# Clear Creek Watershed Management Agreement

## 2007 Annual Report

**Black Hawk /Central City Sanitation District**
**Central Clear Creek Sanitation District**
**Church Ditch Company**
**City of Arvada**
**City of Black Hawk**
**City of Central**
**City of Golden**
**City of Idaho Springs**
**City of Northglenn**
**City of Thornton**
**City of Westminster**
**Clear Creek County**
**Clear Creek Ski Corporation**
**Climax Molybdenum Company**
**Colorado Department of Transportation**
**Farmers Reservoir and Irrigation Company**
**Farmers' Highline Canal Company**
**Coors Brewing Company**
**Gilpin County**
**Jefferson County**
**Mt. Vernon Country Club Metropolitan District**
**Saddleback Metropolitan District**
**Shwayder Camp**
**St. Mary's Glacier Water & Sanitation District**
**Town of Empire**
**Town of Georgetown**
**Town of Silver Plume**

**June 2008**

*This page intentionally left blank*

*Table of Contents*

**Appendices**

## EXECUTIVE SUMMARY

### Introduction

Located due west of Denver, Colorado, the 575-square-mile Clear Creek Watershed spans from its headwaters near the Continental Divide at 14,000 feet in elevation down to the Denver-Metropolitan area at 5,000 feet in elevation where it joins the South Platte River. In addition to offering numerous recreational opportunities, Clear Creek supplies drinking water to approximately 350,000 people in the suburban Denver area, industrial water to Coors Brewing Company and other businesses, and agricultural water to farmers. Clear Creek Watershed includes five counties, six towns and a considerable rural/mountain population. The historic Mineral Belt of Colorado bisects the Clear Creek Watershed. The historic mining and milling boom was an economic benefit to our State but left a legacy of negatively impacted water quality throughout the watershed.

Standley Lake is an agricultural and municipal water supply reservoir located in Jefferson County Colorado that is supplied with water primarily from Clear Creek. The reservoir supplies water for agricultural use by the Farmers Reservoir and Irrigation Company (FRICO) and for municipal supply for the cities of Northglenn, Thornton, and Westminster (Standley Lake Cities). In response to a request by the Standley Lake Cities (SLC) for a Rulemaking Hearing to establish water quality standards and resulting control regulations for Standley Lake, 23 entities developed and agreed to the Clear Creek Watershed Management Agreement (Agreement). This Agreement, adopted in December 1993, sought to address certain water quality issues and concerns within the Clear Creek Basin, specifically, issues that could affect Standley Lake (i.e. Reservoir) water quality. The parties to this Agreement are governmental agencies and private corporations having land use, water supply, and/or wastewater treatment responsibilities within the Clear Creek Basin.

The Agreement requires the Parties to develop a report on an annual basis and submit it to the Water Quality Control Commission. This document serves as the Annual Report for 2007.

### Narrative Standard

A narrative standard for Standley Lake was adopted in lieu of a numeric standard and control regulations. The parties agreed to additional testing, monitoring, and implementation of best management practices on a voluntary basis. The narrative standard for Segment 2, Big Dry Creek, and Standley Lake reads:

> *The tropic status of Standley Lake shall be maintained as mesotrophic as measured by a combination of common indicator parameters such as total phosphorus, chlorophyll a, Secchi depth, and dissolved oxygen. Implementation of this narrative standard shall only be by Best Management Practices and controls implemented on a voluntary basis.*

The Agreement provided that should the narrative standard not be met and substantial progress not made in reducing the nutrient loads to Standley Lake, additional measures may be required including numeric standards or effluent limitations for phosphorus and/or nitrogen in the Upper Basin, and for additional best management controls in Standley Lake. The Clear Creek/Standley Lake Watershed Agreement, Clear Creek Watershed Management Monitoring Program and the Standley Lake Management Plan form the triune agreements related to the water quality of raw water sources into and stored in Standley Lake. This annual report is a pivotal requirement of the Clear Creek/Standley Lake Watershed Agreement. All three are included as appendices to this report

### Monitoring Program Summary

The monitoring program is divided into three geographically based sub-programs, Clear Creek, Tributaries/Canals, and Standley Lake. Extensive detail regarding the entire monitoring program is included in the Monitoring Programs Summary section of this report. A monitoring location map is included at the end of the Executive Summary. A complete list of constituents can be found in Appendix B.

Table 1. 2007 monitoring program summary

| Event description | #Sampling Sites | # Sampling Events | Total # of samples |
|---|---|---|---|
| Creek (ambient) | 25* | 8 (6 short, 2 long) | 98 |
| Tributary | 8 | 12 | 96 |
| Canal | 3 | 8 | 24 |
| Lake | 3 | 19 | 57 |

* 17 creek sites + 8 WWTF

***Clear Creek Program***

In addition to grab samples, the creek is also sampled with autosamplers and continuous, in-stream probes. Automated sampling equipment (autosamplers) provides the ability to initiate remote sample collection. Continuous monitoring of the in-stream conditions captures the impacts to water quality and stream flows from natural precipitation events as well as impacts from construction or other watershed activities. The CC59 autosampler was installed in 2005. The other two autosamplers were installed a year later. These sites are, upstream to downstream:

*CC49 -- On the mainstem of CC upstream of the confluence with the North Fork of CC*
*CC50 -- North Fork of CC above confluence with the mainstem of CC*
*CC59 -- on the mainstem of CC approximately 100 yards upstream of the Church Ditch Headgate.*

During 2007, the in-stream monitoring and automated sampling site located at CC59 was fully functional providing continuous water quality data acquisition for turbidity, conductivity, pH, and stage height. In addition, in-stream probes were set to trigger sampling when water quality or flow parameters exceeded pre-determined limits, thus providing sample data associated with non-ambient type conditions in Clear Creek.

The autosamplers at CC49 and CC50 sites have presented some challenges since installation in 2006: inaccurate triggering for storm event sampling, various analytical probe interferences, instrument damage from rock slides, and vandalism. Gaps in the continuous data record resulted from these interruptions.

A data summary for the two year period of record of 48 hour composite samples at CC59 is presented. Data summaries for CC49 and CC50 are not presented in this report due to the short period of record and the operational difficulties encountered.

*Canal and Tributary Programs*

Grab samples are collected on all the supply canals to Standley Lake on a monthly basis when the individual canals/ditches are running. The Croke and Farmers Highline canals are sampled at three points along each ditch: headgate, midpoint, and lake inlet. The Church and KDPL are sampled at the headgates and lake inlets. Nutrient loadings into Standley Lake are calculated from the lake inlet data. The canal and tributary monitoring programs will be modified in 2008. They will be combined into one program referred to as the Tributary Program, and midpoints will no longer be monitored.

*Standley Lake Program*

Standley Lake is monitored on a bi-weekly basis throughout the year provided the lake is not covered with ice. Samples are collected at the surface, in the phototrophic zone, and five feet off the bottom of the lake. Lake samples were collected in an attempt to accurately assess algal growth, the period of hypolymnetic anoxia, nutrient trends, and lake turnover. A total of 537 grab samples have been collected since 1999. Multiple analyses were performed on each of the samples.

In addition to grab samples, water quality on Standley Lake is monitored using a Remote Underwater Sampling Station (RUSS) unit. The RUSS is placed on the lake in the spring when the ice cover has melted and is retrieved in the fall before the lake freezes. Two sensors measure standard field parameters plus chlorophyll *a*, in a depth integrated manner twice daily. During 2007, the RUSS executed at least one full-column profile on 215 separate days. The aging RUSS unit will be replaced with an YSI profiler in 2008.

Table 2. Summary table of number of grab samples for the period of record - 1994 through 2007

| Site Location | N= |
|---|---|
| Clear Creak - stream | 1,312 |
| Clear Creak – waste water plants | 730 |
| Canal/Tributaries | 865 |
| Standley Lake* | 575 |
| **Total** | 3,482 |

* Record is 1999-2006

The 3,482 samples have resulted in more than 29,000 individual analytical results. The monitoring committee has also instituted a rigorous quality assurance/quality control program. Refer to Appendix C for sample data results. The annual cost for the entire monitoring program is greater than $201,000. See Figure 2 for a detailed breakdown of monitoring costs.

**Data Results for Grab Samples**

***Clear Creek***

In an effort to understand anthropogenic impacts on water quality and in support of the narrative standard on Standley Lake, upstream to downstream nutrient data comparisons for 2007 were made against the 1994 through 2006 sample data.

Table 3. Comparison of 2007 average concentrations (mg/L) to 1994 through 2006 average concentrations (mg/L)

| Parameter | Site Location | | | | | |
|---|---|---|---|---|---|---|
| | CC26** (upstream) | | CC40 (midstream) | | CC60 (downstream) | |
| | '94-'06 | 2007 | '94-'06 | 2007 | '94-'06 | 2007 |
| Total Phosphorus | 0.0125 | 0.0107 | 0.0212 | 0.0144 | 0.0234 | 0.0173 |
| Dissolved Phosphorus | 0.0040 | 0.0034 | 0.0056 | 0.0039 | 0.0038 | 0.0029 |
| Total Nitrogen* | 0.44 | 0.46 | 0.47 | 0.33 | 0.47 | 0.42 |

*TN data begins in 1996
** CC26 data begins in 1998

The maximum concentration for total phosphorus was recorded on 12/6/07 at CC60 (Mainstem in Golden). The reading was 0.0257 mg/L TP. The maximum concentrations recorded for both dissolved reactive phosphorus and total nitrogen were on 5/24/07 and 2/5/07 at CC50 (N. Fork). The readings were 0.0078 mg/L and 0.84 mg/L, respectively.

*Standley Lake - Loadings from Canal/Tributaries, trend analysis and trophic status*

Data was analyzed for loadings, trophic status, and seasonal and regression trends. Multiple statistical tools were used including Microsoft Excel and Lakewatch programs. Canal/Tributaries data was used to determine loadings into Standley Lake.

The reservoir loadings from the canals in 2007 were:

- Total phosphorus – 2,816 pounds
- Dissolved reactive phosphorus - 788 pounds
- Nitrate + Nitrite (as N) – 29,184 pounds
- Ammonia (as N) – 2,666 pounds
- Total Nitrogen – 57,888 pounds

To compare 2007 with previous years' loadings see Table 12.

Rather than use an iterative, statistically based process, the 2003 through 2007 period (five years) was used for all trending analysis. This period is similar to the protocol used by the Colorado Department of Health and Environment. It should be noted that using this methodology may result in trending across distinct populations which introduces bias. Samples were taken from SL10, located at the east side of the reservoir near the dam face. All grab samples were taken in the epilimnion when the lake was stratified. Standley is stratified from June until turnover in mid to late September. The reservoir is isothermic the remaining months.

Table 4. Summary table of trends of various constituents for the years 2003 through 2007.

| Parameter | Significant Trend (Y/N) | If Yes, Annual Change | Comments |
|---|---|---|---|
| Total Algae | N | | |
| Chlorophyll *a* | N | | Higher concentrations observed Oct. – March |
| Total Nitrogen | Y | - 0.163 mg/L/yr | TN is trending downward |
| Nitrate (as N) | Y | - 0.138 mg/L/yr | Nitrate is trending downward |
| Total Phosphorus | Y | 0.017 mg/L/yr | TP is trending upward |
| Dissolved Reactive Phosphorus | N | | |
| DO | Y | - 0.23 mg/L/yr | DO is trending downward |
| Secchi Depth | Y | 0.18 m/yr | Lake clarity is improving |

In support of the narrative standard, the trophic status of Standley Lake is reviewed annually. Table 3 lists the annual trophic status for 1994 through 2007. The Carlson index uses the following parameters or indices to determine trophic status: chlorophyll *a*, secchi depth, total phosphorus, total nitrogen, and hypolimnetic volumetric oxygen depletion. Standley Lake remains mesotrophic.

**Upper Basin Summary**

The Clear Creek Watershed covers an area of approximately 416 square miles in Gilpin, Clear Creek and Jefferson counties. The Upper Basin consists of 15 different stream segments of Clear Creek as part of the South Platte River Basin. There are seven segments on the 303 (d) list and the entire basin is listed as a Superfund site for mining remediation.

There are eleven dischargers in the basin serving a population of approximately 15,000 residents plus daily visitors. As well, there are a substantial number of ISDS systems, especially in the eastern portions of Clear Creek and Gilpin Counties. Historic mining activity has caused elevated levels of metals in groundwater and runoff, thus causing the 303 (d) listings.

**Tributary Basin Summary**

On October 26, 2006 the Cities of Arvada, Northglenn, Thornton, and Westminster signed an intergovernmental agreement with the Church Ditch Water Authority authorizing the use of a section of the ditch as an inceptor canal for the purpose of diverting all or portions of storm water flows around Standley Lake. When the project is completed, the Church Ditch will divert stormwater runoff from 3,996 acres of land around Standley Lake. Construction of the new inflow structure began in 2007 and is expected to be completed in time for the 2008 runoff season.

The City of Arvada is aggressively implementing their Phase II stormwater permit requirements.

**Standley Lake Cities Summary**

The Clear Creek/Standley Lake Watershed Agreement, Clear Creek Watershed Management Monitoring Program and the Standley Lake Management Plan are the policy documents related to the water quality for Standley Lake and its raw water sources. This annual report is a key requirement of the Clear Creek/Standley Lake Watershed Agreement. All of the drinking water for the Cities of Northglenn and Westminster is stored in Standley Lake, as is nearly half of the City of Thornton's water supply. The Standley Lake Cities have a responsibility to their citizens and consumers to deliver safe and aesthetically pleasing drinking water. Recognizing this responsibility, the Standley Lake Cities began working cooperatively to establish programs for the protection of the water quality in Standley Lake. The mission statement for Standley Lake reads:

> *To protect the quality of Standley Lake as a drinking water supply through the application of scientifically based and fiscally responsible management techniques. Optimize the health of Standley Lake and its watershed for current and future generations.*

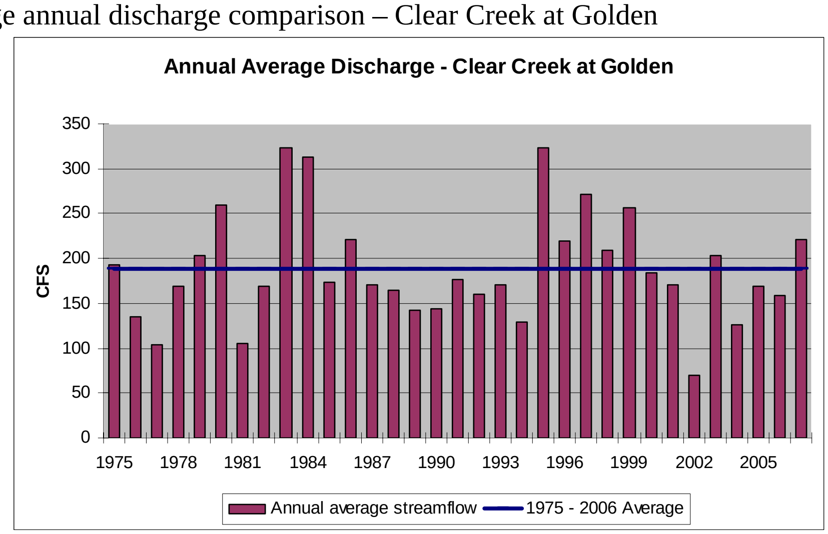
It is paramount that the Standley Lake Cities maintain a focus on protection of this water supply, and continue to commit the necessary resources to accomplish this mission. To this end, the Standley Lake Cities will be seeking a site specific nutrient standard for Standley Lake at the 2009 South Platte Rule Making Hearing. The SLC will be relying on fourteen years of monitoring data, Event Mean Concentration (EMC) studies and both watershed and in lake models to assist in developing the standard. Stakeholder input will be sought through the Source Water Protection Planning process scheduled to begin in 2008.

While the Standley Lake Cities agree that the trophic status of the reservoir was mesotrophic in 2007, there is apprehension about the future health of the reservoir. The Cities remain concerned with taste and odor events caused by winter algae blooms, are not in agreement on the definition of the growing season, and the number of weeks of hypolimnetic anoxia. Repeated enforcement and compliance issues at numerous upstream wastewater treatment plants are also a concern. The Standley Lake Cities are encouraged by the completion of the regional wastewater treatment study and agree with the recommendations.

**Stream Gaging & Flow Summary**

To provide the flow data needed for calculating nutrient loadings, the Upper Clear Creek Watershed Association, Standley Lake Cities, Clear Creek Watershed Foundation, United States Geological Survey, Federal Highway Authority, and the Colorado Department of Transportation continue to work on a program to maintain a network of stream and staff gages. The average annual streamflow at the USGS gage in Golden (CLEGOLCO) for the period 1975 through 2006 was 187 cfs. The average annual streamflow in 2007 was above this average at 220 cfs.

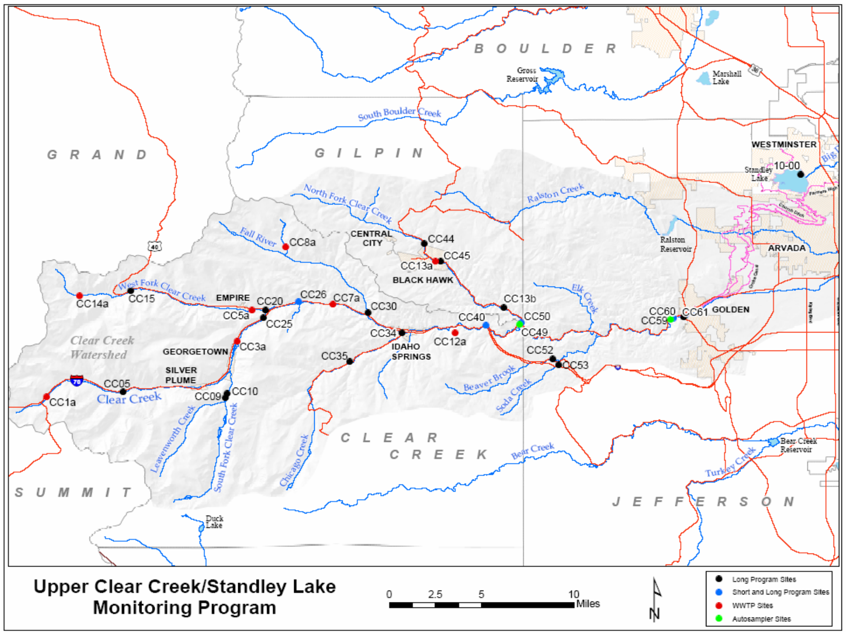
Figure 1. Average annual discharge comparison – Clear Creek at Golden



**Nonpoint Source Control Efforts Summary**

Nonpoint source control efforts play an important role in improving water quality. The majorities of governmental entities in both the upper and tributary basins has adopted and are implementing nonpoint source control regulations. In 2003, the lower basin cities of Arvada, Northglenn, Thornton, Westminster and Golden received Phase II stormwater permits as required by the Clean Water Act. The cities have successfully completed program goals for each year since 2003. Additionally, all of the lower basin cities have adopted regulations providing for erosion control during construction, permanent BMP maintenance and prohibition of illicit discharges. For specific information on completed programs call the Stormwater Coordinator for the city or county of interest. For information on Upper Basin pollution prevention/control efforts, see Section II, Upper Clear Creek Watershed Association (UCCWA).

Figure 1-A. Clear Creek Monitoring Sites




## I. MONITORING PROGRAM

A copy of the Clear Creek Watershed Management Agreement (Agreement) is contained in Appendix A, Section II, paragraph 4, of the Agreement provides for joint design, implementation, and funding of a monitoring program to evaluate nutrient loading from point and non-point sources in the Upper Basin, nutrient loadings from non-point sources in the Tributary Basin, internal Lake loadings and the effect of nutrient reduction measures implemented by the various parties on the trophic status of Standley Lake. The monitoring program is outlined in the Clear Creek Watershed Management Monitoring Program Appendix B.

**Sampling Overview**

*Clear Creek Grab samples*

Seventeen Clear Creek sites and eight wastewater treatment plants were monitored under the program in 2007. Two types of schedules were sampled: a short schedule (February, April, June, July, August, and December) which included four stream sites and four wastewater treatment plants and a long schedule (May and October, i.e. high and low flow) which included all seventeen creek sites and eight wastewater treatment plants. Specific sites sampled during the short and long schedule are represented in Table 6. Data results can be found in Appendix C.

All samples were transported by the sampling teams in coolers with ice to the City of Golden Environmental Services Laboratory for compositing and generation of the quality control splits and spikes. Analyses were performed as follows:

Table 5. Analysis and monitoring responsibilities

| **Entity** | **Parameter/Analyte** | **Sample Type** |
|---|---|---|
| Northglenn | TP & DRP | Grab |
| Westminster | TN, NO3 & Ammonia | Grab |
| Thornton | TSS ,VSS & TOC | Grab |
| EPA | Metals | Grab |
| Golden | Metals for EMC | Grab |
| Arvada | Splits/Spikes for TP & TN | Grab |

Field parameters, including, pH, temperature, conductivity, and dissolved oxygen were analyzed at each site and for each sampling event.

All creek and tributary sites were analyzed for phosphorus, nitrogen, TSS/VSS, TOC and field parameters. Wastewater Treatment Plant effluents (WWTP) were analyzed for phosphorus, nitrogen, TSS/VSS and field parameters. Metals samples were collected in May and October.

The sites included are as follows: See Figure 1-A for site location.

Table 6. Monitoring schedule – grab samples

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CC05 | | | | | x | | | | | x | | |
| CC09 | | | | | x | | | | | x | | |
| CC10 | | | | | x | | | | | x | | |
| CC15 | | | | | x | | | | | x | | |
| CC20 | | | | | x | | | | | x | | |
| CC25 | | | | | x | | | | | x | | |
| CC26 | | x | | x | x | x | x | x | | x | | x |
| CC30 | | | | | x | | | | | x | | |
| CC34 | | | | | x | | | | | x | | |
| CC35 | | | | | x | | | | | x | | |
| CC40 | | x | | x | x | x | x | x | | x | | x |
| CC44 | | | | | x | | | | | x | | |
| CC45 | | | | | x | | | | | x | | |
| CC50 | | x | | x | x | x | x | x | | x | | x |
| CC52 | | | | | x | | | | | x | | |
| CC53 | | | | | x | | | | | x | | |
| CC60 | | x | | x | x | x | x | x | | x | | x |
| CC1a* | | | | | x | | | | | x | | |
| CC3a* | | x | | x | x | x | x | x | | x | | x |
| CC5a* | | | | | x | | | | | x | | |
| CC7a* | | x | | x | x | x | x | x | | x | | x |
| CC8a* | | | | | x | | | | | x | | |
| CC12a* | | x | | x | x | x | x | x | | x | | x |
| CC13b* | | x | | x | x | x | x | x | | x | | x |
| CC14a* | | | | | x | | | | | x | | |

*****Represents a wastewater treatment facility

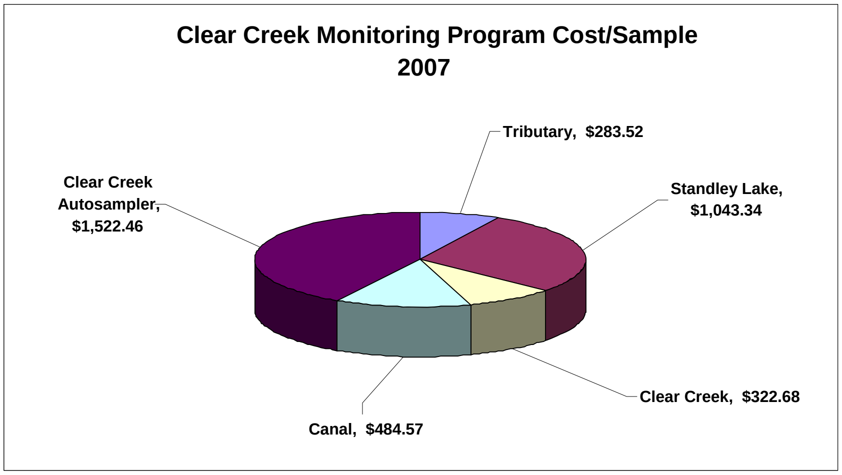
Table 7. Sample count by monitoring program

| Event description | #Sampling Sites | # Sampling Events | Total # of samples |
|---|---|---|---|
| Creek | 25* | 8 (6 short, 2 long) | 98 |
| Tributary | 8 | 12 | 96 |
| Canal | 3 | 8 | 24 |
| Lake | 3 | 16 | 48 |

* 17 creek sites + 8 WWTF

**Monitoring Costs**

Figure 2. Clear Creek Monitoring Program Costs




**Monitoring Program Contributions**

- **Arvada**
  - Operated one auto-sampler for canal sampling
  - Coordinated and funded independent quality control laboratory services - long program only
  - Provided sampling personnel for Clear Creek and canal sampling
  - Provided funding and personnel for autosampling program CC49, CC50

- **Golden**
  - Prepared quality control samples
  - Administered the Clear Creek / Standley Lake database
  - Provided laboratory for turbidity analysis during long program
  - Printed Chain of Custody forms
  - Provided funding and personnel for autosampling program CC59

- **Northglenn**
  - Performed phosphorus analysis (total and ortho-)
  - Provided one auto-sampler and staff for canal sampling
  - Coordinated canal sampling program
  - Conducted and coordinated the tributary sampling program
  - Provided funding and personnel for autosampling program CC49, CC50
  - Lakewatch Committee member
  - Database Peer Review

- **Thornton**
  - Provided field testing instrumentation and analyzes
  - Coordinated overall Clear Creek monitoring program
  - Coordinated delivery of Clear Creek samples to laboratory
  - Routinely provided personnel for Clear Creek sampling
  - Routinely provided personnel for Tributary sampling
  - Delivered sample bottles to sampling teams
  - Provided personnel and autosampler for canal sampling
  - Performed algae counts and identification, chlorophyll a, TSS/VSS, TOC & *E. coli* analyses
  - Lakewatch Committee member
  - Database Peer Review

- **Upper Clear Creek Watershed Association**
  - Provided funding for metals sampling

- **Westminster**
  - Conducted Standley Lake sampling program
  - Provided boat and field testing equipment
  - Routinely provided sampling personnel for Clear Creek sampling
  - Performed total nitrogen, nitrite/nitrate and ammonia analyzes
  - Maintains RUSS equipment and RUSS database
  - Database peer review and data distribution
  - Provided funding and personnel for autosampling program CC49, CC50
  - Lakewatch Committee member
  - Database Peer Review

***Autosamplers and continuous data probes***

In addition to the grab samples, the creek is monitored using autosamplers and continuous read probes. Autosamplers collect event triggered samples as well as monthly, 24 hour composite samples. In-stream water quality monitoring and sampling capability at these sites enable the monitoring program to automatically track water quality changes in the watershed that occur due to anthropogenic and natural factors. The ability to automatically sample when ambient conditions in the Creek change, combined with a continuous picture of water quality in the creek provides critical information on how natural events, such as precipitation, or events associated with construction or other watershed activities can alter water quality. During the 2007 monitoring season, eleven distinct storm events in Clear Creek were successfully captured and recorded at CC59.

The monitoring station at CC59 is the first completed step in automated monitoring for the upper Clear Creek watershed. Installed in 2005, this station has been collecting data for a full two years. Two other sites were established in 2006 for a total of three autosampler sites.
These three sites positioned from upstream to downstream are:

*CC49 -- On the mainstem of CC upstream of the confluence with the North Fork of CC*
*CC50 -- North Fork of CC above confluence with the mainstem of CC*
*CC59 -- On the mainstem of CC approximately 100 yards upstream of the Church Ditch Headgate*

Monthly, from April through October, two consecutive 24-hour composites were sampled and analyzed for nutrients, TSS/VSS, and metals. Field probes for pH, conductivity, temperature, and turbidity were installed and monitored daily using telemetry. During the winter months, only temperature and conductivity data were collected. This data was routinely downloaded.

The sites at CC49 and CC50 have presented some event triggered sampling challenges due to a variety of circumstances from light-interference with the turbidity probes and upstream placer-mining by hobbyists causing a non-event sample to be taken. Probe maintenance during high flows will be addressed in 2008.

The City of Golden provides funding for the CC59 monitoring station. Costs include professional consultation regarding the operation and maintenance of the monitoring station and year end data analysis. City staff is responsible for downloading data from the site throughout the year and also maintains the database for the autosampler monitoring program. The other two autosampler sites are funded and maintained by the SLC.

*Supply Canals – Croke, Kinnear Ditch Pipeline (KDPL), Church, and Farmers High Line*
Grab samples are taken on all the supply canals to Standley Lake on a monthly basis when the individual ditches are running. The Croke and Farmers Highline canals are sampled at three points along the ditch, headgate, midpoint, and inlet. The Church and KDPL are sampled at the headgate and inlets.

The Croke and Farmers' High Line Canals are also sampled with autosamplers as a part of the CC monitoring program. One of the two canals was sampled routinely within seven (7) days following each Upper Clear Creek Basin sampling event. There were three (3) sampling sites on each canal: the headgate, midpoint and inlet to Standley Lake.

Canal autosamplers were set up to collect one sample every hour for a 24-hour composite. The midpoint autosampler was set to start 4-6 hours after the headgate sampler and the lake inlet autosampler was set to start 4-6 hours after the midpoint autosampler. The delay in start times was varied based on flow velocity.

**Quality Assurance / Quality Control**

Quality control samples were collected, prepared, and analyzed in 2007. See Appendix B for details on this program.

**Central City Parkway**

In 2007, stormwater staff from the Cities of Northglenn, Thornton, and Westminster inspected the Central City Parkway on one occasion for erosion control best management practices. Four key locations were evaluated: 1) Hidden Valley exit, 2) area right after the first turn (1st pullout - right side), 3) Russell Gulch and 4) Nevada Gulch/Quartz Mine. The group looked for erosion problems, sediment buildup, and effectiveness of BMPs, excessive debris or sediment at curb inlets and related outfalls, and revegetation of all disturbed areas. In general, there have been improvements in most areas.

Some of the old straw bale barriers and silt fences were removed. Sediment was collected and removed in certain areas. Revegetation continues to take place in most locations. Erosion continued to deteriorate all four key locations, but at a slower rate than previous inspections showed. More rock check dams need to be installed. Central City staff was not available to participate in the June 2007 field inspection. Monitoring and inspection of the road project will continue.

***Standley Lake Monitoring***

In 2007 Westminster Laboratory staff sampled Standley Lake from a boat on 19 dates from February 7, 2007 through December 3, 2007 at site SL10, on the east side of the lake near the dam. At this location, samples were collected at up to three levels: the surface, the phototropic zone (twice the secchi disk depth) and five feet from the bottom. Lake samples were collected twice a month (weather permitting) in an attempt to accurately assess algal growth, the period of hypolimnetic anoxia, and lake turnover. Secchi depth is measured to determine clarity and define the phototropic zone. A multi-parameter sonde with sensors to measure temperature, specific conductance, pH, ORP, turbidity, chlorophyll *a* and dissolved oxygen was lowered through the water column to take readings at 1-meter intervals. Westminster staff also performed laboratory analyses for total nitrogen, nitrate and ammonia. Northglenn staff performed total phosphorus and dissolved reactive phosphorus analyses. Thornton staff performed coliform, solids, total hardness, algae count, algae identification, and chlorophyll *a* analyses. Parameters that were collected on an intermittent basis included metals (quarterly), gross alpha and beta and TOC. Additionally, samples were collected at the boat ramp for BTEX analysis during the summer months to assess water quality impacts from boating.

The Remote Underwater Sampling Station (RUSS) unit was deployed on Standley Lake on March 19, 2007. Daily profiles were taken until November 16, 2007 when the unit was removed due to ice. Two identical YSI 6600 sondes were alternately placed on board the profiler. During the deployment period, the RUSS executed at least one full-column profile on 241 separate days.

**Monitoring Results**

***Clear Creek Grab Sample Summary Tables***

In an effort to understand anthropogenic impacts on water quality and in support of the narrative standard on Standley Lake, upstream to downstream nutrient data comparisons for 2007 were made against the 1994 through 2006 sample data. All of the data used in the following summary were generated from grab samples taken over the hydrograph (8 times/year).

CC26 (Upstream): I-70 at the Lawson gage below the confluences of West Fork CC, Leavenworth Creek and South Fork CC. Anthropogenic influences include wastewater treatment facilities, commercial and domestic septic systems, treated mine waste and stormwater runoff from roadways.

CC40 (Midstream): USGS gage at Kermit’s Restaurant, below the confluences of Chicago Creek and Fall River, upstream of the confluence with North Fork. Anthropogenic influences include multiple wastewater treatment plants, septic systems, abandoned mines, and stormwater runoff from towns and roadways.

CC60 (Downstream): One hundred yards upstream of the Church Ditch Headgate, below the confluences of North Fork CC, Beaver Brook, Soda Creek and Elk Creek. Anthropogenic influences include multiple wastewater treatment plants, septic systems, abandoned mines, rock/gravel mines, and stormwater runoff from towns and roadways.

Table 8. Comparison of 2007 average concentrations (mg/L) to 1994 through 2006 average concentrations (mg/L)

| Parameter | Site Location | | | | | |
|---|---|---|---|---|---|---|
| | CC26** (upstream) | | CC40 (midstream) | | CC60 (downstream) | |
| | '94-'06 | 2007 | '94-'06 | 2007 | '94-'06 | 2007 |
| Total Phosphorus | 0.0125 | 0.0107 | 0.0212 | 0.0144 | 0.0234 | 0.0173 |
| Dissolved Phosphorus | 0.0040 | 0.0034 | 0.0056 | 0.0039 | 0.0038 | 0.0029 |
| Total Nitrogen* | 0.44 | 0.46 | 0.47 | 0.33 | 0.47 | 0.42 |

*TN data begins in 1996
** CC26 data begins in 1998

For the entire data set, see Appendix C.

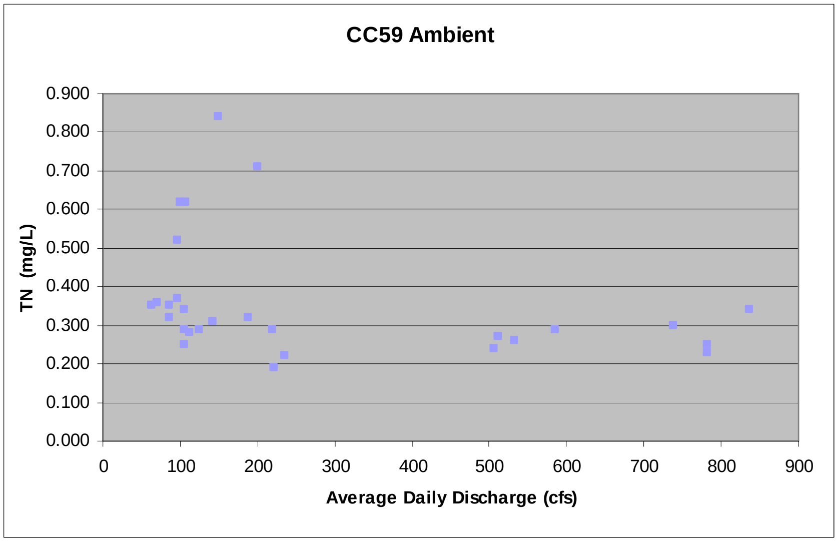
Graphs of nutrient data, 1997-2007, for sites CC26, CC40 and CC60 are located at the end of Section III.

*Clear Creek autosampler results*
Autosamplers collect event triggered samples as well as monthly, 24 hour ambient composite samples. Continuous in-stream water quality monitoring and sampling capability at these sites enable the monitoring program to automatically track water quality changes in the watershed that occur due to anthropogenic and natural factors. The ability to automatically sample when ambient conditions in the creek change, combined with a continuous picture of water quality in the creek provides critical information on how natural events, such as precipitation, or events associated with construction or other watershed activities can alter water quality. During the 2007 monitoring season, eleven distinct storm events in Clear Creek were successfully captured and recorded at CC59.

Monthly, from April through October, two consecutive 24-hour composites were sampled and analyzed for nutrients, TSS/VSS, and metals. Field probes for pH, conductivity, temperature, and turbidity were installed and monitored daily using telemetry. During the winter months, only temperature and conductivity data were collected. This data was routinely downloaded and evaluated.

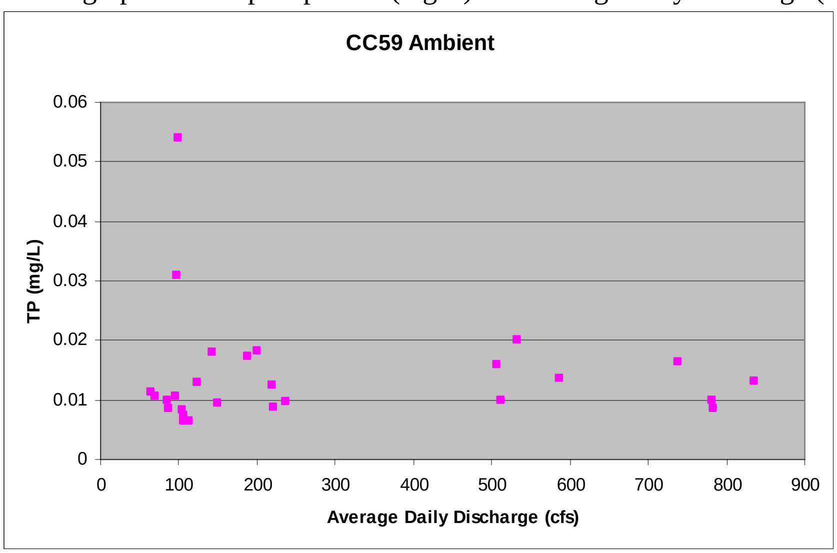
The autosampler network is maintained by the cities of Golden, Arvada and the SLC. CC59, located upstream of the Church Ditch headgate in Golden, has been operational since 2005. CC49 and CC50, mainstem at Lawson and N. Fork respectively, have been in use since 2006. The following graphs were generated using 2006 and 2007 ambient (nonevent) and event data at CC59. No trending was performed as there is insufficient number of sample years. The average daily flow at each site was used for both ambient and event triggered samples. SLC acknowledge that average daily discharge may not be the actual flow at the time of sampling.

Figure 3. Ambient data graph of total nitrogen (mg/L) and average daily discharge (cfs).




The highest concentration (0.84 mg/L) occurred on April 23, 2007 at 50cfs. The lowest concentration (0.19 mg/L) occurred on July 25, 2007 at 221 cfs.

Figure 4. Ambient data graph of total phosphorus (mg/L) and average daily discharge (cfs).




The highest concentration (0.054 mg/L) occurred on April 16, 2006 at 100cfs. The lowest concentration (0.0065 mg/L) occurred on August 30, 2006 at 113 cfs.

*Standley Lake*

In support of the Standley Lake Management Plan, Appendix D, the SLC evaluate trends and trophic status using the Lakewatch computer software. Lakewatch was developed by Dr. Noel Burns, renowned limnologist. A table with the Carlson trophic status values follows in the Trophic Status section. For purposes of trend analysis, the last five years of data were used. All indicators were measured at Standley Lake site SL10, near the dam face.

Two types of Lakewatch graphs are presented. One type is a regression graph with the top regression line being observed data; the bottom regression line, plotted as residuals, is deseasonalized data, i.e. data from which seasonal variation has been removed. Regression lines using least square regressions are calculated for both sets of data. A low p-value correlates to a low probability that the fit of the line is attributable to chance, i.e. there is a high probability of a trend. All data for the 2003 through 2007 period was used to develop these graphs, regardless of thermal stratification status. The second type of Lakewatch graph groups the entire data set by month resulting in a seasonal variation graph.

Westminster staff sampled Standley Lake from a boat on 19 dates in 2007. Lake data is collected daily using a remote underwater sampling station (RUSS). The RUSS unit consists of a floating platform containing solar panels, marine batteries and an on-board computer and communications package. A data cable connects the computer to a combination leveling profiling device and sensor package that floats below the platform. The sensor system moves up and down through the water column. The sensors transmit data via the communication cable to the on-board computer. Data can be downloaded manually or via a SCADA system. A new YSI profiler will replace the RUSS in 2008.

Table 9. Summary table of Standley Lake water quality data for the 2003-2007 period.

| **Parameter** | **Significant Trend (Y/N)** | **If Yes, Annual Change** | **Comments** |
|---|---|---|---|
| Total Algae | N | | |
| Chlorophyll *a* | N | | Higher concentrations observed Oct. – March |
| Total Nitrogen | Y | - 0.163 mg/L/yr | TN is trending downward |
| Nitrate (as N) | Y | - 0.138 mg/L/yr | Nitrate is trending downward |
| Total Phosphorus | Y | 0.017 mg/L/yr | TP is trending upward |
| Dissolved Reactive Phosphorus | N | | |
| DO | Y | - 0.23 mg/L/yr | DO is trending downward |
| Secchi Depth | Y | 0.18 m/yr | Lake clarity is improving |

Figure 5. 2003 through 2007 seasonal chlorophyll *a* is measured in the phototropic zone (two times secchi depth)

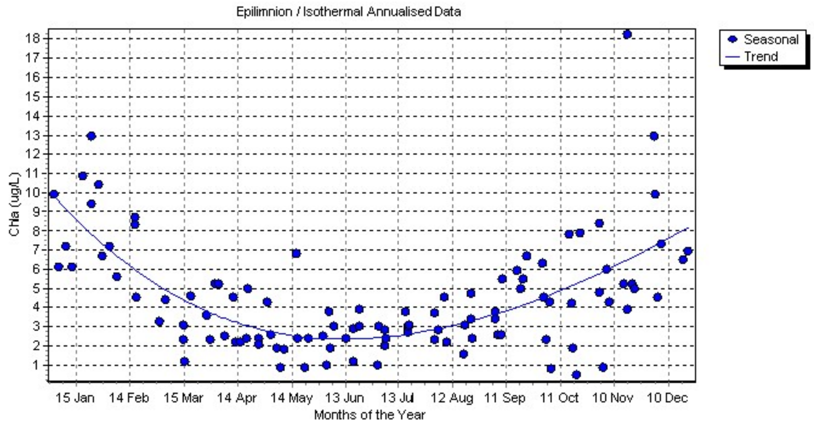
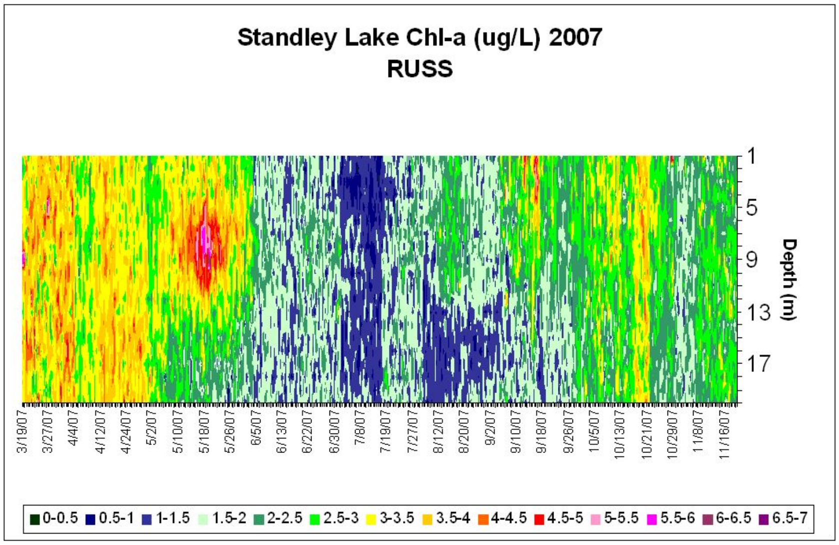



Figure 6. RUSS profile showing an algae bloom in late spring (depth integrated profile).




In 2007, the fall through winter chla concentrations ranged from 2.5 to 5.0 ug/L. High chla concentrations were measured on March 19, 2007 at RUSS deployment. In May, an algae bloom was captured on the isopleth. The Cities of Westminster and Northglenn experienced a taste and odor event shortly afterwards. The City of Thornton was not distributing Standley Lake water at the time. Concentrations dropped during the summer and increased again after turnover in September. Following turnover, algae concentrations increased and remained high until the first part of November when the RUSS was taken off the lake due to impending ice cover. This supports the SLC assertion that Fall through early Spring is the growing season.

Figure 7. Seasonal Dissolved Oxygen (depth integrated profile).

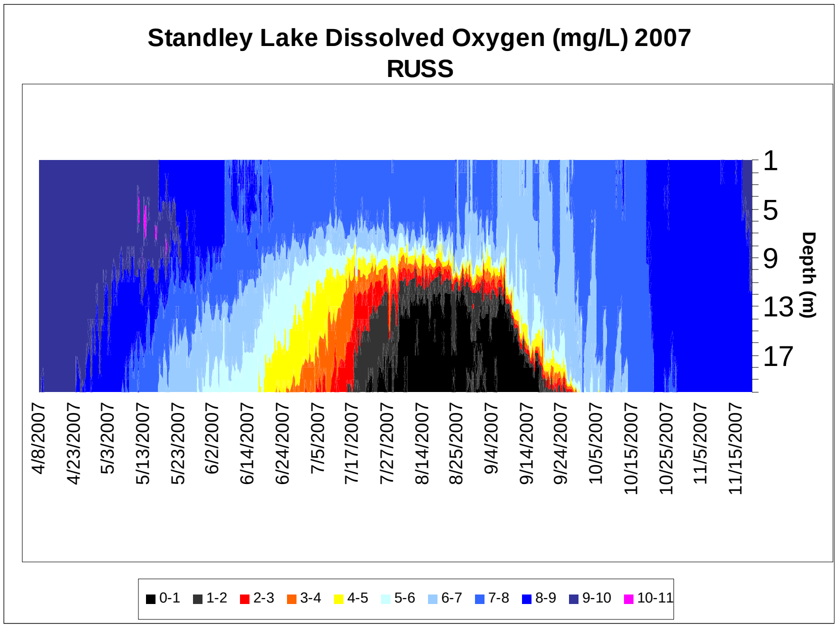



Figure 8. Weeks of hypolimnetic anoxia

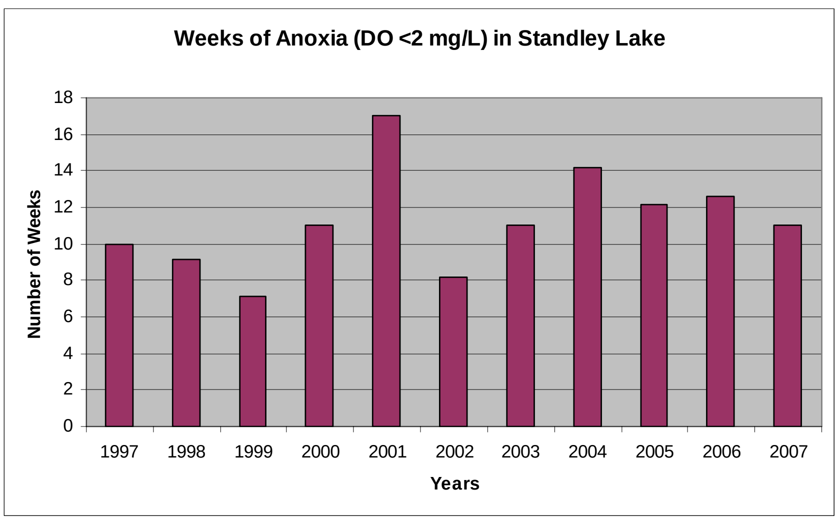
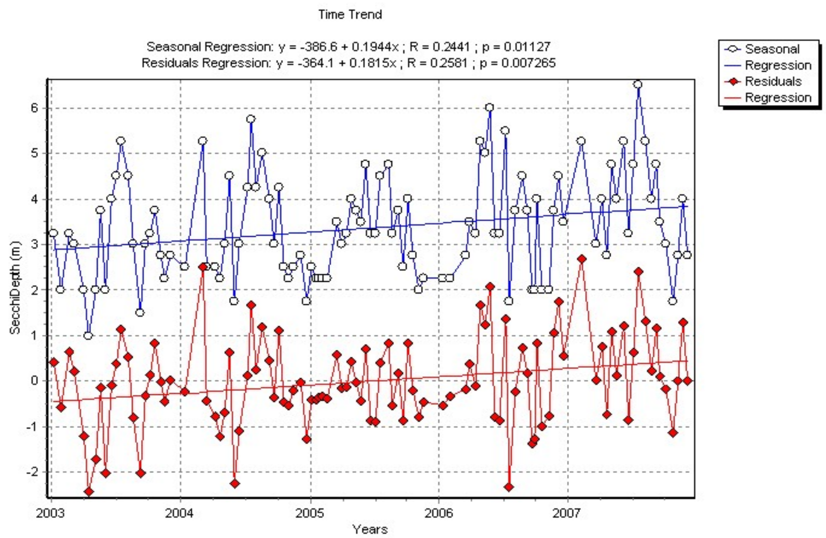
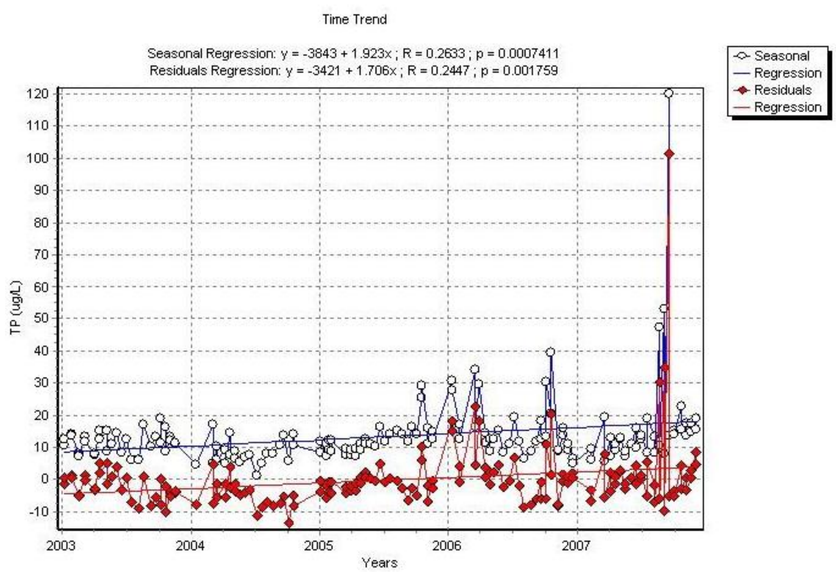


Figure 9. Secchi depth



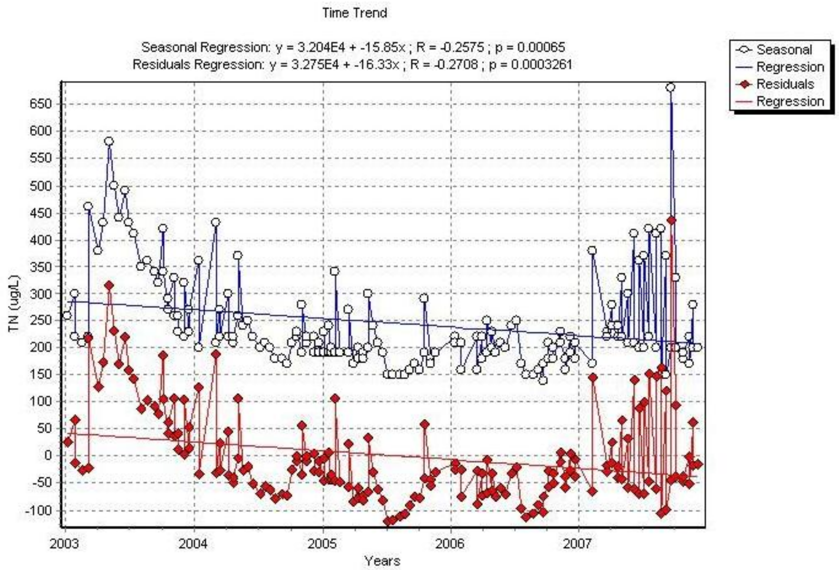

Secchi depth is trending upward (i.e. reservoir clarity is increasing). The trend is significant. The rate of change is 0.182 meters/yr.

