed away. A few stem segments have reestablished in the small polygon marked for this growing season (2004). With such strategies for dispersal, continued value of *Ludwigia palustris* as a salt sensitive species seems useless. Other species found in the polygons that remain in the existing polygon also have limited use due to their tendency to also occur on hummocks. A different species should be selected for use at this site at a different location.

One of the difficulties with selection of a new sensitive herbaceous species at this site is the limited extent of regular tidal flooding. This extent is generally marked by growth of a line of the liverwort, *Porella pinnata* L. To the southwest of this natural line elevation increases and regular tides become more infrequent. Below the line, the only consistently occurring species subject to regular tidal flux has been *Ludwigia palustris*. Distribution of *Porella pinnata* is subject to micro-topographic changes related to substrate (wood or bark) movement. Movements of the thalli of individuals of this species could be expected. *Saururus cernuus* occurs within the belt transect, but apparently only above regular tidal flux.

Amaranthus cannabinus was noted for the first time at the site within the belt transect. This species does not regularly occur outside oligohaline tidal marsh habitats.

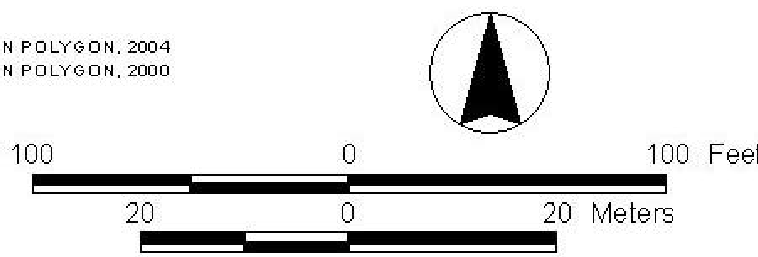
Table 8.44-1. Comparisons of percent cover contributions by sensitive herbaceous species in polygons from years 2000 and 2004 at the Black River (P9), Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Species			**Year**		
	2000	**2001**	**2002**	**2003**	**2004**
Ludwigia palustris	50	20	20	1	5
Polygonum punctatum	--	15	1	--	1
Polygonum arifolium	--	1	<1	--	--
Symphyotrichum elliottii	--	2	<1	1	<1
Scutellaria lateriflora	--	--	<1	--	--
Boehmeria cylindrica	--	--	<1	--	<1



LEGEND

- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2004
- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
- DATA COLLECTION PLATFORM PILING
- CONCRETE BENCHMARK
- BELT TRANSECT BOUNDARY
- BELT TRANSECT MARKER
- SUBSTATION SURVEY POINT



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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2000 AND 2004 AT STATION P9 (BLACK RIVER), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: BLACKR2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 30 FEBRUARY 2005	FIGURE 8.44-1

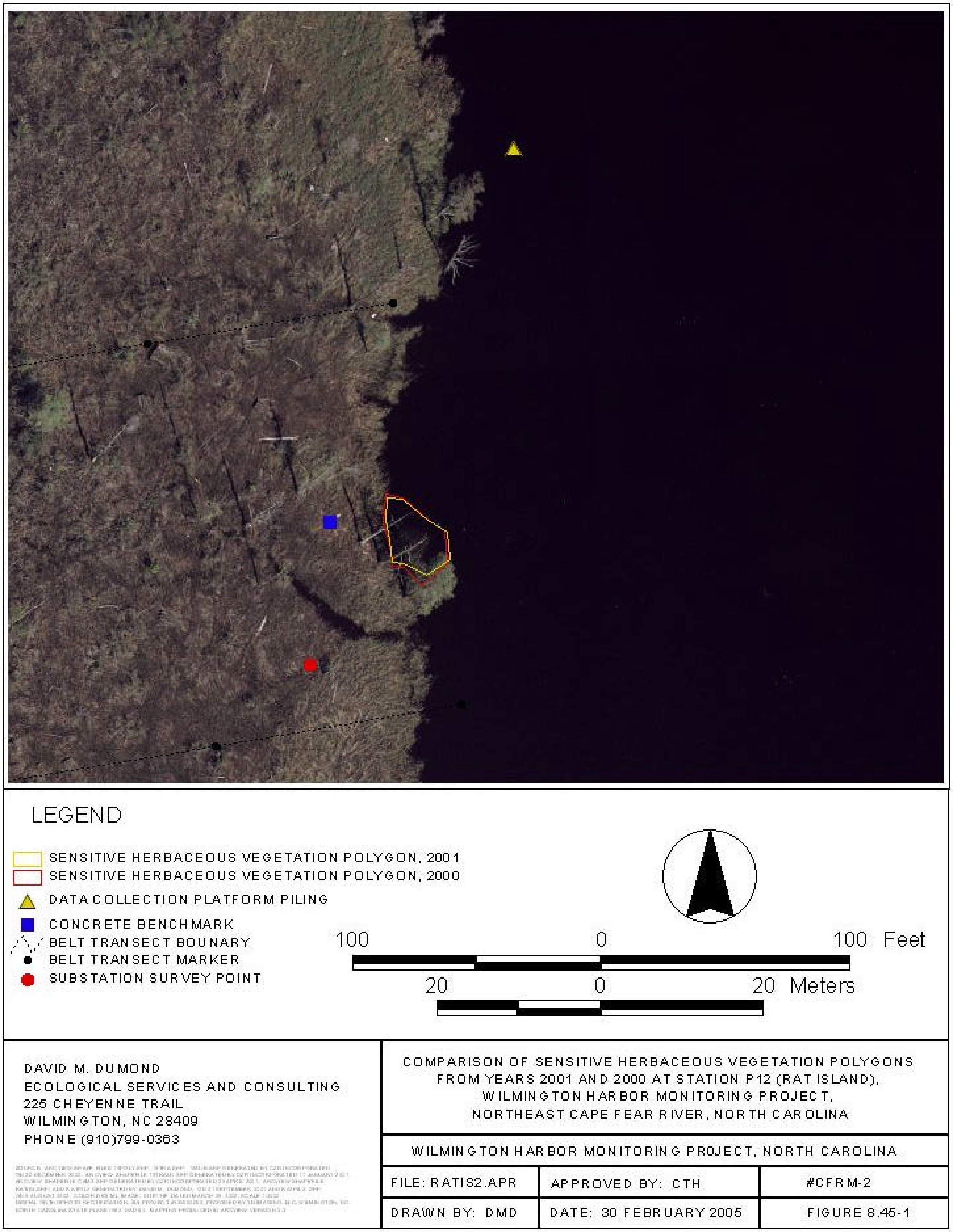
8.45 Rat Island

Schoenoplectus americanus, Carex hyalinolepis and *Sagittaria lancifolia* constitute the major species in the sensitive herbaceous vegetation polygons at the Rat Island polygon (Table 8.45.1). Boundaries of this polygon have remained the same because it became clear that early salinity events (prior to 2002) were eliminating habitat for sensitive herbaceous species (Figure 8.45.1, Table 8.41.1). The dominant species that remain can not strictly be referred to as sensitive herbaceous species. Even these somewhat tolerant species are giving way to *Spartina cynosuroides*, which is rapidly becoming the dominant species at the site. This year *Spartina cynosuroides* constituted 50 percent of the cover within the boundary of the polygon.

Polygonum punctatum, which generally occupies freshwater sites, is present this year. Presence of this species is a chance event and the plant will likely disappear by next year. The presence of *Symphyotrichum tenuifolium*, the common saltmarsh aster of saline marshes, is also present by chance. Each of these species is present as a result of natural wide-dispersal mechanisms and could benefit from appropriately favorable salinity regimes should they persist for a sufficient period of time.

Table 8.45-1. Comparisons of percent cover contributions by sensitive herbaceous species in the polygon for years 2000, 2001, 2002, 2003, and 2004 at the Rat Island (P12), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Species			**Year**		
	2000	**2001**	**2002**	**2003**	**2004**
Schoenoplectus americanus	100	20	30	50	25
Carex hyalinolepis	20	8	10	<1	2
Sagittaria lancifolia	10	30	--	5	10
Alternanthera philoxeroides	<1	--	<1	--	--
Polygonum arifolium	<1	--	--	--	--
Boltonia asteroides	<1	<1	--	--	--
Symphyotrichum subulatum	<1	<1	<1	<1	--
Peltandra virginica	--	1	--	--	--
Rumex verticillatus	--	1	--	--	--
Hymenocallis crassifolia	--	<1	--	1	<1
Polygonum punctatum	--	--	--	--	<1
Symphyotrichum tenuifolium	--	--	--	--	<1


LEGEND
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2001
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNARY
BELT TRANSECT MARKER
SUBSTATION SURVEY POINT
100 0 100 Feet
20 0 20 Meters
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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2001 AND 2000 AT STATION P12 (RAT ISLAND), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA
FILE: RATIS2.APR
APPROVED BY: CTH
#CFRM-2
DRAWN BY: DMD
DATE: 30 FEBRUARY 2005
FIGURE 8.45-1

8.46 Fishing Creek

The Fishing Creek sensitive herbaceous polygon has increased in length, adding more than 1000 ft^2 over the original area and quadrupling last year's area (Table 8.46-1, Figure 8.46-1, Table 8.41.1). *Pontederia cordata*, the main sensitive herbaceous species used to define of the polygon, has rebounded aggressively from the salinity and flooding events of the past two years. It now extends, in somewhat linear fashion, to the northern transect boundary. Configurations of sensitive herbaceous species vegetation polygons for the years 2001, 2002, and 2003 can be reviewed in a previous report (Hackney et al. 2005).

Simple species diversity within the sensitive herbaceous vegetation polygon is the highest since project inception. Twenty-one plant species occupied the site this year. Last year only 17 species were seen and in the year of the highest salinities only 10 species were noted. Thirteen species were reported from the first year of the sampling. Because of the geographic expansion of the polygon the opportunity for more species to occur may now exist. In addition, the increased species diversity this year may indicate a greater diversity of conditions that may have existed last year for promotion of rhizome development, bud-set and expansion.

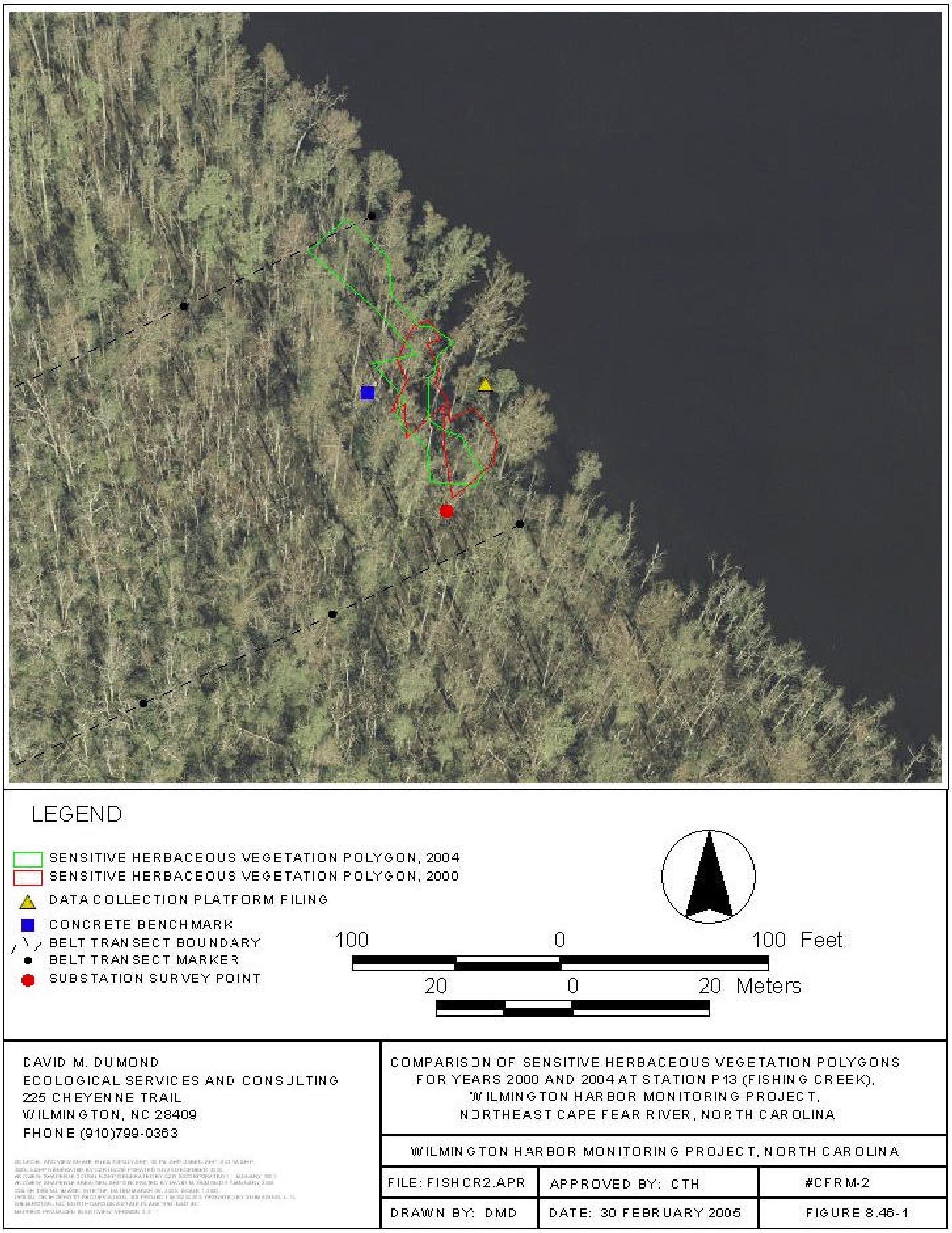
One of the plant species recorded almost every year has been *Zizania aquatica*. The differences in cover contributed by this species last year and the current year are notable, 50% and <1%, respectively. One possible explanation for this great difference is that a system of rhizomes of *Zizania aquatica* has already been in place a more or less long term feature in the substrate. The rhizomes receive photosynthetic food resources from subaerial stems only to a limited extent until some factor or factors reduce competition. During times of stress on associated species, the *Zizania aquatica* is able to extend subaerial stems, to flower, and to set seed. This may have happened last year. As competitive interactions increase accompanying a renewal of normal conditions *Zizania aquatica* again becomes semi-quiescent. *Sagittaria lancifolia* and *Peltandra virginica* may be capable of reacting in the same way, at least to some extent.

Species new to the polygon this year include Amaranthus cannabinus, Hypericum mutilum, Boehmeria cylindrica, Pluchea odorata, and Solidago sempervirens var. mexicana. All of these except Hypericum mutilum and Boehmeria cylindrica are found in somewhat brackish marshes. Pluchea odorata is not here considered a sensitive herbaceous species due to its tendency to be an annual or perennial. Solidago sempervirens, also not included as a sensitive herbaceous species, occupies uplands as well as wetlands. The ability of these species to produce abundant seeds, disperse in floods, and take advantage of somewhat disturbed habitats may account for their presence.

Boltonia asteroides, *Cicuta maculata*, and *Rhynchospora corniculata* were present as sensitive herbaceous species in the polygon again this year. *Lilaeopsis chinensis*, a prostrate perennial species of muddy tidal, usually brackish substrates, is still present at the site. No trees or shrubs observed showed signs of salinity damage.

Table 8.46-1. Comparisons of polygon size and percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, 2002 and 2003 at the Fishing Creek Station (P13), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Species			**Year**		
	2000	**2001**	**2002**	**2003**	**2004**
Pontederia cordata	20	40	5	30	30
Symphyotrichum elliottii	<1	--	--	--	--
Polygonum punctatum	2	1	--	<1	10
Sium suave	<1	2	5	1	1
Polygonum arifolium	1	3	--	10	15
Zizaniopsis miliacea	2	<1	<1	5	5
Saururus cernuus	2	2	--	1	5
Cicuta maculata	<1	2	--	--	1
Sagittaria lancifolia	2	20	5	20	5
Orontium aquaticum	<1	--	--	--	--
Peltandra virginica	<1	1	5	30	12
Rhynchospora corniculata	<1	<1	--	--	<1
Carex sp.	<1	--	--	--	--
Alternanthera philoxeroides	--	5	<1	<1	--
Zizania aquatica	--	2	<1	50	<1
Boltonia asteroides	--	1	--	--	<1
Rumex verticillatus	--	<1	2	1	--
Cinna arundinacea	--	<1	--	<1	<1
Eryngium aquaticum	--	<1	5	2	2
Schoenoplectus americanus	--	--	<1	--	--
Carex hyalinolepis	--	--	--	1	--
Apios americana	--	--	--	<1	<1
Hymenocallis crassifolia	--	--	--	2	--
Ludwigia palustris	--	--	--	<1	<1
Amaranthus cannabinus	--	--	--	--	<1
Hypericum mutilum	--	--	--	--	<1
Boehmeria cylindrica	--	--	--	--	<1


LEGEND
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2004
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNDARY
BELT TRANSECT MARKER
SUBSTATION SURVEY POINT
100 0 100 Feet
20 0 20 Meters
DAVID M. DUMOND
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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FOR YEARS 2000 AND 2004 AT STATION P13 (FISHING CREEK), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA
FILE: FISHCR2.APR
APPROVED BY: CTH
#CFRM-2
DRAWN BY: DMD
DATE: 30 FEBRUARY 2005
FIGURE 8.46-1

8.47 Prince George Creek

The polygon defining the boundary of sensitive herbaceous species vegetation has remained roughly the same size for the last three years at the Prince George Creek Station (Figure 8.47-1, Table 8.41.1, Hackney et al. 2005). Increases in area since 2000 have been due to visible connections with adjacent stands of *Saururus cernuus*, the sensitive herbaceous species used to define the polygon. Cover percentages contributed by this species for 2004 have increased slightly since 2000, but so has the area of the polygon (Table 8.47.1). Cover percentages rose in 2001and dropping considerably in 2002 with the advent of the salinity event.

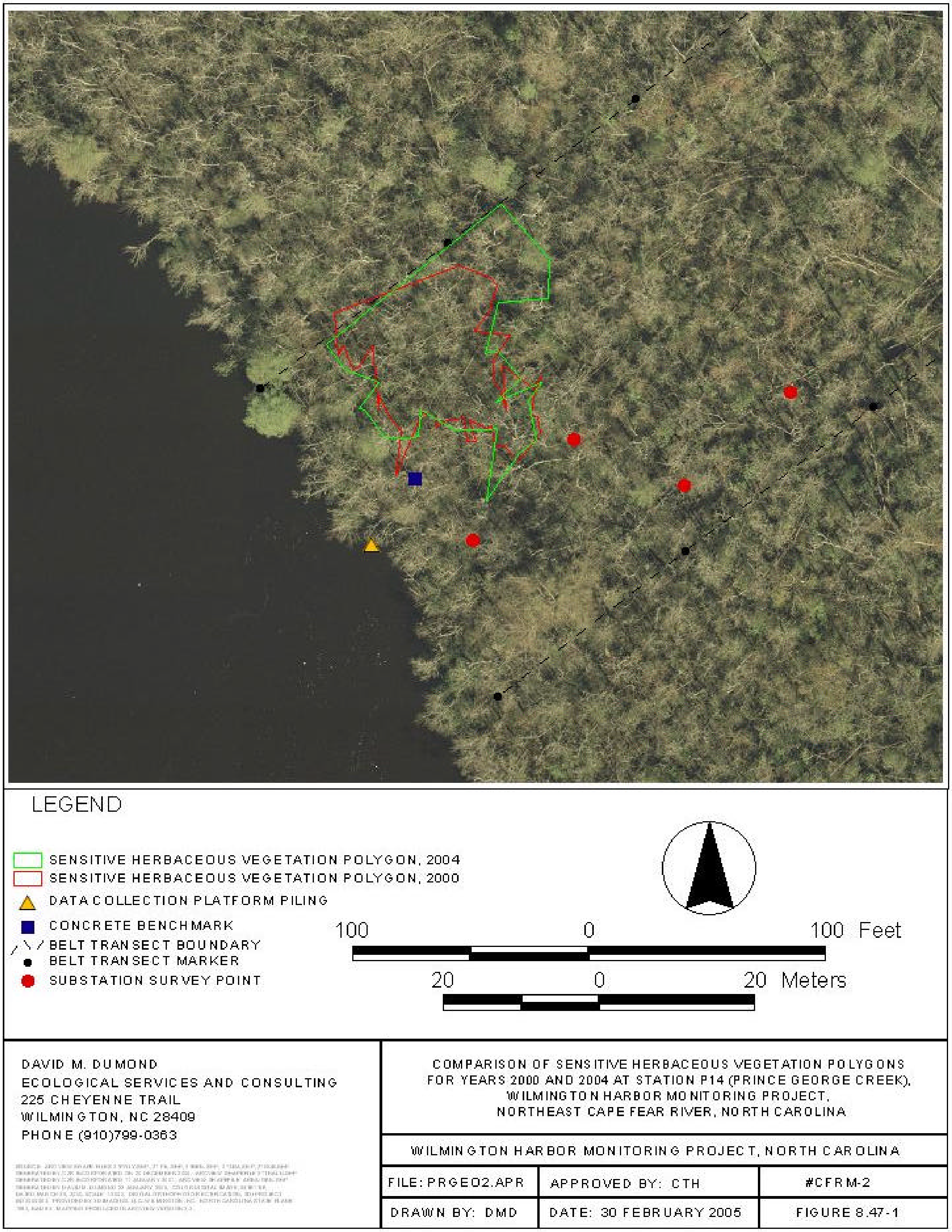
Cover percentages contributed by *Polygonum hydropiper* and *Peltandra virginica* within the sensitive herbaceous vegetation polygon have regained the cover status noted in initial 2000 polygon. *Pontederia cordata* and *Polygonum arifolium* have reappeared following the stresses of the salinity event and subsequent flooding. *Murdannia keisak* and *Hydrocotyle* sp. have newly appeared this year. The former may be a species widely recruited with flooding since it has been noted in at least two sites this year.

Species noted from the general area but not found within the polygon include *Pilea pumila*, a freshwater wetland annual often associated with seepage areas or ephemerally wet habitats. *Bidens* sp. was also noted. *Amaranthus cannabinus* was seen near the outside of the polygon. Closer to the river an exposed mudflat supported a small amount of *Lilaeopsis chinensis*. As indicated earlier, both *Amaranthus cannabinus* and *Lilaeopsis chinensis* are characteristically associated with mild and more strongly brackish tidal marshes, respectively. Occurrences of these species are doubtless related to recent salinity and flooding events.

Simple diversity of sensitive herbaceous species may reflect a sequence of important events at the Prince George Creek Station. Three species were noted at the time of the first sampling in 2000. In 2001 the number of species was up significantly to 10. This increase could be related to human disturbance in the site. In 2002 and 2003 the number of species dropped slightly to 8. The decrease could have been related to the stress of hydrological events during the last two years. This year the total number of species was up to 11. It may be speculated that the increase in 2004 is due, at least in part, to germination and/or growth of additional species the propagula of which were delivered by flood waters.

Table 8.47-1. Comparisons of percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, 2002, 2003, and 2004 at the Prince George Creek Station (P14), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Species			**Year**		
	2000	**2001**	**2002**	**2003**	**2004**
Saururus cernuus	35	60	20	40	40
Polygonum hydropiper	20	15	--	<1	20
Peltandra virginica	10	8	1	5	10
Pontederia cordata	--	5	--	--	<1
Polygonum arifolium	--	5	--	--	2
Cicuta maculata	--	<1	<1	<1	--
Zizania aquatica	--	<1	--	--	--
Cinna arundinacea	--	<1	--	--	<1
Boehmeria cylindrica	--	<1	<1	--	--
Carex lupulina	--	<1	<1	--	--
Alternanthera philoxeroides	--	--	<1	--	--
Decodon verticillatus	--	--	<1	<1	<1
Hymenocallis crassifolia	--	--	<1	<1	1
Zizaniopsis miliacea	--	--	--	<1	<1
Triadenum walteri	--	--	--	<1	--
Murdannia keisak	--	--	--	--	1
Hydrocotyle sp.	--	--	--	--	<1


LEGEND
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2004
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNDARY
BELT TRANSECT MARKER
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WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA
FILE: PRGEO2.APR
APPROVED BY: CTH
#CFRM-2
DRAWN BY: DMD
DATE: 30 FEBRUARY 2005
FIGURE 8.47-1

8.5 Sensitive Herbaceous Vegetation Monitoring in 2004: Summary and Conclusions

Plant data and observations from the current period indicate substantial rebound of the dominant plant species at most of the sensitive herbaceous vegetation sampling stations. This rejuvenation of growth follows hydrological events that included salinity incursions at most stations followed a year later by freshwater flooding generated in the Cape Fear River and Northeast Cape Fear River watersheds from precipitation events (Hackney et al. 2005).

Stations with exceptions to the rejuvenation of vegetation include Rat Island and Black River. The Rat Island station has long experienced salinity events that have already caused considerable change in the vegetation toward that of permanently brackish water marsh. The Black River Station vegetation was not thought to have been influenced by a salinity event, only prolonged flooding. Recovery from flooding has not taken place since most of the plant material was killed and/or removed by flooding.

Rhizome systems are the foundation for most of the dominant herbaceous species present at the sensitive herbaceous vegetation sampling sites. The process of rebound witnessed at most stations is possible because of pre-existing rhizome systems well established in the substrate. Such a system is a storehouse of energy in the form of sugars that are be drawn on during periods of rapid growth and development. In addition, the system is already well secured as a part of the substrate by a diffuse root system capable of supplying rapid demands for water and minerals. The rhizome system is a vegetatively reproducing plant body with built-in mechanisms for rapid extension into a subaerial environment. The subaerial environment allows photosynthesis and sexual reproduction when conditions warrant. In addition the rhizome system provides for survival of suboptimal environmental conditions.

The two hydrological events have also provided temporary habitat and acted as a transport vector for several species not customarily found in the habitats in the project area in which they have appeared. Whether or not the species can succeed will depend on the course of future habitat conditions where they occur. Continued saline conditions will favor one set of species, while freshwater conditions will favor another set. However, during the past year significant or prolonged salinity events appear to have been absent from most sampled sites. Slight salinity increases may have influenced vegetation for a short period of time at the Inner Town Creek Station (P3) during June or July in 2004. Data included in the earlier sections of the current report and the previous report (Hackney et al. 2005) show salinity levels have been notably low.

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APPENDIX A

LIST OF TIDAL RANGE DATA FOR ALL 14 STATIONS USED TO GENERATE FIGURES AND TABLES IN SECTION 3.0

Appendix A. List of tidal range data for all 14 stations used to generate figures and tables in Section 3.0.

