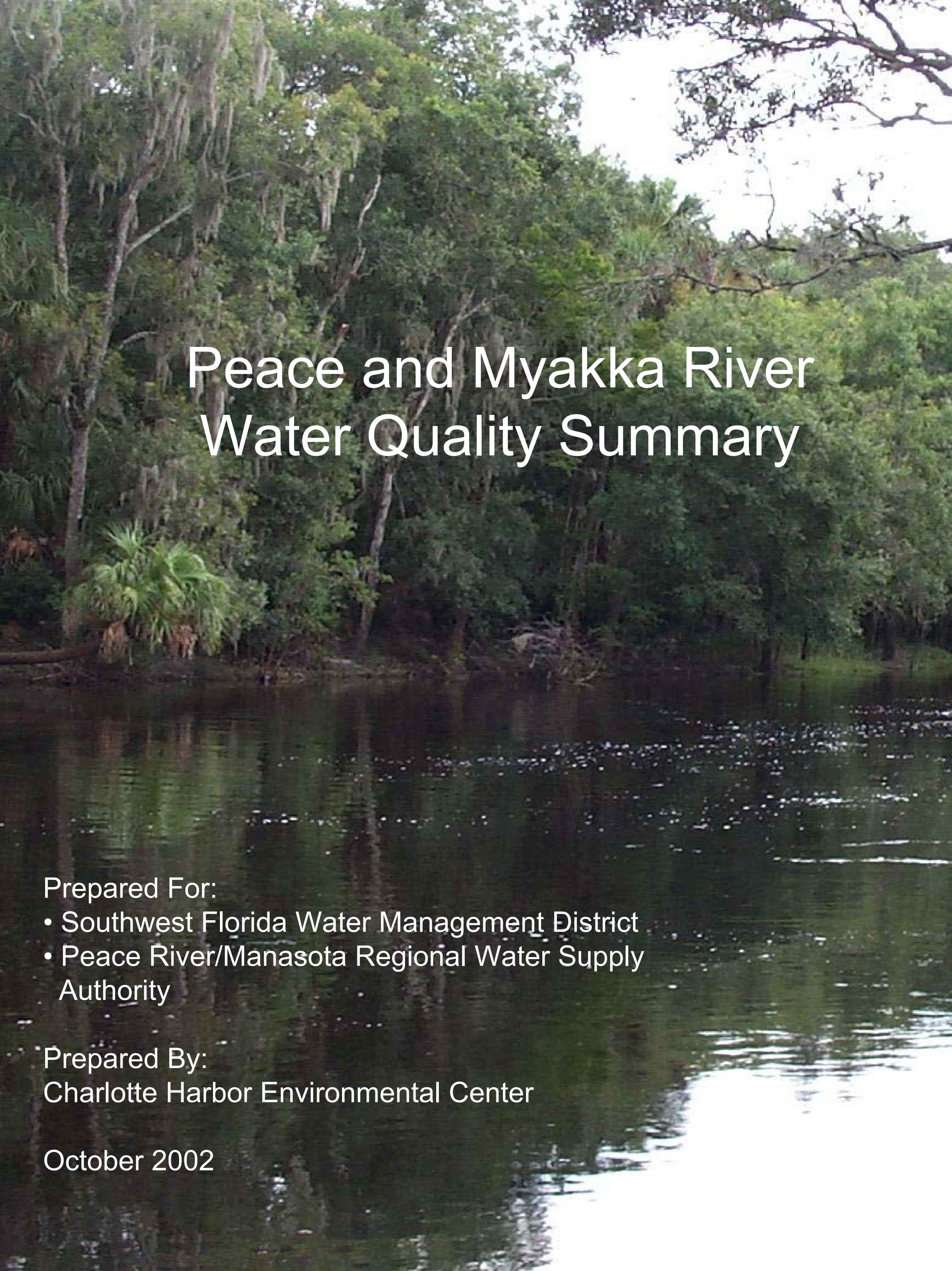

Peace and Myakka River Water Quality Summary

Prepared For:
- Southwest Florida Water Management District
- Peace River/Manasota Regional Water Supply Authority

Prepared By:
Charlotte Harbor Environmental Center

October 2002

Water Quality Conditions
and Pollutant Loads and Yields
in the Peace and Myakka River Basins

Prepared for the
Peace River/Manasota Regional Water Supply Authority
and the
Southwest Florida Water Management District

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EXECUTIVE SUMMARY

BACKGROUND

During the 1980's and 1990's a number of federal, state and regional resource management programs designated the Charlotte Harbor watershed as a priority management area. Protection and enhancement of water quality for use by people and wildlife are fundamental goals of these watershed management efforts.

In 1996 a watershed assessment report funded by the Southwest Florida Water Management District emphasized the important role that monitoring data play in supporting sound watershed management decisions, and recommended that more frequent (e.g., biweekly or monthly) water quality monitoring be initiated at selected sites in the Peace and Myakka River basins (Squires et al. 1996). That recommendation, and concerns about the sufficiency of the information currently available on water quality conditions in the Charlotte Harbor watershed, motivated a number of organizations to work cooperatively to implement the water quality monitoring and assessment project covered in this report.

Using funds provided by the District and the Peace River/Manasota Regional Water Supply Authority, and in-kind services provided by the Charlotte Harbor Environmental Center, the District, the Florida Department of Environmental Protection, and the City of Punta Gorda, the cooperating organizations initiated a monthly water quality monitoring program at a number of stations in the Peace River watershed in October 1997. In October 1998 the program was expanded to include an additional station in the Peace River watershed and a number of stations in the Myakka River basin. (Station locations are shown in Fig. 1 and summarized in Table 1 of the report text.)

To encourage timely analysis and dissemination of the water quality data collected during the initial years of the cooperative monitoring program, the Charlotte Harbor National Estuary Program provided funding for the preparation of three annual project reports (CHEC 1999, 2000, 2001). To help readers interpret this information in the context of regional water quality trends, the initial reports also included analyses of water quality and streamflow trends occurring at selected stations in the Peace and Myakka River basins during the years 1970 through 1998.

In addition to the watershed monitoring program, the District, as part of its Surface Water Improvement and Management (SWIM) program, also carried out a monitoring project in Charlotte Harbor that included portions of the most downstream, tidally-influenced reaches of the Peace and Myakka rivers. (The locations of these stations are shown in Fig. 18, below). The SWIM monitoring project began in January 1993 and was ended in December 2000, in preparation for a multi-agency monitoring program based on a fundamentally different sampling design that was scheduled to begin during 2001.

REPORT ORGANIZATION AND SCOPE

The present report is the fourth in a series of annual summaries, and contains the following elements:

- A summary of water quality conditions in freshwater (non-tidal) portions of the Peace and Myakka rivers during the years 1998-2001, based on monitoring data collected in the initial four years of the cooperative monitoring program;

- Estimates of annual loads, yields, and flow-adjusted loads of selected water quality constituents; and

- A summary of water quality conditions in the tidal (estuarine) portions of both rivers, based on monitoring data collected in those areas by the District's SWIM program during the years 1994 - 2000.

CALENDAR YEARS AND WATER YEARS

Data summaries in this report include two types of years: the familiar calendar year that begins on January 1 and ends on December 31, and the "water year" which begins on October 1 and ends on September 30. The "water year" is equivalent to the federal fiscal year, and is used in many water-resource applications because it is the reporting unit that federal agencies — such as the U.S. Geological Survey — use when summarizing annual climatological and hydrologic data.

RAINFALL AND STREAMFLOW

The amount of rain that falls on a watershed in a given year can have important effects on streamflow and water quality.

In the Peace and Myakka River watersheds, annual rainfall and streamflow levels varied dramatically during water years 1998-2001. A strong El Niño event occurred during the 1998 water year, and total annual rainfall in that year was substantially higher than the long-term (1950–2001) mean value at each monitoring station. Annual mean streamflow was also quite high during the 1998 water year, exceeding 200% of the long-term (1950-2001) values at each station.

Rainfall returned to near-average or below-average levels during water years 1999-2001, and annual mean streamflow declined in response. Annual mean flows at several stations in the upper Peace River basin remained below their long-term values during water years 1999-2001. In the Myakka River basin and other portions of the Peace River watershed, annual mean flows fell during water year 2000, but rebounded in 2001 to levels close to or above their long-term means.

Detailed analyses of rainfall and streamflow trends are beyond the scope of this project, but are currently being conducted by the Charlotte Harbor National Estuary Program.

The Estuary Program plans to release a report summarizing the results of those analyses during 2002.

WATER QUALITY IN NON-TIDAL (FRESHWATER) AREAS

A water quality index (WQI) developed for Florida streams by FDEP was used to summarize existing water quality conditions at the non-tidal stations monitored by the cooperative program during water years 1998-2001.

The WQI was developed using sampling data collected in 1987 from 2,000 stream monitoring sites throughout the state. Based on those data, percentile distributions of several groups of water quality indicators — including nutrients, water clarity, dissolved oxygen and oxygen-demanding substances — were determined on a statewide basis.

WQI values are calculated using those percentile distributions: for example, a station with an average annual total nitrogen concentration of 1.2 mg/L — the median value observed in the 1987 data set — would receive a WQI score of 50 (denoting the 50^{th} percentile) for that indicator.

Overall WQI scores can be averaged across indicator categories to obtain an average index value for each monitoring site. FDEP guidelines suggest that average index values of 0-44 indicate “good,” 45-60 indicate “fair,” and >60 indicate “poor” water quality conditions in Florida streams.

For this study, annual average WQI values were calculated using five water quality constituents (turbidity, total suspended solids, total organic carbon, nitrate+nitrite nitrogen, and total nitrogen). A total of 58 annual average WQI values were calculated for the 16 stations sampled during water years 1998 - 2001.

The Saddle Creek at Structure P-11 station, which is located immediately downstream from Lake Hancock in the upper Peace River basin, exhibited the poorest water quality among the sites sampled, falling in the 75th to 95th percentiles of Florida streams for most parameters in each year.

Other monitoring sites at which “poor” water quality conditions were observed included:

- Peace Creek Canal near Wahneta (in water years 1998 and 1999),
- Peace River at Bartow (1998, 1999)
- Peace River at Ft. Meade (1998)
- Peace River at Zolfo Springs (1998)
- Peace River at Arcadia (1998)
- Big Slough Canal near Myakka City (2000).

Two sites exhibited consistently “good” water quality based on the WQI:

- Shell Creek near Punta Gorda (1998-2001)
- Myakka River at Myakka City (1999-2001).

"Good" water quality conditions were also found during one or more years at the following stations:

- Myakka River near Sarasota (1999, 2000)
- Deer Prairie Slough near North Port (1999)
- Peace River at Ft. Meade (2000)
- Peace River at Arcadia (2000)
- Charlie Creek near Gardner (2000)
- Horse Creek near Myakka Head (1999)
- Horse Creek near Arcadia (1999).

The remaining stations and years were characterized as "fair" based on the WQI.

EXCEEDANCES OF STATE WATER QUALITY STANDARDS

Although WQI values are helpful in providing an easily-understandable summary of general water quality conditions, they are calculated using a limited number of parameters and must be interpreted with care. A more detailed examination of monitoring data, focusing on additional parameters, can also be helpful to identify water quality issues that may go unnoticed in an analysis based on WQI values alone.

The State of Florida has adopted water quality standards (summarized in Ch. 62-302, Florida Administrative Code) for a number of water quality constituents, in order to maintain productive populations of fish and wildlife and protect human health. In some cases these standards may be exceeded due to natural factors, and exceedances of this type should not be interpreted as evidence of degraded water quality. In many cases, however, exceedances of state standards can be linked to specific pollutant discharges or other human activities that are causing negative water quality impacts. Information on the frequency and magnitude of exceedances can thus be helpful in identifying sites where water quality may be declining or degraded. Once such sites are identified, more detailed follow-up studies can be designed and implemented to identify the cause(s) of the observed exceedances.

Specific Conductance

Specific conductance measures the ability of a water sample to carry an electric current, which depends on the presence of ions in the sample, their total concentration, and other physical and chemical characteristics. Freshly distilled water has a conductivity of between 0.5 and 2 µmhos/cm. The Florida standard for specific conductance in fresh surface waters is 1,275 µmhos/cm, a level set to protect populations of native fish and other aquatic organisms.

Exceedances of this standard were observed at four stations during water years 1998-2001:

- Joshua Creek at Nocatee (during 1999, 2000 and 2001)
- Shell Creek near Punta Gorda (during 2001)
- Big Slough Canal near Myakka City (during 1999)
- Big Slough Canal near North Port (during 1999).

In Florida, the presence of elevated specific conductance levels in fresh surface waters often indicate that substantial discharges of groundwater — usually from the Intermediate or Floridan aquifers — are occurring at locations upstream of the sampling point. Agricultural and industrial operations are the most common sources of such groundwater discharges.

Un-Ionized Ammonia

The un-ionized form of ammonia is highly toxic to fish and other aquatic organisms. In water, ionized (NH_4^+) and un-ionized (NH_3) ammonia exist in a dynamic chemical equilibrium, with the un-ionized form becoming increasingly common at higher temperature and pH levels.

The Florida water quality standard for un-ionized ammonia is 0.02 mg NH_3/L. Levels exceeding the standard were observed at two stations during water years 1998 – 2001:

- Saddle Creek at Structure P-11 (in water years 2000 and 2001)
- Horse Creek near Myakka Head (2000).

Levels of un-ionized ammonia that were relatively high (>0.01 mg NH_3/L) but did not exceed the water quality standard were also observed at several other stations, including:

- Peace River at Zolfo Springs (2000, 2001)
- Shell Creek near Punta Gorda (2001)
- Myakka River at Myakka City (1999)
- Big Slough Canal near Myakka City (1999)
- Big Slough Canal near North Port (1999)

The ammonia nitrogen found in rivers and streams can come from a variety of natural and manmade sources. Exceedances of the un-ionized ammonia water quality standard are often associated with discharges from anthropogenic activities, including feedlots and other concentrated animal feeding operations, sewage treatment systems, and industrial facilities that make or use ammonia-based chemical products.

Dissolved Oxygen

Dissolved oxygen (DO) is a critical water quality parameter, due to the importance of DO to the metabolic processes of all multi-celled aquatic organisms.

DO concentrations fluctuate as a result of a number of natural and man-made factors. Important natural factors include seasonal and daily temperature cycles (because the solubility of oxygen in water is higher at lower water temperatures), photosynthesis (because photosynthesizing organisms release DO into the water column, increasing its availability) and respiration/decomposition processes (which consume oxygen and thus cause DO concentrations in the water column to decline).

The primary manmade influences include the discharge of nutrients and organic wastes into waterbodies, which can lead to increased eutrophication, higher rates of photosynthesis, respiration and decomposition, and larger daily and seasonal fluctuations in DO concentrations.

The Florida standard for DO in fresh surface waters is 5 mg/L. For brackish and marine waters, DO should not average less than 5 mg/L in a 24-hour period and should never be less than 4 mg/L. Laboratory studies have shown that DO concentrations below 4 mg/L are stressful for most fish and many shellfish species, and concentrations below 2 mg/L are highly stressful and potentially fatal for many organisms.

During water years 1998 through 2001, DO concentrations below the 5 mg/L standard were observed at least once at each monitoring station in the freshwater portions of the Peace and Myakka River watersheds. Many of these instances may have been associated with natural factors, such as high water temperatures. At several stations, however, low DO levels were a frequent occurrence, observed on 25% or more of the sampling dates. And for some stations the median annual DO concentration (the value measured on at least half the sampling dates during a year) was less than the 5 mg/L standard. This latter group of stations included:

- Peace Creek Canal near Wahneta (water years 1998, 1999, 2000, and 2001)
- Saddle Creek at Structure P-11 (1999, 2001)
- Peace River at Bartow (1998, 1999, 2000, 2001)
- Shell Creek near Punta Gorda (1998)
- Deer Prairie Slough near North Port (2000, 2001)
- Big Slough Canal near North Port (2001).

Chlorophyll-a

Chlorophyll-*a* concentrations, which are used to estimate the biomass of algae and other phytoplankton in the water column, are among the best indicators of a waterbody's trophic state. Annual mean chlorophyll-*a* concentrations in Florida streams are usually at or below 5.5 µg/L. FDEP considers stream water quality to be "impaired" if the annual mean is above 20 µg/L.

Annual mean chlorophyll-a concentrations greater than 20 µg/L were observed at two monitoring stations during the 1998-2001 water years:

- Saddle Creek at Structure P-11 (all years)
- Peace River at Bartow (1998, 1999).

The elevated chlorophyll concentrations at these stations were apparently caused by discharges from Lake Hancock, a hypereutrophic lake that experiences chronic, year-round blooms of planktonic algae and cyanobacteria.

Individual observations of chlorophyll-a concentrations greater than 20 µg/L, which indicated the presence of occasional phytoplankton blooms but did not represent a violation of state water quality standards, were observed at a number of additional stations:

- Peace Creek Canal near Wahneta (1999)
- Peace River at Fort Meade (1998, 1999, 2000)
- Peace River at Zolfo Springs (1998, 1999, 2000)
- Peace River at Arcadia (1998)
- Horse Creek near Myakka Head (2000)
- Horse Creek near Arcadia (1998)
- Myakka River near Sarasota (1999, 2000, 2001).

CONSTITUENT LOADS AND YIELDS

Estimation of loads and yields of water and water quality constituents is a basic component of most watershed assessment programs. 'Load' represents the mass of a constituent (e.g., tons of nitrogen) passing a given point in a stream during a specified time interval (e.g., month, day or year). The 'yield' of a constituent is the load divided by the surface area of the contributing drainage basin, allowing loads produced by basins of different size to be compared on a consistent, per-unit-area basis.

In the present study the largest estimated yields of total nitrogen were observed at the Saddle Creek station during the 1998 water year, and at the Joshua Creek, Shell Creek and Big Slough-Myakka City stations during water year 2001. (It is likely that large constituent yields occurred at every station during the 1998 El Niño event, but monthly water quality sampling was not conducted at many sites in that year.)

Relatively large estimated yields of dissolved inorganic nitrogen (DIN) and nitrate-plus-nitrite (NO_{2+3}-N) nitrogen occurred at the Joshua Creek-Nocatee site in all years. A visible spike occurred at this site in water year 2001, when DIN and NO_{2+3}-N yields exceeded 5 kg N/ha/yr. Other stations with estimated inorganic nitrogen yields greater than 1 kg N/ha/yr included:

- Peace River at Zolfo Springs (1998)
- Peace River at Arcadia (1998)
- Big Slough Canal near Myakka City (2000, 2001)
- Peace River at Fort Meade (1998).

Substantial increases in the estimated yields of DIN (and PO_4-P) occurred between the upstream and downstream stations located on Horse Creek, suggesting the potential presence of anthropogenic sources of those constituents at one or more locations between the two stations.

Estimated yields of inorganic and total phosphorus followed similar temporal and spatial patterns, with the largest values occurring at gages on the main stem of the Peace River (e.g., Fort Meade, Zolfo Springs, and Arcadia) during 1998. Relatively large yields also occurred on the main stem of the Myakka River and at the Big Slough Canal-Myakka City station during 2001.

Yields of total suspended solids (TSS) showed a pronounced spike at the Saddle Creek gaging station during water year 1998, presumably due to episodic discharges from Lake Hancock during El Niño-related storm events. Other stations and years that produced relatively high TSS yields (in comparison to other stations and years) included:

- Shell Creek near Punta Gorda (2001)
- Myakka River at Myakka City (2001)
- Peace River at Bartow (1998)
- Saddle Creek at Structure P-11 (1999, 2000)
- Peace River at Fort Meade (1998)
- Big Slough Canal near Myakka City (2001).

Watershed managers can gain additional insights into spatial and temporal pollutant discharge patterns by examining the annual 'flow-adjusted' loads of important water quality constituents that are discharged from gaged sub-basins. These values are calculated by dividing a sub-basin's estimated annual constituent load (in milligrams) by its measured annual discharge (in liters). The result, expressed in units of mg/L, gives an estimate of the annual average mass of the constituent that was discharged from a sub-basin per unit water flow.

In cases where managers wish to reduce the loads of a particular constituent to a receiving water body, the most cost-effective approach is often to focus on areas that exhibit the highest flow-adjusted loads of that constituent. If effective load reduction methods are available, projects implemented in those areas should tend to produce the largest load reductions per volume of water treated.

For dissolved inorganic nitrogen forms, the largest estimated flow-adjusted loads observed in the Peace-Myakka monitoring program during water years 1998 – 2001 occurred at the following stations:

- Joshua Creek at Nocatee (water years 1999, 2000, and 2001)
- Peace River at Zolfo Springs (1998-2001)
- Big Slough Canal near Myakka City (2000)
- Peace River at Arcadia (1998-2001)
- Peace Creek Canal near Wahneta (2000).

The largest estimated flow-adjusted loads of dissolved inorganic phosphorus were observed at the following stations:

- Peace River at Bartow (1999, 2001)
- Peace River at Fort Meade (1998 – 2000)
- Peace River at Zolfo Springs (1998 – 2001)
- Charlie Creek near Gardner (1999)
- Peace River at Arcadia (1998, 1999, 2001)
- Myakka River near Sarasota (2001)
- Big Slough Canal near Myakka City (2001).

The largest estimated flow-adjusted loads of TSS were observed at the following stations:

- Saddle Creek at Structure P-11 (1998, 1999, 2000)
- Peace River at Bartow (1999, 2000)

WATER QUALITY IN TIDAL (ESTUARINE) AREAS

Between January 1993 and December 2000, as part of a larger Charlotte Harbor monitoring program, the District conducted monthly water quality monitoring at seven sites in the tidal reaches of the Peace and Myakka rivers. The sites were located at geographic coordinates which were at or near locations that had been sampled by the U.S. Geological Survey (USGS) in an earlier monitoring program conducted during the 1980s.

Near-Surface Salinity

The most upstream stations in both river systems (CH-001 in the tidal Myakka and CH-029 in the tidal Peace) were located in oligohaline areas, with median salinities <5 ppt in most years. Over the course of the study period, near-surface salinity levels at both stations ranged from tidal fresh (0 ppt) to mesohaline (>20 ppt).

Median near-surface salinities at the remaining stations were generally mesohaline, ranging between 10 and 25 ppt. Stations CH-002 (Myakka) and CH-004 (Peace) exhibited similar median values, of between 10 and 22 ppt. Stations CH-02B (Myakka) and CH-05B also exhibited similar median values, between 13 and 24 ppt. Highest median salinities (18–26 ppt) occurred at station CH-005, near the mouth of the Peace River.

Near-Surface Color

Natural water color, produced as a result of decomposition of leaf litter and other refractory organic matter, is known to be an important source of light attenuation in the Peace and Myakka river systems and portions of Charlotte Harbor.

Among the stations sampled during water years 1994-2000, median near-surface color levels varied inversely with median near-surface salinities. Color levels were quite high at the most upstream stations, fell by about 50% between those stations and the next downstream sampling locations, and declined another 20-40% at the highest-salinity stations.

Color levels in estuaries are affected by a variety of physical and chemical processes. The simplest physical process is dilution, which occurs when highly colored river water mixes with sea water containing much lower concentrations of the dissolved and colloidal humic acids and other compounds that contribute to water color. Humic materials are also removed from the water column through two physical-chemical processes — flocculation and adsorption — whose rates increase when the materials are transported from fresh to more saline waters. In estuaries, flocculation of humic acid colloids reportedly occurs preferentially at salinities between 0 and 5 ppt.

Median color values for Florida rivers and estuaries, as reported by Friedemann and Hand (1989) based on a survey of several thousand records retrieved from the U.S. EPA STORET database, are 70.0 and 20.0 pcu, respectively. Values observed in the tidal reaches of the Peace and Myakka river systems during water years 1994-2000 were substantially higher than these statewide medians.

Dissolved Oxygen

Annual median dissolved oxygen concentrations varied over a relatively narrow range, between about 5.7 and 7.7 mg/L. Concentrations in the “stressful” (< 4 mg/L) range were recorded at least once during most years at every site. Concentrations in the “hypoxic” (< 2 mg/L) range, which are potentially fatal to organisms that cannot move to areas of higher oxygen availability, were observed at the following stations:

- CH-02B (water years 1995, 1999, 2000)
- CH-004 (all years)
- CH-05B (1994, 1995, 1998, 1999)
- CH-005 (all years)

Chlorophyll-*a*

Chlorophyll-*a* concentrations, which provide estimates of phytoplankton biomass in the water column, are helpful indicators of a waterbody’s trophic state. Annual median concentrations ranged between1.0 µg/L and 13 µg/L at the tidal Myakka River stations and between 2.3 and 10.6 µg/L in the tidal Peace River. The statewide median chlorophyll-*a* concentration for Florida estuaries, as reported by an FDEP survey conducted in the mid-1980’s, is 8.5 µg/L.

Algal blooms (indicated by chlorophyll-*a* concentrations > 20 µg/L) occurred at every Peace and Myakka River station at some time during the monitoring period. Pronounced blooms, with chlorophyll concentrations > 50 µg/L, were observed at three sites.

Annual mean chlorophyll-a concentrations observed at several stations during water years 1994-2000 exceeded 11 µg/L, a value that has been adopted by the State of Florida as indicating potentially impaired water quality conditions in the State’s estuarine waters. Stations and years where the annual mean exceeded the 11 µg/L ‘impairment’ level included:

- Myakka River site CH-002 (water years 1995, 1999)
- Myakka River site CH-02B (1995, 1998, 1999)
- Peace River site CH-029 (1995, 1996)
- Peace River site CH-004 (1994, 1995, 1996, 1999)
- Peace River site CH-05B (1999)
- Peace River site CH-005 (1994).

ACKNOWLEDGMENTS

Many organizations and individuals contributed to this report. Funding was provided by the Peace River Basin Board and the Manasota Basin Board of the Southwest Florida Water Management District, and by the Peace River/Manasota Regional Water Supply Authority. In-kind services were provided by the Charlotte Harbor Environmental Center, City of Punta Gorda, Florida Department of Environmental Protection, and Southwest Florida Water Management District. Al Cheatham and Betty Staugler (CHEC), Bill Harper and Cindy Mick (City of Punta Gorda), and Sam Stone (PR/MRWSA) provided logistical support and technical information on the project area. Chris Anastasiou , Fran Flores, Ian Geraldi, Pam Green, Jill Hood, Jason Hood, Garrett Jabaut, Ralph Meder, Keith Morrison, Nita Ostermann, Kelly Permenter, Brandy Steed, Chris Tomlinson, Brian Vanaeist and Chris Zajac (SWFWMD) collected the water samples and *in situ* hydrographic data. Roberta Starks (SWFWMD) coordinated the monthly monitoring effort, supervised data entry and data management, and served as the project's quality assurance officer. Chemical analyses were performed by laboratory staff at FDEP, SWFWMD, and the Environmental Quality Laboratory, Inc. Sam Stone (PR/MRWSA), and Chris Anastasiou, Roberta Starks, and Dave Tomasko (SWFWMD), coordinated data transfers and provided technical support and recommendations. The report was prepared by Gerold Morrison (CHEC).

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1.0 INTRODUCTION

1.1 BACKGROUND

During the 1980's and 1990's a number of federal, state and regional resource management programs designated the Charlotte Harbor watershed as a priority management area. Protection and enhancement of water quality for use by people and wildlife are fundamental goals of these watershed management efforts.

In 1996 a watershed assessment report funded by the Southwest Florida Water Management District emphasized the important role that monitoring data play in supporting sound watershed management decisions, and recommended that more frequent (e.g., biweekly or monthly) water quality monitoring be initiated at selected sites in the Peace and Myakka River basins (Squires et al. 1996). That recommendation, and concerns about the sufficiency of the information currently available on water quality conditions in the Charlotte Harbor watershed, motivated a number of organizations to work cooperatively to implement the water quality monitoring and assessment project covered in this report.

Using funds provided by the District and the Peace River/Manasota Regional Water Supply Authority, and in-kind services provided by the Charlotte Harbor Environmental Center, the District, the Florida Department of Environmental Protection, and the City of Punta Gorda, the cooperating organizations initiated a monthly water quality monitoring program at a number of stations in the Peace River watershed in October 1997. In October 1998 the program was expanded to include an additional station in the Peace River watershed and a number of stations in the Myakka River basin. In order to provide information on annual mass loadings of priority water quality constituents each of these stations was co-located with an existing stream gaging station, where measurements of stream flow are recorded on a continuous basis by the U.S. Geological Survey. (The locations of these USGS gaging stations, which for technical reasons must be sited in the freshwater, non-tidal portions of a watershed, are shown in Fig. 1 and summarized in Table 1 below.)

To encourage timely analysis and dissemination of the water quality data collected during the initial years of the cooperative monitoring program, the Charlotte Harbor National Estuary Program provided funding for the preparation of three annual project reports (CHEC 1999, 2000, 2001). To help readers interpret this information in the context of regional water quality trends, the initial reports also included analyses of water quality and streamflow trends occurring at selected stations in the Peace and Myakka River basins during the years 1970 through 1998.

In addition to the watershed monitoring program, the District, as part of its Surface Water Improvement and Management (SWIM) program, also carried out a monitoring project in Charlotte Harbor that included portions of the most downstream, tidally-influenced reaches of the Peace and Myakka rivers. (The locations of these stations are shown in Fig. 18, below). The SWIM monitoring project began in January 1993 and was ended in December 2000, in preparation for a multi-agency monitoring program based on a fundamentally different sampling design that was scheduled to begin during 2001.

1.2 WATER QUALITY MANAGEMENT ISSUES

The Peace and Myakka River basins lie in a naturally fertile area that contains extensive phosphate-bearing geological deposits (the Bone Valley formation of the Hawthorn group) and experiences abundant seasonal rainfall and a humid subtropical climate. Phosphate is an important nutrient supporting the growth of terrestrial and aquatic organisms, and many lakes and streams that drain the Bone Valley region are "eutrophic" (exhibit high rates of biological productivity) as a result of naturally elevated phosphate inputs (Odum 1953, Canfield and Hoyer 1988). These naturally eutrophic waterbodies have the potential to become hypereutrophic — exhibiting undesirably high levels of biological productivity — if human activities cause nutrient loads to increase to excessive levels. Several historically-eutrophic lakes located in the headwaters region of the Peace River basin (e.g., Lake Parker, Lake Hancock, Banana Lake) appear to have shifted to hypereutrophic productivity levels in recent decades as a result of additional, manmade nutrient loads.

Eutrophication is a process in which increasing nutrient loads cause changes in the water chemistry and ecological structure of surface water bodies (Day et al. 1989). These changes, which are currently affecting many Florida waters, often include:

- increasing rates of biological production, and increasing biomass of algae or rooted aquatic plants;

- increasing deposition of unutilized organic material to the sediment zone (with associated increases in sediment oxygen demand);

- reduced water clarity, due to increased algal densities and resuspension of unconsolidated bottom sediments; and

- shifts in the composition of plant and animal communities, with increasing abundance of species more highly adapted to nutrient-enriched conditions

In addition to ecological and esthetic impacts, excessive nutrient loads can also affect human uses of surface waters by increasing the frequency of nuisance algal blooms, causing taste and odor problems in potable water sources and contributing to oxygen-related stress or mortality in economically important fish and shellfish species.

From a regulatory perspective the Federal Water Pollution Control Act ("Clean Water Act"), as amended, provides the underlying legal framework for water quality management throughout the United States. The Clean Water Act requires that the chemical, physical and biological integrity of the Nation's waters be maintained at levels that provide "fishable and swimmable" conditions for all citizens. Regulations developed by the U.S. EPA and other agencies to implement the Act have therefore focused on maintaining water quality at levels necessary to support viable populations of fish and wildlife and protect human health.

Water quality standards — which include designated uses, numeric and narrative water quality criteria, and an anti-degradation policy — have been the primary tools used in the national management effort. *Designated uses*, such as potable water supply, shellfish harvesting, wildlife propagation and recreational contact, are identified by each state through its rulemaking process and are established for all waterbodies within a state's jurisdiction (e.g., Ch. 62-302.400, Florida Administrative Code). *Water quality criteria*, which describe the specific water quality conditions needed to achieve designated uses, are also established by rulemaking at the state level (e.g., Ch. 62-302.530, F.A.C.). *Anti-degradation policy*, which is implemented through the permitting process, holds that all existing uses of a waterbody (including those that may exceed the designated uses) should also be maintained. If existing water quality is higher than is strictly necessary to support designated uses, for example, regulatory agencies will seek to maintain that quality unless important economic and social goals require otherwise.

In order to prevent or correct water quality degradation caused by manmade nutrient discharges, state criteria typically include provisions intended to prevent excessive loads from anthropogenic sources (e.g., stormwater runoff; wastewater discharges from municipal, industrial, and agricultural facilities). State policies and programs also support the restoration of water bodies degraded by historical anthropogenic discharges. Like many states, however, Florida has not established numerical criteria for regulating nutrient loads and eutrophication, relying instead on a narrative guideline which states that "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna" (Chap. 62-302.530, F.A.C.).

In areas such as the Peace and Myakka River basins, where many surface water bodies receive naturally-elevated phosphorus loads as well as manmade nutrient discharges from a variety of point and nonpoint sources, regular monitoring and reporting of water quality conditions are helpful to ensure that watershed stakeholders and managers have access to the information needed to assess progress toward the achievement of these state and national water quality goals.