Figure 10. TP graph, using grab samples taken in the epilimnion when the lake is stratified, June till turnover in mid/late September. Standley is isothermal all other months.



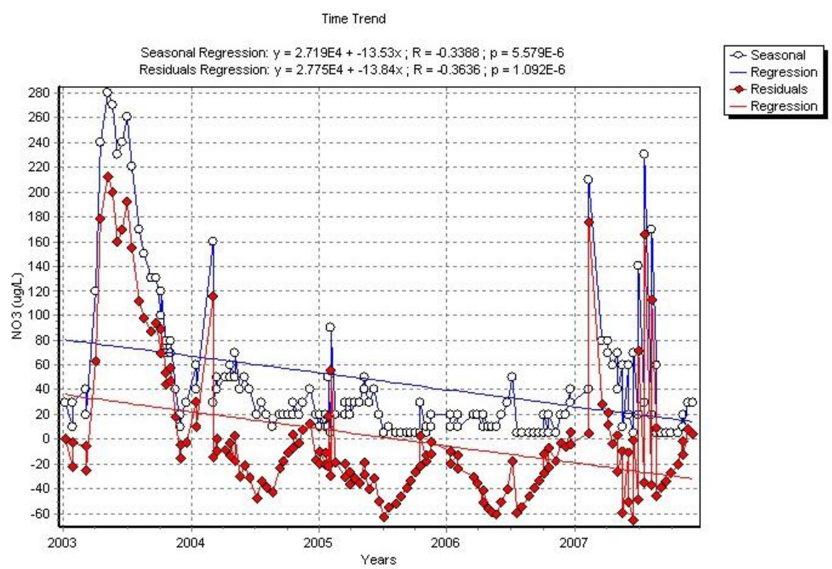

Total phosphorus is trending upward. The trend is significant. The rate of change is 0.0171 mg/L/yr.

Figure 11. TN graph, using grab samples taken in the epilimnion when the lake is stratified, June till turnover in mid/late September. Standley is isothermal all other months.




Total nitrogen (TN) is trending downward. The trend is significant. The rate of change is -0.1633 mg/L/yr.

Figure 12. NO3 graph, using grab samples taken in the epilimnion when the lake is stratified, June till turnover in mid/late September. Standley is isothermal all other months.

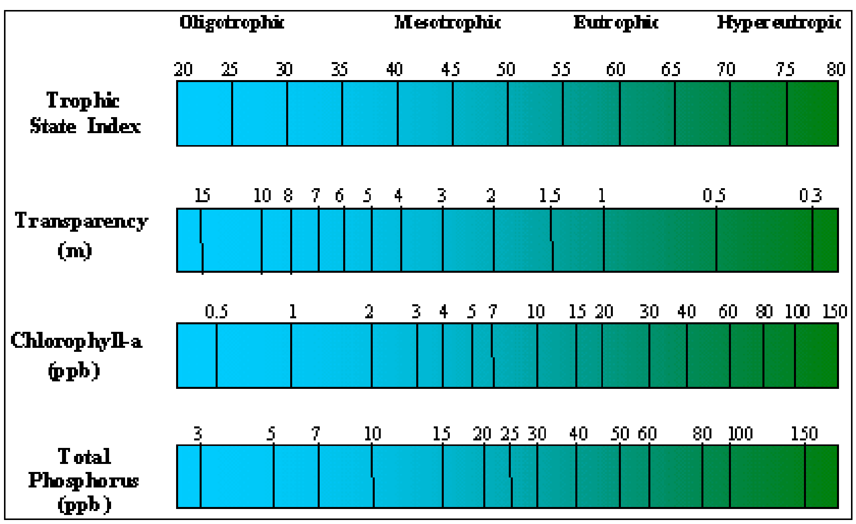



Nitrate is trending downward. The trend is significant. The rate of change is -0.1384 mg/L/yr.

*Loadings and Trophic Index*
Dr. Noel Burns, noted limnologist and developer of the Lakewatch computer program, defines trophic state as "the life supporting capacity per unit volume of a lake. Six commonly measured variables are widely accepted as good indicators of the trophic level of a lake: Chlorophyll *a* (chla), Secchi depth (SD), total phosphorus (TP), total nitrogen (TN), hypolimnetic volumetric oxygen depletion rate (HVOD) and phytoplankton species and biomass." (Burns and Bowman, 2000). Four of the six indicators are mentioned in Standley Lake's narrative standard. Dr. Burns further explains that "trophic levels of lakes are critical indicators of water quality. Trophic state is a scale based on multiple, commonly measured parameters. Water quality is a relative term based on use or uses of the water. Trophic state is considered one aspect of water quality.

The Lakewatch Program uses both the Carlson and Burns classification schemes. The Carlson methodology is used in this report. Carlson's trophic status is based on the assumption that changes in nutrient levels influence algal biomass as measured by chlorophyll *a* which in turn causes changes in lake clarity as measured by Secchi depth. Each increase of ten units on the scale represents a doubling of algal biomass. Carlson was developed using data from naturally occurring lakes, not reservoirs, in the North East United States. These lakes have few rooted aquatic plants and little non-algal turbidity. Phosphorus is the causal agent and biomass (i.e. algal growth) is the response variable. The role of nitrogen and macrophytes on biomass is not considered. The following graphic is from the EPA's web site, aquatic biodiversity, Carlson's Trophic State Index. The colored bars relate to the first set of columns of Table 10 below. Standley Lake's 2007 average trophic state is in the 40 to 46 TSI range, the lake is indeed moderately clear and experiencing increased periods of anoxia in the summer.

Table 10. Carlson's Trophic State Index



| | |
|---|---|
| **TSI <30** | Classic Oligotrophy; Clear water, oxygen through the year in the hypolimnion, salmonid fisheries in deep lakes. |
| **TSI 30-40** | Deeper lakes still exhibit classical oligotraphy, but some shallower lakes will become anoxic in the hypolimnion during the summer. |
| **TS 40-50** | Water moderately clear, but increasing probability of anoxia in hypolimnion during summer. |
| **TS 50-60** | Lower boundary of classical eutrophy: Decreased transparency, anoxic hypolimnion during the summer, macrophyte problems evident, warm-water fisheries only. |
| **TSI 60-70** | Dominance of blue-green algae, algal scums probable, extensive macrophyte problems. |
| **TSI 70-80** | Heavy algal blooms possible throughout the summer, dense macrophyte beds, but extent limited by light penetration. Often would be classified as hypereutrophic. |
| **TSI > 80** | Algal scums, summer fish kills, few macrophytes, dominance of rough fish. |

Table 11. Carlson trophic state for Standley Lake by year.

| **Period** | **chla (ug/L)** | **SD (m)** | **TP (ug/L)** | **TN (ug/L)** | | **TSc** | **TSs** | **TSp** |
|---|---|---|---|---|---|---|---|---|
| May 1994-Dec 1994* | 3.03 | 2.62 | 20.75 | 312.81 | | | | |
| Jan 1995-Dec 1995 | 2.94 | 2.51 | 21.63 | 320.27 | | 41.49 | 46.12 | 47.88 |
| Jan 1996-Dec 1996 | 3.10 | 2.29 | 14.36 | 281.11 | | 41.71 | 48.03 | 42.57 |
| Jan 1997-Dec 1997 | 2.84 | 2.43 | 16.44 | 313.90 | | 40.83 | 47.21 | 44.53 |
| Jan 1998-Dec 1998 | 2.75 | 2.88 | 17.51 | 346.32 | | 40.52 | 44.76 | 45.43 |
| Jan 1999-Dec 1999 | 1.82 | 3.09 | 10.69 | 281.45 | | 36.47 | 43.73 | 38.31 |
| Jan 2000-Dec 2000 | 2.68 | 2.72 | 14.79 | 226.49 | | 40.26 | 45.57 | 43.00 |
| Jan 2001-Dec 2001 | 4.09 | 3.08 | 17.47 | 268.28 | | 44.42 | 43.80 | 45.39 |
| Jan 2002-Dec 2002 | 5.60 | 2.76 | 18.08 | 241.71 | | 47.51 | 45.38 | 45.89 |
| Jan 2003-Dec 2003 | 4.70 | 3.00 | 11.77 | 335.48 | | 45.78 | 44.17 | 39.70 |
| Jan 2004-Dec 2004 | 3.54 | 3.31 | 8.26 | 234.06 | | 43.01 | 42.75 | 34.70 |
| Jan 2005-Dec 2005 | 5.00 | 3.20 | 12.44 | 198.33 | | 46.38 | 43.26 | 40.50 |
| Jan 2006-Dec 2006 | 3.91 | 3.47 | 15.82 | 195.14 | | 43.98 | 42.08 | 43.97 |
| Jan 2007-Dec 2007 | 5.11 | 3.96 | 17.53 | 267.89 | | 46.60 | 40.17 | 45.45 |
| **Average** | **3.54** | **2.87** | **15.39** | **273.49** | | **42.74** | **44.74** | **42.66** |

Using the Carlson index Standley Lake's trophic status would be considered mesotrophic. The SLC have developed a site specific lake model which will be used to compare with the Carlson index in the development of the proposed nutrient standard.

Chla – chlorophyll-a

SD – Secchi Depth

TP – Total Phosphorus

TN – Total Nitrogen

TSc – Trophic Status Chlorophyll

TSs – Trophic Status Secchi Depth

TSp – Trophic  Status Phophorus

Table 12.  Standley Lake Mass Loading Summary, 1994 through 2007 (BDL=MDL)

| Year | **Total Phosphorus (lbs)** | | | **Dissolved Reactive Phosphorus (lbs)** | | | **Nitrate + Nitrate as N (lbs)** | | | **Ammonia as N (lbs)** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inflow Load | Outflow Load | Net Reservoir Loading | Inflow Load | Outflow Load | Net Reservoir Loading | Inflow Load | Outflow Load | Net Reservoir Loading | Inflow Load | Outflow Load | Net Reservoir Loading |
| 1994 | 1,974 | 2,949 | (975) | 772 | 783 | (10) | 17,507 | 14,269 | 3,238 | 2,507 | 4,831 | (2,324) |
| 1995 | 8,166 | 2,611 | 5,555 | 1,201 | 773 | 427 | 35,473 | 27,865 | 7,608 | 5,168 | 2,413 | 2,755 |
| 1996 | 4,283 | 1,834 | 2,448 | 793 | 666 | 127 | 26,550 | 18,416 | 8,135 | 3,322 | 4,339 | (1,017) |
| 1997 | 6,177 | 1,934 | 4,243 | 1,202 | 381 | 820 | 33,188 | 16,493 | 16,695 | 4,077 | 4,058 | 20 |
| 1998 | 10,304 | 1,761 | 8,543 | 978 | 2,191 | (1,213) | 39,148 | 20,598 | 18,551 | 3,377 | 3,188 | 189 |
| 1999 | 8,179 | 2,601 | 5,579 | 944 | 179 | 764 | 47,687 | 25,090 | 22,597 | 4,778 | 2,441 | 2,337 |
| 2000 | 3,604 | 1,749 | 1,855 | 650 | 674 | (24) | 13,865 | 6,625 | 7,240 | 1,405 | 1,188 | 217 |
| 2001 | 11,535 | 2,270 | 9,265 | 898 | 444 | 454 | 27,240 | 12,457 | 14,783 | 1,905 | 5,417 | (3,512) |
| 2002 | 1,827 | 1,629 | 198 | 395 | 485 | (90) | 14,605 | 4,562 | 10,043 | 1,160 | 2,156 | (996) |
| 2003 | 5,116 | 1,526 | 3,590 | 1,197 | 623 | 574 | 45,161 | 26,223 | 18,938 | 2,014 | 1,844 | 170 |
| 2004 | 3,902 | 1,146 | 2,756 | 626 | 625 | 1 | 21,283 | 10,799 | 10,484 | 1,144 | 2,039 | (895) |
| 2005 | 2,902 | 751 | 2,151 | 682 | 179 | 503 | 24,014 | 9,941 | 14,073 | 1435 | 1,903 | 473 |
| 2006 | 4,303 | 2,120 | 2, 201 | 1,173 | 883 | 290 | 19, 670 | 11, 035 | 8, 635 | 1,463 | 2,483 | (1,020) |
| 2007 | 2,816 | 1,528 | 1,288 | 788 | 576 | 212 | 29,184 | 11,289 | 17,895 | 2,666 | 2,475 | 191 |
| MIN | 1,827 | 1,146 | --- | 395 | 131 | --- | 13,865 | 4,562 | --- | 1,160 | 1,188 | --- |
| MAX | 28,798 | 12,558 | --- | 1,754 | 2,191 | --- | 47,687 | 27,865 | --- | 5,168 | 6,305 | --- |
| AVG | 8,086 | 2,890 | --- | 920 | 639 | --- | 28,158 | 16,245 | --- | 2,876 | 3,375 | --- |

Notes: Parentheses indicate a negative value.

For calculation purposes, the method detection limit (MDL) concentration was substituted for non-detected concentrations less than the method detection limit.

Total nitrogen and total phosphorus net reservoir loadings in the 1999 to 2001 time period and again in the 2003-2004 years support the observed changes in Trophic State Index Values.  Figures 13 and 14 show total annual nutrient inflow and outflow loadings on the Y axes with acre feet of water inflows on the second Y axes.

Figure 13.  Total nitrogen load and inflow comparison

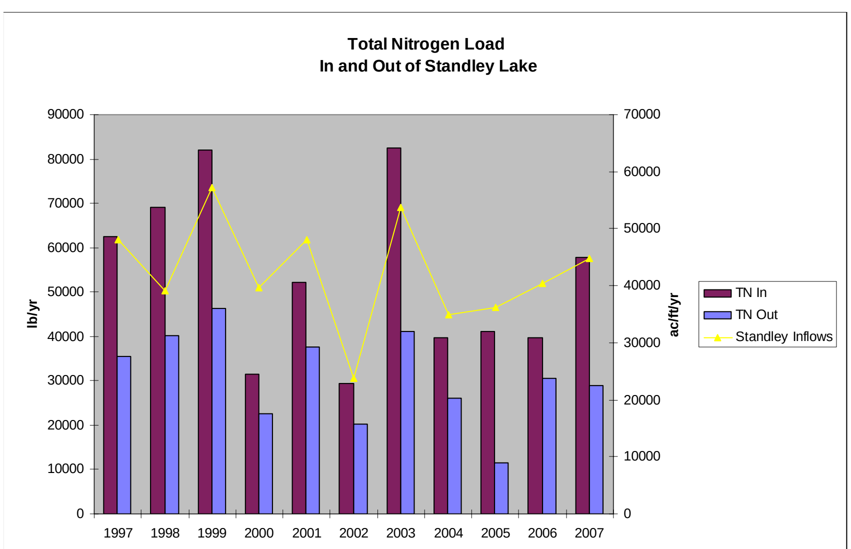
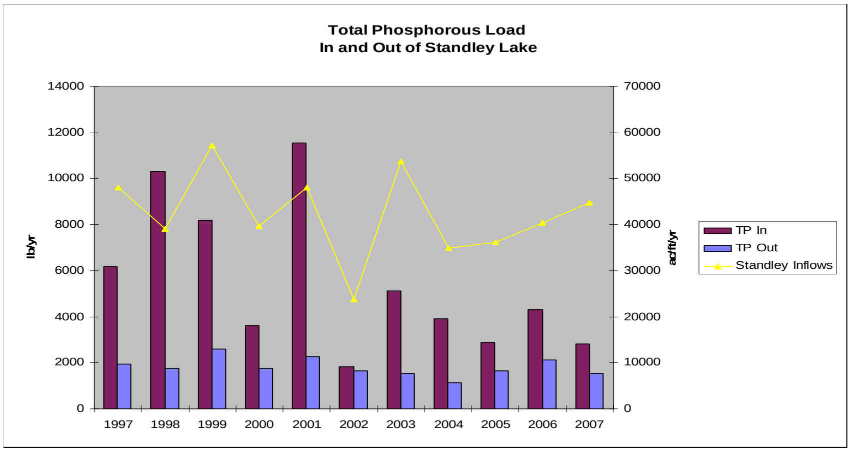


Figure 14. Total phosphorus load and inflow comparison




Three principal ditches deliver water to Standley Lake from Clear Creek. They are: Croke Canal (Croke), Farmers' Highline Canal (FHL) and Church Ditch (WC Church). The Kinnear Ditch Pipeline (KDPL) delivers water to Standley Lake from Coal Creek or the Boulder Diversion Ditch. Understanding the diversion seasons assists in the characterization of pollutant sources. For example, the FHL diversion season is April 14th through October 31st. The Croke diversion season is generally October 31st through April 14th. These waters are predominately low flows and are influenced by wastewater facilities and stormwater runoff. The diversion season for the Church Ditch is April 14th through October 31st. Actual diversion dates may vary slightly due to the seniority of water rights on the South Platte and Clear Creek. Multiple water sources are delivered through the KDPL which allows diversions to occur essentially year round in this ditch.

To characterize nutrient loadings by source, the loading inflow for each ditch was divided by the acre feet of water diverted, yielding pounds of nutrient per acre foot of water diverted. This exercise evaluates the presence or absence of seasonal variation and assists with identifying potential nutrient sources. The information can then be used to identify potential actions to reduce nutrient loadings into Standley Lake. Tables 13 and 14 below summarize nutrient inflows by ditch for 2007.

Table 13. Pounds of nutrient loading per acre foot of water diverted

| Ditch | Diversion Season | lbs/acre ft diverted | | | % of Total 2007 Diversions |
|---|---|---|---|---|---|
| | | TP | DRP | TN | |
| FHL | 4/14 to 10/31 | 0.05 | 0.01 | 0.89 | 55 |
| Croke Canal | 10/31 to 4/14 | 0.08 | 0.02 | 1.78 | 40 |
| WC Church | 4/14 to 10/31 | 0.09 | 0.04 | 1.16 | 3 |
| KDPL | Year round | 0.12 | 0.09 | 2.68 | 2 |

The total percentage may not add up to 100% due to mathematical rounding.

Table 14. Total nutrient loadings by diversion structure

| Ditch | Nutrient Loadings in Pounds for 2007 | | |
|---|---|---|---|
| | TP | DRP | TN |
| FHL | 1,144 | 319 | 21,801 |
| Croke Canal | 1,450 | 339 | 32,223 |
| WC Church | 118 | 55 | 1,531 |
| KDPL | 104 | 75 | 2,332 |

## II. THE UPPER CLEAR CREEK WATERSHED ASSOCIATION

### Introduction

The Upper Clear Creek Watershed Association focused on two main areas in 2007 in addition to its ongoing activities as a 208 Management Agency which involves the reviewing and monitoring of plans and projects.

The first project was that the Clear Creek Wastewater Study Group was organized as a subcommittee of the Upper Clear Creek Watershed Association, with Clear Creek County administering the contract. The Study Group accumulated $143,000 in funding from UCCWA members and the Colorado Department of Local Affairs ($50,000) in order to do a Countywide Wastewater Utility Plan, an analysis of regionalization and consolidation alternatives, and individual Wastewater Utility Plans for each of the ten dischargers in Clear Creek County. As of December 31, 2007, the regionalization/consolidation alternatives analysis was completed and accepted and most of the Wastewater Utility Plans were completed and were in the process of gaining approval from each of the dischargers, UCCWA, and DRCOG. The Wastewater Utility Plans and regionalization/cooperation efforts are important for improving wastewater plant performance, effluent quality, and therefore Clear Creek water quality, especially regarding nutrient levels, over time.

The second project was that the basin's major dischargers formed a working group to develop a response to a proposed metals TMDL on Clear Creek from the Colorado Water Quality Control Division. This effort builds on previous work funded by our 319 grant in 2005. This working group and UCCWA retained consultants during 2007 to formulate proposed revisions to Clear Creek underlying metals standards for presentation to the WQCD in summer 2008. Much work with the consultants was accomplished during 2007 and the proposal was nearly completed.

### City of Black Hawk

In 2007, the City of Black Hawk began the following water quality improvement projects:

- Completed the design for the Dory Hill Historic Tank And Vortex Separator Unit Project. The City of Black Hawk currently operates a diatomaceous earth filtration water treatment plant and a raw water storage reservoir at its Dory Hill site. Raw water is supplied to the reservoir from wells and springs along 4-Mile Gulch through the Historic Mountain Supply Pipeline, and from North Clear Creek by pumping from the North Clear Creek infiltration gallery and pump station. Spring runoff flows and summer thunderstorm events create turbid water conditions that exceed the Dory Hill treatment plant capability. Currently, raw water diversion is suspended whenever turbidity levels exceed treatment plant capability. Construction of the proposed Dory Hill Historic Tank and Vortex Separator Unit Project in early 2008 will enable raw water cleanup to levels suitable for treatment plant use during periods of turbid water conditions.

- Began design for the one-million-gallon Silver Gulch Potable Water Storage Tank Project. Commercial interests in Black Hawk are constructing facility expansions that will add more than 500 hotel rooms to the existing inventory when completed in year 2009. Weekend and holiday water demand typically exceeds diversion and treatment capacity for the potable water systems. Construction of the new water storage tank and connector mains in year 2008 will enable meeting expected weekend demand peaks while maintaining a consistent diversion and treatment rate.

- Acquired water storage rights in Georgetown Lake and began improvements to the outlet works in liaison with the Town of Georgetown. When the improvements are completed, more wet water will be available to downstream water users.

**Black Hawk/Central City Sanitation District**
The Black Hawk/Central City Sanitation District plant continues to meet all discharge permit limits. Flow continues to be around .37 million gallons/day, peak flow over 1 million gallons/day. As the result of an Intergovernmental Agreement, the plant incorporates full scale Biological Nutrient Removal (BNR) and filtration. It removes nutrients to very low levels, even though there are no nutrient limits in its CDPS permit. During 2007 the plant experienced phosphorus levels well below 0.3 mg/l. In 2007, one-third of the collection system was cleaned and television-monitored with no problems found. Sixty feet of asbestos pipe was replaced with PVC pipe. The biosolids from this facility are being shipped to Leadville for a mined land reclamation project.

**Central City**
Central City continued the erosion control measures in 2007 on the Central City Parkway, including further rip rap work replacing hay bales and rock mitigation work. Erosion control measures were applied throughout the City, including cleaning out storm drainage facilities. Central City is working cooperatively with Black Hawk on the addition of drainage detention ponds at Russell Park. The City cooperated with CDPHE on the construction of storm drainage mitigation for Quartz Hill.

**Clear Creek County**
In 2007 the Clear Creek County Environmental Health Department issued 38 Individual Sewage Disposal System (ISDS) permits (30 new, 8 repair) and conducted 230 inspections.

*Clear Creek Regional Wastewater Study Group*
The Clear Creek Wastewater Study Group met throughout 2007 in a continuing effort to facilitate the work of Richard P. Arber and Associates of Lakewood, Colorado in evaluating regional wastewater treatment options in the Upper Clear Creek Basin area of Clear Creek County. In December 2007, the Wastewater Alternatives Evaluation Report drafted by Arber and Associates was completed and approved by the Wastewater Study Group and the contracting entity, Clear Creek County. The report was distributed to over 25 cooperating partners. In addition, ten Wastewater Utility Plans (WUP) were drafted for wastewater dischargers located in the Upper Clear Creek Basin area. These WUPs were presented to their respective wastewater district boards for review and public hearing. Once approved by their wastewater district, each WUP will be reviewed by the Upper Clear Creek Watershed Association and transmitted to the Denver Regional Council of Governments (DRCOG) for adoption. The first of these ten WUPs, the Georgetown/Silver Plume Wastewater Utility Plan, was approved by DRCOG in December, 2007.

*Clear Creek Emergency Call-Down System*
In order to notify down-stream users of water from Clear Creek of any potential contamination from an upstream source, Clear Creek County uses an emergency call-down system using the Emergency Preparedness Network. The Clear Creek County Office of Emergency Management Director continues to update and maintain the database for the call lists. This system applies to incidents/spills into Clear Creek and tributaries leading into Clear Creek.

In 2007, there were six launches from the Clear Creek County Call-Down System:

1/24—The City of Idaho Springs made repairs to a water main near Exit 241 causing mud to enter Clear Creek. 115 numbers called.

3/22—The City of Idaho Springs experienced a water problem. In the event of brown or cloudy water, users were advised to flush faucets until clear. Temporary and not a health hazard. CDPHE notified. 1288 numbers called (includes Idaho Springs water users).

5/15—The Argo Water Treatment Facility in Idaho Springs was releasing untreated water at the rate of 100 gpm. 117 numbers called.

5/15—Follow-up to previous Argo Facility call. All flow stopped. 117 numbers called.

8/21—No text record of the message. Location of the incident is unclear. 122 numbers called.

9/11—The City of Idaho Springs discovered a water leak discharging 150 gpm into Clear Creek. 122 numbers called.

11/21—The Little Bear Mine erupted and spilled into Soda Creek, a tributary of Clear Creek. 141 numbers called.

**Central Clear Creek Sanitation District**
AAA Operations tests monthly for BOD, TSS, FC, ammonia, flow and % capacity and reports that no effluent violations occurred during 2007. CCCSD continues alum addition and controls sludge age to achieve biological nutrient removal. The CCCSD Board of Directors, managers and operations team are always working to improve plant efficiencies. Records are available for review at AAA.

**Clear Creek High School**
The high school is a Zenon (MBR) membrane filtration plant. It came on line in 2004 with management continuing to be provided by AAA Operations. Alum continues to be added for nutrient removal. Alum addition and control of the sludge age continue to improve nutrient removal. AAA Operations tests monthly for BOD, TSS, FC, ammonia, flow and % capacity and reports that no effluent violations occurred during 2007. Records are available for review at AAA.

**Clear Creek Ski Corporation**
Clear Creek Ski Corporation's most recent permit reduced the effluent limit of fecal coli form so it included a compliance schedule in case new construction or modifications were required to achieve the limit. CCSC was able to meet the new limit with operational changes, so no new construction has been planned. Records are available for review at AAA.

**Clear Creek Watershed Foundation**
In 2007, the CCWF's efforts primarily focused on research activities funded by their EPA Watershed Sustainability Grant. More than a year's worth of research culminated in the final project report entitled "2007 Clear Creek Watershed Report: Exploring Watershed Sustainability". This report establishes the existing conditions of the Clear Creek Watershed in terms of its physical, biological, and human dimensions; threats to cleaner water; opportunities for sustainable management of natural resources; and descriptions of more sustainable conditions. Sustainability is defined in terms of the value sets of ecology, society, and economy. Each of these sets is examined in detail within our watershed context in an econometric fashion to determine to what degree current art and science can reflect cause-and-effect of certain actions or inactions. This report also examines the applicability of multi-attribute utility analyses, cost-benefit analyses, and discourse-based valuations to impact decision making in the realm of sustainable watershed management. A discourse-based evaluation by watershed stakeholders was then conducted to quantify overall threats and opportunities in the watershed. Those results were then applied specifically to 80 new projects in order to better define partnerships, funding, and implementation strategies. Subsequently, research/work was conducted by CCWF in the project areas of Alternative Energy & Transportation, Wastewater Treatment Alternatives, Custom Milling, the Clear Creek County Community Wildfire Protection Plan, and the 150$^{th}$ Anniversary of the Colorado Gold Rush.

The CCWF's "orphan" mine remediation efforts in 2007 included: 1) collaborating with the USFS, Coors, and the National Forest Foundation for remediation work at the Lombard Mine & Mill Site in Cumberland Gulch; 2) assisting the State in implementation and long-term maintenance of the retaining wall at the Maude Monroe site (this $600K SEP project is in lieu of Iowa Tank Lines paying a fine); and 3) funding a 2007 trace metals addendum.

In April, CCWF was notified by CDPHE that they were approved to receive a $484K 319 grant for remediation work on Upper Trail Creek and initiated the related water quality monitoring program. Ongoing administrative work and work plan finalization was conducted on the $425K 319 grant for Gilson Gulch remediation (approved in 2006). In August, CCWF was notified by EPA that they were finalists to receive a $744K Targeted Watershed Grant to focus on remediation projects in Lower Trail Creek, North Empire/Lion's Creek and the Maude Monroe. At the time of this report, contracts for all three of these grants were still pending due to administrative issues applied to all water quality grants statewide.

The CCWF's outreach/education efforts continued throughout 2007 as well. In March the CCWF organized and hosted the Clear Creek Watershed Forum 2007: Leading the Way to Watershed Sustainability. At this forum, CCWF's new website was unveiled. Throughout the year, CCWF continued its tradition of public education about watersheds and mining through attendance and presentations made at numerous professional conferences and meetings, projects focused on elementary school education, public tours, nomination of the Maude Monroe site for Historic Preservation and exhibits/booths at events such as the State Fair.

**Climax Molybdenum Company**

*Henderson Mine*

In 2007, Climax completed the new potable micro-filtration water treatment system; an existing system was purchased and installed.

Henderson upgraded the Storm Water Management Plan and new BMPs were installed. BMPs included sediment basins, rock silt fences, concrete barricades to control traffic flow, and new snow plowing procedures. The new BMPs have minimized the amount of road sand leaving the property.

*Urad Mine site*

The upgraded stormwater diversions around the upper and lower tailings impoundments in the Urad Valley greatly diminished the amount of clean snow melt entering the URAD water treatment plant. The diversions were installed in 2005 and 2006.

**Colorado Department of Transportation**

In 2007, CDOT continued its Highway Stormwater Monitoring project along I-70. This includes data on snowmelt and runoff events. CDOT is working with stakeholders on the I-70 Corridor PEIS, using the Collaborative Effort (CE) approach. Water quality impacts are among those being evaluated; mitigation will be identified in the PEIS for all significant impacts. CDOT continues to clean traction sand from I-70 and US 40 within the Clear Creek Watershed. Since the final phase of construction on Berthoud Pass East (Hoop Creek) was completed in 2006, water quality monitoring will continue for three years. Three large sediment control basins were added during the final phase. In the summer of 2007, about 2,000 tons of used traction sand were removed from the east side of Berthoud Pass and placed on the mill tailings cap in Empire. The cap was seeded in late fall. Towards the end of 2007, several new chain up sites for trucks were added to both east and west-bound sides of I-70. This supports the increased enforcement of Colorado chain laws, and should help to reduce truck accidents in winter months. Fewer truck accidents means fewer spills into Clear Creek.

In late 2007, CDOT initiated a study of the water treatment plant at the Eisenhower-Johnson Memorial Tunnel. This effort will track water quality and quantity at the inflow and outflow areas. Although the WWTP at the tunnel treats a much smaller amount of waste since the Homeland Security closed the restrooms to the public, flow levels indicate a large influx of groundwater to the wastewater treatment area. In lieu of keeping the tunnel restrooms open to the public, CDOT supports such facilities at the Georgetown and Silverthorne Visitor Centers.

**Coors Brewing Company**

In addition to our continued stormwater efforts, water quality monitoring and habitat restoration funding, Coors Brewing Company completed construction of floodplain control project to address the proposed, new 100 year flood plain mapping. By completing this work, Coors-owned property east of McIntryre Road will no longer be included on FEMA's DFirm as part of the floodplain.

**Georgetown**

2007 saw the completion of a new Wastewater Utility Plan (WUP) for Georgetown's wastewater system. Richard P. Arber Associates completed the WUP as part of the Clear Creek Countywide Wastewater Utility Plan project wherein Arber Associates completed a regionalization and consolidation alternatives study and an individual WUP for each of the ten dischargers in Clear Creek County.

Georgetown also participated in a Use Attainability Analysis with other dischargers in UCCWA to work on proposed TMDL's for metals on the affected segments of Clear Creek.

After having two ammonia violations in 2006 at its wastewater treatment plant, there were no ammonia discharge violations in 2007. Georgetown did have the following violations in 2007:

BOD percent removal below 85% for June, 2007
Hydraulic flow 30 day average over .58 MGD June, 2007.

2007 was an extraordinary year for snowmelt runoff and after making several years of gains on I&I, 2007 was a bad year for I&I in Georgetown. Georgetown does have a $250,000 project for pipe rehabilitation to address I&I in the 2008 budget and the engineering for that project was completed in 2007.

**Gilpin County**
Gilpin County continues programs that contribute to meeting the goals of the agreement, including requiring best management practices for erosion control, and enhanced individual sewage disposal systems in sensitive areas and areas with higher densities.

**City of Golden**
*Water Quality*
The sanitary sewer Inflow and Infiltration (I&I) mitigation program repaired or replaced 3900 linear feet of sewer line in Tucker Gulch as part of the sewer rehabilitation requirement contained in Golden's CDPS permit.
The Pretreatment Program established a general permitting program for mobile power washers. These permits will allow wastewater from washing operations that are prohibited by the stormwater program to be discharged to the sanitary sewer.

*Stormwater Program*
The Stormwater Program continues its public education campaign by distributing educational materials and attending public events. The City received and responded to 29 reports of discharges, or potential discharges, to the storm sewer system, issuing 8 written warnings. The City administered 34 stormwater quality construction permits; conducted 1,061 erosion and sediment control inspections; issued 25 compliance orders; and issued 7 stop work orders. The Stormwater Maintenance Program made improvements to stormwater inlet boxes throughout the city to improve access making routine cleaning more effective and efficient. The Maintenance Program installed sumped manholes at strategic locations to contain sand and sediments where they can be efficiently removed. It is estimated that this simple and low cost approach will prevent an additional 3,000 cubic yards of sediment and debris from entering Clear Creek each year. The Maintenance Program conducted 3,828 inspections of the storm sewer system and sent 64 letters requesting maintenance from land owners, with subsequent 100% compliance.

*Watershed /Other Activities*
In 2007, the City contributed $6,960.00 to the Rooney Road Recycling Center. The City made an annual contribution of $3,591.00 to the Upper Clear Creek Watershed Association and is an active participant in Association meetings. The City's permanent monitoring and sampling site at CC-59, located above the City intake and the Church Ditch, successfully sampled nine storm events that occurred in the Clear Creek watershed during 2007. The CC-59 monitoring site is part of the cooperative monitoring program between upper and lower basin water users. A summary report of the 2007 water quality data is available from the City upon request.

**Idaho Springs**
Idaho Springs remains active in the Upper Clear Creek Watershed Association, Regional Wastewater Treatment Study Group and the TMDL Subcommittee. The City's wastewater treatment plant continues to improve its effluent quality. 2007 marks the second year where there were no effluent discharge violations. Plant operations staff has elevated their certification levels through education and hands-on training and have been recognized for their efforts from the Colorado Rural Water Association. On-going preventative maintenance and process optimization has increased removal for ammonia, phosphorus and nitrate while reducing power consumption. Sanitary collection system has some improvements in 2007 to manholes to reduce infiltration/inflow. Two (2) small Sanitary Sewer Overflows (SSO's) were experienced in the downtown area. Both were attributed to excessive grease build up from restaurants. The City is implementing a Grease Control Program and will be inspecting all food service establishments in order to reduce the discharge of Fats, Oils and Grease (FOG) to the collection system. Over the next two years the City will be completing capital improvement projects to the wastewater treatment plant.

**Jefferson County**
In 2007 Jefferson County continued its existing stormwater programs and other programs that were implemented as measurable goals, such as installing waterway signs and initiating the post construction inspection program. This program is part of Section 16 of the Zoning Resolution which allows the County to ensure long-term function and maintenance of permanent stormwater quality structures. Also in 2007, there were 82 land disturbance complaints received and 79 were confirmed by Jefferson County staff. Of those 79 violations, 29 cases were referred to court, when staff was unable to achieve compliance. A Notice of Intent (NOI) is required for land disturbance activities that disturb less than one acre. Applicants must submit a NOI detailing the erosion and sediment control BMPs for a small construction site. The plan is reviewed by Jefferson County staff followed by an inspection by a field inspector who is trained in erosion and sediment control. Jefferson County has inspected 1,275 sites with the NOI process since the program inception in 2005.

Jefferson County also maintains an erosion and sediment control program as part of their MS4 permit. The county maintains a small-site erosion control manual that explains the basic principles of erosion control and illustrates techniques to control sediment from small development sites.

**Saddleback Metropolitan District**
The 20 lots in Phase 1 of the 86 lot Saddleback residential development have been sold. Seven (7) homes have received a Certificate of Occupancy with nine (9) more under construction. Well and ISDS monitoring are underway. Sampling continues at the three groundwater monitoring wells requiring down-gradient of the subdivision, and no impacts have been seen to date. Road construction has begun on Phase 2 (21 lots).

**St. Mary's Glacier Water & Sanitation District**
St. Mary's continues to make steady and consistent progress in its I/I program. Each year, sewer lines are cleaned and partially videotaped. Deficiencies in the system are corrected to the extent possible. Each year since the program was implemented, runoff flows through the plant have been lower. St. Mary's considers the program to be a success in reducing I&I in its system. AAA Operations tests monthly for BOD, TSS, FC, ammonia, flow and % capacity and reports that no effluent violations occurred during 2007. AAA continues to control sludge age for biological nutrient removal. Records are available for review at AAA.

**Shwayder Camp**
For several years Shwayder Camp has had issues with its waste water treatment system. In 2006, Shwayder trucked all wastewater offsite for disposal at a downstream wastewater treatment plant. Shwayder Camp enlisted the services of AquaWorks DBO to engineer a new wastewater treatment system and has chosen to install a Fluidyne SBR system that will be operated by AAA Operations. The new SBR treatment system was completed in 2007 and out online. 2008 will be the first full year of operations of the new SBR treatment plant. Initial operations in 2007 showed very positive results. Records are available for review at AAA.

**Silver Plume**
The Town of Silver Plume performed road improvements to reduce dust and sediment during the past year. Over 500 tons of gravel was laid on the street surfaces, significantly reducing exposure of the fine materials.

**Superfund (CDPHE/EPA) Remediation Projects**
The Argo Water Treatment plant continues to operate, treating 160 million gallons of mine impacted water and keeping 310,000 pounds of metal out of Clear Creek in 2007. Treated water included approximately 250 gpm from the Argo Tunnel, 20 gpm from the Big Five Mine and 30 gpm of Virginia Canyon water. CDPHE and EPA constructed the first phase of sediment control measures for the Nevada and Russell Gulches areas. This included construction of two sediment dams and erosion protection measures at five mine waste piles. Design for a second phase that would address a number of mine piles continued in 2007 with a Summer 2008 construction target. EPA and the Colorado School of mines continued treatability testing of sulfate reducing bioreactors for the National Tunnel water. CDPHE, EPA and the Black Hawk Central City Sanitation District teamed on constructing a mitigation wetland that is twice the size that the Sanitation District would have otherwise implemented. The wetland has been in place since July 2007 and a portion of North Clear Creek is routed though the wetland cells. CDPHE and EPA have been coordinating with CDOT in an effort to leverage the Agencies' various interests along North Clear Creek on the Highway 119 corridor. CDPHE's consultant evaluated the capacity of the privately owned Bates Hunter water treatment facility and performed schematic design of conveyances options for the Gregory Incline, Gregory Gulch and National Tunnel mine waters.

## III. TRIBUTARY BASIN, CANAL COMPANIES AND STANDLEY LAKE

*Tributary Basin Area*
The Standley Lake watershed consists of approximately 282,000 acres, including the Clear Creek Basin above Golden and the Tributary Basin. The Tributary Basin consists of approximately 20,750 acres. Tributary entities continue to work with ditch companies to prevent stormwater flows into the Standley Lake supply ditches. At the end of 2007, approximately 13,300 acres or 64% of the total Tributary Basin were separated and therefore no longer drain into canals and subsequently into Standley Lake.

The biggest diversion effort occurred on October 26, 2006 when the Cities of Arvada, Northglenn, Thornton, and Westminster signed an intergovernmental agreement with the Church Ditch Water Authority authorizing the use of approximately a 5 mile section of the ditch as an inceptor for the purpose of diverting storm water flows around Standley Lake. When completed, this effort will prevent 1,392 acres from draining into the Church Ditch, as well as diverting runoff from 2,604 acres that currently drain directly into Standley Lake. Construction of a new Church Ditch inlet structure began in 2007. The ditch will be enlarged to a capacity of 125 cfs.

Figure 15. Church Ditch bypass


In addition to these drainage improvements, permanent Best Management Practices structures such as extended detention basins and stormwater separators are installed in all subdivisions in Arvada.

**City of Arvada**

**Source Control**

*Enforcement Actions*

Arvada aggressively enforces the prohibition of unlawful discharges to its stormwater facilities and in 2007 changes in the Cities regulations provided for more enforcement capabilities. There were six enforcement actions taken in response to illicit discharges, none of which were in the tributary basin.

*Public Education*

Arvada personnel worked with 60 elementary students to place over 60 curb inlet markers that say "No Dumping, Drains To Creek". The students also distributed over 700 door hangers informing the residents of the storm inlet markers and of the importance of proper disposal of waste on storm water and streams. Career days, festivals, the Cities "Nature Center", water bill inserts to over 30,000 accounts; and other venues were used to distribute non-point education message.

*Spill Prevention for Municipal Operations*

Spill Prevention Control and Countermeasure Plans are in place for all city facilities with 90 staff trained on spill response and illicit discharge prevention.

*Erosion Control During Construction*

Since 1993 Arvada has had regulations concerning erosion and sediment control during construction. In 2007, the program was strengthened with the establishment of a Site Development Permit system for construction activities. The new program requires that any construction that disturbs more than 10,000 square feet of earth must apply for a Site Development Permit. The permit requires:

- Documentation of what erosion and sediment control measures will be used
- That the erosion and sediment control devices be installed and properly maintained
- Soil to be stabilized in inactive sites within 45 days of inactivity
- Limits the amount of over lot grading to 60 acres in most cases, with a maximum of 90 acres
- Control of fugitive dust
- An escrow or letter of credit be posted so that the City can step in to correct a problem

The ordinance authorizes a series of remedies for non-compliance:

- Stop Work order
- Withholding of certificates of occupancy or building inspection permits
- Fines up to $999 for each offense
- The City may step in to perform the needed work, and collect its costs

Enforcement efforts to maintain water quality included nine warning letters, six notices of violation, six compliance orders and one stop work order.

*Permanent Stormwater Quality Control for New Development or Significant Redevelopment*

Arvada continues to enforce the requirements that the owner or developer of a new development or a significant redevelopment must provide and maintain reasonable structural best management practices for permanent stormwater quality control within the development, incorporating the criteria for permanent stormwater quality control specified in the Urban Drainage and Flood Control District Criteria Manual, Volume 3 - Best Management Practices.

*Hazardous Substance Spills*

In 2007, Arvada responded to 40 calls reporting illicit discharges with two of these incidents within areas that drain to the Standley Lake tributaries. These incidents resulted in no impact on nearby waterways.

*Clear Creek Water Quality Monitoring Activities*

Arvada, Golden, Northglenn, Thornton and Westminster continued water quality monitoring activities on Clear Creek. Personnel from these cities continued a cooperative monitoring program which involves 8 grab sampling events and the operation of 3 autosamplers that collect 24-hour composite samples and can be triggered to collect samples during storms and other events that affect water quality.

In 2007, Arvada contributed approximately $700 to enhance the auto-sampling portion of the monitoring program.

*Public Education Activities*

Arvada continues to educate the public on illicit discharge prevention through presentations given to schools and other groups.

*Settling Basin Studies*

During the summer of 2007, samples were collected from Clear Creek water after it had gone through a settling basin and before the water entered Arvada Reservoir. The results below are from 11 samplings.

In 2007, the average percent of constituents removed by settling was:

| **Parameter** | **% Reduction** |
|---|---|
| Al | 36% |
| Ammonia | 38% |
| Cu | 13% |
| Fe | 49% |
| Mn | 13% |
| Nitrate | 17% |
| Orthophosphate | 3% |
| Pb | 38% |
| TN | 17% |
| TOC | 0% |
| TP | 27% |
| TSS | 43% |
| VSS | 26% |
| Zn | 34% |

*Household Hazardous Waste Disposal and Recycling*

Arvada is an active member of the Rooney Road Recycling Center, which provides a very effective program for recycling trees and shrubs and a safe disposal site for household hazardous wastes, including pesticides, herbicides, automotive products and electronic waste.

**Ditch Inflows to Standley Lake**

Croke Canal, Church Ditch, Farmers Highline Canal, and Kinnear Ditch Pipeline all divert water to Standley Lake. Transbasin water from the Fraser River Basin is diverted via the Berthoud Pass Ditch to Clear Creek where it is picked up by the Church Ditch for delivery to Standley Lake. All of these canals/ditches received routine maintenance in 2007. Routine maintenance related to water quality includes the following activities:

- Diverting the first flush of the canals and preventing it from entering Standley Lake to avoid contamination from trash and debris, sediment, and other contaminants that accumulate in the canals over the winter
- Cleaning canals to restore capacity
- Placing the removed spoils below the canal's banks and grading slopes to drain away from the canals
- Requiring all development projects adjacent to the ditches to install water quality BMP's designed to mitigate impacts caused by stormwater drainage entering the ditch
- When possible, re-routing stormwater drainage from developments around Standley Lake

Woman Creek Reservoir Authority (WCRA) operates Woman Creek Reservoir and associated delivery structures. Built in 1996 to protect Standley Lake from runoff from the former Rocky Flats Site, water from Woman Creek is intercepted and diverted around Standley Lake to Walnut Creek. Routine maintenance was performed to ensure that all the facilities are in good working order.

## Discharge Permit Violations for the Clear Creek Upper Basin WWTPs in 2007:

The Standley Lake Cities received the following discharge permit violation information from the Water Quality Control Division. This information was derived from the discharge monitoring reports,DMRs. The following wastewater treatment facilities in the Upper Clear Creek Basin received or have outstanding notices of exceedence in 2007:

Table 15. Discharge Permit violations for the Clear Creek Upper Basin WWTPs in 2007.

| Facility Identifier | Exceedence Date | Parameter |
|---|---|---|
| CDOT | December | High chlorine |
| Idaho Springs | 4th quarter | DMR not submitted |
| Clear Creek Ski Corp | July | Low BOD removal |
| Clear Creek Ski Corp | August | High chlorine |
| Clear Creek Ski Corp | September | High chlorine |
| Central Clear Creek | February | DMR not submitted |
| Georgetown | June | Flow |
| Georgetown | June | Low BOD removal |
| Climax Mine | January | High Mercury |
| Climax Mine | February | High Mercury |
| Climax Mine | August | Low BOD removal |

These discharge permit violations are of a great concern to the Standley Lake Cities. Not necessarily from the violation conditions themselves but from the lack of oversight and control that is necessary to operate these wastewater treatment facilities responsibly. It is unsettling that major violations could occur at these facilities because they are not being operated or managed at a level that is required by the regulations. While incomplete or partial paperwork violations would appear minor, actual water quality impacts to Clear Creek could be occurring and are being ignored or hidden by failure to report. The SLC are deeply concerned with the multi-year violations of several of the wastewater treatment facilities.

*Standley Lake Status*

The Statement of Basis and Purpose for the narrative standard for Standley Lake adopted by the Water Quality Control Commission in 1994 stated: "Data collected over the last eleven years for chlorophyll *a* for Standley Lake indicates that the lake has been mesotrophic over that period. The trophic status of Standley Lake is based on the average magnitude of trophic state indicators measured during the period from March 1 through November 30."

The SLC and the Tributary Basin Entities continue to believe that Standley Lake was mesotrophic during 1994 – 2007 and that the trophic status of the reservoir did not change in 2007 based on commonly acceptable trophic parameters such as secchi depth, total phosphorus, and chlorophyll *a*. Based on this data and the data available for previous years, Standley Lake has been mesotrophic for the past 23 years.

The Carlson index indicates that SL was mesotrophic for 2007. However, the TSc was the highest it's been since 2002. Coupled with the large chlorophyll *a* spikes and algae blooms that occur during the winter as well as the increases in the duration of hypolimnetic anoxia are causes for concern.

*Eurasian Water Milfoil*

Eurasian Watermilfoil (EWM), *Myriophyllum spicatum L*, is a non-native, aquatic, noxious weed that grows rapidly and to a depth of 35 feet. EWM grows in dense mats that severely interfere with recreation and has been known to provide a substrate for blue-green algae growth. Blue-green algae blooms can ultimately cause taste and odor events in drinking water supplies. EWM was first observed in Standley Lake in 1998. It was positively identified in 2000.

In 2007 the Standley Lake Cities initiated a pilot study using a solar pond aerator in an attempt to reduce the growth of the milfoil. Eurasian milfoil weevils have been stocked in the reservoir on three occasions from 2003 through 2005. The weevil larva bore into the stem of the milfoil which damages the plant. If the weevils can be sustained at Standley Lake, the weevils may be able to keep the milfoil in control. Data from these mitigation studies are being evaluated.

Milfoil Weevil

Attachment A

# Clear Creek / Standley Lake

# Watershed Agreement

# AGREEMENT

The undersigned parties hereto agree as follows:

I. Preamble.

This Agreement seeks to address certain water quality issues and concerns within the Clear Creek Basin of Colorado, and specifically, such issues as they affect the water quality of Standley Reservoir, an agricultural and municipal water supply reservoir located in Jefferson County Colorado, which is supplied with water primarily from Clear Creek. For purposes of this Agreement, the Clear Creek Basin is divided into three (3) areas of segments: the Upper Clear Creek Basin ("Upper Basin"), consisting of Clear Creek and its tributaries from its source to and including the headgate of the Croke Canal in Golden, Colorado; the Standley Lake Tributary Basin ("Tributary Basin"), consisting of the lands directly tributary to Standley Lake, the Church Ditch, the Farmers High Line Canal, the Croke Canal, and lands directly tributary to these Canals; and Standley Lake ("Standley Lake"), consisting of the Lake itself.

The parties to this Agreement are governmental agencies and private corporations having land use, water supply, and/or wastewater treatment responsibilities within the Clear Creek Basin. The parties are: (1) UCCBA; (2) City of Golden; (3) City of Arvada; (4) Jefferson County; (5) Jefferson Center Metropolitan District; (6) City of Westminster; (7) City of Northglenn; (8) City of Thornton; (9) City of Idaho Springs; (10) Clear Creek County; (11) Gilpin County; (12) Black Hawk/Central City Sanitation District; (13) Town of Empire; (14) City of Black Hawk; (15) City of Central; (16) Town of Georgetown; (17) Town of Silverplume; (18) Central Clear Creek Sanitation District; (19) Alice/St. Mary's Metropolitan District; (20) Clear Creek Skiing Corporation; (21) Henderson Mine; (22) Coors Brewing Company; (23) Church Ditch Company; (24) Farmers High Line Canal and Reservoir Company; and (25) Farmers Reservoir and Irrigation Company. For purposes of this Agreement, the parties can be divided into four (4) functional groups, as follows: The Upper Basin Entities ("Upper Basin Users" or "UCCBA"), consisting of the members of the Upper Clear Creek Basin Association (generally representing entities with jurisdiction over land use and wastewater treatment activities in the Upper Basin that can affect water quality in the Upper Basin); the Tributary Basin Entities ("Tributary Basin Entities"), consisting of the Cities of Golden, Arvada, and Westminster, and the County of Jefferson and the Jefferson Center Metropolitan District (generally representing entities with jurisdiction over land use activities that can affect water quality in the Tributary Basin); the Standley Lake Cities ("Standley Lake Cities"), consisting of the Cities of Westminster, Northglenn, and Thornton, (representing the municipal water users from Standley Lake); and the three canal companies (the "Canal Companies"), consisting of the Church Ditch Company, the Farmers High Line Canal and Reservoir Company, and the Farmers Reservoir and Irrigation Company (representing the entities that own and operate canals through which water is conveyed to Standley Lake for municipal and agricultural use).