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1	4.28	4.27	2.83	4.38	4.25	3.76	xxx	3.06	4.16	3.65	3.06	2.11
2	4.60	4.66	3.22	4.77	4.63	4.20	xxx	3.65	4.54	4.08	3.60	2.80
3	6.12	5.92	3.72	5.97	5.72	5.17	xxx	4.44	6.83	4.99	4.34	3.27
4	5.86	5.50	3.29	5.57	5.31	4.66	xxx	3.67	5.20	4.51	3.75	2.51
5	4.58	4.45	2.89	4.58	4.42	3.89	xxx	3.08	4.31	3.77	3.16	2.16
6	xxx	4.80	3.27	4.96	4.78	4.38	xxx	3.74	4.70	4.20	3.65	2.79
7	xxx	5.96	3.71	6.04	5.74	5.19	xxx	4.35	5.71	5.00	4.28	3.17
8	6.24	5.63	3.31	5.66	5.39	4.69	xxx	3.70	5.27	4.58	3.76	2.50
9	4.73	4.37	2.83	4.48	4.34	3.78	xxx	2.98	4.23	3.70	3.06	2.07
10	5.17	4.94	3.37	5.09	4.90	4.32	xxx	3.80	4.82	4.31	3.75	2.86
11	6.68	6.16	3.83	6.24	5.92	5.19	xxx	4.50	5.83	5.17	4.42	3.26
12	6.27	5.70	3.35	5.74	5.46	4.77	xxx	3.75	5.34	4.64	3.82	2.53
13	xxx	4.53	2.91	4.63	4.48	3.94	xxx	3.14	4.37	3.84	3.21	2.17
14	xxx	4.57	3.10	4.57	4.45	4.07	xxx	3.49	4.35	3.91	3.40	2.56
15	6.47	5.87	3.61	5.82	5.55	5.00	xxx	4.18	5.45	4.84	4.13	3.02
16	6.17	5.68	3.27	5.74	5.46	4.73	xxx	3.69	5.33	4.62	3.77	2.44
17	4.48	4.28	2.73	4.41	4.28	3.72	xxx	2.90	4.16	3.62	2.97	1.94
18	4.51	4.48	3.11	4.66	4.52	4.11	xxx	3.53	4.43	3.99	3.48	2.65
19	6.06	5.76	3.61	5.85	5.60	5.05	xxx	4.29	5.49	4.90	4.20	3.10
20	5.81	5.43	3.17	5.48	5.25	4.54	xxx	3.54	5.13	4.48	3.65	2.42
21	4.61	4.52	2.83	4.63	4.52	3.96	xxx	3.16	4.41	3.88	3.18	2.14
22	4.51	4.55	2.95	4.64	4.50	4.05	xxx	3.37	4.43	3.95	3.36	2.43
23	5.62	5.39	3.29	5.44	5.20	4.64	xxx	3.82	5.11	4.52	3.82	2.72
24	xxx	5.38	3.04	5.28	5.03	4.37	xxx	3.43	4.94	4.30	3.53	2.29
25	xxx	4.47	2.70	4.45	4.28	3.75	xxx	2.99	4.22	3.70	3.07	2.02
26	4.16	4.32	2.87	4.48	4.33	3.91	xxx	3.28	4.26	3.77	3.19	2.25
27	5.05	4.96	3.12	5.04	4.84	4.35	xxx	3.62	4.76	4.20	3.53	2.49
28	5.03	4.93	2.98	5.03	4.79	4.23	xxx	3.40	4.70	4.11	3.38	2.24
29	4.06	4.17	2.68	4.33	4.15	3.66	xxx	2.99	4.07	3.58	2.96	1.97
30	xxx	4.21	2.85	4.30	4.18	3.82	xxx	3.31	4.11	3.67	3.14	2.33
31	xxx	4.75	3.00	4.73	4.55	4.14	xxx	3.52	4.48	3.97	3.36	2.45

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
32	4.78	4.88	3.02	4.89	4.68	4.18	xxx	3.47	4.60	4.05	3.37	2.39
33	4.17	4.42	2.87	4.54	4.38	3.90	xxx	2.76	4.37	3.79	3.17	2.26
34	3.80	4.05	2.74	4.18	4.07	3.70	3.33	3.19	3.98	3.55	3.04	2.22
35	4.08	4.18	2.80	4.28	4.15	3.78	3.37	3.23	4.08	3.63	3.10	2.26
36	4.25	4.38	2.93	4.51	4.32	3.97	3.57	3.43	4.26	3.80	3.27	2.40
37	4.17	4.44	2.96	4.57	4.40	4.05	3.64	3.50	xxx	xxx	3.33	2.42
38	3.70	3.94	2.60	4.03	3.92	3.56	3.17	3.05	3.96	xxx	2.90	2.08
39	3.38	3.56	2.44	3.67	3.55	3.22	2.91	2.77	3.51	3.12	2.65	1.95
40	4.07	4.24	2.94	4.40	4.25	3.90	3.57	3.42	xxx	3.75	3.27	2.49
41	4.45	4.67	3.10	4.82	4.66	4.28	3.85	3.73	xxx	3.78	3.52	2.62
42	3.82	4.08	2.66	4.17	4.05	3.67	3.25	3.11	xxx	3.92	2.99	2.11
43	3.32	3.47	2.42	3.58	3.51	3.16	2.85	2.69	3.41	3.10	2.66	1.94
44	4.02	4.32	2.98	4.48	4.34	3.97	3.65	3.50	4.25	3.84	3.37	2.61
45	4.76	4.82	3.17	4.92	4.73	4.33	3.98	3.82	4.64	4.14	3.59	2.72
46	3.78	3.87	2.55	3.97	3.84	3.48	3.15	3.00	3.79	3.35	2.84	2.06
47	3.51	3.81	2.55	3.93	3.80	3.45	3.14	2.99	3.75	3.35	2.85	2.07
48	3.88	4.05	2.67	4.12	3.98	3.61	3.26	3.08	3.92	3.48	2.94	2.12
49	4.40	4.47	2.85	4.52	4.38	3.98	3.49	3.38	4.31	3.81	3.22	2.31
50	4.27	4.32	2.73	4.37	4.22	3.81	3.32	3.20	4.16	3.67	3.08	2.15
51	3.15	3.43	2.36	3.56	3.45	3.08	2.75	2.58	3.41	3.02	2.54	1.80
52	3.54	3.81	2.72	3.90	3.81	3.50	3.22	3.08	3.76	3.39	2.95	2.28
53	4.46	4.65	3.04	4.67	4.52	4.17	3.75	3.63	4.51	3.99	3.45	2.60
54	4.29	4.51	2.86	4.58	4.42	3.99	3.52	3.36	4.36	3.84	3.24	2.27
55	3.21	3.55	2.45	3.70	3.60	3.22	2.87	2.69	3.56	3.14	2.65	1.86
56	3.61	3.91	2.82	4.00	3.85	3.62	3.33	3.16	3.88	3.50	3.09	2.41
57	4.40	4.55	3.09	4.59	4.46	4.13	3.81	3.66	4.40	3.96	3.47	2.66
58	4.46	4.54	3.06	4.63	4.52	4.12	3.75	3.55	4.43	3.94	3.38	2.49
59	3.23	3.53	2.49	3.68	3.72	3.25	2.90	2.71	3.55	3.15	2.68	1.95
60	3.54	3.81	2.83	3.91	3.89	3.61	3.33	3.20	3.83	3.50	3.14	2.52
61	4.63	4.73	3.30	4.78	4.67	4.38	4.07	3.91	4.27	4.20	3.74	2.95
62	4.21	4.39	2.99	4.48	4.37	4.01	3.64	3.45	xxx	3.86	3.34	2.52
63	3.06	3.43	2.48	3.59	3.55	3.20	2.88	2.73	3.42	3.13	2.72	2.07
64	3.45	3.71	2.76	3.88	3.83	3.52	3.22	3.09	3.78	3.44	3.07	2.44
65	4.65	4.73	3.33	4.82	4.71	4.39	4.05	3.90	4.45	4.22	3.74	2.94
66	4.22	4.33	2.96	4.42	4.29	3.92	3.56	3.39	4.51	3.77	3.26	2.44
67	3.29	3.55	2.64	3.69	3.63	3.27	2.96	2.81	4.12	3.19	2.77	2.08
68	3.47	3.68	2.71	3.81	3.74	3.45	3.16	3.04	3.69	3.12	2.96	2.33

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
69	4.67	4.72	3.24	4.78	4.64	4.31	3.92	3.81	4.60	4.12	3.62	2.82
70	4.27	4.35	2.76	4.44	4.29	3.85	3.40	3.21	4.21	3.71	3.13	2.19
71	3.28	3.45	2.36	3.57	3.51	3.11	2.75	2.56	3.44	3.03	2.56	1.82
72	3.09	3.37	2.46	3.54	3.48	3.19	2.93	2.67	3.43	2.72	2.72	2.12
73	4.43	4.50	3.00	4.59	4.44	4.11	3.70	3.63	4.39	3.93	3.45	2.64
74	4.14	4.36	2.71	4.44	4.27	3.81	3.30	3.16	4.22	3.68	3.07	2.07
75	3.03	3.23	2.19	3.35	3.24	2.81	2.46	2.24	3.21	2.80	2.30	1.53
76	3.14	3.33	2.41	3.46	3.38	3.10	2.87	2.73	3.34	3.04	2.67	2.12
77	4.36	4.47	2.94	4.54	4.40	4.08	3.77	3.62	4.34	3.91	3.42	2.63
78	4.20	4.37	2.67	4.37	4.22	3.75	3.35	3.13	4.18	3.65	3.06	2.08
79	3.04	3.41	2.33	3.51	3.43	3.04	2.72	2.56	3.39	2.98	2.53	1.76
80	3.06	3.45	2.44	3.53	3.44	3.17	2.90	2.81	3.42	3.06	2.66	2.02
81	3.95	4.25	2.76	4.25	4.12	3.78	3.46	3.32	4.08	3.65	3.14	2.34
82	4.15	4.33	2.77	4.35	4.16	3.76	3.42	3.21	4.12	3.65	3.10	2.15
83	2.87	3.39	2.37	3.54	3.39	3.04	2.76	2.61	3.98	2.98	2.54	1.79
84	3.07	3.38	2.47	3.45	3.42	3.13	2.88	2.80	3.35	3.00	2.62	2.05
85	3.67	3.79	2.65	3.81	3.77	3.47	3.22	3.10	3.70	3.30	2.88	2.20
86	4.03	4.27	2.97	4.38	4.25	3.91	3.60	3.43	4.20	3.74	3.25	2.44
87	3.27	3.68	2.63	3.79	3.70	3.36	3.08	2.92	3.79	3.24	2.80	2.09
88	3.18	3.47	2.58	3.55	3.53	3.26	3.10	2.95	3.45	3.15	2.78	2.20
89	3.62	3.71	2.70	3.81	3.75	3.46	3.19	3.09	3.67	3.31	2.91	2.28
90	3.92	4.18	3.08	4.33	4.22	3.92	3.66	3.55	4.15	3.79	3.40	2.76
91	3.55	3.93	2.88	4.07	3.97	3.67	3.41	3.29	3.94	3.58	3.18	2.52
92	3.17	3.56	2.65	3.68	3.63	3.34	3.07	2.96	3.61	3.27	2.89	2.27
93	3.51	3.80	2.81	3.95	3.88	3.58	3.29	3.17	3.85	3.49	3.10	2.45
94	xxx	4.03	3.01	4.26	4.10	3.85	3.58	3.46	xxx	3.74	3.36	2.67
95	xxx	4.31	3.14	4.55	4.38	4.15	3.87	3.75	xxx	4.00	3.59	2.84
96	3.40	3.68	2.59	3.76	3.67	3.37	3.06	2.91	xxx	3.25	2.84	2.08
97	3.15	3.42	2.55	3.48	3.41	3.14	2.88	2.76	3.14	3.04	2.71	2.06
98	3.67	3.90	2.88	3.96	3.84	3.62	3.95	3.30	3.81	3.47	3.14	2.51
99	3.89	4.01	2.90	4.04	3.90	3.63	3.37	3.25	3.90	3.51	3.11	2.42
100	3.79	4.13	2.99	4.25	4.12	3.80	3.50	3.34	4.09	3.71	3.28	2.56
101	3.63	3.94	2.89	4.09	3.99	3.70	3.42	3.30	3.95	3.58	3.18	2.50
102	3.76	4.03	2.95	4.22	4.09	3.75	3.43	3.27	4.06	3.67	3.24	2.55
103	4.46	4.67	3.26	4.82	4.67	4.31	3.98	3.81	4.62	4.17	3.66	2.85
104	4.06	4.27	2.90	4.38	4.24	3.83	3.45	3.23	4.20	3.74	3.22	2.36
105	3.47	3.79	2.71	3.94	3.85	3.46	3.09	2.87	3.80	3.39	2.93	2.18

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
106	4.23	4.37	3.15	4.49	4.41	4.07	3.73	3.52	4.35	3.94	3.50	2.75
107	5.02	5.05	3.42	5.10	4.95	4.58	4.16	4.00	5.45	4.40	3.88	2.99
108	4.89	4.92	3.25	5.00	4.83	4.34	3.90	3.65	4.77	4.22	3.62	2.67
109	xxx	4.19	2.90	4.30	4.21	3.75	3.32	3.09	3.87	3.67	3.14	2.30
110	xxx	4.67	3.36	4.80	4.69	4.14	4.00	3.82	4.62	4.22	3.76	2.95
111	5.77	5.67	3.80	5.76	5.54	4.90	4.69	4.46	5.63	4.95	4.37	3.36
112	5.35	5.27	3.25	5.24	5.04	4.47	3.95	3.66	4.97	4.36	3.67	2.57
113	4.12	4.30	2.87	4.34	4.23	3.73	3.27	3.03	4.15	3.67	3.12	2.24
114	4.67	4.68	3.29	4.82	4.73	4.16	3.92	3.70	4.62	4.17	3.67	2.81
115	6.10	5.74	3.77	5.81	5.63	4.97	4.65	4.38	5.50	4.93	4.28	3.22
116	5.61	5.34	3.18	5.38	5.18	4.61	4.06	3.74	5.07	4.46	3.74	2.60
117	4.29	4.51	2.86	4.60	4.49	4.01	3.54	3.27	4.38	3.89	3.28	2.30
118	4.90	5.02	3.24	5.13	4.90	4.37	4.09	3.84	4.89	4.36	3.77	2.67
119	6.45	6.17	3.71	6.22	5.92	5.22	4.86	4.55	5.83	5.18	4.45	3.14
120	6.06	5.64	3.10	5.66	5.38	4.66	4.00	3.57	5.26	4.55	3.70	2.37
121	4.44	4.36	2.66	4.47	4.30	3.72	3.19	2.86	4.20	3.67	3.01	1.97
122	4.94	4.85	3.17	5.00	4.84	4.28	3.95	3.71	4.74	4.26	3.70	2.77
123	6.63	6.17	3.63	6.21	5.93	5.23	4.77	4.43	5.82	5.15	4.39	3.17
124	6.11	5.64	3.11	5.65	5.39	4.70	4.05	3.63	5.27	4.56	3.71	2.37
125	4.77	4.59	2.74	4.70	4.55	3.98	3.43	3.10	4.44	3.88	3.19	2.09
126	4.89	4.78	3.05	4.92	4.77	4.28	3.83	3.59	4.65	4.13	3.50	2.51
127	6.20	5.86	3.44	5.91	5.67	5.04	4.48	4.14	5.53	4.87	4.08	2.86
128	xxx	5.56	3.07	5.59	5.33	4.59	3.96	3.52	5.21	4.49	3.62	2.23
129	xxx	4.59	2.71	4.67	4.51	3.89	3.37	3.02	4.41	3.83	3.12	1.96
130	4.60	4.58	2.89	4.64	4.52	4.07	3.65	3.35	4.40	xxx	3.28	2.30
131	5.89	5.64	3.31	5.65	5.42	4.84	4.28	3.95	5.29	4.63	3.86	2.64
132	5.77	5.33	2.90	5.36	5.10	4.38	3.72	3.32	4.99	4.27	3.40	2.01
133	4.45	4.28	2.52	4.38	4.22	3.64	3.12	2.81	4.15	3.58	2.88	1.73
134	4.43	4.46	2.86	4.57	4.44	4.02	3.62	3.40	4.33	xxx	3.25	2.28
135	5.41	5.19	3.12	5.22	5.03	4.52	4.02	3.73	4.91	xxx	3.60	2.46
136	5.42	5.21	3.02	5.24	5.02	4.40	3.86	3.50	4.92	4.26	3.49	2.23
137	4.47	4.40	2.70	4.49	4.31	3.77	3.33	3.04	4.23	3.68	3.03	1.94
138	4.27	4.32	2.81	4.44	4.28	3.88	3.51	3.30	4.20	xxx	3.16	2.25
139	4.93	4.90	3.04	4.99	4.80	4.36	3.91	3.65	4.70	4.15	3.50	2.46
140	4.90	4.86	2.94	4.97	4.74	4.24	3.74	3.45	4.65	4.06	3.35	2.22
141	4.45	4.59	2.84	4.73	4.53	4.06	3.61	3.33	xxx	4.16	3.23	2.15
142	3.89	4.04	2.52	4.12	3.99	3.61	3.23	3.01	3.94	3.44	2.87	1.92

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
143	4.21	4.19	2.59	4.26	4.11	3.71	3.30	3.07	4.06	3.55	2.95	1.98
144	4.60	4.65	2.90	4.78	4.57	4.13	3.71	3.45	4.49	3.94	3.31	2.26
145	4.32	4.52	2.83	4.64	4.43	4.01	3.61	3.36	xxx	3.85	3.21	2.18
146	3.85	4.05	2.49	4.13	3.99	3.58	3.21	2.98	3.92	3.45	2.86	1.94
147	3.68	3.84	2.44	3.95	3.83	3.44	3.10	2.89	xxx	3.31	2.76	1.89
148	4.16	4.36	2.81	4.52	4.33	3.93	3.58	3.37	xxx	xxx	3.21	2.31
149	4.21	4.46	2.82	4.57	4.39	3.99	3.64	3.44	xxx	xxx	3.25	2.32
150	3.69	4.02	2.57	4.10	3.94	3.56	3.23	3.03	xxx	3.43	2.90	2.06
151	3.20	3.49	2.35	3.66	3.52	3.16	2.86	2.69	xxx	3.07	2.59	1.85
152	3.75	3.99	2.74	4.19	4.06	3.70	3.41	3.26	xxx	3.56	3.11	2.36
153	4.13	4.40	2.91	4.56	4.42	4.05	3.72	3.62	xxx	xxx	3.38	2.50
154	3.67	4.01	2.62	4.15	4.03	3.68	3.35	3.17	xxx	3.54	3.00	2.17
155	3.03	3.42	2.32	3.57	3.47	3.11	2.78	2.63	xxx	3.04	2.56	1.85
156	3.41	3.83	2.71	4.00	3.89	3.60	3.31	3.18	xxx	3.47	3.06	2.40
157	4.05	4.35	3.02	4.49	4.35	4.05	3.75	3.81	xxx	3.97	3.44	2.69
158	3.64	3.89	2.63	4.00	3.90	3.56	3.27	3.12	xxx	3.44	2.96	2.24
159	2.84	3.24	2.24	3.38	3.32	2.99	2.72	2.58	xxx	2.90	2.48	1.86
160	3.14	3.65	2.37	3.70	3.63	3.35	3.09	2.99	xxx	3.24	2.88	2.30
161	4.06	4.48	2.81	4.51	4.39	4.09	3.80	3.67	xxx	3.92	3.46	2.71
162	3.67	3.93	2.45	3.98	3.88	3.52	3.19	3.01	xxx	3.41	2.91	2.08
163	2.70	3.04	2.06	3.14	3.08	2.76	2.47	2.34	xxx	2.70	2.33	1.70
164	3.31	3.47	2.52	3.64	3.56	3.30	3.06	2.95	xxx	3.17	2.84	2.25
165	4.24	4.38	2.92	4.50	4.38	4.08	3.80	3.65	4.33	4.17	3.45	2.69
166	3.82	4.13	2.62	4.21	3.58	3.70	3.33	3.14	4.05	3.58	3.02	2.15
167	2.72	3.07	2.11	3.17	2.61	2.77	2.50	2.37	3.06	2.71	2.32	1.67
168	3.14	3.40	2.52	3.48	3.44	3.20	3.00	2.92	3.37	2.96	2.77	2.23
169	4.42	4.63	3.07	4.68	4.54	4.25	3.94	3.79	4.50	xxx	3.56	2.75
170	3.98	4.26	2.69	4.37	4.20	3.79	3.43	3.21	4.17	3.67	3.11	2.14
171	2.90	3.21	2.19	3.32	3.22	2.86	2.55	2.38	3.20	2.82	2.40	1.64
172	3.18	3.49	2.52	3.61	3.55	3.28	3.00	2.89	3.52	3.17	2.80	2.18
173	4.34	4.52	3.01	4.61	4.51	4.19	3.85	3.68	4.45	3.99	3.48	2.67
174	xxx	4.39	2.75	4.44	4.37	3.92	3.51	3.31	4.29	3.74	3.15	2.23
175	xxx	3.42	2.30	3.52	3.51	3.07	2.68	2.50	3.44	2.99	2.50	1.75
176	3.29	3.72	2.69	3.77	3.71	3.45	3.18	3.00	3.66	3.32	2.97	2.38
177	4.47	4.73	3.10	4.74	4.59	4.28	3.96	3.81	4.54	4.11	3.60	2.79
178	4.28	4.45	2.85	4.53	4.40	3.99	3.62	3.44	4.34	3.82	3.28	2.37
179	3.30	3.62	2.49	3.74	3.69	3.34	2.97	2.83	3.63	3.20	2.76	2.02

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
180	3.53	3.80	2.11	3.78	3.70	3.42	3.05	2.88	3.66	3.28	2.81	2.13
181	4.48	4.70	2.85	4.65	4.51	4.17	3.80	3.62	4.45	3.99	3.44	2.62
182	4.53	4.67	2.77	4.71	4.59	4.10	3.68	3.46	4.50	3.94	3.32	2.32
183	3.20	3.49	2.22	3.58	3.54	3.12	2.77	2.58	3.47	3.04	2.55	1.75
184	3.59	3.90	2.61	3.94	3.91	3.56	3.26	3.11	3.83	3.46	3.05	2.37
185	4.67	4.78	3.01	4.77	4.66	4.29	3.95	3.77	4.58	4.11	3.60	2.76
186	4.39	4.56	2.76	4.62	4.51	4.11	3.72	3.51	4.44	3.93	3.36	2.42
187	3.46	3.79	2.45	3.89	3.83	3.43	3.06	2.87	3.76	3.32	2.83	2.08
188	3.54	3.85	2.63	3.91	3.85	3.53	3.25	3.05	3.79	3.39	3.00	2.36
189	4.34	4.53	2.90	4.54	4.43	4.11	3.81	3.62	4.37	3.93	3.45	2.67
190	4.34	4.58	2.89	4.66	4.54	4.14	3.80	3.61	4.46	3.98	3.44	2.57
191	3.56	3.90	2.57	4.04	3.96	3.56	3.24	3.06	3.89	3.46	2.98	2.22
192	3.31	3.71	2.64	3.80	3.76	3.47	3.20	3.04	3.68	3.34	2.96	2.35
193	4.10	4.38	2.90	4.42	4.32	4.02	3.73	3.58	4.24	3.85	3.41	2.70
194	4.30	4.57	2.92	4.66	4.51	4.11	3.75	3.54	4.44	3.94	3.39	2.49
195	3.63	3.98	2.65	4.10	4.01	3.64	3.31	3.14	3.94	3.51	3.02	2.23
196	3.63	3.91	2.75	4.03	3.96	3.65	3.33	3.18	3.90	3.50	3.05	2.35
197	4.13	4.37	2.93	4.48	4.37	4.04	3.70	3.52	4.30	3.85	3.35	2.56
198	4.16	4.35	2.97	4.53	4.40	4.05	3.72	3.53	4.34	3.89	3.38	2.54
199	3.86	4.15	2.88	4.36	4.25	3.94	xxx	xxx	4.20	3.99	3.29	2.47
200	3.47	3.78	2.60	3.92	3.83	3.52	3.19	3.03	3.78	3.36	2.91	2.13
201	3.81	4.05	2.74	4.15	4.06	3.73	3.41	3.23	4.00	3.57	3.09	2.30
202	3.89	4.19	2.77	4.27	4.13	3.79	3.46	3.27	4.08	3.62	3.11	2.26
203	3.69	4.07	2.73	4.18	4.05	3.73	3.41	3.24	4.00	3.56	3.07	2.24
204	3.61	3.91	2.61	4.04	3.94	3.58	3.25	3.07	3.89	3.43	2.92	2.08
205	3.50	3.78	2.54	3.92	3.81	3.44	3.11	2.93	3.76	3.31	2.81	2.01
206	3.97	4.32	2.97	4.50	4.35	4.01	3.70	3.53	4.28	3.85	3.36	2.56
207	4.10	4.30	2.99	4.50	4.26	4.00	3.68	3.50	4.28	3.84	3.33	2.48
208	3.82	4.10	2.86	4.26	4.06	3.82	3.51	3.34	4.11	3.69	3.20	2.35
209	3.24	3.56	2.52	3.69	3.61	3.29	2.99	2.83	3.58	3.20	2.77	2.04
210	3.74	4.07	3.00	4.19	4.12	3.75	3.59	3.47	4.06	3.73	3.36	2.74
211	4.42	4.70	3.30	4.80	4.69	4.30	4.11	3.97	4.63	4.23	3.78	3.00
212	3.94	4.20	2.88	4.31	4.21	3.86	3.52	3.35	4.18	3.74	3.26	2.48
213	3.30	3.68	2.61	3.83	3.77	3.42	3.09	2.92	3.73	3.35	2.91	2.22
214	3.80	4.14	3.01	4.34	4.24	3.85	3.60	3.44	4.17	3.81	3.38	2.67
215	4.76	4.92	2.71	5.18	5.03	4.60	4.26	4.16	4.95	4.50	3.98	3.11
216	4.06	4.29	2.83	4.41	4.29	3.88	3.53	3.34	4.23	3.75	3.23	2.34