1.3 REPORT OBJECTIVES AND STRUCTURE

This report provides a summary of water quality conditions, and estimated loads and yields of selected water quality constituents, at a number of monitoring stations located in the non-tidal and tidal reaches of Peace and Myakka rivers. The report is organized as follows:

- **Sect. 2 Water Quality at Non-Tidal Stations** – summarizes the monthly water quality monitoring data collected by the multi-agency monitoring program in non-tidal portions of both rivers during water years 1998-2001;

- **Sect. 3 Constituent Loads and Yields** – provides estimates of annual loads (metric tons/year), yields (kg/ha/yr), and flow-adjusted loads (kg/L) of selected water quality constituents using data collected at the non-tidal monitoring stations during water years 1998 – 2001;

- **Sect. 4 Water Quality at Tidal Stations** – summarizes monthly water quality data collected by the District in the tidal reaches of the Peace and Myakka rivers during water years 1994 – 2000.

2.0 WATER QUALITY AT NON-TIDAL STATIONS

2.1 METHODS

In order to characterize current water quality conditions, monthly monitoring was conducted at a number of sites in the Peace and Myakka River basins during water years 1998, 1999, 2000, 2001 (Table 1).

The water quality monitoring stations were co-located with long-term USGS stream gaging stations (Fig. 1). At each gaging station the USGS collects continuous records of stream stage, makes periodic measurements of stream discharge throughout a range of stages, and computes an estimate of daily mean stream discharge based on the continuous stage records and the measured stage-discharge relationship.

Co-location of water quality monitoring and stream gaging stations is important for at least three reasons (NRC 1999):

- Concentrations of water quality constituents often vary with stream stage, and adequate information on both concentration and stage is needed to allow these dynamic relationships to be documented and understood;

- Records of stream discharge (volume/time) and constituent concentrations (mass/volume) are necessary for the calculation of constituent loads (mass/time), which are important indicators of the effectiveness of water quality management efforts; and

- Watershed management efforts are more likely to succeed if managers have an adequate understanding of relationships between the quantity and quality of surface water flows within the watershed, and relationships between these variables and other ecosystem components.

Monthly water quality monitoring began in the Peace River watershed in October 1997, and in the Myakka River basin in October 1998. Water samples were collected by SWFWMD field staff over a three-day period during the first week of each month. Stations located in the northern portion of the Peace River basin were normally sampled on the initial day of field work; the remaining stations were sampled over the following two days.

Water quality parameters monitored included: specific conductance, pH, temperature, dissolved oxygen (DO), total organic carbon (TOC), nitrate+nitrite nitrogen, ammonia nitrogen, total ammonia+organic nitrogen (TKN), dissolved ortho-phosphate (PO_4), total phosphorus (TP), chlorophyll *a*, color (PCU), total suspended solids (TSS), and turbidity (NTU).

Hydrographic parameters (specific conductance, salinity, pH, temperature, and DO) were measured in the field using multi-probe Hydrolab™ or YSI™ instruments that were calibrated at the beginning and end of each field day.

Water samples were collected at a depth of 0.5m at each gaging station and transported on ice to the analytical laboratory. Concentrations of dissolved ortho-phosphate were determined using samples that were field-filtered, immediately following collection, through 0.45 μm membrane filters and stored on ice until analysis. Samples used for chlorophyll analysis were filtered in the laboratory immediately following sample delivery, using Gellman A/E (1 μm) glass fiber filters, and the filters and attached algal cells were stored frozen prior to chlorophyll extraction. All sampling, sample preservation and transport, and chain of custody procedures were performed in accordance with an EPA-approved quality assurance plan and with existing state (FDEP) and regional (SWFWMD) quality assurance requirements. Chemical analyses were performed by three laboratories (SWFWMD, FDEP, and EQL, Inc.), using EPA-approved analytical methods.

Data quality was assessed and reported on a quarterly basis by SWFWMD staff (e.g., CHEC 2000, 2001). The most significant issues involved the accuracy and precision of a number of total nitrogen determinations made by the SWFWMD laboratory, using a new analytical method, during 1999. Data points affected by these QA concerns have been omitted from the analyses performed for this report. The greatest impact of these omissions has been the creation of data gaps in the estimates of TN loads and yields (Table 3 and Fig. 4) for the 1999 water year.

Table 1. Stations where monthly water quality monitoring was conducted, by water year.

Station name	USGS ID	Drainage Area (mi^2)	WY 1998	WY 1999 through 2001
Peace Creek Canal near Wahneta	02293987	162	✓	✓
Saddle Creek at Structure P-11	02294491	135	✓	✓
Peace River at Bartow	02294650	390	✓	✓
Peace River at Ft. Meade	02294898	480	✓	✓
Peace River at Zolfo Springs	02295637	826	✓	✓
Peace River at Arcadia	02296750	1,367	✓	✓
Charlie Creek near Gardner	02296500	330	✓	✓
Joshua Creek at Nocatee	02297100	132	--	✓
Horse Creek near Myakka Head	02297155	42	✓	✓
Horse Creek near Arcadia	02297310	218	✓	✓
Shell Creek near Punta Gorda	02298202	373	✓	✓
Myakka River at Myakka City	02298608	125	--	✓
Myakka River near Sarasota	02298830	229	--	✓
Deer Prairie Slough near North Port[a]	02299120	--	--	✓
Big Slough Canal near Myakka City	02299410	36.5	--	✓
Big Slough Canal near North Port[b]	02299455	86.2	--	✓

[a]Lack of drainage area information prevented calculation of constituent yield estimates for this station

[b]Incomplete discharge records prevented calculation of loading estimates for this station

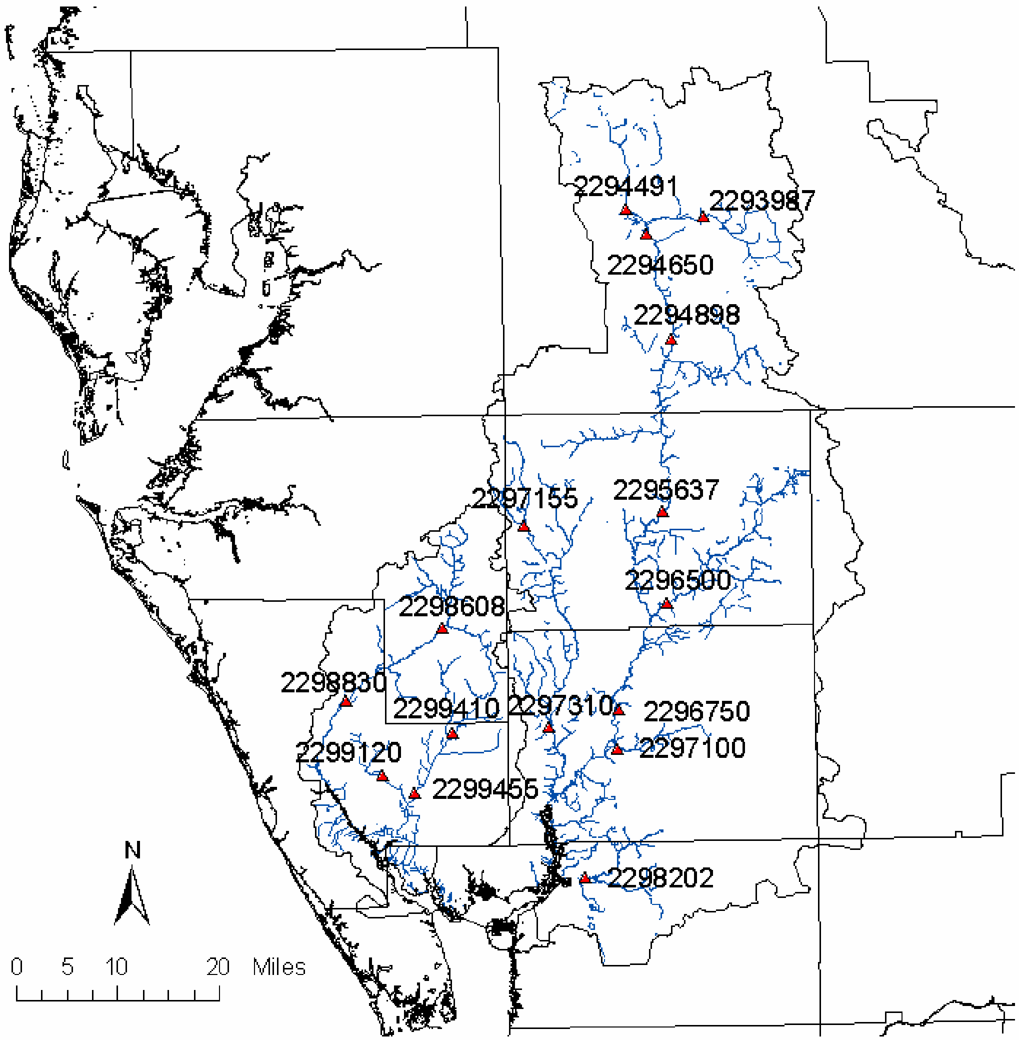

Figure 1. Locations of USGS gaging stations used as non-tidal monitoring sites during water years 1998-2001 (see Table 1).

2.2 RAINFALL AND STREAMFLOW

The amount of rain that falls on a watershed in a given year can have important effects on streamflow and water quality. In the Peace and Myakka River watersheds, annual rainfall and streamflow levels varied dramatically during water years 1998-2001. Total annual rainfall and average annual streamflow at three monitoring stations are shown in Fig. 2.

A strong El Niño event occurred during the 1998 water year, and total annual rainfall in that year was substantially higher than the long-term (1950–2001) mean value at each station. Annual mean streamflows were also quite high during the 1998 water year, exceeding 200% of the long-term (1950-2001) values at each station (Fig. 2).

Rainfall returned to near-average or below-average levels in water years 1999-2001, and annual mean streamflow declined in response to the lower rainfall (Fig. 2). Annual streamflow at the Peace River-Bartow station remained far below its long-term mean during water years 1999-2001, falling to less than 25% of its long-term value in 2001. Annual flows at the other stations — the Peace River at Arcadia and Myakka River near Sarasota — fell to between 30% and 60% of their long-term means during water year 2000, but rebounded in 2001 to levels near or above the long-term means.

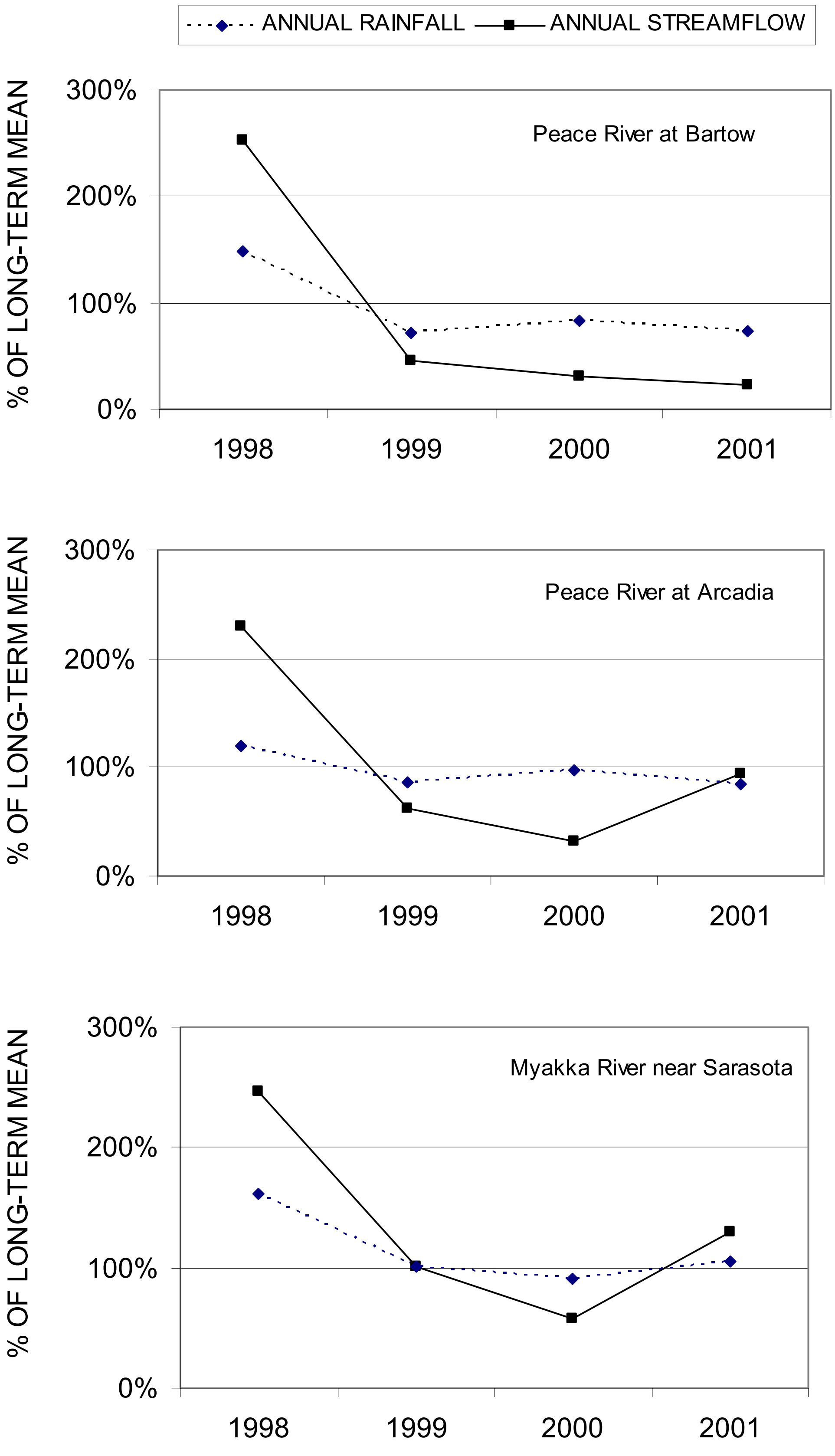

Fig. 2. Annual rainfall and stream discharge at three monitoring locations in the Peace and Myakka River watersheds

2.3 CONSTITUENT CONCENTRATIONS AND WATER QUALITY INDEX (WQI) VALUES

Concentrations of major water quality constituents observed during water years 1998 - 2001 are listed in Appendix A. In comparison to median values observed in a large sample of Florida streams (Hand et al. 1994), concentrations of several constituents appeared elevated at a number of the Peace and Myakka River stations. These parameters included:

- phosphorus forms
- nitrogen forms
- total organic carbon
- turbidity
- TSS
- color
- chlorophyll-*a*.

The State of Florida has developed a stream water quality index (WQI) — based on observed concentrations of nutrients, water clarity, DO, and oxygen demanding substances — that is helpful for summarizing water quality monitoring data (Hand et al. 1994, 1996). Sampling data collected in 1987 from 2,000 Florida stream reaches were used to determine percentile distributions for each indicator on a statewide basis (Hand et al. 1994, 1996). Index scores are calculated based on these percentile distributions. For example, a site exhibiting an average TN concentration of 1.2 mg N/L (the median value observed in the 1987 data set) would receive an index score of 50 for that indicator. Scores are averaged across indicator categories to obtain an average WQI value per site (Hand et al. 1994, 1996). State guidelines suggest that average index values of 0-44 indicate "good," 45-60 indicate "fair," and >60 indicate "poor" water quality conditions in Florida streams.

Hand et al. (1996) provides the following summary of the WQI:

> "The Florida Water Quality Index has several advantages over previous measures. First, since it is based on the percentile distribution of Florida stream data, it is tailored to Florida. Second, the index uses the most important measures of water quality in Florida: clarity, dissolved oxygen, oxygen-demanding substances, nutrients, bacteria, and biological diversity. Third, it is simple to understand and calculate and does not require a mainframe computer or any complex data transformations or averaging schemes. Finally, the index nicely identifies areas of good, fair, and poor water quality that correspond to professional and public opinion."

An application of the WQI to the water year 1998 - 2001 Peace and Myakka River sampling data is shown in Table 2. (In recognition of the naturally-elevated phosphate concentrations that can occur in these basins, TP concentrations were omitted from the average WQI values shown in Table 2.)

For this study, annual average WQI values were calculated using five parameters (turbidity, total suspended solids, total organic carbon, nitrate+nitrite nitrogen, and total nitrogen). A total of 58 annual average WQI values were calculated for the 16 stations sampled during water years 1998 - 2001 (Table 2).

The Saddle Creek at Structure P-11 station, which is located immediately downstream from Lake Hancock in the upper Peace River basin, exhibited the poorest water quality among the sites sampled, falling in the 75th to 95th percentiles of Florida streams for most parameters in each year of monitoring (Table 2).

Other sites at which "poor" water quality conditions were observed included:

- Peace Creek Canal near Wahneta (in water years 1998 and 1999),
- Peace River at Bartow (1998, 1999)
- Peace River at Ft. Meade (1998)
- Peace River at Zolfo Springs (1998)
- Peace River at Arcadia (1998)
- Big Slough Canal near Myakka City (2000).

Two sites exhibited consistently "good" water quality based on the WQI:

- Shell Creek near Punta Gorda (1998-2001)
- Myakka River at Myakka City (1999-2001).

"Good" water quality conditions were also found during one or more years at the following stations:

- Myakka River near Sarasota (1999, 2000)
- Deer Prairie Slough near North Port (1999)
- Peace River at Ft. Meade (2000)
- Peace River at Arcadia (2000)
- Charlie Creek near Gardner (2000)
- Horse Creek near Myakka Head (1999)
- Horse Creek near Arcadia (1999).

The remaining stations and years would be characterized as "fair" based on the WQI.

2.4 EXCEEDANCES OF STATE WATER QUALITY STANDARDS

Although WQI values are helpful in providing an easily-understandable summary of general water quality conditions, they are calculated using a limited number of parameters and must be interpreted with care. A more detailed examination of monitoring data, focusing on additional parameters, can also be helpful to identify water quality issues that may go unnoticed in an analysis based on WQI values alone.

The State of Florida has adopted water quality standards (summarized in Ch. 62-302, Florida Administrative Code) for a number of water quality constituents, in order to maintain productive populations of fish and wildlife and protect human health. In some cases these standards may be exceeded due to natural factors, and exceedances of this type should not be interpreted as evidence of degraded water quality. In many cases, however, exceedances of state standards can be linked to specific pollutant discharges or other human activities that are causing negative water quality impacts. Information on the frequency and magnitude of exceedances can thus be helpful in identifying sites where water quality may be declining or degraded. Once such sites are identified, more detailed follow-up studies can be designed and implemented to identify the cause(s) of the observed exceedances.

Specific Conductance

Specific conductance measures the ability of a water sample to carry an electric current, which depends on the presence of ions in the sample, their total concentration, and other physical and chemical characteristics. Freshly distilled water has a conductivity of between 0.5 and 2 µmhos/cm. The Florida standard for specific conductance in fresh surface waters is 1,275 µmhos/cm, a level set to protect native fish and other aquatic organisms.

Exceedances of this standard were observed at four stations during water years 1998-2001:

- Joshua Creek at Nocatee (during 1999, 2000 and 2001)
- Shell Creek near Punta Gorda (during 2001)
- Big Slough Canal near Myakka City (during 1999)
- Big Slough Canal near North Port (during 1999).

In Florida the presence of elevated specific conductance levels in fresh surface waters often indicate that substantial discharges of groundwater — from the Intermediate or Floridan aquifers — are occurring at locations upstream of the sampling point. Agricultural and industrial operations are the most common sources of such discharges.

Un-Ionized Ammonia

The un-ionized form of ammonia is highly toxic to fish and other aquatic organisms. In water, ionized (NH_4^+) and un-ionized (NH_3) ammonia exist together in equilibrium, with the un-ionized form becoming more common at higher temperature and pH levels.

The Florida water quality standard for un-ionized ammonia is 0.02 mg NH_3/L. Levels exceeding the standard were observed at two stations during water years 1998 – 2001:

- Saddle Creek at Structure P-11 (in water years 2000 and 2001)
- Horse Creek near Myakka Head (2000).

Levels of un-ionized ammonia that were relatively high (>0.01 mg NH_3/L) but did not exceed the water quality standard were also observed at several other stations, including:

- Peace River at Zolfo Springs (2000, 2001)
- Shell Creek near Punta Gorda (2001)
- Myakka River at Myakka City (1999)

- Big Slough Canal near Myakka City (1999)
- Big Slough Canal near North Port (1999).

The ammonia nitrogen found in rivers and streams can come from a variety of natural and manmade sources. Exceedances of the un-ionized ammonia water quality standard are often associated with anthropogenic activities, such as feedlots and other concentrated animal feeding operations, sewage treatment systems and industrial facilities that make or use ammonia-based chemical products.

Dissolved Oxygen

Dissolved oxygen (DO) is a critical water quality parameter, due to the importance of DO to the metabolic processes of all multi-celled aquatic organisms.

DO concentrations are affected by a number of natural and man-made factors. Important natural factors include daily and seasonal temperature cycles (because the solubility of oxygen in water is higher at lower water temperatures), photosynthesis (because photosynthesizing organisms release DO into the water column, increasing its availability) and respiration/decomposition processes (which cause DO concentrations in the water column to decline).

The primary manmade influences include the discharge of nutrients and organic wastes into waterbodies, which can lead to increased eutrophication, higher rates of photosynthesis, respiration and decomposition, and larger daily and seasonal fluctuations in DO concentrations.

The Florida standard for DO in fresh surface waters is 5 mgL/. Concentrations below 4 mg/L are known to be stressful for most fish and many shellfish species. Concentrations below 2 mg/L are highly stressful and potentially lethal.

During water years 1998 through 2001, DO concentrations below the 5 mg/L standard were observed at least once at each station. Many of these instances were probably associated with natural factors, such as elevated water temperature. At several stations, however, low DO levels were a frequent occurrence, observed on 25% or more of the sampling dates. And for some stations the median annual DO concentration (the value measured on at least half the sampling dates in a given year) was less than the 5 mg/L standard. The latter group of stations included:

- Peace Creek Canal near Wahneta (water years 1998, 1999, 2000, and 2001)
- Saddle Creek at Structure P-11 (1999, 2001)
- Peace River at Bartow (1998, 1999, 2000, 2001)
- Shell Creek near Punta Gorda (1998)
- Deer Prairie Slough near North Port (2000, 2001)
- Big Slough Canal near North Port (2001).

The frequent periods of low DO availability occurring at these stations presumably had negative impacts on local populations of fish and other aquatic organisms.

Chlorophyll-*a*

Chlorophyll-*a* concentrations, which are used to estimate the biomass of algae in the water column, are among the best indicators of a waterbody's trophic state. Annual mean chlorophyll-*a* concentrations in Florida streams are usually at or below 5.5 µg/L. FDEP considers stream water quality to be "impaired" if the annual mean is above 20 µg/L.

Annual mean chlorophyll-*a* concentrations greater than 20 µg/L were observed at two stations during the 1998-2001 water years:

- Saddle Creek at Structure P-11 (all years)
- Peace River at Bartow (1998, 1999).

The elevated concentrations at these stations were apparently caused by discharges from Lake Hancock, a hypereutrophic lake that experiences chronic, year-round blooms of algae and cyanobacteria.

Individual observations of chlorophyll-*a* concentrations greater than 20 µg/L, which indicated the presence of occasional algal blooms but did not represent a violation of state water quality standards, were observed at a number of additional stations:

- Peace Creek Canal near Wahneta (1999)
- Peace River at Fort Meade (1998, 1999, 2000)
- Peace River at Zolfo Springs (1998, 1999, 2000)
- Peace River at Arcadia (1998)
- Horse Creek near Myakka Head (2000)
- Horse Creek near Arcadia (1998)
- Myakka River near Sarasota (1999, 2000, 2001).

Table 2. Annual WQI values for non-tidal stations, water years 1998 – 2001.

Peace Creek Canal near Wahneta (USGS gage no. 02293987) .

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	39	54	71	80	73	61	“poor”
1999	53	59	73	82	80	67	“poor”
2000	55	33	70	72	81	57	“fair”
2001	48	36	78	76	81	60	“fair”

Saddle Creek at Structure P-11 (USGS gage no. 02294491).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	>90	>90	69	12	79	68	“poor”
1999	>90	>90	83	26	71	75	“poor”
2000	>90	>90	75	12	84	69	“poor”
2001	>90	>90	39	24	>90	77	“poor”

Peace River at Bartow (USGS gage no. 02294650).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	80	72	62	71	86	71	“poor”
1999	86	75	72	80	>90	78	“poor”
2000	47	19	67	62	83	49	“fair”
2001	30	24	72	73	>90	50	“fair”

Peace River at Ft. Meade (USGS gage no. 02294898).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	77	67	54	81	>90	70	“poor”
1999	51	52	53	85	89	60	“fair”
2000	39	5	37	85	90	42	“good”
2001	32	13	43	>90	88	46	“fair”

Peace River at Zolfo Springs (USGS gage no. 02295637).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	59	55	54	88	>90	64	"poor"
1999	40	43	53	>90	>90	58	"fair"
2000	25	44	48	>90	>90	53	"fair"
2001	33	15	57	>90	>90	50	"fair"

Peace River at Arcadia (USGS gage no. 02296750).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	54	52	54	89	>90	62	"poor"
1999	43	39	56	90	90	57	"fair"
2000	5	5	51	85	>90	36	"good"
2001	5	--	61	>90	>90	54	"fair"

Joshua Creek at Nocatee (USGS gage no. 02297100).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	--	--	--	--	--	--	--
1999	14	20	59	>90	50	47	“fair”
2000	41	14	46	>90	57	49	“fair”
2001	47	15	55	>90	63	53	“fair”

Charlie Creek near Gardner (USGS gage no. 02296500).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	28	39	74	80	84	55	“fair”
1999	24	18	70	70	82	45	“fair”
2000	5	5	69	79	82	39	“good”
2001	5	--	72	>90	82	57	“fair”

Horse Creek near Myakka Head (USGS gage no. 02297155).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	12	16	68	49	77	45	"fair"
1999	11	16	61	36	80	31	"good"
2000	59	20	54	73	84	52	"fair"
2001	14	16	70	86	84	47	"fair"

Horse Creek near Arcadia (USGS gage no. 02297310).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	16	20	63	84	81	46	"fair"
1999	5	12	58	84	77	38	"good"
2000	32	16	55	>90	83	49	"fair"
2001	38	11	60	>90	79	51	"fair"

Shell Creek near Punta Gorda (USGS gage no. 02298202).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	18	18	56	47	62	35	“good”
1999	14	13	--	45	57	24	“good”
2000	19	5	62	22	53	27	“good”
2001	38	12	55	42	59	37	“good”

Myakka River at Myakka City (USGS gage no. 02298608).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	--	--	--	--	--	--	--
1999	5	14	69	35	75	31	“good”
2000	30	12	60	43	69	36	“good”
2001	69	17	19	22	71	43	“good”

Myakka River near Sarasota (USGS gage no. 02298830).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	--	--	--	--	--	--	--
1999	5	13	73	12	77	26	“good”
2000	38	18	70	16	77	36	“good”
2001	55	51	70	56	76	58	“fair”

Deer Prairie Slough near North Port (USGS gage no. 02299120).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	--	--	--	--	--	--	--
1999	25	57	72	19	73	43	“good”
2000	71	53	72	20	86	54	“fair”
2001	60	58	63	26	81	52	“fair”

Big Slough Canal near Myakka City (USGS gage no. 02299410).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	--	--	--	--	--	--	--
1999	51	55	70	64	74	60	"fair"
2000	72	58	62	78	78	67	"poor"
2001	50	21	68	73	76	53	"fair"

Big Slough Canal near North Port (USGS gage no. 02299455).

Water Year	TSS	Turbidity	TOC	NO_{2+3}	TP	Mean WQI (w/out TP)	Water Quality Characterization
1998	--	--	--	--	--	--	--
1999	34	42	67	42	74	46	"fair"
2000	49	24	64	65	72	50	"fair"
2001	48	23	56	61	71	47	"fair"

3.0 CONSTITUENT LOADS AND YIELDS

Estimation of loads and yields of water and water quality constituents is a basic component of most watershed assessment programs. 'Load' represents the mass of a constituent (e.g., tons of nitrogen) passing a given point in a stream during a specified time interval (e.g., month, day or year). The 'yield' of a constituent is the load divided by the surface area of the contributing drainage basin, allowing loads produced by basins of different size to be compared on a consistent, per-unit-area basis.

3.1 ANNUAL LOADS

Loading rates are estimated by measuring streamflow and constituent concentrations at the locations of interest, and computing load as the product of the flow and concentration values. Due to cost constraints, however, flow and concentration measurements are often collected at very different frequencies. In many monitoring studies, flows are measured continuously while constituent concentrations are measured less frequently and at discrete time intervals (e.g., biweekly or monthly). The different frequency of collection of flow and concentration values introduces significant complications into the load estimation problem.

Three general types of estimators have been proposed to address these complications (Preston et al. 1989):

- *Averaging estimators* use averages or other values to represent constituent concentrations on days when sampling was not performed, producing a synthetic time series of concentration values that can be used when computing estimated daily, weekly, monthly and annual loads. This is the simplest method, but is subjective and based on a number of implicit assumptions which, if violated, may lead to estimation bias;

- *Regression estimators* typically use log-log regression to describe the relationship between constituent concentration and flow. The regression equation is then used to create a synthetic time series of estimated concentration values, based on measured flows. This approach works best for constituents whose concentrations are highly correlated with flow.

- *Ratio estimators* are derived from survey sampling statistics, and use the measured flow values as an 'auxiliary variable' and load as the dependent variable. The ratio estimator is a 'best linear unbiased estimator' (Cochran 1977) if two conditions are met:
    - the relationship between load and flow is a straight line through the origin; and
    - the variance of the load values is an increasing function of flow.

After examining flow and concentration records from the 1998 – 2001 Peace-Myakka monitoring program, the ratio estimator approach was chosen to estimate constituent loads for this period. The averaging approach, although simple and flexible, is subjective and prone to bias. The regression approach does not appear applicable to this data set, because concentrations of most constituents do not show strong relationships with flow. The two primary assumptions of the ratio estimator — that a scatterplot of load vs. flow approximates a straight line through the origin, whose variance increases with increasing flow — appear reasonable for most constituents included in the monitoring program. Also, in comparison to the other methods, ratio estimators are considered to be more robust to sources of potential estimation bias (Preston et al. 1989).

As a working rule, ratio estimators are best applied in cases where the sample size is greater than 30 for each time period of interest (Cochran 1977). For typical watershed assessment applications this implies that, for best accuracy and precision in the estimation of constituent loads and yields, a minimum of 30 water quality samples should be collected during each time period (e.g., year) for which loading estimates will be calculated.

Using the ratio estimator described by Cochran (1977) and Preston et al. (1989), annual loads of selected water quality constituents (nitrogen forms, phosphorus forms, and TSS) were calculated at each monitoring station for water years 1998 through 2002. The estimator takes the form:

$$\widehat{L} = (\bar{l} / \overline{q})Q$$

where:

$\widehat{L}$ is the estimated annual load

$\bar{l}$ is the average load on days when both discharge and concentration were measured

$\overline{q}$ is the average discharge on days when both flow and concentration were measured

Q is total annual discharge.

Estimated annual loads of TN, DIN, NH_4-N , NO_{2+3}-N, TP, PO_4-P, and TSS calculated using this method are shown in Tables 3-9.

Table 3. Estimated annual TN loads (metric tons/year), water years 1998 – 2001.

Station name	USGS ID	Estimated Annual Load (metric tons) WY 1998	WY 1999	WY 2000	WY 2001
Peace Creek Canal near Wahneta	02293987	253.5	--	63.1	38.0
Saddle Creek at Structure P-11	02294491	586.4	--	0.3	1.3
Peace River at Bartow	02294650	785.6	--	56.5	37.5
Peace River at Ft. Meade	02294898	932.2	--	59.2	29.9
Peace River at Zolfo Springs	02295637	1,343.3	--	165.8	464.2
Charlie Creek near Gardner	02296500	437.1	249.9	48.9	255.7
Peace River at Arcadia	02296750	1,923.5	790.1	266.1	1,023.3
Joshua Creek at Nocatee	02297100	--	--	68.6	352.8
Horse Creek near Myakka Head	02297155	27.3	--	2.0	32.5
Horse Creek near Arcadia	02297310	264.6	--	23.7	439.6
Shell Creek near Punta Gorda	02298202	487.8	406.2	172.9	944.7
Myakka River at Myakka City	02298608	--	--	44.3	236.9
Myakka River near Sarasota	02298830	--	--	111.0	359.6
Deer Prairie Slough near North Port	02299120	--	--	51.1	53.0
Big Slough Canal near Myakka City	02299410	--	--	45.7	98.4

Table 4. Estimated annual DIN loads (metric tons N/year), water years 1998 – 2001.