In accordance with the geographical and functional divisions, this Agreement generally sets out rights and obligations with respect to certain water quality matters within the Clear Creek Basin (as above defined) by area or segment and by functional group.

II. Agreement.

1. The parties will submit a joint alternative proposal to the Water Quality Control Commission ("WQCC") in the matter captioned "For Consideration of Revisions to the Water Quality Classifications and Standards, Including Adoption of a Narrative Standard, for Segment 2, Standley Lake, of Big Dry Creek, in the South Platte Basin, and Adoption of a Standley Lake Control Regulation" on or before December 23, 1993. Said alternative proposal shall contain the following points:

a. Request the WQCC to adopt a narrative standard only for Standley Lake at this time, with further consideration of any control regulation or numeric criteria for implementation of the standard at or after the triennial review of the South Platte River to be held in 1997. The narrative standard shall require maintenance of Standley Lake in a mesotrophic state, as measured by a combination of relevant indicators, as recommended by the parties' consultants prior to December 23, 1993.

b. Request language in the Rule and in the Statement of Basis and Purpose for the regulation explaining that during the next triennium ending in 1997 ("triennium") the parties hereto will be conducting additional testing and monitoring, as well as implementing certain best management practices and controls on a voluntary basis, the results of which will be reported to the WQCC on an annual basis, and that point-source discharge permits written during the triennium shall not include any new or more stringent nutrient effluent limitations or wasteload allocations to meet the narrative standard. The proposed language will also refer to the intention of the parties and the Commission that should the narrative standard not be met at the end of the triennium, and substantial progress has not been made in reducing the nutrient loads to Standley Lake, additional measures may be required, including numeric standards or effluent limitations for phosphorous and/or nitrogen in the Upper Basin, and for additional best management controls in Standley Lake to be considered.

2. Should the WQCC fail to approve and adopt the substance of the proposed alternative described in paragraphs 1.a. and 1.b. above, this agreement shall automatically terminate and the parties shall be released from all other obligations and rights hereunder.

3. At or after the triennial review in 1997, the UCCBA and Standley Lake Cities agree that if substantial progress has not been made by the UCCBA in reducing its portion of nutrient loading and in developing controls to maintain appropriate reductions in nutrient loads to Standley Lake sufficient to maintain the narrative standard, they

will jointly petition the Commission to adopt a control regulation for Standley Lake containing the following points:

a. Total Phosphorous effluent limitation of 1.0 mg/l as P as a thirty (30) day average at the Upper Clear Creek Wastewater Treatment Plants, or such other numeric standard(s) or effluent limitations (s) for phosphorous or nitrogen, or in combination, with opportunity for point to point source and nonpoint source to point source trading among the entities that operate the UCCBA treatment plants, as has been determined will be effective in achieving and maintaining the narrative standard for Standley lake. Such numeric standard(s) or effluent limitation(s) shall be implemented over a three year period to allow time for the affected entities to fund, design and construct improvements necessary to meet the standards.

b. In-lake treatment to reduce internal phosphorous loading by 50% from the 1989-90 measured loadings in the 1993 USGS report by Mueller and Ruddy, or such other standards for reduction of internal phosphorous and nitrogen loading as has been determined will be effective in achieving and maintaining the narrative standard for Standley Lake, within three (3) years.

4. The UCCBA, in consultation with the Standley Lake Cities and Tributary Basin Entities will prepare a Best Management Practices Manual by December 31, 1994 for nonpoint sources that will cover disturbed areas of 1 acre or more and use its best efforts to have it approved and adopted for implementation by all jurisdictions within the Upper Basin by July 1, 1995. This Manual will be prepared to deal with the geologic, topographic and weather conditions existing within the Upper Basin to facilitate the reduction of nutrient loading from the various activities of the Upper Basin. This Manual will be coordinated with the Standley Lake Cities and Tributary Basin entities. The plan will include a program for monitoring representative results, to be included in the overall basin monitoring plan. For purposes of development of BMPs, Jeffco will not be considered to be part of the UCCBA.

5. The UCCBA, in consultation with the Standley Lake Cities and the Tributary Basin Entities, will examine the costs and effects of nutrient removal at UCCBA wastewater treatment plants, including operational controls or modifications which would decrease nutrient loads. Recommendations of such review shall be furnished to all the parties hereto by June 30, 1994. The UCCBA will use its best efforts to have its members implement operational modifications which can be implemented without significant capital improvements as quickly as reasonably practical.

6. The Standley Lake Cities, in consultation with the other parties, will develop a Standley Lake Management Plan by December 31, 1994 which will address in-lake nutrient loading and potential nutrient loading from lake activities, water supply operations, recreational activities, and activities in the watershed. The Standley Lake Cities will use their best efforts to implement the Lake Management Plan by

June, 1995. It is understood that the water rights implications of the plan must be considered.

7. The parties will jointly design, implement, and fund in such allocations as they shall agree a monitoring program to evaluate (1) nutrient loadings from point sources; (2) nutrient loadings from non-point sources in the Upper Basin; (3) nutrient loadings from non-point sources in the Tributary Basin; (4) internal Lake loading; and (5) the effect of nutrient reduction measures implemented by the various parties on the trophic status of Standley Lake. The results of the monitoring program will be provided to the Water Quality Control Commission for informational purposes annually. A description of the monitoring program will be included with the Annual Reports.

8. The Tributary Basin Entities and the Standley Lake Cities, in consultation with the other parties, will develop Best Management Practices (BMPs) for each of their jurisdictions by December 31, 1994, and shall use their best efforts to have them adopted as regulations by July, 1995. The BMPs will be designed to remove pollutants to the maximum extent practical considering the costs and benefits of possible measures; provided, however that no retro-fitting of existing construction or development will be required.

9. The Tributary Basin Entities, the Standley Lake Cities and the Canal Companies will develop a Management Plan for the Tributary Basin, addressing stormwater quality and quantity, hazardous substance spills, canal flushing, crossing permits, the Canal Companies' stormwater concerns, and the water rights implications of the above by December, 1994, and use their best efforts to achieve adoption of the portions of the Plan under the control of each entity by July, 1995. If not all affected parties adopt the agreed measures, then the parties that have adopted such measures will determine whether or not to implement the Plan despite such non-adoption by one or more parties.

10. Each functional group (The UCCBA, The Tributary Entities, The Standley Lake Cities, and the Canal Companies) shall provide each other group with semi-annual reports detailing the progress made on the implementation of its responsibilities herein, including development of any BMPs, nutrient reduction programs or controls, or other items required by this agreement, beginning in June, 1994. The parties shall also meet periodically after each report is completed to discuss progress by the parties. It is anticipated that the various functional groups may assign or appoint task groups or committees to address specific tasks or areas of concern (e.g. BMPs; ISDS; Wastewater Plant operational changes; monitoring, etc). If so, then the task groups shall provide the appropriate reports and participate in follow-up meetings.

11. This agreement may be enforced as a contract according to the laws of the State of Colorado; however, this agreement shall not create any right to claim or recover monetary damages for a breach thereof.

12. It is anticipated that other regional agencies with land use and/or water quality responsibilities or impacts within the Clear Creek Basin (as above defined) may join in the parties' monitoring and other efforts pursuant to this Agreement.

13. This Agreement may be executed in counterparts.

Attachment B

# CLEAR CREEK WATERSHED MANAGEMENT

# MONITORING PROGRAM

Upper Clear Creek Basin
Standley Lake Supply Canals
Standley Lake

Prepared by Clear Creek Watershed/Standley Lake
Monitoring Committee

**TABLE of CONTENTS**

*Appendix D-3: Quality Assurance / Quality Control Program: Westminster's Laboratory; components for; nitrogen series.

*Appendix D-4: Quality Assurance / Quality Control Program: Spike and Duplicate preparation.

*Appendix E: Entity participation (who does what)

## INTRODUCTION

An agreement between the Upper Clear Creek Watershed Association, the "Tributary Basin" entities and the Standley Lake Cities was developed to address certain issues and concerns as might affect the water quality of Standley Lake (see appendix A for the agreement including a listing of parties to the agreement). Part of the agreement was to design and implement a Monitoring Program and is intended to be applied throughout its duration. The Clear Creek Watershed/Standley Lake Monitoring Committee (members representing the parties to the agreement) annually evaluate the results of the monitoring and make changes to the program as appropriate. The Monitoring Program with any changes or additions/deletions is documented in the annual report to the Colorado Water Quality Control Commission (WQCC).

Based on the agreement, a monitoring program was established to evaluate the following:

- Nutrient loadings from point sources in the Upper Clear Creek Basin.
- Nutrient loadings from non-point sources in the Upper Clear Creek Basin.
- Nutrient loadings from non-point sources in the Tributary Basin.
- Internal loadings on Standley Lake.
- Effects of nutrient reduction measures on the trophic status of Standley Lake.

After the agreement had been finalized an additional component was added to evaluate the effect of organic material from Clear Creek on the dissolved oxygen concentrations in Standley Lake, primarily during the spring/summer runoff period.

**MONITORING SITES ***

**<u>Clear Creek Monitoring Sites/Rationale</u>**

The sampling sites in the Upper Basin were selected to divide the stream into sections that would identify point and non-point contributions. These sites were selected as part of an initial sampling program in 1992-93 and where possible are consistent with the sites used in the Super Fund sampling program. The Super Fund sites were selected because of the potential to use the existing database in stream model calibrations. Stream flow monitoring stations were installed at the following corresponding sites: CC-10, CC-20, CC-25, CC-26, CC-35, CC-40, CC-50 and CC-60. Flows are also recorded at the Golden gage.

CC-05 Mainstem of Clear Creek (CC) at Bakerville
CC-09 Leavenworth Creek Added for 1999
CC-10 South Fork of CC at Leavenworth Creek
CC-15 West Fork of CC below Berthoud
CC-20 West Fork of CC below Empire
CC-25 Mainstem of CC above West Fork
CC-26 Mainstem of CC at Lawson gage Added 4/98
CC-30 Fall River above mainstem of CC
CC-34 Mainstem of CC upstream of Chicago Creek Added 2/03
CC-35 Chicago Creek above Idaho Springs Water Treatment Plant
CC-40 Mainstem of CC below Idaho Springs Wastewater Treatment Plants (WWTP)
CC-44* North Fork of CC above Black Hawk/Central City WTP intake
CC-45 North Fork of CC above Black Hawk/Central City WWTP
CC-49 Mainstem of CC above the confluence of North Fork of CC
CC-50 North Fork of CC above confluence of mainstem of CC
CC-52 Beaver Brook Added in 2001
CC-53 Soda Creek Added in 2001
CC-54 Confluent of Soda Creek and Beaver Brook dropped for 2001
CC-59 Mainstem of CC upstream approximately 100 yards of Church Ditch Headgate
CC-60 Mainstem of CC at Church Headgate

*Original sampling site is CC-45. CC-44 added in 1999.

**<u>Wastewater Treatment Plant Monitoring Sites</u>**

15. Loveland (CC1a)
16. Georgetown (CC3a)
17. Empire (CC5a)
18. Central Clear Creek (CC7a)
19. St Mary's WWTP (CC8a) - added in 2001
20. Idaho Springs (CC12a)
21. Black Hawk / Central City (CC13a), new facility at BH/CC (13b)
22. Henderson Mine (CC14a)

* Eisenhower Tunnel (CC15a) – not monitored. Data received from DMR

**MONITORING SITES** (cont.)

**Canal Monitoring Sites**

The canal sampling sites were selected to assess the relative loadings to the canals from Jefferson County, portions of Golden and portions of Arvada.

22. Church Ditch at Headgate on Mainstem of CC (TO1-AS or T01-GR)
23. Farmers High Line at Headgate on Mainstem of CC (TO2-AS or T02-GR)
24. Croke Canal at Headgate on Mainstem of CC (TO3-AS or T03-GR)
25. Church Ditch at 64th (T34-AS or T34-GR)
26. Farmer High Line Canal at 64th (T33-AS or T33-GR)
27. Croke Canal at 64th (T31-AS or T31-GR)
28. Church as it enters Standley Lake (T09-AS or T09-GR)
29. Farmer High Line Canal as it enters Standley Lake (T11 –AS or T-11GR)
30. Croke Canal as it enters Standley Lake (T04-AS or T04-GR)

**Standley Lake**

The site over the outlet was selected for monitoring because this is the site with the most historic data and is the area from which the water is drawn into the filter plants. By having one site, more samples over time can be taken for the same analytical effort and therefore, provide more data to assess the condition of Standley Lake. Monitoring locations are:

1. 10-0 – Surface (Secchi depth recorded only)
2. 10-70 – 5 feet from bottom
3. 10-PZ – Photic Zone (2X Secchi depth)

*Monitoring sites are contained in Table 1 and in the narrative description (pages 8, 9 and 10).

**Autosamplers**

The autosampler stations are identified as:

*CC49 -- On the mainstem of CC upstream of the confluence of the North Fork of CC*
*CC50 -- North Fork of CC above confluence of mainstem of CC*
*CC59 -- On the mainstem of CC approximately 100 yards upstream of the Church Ditch Headgate*

The purpose of these sites is to get a better idea of water quality throughout the watershed by analyzing two 24-hour composites and continuous monitoring of pH, Temperature, Turbidity, and Conductivity using telemetry. In 2006, these sample sites will be equipped to sample storm events to help aid in the characterization of non-point source contributions.

**MONITORING SCHEDULE (Creek and Canal Sites Only)**

Sampling dates for wastewater treatment plants and stream sites were selected to correspond to seasonally varying flow conditions in Clear Creek. Canal composites are collected within seven days of the stream sampling. Laboratory constants require that all sampling be conducted on a Monday, Tuesday, Wednesday, or a Thursday. Each year, sampling is done on approximately the same schedule.

1. Early February (Monday)
2. Early April (Tuesday)
3. Late May (Thursday)
4. Mid June (Wednesday)
5. Mid July (Monday)
6. Mid August (Tuesday)
7. Mid October (Wednesday)
8. Early December (Thursday)

During the spring / summer runoff period, generally mid-May to mid July, the Farmer Highline or Croke Canals, which ever is flowing greater, will be monitored. Standley Lake will be monitored every two weeks from March through November. This regularly spaced and frequent sampling is necessary to provide adequate data to evaluate the trophic status of Standley Lake.

**MONITORING PROGRAM VARIABLES** (with some limits noted)*

| Stream Variables | Reporting Limits |
|---|---|
| Total Nitrogen | 100 ug/L |
| Nitrate + Nitrite, Ammonia | 10 ug/L |
| Total Phosphorus | 2.5 ug/L |
| Diss. Ortho Phosphorus | 2.5 ug/L |
| Total Organic Carbon | 0.5 mg/L |
| Suspended Solids, Total and Volatile | 1 mg/L |
| Physical Properties: Temperature, pH, Specific Conductance and Turbidity | See SOP's |

| Canal Variables | Reporting Limits |
|---|---|
| Total Nitrogen | 100 ug/L |
| Nitrate + Nitrite, Ammonia | 10 ug/L |
| Total Phosphorus | 2.5 ug/L |
| Diss. Ortho Phosphorus | 2.5 ug/L |
| Suspended Solids, Total and Volatile | 1 mg/L |
| Physical Properties: Temperature, pH, Specific Conductance and Turbidity | See SOP's |

| Lake Variables | Reporting Limits |
|---|---|
| Total Nitrogen | 100 ug/L |

| | |
|---|---|
| Nitrate + Nitrite, Ammonia | 10 ug/L |
| Total Phosphorus | 2.5 ug/L |
| Diss. Ortho Phosphorus | 2.5 ug/L |
| Total Organic Carbon | 0.5 mg/L |
| Suspended Solids, Total and Volatile | 1 mg/L |
| Physical Properties: Temperature, pH, DO, Specific Conductance, Turbidity, Secchi depth (feet) | See SOP's |
| Chlorophyll a, algae count and identification | See SOP's |

| Wastewater Treatment Plant Variables | Reporting Limits |
|---|---|
| Total Nitrogen | 100 ug/L |
| Nitrate + Nitrite, Ammonia | 10 ug/L |
| Total Phosphorus | 2.5 ug/L |
| Diss. Ortho Phosphorus | 2.5 ug/L |
| Suspended Solids, Total and Volatile | 1 mg/L |
| Physical Properties: Temperature, pH, | |
| Specific Conductance, Turbidity | See SOP's |

* SOP's and QA/QC for these variables are contained in Appendix D, 1-3.

**SAMPLE COLLECTION ***

Stream All samples are grab samples.

Wastewater Treatment Plants All samples are grab samples.

Canals Samples are 24-hour time composite samples when possible. For the samples collected in conjunction with the upper basin stream and wastewater treatment plant monitoring component, a time delay in the downstream direction will be estimated so the same water is sampled from Golden to Standley Lake. The length of the delay will depend on the flow rate in each canal. If a composite sample is not available, a grab sample will be collected and analyzed in place of the composite sample.

Lake 10- PZ samples are a composite taken with a column tube through the photic zone (2X secchi depth). 10-70 samples are grabs samples.

*Standard Operating Procedures for sampling are contained in Appendix C, 1-3.

**QUALITY ASSURANCE / QUALITY CONTROL PROGRAM***

Summary

Split and spike quality control samples are prepared for selected stream and lake parameters and are analyzed by three laboratories.

| | |
|---|---|
| Laboratories | - Northglenn<br>- Westminster |
| Variables | - Stream sampling- TP and TN<br>- Lake sampling – TP, TN, suspended and volatile solids, chlorophyll a |

Discussion

Spike and split quality control samples are prepared for each of the 8 upper basin stream surveys by the City of Golden at their laboratory on the day of sampling. There are also 32 splits from the Lake sampling prepared by Westminster and sent to the University of Missouri for TP, TN, suspended and volatile solids and chlorophyll a analyses. Samples from the wastewater treatment plants will not be regularly included in the split/spike portion of the QA/QC program because of the anticipated higher concentrations.
For purposes of this report, only the spike and duplicate results on the selected upper basin stream samples are reported.

Preparation of Stream QC Samples

For each of the eight sampling surveys, there will be one split and one spike distributed to each laboratory. A different site is randomly selected each time. Samples are distributed as follows:

1. Split to UMLL for TP, TN
2. Split to Westminster for TN
3. Split to Northglenn for TP
4. Spike to UMLL for TP, TN
5. Spike to Westminster for TN
6. Spike to Northglenn for TP

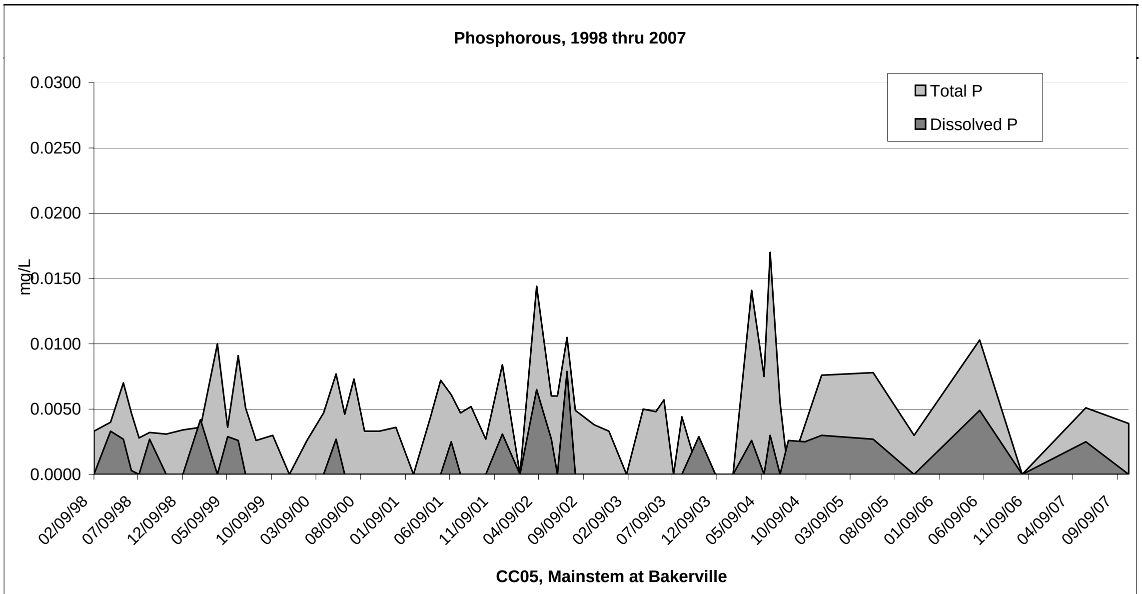
*Quality Assurance and Quality Control Procedures for spike/duplicate preparation and sample handling for all laboratories are contained in Appendix D, 1-4.

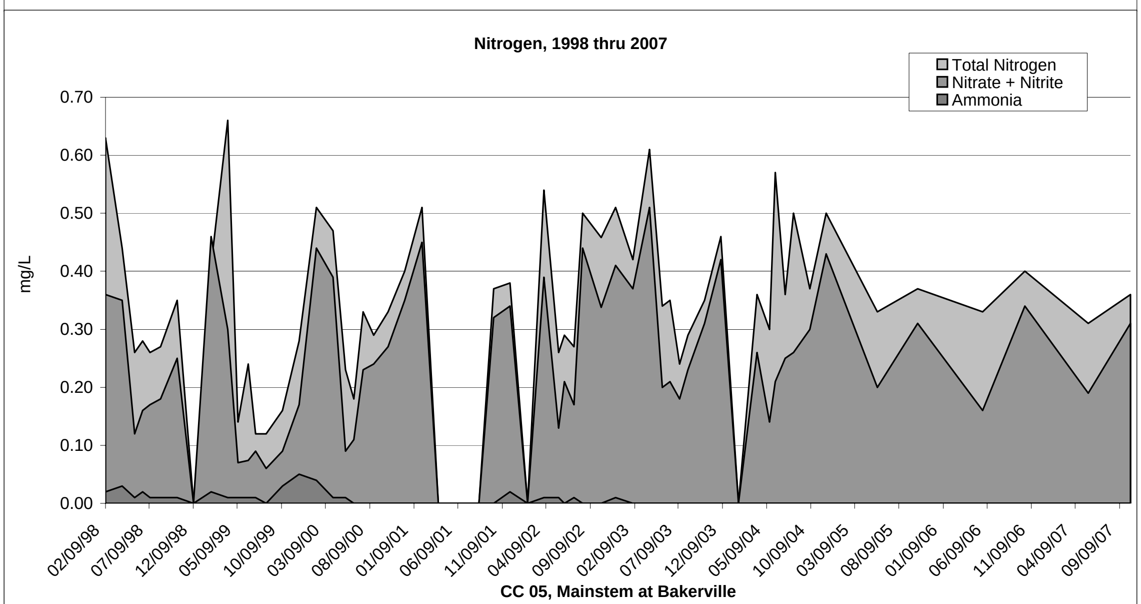
## DATA MANAGING and REPORTING

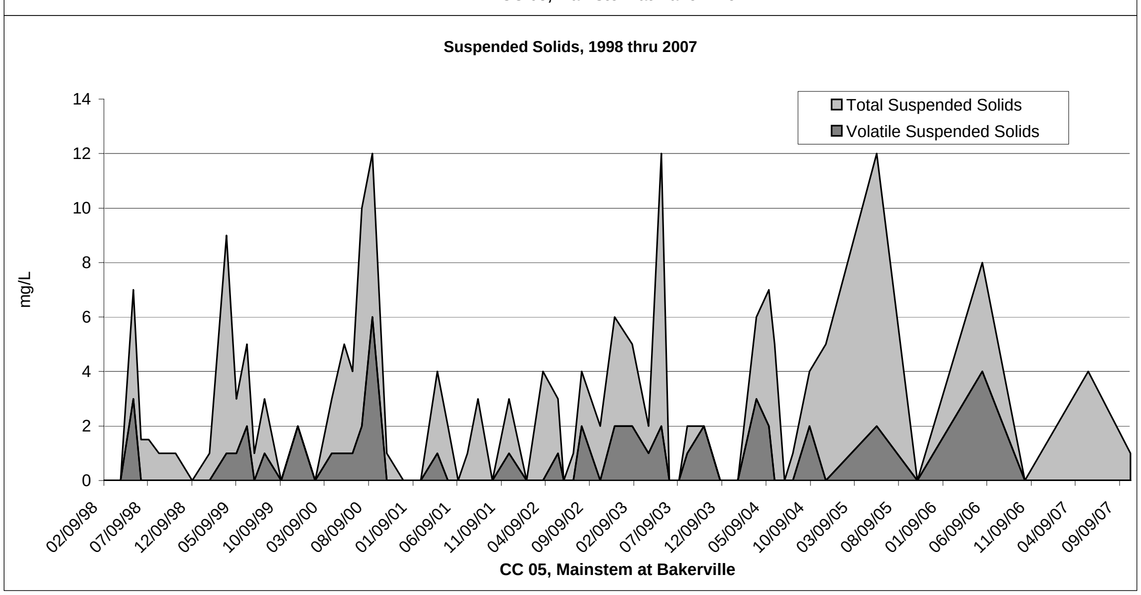
The City of Golden is responsible for collecting all monitoring data from the field and different laboratories and compiling this data in a spreadsheet format (EXCEL).

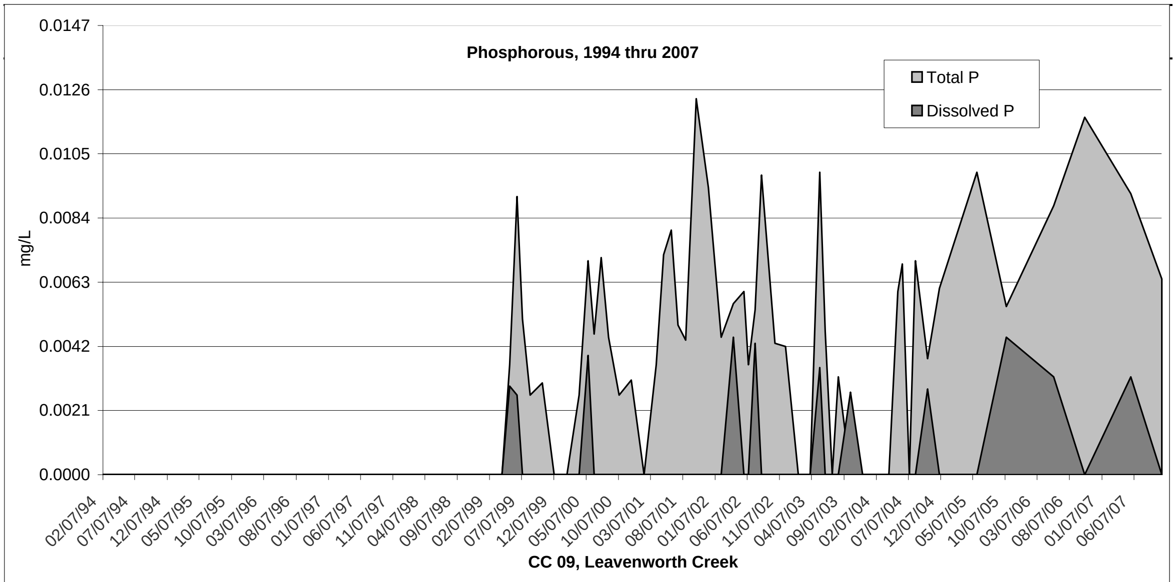
The Standley Lake Cities share a common Access database. Each city enters their own data and has a representative that is on a committee for peer review of the data. Each quarter, the data is peer reviewed, downloaded, and given to the City of Golden to compile into a spreadsheet format.

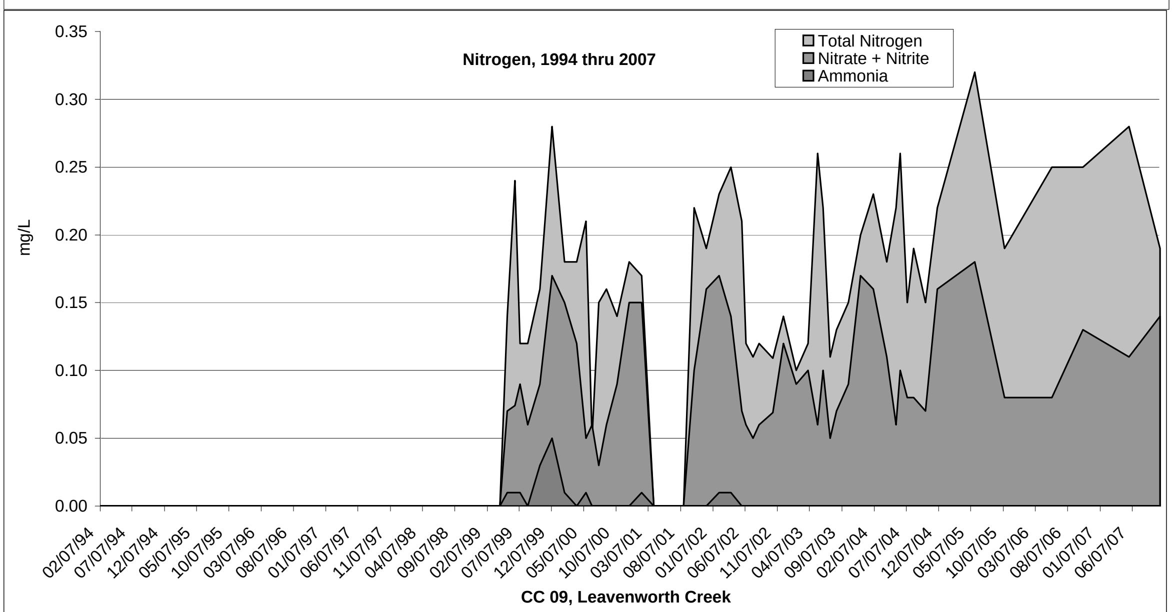
Data results of this program, along with other reporting requirements as stated in the Joint Agreement, will be reported on annual basis to the Colorado Water Quality Control Commission. Only data collected during the normal sampling schedule will be included in the Annual Monitoring Report. This data will be reported in tabular and graphic form. Data interpretation will not be a part of the Annual Monitoring Report. Following each regularly scheduled sampling event tabulated data reports will be sent to the Upper Clear Creek Watershed Association, Tributary Basin entities and the Standley Lake Cities.

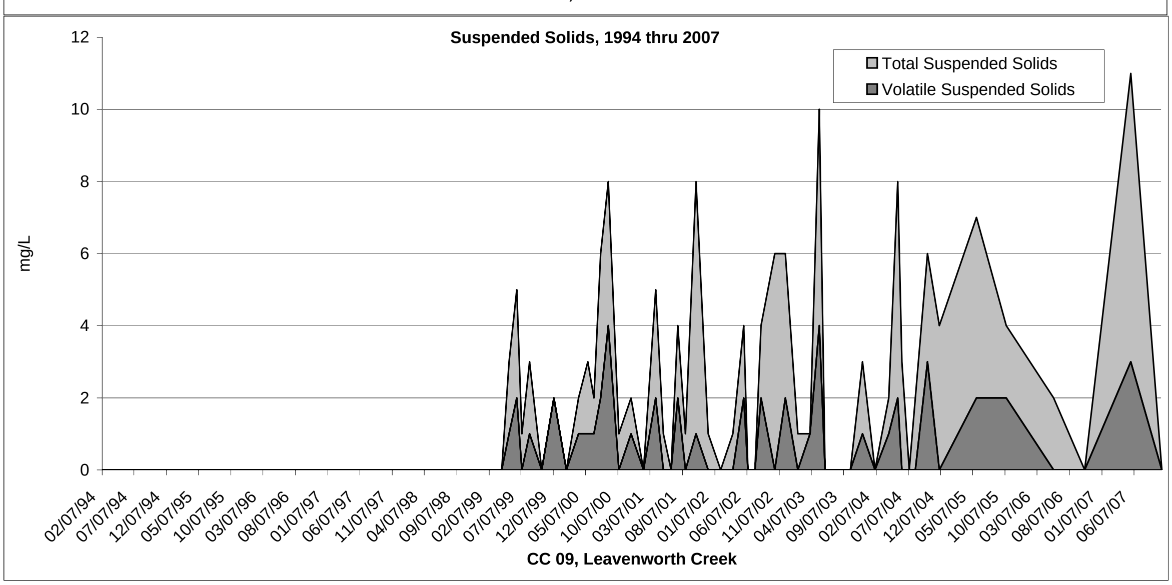

Phosphorous, 1998 thru 2007
Total P
Dissolved P
mg/L
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
02/09/98
07/09/98
12/09/98
05/09/99
10/09/99
03/09/00
08/09/00
01/09/01
06/09/01
11/09/01
04/09/02
09/09/02
02/09/03
07/09/03
12/09/03
05/09/04
10/09/04
03/09/05
08/09/05
01/09/06
06/09/06
11/09/06
04/09/07
09/09/07
CC05, Mainstem at Bakerville

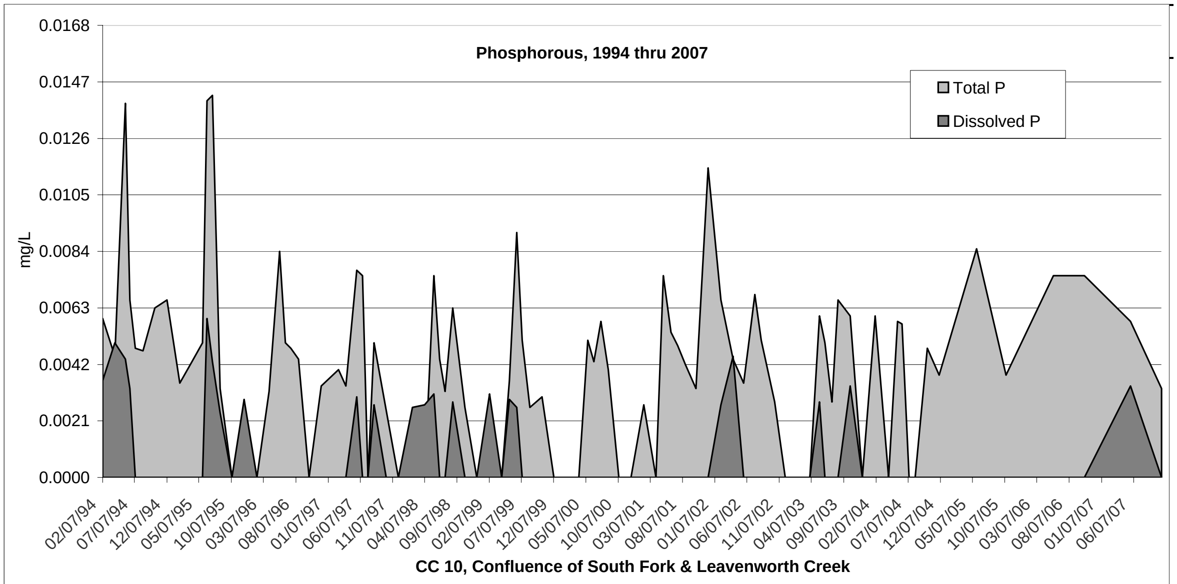

Nitrogen, 1998 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
02/09/98
07/09/98
12/09/98
05/09/99
10/09/99
03/09/00
08/09/00
01/09/01
06/09/01
11/09/01
04/09/02
09/09/02
02/09/03
07/09/03
12/09/03
05/09/04
10/09/04
03/09/05
08/09/05
01/09/06
06/09/06
11/09/06
04/09/07
09/09/07
CC 05, Mainstem at Bakerville


Suspended Solids, 1998 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
14
12
10
8
6
4
2
0
02/09/98
07/09/98
12/09/98
05/09/99
10/09/99
03/09/00
08/09/00
01/09/01
06/09/01
11/09/01
04/09/02
09/09/02
02/09/03
07/09/03
12/09/03
05/09/04
10/09/04
03/09/05
08/09/05
01/09/06
06/09/06
11/09/06
04/09/07
09/09/07
CC 05, Mainstem at Bakerville

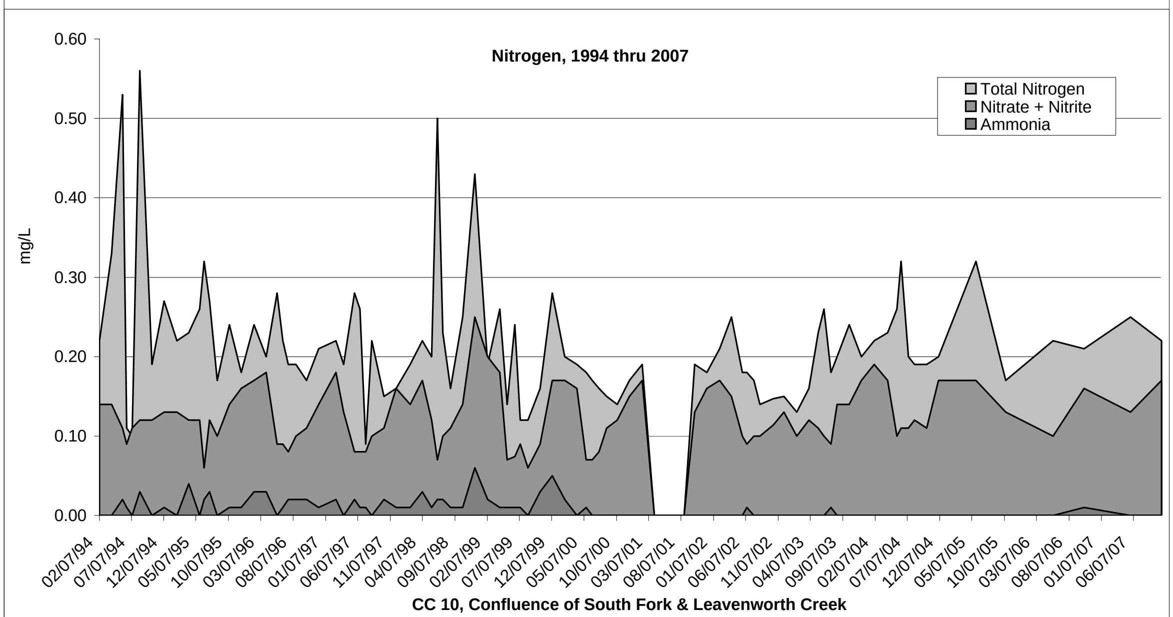

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.0147
0.0126
0.0105
0.0084
0.0063
0.0042
0.0021
0.0000
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 09, Leavenworth Creek


Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 09, Leavenworth Creek

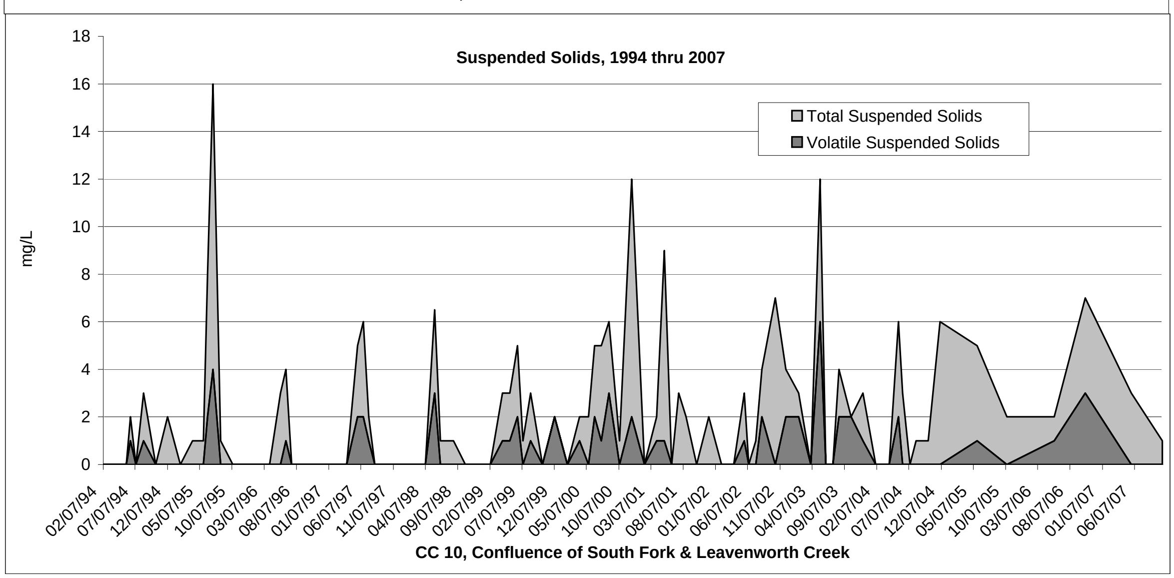

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
12
10
8
6
4
2
0
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 09, Leavenworth Creek



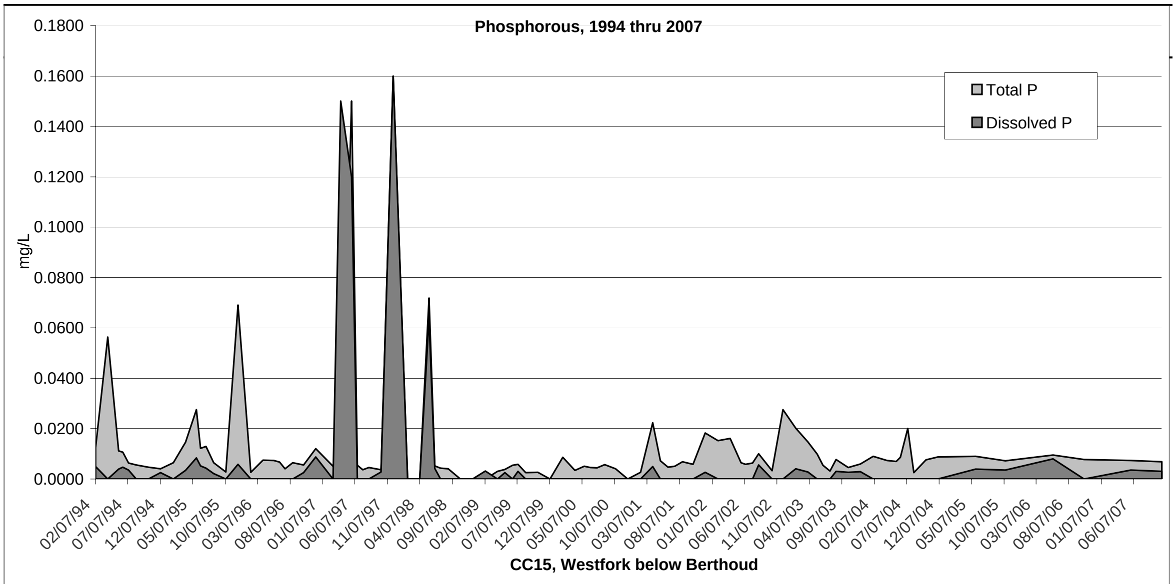
Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.0168
0.0147
0.0126
0.0105
0.0084
0.0063
0.0042
0.0021
0.0000
CC 10, Confluence of South Fork & Leavenworth Creek

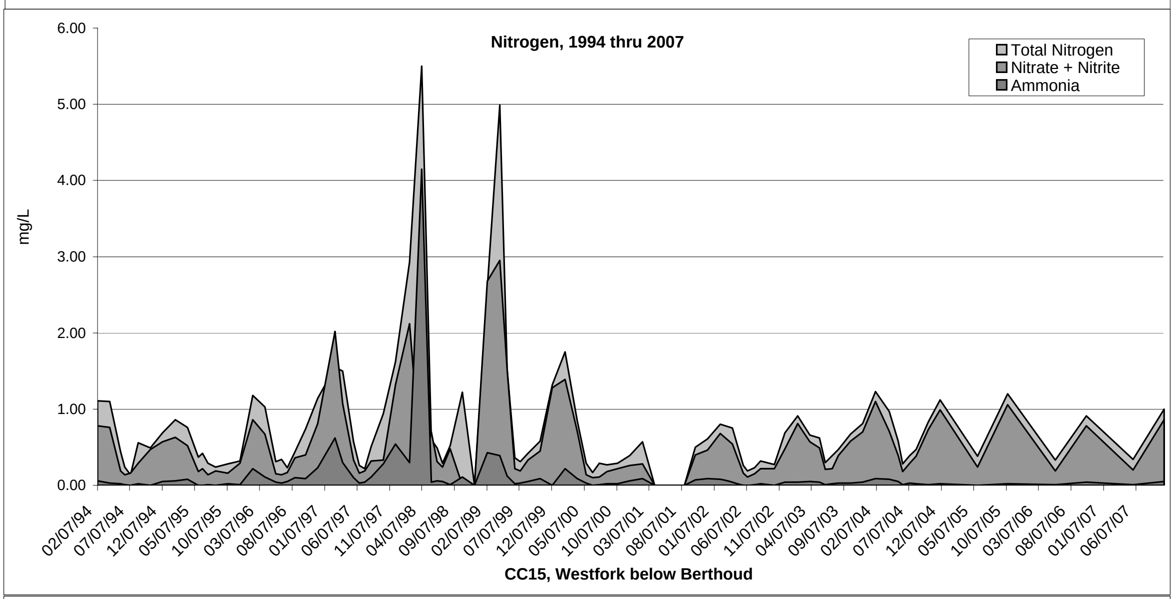



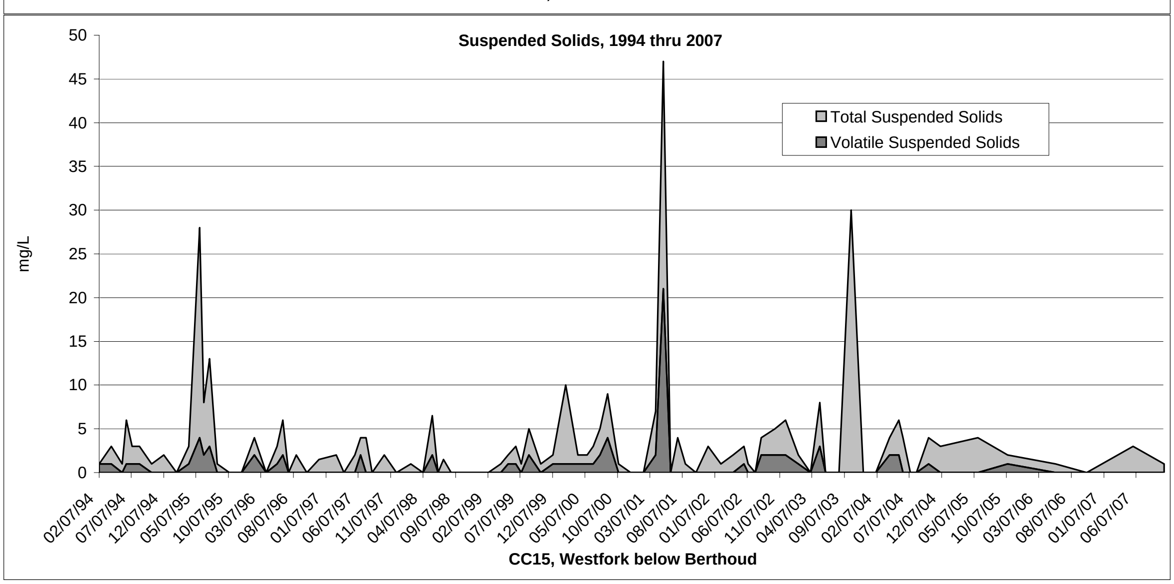
Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
0.60
0.50
0.40
0.30
0.20
0.10
0.00
CC 10, Confluence of South Fork & Leavenworth Creek

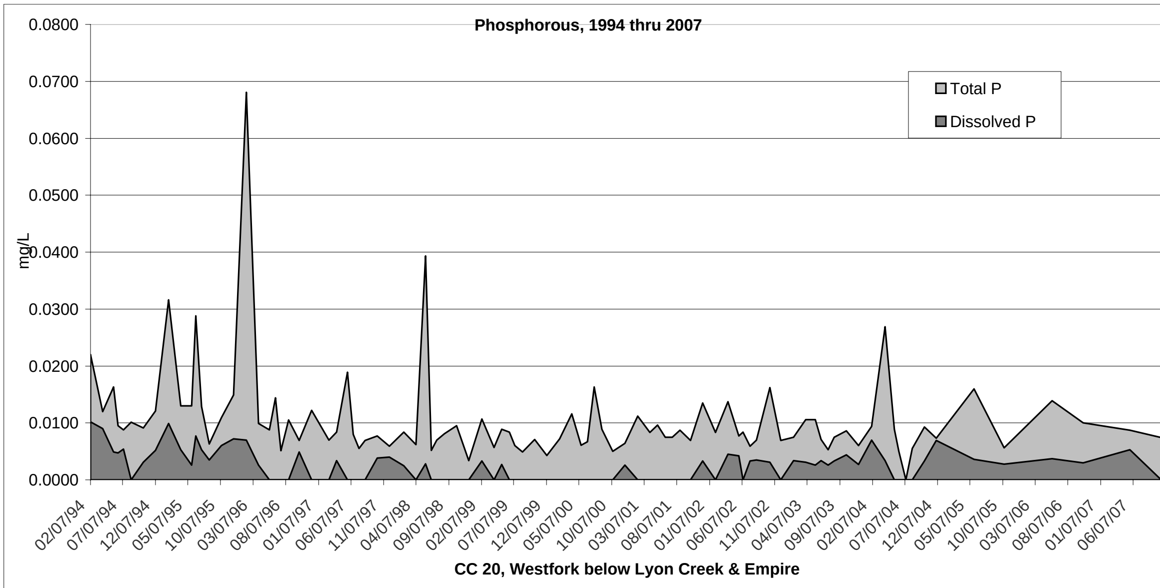



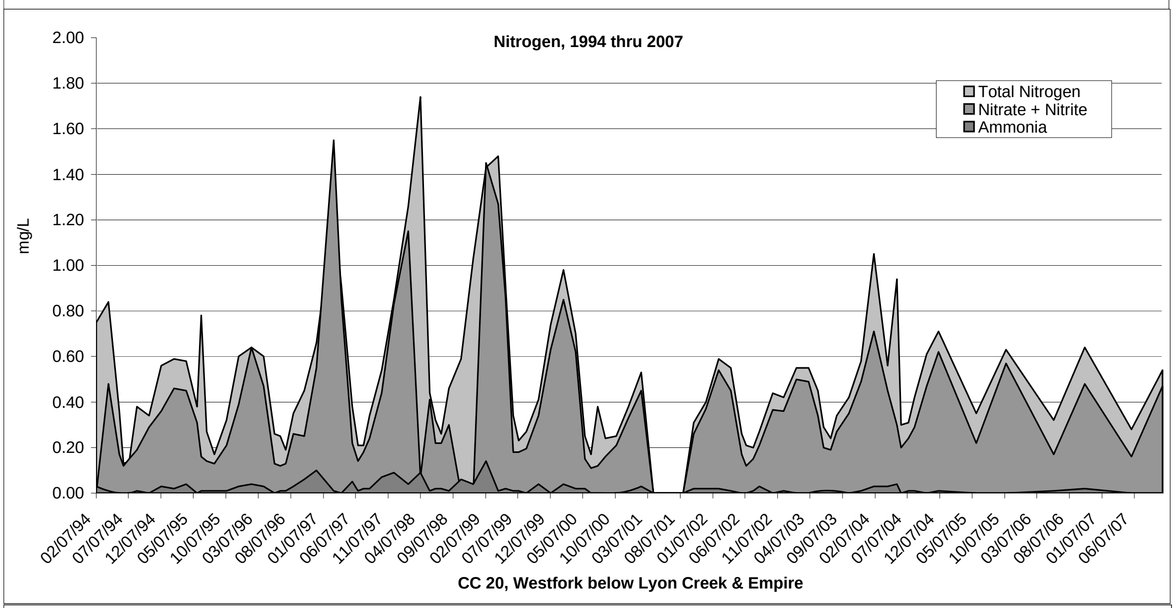
Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
18
16
14
12
10
8
6
4
2
0
CC 10, Confluence of South Fork & Leavenworth Creek