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
217	3.16	3.52	2.50	3.70	3.61	3.24	2.92	2.76	3.56	3.17	2.75	2.04
218	3.93	4.26	3.07	4.42	4.29	3.95	3.67	3.52	4.25	3.86	3.42	2.69
219	5.15	5.30	3.53	5.42	5.24	4.83	4.48	4.28	5.19	4.67	4.10	3.14
220	4.81	4.76	2.98	4.84	4.70	4.21	3.77	3.52	4.61	4.05	3.43	2.37
221	3.53	3.69	2.51	3.76	3.68	3.28	2.91	2.70	3.60	3.19	2.72	1.92
222	4.26	4.53	3.21	4.63	4.50	xxx	3.89	3.72	4.46	4.07	3.63	2.88
223	5.66	5.68	3.69	5.77	5.56	xxx	4.60	4.51	5.50	4.95	4.34	3.31
224	5.30	5.15	2.79	5.08	4.85	4.18	3.73	3.44	4.71	4.07	3.42	2.27
225	3.83	3.89	2.28	3.84	3.73	3.18	2.82	2.60	3.61	3.14	2.66	1.81
226	4.49	4.55	3.27	4.69	4.49	xxx	3.92	3.74	4.51	4.14	3.69	2.92
227	6.02	5.67	3.75	5.84	5.53	xxx	4.77	4.54	5.52	4.99	4.37	3.33
228	5.60	5.31	3.29	5.37	5.21	4.66	4.16	3.87	5.10	4.50	3.81	2.72
229	4.50	4.40	2.94	4.54	4.45	3.98	3.53	3.29	4.36	3.86	3.29	2.36
230	4.78	4.80	3.32	5.00	4.70	xxx	4.02	3.77	4.77	4.31	3.81	2.92
231	6.25	5.91	3.79	6.11	5.98	xxx	4.84	4.56	5.75	5.15	4.49	3.37
232	5.81	5.45	3.22	5.50	5.28	4.65	4.10	3.77	5.18	4.54	3.79	2.59
233	4.80	4.65	2.96	4.75	4.62	4.11	3.64	3.37	4.54	4.01	3.39	2.36
234	5.11	5.01	3.25	5.15	5.00	xxx	4.07	3.75	4.91	4.38	3.78	2.80
235	6.47	6.08	3.65	6.15	5.89	xxx	4.71	4.39	5.78	5.11	4.37	3.17
236	5.89	5.44	3.04	5.44	5.16	4.45	3.85	3.45	3.73	4.38	3.59	2.30
237	4.68	4.58	2.76	4.68	4.50	3.98	3.51	3.21	4.39	3.88	3.21	2.13
238	5.28	5.02	3.12	5.15	4.96	4.39	3.86	3.52	4.85	4.32	3.62	2.54
239	6.24	5.75	3.40	5.82	5.59	4.93	4.33	3.94	5.45	4.80	3.99	2.75
240	6.04	5.54	3.04	5.46	5.24	4.46	3.81	3.35	5.11	4.44	3.60	2.29
241	5.12	4.90	2.79	4.82	4.67	4.01	3.46	3.05	xxx	xxx	3.29	2.13
242	4.89	4.89	2.93	4.92	4.78	4.19	3.65	3.27	xxx	4.08	3.42	2.31
243	6.01	5.62	3.26	5.65	5.43	4.74	4.08	3.65	5.27	4.62	3.81	2.57
244	5.63	5.30	2.93	5.39	5.15	4.44	3.77	3.32	5.00	4.35	3.52	2.14
245	4.89	4.65	2.68	4.74	4.56	3.91	3.35	2.93	4.46	3.89	3.17	1.95
246	4.91	4.71	2.79	4.73	4.57	4.06	3.59	3.25	4.47	3.92	3.25	2.18
247	5.30	5.12	2.94	5.15	4.94	4.37	3.83	3.47	4.84	4.23	3.48	2.29
248	5.46	5.19	2.94	5.24	5.03	4.40	3.84	3.45	4.93	4.28	3.48	2.21
249	4.80	4.76	2.79	4.84	4.67	4.10	3.57	3.22	4.58	xxx	3.25	2.08
250	4.41	4.34	2.59	4.44	4.28	3.83	3.38	3.10	4.20	xxx	3.01	1.96
251	4.77	4.63	2.71	4.73	4.53	4.04	3.56	3.25	4.45	3.89	3.19	2.08
252	4.92	4.87	2.78	4.95	4.74	4.19	3.67	3.34	4.65	4.03	3.27	2.07
253	4.56	4.66	2.70	4.79	4.60	4.07	3.57	3.26	4.53	3.93	3.19	2.02

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
254	4.07	4.27	2.21	4.29	4.14	3.66	3.26	3.00	4.09	3.57	2.90	1.86
255	3.76	3.82	2.08	3.81	3.69	3.25	2.91	2.68	3.63	3.20	2.62	1.71
256	4.38	4.52	2.81	4.67	4.54	4.13	3.78	3.57	4.43	3.98	3.41	2.43
257	4.70	5.39	2.80	4.71	4.55	4.10	3.72	3.50	4.45	3.94	3.33	2.31
258	3.61	3.70	2.30	3.80	3.67	3.33	3.04	2.89	3.63	3.22	2.73	1.98
259	3.25	3.57	2.25	3.72	3.63	3.31	3.02	2.89	3.58	3.20	2.73	1.99
260	3.65	3.91	2.49	4.06	3.93	3.56	3.25	3.08	3.88	3.44	2.93	2.05
261	4.11	4.33	2.68	4.42	4.27	3.90	3.57	3.38	4.23	3.75	3.20	2.25
262	3.50	3.75	2.24	3.77	3.67	3.31	2.96	2.78	3.65	3.20	2.65	1.73
263	2.71	3.13	1.97	3.23	3.17	2.83	2.51	2.34	3.11	2.77	2.29	1.52
264	3.41	3.83	2.54	4.00	3.87	3.55	3.25	3.10	3.77	3.41	2.93	2.17
265	3.65	4.00	2.58	4.14	4.00	3.69	3.40	3.27	3.93	3.53	3.03	2.21
266	3.45	3.79	2.50	3.87	3.80	3.49	3.21	3.08	3.70	3.35	2.85	2.05
267	2.55	3.02	2.06	3.16	3.11	2.79	2.51	2.35	3.01	2.72	2.28	1.59
268	3.00	3.51	2.59	3.71	4.33	3.38	3.16	3.05	3.54	3.27	2.92	2.35
269	3.68	4.05	2.86	4.20	4.09	3.84	3.62	3.66	4.01	3.68	3.28	2.59
270	3.16	3.54	2.49	3.63	3.58	3.32	3.10	3.01	3.54	3.20	2.79	2.13
271	2.26	2.77	2.03	2.91	2.89	2.63	2.40	2.29	2.84	2.55	2.21	1.70
272	2.82	3.33	2.54	3.55	3.47	3.23	3.02	2.93	3.37	3.11	2.79	2.29
273	3.69	4.13	2.99	4.30	4.17	3.93	3.71	3.61	4.09	3.77	3.36	2.71
274	3.40	3.82	2.66	3.89	3.84	3.57	3.32	3.20	3.79	3.42	2.97	2.28
275	2.50	3.06	2.18	3.14	3.13	2.85	2.59	2.49	3.10	2.77	2.39	1.83
276	2.90	3.44	2.52	3.41	3.40	3.12	2.93	3.57	3.35	3.04	2.73	2.26
277	3.72	4.18	3.01	4.16	4.10	3.83	3.63	3.56	4.05	3.70	3.33	2.72
278	3.51	3.93	2.79	4.04	3.97	3.70	3.43	3.31	3.94	3.56	3.11	2.39
279	2.49	2.97	2.17	3.12	3.07	2.79	2.54	2.44	3.05	2.72	2.35	1.82
280	xxx	3.55	2.67	3.61	3.55	3.27	3.12	3.06	3.51	3.25	2.93	2.46
281	xxx	4.46	3.37	4.44	4.37	4.11	3.93	3.83	4.32	4.01	3.61	2.96
282	xxx	3.79	2.52	3.77	3.62	3.33	3.01	2.74	3.61	3.25	2.78	xxx
283	xxx	3.53	2.39	3.52	3.45	3.20	2.99	2.82	xxx	xxx	2.74	xxx
284	xxx	4.34	2.94	4.38	4.30	3.95	3.63	3.47	xxx	xxx	3.31	2.47
285	xxx	4.37	2.95	4.49	4.33	3.95	3.60	3.43	4.24	3.83	3.28	2.38
286	xxx	3.95	2.58	4.07	xxx	3.61	3.27	3.08	3.88	xxx	xxx	2.18
287	xxx	xxx	2.73	4.95	xxx	3.34	3.00	2.77	3.57	xxx	xxx	xxx
288	xxx	xxx	1.39	3.98	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
289	xxx	xxx	1.81	3.78	3.64	xxx	xxx	xxx	xxx	xxx	xxx	xxx
290	xxx	4.63	2.40	4.60	4.51	3.98	xxx	xxx	xxx	xxx	3.24	xxx

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
291	xxx	3.87	2.09	3.89	3.87	3.38	2.95	2.55	3.71	3.29	2.73	1.71
292	xxx	4.10	2.08	4.13	4.07	3.56	3.07	2.63	3.92	3.51	2.94	1.89
293	xxx	4.69	2.50	4.74	4.64	4.11	3.61	3.18	4.49	3.99	3.34	2.15
294	4.19	4.46	1.78	4.56	4.45	3.80	3.19	2.65	4.31	3.75	3.07	1.78
295	3.60	4.11	1.68	4.18	4.08	3.46	2.87	2.34	3.97	3.46	2.85	1.66
296	4.03	4.49	1.57	4.66	4.50	3.72	2.96	2.30	4.39	3.85	3.18	1.93
297	4.79	5.02	2.02	5.21	5.03	4.22	3.45	2.75	4.86	4.26	3.51	2.14
298	4.57	4.81	1.50	4.94	4.74	3.84	2.91	2.10	4.60	3.98	3.20	1.80
299	4.00	4.42	1.26	4.57	4.37	3.48	2.59	1.86	4.25	3.68	2.98	1.68
300	3.85	4.34	1.38	4.49	4.28	3.43	2.57	1.88	xxx	3.65	3.01	1.78
301	4.71	4.98	1.80	5.07	4.87	3.99	3.08	2.29	xxx	4.15	3.41	2.04
302	4.59	4.83	1.58	4.92	4.71	3.76	2.83	2.00	4.56	3.92	3.10	1.62
303	4.16	4.51	1.37	4.66	4.44	3.52	2.60	1.83	4.33	3.74	2.99	1.61
304	4.05	4.29	1.58	4.38	4.18	3.40	2.58	1.90	4.07	3.52	2.81	1.51
305	4.37	4.60	1.65	4.64	4.44	3.62	2.78	2.05	4.30	3.72	2.98	1.64
306	4.67	4.93	1.93	5.01	4.82	3.95	3.07	2.33	4.64	3.96	3.13	1.63
307	4.28	4.63	1.71	4.75	4.55	3.71	2.83	2.10	4.41	3.88	2.99	1.57
308	4.29	4.55	1.96	4.64	4.44	3.72	2.98	2.35	4.30	3.50	2.94	1.55
309	4.21	4.45	1.83	4.52	4.32	3.60	2.86	2.25	4.18	3.59	2.86	1.50
310	4.31	4.74	2.30	4.84	4.65	3.94	3.17	2.56	4.50	3.91	3.17	1.76
311	4.45	4.88	2.24	4.98	4.80	4.08	3.32	2.71	4.63	4.02	3.24	1.79
312	4.13	4.47	2.22	4.55	4.38	3.67	2.94	2.32	4.23	3.66	2.92	1.60
313	3.82	4.24	2.08	4.33	4.17	3.47	2.74	2.13	4.03	3.49	2.80	1.52
314	4.08	4.49	2.50	4.59	4.43	3.74	3.01	2.42	4.29	3.76	3.10	1.78
315	4.47	4.86	2.58	4.92	4.73	4.05	3.31	2.73	4.60	4.03	3.31	1.92
316	4.12	4.29	2.30	4.31	4.09	3.33	2.59	1.97	3.96	3.38	2.62	1.25
317	3.50	3.81	2.06	3.86	3.67	2.92	2.22	1.61	3.55	3.03	2.35	1.12
318	3.98	4.63	2.81	4.70	4.49	3.82	3.16	2.56	4.42	3.87	3.16	1.80
319	4.67	4.90	2.91	4.95	4.72	4.04	3.34	2.73	4.63	4.05	3.29	1.84
320	3.87	4.22	2.54	4.31	4.15	3.53	2.94	2.42	4.01	3.50	2.84	1.60
321	3.40	3.88	2.36	3.98	3.84	3.22	2.65	2.13	3.70	3.21	2.59	1.41
322	3.50	4.00	2.58	4.12	4.01	3.46	2.95	2.49	3.87	3.43	2.87	1.80
323	4.58	4.80	2.89	4.88	4.73	4.12	3.58	3.11	4.57	4.02	3.33	2.03
324	4.05	4.36	2.46	4.39	4.14	3.55	2.95	2.41	4.08	3.53	2.81	1.52
325	3.07	3.65	2.18	3.76	3.53	2.98	2.40	1.87	3.50	3.04	2.43	1.31
326	3.72	4.24	2.72	4.46	4.28	3.66	3.07	2.57	4.16	3.69	3.09	1.94
327	4.61	4.86	2.96	5.00	4.81	4.16	3.56	3.05	4.67	4.10	3.39	2.07

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
328	4.26	4.52	2.66	4.58	4.44	3.78	3.18	2.67	4.30	3.72	3.02	1.76
329	3.16	3.64	2.28	3.81	3.69	3.08	2.50	2.00	3.57	3.11	2.51	1.42
330	3.71	4.28	2.89	4.48	4.34	3.85	3.37	2.96	4.25	3.83	3.28	2.26
331	4.76	5.00	3.15	5.11	4.94	4.39	3.87	3.46	4.82	4.27	3.61	2.42
332	4.41	4.56	2.77	4.64	4.51	3.94	3.43	3.01	4.34	3.80	3.14	1.99
333	3.52	3.95	2.54	4.09	3.99	3.46	2.98	2.59	3.85	3.39	xxx	1.75
334	3.93	4.32	2.92	4.45	4.37	3.91	3.50	3.19	4.24	3.81	xxx	2.29
335	5.10	5.32	3.30	5.38	5.22	4.64	4.15	3.78	5.08	4.51	xxx	2.63
336	5.00	5.14	2.98	5.20	5.00	4.32	3.73	3.28	4.84	4.18	xxx	2.07
337	3.95	4.30	2.69	4.43	4.28	3.69	3.16	2.77	4.15	3.60	xxx	1.77
338	4.39	4.77	3.10	4.90	4.77	4.27	3.82	3.52	4.66	4.15	xxx	2.48
339	5.76	5.74	3.44	5.79	5.57	4.94	4.40	4.02	5.42	4.78	xxx	2.75
340	5.38	5.30	2.97	5.36	5.12	4.40	3.80	3.36	4.96	4.28	xxx	2.13
341	4.41	4.54	2.70	4.66	4.49	3.88	3.34	2.99	4.36	3.78	xxx	1.91
342	4.98	5.02	3.13	5.18	4.98	4.42	3.91	3.57	4.85	4.29	xxx	2.52
343	5.92	5.75	3.45	5.92	5.65	4.98	4.40	4.01	5.50	4.83	xxx	2.74
344	5.44	5.33	2.94	5.40	5.15	4.41	3.80	3.35	5.00	4.32	xxx	2.15
345	4.82	4.90	2.82	5.03	4.83	4.16	3.61	3.21	4.68	4.08	xxx	2.07
346	5.16	4.94	2.72	4.95	4.75	4.05	3.50	3.10	4.59	3.99	xxx	1.95
347	5.87	5.73	3.10	5.78	5.52	4.70	4.02	3.54	5.34	4.62	xxx	2.30
348	5.77	5.06	2.50	5.11	4.82	4.01	3.28	2.76	4.65	3.93	xxx	1.58
349	4.68	4.13	2.11	4.17	3.97	3.31	2.73	2.31	3.84	3.30	xxx	1.34
350	5.48	5.24	2.90	5.34	5.15	4.47	3.83	3.36	4.98	4.35	xxx	2.19
351	5.78	5.34	2.89	5.39	5.18	4.50	3.86	3.42	5.00	4.30	xxx	2.08
352	xxx	5.50	3.03	5.59	5.37	4.61	3.92	3.39	5.23	4.57	xxx	2.42
353	xxx	5.23	2.91	5.36	5.15	4.46	3.80	3.28	4.98	4.34	xxx	2.26
354	5.20	5.13	2.95	5.26	4.87	4.28	3.57	2.99	4.87	4.29	xxx	2.47
355	5.32	5.27	2.99	5.38	5.01	4.41	3.71	3.13	4.97	4.37	xxx	2.50
356	5.49	5.30	2.86	5.42	5.18	4.28	3.32	2.57	5.04	4.39	xxx	2.35
357	5.30	5.02	2.91	5.34	5.12	4.23	3.27	2.50	4.99	4.36	xxx	2.42
358	4.79	4.76	2.32	5.09	4.87	3.93	3.03	2.22	4.74	4.16	xxx	2.30
359	4.93	5.01	2.51	5.15	4.93	3.98	3.08	2.26	4.79	4.20	xxx	2.28
360	4.62	4.84	2.11	4.98	4.78	3.82	2.91	2.09	4.65	4.08	xxx	2.22
361	4.97	5.04	2.31	5.13	4.92	3.95	3.04	2.20	4.79	4.21	xxx	2.30
362	4.65	4.78	1.81	4.87	4.65	3.68	2.77	1.93	4.52	3.92	xxx	2.00
363	4.28	4.51	1.81	4.63	4.43	3.48	2.59	1.79	4.32	3.77	xxx	1.96
364	4.41	4.62	1.80	4.75	4.55	3.61	2.69	1.87	4.43	3.89	xxx	2.01

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
365	4.62	4.84	1.88	4.96	4.74	3.78	2.83	1.99	4.61	4.04	3.02	2.09
366	4.23	4.58	1.76	4.60	4.40	3.52	2.59	1.78	4.26	3.71	2.72	1.85
367	3.46	4.02	1.48	4.09	3.90	3.08	2.21	1.49	3.79	3.32	3.07	1.68
368	3.70	4.21	1.96	4.40	4.21	3.36	2.55	1.84	4.12	3.66	3.27	2.07
369	4.29	4.59	2.06	4.75	4.56	3.65	2.79	2.00	4.44	3.92	2.71	2.18
370	3.71	3.99	1.80	4.11	3.95	3.18	2.39	1.68	3.81	3.32	2.36	1.67
371	3.12	3.38	1.49	3.52	3.36	2.67	1.95	1.36	3.28	2.88	2.77	1.47
372	3.32	3.67	2.01	3.84	3.71	3.04	2.38	1.84	3.64	3.26	3.05	1.94
373	3.85	4.13	2.12	4.30	4.18	3.44	2.69	2.05	4.07	3.61	2.46	2.09
374	xxx	3.40	1.85	3.50	3.41	2.87	2.31	1.81	3.29	2.92	2.28	1.64
375	xxx	3.11	1.67	3.21	3.13	2.60	2.06	1.56	3.03	2.70	xxx	1.52
376	xxx	3.43	1.90	3.53	3.43	2.94	2.44	1.96	3.31	2.91	xxx	1.49
377	xxx	3.84	2.10	3.89	3.79	3.28	2.77	2.29	3.68	3.26	xxx	1.72
378	xxx	3.30	1.80	3.35	3.30	2.92	2.54	2.21	3.18	2.81	xxx	1.43
379	xxx	2.97	1.58	3.00	2.96	2.58	2.21	1.88	2.85	2.52	xxx	1.25
380	xxx	2.99	1.69	3.05	2.98	2.67	2.39	2.16	2.88	2.57	xxx	1.41
381	xxx	3.52	1.98	3.57	3.47	3.13	2.80	2.56	3.38	3.01	xxx	1.67
382	xxx	3.20	1.54	3.12	3.04	2.71	2.36	2.11	2.96	2.55	xxx	1.14
383	xxx	2.70	1.37	2.67	2.63	2.32	2.01	1.78	2.56	2.21	2.09	1.04
384	xxx	3.06	1.61	3.07	3.02	2.71	2.42	2.16	2.92	2.54	2.42	1.31
385	xxx	3.53	1.89	3.60	3.72	3.17	2.82	2.59	3.39	2.97	2.16	1.52
386	2.96	3.30	1.56	3.34	3.25	2.86	2.49	2.21	3.12	2.71	xxx	1.21
387	2.29	2.73	1.28	2.72	2.64	2.30	1.97	1.69	2.51	2.18	2.79	0.97
388	3.24	3.87	1.94	3.94	3.85	3.40	2.93	2.52	3.72	3.32	2.71	1.85
389	3.37	3.84	1.96	3.93	3.87	3.44	2.99	2.59	3.73	3.28	2.94	1.74
390	3.33	3.98	2.03	4.14	4.03	3.41	2.79	2.23	3.92	3.48	2.37	1.97
391	2.53	3.22	1.48	3.43	3.31	2.74	2.18	1.69	3.22	2.84	2.75	1.47
392	2.63	xxx	1.82	3.61	3.47	2.85	2.22	1.71	3.41	3.10	3.42	2.06
393	3.72	4.30	2.45	4.47	4.34	3.68	2.98	2.40	4.23	3.84	2.73	xxx
394	3.48	3.96	1.61	4.10	3.95	3.19	2.42	1.71	3.82	3.33	2.58	1.64
395	3.14	3.67	1.58	3.82	3.67	2.93	2.21	1.55	3.56	3.14	2.68	1.55
396	3.08	3.69	1.18	3.85	3.72	2.96	2.21	1.53	3.62	3.21	3.11	1.65
397	3.93	4.34	1.81	4.48	4.34	3.53	2.72	1.96	4.22	3.72	2.60	1.94
398	3.49	3.89	0.98	4.00	3.86	3.02	2.19	1.40	3.72	3.22	2.49	1.48
399	3.21	3.66	0.94	3.80	3.64	2.84	2.06	1.33	3.52	3.06	2.85	1.41
400	3.67	4.10	1.02	4.28	4.06	3.12	2.23	1.39	3.97	3.47	3.15	1.71
401	4.32	4.67	1.34	4.80	4.60	3.61	2.67	1.75	4.46	3.88	2.91	1.89

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
402	4.21	4.53	1.27	4.64	4.43	3.33	2.31	1.34	4.30	3.68	2.73	1.59
403	3.80	4.16	0.99	4.30	4.10	3.05	2.11	1.26	3.99	3.43	2.95	1.49
404	4.05	4.40	1.36	4.54	4.30	3.17	2.17	1.19	4.21	3.64	3.22	1.71
405	4.72	4.92	1.52	5.04	4.79	3.62	2.55	1.55	4.65	4.00	2.88	1.86
406	4.30	4.54	1.46	4.66	4.41	3.23	2.17	1.18	4.28	3.66	2.84	1.53
407	4.10	4.38	1.33	4.51	4.26	3.12	2.12	1.21	4.18	3.59	2.92	1.53
408	4.45	4.54	1.54	4.65	4.38	3.17	2.11	1.14	4.31	3.70	2.98	1.56
409	4.45	4.64	1.48	4.76	4.49	3.26	2.20	1.23	4.39	3.76	3.03	1.60
410	4.60	4.76	1.79	4.89	4.58	3.30	2.18	1.18	4.47	3.81	3.02	1.61
411	4.52	4.75	1.69	4.88	4.58	3.31	2.19	1.20	4.46	3.80	3.06	1.60
412	4.89	4.92	1.88	5.01	4.70	3.43	2.24	1.25	4.57	3.88	3.02	1.61
413	4.79	4.85	1.81	4.94	4.62	3.35	2.16	1.19	4.52	3.84	3.11	1.61
414	4.89	4.93	1.96	5.04	4.70	3.45	2.35	1.43	4.60	3.93	3.14	1.70
415	4.92	4.95	1.96	5.04	4.71	3.45	2.32	1.35	4.60	3.94	3.10	1.71
416	4.76	4.92	1.98	4.99	4.71	3.59	2.54	1.65	4.59	3.92	3.01	1.66
417	4.63	4.85	1.90	4.89	4.61	3.47	2.40	1.48	4.49	3.83	2.98	1.60
418	4.46	4.70	1.97	4.73	4.50	3.59	2.69	1.93	4.36	3.74	3.36	1.66
419	5.04	5.28	2.23	5.35	5.06	4.06	3.08	2.29	4.92	4.20	xxx	1.88
420	4.67	4.29	1.42	4.13	3.91	3.03	2.32	1.72	3.73	3.09	xxx	1.02
421	3.65	3.51	1.22	3.34	3.16	2.37	1.72	1.17	3.07	2.58	xxx	0.94
422	4.66	5.04	2.16	5.03	4.85	4.00	3.25	2.63	4.68	4.02	2.91	1.82
423	4.85	4.84	1.93	4.79	4.58	3.71	2.73	2.29	4.40	3.73	3.45	1.49
424	5.01	5.09	2.34	5.15	4.95	4.21	3.49	2.90	4.80	4.19	2.91	2.11
425	4.18	4.34	1.89	4.47	4.30	3.62	2.94	2.40	4.17	3.60	3.40	1.66
426	3.74	4.24	2.39	4.48	4.35	3.86	3.33	2.90	4.29	3.90	3.83	xxx
427	5.17	5.16	2.72	5.29	5.12	4.57	3.99	3.52	4.99	4.46	2.95	xxx
428	4.24	4.30	2.09	4.39	4.24	3.65	3.08	2.60	4.09	3.58	2.84	1.93
429	3.70	3.93	1.98	4.10	3.96	3.38	2.84	2.35	3.84	3.40	2.83	1.89
430	3.55	3.83	2.06	4.04	3.91	3.38	2.90	2.45	3.80	3.35	3.34	1.90
431	4.70	4.72	2.39	4.81	4.67	4.07	3.52	3.07	4.55	3.98	2.73	2.20
432	4.22	4.29	1.98	4.29	4.09	3.46	2.85	2.35	4.00	3.42	2.35	1.58
433	3.14	3.53	1.67	3.62	3.47	2.90	2.33	1.83	3.39	2.95	2.70	1.36
434	3.49	3.76	2.05	3.92	3.79	3.26	2.76	2.32	3.66	3.25	3.28	1.76
435	4.65	4.80	2.46	4.86	4.65	4.04	3.48	3.00	4.53	3.98	2.71	2.10
436	4.26	4.36	2.04	4.33	4.14	3.49	2.84	2.29	4.03	3.46	2.22	1.48
437	2.89	3.35	1.63	3.45	3.34	2.78	2.20	1.68	3.23	2.80	2.95	1.22
438	3.59	4.09	2.29	4.27	4.09	3.50	2.93	2.42	3.96	3.52	3.20	1.92