Station name	USGS ID	Estimated Annual Load (metric tons) WY 1998	WY 1999	WY 2000	WY 2001
Peace Creek Canal near Wahneta	02293987	30.5	9.6	10.9	4.8
Saddle Creek at Structure P-11	02294491	5.1	1.6	1.1	0.1
Peace River at Bartow	02294650	74.5	17.1	8.1	6.0
Peace River at Ft. Meade	02294898	174.5	25.9	13.4	6.6
Peace River at Zolfo Springs	02295637	388.6	115.4	87.4	153.4
Charlie Creek near Gardner	02296500	95.2	45.4	10.2	65.2
Peace River at Arcadia	02296750	647.5	240.3	111.4	347.2
Joshua Creek at Nocatee	02297100	--	63.0	40.6	185.2
Horse Creek near Myakka Head	02297155	2.3	0.8	0.4	2.9
Horse Creek near Arcadia	02297310	62.8	13.7	8.0	56.2
Shell Creek near Punta Gorda	02298202	57.7	39.7	18.6	81.8
Myakka River at Myakka City	02298608	--	12.3	21.8	12.5
Myakka River near Sarasota	02298830	--	8.4	10.2	37.0
Deer Prairie Slough near North Port	02299120	--	1.1	1.9	2.6
Big Slough Canal near Myakka City	02299410	--	4.7	15.2	13.8

Table 5. Estimated annual NO_{2+3}-N loads (metric tons N/year), water years 1998 – 2001.

Station name	USGS ID	Estimated Annual Load (metric tons) WY 1998	WY 1999	WY 2000	WY 2001
Peace Creek Canal near Wahneta	02293987	21.3	7.4	7.6	3.4
Saddle Creek at Structure P-11	02294491	2.7	0.7	0.6	<0.1
Peace River at Bartow	02294650	48.0	12.0	6.1	3.2
Peace River at Ft. Meade	02294898	154.8	21.3	11.2	6.0
Peace River at Zolfo Springs	02295637	361.5	105.7	81.6	141.7
Charlie Creek near Gardner	02296500	81.5	31.7	8.7	48.3
Peace River at Arcadia	02296750	589.5	214.7	103.6	301.3
Joshua Creek at Nocatee	02297100	--	60.0	39.0	179.0
Horse Creek near Myakka Head	02297155	1.9	0.6	0.3	2.1
Horse Creek near Arcadia	02297310	55.9	12.1	7.3	46.2
Shell Creek near Punta Gorda	02298202	44.8	22.7	12.2	55.9
Myakka River at Myakka City	02298608	--	3.8	6.2	6.5
Myakka River near Sarasota	02298830	--	2.1	2.0	21.5
Deer Prairie Slough near North Port	02299120	--	0.5	0.4	0.5
Big Slough Canal near Myakka City	02299410	--	3.0	13.0	10.2

Table 6. Estimated annual NH_4-N loads (metric tons N/year), water years 1998 – 2001.

Station name	USGS ID	Estimated Annual Load (metric tons) WY 1998	WY 1999	WY 2000	WY 2001
Peace Creek Canal near Wahneta	02293987	9.1	2.3	3.3	1.4
Saddle Creek at Structure P-11	02294491	2.4	0.9	0.5	<0.1
Peace River at Bartow	02294650	26.6	5.1	1.9	2.7
Peace River at Ft. Meade	02294898	19.7	4.6	2.2	0.6
Peace River at Zolfo Springs	02295637	27.1	9.8	5.7	11.7
Charlie Creek near Gardner	02296500	13.7	13.7	1.5	16.9
Peace River at Arcadia	02296750	58.0	25.6	7.7	45.9
Joshua Creek at Nocatee	02297100	--	3.0	1.6	6.2
Horse Creek near Myakka Head	02297155	0.4	0.2	0.1	0.8
Horse Creek near Arcadia	02297310	6.9	1.6	0.7	10.0
Shell Creek near Punta Gorda	02298202	12.8	17.0	6.4	25.9
Myakka River at Myakka City	02298608	--	8.6	15.6	6.0
Myakka River near Sarasota	02298830	--	6.2	8.2	15.5
Deer Prairie Slough near North Port	02299120	--	0.6	1.5	2.1
Big Slough Canal near Myakka City	02299410	--	1.8	2.1	3.6

Table 7. Estimated annual TP loads (metric tons P/year), water years 1998 – 2001.

Station name	USGS ID	Estimated Annual Load (metric tons) WY 1998	WY 1999	WY 2000	WY 2001
Peace Creek Canal near Wahneta	02293987	30.4	13.6	10.9	7.4
Saddle Creek at Structure P-11	02294491	93.3	15.9	1.9	2.5
Peace River at Bartow	02294650	174.2	66.5	17.0	22.9
Peace River at Ft. Meade	02294898	540.0	148.5	54.0	20.4
Peace River at Zolfo Springs	02295637	802.4	346.4	142.9	241.4
Charlie Creek near Gardner	02296500	159.3	91.5	13.9	81.0
Peace River at Arcadia	02296750	1,072.8	506.9	134.8	479.1
Joshua Creek at Nocatee	02297100	--	16.6	6.9	26.3
Horse Creek near Myakka Head	02297155	7.8	4.6	1.8	11.8
Horse Creek near Arcadia	02297310	107.6	41.0	8.1	101.0
Shell Creek near Punta Gorda	02298202	59.7	64.1	18.1	147.6
Myakka River at Myakka City	02298608	--	41.8	45.4	85.0
Myakka River near Sarasota	02298830	--	99.1	50.8	150.3
Deer Prairie Slough near North Port	02299120	--	1.7	5.6	6.0
Big Slough Canal near Myakka City	02299410	--	5.5	9.6	29.4

Table 8. Estimated annual PO_4-P loads (metric tons P/year), water years 1998 – 2001.

Station name	USGS ID	Estimated Annual Load (metric tons) WY 1998	WY 1999	WY 2000	WY 2001
Peace Creek Canal near Wahneta	02293987	18.7	10.5	6.8	6.2
Saddle Creek at Structure P-11	02294491	26.8	5.0	0.1	0.3
Peace River at Bartow	02294650	84.4	38.7	11.9	20.9
Peace River at Ft. Meade	02294898	361.2	115.7	44.5	17.5
Peace River at Zolfo Springs	02295637	616.8	284.5	122.0	194.7
Charlie Creek near Gardner	02296500	146.6	75.0	10.2	63.9
Peace River at Arcadia	02296750	857.9	490.3	114.1	346.8
Joshua Creek at Nocatee	02297100	--	13.1	4.7	21.6
Horse Creek near Myakka Head	02297155	6.8	4.0	1.5	9.0
Horse Creek near Arcadia	02297310	95.8	33.0	7.0	81.7
Shell Creek near Punta Gorda	02298202	36.0	50.0	12.1	108.4
Myakka River at Myakka City	02298608	--	39.1	39.9	76.3
Myakka River near Sarasota	02298830	--	85.5	44.0	132.5
Deer Prairie Slough near North Port	02299120	--	1.1	4.2	4.9
Big Slough Canal near Myakka City	02299410	--	4.0	7.3	23.6

Table 9. Estimated annual TSS loads (metric tons/year), water years 1998 – 2001.

Station name	USGS ID	Estimated Annual Load (metric tons) WY 1998	WY 1999	WY 2000	WY 2001
Peace Creek Canal near Wahneta	02293987	465.4	217.7	392.4	125.0
Saddle Creek at Structure P-11	02294491	7,998.4	2,193.1	2,229.8	60.4
Peace River at Bartow	02294650	7,062.1	3,792.5	1,523.6	99.6
Peace River at Ft. Meade	02294898	6,627.8	1,739.2	807.1	126.2
Peace River at Zolfo Springs	02295637	6,374.2	2,285.4	1,491.7	2,268.4
Charlie Creek near Gardner	02296500	1,630.4	862.6	145.1	556.1
Peace River at Arcadia	02296750	7,838.4	3,489.9	1,083.2	2,668.1
Joshua Creek at Nocatee	02297100	--	351.3	208.5	996.3
Horse Creek near Myakka Head	02297155	81.5	51.7	29.2	66.2
Horse Creek near Arcadia	02297310	1,126.8	150.2	55.5	1,457.6
Shell Creek near Punta Gorda	02298202	1,049.2	964.9	255.4	9,285.4
Myakka River at Myakka City	02298608	--	78.5	398.0	3,170.0
Myakka River near Sarasota	02298830	--	316.9	171.5	1,525.4
Deer Prairie Slough near North Port	02299120	--	91.6	99.2	312.8
Big Slough Canal near Myakka City	02299410	--	69.5	202.4	496.1

3.2 ANNUAL YIELDS

Estimated annual yields (in kilograms per hectare per year) were calculated by dividing the estimated annual loads by the surface area of the gaged sub-basins. Spatial and temporal patterns in the estimated yields during water years 1998 – 2001 are summarized in Figs. 4-10.

The highest water yields were observed in the Myakka River watershed during the 1998 water year (Fig. 4), as a result of the high rainfall and runoff associated with the El Niño weather pattern that occurred in that year. At most stations in both watersheds, water yields showed progressive declines in water years 1999 and 2000 in response to lower rainfall levels, and then rebounded somewhat in 2001. Yields at three stations in the upper Peace River watershed (Saddle Creek at Structure P-11, Peace River at Bartow, and Peace River at Fort Meade) followed a somewhat different pattern, showing a continuing decline through water years 1999, 2000 and 2001 (Fig. 4).

The highest estimated TN yields were observed at the Saddle Creek station during the 1998 water year, and at the Joshua Creek, Shell Creek and Big Slough-Myakka City stations during water year 2001 (Fig. 5). (It is likely that high yields occurred at every station during the 1998 El Niño event, but monthly water quality sampling was not conducted at many sites in that year.)

Relatively high estimated yields of DIN and NO_{2+3}-N — greater than 1 kg N/ha/yr — occurred at the Joshua Creek site in all years (Fig. 6). A visible spike occurred at this site in water year 2001, when DIN and NO_{2+3}-N yields exceeded 5 kg N/ha/yr. Other stations with estimated yields greater than 1 kg N/ha/yr included:

- Peace River at Zolfo Springs (1998)
- Peace River at Arcadia (1998)
- Big Slough Canal near Myakka City (2000, 2001)
- Peace River at Fort Meade (1998).

Interestingly, estimated DIN yields at the Saddle Creek gage were low relative to other sites in the Peace River basin. Concentrations of inorganic N were frequently below detection limits at the Saddle Creek gage, suggesting that the abundant phytoplankton populations in Lake Hancock had effectively stripped much of the inorganic N from the water column and converted it to organic forms. (Nitrogen fixation by cyanobacteria in Lake Hancock may also provide a significant proportion of the organic N measured at the Saddle Creek gage.)

Substantial increases in the estimated yields of DIN (and PO_4-P) occurred between the upstream and downstream stations located on Horse Creek, suggesting the potential presence of anthropogenic sources of those constituents at one or more locations between the two stations.

NH_4-N contributed a much smaller portion of the overall DIN yield, typically < 0.2 kg N/ha/yr (Fig. 7). The highest estimated yields of NH_4-N occurred at the Myakka River-

Myakka City gaging station (in water years 1999 and 2000), and at the Big Slough Canal (2001), Shell Creek (2001), Myakka River-Sarasota (2001) and Peace River-Bartow (1998) stations.

Estimated yields of PO_4-P and total phosphorus followed similar temporal and spatial patterns, with the largest values occurring at gages on the main stem of the Peace River (e.g., Fort Meade, Zolfo Springs, and Arcadia) during 1998 (Figs. 8, 9). Relatively large yields also occurred on the main stem of the Myakka River and at the Big Slough Canal-Myakka City station during 2001.

TSS yield showed a pronounced spike at the Saddle Creek gaging station during water year 1998 (Fig. 10), presumably due to episodic discharges from Lake Hancock during El Niño-related storm events. Other stations and years that produced relatively high TSS yields (in comparison to other stations and years) included:

- Shell Creek near Punta Gorda (2001)
- Myakka River at Myakka City (2001)
- Peace River at Bartow (1998)
- Saddle Cree at Structure P-11 (1999, 2000)
- Peace River at Fort Meade (1998)
- Big Slough Canal near Myakka City (2001).

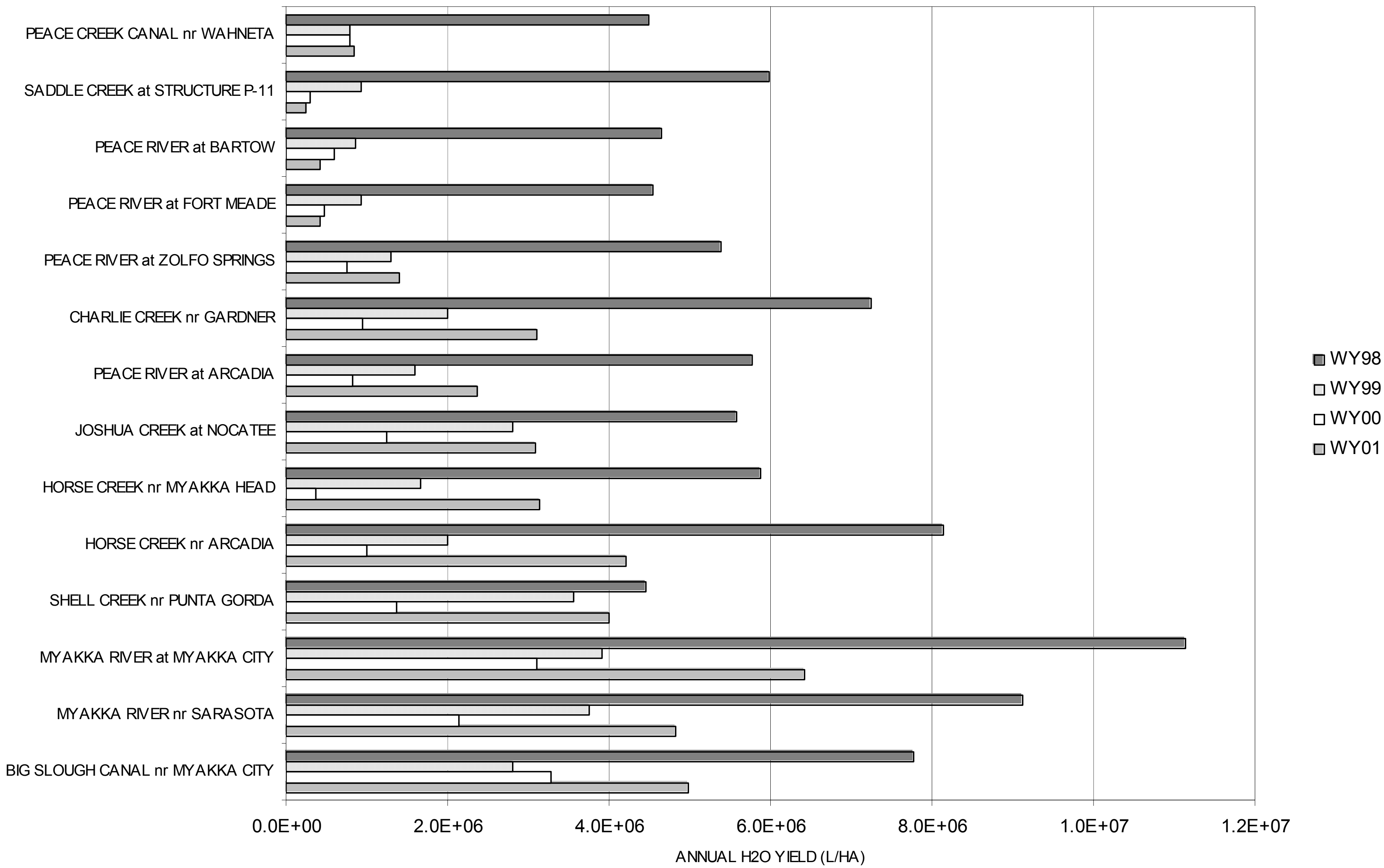

Fig. 3. Measured water yields, water years 1998 – 2001.

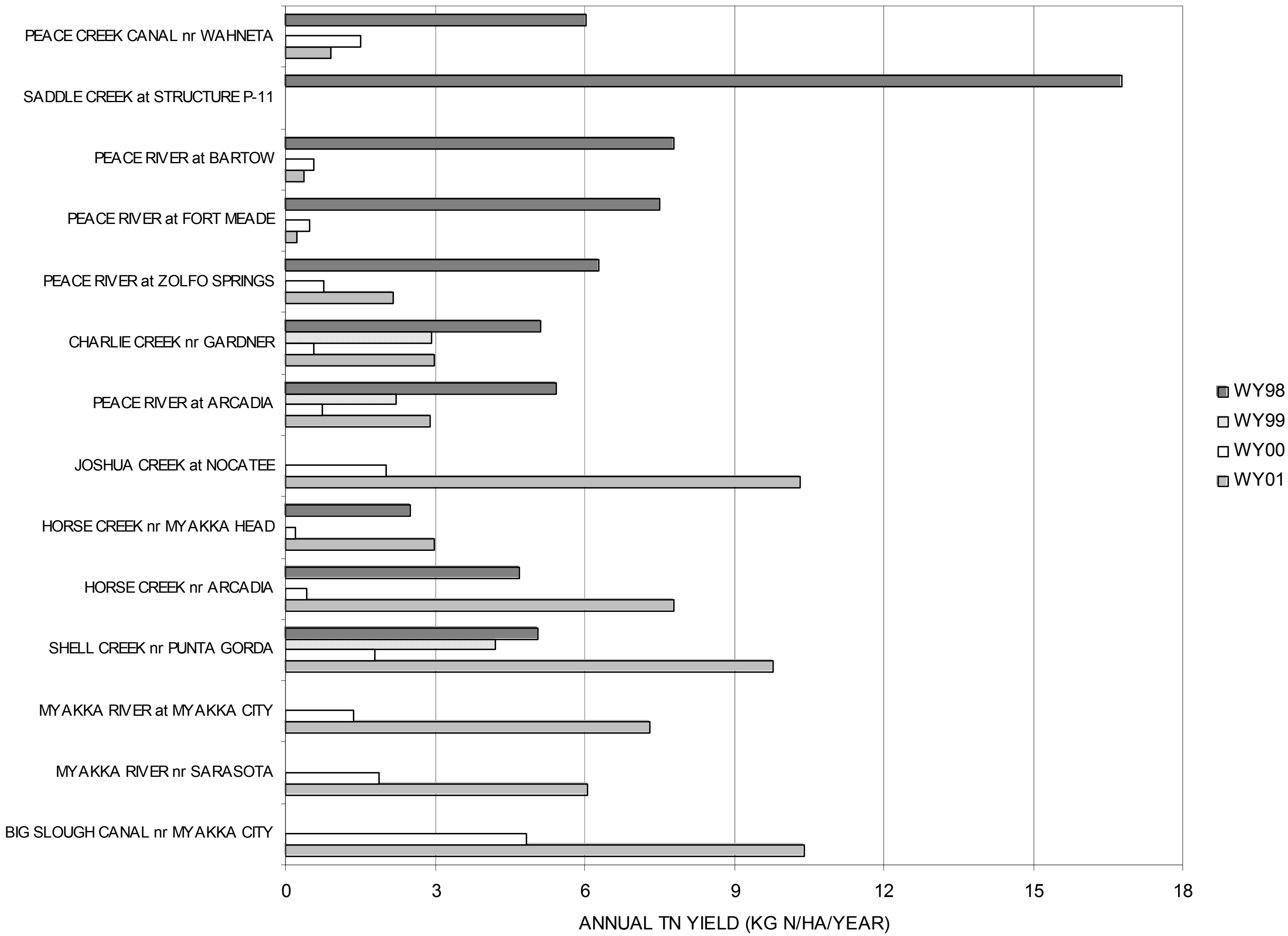

Fig. 4. Estimated TN yields, water years 1998 – 2001.

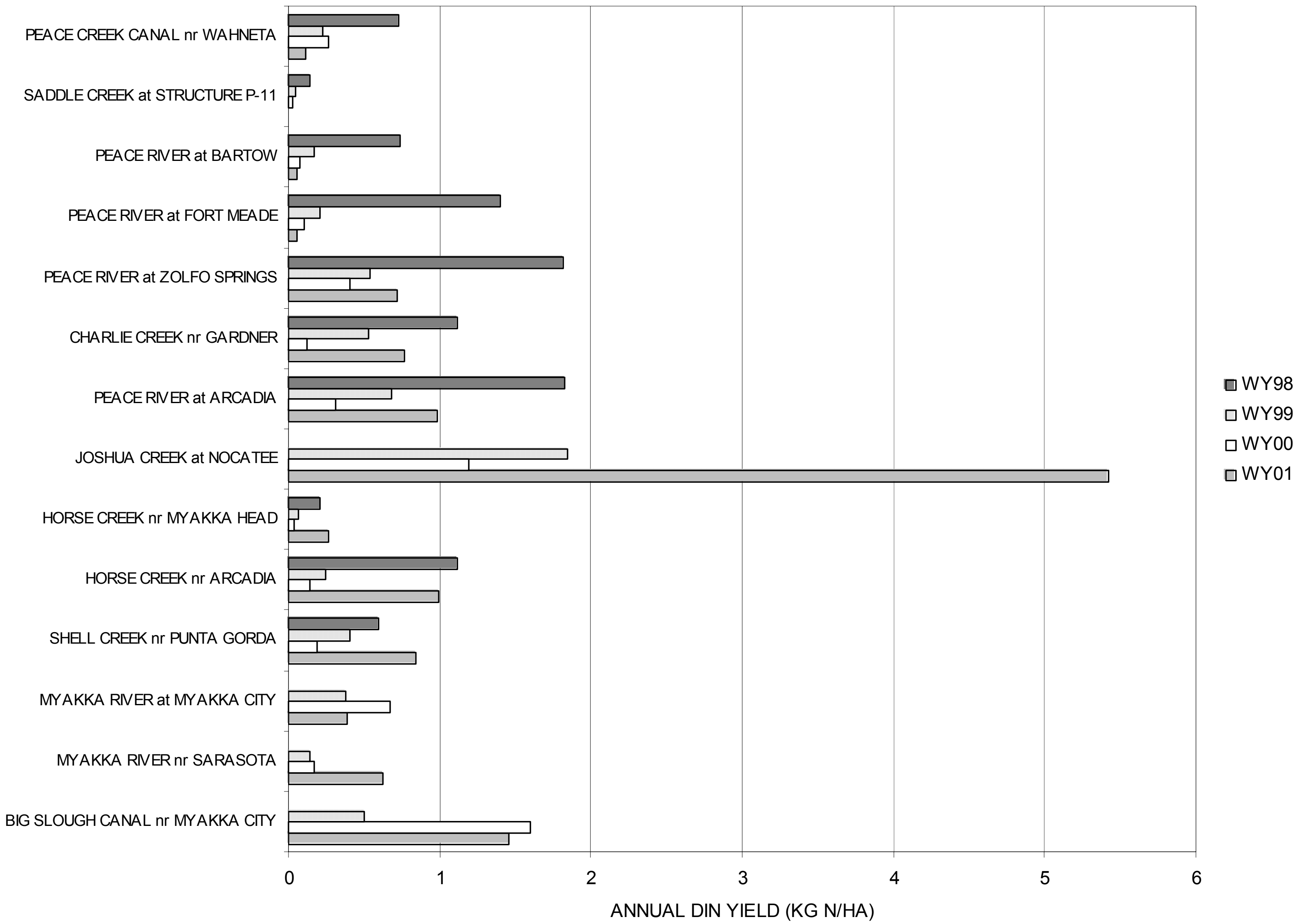

Fig. 5. Estimated DIN yields, water years 1998 – 2001.

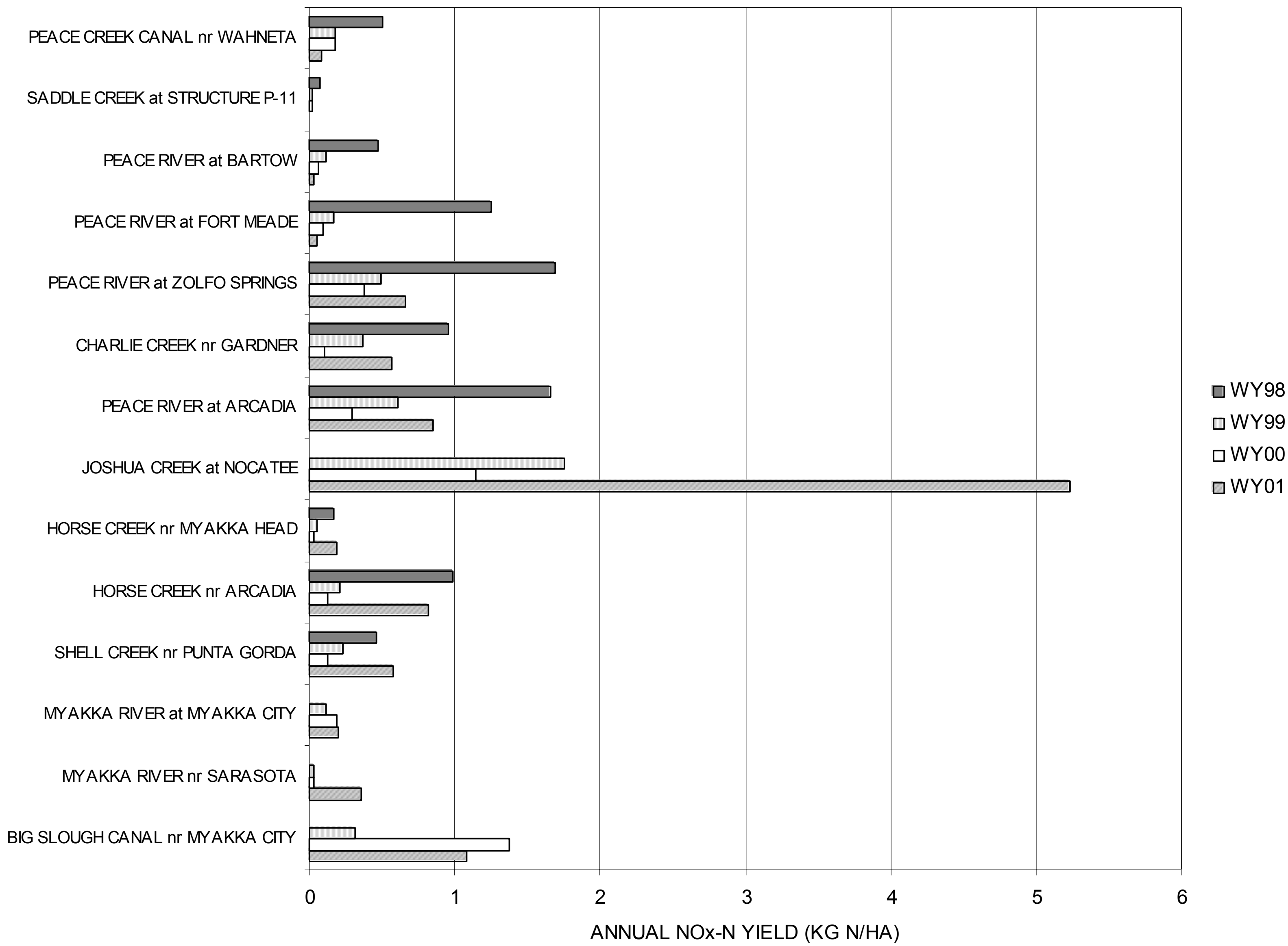

Fig. 6. Estimated NO_{2+3}-N yields, water years 1998 – 2001.

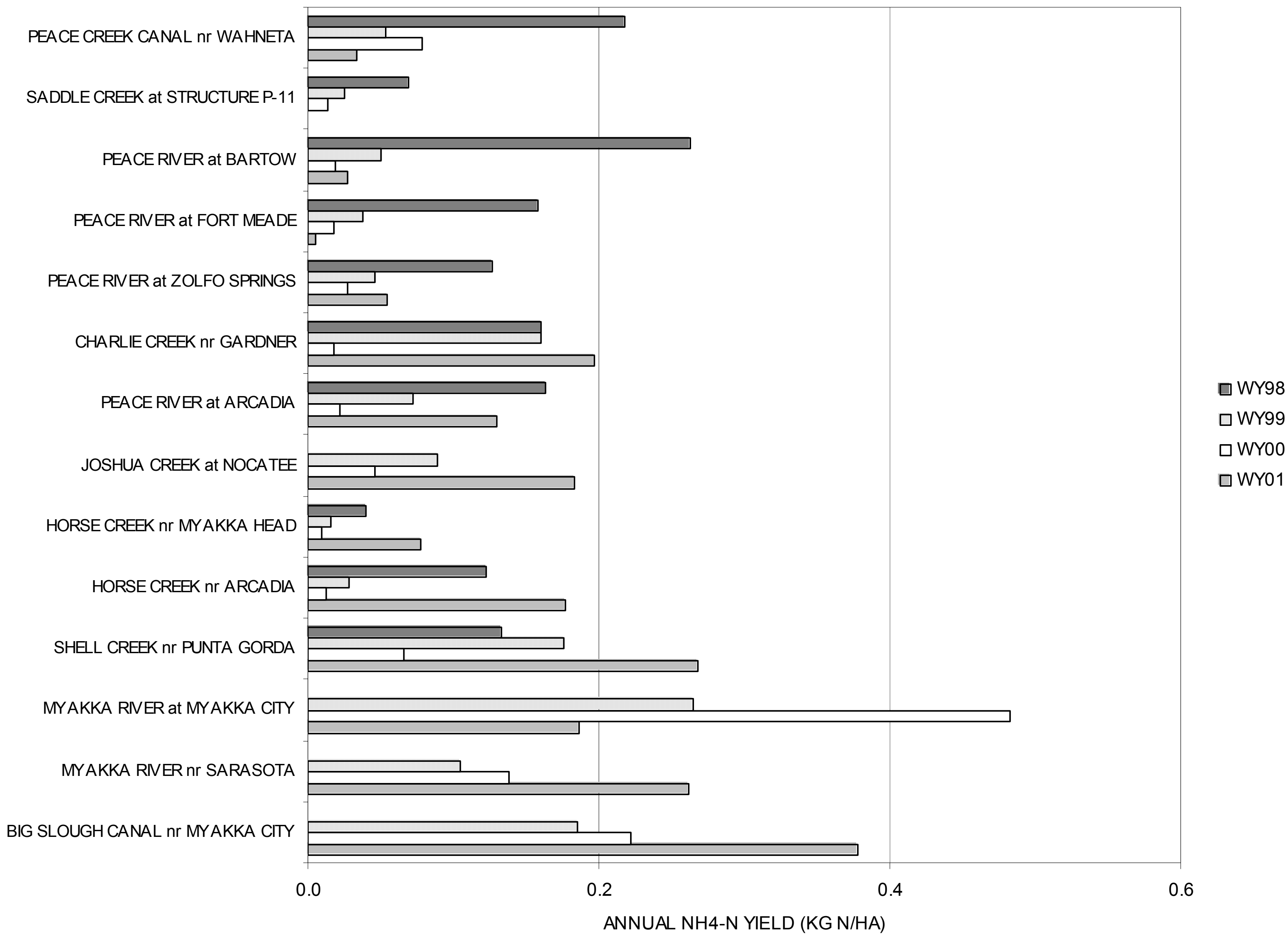

Fig. 7. Estimated NH_4-N yields, water years 1998 – 2001.

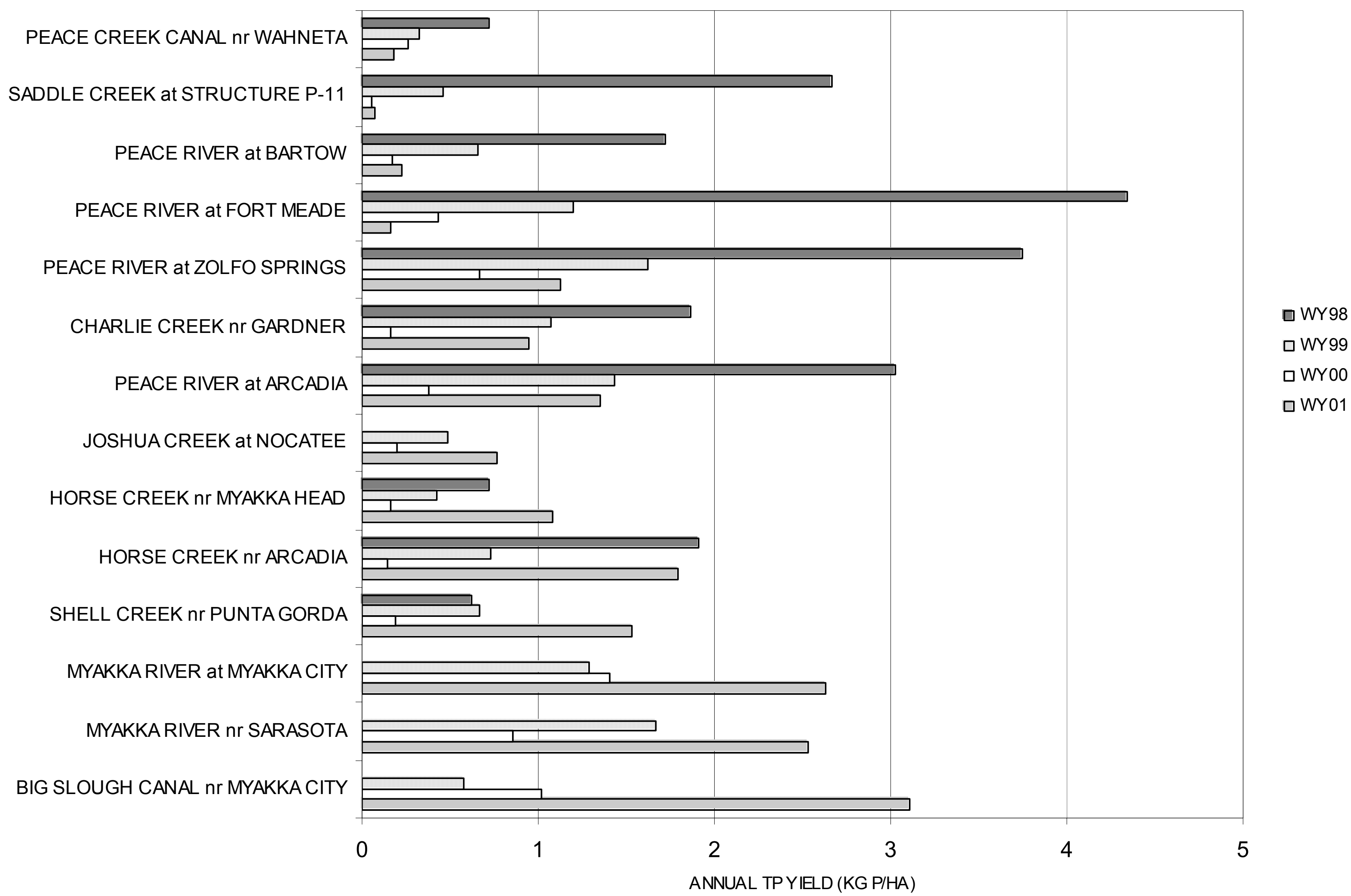

Fig. 8. Estimated TP yields, water years 1998 – 2001.