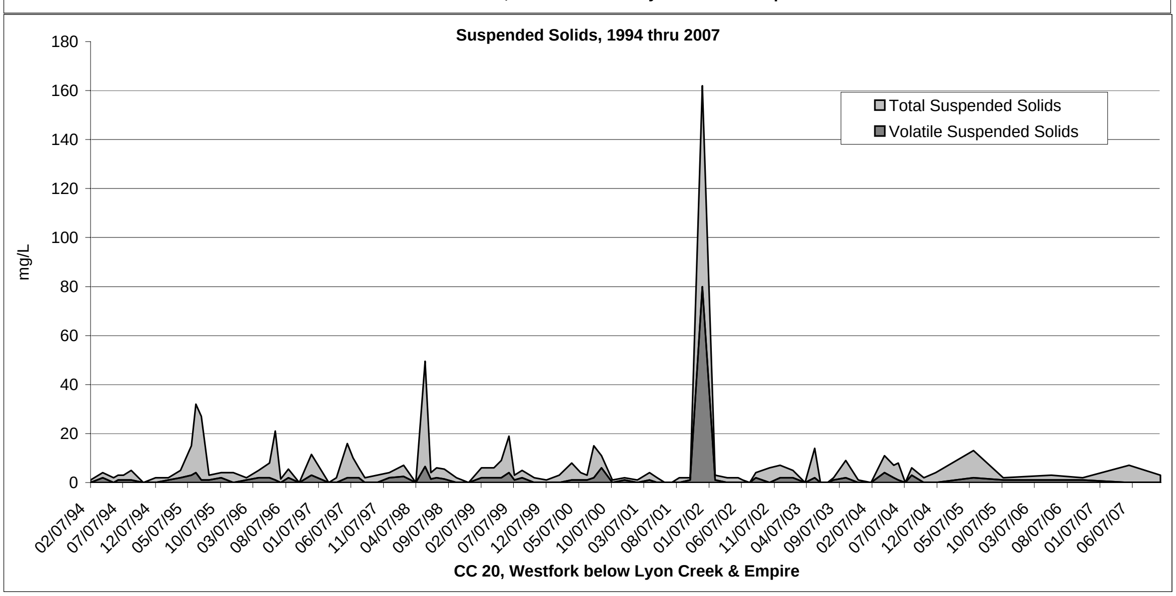

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
CC15, Westfork below Berthoud

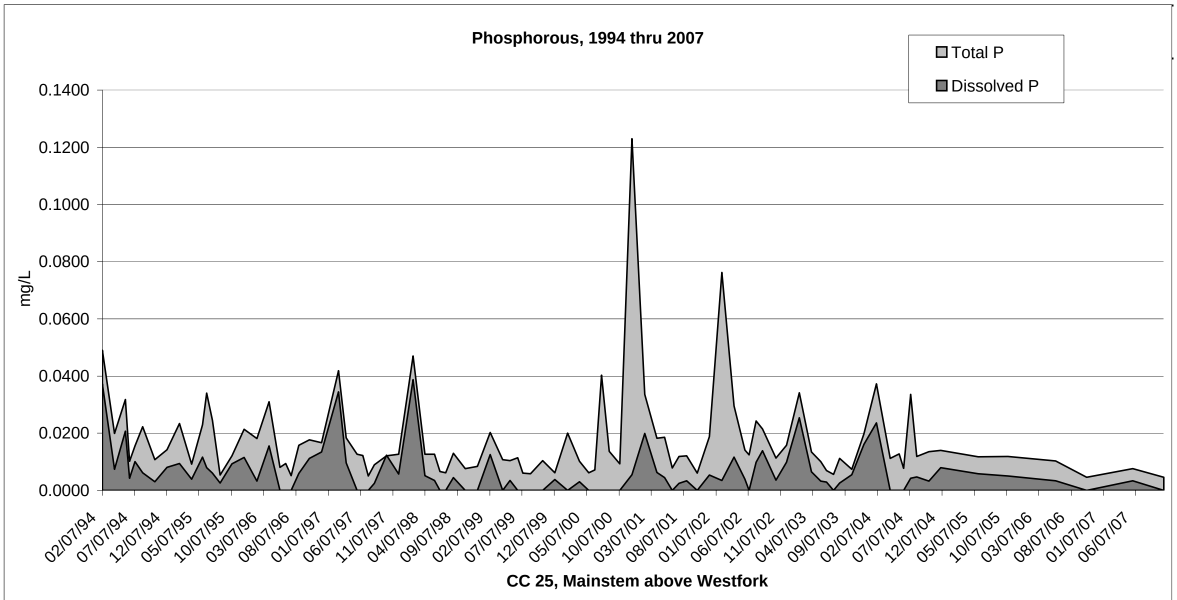

Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
CC15, Westfork below Berthoud


Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
CC15, Westfork below Berthoud

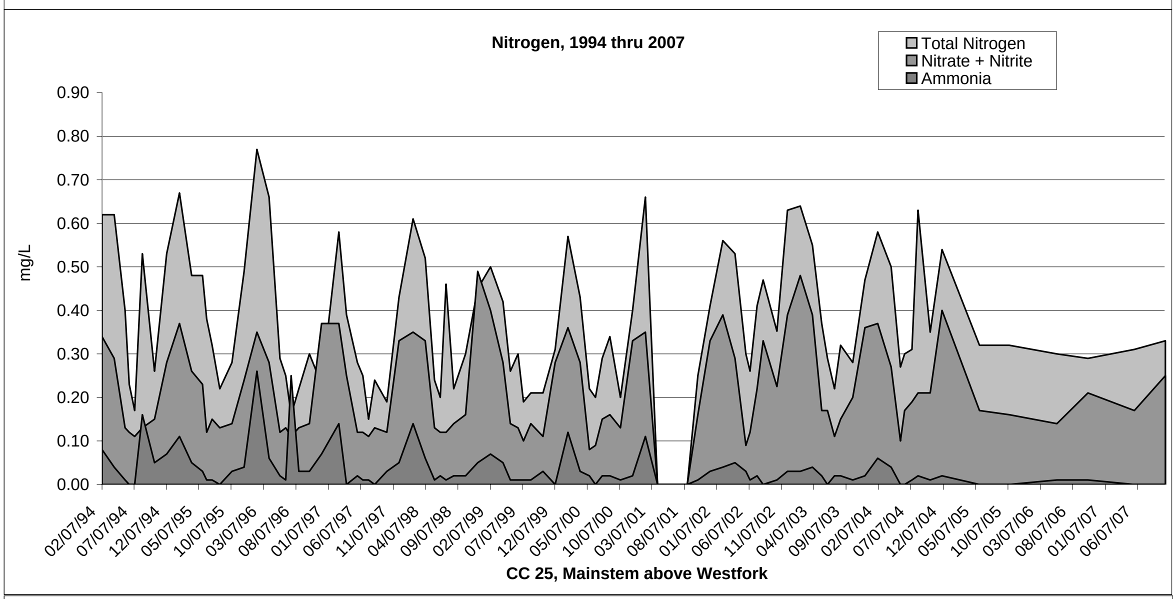

Phosphorous, 1994 thru 2007
mg/L
Total P
Dissolved P
CC 20, Westfork below Lyon Creek & Empire


Nitrogen, 1994 thru 2007
mg/L
Total Nitrogen
Nitrate + Nitrite
Ammonia
CC 20, Westfork below Lyon Creek & Empire

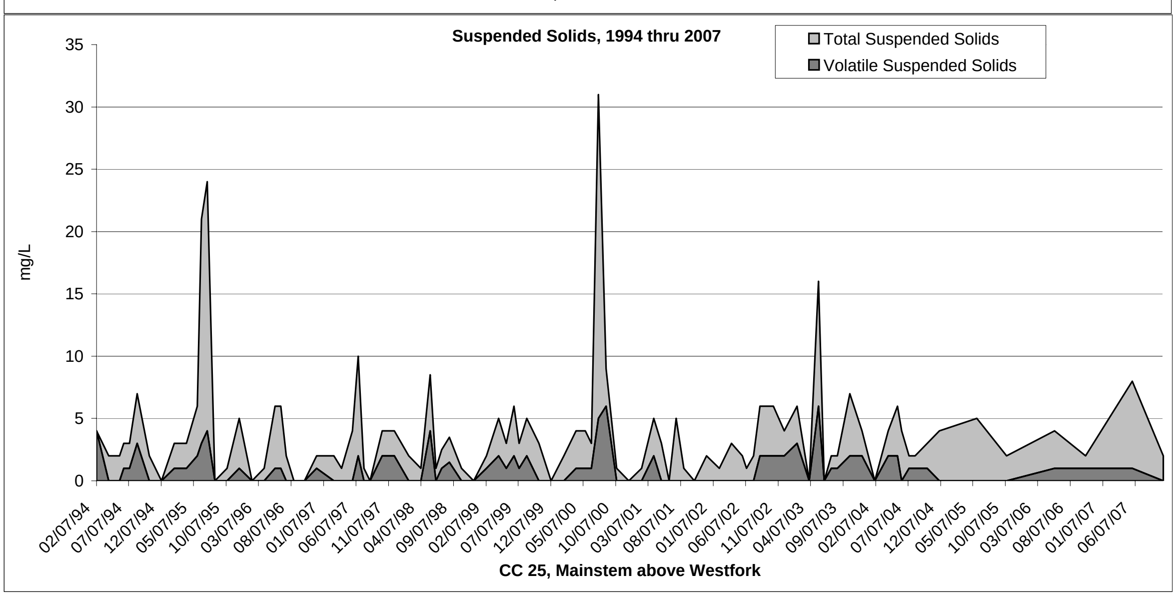

Suspended Solids, 1994 thru 2007
mg/L
Total Suspended Solids
Volatile Suspended Solids
CC 20, Westfork below Lyon Creek & Empire



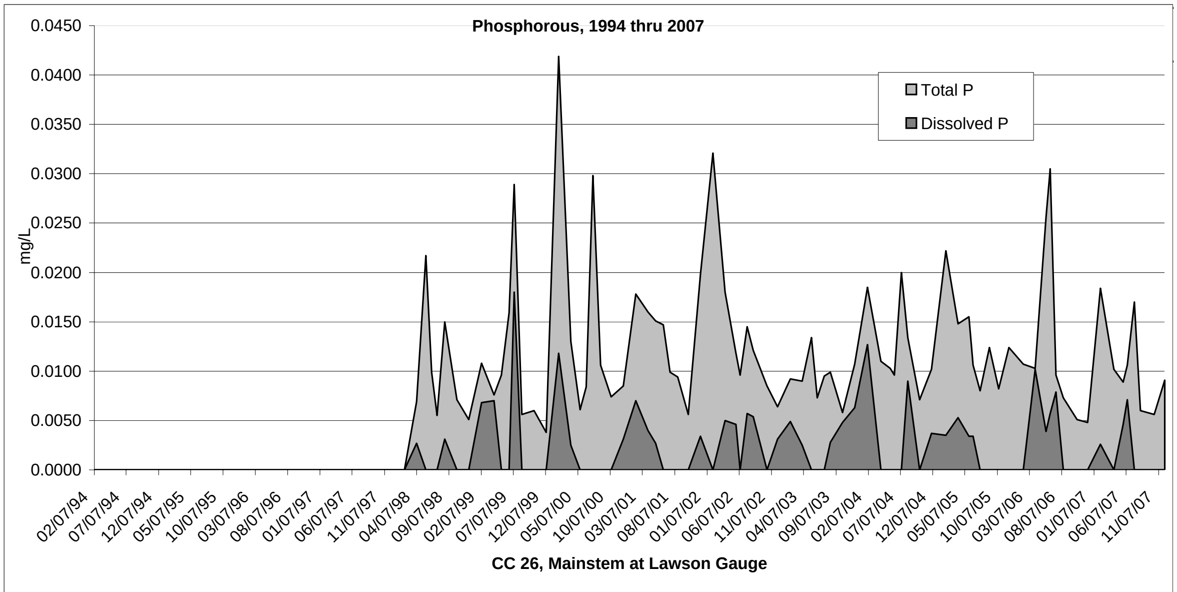
Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 25, Mainstem above Westfork

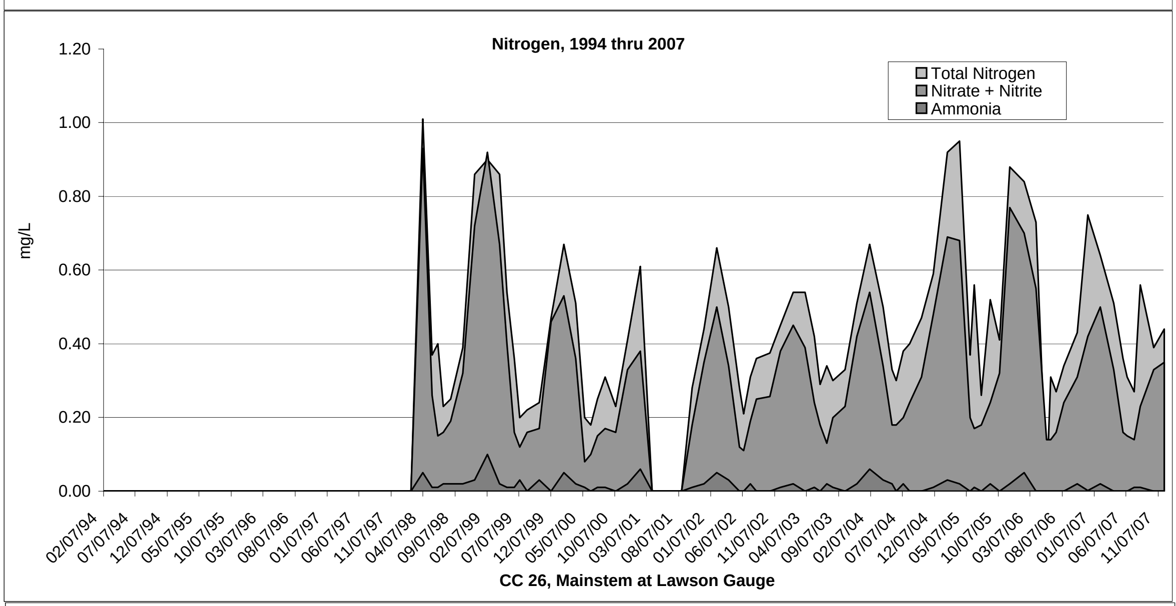
Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 25, Mainstem above Westfork

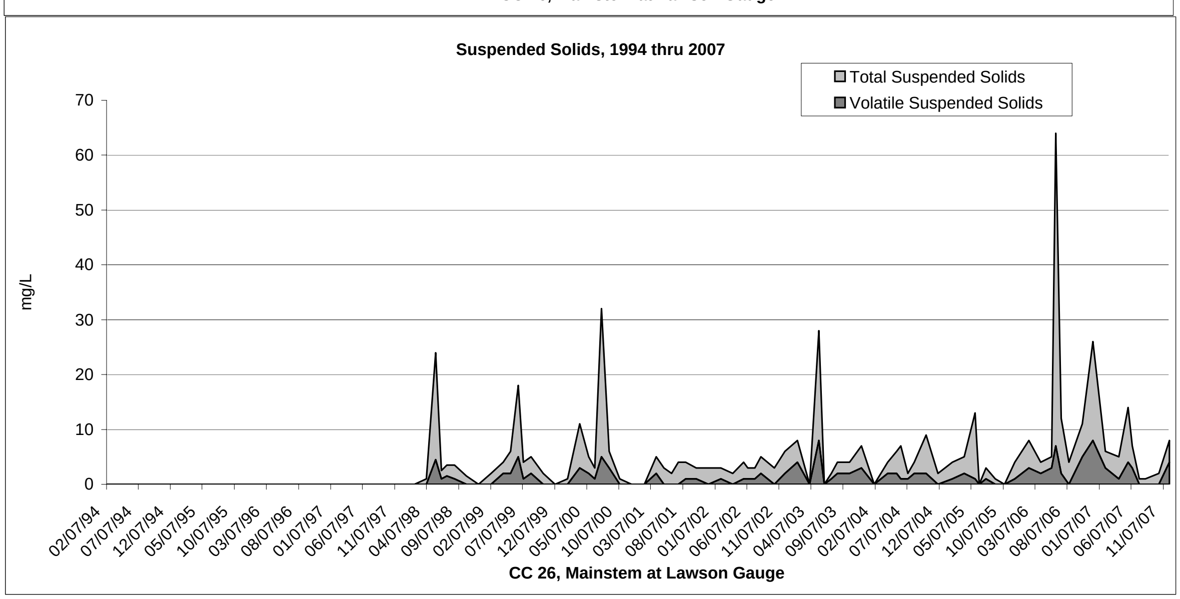
Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
35
30
25
20
15
10
5
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 25, Mainstem above Westfork



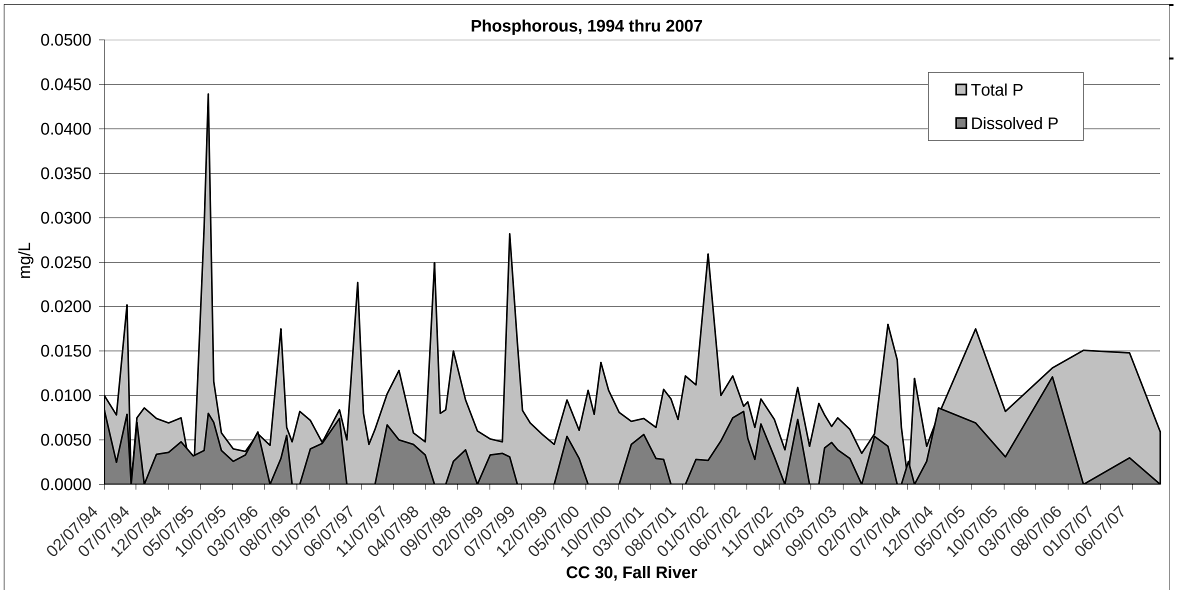
Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.0450
0.0400
0.0350
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC 26, Mainstem at Lawson Gauge

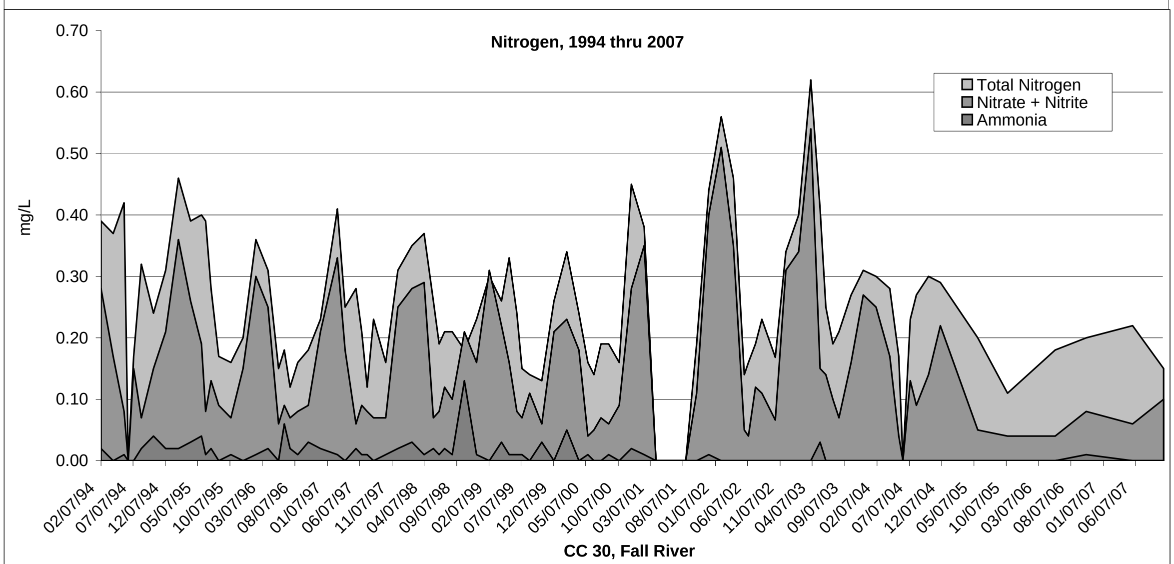



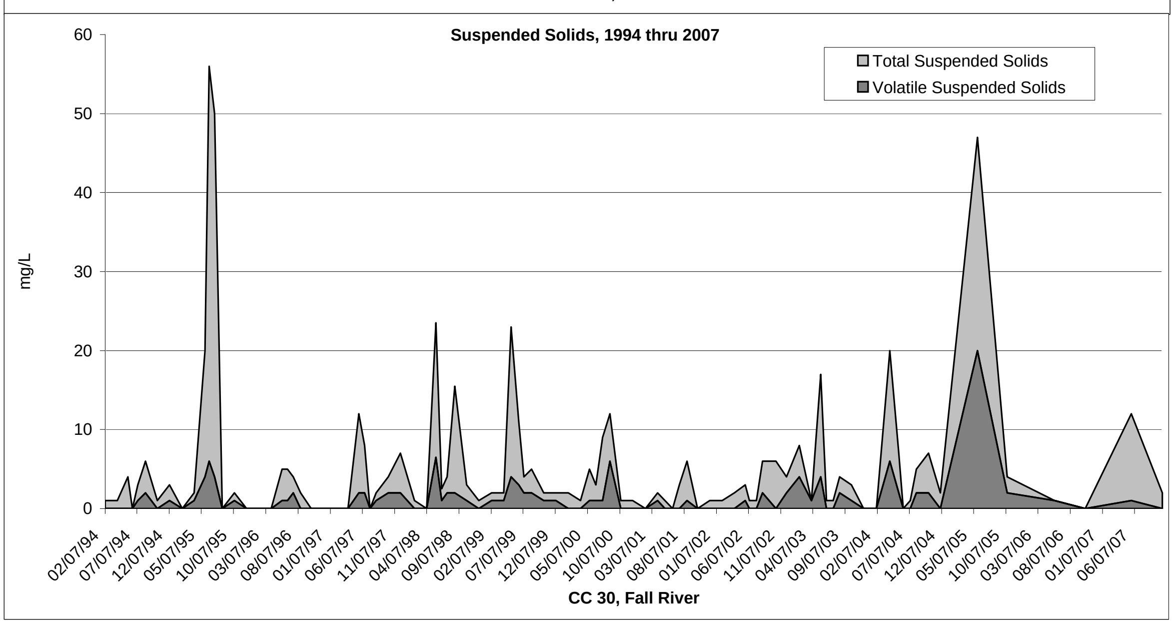
Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
1.20
1.00
0.80
0.60
0.40
0.20
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC 26, Mainstem at Lawson Gauge

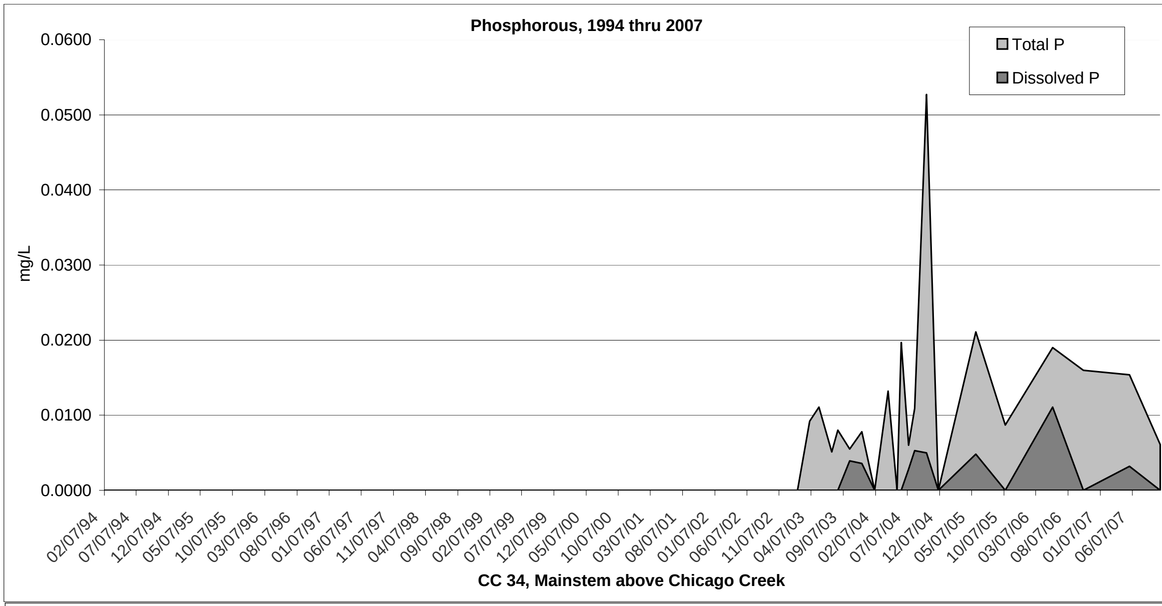



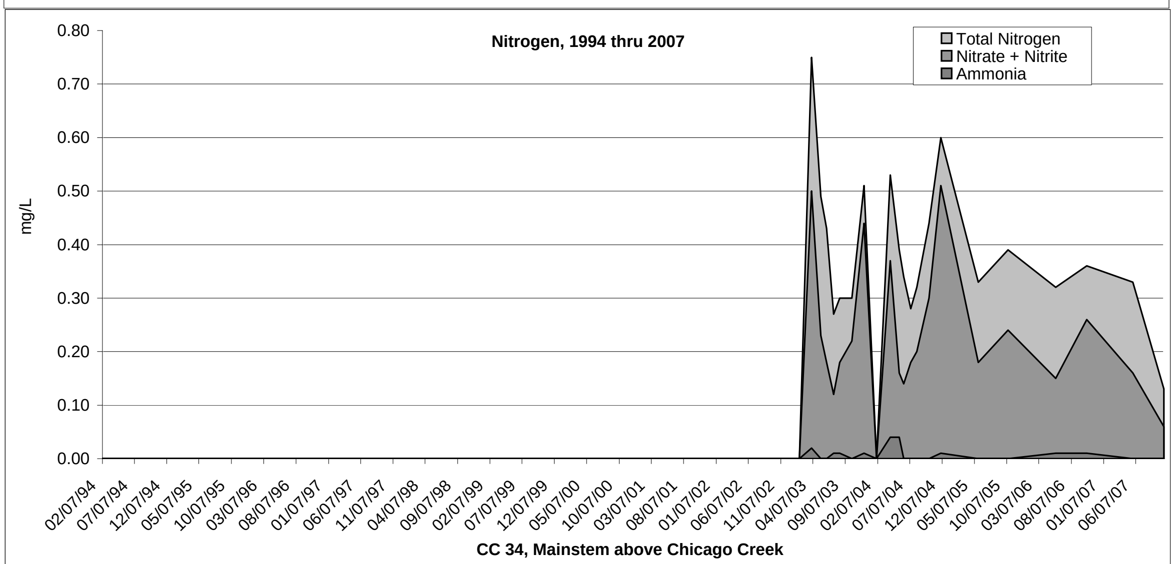
Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
70
60
50
40
30
20
10
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC 26, Mainstem at Lawson Gauge

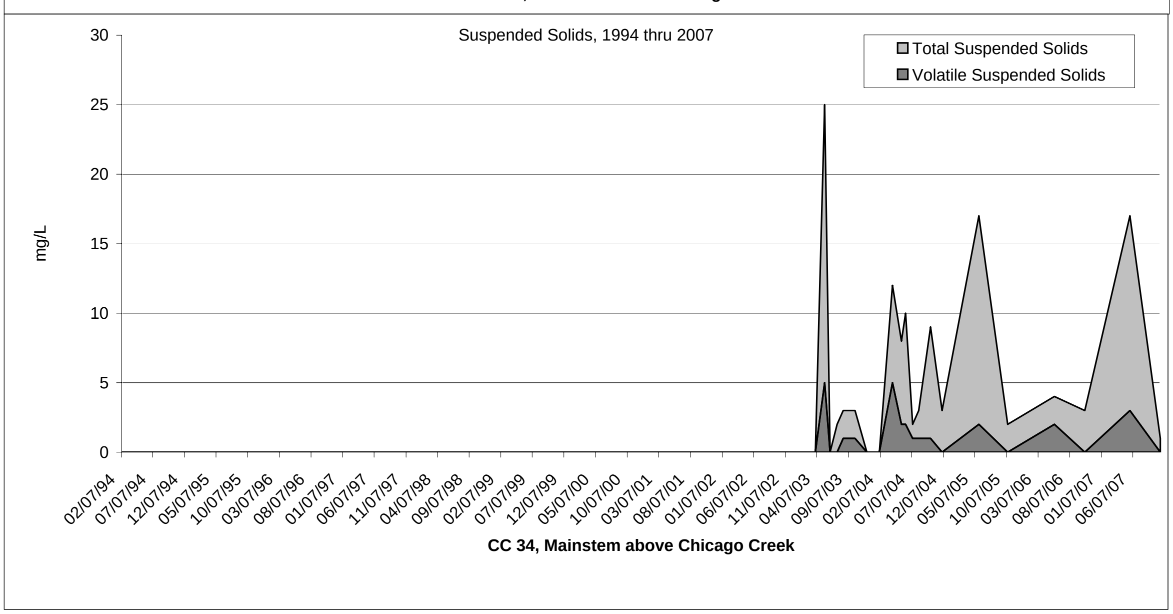

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.0500
0.0450
0.0400
0.0350
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 30, Fall River

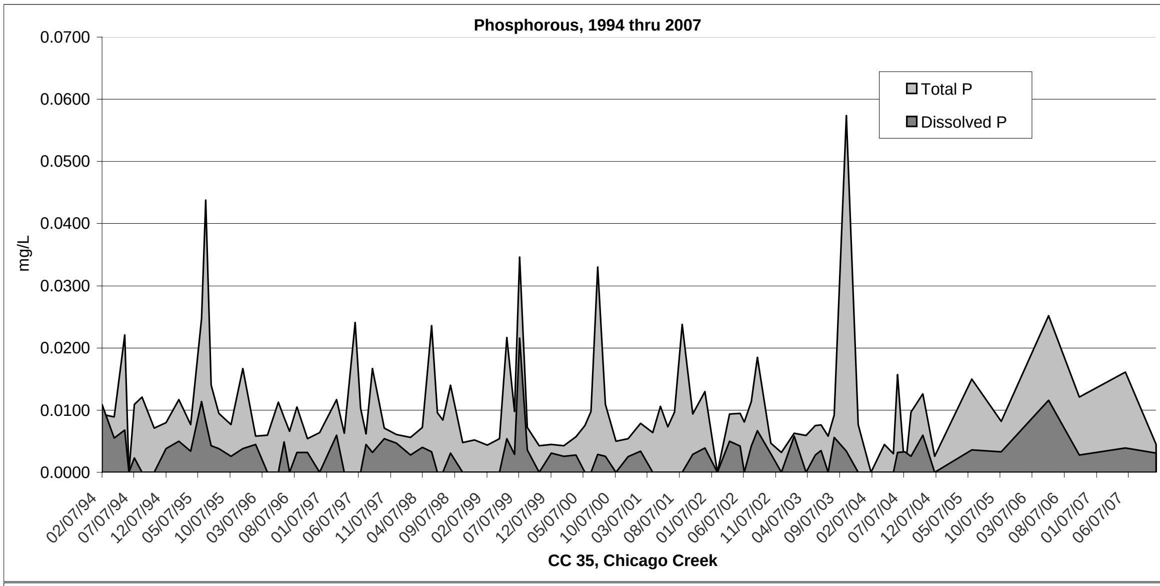

Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 30, Fall River

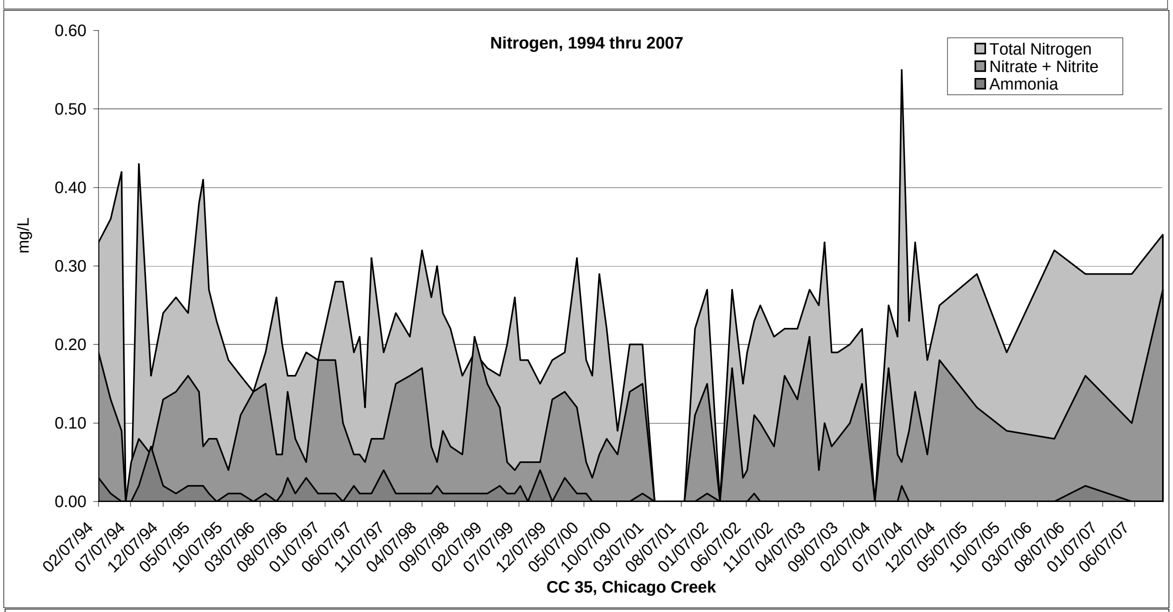

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
60
50
40
30
20
10
0
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 30, Fall River

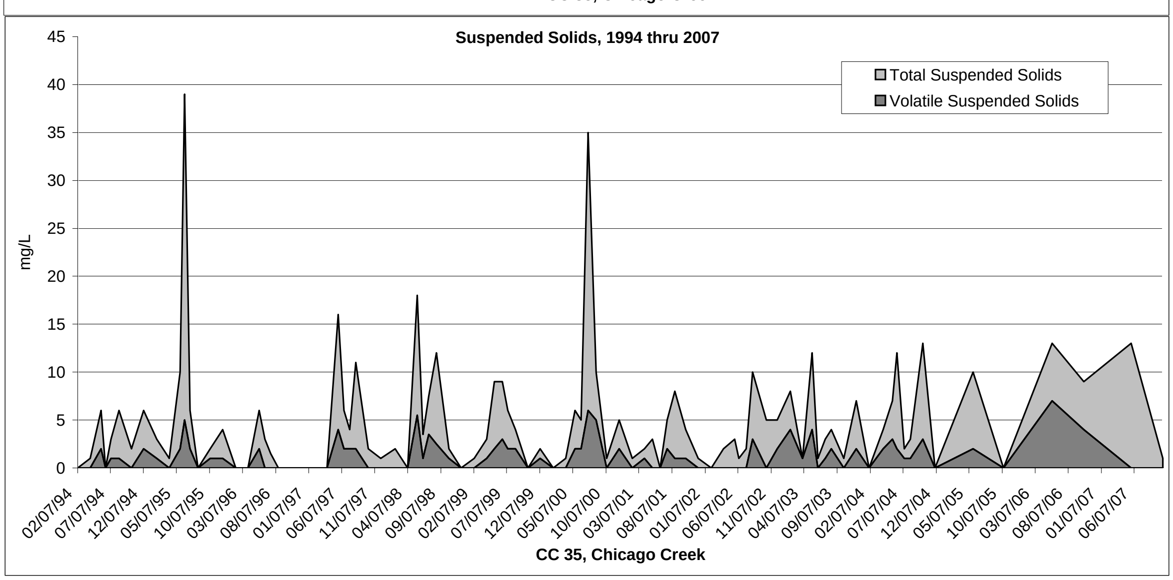

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 34, Mainstem above Chicago Creek

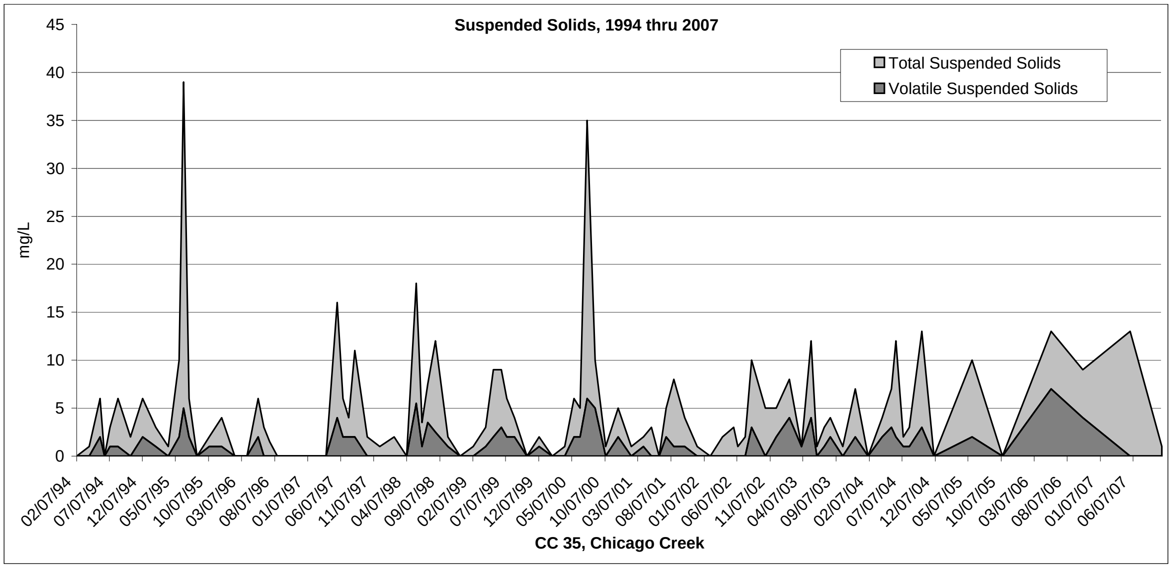

Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 34, Mainstem above Chicago Creek

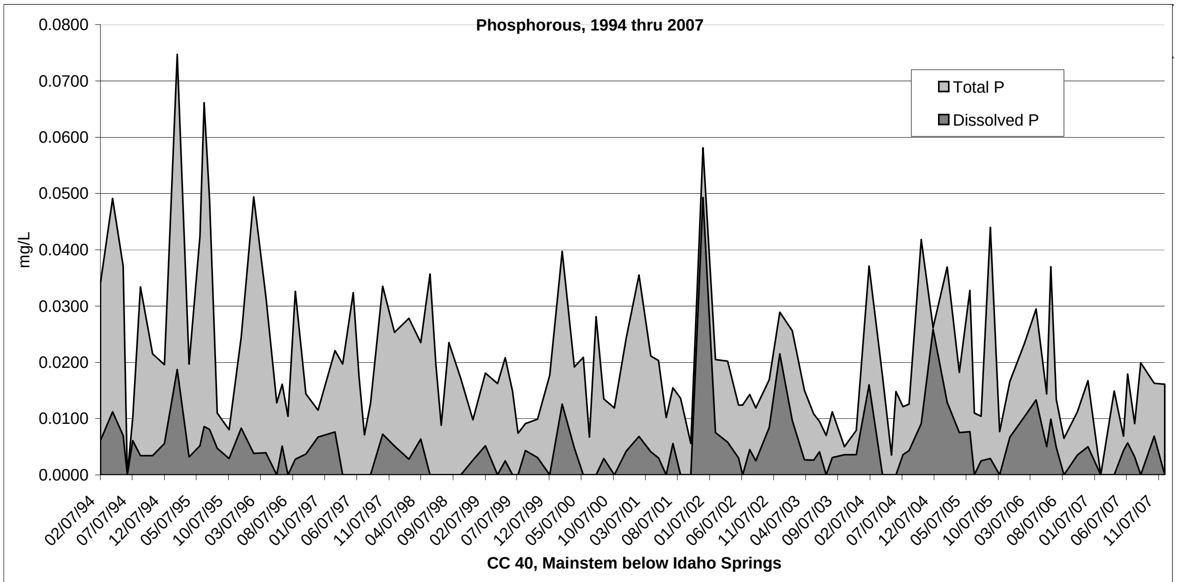

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
30
25
20
15
10
5
0
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 34, Mainstem above Chicago Creek

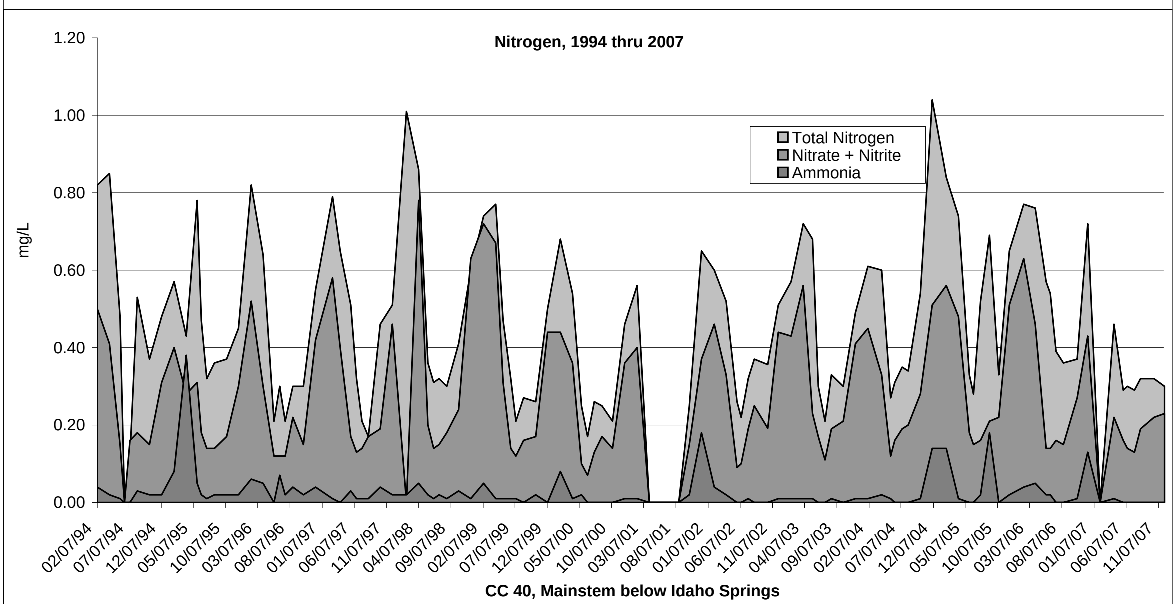

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 35, Chicago Creek

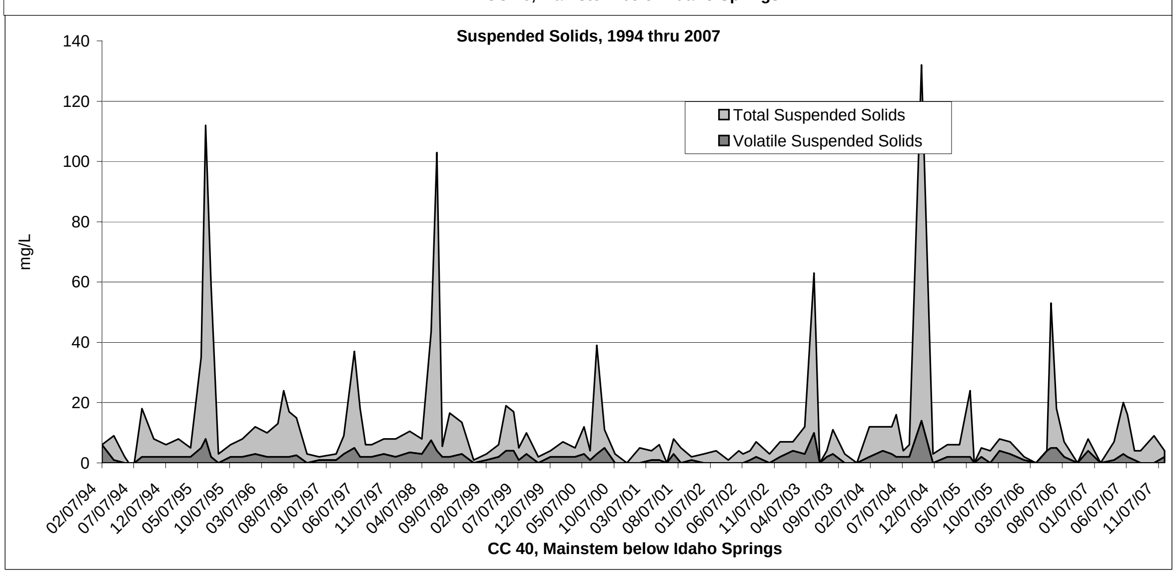

Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
0.60
0.50
0.40
0.30
0.20
0.10
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 35, Chicago Creek

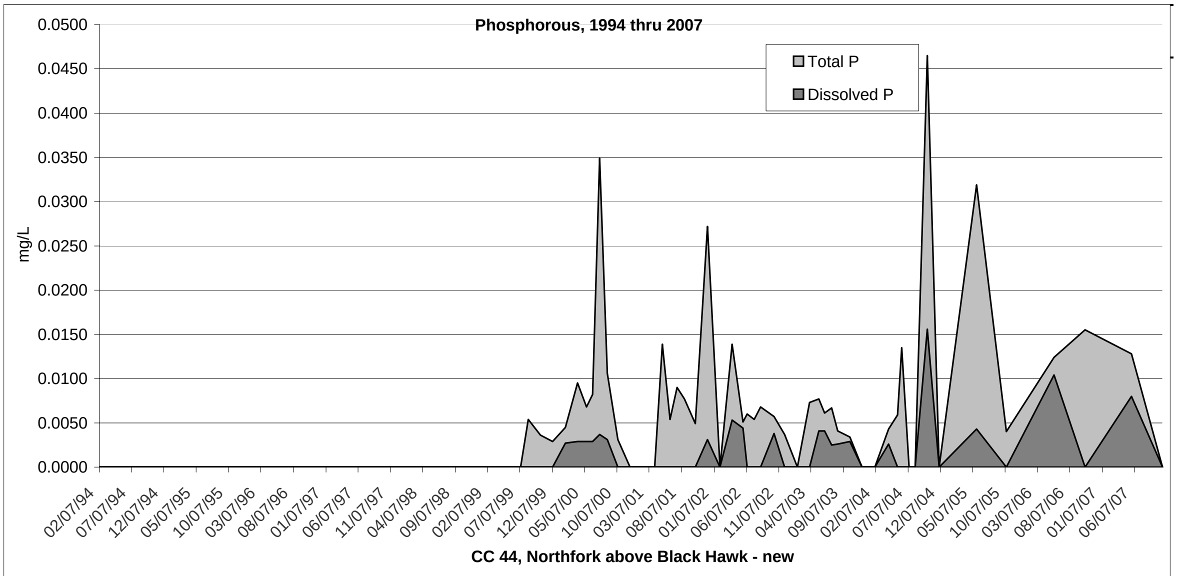

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
45
40
35
30
25
20
15
10
5
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 35, Chicago Creek

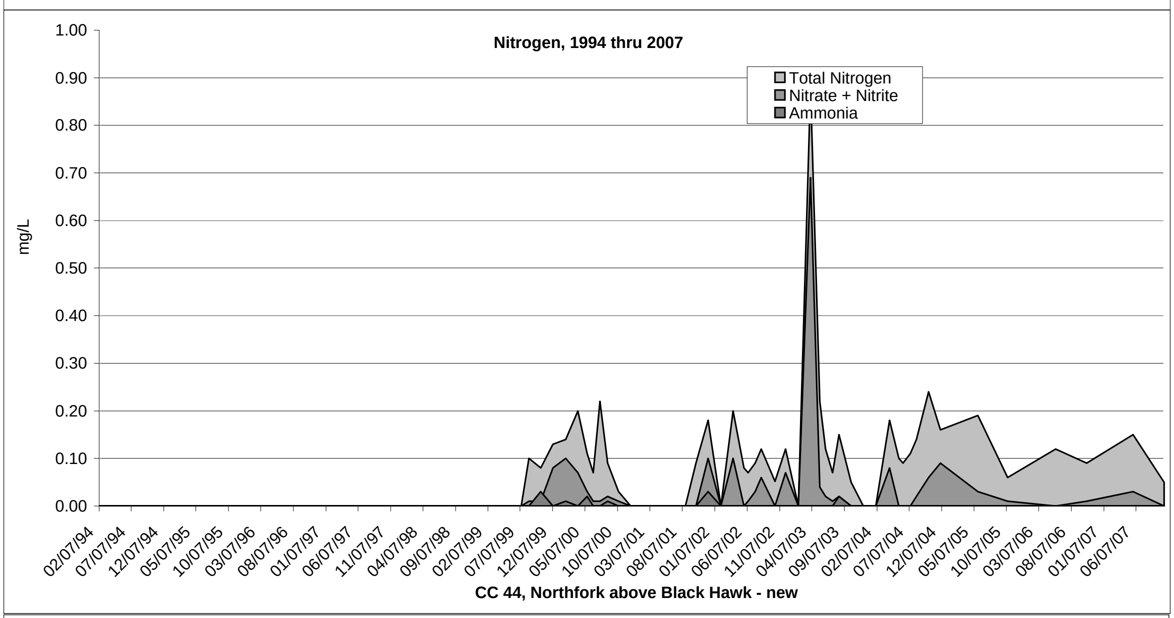

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
45
40
35
30
25
20
15
10
5
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 35, Chicago Creek