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
439	4.34	4.65	2.47	4.76	4.65	3.92	3.32	2.83	4.42	xxx	3.09	2.03
440	4.38	4.60	2.45	4.65	4.49	3.81	3.12	2.57	4.35	3.79	2.53	1.89
441	3.15	3.68	2.03	3.82	3.70	3.06	2.42	1.88	3.56	3.11	3.18	1.52
442	3.57	4.13	2.60	4.32	4.17	3.63	3.12	2.69	4.08	3.68	3.52	2.32
443	4.58	4.85	2.86	4.95	4.76	4.20	3.65	3.21	4.64	4.13	3.13	2.52
444	4.24	4.54	2.62	4.59	4.47	3.89	3.33	2.87	4.32	3.78	2.85	2.07
445	3.59	4.00	2.38	4.12	4.02	3.46	2.95	2.51	3.91	3.44	3.05	1.88
446	3.65	4.06	2.57	4.23	4.10	3.65	3.24	2.87	4.01	3.57	3.53	2.17
447	4.82	4.95	2.92	5.03	4.84	4.29	3.78	3.36	4.71	4.15	3.24	2.46
448	4.88	4.91	2.72	4.96	4.78	4.12	3.53	3.05	4.61	3.98	2.93	1.99
449	4.12	4.25	2.47	4.37	4.23	3.65	3.11	2.68	4.10	3.58	3.18	1.83
450	4.28	4.45	2.73	4.56	4.45	3.96	3.51	3.17	4.31	3.82	3.52	2.18
451	5.09	5.13	2.98	5.20	5.01	4.40	3.88	3.50	4.85	4.25	3.35	2.36
452	5.14	5.08	2.84	5.14	4.93	4.25	3.70	3.28	4.76	4.11	3.12	2.09
453	4.66	4.64	2.67	4.70	4.54	3.94	3.42	3.02	4.40	3.82	3.43	1.95
454	4.81	4.86	2.91	4.97	4.81	4.28	3.79	3.44	4.67	4.11	3.62	2.31
455	5.40	5.32	3.05	5.40	5.18	4.55	4.01	3.63	5.01	4.38	3.28	2.39
456	5.14	4.99	2.70	5.03	4.80	4.15	3.61	3.22	4.65	4.04	3.28	2.06
457	4.79	4.87	2.71	4.94	4.74	4.12	3.60	3.22	4.61	4.02	3.32	2.09
458	5.19	5.05	2.82	5.06	4.85	4.22	3.66	3.27	4.72	4.08	3.54	2.07
459	5.52	5.38	2.95	5.44	5.19	4.46	3.88	3.46	5.04	4.35	2.93	2.19
460	5.29	4.90	2.48	4.84	4.58	3.83	3.25	2.83	4.45	3.78	3.12	1.61
461	5.00	4.89	2.60	4.93	4.69	3.99	3.39	2.95	4.60	3.94	3.14	1.80
462	5.28	4.90	2.55	5.08	4.82	4.10	3.45	2.97	4.69	3.99	2.56	1.66
463	4.54	4.11	2.14	4.16	3.97	3.36	2.79	2.41	3.84	3.28	3.63	1.32
464	5.22	5.18	2.95	5.25	5.10	4.51	3.96	3.60	4.94	4.36	3.50	2.38
465	5.41	5.16	2.92	5.25	5.08	4.48	3.93	3.57	4.90	4.27	3.50	2.22
466	5.00	5.09	2.92	5.04	4.87	4.34	3.85	3.50	4.72	4.16	3.39	2.42
467	4.82	5.00	2.85	4.97	4.78	4.25	3.77	3.47	4.62	4.06	3.48	2.31
468	4.74	4.83	2.96	4.96	4.80	4.26	3.77	3.46	4.65	4.12	3.81	2.47
469	5.34	5.36	3.16	5.44	5.28	4.72	4.21	3.86	5.11	4.51	3.22	2.67
470	4.82	4.79	2.68	4.85	4.65	3.99	3.39	2.91	4.52	3.92	3.08	2.06
471	4.41	4.50	2.59	4.58	4.43	3.86	3.30	2.84	4.31	3.75	3.04	2.01
472	4.23	4.41	2.56	4.49	4.36	3.73	3.12	2.60	4.24	3.69	3.37	1.99
473	4.86	4.92	2.80	4.96	4.81	4.12	3.51	2.96	4.66	4.06	3.04	2.20
474	4.58	4.65	2.48	4.68	4.51	3.65	3.01	2.37	4.38	3.78	2.74	1.82
475	3.81	4.05	2.26	4.15	4.04	3.23	2.60	1.97	3.92	3.41	2.96	1.66

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
476	4.03	4.22	2.45	4.34	4.24	3.47	2.83	2.21	4.11	3.60	3.17	1.91
477	4.54	4.64	2.61	4.70	4.56	3.76	3.12	2.50	4.42	3.85	2.87	2.02
478	4.21	4.36	2.34	4.37	4.24	3.48	2.81	2.19	4.11	3.55	2.34	1.70
479	3.08	3.50	1.97	3.52	3.46	2.74	2.11	xxx	3.35	2.90	2.97	1.40
480	3.54	4.02	2.50	4.11	4.03	3.32	2.79	2.25	3.92	3.48	3.23	2.14
481	4.24	4.46	2.69	4.56	4.44	3.75	3.18	2.64	4.32	3.81	2.66	2.25
482	3.58	4.02	2.22	3.94	3.83	3.21	2.63	2.11	3.72	3.22	2.32	1.73
483	xxx	3.46	1.99	3.42	3.30	2.67	2.12	1.60	3.22	2.81	2.66	1.53
484	3.26	3.55	2.28	3.70	3.60	3.07	2.53	2.05	3.51	3.13	2.95	1.91
485	3.72	4.03	2.48	4.15	4.04	3.51	2.96	2.47	3.95	3.47	2.53	2.11
486	3.22	3.59	2.14	3.67	3.58	3.07	2.54	2.06	3.48	3.03	2.09	1.69
487	2.44	2.94	1.83	3.05	2.99	2.48	1.96	1.50	2.89	2.53	2.41	1.37
488	2.46	3.08	2.12	3.21	3.15	2.75	2.33	1.96	3.06	2.76	2.76	1.87
489	3.23	3.62	2.34	3.70	3.64	3.25	2.83	2.44	3.53	3.18	2.43	2.08
490	2.98	3.32	2.07	3.42	3.38	2.94	2.52	2.12	3.28	2.90	1.85	1.73
491	2.18	2.53	1.67	2.64	2.60	2.15	1.72	1.34	2.51	2.22	2.24	1.32
492	2.33	2.75	2.02	2.89	2.83	2.54	2.24	1.99	2.75	2.53	2.73	1.82
493	3.13	3.45	2.33	3.56	3.50	3.22	xxx	2.66	3.40	3.13	2.28	2.15
494	2.76	3.02	1.97	3.07	3.02	2.77	2.51	2.28	2.94	2.66	1.86	1.71
495	1.99	2.42	1.69	2.52	2.46	2.22	1.98	1.77	2.39	2.17	2.36	1.40
496	2.37	2.89	2.10	3.07	3.02	2.80	2.58	2.41	2.92	2.69	2.73	1.88
497	3.00	3.38	2.33	3.53	3.47	3.23	2.99	2.80	3.37	3.10	2.40	2.15
498	2.71	3.05	2.06	3.13	3.10	2.89	2.67	2.51	3.05	2.78	2.16	1.84
499	2.35	2.75	1.89	2.84	2.81	2.59	2.37	2.23	2.75	2.52	2.30	1.65
500	2.28	2.86	2.01	3.00	2.93	2.61	2.55	2.44	2.84	2.62	2.58	1.81
501	2.83	3.28	2.21	3.40	3.27	3.03	2.85	2.72	3.22	2.93	2.65	2.04
502	3.16	3.48	2.30	3.59	3.48	3.18	2.96	2.83	3.45	3.12	2.41	1.97
503	2.67	3.10	2.13	3.24	3.16	2.90	2.65	2.54	3.13	2.85	2.67	1.80
504	2.94	3.39	2.36	3.56	3.44	3.20	2.97	2.84	3.39	3.08	2.91	2.06
505	3.31	3.76	2.52	3.87	3.75	3.48	3.25	3.11	3.70	3.36	2.97	2.22
506	xxx	3.93	2.60	4.00	3.90	3.59	3.33	3.16	3.85	3.47	2.87	2.18
507	xxx	3.77	2.52	3.89	3.79	3.48	3.20	3.03	3.74	3.36	2.94	2.09
508	xxx	3.79	2.56	3.86	3.81	3.54	3.26	3.12	3.77	3.40	3.24	2.22
509	xxx	4.24	2.78	4.28	4.20	3.91	3.60	3.43	4.17	3.75	3.15	2.43
510	4.05	4.28	2.70	4.39	4.25	3.86	3.50	3.28	4.19	3.72	2.93	2.19
511	3.91	3.98	2.58	4.09	3.97	3.59	3.25	3.04	3.90	3.46	3.05	2.04
512	3.95	4.03	2.66	4.12	4.02	3.71	3.40	3.22	3.95	3.54	3.38	2.23

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
513	4.33	4.50	2.88	4.62	4.46	4.13	3.78	3.56	4.41	3.93	3.15	2.45
514	xxx	4.46	2.70	4.49	4.33	3.91	3.54	3.27	xxx	3.75	3.18	2.12
515	xxx	4.49	2.73	4.51	4.37	3.94	3.56	3.29	xxx	3.77	2.93	2.16
516	xxx	4.22	2.48	4.28	4.12	3.68	3.30	3.04	4.03	3.51	3.14	1.90
517	xxx	4.57	2.63	4.61	4.43	3.93	3.52	3.23	4.33	3.76	3.07	2.05
518	xxx	4.60	2.59	4.65	4.48	3.96	3.48	3.16	4.37	3.78	3.20	1.91
519	xxx	4.78	2.70	4.82	4.64	4.10	3.60	3.27	4.52	3.93	2.86	2.02
520	xxx	4.53	2.39	4.54	4.34	3.76	3.23	2.87	4.20	3.61	2.83	1.62
521	xxx	4.37	2.37	4.43	4.24	3.68	3.18	2.83	4.11	3.55	3.21	1.64
522	xxx	4.90	2.70	4.97	4.76	4.17	3.65	3.27	4.65	4.01	3.19	1.91
523	xxx	4.92	2.69	4.97	4.76	4.17	3.63	3.25	4.65	4.00	3.05	1.88
524	xxx	4.75	2.56	4.77	4.56	4.01	3.47	3.13	4.45	3.85	2.88	1.81
525	xxx	4.44	2.42	4.49	4.30	3.77	3.28	2.97	4.19	3.63	3.02	1.70
526	xxx	4.49	2.54	4.58	4.39	3.90	3.45	3.15	4.29	3.74	3.52	1.91
527	xxx	5.46	2.97	5.51	5.20	4.58	4.00	3.62	5.10	4.39	3.07	2.19
528	xxx	5.12	2.37	5.15	4.83	4.02	3.31	2.82	4.70	3.98	2.37	1.61
529	xxx	3.70	1.80	3.81	3.67	3.07	2.56	2.19	3.53	3.05	3.36	1.25
530	xxx	4.73	2.80	4.82	4.71	4.19	3.70	3.37	4.56	4.03	3.66	2.26
531	xxx	5.43	3.05	5.48	5.30	4.70	4.12	3.74	5.14	4.48	3.18	2.36
532	xxx	4.89	2.63	4.97	4.75	4.14	3.54	3.14	4.64	4.00	2.59	1.91
533	xxx	3.86	2.19	3.98	3.86	3.33	2.85	2.52	3.76	3.26	3.69	1.57
534	xxx	4.85	3.13	4.98	4.85	4.41	4.09	3.86	4.76	4.29	3.98	2.77
535	xxx	5.57	3.32	5.64	5.40	4.89	4.45	4.18	5.30	4.71	3.40	2.83
536	xxx	4.89	2.87	4.97	4.77	4.26	3.76	3.47	4.66	4.09	2.86	2.30
537	xxx	3.92	2.49	4.07	3.94	3.50	3.10	2.86	3.87	3.41	3.38	1.98
538	xxx	4.30	2.98	4.48	4.40	4.03	3.72	3.56	4.29	3.88	3.93	2.61
539	xxx	5.22	3.32	5.35	5.22	4.78	4.38	4.16	5.09	4.56	3.45	2.95
540	xxx	4.93	3.00	5.03	4.84	4.34	3.87	3.57	4.74	4.15	2.86	2.36
541	xxx	3.92	2.58	4.09	3.97	3.53	3.14	2.95	3.88	3.42	3.18	2.08
542	xxx	4.16	2.88	4.25	4.15	3.84	3.53	3.45	4.04	3.64	3.71	2.51
543	xxx	5.03	3.22	5.07	4.91	4.55	4.16	3.97	4.80	4.29	3.18	2.75
544	4.42	4.47	2.80	4.57	4.42	4.00	3.58	3.33	4.34	3.80	2.48	2.19
545	3.19	3.37	2.32	3.52	3.41	3.04	2.72	2.53	3.35	2.95	3.21	1.74
546	xxx	3.90	2.89	4.11	4.01	3.72	3.49	3.37	xxx	3.61	3.75	2.56
547	xxx	4.84	3.29	4.95	4.81	4.49	4.18	4.01	xxx	4.29	3.30	2.90
548	4.08	4.39	2.90	4.51	4.36	4.01	3.68	3.50	4.30	3.83	2.97	2.45
549	3.59	3.90	2.68	4.04	3.92	3.57	3.26	3.10	3.85	3.45	2.89	2.21

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
550	3.44	3.69	2.58	3.84	3.73	3.44	3.17	3.04	3.68	3.32	3.47	2.21
551	4.73	4.78	3.09	4.85	4.64	4.31	3.97	3.78	4.62	4.13	3.06	2.72
552	4.40	4.45	2.58	4.52	4.32	3.85	3.43	3.16	4.26	3.72	2.80	1.98
553	3.84	4.00	2.42	4.05	3.91	3.48	3.11	2.87	3.85	3.38	2.81	1.85
554	3.72	3.91	2.38	4.00	3.85	3.49	3.17	2.98	3.80	3.35	3.20	1.94
555	4.55	4.51	2.69	4.60	4.41	4.00	3.63	3.39	4.34	3.84	3.01	2.20
556	4.62	4.51	2.50	4.54	4.37	3.83	3.40	3.07	4.28	3.73	2.84	1.84
557	4.13	4.14	2.36	4.21	4.04	3.57	3.18	2.89	3.98	3.48	2.79	1.76
558	4.03	4.08	2.31	4.15	3.98	3.54	3.15	2.88	3.93	3.43	3.14	1.74
559	4.67	4.67	2.60	4.72	4.54	4.01	3.56	3.24	4.45	3.87	2.87	1.96
560	4.81	4.55	2.30	4.57	4.38	3.73	3.21	2.81	4.26	3.67	2.83	1.58
561	4.48	4.36	2.26	4.41	4.24	3.63	3.14	2.77	4.13	3.58	2.79	1.61
562	4.34	4.30	2.26	4.33	4.22	3.61	3.14	2.80	4.06	3.51	2.96	1.59
563	4.78	4.66	2.38	4.65	4.44	3.83	3.30	2.92	4.33	3.72	2.94	1.68
564	5.05	4.80	2.30	4.79	4.54	3.85	3.29	2.87	4.42	3.78	2.83	1.59
565	4.79	4.53	2.24	4.56	4.34	3.70	3.17	2.77	4.22	3.64	2.87	1.55
566	4.72	4.55	2.27	4.58	4.36	3.78	3.26	2.89	4.26	3.67	2.88	1.59
567	4.73	4.59	2.27	4.63	4.39	3.79	3.26	2.88	4.30	3.69	3.03	1.58
568	4.98	4.78	2.38	4.84	4.58	3.97	3.43	3.04	4.49	3.87	2.99	1.70
569	5.03	4.76	2.37	4.80	4.54	3.93	3.39	3.00	4.45	3.83	3.00	1.67
570	4.92	4.70	2.37	4.76	4.51	3.93	3.41	3.04	4.42	3.82	2.90	1.73
571	4.65	4.50	2.27	4.61	4.37	3.80	3.31	2.95	4.28	3.70	3.00	1.64
572	4.99	4.64	2.38	4.70	4.50	3.94	3.42	3.08	4.40	3.80	3.09	1.76
573	5.17	4.83	2.47	4.84	4.65	4.07	3.52	3.17	4.54	3.92	3.09	1.82
574	5.15	4.85	2.45	4.90	4.67	4.03	3.50	3.13	4.55	3.94	2.79	1.79
575	4.54	4.32	2.20	4.42	4.21	3.63	3.17	2.84	4.12	3.57	3.10	1.60
576	4.65	4.54	2.51	4.65	4.45	3.95	3.54	3.25	4.38	3.83	3.23	2.00
577	5.13	4.86	2.64	4.93	4.70	4.17	3.71	3.40	4.61	4.01	3.17	2.05
578	5.06	4.81	2.57	4.86	4.64	4.09	3.60	3.28	4.54	3.95	2.80	1.97
579	4.22	4.16	2.28	4.26	4.09	3.60	3.18	2.91	4.01	3.50	3.00	1.73
580	4.19	4.19	2.48	4.32	4.16	3.76	3.41	3.19	4.02	3.60	3.36	2.06
581	4.99	4.87	2.76	4.95	4.74	4.25	3.83	3.56	4.58	4.06	3.10	2.27
582	4.88	4.73	2.55	4.77	4.58	3.99	3.50	3.19	4.47	3.87	2.69	1.92
583	3.88	3.95	2.22	4.05	3.94	3.43	3.02	2.77	3.84	3.35	2.98	1.68
584	3.94	4.10	2.51	4.22	4.09	3.72	3.37	3.18	4.02	3.56	3.31	2.08
585	4.72	4.72	2.75	4.79	4.61	4.19	3.77	3.52	4.53	3.98	2.99	2.26
586	4.60	4.45	2.50	4.50	4.34	3.83	3.38	3.10	4.24	3.68	2.45	1.90

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
587	3.27	3.47	2.09	3.61	3.50	3.09	2.73	2.53	3.43	3.00	2.99	1.58
588	3.64	3.91	2.58	4.06	3.94	3.65	3.35	3.21	3.89	3.48	3.19	2.24
589	4.28	4.35	2.71	4.44	4.28	3.96	3.62	3.45	4.22	3.75	3.06	2.32
590	4.12	4.20	2.63	4.31	4.16	3.81	3.45	3.27	4.09	3.63	2.40	2.18
591	2.98	3.29	1.12	3.43	3.34	2.95	2.67	2.52	3.28	2.85	2.93	1.71
592	3.23	3.64	2.60	3.77	3.74	3.41	3.20	3.10	3.67	3.30	3.39	2.37
593	4.10	4.31	2.93	4.42	4.34	4.06	3.78	3.66	4.27	3.87	2.91	2.67
594	3.62	3.86	2.57	3.96	3.86	3.55	3.25	3.10	3.83	3.41	2.43	2.18
595	2.73	3.09	2.19	3.23	3.19	2.90	2.66	2.54	3.15	2.82	2.64	1.84
596	2.74	3.14	2.35	3.30	3.28	3.07	2.87	2.80	3.24	2.95	3.23	2.13
597	3.67	3.99	2.78	4.12	4.04	3.83	3.57	3.47	4.02	3.65	2.76	2.56
598	3.36	3.67	2.42	3.80	3.67	3.39	3.09	2.94	3.65	3.25	2.20	2.02
599	2.40	2.85	2.02	3.00	2.93	2.66	2.41	2.28	2.91	2.58	2.58	1.63
600	2.65	3.07	2.29	3.21	3.18	2.99	2.80	2.73	3.10	2.88	2.89	2.10
601	3.27	3.56	2.53	3.69	3.60	3.39	3.17	3.10	3.52	3.26	2.81	2.31
602	3.10	3.48	2.45	3.63	3.55	3.31	3.09	2.98	3.52	3.20	2.34	2.25
603	2.58	2.86	2.08	3.02	3.00	2.77	2.57	2.47	2.96	2.68	2.22	1.86
604	2.27	2.58	1.96	2.76	2.73	2.56	2.39	2.33	2.70	2.50	3.08	1.79
605	3.32	3.71	2.60	3.84	3.75	3.57	3.37	3.28	3.72	3.45	2.40	2.47
606	3.03	3.28	2.01	3.25	3.13	2.91	2.70	2.57	3.07	2.76	xxx	xxx
607	xxx	1.67	1.08	1.63	1.59	1.37	xxx	xxx	1.51	xxx	xxx	xxx
608	xxx	2.74	2.22	2.90	2.89	2.75	xxx	2.60	2.83	xxx	3.37	2.21
609	xxx	3.93	2.84	4.06	3.96	3.80	3.62	3.56	3.93	3.68	2.81	2.80
610	3.24	3.50	2.45	3.51	3.47	3.26	3.04	2.94	3.45	3.17	2.54	2.27
611	2.58	3.01	2.22	3.10	3.09	2.92	2.70	2.61	3.06	2.83	2.78	2.09
612	2.90	3.33	2.46	3.54	3.45	3.24	2.98	2.86	3.40	3.12	3.00	2.23
613	3.10	3.56	2.63	3.76	3.66	3.46	3.24	3.13	3.63	3.34	3.29	2.43
614	3.43	3.89	2.87	4.00	3.96	3.79	3.57	3.47	3.93	3.63	2.91	2.69
615	3.03	3.45	2.56	3.61	3.57	3.38	3.13	3.02	3.55	3.25	2.74	2.34
616	xxx	3.25	2.46	3.43	3.35	3.15	2.90	2.80	3.34	3.06	3.03	2.26
617	xxx	3.58	2.67	3.74	3.66	3.49	3.26	3.17	3.65	3.36	3.29	2.52
618	3.60	3.96	2.91	4.09	4.05	3.84	3.58	3.46	4.02	3.68	3.02	2.67
619	3.40	3.69	2.72	3.83	3.79	3.55	3.27	3.14	3.74	3.41	3.42	2.42
620	3.53	3.99	3.02	4.18	4.11	3.71	3.64	3.53	4.08	3.77	3.42	2.80
621	3.86	4.14	3.05	4.23	4.16	3.74	3.64	3.53	4.12	3.78	3.36	2.75
622	3.68	4.01	2.98	4.12	4.06	3.74	3.56	3.45	4.03	3.70	3.60	2.74
623	4.11	4.27	3.18	4.40	4.32	4.00	3.84	3.72	4.29	3.95	3.44	2.94

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
624	4.14	4.23	3.04	4.35	4.29	3.98	3.67	3.51	4.24	3.85	3.53	2.69
625	4.06	4.37	3.09	4.47	4.40	4.09	3.78	3.62	4.36	3.95	3.49	2.79
626	4.28	4.43	3.09	4.53	4.41	4.08	3.78	3.61	4.37	3.95	3.75	2.74
627	4.85	4.78	3.30	4.88	4.77	4.42	4.10	3.91	4.70	4.26	3.60	2.94
628	4.88	4.74	3.18	4.85	4.69	4.31	3.95	3.74	4.52	4.15	3.40	2.74
629	4.39	4.38	3.02	4.54	4.40	4.04	3.69	3.50	4.34	3.91	3.56	2.59
630	4.56	4.65	3.15	4.66	4.54	4.17	3.87	3.69	4.45	4.05	3.99	2.76
631	5.40	5.35	3.46	5.30	5.15	4.71	4.38	4.16	5.06	4.56	3.71	3.06
632	5.44	5.12	3.27	5.19	5.01	4.53	4.10	3.84	4.91	4.37	3.36	2.68
633	4.67	4.56	3.02	4.66	4.53	4.10	3.69	3.46	4.43	3.95	3.53	2.45
634	4.64	4.61	3.13	4.71	4.59	4.25	3.88	3.68	4.51	4.06	4.21	2.70
635	5.89	5.67	3.62	5.74	5.52	5.06	4.63	4.38	5.44	4.87	3.37	3.17
636	5.70	5.13	2.90	5.10	4.89	4.30	3.77	3.41	4.77	4.14	2.85	2.10
637	4.29	4.06	2.55	4.13	4.01	3.58	3.15	2.87	3.92	3.44	3.75	1.87
638	4.90	4.83	3.18	5.05	4.62	xxx	4.13	3.92	4.83	4.32	3.73	2.80
639	5.77	5.11	3.23	5.20	4.72	xxx	4.15	3.92	4.91	4.36	3.96	2.69
640	5.81	5.33	3.38	5.45	4.97	xxx	4.32	4.05	5.14	4.59	3.48	2.95
641	4.83	4.59	3.00	4.81	4.40	xxx	3.81	3.57	4.57	4.07	3.66	2.56
642	4.58	4.09	3.19	4.71	4.47	xxx	3.88	3.68	4.54	4.13	4.47	2.84
643	6.26	5.44	3.75	5.94	5.61	xxx	4.86	4.62	5.65	5.09	3.67	3.41
644	5.95	5.12	3.16	5.33	5.12	4.50	3.97	3.64	5.01	4.39	3.17	2.54
645	4.47	4.09	2.79	4.42	4.32	3.82	3.38	3.11	4.22	3.75	3.46	2.27
646	4.65	4.50	3.07	4.63	4.53	4.14	3.76	3.55	4.45	4.01	4.16	2.60
647	6.10	5.72	3.56	5.76	5.54	5.03	4.57	4.28	5.46	4.86	xxx	3.05
648	5.70	5.21	3.00	5.22	4.99	4.35	3.79	3.41	4.90	4.25	xxx	2.23
649	4.17	4.11	2.60	4.22	4.10	3.59	3.13	2.84	4.02	3.53	xxx	1.94
650	4.27	4.51	2.94	4.46	4.36	3.99	3.60	3.38	4.30	3.84	xxx	2.44
651	5.58	5.50	3.32	5.37	5.19	4.74	4.26	3.96	5.13	4.54	3.40	2.77
652	5.47	5.06	2.95	5.09	4.86	4.27	3.72	3.33	4.79	4.17	2.81	2.20
653	4.10	3.98	2.52	4.11	3.99	3.48	3.05	2.74	3.90	3.42	3.29	1.84
654	4.21	4.31	2.93	4.43	4.35	3.93	3.53	3.25	4.24	3.81	3.73	2.44
655	5.18	5.10	3.23	5.15	5.01	4.57	4.11	3.79	4.90	4.37	3.31	2.70
656	4.83	4.75	2.92	4.82	4.64	4.10	3.54	3.13	4.56	4.00	2.84	2.21
657	3.75	3.93	2.59	4.09	3.98	3.49	3.00	2.62	3.88	3.43	3.16	1.94
658	3.83	4.10	2.83	4.24	4.19	3.78	3.37	3.06	4.05	3.66	3.56	2.38
659	4.70	4.85	3.10	4.86	4.78	4.31	3.83	3.49	4.65	4.14	3.26	2.60
660	4.54	4.65	2.90	4.66	4.55	4.04	3.55	3.18	4.42	3.88	2.95	2.23