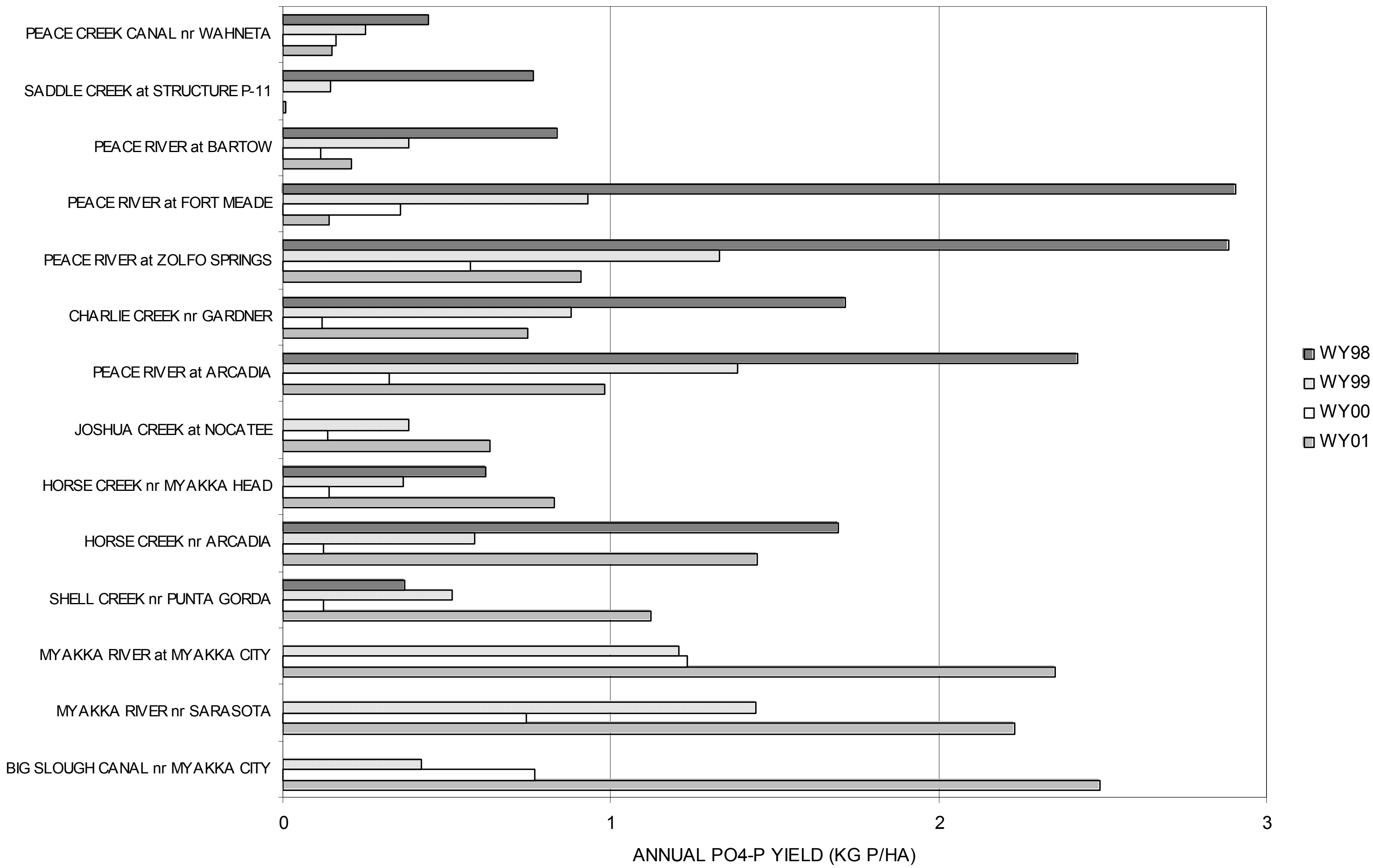

Fig. 9. Estimated PO_4-P yields, water years 1998 – 2001.

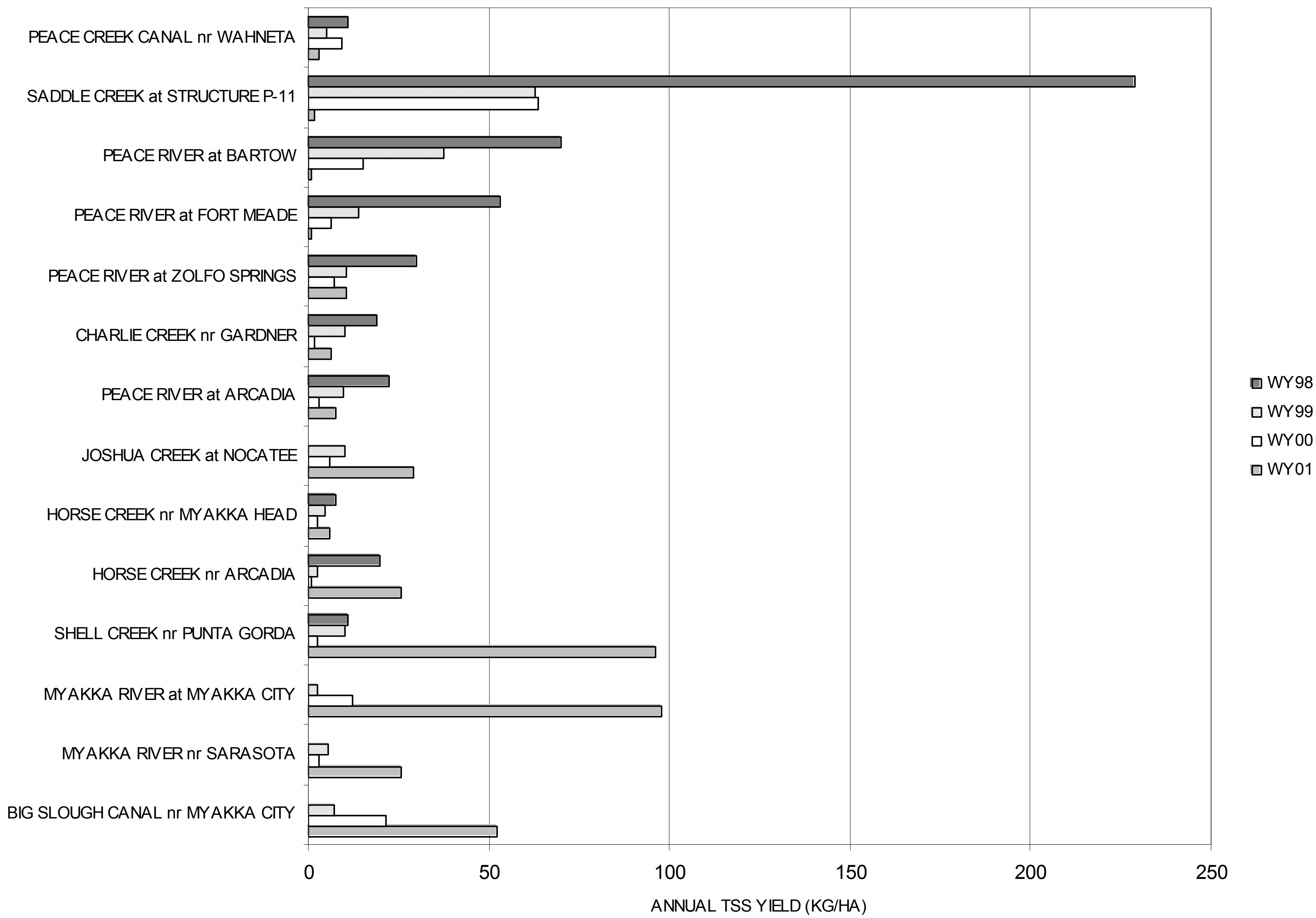

Fig. 10. Estimated TSS yields, water years 1998 – 2001.

3.3 ANNUAL FLOW-ADJUSTED LOADS

Watershed managers can gain additional insights into spatial and temporal pollutant discharge patterns by examining the annual ‘flow-adjusted’ loads of important water quality constituents that are discharged from gaged sub-basins.

These values are calculated by dividing a sub-basin’s estimated annual constituent load (in milligrams) by its measured annual discharge (in liters). The result, expressed in units of mg/L, gives an estimate of the mass of the constituent that was discharged from the sub-basin per unit water flow.

In cases where managers wish to reduce loadings of a particular constituent to a receiving waterbody, the most cost-effective approach is often to focus on areas that exhibit the highest flow-adjusted loads of that constituent. If effective load reduction methods are available, projects implemented in those areas should tend to produce the largest load reductions per volume of water treated.

Estimated annual flow-adjusted loads of nutrient forms and TSS from gaged sub-basins in the Peace and Myakka River watersheds are summarized, for water years 1998 – 2001, in Figs. 11-17.

For dissolved inorganic nitrogen forms, the largest estimated flow-adjusted loads (>0.3 mg N/L) occurred at the following monitoring stations:

- Joshua Creek at Nocatee (water years 1999, 2000, and 2001)
- Peace River at Zolfo Springs (1998-2001)
- Big Slough Canal near Myakka City (2000)
- Peace River at Arcadia (1998-2001)
- Peace Creek Canal near Wahneta (2000).

For dissolved inorganic phosphorus, the largest estimated flow-adjusted loads (> 0.4 mg P/L) were observed at the following stations:

- Peace River at Bartow (1999, 2001)
- Peace River at Fort Meade (1998 – 2000)
- Peace River at Zolfo Springs (1998 – 2001)
- Charlie Creek near Gardner (1999)
- Peace River at Arcadia (1998, 1999, 2001)
- Myakka River near Sarasota (2001)
- Big Slough Canal near Myakka City (2001).

For TSS, the largest estimated flow-adjusted loads (> 25 mg/L) were observed at the following stations:

- Saddle Creek at Structure P-11 (1998, 1999, 2000)
- Peace River at Bartow (1999, 2000)

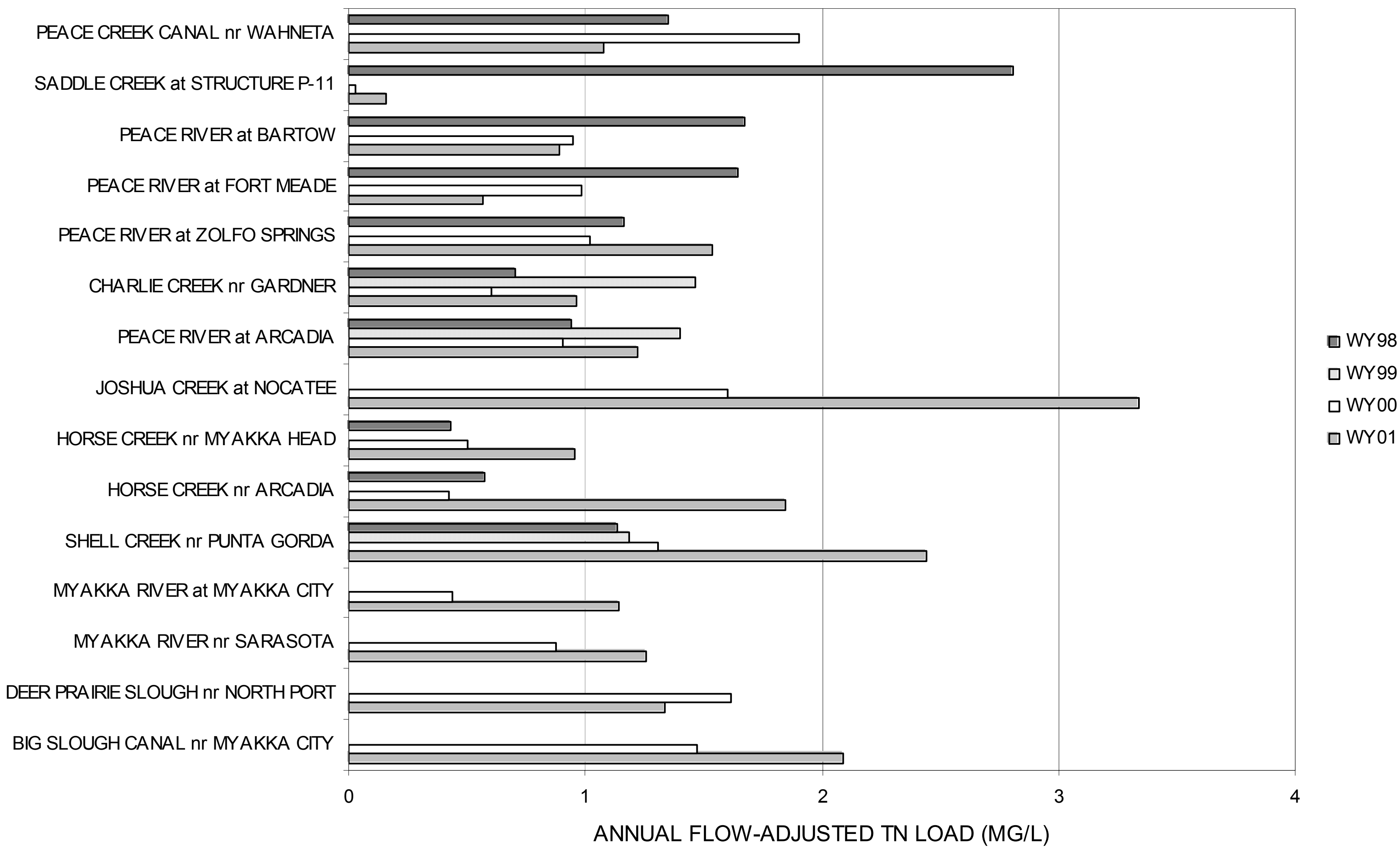

Fig. 11. Estimated flow-adjusted TN loads, water years 1998 – 2001.

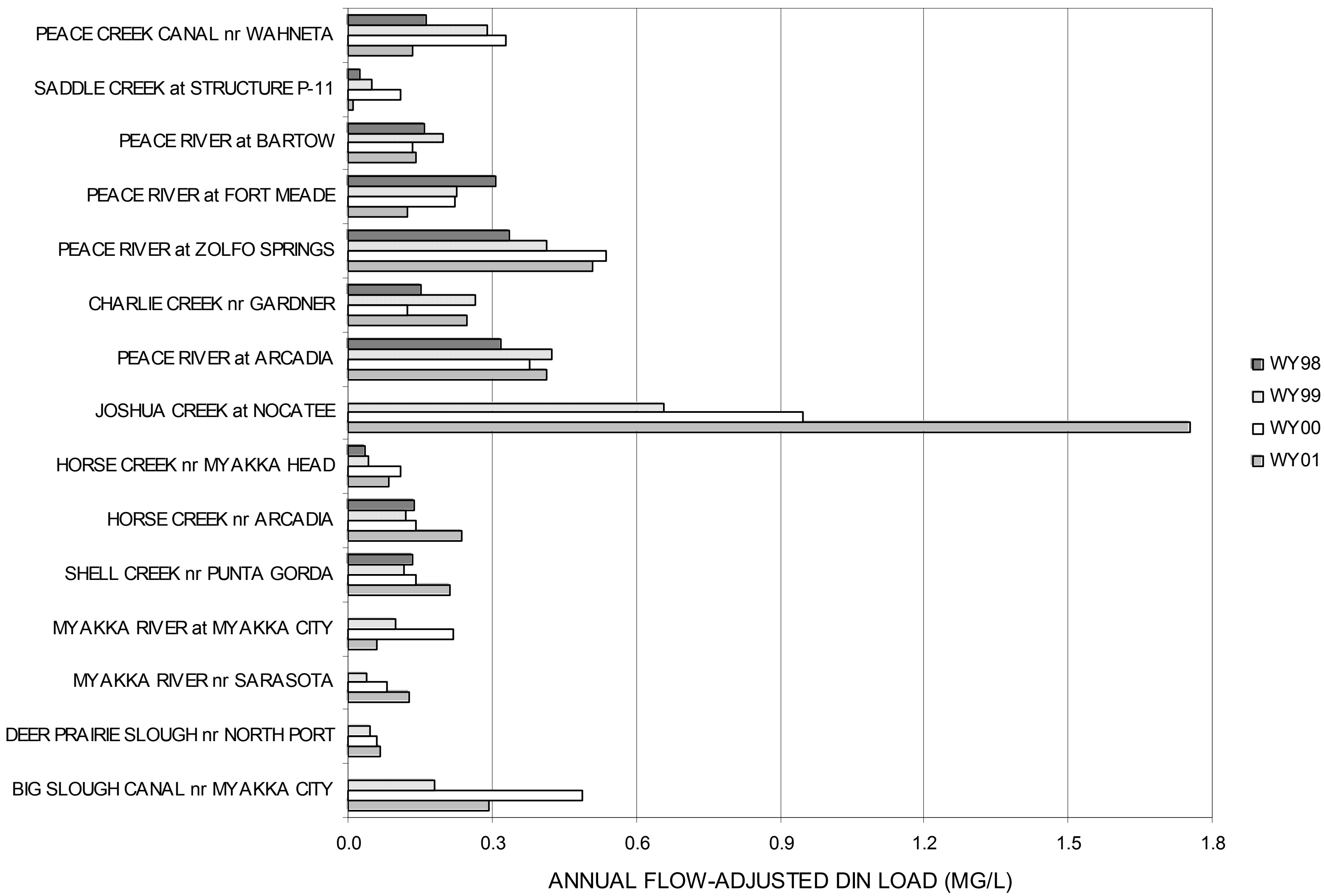

Fig. 12. Estimated flow-adjusted DIN loads, water years 1998 – 2001.

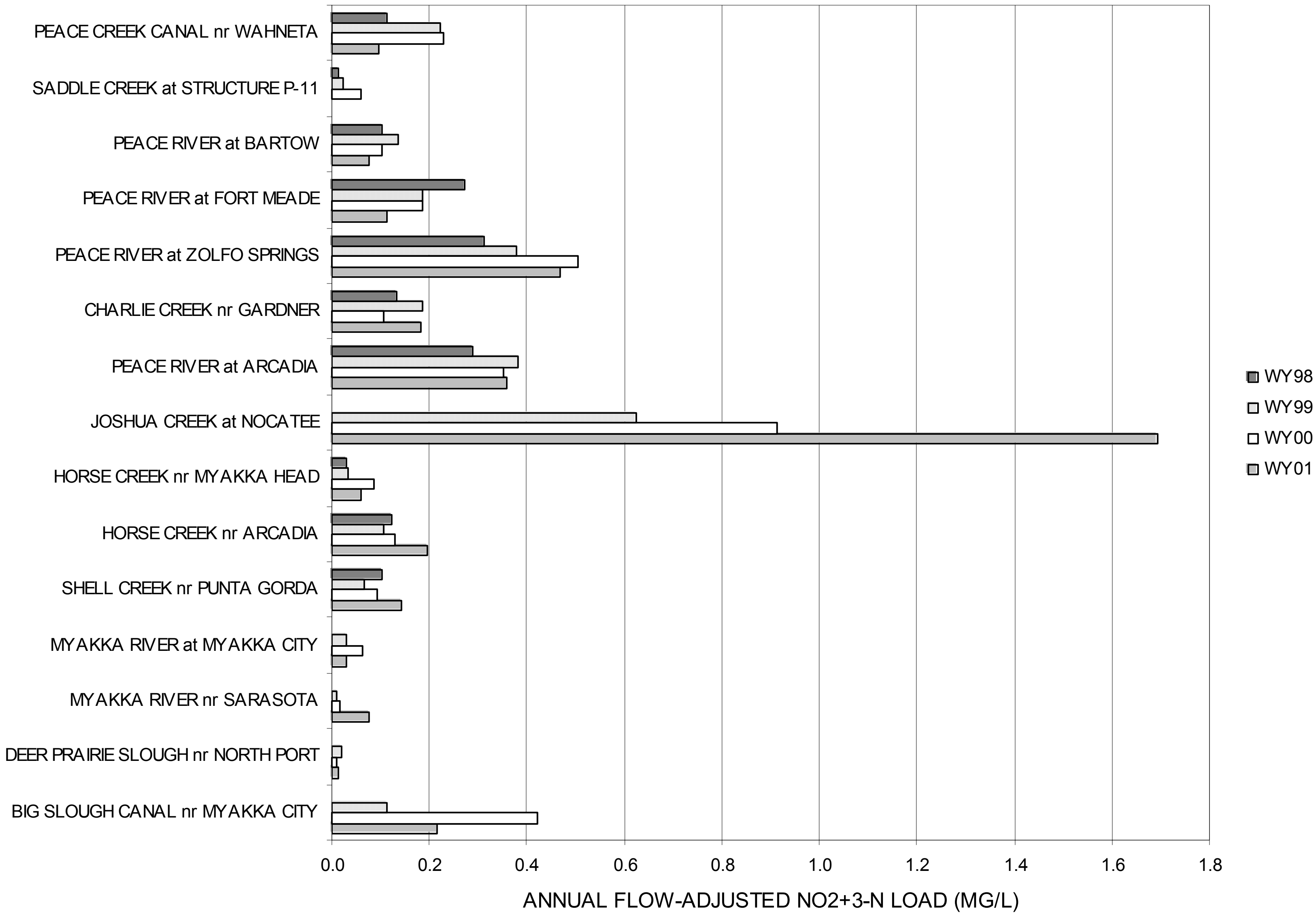

Fig. 13. Estimated flow-adjusted NO_{2+3} - N loads, water years 1998 – 2001.

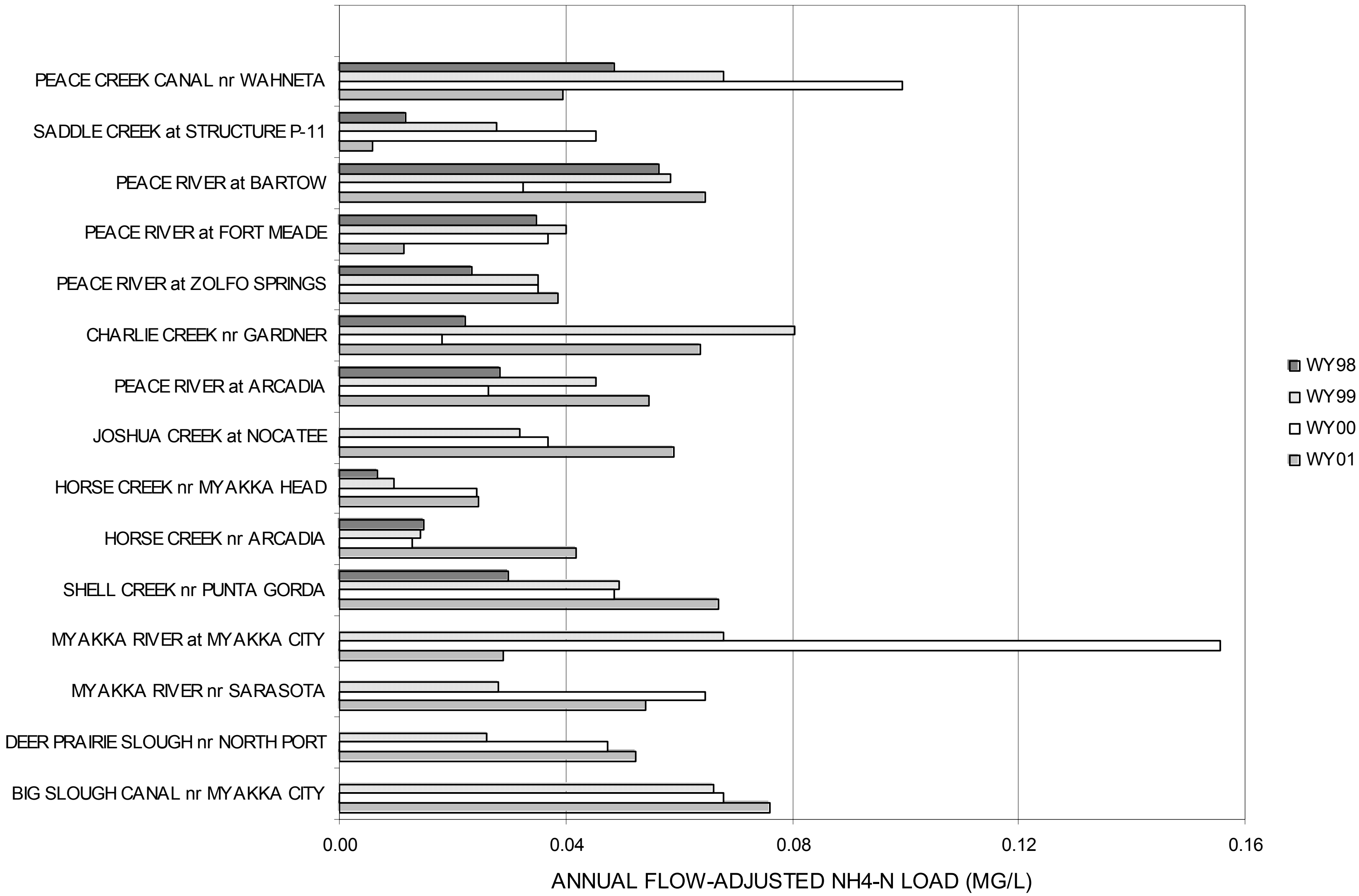

Fig. 14. Estimated flow-adjusted NH_4 - N loads, water years 1998 – 2001.

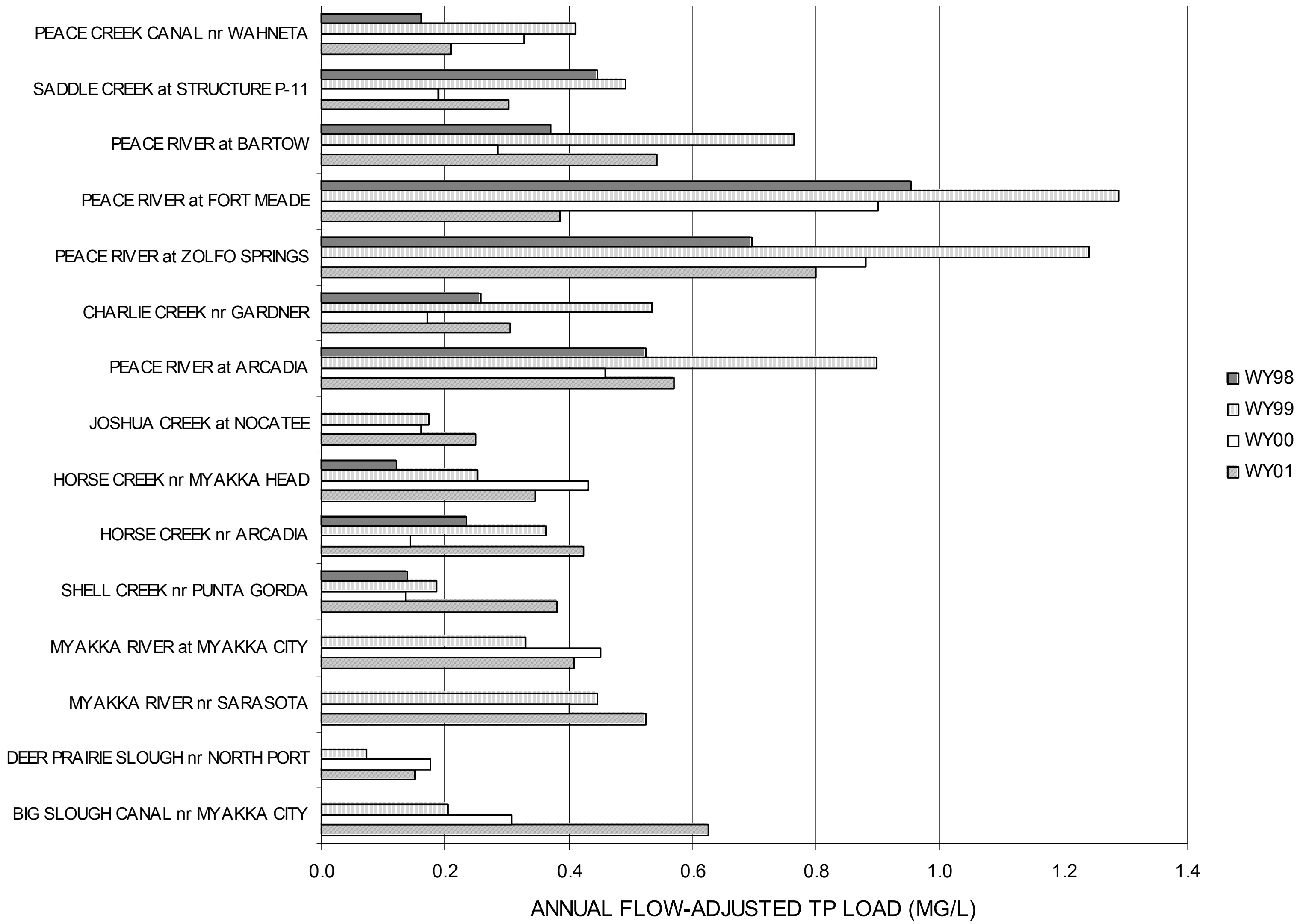

Fig. 15. Estimated flow-adjusted TP loads, water years 1998 – 2001.

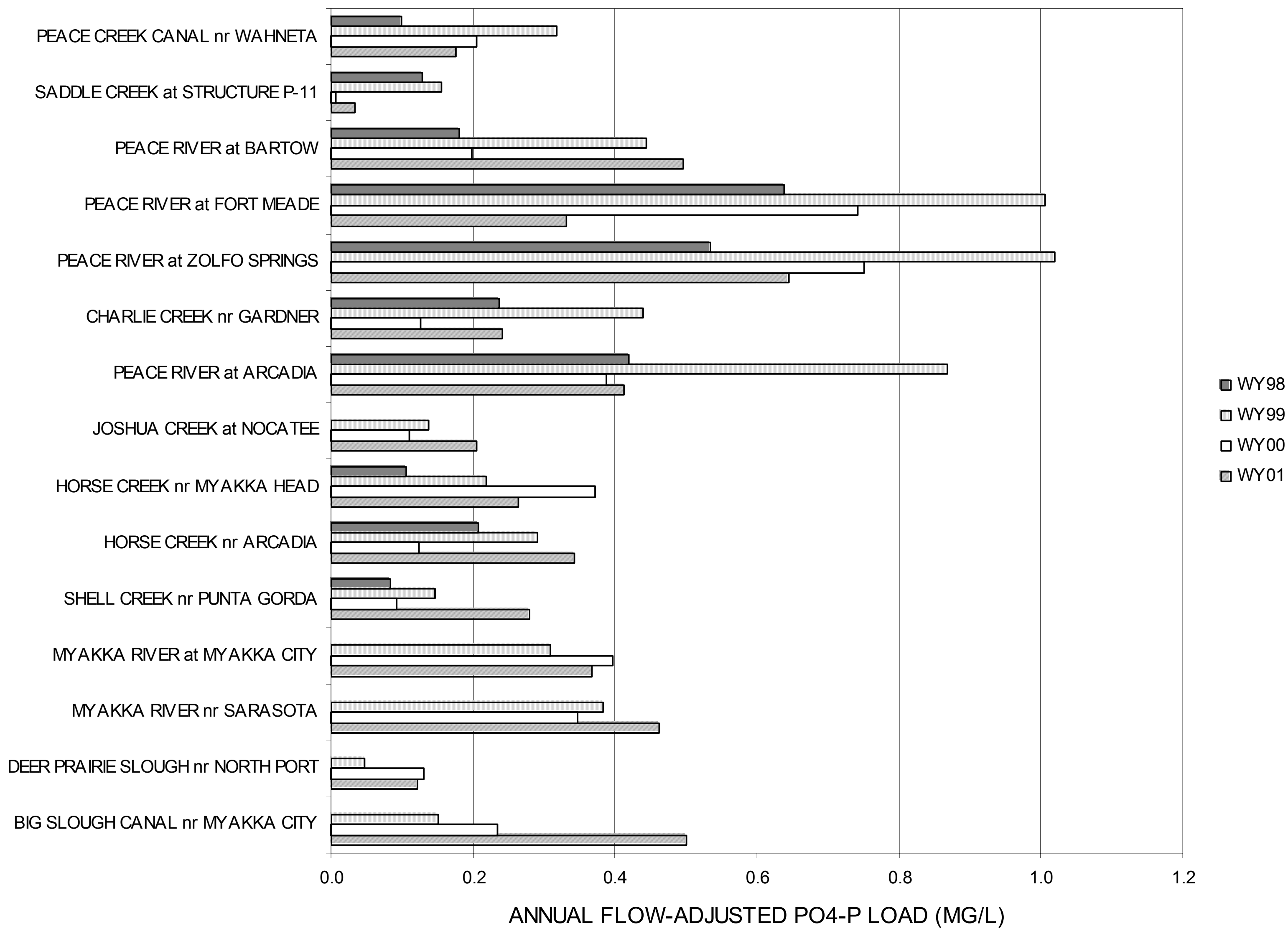

Fig. 16. Estimated flow-adjusted PO_4 - P loads, water years 1998 – 2001.