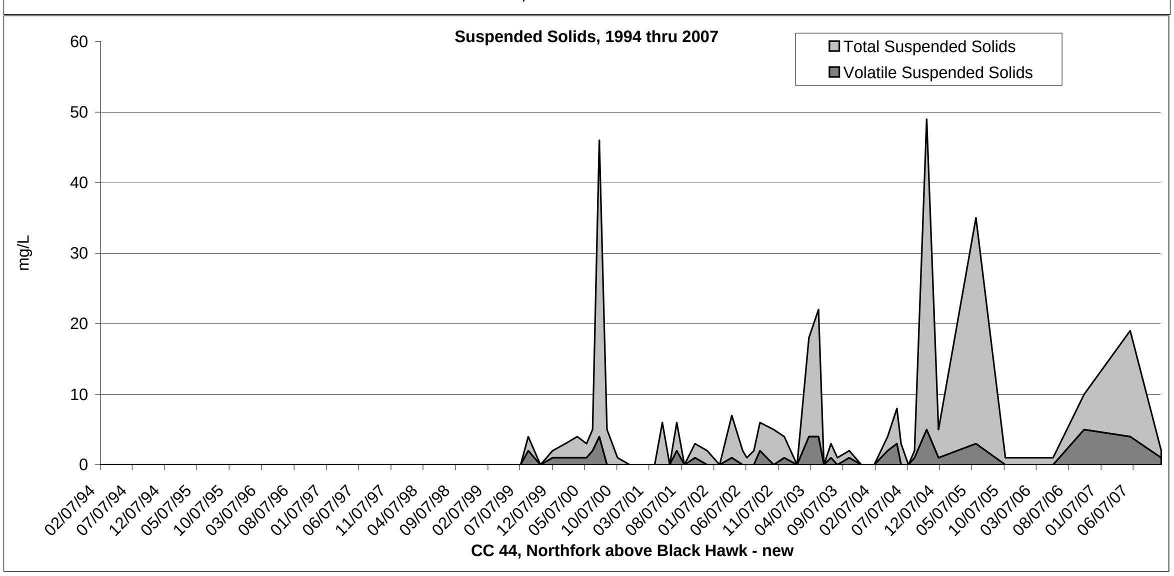

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.0800
0.0700
0.0600
0.0500
0.0400
0.0300
0.0200
0.0100
0.0000
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 40, Mainstem below Idaho Springs

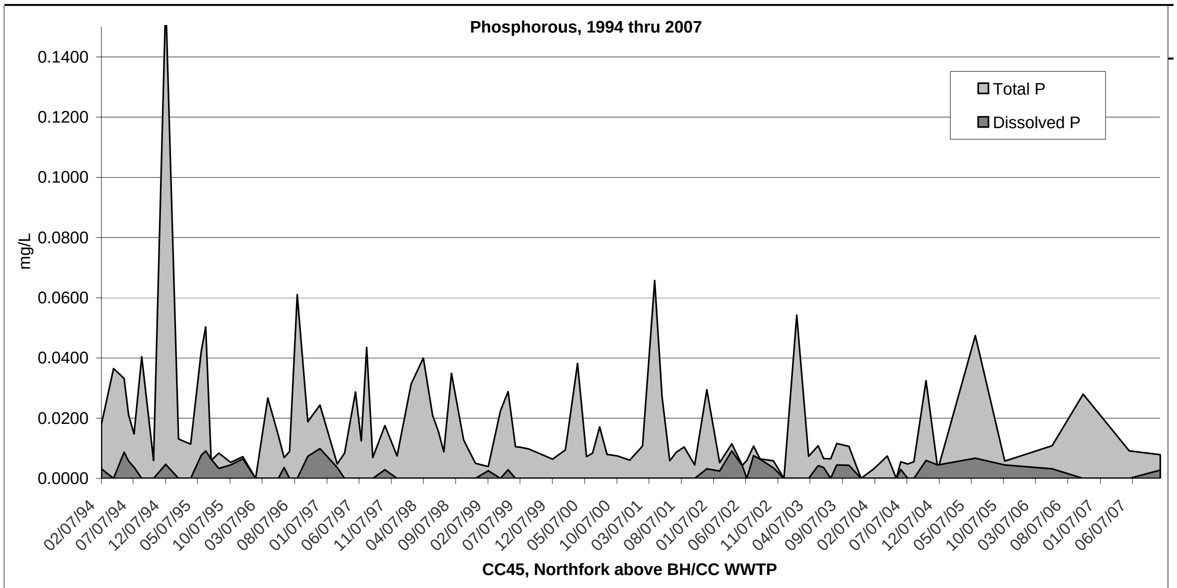

Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
1.20
1.00
0.80
0.60
0.40
0.20
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 40, Mainstem below Idaho Springs

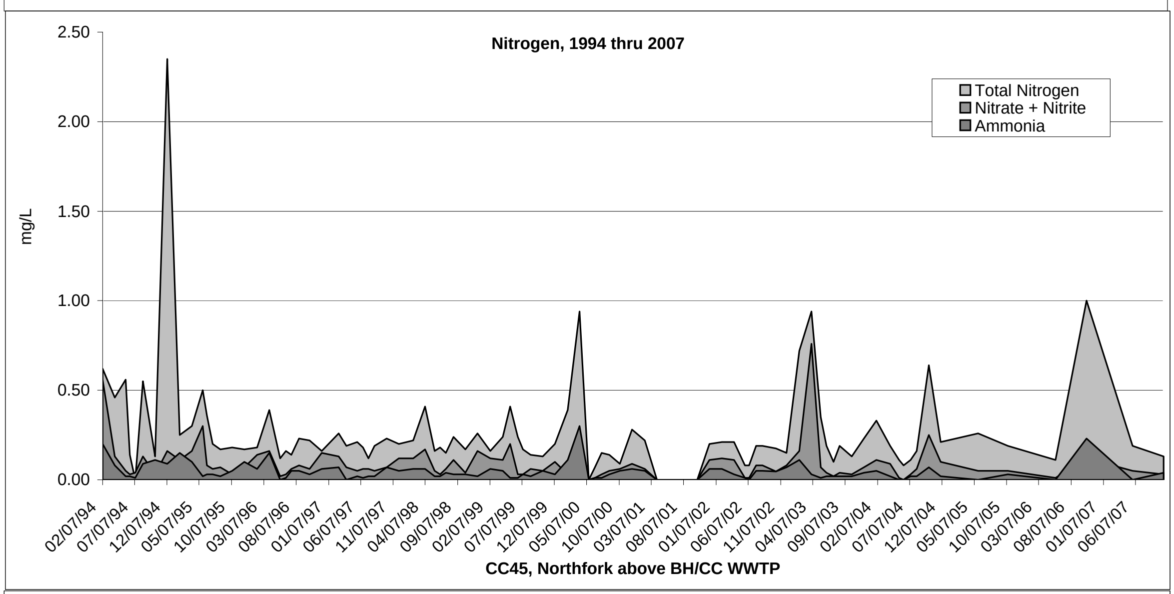

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
140
120
100
80
60
40
20
0
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 40, Mainstem below Idaho Springs

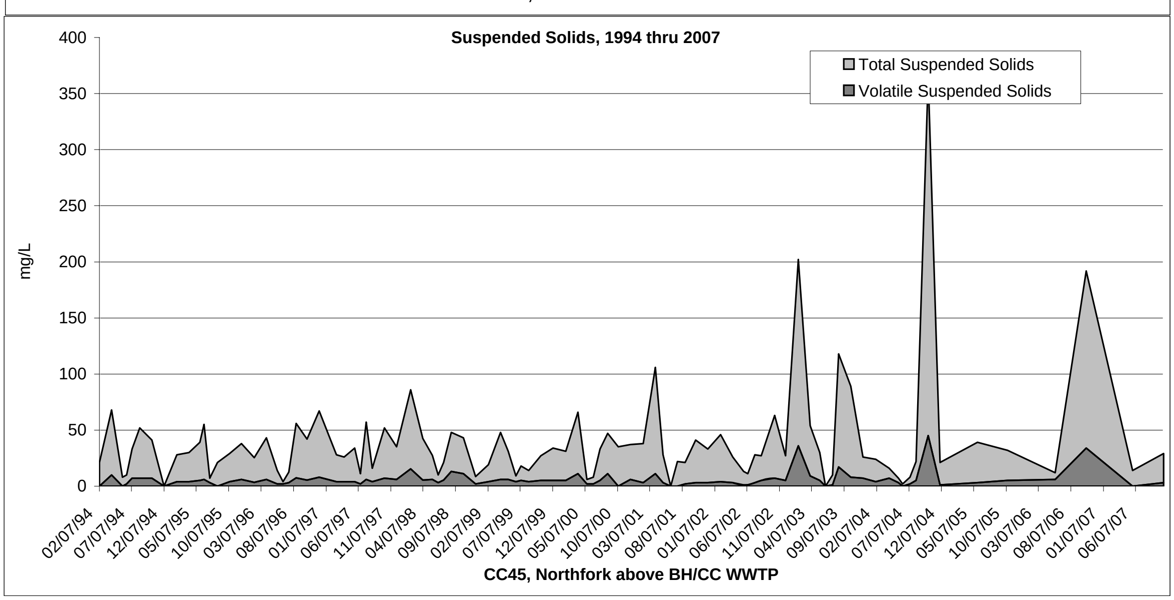

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.0500
0.0450
0.0400
0.0350
0.0300
0.0250
0.0200
0.0150
0.0100
0.0050
0.0000
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 44, Northfork above Black Hawk - new

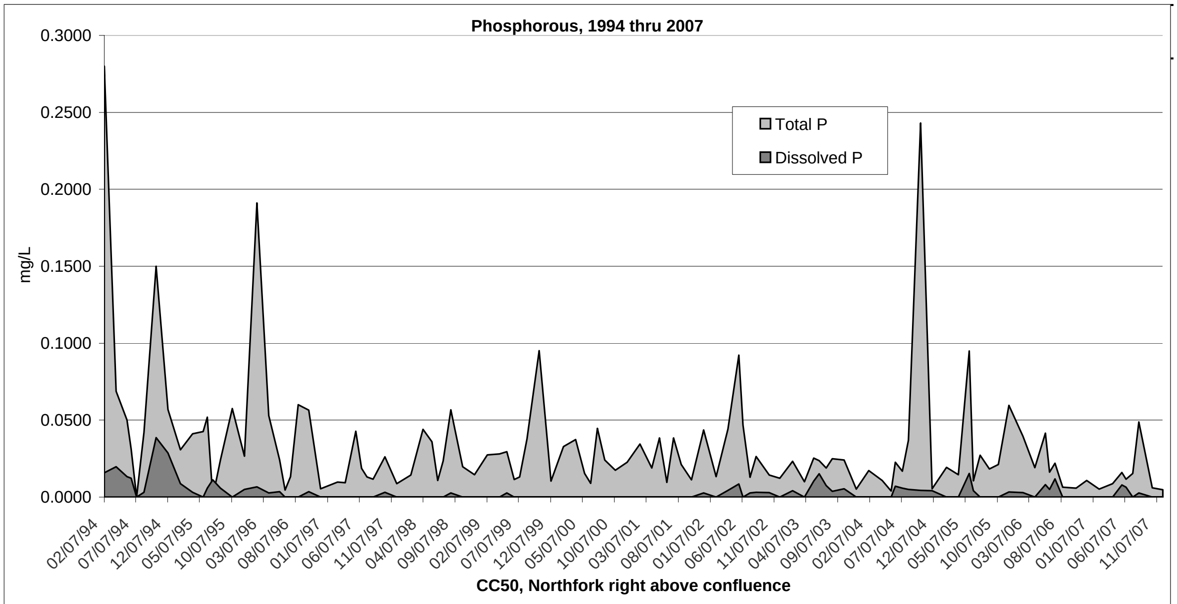

Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 44, Northfork above Black Hawk - new

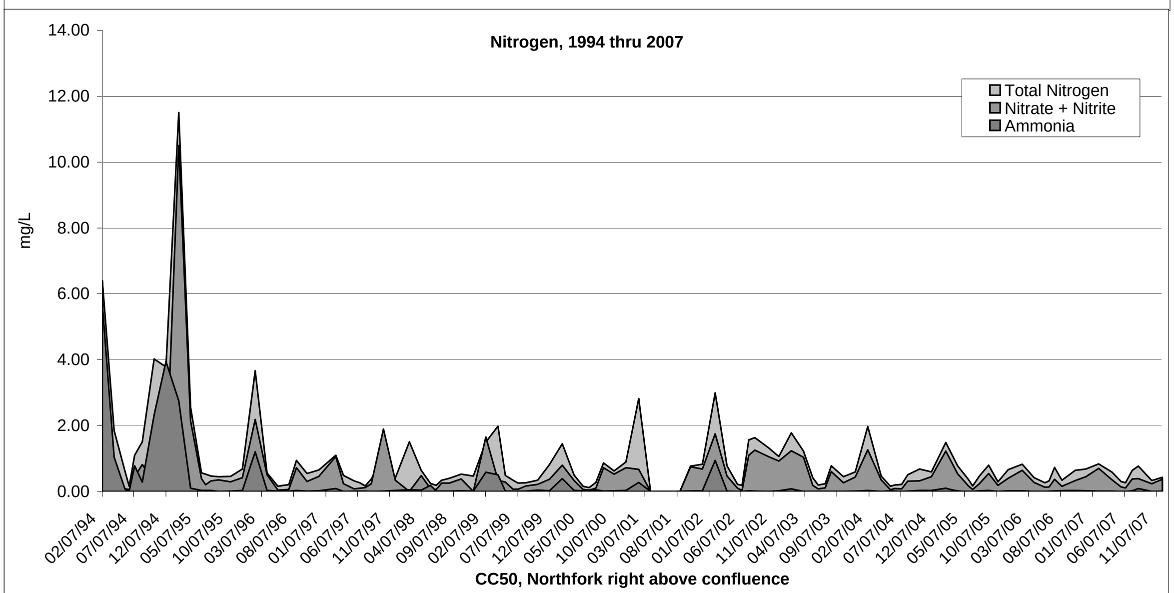

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
60
50
40
30
20
10
0
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 44, Northfork above Black Hawk - new

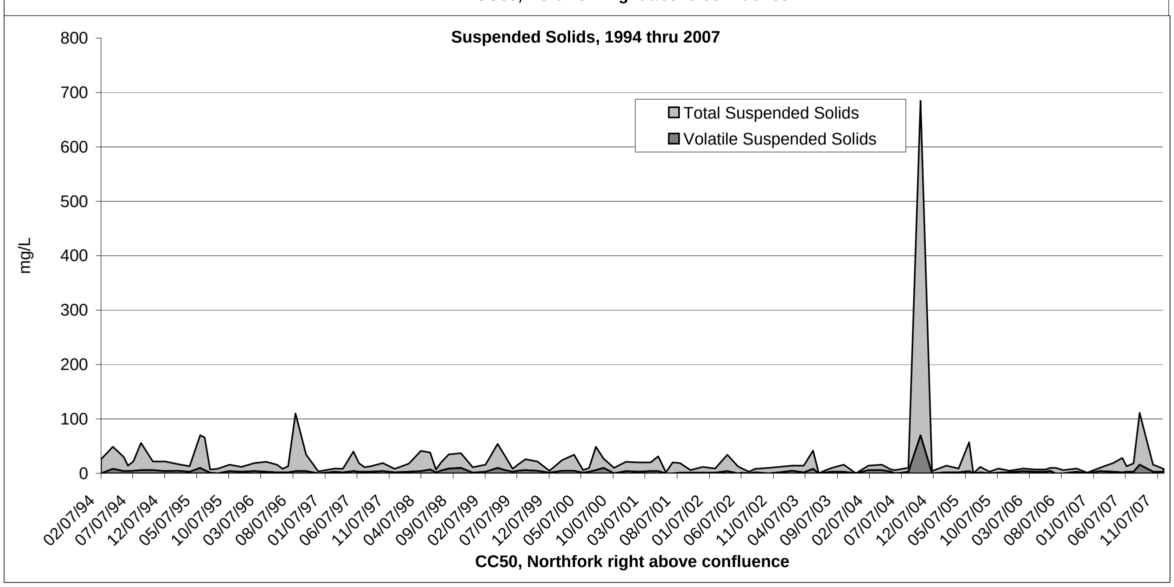

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC45, Northfork above BH/CC WWTP

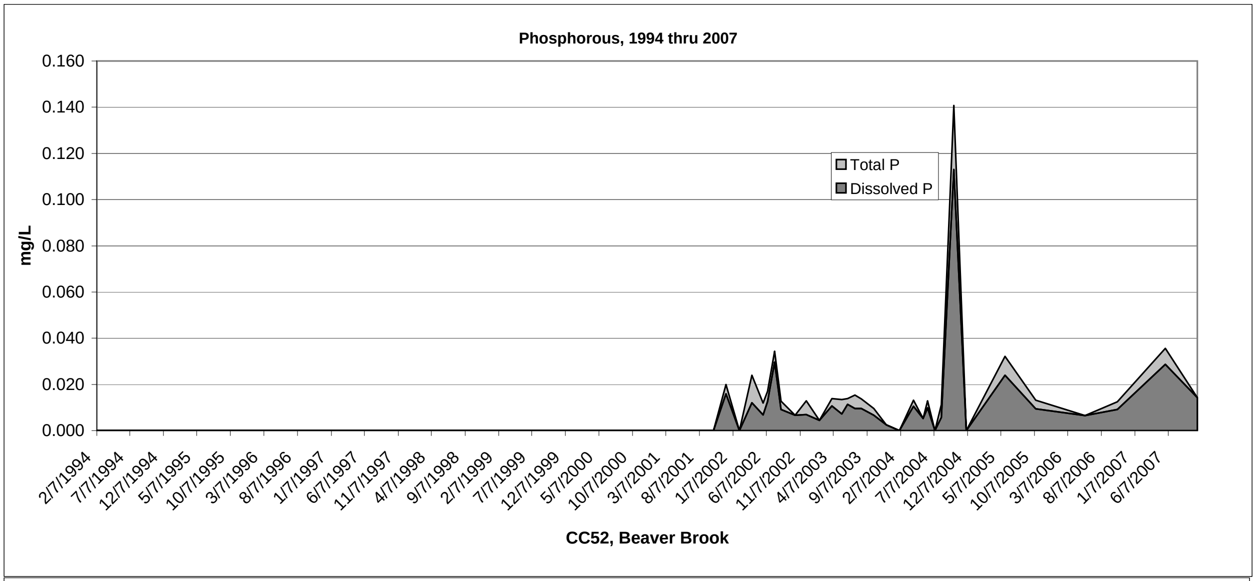

Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
2.50
2.00
1.50
1.00
0.50
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC45, Northfork above BH/CC WWTP


Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
400
350
300
250
200
150
100
50
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC45, Northfork above BH/CC WWTP

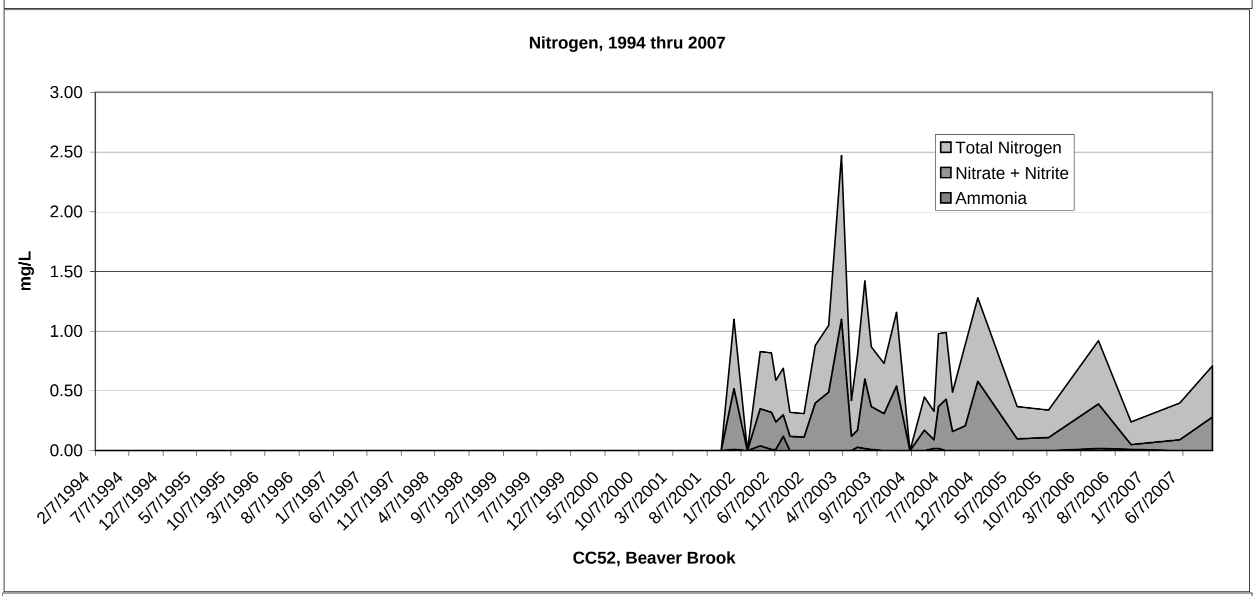

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC50, Northfork right above confluence


Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC50, Northfork right above confluence

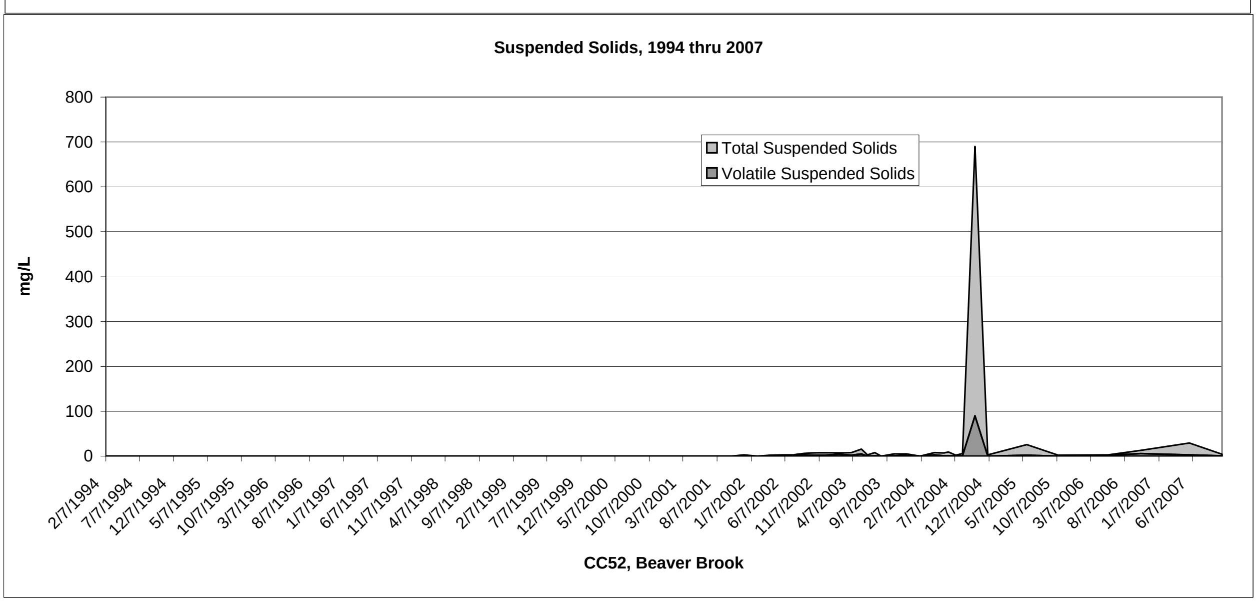

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
800
700
600
500
400
300
200
100
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC50, Northfork right above confluence



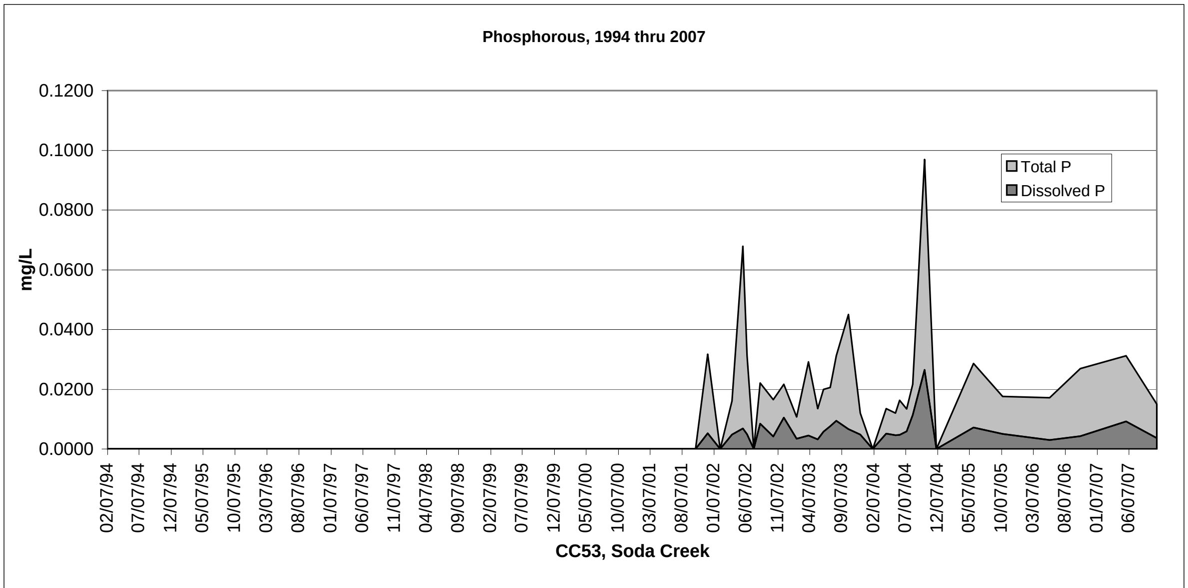
Phosphorous, 1994 thru 2007
mg/L
Total P
Dissolved P
CC52, Beaver Brook

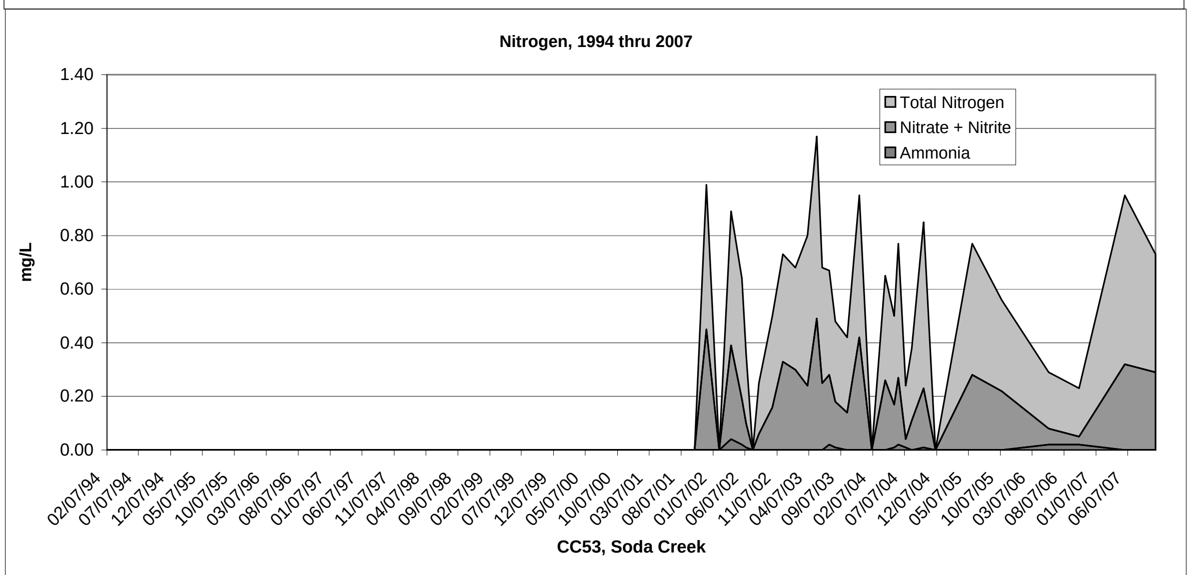



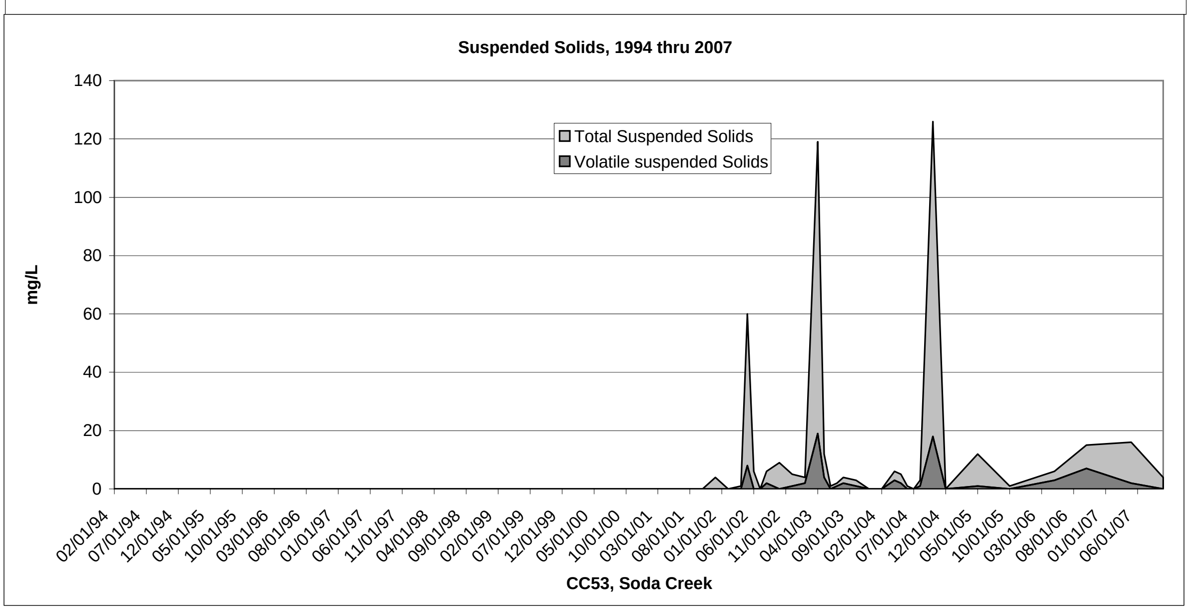
Nitrogen, 1994 thru 2007
mg/L
Total Nitrogen
Nitrate + Nitrite
Ammonia
CC52, Beaver Brook

Suspended Solids, 1994 thru 2007
mg/L
Total Suspended Solids
Volatile Suspended Solids
CC52, Beaver Brook


Phosphorous, 1994 thru 2007
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
mg/L
Total P
Dissolved P
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC53, Soda Creek

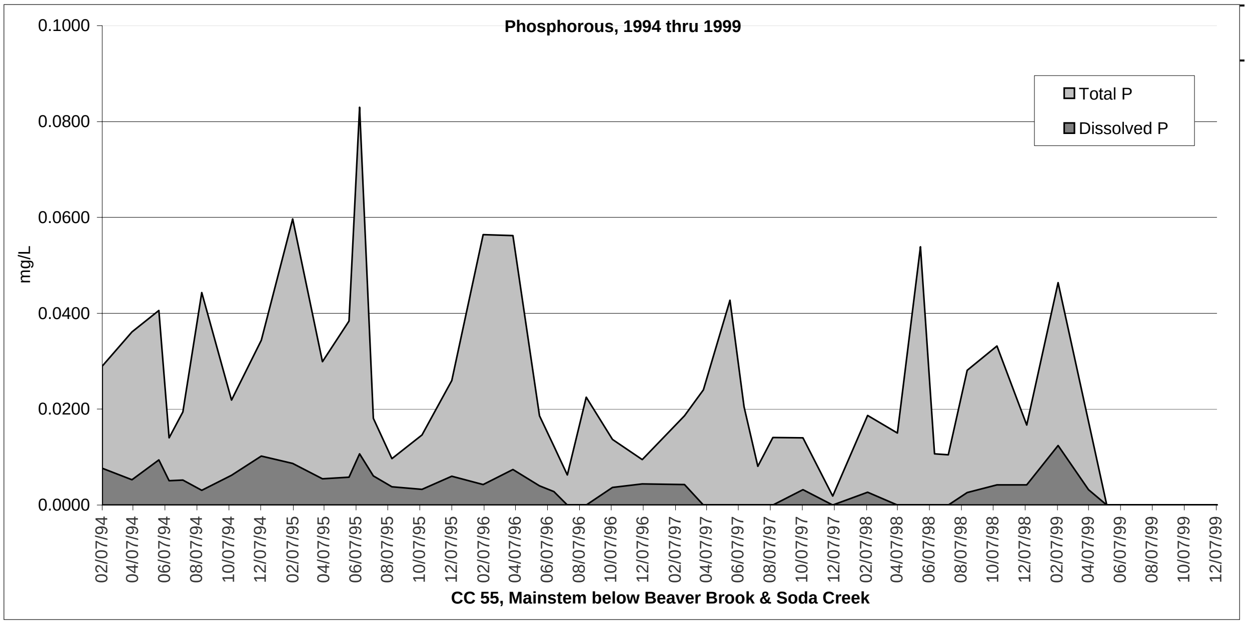

Nitrogen, 1994 thru 2007
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
mg/L
Total Nitrogen
Nitrate + Nitrite
Ammonia
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC53, Soda Creek


Suspended Solids, 1994 thru 2007
140
120
100
80
60
40
20
0
mg/L
Total Suspended Solids
Volatile suspended Solids
02/01/94
07/01/94
12/01/94
05/01/95
10/01/95
03/01/96
08/01/96
01/01/97
06/01/97
11/01/97
04/01/98
09/01/98
02/01/99
07/01/99
12/01/99
05/01/00
10/01/00
03/01/01
08/01/01
01/01/02
06/01/02
11/01/02
04/01/03
09/01/03
02/01/04
07/01/04
12/01/04
05/01/05
10/01/05
03/01/06
08/01/06
01/01/07
06/01/07
CC53, Soda Creek

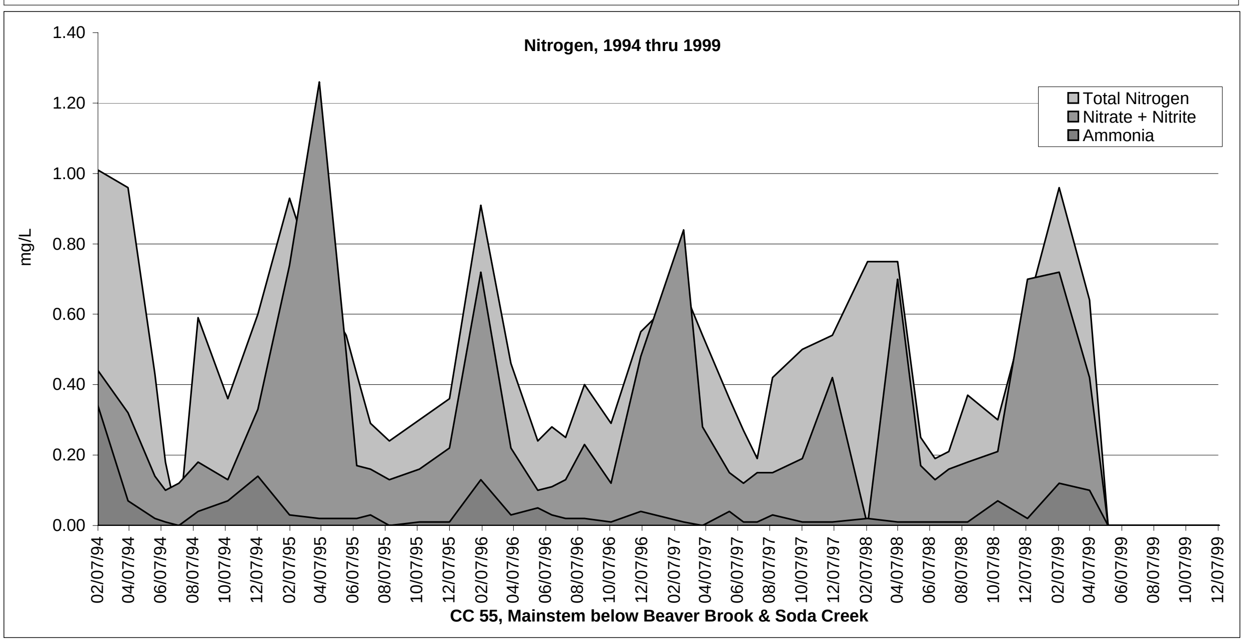
| Date | Time | Temp | pH | Cond. | Turb. | Diss. P | TP | TSS | VSS | NH3 | NO3/NO2 | TN | Chlorides | TKN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | deg C | s.u. | (uS/cm) | (NTU) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) | (mg/L) |

## CC54 Confluence of Beaver Brook and Soda Creek

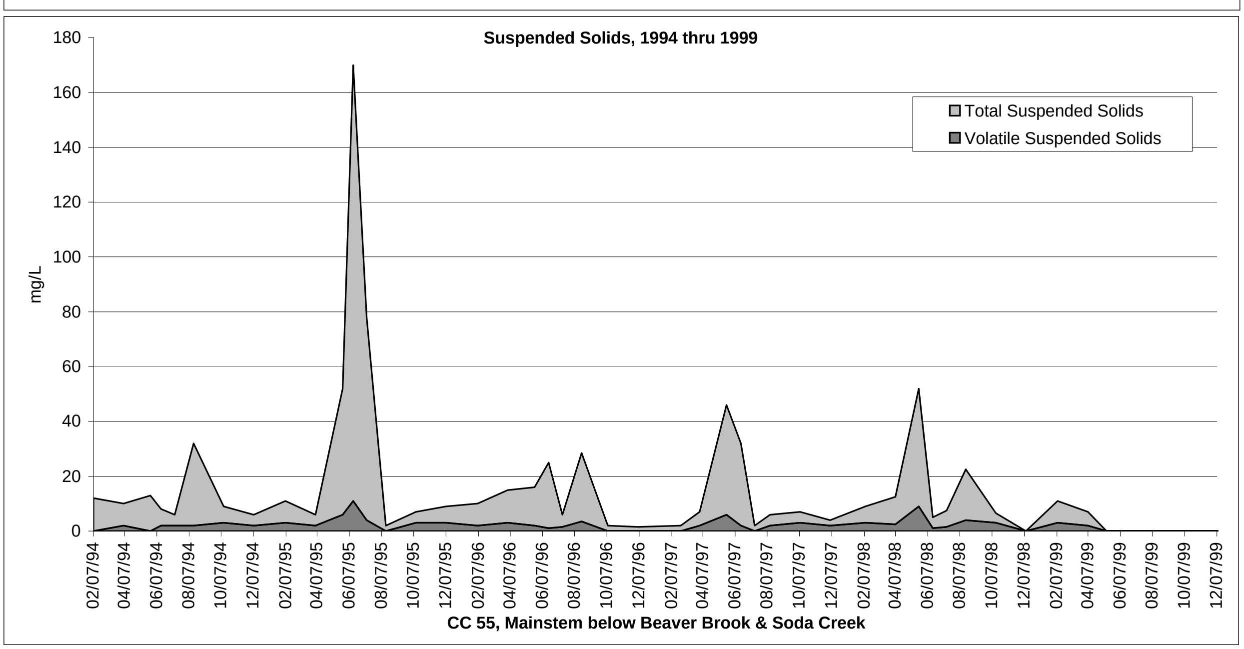
| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 05/12/99 | 1235 | 6.9 | 7.81 | 152 | 23.00 | 0.0037 | 0.0365 | 21 | 4 | 0.01 | 0.18 | 0.47 | | |
| 06/17/99 | 1315 | 11.1 | 7.59 | 174 | 11.00 | 0.0031 | 0.0220 | 12 | 5 | 0.01 | 0.12 | 0.34 | | |
| 07/12/99 | 1351 | 17.4 | 8.16 | 232 | 7.00 | 0.0142 | 0.0313 | 9 | 3 | 0.02 | 0.20 | 0.39 | | |
| 08/17/99 | 1520 | 15.3 | 7.15 | 166 | 15.00 | 0.0030 | 0.0300 | 18 | 5 | 0.03 | 0.21 | 0.35 | | |
| 10/13/99 | 1303 | 9.2 | 7.25 | 302 | 3.00 | <0.0025 | 0.0078 | <1 | <1 | 0.02 | 0.18 | 0.32 | | |
| 12/09/99 | | | | | | | | | | | | | | |
| 02/07/00 | 1145 | 0.3 | 7.21 | 320 | 4.0 | 0.0040 | 0.0094 | 3 | 2 | 0.03 | 0.52 | 0.61 | | |
| 04/04/00 | 1226 | 6.6 | 7.98 | 440 | 10.9 | 0.0040 | 0.0223 | 12 | 2 | 0.0 | 0.32 | 0.47 | | |
| 05/17/00 | 1130 | 8.0 | 7.55 | 247 | 7.7 | 0.0031 | 0.0125 | 7 | 2 | 0.03 | 0.16 | 0.36 | | |
| 06/15/00 | 1105 | 14.20 | 7.72 | 620.0 | 4.9 | 0.0083 | 0.0230 | 6 | 3 | <0.01 | 0.29 | 0.58 | | |
| 07/17/00 | 1140 | 16.84 | 7.59 | 200 | 180.00 | 0.0101 | 0.1140 | 119 | 15 | 0.02 | 0.15 | 0.63 | | |
| 08/22/00 | 1130 | 15.7 | 8.16 | 274 | 5.0 | 0.0038 | 0.0130 | 2 | <1 | <0.01 | 0.14 | 0.24 | | |
| 10/11/00 | 1100 | | 7.93 | 537 | 0.3 | 0.0157 | 0.0232 | 1 | <1 | <0.01 | 0.26 | 0.34 | | |
| 12/07/00 | | | | | | | | | | | | | | |
| 02/05/01 | | | | | | | | | | | | | | |
| 04/03/01 | 1229 | 6.0 | 7.64 | 307 | 1 | 0.0027 | 1/0/1900 | | | | | | | |
| 05/09/01 | | | | | | | | | | | | | | |
| 06/14/01 | | | | | | | | | | | | | | |
| 07/16/01 | | | | | | | | | | | | | | |
| 08/21/01 | | | | | | | | | | | | | | |
| 10/10/01 | 1200 | 5.7 | 7.70 | 633 | 1.7 | <0.0025 | 0.0065 | 2 | 2 | 0.01 | 0.20 | 0.28 | | |
| 12/6/2001* | | | | | | | | | | | | | | |
| | * sampling discontinued at this site | | | | | | | | | | | | | |
| 1994 Average | | | | | | | | | | | | | | |
| 1995 Average | | | | | | | | | | | | | | |
| 1996 Average | | | | | | | | | | | | | | |
| 1997 Average | | | | | | | | | | | | | | |
| 1998 Average | | | | | | | | | | | | | | |
| 1999 Average | | 12.0 | 7.59 | 205 | 11.80 | 0.0048 | 0.0255 | 12 | 3 | 0.02 | 0.18 | 0.37 | | |
| 2000 Average | | 10.3 | 7.73 | 377 | 30.40 | 0.0070 | 0.0311 | 21 | 3 | 0.01 | 0.26 | 0.46 | | |
| 2001 Average | | 5.8 | 7.67 | 470 | 1.35 | 0.0014 | 0.0087 | 2 | 2 | 0.01 | 0.20 | 0.28 | | |
| 1994-01 Period | | 10.2 | 7.67 | 329 | 19.61 | 0.0054 | 0.0259 | 16 | 3 | 0.02 | 0.23 | 0.41 | | |



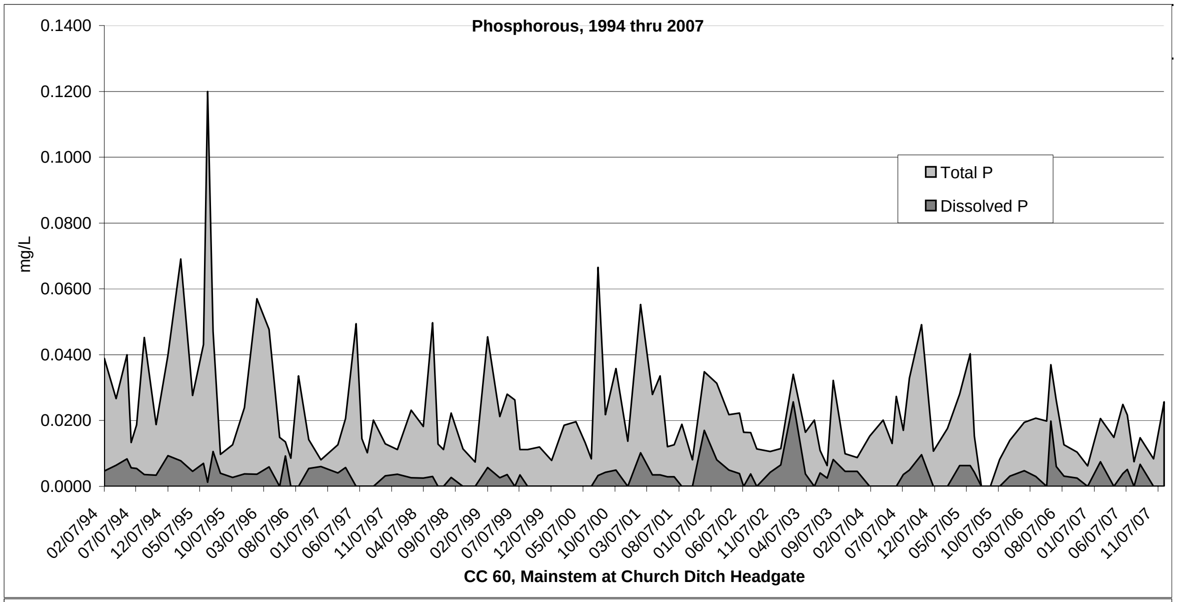
Phosphorous, 1994 thru 1999
Total P
Dissolved P
mg/L
CC 55, Mainstem below Beaver Brook & Soda Creek

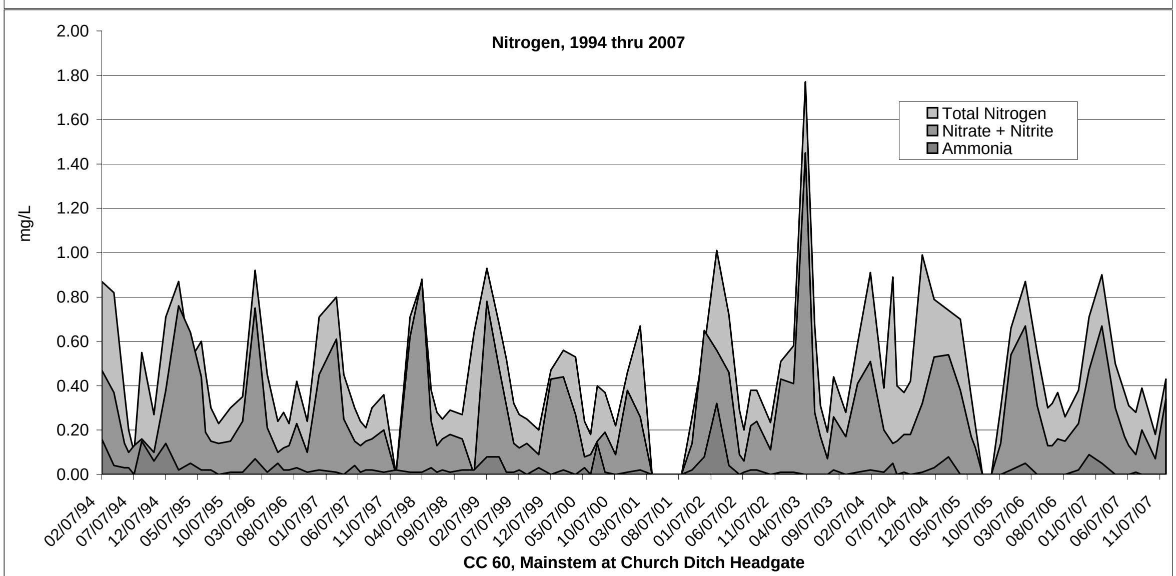



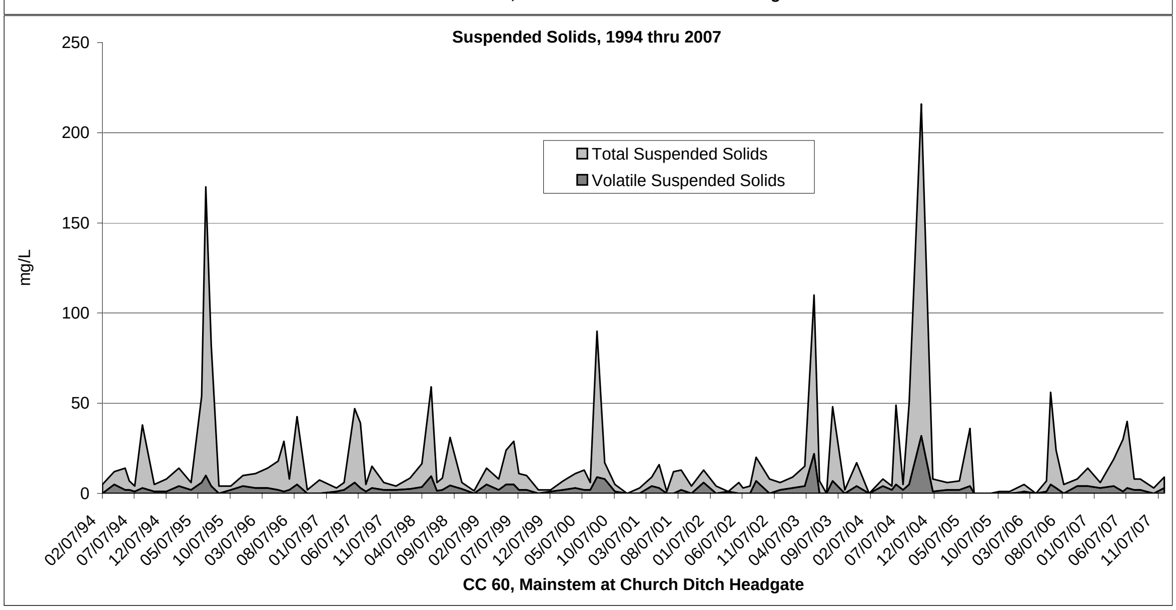
Nitrogen, 1994 thru 1999
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
CC 55, Mainstem below Beaver Brook & Soda Creek

