Clear Creek Watershed Management Agreement

2009 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
Clear Creek Watershed Foundation
Climax Molybdenum Company
Colorado Department of Transportation
Farmers Reservoir and Irrigation Company
Farmers' Highline Canal Company
Gilpin County
Jefferson County
Molson Coors Brewing Company
Saddleback Metropolitan District
Shwayder Camp
St. Mary's Glacier Water & Sanitation District
Town of Empire
Town of Georgetown
Town of Silver Plume

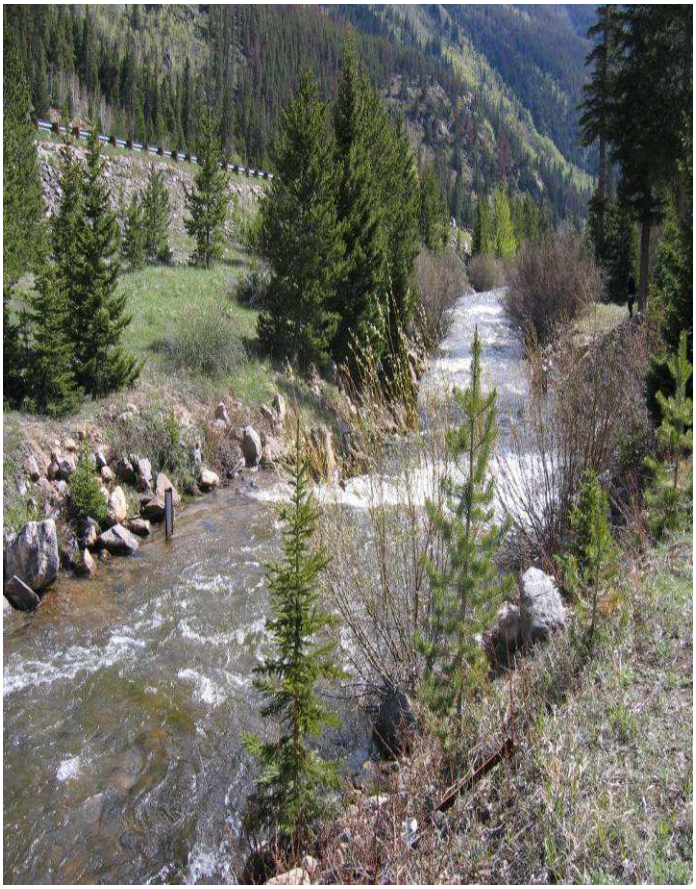

Photo: Clear Creek at Bakerville

August 2010

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EXECUTIVE SUMMARY

Introduction

The Clear Creek Watershed is located due west of Denver, Colorado, spanning 575-square-miles from the Creek's headwaters near the Continental Divide (14,000 feet in elevation) to just under one mile high when it joins the South Platte River in the northern metropolitan Denver area. The watershed includes five counties, six towns and a considerable rural/mountain population. The historic Mineral Belt bisects the Clear Creek Watershed and while the mining and milling boom was an economic benefit to our State, it left a legacy of negatively impacted water quality throughout the watershed.

Clear Creek is a hard working Creek. It supplies water to approximately 350,000 people in the watershed, supports numerous industries, including those focused on recreation and farming, and provides habitat for some of the best fisheries close to an urban setting in Colorado. Standley Lake is the largest reservoir that is filled with water from Clear Creek. Standley Lake is an agricultural and municipal water supply storage reservoir for downstream users including the Cities of Northglenn, Westminster, and Thornton and farmers on the plains of Adams and Weld counties. Standley Lake is owned and operated by Farmers Reservoir and Irrigation Company (FRICO).

Regulatory History

In response to a failed request by the Standley Lake Cities (SLC) to establish a phosphorus standard on Standley Lake at the 1989 South Platte Rulemaking Hearing, 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 required the development of a management plan for Standley Lake and a monitoring plan to address nutrient loadings. The Agreement is included as Appendix A to this report.

The 1993 narrative standard for Upper South Platte, Big Dry Creek Segment 2, reads:

> *The trophic 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.*

Many water quality improvements have been made in the watershed since the 1993 Agreement was signed. In 2009, the SLC submitted a proposal to the Water Quality Control Commission (WQCC) for a chlorophyll standard to protect the water quality in Standley Lake. The WQCC ruled on the proposal at the June 2009 South Platte Basin Standards Rule Making Hearing and approved a chlorophyll standard of 4.0 ug/L with a permissible exceedance of an assessment threshold of 4.4 ug/L once every five years. The Commission retained the narrative standard with a slight modification by removing the statement describing implementation of the narrative standard shall only be by Best Management Practices and controls implemented on a voluntary basis (note underlined section above).

Excerpts from WQCC Regulation #38 pertaining to the WQCC ruling on the chlorophyll standard for Standley Lake is included as Appendix B to this document.

Monitoring Program Summaries

The Monitoring Program focuses on assessing watershed contributions to nutrient loading in Standley Lake and the lake ecosystem's response to nutrient stimulation under dynamic environmental conditions. Nutrients of interest include total phosphorus (TP), dissolved phosphorus (DRP or DP) and total nitrogen (TN). The water quality monitoring program is divided into three geographically based sub-programs: Upper Clear Creek, Tributary Basin and Standley Lake. Detail regarding the monitoring program is included in the Monitoring Program section of this report. A map of the monitoring locations is included at the end of the Executive Summary as Figure ES-9.

A total of 4,158 samples have been collected since 1994, resulting in more than 36,000 individual analytical results. The rigorous quality assurance/quality control program ensures reliable and accurate analytical results. Refer to Appendix C for all sample data. The annual monitoring costs for the entire monitoring program are in excess of $200,000.

Stream Gages and Flow Summary

Stream flow information is required to determine nutrient loadings into Standley Lake. Gages are supported financially by the SLC, the Upper Clear Creek Watershed Association, the Clear Creek Watershed Foundation, the United States Geological Survey, the Federal Highway Authority, and the Colorado Department of Transportation. These agencies all recognize the importance of acquiring reliable flow data as a key component in assessing nutrient loading. The USGS gage in Golden (CLEGOLCO) is the gage closest to the diversion canal headgates to Standley Lake. The stream flows recorded at the USGS gage in Golden are used as the watershed location point for comparing annual stream flow patterns and trends (see Figure ES-1). The average annual stream flow at the USGS gage in Golden for the period 1995 through 2008 was 197 cubic feet per second (cfs). The average annual stream flow in 2009 was slightly below this average at 194 cfs.

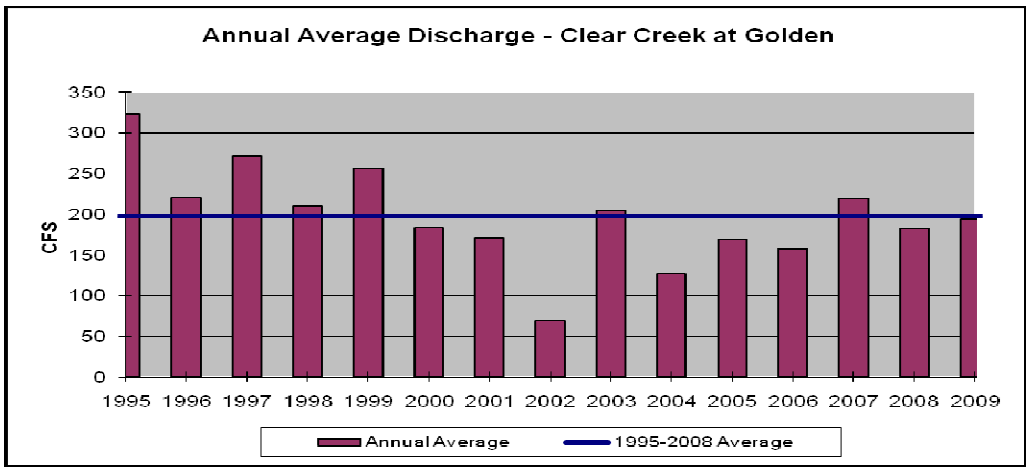

Figure ES-1. Average annual stream flow comparison – Clear Creek at Golden

Clear Creek Data Summary

In an effort to understand anthropogenic impacts on water quality and in support of the site specific standard on Standley Lake, nutrient data from grab samples at three key locations on the mainstem of Clear Creek were evaluated. The average concentration of total phosphorus, dissolved phosphorus, and total nitrogen for 2009 samples are compared to the average results for the previous five years. The data is summarized in Table ES-1. The nutrient concentrations have decreased for all three locations except for dissolved phosphorus at the upstream location (Lawson Gage) CC26.

Table ES-1. Comparison of Clear Creek Grab Samples 2009 Average to 2004-2008 Average

Parameter	Site Location					
	CC26 (upstream)		CC40 (midstream)		CC60 (downstream)	
	2009	2004 – 2008	2009	2004 – 2008	2009	2004 – 2008
Total Phosphorus (mg/L)	0.0105	0.0118	0.0094	0.0192	0.0063	0.0192
Dissolved Phosphorus (mg/L)	0.0046	0.0038	0.0043	0.0063	0.0029	0.0044
Total Nitrogen (mg/L)	0.37	0.50	0.41	0.48	0.38	0.48

Ambient Autosamplers Data Summary

In addition to grab samples, water quality in the Creek is also monitored with automated sampling equipment (autosamplers) and continuous, in-stream probes. Autosamplers provide 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. Four autosamplers have been installed since 2005 at strategic locations. Three autosamplers are located on the Mainstem of Clear Creek and one autosampler is located on the North Fork of Clear Creek (Figure ES-2).

Figure ES-2. Autosampler station on North Fork of Clear Creek (CC AS 50). Gage is the green box on the right, the autosampler is in the middle and the continuous probes/sample collection line is the pipe leading from the creek on the left.

During 2009 all of the in-stream monitoring and automated sampling sites were fully functional providing continuous water quality data acquisition for turbidity, conductivity, pH, and stage height. In addition, in-stream probes at CC AS 49 and CC AS 59 were set to trigger sampling when water quality or flow parameters exceeded pre-determined limits, thus providing sample data associated with non-ambient (event) type conditions in Clear Creek.

The data for the 48 hour ambient composite samples are summarized in Table ES-2. The period of record varies by site based on installation date and is noted in the table header.

Table ES-2. Comparison of Clear Creek Ambient Autosampler Results - 2009 Averages to all available data

Parameter	Site Location							
	CC AS 26 (upstream)		CC AS 49 (midstream)		CC AS 50 (N. Fork at confluence)		CC AS 59 (downstream)	
	2009	2008	2009	2006 – 2008	2009	2006 – 2008	2009	2005-2008
Total Phosphorus (mg/L)	0.0066	0.0078	0.0069	0.0170	0.0086	0.0321	0.0069	0.0155
Dissolved Phosphorus (mg/L)	0.0027	0.0039	0.0030	0.0043	0.0025	0.0096	0.0027	0.0035
Total Nitrogen (mg/L)	0.32	0.31	0.30	0.35	0.76	0.60	0.32	0.34

Event Autosamplers Data Summary

In addition to the 48 hr composites, autosamplers are set to sample on the mainstem of Clear Creek when turbidities exceed a predetermined level. Precipitation is highly variable in Colorado; therefore, the number of events captured differs by location. Data from the furthest downstream location, CC AS 59 in Golden, shows a good correlation between turbidity and total nitrogen during events (Figure ES-3). The correlation between turbidity and total phosphorus is poor during events; therefore the data is not presented in this report. Limitations identified in the total phosphorus laboratory method will require collection of additional event samples to accurately quantify the phosphorus loadings from events that mobilize significant quantities of suspended solids downstream.

The Monitoring Program continues to improve on event characterization. To that end, the program will begin correlating real time flow data with sample results at several of the autosampler locations in order to improve loadings estimates for high flow events.

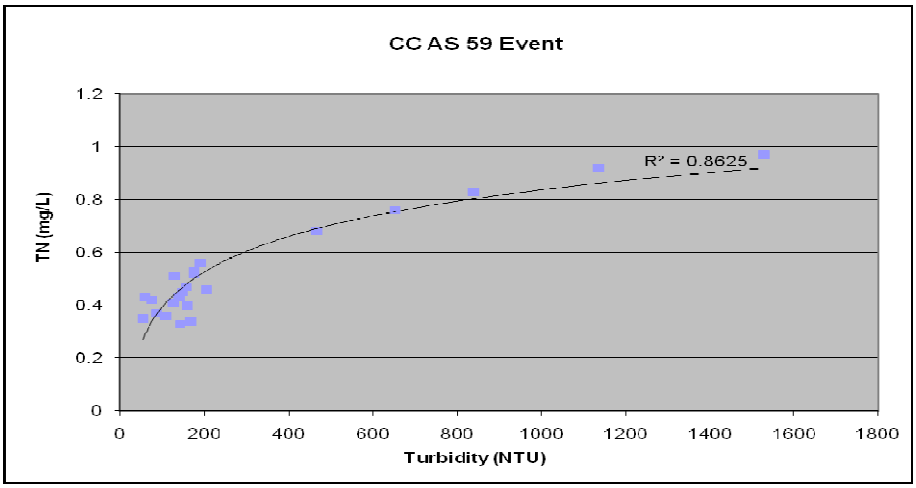

Figure ES-3. Autosampler station (CC AS 50) TN vs. Turbidity

Tributary Basin Data Summary

Three principal ditches deliver water to Standley Lake from Clear Creek. They are: Croke Canal (Croke), Farmers' Highline Canal (FHL) and Church Ditch (Church). The Kinnear Ditch Pipeline (KDPL) delivers water to Standley Lake from Coal Creek and/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 which includes a few weeks of winter flows (which are predominately wastewater), spring runoff, and summer storm runoff.

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.

Table ES-3 characterizes nutrient loadings by source, the loading inflow for each ditch was divided by the number of 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.

Table ES-3. Tributaries - Pounds of nutrient loading per acre-foot of water diverted in 2009

Ditch	**Diversion Season**	**lbs/acre-ft diverted**			**% of Total 2009 Diversions**
		TP	**DRP**	**TN**	
FHL	4/14 to 10/31	0.0226	0.0085	0.78	67%
Croke Canal	10/31 to 4/14	0.0433	0.0173	1.23	21%
Church	4/14 to 10/31	0.0401	0.0144	0.61	6%
KDPL	Year round	0.0434	0.0293	1.75	6%

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

Standley Lake Data Summary

Water quality monitoring of Standley Lake includes grab samples for assessing the chemical and biological components of the lake ecosystem and in support of the site specific standard. A lake profiler collects data on the lake from its surface to 5 feet off the bottom four times a day when deployed (ice off season). The profiler was operational on the lake from March 18th to November 24th in 2009. The profiler 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 also be downloaded manually. The instrument performs 4 profiles each day or one profile every 6 hours. The following parameters are measured: dissolved oxygen, pH, temperature, conductivity, chlorophyll a, and turbidity.