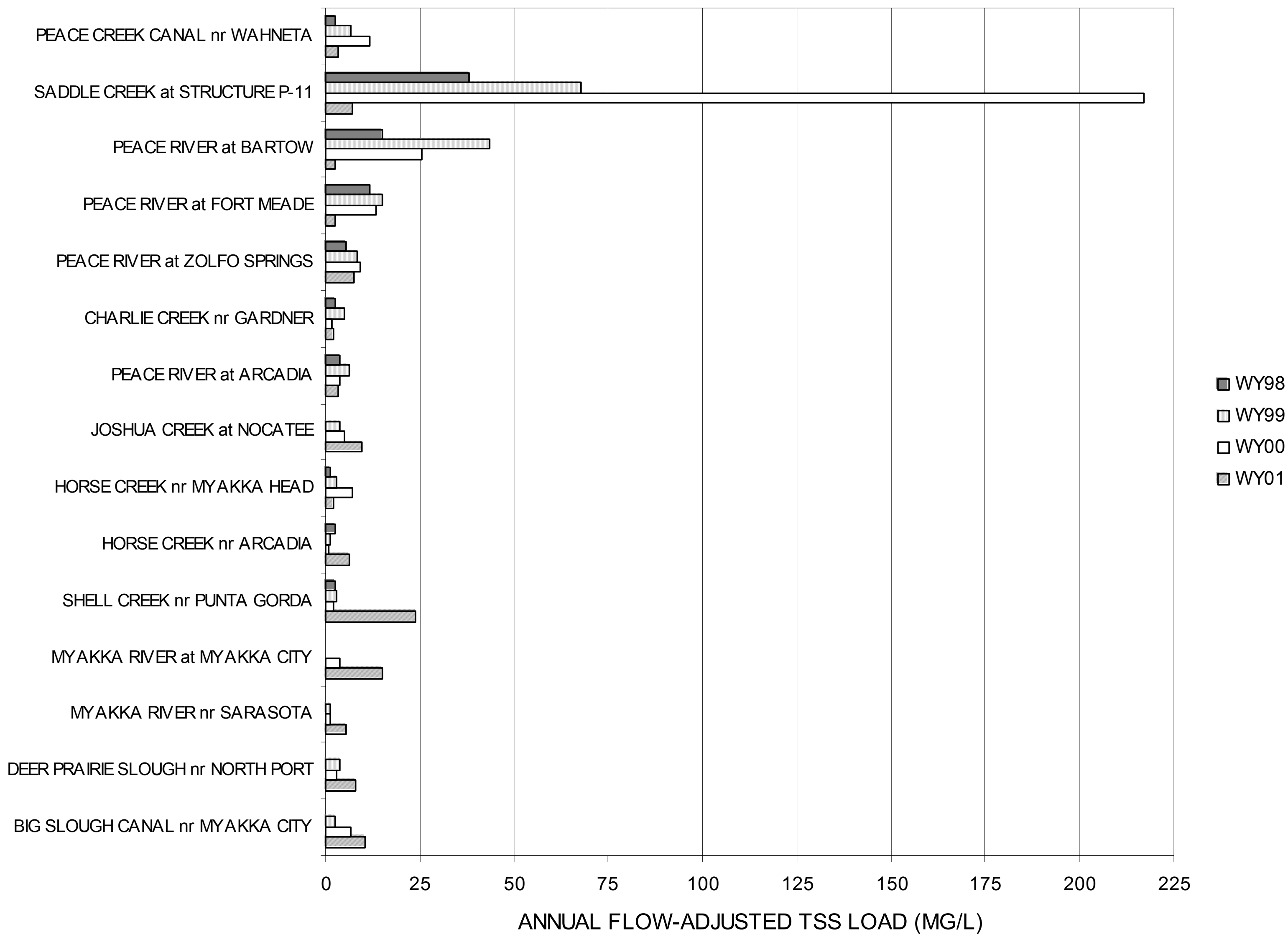

Fig. 17. Estimated flow-adjusted TSS loads, water years 1998 – 2001.

4.0 WATER QUALITY AT TIDAL STATIONS

Between January 1993 and December 2000, as part of a larger Charlotte Harbor monitoring program, the District conducted monthly water quality monitoring at seven sites in the tidal reaches of the Peace and Myakka rivers. The sites were located at fixed geographic coordinates (shown in Fig. 18), which were at or near locations that had been sampled by the U.S. Geological Survey (USGS) in an earlier monitoring program conducted during the 1980s.

The 1993-2000 monitoring program used a synoptic, tidally-based sampling design. During each monthly sampling event all sites were sampled within a single 24-hour period. At each site sampling was performed within one hour of (predicted) slack low tide. The objective of this design was to provide synoptic water quality information from a set of fixed monitoring locations. To provide a clearer picture of watershed impacts, the data were collected during the portion of the tidal cycle when water quality would be most influenced by hydrologic and pollutant loadings from the Peace and Myakka River watersheds and least influenced by estuarine and marine water masses from Charlotte Harbor and the Gulf of Mexico.

The monitoring stations were generally shallow-water sites, with water depths typically ranging between 1-3 m . Only two stations — CH-002 on the Myakka River and CH-005 on the Peace — had depths exceeding 3m on most sampling dates.

During each monthly sampling event the monitoring design, based on U.S. EPA guidance (EPA 1991), called for near-surface water chemistry samples to be collected at a depth of 0.5 m at each station. At the two deeper-water sites an additional (near-bottom) sample was collected at a depth 0.5 m above the bottom. Vertical hydrographic profiles were recorded during each sampling event, with measurements taken at depth intervals of 0.5 m (shallow-water stations) or 1 m (deeper-water stations), beginning at the top of the water column and extending to the bottom.

Summaries of selected water quality constituents are shown in Appendix B. In addition, detailed analyses of water quality status and trends in Charlotte Harbor and the tidal reaches of its tributaries— based on data collected by the District and a number of other agencies — is currently being performed by the Charlotte Harbor National Estuary Program. A report summarizing those analyses will be published by the Estuary Program during 2002.

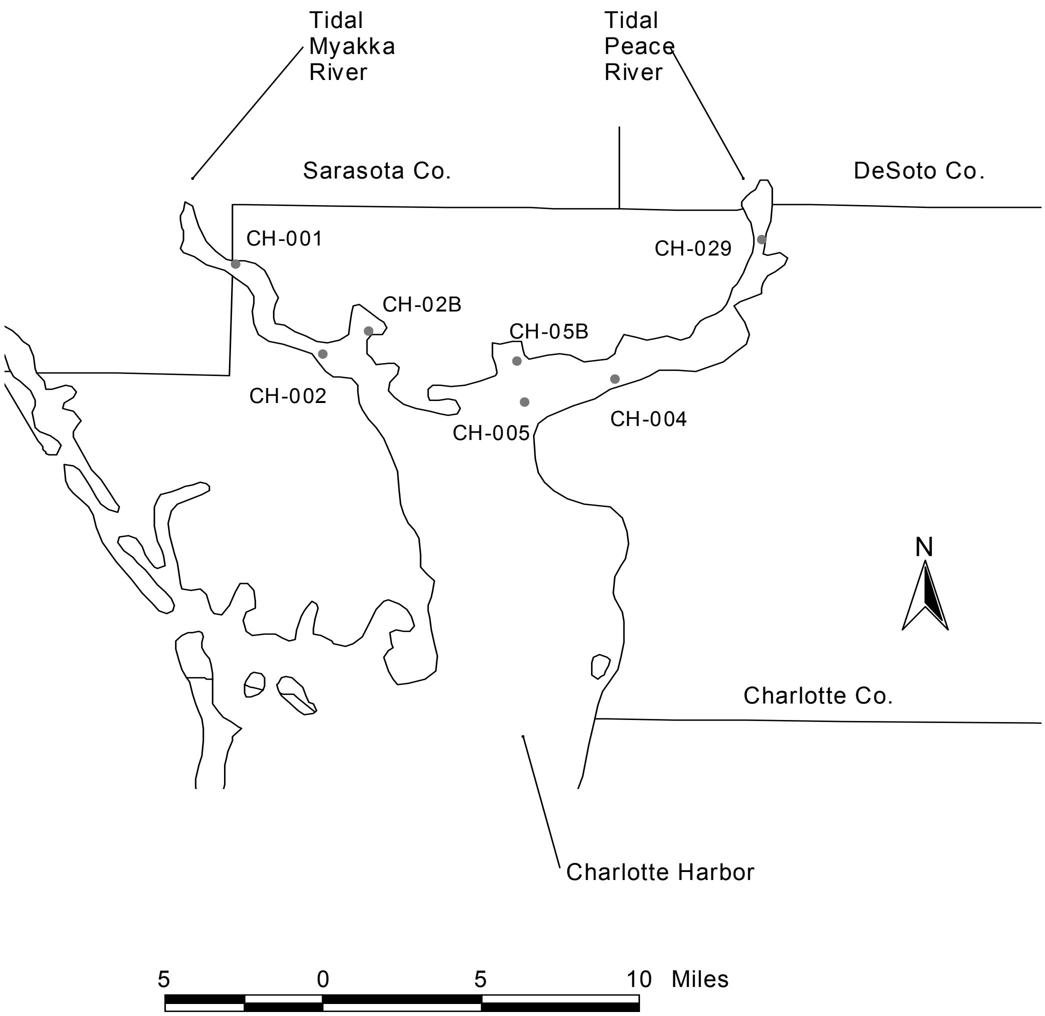

Figure 18. Location of the SWFWMD fixed-station monitoring locations in the tidal reaches of the Peace and Myakka river systems.

4.1 PHYSICAL PARAMETERS

Near-Surface Salinity

Annual near-surface salinity patterns at the seven monitoring stations during water years 1994 – 2000 are summarized, in percentile form, in Appendix B.

The most upstream stations in both river systems (CH-001 in the tidal Myakka and CH-029 in the tidal Peace) were located in oligohaline areas, with median salinities <5 ppt in most years. Over the course of the study period, near-surface salinity levels at both stations ranged from tidal fresh (0 ppt) to mesohaline (>20 ppt).

Median near-surface salinities at the remaining stations were generally mesohaline, ranging between 10 and 25 ppt. Stations CH-002 (Myakka) and CH-004 (Peace) exhibited similar median values, of between 10 and 22 ppt. Stations CH-02B (Myakka) and CH-05B also exhibited similar median values, between 13 and 24 ppt. Highest median salinities (18–26 ppt) occurred at station CH-005, near the mouth of the Peace River.

The maximum salinity value shown in Appendix B (44.95 ppt), a near-surface value reported from station CH-005, apparently reflects an instrument malfunction or typographic error, and has been removed from the District database (C. Anastasiou, *personal communication*).

Near-Surface Color

Natural water color, produced as a result of decomposition of leaf litter and other refractory organic matter, has been shown to be an important source of light attenuation in the Peace and Myakka river systems and portions of Charlotte Harbor (McPherson and Miller 1987).

Among the stations sampled during water years 1994-2000, median near-surface color levels varied inversely with median near-surface salinities. Color levels were quite high at the most upstream stations (CH-001 and CH-029), fell by about 50% between those stations and the next downstream sampling locations (CH-002 and CH-004), and declined another 20-40% at the highest-salinity stations (CH-02B, CH-05B, and CH-005) (Appendix B).

Color levels in estuaries are affected by a variety of physical and chemical processes. The simplest physical process is dilution, which occurs when highly colored river water mixes with sea water containing much lower concentrations of the dissolved and colloidal humic acids and other compounds that contribute to water color. Humic materials are also removed from the water column through two physical-chemical processes — flocculation and adsorption — whose rates increase when the materials are transported from fresh to more saline waters. In estuaries, flocculation of humic acid colloids reportedly occurs preferentially at salinities between 0 and 5 ppt (Day et al. 1989).

Median color values for Florida rivers and estuaries, as reported by Friedemann and Hand (1989) based on a survey of several thousand records retrieved from the U.S. EPA STORET database, are 70.0 and 20.0 pcu, respectively. Values observed in the tidal reaches of the Peace and Myakka river systems during water years 1994-2000 (Appendix B) were substantially higher than these statewide medians.

Near-Surface TSS

Concentrations of total suspended solids (TSS) reflect levels of organic and inorganic particulate matter present in the water column. High levels of TSS can impact the quality of aquatic habitats by reducing water clarity and light penetration, thus affecting the growth of algae and rooted aquatic plants. Areas of high TSS deposition and resuspension are often sub-optimal habitats for many aquatic organisms, due to fouling and smothering effects and reductions in dissolved oxygen availability that can occur as a result of elevated sediment oxygen demand.

Annual median near-surface TSS values in the tidal Peace and Myakka river samples ranged between 3 and 36 mg/L, with the higher values occurring at the more downstream stations (Appendix B). Median values for Florida rivers and estuaries reported by Friedemann and Hand (1989) are 7.0 and 17.5 mg/L, respectively. With the exception of relatively high values observed at several stations during the 2000 water year, TSS concentrations at the tidal Peace and Myakka River monitoring sites do not appear to be elevated with respect to other Florida water bodies.

Near-Surface Turbidity

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a water sample. It is primarily caused by suspended matter (e.g., clay, silt, and finely-divided organic and inorganic materials), soluble colored organic compounds, and plankton and other microscopic organisms (APHA 1989).

Annual median values measured at the tidal Peace-Myakka monitoring stations during water years 1994 - 2000 ranged between 1.7 and 7.3 NTU, with the highest values occurring at the most upstream stations on both rivers (Appendix B).

Turbidity measurements can be affected by high levels of water color, apparently due to light absorption by the dissolved substances that are also responsible for color (APHA 1989). Because the tidal Peace and Myakka are highly colored river systems, comparisons of turbidity measurements from these areas with measurements from other rivers, with different color characteristics, should be done with caution.

Secchi Depth

Secchi depth — the average depth at which a standardized (20 cm diameter) white or black-and-white disk disappears and reappears when lowered into the water column from the deck of a boat or dock — is a simple measure of water transparency. Because transparency is affected by a number of factors, including water color, TSS and turbidity, Secchi depths can exhibit substantial temporal and spatial variability within and between water bodies. Median statewide Secchi depth values for Florida rivers and estuaries, reported by Friedemann and Hand (1989), are 0.8 m and 1.1 m, respectively.

Median Secchi depth values for the tidal Peace and Myakka River stations are shown in Appendix B. The lowest median values were recorded at the most upstream stations (CH-001 and CH-029) in both river systems, presumably reflecting the high color and turbidity levels that occurred at those sites. In general median Secchi depths appeared to increase along the salinity gradient in both rivers, although reductions occurred at stations CH-02B and CH-05B. Both of these stations were located in shallow shoreline embayments away from the rivers' main stems, where water transparency may have been affected by site-specific factors.

Near-Surface pH

pH is a measurement of the acidity of a water sample. Values <7 indicate an acidic condition, ph 7 is neutral, and values >7 are considered basic or "alkaline." Due to their chemical characteristics, marine and estuarine waters tend to be more highly buffered than fresh water systems, usually exhibiting pH values in the range of 7.8 to 8.3 (marine) or 7.5 to 8.8 (estuarine) standard units (Day et al. 1989).

Highly acidic (ph < 4.5) or basic (pH > 9.5) conditions, which can occur due to a variety of natural or man-made factors, can be harmful or fatal to aquatic organisms, either directly or due to increased mobilization or toxicity of other substances in the environment.

pH values varied over a relatively narrow range at the tidal Peace-Myakka stations (Appendix B), with annual median values at each station ranging between 6.8 and 7.9 units. Among the individual monthly readings the most acidic value (5.5) occurred at the most upstream of the tidal Peace River stations, perhaps reflecting the high color levels (caused in part by humic acids) that occurred at that site. The most basic value (8.9) occurred at station CH-004, a site that experienced relatively frequent algal blooms which may have led to increased pH levels as a result of CO_2 uptake by algal cells during photosynthesis.

Dissolved Oxygen

Annual median dissolved oxygen concentrations observed at the tidal Peace-Myakka stations during water years 1994-2000 varied between 5.7 and 7.7 mg/L mg/L (Appendix B). During the period, concentrations in the "stressful" (< 4 mg/L) range were recorded at least once during most years at every site. Concentrations in the "hypoxic" (< 2 mg/L) range were observed at the following stations:

- CH-02B (water years 1995, 1999, 2000)
- CH-004 (all years)
- CH-05B (1994, 1995, 1998, 1999)
- CH-005 (all years)

4.2 MACRONUTRIENTS – DISSOLVED INORGANIC N AND P

The availability of dissolved inorganic nitrogen and phosphorus are important determinants of algal productivity, which in turn has major effects on oxygen dynamics and other aspects of a water body's trophic state.

As a general rule of thumb, laboratory studies indicate that the availability of DIP and DIN begin to limit phytoplankton growth when their concentrations fall below 0.001 – 0.005 mg P/L and 0.005 – 0.020 mg N/L, respectively (Chapra 1997). By comparing observed DIP and DIN concentrations to these values — which are "half saturation constants" measured for a variety of phytoplankton species in Michaelis-Menton nutrient uptake experiments — the likelihood and potential frequency of P or N limitation in a given waterbody can be assessed (Chapra 1997).

NEAR-SURFACE DIP

Given the phosphate-rich geology of the Peace and Myakka River watersheds, which support a large phosphate mining and processing industry, it would be surprising to find evidence of frequent or pronounced phosphorus limitation in the tidal reaches of either river (e.g., Odum 1953, Hammett 1987, Fraser 1991, Montgomery et al. 1991).

Based on the water year 1994-2000 monitoring data, P limitation does not appear to be an important factor affecting phytoplankton productivity in either area. Median DIP concentrations ranged from 0.06 to 0.6 mg P/L at all sites, with the highest median value observed at the most upstream station (CH-029) in the tidal Peace River (Appendix B). The lowest concentrations observed during individual sampling events ranged from below 0.01 (the laboratory detection limit) to about 0.4 mg DIP/L.

It is possible that some or all of the values that were below the laboratory detection limit may have fallen within the potential nutrient limitation range (0.001 – 0.005 mg P/L) as defined by Chapra (1997). By definition, however, it is not possible to quantify values that fall below the detection limit, so the available data cannot resolve this question. On the other hand, the 25th percentile concentrations observed at each station were substantially higher (>0.03 mg DIP/L) than the upper-bound value for potential P limitation (0.005 mg DIP/L) provided by Chapra (1997), suggesting that P limitation, if it occurred, was not a frequent event during the study period.

NEAR-SURFACE DIN

Annual median near-surface DIN concentrations ranged between 0.02 and 0.52 mg N/L at the tidal Myakka River stations, and between 0.03 and 0.40 mg N/L at the tidal Peace River stations (Appendix B). Median concentrations appear to vary inversely with salinity in both river systems.

If 0.01 mg DIN/L — which was the effective detection limit for DIN forms in the District monitoring program for DIN forms, and the mid-range of potential N limitation values discussed by Chapra 1997 — is used to estimate the threshold for N limitation in phytoplankton, it appears that N availability may have limited phytoplankton productivity at several of the tidal river stations sampled during 1993-2000. DIN concentrations below the laboratory detection limit were observed during at least one sampling event at each station. The 25th percentile value was equal to the detection limit in one or more water years at each station, indicating that DIN concentrations equal to or less than the detection limit were observed on 25% of the sampling dates at the station during that year.

4.3 CHLOROPHYLL-*a*

Chlorophyll-*a* concentrations, which provide estimates of phytoplankton biomass in the water column, are helpful indicators of a waterbody's trophic state. A summary of near-surface chlorophyll-a concentrations observed at the tidal Peace and Myakka River monitoring stations is shown in Appendix B. Annual median values ranged between the laboratory detection limit (1.0 µg/L) and 13 µg/L at the tidal Myakka stations and between 2.3 and 10.6 µg/L in the tidal Peace. The statewide median chlorophyll-*a* concentration for Florida estuaries, as reported by Freidemann and Hand (1989), is 8.5 µg/L.

Algal blooms (indicated by chlorophyll-*a* concentrations > 20 µg/L) occurred at every station at some time during the monitoring period. Pronounced blooms, with chlorophyll concentrations > 50 µg/L, were observed at three sites (CH-002, CH-02B, and CH-004).

Annual mean chlorophyll-a concentrations observed at several stations during water years 1994-2000 exceeded 11 µg/L, a value that has been proposed by the State of Florida as representative of potentially impaired water quality conditions in the State's estuarine waters. Stations and years where the proposed impairment level were exceeded include:

- CH-002 (water years 1995, 1999)
- CH-02B (1995, 1998, 1999)
- CH-029 (1995, 1996)
- CH-004 (1994, 1995, 1996, 1999)
- CH-05B (1999)
- CH-005 (1994).

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Water Quality Conditions
and Pollutant Loads and Yields
in the Peace and Myakka River Basins

Appendices

Prepared for the
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and the
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APPENDIX A

CONSTITUENT SUMMARIES FOR NON-TIDAL STATIONS

TURBIDITY (NTU), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	3.8000	4.1000	4.6000	6.0667	5.3000	14.9000
	1999	12	4.7000	6.3000	8.5000	9.6000	10.8500	25.0000
	2000	11	1.8000	3.6000	5.1000	4.6136	5.8000	6.0500
	2001	12	1.9000	2.6500	3.4500	3.6833	4.4500	6.8000
2294491	1998	8	20.0000	25.0000	31.5000	32.5000	38.5000	50.0000
	1999	12	14.7000	20.7500	29.5000	32.8083	44.7500	59.0000
	2000	11	8.6000	12.3000	13.8000	19.1273	19.1000	61.0000
	2001	10	7.5000	18.5000	29.5000	57.1200	68.0000	240.0000
2294650	1998	9	8.0000	8.1000	10.3000	12.9111	11.2000	30.0000
	1999	12	5.8000	8.4000	10.2500	15.4000	16.5000	55.0000
	2000	11	1.3000	2.8000	3.6000	5.0273	5.0000	21.0000
	2001	12	1.3000	2.2500	2.6500	2.7333	3.1000	5.0000
2294898	1998	9	4.0000	7.1000	8.2000	11.6444	11.0000	29.0000
	1999	12	2.8500	3.1750	4.8500	6.6167	9.0500	16.0000
	2000	11	0.8000	1.2000	1.7000	3.4091	2.7000	12.1000
	2001	12	0.6600	0.9500	1.5000	1.7883	2.3000	5.1000
2295637	1998	9	2.0000	4.6000	6.0000	7.0222	7.7000	15.3000
	1999	12	1.2000	1.7000	4.1500	4.8875	7.4500	12.5000
	2000	11	0.7000	0.8000	1.3000	2.7818	3.3000	9.2000
	2001	12	0.5000	0.7000	1.4000	4.9650	3.7500	38.0000

TURBIDITY, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	1.0000	3.0000	3.2000	4.4333	4.1000	14.1000
	1999	12	1.3000	2.2500	2.8500	3.1250	3.7000	6.8000
	2000	11	0.3500	0.8000	1.1000	1.3727	1.6000	3.8000
	2001	3	0.3000	0.3000	0.8000	1.0667	2.1000	2.1000
2296750	1998	9	2.9500	4.0000	5.0000	6.1778	6.2000	15.8000
	1999	12	2.3000	2.6500	3.6500	5.0000	7.0000	11.0000
	2000	11	0.5000	0.7500	0.8500	1.7000	1.7000	7.6000
	2001	3	0.8000	0.8000	1.3000	1.4333	2.2000	2.2000
2297100	1998	3	1.5000	1.5000	3.4000	3.0000	4.1000	4.1000
	1999	12	0.8000	1.5500	2.7000	3.1000	4.2500	7.5000
	2000	11	0.6500	0.9000	1.3000	2.3091	4.8000	5.0000
	2001	12	0.8000	1.1500	1.9000	2.2083	3.0500	5.2000
2297155	1998	9	1.0000	1.6000	2.5000	2.3889	3.3000	3.8000
	1999	12	0.8000	1.1500	1.8500	2.4000	2.5500	8.4000
	2000	11	0.8000	0.9000	1.2000	3.4273	3.1000	18.6000
	2001	12	0.7600	0.9500	1.6500	2.1383	3.1000	5.3000
2297310	1998	9	1.2000	2.5000	2.9000	3.2833	3.2000	7.5000
	1999	11	0.5000	0.9000	1.8000	2.1000	3.0000	4.0000
	2000	10	0.4000	1.0000	1.0500	2.2350	3.0500	7.4000
	2001	12	0.5500	0.8400	1.3000	1.9650	3.0000	4.7000

TURBIDITY, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	1.9000	2.4500	3.2000	3.0722	3.7000	4.7000
	1999	12	1.2800	1.7750	2.0000	1.9025	2.0500	2.2000
	2000	12	1.0000	1.2000	1.4000	1.5750	1.9000	2.8000
	2001	12	0.7000	0.9500	1.2000	1.5250	1.4000	4.6000
2298608	1999	12	0.2000	0.7500	1.1000	1.1083	1.5000	2.1000
	2000	10	0.6000	0.7000	2.0500	2.7200	3.4500	7.6000
	2001	12	0.5000	0.9000	1.3500	2.4667	2.0500	12.0000
2298830	1999	12	1.0000	1.4500	1.8500	2.3125	2.9000	4.8000
	2000	10	0.8000	1.2000	1.4500	2.5900	3.4000	8.0000
	2001	12	1.0000	1.1500	1.7500	5.0500	3.8500	33.0000
2299120	1999	11	2.5000	3.4000	4.3000	6.5227	7.5000	23.0000
	2000	11	1.4000	2.2000	5.5000	5.7955	7.7500	14.7000
	2001	12	1.4000	5.5000	7.5000	7.2750	9.9000	11.6000
2299410	1999	10	1.1000	2.0000	3.6500	4.9700	8.7000	10.5000
	2000	10	2.0000	3.4000	7.8000	10.7900	15.7000	28.0000
	2001	12	1.3000	1.3500	2.4500	2.8167	3.8500	5.8000
2299455	1999	11	1.8000	2.0000	3.2000	5.0818	7.8000	14.1000
	2000	11	1.1000	2.8000	3.2000	4.1909	4.8000	10.6000
	2001	11	0.0400	1.1500	4.1000	3.3627	5.5000	5.9000

TSS (MG/L), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	0.0025	3.0000	3.2000	5.3006	5.5000	15.0000
	1999	12	2.8710	3.8400	5.0200	7.8262	8.2369	34.0667
	2000	11	0.0025	3.1350	6.0000	8.5414	15.0000	27.0000
	2001	12	0.0025	2.5000	5.5000	5.0838	6.5000	12.0000
2294491	1998	8	30.0000	47.5000	61.2000	63.4250	80.0000	100.0000
	1999	12	7.2500	26.6042	45.2250	58.5238	75.7083	211.0000
	2000	11	24.8667	28.0667	33.0000	64.9333	81.0000	206.3333
	2001	10	12.0000	21.0000	45.0000	83.4000	129.0000	278.0000
2294650	1998	9	7.0000	10.5000	13.0000	19.0889	16.0000	67.1000
	1999	12	2.7467	4.0975	11.4123	22.6795	17.8810	151.2500
	2000	11	0.0025	3.0000	6.4815	10.7732	13.0000	48.3000
	2001	12	0.0025	0.0025	2.0000	3.1677	4.5000	11.0000
2294898	1998	9	5.2000	8.5000	12.0000	19.6667	15.0000	54.0000
	1999	12	0.4235	1.4950	2.3446	6.1232	10.2231	25.6875
	2000	11	0.0025	2.0000	6.0000	8.6169	16.3235	23.0000
	2001	12	0.0025	1.0013	4.5000	3.9173	6.0000	8.0000
2295637	1998	9	1.0000	2.4000	7.0000	10.2667	18.0000	30.0000
	1999	12	0.3200	0.6300	2.2665	4.9243	8.2389	18.5312
	2000	11	0.0025	0.0025	6.0000	5.5761	10.0000	13.7500
	2001	12	0.0025	0.0025	2.0000	4.0010	6.0000	15.0000

TSS, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	0.0025	1.2000	2.4000	3.4669	3.0000	10.0000
	1999	12	0.0025	0.0025	4.5000	3.8342	6.0000	9.0000
	2000	11	0.0025	0.0025	0.0025	0.4568	0.0025	5.0000
	2001	12	0.0025	0.0025	0.0025	1.7517	4.0000	7.0000
2296750	1998	9	1.2500	4.8000	5.4000	8.6222	9.7500	26.0000
	1999	12	0.0025	2.0013	5.5000	6.3340	9.5000	16.0000
	2000	11	0.0025	0.0025	0.0025	1.5475	0.0025	13.0000
	2001	12	0.0025	0.0025	0.0025	2.4181	4.5000	10.0000
2297100	1998	3	2.8000	2.8000	4.0000	5.9333	11.0000	11.0000
	1999	12	0.0025	0.4150	1.3950	2.1711	3.3800	8.0400
	2000	11	0.0025	1.2800	5.5000	5.2659	10.0000	11.0000
	2001	12	0.0025	0.0025	4.0000	5.5842	10.5000	17.0000
2297155	1998	9	0.0025	0.0025	1.5000	2.5900	2.8000	10.0000
	1999	12	0.0208	0.1545	0.4673	1.6751	1.7092	10.9400
	2000	11	0.0025	0.1700	3.0000	9.7349	10.0000	51.0000
	2001	12	0.0025	0.0025	0.0025	1.6681	3.5000	7.0000
2297310	1998	9	0.0025	1.0000	1.6000	3.1228	4.0000	10.0000
	1999	11	0.1122	0.4141	0.7400	1.1676	1.8367	3.2449
	2000	10	0.0025	0.0025	3.3000	4.3298	8.0000	15.0000
	2001	12	0.0025	0.0025	4.5000	5.0844	9.0000	18.0000

TSS, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	1.0000	1.5000	3.0000	2.7111	3.6000	4.4000
	1999	12	1.6000	2.0000	2.6500	2.8750	3.5500	5.3000
	2000	12	0.8000	1.8500	2.6500	2.9667	3.2000	10.0000
	2001	12	0.0025	1.4000	1.8500	4.0002	4.2000	20.0000
2298608	1999	12	0.0025	0.3100	0.5350	1.0044	1.5017	3.8687
	2000	10	0.0025	3.0000	5.2950	4.9468	6.0000	10.0000
	2001	12	0.0025	0.0025	3.0000	11.5010	9.0000	90.0000
2298830	1999	12	0.9000	1.0889	1.2575	2.2142	3.0450	6.7451
	2000	10	0.0025	1.0000	1.6150	4.9207	3.0000	24.0000
	2001	12	0.0025	0.0025	4.5000	5.9175	9.0000	25.0000
2299120	1999	11	0.6400	1.7800	2.7400	3.3084	4.6723	7.2885
	2000	11	0.0025	2.3100	6.1010	13.0149	17.0000	53.0000
	2001	12	1.0000	2.0000	6.0000	8.2083	11.2500	24.0000
2299410	1999	10	0.1900	0.9800	4.1086	4.1586	5.3939	13.7755
	2000	10	3.7800	6.0000	9.8027	15.2280	20.8947	47.0000
	2001	12	0.0025	1.0000	2.5000	5.2504	11.5000	14.0000
2299455	1999	11	0.0025	0.1500	3.0000	4.4974	8.6824	12.0615
	2000	11	0.0025	2.0000	6.3047	7.0852	11.0000	18.5000
	2001	11	0.0025	0.0025	0.0025	6.0014	14.0000	26.0000

COLOR (PCU), BY STATION AND WATER

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	140.0000	223.0000	264.0000	252.8889	303.0000	350.0000
	1999	12	125.0000	162.5000	225.0000	208.3333	250.0000	300.0000
	2000	11	2.5000	70.0000	150.0000	159.7727	255.0000	325.0000
	2001	12	80.0000	80.0000	120.0000	138.7500	170.0000	300.0000
2294491	1998	8	55.0000	66.5000	85.5000	91.8750	112.0000	152.0000
	1999	12	35.0000	40.0000	45.0000	52.0833	60.0000	100.0000
	2000	11	35.0000	40.0000	50.0000	56.3636	75.0000	90.0000
	2001	10	50.0000	65.0000	77.5000	81.0000	80.0000	140.0000
2294650	1998	9	143.0000	158.0000	195.0000	198.9444	221.0000	320.0000
	1999	12	85.0000	137.5000	162.5000	171.6667	212.5000	300.0000
	2000	11	35.0000	65.0000	175.0000	156.3636	250.0000	300.0000
	2001	12	40.0000	62.5000	80.0000	107.9167	145.0000	275.0000
2294898	1998	9	50.0000	130.0000	150.0000	140.2222	178.0000	187.0000
	1999	12	30.0000	40.0000	67.5000	87.0833	112.5000	225.0000
	2000	11	20.0000	30.0000	70.0000	86.3636	150.0000	225.0000
	2001	12	15.0000	22.5000	37.5000	53.7500	47.5000	250.0000
2295637	1998	9	60.0000	92.0000	158.0000	134.8889	180.0000	197.0000
	1999	12	30.0000	40.0000	92.5000	85.4167	112.5000	200.0000
	2000	11	15.0000	20.0000	60.0000	86.3636	165.0000	200.0000
	2001	12	15.0000	22.5000	32.5000	78.3333	140.0000	225.0000