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
661	3.87	4.05	2.68	4.16	4.07	3.59	3.16	2.82	3.95	3.50	3.05	2.04
662	3.78	4.02	2.75	4.19	4.07	3.70	3.34	3.06	3.96	3.56	3.28	2.22
663	4.22	4.40	2.91	4.53	4.38	3.99	3.59	3.29	4.29	3.84	3.29	2.38
664	4.56	4.55	2.94	4.64	4.52	4.07	3.63	3.32	4.41	3.91	3.05	2.34
665	4.15	4.18	2.77	4.31	4.20	3.77	3.36	3.07	4.09	3.62	3.05	2.16
666	3.81	4.04	2.74	4.21	4.08	3.71	3.36	3.12	3.97	3.55	3.24	2.24
667	4.09	4.32	2.87	4.49	4.34	3.94	3.56	3.32	4.23	3.78	3.38	2.37
668	4.49	4.60	3.01	4.76	4.62	4.17	3.74	3.45	4.49	3.99	3.19	2.40
669	4.23	4.34	2.89	4.49	4.36	3.93	3.52	3.22	4.25	3.77	3.22	2.27
670	3.92	4.19	2.86	4.40	4.26	3.91	3.59	3.38	4.16	3.73	3.24	2.41
671	4.05	4.28	2.87	4.47	4.30	3.91	3.55	3.35	4.20	3.76	3.36	2.39
672	4.50	4.49	2.99	4.64	4.50	4.10	3.72	3.50	4.39	3.93	3.50	2.45
673	4.76	4.72	3.12	4.84	4.69	4.28	3.89	3.64	4.59	4.10	3.11	2.56
674	4.05	4.24	2.77	4.36	4.20	3.85	3.51	3.30	4.14	3.67	3.10	2.25
675	4.01	4.18	2.75	4.31	4.16	3.81	3.46	3.25	4.09	3.65	3.23	2.24
676	4.40	4.46	2.88	4.58	4.44	4.01	3.62	3.38	4.34	3.85	3.47	2.25
677	4.76	4.79	3.06	4.89	4.72	4.29	3.89	3.64	4.64	4.11	3.19	2.46
678	4.58	4.59	2.81	4.69	4.49	4.03	3.60	3.32	4.41	3.85	2.94	2.12
679	4.02	4.15	2.64	4.28	4.14	3.69	3.31	3.07	4.04	3.54	3.13	1.96
680	4.17	4.30	2.77	4.42	4.30	3.87	3.49	3.25	4.20	3.72	3.48	2.19
681	4.90	4.90	3.04	4.99	4.81	4.34	3.90	3.62	4.72	4.15	3.01	2.42
682	xxx	4.51	2.64	4.54	4.35	3.85	3.38	3.07	4.26	3.70	2.78	1.94
683	xxx	4.04	2.45	4.14	3.99	3.54	3.12	2.85	3.89	3.40	2.97	1.81
684	4.27	4.28	2.63	4.35	4.21	3.77	3.34	3.08	4.10	3.59	3.36	2.00
685	5.08	4.99	2.94	5.02	4.81	4.29	3.80	3.47	4.71	4.11	3.51	2.25
686	5.10	5.22	3.00	5.29	5.08	4.48	xxx	3.54	4.95	4.32	2.34	2.22
687	3.16	3.45	2.17	3.56	3.44	2.97	2.54	2.24	3.34	2.91	3.34	1.37
688	3.80	4.08	2.95	4.21	4.11	xxx	3.56	3.37	4.08	3.76	3.93	2.64
689	5.13	5.12	3.37	5.15	5.01	xxx	4.35	4.14	4.93	4.48	3.36	3.03
690	4.58	4.63	2.98	4.68	4.54	4.09	3.71	3.45	4.42	3.94	3.03	2.43
691	3.84	4.06	2.71	4.19	4.10	3.67	3.30	3.07	3.99	3.56	3.26	2.19
692	3.83	4.12	2.90	4.26	4.13	3.85	3.54	3.37	4.10	3.73	3.81	2.49
693	4.88	4.94	3.28	5.03	4.84	4.53	4.19	3.98	4.81	4.36	3.21	2.89
694	xxx	4.58	2.84	4.63	4.44	3.98	3.55	3.26	4.36	3.84	3.09	2.21
695	xxx	4.23	2.76	4.33	4.20	3.79	3.41	3.15	4.12	3.67	3.16	2.18
696	xxx	4.34	2.75	4.41	4.31	3.90	3.49	3.23	4.19	3.74	3.06	2.17
697	xxx	4.22	2.74	4.30	4.17	3.75	3.34	3.07	4.06	3.62	3.39	2.15

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
698	xxx	4.61	2.99	4.73	4.59	4.15	3.73	3.44	4.46	3.99	2.60	2.44
699	xxx	3.60	2.37	3.76	3.67	3.26	2.88	2.61	3.55	3.14	3.19	1.74
700	xxx	3.77	2.84	3.94	3.89	xxx	3.40	3.24	3.83	3.55	3.91	2.57
701	xxx	4.91	3.34	4.96	4.86	xxx	4.27	4.09	4.77	4.37	3.19	3.09
702	4.24	4.35	2.81	4.40	4.27	3.89	3.50	3.25	4.17	3.72	2.74	2.33
703	3.03	3.54	2.47	3.71	3.63	3.29	2.95	2.73	3.54	3.18	2.85	2.06
704	3.12	3.56	2.55	3.73	3.70	3.40	3.10	2.90	3.61	3.28	3.49	2.18
705	4.35	4.50	3.01	4.57	4.52	4.18	3.84	3.60	4.41	4.01	3.01	2.65
706	4.04	4.20	2.65	4.31	4.17	3.73	3.31	3.00	4.06	3.59	2.45	2.05
707	2.86	3.27	2.26	3.46	3.36	2.98	2.61	2.32	3.26	2.90	2.47	1.72
708	2.82	3.18	2.27	3.26	3.24	2.96	2.67	2.44	3.14	2.85	3.15	1.89
709	3.78	4.23	2.73	4.28	4.19	3.86	3.49	3.23	4.10	3.68	3.31	2.34
710	4.25	4.70	2.91	4.75	4.58	4.12	3.59	3.22	4.48	3.97	2.11	2.31
711	2.77	3.06	1.99	3.14	3.05	2.62	2.16	xxx	2.94	2.59	2.59	1.42
712	2.64	3.05	2.36	3.24	3.21	2.93	2.67	2.43	3.13	2.90	3.41	2.14
713	3.83	4.17	3.01	4.33	4.27	3.98	3.70	3.47	4.18	3.84	2.75	2.73
714	3.28	3.67	2.49	3.73	3.68	3.34	2.99	2.71	3.59	3.21	2.38	2.03
715	2.60	3.13	2.21	3.20	3.19	2.86	2.54	2.27	3.09	2.77	2.90	1.79
716	3.11	3.54	2.61	3.69	3.69	3.36	3.06	2.82	3.58	3.27	2.96	2.29
717	3.39	3.70	2.67	3.86	3.82	3.50	3.19	2.95	3.72	3.39	2.84	2.29
718	3.19	3.60	2.59	3.76	3.65	3.38	3.07	2.86	3.58	3.25	2.60	2.27
719	2.67	3.24	2.35	3.45	3.36	3.09	2.80	2.60	3.29	2.96	2.55	2.06
720	2.52	3.06	2.32	3.24	3.24	3.00	2.76	2.58	3.16	2.89	2.91	2.04
721	2.94	3.51	2.60	3.66	3.64	3.39	3.12	2.93	3.56	3.28	3.16	2.32
722	3.27	3.95	2.84	4.06	3.99	3.68	3.37	3.17	3.88	3.56	2.68	2.50
723	2.72	3.43	2.44	3.52	3.48	3.18	2.90	2.71	3.38	3.07	2.78	2.11
724	2.71	3.34	2.51	3.54	3.48	3.24	3.00	2.83	3.40	3.13	3.06	2.27
725	3.03	3.63	2.74	3.88	3.80	3.55	3.29	3.12	3.72	3.42	3.19	2.44
726	3.13	3.89	2.89	3.92	3.90	3.66	3.40	3.23	3.82	3.53	3.17	2.63
727	3.28	3.94	2.89	3.94	3.91	3.65	3.39	3.22	3.83	3.53	2.98	2.59
728	3.26	3.70	2.72	3.93	3.84	3.51	3.21	3.00	3.77	3.41	2.89	2.27
729	3.03	3.53	2.63	3.75	3.71	3.40	3.09	2.89	3.62	3.30	3.36	2.26
730	3.49	3.96	2.99	4.18	4.13	3.83	3.58	3.41	xxx	3.74	3.65	2.75
731	4.05	4.42	3.25	4.63	4.50	4.18	3.92	3.74	xxx	4.08	2.97	2.92
732	3.39	3.81	2.73	3.95	3.83	3.52	3.20	3.00	3.77	3.40	2.96	2.29
733	3.04	3.64	2.79	3.83	3.75	3.46	3.10	2.95	3.68	3.35	3.26	2.34
734	3.72	4.09	2.97	4.25	4.18	3.84	3.49	3.29	4.07	3.71	3.45	2.52

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
735	4.27	4.45	3.17	4.55	4.46	4.09	3.73	3.50	4.34	3.93	3.56	2.65
736	4.36	4.64	3.20	4.80	4.69	4.25	xxx	3.49	4.58	4.11	3.04	2.67
737	3.51	3.94	2.79	4.15	4.04	3.63	3.27	3.00	3.95	3.53	3.61	2.27
738	3.96	4.34	3.22	4.58	4.27	xxx	3.85	3.63	4.41	4.05	4.19	2.86
739	5.14	5.26	3.69	5.42	5.08	xxx	4.51	4.29	5.20	4.75	3.56	3.27
740	4.60	4.77	3.21	4.88	4.73	4.29	3.87	3.63	4.63	4.14	3.32	2.64
741	3.92	4.31	3.03	4.48	4.35	3.94	3.54	3.31	4.25	3.83	3.57	2.49
742	4.30	4.56	3.22	4.73	4.62	4.16	3.86	3.64	4.52	4.09	4.33	2.71
743	5.83	5.77	3.76	5.87	5.67	5.08	4.68	4.39	5.57	4.99	3.45	3.22
744	5.29	5.08	3.06	5.13	4.87	4.27	xxx	3.41	4.76	4.15	2.96	2.28
745	4.10	4.18	2.73	4.31	4.13	3.62	3.16	2.89	4.03	3.54	3.78	2.02
746	5.04	4.98	3.34	5.13	4.98	4.43	4.19	3.82	4.89	4.39	4.17	2.80
747	6.17	5.78	3.62	5.85	5.60	4.97	4.54	4.24	5.52	4.90	3.90	3.01
748	6.16	5.69	3.40	5.76	5.49	4.82	4.24	3.84	5.37	4.70	3.08	2.64
749	4.49	4.33	2.80	4.48	4.34	3.79	3.30	2.97	4.22	3.71	4.04	2.06
750	5.15	xxx	3.54	5.28	4.55	xxx	4.27	4.00	xxx	4.61	4.74	3.08
751	6.81	xxx	4.04	6.44	5.60	xxx	5.16	4.85	xxx	5.47	3.73	3.53
752	5.93	5.46	3.31	5.49	5.24	4.58	3.94	3.52	5.12	4.48	3.40	2.54
753	4.81	4.70	3.08	4.85	4.70	4.15	3.61	3.22	4.58	4.05	3.66	2.39
754	5.01	4.90	3.30	5.01	4.87	4.33	3.79	3.38	4.76	4.28	4.23	2.69
755	6.31	5.92	3.68	5.96	5.74	5.08	4.46	4.00	5.60	5.00	xxx	3.04
756	6.37	5.93	3.46	5.98	5.69	4.84	4.03	3.42	5.55	4.86	xxx	2.59
757	4.46	4.32	2.78	4.46	4.29	3.57	2.87	2.31	4.20	3.68	xxx	1.93
758	4.78	xxx	3.50	5.12	4.53	xxx	3.93	3.52	xxx	4.54	xxx	3.11
759	6.46	xxx	3.99	6.19	5.49	xxx	4.75	4.31	xxx	5.32	xxx	3.52
760	5.84	5.52	3.49	5.58	5.38	4.72	4.10	3.64	5.25	4.65	xxx	2.79
761	4.23	4.41	2.98	4.54	4.41	3.82	3.27	2.84	4.32	3.83	xxx	2.31
762	4.85	xxx	3.57	5.28	4.54	xxx	4.23	3.91	xxx	4.62	xxx	3.17
763	6.35	xxx	3.95	6.04	5.23	xxx	4.78	4.44	xxx	5.19	xxx	3.46
764	5.63	5.29	3.41	5.27	5.10	4.51	4.00	3.63	4.96	4.39	xxx	2.73
765	4.51	4.68	3.19	4.79	4.69	4.15	3.70	3.35	4.56	4.08	xxx	2.63
766	4.38	4.55	3.19	4.63	4.58	xxx	3.76	3.47	4.47	4.05	xxx	2.70
767	5.36	5.36	3.56	5.40	5.30	xxx	4.34	4.01	5.18	4.66	3.69	3.04
768	5.18	5.15	3.27	5.20	5.06	4.50	3.95	3.54	4.93	4.36	3.37	2.60
769	4.41	4.59	3.04	4.67	4.56	4.06	3.57	3.19	4.45	3.97	3.52	2.42
770	4.32	4.63	3.14	4.73	4.63	4.20	3.78	3.46	4.52	4.08	3.70	2.65
771	4.79	4.93	3.27	5.01	4.89	4.43	3.97	3.65	4.77	4.29	3.63	2.75

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
772	4.79	4.87	3.21	4.98	4.84	4.33	3.88	3.54	4.71	4.23	3.34	2.66
773	4.23	4.43	3.02	4.54	4.45	3.96	3.54	3.22	4.32	3.88	3.29	2.46
774	3.99	4.22	2.94	4.35	4.29	3.88	3.52	3.25	4.18	3.76	3.59	2.46
775	4.44	4.65	3.15	4.78	4.68	4.25	3.86	3.56	4.58	4.12	3.48	2.69
776	4.42	4.69	3.11	4.78	4.67	4.22	3.77	3.45	4.55	4.07	3.37	2.56
777	4.22	4.49	3.03	4.61	4.51	4.08	3.65	3.34	4.39	3.94	2.98	2.48
778	3.63	3.92	2.66	4.09	3.94	3.59	3.23	2.95	3.85	3.46	3.05	2.19
779	3.55	3.96	2.70	4.15	4.01	3.66	3.29	3.01	3.92	3.53	3.68	2.27
780	4.57	4.81	3.18	4.96	4.86	4.37	3.87	3.53	4.73	4.26	2.72	2.70
781	xxx	3.71	2.51	3.80	3.70	3.24	2.82	2.48	3.62	3.20	3.51	1.98
782	xxx	4.07	3.09	4.29	4.01	xxx	3.61	3.38	4.14	3.86	3.92	2.94
783	xxx	4.64	3.35	4.92	4.63	xxx	4.18	3.97	4.70	4.37	3.36	3.06
784	3.88	4.15	3.03	4.28	4.22	3.89	3.55	3.31	4.13	3.78	3.90	2.61
785	4.55	4.83	3.42	4.90	4.84	4.48	4.10	3.83	4.74	4.36	3.09	3.12
786	4.04	4.17	2.79	4.23	4.10	3.70	3.30	3.00	4.01	3.59	2.77	2.31
787	3.11	xxx	2.55	3.66	3.59	3.23	2.86	2.60	3.51	3.17	3.39	2.16
788	3.95	xxx	3.03	4.49	4.42	4.00	3.58	3.28	4.30	3.90	3.57	2.61
789	4.45	xxx	3.19	4.77	4.66	4.23	3.79	3.47	4.55	4.11	3.47	2.72
790	4.22	xxx	3.09	4.64	4.54	4.08	3.67	3.37	4.42	3.98	2.99	2.64
791	3.43	xxx	2.72	4.06	3.98	3.56	3.18	2.90	3.87	3.46	3.08	2.26
792	3.34	xxx	2.78	3.99	3.93	3.61	3.30	3.08	3.83	3.50	3.90	2.46
793	4.60	xxx	3.36	5.09	4.96	4.57	4.18	3.93	4.86	4.43	3.24	3.05
794	4.39	xxx	2.91	4.59	4.42	3.95	xxx	3.15	4.31	3.81	2.60	2.27
795	3.12	xxx	2.44	3.58	3.48	3.07	xxx	2.36	3.41	3.03	3.65	1.89
796	4.05	xxx	3.17	4.67	4.51	xxx	3.79	3.51	4.51	4.12	3.76	2.84
797	4.86	xxx	3.33	4.94	4.75	xxx	4.00	3.71	4.73	4.28	3.36	2.86
798	4.00	xxx	2.98	4.36	4.31	3.93	3.60	3.35	4.21	3.82	3.18	2.62
799	3.66	xxx	2.83	4.20	4.12	3.75	3.42	3.18	4.04	3.65	3.20	2.43
800	3.70	xxx	2.85	4.23	4.15	3.81	3.49	3.27	4.06	3.67	3.88	2.42
801	4.97	xxx	3.36	5.09	4.98	4.56	4.17	3.90	4.88	4.43	3.26	2.97
802	4.37	xxx	2.83	4.55	4.40	4.00	3.63	3.37	4.30	3.83	2.91	2.30
803	3.58	xxx	2.58	4.01	3.88	3.50	3.15	2.92	3.79	3.41	3.22	2.07
804	xxx	xxx	2.75	4.37	4.24	3.87	3.53	3.32	4.14	3.75	3.57	2.38
805	xxx	xxx	3.05	4.91	4.73	4.34	3.94	3.70	4.64	4.18	3.23	2.62
806	xxx	xxx	2.69	4.55	4.42	4.01	3.59	3.32	4.32	3.85	2.62	2.25
807	xxx	xxx	2.24	3.62	3.58	3.21	2.86	2.62	3.51	3.13	3.08	1.83
808	xxx	xxx	2.71	3.94	3.88	3.62	3.30	3.14	3.81	3.50	3.51	2.40

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
809	xxx	xxx	3.02	4.55	4.45	4.16	3.83	3.68	4.36	3.98	3.39	2.72
810	xxx	xxx	2.91	4.60	4.49	4.07	3.70	3.48	4.44	3.97	3.02	2.46
811	xxx	xxx	2.60	4.10	4.01	3.64	3.29	3.07	3.98	3.56	3.10	2.18
812	xxx	xxx	2.70	4.07	4.02	3.69	3.38	xxx	3.95	3.58	3.66	2.34
813	xxx	xxx	3.09	4.81	4.72	4.37	4.02	xxx	4.64	4.21	3.27	2.76
814	xxx	xxx	2.82	4.63	4.47	4.05	3.62	3.38	4.42	3.89	2.80	2.25
815	3.49	xxx	2.50	3.94	3.83	3.43	3.05	2.84	3.77	3.32	3.06	1.95
816	3.49	xxx	2.73	4.02	3.99	3.67	3.35	3.18	3.88	3.53	3.44	2.31
817	4.19	xxx	2.98	4.55	4.50	4.16	3.81	3.61	4.40	3.99	3.36	2.57
818	4.50	xxx	2.95	4.72	4.59	4.17	3.76	3.50	4.49	4.00	2.45	2.34
819	3.01	xxx	2.23	3.52	3.43	3.04	2.70	2.47	3.34	2.96	3.03	1.68
820	3.11	xxx	2.69	3.76	3.74	3.47	3.28	3.14	xxx	3.39	3.65	2.47
821	4.21	xxx	3.17	4.63	4.55	4.25	3.99	3.85	xxx	4.11	3.39	2.87
822	4.15	xxx	3.03	4.56	4.43	4.07	3.70	3.51	4.34	3.93	2.72	2.53
823	3.10	xxx	2.47	3.69	3.61	3.27	2.96	2.77	3.52	3.17	3.00	2.06
824	3.11	xxx	2.67	3.75	3.72	3.45	3.24	3.11	3.65	3.36	3.52	2.43
825	3.94	xxx	3.11	4.44	4.38	4.09	3.81	3.68	4.31	3.96	3.42	2.77
826	3.97	xxx	3.09	4.46	4.35	4.01	3.68	3.51	4.28	3.89	2.87	2.63
827	3.09	xxx	2.59	3.73	3.66	3.34	3.08	2.92	3.58	3.25	2.96	2.23
828	3.06	xxx	2.64	3.69	3.66	3.41	3.18	3.06	3.59	3.30	3.41	2.39
829	3.77	xxx	3.04	4.30	4.22	3.95	3.67	3.55	4.16	3.83	3.23	2.71
830	3.67	xxx	2.92	4.20	4.10	3.77	3.46	3.32	4.03	3.69	2.98	2.51
831	3.19	xxx	2.68	3.81	3.75	3.45	3.18	3.04	3.68	3.39	2.95	2.35
832	3.11	xxx	2.65	3.74	3.69	3.42	3.18	3.06	3.63	3.35	3.17	2.32
833	3.53	xxx	2.88	4.07	4.00	3.71	3.43	3.32	3.93	3.61	3.10	2.46
834	3.30	xxx	2.80	3.92	3.84	3.58	3.32	3.21	3.77	3.48	3.07	2.50
835	3.21	xxx	2.77	3.89	3.80	3.54	3.28	3.15	3.73	3.45	2.94	2.48
836	3.15	xxx	2.67	3.83	3.75	3.45	3.15	3.01	3.69	3.36	2.88	2.30
837	3.04	xxx	2.62	3.73	3.68	3.38	3.09	2.95	3.63	3.29	3.18	2.26
838	3.26	xxx	2.87	3.95	3.89	3.66	3.42	3.30	3.83	3.56	3.33	2.60
839	3.55	xxx	2.98	4.18	4.08	3.84	3.58	3.46	4.03	3.74	3.09	2.67
840	3.41	xxx	2.79	4.03	3.91	3.61	3.30	3.16	3.87	3.53	2.75	2.39
841	2.80	xxx	2.49	3.57	3.50	3.20	2.91	2.80	3.46	3.15	3.22	2.17
842	3.31	xxx	2.88	3.99	3.94	xxx	3.46	3.35	3.88	3.60	3.62	2.66
843	4.07	xxx	3.23	4.56	4.43	xxx	3.89	3.77	4.37	4.05	3.24	2.93
844	3.81	xxx	2.93	4.31	4.13	3.80	3.55	3.29	4.10	3.72	2.75	2.49
845	2.88	3.38	2.53	3.61	3.51	3.20	2.87	2.75	3.46	3.15	3.35	2.14

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
846	3.46	3.94	2.94	4.14	3.99	xxx	3.57	3.44	4.01	3.73	4.07	2.73
847	4.73	5.02	3.59	5.16	4.93	xxx	4.41	4.26	4.95	4.56	3.25	3.25
848	4.11	4.34	2.98	4.42	4.25	3.89	xxx	3.32	4.19	3.75	2.86	2.40
849	3.22	3.66	2.64	3.81	3.69	3.37	xxx	2.85	3.65	3.28	3.42	2.17
850	3.88	4.20	3.04	4.42	4.32	xxx	3.68	3.51	4.25	3.88	3.95	2.67
851	5.11	5.09	3.50	5.22	5.06	xxx	4.32	4.12	4.98	4.51	3.51	3.02
852	4.57	4.72	3.13	4.82	4.64	4.22	3.84	3.59	4.58	4.09	3.06	2.60
853	3.65	4.01	2.80	4.17	4.03	3.64	3.29	3.08	3.96	3.56	3.48	2.28
854	4.06	4.34	3.11	4.56	4.44	xxx	3.73	3.54	4.34	3.96	4.36	2.68
855	5.86	5.79	3.76	5.88	5.68	xxx	4.75	4.49	5.56	5.01	3.38	3.29
856	5.41	5.14	3.02	5.07	4.84	4.26	3.72	3.38	4.74	4.12	2.87	2.21
857	4.11	4.14	2.65	4.17	4.02	3.55	3.11	2.84	3.93	3.46	3.86	1.93
858	4.98	5.08	3.38	5.23	4.91	xxx	4.19	3.94	4.96	4.47	4.26	2.85
859	6.30	5.91	3.69	5.96	5.57	xxx	4.68	4.36	5.59	4.99	3.76	3.06
860	5.83	5.41	3.28	5.48	5.24	4.63	4.12	3.76	5.12	4.49	3.47	2.55
861	5.01	4.85	3.07	5.01	4.80	4.24	3.78	3.46	4.70	4.14	3.71	2.37
862	5.22	5.06	3.26	5.19	5.01	4.51	4.04	3.76	4.89	4.37	4.32	2.66
863	6.54	6.14	3.70	6.18	5.90	5.28	4.69	4.34	5.78	5.12	3.73	3.05
864	6.43	5.76	3.21	5.77	5.44	4.71	4.04	3.60	5.33	4.61	3.06	2.32
865	4.88	4.52	2.73	4.62	4.42	3.83	3.29	2.93	4.32	3.77	3.92	1.94
866	5.44	5.21	3.40	5.37	4.98	xxx	4.24	3.95	5.09	4.57	4.47	2.88
867	6.78	6.28	3.80	6.33	5.84	xxx	xxx	xxx	5.94	5.26	3.84	xxx
868	6.41	5.82	3.30	5.85	5.52	4.81	4.15	xxx	5.42	4.69	3.34	xxx
869	5.14	4.82	2.94	4.97	4.73	4.13	3.58	3.23	4.65	4.06	3.97	xxx
870	5.46	5.28	3.45	5.44	5.07	xxx	4.29	4.04	5.16	4.63	4.33	xxx
871	6.50	6.05	3.71	6.13	5.69	xxx	4.73	4.41	5.75	5.11	3.86	xxx
872	6.39	5.73	3.36	5.79	5.49	4.81	4.19	3.80	5.38	4.70	3.43	xxx
873	5.23	4.89	3.06	5.02	4.79	4.22	3.69	3.37	4.71	4.14	3.74	xxx
874	5.05	4.99	3.30	5.12	4.94	4.44	4.06	3.82	4.86	4.35	4.26	xxx
875	6.12	5.85	3.60	5.96	5.71	5.10	4.62	4.30	5.60	4.98	3.61	xxx
876	5.99	5.47	3.18	5.47	5.19	4.53	3.91	3.52	5.07	4.40	3.37	xxx
877	5.12	4.87	2.99	4.94	4.75	4.19	3.65	3.32	4.64	4.06	3.25	xxx
878	4.79	4.66	2.93	4.65	4.50	4.04	3.59	3.32	4.41	3.89	3.31	xxx
879	xxx	4.99	3.06	4.87	4.64	4.13	3.66	3.37	4.56	4.01	4.30	xxx
880	xxx	xxx	3.58	6.27	5.31	xxx	4.65	4.23	5.74	5.17	3.46	xxx
881	xxx	xxx	3.00	5.10	4.23	xxx	3.72	3.36	4.66	4.19	3.38	xxx
882	xxx	4.12	2.97	4.37	4.01	3.89	3.57	3.36	4.21	3.84	3.72	xxx