Chlorophyll

In 2009, the Water Quality Control Commission adopted a site specific standard for chlorophyll on Standley Lake. The standard is based on the most recent 14 years of lake chlorophyll data collected by the SLC. Chlorophyll was selected as the control of choice due to uncertainties surrounding the direct response of algae to nutrients (phosphorus and nitrogen) and other factors that may affect this relationship. The SLC will continue to work on the relationship between chlorophyll and nutrients in an effort to dovetail with the state's Nutrient Standards development effort. The intent of the chlorophyll standard is to protect the current classified uses and status quo of the water quality in Standley Lake, in support of the lake's role as a direct drinking water supply, and in recognition of the significant efforts that have already been undertaken to protect water quality in the upper reaches of Clear Creek, in the basins that are tributary to the feeder canals, and in the tributary areas adjacent to Standley Lake.

The adopted chlorophyll standard is defined as a 9-month average of lake samples collected between March through November, the Standley Lake Year, at site **P**hotic**Z**one-10 (PZ-10). The assessment threshold is designed to address the concern about the risk of incorrectly counting an exceedance that is actually a result of natural variability but does not indicate a substantive change in current conditions. The assessment threshold was developed by calculating the standard error of each 9-month average from which the 90th percentile value of the average was determined

The past five years of chlorophyll data relative to the new chlorophyll standard is presented in Figure ES-4. The 2009 depth integrated profile of Standley Lake chlorophyll data is presented in Figure ES-5. The chlorophyll a data collected from the profiler is considered screening level data and the results are generally about 1 µg/L less than the analytical results achieved using standard laboratory procedures for quantifying chlorophyll a.

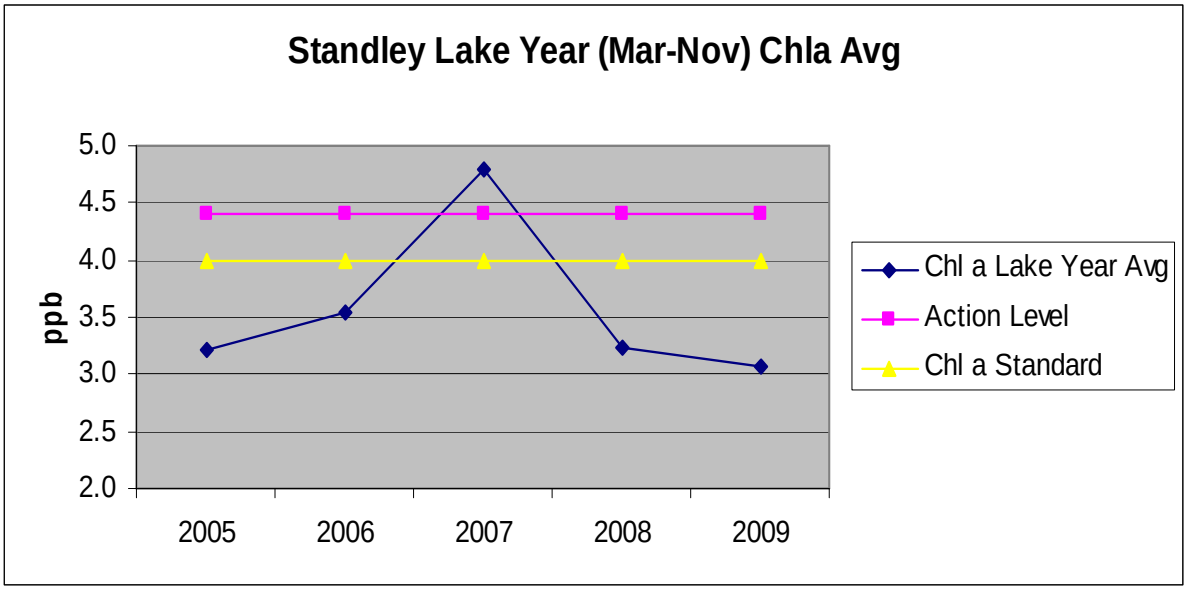

Figure ES-4. Annual Standley Lake Year Chlorophyll a results 2005-2009

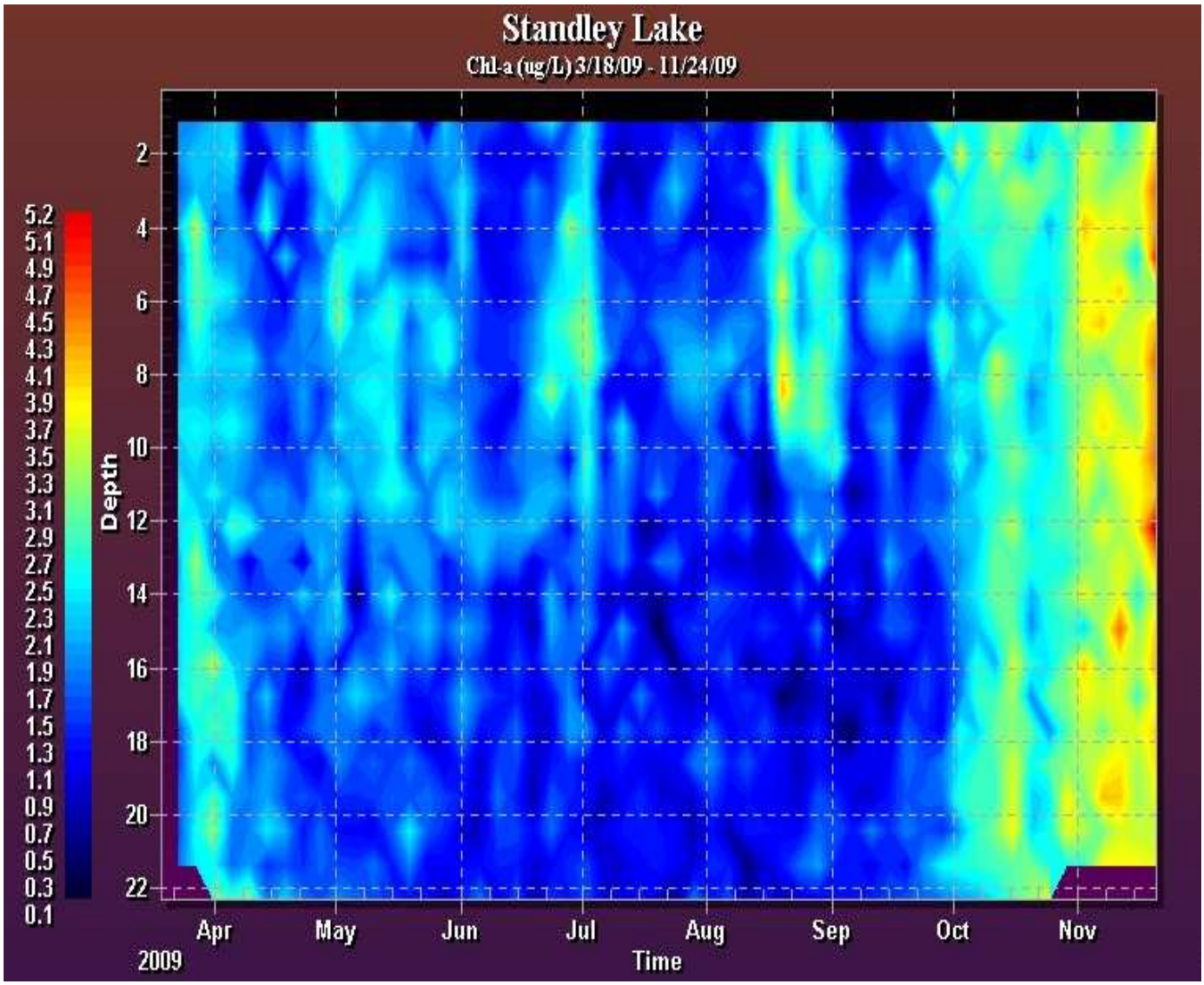

Figure ES-5. Depth integrated profile of Standley Lake for chlorophyll a (2009). Note the increases in chlorophyll concentration after lake turnover in September.

The chlorophyll data collected using the profiler assists the water treatment facility operators as they optimize treatment to minimize taste and odor issues and reduce the potential for formation of disinfection byproducts resulting from algae blooms.

Dissolved Oxygen

Standley Lake is listed on the Monitoring and Evaluation List for dissolved oxygen (DO). DO is important to both aquatic life health and water supply uses. During low DO conditions, nutrients and metals are resuspended resulting in increased treatment costs and the potential for taste and odor events. The duration of lake anoxia (DO less than 2 mg/L) has increased over the last 15 years. The average period of anoxia during 1995 - 2000 was 61.5 days. The average period of anoxia during 2002 -2009 was 80 days. The 2001 drought year was not averaged into either time period. The isopleth in Figure ES-6 represents the DO data collected by the profiler during 2009.

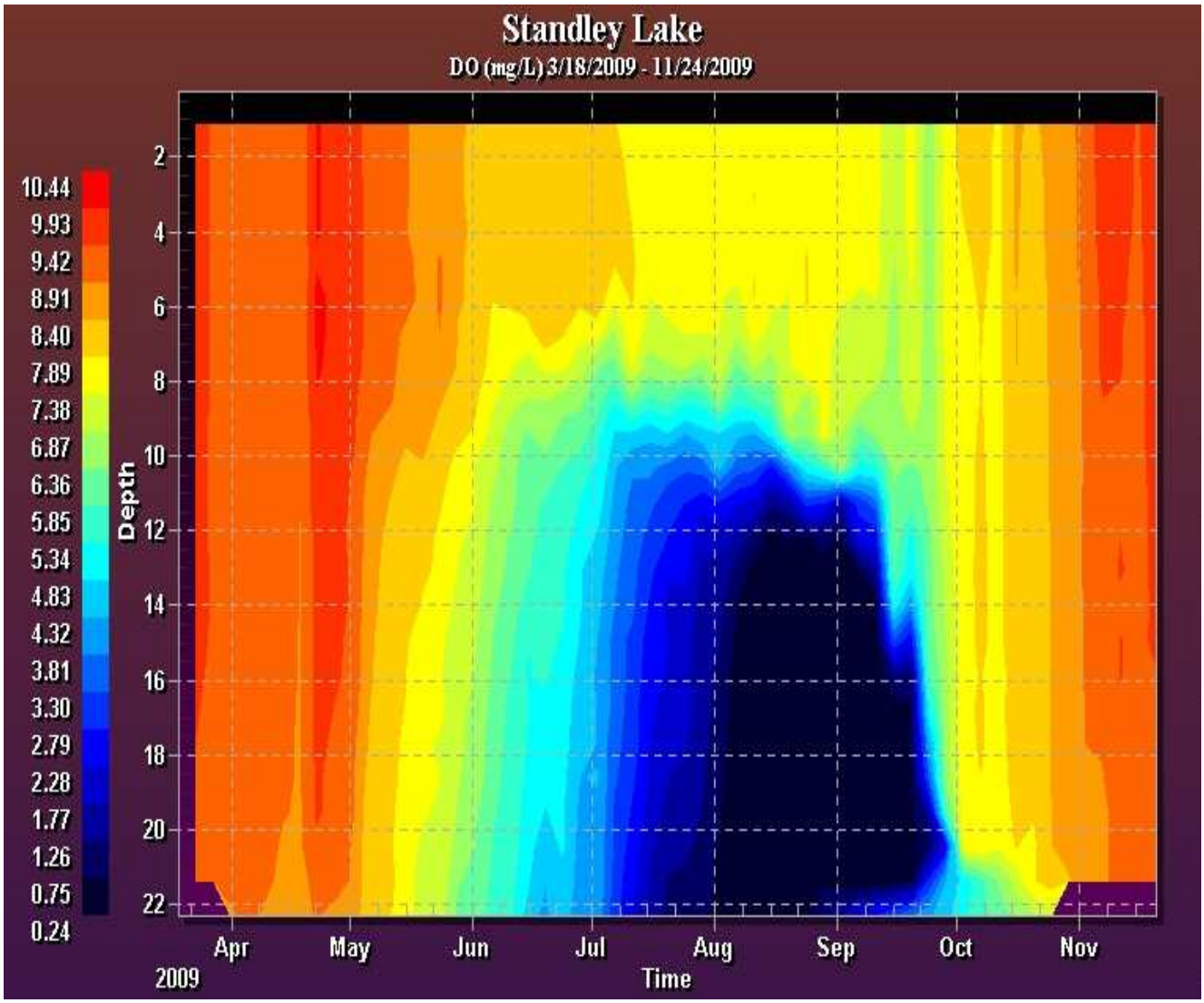

Figure ES-6. Depth integrated profile of Standley Lake for dissolved oxygen.

Nutrients

Nutrient loadings into Standley Lake are evaluated annually. Nutrients are removed through hypolymnetic withdrawal. A summary of nutrient loadings into and out of the lake, including volume of water diverted, are shown in Figures ES-7 and ES-8.

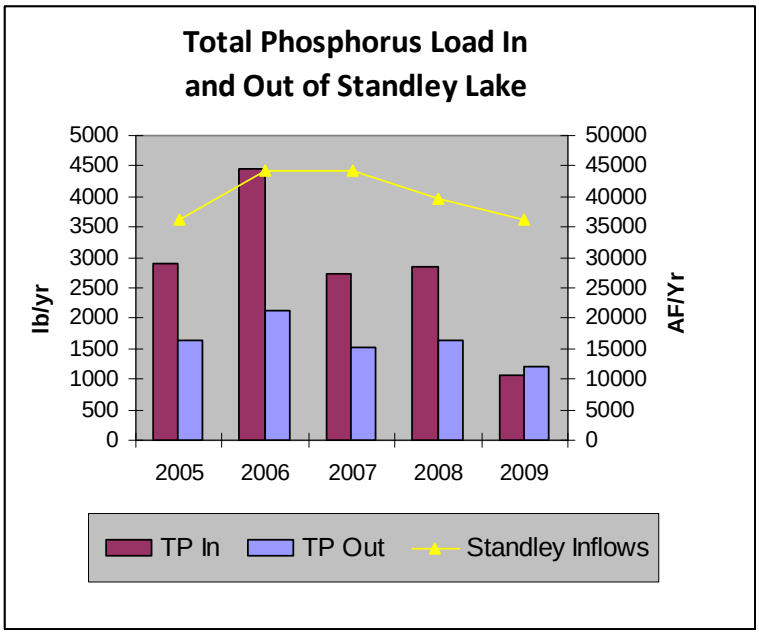

Figure ES-7. Standley Lake - Total phosphorus load and inflow 2005-2009

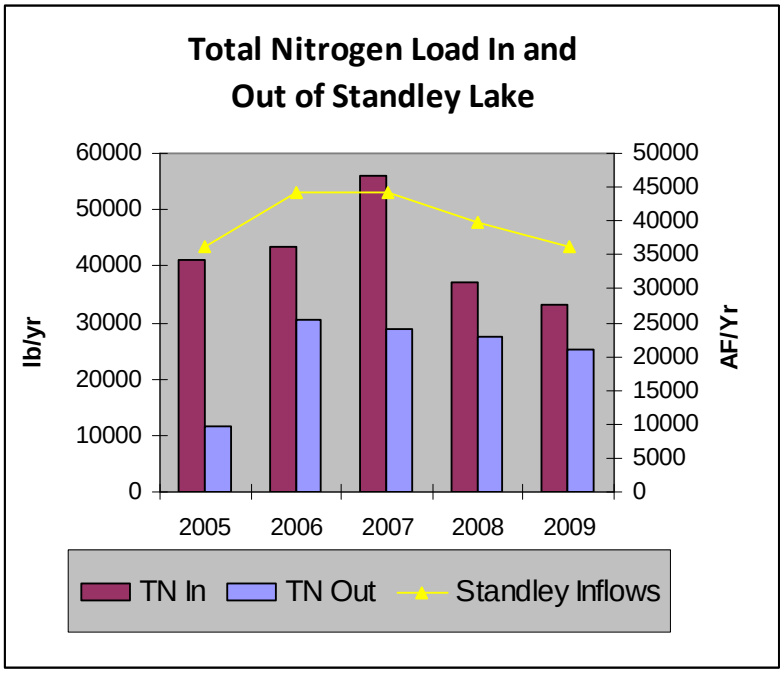

Figure ES-8. Standley Lake - Total nitrogen load and inflow 2005-2009

UCCWA Summary

The Upper Clear Creek Watershed Association focused on two main areas in 2009 in addition to its ongoing activities as a 208 Management Agency which involves the reviewing and monitoring of plans and projects.