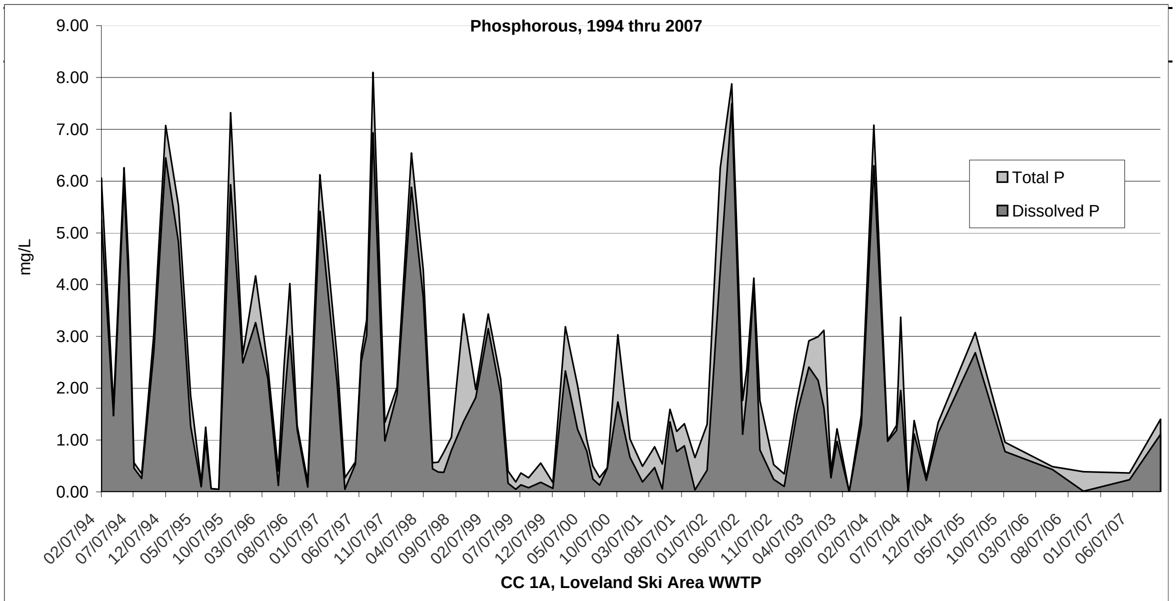



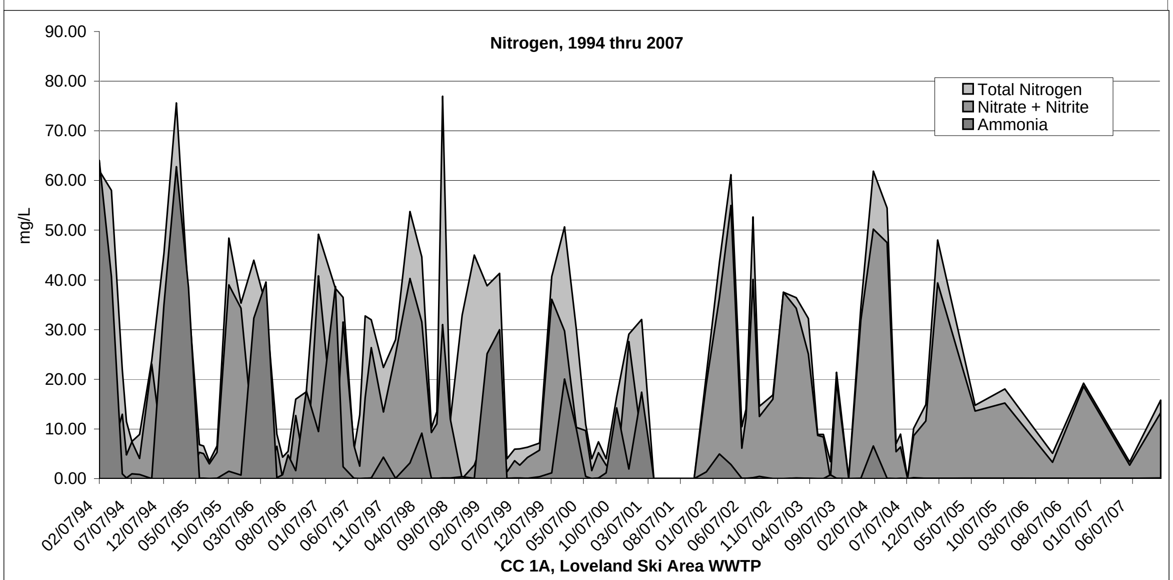
Suspended Solids, 1994 thru 1999
Total Suspended Solids
Volatile Suspended Solids
mg/L
CC 55, Mainstem below Beaver Brook & Soda Creek

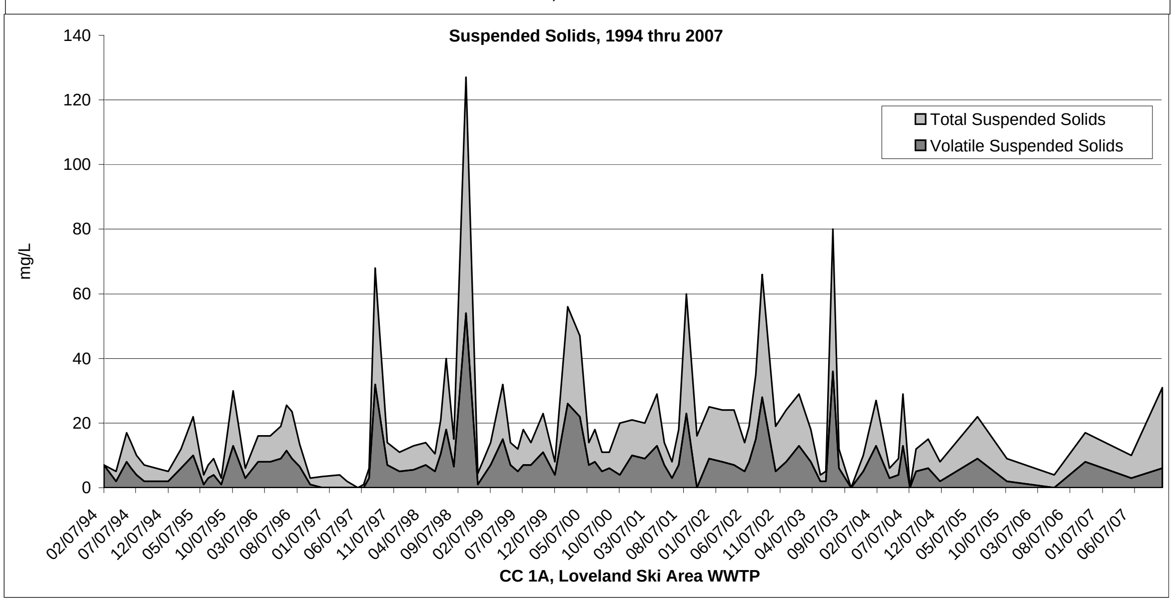

Phosphorous, 1994 thru 2007
mg/L
0.1400
0.1200
0.1000
0.0800
0.0600
0.0400
0.0200
0.0000
Total P
Dissolved P
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 60, Mainstem at Church Ditch Headgate

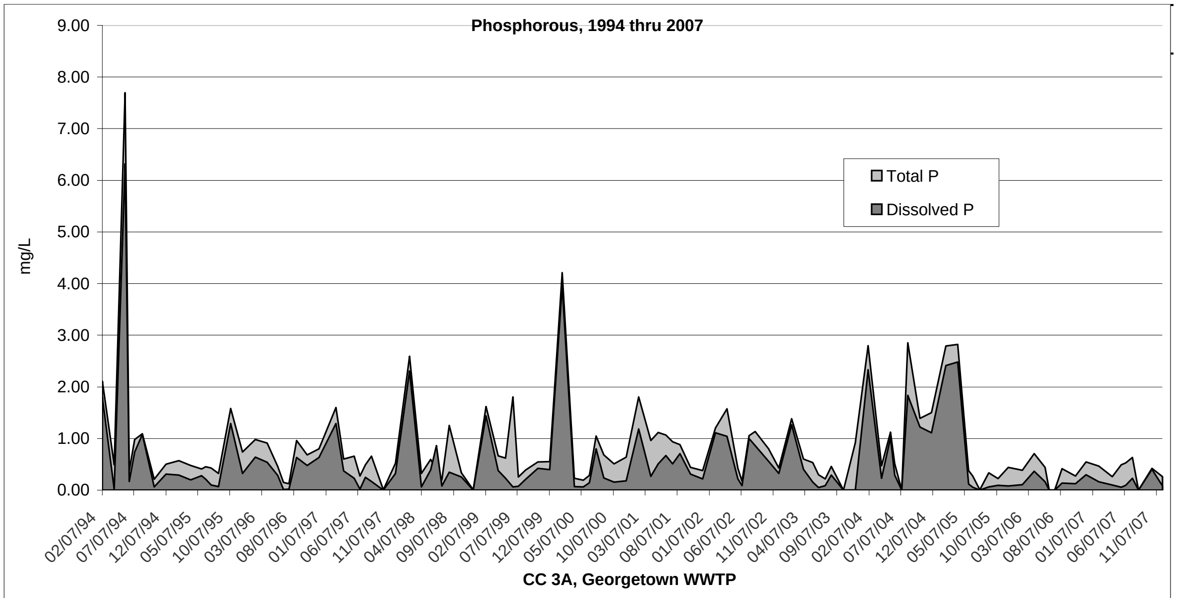

Nitrogen, 1994 thru 2007
mg/L
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Total Nitrogen
Nitrate + Nitrite
Ammonia
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 60, Mainstem at Church Ditch Headgate


Suspended Solids, 1994 thru 2007
mg/L
250
200
150
100
50
0
Total Suspended Solids
Volatile Suspended Solids
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 60, Mainstem at Church Ditch Headgate

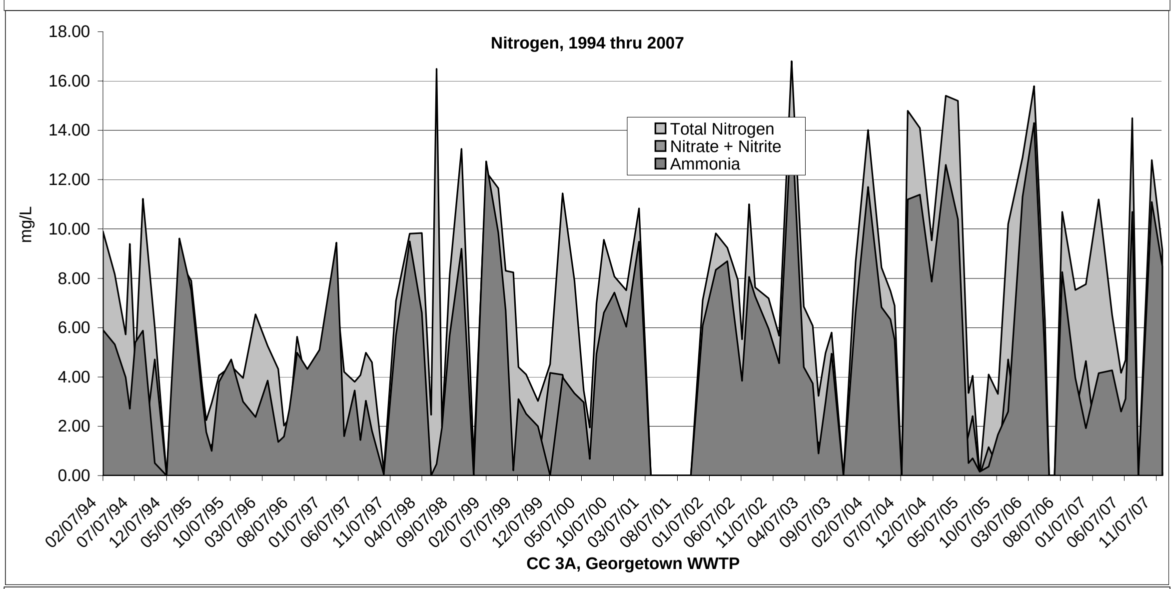

Phosphorous, 1994 thru 2007
mg/L
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Total P
Dissolved P
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 1A, Loveland Ski Area WWTP


Nitrogen, 1994 thru 2007
mg/L
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Total Nitrogen
Nitrate + Nitrite
Ammonia
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 1A, Loveland Ski Area WWTP

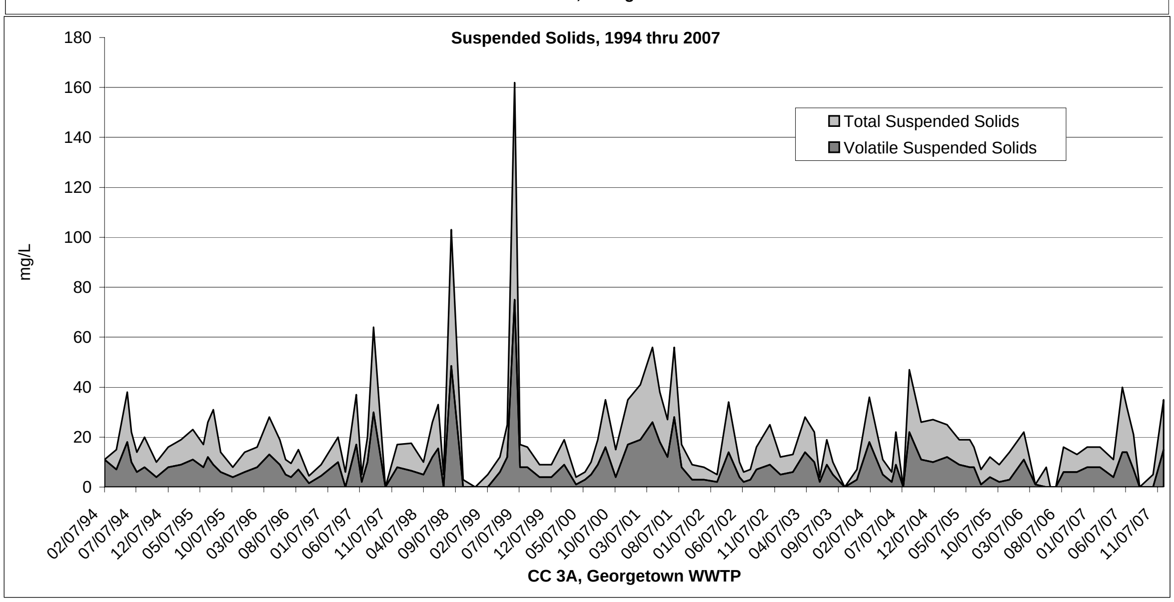

Suspended Solids, 1994 thru 2007
mg/L
140
120
100
80
60
40
20
0
Total Suspended Solids
Volatile Suspended Solids
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 1A, Loveland Ski Area WWTP



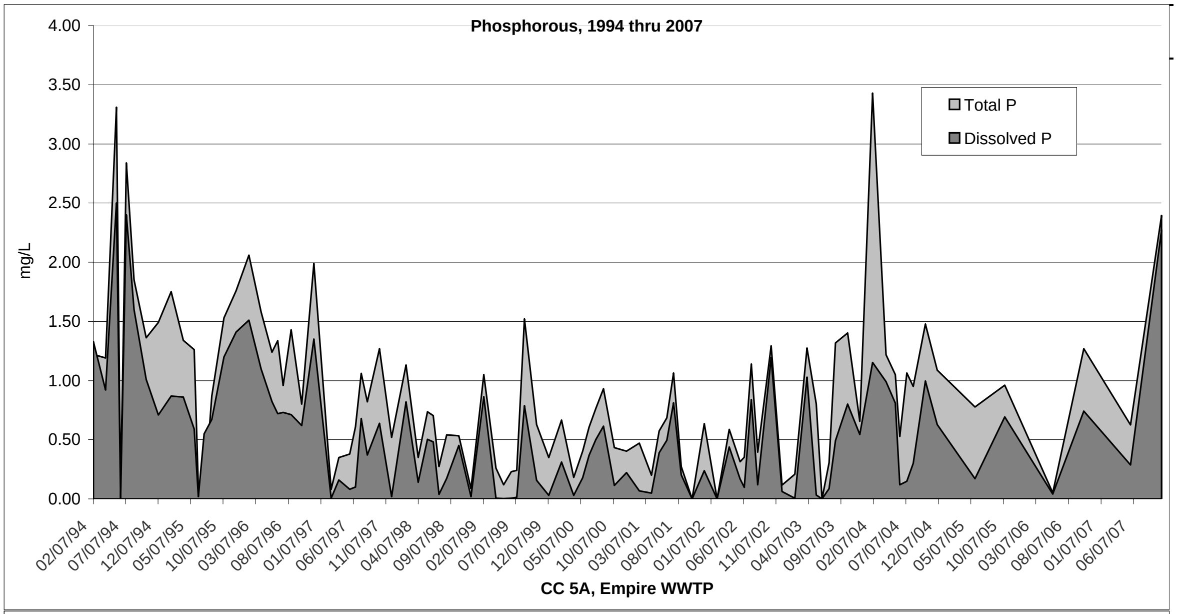
Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 3A, Georgetown WWTP

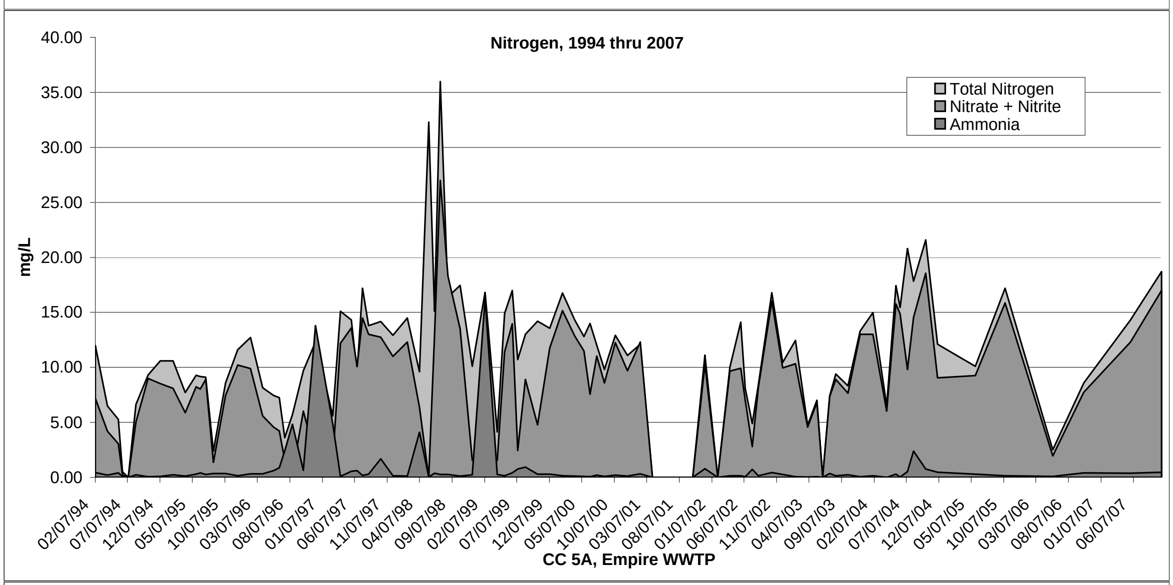
Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 3A, Georgetown WWTP

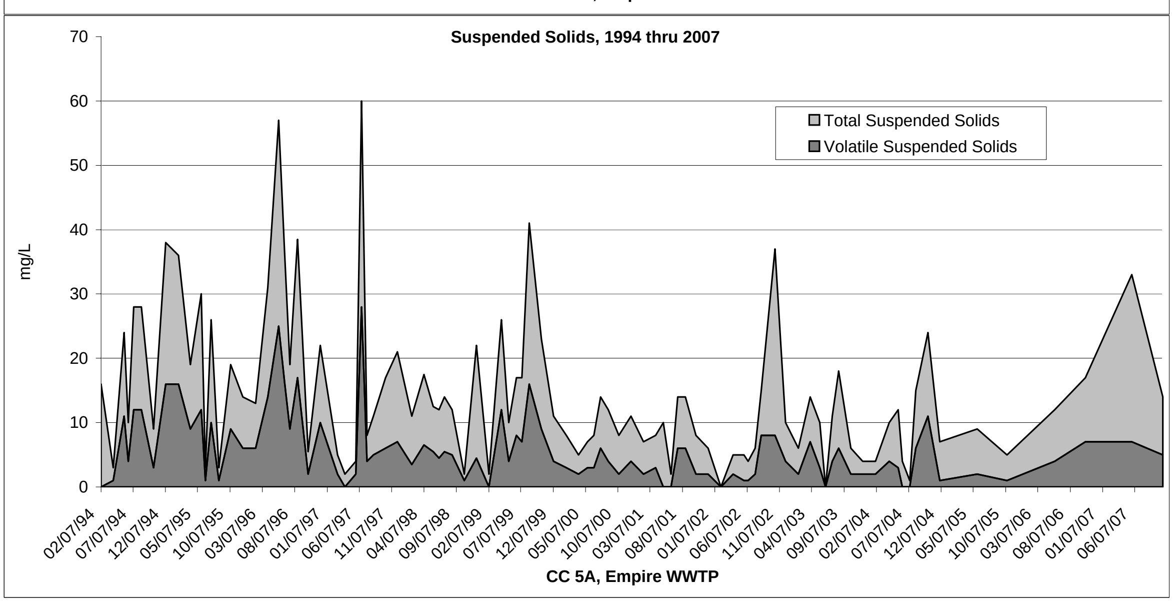
Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
180
160
140
120
100
80
60
40
20
0
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 3A, Georgetown WWTP



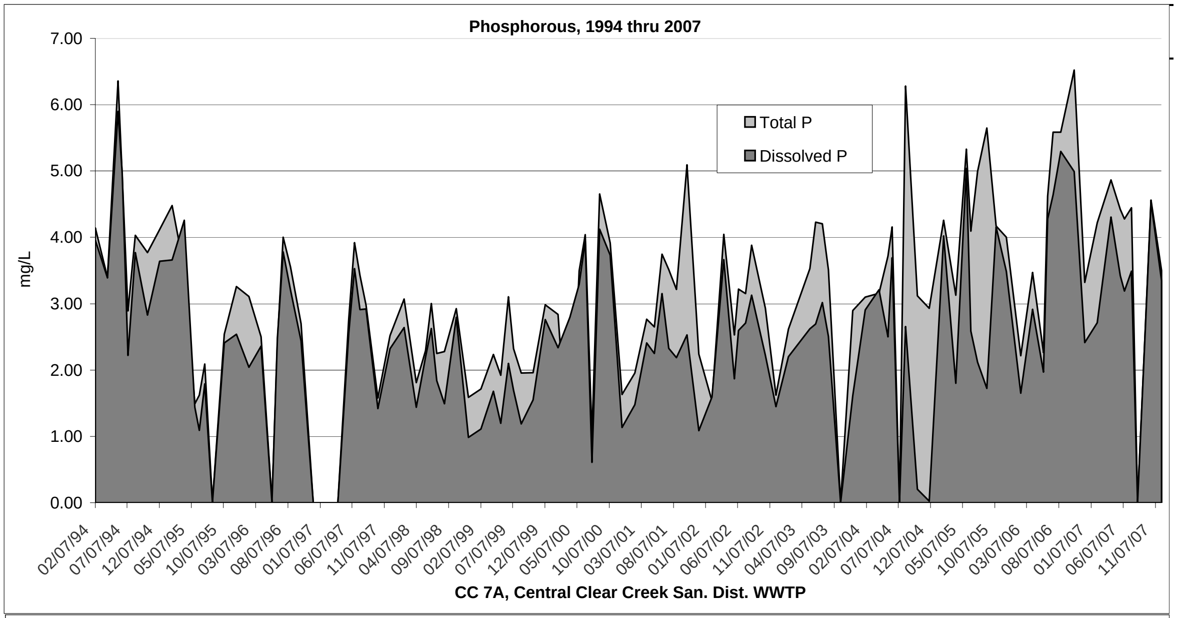
Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 5A, Empire WWTP

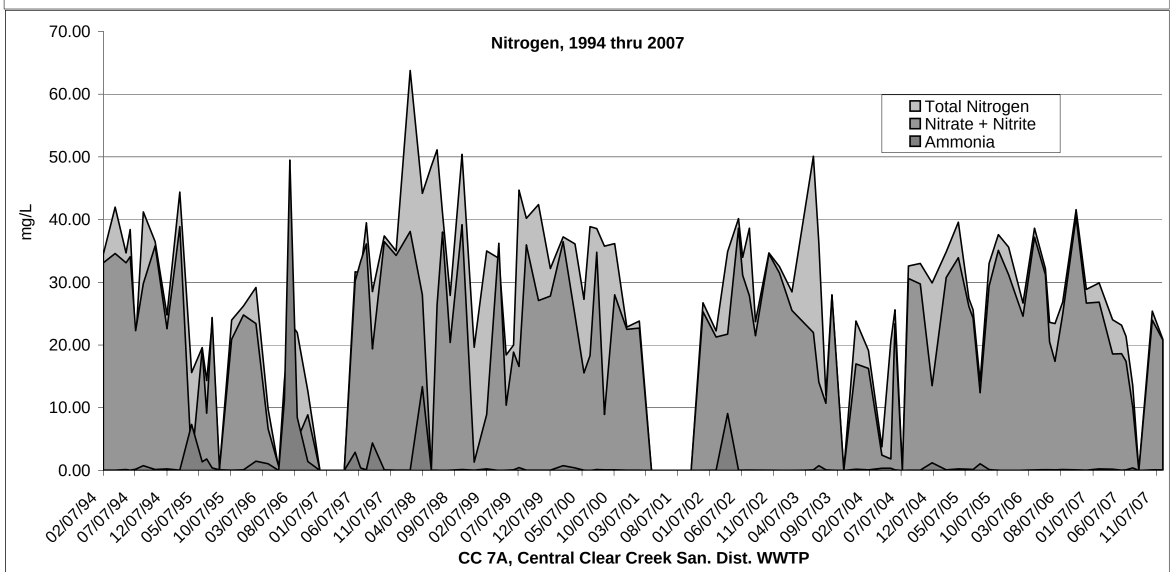



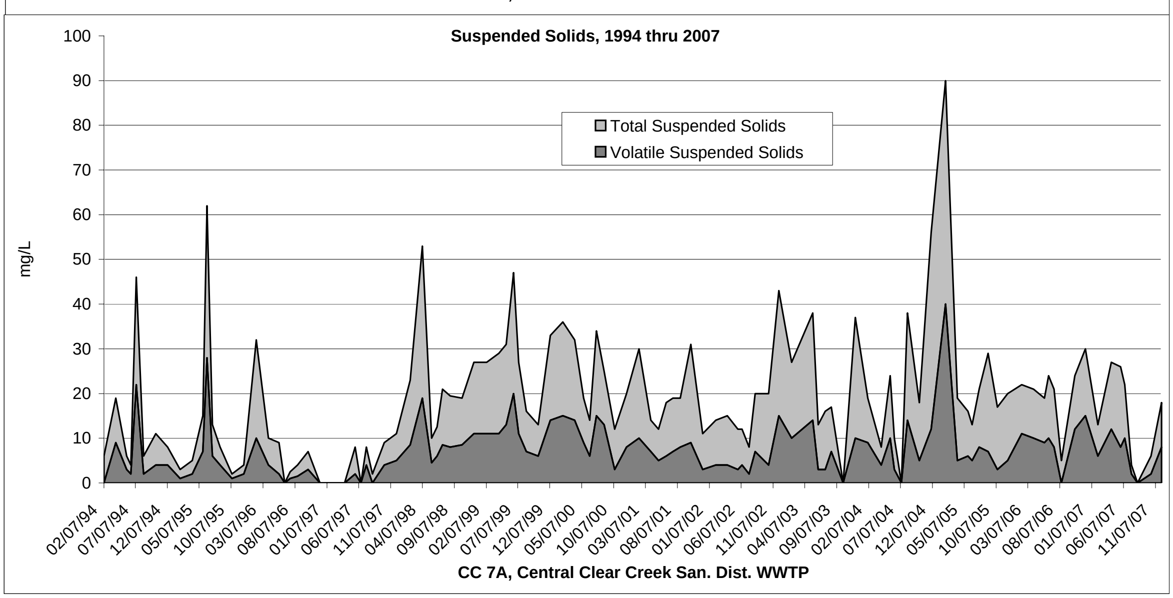
Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 5A, Empire WWTP

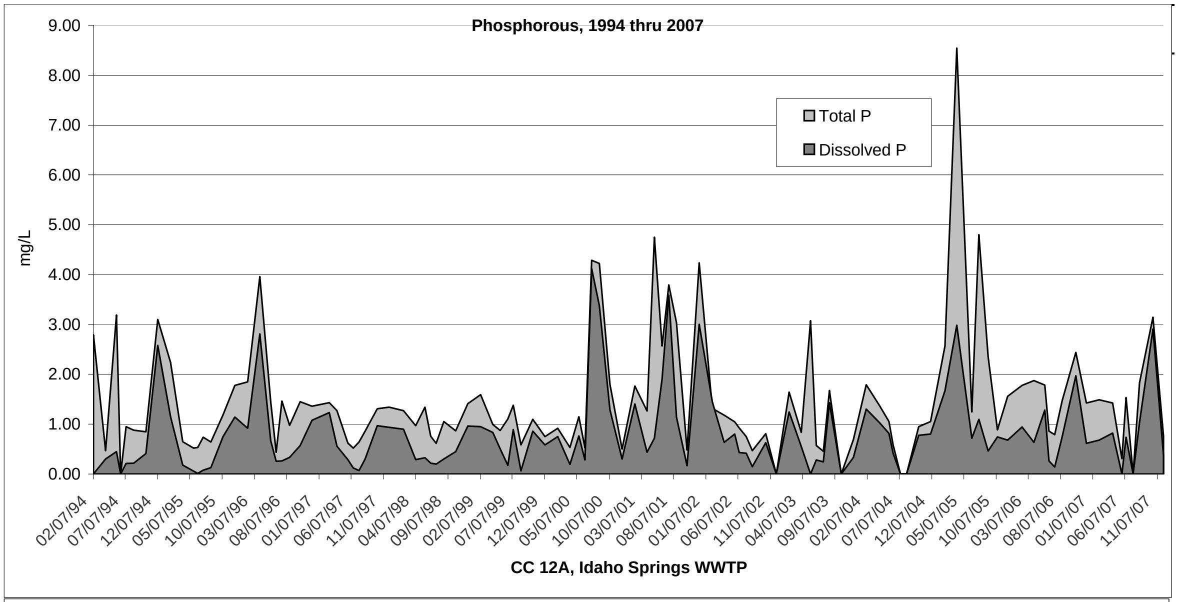



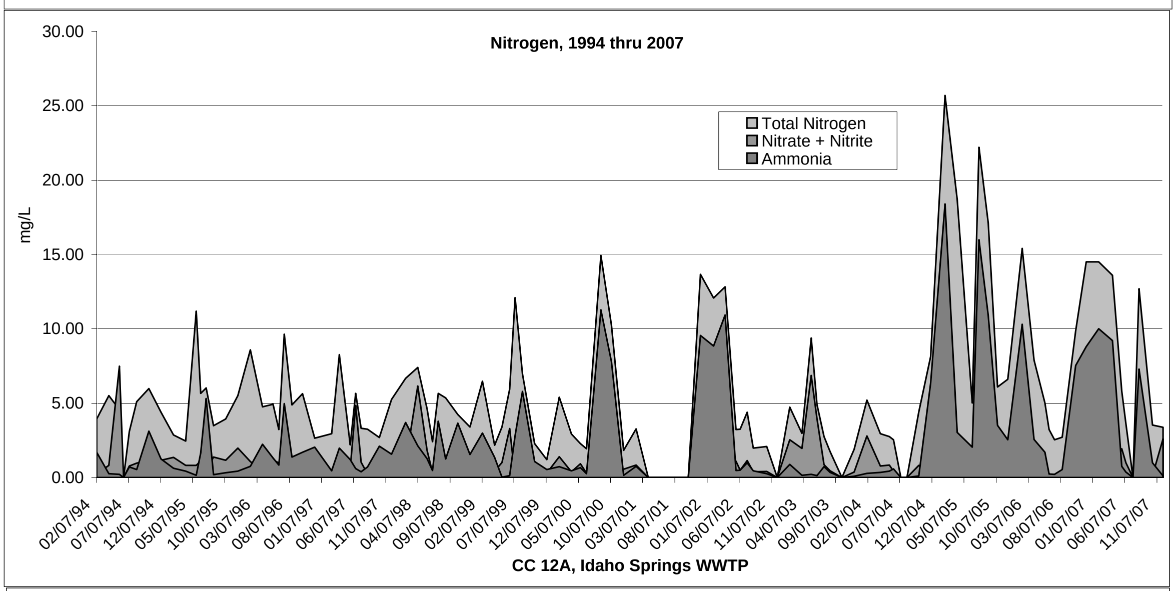
Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
70
60
50
40
30
20
10
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
CC 5A, Empire WWTP

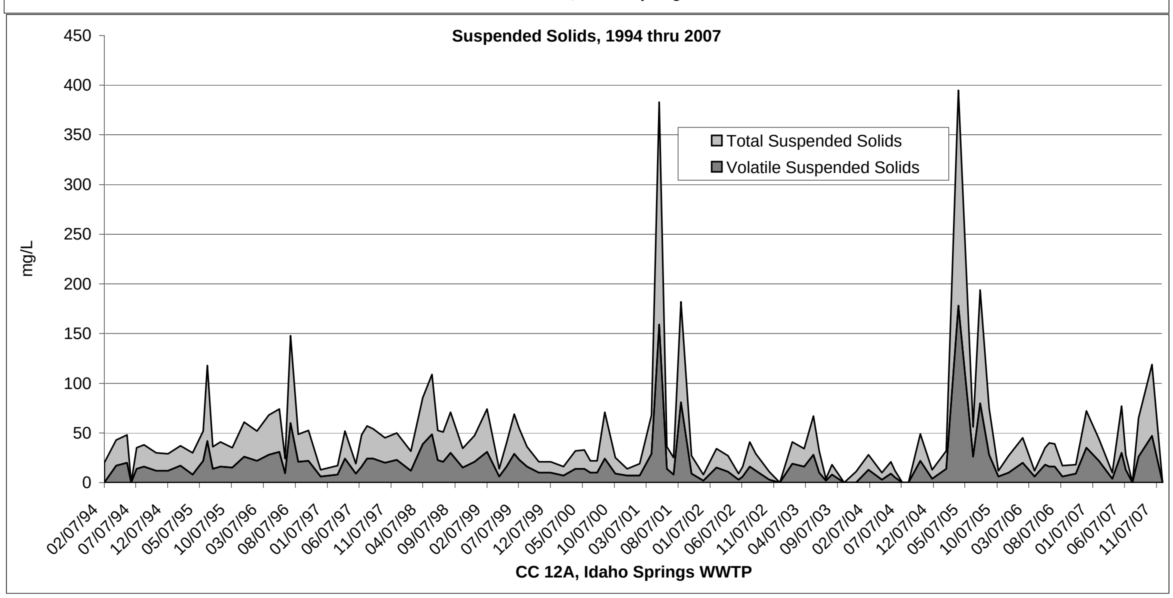

Phosphorous, 1994 thru 2007
mg/L
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Total P
Dissolved P
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 7A, Central Clear Creek San. Dist. WWTP

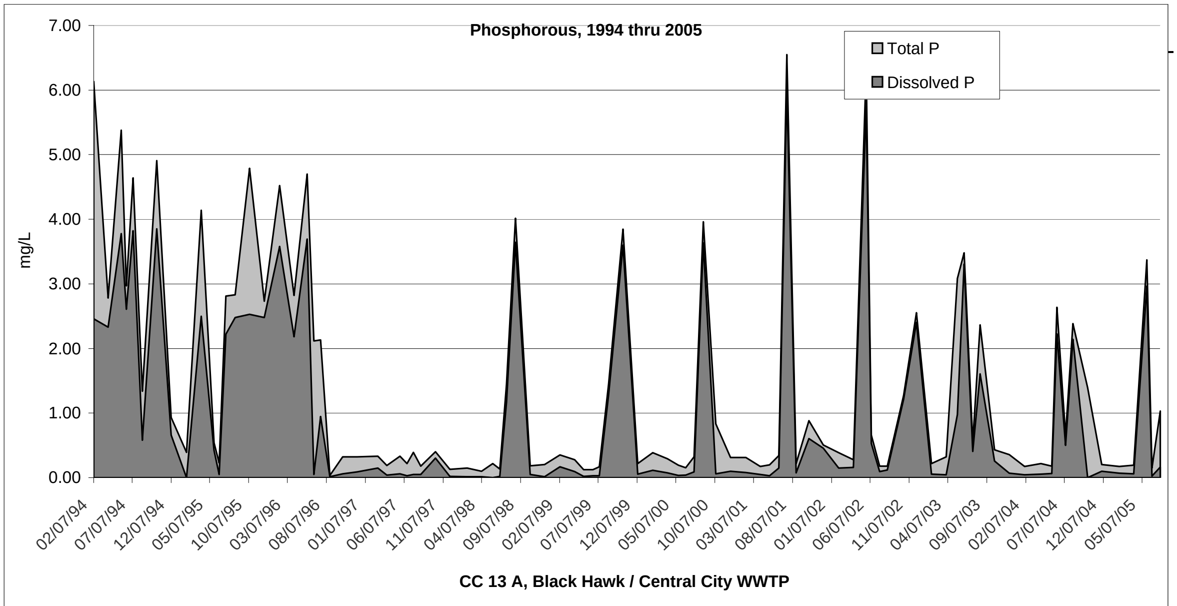

Nitrogen, 1994 thru 2007
mg/L
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Total Nitrogen
Nitrate + Nitrite
Ammonia
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 7A, Central Clear Creek San. Dist. WWTP

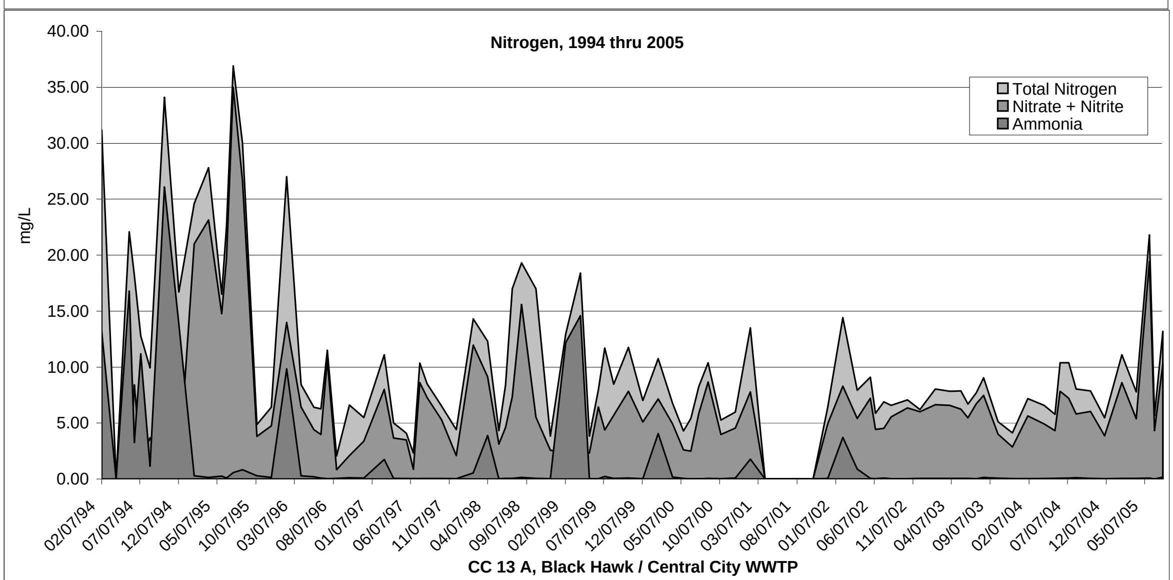

Suspended Solids, 1994 thru 2007
mg/L
100
90
80
70
60
50
40
30
20
10
0
Total Suspended Solids
Volatile Suspended Solids
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 7A, Central Clear Creek San. Dist. WWTP

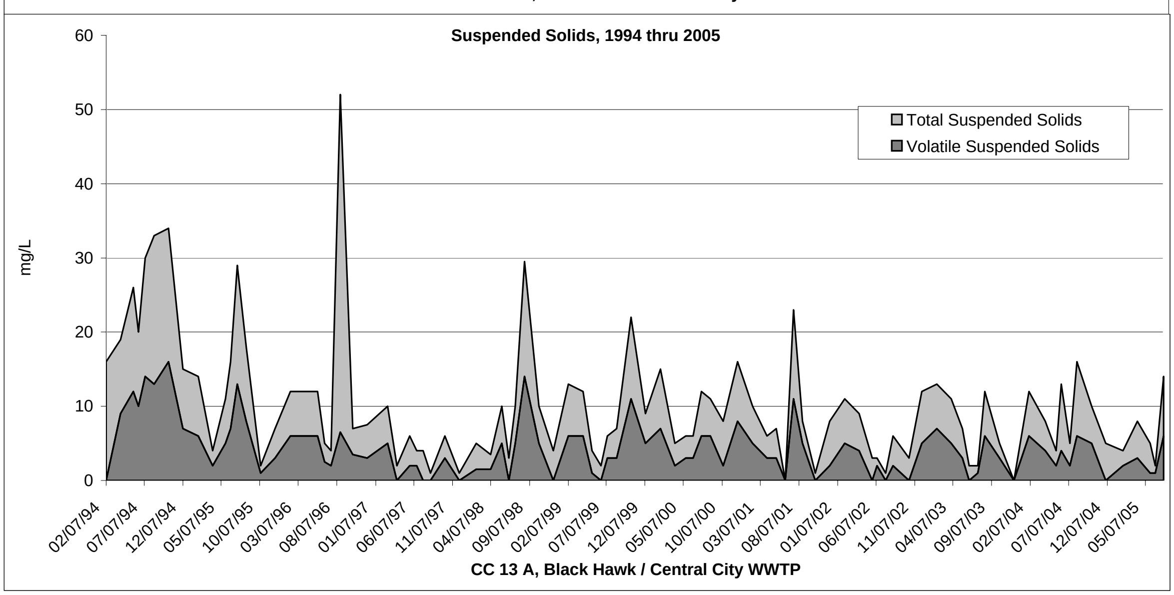

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC 12A, Idaho Springs WWTP

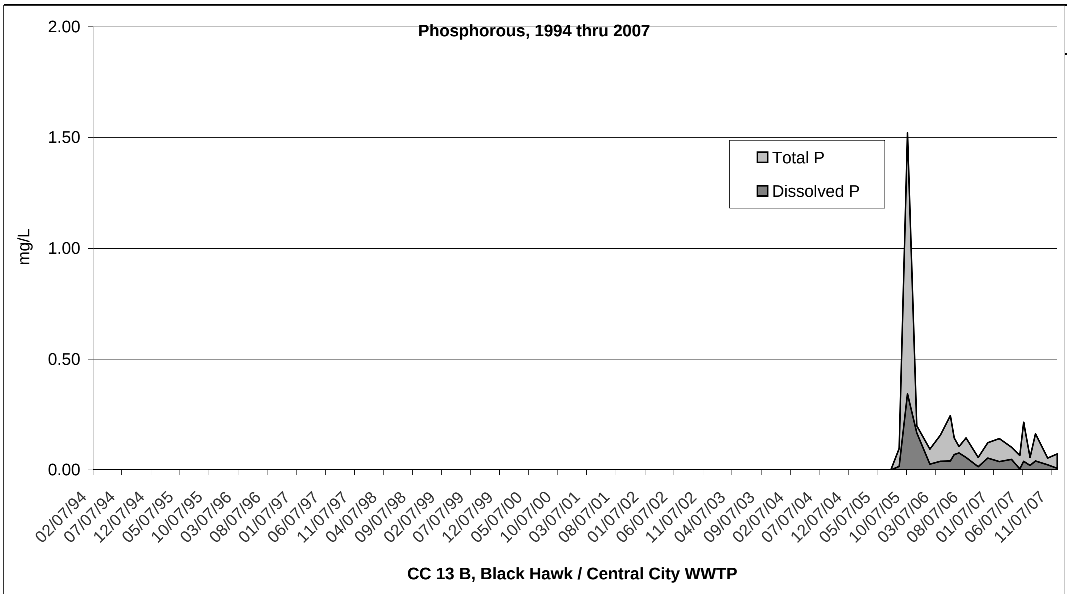

Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
30.00
25.00
20.00
15.00
10.00
5.00
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC 12A, Idaho Springs WWTP

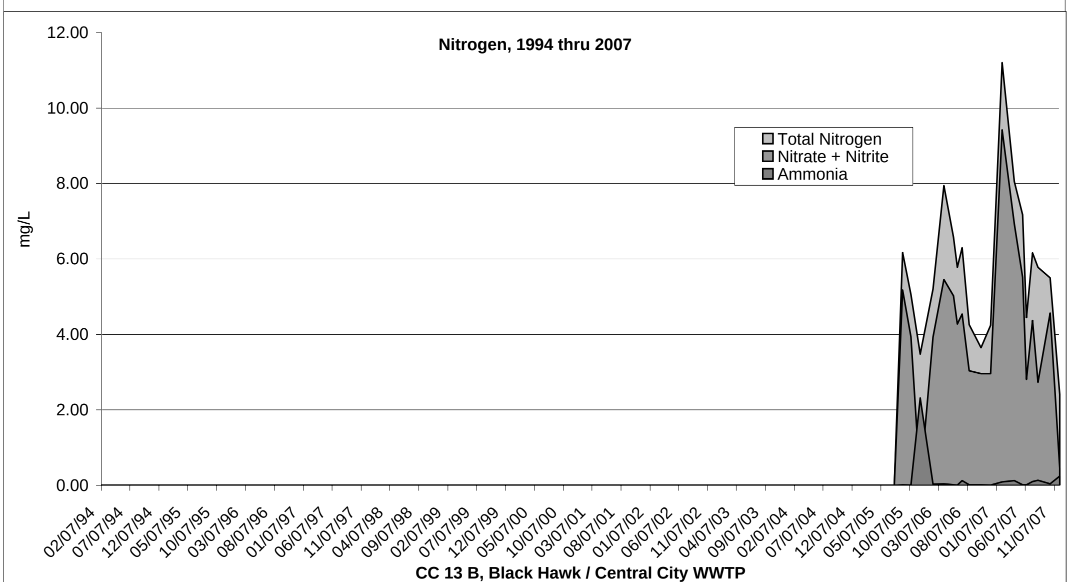

Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
450
400
350
300
250
200
150
100
50
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
10/07/05
03/07/06
08/07/06
01/07/07
06/07/07
11/07/07
CC 12A, Idaho Springs WWTP

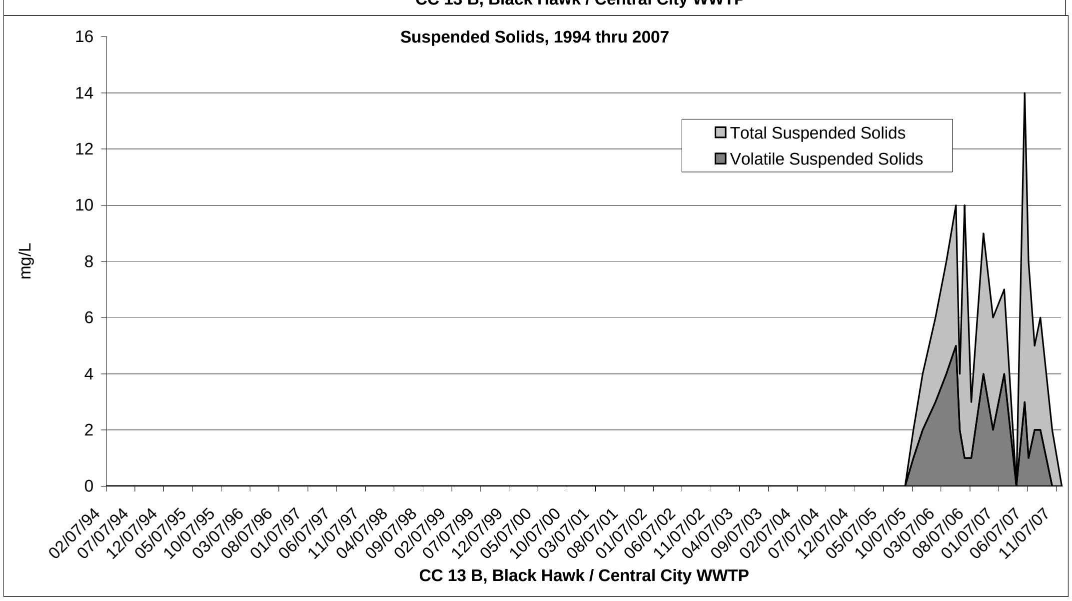

Phosphorous, 1994 thru 2005
Total P
Dissolved P
mg/L
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
CC 13 A, Black Hawk / Central City WWTP

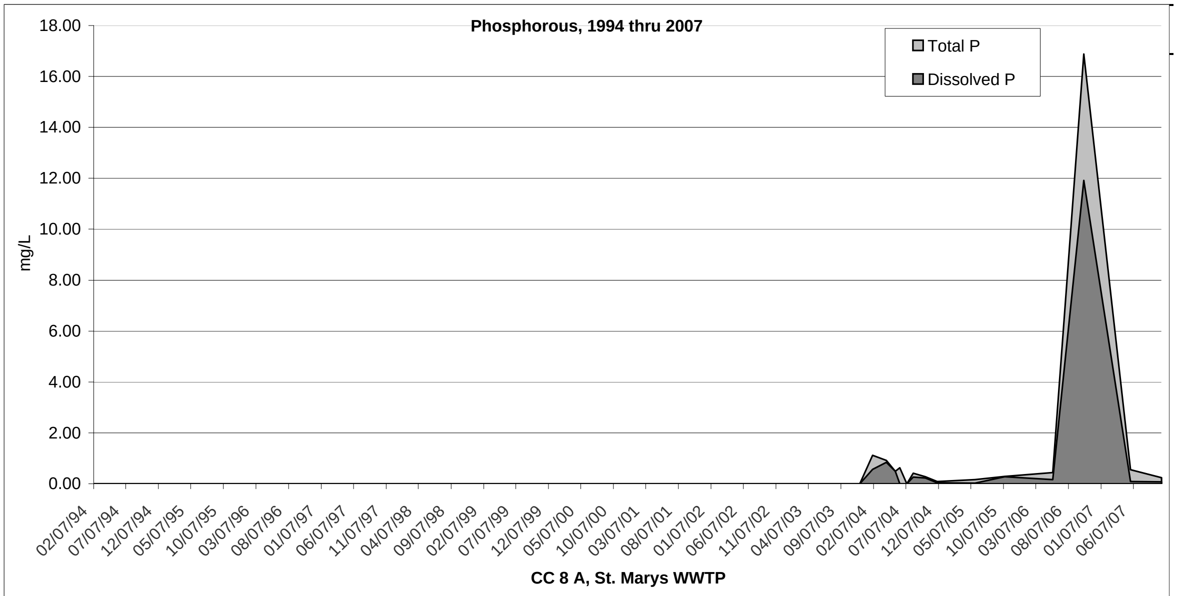

Nitrogen, 1994 thru 2005
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
CC 13 A, Black Hawk / Central City WWTP