COLOR, BY STATION AND WATER

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	70.0000	231.0000	340.0000	274.4444	343.0000	377.0000
	1999	12	60.0000	87.5000	175.0000	225.8333	350.0000	500.0000
	2000	11	50.0000	60.0000	120.0000	153.6364	250.0000	400.0000
	2001	3	40.0000	40.0000	400.0000	313.3333	500.0000	500.0000
2296750	1998	9	60.0000	106.0000	179.0000	157.6667	214.0000	222.5000
	1999	12	40.0000	62.5000	90.0000	130.0000	200.0000	300.0000
	2000	11	40.0000	50.0000	60.0000	99.0909	120.0000	300.0000
	2001	3	50.0000	50.0000	60.0000	136.6667	300.0000	300.0000
2297100	1998	3	90.0000	90.0000	109.0000	123.0000	170.0000	170.0000
	1999	12	40.0000	55.0000	77.5000	105.4167	125.0000	300.0000
	2000	11	25.0000	30.0000	60.0000	79.7727	100.0000	250.0000
	2001	12	30.0000	37.5000	58.7500	80.6250	115.0000	240.0000
2297155	1998	9	104.0000	152.0000	321.0000	295.7778	374.0000	520.0000
	1999	12	60.0000	105.0000	212.5000	234.5833	325.0000	500.0000
	2000	11	30.0000	45.0000	90.0000	95.0000	120.0000	250.0000
	2001	12	45.0000	57.5000	85.0000	162.5000	312.5000	400.0000
2297310	1998	9	66.0000	95.0000	261.0000	213.2222	274.0000	336.0000
	1999	11	30.0000	70.0000	150.0000	190.9091	250.0000	500.0000
	2000	10	25.0000	35.0000	107.5000	100.0000	150.0000	200.0000
	2001	12	15.0000	42.5000	65.0000	136.8750	267.5000	350.0000

COLOR, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	56.5000	73.0000	173.0000	144.4444	194.0000	210.0000
	1999	12	45.0000	65.0000	129.0000	128.3333	185.0000	218.0000
	2000	8	40.0000	43.0000	58.5000	95.3750	150.0000	220.0000
	2001	12	49.0000	52.0000	85.0000	108.1667	115.0000	340.0000
2298608	1999	12	70.0000	92.5000	112.5000	140.8333	200.0000	250.0000
	2000	10	40.0000	65.0000	100.0000	120.0000	150.0000	300.0000
	2001	12	40.0000	75.0000	95.0000	108.3333	142.5000	195.0000
2298830	1999	12	70.0000	85.0000	137.5000	166.0417	237.5000	300.0000
	2000	10	42.5000	55.0000	117.5000	126.2500	200.0000	225.0000
	2001	12	10.0000	62.5000	90.0000	124.5833	202.5000	260.0000
2299120	1999	11	25.0000	150.0000	200.0000	198.6364	300.0000	325.0000
	2000	11	20.0000	110.0000	220.0000	193.1818	270.0000	350.0000
	2001	12	30.0000	42.5000	113.7500	131.0417	200.0000	300.0000
2299410	1999	10	30.0000	50.0000	100.0000	180.5000	300.0000	500.0000
	2000	10	30.0000	70.0000	132.5000	148.5000	200.0000	325.0000
	2001	12	25.0000	47.5000	80.0000	120.8333	210.0000	280.0000
2299455	1999	11	30.0000	60.0000	125.0000	169.3182	300.0000	350.0000
	2000	11	30.0000	45.0000	100.0000	140.0000	240.0000	350.0000
	2001	11	30.0000	40.0000	80.0000	106.5909	200.0000	210.0000

pH, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	5.9200	6.4800	6.5300	6.6800	6.8800	7.4800
	1999	12	5.9000	6.7050	6.9850	6.8525	7.0350	7.3700
	2000	11	6.0300	6.6000	6.9200	6.8636	7.1500	7.4000
	2001	12	6.5900	6.7500	6.9950	7.0417	7.3200	7.5200
2294491	1998	8	6.9100	7.4550	8.6100	8.2900	9.0600	9.1600
	1999	12	7.4300	7.9600	8.1800	8.3642	8.8100	9.6100
	2000	11	6.5100	7.4100	8.3200	8.0327	8.7000	9.1600
	2001	10	6.7600	7.2100	7.3500	7.6260	8.4000	8.9500
2294650	1998	9	6.2000	6.8100	6.9300	6.8667	7.0300	7.2700
	1999	12	6.4500	7.0350	7.0550	7.1008	7.2400	7.5600
	2000	11	6.1000	6.6400	7.0200	6.8845	7.2100	7.2900
	2001	12	6.3400	6.8650	7.2400	7.1983	7.5450	7.8900
2294898	1998	8	6.6800	7.0400	7.1750	7.1900	7.4350	7.5400
	1999	12	6.7300	7.3600	7.4850	7.4300	7.5950	7.8400
	2000	11	7.0400	7.3300	7.4200	7.4936	7.6200	8.0700
	2001	12	7.1900	7.3050	7.6250	7.7525	7.9850	9.1300
2295637	1998	9	6.7500	7.2700	7.3800	7.4133	7.4800	8.0000
	1999	12	6.9200	7.5600	7.7100	7.6358	7.8100	7.8700
	2000	11	7.1700	7.3400	7.5800	7.8509	8.1900	8.9800
	2001	12	6.6000	7.4950	7.9250	7.9158	8.6350	9.0700

pH, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	6.4800	6.5300	6.7800	6.7622	6.9800	7.0800
	1999	12	6.4300	6.6800	7.0850	6.9217	7.1500	7.2400
	2000	11	6.7000	6.8700	7.1800	7.1173	7.3500	7.4800
	2001	12	5.9800	6.7050	7.0900	7.0808	7.5600	7.8500
2296750	1998	9	6.8100	7.1000	7.1700	7.2644	7.3400	8.0000
	1999	12	6.8100	7.3000	7.5700	7.5092	7.7200	8.1800
	2000	11	7.1000	7.4300	7.7800	7.7500	8.1100	8.1800
	2001	12	6.2900	6.9700	8.1850	7.8458	8.7050	8.9700
2297100	1998	3	7.0000	7.0000	7.2300	7.3033	7.6800	7.6800
	1999	12	6.9400	7.3500	7.4350	7.4033	7.5800	7.6400
	2000	11	6.5400	7.4000	7.6300	7.5464	7.7400	8.0500
	2001	12	6.6400	7.3850	7.6550	7.5925	7.9400	8.1200
2297155	1998	9	6.0000	6.5500	6.6800	6.8244	7.3700	7.5200
	1999	12	6.3000	6.7700	6.9450	6.9900	7.3200	7.6100
	2000	11	6.5800	7.1300	7.3100	7.3355	7.5800	8.2700
	2001	12	5.6000	6.7550	7.1400	6.9375	7.4000	7.5300
2297310	1998	9	6.5500	6.5700	6.9600	6.8744	7.0600	7.3200
	1999	11	6.2900	6.8000	7.0500	7.0673	7.3700	7.7900
	2000	10	6.6600	6.9900	7.3200	7.2360	7.4700	7.6600
	2001	12	5.4800	6.6400	7.3550	7.0717	7.5800	7.8100

pH, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	6.9100	7.1200	7.2500	7.2789	7.5000	7.5700
	1999	12	7.1000	7.2450	7.5450	7.5075	7.7000	7.9500
	2000	12	7.0300	7.4100	7.7600	7.7017	8.0100	8.1100
	2001	12	6.8700	7.7300	7.7900	7.7958	8.0400	8.4100
2298608	1999	12	6.4200	6.6050	6.8700	6.9600	7.1100	7.8500
	2000	10	6.3000	6.8000	7.1450	7.0380	7.2800	7.5100
	2001	12	5.9900	6.5150	7.1800	7.0208	7.3550	8.4200
2298830	1999	12	6.2300	6.5900	7.0100	7.0125	7.3000	8.0600
	2000	10	6.3000	7.0200	7.2950	7.1340	7.3600	7.6400
	2001	12	5.6200	6.4000	6.8850	6.8150	7.3300	7.5200
2299120	1999	11	6.0600	6.4800	7.0000	6.9345	7.3200	8.0300
	2000	11	5.9500	6.7100	7.0200	6.9591	7.3400	7.6000
	2001	12	5.4400	6.3000	7.0350	6.7450	7.2450	7.3000
2299410	1999	10	6.5100	6.7200	7.3450	7.2140	7.5400	7.8000
	2000	10	6.4600	6.7300	7.0850	7.0570	7.3900	7.5200
	2001	12	5.9200	6.9950	7.2750	7.1800	7.6050	7.9900
2299455	1999	11	6.9100	7.0000	7.3200	7.2955	7.4300	7.9400
	2000	10	6.6600	6.8800	7.3300	7.2390	7.5600	7.8200
	2001	11	5.8300	6.6900	7.0700	6.9927	7.3700	7.7600

SPEC. COND. (uS/CM), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	126.7000	159.0000	209.0000	221.9667	270.0000	405.0000
	1999	12	125.0000	228.5000	297.5000	316.7500	408.5000	563.0000
	2000	11	132.3000	228.0000	268.0000	347.7545	514.0000	646.0000
	2001	12	238.0000	383.0000	484.5000	453.4167	545.0000	601.0000
2294491	1998	8	147.8000	156.5000	173.0000	173.3500	191.0000	198.0000
	1999	12	147.0000	178.0000	202.0000	196.4167	216.0000	246.0000
	2000	11	173.0000	201.0000	221.0000	228.5455	244.0000	324.0000
	2001	10	125.0000	236.0000	291.5000	314.0000	413.0000	456.0000
2294650	1998	9	129.3000	157.0000	191.0000	216.1444	264.0000	350.0000
	1999	12	131.0000	212.0000	304.5000	313.0000	359.5000	683.0000
	2000	11	151.0000	219.0000	244.0000	326.6364	426.0000	669.0000
	2001	12	255.0000	341.5000	433.0000	425.5833	500.0000	645.0000
2294898	1998	8	182.0000	194.0000	263.5000	307.2500	405.5000	550.0000
	1999	12	172.0000	324.5000	404.5000	398.4167	483.5000	570.0000
	2000	11	241.0000	293.0000	403.0000	426.0909	574.0000	685.0000
	2001	12	242.0000	308.0000	365.0000	383.5000	471.5000	585.0000
2295637	1998	9	194.0000	219.0000	339.0000	316.0000	390.0000	450.0000
	1999	12	215.0000	339.5000	400.5000	404.5833	476.5000	555.0000
	2000	11	278.0000	363.0000	478.0000	479.0909	636.0000	733.0000
	2001	12	257.0000	422.0000	522.0000	481.5000	550.0000	677.0000

SPEC. COND., BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	122.0000	127.9000	149.7000	192.9667	282.0000	333.0000
	1999	12	117.0000	163.5000	215.5000	240.5000	308.5000	409.0000
	2000	10	119.0000	229.0000	310.5000	315.7000	434.0000	464.0000
	2001	12	193.0000	294.5000	461.5000	426.5000	548.0000	654.0000
2296750	1998	9	194.0000	210.0000	335.0000	302.3333	379.0000	436.0000
	1999	12	182.0000	301.5000	351.5000	377.0000	479.5000	599.0000
	2000	11	230.0000	410.0000	472.0000	476.3636	560.0000	650.0000
	2001	12	232.0000	339.5000	593.5000	503.6667	625.0000	648.0000
2297100	1998	3	683.0000	683.0000	893.0000	845.3333	960.0000	960.0000
	1999	12	389.0000	779.0000	830.5000	896.4167	1054.5000	1495.0000
	2000	11	456.0000	1020.0000	1116.0000	1243.0909	1773.0000	1989.0000
	2001	12	761.0000	1017.5000	1394.0000	1484.0833	1906.5000	2468.0000
2297155	1998	9	72.7000	96.0000	119.0000	139.9000	171.0000	248.0000
	1999	12	76.0000	109.0000	140.5000	145.0833	181.0000	218.0000
	2000	11	98.0000	180.0000	226.0000	225.0909	286.0000	372.0000
	2001	12	84.0000	158.0000	241.0000	233.8333	307.5000	401.0000
2297310	1998	9	130.7000	141.7000	245.0000	328.9889	469.0000	739.0000
	1999	11	86.0000	290.0000	352.0000	426.6364	611.0000	817.0000
	2000	10	379.0000	475.0000	544.0000	606.0000	772.0000	907.0000
	2001	12	146.0000	318.0000	687.0000	587.6667	827.0000	872.0000

SPEC. COND., BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	418.0000	483.0000	595.0000	682.7778	866.0000	993.0000
	1999	12	484.0000	546.5000	626.0000	669.7500	799.0000	941.0000
	2000	12	484.0000	749.0000	894.0000	880.0833	1029.5000	1204.0000
	2001	12	442.0000	863.0000	1152.0000	1151.5833	1432.5000	2010.0000
2298608	1999	12	164.0000	233.5000	296.5000	353.0000	499.0000	595.0000
	2000	10	119.0000	344.0000	429.5000	462.2000	578.0000	859.0000
	2001	12	227.0000	293.5000	456.0000	440.6667	520.5000	763.0000
2298830	1999	12	133.0000	218.5000	262.0000	339.3750	442.5000	695.0000
	2000	10	200.0000	370.0000	417.0000	464.5000	624.0000	809.0000
	2001	12	149.0000	245.0000	397.0000	415.4167	571.0000	710.0000
2299120	1999	11	58.0000	91.2000	129.0000	222.7364	423.0000	533.0000
	2000	11	70.0000	97.0000	290.0000	271.6091	405.0000	480.0000
	2001	12	78.0000	96.5000	391.0000	330.9167	521.0000	538.0000
2299410	1999	10	324.0000	356.0000	609.5000	701.0000	849.0000	1419.0000
	2000	10	298.0000	358.0000	433.0000	514.8000	642.0000	914.0000
	2001	12	166.0000	345.5000	690.5000	683.9167	1031.5000	1237.0000
2299455	1999	11	255.0000	294.0000	554.0000	620.9091	925.0000	1276.0000
	2000	10	203.0000	356.0000	776.5000	712.1000	1116.0000	1236.0000
	2001	11	138.0000	289.0000	626.0000	634.0000	1105.0000	1265.0000

DO (MG/L), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	2.0000	2.9000	3.8800	4.1633	4.8600	7.4700
	1999	12	0.8000	3.3900	4.0650	4.7542	6.6250	8.0200
	2000	11	0.2400	0.7000	1.7600	3.1782	6.1000	8.3400
	2001	12	0.3200	1.7700	3.3100	3.4783	5.3350	6.5400
2294491	1998	8	1.7000	3.0950	6.3650	5.5350	7.3600	8.9400
	1999	12	2.9200	4.5150	5.4100	6.1133	7.8200	10.8600
	2000	11	1.7500	4.4400	6.8100	6.3082	7.9700	11.6100
	2001	10	0.3100	2.1200	4.1200	4.7190	5.4900	15.5600
2294650	1998	9	1.9700	2.8600	3.4100	3.9900	4.7500	6.7100
	1999	12	2.7100	2.8750	3.7000	4.7142	6.7300	8.5300
	2000	11	0.0500	1.1100	2.5000	3.2045	5.6100	8.1300
	2001	12	1.0000	2.4300	4.2600	4.3233	6.2100	7.8800
2294898	1998	8	5.0000	5.1100	5.4850	5.6938	5.9800	7.4000
	1999	12	4.4500	5.2850	6.6700	6.6200	7.8050	8.7200
	2000	11	4.3100	5.0800	7.8000	7.1727	8.5900	12.2300
	2001	12	3.0900	5.7550	8.8550	8.3458	10.6550	13.2400
2295637	1998	9	6.1200	6.4100	7.0000	7.0956	7.4000	8.7400
	1999	12	4.8500	6.6800	7.5900	7.4258	8.2000	9.6900
	2000	11	5.7500	6.7700	8.3100	8.5109	9.6800	11.5800
	2001	12	5.4800	6.4050	9.5250	9.0725	11.2350	12.6000

DO, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	4.4600	5.8700	6.0000	6.2389	6.7900	7.7200
	1999	12	3.8600	5.7100	6.8950	6.6167	7.7900	8.6600
	2000	10	5.1900	5.3400	7.2400	7.1130	7.9900	10.8400
	2001	11	3.0400	4.9700	5.9500	6.8764	9.6700	11.2800
2296750	1998	9	6.0900	6.2900	6.4400	6.8889	7.5800	8.2400
	1999	12	4.1400	6.8400	7.2350	7.2617	8.1200	8.9800
	2000	11	5.3200	7.5000	8.3300	8.3582	9.1400	12.4000
	2001	11	3.8800	4.9600	9.6500	8.6264	11.7100	14.5600
2297100	1998	3	5.9000	5.9000	7.0000	6.7000	7.2000	7.2000
	1999	11	5.5400	6.8200	7.4600	7.3573	8.0600	8.4200
	2000	11	5.3800	6.5100	7.5100	8.9845	9.7600	20.2100
	2001	11	4.5600	6.0200	8.8100	8.5045	11.1500	11.3500
2297155	1998	9	4.7700	6.5100	7.5800	7.3011	8.0700	9.1200
	1999	12	4.7200	6.6600	7.8750	7.6167	8.5650	9.4000
	2000	11	4.4200	5.9300	7.4600	7.3464	8.7200	10.6900
	2001	12	5.2500	5.7550	6.5550	6.8483	7.3500	10.9100
2297310	1998	9	5.8200	6.1500	6.8200	6.6967	7.0100	7.5000
	1999	11	4.8200	6.4400	7.3500	7.1027	8.0500	8.2700
	2000	10	3.9400	5.7700	7.8650	7.6570	9.2900	11.2500
	2001	12	4.1100	5.2700	8.0550	8.0258	10.6450	11.9200

DO, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	2.0000	3.4800	4.5100	4.5567	4.9900	8.0200
	1999	12	1.4000	2.9150	5.1200	5.0158	6.9450	8.7900
	2000	12	1.3800	5.4950	6.6450	6.3142	7.7050	8.9200
	2001	11	5.3300	7.5000	8.3000	8.0200	8.7700	9.5500
2298608	1999	12	3.3100	4.1200	5.9750	5.8392	6.8700	8.8500
	2000	10	3.4700	4.2600	6.0150	6.3490	7.9600	10.0600
	2001	12	2.1000	3.5650	7.7100	7.0367	9.5400	12.5200
2298830	1999	12	0.2200	0.5900	5.1600	3.9433	5.7750	7.4300
	2000	10	0.0500	1.1600	6.1500	5.1830	7.1100	11.3300
	2001	12	1.2300	1.9550	5.1050	4.9600	8.2150	9.8200
2299120	1999	11	3.7600	4.0600	7.4200	6.6191	8.2500	10.0700
	2000	11	1.0800	3.2500	4.8000	5.2664	6.2300	11.6400
	2001	12	1.1900	3.3500	4.1050	4.2533	5.4300	7.5100
2299410	1999	10	3.2300	5.3300	6.0000	6.1060	6.7500	8.7400
	2000	10	2.3100	4.5800	5.4050	5.9060	7.7600	9.6300
	2001	12	2.3600	3.5100	5.5300	6.0183	8.0500	12.3100
2299455	1999	10	3.4500	5.3700	6.5100	6.6280	8.6200	9.2100
	2000	10	1.7600	4.3300	5.8500	6.8000	8.1100	16.7500
	2001	11	0.5900	3.3000	4.9900	4.9373	6.3200	10.2900

CHLA [MONOCHROMATIC, uG/L], BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	0.5000	0.5000	0.5000	1.4567	0.5000	8.5400
	1999	12	0.5000	1.7950	2.8050	4.3933	4.3650	20.4000
	2000	11	0.5000	0.5000	0.5000	3.0250	5.7150	12.3000
	2001	12	0.5000	0.5000	0.5000	0.8142	0.5000	4.2700
2294491	1998	8	53.4000	88.1000	114.8000	136.8324	184.2300	266.9990
	1999	12	82.2500	98.7500	154.0850	172.5433	226.0000	333.0000
	2000	11	13.4000	32.0000	66.8000	128.1727	117.0000	512.0000
	2001	10	0.5000	21.4000	151.3500	187.9000	260.0000	612.0000
2294650	1998	9	0.5000	6.4100	18.7000	22.7167	35.6000	69.4000
	1999	12	1.2700	2.0900	3.9500	29.9908	36.6650	155.0000
	2000	11	0.5000	0.5000	2.6700	18.3227	20.3000	119.0000
	2001	12	0.5000	0.5000	0.5000	1.9758	0.5000	10.7000
2294898	1998	9	0.5000	0.5000	11.6000	16.5522	24.0000	64.1000
	1999	12	0.5000	0.5000	1.6950	14.9708	23.8050	64.2000
	2000	11	0.5000	0.5000	1.0700	8.7318	11.2000	47.7000
	2001	12	0.5000	0.5000	0.5000	1.9750	0.5000	17.1000
2295637	1998	8	0.5000	0.5000	4.6750	14.0063	10.7000	79.8000
	1999	12	1.0800	1.2800	2.4450	5.8304	8.7100	23.0000
	2000	11	0.5000	0.5000	1.1300	5.6118	6.9400	23.5000
	2001	12	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

CHLA [MONOCHROMATIC], BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
	1999	6	0.5000	0.5000	2.0250	1.7033	2.5200	2.6500
	2000	11	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
	2001	12	0.5000	0.5000	0.5000	1.0333	1.0500	4.5000
2296750	1998	9	0.5000	0.5000	2.9350	5.8211	4.8100	26.7000
	1999	6	1.1600	1.9000	3.1750	3.2017	4.2700	5.5300
	2000	11	0.5000	0.5000	0.5000	0.9527	0.5000	5.4800
	2001	12	0.5000	0.5000	0.5000	1.1750	1.7500	4.4000
2297100	1998	3	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
	1999	12	0.5000	0.5000	0.5000	1.1567	1.5650	3.3700
	2000	11	0.5000	0.5000	0.5000	1.5536	2.1400	6.1400
	2001	12	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
2297155	1998	9	0.5000	0.5000	0.5000	0.9033	0.5000	3.5600
	1999	12	0.5000	0.5000	1.0550	1.2171	1.6450	3.3600
	2000	11	0.5000	0.5000	0.5000	12.9700	1.6000	129.0000
	2001	12	0.5000	0.5000	0.5000	0.5700	0.5000	1.3400
2297310	1998	9	0.5000	0.5000	0.5000	4.0667	0.5000	31.5000
	1999	11	0.5000	0.5000	0.5000	1.3227	1.8400	4.1200
	2000	10	0.5000	0.5000	0.5000	1.8420	2.1400	6.6800
	2001	12	0.5000	0.5000	0.5000	0.9475	0.5000	5.8700

CHLA [MONOCHROMATIC], BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	0.5000	0.5000	4.9000	7.0156	11.2000	20.0000
2298608	1999	11	0.5000	0.5000	1.6700	1.7255	2.4400	3.8500
	2000	10	0.5000	0.5000	0.5000	0.9870	1.3700	2.6700
	2001	12	0.5000	0.5000	0.5000	0.6067	0.5000	1.7800
2298830	1999	11	0.5000	3.5300	4.3500	6.1068	6.3350	23.3000
	2000	10	0.5000	1.8700	3.4700	6.2590	9.3700	22.9000
	2001	12	0.5000	0.5000	3.2000	6.4825	6.6750	36.8000
2299120	1999	10	0.5000	1.1000	2.3550	2.6705	4.0600	5.6400
	2000	11	0.5000	0.5000	1.5800	3.1291	2.1400	20.0000
	2001	12	0.5000	0.5000	0.5000	1.8033	1.0500	13.4000
2299410	1999	9	0.5000	1.2400	2.3000	4.6356	6.1500	19.2200
	2000	10	0.5000	1.6000	2.4100	3.4040	3.2000	9.3500
	2001	12	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000
2299455	1999	10	0.5000	0.5000	2.6725	3.2285	3.9300	9.2550
	2000	11	0.5000	0.5000	0.5000	1.3505	2.1800	4.0000
	2001	11	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000

NH4-N (MG N/L), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	0.0050	0.0500	0.0850	0.0973	0.1390	0.2220
	1999	12	0.0280	0.0550	0.0810	0.0814	0.1100	0.1400
	2000	11	0.0230	0.0460	0.0760	0.0986	0.1230	0.2290
	2001	12	0.0260	0.0335	0.0500	0.0609	0.0760	0.1620
2294491	1998	8	0.0050	0.0050	0.0050	0.0144	0.0245	0.0410
	1999	12	0.0050	0.0050	0.0050	0.0168	0.0243	0.0730
	2000	11	0.0050	0.0050	0.0290	0.1989	0.2090	1.2600
	2001	10	0.0180	0.0850	0.1490	1.6577	1.3100	8.1900
2294650	1998	9	0.0050	0.0110	0.0310	0.0702	0.0950	0.2360
	1999	12	0.0210	0.0425	0.0760	0.0789	0.1160	0.1440
	2000	10	0.0050	0.0250	0.0450	0.0487	0.0690	0.1000
	2001	12	0.0050	0.0270	0.0535	0.0870	0.0780	0.3870
2294898	1998	9	0.0050	0.0260	0.0390	0.0367	0.0430	0.0690
	1999	12	0.0050	0.0165	0.0335	0.0309	0.0400	0.0610
	2000	11	0.0050	0.0050	0.0360	0.0295	0.0420	0.0560
	2001	12	0.0050	0.0095	0.0200	0.0300	0.0305	0.1470
2295637	1998	9	0.0050	0.0120	0.0190	0.0241	0.0400	0.0600
	1999	12	0.0050	0.0160	0.0265	0.0355	0.0403	0.1210
	2000	10	0.0050	0.0130	0.0320	0.0295	0.0460	0.0540
	2001	12	0.0050	0.0170	0.0265	0.0310	0.0405	0.0750

NH4-N, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	0.0050	0.0420	0.0510	0.0443	0.0530	0.0670
	1999	12	0.0050	0.0285	0.0360	0.0553	0.0590	0.1600
	2000	11	0.0050	0.0230	0.0380	0.0395	0.0530	0.0970
	2001	12	0.0110	0.0210	0.0290	0.0582	0.0685	0.2500
2296750	1998	9	0.0050	0.0160	0.0395	0.0417	0.0455	0.0960
	1999	12	0.0190	0.0300	0.0495	0.0498	0.0580	0.1200
	2000	11	0.0200	0.0270	0.0460	0.0481	0.0570	0.1100
	2001	12	0.0110	0.0275	0.0380	0.0563	0.0900	0.1300
2297100	1998	3	0.0110	0.0110	0.0150	0.0150	0.0190	0.0190
	1999	12	0.0050	0.0115	0.0205	0.0292	0.0430	0.0770
	2000	10	0.0050	0.0050	0.0200	0.0248	0.0390	0.0690
	2001	12	0.0050	0.0083	0.0318	0.0360	0.0465	0.1290
2297155	1998	9	0.0050	0.0050	0.0170	0.0199	0.0360	0.0400
	1999	12	0.0050	0.0050	0.0090	0.0132	0.0205	0.0340
	2000	10	0.0050	0.0050	0.0195	0.1155	0.0530	0.8470
	2001	12	0.0050	0.0090	0.0300	0.2694	0.0495	2.9300
2297310	1998	9	0.0050	0.0250	0.0380	0.0339	0.0440	0.0620
	1999	11	0.0050	0.0050	0.0210	0.0267	0.0340	0.0850
	2000	9	0.0050	0.0050	0.0350	0.0399	0.0680	0.0860
	2001	12	0.0050	0.0095	0.0273	0.0397	0.0725	0.0890

NH4-N, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	0.0050	0.0050	0.0050	0.0201	0.0240	0.0600
	1999	12	0.0050	0.0100	0.0285	0.0386	0.0695	0.0940
	2000	12	0.0050	0.0050	0.0180	0.0310	0.0575	0.0770
	2001	12	0.0050	0.0105	0.0265	0.0362	0.0550	0.1030
2298608	1999	12	0.0050	0.0050	0.0205	0.0723	0.0955	0.3030
	2000	10	0.0050	0.0200	0.0358	0.0714	0.1265	0.1970
	2001	12	0.0050	0.0130	0.0235	0.0348	0.0475	0.1440
2298830	1999	12	0.0050	0.0118	0.0273	0.0455	0.0550	0.2170
	2000	10	0.0050	0.0050	0.0373	0.0570	0.0760	0.2060
	2001	12	0.0050	0.0200	0.0305	0.0488	0.0825	0.1190
2299120	1999	11	0.0050	0.0050	0.0320	0.0369	0.0640	0.0890
	2000	11	0.0050	0.0300	0.0800	0.0928	0.1150	0.2840
	2001	12	0.0050	0.0345	0.0525	0.0739	0.0840	0.2630
2299410	1999	10	0.0050	0.0050	0.0480	0.0876	0.2100	0.2350
	2000	10	0.0150	0.0580	0.1140	0.2239	0.1660	0.9460
	2001	12	0.0050	0.0195	0.0395	0.0633	0.0970	0.2280
2299455	1999	11	0.0050	0.0145	0.0560	0.0629	0.0890	0.2050
	2000	11	0.0050	0.0220	0.0695	0.0709	0.1120	0.1390
	2001	11	0.0050	0.0410	0.0810	0.0926	0.1720	0.2320

NO23-N (MG N/L), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	0.0260	0.1000	0.2360	0.2891	0.4870	0.7170
	1999	12	0.0050	0.2110	0.3965	0.3602	0.4760	0.7890
	2000	10	0.0050	0.0670	0.1275	0.2131	0.3360	0.5930
	2001	12	0.0050	0.1330	0.1645	0.2717	0.4435	0.7120
2294491	1998	8	0.0050	0.0050	0.0050	0.0174	0.0280	0.0580
	1999	12	0.0050	0.0050	0.0050	0.0409	0.0115	0.4100
	2000	10	0.0050	0.0050	0.0140	0.0190	0.0330	0.0530
	2001	10	0.0050	0.0180	0.0200	0.0377	0.0260	0.1890
2294650	1998	9	0.0600	0.1040	0.1370	0.1874	0.2580	0.4560
	1999	12	0.0050	0.1110	0.2210	0.3302	0.5180	0.9000
	2000	10	0.0050	0.0150	0.0520	0.1571	0.3520	0.5210
	2001	12	0.0170	0.0925	0.1750	0.2021	0.2685	0.6180
2294898	1998	9	0.1300	0.1890	0.3020	0.3518	0.4300	0.8910
	1999	12	0.0240	0.2900	0.5430	0.5073	0.6780	1.1700
	2000	11	0.0050	0.1330	0.2550	0.2794	0.3780	0.7330
	2001	12	0.0120	0.1415	0.2845	0.7716	1.4600	2.3700
2295637	1998	9	0.2500	0.3350	0.4780	0.5881	0.6680	1.1400
	1999	12	0.0050	0.4695	0.6543	0.6471	0.9460	1.3600
	2000	10	0.2050	0.4360	0.5950	0.6679	0.7740	1.4300
	2001	12	0.4680	0.6275	0.9270	1.0192	1.3050	1.9300

NO23-N, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	0.0840	0.1740	0.2300	0.3204	0.3990	0.7860
	1999	12	0.0050	0.1100	0.1800	0.2256	0.3900	0.4700
	2000	11	0.0050	0.0130	0.2000	0.2740	0.6100	0.7200
	2001	12	0.0050	0.0130	0.2250	1.2130	1.3500	7.9000
2296750	1998	9	0.3000	0.3770	0.4445	0.6234	0.7540	1.3500
	1999	12	0.2900	0.4100	0.6050	0.6017	0.8100	0.8500
	2000	11	0.0050	0.1600	0.5500	0.5092	0.7800	1.1000
	2001	12	0.0050	0.2350	0.6050	0.7993	0.9350	2.9000
2297100	1998	3	0.9530	0.9530	1.0500	1.0443	1.1300	1.1300
	1999	12	0.0200	0.8090	0.9725	1.0308	1.1050	2.2000
	2000	10	0.0305	0.4940	0.9855	1.0427	1.2100	2.9300
	2001	12	0.5370	0.7093	0.9835	1.4229	2.1000	3.5200
2297155	1998	9	0.0540	0.0790	0.1080	0.1057	0.1200	0.1790
	1999	12	0.0050	0.0245	0.0580	0.0654	0.1033	0.1480
	2000	10	0.0050	0.0140	0.0785	0.2552	0.1480	1.9500
	2001	12	0.0050	0.0160	0.0690	0.5021	0.1260	4.9000
2297310	1998	9	0.1710	0.2390	0.3320	0.4273	0.3960	1.0550
	1999	11	0.0050	0.0930	0.4490	0.3981	0.6540	0.8020
	2000	9	0.0190	0.4710	0.5530	0.5139	0.6400	0.8180
	2001	12	0.1850	0.3145	0.8373	1.1329	1.7600	2.9900