Work begun in 2007 toward a Countywide Wastewater Utility Plan and individual Wastewater Utility Plans for each of the ten dischargers in Clear Creek County was completed. The remaining plans were reviewed by UCCWA and forwarded to DRCOG with recommendations to approve. The Wastewater Utility Plans are important for improving wastewater plant performance, effluent quality, and therefore Clear Creek water quality, especially regarding nutrient levels, over time.

UCCWA continued work with consultants in preparation for a Water Quality Control Division hearing in April to establish new underlying zinc standards, continued from 2008.

Work began in 2009, in cooperation with the Standley Lake Cities, to revise the Clear Creek/Standley Lake Watershed Agreement. The revised agreement is expected to be presented for approval by both parties in 2010.

In its role as the 208 Management Agency for the Watershed, UCCWA reviewed four projects referred for comment. UCCWA members voted to comment on three other matters that, while not officially referred for comment, were deemed of significance in the watershed.

A new member was added to the UCCWA rolls in 2009 as we welcomed the Clear Creek Watershed Foundation. This new member brings a proven track record of interest in, and support of, all efforts to improve water quality in the upper Clear Creek watershed.

Tributary Basin and Nonpoint Source Control Efforts Summary

In 2009, the Church Ditch Water Authority constructed a flow separation/bypass structure at the intersection of the Church Ditch and Little Dry Creek. The project separated Church Ditch water delivery flow from Little Dry Creek stormwater. The project goals were achieved by conveying the Church Ditch under Little Dry Creek in a concrete box culvert. A gate upstream of the crossing will allow for flushing into Little Dry Creek.

Arvada is dedicated to protecting stormwater quality in order to protect the environment within Arvada and to ensure that activities in Arvada do not contribute significantly to water degradation downstream. A significant portion of the Standley Lake canal basin lies within the City of Arvada. For almost two decades, Arvada has improved stormwater quality by returning flows into natural drainage ways and by developing a comprehensive Stormwater program. A major component of this program is related to active and post-construction site erosion control inspections and enforcement. Arvada continues to operate an illicit discharge detection and elimination program. Pollution Prevention is another ongoing component of Arvada's stormwater protection efforts. In 2009, Arvada designated Wastewater personnel as first responders in the case of off-hours emergencies that could threaten surface water quality.

Standley Lake Cities Summary

In addition to the site specific chlorophyll standard, the SLC accomplishments in 2009 were numerous.

SLC staff members have been instrumental in representing the drinking water perspective during CDPHE's workgroup meetings for developing state nutrient criteria standards which will be proposed to the WQCC for rulemaking in 2011.

In 2009, the City of Westminster acquired FlowCAM technology to assist in monitoring Standley Lake for algae and zooplankton. The instrumentation developed by Fluid Imaging Technologies is a non-destructive analysis of water samples using flow cytometry and a high speed digital camera to identify and quantify the diverse biological species present in the lake. The algae data can be correlated to the chlorophyll concentrations.

The SLC took a proactive approach to protection of Standley Lake from zebra mussel infestation by increasing the length of the quarantine period prior to the start of boating season in 2009. Rigorous analytical testing continued for detection of zebra mussel veligers.

In 2009, the Church Ditch Water Authority constructed a flow separation/bypass structure at the intersection of the Church Ditch and Little Dry Creek to separate Church water delivery flow from Little Dry Creek stormwater. The completed project conveys the Church Ditch under Little Dry Creek in a concrete box culvert. A gate upstream of the crossing allows for flushing into Little Dry Creek.

Source Water Protection

Clean and dependable public water supplies are critical to the health and economic sustainability of the Clear Creek Watershed and the Standley Lake Cities. Considering the associated economic value and the importance of the Cities' water resources, local public water providers have worked diligently for years to protect the water sources. These efforts form the basis for creation of an Upper Clear Creek and Standley Lake Watershed Source Water Protection Plan. Source water issues often impact multiple public water providers and long-term solutions will likely require both communication and cooperation. The protection plan development process was locally driven and designed to enhance collaboration between public water providers and community stakeholders. This voluntary program increased awareness of protecting water resources and provided an excellent framework for watershed collaboration with a drinking water focus. Funding was obtained to facilitate this process through a $50,000 grant administered by the Colorado Department of Public Health and Environment.

Meaningful outcomes included increased public awareness, greater communication between water providers, decision makers and stakeholders, better access to watershed data, and other benefits. An effort is currently underway to update the Watershed Agreement to better identify common goals among all the stakeholders.

The Source Water Protection Plan document and a Best Management Practices guidance document will be posted on the State's Source Water Protection website when finalized. This Source Water Protection Plan provides local public water providers and community stakeholders appropriate protection and pollution prevention strategies.

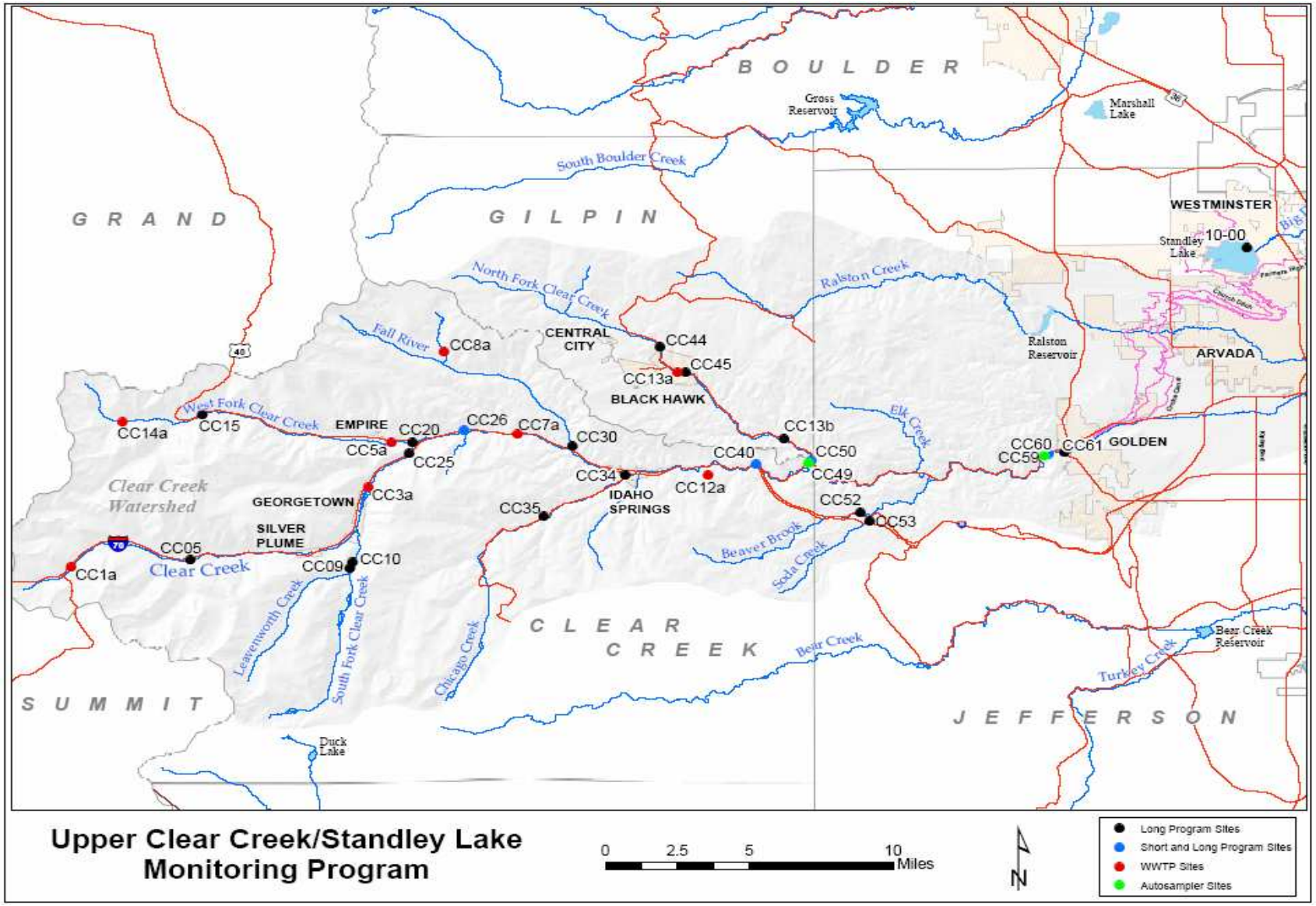

Figure ES-9. Watershed Map including monitoring locations

I. MONITORING PROGRAM

Clear Creek Program

The Clear Creek Watershed Agreement (see Appendix A) directs creation of a jointly designed, implemented and funded monitoring program to evaluate nutrient loading from point and non-point sources in the watershed. The program is also designed to assess internal lake loadings and the effect of nutrient reduction measures implemented by various parties on the trophic status of Standley Lake.

The monitoring program is divided into three geographically based sub-programs: Clear Creek, Tributary Basin and Standley Lake. A monitoring location map is included as the last page in the Executive Summary. Table 1 summarizes the number of samples collected for each sub-program.

Table 1. Monitoring Events Summary – 1994 through 2009

Monitoring Program description	Number of sampling locations	Number of samples collected in 2009	Total number of samples collected 1994 – 2009
Creek (grab)	17	54	1422
Creek (wastewater plants)	9	42	818
Creek (autosamplers) *	4	48	181
Tributaries/ Canals	9	75	1028
Lake *	4	70	709
Total	43	289	4158

* Creek autosampler data period of record 2005 -2009. Lake data period of record is 1999 – 2009.

The 4,158 samples have resulted in more than 36,000 individual analytical results. The monitoring program costs for 2009 were greater than $200,000. The Monitoring Committee has instituted a rigorous quality assurance/quality control program for analytical data generation and evaluation. It is safe to say that monitoring is the foundation of the Clear Creek Agreement. Refer to Appendix C for all sample data results.

Clear Creek Ambient Grab Program

Grab samples (Figure 1) are single point-in-time samples collected in-stream and at wastewater treatment plant (WWTP) effluents throughout the watershed. Grab sample locations were selected to correspond with established USGS gage stations and additional sites have been included over the years as the monitoring program has evolved. Grab samples are collected eight times during the year to correspond with seasonally varying flow conditions.

Figure 1. Grab sampling on Clear Creek.

Clear Creek Autosampler Program

In addition to grab samples, the creek is also sampled with autosamplers and monitored with 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 precipitations events as well as impacts from construction or other watershed activities. The continuous in-stream monitoring probes provided continuous water quality data acquisition for turbidity, conductivity, pH, and stage height. Autosamplers were set to trigger a sampling event when water quality or flow parameters exceeded pre-determined limits, thus providing sample data associated with non-ambient conditions in Clear Creek.

Four autosamplers have been installed since inception of the autosampler program in 2005. Table 2 summarizes the data collection history for the Clear Creek autosamplers. Geographically situated on the Mainstem and North Fork of Clear Creek, in an upstream to downstream configuration, these sites are identified as:

CC AS 26—on the mainstem of CC downstream of the confluence with the West Fork of CC (Lawson gage)
CC AS 49 – on the mainstem of CC upstream of the confluence with the North Fork of CC
CC AS 50 – North Fork of CC above confluence with the mainstem of CC
CC AS 59 – on the mainstem of CC approximately 100 yards upstream of the Church Ditch Headgate

Table 2. Clear Creek Autosampler History

Location	**Data Period of Record**	**Number of Autosampler Monitoring Events**			
		2005-2008		**2009**	
		Ambient	**Event**	**Ambient**	**Event**
CC AS 26	2008 - 2009	6	*	6	*
CC AS 49	2006 - 2009	14	8	7	7
CC AS 50	2006 - 2009	15	*	7	*
CC AS 59	2005 - 2009	16	13	7	4

* Not applicable – this autosampler is not programmed to collect event samples

Tributary Basin Program
Grab samples are collected on all the supply canals to Standley Lake on a monthly basis when the individual ditches are running. In addition, the Croke and Farmers' High Line canals and the Church Ditch are equipped with continuous in-stream monitoring probes and autosamplers at the lake inlets. Lake loadings are calculated using the lake inlet data.

Standley Lake Program
Standley Lake is monitored consistently on a bi-weekly basis throughout the year provided the lake is not covered with ice. Samples are collected at the surface, in the photic zone (two times the Secchi depth) 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 709 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 profiler. The profiler is placed on the lake when the ice has melted in the spring and is retrieved from the lake before the surface freezes. Analytical probes measure standard field parameters plus chlorophyll a, in a depth integrated manner four times daily. The profiler executed at least one full-column profile on 252 separate days in 2009.

Monitoring Results

Clear Creek Grab Sample Results
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 2009 were made against the previous five years of sample data at strategic locations on the Clear Creek mainstem. All of the data summarized in Table 3 were generated from grab samples taken over the hydrograph (8 times/year). Figures 2 through 7 provide nutrient data over the past five years.