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
883	4.96	4.74	3.20	4.88	4.50	4.41	4.11	3.90	4.68	4.25	3.39	xxx
884	4.56	4.42	2.99	4.58	4.44	3.95	3.51	3.16	4.35	3.92	3.52	xxx
885	4.55	4.50	3.07	4.66	4.58	4.12	3.71	3.33	4.45	4.05	2.98	xxx
886	4.01	4.04	2.63	4.13	4.02	3.45	2.92	2.41	3.93	3.52	3.02	xxx
887	xxx	4.05	2.68	4.15	4.04	3.49	2.95	2.44	3.95	3.55	2.97	xxx
888	xxx	4.05	2.69	4.12	3.98	3.35	2.73	2.16	3.91	3.49	3.32	xxx
889	xxx	4.49	2.88	4.60	4.45	3.77	3.15	2.56	4.37	3.90	3.25	xxx
890	4.40	4.51	2.77	4.70	4.53	3.70	2.93	2.21	4.44	3.92	2.81	xxx
891	3.57	3.89	2.51	4.07	3.95	3.15	2.40	1.72	3.85	3.40	2.95	xxx
892	3.61	3.96	2.67	4.06	3.97	3.22	2.53	1.91	3.86	3.47	3.12	xxx
893	4.05	4.19	2.78	4.30	4.19	3.43	2.73	2.09	4.06	3.65	3.03	xxx
894	3.83	4.10	2.69	4.27	4.14	3.35	2.61	1.91	4.01	3.58	2.76	xxx
895	3.22	3.69	2.49	3.93	3.81	3.04	2.32	1.66	3.69	3.29	2.68	1.94
896	3.20	3.55	2.48	3.66	3.58	2.90	2.26	1.67	3.47	3.15	3.23	2.01
897	4.10	4.29	2.83	4.34	4.25	3.54	2.87	2.21	4.16	3.77	2.54	2.39
898	3.52	3.72	2.24	3.80	3.69	3.03	2.36	1.71	3.59	3.13	2.30	1.55
899	2.69	3.25	2.05	3.38	3.29	2.64	1.98	1.37	3.19	2.80	2.84	1.45
900	3.36	3.87	2.55	3.96	3.89	3.25	2.59	2.01	3.76	3.36	3.05	1.96
901	3.95	4.26	2.69	4.32	4.21	3.56	2.89	2.27	4.13	3.65	2.57	2.07
902	3.34	3.70	2.27	3.86	3.69	3.06	2.48	1.89	3.61	3.15	2.12	1.60
903	2.38	2.97	1.97	3.18	3.02	2.43	1.89	1.38	2.92	2.58	2.80	1.33
904	3.13	3.67	2.53	3.86	3.74	3.11	2.52	2.00	3.64	3.28	3.25	2.02
905	4.16	4.43	2.86	4.56	4.45	3.78	3.15	2.56	4.34	3.85	2.90	2.28
906	3.60	4.03	2.52	4.17	4.06	3.36	2.71	2.08	3.97	3.50	2.33	1.94
907	2.73	3.20	2.12	3.39	3.29	2.63	2.03	1.46	3.21	2.83	2.73	1.52
908	xxx	3.54	2.48	3.73	3.62	2.99	2.40	1.84	3.55	3.19	3.39	2.02
909	xxx	4.55	2.95	4.68	4.53	3.84	3.20	2.58	4.45	3.98	2.57	2.49
910	xxx	3.85	2.24	3.98	3.81	3.06	2.41	1.76	3.73	3.22	2.64	1.55
911	xxx	3.79	2.20	3.95	3.82	3.07	2.41	1.76	3.74	3.26	3.41	1.62
912	xxx	4.72	2.90	4.80	4.63	3.82	2.98	2.24	4.54	4.06	2.81	2.25
913	xxx	4.25	2.62	4.26	4.04	3.25	2.42	1.69	3.94	3.46	3.45	1.76
914	4.36	4.42	3.01	4.70	4.53	3.77	3.06	2.42	4.44	4.01	2.92	2.59
915	3.23	3.61	2.55	3.98	3.87	3.14	2.45	1.84	3.79	3.41	3.19	2.12
916	3.58	3.46	2.89	4.16	4.06	3.56	3.04	2.56	4.02	3.64	4.05	2.46
917	5.01	4.66	3.49	5.27	5.10	4.55	3.98	3.46	5.07	4.60	2.82	3.13
918	3.93	4.06	2.51	4.12	3.99	3.53	3.05	2.66	3.90	3.41	2.89	1.90
919	3.72	4.05	2.55	4.15	4.02	3.54	3.04	2.66	3.93	3.46	3.38	1.98

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
920	4.37	4.57	2.95	4.87	4.75	4.21	3.66	3.26	4.61	4.06	3.36	2.27
921	4.50	4.54	2.96	4.82	4.70	4.16	3.61	3.21	4.58	4.03	2.86	2.27
922	3.90	4.13	2.52	4.19	4.14	3.61	3.17	2.82	3.98	3.47	2.81	1.89
923	3.72	4.01	2.50	4.11	4.05	3.53	3.10	2.75	3.89	3.41	2.89	1.87
924	3.84	4.17	2.54	4.21	4.11	3.68	3.23	2.90	3.99	3.52	3.29	1.91
925	4.55	4.81	2.85	4.81	4.67	4.14	3.62	3.26	4.55	4.00	3.07	2.18
926	4.53	4.63	2.65	4.67	4.50	3.94	3.40	3.03	4.37	3.78	2.42	1.89
927	3.22	3.53	2.19	3.66	3.55	3.10	2.66	2.35	3.44	3.00	3.28	1.47
928	3.81	4.00	2.85	4.43	4.35	3.95	3.60	3.36	4.23	3.83	3.31	2.41
929	4.55	4.26	2.90	4.56	4.46	4.04	3.67	3.42	4.33	3.88	3.23	2.38
930	4.22	4.32	2.82	4.42	4.31	3.92	3.57	3.33	4.19	3.76	2.89	2.34
931	3.52	3.79	2.56	3.99	3.88	3.51	3.15	2.94	3.77	3.39	3.33	2.07
932	3.73	4.03	2.92	4.37	4.22	3.91	3.60	3.46	4.10	3.78	3.56	2.63
933	4.34	4.47	3.08	4.73	4.56	4.22	3.89	3.73	4.44	4.07	3.41	2.75
934	4.44	4.44	3.05	4.58	4.43	4.05	3.70	3.49	4.34	3.94	3.14	2.55
935	3.71	3.98	2.82	4.18	4.06	3.70	3.37	3.17	3.98	3.62	3.25	2.36
936	3.63	3.93	2.89	4.19	4.11	3.78	3.47	3.30	4.04	3.71	3.67	2.54
937	4.54	4.57	3.18	4.80	4.66	4.32	3.98	3.78	4.60	4.21	3.13	2.81
938	4.11	4.20	2.77	4.33	4.14	3.76	3.38	3.14	4.11	3.68	3.33	2.24
939	4.06	4.40	2.90	4.52	4.36	3.98	3.59	3.35	4.31	3.88	2.74	2.45
940	3.91	3.94	2.31	4.01	3.87	3.42	2.99	2.70	3.83	3.36	2.52	1.72
941	3.52	3.55	2.21	3.60	3.52	3.08	2.71	2.44	3.47	3.06	3.15	1.64
942	3.84	4.09	2.71	4.26	4.19	3.80	3.44	3.20	4.09	3.67	3.01	2.30
943	3.80	3.94	2.62	4.13	4.05	3.68	3.32	3.07	3.94	3.53	2.98	2.15
944	3.67	3.86	2.60	4.01	3.92	3.57	3.24	3.01	3.84	3.46	2.97	2.16
945	3.68	3.88	2.59	4.04	3.94	3.59	3.26	3.04	3.86	3.47	2.86	2.15
946	3.58	3.74	2.53	3.85	3.75	3.43	3.12	2.91	3.70	3.33	3.15	2.13
947	3.92	4.11	2.72	4.19	4.08	3.76	3.43	3.20	4.04	3.65	2.79	2.37
948	3.60	3.84	2.39	3.90	3.83	3.44	3.04	2.76	3.80	3.36	2.65	1.86
949	3.28	3.56	2.31	3.66	3.60	3.23	2.86	2.58	3.56	3.16	2.73	1.79
950	3.30	3.58	2.42	3.68	3.56	3.26	2.98	2.74	3.52	3.17	3.07	2.00
951	4.09	4.20	2.66	4.24	4.09	3.73	3.39	3.13	4.04	3.60	2.83	2.19
952	3.98	4.09	2.39	4.05	3.92	3.49	3.08	2.75	3.88	3.42	2.45	1.81
953	3.06	3.41	2.12	3.44	3.34	2.99	2.64	2.34	3.32	2.95	2.58	1.59
954	3.06	3.37	2.27	3.47	3.39	3.11	2.81	2.59	3.33	3.01	3.10	1.93
955	4.18	4.23	2.62	4.27	4.12	3.77	3.40	3.14	4.07	3.64	2.74	2.24
956	3.90	4.01	2.27	4.07	3.91	3.42	2.97	2.61	3.87	3.38	2.35	1.67

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
957	2.92	3.30	2.02	3.43	3.34	2.90	2.51	2.18	3.31	2.90	3.27	1.47
958	4.19	4.41	2.79	4.56	4.44	3.97	3.53	3.17	4.34	3.86	3.54	2.24
959	5.07	5.00	3.01	5.05	4.86	4.34	3.85	3.47	4.76	4.20	3.00	2.37
960	4.10	4.28	2.50	4.41	4.22	3.73	3.26	2.93	4.13	3.62	2.52	1.96
961	3.23	3.53	2.18	3.71	3.58	3.14	2.74	2.44	3.48	3.06	2.92	1.66
962	3.76	3.90	2.57	3.98	3.90	3.52	3.18	2.91	3.80	3.42	3.64	2.13
963	5.05	5.07	3.06	5.09	4.92	4.47	4.00	3.67	4.83	4.29	2.90	2.58
964	4.37	4.36	2.39	4.36	4.15	3.64	3.11	2.71	4.12	3.57	2.65	1.72
965	3.40	3.76	2.16	3.79	3.68	3.23	2.79	2.44	3.63	3.22	3.02	1.61
966	4.15	4.40	2.55	4.43	4.31	3.74	3.23	2.83	4.21	3.69	3.50	1.90
967	5.42	5.27	2.95	5.30	5.06	4.40	3.79	3.31	4.97	4.30	3.21	2.19
968	5.24	5.07	2.65	5.13	4.81	4.07	3.38	2.80	4.75	4.08	2.76	1.78
969	3.94	4.16	2.26	4.28	4.09	3.43	2.85	2.35	4.01	3.49	3.34	1.54
970	4.64	4.78	2.81	4.89	4.73	4.09	3.52	3.04	4.60	4.05	3.73	2.15
971	5.96	5.66	3.14	5.72	5.44	4.71	4.01	3.45	5.29	4.58	3.41	2.33
972	5.95	5.44	2.85	5.47	5.16	4.36	3.64	3.05	5.03	4.32	3.03	1.96
973	4.88	4.67	2.54	4.76	4.52	3.81	3.20	2.68	4.42	3.83	3.46	1.76
974	5.27	5.04	2.91	5.15	5.03	4.30	3.72	3.26	4.80	4.22	3.89	2.22
975	6.41	5.93	3.26	5.96	5.65	4.88	4.17	3.62	5.50	4.78	3.44	2.44
976	6.23	5.59	2.87	5.56	5.24	4.44	3.68	3.10	5.11	4.37	3.11	1.94
977	5.29	4.86	2.58	4.92	4.68	3.97	3.32	2.81	4.56	3.93	3.62	1.77
978	5.65	5.43	3.01	5.49	5.22	4.51	3.87	3.37	5.10	4.45	3.89	2.26
979	6.39	6.01	3.25	6.02	5.69	4.90	4.19	xxx	5.56	4.82	3.50	2.41
980	6.27	5.76	2.93	5.71	5.35	4.50	3.71	3.09	5.20	4.46	3.29	1.99
981	5.56	5.26	2.74	5.26	4.97	4.19	3.48	2.92	4.83	4.16	3.55	1.89
982	5.59	5.28	2.96	5.39	5.15	4.42	3.75	3.22	5.01	4.37	3.66	2.18
983	6.09	5.64	3.08	5.67	5.38	4.61	3.88	3.32	5.23	4.54	3.69	2.22
984	5.93	5.63	3.04	5.69	5.44	4.60	3.86	3.30	5.28	4.58	3.20	2.24
985	5.08	4.86	2.70	4.97	4.76	4.01	3.36	2.84	4.62	4.00	3.75	1.92
986	5.55	5.34	3.18	5.36	5.15	4.57	3.98	3.52	5.05	4.49	3.96	2.61
987	6.10	5.74	3.31	5.73	5.50	4.87	4.23	3.75	5.38	4.76	3.48	2.69
988	5.51	5.19	2.96	5.22	5.02	4.36	3.73	3.25	4.87	4.25	3.45	2.22
989	5.12	5.02	2.92	5.09	4.91	4.28	3.67	3.20	4.77	4.18	3.43	2.24
990	5.13	5.01	2.95	5.07	4.91	4.29	3.70	3.24	4.77	4.17	3.56	2.24
991	5.37	5.23	3.03	5.28	5.10	4.44	3.83	3.35	4.96	4.34	3.33	2.32
992	5.23	5.03	2.85	5.12	4.90	4.23	3.60	3.12	4.76	4.13	3.17	2.05
993	4.75	4.64	2.75	4.75	4.58	3.98	3.38	2.93	4.45	3.89	3.32	1.99

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
994	4.65	4.71	2.87	4.78	4.67	4.14	3.61	3.21	4.54	4.00	3.13	2.20
995	4.36	4.45	2.72	4.55	4.45	3.92	3.40	3.03	4.31	3.79	3.44	2.03
996	4.58	4.71	2.99	4.89	4.73	4.23	3.76	3.42	4.58	4.09	3.36	2.38
997	4.52	4.64	2.95	4.79	4.62	4.12	3.66	3.31	4.49	4.00	3.51	2.32
998	4.64	4.73	3.09	4.88	4.73	4.27	3.86	3.57	4.61	4.12	3.19	2.51
999	4.05	4.30	2.83	4.51	4.37	3.91	3.49	3.23	4.26	3.78	3.23	2.24
1000	3.78	4.14	2.90	4.30	4.21	3.86	3.52	3.34	4.11	3.72	3.19	2.49
1001	3.85	4.12	2.85	4.28	4.16	3.81	3.47	3.28	4.07	3.68	3.40	2.44
1002	4.09	4.31	3.05	4.54	4.40	4.02	3.69	3.49	4.30	3.90	2.89	2.60
1003	3.26	3.63	2.57	3.87	3.79	3.42	3.13	2.93	3.69	3.34	3.14	2.17
1004	3.20	3.72	2.78	3.92	3.86	3.54	3.36	3.22	3.79	3.50	3.63	2.53
1005	4.07	4.46	3.22	4.59	4.48	4.14	3.91	3.77	4.41	4.06	2.97	2.90
1006	3.42	3.78	2.70	3.94	3.83	3.53	3.24	3.09	3.75	3.40	2.62	2.31
1007	2.59	3.16	2.35	3.39	3.33	3.06	2.81	2.66	3.25	2.97	2.78	2.10
1008	2.70	3.28	2.47	3.50	3.46	3.23	3.01	2.89	3.39	3.12	3.11	2.24
1009	3.61	3.82	2.82	3.94	3.88	3.63	3.38	3.26	3.82	3.52	2.64	2.48
1010	2.88	3.25	2.36	3.37	3.29	3.07	2.87	2.77	3.26	2.98	2.44	2.09
1011	2.37	2.99	2.20	3.14	3.05	2.83	2.65	2.54	3.04	2.76	2.88	1.94
1012	2.85	3.49	2.59	3.56	3.53	3.32	3.11	3.02	3.50	3.23	3.19	2.36
1013	3.41	3.96	2.82	4.02	3.95	3.72	3.45	3.36	3.90	3.60	3.15	2.55
1014	3.21	3.81	2.72	3.96	3.83	3.61	3.38	3.27	3.81	3.52	2.11	2.53
1015	1.97	2.49	1.82	2.64	2.59	2.41	2.23	2.15	2.56	2.35	2.66	1.70
1016	2.66	3.11	2.39	3.19	3.21	3.01	2.86	2.77	3.15	2.93	3.40	2.24
1017	3.46	3.97	3.04	4.11	4.04	3.82	3.65	3.56	3.99	3.74	3.10	2.84
1018	3.20	3.70	2.77	3.87	3.72	3.49	3.28	3.18	3.72	3.46	2.57	2.53
1019	2.41	3.06	2.25	3.20	3.15	2.92	2.71	2.60	3.12	2.89	3.03	2.07
1020	2.88	3.54	2.66	3.66	3.63	3.28	3.22	3.12	3.58	3.35	3.56	2.50
1021	3.69	4.20	3.17	4.34	4.22	3.87	3.78	3.68	4.21	3.93	3.30	2.90
1022	3.46	3.89	2.92	4.11	3.95	3.72	3.47	3.36	3.95	3.65	2.85	2.66
1023	2.84	3.39	2.48	3.54	3.44	3.20	2.98	2.87	3.44	3.16	3.13	2.30
1024	3.20	3.74	2.75	3.86	3.75	xxx	3.29	3.17	3.78	3.47	3.84	2.51
1025	4.21	4.64	3.39	4.80	4.62	xxx	4.10	3.97	4.64	4.27	3.55	3.08
1026	4.21	4.50	3.16	4.61	4.43	4.14	3.82	3.65	4.42	4.03	3.04	2.75
1027	3.35	3.73	2.70	3.92	3.79	3.50	3.20	3.03	3.78	3.45	3.18	2.36
1028	3.54	3.74	2.81	3.97	3.89	xxx	3.35	3.22	3.86	3.55	3.53	2.55
1029	4.25	4.26	3.17	4.43	4.31	xxx	3.74	3.63	4.29	3.94	3.44	2.84
1030	4.07	4.28	3.10	4.47	4.30	3.99	3.66	3.51	4.29	3.91	3.29	2.73

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1031	3.84	4.11	2.98	4.28	4.15	3.82	3.50	3.33	4.11	3.74	3.27	2.60
1032	3.72	4.03	2.93	4.16	4.09	3.78	3.48	3.32	4.03	3.68	3.72	2.57
1033	4.54	4.68	3.32	4.75	4.62	4.31	4.00	3.84	4.57	4.18	3.40	2.94
1034	4.37	4.49	3.06	4.57	4.40	4.03	3.69	3.50	4.36	3.93	3.34	2.59
1035	4.22	4.34	3.02	4.44	4.31	3.94	3.62	3.45	4.24	3.84	3.29	2.56
1036	3.99	4.26	2.93	4.40	4.26	3.89	3.58	3.40	4.18	3.79	3.71	2.48
1037	4.63	4.85	3.25	4.98	4.80	4.41	4.06	3.85	4.74	4.28	3.46	2.82
1038	4.62	4.74	3.01	4.85	4.66	4.22	3.79	3.52	4.60	4.08	3.04	2.42
1039	3.94	4.13	2.73	4.25	4.10	3.69	3.30	3.07	4.04	3.59	3.48	2.14
1040	4.43	4.56	3.07	4.70	4.43	4.14	3.76	3.55	4.48	4.03	3.66	2.61
1041	4.87	4.82	3.19	4.95	4.65	4.37	4.02	3.80	4.70	4.23	3.30	2.73
1042	4.43	4.41	2.93	4.51	4.36	3.95	3.59	3.36	4.30	3.84	3.35	2.42
1043	4.36	4.47	2.93	4.57	4.43	4.04	3.67	3.44	4.36	3.90	3.23	2.45
1044	4.37	4.42	2.86	4.51	4.36	3.91	3.52	3.23	4.29	3.82	3.35	2.27
1045	4.60	4.55	2.96	4.64	4.52	4.08	3.69	3.38	4.44	3.96	3.13	2.40
1046	4.43	4.39	2.81	4.48	4.31	3.85	3.42	3.06	4.23	3.76	3.23	2.14
1047	4.35	4.47	2.87	4.59	4.42	3.95	3.52	3.16	4.33	3.86	3.23	2.23
1048	4.50	4.56	2.88	4.66	4.50	3.97	3.49	3.10	4.40	3.89	3.05	2.19
1049	4.40	4.37	2.77	4.39	4.29	3.76	3.30	2.92	4.16	3.66	3.19	2.08
1050	4.14	4.37	2.79	4.44	4.36	3.88	3.44	3.08	4.23	3.76	3.72	2.28
1051	xxx	5.43	3.19	5.39	5.15	4.60	4.05	3.63	5.03	4.44	2.73	2.60
1052	xxx	4.27	2.25	4.21	3.97	3.47	2.97	2.58	3.87	3.36	2.68	1.63
1053	xxx	3.85	2.17	3.95	3.77	3.28	2.84	2.47	3.71	3.26	3.13	1.64
1054	xxx	4.86	2.64	4.94	4.69	4.02	3.39	2.88	4.58	3.95	2.86	1.77
1055	4.32	4.18	2.47	4.37	4.02	3.59	3.01	2.54	4.08	3.56	3.37	1.67
1056	4.67	4.32	2.91	4.80	4.66	4.11	xxx	3.16	4.50	4.02	2.90	2.19
1057	3.74	3.74	2.58	4.26	4.12	3.59	xxx	2.68	3.98	3.53	3.43	1.86
1058	4.01	3.82	3.03	4.66	4.53	4.06	xxx	3.20	4.44	4.02	3.27	2.49
1059	4.16	3.71	2.88	4.52	4.39	3.95	3.50	3.14	4.28	3.84	3.32	2.31
1060	4.10	3.69	3.00	4.48	4.37	3.86	3.36	2.94	4.27	3.85	2.98	2.45
1061	3.59	3.29	2.71	4.12	4.03	3.52	3.05	2.62	3.93	3.50	3.11	2.17
1062	3.49	3.32	2.86	4.06	3.97	3.48	3.01	2.59	3.91	3.54	3.57	2.46
1063	4.30	3.93	3.20	4.64	4.54	4.05	3.55	3.12	4.44	4.04	3.10	2.81
1064	3.67	3.83	2.83	4.19	4.09	3.52	3.02	2.52	3.98	3.58	2.77	2.32
1065	3.10	3.41	2.57	3.78	3.69	3.11	2.18	2.12	3.62	3.24	3.02	2.06
1066	xxx	3.46	2.80	4.01	3.91	3.37	2.82	2.37	3.85	3.49	3.63	2.37
1067	xxx	4.31	3.24	4.81	4.69	4.14	3.58	3.09	4.58	4.17	3.10	2.81

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1068	4.01	4.23	2.85	4.48	4.28	3.63	3.02	2.44	4.17	3.71	2.53	2.16
1069	2.80	3.29	2.40	3.62	3.49	2.86	2.27	1.74	3.40	3.02	3.09	1.76
1070	3.20	3.37	2.82	3.97	3.90	3.36	2.80	2.32	3.83	3.49	3.56	2.42
1071	4.08	4.13	3.19	4.68	4.57	4.02	3.44	2.91	4.49	4.06	3.41	2.74
1072	4.20	4.13	3.13	4.67	4.50	3.87	xxx	2.64	4.40	3.95	2.69	2.49
1073	3.03	3.34	2.60	3.77	4.13	xxx	xxx	1.81	3.51	3.12	xxx	1.92
1074	xxx	xxx	3.22	4.37	4.04	xxx	xxx	2.69	4.23	3.89	xxx	2.85
1075	xxx	xxx	3.72	5.34	4.99	4.58	xxx	3.56	5.13	4.70	3.32	3.33
1076	4.19	4.18	3.05	4.68	4.50	3.90	xxx	2.76	4.41	3.91	3.21	2.37
1077	3.44	3.84	2.95	4.39	4.23	3.64	xxx	2.50	4.17	3.74	3.68	2.34
1078	4.31	4.71	3.34	5.00	4.73	4.24	xxx	3.12	4.75	4.27	3.91	2.71
1079	5.07	5.15	3.54	5.37	5.09	4.57	xxx	3.42	5.08	4.55	3.51	2.85
1080	4.82	4.92	3.27	4.97	4.81	4.22	xxx	3.14	4.66	4.16	3.39	2.49
1081	4.37	4.65	3.15	4.78	4.62	4.05	xxx	3.00	4.48	4.01	3.46	2.41
1082	4.69	4.82	3.27	4.86	4.70	4.14	xxx	3.16	4.54	4.07	4.25	2.49
1083	6.04	6.06	3.89	6.02	5.76	5.05	xxx	3.90	xxx	5.00	4.00	3.06
1084	6.68	6.11	3.47	6.25	5.90	4.94	xxx	3.33	5.72	4.97	3.11	2.31
1085	5.30	4.73	2.82	4.88	4.59	3.81	xxx	2.36	4.48	3.90	4.08	1.69
1086	5.10	xxx	3.57	5.39	4.72	xxx	xxx	3.66	5.02	4.69	4.43	3.06
1087	6.26	xxx	3.84	6.13	5.39	xxx	xxx	4.16	5.65	5.17	3.93	3.22
1088	6.27	5.63	3.51	5.76	5.36	4.79	xxx	3.67	xxx	4.71	3.85	2.68
1089	5.90	5.35	3.45	5.55	5.18	4.64	xxx	3.56	5.18	4.59	4.00	2.66
1090	5.79	5.35	3.55	5.63	5.19	xxx	xxx	3.74	5.30	4.72	4.12	2.85
1091	6.18	5.59	3.65	5.84	5.37	xxx	xxx	3.88	5.48	4.86	3.73	2.92
1092	5.84	5.46	3.36	5.52	5.23	4.51	xxx	3.35	5.12	4.49	3.84	2.52
1093	5.68	5.50	3.42	5.60	5.34	4.62	xxx	3.47	5.22	4.61	3.86	2.63
1094	5.77	5.52	3.40	5.67	5.40	4.64	xxx	3.34	5.28	4.64	3.74	2.60
1095	5.47	5.33	3.32	5.48	5.24	4.51	xxx	3.23	5.11	4.49	3.61	2.52
1096	5.61	5.28	3.27	5.33	5.12	4.39	xxx	3.11	4.96	4.37	3.56	2.42
1097	5.76	5.28	3.24	5.31	5.08	4.34	xxx	3.06	4.91	4.32	4.37	2.37
1098	6.90	xxx	3.78	6.22	5.31	xxx	xxx	3.75	5.53	5.16	4.39	3.06
1099	6.62	xxx	3.77	6.32	5.39	xxx	xxx	3.81	5.63	5.23	3.64	3.03
1100	5.31	5.16	3.26	5.26	5.04	4.39	xxx	3.24	4.92	4.35	3.71	2.50
1101	5.50	5.21	3.31	5.28	5.08	4.42	xxx	3.27	4.95	4.39	3.74	2.58
1102	5.66	5.31	3.31	5.44	5.23	4.51	xxx	3.34	5.09	4.48	3.43	2.55
1103	5.06	4.82	3.11	4.96	4.78	4.11	xxx	2.99	4.65	4.10	3.53	2.34
1104	4.54	4.75	3.17	4.88	4.73	4.21	xxx	3.27	4.60	4.11	3.83	2.54