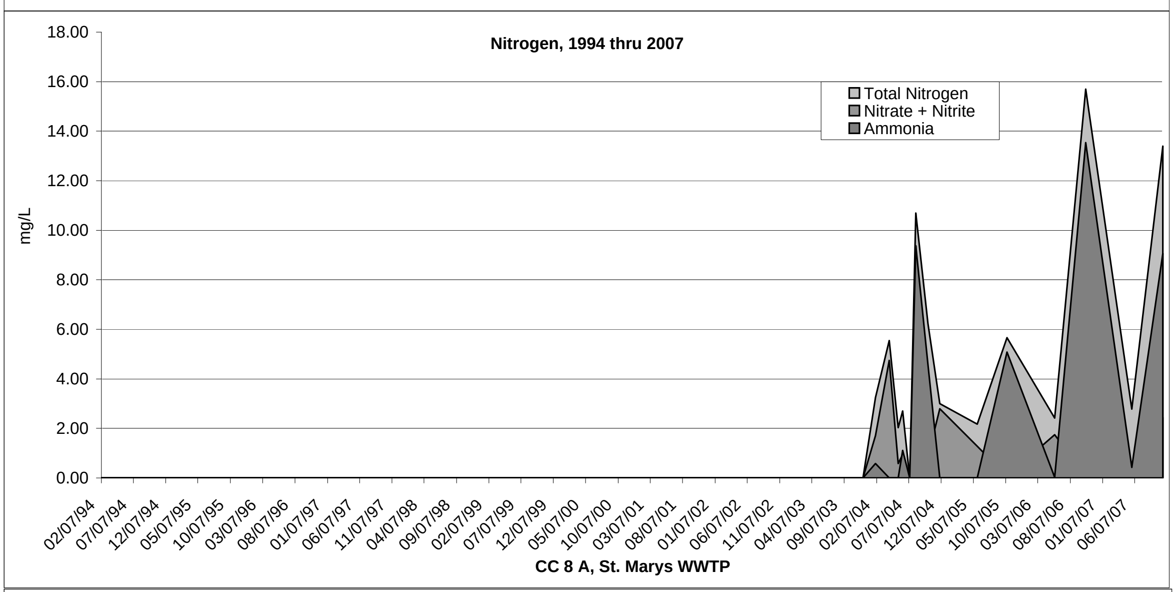

Suspended Solids, 1994 thru 2005
Total Suspended Solids
Volatile Suspended Solids
mg/L
60
50
40
30
20
10
0
02/07/94
07/07/94
12/07/94
05/07/95
10/07/95
03/07/96
08/07/96
01/07/97
06/07/97
11/07/97
04/07/98
09/07/98
02/07/99
07/07/99
12/07/99
05/07/00
10/07/00
03/07/01
08/07/01
01/07/02
06/07/02
11/07/02
04/07/03
09/07/03
02/07/04
07/07/04
12/07/04
05/07/05
CC 13 A, Black Hawk / Central City WWTP

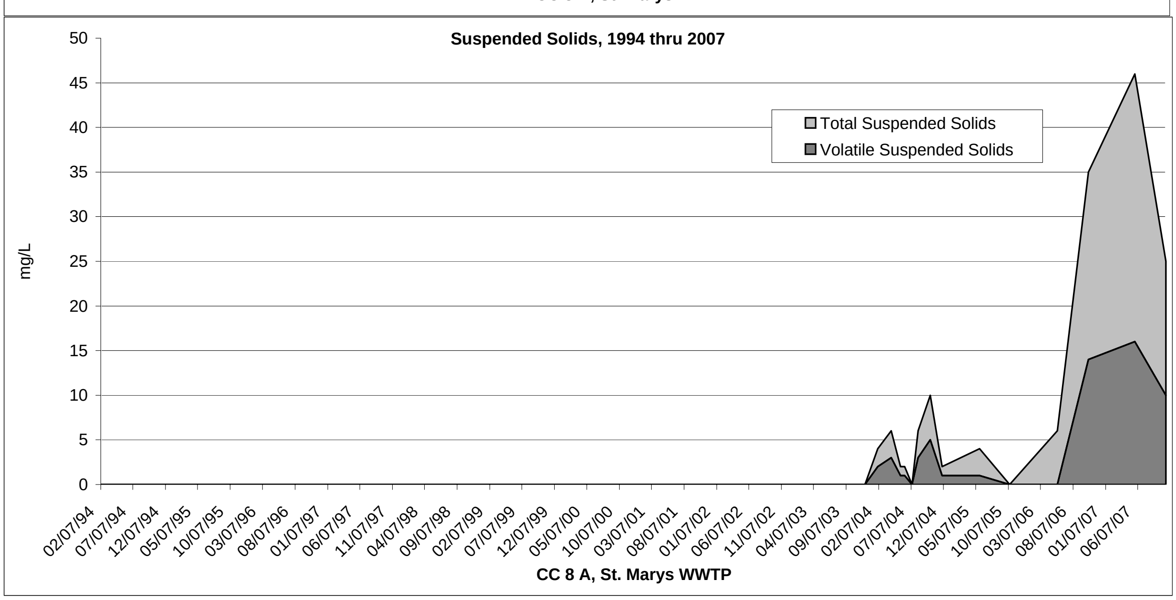

Phosphorous, 1994 thru 2007
mg/L
2.00
1.50
1.00
0.50
0.00
Total P
Dissolved P
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 13 B, Black Hawk / Central City WWTP

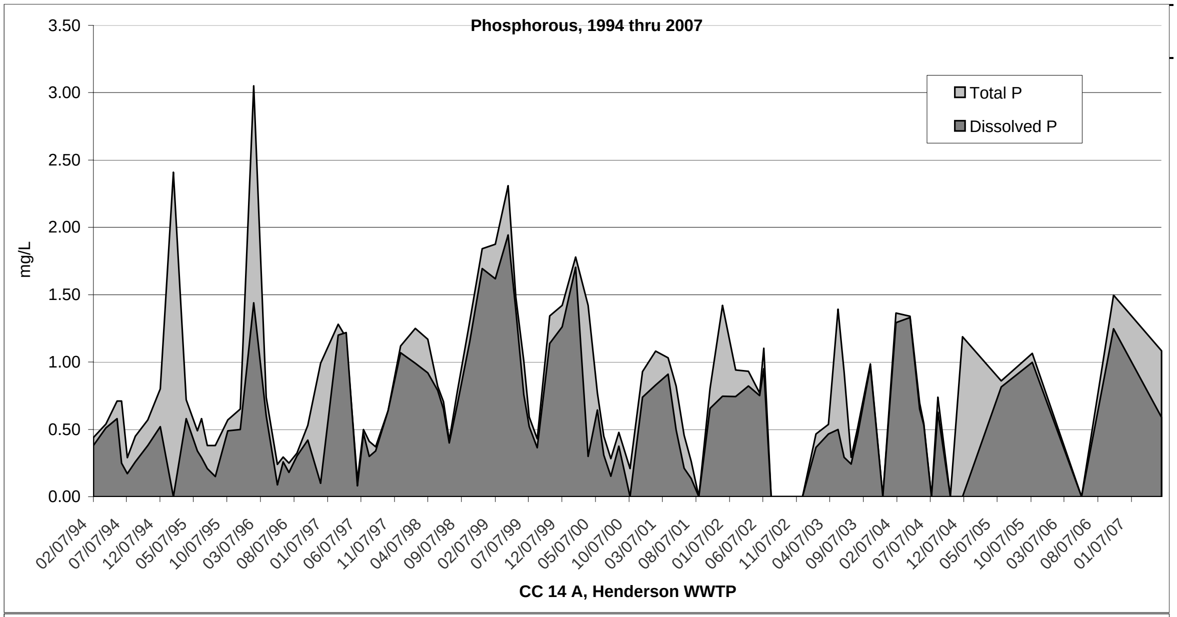

Nitrogen, 1994 thru 2007
mg/L
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Total Nitrogen
Nitrate + Nitrite
Ammonia
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 13 B, Black Hawk / Central City WWTP

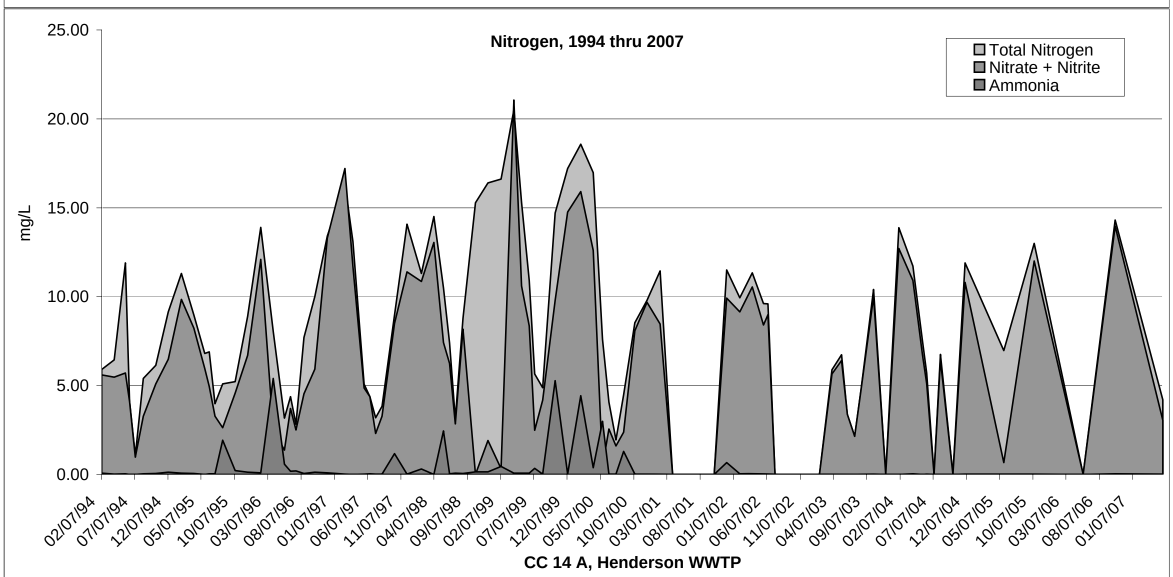

Suspended Solids, 1994 thru 2007
mg/L
16
14
12
10
8
6
4
2
0
Total Suspended Solids
Volatile Suspended Solids
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07 11/07/07
CC 13 B, Black Hawk / Central City WWTP

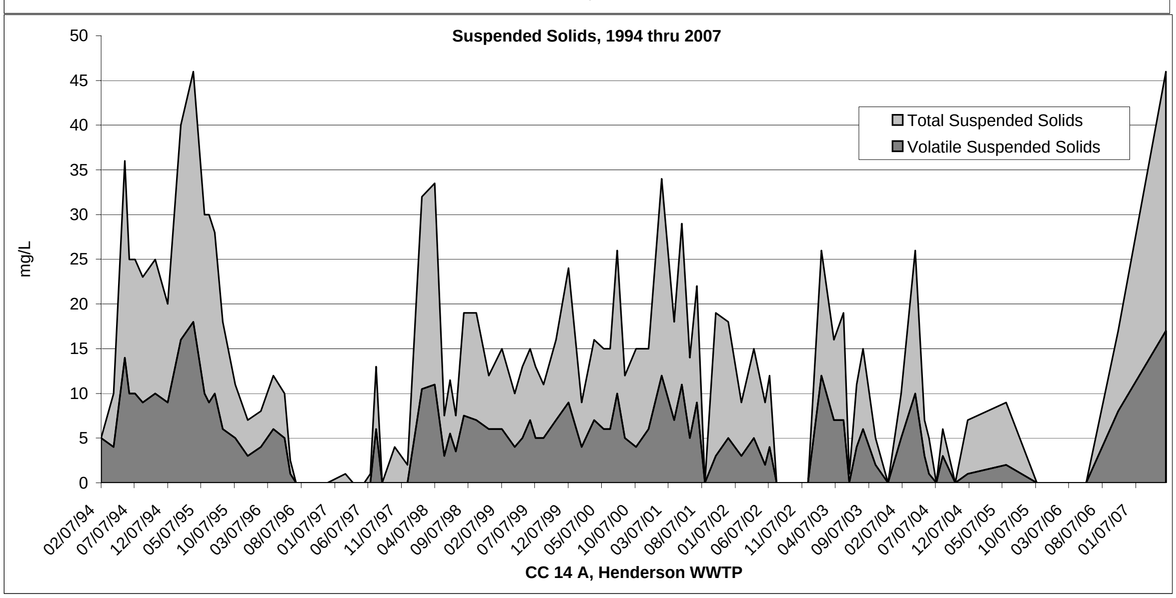

Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 8 A, St. Marys WWTP


Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 8 A, St. Marys WWTP


Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
50
45
40
35
30
25
20
15
10
5
0
02/07/94 07/07/94 12/07/94 05/07/95 10/07/95 03/07/96 08/07/96 01/07/97 06/07/97 11/07/97 04/07/98 09/07/98 02/07/99 07/07/99 12/07/99 05/07/00 10/07/00 03/07/01 08/07/01 01/07/02 06/07/02 11/07/02 04/07/03 09/07/03 02/07/04 07/07/04 12/07/04 05/07/05 10/07/05 03/07/06 08/07/06 01/07/07 06/07/07
CC 8 A, St. Marys WWTP


Phosphorous, 1994 thru 2007
Total P
Dissolved P
mg/L
CC 14 A, Henderson WWTP


Nitrogen, 1994 thru 2007
Total Nitrogen
Nitrate + Nitrite
Ammonia
mg/L
CC 14 A, Henderson WWTP


Suspended Solids, 1994 thru 2007
Total Suspended Solids
Volatile Suspended Solids
mg/L
CC 14 A, Henderson WWTP

## AVERAGE NUMBERS (USED FOR 1994)

**Dup (% RPD)**

| | Feb-94 | Apr-94 | May-94 | Jun-94 | Jul-94 | Aug-94 | Oct-94 | Dec-94 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | | | 9.42 | 15.87 | 61.42 | 11.24 | 4.14 | 19.78 |
| **Westminster - TN** | | | 25.88 | 4.26 | 19.35 | 46.15 | 51.16 | 4.26 |
| **Allowable Limit** | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |

**Spike (% recovery) off AVERAGE of duplicate & original**

| | Feb-94 | Apr-94 | May-94 | Jun-94 | Jul-94 | Aug-94 | Oct-94 | Dec-94 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | | | 81.04 | 91.98 | 94.41 | 97.79 | 93.86 | 124.43 |
| **Westminster - TN** | | | 91.09 | 110.13 | 78.85 | 36.06 | 123.68 | 107.14 |
| **ACZ - TP** | | | 45.24 | 98.30 | 90.52 | 107.92 | 87.72 | 0.00 |
| **ACZ - TN** | | | | | | 48.08 | 52.63 | 85.71 |
| **U. of Mo. - TP** | | | 99.14 | 100.48 | -86.79 | 98.81 | 93.33 | 90.91 |
| **U. of Mo. - TN** | | | 137.65 | 93.67 | 96.15 | 96.15 | 84.21 | 102.86 |
| **Lower Limit** | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 |
| **Upper Limit** | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 |

## AVERAGE NUMBERS (USED FOR 1995)

**Dup (% RPD)**

| | Feb-95 | Apr-95 | May-95 | Jun-95 | Jul-95 | Aug-95 | Oct-95 | Dec-95 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | 6.78 | 32.35 | 8.77 | 13.01 | n/a | 39.02 | n/a | 0.00 |
| **Westminster - TN** | 19.05 | 2.13 | 4.26 | 21.54 | 4.35 | 6.06 | 6.45 | 11.76 |
| **Allowable Limit** | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |

**Spike (% recovery) off AVERAGE of original & duplicate #s**

| | Feb-95 | Apr-95 | May-95 | Jun-95 | Jul-95 | Aug-95 | Oct-95 | Dec-95 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | 118.50 | 83.56 | 79.00 | 63.00 | 18.18 | 89.33 | 112.00 | 87.20 |
| **Westminster - TN** | 112.00 | 98.46 | 76.67 | 87.50 | 92.00 | 95.71 | -1.67 | 90.00 |
| **ACZ - TP** | 70.00 | n/a | 80.00 | n/a | n/a | n/a | 106.67 | 32.00 |
| **ACZ - TN** | 80.00 | 92.31 | -33.33 | 100.00 | 120.00 | 85.71 | n/a | 100.00 |
| **U. of Mo. - TP** | 40.00 | 80.00 | 86.67 | 40.00 | 50.91 | 80.00 | 106.67 | |
| **U. of Mo. - TN** | 92.00 | 52.31 | 133.33 | 85.00 | 92.00 | 94.29 | 0.00 | |
| **Lower Limit** | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 |
| **Upper Limit** | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 |

## AVERAGE NUMBERS (USED FOR 1996)

**Dup (% RPD)**

| | Feb-96 | Apr-96 | May-96 | Jun-96 | Jul-96 | Aug-96 | Oct-96 | Dec-96 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | n/a | 10.53 | 26.36 | 24.00 | n/a | 11.65 | 2.82 | 1.19* |
| **Westminster - TN** | 7.91 | 9.52 | 17.54 | 3.51 | n/a | 7.41 | 18.18 | 12.9* |
| **Allowable Limit** | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |

**Spike (% recovery) off AVERAGE of original & duplicate #s**

| | Feb-96 | Apr-96 | May-96 | Jun-96 | Jul-96 | Aug-96 | Oct-96 | Dec-96 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | 82.00 | 88.40 | 89.09 | 96.33 | 119.00 | 39.56 | 76.44 | 103.00 |
| **Westminster - TN** | 96.36 | 112.00 | 16.36 | 98.33 | 115.00 | 51.11 | 128.89 | 137.14 |
| **U. of Mo. - TP** | 90.00 | 96.00 | 94.55 | 93.33 | n/a | 44.44 | 80.00 | 166.00 |
| **U. of Mo. - TN** | 87.27 | 96.00 | 101.82 | 73.33 | n/a | 48.89 | 106.67 | 105.70 |
| **Lower Limit** | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 |
| **Upper Limit** | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 |

## QC Calcs. Result Calculations Page - AVERAGE NUMBERS (USED FOR 1997)

**Dup (% RPD)**

| | Feb-97 | Apr-97 | May-97 | Jun-97 | Jul-97 | Aug-97 | Oct-97 | Dec-97 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | 1.66 | 4.65 | 36.47 | 8.92 | 0.00 | 4.72 | 5.56 | 25.81 |
| **Westminster - TN** | 15.87 | 22.44 | 28.57 | 12.24 | 38.10 | 30.00 | 40.96 | 19.30 |
| **Allowable Limit** | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |

**Spike (% recovery) off AVERAGE of original & duplicate #s**

| | Feb-97 | Apr-97 | May-97 | Jun-97 | Jul-97 | Aug-97 | Oct-97 | Dec-97 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | 39.67 | 86.00 | 101.60 | 112.50 | 80.00 | 106.50 | 82.67 | 86.00 |
| **Westminster - TN** | 100.00 | 27.50 | 150.00 | 62.50 | 102.86 | 106.67 | 78.33 | 94.00 |
| **U. of Mo. - TP** | 93.33 | 80.00 | 24.00 | 110.00 | 71.11 | 90.00 | 86.60 | 90.00 |
| **U. of Mo. - TN** | 104.00 | 30.00 | 100.00 | 105.00 | 85.71 | 80.00 | 100.00 | 104.00 |
| **Lower Limit** | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 |
| **Upper Limit** | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 |

## AVERAGE NUMBERS (USED FOR 1998)

**Dup (% RPD)**

| | Feb-98 | Apr-98 | May-98 | Jun-98 | Jul-98 | Aug-98 | Oct-98 | Dec-98 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | 0.00 | 11.68 | 22.45 | 7.26 | 17.61 | 1.57 | 4.03 | 5.33 |
| **Westminster - TN** | 3.03 | 13.33 | 5.26 | 11.32 | 20.69 | 22.22 | 14.29 | 4.16 |
| **Allowable Limit** | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |

**Spike (% recovery) off AVERAGE of original & duplicate #s**

| | Feb-98 | Apr-98 | May-98 | Jun-98 | Jul-98 | Aug-98 | Oct-98 | Dec-98 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | 81.45 | 98.00 | 77.33 | 91.33 | 82.50 | 82.80 | 87.56 | 61.33 |
| **Westminster - TN** | 107.27 | 76.00 | 80.00 | 135.00 | 80.00 | 100.00 | 91.43 | 51.43 |
| **U. of Mo. - TP** | 90.90 | 60.00 | 88.89 | 80.00 | 80.00 | 88.00 | 106.67 | 62.22 |
| **U. of Mo. - TN** | 76.36 | 100.00 | 85.71 | 66.67 | 85.00 | 96.00 | 91.43 | 80.00 |
| **Lower Limit** | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 |
| **Upper Limit** | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 |

## AVERAGE NUMBERS (USED FOR 1999)

**Dup (% RPD)**

| | Feb-99 | Apr-99 | May-99 | Jun-99 | Jul-99 | Aug-99 | Oct-99 | Dec-99 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | | 34.78% | 15.93% | 7.09% | 3.81% | 13.33% | 13.79% | 3.88% |
| **Westminster - TN** | 3.13% | 2.01% | 2.15% | 3.17% | 12.50% | 8.80% | 5.31% | 0.00% |
| **Allowable Limit** | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 | 25.00 |

**Spike (% recovery) off AVERAGE of original & duplicate #s**

| | Feb-99 | Apr-99 | May-99 | Jun-99 | Jul-99 | Aug-99 | Oct-99 | Dec-99 |
|---|---|---|---|---|---|---|---|---|
| **Northglenn - TP** | | 90.67% | 76.00% | 64.80% | 83.56% | 75.00% | 93.33% | 165.20% |
| **Westminster - TN** | 86.67% | 107.50% | 94.00% | 102.00% | 91.43% | 101.14% | 91.67% | 84.00% |
| **U. of Mo. - TP** | 93.33% | 97.78% | 70.00% | 152.00% | 71.11% | 100.00% | 80.00% | |
| **U. of Mo. - TN** | 86.67% | 110.00% | 96.00% | 88.00% | | 102.86% | 90.00% | |
| **Lower Limit** | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | |
| **Upper Limit** | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | 120.00 | |

| Date | NH3 (mg/L) as N | NO3+NO2 (mg/L) as N | TN (mg/L) as N | TKN (mg/L) as N | Secchi (feet) | Algae Count | Chlorophyll (ug/L uncorrected | Diss. P (ug/L) | TP (ug/L) | TSS (mg/L) | TVS (mg/L) | Cl- (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

10-70 10 feet from bottom near dam

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/18/1994 | 0.03 | 0.19 | 0.34 | 0.10 | | | | | 10.7 | | | |
| 3/28/1994 | 0.01 | 0.14 | 0.35 | 0.18 | | | | 12.6 | 17.0 | 8 | 2 | |
| 4/12/1994 | 0.01 | 0.05 | 0.54 | 0.44 | | | | 8.1 | 23.0 | 3 | <1 | |
| 4/28/1994 | 0.08 | 0.08 | 0.44 | 0.21 | | | | 11.7 | 30.8 | 4 | 1 | |
| 5/9/1994 | 0.08 | 0.07 | 0.47 | 0.28 | | | | | 30.1 | 10 | 2 | |
| 5/23/1994 | 0.02 | 0.02 | 0.29 | 0.17 | | | | 12.5 | 15.6 | | | |
| 6/6/1994 | 0.10 | 0.05 | 0.33 | 0.36 | | | | 0.0 | 15.0 | 4 | <1 | 14.3 |
| 6/20/1994 | 0.12 | 0.10 | 0.28 | 0.28 | | | | | 18.4 | 3 | 1 | 5.1 |
| 7/11/1994 | 0.02 | 0.21 | 0.30 | <0.1 | | | | 10.6 | | 20 | 4 | 8.6 |
| 7/25/1994 | 0.07 | 0.22 | 0.46 | 0.16 | | | | 5.4 | | 18 | 6 | 9.1 |
| 8/9/1994 | 0.10 | 0.22 | 0.52 | 0.10 | | | | 10.9 | | 24 | 2 | 10.2 |
| 8/22/1994 | 0.14 | 0.17 | 0.50 | 0.12 | | | | 7.8 | 34.1 | 9 | 1 | 12.2 |
| 9/12/1994 | 0.23 | 0.03 | 0.41 | 0.32 | | | | 8.0 | 21.5 | 18 | 3 | 4.2 |
| 9/29/1994 | 0.03 | 0.05 | 0.23 | 0.26 | | | | 14.3 | | 15 | 2 | 6.3 |
| 10/18/1994 | 0.02 | 0.01 | 0.30 | 0.19 | | | | 5.6 | 43.4 | 8 | 2 | 12.8 |
| 10/31/1994 | <0.01 | 0.03 | 0.17 | 0.11 | | | | 5.5 | 25.9 | 4 | 1 | 7.9 |
| 10/31/1994 | 0.05 | 0.06 | 0.21 | 0.13 | | | | 6.7 | 41.1 | | | 6.0 |
| 11/28/1994 | 0.03 | 0.04 | 0.21 | 0.26 | | | | 5.5 | 19.6 | 7 | 2 | 10.4 |
| 3/9/1995 | 0.04 | 0.06 | 0.2 | | | | | <2.5 | 16.6 | 4 | 2 | 12 |
| 3/29/1995 | 0.05 | 0.03 | 0.21 | | | | | <2.5 | 55.0 | 25 | 3 | |
| 4/13/1995 | 0.07 | 0.04 | 0.47 | | | | | <2.5 | 67.5 | 70 | 6 | 9 |
| 4/25/1995 | 0.05 | 0.05 | 0.26 | | | | | 6.5 | | 39 | 6 | 15 |
| 5/16/1995 | 0.07 | 0.10 | 0.34 | | | | | 5.8 | 49.1 | 10 | 3 | |
| 5/31/1995 | 0.07 | 0.26 | 0.52 | | | | | | 54.1 | 16 | 3 | 19 |
| 6/13/1995 | 0.09 | 0.27 | 0.59 | | | | | 11.3 | 23.8 | 7 | 2 | 16 |
| 6/26/1995 | 0.09 | 0.33 | 0.48 | | | | | 15.5 | 32.1 | 13 | 3 | 17 |
| 7/11/1995 | 0.02 | 0.42 | 0.69 | | | | | 9.2 | 21.0 | 14 | 2 | 14 |
| 7/24/1995 | 0.04 | 0.35 | 0.52 | | | | | 7.9 | 21.6 | 12 | 3 | 18 |
| 8/7/1995 | 0.02 | 0.36 | 0.64 | | | | | 5.8 | 64.3 | 90 | 9 | 20 |
| 8/22/1995 | 0.04 | 0.36 | 0.60 | | | | | 5.1 | 24.6 | 19 | 4 | 18 |
| 9/5/1995 | 0.02 | 0.36 | 0.58 | | | | | 8.8 | 35.3 | 23 | 6 | 8 |
| 9/18/1995 | 0.03 | 0.31 | 0.50 | | | | | 6.2 | <10 | 11 | 5 | 8 |
| 10/2/1995 | 0.02 | 0.13 | 0.31 | | | | | 3.3 | 15.7 | 10 | 4 | |
| 10/24/1995 | 0.04 | 0.10 | 0.32 | | | | | 5.8 | 12.6 | 7 | 3 | 10 |
| 11/6/1995 | 0.02 | 0.13 | 0.30 | | | | | 5.3 | 9.2 | 3 | <1 | 13 |
| 11/20/1995 | 0.07 | 0.11 | 0.37 | | | | | 6.7 | 27.7 | 19 | 3 | 8 |
| 3/11/1996 | 0.02 | 0.14 | 0.32 | | | | | 3.1 | 8.3 | 5 | <1 | |
| 3/27/1996 | 0.04 | 0.14 | 0.31 | | | | | <2.5 | 7.5 | 4 | 1 | |
| 4/8/1996 | 0.03 | 0.16 | 0.34 | | | | | <2.5 | 12.2 | 6 | 1 | |
| 4/23/1996 | 0.04 | 0.16 | 0.32 | | | | | <2.5 | 8.8 | 8 | 2 | |
| 5/7/1996 | 0.07 | 0.08 | 0.28 | | | | | <2.5 | 12.6 | 6 | 2 | |
| 5/20/1996 | 0.03 | 0.07 | 0.22 | | | | | <2.5 | 9.7 | 4 | 2 | |
| 6/3/1996 | 0.06 | 0.1 | 0.36 | | | | | <2.5 | 13.7 | 3 | <1 | |
| 6/18/1996 | 0.16 | 0.12 | 0.37 | | | | | 4.3 | 16.8 | 8 | 3 | |
| 7/1/1996 | 0.02 | 0.23 | 0.40 | | | | | 7.2 | 23.9 | 11 | 2 | |
| 7/15/1996 | 0.03 | 0.25 | 0.44 | | | | | 3.8 | 14.2 | 12 | 2 | |
| 7/30/1996 | 0.05 | 0.30 | 0.59 | | | | | 6.9 | 7.6 | 19 | 3 | |
| 8/13/1996 | 0.02 | 0.21 | 0.40 | | | | | 9.0 | 10.7 | 14 | 2 | |
| 8/26/1996 | 0.06 | 0.18 | 0.36 | | | | | 11.0 | 18.7 | 15 | 2 | |
| 9/9/1996 | 0.09 | 0.12 | 0.29 | | | | | 10.0 | 37.8 | 6 | <1 | |
| 9/24/1996 | 0.02 | 0.01 | 0.23 | | | | | 7.8 | 25.2 | 6 | 2 | |
| 10/7/1996 | 0.06 | 0.10 | 0.25 | | | | | 16.4 | 58.5 | 31 | 3 | |
| 10/21/1996 | 0.02 | 0.01 | 0.43 | | | | | 8.0 | 40.4 | 58 | 6 | |
| 11/5/1996 | 0.03 | 0.01 | 0.18 | | | | | 7.7 | 10.0 | 3 | 2 | |
| 11/21/1996 | 0.05 | 0.02 | 0.21 | | | | | 6.7 | 14.6 | 1 | 1 | |
| 3/11/1997 | 0.04 | 0.08 | 0.3 | | | | | 2.6 | 10.7 | 5 | 2 | |
| 3/26/1997 | 0.04 | 0.09 | 0.54 | | | | | <2.5 | 27.9 | 24 | 3 | |
| 4/16/1997 | 0.03 | 0.09 | 0.39 | | | | | <2.5 | 23.8 | 14 | 3 | |
| 4/30/1997 | 0.03 | 0.07 | 0.38 | | | | | 4.8 | 47.8 | 44 | 4 | |
| 5/14/1997 | 0.08 | 0.09 | 0.34 | | | | | 4.7 | 19.1 | 10 | 3 | |
| 5/27/1997 | | | | | | | | 3.7 | 13.5 | 3 | <1 | |
| 6/12/1997 | 0.06 | 0.16 | 0.26 | | | | | 3.5 | 86.3 | 204 | 17 | |
| 6/24/1997 | 0.03 | 0.2 | 0.38 | | | | | 2.6 | 21.2 | 9 | 3 | |
| 7/8/1997 | 0.02 | 0.21 | 0.42 | | | | | 4 | 27.9 | 8 | 2 | |
| 7/22/1997 | 0.02 | 0.18 | 0.39 | | | | | 3.3 | 29.8 | 7 | 3 | |
| 8/5/1997 | 0.02 | 0.29 | 0.43 | | | | | 5.6 | 33.8 | 10 | 4 | |
| 8/19/1997 | 0.03 | 0.29 | 0.45 | | | | | <2.5 | 27.7 | 9 | 2 | |
| 9/2/1997 | 0.01 | 0.2 | 0.47 | | | | | 2.8 | 18 | 8 | 3 | |
| 9/18/1997 | 0.03 | 0.17 | 0.46 | | | | | | 16.6 | 11 | 3 | |
| 9/23/1997 | | | | | | | | | | | | |
| 9/30/1997 | 0.03 | 0.07 | 0.27 | | | | | <2.5 | 18.5 | 7 | 2 | |
| 10/14/1997 | 0.06 | 0.04 | 0.27 | | | | | 2.6 | 15.2 | 10 | 2 | |
| 10/28/1997 | 0.06 | 0.03 | 0.23 | | | | | 2.5 | 16.4 | 6 | 3 | |
| 11/13/1997 | 0.03 | 0.06 | 0.24 | | | | | 3.3 | 12.2 | 3 | 2 | |
| 11/24/1997 | 0.01 | 0.06 | 0.19 | | | | | 2.5 | 10.8 | 4 | 2 | |
| 3/10/1998 | 0.04 | 0.12 | 0.38 | | | | | 3.6 | 7.1 | 7 | 4 | |

| Date | NH3 (mg/L) as N | NO3+NO2 (mg/L) as N | TN (mg/L) as N | TKN (mg/L) as N | Secchi (feet) | Algae Count | Chlorophyll (ug/L uncorrected | Diss. P (ug/L) | TP (ug/L) | TSS (mg/L) | TVS (mg/L) | Cl- (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

10-70 10 feet from bottom near dam

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3/25/1998 | le | 0.13 | 0.41 | | | | | 3.7 | 23.5 | 28 | 7 | |
| 4/6/1998 | 0.07 | 0.31 | 0.56 | | | | | 6.7 | 13.5 | 9 | 2 | |
| 4/21/1998 | 0.06 | 0.18 | 0.64 | | | | | 3.2 | 14.6 | 8 | <1 | |
| 5/4/1998 | 0.02 | 0.18 | 0.4 | | | | | <2.5 | 11.3 | 5 | <1 | |
| 5/18/1998 | 0.06 | 0.21 | 0.32 | | | | | <2.5 | 11.3 | 7 | <1 | |
| 6/2/1998 | 0.06 | 0.2 | 0.4 | | | | | 3.6 | 11.7 | 5 | 1 | |
| 6/15/1998 | 0.03 | 0.17 | 0.25 | | | | | 3.1 | 17.6 | 7 | 3 | |
| 6/29/1998 | 0.05 | 0.18 | 0.38 | | | | | 5 | 21.2 | 11 | 5 | |
| 7/13/1998 | 0.01 | 0.26 | 0.58 | | | | | 8.1 | 36.1 | 15 | 5 | |
| 7/27/1998 | 0.01 | 0.3 | 0.57 | | | | | 8.3 | 26.7 | 13 | 3 | |
| 8/10/1998 | 0.03 | 0.26 | 0.45 | | | | | 6 | 26.1 | 13 | 3 | |
| 8/24/1998 | 0.04 | 0.23 | 0.61 | | | | | 4.5 | 21.6 | 11 | 4 | |
| 9/8/1998 | 0.19 | 0.17 | 0.63 | | | | | <2.5 | 8.1 | 3 | 2 | |
| 9/21/1998 | 0.17 | 0.13 | 0.43 | | | | | 9.4 | 26.3 | 7 | 2 | |
| 10/5/1998 | 0.1 | 0.06 | 0.3 | | | | | 3.7 | 19.6 | 12 | 4 | |
| 10/20/1998 | 0.09 | 0.07 | 0.36 | | | | | 3.6 | 25.9 | 13 | 2 | |
| 11/4/1998 | 0.04 | 0.06 | 0.31 | | | | | <2.5 | 13.5 | 8 | 2 | |
| 11/16/1998 | 0.03 | 0.02 | 0.37 | | | | | <2.5 | 14.3 | 7 | 3 | |
| 3/2/1999 | 0.0 | 0.1 | 0.2 | | | | | <2.5 | 7.0 | 3 | <1 | |
| 3/9/1999 | 0.0 | 0.1 | 0.4 | | | | | <2.5 | 7.7 | 3 | 2 | |
| 3/22/1999 | 0.1 | 0.1 | 0.4 | | | | | <2.5 | 7.7 | 1 | <1 | |
| 4/6/1999 | | | | | | | | <2.5 | 12.1 | 6 | 2 | |
| 4/21/1999 | | | | | | | | <2.5 | 11.4 | 7 | 3 | |
| 5/13/1999 | 0.0 | 0.2 | 0.3 | | | | | n/m | n/m | 7 | 2 | |
| 5/24/1999 | 0.0 | 0.2 | 0.4 | | | | | <2.5 | 19.8 | 9 | 1 | |
| 6/1/1999 | 0.0 | 0.2 | 0.4 | | | | | <2.5 | 15.0 | 9 | 2 | |
| 6/7/1999 | 0.0 | 0.2 | 0.4 | | | | | <2.5 | 15.8 | 9 | 3 | |
| 6/21/1999 | 0.0 | 0.2 | 0.4 | | | | | 2.5 | 14.3 | 5 | 2 | |
| 6/29/1999 | 0.1 | 0.3 | 0.6 | | | | | 4.2 | 21.0 | 9 | 3 | |
| 7/7/1999 | 0.0 | 0.2 | 0.4 | | | | | 3.9 | 17.7 | 9 | 3 | |
| 7/20/1999 | 0.0 | 0.2 | 0.4 | | | | | 3.4 | 13.5 | 16 | 2 | |
| 8/3/1999 | <0.01 | 0.3 | 0.5 | | | | | 3.7 | 24.9 | 10 | 4 | |
| 8/16/1999 | 0.1 | 0.3 | 0.5 | | | | | 4.8 | 29.4 | 11 | 3 | |
| 9/1/1999 | 0.0 | 0.2 | 0.4 | | | | | 2.7 | 18.6 | 10 | 5 | |
| 9/13/1999 | 0.0 | 0.2 | 0.5 | | | | | 2.8 | 21.9 | 17 | 3 | |
| 9/27/1999 | 0.1 | 0.1 | 0.3 | | | | | <2.5 | 14.1 | 5 | 1 | |
| 10/12/1999 | 0.0 | 0.0 | 0.3 | | | | | <2.5 | 10.8 | 6 | 2 | |
| 10/26/1999 | 0.1 | 0.1 | 0.2 | | | | | <2.5 | 17.6 | 8 | 3 | |
| 11/8/1999 | 0.0 | <0.01 | 0.2 | | | | | <2.5 | 17.5 | 8 | 1 | |
| 11/29/1999 | 0.0 | 0.1 | 0.3 | | | | | 2.6 | 17.7 | 7 | 3 | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1994 Avg | 0.07 | 0.10 | 0.35 | 0.22 | | | | 8.34 | 24.72 | 10 | 2 | |
| 1995 Avg | 0.05 | 0.21 | 0.44 | | | | | 7.37 | 33.14 | 22 | 4 | |
| 1996 Avg | 0.05 | 0.13 | 0.33 | | | | | 7.84 | 18.48 | 11 | 2 | |
| 1997 Avg | 0.04 | 0.13 | 0.36 | | | | | 3.5 | 25.1 | 21 | 4 | |
| 1998 Avg | 0.06 | 0.17 | 0.44 | | | | | 5.18 | 18.42 | 9.66 | 3.06 | |
| 1999 Avg | 0.05 | 0.16 | 0.37 | | | | | 3.40 | 15.98 | 7.95 | 2.50 | |
| 94-99 Avg | 0.05 | 0.15 | 0.38 | 0.22 | | | | 6.10 | 22.13 | 13.56 | 2.93 | 11.56 |
| Max | 0.23 | 0.42 | 0.69 | 0.44 | | | | 16.40 | 86.30 | 204.00 | 17.00 | 20.00 |
| Min | 0.01 | 0.01 | 0.17 | 0.10 | | | | 0.00 | 7.00 | 1.00 | 1.00 | 4.17 |

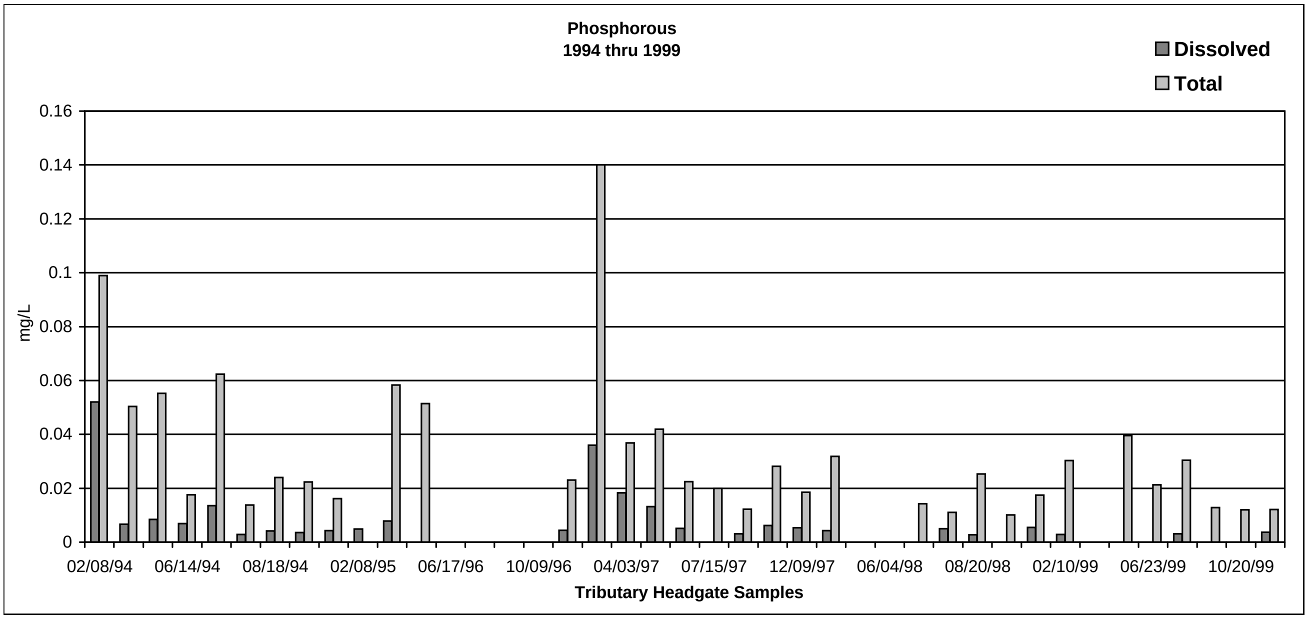
| Date | NH3 (mg/L) as N | NO3+NO2 (mg/L) as N | TN (mg/L) as N | TKN (mg/L) as N | Secchi (feet) | Algae Count | Chlorophyll (ug/L uncorrected | Diss. P (ug/L) | TP (ug/L) | TSS (mg/L) | TVS (mg/L) | Cl- (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10-PZ** | **Photic Zone (2X Secchi depth) near dam** | | | | | | | | | | | |
| 03/18/94 | 0.03 | 0.16 | 0.39 | 0.11 | 6.5 | 1285 | 4.2 | 3.3 | 10.5 | | | |
| 03/28/94 | 0.03 | 0.14 | 0.44 | 0.25 | 4 | 1115 | 5.7 | 8.5 | 8.4 | 8 | 2 | |
| 04/12/94 | 0.02 | 0.05 | 0.31 | 0.18 | 3.5 | 3234 | 5.6 | 4.6 | 23.9 | 6 | 1 | |
| 04/28/94 | 0.02 | <0.01 | 0.54 | 0.23 | 4 | 1772 | 7.4 | 15.8 | 22.8 | 3 | 1 | |
| 05/09/94 | 0.04 | 0.05 | 0.42 | 0.25 | | 2048 | 6.7 | | 13.3 | 5 | 2 | |
| 05/23/94 | 0.02 | 0.02 | 0.22 | 0.11 | 11.5 | 150 | 1.6 | 9.9 | | | | |
| 06/06/94 | 0.02 | 0.04 | 0.23 | 0.17 | 9 | 277 | 1.2 | | | <1 | <1 | 11.2 |
| 06/20/94 | 0.02 | 0.03 | 0.27 | 0.27 | 10 | 242 | 1.4 | | 11.4 | | | 9.2 |
| 07/11/94 | 0.01 | 0.04 | 0.17 | <0.1 | 11 | 74 | 2.3 | 3.8 | 12.5 | 4 | 3 | 6.1 |
| 07/25/94 | 0.02 | 0.06 | 0.29 | 0.21 | 15 | 78 | 1.2 | 2.5 | | 6 | 4 | |
| 08/09/94 | 0.01 | 0.04 | 0.37 | 0.14 | 11 | 216 | 1.5 | 3.1 | | 1 | <1 | |
| 08/22/94 | 0.03 | 0.03 | 0.44 | <0.1 | 12 | 115 | 1.3 | 2.7 | 18.7 | 2 | <1 | 9.4 |
| 09/12/94 | 0.01 | 0.02 | 0.26 | 0.13 | 8 | 148 | 2.5 | | 15.2 | 2 | <1 | 13.5 |
| 09/29/94 | 0.01 | 0.03 | 0.18 | 0.12 | 7.5 | 181 | 2.2 | 3.4 | 18.6 | 2 | <1 | 7.3 |
| 10/18/94 | 0.04 | 0.01 | 0.66 | 0.14 | 3.5 | 715 | 3.1 | 6.1 | 23.9 | 1 | 1 | 11.2 |
| 10/31/94 | 0.01 | 0.01 | 0.23 | 0.17 | 3.5 | 302 | 4.9 | 4.8 | 26.1 | 6 | 1 | 12.8 |
| 11/07/94 | 0.04 | 0.01 | 0.21 | 0.10 | 5 | 247 | 4.0 | 3.8 | 31.8 | 3 | 2 | 11.9 |
| 11/28/94 | 0.04 | 0.05 | 0.23 | 0.20 | 5 | 225 | 5.1 | 6.9 | 33.9 | 6 | 2 | 16.9 |
| 03/09/95 | 0.07 | 0.04 | 0.22 | | 8.5 | 577 | 3.0 | 3.0 | 15.9 | 4 | 2 | 14 |
| 03/29/95 | 0.02 | 0.03 | 0.24 | | 5 | 1654 | 6.9 | <2.5 | 20.1 | 5 | 1 | 14 |
| 04/13/95 | 0.06 | 0.05 | 0.22 | | 7.5 | 85 | 1.4 | 5.5 | 13.6 | 3 | 1 | 10 |
| 04/25/95 | 0.03 | 0.05 | 0.25 | | 6.5 | 98 | 2.8 | <2.5 | 19.0 | 4 | 2 | 11 |
| 05/16/95 | 0.04 | 0.10 | 0.31 | | 9.5 | 58 | 1.6 | 4.0 | 24.3 | 2 | 2 | 16 |
| 05/31/95 | 0.08 | 0.21 | 0.52 | | 3.0 | 31 | 1.0 | 0.0 | 24.2 | 6 | 2 | 18 |
| 06/13/95 | 0.03 | 0.19 | 0.42 | | 9.5 | 23 | 0.9 | 4.3 | 12.4 | 3 | 2 | 17 |
| 06/26/95 | 0.04 | 0.21 | 0.34 | | 9.5 | 21 | | 4.8 | 12.5 | 2 | 1 | |
| 07/11/95 | 0.02 | 0.20 | 0.47 | | 9.0 | 452 | 2.7 | 3.2 | 11.9 | 3 | 2 | 16 |
| 07/24/95 | 0.04 | 0.14 | 0.42 | | 7.5 | 67 | 2.1 | 15.2 | | 3 | 2 | 15 |
| 08/07/95 | 0.02 | 0.13 | 0.35 | | 11.5 | 46 | 1.2 | 2.6 | 20.2 | 1 | 1 | 12 |
| 08/22/95 | 0.04 | 0.12 | 0.35 | | 14.0 | 61 | 2.7 | 4.0 | 14.9 | <1 | <1 | 12 |
| 09/05/95 | 0.03 | 0.12 | 0.32 | | 18.5 | 21 | 1.8 | 3.2 | 14.7 | 2 | 1 | 7 |
| 09/18/95 | 0.04 | 0.10 | 0.32 | | 8.5 | 61 | 3.6 | 3.5 | <10 | 3 | 3 | 11 |
| 10/02/95 | 0.02 | 0.08 | 0.29 | | 5.5 | 57 | 4.0 | 4.0 | 7.4 | <1 | <1 | |
| 10/24/95 | 0.04 | 0.09 | 0.37 | | 8.0 | 310 | 2.5 | 2.6 | 8.3 | 4 | 2 | 12 |
| 11/06/95 | 0.02 | 0.10 | 0.34 | | 6 | 76 | 3.5 | 4.1 | 4.6 | 4 | 2 | 13 |
| 11/20/95 | 0.08 | 0.14 | 0.48 | | 7.5 | 39 | 3.1 | 4.5 | 11.8 | 2 | <1 | 9 |
| 03/11/96 | 0.03 | 0.15 | 0.33 | | 6.5 | 185 | 2.5 | <2.5 | 8.0 | 2 | <1 | |
| 03/27/96 | 0.04 | 0.15 | 0.32 | | 4.5 | 636 | 1.3 | <2.5 | 12.2 | 5 | 2 | |
| 04/08/96 | 0.02 | 0.15 | 0.36 | | 5 | 825 | 2.8 | <2.5 | 9.7 | 3 | <1 | |
| 04/23/96 | 0.02 | 0.11 | 0.37 | | 2 | 1045 | 8.0 | <2.5 | 8.9 | 7 | 2 | |
| 05/07/96 | 0.01 | 0.03 | 0.21 | | 5 | 1622 | 7.0 | <2.5 | 9.4 | 5 | 2 | |
| 05/20/96 | 0.01 | 0.02 | 0.13 | | 9 | 41 | 1.0 | <2.5 | 9.2 | 2 | 2 | |
| 06/03/96 | 0.02 | 0.05 | 0.29 | | 6.5 | 22 | 2.7 | <2.5 | 8.7 | 5.5 | 1 | |
| 06/18/96 | 0.04 | 0.04 | 0.26 | | 10.5 | 28 | 1.3 | <2.5 | 15.8 | 3 | <1 | |
| 07/01/96 | 0.02 | 0.04 | 0.26 | | 10.5 | | 1.8 | <2.5 | 10.4 | 1.5 | <1 | |
| 07/15/96 | 0.04 | 0.18 | 0.27 | | 14.5 | 16 | 2.1 | <2.5 | 8.9 | 2 | 1.5 | |
| 07/30/96 | 0.04 | 0.05 | 0.32 | | 12.5 | 7 | 2.1 | <2.5 | 6.9 | 1.5 | 1 | |
| 08/13/96 | 0.02 | 0.03 | 0.24 | | 12.0 | 162 | 1.3 | 4.0 | 5.5 | <1 | <1 | |
| 08/26/96 | 0.02 | 0.01 | 0.23 | | 11.5 | 2 | 1.7 | 4.0 | 15.1 | <1 | <1 | |
| 09/09/96 | 0.04 | 0.01 | 0.22 | | 10.5 | 136 | 2.1 | 4.0 | 15.6 | <1 | <1 | |
| 09/24/96 | 0.03 | 0.01 | 0.25 | | 4.5 | 80 | 2.4 | 7.0 | 21.6 | 3.5 | 1.5 | |
| 10/07/96 | 0.01 | 0.03 | 0.31 | | 4.0 | 178 | 3.9 | 7.4 | 15.1 | 3 | 2 | |
| 10/21/96 | 0.02 | 0.01 | 0.3 | | 6 | 150 | 1.9 | 6.8 | 15.6 | 7 | 2 | |
| 11/05/96 | 0.03 | 0.01 | 0.27 | | 6 | 96 | 2.7 | 6.6 | 11.9 | 3.5 | 3 | |
| 11/21/96 | 0.06 | 0.01 | 0.27 | | 6 | 180 | 4.0 | 6.0 | 11.4 | <1 | <1 | |
| 03/11/97 | 0.07 | 0.08 | 0.33 | | 7 | 1140 | 3.7 | 2.9 | 9.2 | 1 | <1 | |
| 03/26/97 | 0.03 | 0.09 | 0.37 | | 9 | 368 | 2.3 | <2.5 | 7.8 | 1 | 1 | |
| 04/16/97 | 0.02 | 0.08 | 0.36 | | 5.5 | 381 | 2.1 | <2.5 | 12.9 | 2 | <1 | |
| 04/30/97 | 0.03 | 0.06 | 0.4 | | 4 | 430 | 2.5 | 4.5 | 11.6 | 4 | 2 | |
| 05/14/97 | 0.04 | 0.06 | 0.39 | | 12 | 211 | 2.1 | <2.5 | 11 | 2 | 1 | |
| 05/27/97 | | | | | 5.5 | 58 | 1.2 | 3.7 | 20 | 4 | 3 | |
| 06/12/97 | 0.03 | 0.08 | 0.65 | | 5 | 54 | 2.1 | <2.5 | 10.9 | 3 | 1 | |
| 06/24/97 | 0.02 | 0.06 | 0.31 | | 4 | 12 | 1.4 | <2.5 | 13.8 | 5 | 3 | |
| 07/08/97 | 0.03 | 0.06 | 0.28 | | 8.5 | 38 | 1.3 | <2.5 | 17.6 | 1 | <1 | |
| 07/22/97 | 0.01 | 0.04 | 0.24 | | 16 | 47 | 1.1 | <2.5 | 19.7 | 1 | 1 | |
| 08/05/97 | 0.04 | 0.05 | 0.2 | | 13.5 | 22 | 1.4 | <2.5 | 12 | 1 | <1 | |
| 08/19/97 | 0.01 | 0.07 | 0.21 | | 11.5 | 38 | 4.7 | <2.5 | 7.1 | 3 | 1 | |
| 09/02/97 | 0.01 | 0.04 | 0.27 | | 9 | 57 | 2.6 | <2.5 | 9.1 | 3 | 3 | |
| 09/18/97 | 0.04 | 0.03 | 0.21 | | 8.5 | le | 1.4 | nm | 8 | 3 | 2 | |
| 09/23/97 | | | | | | | | | | | | |
| 09/30/97 | 0.05 | 0.04 | 0.31 | | 5.5 | 40 | 3.2 | <2.5 | 10.4 | 2 | 2 | |
| 10/14/97 | 0.06 | 0.04 | 0.25 | | 3.5 | 114 | 3.2 | 3.1 | 12.4 | 7 | 3 | |
| 10/28/97 | 0.04 | 0.02 | 0.26 | | 6 | 49 | 5.2 | <2.5 | 10.8 | 3 | 3 | |
| 11/13/97 | 0.03 | 0.06 | 0.23 | | 5.5 | 78.0 | 3.2 | 3.1 | 10.1 | 3 | 2 | |
| 11/24/97 | 0.01 | 0.06 | 0.25 | | 6 | 113 | 4.6 | 3.2 | 14.8 | 4 | 2 | |
| 03/10/98 | 0.07 | 0.12 | 0.45 | | 11 | 101 | 1.7 | 2.9 | 7.3 | 5 | 3 | |