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 West Fork CC, Leavenworth Creek, Chicago Creek, Fall River, and South Fork CC, 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): At 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 3. Comparison Clear Creek Grab Sample 2009 averages to 2004 through 2008 averages

Parameter	Site Location					
	CC26 (upstream)		CC40 (midstream)		CC60 (downstream)	
	2009	2004 – 2008	2009	2004 – 2008	2009	2004 – 2008
Total Phosphorus (mg/L)	0.0105	0.0118	0.0094	0.0192	0.0063	0.0192
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Total Nitrogen (mg/L)	0.37	0.50	0.41	0.48	0.38	0.48

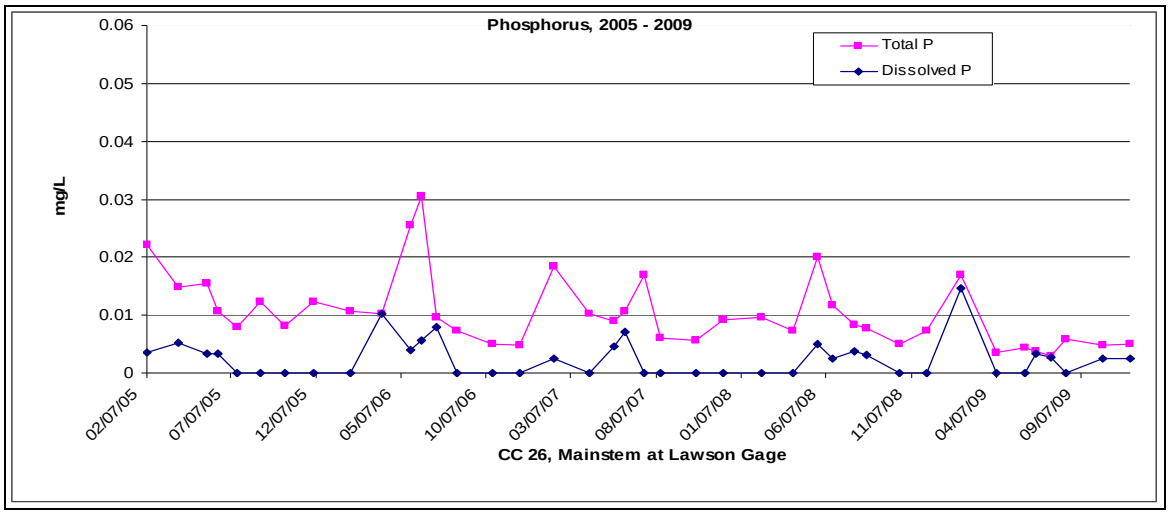


Figure 2. Phosphorus results for CC26 (upstream)

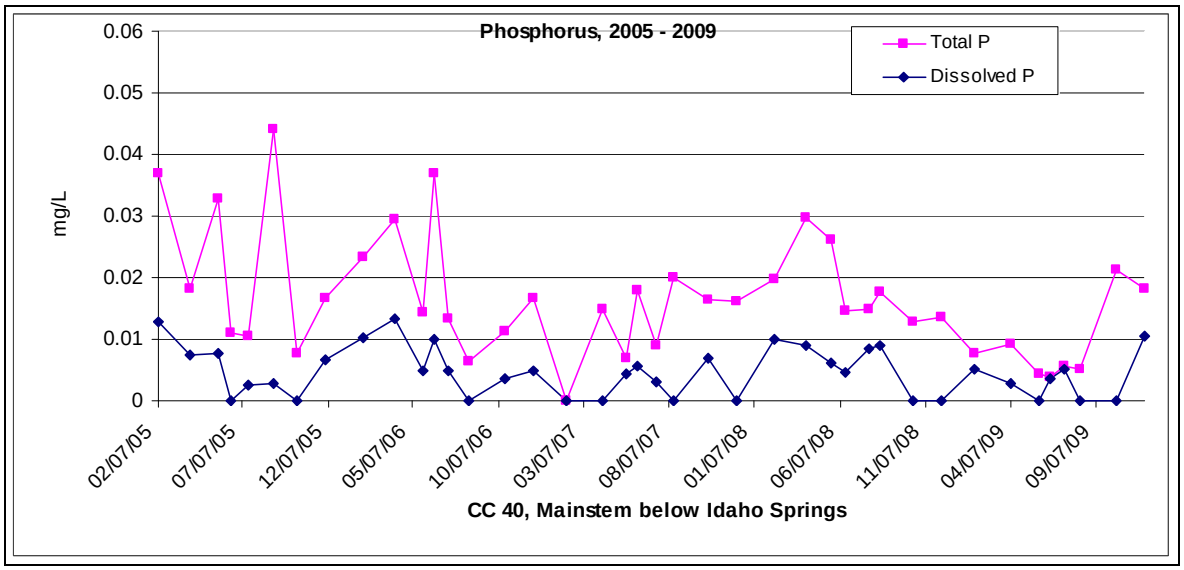


Figure 3. Phosphorus results for CC40 (midstream)

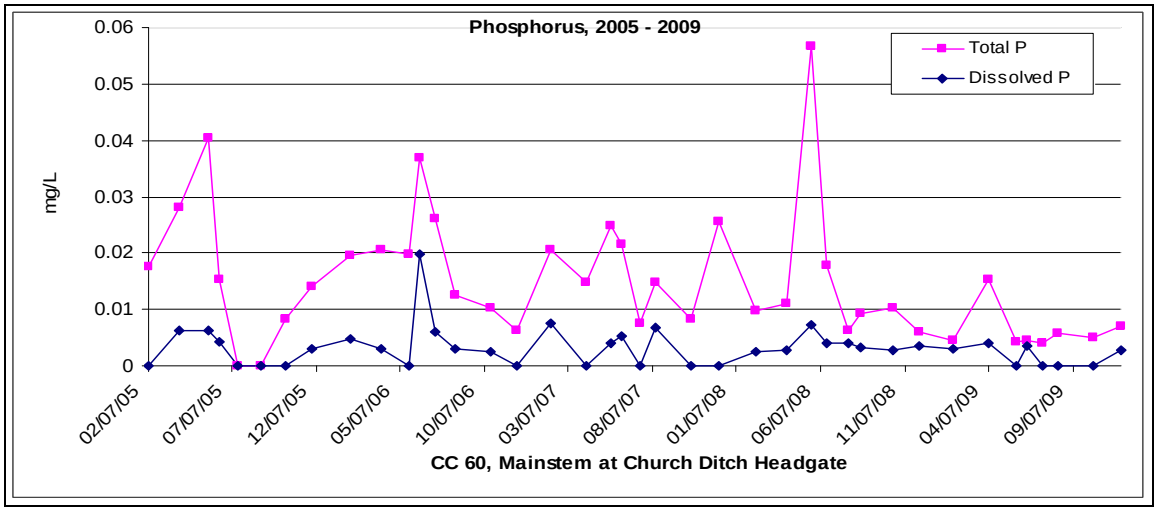


Figure 4. Phosphorus results for CC60 (downstream)

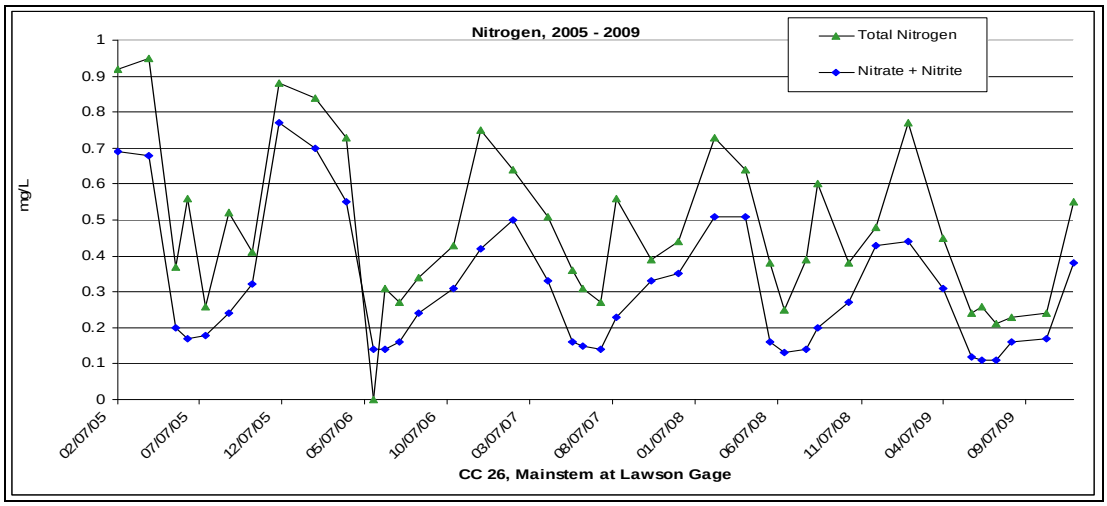


Figure 5. Nitrogen results for CC26 (upstream)

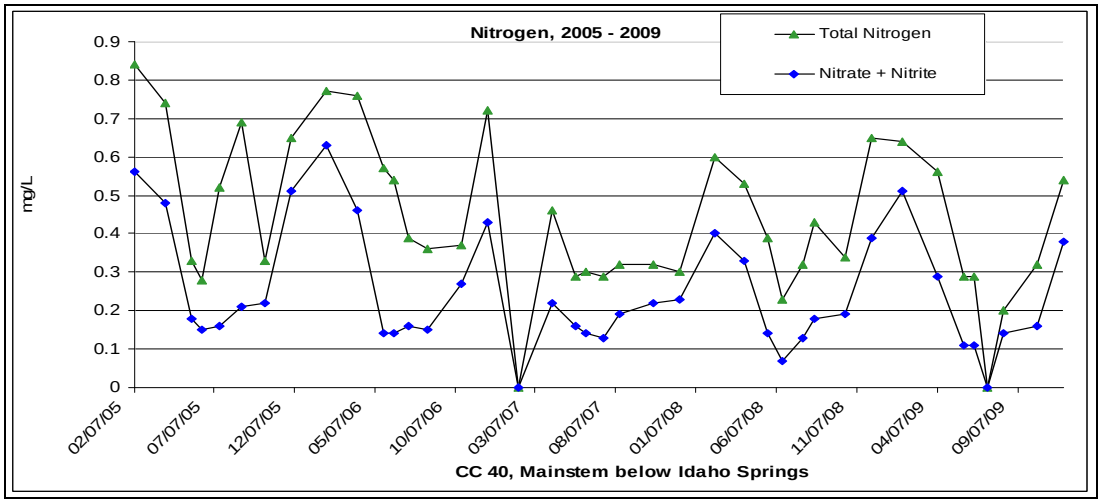


Figure 6. Nitrogen results for CC40 (midstream)

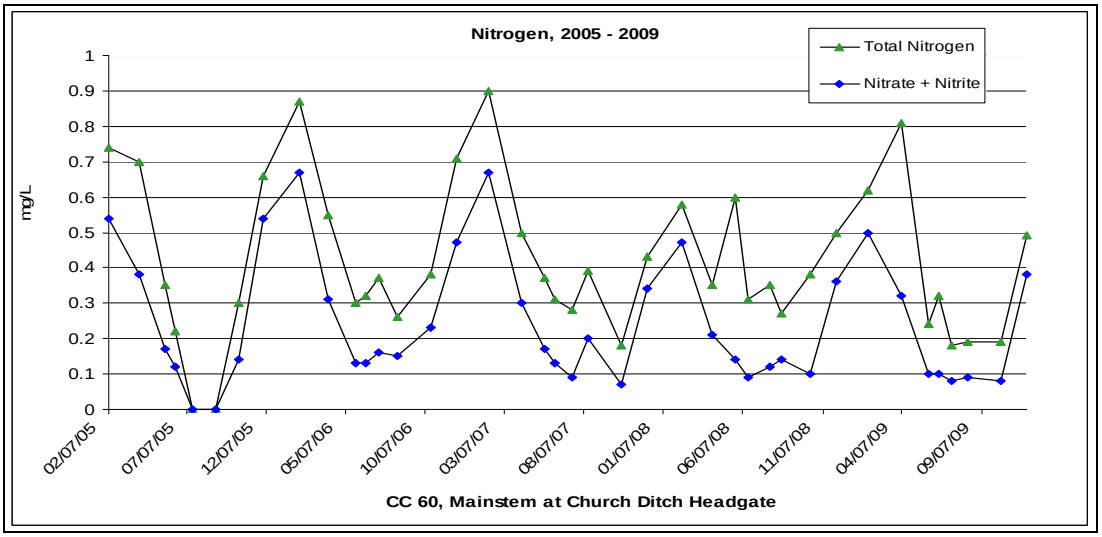


Figure 7. Nitrogen results for CC60 (downstream)

Clear Creek Autosampler Results

Autosamplers collect event triggered samples in addition to monthly composite samples. In-stream water quality monitoring and sampling capability at these sites allows for tracking of 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.

From April through October, two consecutive 24-hour composites were sampled and analyzed for nutrients, TSS/VSS, and metals. Continuous read 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 as these probes can withstand the cold temperatures and require less frequent calibration than the additional probes.

The autosampler network is maintained by the cities of Golden, Arvada and the SLC. CC AS 59, located immediately upstream of the Church Ditch Headgate in Golden, has been in use since 2005. CC AS 49 and CC AS 50, mainstem at Kermits, and N. Fork respectively, have been in use since 2006. The autosampler at CC AS 26, mainstem at Lawson, was installed in 2008. The following graphs (Figures 8 and 9) were generated using 2006 - 2009 ambient (nonevent) data at CC AS 59, the autosampler with the longest period of record. Scatter plots for total nitrogen and total phosphorus are presented with correlations to average daily discharge. Daily average flow was taken from the USGS gage at Golden (CLEGOLCO). Trending of the data was not performed.