NO23-N, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	0.0050	0.0170	0.1470	0.1030	0.1670	0.2100
	1999	12	0.0050	0.0050	0.0795	0.0694	0.1150	0.1790
	2000	12	0.0050	0.0050	0.0200	0.0590	0.0875	0.2510
	2001	12	0.0050	0.0050	0.0100	0.0438	0.0810	0.1490
2298608	1999	12	0.0050	0.0050	0.0195	0.0483	0.0810	0.1580
	2000	10	0.0130	0.0360	0.0845	0.0808	0.1100	0.1645
	2001	12	0.0050	0.0050	0.0170	0.0348	0.0645	0.1000
2298830	1999	12	0.0050	0.0050	0.0085	0.0173	0.0250	0.0520
	2000	10	0.0050	0.0050	0.0080	0.0173	0.0300	0.0490
	2001	12	0.0050	0.0085	0.0295	0.1207	0.1020	0.8840
2299120	1999	11	0.0050	0.0050	0.0180	0.0218	0.0260	0.0740
	2000	11	0.0050	0.0050	0.0210	0.0288	0.0500	0.1105
	2001	12	0.0050	0.0050	0.0145	0.0441	0.0365	0.2780
2299410	1999	10	0.0050	0.0120	0.0945	0.1242	0.1170	0.6230
	2000	10	0.0050	0.0720	0.1845	0.3405	0.3320	1.8400
	2001	12	0.0050	0.0190	0.0790	0.2097	0.2040	1.0300
2299455	1999	11	0.0050	0.0050	0.0520	0.0659	0.0990	0.2420
	2000	11	0.0050	0.0410	0.0740	0.1459	0.1550	0.7510
	2001	11	0.0050	0.0270	0.0560	0.1337	0.1540	0.5380

TKN (MG/L), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	1.1700	1.2100	1.4100	1.4367	1.4800	2.1200
	2000	10	0.9650	1.1600	1.4350	1.7785	2.3700	3.3200
	2001	12	1.0300	1.2450	1.3600	1.5983	1.9550	2.5900
2294491	1998	8	2.8800	3.5900	4.4800	4.7313	6.1450	6.5400
	2000	10	1.2200	2.6800	3.2500	4.2670	4.5400	12.1000
	2001	10	1.5900	2.0800	8.7650	8.9850	14.4000	21.4000
2294650	1998	9	0.5360	1.4700	1.5400	1.8673	1.7500	3.5800
	2000	10	0.9670	1.1100	1.5050	1.5307	1.7200	2.6800
	2001	12	0.8990	0.9340	1.2550	1.4565	1.8000	2.6900
2294898	1998	9	0.7710	0.9030	1.4300	1.4142	1.4700	2.4200
	2000	10	0.5500	0.5970	0.7110	0.9140	1.1300	2.1100
	2001	12	0.4530	0.5475	0.6430	0.7638	0.8630	1.8300
2295637	1998	9	0.7070	0.8330	1.1100	1.0926	1.2600	1.5000
	2000	10	0.6140	0.7900	0.8975	0.9842	1.1500	1.7200
	2001	12	0.5800	0.6260	0.7625	0.9764	1.2650	1.8500
2296500	1998	9	0.6860	0.9910	1.3000	1.1613	1.3100	1.4000
	1999	12	0.5600	0.7650	0.9600	1.1583	1.6000	2.0000
	2000	11	0.6000	0.6000	0.9400	1.0036	1.3000	1.9000
	2001	12	0.5000	0.5900	0.7150	1.1000	1.7000	2.5000

TKN, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296750	1998	9	0.8815	0.9060	0.9910	1.0789	1.1600	1.5700
	1999	12	0.5500	0.6300	0.7650	0.9108	1.3000	1.4000
	2000	11	0.5400	0.6800	0.7600	0.8300	1.0000	1.3000
	2001	12	0.5700	0.6000	0.7050	0.9883	1.4500	2.0000
2297100	1998	3	0.9990	0.9990	1.1100	1.1163	1.2400	1.2400
	2000	10	0.4800	0.7690	0.8558	0.9727	1.3000	1.6600
	2001	12	0.7660	0.8815	1.1400	1.3148	1.4800	2.6500
2297155	1998	9	0.5810	0.8300	0.9440	0.9658	1.1000	1.6100
	2000	10	0.4700	0.5810	0.7310	1.0479	1.2400	3.0800
	2001	12	0.4210	0.5940	1.0635	1.4227	1.6750	5.0800
2297310	1998	9	0.3730	0.8070	0.9510	0.8921	1.1000	1.2000
	2000	10	0.4700	0.7350	0.9955	1.0051	1.2300	1.5200
	2001	12	0.5620	0.6940	0.8848	1.4150	1.8450	4.4900
2298202	1998	9	0.9025	1.0800	1.3000	1.2425	1.3600	1.5400
	1999	12	0.0250	0.9005	1.0510	1.1113	1.4500	1.7800
	2000	12	0.0250	0.8650	1.1150	1.0963	1.3900	1.7300
	2001	12	0.7400	0.9755	1.2000	1.2243	1.3900	2.0400
2298608	2000	9	0.6650	0.8500	0.9140	0.9504	1.0200	1.2200
	2001	12	0.6610	0.7983	1.0450	1.0823	1.1900	2.1100

TKN, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298830	2000	9	0.7400	0.9595	1.1900	1.3156	1.6400	1.8500
	2001	12	0.9120	1.1650	1.3050	1.3277	1.4450	1.8100
2299120	2000	10	0.5470	1.0250	1.6550	1.6428	1.9100	3.7300
	2001	12	0.3860	0.6335	1.1115	1.1718	1.7050	2.1300
2299410	2000	9	0.5900	0.7180	1.5400	1.4641	2.0500	2.3500
	2001	12	0.6060	0.8345	1.2000	1.2239	1.6550	1.8800
2299455	2000	10	0.6100	0.7590	0.9745	1.1699	1.5700	2.0200
	2001	11	0.5005	0.6745	1.1500	1.1026	1.5300	1.6400

PO4-P (MG P/L), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	0.0670	0.0900	0.2390	0.2411	0.3240	0.6270
	1999	12	0.1360	0.2398	0.3520	0.4667	0.5900	1.0500
	2000	11	0.1180	0.1540	0.2160	0.3811	0.6740	1.2300
	2001	12	0.1170	0.2375	0.3135	0.4238	0.6480	0.8210
2294491	1998	8	0.0050	0.0155	0.0975	0.1115	0.2115	0.2380
	1999	12	0.0050	0.0050	0.0225	0.0348	0.0488	0.1165
	2000	11	0.0050	0.0050	0.0180	0.0281	0.0310	0.1480
	2001	10	0.0140	0.1230	0.4200	0.6711	0.8360	2.1900
2294650	1998	9	0.0940	0.1655	0.2080	0.5915	1.1000	1.3000
	1999	12	0.0140	0.2745	0.7865	1.1694	2.0300	3.4390
	2000	11	0.0390	0.1880	0.3450	0.4256	0.5280	1.1200
	2001	12	0.1440	0.3535	0.5365	0.9250	1.6550	2.1600
2294898	1998	9	0.2200	0.5010	0.6700	0.6522	0.8640	0.9430
	1999	12	0.4650	0.5610	0.6525	0.6801	0.7885	0.9540
	2000	11	0.6050	0.6540	0.6800	0.7427	0.8200	1.0200
	2001	12	0.3280	0.3475	0.5565	0.5783	0.7855	0.9950
2295637	1998	9	0.5580	0.7900	0.8410	0.8232	0.8810	1.1200
	1999	12	0.5900	0.8723	0.9308	0.9473	1.0445	1.2260
	2000	11	0.6410	0.7350	0.8610	0.9033	1.1100	1.1800
	2001	12	0.8420	0.9560	1.1050	1.1333	1.2850	1.6500

PO4-P, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	0.3140	0.4200	0.5200	0.5408	0.6440	0.9070
	1999	12	0.2800	0.4100	0.4850	0.5067	0.6600	0.7200
	2000	11	0.1700	0.3200	0.4100	0.4664	0.6200	1.1000
	2001	12	0.1300	0.2150	0.3800	0.3925	0.5000	0.8000
2296750	1998	9	0.5305	0.7365	0.8005	0.7799	0.8930	0.9600
	1999	11	0.6400	0.8000	0.8500	0.8545	0.9800	1.0000
	2000	11	0.5400	0.6300	0.8900	0.8627	1.1000	1.2000
	2001	12	0.4600	0.6850	0.7300	0.7867	0.9050	1.2000
2297100	1998	3	0.1360	0.1360	0.1920	0.1770	0.2030	0.2030
	1999	12	0.0740	0.1065	0.1315	0.1426	0.1690	0.2500
	2000	11	0.0510	0.0870	0.1040	0.1106	0.1400	0.1490
	2001	12	0.0415	0.0625	0.1070	0.1385	0.1915	0.3540
2297155	1998	9	0.1760	0.2920	0.3630	0.3573	0.3810	0.5760
	1999	12	0.2340	0.2495	0.3490	0.3975	0.4335	0.9270
	2000	11	0.2880	0.2980	0.3660	0.4770	0.6610	0.9780
	2001	12	0.3000	0.3565	0.5250	0.5246	0.6220	0.9150
2297310	1998	9	0.3500	0.3700	0.3920	0.4010	0.4300	0.4460
	1999	11	0.3070	0.3370	0.3510	0.3721	0.3890	0.5470
	2000	10	0.2250	0.2920	0.3653	0.5122	0.6070	1.5700
	2001	12	0.1550	0.2998	0.3795	0.3938	0.4650	0.6820

PO4-P, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	0.0580	0.0900	0.1200	0.1175	0.1330	0.1950
	1999	12	0.0340	0.0515	0.0780	0.1046	0.1135	0.2990
	2000	12	0.0050	0.0285	0.0515	0.0612	0.0825	0.1610
	2001	12	0.0050	0.0270	0.0820	0.0940	0.1410	0.2620
2298608	1999	12	0.1030	0.1705	0.3230	0.2948	0.3895	0.4590
	2000	10	0.1260	0.1590	0.2300	0.2490	0.2650	0.4530
	2001	12	0.0250	0.1048	0.1800	0.2220	0.3460	0.4580
2298830	1999	12	0.2480	0.2910	0.3493	0.3660	0.4295	0.5385
	2000	10	0.0750	0.2250	0.2515	0.2730	0.3340	0.5520
	2001	12	0.0620	0.1695	0.3160	0.3293	0.4690	0.5950
2299120	1999	11	0.0400	0.0700	0.0880	0.1405	0.2000	0.3960
	2000	11	0.0140	0.1030	0.3800	0.3822	0.4300	1.3900
	2001	12	0.0790	0.1225	0.1920	0.2278	0.2895	0.5720
2299410	1999	10	0.1030	0.2250	0.2775	0.2809	0.3450	0.5150
	2000	10	0.0890	0.1270	0.3055	0.2919	0.4220	0.4520
	2001	12	0.0320	0.1140	0.2805	0.2741	0.4080	0.5620
2299455	1999	11	0.1365	0.1815	0.2820	0.2879	0.3610	0.5420
	2000	11	0.1040	0.1500	0.1550	0.1884	0.2235	0.3990
	2001	11	0.0350	0.1270	0.2060	0.2071	0.2860	0.3310
	2002	3	0.1570	0.1570	0.2170	0.2233	0.2960	0.2960

TP (MG/L), BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	0.1080	0.1300	0.3570	0.3289	0.4390	0.7710
	1999	12	0.2020	0.2783	0.4485	0.5203	0.6630	1.0600
	2000	11	0.1545	0.2180	0.2700	0.4772	0.7360	1.4500
	2001	12	0.1890	0.3085	0.4095	0.4914	0.6935	0.8370
2294491	1998	8	0.3950	0.5295	0.5885	0.5740	0.6255	0.7100
	1999	12	0.1520	0.2040	0.3010	0.3098	0.3860	0.5550
	2000	11	0.0490	0.1570	0.3340	0.3527	0.5230	0.9630
	2001	10	0.3940	1.2700	1.6900	2.6454	2.9500	10.5000
2294650	1998	9	0.2490	0.3275	0.6000	0.8338	1.2900	1.6600
	1999	12	0.3940	0.4720	0.9450	1.3853	2.3200	3.5280
	2000	11	0.1260	0.2400	0.4280	0.5189	0.5890	1.3000
	2001	12	0.1950	0.4050	0.6170	1.0328	1.8700	2.3900
2294898	1998	9	0.6800	0.8300	1.0600	0.9892	1.1200	1.2700
	1999	12	0.5830	0.6895	0.8233	0.8443	1.0050	1.1560
	2000	11	0.6610	0.7370	0.8650	0.9219	1.0400	1.4200
	2001	12	0.3450	0.4485	0.7490	0.6863	0.8850	1.0900
2295637	1998	9	0.7720	0.9080	0.9520	1.0357	1.0800	1.7800
	1999	12	0.8370	1.0015	1.0533	1.0863	1.1605	1.3650
	2000	11	0.7820	0.8770	0.9600	1.0020	1.1900	1.2300
	2001	12	0.9470	1.0750	1.2200	1.2766	1.3700	2.1600

TP, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	0.4630	0.4900	0.6010	0.6379	0.7450	0.9980
	1999	12	0.3600	0.4650	0.5850	0.5742	0.6500	0.8000
	2000	11	0.2500	0.4300	0.4900	0.5555	0.6700	1.2000
	2001	12	0.1600	0.2800	0.4900	0.4867	0.5700	1.0000
2296750	1998	9	0.6720	0.8510	0.9340	0.9133	0.9800	1.0700
	1999	12	0.5900	0.8800	0.9700	0.9608	1.1000	1.2000
	2000	11	0.6200	0.7200	0.8800	0.9582	1.1000	1.3000
	2001	12	0.5100	0.7650	0.8450	0.8767	1.0150	1.3000
2297100	1998	3	0.2350	0.2350	0.2450	0.2443	0.2530	0.2530
	1999	12	0.0930	0.1350	0.1525	0.1791	0.2090	0.3400
	2000	11	0.0665	0.1115	0.1480	0.1504	0.1890	0.2530
	2001	12	0.0650	0.1075	0.1335	0.1812	0.2568	0.4140
2297155	1998	9	0.2320	0.3480	0.3660	0.4151	0.4930	0.6350
	1999	12	0.2630	0.2850	0.3995	0.4384	0.4640	0.9870
	2000	11	0.3080	0.3440	0.3990	0.5767	0.9240	1.2300
	2001	12	0.3000	0.4315	0.5705	0.6066	0.7710	1.1500
2297310	1998	9	0.4200	0.4610	0.4650	0.4871	0.5250	0.5750
	1999	11	0.3430	0.3690	0.3730	0.4261	0.4670	0.6750
	2000	10	0.2530	0.3350	0.4785	0.5874	0.6960	1.6500
	2001	12	0.2020	0.3435	0.4108	0.4644	0.5980	0.8300

TP, BY STATION AND WATER YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	0.1120	0.1240	0.1700	0.1782	0.1985	0.2730
	1999	12	0.0650	0.0760	0.1295	0.1506	0.1780	0.3650
	2000	12	0.0390	0.0665	0.0905	0.1090	0.1375	0.2520
	2001	12	0.0510	0.0675	0.1445	0.1460	0.1985	0.3390
2298608	1999	12	0.1270	0.1895	0.3485	0.3226	0.4075	0.5340
	2000	10	0.1540	0.1980	0.2570	0.2834	0.2985	0.5180
	2001	12	0.1040	0.1440	0.2765	0.2756	0.3845	0.4880
2298830	1999	12	0.2980	0.3315	0.4090	0.4246	0.4730	0.6630
	2000	10	0.1850	0.2270	0.3048	0.3343	0.3940	0.6650
	2001	12	0.1700	0.2280	0.4090	0.4035	0.5465	0.6420
2299120	1999	11	0.0730	0.0880	0.1290	0.2455	0.4030	0.8540
	2000	11	0.0430	0.1280	0.4390	0.6634	0.9410	1.8800
	2001	12	0.1030	0.2195	0.5293	0.4798	0.6645	0.9740
2299410	1999	10	0.1290	0.2390	0.3440	0.3638	0.4600	0.6750
	2000	10	0.1280	0.1420	0.4025	0.4142	0.5730	0.7460
	2001	12	0.0800	0.1490	0.3305	0.3548	0.5455	0.6550
2299455	1999	11	0.1840	0.2740	0.3205	0.3546	0.4345	0.6060
	2000	10	0.1250	0.1730	0.2548	0.2539	0.2915	0.5290
	2001	11	0.0710	0.2020	0.2860	0.2763	0.3745	0.4220
	2002	3	0.2610	0.2610	0.2720	0.2910	0.3400	0.3400

TOC (MG/L), BY STATION AND YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2293987	1998	9	13.0000	19.9000	21.9000	20.5222	22.6000	26.8000
	1999	12	13.7000	17.4000	23.0500	22.8750	28.4000	30.9000
	2000	11	11.5000	13.4000	19.6000	21.4314	27.9000	37.6000
	2001	12	12.2000	15.4000	18.9000	22.8417	30.3500	38.1000
2294491	1998	8	11.8000	13.0500	16.6000	16.4500	19.7000	21.1000
	1999	12	22.4000	26.6250	30.4000	29.7292	33.2000	35.4000
	2000	11	13.6000	18.1400	20.7000	24.4191	24.8000	46.8200
	2001	10	9.2600	23.4000	31.9500	38.3660	58.2000	62.1000
2294650	1998	9	12.6000	15.5000	18.1000	17.0000	18.4000	20.5000
	1999	12	13.3000	17.4500	21.9000	21.2250	25.4500	27.3000
	2000	11	11.7000	13.6000	20.3000	21.9018	28.0000	39.3700
	2001	12	8.9700	12.3500	15.4000	19.1308	25.1000	36.0000
2294898	1998	9	8.2600	14.2000	15.1000	14.3844	15.8000	20.8000
	1999	12	8.0500	10.1000	13.4000	15.4458	21.9000	25.0000
	2000	11	3.1800	7.9200	11.4100	13.0300	20.2000	26.8000
	2001	12	4.3700	5.3300	6.1700	9.7250	11.5500	30.9000
2295637	1998	9	9.1400	10.9000	13.4000	15.0933	16.7000	30.6000
	1999	12	8.7000	10.5500	13.5500	14.8042	18.6250	24.0000
	2000	11	9.3000	10.2000	12.7000	14.4691	19.3500	23.9900
	2001	12	7.1500	8.0300	9.9400	15.0000	22.7000	30.8000

TOC, BY STATION AND YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2296500	1998	9	8.9600	19.6000	20.7000	21.2844	26.4000	30.4000
	1999	12	10.0000	13.5000	22.5000	24.0000	33.5000	47.0000
	2000	11	9.7000	9.8000	15.0000	18.9273	22.0000	50.0000
	2001	12	7.4000	7.9500	13.9000	19.7000	27.5000	49.0000
2296750	1998	9	8.6900	12.7000	14.7000	14.6511	17.1500	20.7000
	1999	11	9.9000	12.0000	15.0000	16.9909	23.0000	31.0000
	2000	11	8.1000	11.0000	12.0000	13.4000	16.0000	21.0000
	2001	12	8.0000	9.0500	10.4000	15.6583	22.0000	34.0000
2297100	1998	3	12.7000	12.7000	14.1000	15.1333	18.6000	18.6000
	1999	12	10.6000	13.2000	15.3500	17.3225	22.5500	27.3000
	2000	11	8.7550	10.4000	11.8000	14.3732	17.8000	24.1700
	2001	12	9.3100	10.8500	12.6000	15.2675	19.8000	26.0000
2297155	1998	9	9.5200	11.7000	21.8000	19.4244	25.4000	32.6000
	1999	12	9.6000	12.7750	20.0500	20.7792	29.8500	32.7000
	2000	11	7.5200	8.7400	13.3550	14.9332	22.5300	27.3000
	2001	12	8.8200	10.6500	14.2500	20.4350	32.2000	43.0000
2297310	1998	9	8.0600	14.0000	17.1000	17.0900	22.9000	25.0000
	1999	11	9.7000	10.4000	16.4000	19.4055	28.3000	37.6000
	2000	10	8.8900	9.7600	15.8000	15.4010	20.3000	23.6000
	2001	12	7.1100	9.0975	13.8500	18.4417	29.4500	37.4000

TOC, BY STATION AND YEAR

GAGE_NUM	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
2298202	1998	9	11.8000	13.5000	16.7000	16.3833	18.7000	20.9000
	1999	5	13.8000	18.7000	23.9000	22.3000	24.3000	30.8000
	2000	12	11.7000	15.6500	18.4000	18.8667	23.1500	25.0000
	2001	12	10.4000	12.5000	14.6000	16.1750	18.8500	29.1000
2298608	1999	12	16.8000	17.3500	19.6000	21.0192	25.5000	28.5000
	2000	10	13.2000	16.0000	17.4500	17.9350	20.7000	23.2500
	2001	12	13.6000	15.5250	18.1000	19.8292	22.7500	30.3000
2298830	1999	12	18.0000	18.6050	21.7500	23.4758	28.9000	32.0000
	2000	10	14.9000	16.9000	20.4250	19.9835	21.8400	26.1000
	2001	12	15.0000	18.7500	21.6500	21.7875	25.0750	28.8000
2299120	1999	11	11.6000	18.0000	22.1000	22.3682	28.1000	33.5000
	2000	11	10.7000	19.1600	25.3000	24.3982	28.8000	49.1000
	2001	12	6.2900	11.9250	20.4750	19.2992	25.8000	32.8000
2299410	1999	10	7.7500	12.9000	16.5500	21.8850	34.5000	38.2000
	2000	10	10.2000	13.1000	17.6000	18.7500	24.4000	30.0000
	2001	12	7.7200	10.4500	19.5000	19.8417	28.4500	36.0000
2299455	1999	11	9.3550	14.9500	17.7500	21.3914	33.4500	35.9000
	2000	11	11.1000	12.8400	16.0000	18.5214	24.9500	29.8000
	2001	11	7.8600	10.0000	18.4000	18.0641	24.4000	26.4000

APPENDIX B

CONSTITUENT SUMMARIES FOR TIDAL STATIONS

WATER YEARS 1994 - 2000

Near-surface salinity (ppt)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-001	1994	12	0.1000	1.0250	6.9250	6.1583	10.1500	13.6000
	1995	12	0.0000	0.2500	3.0500	3.5403	4.8250	10.2000
	1996	12	0.1000	1.5500	3.9250	4.8889	7.1500	14.0667
	1997	11	0.0000	7.4000	11.9500	10.6500	14.8667	18.3000
	1998	11	0.0000	0.2200	1.6000	2.2556	3.3500	10.3500
	1999	10	0.1500	0.3200	2.0192	6.6068	15.6100	19.0100
	2000	11	0.1700	1.6050	7.4133	8.7979	13.4050	24.8850
CH-002	1994	12	0.3000	8.7893	16.9133	14.3953	20.1500	22.7000
	1995	12	0.0000	4.0000	12.6571	10.2087	14.2214	17.6714
	1996	12	0.1000	11.0000	13.8298	12.9170	15.9143	20.1250
	1997	12	5.7733	14.5429	19.9567	18.1479	22.1607	25.6857
	1998	11	0.1000	0.8883	10.2286	7.8387	12.2317	17.9717
	1999	10	2.7114	6.7433	11.4690	12.8154	21.0629	23.7286
	2000	11	0.3071	13.7857	19.7400	17.6164	23.6650	27.9729
CH-02B	1994	12	1.9000	12.3167	21.0167	17.4299	22.6542	23.7000
	1995	12	0.0000	8.2500	15.7500	13.1592	17.7500	19.3000
	1996	12	0.6333	13.7083	17.1750	15.3225	18.6167	20.6700
	1997	12	10.0333	17.7500	22.6000	20.9847	24.3333	27.1000
	1998	11	1.1000	6.3000	13.2000	12.0679	16.7000	26.2867
	1999	10	10.2467	12.5550	14.2492	16.5645	21.7700	24.4167
	2000	11	8.6500	16.3950	23.2967	20.7386	25.3000	28.5600

Near-surface salinity (ppt)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	0.0000	0.0000	0.1333	2.5285	3.0667	11.2000
	1995	12	0.0000	0.0000	0.0000	0.1972	0.0000	2.2667
	1996	12	0.0000	0.0000	0.0000	0.3329	0.2000	2.6200
	1997	12	0.0000	0.1500	3.6733	3.3335	6.1575	7.6000
	1998	10	0.0000	0.0300	0.1500	0.4037	0.2000	2.6750
	1999	10	0.1000	0.1600	0.3100	3.5111	9.1600	10.4020
	2000	10	0.1000	0.8000	4.0313	7.6822	14.3950	23.4500
CH-004	1994	12	0.0000	15.4100	19.5800	18.3083	24.3325	25.7800
	1995	12	0.1000	8.9700	15.0300	12.2556	15.8250	20.1800
	1996	12	2.2400	12.1000	14.7700	13.9644	16.8800	19.7333
	1997	10	10.2000	21.9500	22.7667	20.9417	24.4200	25.5000
	1998	9	0.0400	8.5500	12.8250	11.0589	13.6400	17.6000
	1999	10	8.8750	14.7750	18.2460	18.3463	24.1667	26.0633
	2000	10	12.9400	20.8580	22.0733	23.0863	27.1833	31.4000
CH-05B	1994	12	2.0000	16.6667	23.1917	19.9444	24.8750	25.7667
	1995	12	0.6750	10.8333	17.0500	15.0271	19.7917	23.0500
	1996	12	2.2000	15.2000	16.3500	15.9000	19.1833	20.1667
	1997	10	7.1333	18.8333	24.3750	21.7933	26.0333	27.7000
	1998	10	6.9333	10.8333	14.8333	16.7363	18.5000	40.6600
	1999	10	12.2767	15.2733	20.2450	19.9470	24.2900	28.9167
	2000	10	10.7000	20.1000	24.7167	23.9440	28.9333	32.2333

Near-surface salinity (ppt)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	9.7143	20.1125	24.2333	22.8375	26.5929	28.0250
	1995	12	2.4429	13.6786	19.9143	17.1465	20.8833	22.5750
	1996	12	7.5714	18.4071	19.0429	18.6065	20.3688	22.7125
	1997	10	14.1714	24.5000	26.3107	24.8832	28.3375	28.8714
	1998	10	5.5471	15.3857	18.2714	19.5454	21.2429	49.9500
	1999	11	14.5429	16.2113	20.6714	21.4640	26.0438	29.2325
	2000	10	16.6000	23.8714	26.3164	26.1293	30.8000	32.4286

Near-surface color (PCU)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
1	1994	12	30.0000	50.0000	80.0000	126.2500	200.0000	350.0000
	1995	12	60.0000	70.0000	106.2500	136.4583	200.0000	280.0000
	1996	12	30.0000	50.0000	100.0000	103.8333	137.5000	250.0000
	1997	12	34.0000	51.2500	73.5000	109.1250	102.5000	332.0000
	1998	11	63.0000	120.0000	180.0000	172.4091	205.0000	311.0000
	1999	10	30.0000	30.0000	150.0000	151.0000	250.0000	300.0000
	2000	11	20.0000	30.0000	80.0000	104.7727	195.0000	250.0000
CH-002	1994	12	12.5000	22.5000	42.5000	76.2500	101.2500	300.0000
	1995	12	20.0000	40.0000	65.0000	110.6250	206.2500	250.0000
	1996	12	17.5000	27.5000	51.2500	67.7778	79.1667	250.0000
	1997	12	15.5000	34.0833	41.8333	70.7639	48.4167	259.5000
	1998	11	45.6667	70.0000	127.5000	134.9545	176.0000	313.3333
	1999	10	12.5000	15.0000	103.7500	112.2500	187.5000	270.0000
	2000	11	12.5000	20.0000	40.0000	67.9545	112.5000	250.0000
CH-02B	1994	12	15.0000	20.0000	25.0000	57.7083	68.7500	250.0000
	1995	12	20.0000	30.0000	40.0000	72.9167	125.0000	175.0000
	1996	12	2.5000	22.5000	35.0000	45.2083	50.0000	175.0000
	1997	12	18.0000	27.0000	34.0000	52.1667	36.5000	185.0000
	1998	11	46.0000	75.0000	80.0000	100.8182	132.0000	183.0000
	1999	10	15.0000	20.0000	77.5000	78.5000	125.0000	175.0000
	2000	11	10.0000	20.0000	25.0000	50.0000	80.0000	175.0000

Near-surface color (PCU)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	55.0000	70.0000	150.0000	143.7500	200.0000	250.0000
	1995	12	100.0000	125.0000	187.5000	177.5000	200.0000	280.0000
	1996	12	50.0000	77.5000	122.5000	118.7500	150.0000	250.0000
	1997	12	42.0000	50.0000	76.5000	115.1667	165.5000	286.0000
	1998	10	80.0000	119.0000	160.0000	172.5000	220.0000	303.0000
	1999	10	40.0000	40.0000	80.0000	133.0000	250.0000	300.0000
	2000	12	25.0000	32.5000	51.2500	89.7917	112.5000	300.0000
CH-004	1994	12	15.0000	20.0000	45.0000	60.4167	92.5000	175.0000
	1995	12	50.0000	60.0000	100.0000	116.2500	150.0000	250.0000
	1996	12	20.0000	45.0000	60.0000	79.5833	100.0000	250.0000
	1997	12	19.0000	31.0000	40.5000	64.7083	62.5000	255.0000
	1998	10	56.0000	80.0000	107.7500	120.1500	167.0000	210.0000
	1999	10	10.0000	20.0000	40.0000	87.0000	175.0000	250.0000
	2000	12	10.0000	17.5000	27.5000	50.2083	43.7500	250.0000
CH-05B	1994	12	2.5000	17.5000	30.0000	53.0417	74.5000	225.0000
	1995	12	20.0000	30.0000	42.5000	68.3333	97.5000	225.0000
	1996	12	10.0000	17.5000	27.5000	36.7500	40.0000	150.0000
	1997	12	10.0000	19.0000	29.5000	42.6667	43.0000	148.0000
	1998	10	54.0000	60.0000	75.0000	84.1000	109.0000	146.0000
	1999	10	2.5000	10.0000	30.0000	50.2500	100.0000	125.0000
	2000	12	10.0000	12.5000	20.0000	27.9167	40.0000	85.0000

Near-surface color (PCU)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	10.0000	12.5000	17.5000	44.5833	47.5000	212.5000
	1995	12	17.5000	28.7500	40.0000	69.7222	98.3333	225.0000
	1996	12	2.5000	17.5000	27.5000	37.5417	40.0000	150.0000
	1997	12	8.5000	15.2500	28.5833	40.4722	32.2500	174.5000
	1998	10	41.0000	50.0000	62.5000	77.1500	96.5000	170.0000
	1999	11	2.5000	7.5000	36.6667	61.2121	112.5000	200.0000
	2000	12	10.0000	12.5000	16.2500	24.7917	27.5000	82.5000

Near-surface TSS (mg/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-001	1994	12	2.4000	3.5395	4.6995	7.7191	11.2615	20.0950
	1995	12	2.7420	3.3835	3.9378	5.4818	7.4735	11.6320
	1996	12	2.0000	3.2560	4.7685	4.8003	6.4000	7.8720
	1997	12	4.0000	5.3500	8.2750	8.4458	10.4500	17.0000
	1998	11	1.0000	3.6000	6.0000	6.9591	8.2500	21.2000
	1999	10	2.2500	2.7600	11.5199	11.3728	12.2059	30.4444
	2000	11	1.0000	8.0000	11.0000	17.2803	27.0000	52.0000
CH-002	1994	12	3.5405	4.4670	8.2403	9.7618	14.4955	19.3540
	1995	12	1.9830	4.0168	6.8448	7.7068	9.9420	17.8765
	1996	12	3.2010	4.1103	5.0178	6.3188	9.4500	11.5000
	1997	12	3.5333	8.7417	11.2000	11.9069	14.9583	20.8500
	1998	11	1.0000	9.3333	12.0000	11.7803	15.2500	19.3333
	1999	10	3.7125	9.0556	12.8363	16.8481	16.8666	57.9050
	2000	11	3.5000	8.1730	36.0000	29.3059	46.9222	53.0000
CH-02B	1994	12	3.1400	4.5745	6.7940	9.1915	13.3775	20.3695
	1995	12	4.4030	5.1460	7.2345	9.2494	12.5725	19.5600
	1996	12	3.1350	5.6463	8.4540	8.7894	10.3805	21.0000
	1997	12	7.8000	11.1500	13.4500	15.1833	17.3000	26.4000
	1998	11	1.0000	9.0000	11.0000	11.7364	17.2000	21.5000
	1999	10	4.4400	5.6900	6.9685	8.5667	10.4000	19.4150
	2000	11	5.1200	19.7500	30.2679	33.3762	43.0000	78.0000