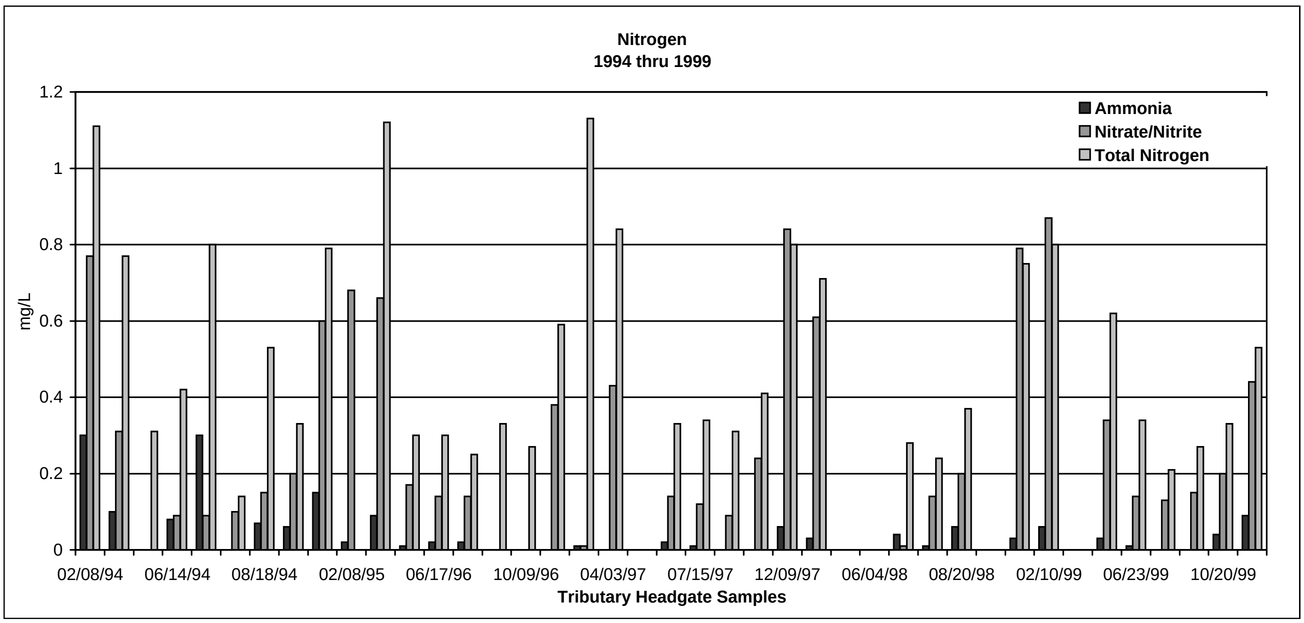
| Date | NH3 (mg/L) as N | NO3+NO2 (mg/L) as N | TN (mg/L) as N | TKN (mg/L) as N | Secchi (feet) | Algae Count | Chlorophyll (ug/L uncorrected | Diss. P (ug/L) | TP (ug/L) | TSS (mg/L) | TVS (mg/L) | Cl- (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10-PZ | Photic Zone (2X Secchi depth) near dam | | | | | | | | | | | |
| 03/25/98 | le | 0.14 | 0.42 | | 9 | 47 | 1.8 | 2.9 | 9.3 | 4.5 | 2.5 | |
| 04/06/98 | 0.04 | 0.15 | 0.37 | | 9.5 | 41 | 1.8 | 2.5 | 11.3 | 2 | 2 | |
| 04/21/98 | 0.02 | 0.19 | 0.6 | | 6 | 50 | 0.7 | 2.7 | 13.9 | 4.5 | 1 | |
| 05/04/98 | 0.06 | 0.14 | 0.4 | | 12 | na | 1.6 | <2.5 | 7.3 | 2.5 | 2.5 | |
| 05/18/98 | 0.08 | 0.14 | 0.4 | | 9 | 79 | 1.0 | <2.5 | 8.8 | 3.5 | <1 | |
| 06/02/98 | 0.05 | 0.11 | 0.28 | | 8.5 | 66 | 1.4 | 2.5 | 10.8 | 2.5 | <1 | |
| 06/15/98 | 0.03 | 0.1 | 0.25 | | 7 | 29 | 1.8 | 2.5 | 15.3 | 2.5 | <1 | |
| 06/29/98 | 0.06 | 0.09 | 0.46 | | 9 | 32 | 2.5 | <2.5 | 16.7 | 4.5 | 2.5 | |
| 07/13/98 | 0.06 | 0.07 | 0.28 | | 13 | 68 | 1.7 | 3.5 | 6.1 | 3.5 | 3.5 | |
| 07/27/98 | 0.06 | 0.06 | 0.37 | | 18 | 70 | 2.4 | 2.9 | 9.1 | 2.5 | <1 | |
| 08/10/98 | 0.04 | 0.04 | 0.23 | | 16 | 92 | 2.5 | 2.8 | 12.3 | 2.5 | 1 | |
| 08/24/98 | 0.06 | 0.08 | 0.27 | | 17 | 26 | 3.3 | <2.5 | 19 | 2.5 | 1.5 | |
| 09/08/98 | 0.04 | 0.01 | 0.34 | | 12.5 | 14 | 2.0 | 6.5 | 29.7 | 10.5 | 3.5 | |
| 09/21/98 | 0.03 | 0.01 | 0.33 | | 6 | 52 | 1.3 | <2.5 | 12.8 | 6 | 1 | |
| 10/05/98 | 0.08 | 0.05 | 0.27 | | 4.5 | 58 | 2.6 | 2.8 | 18 | 6 | 1.5 | |
| 10/20/98 | 0.07 | 0.04 | 0.25 | | 5 | 354 | 3.5 | <2.5 | 13.3 | 6 | 3 | |
| 11/04/98 | 0.03 | 0.03 | 0.26 | | 5 | 387 | 4.1 | <2.5 | 13.3 | 4.5 | 2 | |
| 11/16/98 | 0.02 | 0.03 | 0.33 | | 6 | 784 | 5.9 | <2.5 | 12.2 | 6.5 | 4.5 | |
| 03/02/99 | 0.04 | 0.08 | 0.24 | | 2.75 | 61 | 0.8 | <2.5 | 7 | 3 | <1 | |
| 03/09/99 | 0.03 | 0.08 | 0.38 | | 4.5 | 175 | 1.0 | <2.5 | 7.9 | 3 | 2 | |
| 03/22/99 | 0.13 | 0.09 | 0.35 | | 4 | 49 | 0.8 | <2.5 | 7.7 | 1 | <1 | |
| 04/06/99 | | | | | 3 | 59 | 3.1 | <2.5 | 12.1 | 6 | 2 | |
| 04/21/99 | | | | | 3 | 100 | 2.2 | <2.5 | 11.4 | 7 | 3 | |
| 05/13/99 | 0.03 | 0.15 | 0.33 | | 1.6 | 56 | 2 | n/m | n/m | 7 | 2 | |
| 05/24/99 | 0.04 | 0.18 | 0.40 | | 2.75 | 55 | 1 | <2.5 | 19.8 | 9 | 1 | |
| 06/01/99 | 0.02 | 0.20 | 0.40 | | 1.25 | 18 | 1 | <2.5 | 15 | 9 | 2 | |
| 06/07/99 | 0.02 | 0.18 | 0.40 | | 2 | n/s | n/s | <2.5 | 15.8 | 9 | 3 | |
| 06/21/99 | 0.02 | 0.23 | 0.39 | | 4.75 | 107 | 1.2 | 2.5 | 14.3 | 5 | 2 | |
| 06/29/99 | 0.06 | 0.26 | 0.58 | | 4.25 | 29 | 1.3 | 4.2 | 21 | 9 | 3 | |
| 07/07/99 | 0.02 | 0.17 | 0.39 | | 4.5 | 133 | 1.9 | 3.9 | 17.7 | 9 | 3 | |
| 07/20/99 | 0.03 | 0.23 | 0.39 | | 5.5 | 20 | 1.1 | 3.4 | 13.5 | 16 | 2 | |
| 08/03/99 | <0.01 | 0.28 | 0.49 | | 4.75 | 40 | 1.4 | 3.7 | 24.9 | 10 | 4 | |
| 08/16/99 | 0.11 | 0.30 | 0.50 | | 3.75 | 44 | 1.7 | 4.8 | 29.4 | 11 | 3 | |
| 09/01/99 | 0.03 | 0.24 | 0.43 | | 3.25 | 142 | 3.3 | 2.7 | 18.6 | 10 | 5 | |
| 09/13/99 | 0.03 | 0.22 | 0.48 | | 2.5 | 123 | 2.8 | 2.8 | 21.9 | 17 | 3 | |
| 09/27/99 | 0.06 | 0.07 | 0.25 | | 1.75 | 177 | 1.9 | <2.5 | 14.1 | 5 | 1 | |
| 10/12/99 | 0.04 | 0.03 | 0.28 | | 3 | 230 | 2.4 | <2.5 | 10.8 | 6 | 2 | |
| 10/26/99 | 0.08 | 0.05 | 0.24 | | 2.75 | 57 | 5.5 | <2.5 | 17.6 | 8 | 3 | |
| 11/08/99 | 0.04 | <0.01 | 0.22 | | 2.8 | 154 | 2.6 | <2.5 | 17.5 | 8 | 1 | |
| 11/29/99 | 0.04 | 0.05 | 0.32 | | 1.5 | 167 | 2.7 | 2.6 | 17.7 | 7 | 3 | |
| 1994 Avg | 0.02 | 0.05 | 0.33 | 0.174 | 7.6 | 690 | 3.4 | 5.7 | 19.3 | 4 | 2 | 13.4 |
| 1995 Avg | 0.04 | 0.12 | 0.35 | | 8.6 | 208 | 2.6 | 4.3 | 14.7 | 3 | 2 | 12.9 |
| 1996 Avg | 0.03 | 0.06 | 0.27 | | 7.7 | 301 | 2.8 | 5.7 | 11.6 | 4 | 2 | |
| 1997 Avg | 0.03 | 0.06 | 0.31 | | 7.7 | 171 | 2.6 | 1.1 | 12.1 | 3 | 2 | |
| 1998 Avg | 0.05 | 0.08 | 0.35 | | 9.7 | 124 | 2.3 | 1.8 | 13.0 | 4 | 2 | |
| 1999 Avg | 0.05 | 0.16 | 0.37 | | 3.2 | 95 | 2.0 | 3.4 | 16.0 | 8 | 3 | |
| 94-99 Avg | 0.04 | 0.09 | 0.33 | 0.17 | 7.3 | 263 | 2.6 | 4.4 | 14.2 | 4 | 2 | 12.2 |
| Max | 0.13 | 0.30 | 0.66 | 0.27 | 18.5 | 3234 | 8.0 | 15.8 | 33.9 | 17 | 5 | 18.0 |
| Min | 0.01 | 0.01 | 0.13 | 0.10 | 1.3 | 2 | 0.7 | 0.0 | 4.6 | 1 | 1 | 6.1 |

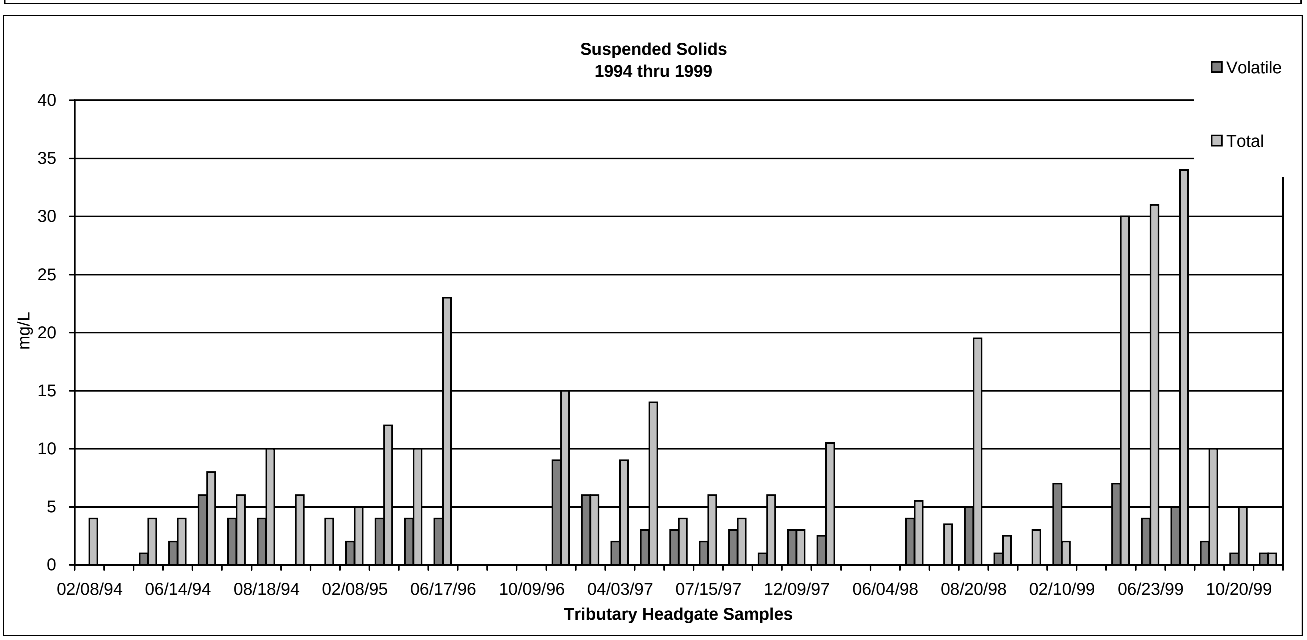
# Clear Creek Sampling Summary

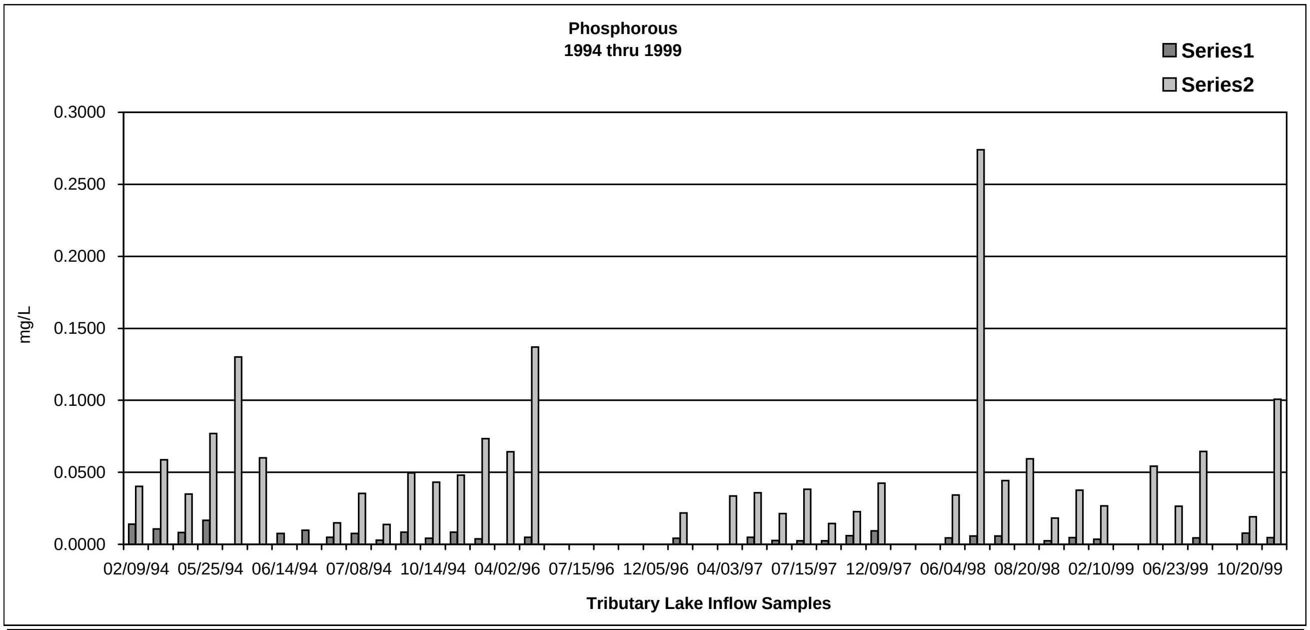
| | | Total Phosphorous, ug/L | | | | | Total Nitrogen, mg/L | | | | | Total Susp | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1994 | 1995 | 1996 | 1997 | 1998 | 1994 | 1995 | 1996 | 1997 | 1998 | 1994 | 1995 |
| Mainstem at Bakerville | CC05 | 8.8 | 11.9 | 14.4 | 21.0 | 3.9 | 0.48 | 0.59 | 0.31 | 0.32 | 1.45 | 2 | 5 |
| Levenworth Creek | CC10 | 6.7 | 6.7 | 4.9 | 3.8 | 3.0 | 0.29 | 0.24 | 0.21 | 0.20 | 0.27 | 2 | 4 |
| Westfork below Berthoud | CC15 | 13.9 | 19.0 | 6.6 | 41.6 | 18.3 | 0.60 | 0.44 | 0.68 | 0.90 | 1.44 | 2 | 9 |
| Westfork below Empire | CC20 | 12.5 | 16.4 | 17.0 | 8.5 | 10.9 | 0.44 | 0.46 | 0.43 | 0.58 | 0.76 | 2 | 10 |
| Mainstem above Westfork | CC25 | 21.7 | 19.7 | 15.2 | 15.5 | 14.3 | 0.42 | 0.42 | 0.36 | 0.31 | 0.38 | 2 | 7 |
| Mainstem at Lawson Gauge | CC26 | | | | | 0.9 | | | | | 0.44 | | |
| Fall River | CC30 | 9.8 | 15.1 | 7.4 | 9.7 | 10.3 | 0.32 | 0.31 | 0.21 | 0.25 | 0.25 | 2 | 23 |
| Chicago Creek | CC35 | 11.2 | 17.0 | 7.6 | 11.1 | 9.8 | 0.32 | 0.27 | 0.19 | 0.23 | 0.24 | 3 | 8 |
| Mainstem below Idaho Springs | CC40 | 29.3 | 36.9 | 22.4 | 21.3 | 20.8 | 0.52 | 0.47 | 0.42 | 0.45 | 0.47 | 7 | 27 |
| Northfork above Blackhawk | CC45 | 41.1 | 18.0 | 23.0 | 16.2 | 21.2 | 0.69 | 0.27 | 0.20 | 0.20 | 0.22 | 29 | 27 |
| Northfork above confluence | CC50 | 97.0 | 39.2 | 51.0 | 17.6 | 27.5 | 2.43 | 2.15 | 0.86 | 0.53 | 0.54 | 26 | 22 |
| Mainstem below Beaver Brook | CC55 | 30.0 | 34.9 | 24.4 | 18.0 | 23.4 | 0.59 | 0.47 | 0.42 | 0.44 | 0.43 | 10 | 38 |
| Mainstem at Church Ditch | CC60 | 30.2 | 44.1 | 24.7 | 18.9 | 19.5 | 0.49 | 0.45 | 0.44 | 0.38 | 0.45 | 10 | 39 |

| ended Solids, mg/L | | |
| --- | --- | --- |
| 1996 | 1997 | 1998 |
| 4 | 2 | 1 |
| 3 | 1 | 1 |
| 2 | 2 | 1 |
| 6 | 4 | 8 |
| 3 | 3 | 2 |
| | | 4 |
| 3 | 3 | 5 |
| 3 | 4 | 4 |
| 10 | 9 | 22 |
| 28 | 28 | 28 |
| 26 | 13 | 21 |
| 11 | 11 | 11 |
| 15 | 13 | 14 |

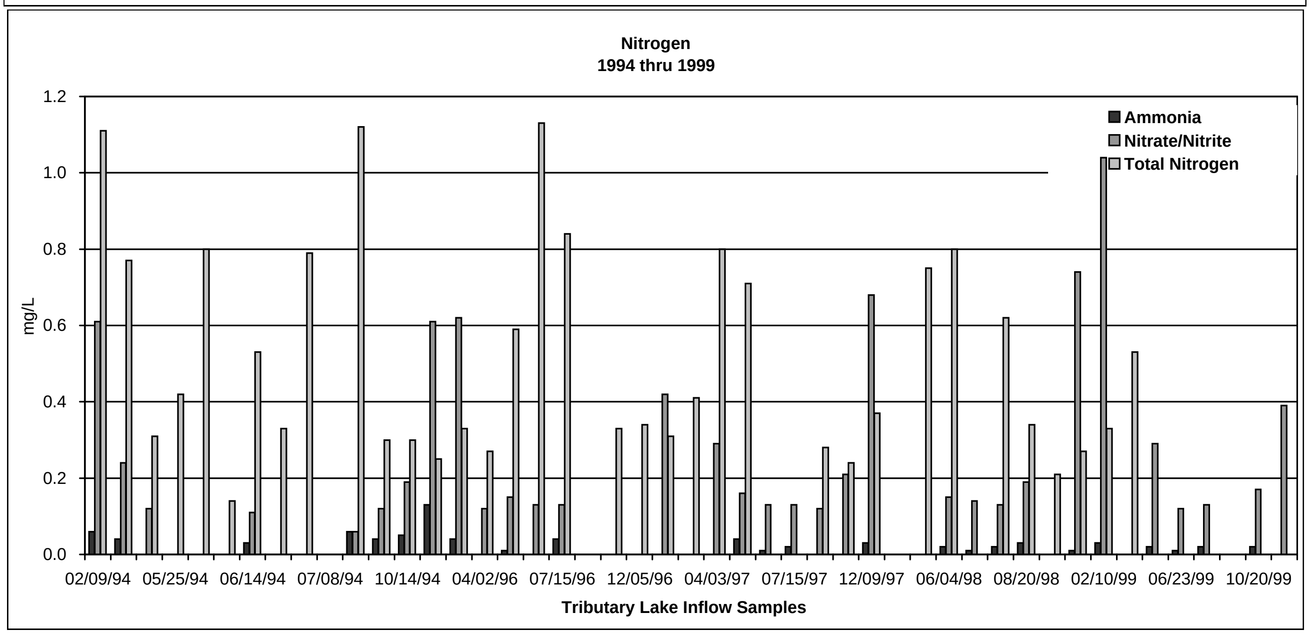

Phosphorous
1994 thru 1999
Dissolved
Total
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
mg/L
02/08/94
06/14/94
08/18/94
02/08/95
06/17/96
10/09/96
04/03/97
07/15/97
12/09/97
06/04/98
08/20/98
02/10/99
06/23/99
10/20/99
Tributary Headgate Samples


Nitrogen
1994 thru 1999
Ammonia
Nitrate/Nitrite
Total Nitrogen
1.2
1
0.8
0.6
0.4
0.2
0
mg/L
02/08/94
06/14/94
08/18/94
02/08/95
06/17/96
10/09/96
04/03/97
07/15/97
12/09/97
06/04/98
08/20/98
02/10/99
06/23/99
10/20/99
Tributary Headgate Samples

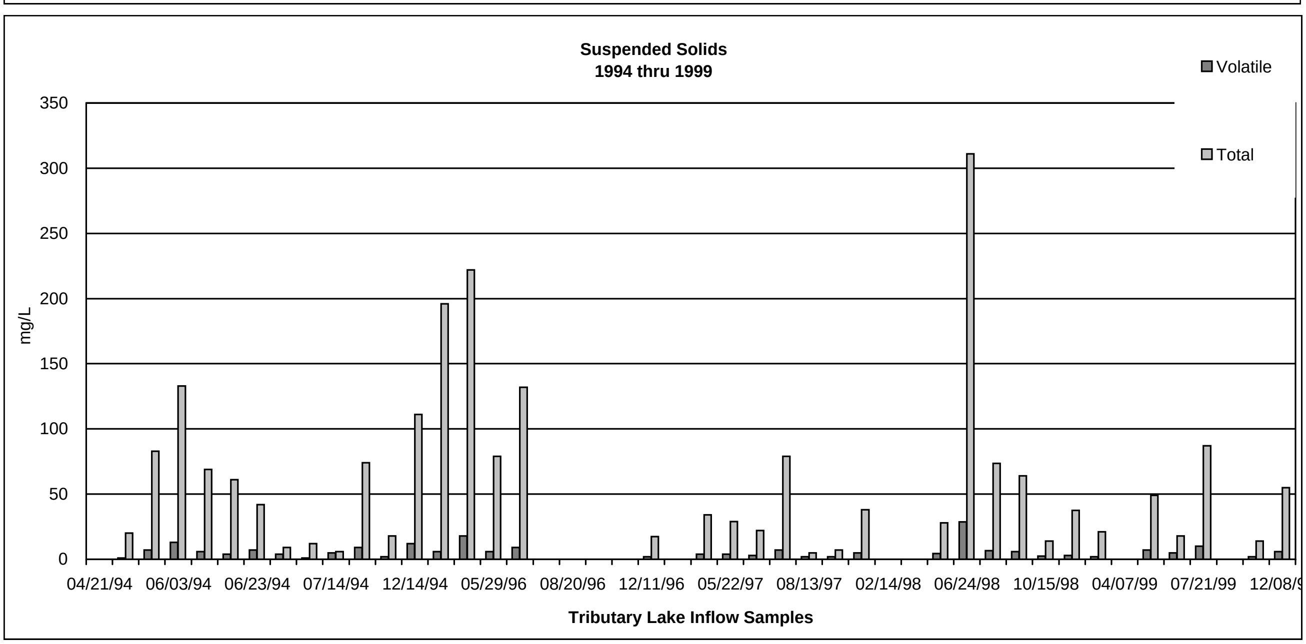

Suspended Solids
1994 thru 1999
Volatile
Total
40
35
30
25
20
15
10
5
0
mg/L
02/08/94
06/14/94
08/18/94
02/08/95
06/17/96
10/09/96
04/03/97
07/15/97
12/09/97
06/04/98
08/20/98
02/10/99
06/23/99
10/20/99
Tributary Headgate Samples



Phosphorous
1994 thru 1999
Series1
Series2
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
mg/L
02/09/94 05/25/94 06/14/94 07/08/94 10/14/94 04/02/96 07/15/96 12/05/96 04/03/97 07/15/97 12/09/97 06/04/98 08/20/98 02/10/99 06/23/99 10/20/99
Tributary Lake Inflow Samples

Nitrogen
1994 thru 1999
Ammonia
Nitrate/Nitrite
Total Nitrogen
1.2
1.0
0.8
0.6
0.4
0.2
0.0
mg/L
02/09/94 05/25/94 06/14/94 07/08/94 10/14/94 04/02/96 07/15/96 12/05/96 04/03/97 07/15/97 12/09/97 06/04/98 08/20/98 02/10/99 06/23/99 10/20/99
Tributary Lake Inflow Samples

Suspended Solids
1994 thru 1999
Volatile
Total
350
300
250
200
150
100
50
0
mg/L
04/21/94 06/03/94 06/23/94 07/14/94 12/14/94 05/29/96 08/20/96 12/11/96 05/22/97 08/13/97 02/14/98 06/24/98 10/15/98 04/07/99 07/21/99
Tributary Lake Inflow Samples

# Tributary Mid-Point Samples

| Date | Code | Location | pH | Turb. (NTU) | Cond. (uS/cm) | Diss. P (mg/L) | TP (mg/L) | VSS (mg/L) | TSS (mg/L) | Chlorides (mg/L) | NH3 (mg/L) | NO3/NO2 (mg/L) | TKN (mg/L) | TN (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 04/21/94 | T33-AS | FHL | | | | 0.0055 | 0.041 | | | | 0.04 | 0.28 | 0.21 | 0.75 |
| 05/25/94 | T33-AS | FHL | 7.30 | 9.10 | 100 | 0.0084 | 0.038 | 3 | 23 | 3.0 | | | 0.12 | 0.3 |
| 06/14/94 | T33-AS | FHL | 7.70 | 7.80 | 93 | 0.0061 | 0.0317 | 4 | 20 | 11.2 | 0.05 | 0.11 | 0.31 | 0.23 |
| 07/14/94 | T34-AS | Church | | 2.80 | 122 | 0.0025 | 0.0126 | 4 | 8 | 5.1 | 0.03 | 0.1 | <0.1 | 0.26 |
| 07/14/94 | T33-AS | FHL | | 2.00 | 132 | 0.0025 | 0.0097 | 4 | 7 | 5.1 | 0.04 | 0.08 | <0.1 | 0.14 |
| 08/18/94 | T33-AS | FHL | | 31.00 | 181 | 0.0059 | 0.0273 | 6 | 68 | 7.1 | 0.01 | 0.1 | 0.12 | 0.5 |
| 10/14/94 | T33-AS | FHL | | 6.43 | 250 | 0.0036 | 0.0227 | 1 | 10 | 11.2 | 0.05 | 0.18 | 0.12 | 0.39 |
| 12/13/94 | T33-AS | FHL | | 4.40 | 365 | 0.005 | 0.0284 | 2 | 10 | 18.2 | 0.14 | 0.55 | <0.1 | 0.82 |
| 02/08/95 | T31-AS | Croke | | 47.00 | 293 | 0.0076 | | | | 15.0 | 0.0 | 0.62 | 0.76 | |
| 02/05/96 | T31-AS | Croke | | 7.02 | 387 | 0.0071 | 0.0314 | 2 | 14 | | 0.08 | 0.61 | | 1.01 |
| 05/29/96 | T31-AS | Croke | | 2.64 | 131 | <0.0025 | 0.0604 | | | | 0.01 | 0.17 | | 0.31 |
| 06/17/96 | T33-AS | FHL | | 14.50 | 85 | | | 10 | 65 | | 0.04 | 0.14 | | 0.29 |
| 07/15/96 | T33-AS | FHL | | 4.60 | 105 | | | | | | 0.03 | 0.15 | | 0.26 |
| 08/20/96 | T33-AS | FHL | | 3.60 | 159 | | | | | | | | | 0.46 |
| 10/09/96 | T33-AS | FHL | | | | | | | | | | | | 0.28 |
| 12/05/96 | T33-AS | FHL | | | | | | | | | | | | |
| 03/05/97 | T31-AS | Croke | | 12.5 | 327 | 0.0026 | 0.2000 | 13 | 65 | | 0.05 | 0.55 | | 1.4 |
| 04/03/97 | T31-AS | Croke | | 6 | 331 | 0.0094 | 0.0122 | 2 | 8 | | | 0.37 | | 0.6 |
| 12/09/97 | T31-AS | Croke | | 9.60 | 325 | 0.0042 | 0.0205 | 2 | 13 | | 0.04 | 0.59 | | 0.73 |
| 05/22/97 | T33-AS | FHL | | | | 0.0026 | 0.0281 | 3 | 16 | | 0.02 | 0.19 | | 0.38 |
| 06/18/97 | T33-AS | FHL | | 36 | 101 | <0.0025 | 0.0553 | 3 | 21 | | 0.02 | 0.14 | | 0.4 |
| 07/15/97 | T33-AS | FHL | | 10.3 | 106 | <0.0025 | 0.0171 | 3 | 20 | | 0.01 | 0.14 | | 0.39 |
| 08/13/97 | T33-AS | FHL | | 7.2 | 1.38 | <0.0025 | 0.0158 | 3 | 7 | | <0.01 | 0.11 | | 0.33 |
| 10/14/97 | T33-AS | FHL | | | | 0.0035 | 0.0172 | 3 | 7 | | | 0.23 | | 0.39 |
| 02/14/98 | T31-AS | Croke | | 8.3 | 375 | 0.0094 | 0.0233 | 6 | 9.5 | | 0.04 | 0.58 | | 0.72 |
| 04/07/98 | T31-AS | Croke | | | | | | | | | | | | |
| 06/04/98 | T33-AS | FHL | | | | | | | | | | | | |
| 06/24/98 | T33-AS | FHL | | 9 | | <0.0025 | 0.0314 | 2 | 14 | | 0.01 | 0.01 | | 0.27 |
| 07/16/98 | T33-AS | FHL | | | | 0.0052 | 0.0190 | 3 | 17.0 | | 0.02 | 0.18 | | 0.25 |
| 08/20/98 | T33-AS | FHL | | | | <0.0025 | 0.0278 | 4 | 22 | | 0.03 | 0.19 | | 0.48 |
| 10/15/98 | T33-AS | FHL | | 5 | 221.0 | <0.0025 | 0.0136 | 2 | 11 | | | | | |
| 12/16/98 | T31-AS | Croke | | 2.6 | 337 | 0.0025 | 0.0472 | 2 | 27.5 | | 0.03 | 0.74 | | 0.82 |
| 02/10/99 | T31-AS | Croke | | n/m | n/m | 0.0037 | 0.0893 | 9 | 95 | | 0.08 | 1.48 | | 1.02 |
| 04/07/99 | T03-AS | Croke | | | | | | | | | | | | |
| 05/12/99 | T33-AS | FHL | | 19.6 | 320 | <0.0025 | 0.04 | 7 | 27 | | 0.08 | 0.34 | | 0.64 |
| 06/23/99 | T33-AS | FHL | | 7.32 | 77.6 | 0.0026 | 0.0246 | 5 | 19 | | 0.01 | 0.14 | | 0.54 |
| 07/21/99 | T33-AS | FHL | | | | | | | | | | | | |
| 08/19/99 | T33-AS | FHL | | | | <0.0025 | 0.0211 | 2 | 13 | | 0.01 | 0.14 | | 0.3 |
| 10/20/99 | T33-AS | FHL | | | | 0.0067 | 0.0201 | 2 | 10 | | 0.04 | 0.19 | | 0.39 |
| 12/08/99 | T31-AS | Croke | | | | 0.0052 | 0.03 | 3 | 24 | | 0.02 | 0.42 | | 0.56 |

**Attachment D**

# STANDLEY LAKE MANAGEMENT PLAN

## I. Mission Statement

To protect the quality of Standley Lake as a drinking water supply through the application of scientifically based and fiscally responsible management techniques. Optimize the health of Standley Lake and its watershed for current and future generations.

## II. Basis and Purpose

On June 28, 1989, the cities of Northglenn, Thornton and Westminster ("Standley Lake Cities") signed an intergovernmental agreement ("IGA") to protect the drinking water quality of Standley Lake. As outlined in the IGA, the Standley Lake Cities have worked cooperatively to establish programs for the protection of the water quality in Standley Lake. Prior to the establishment of the IGA, a joint monitoring program for the evaluation of Standley Lake and the tributary basins' water quality had been ongoing for several years.

Efforts to protect the water quality of Standley Lake originated from several taste and odor events caused by blue-green algal blooms. The last of these taste and odor events occurred in 1988. Citizens were upset with the quality of their potable water, and many expressed a loss of faith in the ability of their municipalities to deliver safe water. The Standley Lake Cities have a responsibility to their citizens and consumers to deliver safe and aesthetically pleasing drinking water.

All of the drinking water for the cities of Northglenn and Westminster is stored in Standley Lake, as is 40 percent of the city of Thornton's water supply. The quality of this supply is threatened by stormwater discharge, contaminant spills, and other point and non-point sources. It is paramount that the Standley Lake Cities maintain a focus on protection of this water supply, and continue to commit the necessary resources to accomplish this mission.

Over time, efforts have been made to provide an increased level of water quality protection including the expansion of cooperative monitoring and quality control programs. In addition, the Standley Lake Cities have collaborated on the development of a Water Quality Cost Sharing IGA, a Regional Park IGA, a Lake Management Plan, and special water quality studies. In 1993, a regulatory component was added to the program by working with the Colorado Water Quality Control Commission ("CWQCC") and the Colorado Department of Public Health and Environment ("CDPHE"). As a result, a narrative standard for Standley Lake was established which states that the lake will be maintained in a mesotrophic state and requires an annual report containing water quality data to be shared with CWQCC and CDPHE.

Temporary degradation of drinking water quality in Standley Lake can have serious political and economic impacts and long-term degradation of water quality would be catastrophic. The Standley Lake Cities are prepared to respond quickly to water quality concerns and are united to continue to modify and enhance efforts to further protect the drinking water quality of Standley Lake. This commitment will continue through a sustained focus on the Water Quality Mission and dedication of adequate resources to protect water quality for current and future generations.

## III. Background

In December of 1993, in response to a request by the Standley Lake Cities for a Rulemaking Hearing for the establishment of water quality standards and resulting control regulations, a number of local governmental entities and private parties entered into the Upper Clear Creek Watershed Management Agreement ("WMA"), which provides a framework for water quality management in the upper Clear Creek Watershed. The WMA, in addition to other provisions, provided for:

1. The adoption of a narrative standard for Standley Lake that required maintenance of Standley Lake in a mesotrophic state as measured by a combination of relevant indicators;

2. The parties to conduct additional testing and monitoring;
3. The parties to implement certain best management practices and controls on a voluntary basis, the results of which will be reported to the Colorado Water Quality Control Commission on an annual basis.

Pursuant to paragraph six of the WMA, the Standley Lake Cities, in consultation with other parties, agreed to develop a Standley Lake Management Plan by December 1994, to address in-lake nutrient loading and potential nutrient loading form lake activities, water supply operations, recreational activities, and activities in the watershed. The Standley Lake Cities implemented the plan in February 1995 as agreed.

This Standley Lake Management Plan ("SLMP") is intended to address the requirements of paragraph six of the WMA and the Mission Statement and Goals of the Standley Lake Cities ("SLMSG").

## IV. Discussion

Standley Lake, denominated Segment 2 of Big Dry Creek in the South Platte River Basin, is a terminal water storage reservoir providing municipal water supply to approximately 280,000 people in the water service areas of the Standley Lake Cities. Standley Lake also provides irrigation water supply for farmers under the Standley Division of the Farmers Reservoir and Irrigation Company ("FRICO"). The Reservoir is located in the northwest metropolitan Denver area, in a drainage basin that is fed directly by Woman Creek and Upper Big Dry Creek. The majority of its water supply, however, is supplied by Clear Creek through three canals: The Church Ditch, the Farmers Highline Canal, and the Croke Canal. These canals draw water from Clear Creek above the City of Golden, and flow generally northward approximately 16 to 25 miles across a series of drainages to Standley Lake.

In the late 1970s and early 80s, the Standley Lake Cities became increasing concerned over the water quality in Standley Lake due to issues surrounding upstream wastewater discharges and several incidents of taste and odor in the drinking water treated form Standley Lake. In addition, Standley Lake has experienced extended periods of severe oxygen depletion (anoxia) in the hypolimnion (lower cold water portion) of the lake during the period of summer stratification. Such anoxia can result in the release of various metals, as well as the recirculation of nutrients from the sediments in the lake's bottom. These releases create the potential for violations of drinking water standards, aesthetic concerns and increases water treatment costs.

Dr Alex Horn, a consultant to the Standley Lake Cities, has reviewed data from the Standley Lake Cities' lake monitoring programs and the USGS 1989-1990 study of Standley Lake. Dr. Horn believes that the cause of the summer anoxia in the hypolimnion is the die-off and decomposition of the spring algae bloom in the lake. As the algae decompose, this decomposition of algae depletes the oxygen located with the lower layer of the lake. This oxygen depletion, in turn, can result in releases, as noted above, of various nuisance metals as well as nutrients from sediments in the lake bottom. Dr Horn believes that the episodic fall taste and odor problems experienced in the lake have resulted from algae blooms that are encouraged by the recirculation, after lake turnover in the fall, of nutrients released from the decomposition of the spring algae bloom during summer, as well as from nutrients released into the water column from the lake sediments during the period of anoxia during the summer. The spring bloom, Dr Horn believes, results from the addition of highly bioavailable nutrients in the winter inflows to the reservoir. This analysis led the Standley Lake Cities to request the Rulemaking Hearing which in turn lead to the WMA, the SLMP, and the SLMSG.

## V. Scope of Plan

The following items detail the key actions that the Standley Lake Cities have or will attempt to implement as part of the SLMP in accordance with the WMA and SLMSG.

1. Standley Lake Eutrophication Model ("SLEM"), Hydrosphere Resource Consultants, 1997, developed to incorporate two items:

   A. Development of a nutrient food chain model for the reservoir to explicitly simulate autochthonous carbon production in the system. This would allow one to assess the impact of settling and decomposing algae on hypolimnetic oxygen concentrations;

   B. Development of a mechanistic sediment oxygen demand ("SOD") model to simulate SOD as a function of the flux of organic carbon to the sediments.

   C. Conclusions of SLEM (Version 2, 2000, Hydrosphere):

      1) Allochthonous Particulate Organic Matter (external sources) shows a decrease in contribution to the SOD.
      2) SOD is a function of settling organic matter in the reservoir. Eight percent of the overall SOD can be attributed to allochthonous POC, the rest is from settling algae and particulate matter.
      3) The model under predicts hypolimnetic nitrate during the stratification period. Possible strong nitrate gradients in the hypolimnion during the summer may be the reason that the average hypolimnetic nitrate concentrations predicted by the SLEM do not match the values taken near the bottom of the reservoir.
      4) Reservoir hydrology can play a significant role on the period of anoxia.
      5) The reservoir is phosphorous limited. External phosphorous loadings represent over 90% of the total phosphorous loading to the reservoir. The remaining loading is a result of sediment releases during periods of anoxic conditions.

   D. This model is scheduled to be updated in 2004-2005.

2. Regional Park IGA, 1994

A. The Standley Lake Cities have entered into an IGA addressing recreational use of Standley Lake as a regional park.

B. The IGA included the following controls as assurance that water quality will not be impacted from the users:

1) Water supply operations and water quality protection take precedence over recreation.
2) Allowed boat permits not to exceed 550, with limits for the maximum number of boats on the lake at any one time (150).
3) No personal watercraft (jet skis, etc.) allowed.
4) A permanent system for sanitary facilities.
5) No wake areas at 10-foot water depths.
6) All developed areas in the park will be drained away from the lake.
7) Recreation activities impacting water quality must be eliminated unless impacts can be mitigated.
8) No pre-1971 outboard motors will be allowed.

3. Stormwater Inflow Management ("SIM")

A. Canal Companies Bypass Policies. The Standley Lake Cities will support continuation of the Canal Company policies concerning stormwater structures.

B. Stormwater inflows entering Standley Lake will be bypassed under the following circumstances:

1) Standley Lake has not yet filled for the year, but snow-pack is at or above normal, senior calls are not in effect and not anticipated to be in effect so as to prevent Standley Lake from filling. Standley lake is therefore, reasonably certain to fill.
2) Standley Lake remains full and the water supply outlook for Clear Creek, published June 1st by the Soil Conservation Service ("SCS") shows water supplies at or above average and Clear Creek flows have been above average.

C. If the Canal Companies, after consultation with the Standley Lake Cities, determine to take Tributary Basin stormwater that otherwise would be bypasses by means of structures constructed by the Tributary Basin Entities, then the Tributary Basin Entities shall not be responsible for the quality of water so accepted into the canal as long as permanent BMPs are in place.

D. If it is determined that particulate matter within Clear Creek and the diversion canals contain significant oxygen demand, the Standley Lake Cities will support the adoption by the Canal Companies of a policy of monitoring water supply conditions and sediment loads in Clear Creek. This policy may forego diversion for several days during the peak sediment loading in Clear Creek during spring run-off provided snow-pack conditions, weather conditions, river calls, and the June 1st SCS water supply outlook make it certain that foregone diversions will not adversely affect water yield.

E. The Canal Companies will continue the current canal flushing practices that bypass Standley Lake. The Standley Lake Cities and the Canal Companies acknowledge the potential for loss of usable yield, but will accept such reasonably minimal losses.

4. Monitoring

A. The Standley Lake Cities began monitoring the water quality in Standley Lake in 1980 in response to taste and odor problems and concerns about water quality impacts from upstream wastewater discharges. The monitoring program has been modified over time and includes in-lake sampling at several points and a Remote Sensoring System.

B. Part one of the Standley Lake Monitoring Program includes sampling of the lake at four different points (10-00, 10-35, 10-70, 10-PZ) and the Water Treatment Plant intakes. Analysis, frequency, and criteria are displayed in *Table 1*.

| ANALYSIS | FREQUENCY | CRITERIA |
|---|---|---|
| Profile (field measurements) | **All events** | |
| Metals (Soluble and acid extractable) | 4/year | Winter,Runoff,Low DO,& After DO |
| F.Coliform & E.Coliform | 1/month | |
| Gross Alpha/Beta | 4/year | Winter,Runoff,Low DO,& After DO |
| Nutrients | 2/month -><br>Every 2 wks-> | December-February<br>March-November |
| Suspended Solids (total and volatile)& T.Hardness | 1/month -><br>Every 2 wks> | December-February<br>March-November |
| Chlorophyll a (uncorrected) & Algae (count & ID) | All events | |
| BTEX | 1/month | April-September |
| TOC | 1/month | |

*Table 1*

C. Part two of the Standley Lake Monitoring Program is the Remote Underwater Sensoring System ("RUSS"). The RUSS contains water quality probes for pH, Conductivity, Dissolved Oxygen, Temperature, Turbidity and Chlorophyll-a. A profile is done with the RUSS twice per day of all parameters. The RUSS is deployed in before run-off and removed in November.

5. Hypolimnetic Withdrawals

A. For one year, water will be withdrawn from Standley Lake at the higher of the two intakes for treatment. The next year, water will be withdrawn from the lower of the two intakes. The data will then be complied and evaluated. After the two years, the water resources, water quality, and water treatment personnel will develop an "action plan" for withdrawing water into the treatment plants. In the event that water quality is not of the highest or causing treatment issues, the intakes can be changed pursuant to the action plan.

B. The action plan for withdrawals will be in place by Spring of 2005.

6. External Loadings

A. Each year water quality data from the inflows into Standley Lake will be evaluated for nutrients and metals. Loadings from these analytes will be calculated and compared to previous years.

B. In the event that any of the analytes show considerable increase in loadings, an action plan will be developed to determine the cause of these significant loadings.

C. A stormwater sampling program will be developed by Spring of 2005 to determine loadings from storm events. This program will include several automatic samplers at various points in the basin and at the inflows to Standley Lake.

7. Eurasian Water Milfoil Integrated Pest Management Plan ("EWMIP")

A. Eurasian Water Milfoil (EWM) was discovered in Standley Lake in 1998. EWM is an invasive noxious weed that takes over for many other native species in the lake.

B. The Standley Lake Cities evaluated several different methods of controlling EWM. An ecologically safe and non-disruptive method was chosen in 2001. The method involves adding EWM weevils. These weevils will burrow in the stems and ultimately kill the plant. Although the weevils will not completely rid Standley Lake of EWM, it will, however, keep it under control and minimize the overall mass.

C. This is a several tiered project that will last several years at a significant cost. The project was started in 2002, and in 2004, it was reported that the weevils were surviving and starting to make an impact on the milfoil.

D. Part of this plan will also include water quality monitoring and determining the affects of EWM on water quality.

8. Water Quality Action Plan ("WQAP")

   A. Current and past lake data will be evaluated for trends. These trends will then be used to determine future trends in the lake. These trends will then be used to avoid potentially negative impacts to the lake.

   B. A comparison of algae, loadings, and in-lake concentrations will also be evaluated to determine causes of algal growth and anoxia.

   C. If certain indicators are shown to cause significant degradation in the lake, the Standley Lake Cities will evaluate possible causes of impacts and resolve the problems through remediation or legislation.

9. Lakewatch and Trophic Status

   A. In 2001, the City of Westminster purchased trending software called Lakewatch. This software was developed by Noel Burns, a consultant and limnologist from New Zealand. The purpose of this software is to evaluate trends in the lake and determine trophic status from several different components.

   B. This software has been used for several years and has become an accepted tool for trending in Standley Lake by the Standley Lake Cities.

   C. Continued evaluation of this data and software is being conducted on a yearly basis with the assistance and guidance of Noel Burns.

   D. An accepted method for determining trophic status is continually evaluated and studied. A model for determining Trophic Status specifically to Standley Lake is being considered.

10. Quality Assurance Project Plan ("QAPP")

   A. A QAPP for Standley Lake will be completed by December of 2005.

## VI. Activities/Capital Improvements

1. Dam Renovation Project and Spillway

   A. The construction phase of project began in August of 2002 and was completed in late summer of 2004.
   B. The project included dam stability, new outlet works, new valve house and a new spillway. The cost of this project was approximately 35 million.

2. Crossing Permits

   A. The Standley Lake Cities will continue to support the Canal Companies' current policy of seeking to address current and future pollution problems and issues related to stormwater and flooding controls when the opportunity arises in issuance of crossing permits or through other forms.

3. Watershed Protection Ordinances

    A. The Standley Lake Cities will evaluate, pursuant C.R.S. §(1)(b), watershed protection ordinances to address watershed activities with potential nutrient-loading effects. On December 8, 1994, the City of Northglenn adopted CB-1196 (Ordinance 1115), establishing a Watershed Protection Area and Permit Program.

4. Church Ditch By-Pass Project
   **(Shelley, info please….)**

## VII. Consulting

1. There are some tasks/studies that the Standley Lake Cities' staff may not have to expertise to accomplish. In those cases, a consultant whose area of expertise is required, will be hired to complete some of the water quality tasks/studies in Standley Lake.

2. These consultants will be under contract through the Standley Lake IGA and will report findings directly to the IGA.

3. Several studies can be ongoing at one time and results will be made available, if possible, at grantor's request.

## VIII. Water Quality Studies

1. Arbor and Associates Lake Studies, 1981-1988
2. USGS Lake Study, 1989-1990
3. Alex Horn, Standley Lake Evaluation, 1993
4. RBD/CDM, Clear Creek/Standley Lake Watershed Management Study, 1994
5. CDM Updates to Watershed Management Study, 1994
6. RBD Data Report, 1994
7. Hydrosphere Standley Lake Eutrophication Model, Version 1, 1997
8. Hydrosphere Standley Lake Eutrophication Model, Version 2, 2000
9. Noel Burns Trophic Status Study, 2002
10. CDM Updates to Watershed Management Study, 2004
11. Hydrosphere Standley Lake Eutrophication Model Updates, 2004