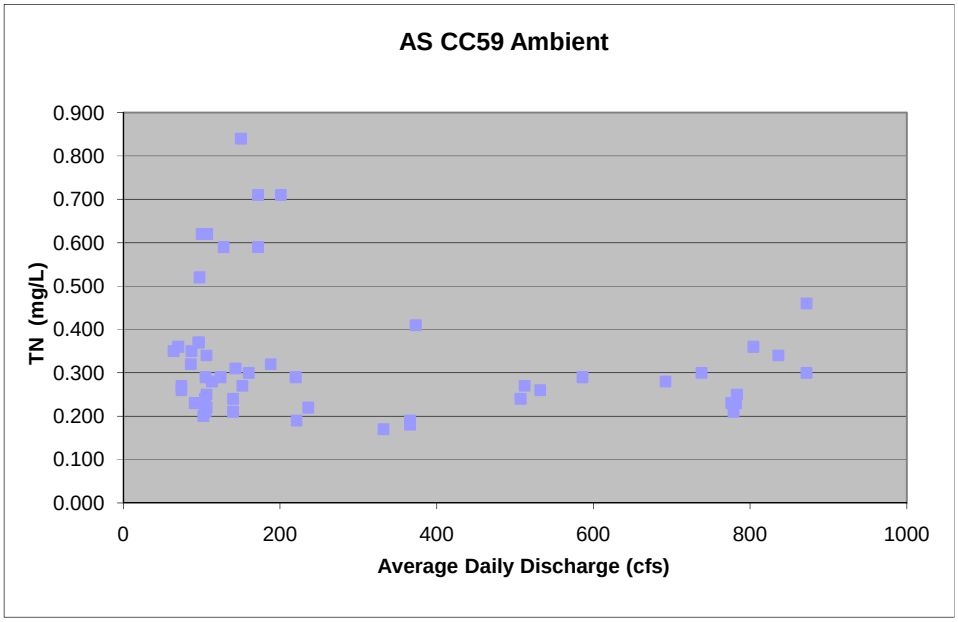


Figure 8. CC59 ambient data graph (2005-2009) - total nitrogen and average daily discharge

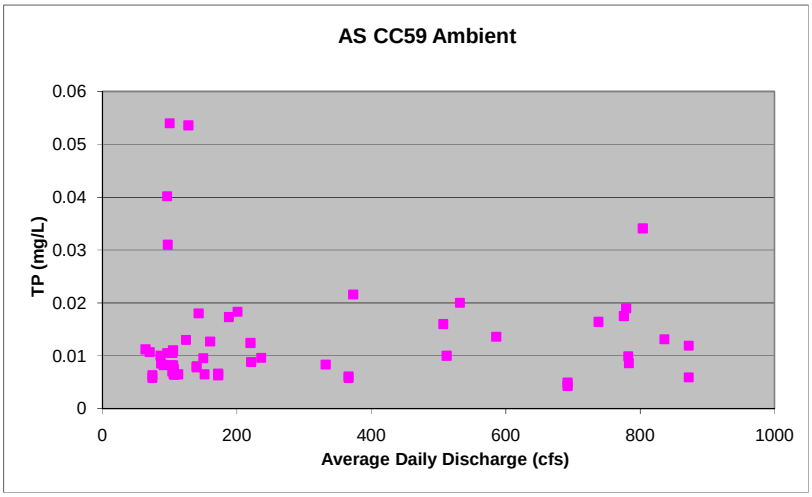


Figure 9. CC59 ambient data graph (2005-2009) - total phosphorus and average daily discharge

Autosampler Events

In addition to the 48 hr composites, autosamplers are set to sample on the mainstem of Clear Creek when turbidities exceed a predetermined level. Precipitation is highly variable in Colorado; therefore, the number of events captured differs by location. Data from the furthest downstream location, CC AS 59 in Golden, shows a good correlation between turbidity and total nitrogen during events (Figure 10). The correlation between turbidity and total phosphorus is poor during events; therefore the data is not presented in this report. Limitations identified in the total phosphorus laboratory method will require collection of additional event samples to accurately quantify the phosphorus loadings from events that mobilize significant quantities of suspended solids downstream.

The Monitoring Program continues to improve on event characterization. To that end, the program will begin correlating real time flow data with sample results at several of the autosampler locations in order to improve loadings estimates for high flow events.

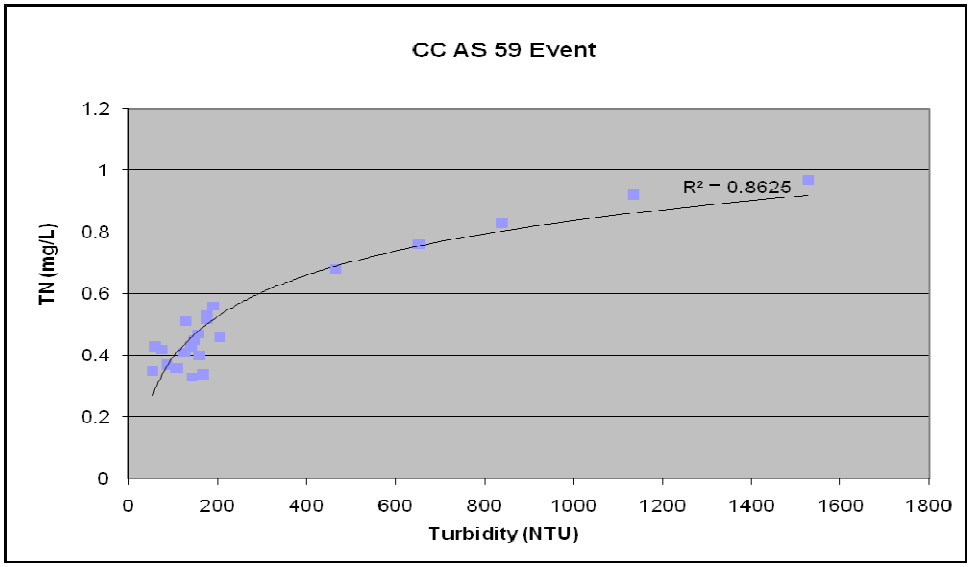


Figure 10. CC AS 59 Events – Turbidity vs. Total Nitrogen – 2006-2009

Tributary Basin Results

Three principal ditches deliver water to Standley Lake from Clear Creek. They are: Croke Canal (Croke), Farmers' Highline Canal (FHL) and Church Ditch (Church). Additionally, the Kinnear Ditch Pipeline (KDPL) delivers water to Standley Lake from Coal Creek and/or the Boulder Diversion Ditch. Understanding the diversion seasons assists in the characterization of pollutant sources. The diversion seasons are detailed in Table 4. 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 when the ditch is in priority.

To characterize nutrient loadings by source, the loading inflow for each ditch was divided by the number of 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. Table 5 summarizes nutrient inflows by ditch for 2009.

Table 4. Pounds of nutrient loading per acre-foot of water diverted in 2009

Ditch	Diversion Season	Factors affecting water quality	lbs/acre-ft diverted			% of Total 2009 Diversions
			TP	DRP	TN	
FHL	4/14 to 10/31	Low flows comprised of wastewater. Higher flows are precipitation or spring runoff driven.	0.0226	0.0085	0.78	67%
Croke Canal	10/31 to 4/14	Wastewater dominated.	0.0433	0.0173	1.23	21%
Church	4/14 to 10/31	Low flows comprised of wastewater. Higher flows include precipitation events and spring runoff.	0.0401	0.0144	0.61	6%
KDPL	Year round	On-site waste system (septic) and precipitation driven.	0.0434	0.0293	1.75	6%

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

Table 5. Total nutrient loadings by ditch/canal in 2009

Ditch	Nutrient Loadings for 2009 (lbs)		
	TP	DRP	TN
FHL	549	208	18,875
Croke Canal	333	133	9,446
Church	82	29	1,233
KDPL	89	60	3,553

Standley Lake Results

Lake data is collected by analysts on a boat collected grab samples or by a profiler instrument. The profiler 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. The instrument performs 4 profiles each day or one profile every 6 hours. The following parameters are measured: dissolved oxygen, pH, temperature, conductivity, chlorophyll a, and turbidity.

Chlorophyll

In 2009, the SLC submitted a proposal to the Water Quality Control Commission (WQCC) for a chlorophyll standard to protect the water quality in Standley Lake. The WQCC ruled on the proposal at the June, 2009 South Platte Basin Standards Rule Making Hearing and approved a chlorophyll standard of 4.0 ug/L with a permissible exceedance of an assessment threshold of 4.4 ug/L once every five years. The standard is based on the most recent 14 years of lake chlorophyll data collected by the SLC. Chlorophyll was selected as the control of choice due to uncertainties surrounding the direct response of algae to nutrients (phosphorus and nitrogen) and other factors that may affect this relationship. The SLC will continue to work on the relationship between chlorophyll and nutrients in an effort to dovetail with the state's Nutrient Standards development effort. The intent of the chlorophyll standard is to protect the current classified uses and status quo of the water quality in Standley Lake, in support of the lake's role as a direct drinking water supply, and in recognition of the significant efforts that have already been undertaken to protect water quality in the upper reaches of Clear Creek, in the basins that are tributary to the feeder canals, and in the tributary areas adjacent to Standley Lake.

The adopted chlorophyll standard is defined as a 9-month average of lake samples collected between March through November, the Standley Lake Year, at site **P**hotic**Z**one-10 (PZ-10). The assessment threshold is designed to address the concern about the risk of incorrectly counting an exceedance that is actually a result of natural variability but does not indicate a substantive change in current conditions. The assessment threshold was developed by calculating the standard error of each 9-month average from which the 90^{th} percentile value of the average was determined. The Commission retained the narrative standard with a slight modification by removing the statement describing implementation of the narrative standard shall only be by Best Management Practices and controls implemented on a voluntary basis.

Excerpts from WQCC Regulation #38 pertaining to the WQCC ruling on the chlorophyll standard for Standley Lake is included as Appendix B to this document.

The chlorophyll a data for the past five years includes one exceedance of the new standard in 2007 (Figure 11). The May event in 2007 resulted in a taste and odor event for the cities of Westminster and Northglenn.

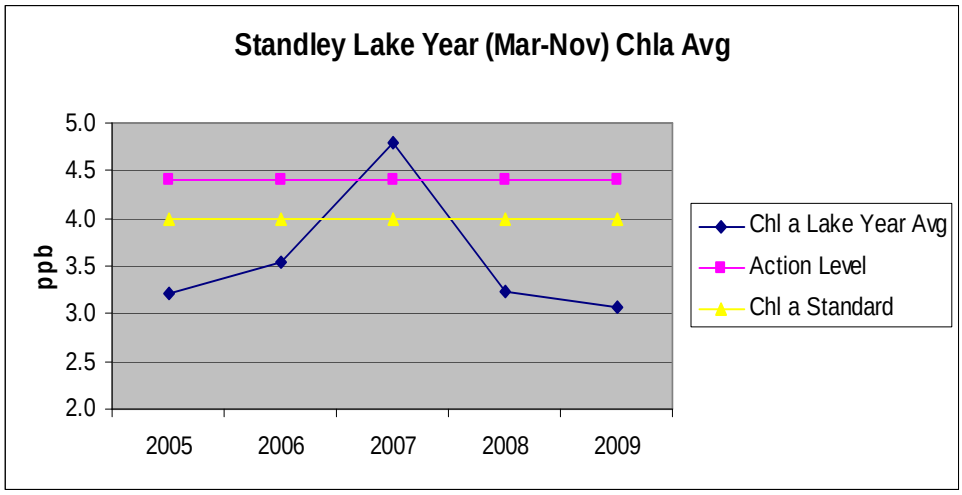


Figure 11. Annual Standley Lake Year Chlorophyll a results 2005-2009

Chlorophyll a and Secchi Depth

Chlorophyll a is generally lower in the summer months, rising in the fall after turnover with continued increases through the winter. Figure 12 is a comparison of secchi depth and chlorophyll a since 2005. In general, secchi depth decreases with increased chlorophyll a concentrations and visa versa.

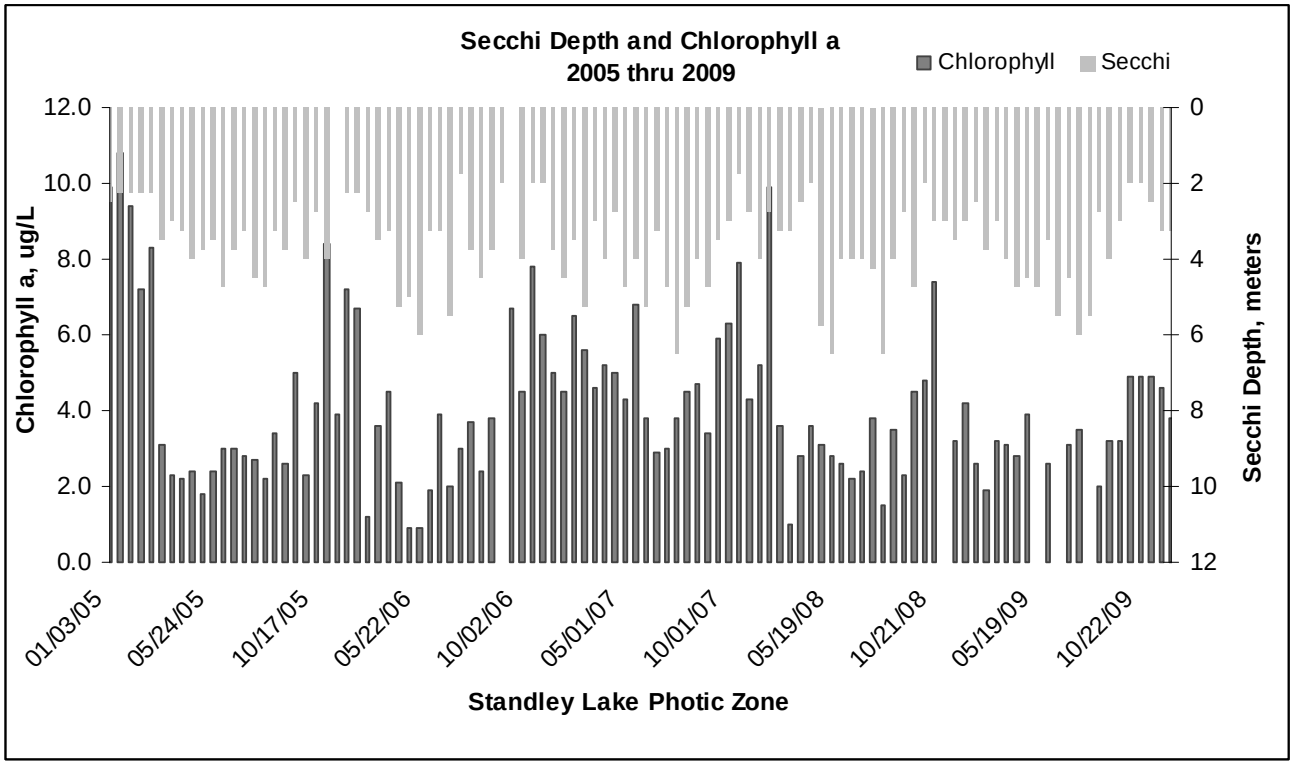


Figure 12. Comparison of Chlorophyll a and Secchi Depth (2005-2009)