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1105	5.14	5.22	3.39	5.33	5.14	4.56	xxx	3.55	5.02	4.47	3.79	2.75
1106	4.90	5.19	3.29	5.35	5.17	4.56	xxx	3.55	5.06	4.47	3.20	2.68
1107	4.18	4.37	2.92	4.56	4.39	3.84	xxx	2.93	4.30	3.80	3.42	2.26
1108	4.19	4.37	3.09	4.58	4.46	4.02	xxx	3.33	4.34	3.93	3.80	2.63
1109	4.78	4.88	3.33	5.05	4.93	4.45	xxx	3.71	4.80	4.35	3.46	2.91
1110	4.56	4.62	3.10	4.75	4.63	4.13	xxx	3.36	4.51	4.04	2.98	2.54
1111	3.66	3.90	2.72	4.10	4.03	3.57	xxx	2.85	3.93	3.51	3.03	2.17
1112	3.36	3.74	2.75	3.93	3.88	3.58	3.26	3.05	3.78	3.45	3.48	2.38
1113	4.08	4.39	3.09	4.51	4.41	4.08	3.74	3.50	4.32	3.95	3.14	2.72
1114	xxx	4.11	2.80	4.27	4.12	3.75	3.42	3.18	4.03	3.64	2.48	2.37
1115	xxx	3.28	2.34	3.39	3.33	2.98	2.68	2.47	3.24	2.91	2.96	1.86
1116	xxx	3.57	2.55	3.73	3.76	3.45	3.18	3.00	3.66	3.35	3.58	2.36
1117	xxx	4.35	3.03	4.53	4.47	4.14	3.85	3.64	4.37	4.03	2.62	2.86
1118	xxx	3.45	2.31	3.58	3.48	3.16	2.86	2.62	3.44	3.09	2.25	1.91
1119	xxx	2.91	2.04	3.03	2.97	2.67	2.39	2.16	2.93	2.64	2.54	1.65
1120	xxx	3.15	2.25	3.27	3.23	2.94	2.69	2.48	3.17	2.88	3.02	2.03
1121	xxx	3.82	2.62	3.94	3.86	3.58	3.31	3.09	3.79	3.44	2.62	2.39
1122	3.20	3.42	2.23	3.55	3.38	3.03	2.67	2.35	3.40	3.08	2.35	1.87
1123	2.51	2.98	2.00	3.12	3.04	2.72	2.39	2.09	3.01	2.76	2.24	1.64
1124	2.27	2.71	1.92	2.76	2.74	2.45	2.14	1.84	2.70	2.52	2.72	1.72
1125	3.07	3.38	2.25	3.43	3.37	3.06	2.72	2.38	3.35	3.09	2.52	2.10
1126	2.98	3.40	2.08	3.54	3.36	2.86	2.36	1.87	3.36	3.00	1.93	1.70
1127	2.02	2.50	1.70	2.71	2.58	2.10	1.64	1.20	2.54	2.28	2.23	1.32
1128	2.43	2.76	1.98	2.97	2.89	2.41	1.92	1.46	2.83	2.58	2.61	1.70
1129	2.89	3.33	2.24	3.50	3.40	2.91	2.40	1.89	3.33	3.03	2.82	1.98
1130	3.37	3.74	2.48	3.92	3.78	3.13	2.50	1.87	3.68	3.32	2.50	2.04
1131	2.60	3.29	2.21	3.54	3.44	2.78	2.17	1.58	3.33	2.99	2.85	1.76
1132	2.94	3.57	2.54	3.78	3.73	3.09	2.43	1.83	3.60	3.29	2.87	2.19
1133	3.32	3.65	2.58	3.84	3.73	3.09	2.44	1.85	3.63	3.30	2.99	2.22
1134	3.38	3.81	2.73	3.93	3.82	3.16	2.51	xxx	3.72	3.41	2.97	2.36
1135	3.20	3.79	2.67	3.92	3.83	3.18	2.52	1.92	3.73	3.40	3.01	2.29
1136	3.27	3.81	2.71	4.00	3.92	3.24	2.58	1.99	3.81	3.46	3.24	2.26
1137	3.83	4.15	2.89	4.28	4.20	3.50	2.81	2.18	4.09	3.71	3.15	2.46
1138	3.84	4.25	2.83	4.31	4.20	3.48	2.80	2.16	4.11	3.69	3.20	2.33
1139	3.75	4.33	2.86	4.37	4.24	3.53	2.85	2.21	4.17	3.75	1.91	2.38
1140	xxx	3.54	2.24	3.54	3.44	xxx	2.33	1.80	xxx	xxx	2.29	1.76
1141	xxx	4.07	2.51	3.97	3.88	3.30	2.72	2.18	xxx	3.40	2.75	2.06

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1142	xxx	4.19	2.48	4.03	3.91	3.25	2.59	1.98	3.78	3.35	2.48	1.79
1143	3.43	3.78	2.28	3.65	3.53	2.88	2.22	1.63	3.45	3.01	3.52	1.62
1144	4.32	4.90	3.08	4.95	4.80	3.99	3.17	2.48	4.67	4.16	3.43	2.46
1145	4.56	4.81	3.04	4.96	4.80	4.01	3.20	2.50	4.66	4.11	3.16	2.36
1146	4.18	4.44	2.84	4.53	4.36	3.66	2.94	2.30	4.26	3.77	3.36	2.24
1147	4.57	4.75	2.97	4.83	4.62	3.91	3.18	2.54	4.50	3.99	3.24	2.37
1148	4.34	4.62	2.84	4.74	4.57	3.79	3.06	2.41	4.44	3.90	3.38	2.15
1149	4.60	4.80	2.96	4.90	4.75	3.94	3.20	2.55	4.62	4.06	3.15	2.27
1150	4.49	4.68	2.77	4.78	4.60	3.83	3.07	2.41	4.46	3.87	3.31	1.99
1151	4.80	4.97	2.88	5.02	4.82	4.01	3.23	2.56	4.67	4.06	3.34	2.10
1152	4.82	5.02	2.85	5.08	4.90	4.06	3.29	2.64	4.74	4.11	3.22	2.04
1153	4.63	4.72	2.78	4.84	4.67	3.85	3.10	2.46	4.54	3.95	3.14	1.99
1154	4.61	4.69	2.72	4.81	4.60	3.85	3.14	2.54	4.47	3.88	3.36	1.94
1155	5.01	5.11	2.87	5.18	4.94	4.15	3.40	2.77	4.79	4.15	3.30	2.07
1156	5.10	5.14	2.78	5.20	4.96	4.08	3.31	2.64	4.80	4.13	3.10	1.90
1157	4.66	4.67	2.64	4.79	4.59	3.75	3.01	2.38	4.44	3.84	2.74	1.80
1158	4.13	4.09	2.29	4.26	4.09	3.39	2.78	2.25	3.94	3.41	2.93	1.58
1159	4.35	4.35	2.45	4.51	4.33	3.61	3.00	2.45	4.20	3.65	2.97	1.73
1160	4.74	4.56	2.58	4.58	4.39	3.70	3.06	2.49	4.26	3.71	3.26	1.69
1161	5.11	5.08	2.76	5.14	4.87	4.11	3.39	2.78	4.76	4.10	3.18	1.85
1162	5.32	5.06	2.55	5.18	4.89	4.02	3.24	2.53	4.76	4.06	2.96	1.67
1163	4.81	4.65	2.41	4.76	4.51	3.70	2.95	2.29	4.35	3.75	3.40	1.58
1164	5.33	5.27	2.71	5.38	5.13	4.24	3.40	2.72	4.96	4.27	2.65	1.90
1165	4.08	4.11	2.22	4.22	4.03	3.24	2.46	1.85	3.90	3.35	3.21	1.43
1166	3.90	4.32	2.61	4.49	4.33	3.73	3.12	2.62	4.22	3.78	3.71	2.24
1167	5.12	5.28	2.99	5.38	5.17	4.51	3.87	3.32	5.01	4.43	3.16	2.51
1168	4.66	4.79	2.57	4.89	4.67	3.88	3.13	2.47	4.53	3.91	2.78	1.92
1169	3.71	4.02	2.28	4.22	4.05	3.31	2.58	1.95	3.93	3.42	3.11	1.68
1170	3.74	4.25	2.61	4.39	4.25	3.55	2.83	2.21	4.14	3.68	3.54	2.13
1171	4.66	5.01	2.92	5.09	4.91	4.17	3.44	2.79	4.78	4.20	3.13	2.41
1172	4.41	4.68	2.58	4.82	4.57	3.72	2.90	2.15	4.45	3.84	2.68	1.89
1173	3.35	3.48	2.23	4.12	3.92	3.13	2.34	1.63	3.81	xxx	3.11	1.57
1174	3.71	4.19	2.64	4.38	4.22	3.48	2.71	2.03	4.11	xxx	3.52	2.16
1175	4.81	4.93	2.94	5.06	4.84	4.05	3.25	2.53	4.72	4.17	3.00	2.44
1176	4.37	4.49	2.55	4.62	4.38	3.55	2.74	2.01	4.27	3.68	2.60	1.88
1177	3.32	3.75	2.24	3.96	3.76	2.98	2.21	1.52	3.68	3.19	2.79	1.61
1178	3.22	3.77	2.43	3.98	3.83	3.14	2.43	1.80	3.75	3.32	xxx	1.90

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1179	4.94	5.51	3.13	5.54	5.39	xxx	xxx	xxx	xxx	xxx	xxx	xxx
1180	xxx	4.40	1.77	4.23	4.12	xxx	xxx	xxx	xxx	xxx	xxx	xxx
1181	xxx	2.65	1.18	2.52	2.52	xxx	xxx	xxx	xxx	xxx	xxx	xxx
1182	xxx	4.18	2.30	4.12	4.04	xxx	xxx	1.82	xxx	xxx	xxx	xxx
1183	3.89	4.11	2.26	4.16	3.96	3.12	xxx	1.58	3.85	3.37	xxx	1.60
1184	4.17	4.72	2.66	4.82	4.63	3.86	xxx	2.42	4.53	4.09	3.17	2.39
1185	3.80	4.38	2.46	4.49	4.31	3.53	xxx	2.05	4.22	3.76	3.26	2.07
1186	3.70	4.37	2.51	4.46	4.30	3.68	xxx	2.48	4.23	3.80	3.61	2.36
1187	4.59	4.94	2.80	4.96	4.79	4.15	xxx	2.86	4.68	4.19	3.31	2.62
1188	4.21	4.61	2.50	4.72	4.57	3.96	xxx	2.80	4.42	3.91	3.42	2.24
1189	4.21	4.74	2.54	4.91	4.73	4.10	xxx	2.95	4.58	4.05	3.32	2.29
1190	4.18	4.70	2.56	4.86	4.67	4.04	xxx	2.85	4.53	3.98	3.48	2.22
1191	4.67	4.96	2.67	5.06	4.87	4.23	xxx	3.00	4.72	4.15	3.44	2.35
1192	4.98	5.18	2.69	5.25	5.01	4.24	xxx	2.78	4.85	4.22	3.30	2.20
1193	4.65	4.92	2.56	5.04	4.80	4.05	xxx	2.62	4.66	4.06	3.42	2.11
1194	4.52	4.84	2.73	5.01	4.79	4.05	xxx	2.64	4.66	4.10	3.66	2.27
1195	5.10	5.29	2.88	5.38	5.17	4.39	xxx	2.96	5.01	4.40	3.52	2.41
1196	5.42	5.38	2.87	5.42	5.15	4.24	xxx	2.64	4.99	4.32	3.48	2.18
1197	5.15	5.27	2.80	5.32	5.06	4.15	3.29	2.55	4.93	4.25	3.56	2.17
1198	5.16	5.32	2.94	5.37	5.13	4.23	3.35	2.59	5.01	4.35	3.63	2.26
1199	5.23	5.37	2.96	5.45	5.22	4.33	3.44	2.70	5.07	4.43	3.38	2.28
1200	5.34	5.30	2.93	5.22	4.95	4.08	3.25	2.53	4.82	4.17	3.51	2.05
1201	5.59	5.49	3.03	5.38	5.07	4.18	3.35	2.62	4.97	4.31	3.50	2.17
1202	5.35	5.39	2.93	5.39	5.13	4.23	3.37	2.65	4.99	4.33	3.39	2.07
1203	5.28	5.22	2.85	5.24	5.00	4.10	3.22	2.51	4.87	4.21	3.51	2.00
1204	5.59	5.34	2.92	5.45	5.18	4.34	3.51	2.88	5.01	4.34	3.71	2.13
1205	6.13	5.80	3.07	5.82	5.52	4.62	3.74	3.07	5.34	4.61	3.65	2.24
1206	5.77	5.85	2.93	5.73	5.48	4.61	3.80	3.17	5.31	4.56	3.28	2.15
1207	5.18	5.21	2.68	5.12	4.89	4.08	3.32	2.72	4.74	4.08	3.58	1.91
1208	5.03	5.08	2.86	5.26	5.07	4.38	3.76	3.26	4.90	4.29	3.95	2.30
1209	5.95	5.79	3.14	5.94	5.67	4.90	4.20	3.67	5.51	4.79	3.40	2.52
1210	5.59	5.31	2.71	5.39	5.14	4.31	3.59	3.01	4.98	4.26	2.99	1.95
1211	4.60	4.45	2.42	4.60	4.43	3.71	3.08	2.53	4.30	3.70	3.12	1.73
1212	4.60	4.36	2.58	4.66	4.44	3.80	3.20	2.66	4.32	3.78	3.72	1.98
1213	5.57	5.40	3.00	5.66	5.39	4.64	3.96	3.38	5.23	4.55	3.17	2.33
1214	5.40	5.17	2.56	5.12	4.89	3.99	3.17	2.46	4.75	4.04	2.76	1.72
1215	4.21	4.26	2.22	4.29	4.16	3.36	2.61	1.94	4.04	3.47	3.08	1.51

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1216	4.37	4.49	2.54	4.63	4.46	3.71	2.93	2.28	4.33	3.78	3.34	1.88
1217	5.07	5.05	2.76	5.13	4.91	4.13	3.34	2.67	4.77	4.13	3.18	2.03
1218	4.76	4.91	2.58	4.97	4.76	3.90	3.12	2.41	4.62	3.97	2.76	1.84
1219	3.83	4.14	2.25	4.28	4.10	3.29	2.53	1.83	3.97	3.44	2.97	1.57
1220	3.83	4.13	2.46	4.29	4.16	3.49	2.86	2.30	4.04	3.55	3.35	1.97
1221	4.85	4.91	2.77	4.99	4.81	4.08	3.42	2.85	4.66	4.05	2.76	2.18
1222	4.30	4.31	2.24	4.39	4.18	3.47	2.83	2.24	4.04	3.47	2.18	1.58
1223	3.17	3.28	1.83	3.42	3.26	2.61	2.02	1.46	3.16	2.74	2.80	1.22
1224	3.46	3.74	2.32	3.89	3.79	3.23	2.70	2.23	3.69	3.29	3.14	1.90
1225	4.37	4.38	2.58	4.45	4.34	3.76	3.21	2.72	4.21	3.73	2.48	2.14
1226	3.46	3.65	2.06	3.73	3.60	3.07	2.55	2.08	3.47	3.04	2.23	1.54
1227	2.72	3.16	1.88	3.31	3.18	2.66	2.15	1.68	3.10	2.72	2.50	1.38
1228	3.10	3.49	2.12	3.64	3.51	2.99	2.51	2.05	3.42	3.02	2.75	1.65
1229	3.83	3.96	2.31	4.00	3.87	3.33	2.84	2.38	3.77	3.33	2.68	1.83
1230	3.46	3.81	2.21	3.61	3.80	3.24	2.72	2.23	3.69	3.32	2.00	1.69
1231	2.57	2.91	1.74	2.86	2.94	2.43	1.93	1.49	2.89	2.46	2.18	1.17
1232	2.44	2.84	1.89	3.00	3.03	2.44	2.06	1.72	2.73	2.49	2.57	1.65
1233	3.09	3.40	2.13	3.43	3.35	2.98	2.59	2.19	3.22	2.96	2.26	1.94
1234	2.89	3.17	1.94	3.12	3.11	2.68	2.23	1.77	3.04	2.71	1.99	1.53
1235	2.22	2.72	1.73	2.68	2.73	2.31	1.87	1.45	2.67	2.38	1.81	1.35
1236	2.18	2.51	1.66	2.50	2.47	2.11	1.72	1.34	2.39	2.16	2.34	1.28
1237	3.00	3.23	1.99	3.21	3.14	2.75	2.35	1.93	3.04	2.77	2.26	1.65
1238	3.13	3.32	1.93	3.35	3.22	2.71	2.21	1.69	3.16	2.81	2.04	1.38
1239	2.28	2.86	1.70	2.95	2.90	2.41	1.90	1.39	2.82	2.53	2.23	1.21
1240	2.52	3.01	1.90	3.07	3.06	2.63	2.14	1.66	2.93	2.64	2.36	1.48
1241	2.82	3.26	2.02	3.34	3.26	2.81	2.33	1.84	3.16	2.81	2.61	1.58
1242	3.30	3.68	2.29	3.85	3.67	3.17	2.65	2.16	3.53	3.14	2.26	1.70
1243	2.43	3.11	2.01	3.34	3.19	2.70	2.19	1.73	3.07	2.73	2.68	1.47
1244	2.82	3.47	2.40	3.64	3.61	3.22	2.80	2.44	3.45	3.13	2.64	1.90
1245	3.03	3.51	2.38	3.65	3.59	3.21	2.80	2.45	3.46	3.10	2.86	1.85
1246	3.28	3.71	2.61	3.88	3.79	3.47	3.12	2.82	3.65	3.30	2.80	2.12
1247	3.08	3.63	2.52	3.84	3.73	3.41	3.06	2.79	3.61	3.25	2.84	2.06
1248	3.09	3.70	2.61	3.86	3.81	3.51	3.19	2.95	3.68	3.31	2.91	2.12
1249	3.37	3.85	2.66	3.96	3.90	3.58	3.25	3.01	3.80	3.40	3.02	2.15
1250	3.66	4.02	2.80	4.13	4.06	3.74	3.40	xxx	3.94	3.53	3.06	2.20
1251	3.59	4.02	2.80	4.18	4.08	3.77	3.23	3.19	3.96	3.57	3.09	2.24
1252	3.64	4.10	2.85	4.28	4.17	3.83	3.47	3.22	4.04	3.63	2.96	2.24

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1253	3.59	3.98	2.78	4.17	4.05	3.68	3.32	3.07	3.93	3.49	3.25	2.12
1254	4.06	4.27	3.01	4.44	4.31	3.95	3.61	3.40	4.19	3.76	3.44	2.43
1255	4.44	4.60	3.14	4.73	4.71	4.22	3.85	3.67	4.47	3.99	3.30	2.54
1256	4.22	4.54	3.05	4.65	4.54	4.11	3.70	3.44	4.39	3.90	3.17	2.34
1257	4.10	4.39	2.98	4.50	4.40	3.96	3.55	3.30	4.24	3.76	3.15	2.24
1258	4.17	4.40	3.02	4.40	4.25	3.90	3.53	3.34	4.12	3.67	3.59	2.33
1259	4.93	5.06	3.31	5.02	4.84	4.43	4.01	3.77	4.71	4.18	3.10	2.61
1260	4.57	4.59	2.86	4.63	4.45	3.96	3.52	3.21	4.31	3.75	2.98	2.00
1261	4.05	4.20	2.78	4.30	4.18	3.75	3.37	3.08	4.05	3.57	3.07	1.98
1262	4.62	4.43	2.86	4.52	4.38	3.92	xxx	3.23	4.22	3.70	3.17	2.02
1263	5.18	4.77	3.00	4.77	4.56	4.06	xxx	3.31	4.42	3.85	3.59	2.08
1264	5.39	5.27	3.24	5.26	5.11	4.53	xxx	3.69	4.97	4.34	3.24	2.40
1265	4.71	4.73	2.98	4.79	4.67	4.12	xxx	3.35	4.52	3.94	3.76	2.14
1266	4.87	4.99	3.34	5.17	4.74	4.37	xxx	3.94	4.84	4.35	3.95	2.77
1267	5.56	5.42	3.47	5.57	5.09	4.66	xxx	4.14	5.18	4.61	3.71	2.82
1268	5.34	5.19	3.33	5.28	5.04	4.56	xxx	3.82	4.97	4.39	3.24	2.64
1269	4.32	4.43	2.98	4.55	4.39	3.98	xxx	3.30	4.33	3.83	3.41	2.30
1270	4.51	4.48	3.17	4.57	4.44	4.07	xxx	3.55	4.36	3.92	4.01	2.59
1271	5.50	5.40	3.57	5.44	5.25	4.82	xxx	4.20	5.16	4.63	3.82	3.01
1272	5.36	5.39	3.40	5.50	5.14	4.75	xxx	3.90	5.16	4.54	3.16	2.65
1273	4.22	4.37	2.95	4.56	4.27	3.94	xxx	3.18	4.29	3.78	3.52	2.18
1274	4.23	4.46	3.20	4.66	4.40	4.03	xxx	3.65	4.45	4.05	4.29	2.71
1275	5.72	5.76	3.74	5.86	5.49	4.99	xxx	4.45	5.53	4.97	3.70	3.22
1276	5.54	5.42	3.27	5.43	5.19	4.61	xxx	xxx	5.06	4.44	3.04	2.53
1277	4.25	4.33	2.82	4.40	4.26	3.78	xxx	xxx	4.15	3.65	3.52	2.10
1278	4.61	4.58	3.18	4.76	4.56	4.15	xxx	3.65	4.53	4.06	3.90	2.66
1279	5.53	5.21	3.46	5.32	5.07	4.62	xxx	4.08	5.03	4.51	3.82	2.91
1280	5.18	5.22	3.40	5.32	5.05	4.61	xxx	3.96	5.02	4.47	3.29	2.77
1281	4.14	4.37	3.00	4.54	4.31	3.94	xxx	3.36	4.31	3.84	3.06	2.37
1282	3.73	3.94	2.81	4.04	3.95	3.65	xxx	3.19	3.86	3.49	3.80	2.34
1283	4.94	5.02	3.34	5.05	4.91	4.56	xxx	3.99	4.80	4.34	3.46	2.91
1284	4.88	4.99	3.09	4.98	4.81	4.32	xxx	3.57	4.72	4.14	2.93	2.39
1285	3.63	4.03	2.70	4.17	4.05	3.60	xxx	3.01	3.98	3.49	3.09	2.04
1286	3.59	4.01	2.83	4.09	4.05	3.72	xxx	3.29	3.95	3.55	3.70	2.33
1287	4.92	5.07	3.27	5.03	4.92	4.52	xxx	3.91	4.81	4.29	3.31	2.74
1288	4.82	4.84	2.99	4.85	4.66	4.18	xxx	3.43	4.56	3.98	2.79	2.24
1289	3.41	3.85	2.58	3.99	3.87	3.47	xxx	2.86	3.80	3.33	3.13	1.90