Near-surface TSS (mg/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	0.9800	2.0050	2.9030	5.7511	6.8180	20.0000
	1995	12	1.8435	2.5325	3.6215	5.8034	7.4850	19.0000
	1996	12	2.4700	5.3540	7.7883	8.8735	10.3750	23.5000
	1997	12	2.7000	4.0000	5.7000	6.4750	8.9500	12.2000
	1998	10	1.0000	4.0000	6.0000	5.7450	8.0000	9.2000
	1999	10	1.6000	2.4600	2.9470	2.9634	3.4844	4.8710
	2000	12	1.0000	4.5100	8.1050	15.6300	25.0000	53.0000
CH-004	1994	12	5.7880	7.2255	9.8978	11.6701	14.1450	28.9130
	1995	12	2.0380	4.6615	8.5475	9.7456	9.6115	27.9440
	1996	12	2.0000	4.7215	6.2000	6.8171	8.6110	14.0000
	1997	12	6.5000	9.8000	13.0500	15.6375	21.5500	34.8000
	1998	9	1.0000	7.5000	13.5000	10.4722	14.0000	15.6000
	1999	10	3.2840	7.5474	8.5954	9.0753	9.4419	17.3885
	2000	12	4.0000	15.8827	26.2329	29.1636	44.0000	60.5000
CH-05B	1994	12	2.7250	6.3170	8.1735	9.4790	12.1020	18.7880
	1995	12	2.2500	4.6485	5.7950	7.4628	7.6120	24.5650
	1996	12	3.5540	4.1310	6.1575	6.7903	6.9000	19.0000
	1997	12	6.4000	10.4000	12.9000	13.4875	16.3000	20.9000
	1998	10	1.0000	11.0000	12.2000	11.8300	15.0000	18.4000
	1999	10	4.0770	6.3621	7.2844	7.4286	7.6964	11.6957
	2000	12	3.0000	17.6161	33.0000	31.0135	40.7453	59.0000

Near-surface TSS (mg/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	4.0450	6.4620	7.8943	9.4815	12.5380	17.1810
	1995	12	2.9115	5.5158	7.9970	10.0582	15.9183	18.3815
	1996	12	4.1370	5.7275	7.6118	7.8578	8.8000	13.8660
	1997	12	5.9000	9.6500	11.8500	15.1292	20.3750	38.2000
	1998	10	1.0000	15.0000	17.0000	16.2050	20.5000	20.8000
	1999	11	2.6230	6.7303	7.4075	7.6919	9.3525	12.4288
	2000	12	11.6846	20.9367	35.0449	34.7057	45.5000	60.5000

Near-surface turbidity (NTU)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-001	1994	12	0.8000	1.8000	3.2000	3.3417	4.1000	8.0000
	1995	12	1.9000	2.2500	3.0000	3.6625	4.2500	9.4000
	1996	12	2.2000	2.5000	2.8500	3.0083	3.2000	4.8000
	1997	12	1.9000	2.3000	2.9500	3.0833	3.4500	5.8000
	1998	11	1.3000	2.3000	2.9000	3.1091	4.0500	5.0000
	1999	10	2.7000	2.8000	4.5000	5.6100	7.5000	12.2000
	2000	11	1.5000	1.9000	2.6000	2.7545	3.5000	4.5000
CH-002	1994	12	0.3500	2.1000	3.2500	3.0042	3.9250	4.7000
	1995	12	1.8500	2.1750	2.7083	3.5181	4.3250	8.5000
	1996	12	1.5000	1.8250	2.2250	2.5028	3.4417	3.7000
	1997	12	1.8500	2.5000	2.9500	3.1153	3.3417	5.0333
	1998	11	1.4500	2.7000	3.3667	3.4939	4.3333	6.2500
	1999	10	2.2000	3.0000	5.1750	4.9533	7.5000	7.8000
	2000	11	1.1500	1.4000	1.9500	2.8455	3.5500	9.1500
CH-02B	1994	12	0.4000	1.9500	2.7500	2.6292	3.7000	4.5500
	1995	12	1.6000	2.4750	3.2000	3.6125	4.2500	8.0000
	1996	12	1.4000	2.4000	2.5500	3.0500	3.1000	7.7000
	1997	12	2.0000	2.7500	3.0750	3.1958	3.8000	4.7000
	1998	11	1.8000	2.1000	3.6000	3.5000	4.0000	7.3000
	1999	10	1.8000	2.3500	3.1000	3.9050	4.5000	10.1000
	2000	11	0.9000	1.1000	1.7000	2.4636	3.1000	6.0000

Near-surface turbidity (NTU)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	1.4000	2.4000	3.7500	3.9000	5.3500	7.1000
	1995	12	2.9500	3.2000	4.4500	5.5625	7.0500	13.4000
	1996	12	3.3000	4.6750	7.3000	7.4958	8.5500	16.8000
	1997	12	1.8000	2.5000	3.2000	3.7583	4.3000	8.4000
	1998	10	2.5000	3.0000	3.6500	3.9500	4.5000	6.9000
	1999	10	2.2000	3.0000	3.5000	3.6600	4.2000	5.5000
	2000	12	1.8000	2.0000	2.4000	2.9333	4.0000	4.6000
CH-004	1994	12	1.5000	2.0500	2.8500	3.7208	5.4500	7.0000
	1995	12	2.5000	2.9500	3.9000	4.7833	4.7500	11.9000
	1996	12	1.8000	2.6000	2.9000	3.3708	3.9250	7.2000
	1997	12	2.2000	2.4500	3.0000	3.3667	3.9000	6.9000
	1998	10	2.1000	2.4000	2.5750	3.0950	3.1000	7.9000
	1999	10	2.6000	3.1000	3.7000	4.2850	5.5000	7.1500
	2000	12	0.9000	1.1000	1.9500	2.6750	4.0750	5.9000
CH-05B	1994	12	1.4000	1.9000	2.5000	2.4250	2.7000	3.9000
	1995	12	1.5000	2.3000	2.4500	2.9958	3.2500	8.0000
	1996	12	1.6000	1.8500	2.3000	2.4917	2.5500	5.1000
	1997	12	1.9000	2.4500	2.9000	3.6208	4.7500	8.7000
	1998	10	1.5000	2.0000	2.3000	3.1050	4.6500	6.0000
	1999	10	2.3000	2.5000	2.8000	2.9500	3.3000	3.9000
	2000	12	1.0000	1.2000	1.5000	3.0083	3.9000	10.7000

Near-surface turbidity (NTU)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	1.0000	1.4750	2.1750	2.3739	2.7683	5.3000
	1995	12	1.6000	2.4000	2.7000	3.3250	4.2000	6.6000
	1996	12	1.8500	2.0000	2.2000	2.3875	2.7000	3.9000
	1997	12	0.9500	1.6500	2.3000	2.6417	3.3250	6.2000
	1998	10	0.9500	2.5000	2.8500	3.3850	4.4000	6.3500
	1999	11	2.1000	2.2000	2.9000	2.9182	3.3000	4.2000
	2000	12	0.7500	1.1500	1.9250	3.0708	4.8750	8.3500

Secchi depth (m)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-001	1994	12	0.4000	0.5000	0.5250	0.5917	0.7500	0.8500
	1995	12	0.3000	0.4500	0.5500	0.5667	0.6500	0.9500
	1996	12	0.6500	0.6500	0.7750	0.7750	0.9000	0.9000
	1997	12	0.2500	0.4000	0.7500	0.7571	1.1000	1.2000
	1998	11	0.3500	0.5500	0.6000	0.6444	0.6500	1.2500
	1999	10	0.3500	0.4500	0.6000	0.6500	0.7500	1.1500
	2000	11	0.5000	0.5500	0.6000	0.6071	0.6500	0.7500
CH-002	1994	12	0.3700	0.5000	1.0500	1.1382	1.5500	2.1000
	1995	12	0.3500	0.5750	1.0000	0.9958	1.4500	1.5000
	1996	12	1.0500	1.3000	1.4750	1.5188	1.7250	2.1000
	1997	12	0.4500	1.0750	1.3500	1.2375	1.5000	1.8000
	1998	11	0.3500	0.6000	0.8500	0.7864	0.9500	1.3500
	1999	10	0.3500	0.5500	0.8250	0.9320	1.1500	1.7500
	2000	11	0.5500	0.7500	1.0500	1.1618	1.5500	2.0500
CH-02B	1994	12	0.6700	0.8500	1.0000	0.9883	1.0500	1.3500
	1995	12	0.4500	0.6500	0.7500	0.7700	0.8700	1.1000
	1996	12	0.3000	0.7000	1.0000	0.9000	1.1500	1.2500
	1997	12	0.4500	0.7500	1.0500	0.9750	1.2500	1.2500
	1998	11	0.3500	0.4500	0.7000	0.7409	1.0000	1.3500
	1999	10	0.6500	0.6500	0.7000	0.9000	1.2000	1.4500
	2000	11	0.5500	0.8300	0.9500	0.9471	1.2000	1.2500

Secchi depth (m)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	0.4000	0.5500	0.8200	0.8908	1.1250	1.7500
	1995	12	0.3500	0.3750	0.5250	0.6104	0.7750	1.2500
	1996	12	0.3500	0.5500	0.5500	0.6273	0.6000	1.3500
	1997	12	0.4000	0.6500	0.8500	0.9479	1.2250	1.6500
	1998	10	0.4500	0.5000	0.6500	0.6800	0.8500	1.0000
	1999	10	0.4500	0.5000	1.0315	1.1463	1.5500	2.2500
	2000	12	0.4500	0.7250	0.8750	0.8958	1.1000	1.4000
CH-004	1994	12	0.4000	0.6000	0.9750	1.0675	1.5000	1.9500
	1995	12	0.4000	0.5250	0.8500	0.8313	1.0250	1.5500
	1996	12	0.5000	0.7500	1.1750	1.1583	1.5500	1.7500
	1997	12	0.5500	0.8750	1.0250	1.1583	1.5375	1.8000
	1998	10	0.4000	0.5500	0.6500	0.7833	1.0500	1.3000
	1999	10	0.4500	0.5500	1.3000	1.1100	1.5500	1.6500
	2000	12	0.5500	0.6500	1.1000	1.2409	1.7500	2.0000
CH-05B	1994	12	0.8000	0.8000	0.9000	1.0000	1.2000	1.4000
	1995	12	0.5500	0.6500	0.6500	0.8700	0.9500	1.5500
	1996	12	0.9000	1.0000	1.0000	1.0750	1.1500	1.4000
	1997	12	0.5000	0.9500	0.9500	1.0333	1.2500	1.3500
	1998	10	0.5000	0.6500	1.0000	0.8667	1.0500	1.3000
	1999	10	0.6500	0.6500	0.7500	0.9000	1.0000	1.4500
	2000	12	0.6500	0.8500	1.3500	1.2000	1.4500	1.5000

Secchi depth (m)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	0.4000	1.1750	1.6250	1.5592	1.9750	2.6000
	1995	12	0.4000	0.7500	1.0250	1.1208	1.3500	2.5500
	1996	12	1.0000	1.3250	1.7500	1.7042	2.1250	2.3500
	1997	12	0.3500	1.3000	1.7000	1.5471	1.8000	2.2500
	1998	10	0.5000	0.6500	1.1000	1.1450	1.4500	2.0000
	1999	11	0.4500	0.5500	1.5750	1.4650	2.0000	2.9500
	2000	12	0.8500	1.2000	1.5250	1.6667	2.0250	2.7500

Near-surface pH

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
1	1994	12	6.4750	7.1125	7.3025	7.2663	7.4950	7.6750
	1995	12	6.6100	6.9775	7.2700	7.1663	7.3850	7.4400
	1996	12	6.6000	7.2100	7.3633	7.3342	7.5550	7.6733
	1997	12	7.2250	7.3450	7.4758	7.4899	7.6370	7.7500
	1998	11	6.7300	7.1800	7.8300	7.6336	7.8950	8.4833
	1999	10	7.2033	7.7300	7.8900	7.8292	8.0400	8.2150
	2000	11	7.1333	7.2567	7.7200	7.6542	7.9100	8.1750
CH-002	1994	12	6.8117	7.4192	7.5965	7.5402	7.7456	7.9100
	1995	12	6.6129	7.2164	7.3625	7.3636	7.6264	7.9586
	1996	12	6.7443	7.4651	7.5936	7.5127	7.6653	7.7171
	1997	12	7.0867	7.5664	7.6933	7.6346	7.7648	7.8283
	1998	11	6.8760	7.5429	7.6567	7.5675	7.7186	8.0200
	1999	10	7.4600	7.4914	7.8967	7.8233	7.9957	8.1250
	2000	11	7.2033	7.5886	7.6780	7.6482	7.8114	7.9557
CH-02B	1994	12	6.7900	7.4242	7.6250	7.5588	7.7517	8.0633
	1995	12	7.0467	7.1475	7.3367	7.3992	7.6071	8.0067
	1996	12	7.0633	7.4308	7.5883	7.5890	7.7667	7.9433
	1997	12	7.2700	7.5517	7.6425	7.6213	7.7317	7.8600
	1998	11	7.3300	7.5800	7.7033	7.7085	7.8150	8.0367
	1999	10	7.2433	7.7550	7.8700	7.8312	8.0433	8.2700
	2000	11	7.1300	7.4367	7.7500	7.6742	7.8900	8.0267

Near-surface pH

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	5.5075	6.8271	7.0129	6.9694	7.3954	7.4475
	1995	12	6.1475	6.4740	6.7683	6.7446	6.9392	7.4260
	1996	12	6.3520	7.0420	7.2733	7.2304	7.6375	7.7367
	1997	12	6.8475	7.1148	7.2123	7.2360	7.3733	7.5520
	1998	10	6.9150	7.1325	7.2638	7.5294	7.8475	8.5900
	1999	10	7.0020	7.1533	7.3720	7.3877	7.5200	8.2325
	2000	12	6.9533	7.1170	7.3175	7.2786	7.3950	7.6200
CH-004	1994	12	5.6875	7.4383	7.5520	7.5114	7.9545	8.2020
	1995	12	6.5200	7.0795	7.3615	7.2766	7.5628	7.9400
	1996	12	6.5840	7.0123	7.4350	7.3271	7.6260	7.7150
	1997	12	6.8320	7.4450	7.6123	7.5720	7.7742	7.9200
	1998	10	7.0625	7.3080	7.3846	7.5800	7.7260	8.9140
	1999	10	7.2500	7.4720	7.6830	7.6541	7.8800	7.9300
	2000	12	7.3100	7.6170	7.7230	7.6994	7.8555	7.9725
CH-05B	1994	12	6.7300	7.4483	7.5617	7.5946	7.9025	8.1033
	1995	12	6.9700	7.1567	7.3767	7.3607	7.5633	7.7000
	1996	12	7.0033	7.2383	7.5133	7.4381	7.6200	7.7300
	1997	12	7.2367	7.4483	7.7267	7.6324	7.8083	7.8625
	1998	10	7.0400	7.3733	7.4400	7.4611	7.5900	7.9567
	1999	10	7.4200	7.5300	7.8450	7.7838	7.9200	8.1767
	2000	12	6.9400	7.5917	7.6850	7.6333	7.7767	8.0267

Near-surface pH

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	6.7843	7.5728	7.7489	7.7060	8.0025	8.1729
	1995	12	6.8400	7.3394	7.5875	7.4808	7.7349	7.8150
	1996	12	6.8629	7.4306	7.5529	7.5039	7.6571	7.7886
	1997	12	7.3529	7.5436	7.7329	7.6777	7.7806	7.9400
	1998	10	7.2886	7.4643	7.6164	7.6101	7.7914	7.8514
	1999	11	7.5143	7.5675	7.8329	7.7758	7.9525	7.9813
	2000	12	7.0786	7.6264	7.7600	7.7004	7.8392	8.0900

DO (mg/L) – all depths

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-001	1994	24	4.1400	5.5850	6.8400	6.5746	7.4800	9.1800
	1995	24	4.1200	5.1200	6.0700	6.0588	6.7550	8.0600
	1996	23	5.0000	5.7400	7.6500	7.0904	7.8400	9.0700
	1997	33	4.7100	6.2500	6.6400	6.8564	7.6600	9.4800
	1998	23	3.5100	6.6400	7.0500	7.2396	8.4400	9.7100
	1999	22	3.6300	5.5600	6.1700	6.3582	6.4100	9.3900
	2000	24	3.7400	5.4950	6.3800	6.5400	8.1300	9.6700
CH-002	1994	77	3.6600	5.5700	6.5700	6.4001	7.5200	9.1000
	1995	82	3.0300	5.7600	6.2350	6.1340	6.7400	10.6700
	1996	84	2.9100	6.2050	6.8200	6.7848	7.6150	8.8500
	1997	75	3.7000	6.0500	6.6400	6.6995	7.2300	10.7000
	1998	66	4.3200	5.5900	7.0100	7.0365	8.3700	9.8900
	1999	60	3.1600	5.4900	6.4600	6.2465	6.8700	9.2700
	2000	69	3.9600	5.2000	6.9300	6.4358	7.3000	8.6400
CH-02B	1994	35	2.3200	5.5700	6.5100	6.2754	7.1100	8.7500
	1995	33	0.4900	4.9000	6.0100	5.7555	6.6400	9.7000
	1996	34	4.8500	6.0900	6.4950	6.7812	7.4900	8.5800
	1997	34	2.3800	5.6300	6.4300	6.4168	6.9000	9.8900
	1998	28	2.7100	5.5500	7.2100	6.9954	8.7450	12.1000
	1999	23	0.0500	5.4100	6.1300	5.6387	6.9000	9.9800
	2000	29	1.1400	5.1300	6.2800	5.9624	7.3300	8.4000

DO (mg/L) – all depths

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	45	3.1900	4.3500	5.0100	5.3893	6.7300	8.5800
	1995	45	3.4700	4.3900	6.5500	6.2311	7.1000	10.4100
	1996	51	3.3100	4.2800	7.3600	6.5692	8.7300	9.7400
	1997	51	4.5700	5.3000	6.1800	6.3004	7.3000	8.5400
	1998	41	4.3400	4.9900	6.0600	6.1115	7.2400	8.1500
	1999	39	3.3100	4.2500	6.2500	5.9603	7.2500	9.9100
	2000	48	3.2200	4.7300	5.9850	5.8463	6.7450	8.1500
CH-004	1994	55	0.2900	4.7000	6.0500	5.5749	6.9800	8.3400
	1995	54	1.0000	3.8800	5.5950	5.2602	6.3900	8.8300
	1996	61	1.7500	4.3400	6.2800	6.2752	8.2800	10.5900
	1997	64	1.1200	5.7650	6.5100	6.2597	7.7000	8.1800
	1998	48	1.2600	4.2650	5.7450	5.1710	6.4950	8.0700
	1999	46	1.0400	4.0400	6.0800	5.9767	8.3500	10.8500
	2000	58	1.9900	4.4900	6.2700	5.9417	7.2400	8.6700
CH-05B	1994	33	0.6300	5.0200	6.2600	5.9318	7.1400	7.9200
	1995	30	1.4300	4.9000	5.5800	5.4080	6.0200	8.1400
	1996	34	4.0000	4.8400	6.6050	6.4488	7.7300	9.0000
	1997	38	3.5300	6.1800	6.7500	6.7237	7.7300	8.2500
	1998	29	0.7100	4.6300	5.7500	5.4410	7.2500	8.1300
	1999	24	1.0500	5.5050	6.5600	6.5988	9.6650	11.8900
	2000	34	3.5100	5.7000	6.3600	6.1944	6.5500	8.4900

DO (mg/L) – all depths

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	73	0.0500	4.3700	6.1400	5.4493	7.0700	8.2300
	1995	80	0.0500	4.5050	5.7350	5.1195	6.3700	8.2400
	1996	87	0.7700	4.8800	6.5100	5.9863	7.9800	9.7100
	1997	88	0.7600	6.1150	6.4800	6.4924	7.2900	10.4700
	1998	70	1.0800	3.9500	5.5000	5.0393	6.1500	8.2000
	1999	74	0.4600	3.2200	5.8350	5.2928	7.7200	9.6700
	2000	83	0.8300	5.0500	6.5200	6.0577	7.1300	8.2800

Near-surface PO_4 —P (mg P/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-001	1994	12	0.0770	0.0855	0.1135	0.1363	0.1800	0.2750
	1995	12	0.1260	0.1988	0.2465	0.2448	0.2985	0.3410
	1996	12	0.1270	0.1560	0.2073	0.2048	0.2293	0.3260
	1997	12	0.1070	0.1203	0.1725	0.1979	0.2550	0.4100
	1998	11	0.0050	0.2000	0.2300	0.2282	0.2600	0.3800
	1999	10	0.1320	0.1330	0.1880	0.2318	0.3070	0.5150
	2000	11	0.0360	0.0720	0.1580	0.1396	0.1960	0.2380
CH-002	1994	12	0.0360	0.0438	0.0708	0.0860	0.1255	0.1740
	1995	12	0.1210	0.1518	0.2043	0.2075	0.2548	0.3230
	1996	12	0.1020	0.1178	0.1638	0.1711	0.1948	0.2890
	1997	12	0.0610	0.0775	0.1052	0.1356	0.1559	0.3850
	1998	11	0.0050	0.2000	0.2170	0.2073	0.2420	0.3100
	1999	10	0.0835	0.1095	0.1681	0.2072	0.3015	0.4335
	2000	11	0.0505	0.0730	0.0975	0.1025	0.1280	0.1895
CH-02B	1994	12	0.0300	0.0370	0.0475	0.0708	0.1040	0.1510
	1995	12	0.0890	0.1170	0.1755	0.1656	0.1960	0.2640
	1996	12	0.0815	0.1145	0.1275	0.1440	0.1615	0.2430
	1997	12	0.0420	0.0640	0.0820	0.0952	0.1005	0.2600
	1998	11	0.0050	0.1100	0.1500	0.1501	0.2130	0.2230
	1999	10	0.0850	0.0880	0.1350	0.1673	0.2190	0.3320
	2000	11	0.0440	0.0540	0.0890	0.0896	0.1090	0.1670

Near-surface PO_4 —P (mg P/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	0.4450	0.4655	0.5470	0.5574	0.6170	0.8140
	1995	12	0.1980	0.5855	0.7515	0.7077	0.8295	1.0780
	1996	12	0.3950	0.4620	0.5223	0.5314	0.6110	0.6675
	1997	12	0.4060	0.4480	0.4870	0.5114	0.5750	0.6650
	1998	10	0.4170	0.5300	0.5980	0.5964	0.6650	0.8040
	1999	10	0.4050	0.5170	0.5675	0.6013	0.6890	0.9470
	2000	12	0.2810	0.4510	0.4970	0.4866	0.5798	0.6050
CH-004	1994	12	0.0930	0.1230	0.1650	0.1939	0.2270	0.4640
	1995	11	0.3135	0.3820	0.4480	0.4529	0.5310	0.6990
	1996	12	0.1790	0.2230	0.2655	0.2940	0.3630	0.4550
	1997	12	0.0860	0.1005	0.1240	0.1669	0.2250	0.3900
	1998	10	0.2500	0.2800	0.3380	0.3540	0.4000	0.5275
	1999	10	0.0980	0.1860	0.2353	0.2791	0.3390	0.7000
	2000	11	0.0240	0.0900	0.1200	0.1480	0.1390	0.4560
CH-05B	1994	12	0.0535	0.0580	0.0885	0.1161	0.1740	0.2470
	1995	12	0.1390	0.1790	0.2235	0.2480	0.3105	0.3830
	1996	12	0.0940	0.1500	0.1885	0.1958	0.2520	0.3050
	1997	12	0.0460	0.0655	0.0805	0.1127	0.1460	0.3300
	1998	10	0.0050	0.1780	0.2350	0.2170	0.2840	0.3400
	1999	10	0.0820	0.0880	0.1435	0.1620	0.2310	0.3440
	2000	12	0.0270	0.0645	0.0770	0.0895	0.1060	0.1950

Near-surface PO_4 —P (mg P/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	0.0180	0.0538	0.0718	0.1020	0.1278	0.3360
	1995	12	0.1450	0.1985	0.2368	0.2573	0.3283	0.3900
	1996	12	0.1045	0.1190	0.1588	0.1779	0.2360	0.2995
	1997	12	0.0310	0.0433	0.0548	0.0835	0.1073	0.2700
	1998	10	0.0050	0.1700	0.1850	0.2008	0.2425	0.3605
	1999	11	0.0543	0.0790	0.1463	0.1793	0.2285	0.5995
	2000	12	0.0285	0.0493	0.0600	0.0714	0.0825	0.1865

Near-surface DIN (mg N/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-001	1994	12	0.0100	0.0415	0.1050	0.0972	0.1390	0.1890
	1995	12	0.0235	0.0645	0.1038	0.0951	0.1298	0.1370
	1996	12	0.0200	0.0570	0.1045	0.0889	0.1170	0.1355
	1997	12	0.0100	0.0175	0.0310	0.0729	0.0980	0.2940
	1998	11	0.0100	0.0100	0.0920	0.0892	0.1390	0.2200
	1999	10	0.0100	0.0100	0.0410	0.0562	0.0960	0.1370
	2000	11	0.0100	0.0220	0.0780	0.1136	0.1440	0.4110
CH-002	1994	12	0.0100	0.0135	0.0443	0.0536	0.0753	0.1410
	1995	12	0.0100	0.0145	0.0688	0.0841	0.1435	0.2000
	1996	12	0.0100	0.0178	0.0258	0.0544	0.0738	0.2100
	1997	12	0.0100	0.0100	0.0138	0.0473	0.0293	0.3200
	1998	11	0.0100	0.0100	0.1067	0.0919	0.1367	0.2300
	1999	10	0.0100	0.0100	0.0150	0.0433	0.0215	0.1510
	2000	11	0.0185	0.0260	0.0570	0.0497	0.0695	0.0785
CH-02B	1994	12	0.0100	0.0100	0.0135	0.0507	0.0850	0.1620
	1995	12	0.0100	0.0183	0.0455	0.0889	0.0885	0.3400
	1996	12	0.0100	0.0178	0.0245	0.0616	0.0810	0.2570
	1997	12	0.0100	0.0100	0.0160	0.0422	0.0480	0.2110
	1998	11	0.0100	0.0100	0.0100	0.0463	0.0900	0.1700
	1999	10	0.0100	0.0100	0.0150	0.0459	0.0230	0.2470
	2000	11	0.0100	0.0290	0.0470	0.0533	0.0780	0.1150

Near-surface DIN (mg N/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	0.0100	0.3565	0.5190	0.4878	0.6180	0.9800
	1995	12	0.0250	0.2830	0.3810	0.4361	0.4715	1.3750
	1996	12	0.0250	0.1705	0.3725	0.4731	0.6495	1.5330
	1997	12	0.0240	0.2505	0.4490	0.4451	0.6525	0.8870
	1998	10	0.0100	0.0100	0.4135	0.3632	0.4880	0.8500
	1999	10	0.0210	0.0500	0.3090	0.3188	0.4390	0.7560
	2000	12	0.0240	0.0690	0.4645	0.3577	0.5240	0.7420
CH-004	1994	12	0.0250	0.0330	0.1090	0.1246	0.1833	0.2980
	1995	12	0.0100	0.0138	0.2853	0.2011	0.3215	0.4470
	1996	12	0.0100	0.0255	0.0605	0.1264	0.2695	0.2975
	1997	12	0.0100	0.0100	0.0285	0.0853	0.0513	0.4420
	1998	10	0.0100	0.0100	0.1240	0.1656	0.3150	0.4300
	1999	10	0.0100	0.0100	0.1750	0.1487	0.2710	0.3350
	2000	12	0.0190	0.0288	0.0420	0.0638	0.0560	0.3240
CH-05B	1994	12	0.0100	0.0130	0.0350	0.0647	0.0718	0.3480
	1995	12	0.0100	0.0295	0.0818	0.1290	0.2180	0.3890
	1996	12	0.0100	0.0255	0.0355	0.0523	0.0600	0.2100
	1997	12	0.0100	0.0100	0.0100	0.0225	0.0280	0.0900
	1998	10	0.0100	0.0100	0.0435	0.0874	0.1500	0.3000
	1999	10	0.0100	0.0100	0.0150	0.0388	0.0280	0.1980
	2000	12	0.0100	0.0155	0.0423	0.0590	0.0615	0.2810

Near-surface DIN (mg N/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	0.0100	0.0200	0.0245	0.0702	0.0838	0.4010
	1995	12	0.0160	0.0253	0.0840	0.1365	0.2480	0.3705
	1996	12	0.0200	0.0233	0.0505	0.0844	0.0850	0.2845
	1997	12	0.0100	0.0100	0.0155	0.0576	0.0275	0.2850
	1998	10	0.0100	0.0100	0.0410	0.1039	0.1600	0.3300
	1999	11	0.0100	0.0150	0.0259	0.0837	0.1365	0.2680
	2000	12	0.0100	0.0293	0.0415	0.0626	0.0513	0.2465

Near-surface chlorophyll-*a* (µg/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-001	1994	11	1.4000	1.5200	3.3800	6.9265	10.8100	24.6100
	1995	12	1.4200	2.5050	4.5400	4.8908	6.3075	13.4400
	1996	12	1.2300	1.6900	4.2225	5.8388	6.3900	27.5000
	1997	12	0.5000	3.0700	4.8125	6.4292	10.0200	15.5000
	1998	11	0.5000	0.5000	0.5000	1.8768	3.3400	5.8750
	1999	10	2.2300	4.7600	6.0400	10.7250	11.4000	44.9000
	2000	11	1.0700	2.6700	5.8700	6.8073	8.5400	19.1000
CH-002	1994	12	1.5000	2.6955	5.7825	6.7092	9.3200	17.2850
	1995	12	1.1900	3.1067	4.6175	13.0111	20.3650	53.4650
	1996	12	0.5000	2.2250	6.4600	6.4218	9.8250	11.7500
	1997	12	1.1650	5.3850	5.6875	7.5950	7.4767	28.6667
	1998	11	0.5000	2.4800	5.0750	5.0376	7.1433	11.4950
	1999	10	2.1850	6.0600	13.0417	16.4363	27.3000	32.3500
	2000	11	1.4700	2.4050	5.0650	6.8400	9.5900	21.4000
CH-02B	1994	12	1.3600	3.1950	5.5100	7.2855	7.4675	31.4000
	1995	12	2.9650	3.7450	6.5625	11.5358	16.4250	41.0200
	1996	12	0.5000	2.3000	4.6550	4.9904	6.1050	12.3000
	1997	12	0.5000	5.0750	6.0050	7.7208	7.8900	22.3000
	1998	11	0.5000	3.3400	6.1000	18.4700	16.6000	93.5000
	1999	10	3.1200	5.1600	9.2000	15.6695	14.6000	48.7000
	2000	11	1.3400	2.1400	10.1460	8.5424	13.4000	18.9000

Near-surface chlorophyll-*a* (μg/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-029	1994	12	0.5000	0.8450	2.3455	3.2015	3.6600	13.7000
	1995	12	1.0350	1.5200	2.9800	13.2795	35.3900	40.9400
	1996	12	0.5000	4.7900	10.1625	11.5458	17.7150	30.7000
	1997	12	0.5000	1.0500	3.6350	7.5042	7.7800	46.5000
	1998	10	0.5000	0.5000	5.0725	8.6195	14.7000	30.1000
	1999	10	1.4900	1.6800	5.7700	8.0500	13.8000	21.1000
	2000	12	1.0200	3.2500	9.5350	8.6558	12.2500	18.4500
CH-004	1994	12	1.1890	3.0950	6.4465	20.0743	22.7500	126.3000
	1995	11	1.3800	2.5200	4.7300	13.5718	22.1200	62.6900
	1996	12	1.6100	5.9300	9.6100	18.5263	20.1400	98.7000
	1997	12	0.5000	2.6700	5.5000	6.6946	10.5350	16.6000
	1998	10	0.5000	0.5000	3.6350	4.5655	5.5300	15.5000
	1999	10	6.2200	8.4300	10.6250	16.2500	21.4000	38.6000
	2000	11	0.5000	1.0700	4.8100	9.4586	17.8000	35.4000
CH-05B	1994	12	1.0100	2.7750	4.4160	6.4302	10.4050	14.8800
	1995	12	1.3900	5.1000	6.8425	8.2354	8.7600	27.7700
	1996	12	0.5000	2.4550	6.4250	7.4650	9.4650	23.5000
	1997	12	0.5000	2.9400	4.5450	4.9258	6.3500	10.7000
	1998	10	0.5000	2.0000	6.6750	7.3580	9.3400	21.4000
	1999	10	4.6900	5.8000	10.1550	12.9450	18.7000	25.4500
	2000	11	0.5000	2.1360	4.4500	4.7160	6.4100	11.7000

Near-surface chlorophyll-*a* (µg/L)

SITE	WY	N	Minimum	25th Pctl	50th Pctl	Mean	75th Pctl	Maximum
CH-005	1994	12	0.5000	2.5500	4.1208	11.6510	20.9625	44.7950
	1995	12	2.3500	2.5900	7.6300	8.4311	10.5600	26.7000
	1996	12	2.0150	4.1625	5.7875	7.5167	8.3850	23.3950
	1997	12	1.0350	2.3325	3.6050	6.9400	6.3450	39.6550
	1998	10	0.5000	1.0700	4.3375	4.0545	5.6050	8.8200
	1999	11	3.4750	5.6267	6.9025	9.8687	9.4500	26.1500
	2000	11	1.5700	2.0050	3.9150	5.8820	9.5900	15.3500