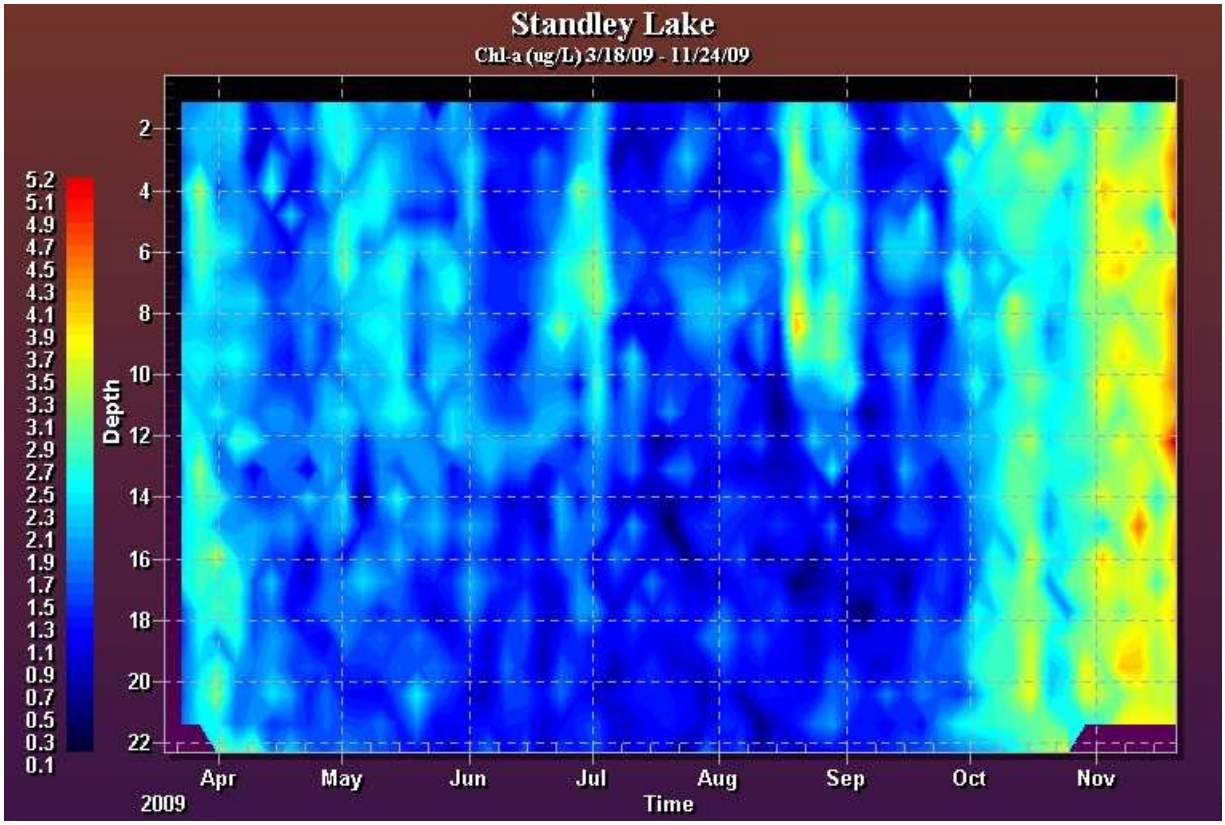


Figure 13. Depth integrated profile of Standley Lake for chlorophyll a (2009). Note the increases in chlorophyll concentration after lake turnover in September.

The chlorophyll data collected using the profiler assists the water treatment facility operators as they optimize treatment to minimize taste and odor issues and reduce the potential for formation of disinfection byproducts resulting from algae blooms.

In addition to the profiler, the City of Westminster acquired FlowCAM technology to assist in monitoring Standley Lake for algae and zooplankton. The instrumentation developed by Fluid Imaging Technologies is a non-destructive analysis of water samples using flow cytometry and a high speed digital camera to identify and quantify the diverse biological species present in the lake. The algae data can be correlated to the chlorophyll concentrations. The biological diversity of the lake changes based on a variety of seasonal factors including temperature, dissolved oxygen and nutrient inputs. These factors and the balance between zooplankton and algae populations aid in predicting the potential for taste and odor events weeks in advance; thus the water treatment plant operators are prepared to respond appropriately to minimize the impacts. The advantage of the non-destructive FlowCAM technology is the ability to further observe the identified algae under the microscope.

Dissolved Oxygen

Figure 14 reveals the strong seasonality demonstrated by dissolved oxygen (DO) with lower concentrations at the lake bottom during the summer months when the lake is stratified. The duration of lake anoxia (DO less than 2 mg/L) has increased over the last 15 years. The average period of anoxia during 1995 - 2000 was 61.5 days. The average period of anoxia during 2002 -2009 was 80 days. The 2001 drought year was not averaged into either time period. Figure 15 details the days of lake anoxia for 1995 – 2009.

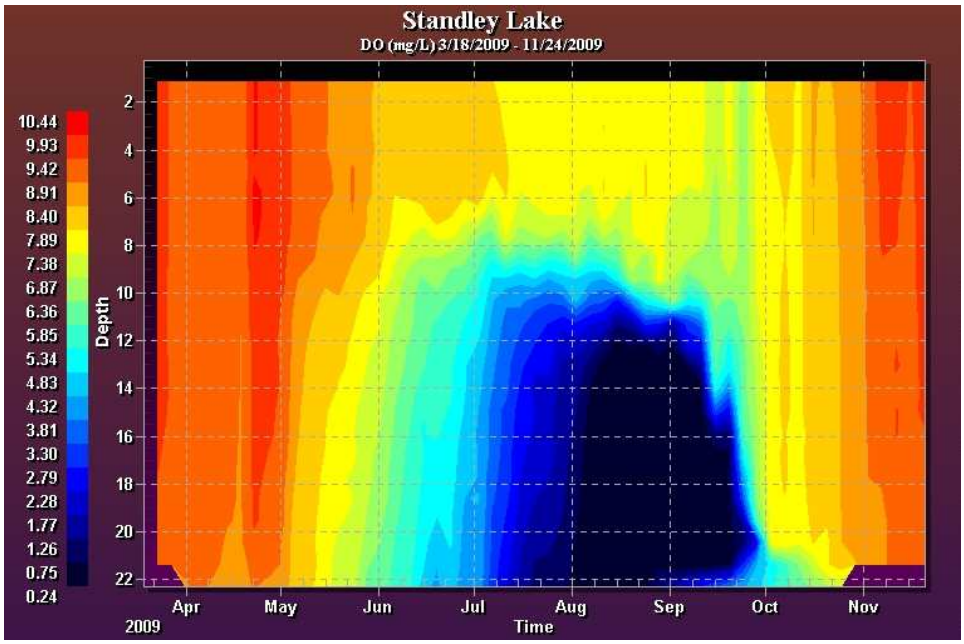


Figure 14. Depth integrated profile of Standley Lake for Dissolved Oxygen

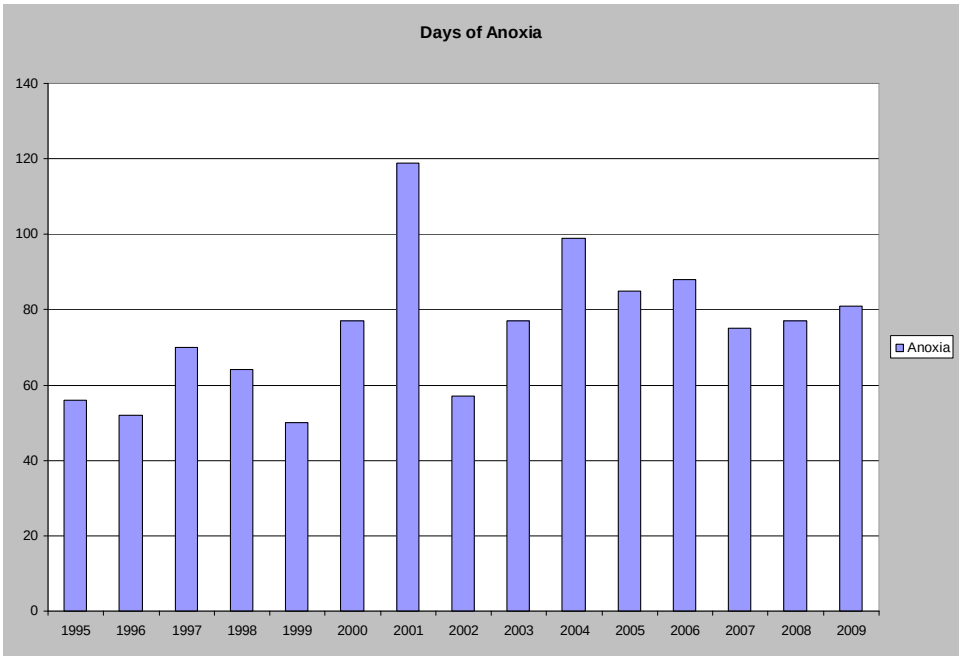


Figure 15. Days of lake anoxia 1995 – 2009.

Nutrient Loadings

The 2009 mass loadings for nutrients are summarized in Table 6. Figures 16 and 17 are graphs of the nutrient loads for the past five years.

Table 6. Standley Lake Nutrient Loadings 2005 -2009

Year	Total Phosphorus (lbs)			Dissolved Reactive Phosphorus (lbs)			Total Nitrogen (lbs)		
	Inflow Load	Outflow Load	Net Reservoir Loading	Inflow Load	Outflow Load	Net Reservoir Loading	Inflow Load	Outflow Load	Net Reservoir Loading
2005	2,902	751	2,151	682	179	503	41,233	11,524	29,709
2006	4,461	2,121	2,340	1,241	883	358	43,399	30,448	12,951
2007	2,740	1,528	1,212	770	576	194	56,139	28,862	27,277
2008	2,848	1,632	1,216	670	578	92	37,254	27,435	9,819
2009	1,052	1,205	(153)	430	489	(59)	33,107	25,080	8,027

Notes: Parentheses indicate a negative value. NA- Not Available. The loadings have been adjusted from previous published reports to reflect corrected flow calculations.
* For calculation purposes, the method detection limit (MDL) concentration was substituted for non-detected concentrations less than the method detection limit.

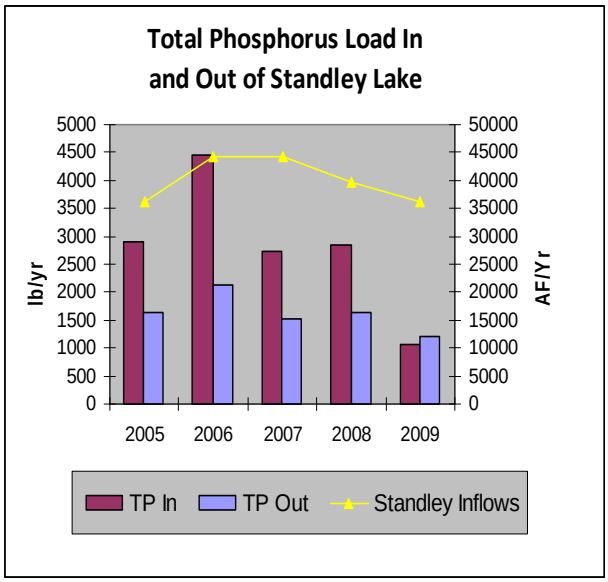


Figure 16. Total phosphorus load and inflow 2005-2009

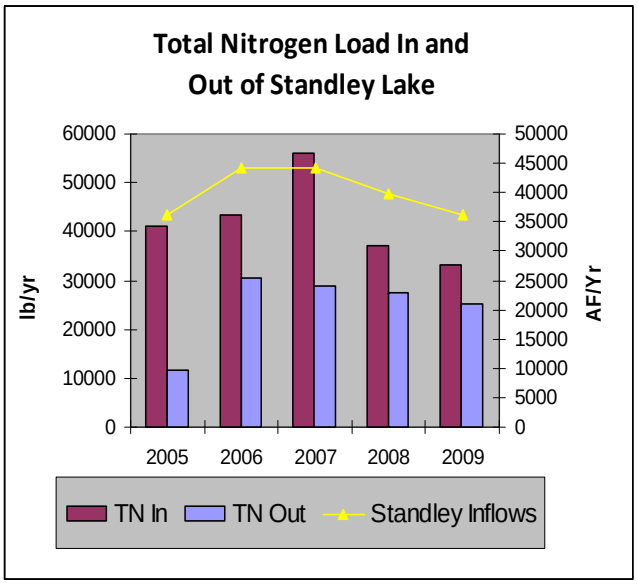


Figure 17. Total nitrogen load and inflow 2005-2009

Nutrient Standards Development Process

The U.S. Environmental Protection Agency (EPA) has been striving to develop national nutrient criteria to address over-enrichment of the nation's surface water supplies. In choosing to regulate nitrogen and phosphorus concentrations, it is inherently assumed that these nutrients regulate the growth of algae. The WQCC has delayed consideration of numeric nutrient criteria for rivers and streams, lakes and reservoirs, and direct-use water supply reservoirs until June 2011. This gives the Division and the stakeholders more time to more fully discuss the proposed criteria.

The SLC are active in the workgroup process for establishing nutrient criteria. Standley Lake operates as a direct-use water supply in that the water is drawn directly from the lake for drinking water treatment. Algal production in the lake is directly linked to the cumulative nutrient loads from upstream contributions. Increased algae populations can subject the treated drinking water to taste and odor issues and increase the risk for formation of disinfection byproducts.

Aquatic Nuisance Species

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 and it was positively identified in 2000.

Eurasian Watermilfoil Weevils were stocked in Standley Lake in 2002, 2004, 2005, and 2006. Weevils are used to control the growth of EWM. Weevils were stocked in 8 locations through out the west side of the reservoir. Adult weevils hibernate along the shoreline in the winter and migrate out to the milfoil plants in the spring. They lay their eggs on the top part of the stem and the larvae burrow into the plant, which causes it to fall out of the water column. As the weevils graze and damage the milfoil, the height and densities decrease. Weevils will never get rid of milfoil completely, but they can control the density of the plants. The milfoil has been the predominant vegetative species in the lake, but the population continued to decline in 2009.

Zebra and Quagga Mussels

Zebra mussels were discovered in Colorado in Lake Pueblo in 2008. The City of Westminster continues to operate a boat inspection and quarantine program to protect Standley Lake from an infestation of zebra and/or quagga mussels. The program includes a combination of inspecting, tagging and quarantining boats, spray washing stations, restrictions on aquatic bait, and an education program for the public and Standley Lake guests. The SLC took a proactive approach to protection of Standley Lake from zebra mussel infestation by increasing the length of the quarantine period prior to the start of boating season in 2009.

To date, no zebra or quagga mussels have been detected in Standley Lake. Monitoring methods initiated in 2008 continued in 2009 and includes microscopic analysis, FlowCAM analysis, shoreline surveys, and substrate samplers. Early detection efforts are important to best prepare operations staff of threats to the drinking water treatment infrastructure.