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1290	3.72	4.03	2.86	4.20	4.11	3.79	xxx	3.32	4.02	3.61	3.42	2.31
1291	4.70	4.62	3.13	4.66	4.56	4.20	xxx	3.67	4.46	3.98	3.57	2.53
1292	4.69	4.91	3.16	4.98	4.84	4.43	xxx	3.79	4.78	4.21	2.95	2.58
1293	3.81	4.13	2.72	4.19	4.07	3.68	xxx	3.07	4.03	3.52	3.09	2.07
1294	3.52	3.87	2.79	3.99	3.94	3.65	xxx	3.25	3.87	3.51	3.65	2.42
1295	4.51	4.66	3.19	4.78	4.67	4.35	xxx	3.90	4.58	4.15	3.51	2.82
1296	4.62	4.74	3.14	4.88	4.68	4.28	xxx	3.68	4.59	4.09	3.33	2.57
1297	4.08	4.37	2.99	4.56	4.39	4.04	xxx	3.50	4.31	3.86	3.26	2.46
1298	3.88	4.20	2.91	4.35	4.25	3.92	xxx	3.44	4.17	3.74	3.31	2.43
1299	4.35	4.37	2.99	4.45	4.33	3.99	xxx	3.49	4.25	3.81	3.41	2.46
1300	4.48	4.54	3.06	4.64	4.46	4.10	xxx	3.59	4.40	3.94	3.64	2.55
1301	4.64	4.87	3.20	4.99	4.79	4.41	xxx	3.84	4.72	4.22	3.29	2.71
1302	4.38	4.58	2.91	4.65	4.48	4.08	xxx	3.42	4.41	3.90	3.27	2.32
1303	4.38	4.53	2.91	4.58	4.41	4.02	xxx	3.40	4.35	3.86	3.53	2.33
1304	4.88	4.91	3.12	5.01	4.79	4.34	xxx	3.68	4.72	4.19	3.51	2.51
1305	4.92	4.91	3.10	5.01	4.80	4.34	xxx	3.67	4.72	4.18	3.60	2.48
1306	4.74	4.87	3.15	4.98	4.80	4.38	xxx	3.81	4.72	4.20	3.29	2.64
1307	4.51	4.44	2.98	4.56	4.41	4.00	xxx	3.47	4.31	3.84	3.57	2.42
1308	4.90	4.61	3.16	4.81	4.64	4.27	xxx	3.75	4.57	4.11	3.67	2.73
1309	5.49	4.84	3.31	4.93	4.74	4.39	4.07	3.86	4.68	4.20	3.59	2.82
1310	5.15	4.76	2.67	5.02	4.82	4.43	4.04	3.80	4.72	4.17	3.06	2.47
1311	4.45	4.06	2.45	4.33	3.77	3.73	3.37	3.15	4.06	3.61	3.45	2.14
1312	5.03	4.52	2.93	4.62	3.93	3.83	3.76	3.58	4.33	3.93	4.17	2.62
1313	5.61	5.44	3.29	5.60	4.85	4.77	4.64	4.43	5.28	4.78	3.45	3.08
1314	5.09	4.88	2.76	4.91	4.62	4.27	3.85	3.60	4.67	4.11	3.31	2.38
1315	4.41	4.52	2.67	4.59	4.36	4.03	3.65	3.44	4.41	3.90	3.22	2.32
1316	4.54	4.40	2.51	4.70	4.35	3.98	3.60	3.38	4.31	3.81	3.92	2.20
1317	5.71	5.51	3.03	5.51	5.33	4.86	4.38	4.06	5.28	4.65	3.31	2.70
1318	5.27	5.13	2.43	5.37	4.92	4.29	3.72	3.31	4.83	4.14	2.83	1.92
1319	4.26	4.22	2.09	4.45	4.15	3.61	3.14	2.82	4.05	3.51	3.10	1.67
1320	4.30	4.35	2.29	4.46	4.32	3.90	3.52	3.27	4.19	3.70	3.62	2.03
1321	5.39	5.28	2.69	5.32	5.12	4.61	4.11	3.78	4.99	4.36	3.29	2.34
1322	5.37	5.18	2.46	5.20	4.95	4.34	3.73	3.34	4.85	4.14	2.67	1.88
1323	3.96	4.03	1.98	4.20	3.96	3.45	2.99	2.70	3.87	3.34	3.16	1.52
1324	4.28	4.39	2.44	4.23	4.35	3.94	3.56	3.24	4.20	3.75	3.59	2.13
1325	5.34	5.22	2.75	5.25	5.05	4.58	4.12	3.80	4.90	4.31	3.20	2.39
1326	4.95	4.88	2.53	4.90	4.70	4.14	3.65	3.29	4.59	3.96	2.67	1.94

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1327	3.68	3.90	2.09	4.01	3.89	3.40	2.99	2.72	3.77	3.29	3.07	1.60
1328	3.80	4.14	2.53	4.26	4.16	3.79	3.44	3.24	4.02	3.61	3.44	2.15
1329	4.74	4.91	2.80	4.91	4.76	4.33	2.39	3.66	4.64	4.08	3.16	2.38
1330	4.53	4.72	2.66	4.69	4.55	4.05	xxx	3.31	4.43	3.84	2.57	2.03
1331	3.32	3.68	2.21	3.79	3.69	3.25	xxx	xxx	3.58	3.12	2.95	1.63
1332	3.53	3.88	2.63	4.03	3.93	3.64	3.27	3.10	3.83	3.41	3.42	2.18
1333	4.43	4.65	2.92	4.73	4.59	4.23	3.88	3.67	4.47	3.98	3.10	2.50
1334	4.29	4.47	2.74	4.52	4.38	3.95	3.58	3.32	4.25	3.73	2.50	2.04
1335	3.07	3.60	2.29	3.65	3.58	3.17	2.84	2.63	3.49	3.03	2.80	1.64
1336	3.13	3.80	2.58	3.69	3.67	3.39	3.13	3.00	3.60	3.15	3.14	2.11
1337	3.91	4.26	2.79	4.18	4.09	3.79	3.52	3.37	4.00	3.61	3.08	2.37
1338	3.74	4.12	2.79	4.20	4.09	3.77	3.52	3.36	3.98	3.58	2.43	2.26
1339	2.89	3.25	2.28	3.36	3.31	3.01	2.78	2.64	3.20	2.85	2.53	1.72
1340	2.64	3.04	2.33	3.22	3.19	2.98	2.80	2.73	3.13	2.85	3.26	2.03
1341	3.76	4.10	2.88	4.21	4.12	3.88	3.64	3.54	4.06	3.69	2.86	2.57
1342	3.66	3.97	2.64	4.06	3.92	3.59	3.28	3.11	3.86	3.38	2.39	2.00
1343	2.56	3.20	2.28	3.38	3.30	2.99	2.73	2.60	3.23	2.84	2.49	1.68
1344	2.60	3.15	2.32	3.24	3.21	3.00	2.81	2.75	3.13	2.85	2.88	1.93
1345	3.38	3.75	2.61	3.79	3.70	3.49	3.27	3.17	3.63	3.30	2.86	2.20
1346	3.42	3.81	2.63	3.93	3.79	3.53	3.29	3.15	3.72	3.34	2.45	2.11
1347	2.60	3.17	2.30	3.35	3.26	3.03	2.81	2.71	3.18	2.86	2.43	1.79
1348	2.55	3.08	2.26	3.16	3.15	2.95	2.74	2.68	3.08	2.79	2.57	1.87
1349	2.93	3.33	2.41	3.41	3.33	3.11	2.90	2.82	3.27	2.95	2.94	1.99
1350	3.19	3.68	2.71	3.87	3.74	3.52	3.32	3.22	3.66	3.34	2.59	2.28
1351	2.72	3.23	2.42	3.41	3.36	3.13	2.95	2.89	3.26	2.97	2.50	1.97
1352	2.47	2.98	2.22	3.15	3.13	2.93	2.77	2.73	3.06	2.81	2.85	2.02
1353	3.10	3.52	2.55	3.63	3.57	3.37	3.17	3.07	3.52	3.22	2.97	2.24
1354	3.27	3.67	2.64	3.82	3.68	3.48	3.29	3.19	3.64	3.34	2.83	2.31
1355	3.10	3.54	2.53	3.64	3.52	3.32	3.13	3.05	3.48	3.19	2.53	2.21
1356	2.67	3.22	2.30	3.27	3.21	3.01	2.81	2.74	3.20	2.88	2.80	1.98
1357	3.09	3.60	2.50	3.65	3.54	3.33	3.12	3.02	3.53	3.18	2.91	2.18
1358	3.56	3.82	2.57	3.91	3.78	3.51	3.27	3.14	3.75	3.36	3.00	2.21
1359	3.62	3.85	2.64	4.00	3.88	3.62	3.37	3.25	3.85	3.46	2.68	2.29
1360	3.05	3.50	2.37	3.64	3.54	3.27	3.02	2.88	3.52	3.13	2.62	1.95
1361	2.98	3.45	2.35	3.56	3.48	3.18	2.94	2.81	3.46	3.06	3.05	1.93
1362	3.66	4.06	2.76	4.11	4.01	3.71	3.45	3.30	3.95	3.54	3.28	2.33
1363	3.97	4.34	2.88	4.43	4.30	4.03	3.74	3.57	4.23	3.81	2.90	2.46

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1364	3.75	4.07	2.56	4.06	3.97	3.63	3.29	3.12	3.92	3.45	2.76	2.02
1365	3.42	3.83	2.49	3.83	3.77	3.42	3.11	2.95	3.71	3.26	2.99	1.95
1366	3.86	4.09	2.75	4.20	4.09	3.74	3.43	3.24	4.00	3.55	3.42	2.12
1367	4.64	4.79	3.08	4.85	4.67	4.28	3.92	3.69	4.60	4.06	3.19	2.42
1368	4.29	4.65	2.76	4.74	4.52	4.03	3.61	3.30	4.47	3.86	2.41	2.04
1369	3.34	3.50	2.25	3.58	3.43	3.00	2.71	2.49	3.37	2.91	2.99	1.56
1370	3.70	3.83	2.69	3.96	3.80	3.54	3.34	3.21	3.74	3.39	3.98	2.30
1371	5.37	5.45	3.36	5.52	5.27	4.86	4.49	4.24	5.20	4.63	3.11	2.90
1372	4.93	4.82	2.60	4.82	4.61	4.01	xxx	3.13	4.52	3.87	2.77	1.80
1373	3.95	4.07	2.33	4.11	3.97	3.49	xxx	2.77	3.89	3.39	3.08	1.64
1374	4.39	4.43	2.66	4.47	4.30	3.89	3.50	3.26	4.20	3.70	3.55	2.01
1375	5.40	5.24	3.02	5.29	5.05	4.54	4.04	3.72	4.95	4.31	3.24	2.29
1376	5.55	5.14	2.73	5.15	4.88	4.24	3.64	3.25	4.79	4.09	2.66	1.84
1377	4.09	4.07	2.30	4.12	3.96	3.43	2.97	2.68	3.87	3.33	3.32	1.51
1378	4.66	4.67	2.87	4.72	4.47	4.17	3.76	3.53	4.46	3.96	3.78	2.24
1379	6.04	5.62	3.28	5.62	5.27	4.85	4.32	4.00	5.24	4.58	3.38	2.48
1380	5.46	5.24	2.78	5.26	5.02	4.39	3.82	3.46	4.90	4.20	2.99	2.03
1381	4.58	4.52	2.46	4.56	4.38	3.85	3.37	3.07	4.28	3.70	2.99	1.79
1382	4.50	4.36	2.47	4.41	4.25	3.80	xxx	3.14	4.15	3.63	3.41	1.90
1383	5.61	5.17	2.87	5.12	4.90	4.33	xxx	3.54	4.78	4.15	3.42	2.20
1384	5.52	5.28	2.73	5.28	5.05	4.41	xxx	3.51	4.92	4.23	3.05	2.04
1385	4.70	4.58	2.41	4.65	4.47	3.93	xxx	3.16	4.37	3.78	3.06	1.78
1386	4.49	4.44	2.40	4.51	4.32	3.85	xxx	3.20	4.22	3.71	3.75	1.97
1387	5.83	5.65	2.94	5.68	5.38	4.76	xxx	3.82	5.26	4.55	3.24	2.38
1388	5.72	5.33	2.41	5.26	5.00	4.21	xxx	3.04	4.89	4.14	2.65	1.71
1389	4.18	4.12	1.96	4.12	4.00	3.39	xxx	2.52	3.91	3.38	2.98	1.41
1390	4.39	4.32	2.27	4.42	4.25	3.79	3.36	3.10	4.16	3.65	3.52	1.84
1391	5.55	5.33	2.71	5.40	5.13	4.53	3.97	3.60	5.02	4.34	3.23	2.15
1392	5.58	5.23	2.41	5.25	4.97	4.23	3.57	3.10	4.87	4.13	2.65	1.74
1393	4.19	4.12	1.94	4.21	4.03	3.43	2.90	2.56	3.94	3.38	2.98	1.40
1394	4.20	4.27	2.29	4.36	4.21	3.78	3.36	3.13	4.11	3.61	3.37	1.90
1395	5.29	5.10	2.62	5.12	4.89	4.36	3.83	3.51	4.77	4.15	3.22	2.10
1396	5.41	5.09	2.49	5.09	4.83	4.20	3.62	3.23	4.71	4.06	2.66	1.84
1397	4.07	4.06	2.05	4.16	3.98	3.44	3.00	2.69	3.88	3.35	3.06	1.51
1398	4.04	4.23	2.46	4.35	4.24	3.83	3.52	3.32	4.13	3.65	3.20	2.12
1399	4.72	4.62	2.57	4.68	4.51	4.08	3.70	3.46	4.41	3.86	3.47	2.16
1400	5.04	4.99	2.82	5.12	4.79	4.39	3.95	3.68	4.76	4.18	3.09	2.38

Station	P1	P2	P3	P4	P6	P7	P8	P9	P11	P12	P13	P14
1401	4.26	4.41	2.53	4.59	4.30	3.91	3.51	3.27	4.26	3.73	3.15	2.08
1402	3.89	4.16	2.68	4.27	4.16	3.82	3.53	3.38	4.07	3.64	3.43	2.34
1403	4.57	4.68	2.85	4.71	4.57	4.20	3.86	3.67	4.49	3.99	3.51	2.52
1404	4.87	4.98	3.01	5.04	4.72	4.39	3.99	3.74	4.77	4.18	3.36	2.47
1405	4.61	4.70	2.87	4.79	4.48	4.18	3.81	3.59	4.53	3.99	3.16	2.37
1406	4.14	4.25	2.69	4.36	4.23	3.86	3.53	3.35	4.15	3.69	3.28	2.27
1407	4.39	4.48	2.77	4.57	4.43	4.03	3.67	3.46	4.35	3.86	3.42	2.34
1408	4.61	4.72	2.91	4.83	4.64	4.22	3.85	3.62	4.56	4.04	3.40	2.42
1409	4.59	4.68	2.88	4.79	4.60	4.20	3.83	3.61	4.52	4.00	2.99	2.40
1410	4.03	4.23	2.60	4.30	4.16	3.78	3.44	3.25	4.11	3.61	3.04	2.15
1411	4.14	4.30	2.65	4.35	4.22	3.82			4.16	3.67		

APPENDIX B

METADATA COVERING GIS/GPS FILES USED IN TEXT FIGURES IN SENSITIVE HERBACEOUS VEGETATION POLYGONS: 2004 ASSESSMENTS AT SEVEN STATIONS ESTABLISHED FOR THE WILMINGTON HARBOR MONITORING PROJECT IN THE CAPE FEAR RIVER ESTUARY, NORTH CAROLINA

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**13ben.shp 13ben.dbf 13ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**13pil.shp 13pil.dbf 13pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**13poly.shp 13poly.dbf 13poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (13poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	**13sub.shp 13sub.dbf 13sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site9.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**13tra.shp 13tra.dbf 13tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**Area-gen. shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 Jan 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P3, TOWN CREEK

FIGURE 8.41-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA

FILE NAMES:	**Point-ge .shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Points depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 January 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P7, INDIAN CREEK

FIGURE 8.42-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**15ben.shp 15ben.dbf 15ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	**15pil.shp 15pil.dbf 15pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P7, INDIAN CREEK

FIGURE 8.42-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**Indcr2.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2003
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8 and Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	6 January 2003
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363
FILE NAMES:	**15sub.shp 15sub.dbf 15sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P7, INDIAN CREEK

FIGURE 8.42-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site8.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P7, INDIAN CREEK

FIGURE 8.42-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA**

FILE NAMES:	**15tra.shp**	**15tra.dbf**	**15tra.shx**

DESCRIPTION OF LAYER: Points depicting belt transect markers

SOURCE: Trimble PRO XRS GPS Unit

DATA TYPE: Points

SOFTWARE: Pathfinder Office 2.1 and Arcview version 3.2
DATUM: North American Datum (NAD) 1983
COORDINATE SYSTEM: U.S. State Plane 1983
REGION: North Carolina 3200
UNITS OF MEASURE: Feet
DATA COLLECTION: 20 December 2000

SOURCE: CZR Incorporated
SOURCE CONTACT: Samuel Cooper
SOURCE ADDRESS: 4709 College Acres, Suite 2
Wilmington, NC 28403
SOURCE PHONE: 910/392-9253
SOURCE FAX: 910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P8, DOLLISONS LANDING

FIGURE 8.43-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**16ben.shp 16ben.dbf 16ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	**16pil.shp 16pil.dbf 16pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P8, DOLLISONS LANDING

FIGURE 8.43-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**Area-gen.shp, .dbf .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2002
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	6 January 2003
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363
FILE NAMES:	**16sub.shp 16sub.dbf 16sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P8, DOLLISONS LANDING

FIGURE 8.43-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site3.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns):
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P8, DOLLISONS LANDING

FIGURE 8.43-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA

FILE NAMES:	**16tra.shp 16tra.dbf 16tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**17ben.shp 17ben.dbf 17ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**17pil.shp 17pil.dbf 17pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**17poly.shp 17poly.dbf 17poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (17poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**17sub.shp 17sub.dbf 17sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site4.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P9, BLACK RIVER

FIGURE 8.44-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**17tra.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**Area-gen.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 January, 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P12, RAT ISLAND

FIGURE 8.45-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**Cam2.shp Came2.dbf Cam2.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**Ratpil2.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Point depicting new location of piling, 2002
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8 and Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	5 August 2002
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P12, RAT ISLAND

FIGURE 8.45-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**19poly.shp 19poly.dbf 19poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (19poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**19sub.shp 19sub.dbf 19sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P12, RAT ISLAND

FIGURE 8.45-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA

FILE NAMES:	**site5.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P12, RAT ISLAND

FIGURE 8.45-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA

FILE NAMES:	**19tra.shp 19tra.dbf 19tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**RATISL.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2001
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8, Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	23 August, 2001
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA**

FILE NAMES:	**20ben.shp 20ben.dbf 20ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**20pil.shp 20pil.dbf 20pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**20poly.shp 20poly.dbf 20poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (20poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**20sub.shp 20sub.dbf 20sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA

FILE NAMES:	**site2b.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1” = 250’ Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272’ based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P13, FISHING CREEK

FIGURE 8.46-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**20tra.shp 20tra.dbf 20tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**Area-gen, .shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	22 January, 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**21ben.shp 21ben.dbf 21ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**21pil.shp 21pil.dbf 21pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

**CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA**

FILE NAMES:	**21poly.shp 21poly.dbf 21poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (21poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**21sub.shp 21sub.dbf 21sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA

FILE NAMES:	**site1.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT,
NORTH CAROLINA

FILE NAMES:	**21tra.shp 21tra.dbf 21tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**Area-gen.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2004
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	22 January, 2005
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

APPENDIX C

AREAS AND LOCATIONS OF NEW YEAR 2004 SENSITIVE HERBACEOUS SPECIES POLYGONS AT SAMPLING STATIONS IN THE CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

Areas and locations of year 2004 sensitive herbaceous species polygons at sampling stations in the Cape Fear River Estuary, Wilmington Harbor Monitoring Project, North Carolina.

Station Name/Number	Polygon Area (ft^2)	Point Number	Northing* (ft)	Easting* (ft)
Town Creek/ P3-A	1378.69	1A	140253.597	2304205.064
		2A	140251.317	2304198.981
		3A	140252.091	2304194.557
		4A	140249.037	2304185.857
		5A	140245.324	2304181.427
		6A	140234.517	2304182.420
		7A	140231.591	2304178.609
		8A	140223.041	2304170.889
		10A	140204.577	2304196.823
		11A	140219.342	2304207.068
		12A	140229.920	2304215.270
		13A	140250.071	2304218.512
P3-B		1B	140266.073	2304221.414
		2B	140263.301	2304220.977
		3B	140266.151	2304229.020
		4B	140266.619	2304234.754
		5B	140270.253	2304238.821
		6B	140273.119	2304233.448
		7B	140272.268	2304226.442
P3-C	47.93	1C	140287.854	2304231.342
		2C	140285.605	2304241.664
		3C	140291.891	2304234.126
		Outlier Point	140266.966	2304215.868
		Outlier Point	140292.987	2304240.588
		Outlier Point	140299.998	2304226.821
Black River/ P9	69.45	A	216670.004	2286291.666
		B	216676.974	2286286.232
		C	216681.300	2286296.966
		D	216674.683	2286297.453
Fishing Creek P13	2613.60	1	215482.530	2303575.895
		2	215461.828	2303576.164
		3	215456.930	2303583.156
		4	215453.789	2303591.400
		5	215444.293	2303596.735
		6	215436.635	2303602.588
		7	215430.734	2303598.796
		8	215432.612	2303576.729
		9	215448.692	2303574.919
		10	215459.079	2303563.969
		11	215464.591	2303560.254
		12	215472.164	2303564.401
		13	215489.139	2303548.713
		14	215493.745	2303569.954
		15	215516.942	2303548.906
		16	215543.022	2303518.184
		17	215558.475	2303536.446
		18	215539.395	2303556.743
		19	215522.596	2303557.609
		20	215506.745	2303571.822
		21	215506.847	2303577.259

Station Name/Number	Polygon Area Polygon Area (ft^2)	Point Number	Northing* (ft) NAD 83	Easting* (ft) NAD 83
Fishing Creek/P13		22	215499.234	2303587.777
		23	215494.488	2303581.572
		24	215491.820	2303579.900
		25	215485.041	2303578.938
Prince George Creek./P14	5227.20	1	227255.909	2320208.652
		2	227245.418	2320216.795
		3	227240.070	2320231.142
		4	227228.775	2320222.615
		5	227228.378	2320224.883
		6	227216.914	2320233.760
		7	227216.203	2320243.469
		8	227217.024	2320247.507
		9	227228.030	2320248.646
		10	227219.848	2320262.254
		11	227220.249	2320277.301
		12	227220.596	2320281.026
		13	227190.048	2320276.245
		14	227209.802	2320290.116
		15	227215.288	2320297.158
		16	227232.327	2320293.828
		17	227239.936	2320299.811
		18	227231.817	2320280.284
		19	227241.547	2320290.834
		20	227253.695	2320280.917
		21	227251.934	2320275.708
		22	227273.767	2320281.395
		23	227275.253	2320302.308
		24	227291.838	2320302.868
		25	227315.223	2320282.359

*North Carolina State Coordinate System, Region 3200, North American Datum, 1983.

APPENDIX D

LIST OF SPECIES, COMMON NAMES AND AUTHORITIES FOR PLANTS SEEN IN OR NEAR POLYGONS AT SAMPLING STATIONS IN THE CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

A list of plant species used in text and tables with accompanying authorities and common names follows. Both common and scientific names for vascular plants follow Kartesz and Meachum 1999. Species considered sensitive herbaceous species are marked with an asterisk (*).

Acer rubrum L. Red Maple
**Alternanthera philoxeroides* (Mart.) Griseb. Alligator-Weed
Amaranthus cannabinus (L.) Sauer Tidal-Marsh Amaranth
Apios americana Medik. Groundnut
**Aster* sp. Probably *Symphyotrichum* sp.
Bidens laevis (L.) B.S.P. Smooth Beggarticks
Bidens sp. Beggarticks
**Boehmeria cylindrica* (L.) Sw. Small-Spike False Nettle
**Boltonia asteroides* (L.) L'Hér. White Doll's-Daisy
**Carex* L. Sedge
**Carex crinita* Lam. Fringed Sedge
**Carex crinita* var. *brevicrinis* Fern. Fringed Sedge
**Carex hyalinolepis* Steud. Shoreline Sedge
**Carex lupulina* Muhl. Ex Willd. Hop Sedge
Chasmanthium latifolium (Michx.) Yates Indian Wood-Oats
**Cicuta maculata* L. Spotted Water-Hemlock
**Cinna arundinacea* L. Sweet Wood-Reed
**Commelina virginica* L. Virginia Dayflower
**Decodon verticillatus* (L.) Ell. Swamp-Loosestrife
**Dulichium arundinaceum* (L.) Britt. Three-Way Sedge
**Eryngium aquaticum* L. Rattlesnake-Master
**Galium* L. Bedstraw
**Hymenocallis floridana* (Raf.) Morton Florida Spider-Lily
Hypericum mutilum L. Dwarf St. John's-Wort
Impatiens capensis Meerb. Spotted Touch-Me-Not
Lilaeopsis chinensis (L.) Kuntze Eastern Grasswort
**Ludwigia grandiflora* (M. Micheli) Greuter & Burdet Large-Flower Primrose-Willow
**Ludwigia palustris* (L.) Ell. Marsh Primrose-Willow
**Lycopus virginicus* L. Virginia Water-Horehound
Mikania scandens (L.) Willd. Climbing Hempvine
**Murdannia keisak* (Hassk.) Hand.-Maz. Wart-Removing-Herb
Nyssa aquatica L. Water Tupelo
**Orontium aquaticum* L. Goldenclub
Osmunda regalis L. Gray Royal Fern
**Peltandra virginica* (L.) Schott Green Arrow-Arum
Pilea pumila (L.) Gray Canadian Clearweed
Pluchea odorata (L.) Cass. Sweetscent
Smilax rotundifolia L. Horsebrier
**Polygonum arifolium* L. Halberd-Leaf Tearthumb
**Polygonum hydropiper* L. Mild Water-Pepper
**Polygonum punctatum* Ell. Dotted Smartweed
Polygonum virginianum L. Jumpseed
**Pontederia cordata* L. Pickerelweed
Porella pinnata L Leafy Liverwort
**Rhynchospora corniculata* (Lam.) Gray Short-Bristle Horned Beak Sedge
**Rhynchospora inundata* (Oakes) Fern. Narrow-Fruit Horned Beak Sedge
Rosa palustris Marsh. Swamp Rose
**Rumex verticillatus* L. Swamp Dock
**Sagittaria lancifolia* L. Bull-Tongue Arrowhead
**Saururus cernuus* L. Lizard's-Tail
**Scutellaria lateriflora* L. Mad Dog Skullcap
**Schoenoplectus americanus* (Pers.) Volk. Ex Schinz & R. Keller Chairmaker's Club-Rush

**Sium suave* Walt. Hemlock Water-Parsnip
Solidago sempervirens var. *mexicana* (L.) Fern. Seaside Goldenrod
Spartina cynosuroides (L.) Roth Big Cord Grass
**Symphyotrichum elliottii* (Torr. & Gray) Nesom Marsh American-Aster
Symphyotrichum subulatum (Michx.) Nesom Seaside American-Aster
Taxodium ascendens Brongn. Pond-Cypress
Toxicodendron radicans (L.) Kuntze Eastern Poison-Ivy
**Triadenum walteri* (J.G. Gmel.) Gleason Greater Marsh-St. John's-Wort
**Typha latifolia* L. Broad-Leaf Cat-Tail
**Zizania aquatica* L. Indian Wild Rice
**Zizaniopsis miliacea* (Michx.) Doell & Aschers. Marsh-Millet

Literature Cited

Kartesz, J.T., and C.A. Meacham. 1999. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.