Watershed Activities

Source Water Protection

Clean and dependable public water supplies are critical to the health and economic sustainability of the Clear Creek Watershed and the Standley Lake Cities. Considering the associated economic value and the importance of the Cities' water resources, local public water providers have worked diligently for years to protect the water sources. These efforts form the basis for creation of an Upper Clear Creek and Standley Lake Watershed Source Water Protection Plan. Source water issues often impact multiple public water providers and long-term solutions will likely require both communication and cooperation. The protection plan development process was locally driven and designed to enhance collaboration between public water providers and community stakeholders. This voluntary program increased awareness of protecting water resources and provided an excellent framework for watershed collaboration with a drinking water focus. Funding was obtained to facilitate this process through a $50,000 grant administered by the Colorado Department of Public Health and Environment.

Meaningful outcomes included increased public awareness, greater communication between water providers, decision makers and stakeholders, better access to watershed data, and other benefits. An effort is currently underway to update the Watershed Agreement to better identify common goals among all the stakeholders.

The Source Water Protection Plan document and a Best Management Practices guidance document will be posted on the State's Source Water Protection website when finalized. This Source Water Protection Plan provides local public water providers and community stakeholders appropriate protection and pollution prevention strategies.

II. The Upper Clear Creek Watershed Association

The Upper Clear Creek Watershed Association (UCCWA) focused on two main areas in 2009 in addition to its ongoing activities as a 208 Management Agency which involves the reviewing and monitoring of plans and projects.

Work begun in 2007 toward a Countywide Wastewater Utility Plan and individual Wastewater Utility Plans for each of the ten dischargers in Clear Creek County was completed. The remaining plans were reviewed by UCCWA and forwarded to DRCOG with recommendations to approve. The Wastewater Utility Plans are important for improving wastewater plant performance, effluent quality, and therefore Clear Creek water quality, especially regarding nutrient levels, over time.

UCCWA continued work with consultants in preparation for a Water Quality Control Division hearing in April to establish new underlying zinc standards, continued from 2008.

Work began in 2009, in cooperation with the Standley Lake Cities, to revise the Clear Creek/Standley Lake Watershed Agreement. The revised agreement is expected to be presented for approval by both parties in 2010.

In its role as the 208 Management Agency for the Watershed, UCCWA reviewed four projects referred for comment. UCCWA members voted to comment on three other matters that, while not officially referred for comment, were deemed of significance in the watershed.

A new member was added to the UCCWA rolls in 2009 as we welcomed the Clear Creek Watershed Foundation. This new member brings a proven track record of interest in, and support of, all efforts to improve water quality in the upper Clear Creek watershed.

City of Black Hawk

In 2009, the City of Black Hawk undertook the following water improvement projects:

- The Dory Hill Vortex Pretreatment Building is on line for the second season and the water treatment staff is in the process of optimizing this system. 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. Historically, the turbid water from the spring runoff flows and summer thunderstorm events sometimes exceeded the Dory Hill treatment plant capability and when that occurs, raw water diversion is suspended.
- The construction of the one-million-gallon Silver Gulch Potable Water Storage Tank is substantially complete. The new Ameristar Hotel is finished and is occupied with more than 530 hotel rooms. The Silver Gulch Tank's storage has taken the peak loads off the Dory Hill Treatment Facility.
- The City has acquired a joint interest in Green Lake with Clear Creek County, along with a water delivery right by way of Vidler Tunnel to Leavenworth Creek: The construction of a new pump station and control vault, new diversion pipeline, and minor repairs to the existing dam that was started in 2009 will continue during the 2010 construction season. Ultimately, Green Lake will provide up to 270 acre-feet of raw water storage for the County and City use during low stream flow conditions in Clear Creek.
- The Jerry B. Buckley Power Plant and three-acre site alongside Clear Creek at Georgetown Lake has been decommissioned – the equipment has been dismantled and salvaged and the 40 cfs penstock has been removed. A preliminary engineering report has been submitted to the City delineating options to increase the release from the reservoir to protect senior water right of downstream users during periods when the reservoir water level is below the spillway crest. The 3-acre site has been sold to a private party along with the existing wood frame building.
- The City is working with the Colorado Department of Public Health and Environment (CDPHE) and the US Environmental Protection Agency (EPA) for removal of mine waste rock piles within the City boundaries. In 2009, the City removed approximately 3,000 cubic yards of mine waste rock and

transported it to the CDPHE/EPA's Church Placer Repository northwest of Central City. Black Hawk plans to continue working with CDPHE & EPA toward the clean-up of mine waste material from the City

Black Hawk/Central City Sanitation District

The Black Hawk/Central City Sanitation District plant continues to meet all discharge permit limits. Average daily flows remained below 0.55 million gallons/day. As the result of an Intergovernmental Agreement, the plant incorporates full scale Biological Nutrient Removal (BNR) and filtration. It consistently removes nutrients to very low levels, even though there are no nutrient limits in its CDPS permit. During 2009 the plant experienced total phosphorus levels well below 0.3 mg/l.

City of Central

Central City continued its standard erosion control measures in 2009 on the Central City Parkway and throughout the City including rock mitigation work, cleaning out storm drains and removing sand from gutters and on the shoulders from winter maintenance. Central City continues working with Black Hawk on projects of mutual benefit. The City cooperated with CDPHE on several projects in and adjacent to the City.

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 2009. 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.

Clear Creek County

Clear Creek County Environmental Health

The Clear Creek County Environmental Health Department issued 37 Individual Sewage Disposal System (ISDS) permits (23 new, 2 renew, 12 repairs) in 2009. The Environmental Health Department conducted 128 inspections during 2009.

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 continues to use an emergency call-down system. The Clear Creek County Office of Emergency Management Director updates and maintains the database for the call lists. This system applies to incidents/spills into Clear Creek and tributaries leading into Clear Creek. There were 7 incidents in 2009.

Clear Creek High School

The Clear Creek High School is a Zenon (MBR) membrane filtration plant. It came on line in 2004 with management continuing to be provided by AAA Operations, Inc. Alum continues to be added for nutrient removal when needed. 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 2009.

Clear Creek Ski Corporation (Loveland Ski Area)

Clear Creek Ski Corporation's most recent permit reduced the effluent limit of fecal coli form so a compliance schedule was included in the event new construction or modifications were required to achieve the limit. CCSC continues to meet the new limit with operational changes only.

Clear Creek Watershed Foundation (CCWF)

In 2009, CCWF maintained its focus on projects and initiatives identified in its 2007 *Clear Creek Watershed Report: Exploring Watershed Sustainability*. CCWF continued to advance projects, partnerships, funding, and implementation strategies in the areas of Alternative Energy & Transportation, Water & Wastewater Management/Waste Stream Reduction, Orphan Mine Remediation, Natural Resource Management and Public Outreach & Education.

- Supported Clear Creek County's Renewable Energy Initiative through ongoing research and communication with EPA, USFS, State (GEO, Brownfields Foundation, etc.), Clear Creek County, CCEDC (attended annual meeting – New Energy Economy), Idaho Springs, and other interested parties; and gave presentation at the annual Colorado Watershed Conference.
- Organized and co-hosted the February Renewable Energy Symposium**.**
- Ongoing involvement with the I-70 SWEEP and PEIS process.
- Ongoing participation with UCCWA.
- Participation in Standley Lake Cities' Source Water Assessment and Protection (SWAP) Study Steering Committee and BMP Report.
- Ongoing tracking of and participation in CDPHE/WQCC Water Quality Standards, South Platte/Regulation 38 Hearing and Nutrient Criteria.
- Gilson Gulch Orphan Mine Remediation 319/NPS grant ($425K). The first sub-project, the Silver Age Mine Project, was completed; run-on/run-off controls and installation of a French Drain diversion around mine waste piles to divert clean water away from contaminated waste Design work began for the second sub-project, the Gilson Gulch Outlet Project, and the third sub-project, the Upper Gilson Gulch Erosion and Sediment Control Project (Figure 18).

Figure 18. CCWF work in progress in Gilpin Gulch, Idaho Springs

- Upper Trail Creek Orphan Mine Remediation 319/NPS grant ($484K). Work has begun; land/access work, preliminary site characterization, and water quality monitoring.
- EPA Targeted Watershed Grant ($744K) for remediation projects in Lower Trail Creek, North Empire/Lion's Creek and the Maude Monroe. Lower Trail Creek Remediation Project completed, including site characterization, surveys, access/easement research, QAPP/SAP finalized; clean out of the channel, drainage controls and sediment traps installed; and ongoing water quality monitoring. Began Aorta/North Empire Creek remediation project research, and EPA sugarbeet/lime waste research.
- West Gold Orphan Mine Site; spring revegetation of 2008 remediation project (Figures 19 and 20).

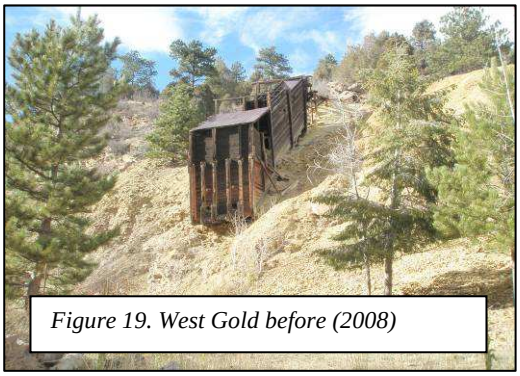


Figure 19. West Gold before (2008)

Figure 20. West Gold revegetation in process

- Preliminary research for Castleton Mine and Minnesota Mine remediation projects.
- Ongoing research and communication regarding local mining issues.
- Collaborated with the USFS, EPA Region 8, Coors, Clear Creek County, and the National Forest Foundation/Friends of the Forest and managed the greenback cutthroat trout habitat creation and wetland restoration at Grizzly Gulch.
- Ongoing discussions with Trout Unlimited and EPA Region 8 concerning stream habitat restoration projects/*Fishing Is Fun*; and the WDTU *Home Rivers Initiative* for Clear Creek.
- Coordinated with USFS and Mill Creek property owners for wildfire mitigation planning.

Climax Molybdenum Company

Henderson Mine

In 2009, Henderson improved the Storm Water Management Plan by adding more barricades to protect rock silt fences. All of the storm water BMPs were cleaned and repaired before the winter storms began.

Urad Mine site

Some of the drains were upgraded to aid in dam drainage.

Colorado Department of Transportation

In 2009, 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 for impacts will be identified in the PEIS. 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 in this basin was completed by the end of 2009. A final report on Hoop Creek will be available this fall by request to CDOT. This concludes the three-year, post-construction monitoring required by the 404 permit. Minimal monitoring for sediment and chloride will continue for another year at the mouth of Hoop Creek. A petroleum spill in the fall of 2009 resulted in thousands of gallons entering the watershed. Petroleum products are just appearing in Hoop Creek. Although CDOT is not the responsible party, we have requested an immediate cleanup action.

Sediment has been routinely measured and removed from the sediment control basins built during the final Berthoud East projects. This sediment is being placed at a site adjacent to Fall River, within I-70 Right-of-Way. The mill tailings cap in Empire, is now full, and has been regraded and reseeded. Vegetation is growing on the older portion, but the newer area will be seeded again. CDOT continues to look for new sites for sand disposal, as well as support research for traction sand reuse.

Lighting is being added to chain up sites for trucks along both east and west-bound sides of I-70. Lighting increases safety at the sites, supports enforcement of Colorado chain laws, and helps to reduce truck accidents in winter months. Fewer truck accidents mean fewer spills into Clear Creek.

The study of water exiting the Eisenhower-Johnson Memorial Tunnel was continued in 2009. This effort tracks water quality and quantity at the inflow and outflow areas. Flow levels indicate a large influx of groundwater to the wastewater treatment area during spring snowmelt. Regular monitoring of outflow will continue indefinitely, as part of the Tunnel's subterranean discharge permit with CDPHE.

Town of Georgetown

Georgetown completed a Preliminary Engineering and Final Engineering Reports for upgrading the Wastewater Plant. Received $5,800,000 in ARRA funding to do improvements to the Wastewater Plant; $2,000,000 in loan forgiveness, $3,800,000 loan at 0% interest for 20 years.

Wastewater Treatment Facility Improvements started in September 2009 with site improvements including:

- Headworks Improvements (enclosure and grit removal)
- Biological Treatment Process
- Secondary Clarifier Equipment
- Conversion of Existing Clarifier to Effluent Equalization/Backup Clarifier
- Tertiary Filtration using Effluent Sand Filters
- Chemical Storage and Feed Systems
- Aerated Biosolids Storage and Handling

- Facility Operations Building
- Facility Electrical and Control System
- Remodel Existing Operations and Administration Building

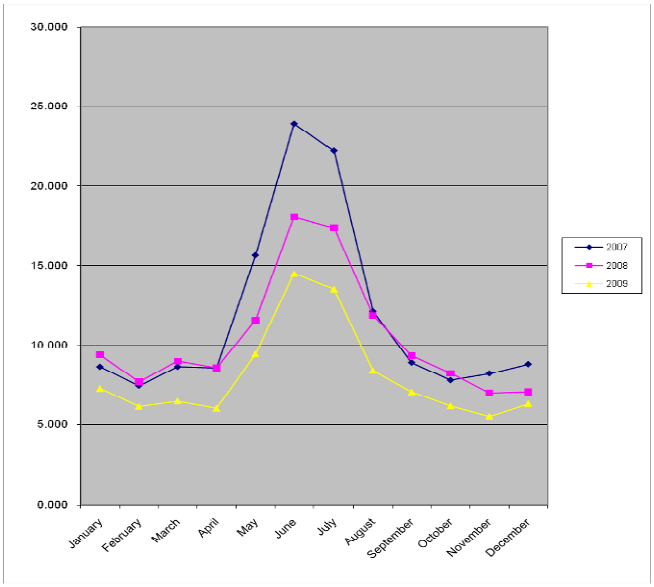
There were no violations in 2009.

Silver Plume completed a Preliminary Engineer Report for the rehabilitation of their sewer collection lines. Silver Plume flow is 30% of Georgetown's wastewater plant influent.

After completion of the sewer collection line in 2008 the Wastewater Plant influent flow deceased by 32 % from 2007 to 2009 (Table 7 and Figure 21).

Table 7 and Figure 21. Town of Georgetown Monthly WWTP influent flow total in million gallons

	2007	2008	2009
January	8.626	9.383	7.262
February	7.439	7.686	6.134
March	8.626	8.994	6.484
April	8.562	8.563	6.023
May	15.633	11.561	9.443
June	23.916	18.056	14.500
July	22.240	17.382	13.533
August	12.119	11.852	8.399
September	8.894	9.341	7.060
October	7.779	8.227	6.175
November	8.206	6.983	5.534
December	8.796	7.053	6.301
Total Year	**141**	**125**	**97**



Gilpin County

Gilpin County continues programs implemented under the Watershed Agreement, including strengthened ISDS regulations, particularly in identified sensitive areas and in areas with higher densities, and erosion control best management practices.

City of Golden

Water Quality/Pretreatment Program

- The City maintains a permanent monitoring and sampling station at CC59, located above the City's water intake, approximately 1 mile above the intersection of US 6 and Highway 93 in Golden. This site is part of the cooperative monitoring program between the upper and lower basin water users and is used for continuous in-stream data acquisition, ambient monthly sampling and storm event triggered monitoring. Automatic samplers successfully collected samples for 4 large storm events during the 2009 season. A complete analysis of this data is available from the City upon request.

Stormwater Program

- The Stormwater Program continues its public education campaign by distributing educational materials and attending public events.
- The City responded to 26 reports of discharges, or potential discharges, to the storm sewer system, issuing 6 written warnings and invoicing twice for reimbursement of clean-up costs.
- The City administered 27 stormwater quality construction permits; conducted 762 erosion and sediment control inspections; issued 237 written notifications of violation, 109 verbal notifications of violation, withheld 5 permits, and used performance security for corrections at three sites.
- The Stormwater Maintenance Program conducted 171 inspections of permanent water quality BMPs and sent 163 letters requesting maintenance to land owners, with subsequent 100% compliance.
- The City updated written procedures to prevent or reduce pollutants in runoff from municipal operations.

Water Quality/Pretreatment Program

- On May 2, 2009, the City sponsored the first annual pharmaceutical drug take back program as part of the City's annual community recycle and clean up days. Almost 100 pounds of prescription and non-prescription drugs were collected and properly disposed of. The City expects to host this program on an annual basis.
- The Pretreatment Program issued 3 Mobile Power Washing permits in 2009.

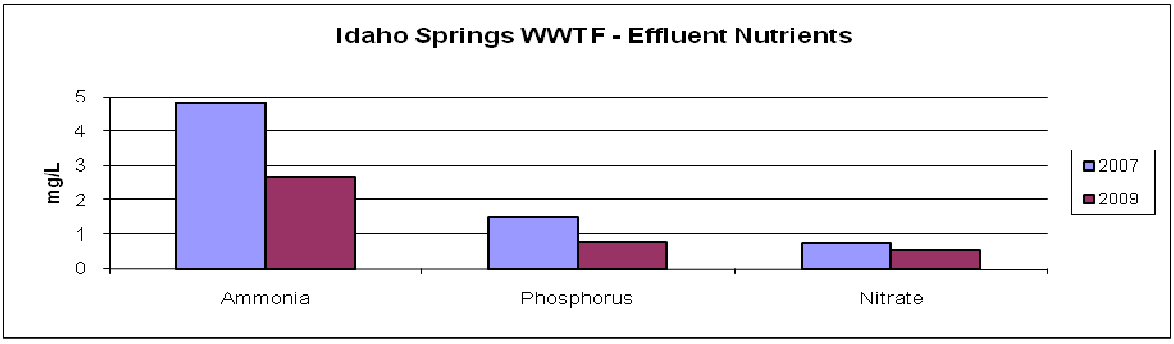
City of Idaho Springs

Idaho Springs remains completely committed to water quality protection. It was the fourth year with Ramey Environmental Compliance onboard, and no discharge violations were experienced. For the third year in a row, our newest operator was awarded Rookie Operator of the Year from CRWA, and we received Wastewater Plant of the Year for 2009.

Our focus has been nutrient removal, and with the expertise of REC and our dedicated staff we are pleased with the results achieved from the twenty-five year old SBR. The annual average discharge of ammonia was 2.23, nitrate was 0.52, and phosphorus was 0.81.

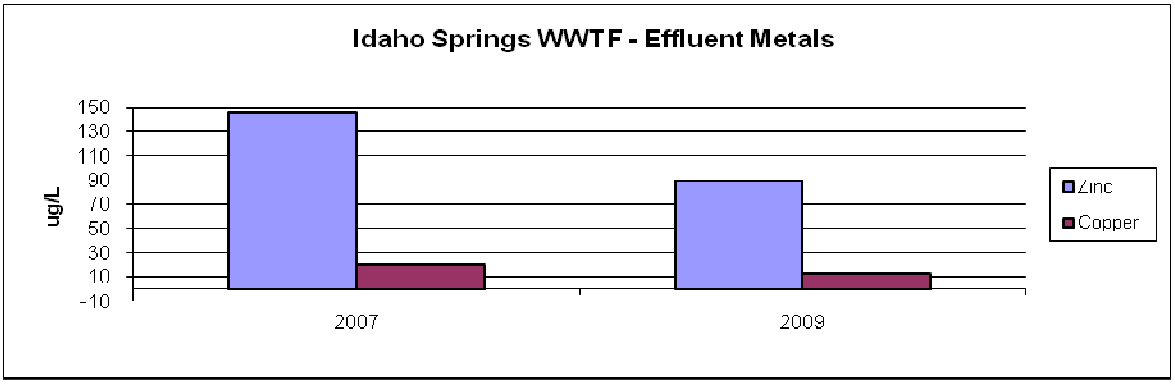
What did not happen was the final phase of the collection system upgrade that would have removed five manholes from Clear Creek, and eliminated severe I&I during high creek levels. The approved and engineered project was a victim of the State's budget deficit, and funding was pulled just prior to the scheduled bid process. The substantial WWTF upgrades approved in 2008 have also been delayed, with construction now anticipated to begin mid to late 2010.

Table 8 and Figure 22. Idaho Springs WWTF – Effluent Nutrients



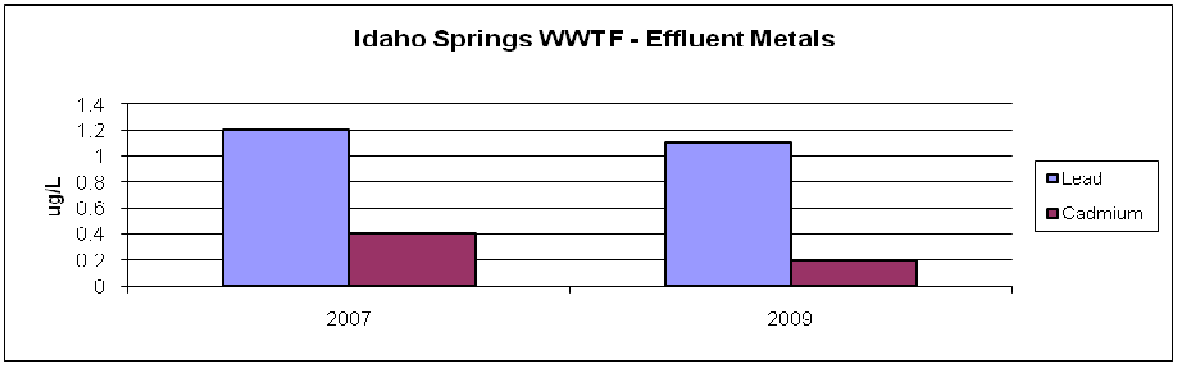
	2007	2009
Ammonia	4.83	2.65
Phosphorus	1.48	0.78
Nitrate	0.75	0.54

Table 9 and Figure 23. Idaho Springs WWTP – Effluent Metals (Zinc and Copper)



	2007	2009
Zinc	145.5	88.7
Copper	20.7	11.9

Table 10 and Figure 24. Idaho Springs WWTF – Effluent Metals (Lead and Cadmium)



	2007	2009
Lead	1.2	1.1
Cadmium	0.4	0.2

Jefferson County

Jefferson County has a municipal separate storm sewer (MS4) permit. Jefferson County's program includes: Public Education and Outreach; Public Participation and Involvement; Illicit Discharge Detection and Elimination; Construction Site Runoff Control; Post Construction Site Runoff Control; and Pollution Prevention/Good Housekeeping.

Jefferson County supports many stormwater management programs in the watershed, including the Rooney Road Recycling Center, which also serves as watershed prevention BMP. The Rooney Road Recycling Center provides proper disposal programs for residents of Unincorporated Jefferson County and the cities and towns of, Arvada, Golden, Lakewood, Mountain View, Lakeside, Edgewater, Morrison, Westminster and Wheat Ridge, to recycle their household hazardous waste (HHW). HHW includes electronic waste, household chemicals, paints, propane cylinders and automotive products. HHW materials collected at the facility since 1994 total more than 4,129,560 lbs of potential surface water and ground water pollutants. In 2009 the

HHW program serviced 3247 participants, with 2.3% of those utilizing the Door-to Door program. 1,061 participants were from the Unincorporated Jefferson Counted accounting for over 33 % of the total participation. More than 18,400 participants provided approximately 58 million pounds (74,000 cubic yards) of yard waste, construction lumber and tree limbs to be, ground, chipped and recycled into mulch and compost.

The county provides opportunities for residents and visitors in the watershed to learn and be involved in environmental stewardship and programs that promote water quality. The county has a comprehensive storm sewer outfall map to trace sources of potential illicit discharges and illegal dumping in the watershed.

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. Jefferson County has an inspection program for illicit discharges, construction activities, and includes post-construction Inspections.

Jefferson County Storm Water 2009 Activities and Actions

- Illicit Discharge Verbal Notification of Violation – 2
- Illicit Discharge Monetary Penalty/Fine – 0
- Construction Sites Covered by Program – 614
- Construction Inspections – 3,035
- Enforcement Verbal Notification of Violation – 495
- Post-Construction Inspections – 9
- Storm drain marking program - Ongoing

Molson Coors Brewing Company

Coors Brewing Company continues to fund stormwater efforts, water quality monitoring and habitat restoration funding throughout the Clear Creek watershed. In particular, Coors funded $30,000 to the Clear Creek Watershed Foundation and provided funding for the “Golden Mile” in Golden, a Trout Unlimited stream restoration project. In addition, Coors is involved with multiple committees to focus on sustainable and long-term programs to enhance the quality and sustainability of the Clear Creek watershed and ecosystem as well as focusing on our Global Water Commitment.

At the Golden Brewery, a nearly $4 million project was completed to ensure that water flowing through the Agricultural Ditch was protected from brewery processes and to eliminate the need to shut the ditch down for quarterly inspections of brewery equipment.

Saddleback Metropolitan District

The 20 lots in Phase 1 of the 86 lot Saddleback residential development have been sold. Most homes have received a Certificate of Occupancy with a few under construction. Well and ISDS monitoring are underway. Sampling continues at the three groundwater monitoring wells down-gradient of the subdivision, and no impacts have been seen to date. Road construction is completed and awaiting certification from the County on Phase 2A (13 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 2009. AAA continues to control sludge age for biological nutrient removal.

Town of Silver Plume

The Town of Silver Plume continues to ensure no adverse impact to water quality in Clear Creek. The town does not apply chemicals to roadways for snow melt, thus precluding leaching into storm water. The Town took steps to begin a Preliminary Engineering Report on repairs to the waste water collection system to reduce/eliminate I&I. The presentation of the report is expected in early 2010 and the Town will seek funding to implement the recommendations of the report.

Superfund (CDPHE/EPA) Remediation Projects

The Argo Tunnel Water Treatment plant continues to operate, treating an average of 225 gallons per minute from the Argo Tunnel, Big Five Mine adit and Virginia Canyon ground water. The plant's operation prevents an average of 790 pounds per day of metals from entering Clear Creek. On October 1, 2009, the remedy status of the WTP was transitioned from Long-Term Remedial Action to O&M, and CDPHE assumed 100% of the operation and maintenance costs.

The third phase of implementing sediment control and mine waste pile remediation efforts was completed in 2009. The mine waste rock and sediment control project was implemented in three separate phases due to the scope of the project and the numerous waste rock piles involved in the project. Phase I was completed in 2007 and included construction of both the Nevada Gulch and Russell Gulch sediment retention dams. Additional effort was directed at select waste rock piles located in both Russell and Willis Gulches. Phase II was implemented in 2008 and included significant grading/stabilization work on the repository and capping of the Pittsburg waste rock and tailings piles.

Phase III construction activities began July 6, 2009, with McCollum's Excavating conducting the work. This project involved the excavation, transportation and consolidation of select waste rock piles from Nevada Gulch, Russell Gulch and South Willis Gulch to the repository and reclamation where the piles were removed. Phase III was halted in November as snow storms resulted in numerous delays and ground that needed to be excavated froze. By mid-November the site was covered with over eight inches of snow. McCollum's contract will be extended to allow them to return in spring to complete the re-vegetation and reclamation work and implement a change order to address the erosion that occurred at the Pittsburg Mine location during a significant late July 2009 storm event.

The City of Black Hawk contacted the agencies seeking approval to re-locate 3000 cubic yards of waste rock from within a residential area and adjacent to the flow in Chase Gulch, a tributary to the already impacted North Fork of Clear Creek, to the Phase III consolidation area. Approval was granted and the city successfully completed their project.

CDPHE and EPA are considering a design to expand the consolidation area to provide additional capacity into the future. This design, if approved, would be implemented during the summer of 2010.

CDPHE and EPA continue to work towards implementing a water treatment remedy along North Clear Creek. The OU4 Record of Decision selected active treatment of the Gregory Incline discharge and Gregory Gulch alluvial ground water at a privately owned water treatment plant, along with passive treatment of the National Tunnel discharge in a sulfate reducing bioreactor. Additional studies have been performed, and CDPHE and EPA are considering pursuing an amendment to the remedy to allow for active treatment of the Gregory Incline, Gregory Gulch and National Tunnel at a new water treatment plant.

CDPHE and EPA have been coordinating with CDOT in an effort to leverage the agencies' various interests along North Clear Creek on the SH 119 corridor. These interests were formalized in an interagency agreement executed August 2009 between CDPHE and CDOT. CDPHE has identified the SH 119 right-of-way to be an ideal location to site a pipeline for conveying mine drainages to a downstream location for treatment, and CDOT has indicated a willingness to allow CDPHE to locate the pipeline and treatment system within the right-of-way during highway widening construction.

III. TRIBUTARY BASIN and CANAL COMPANIES

Tributary Basin Area

The Standley Lake watershed encompasses 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 inflows into the Standley Lake supply ditches.

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 all or portions of the storm water flows around Standley Lake (see Figure 27). This effort prevents 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 was completed in 2008 (Figure 25). The ditch will be enlarged to a capacity of 125cfs in phases as development occurs.

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.

Figure 25. Church Ditch bypass overview

Ditch Inflows to Standley Lake

The Croke Canal, Church Ditch and Farmers' High Line Canal divert water from Clear Creek to Standley Lake. West Slope water via the Moffat Tunnel and water from Coal Creek are also diverted to Standley Lake through the Kinnear Ditch Pipe Line. Additional 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. These water delivery structures received routine maintenance in 2009. 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
- Stopping diversions into the canals in response to events that potentially impact water quality such as mine blow-outs, vehicle crashes, and other occurrences reported through the emergency call-down system
- Maintaining and cleaning canals to restore capacity,
- Placing the removed spoils below the canals' banks and grading slopes to drain away from the canals
- Requiring all development projects adjacent to the canals to install water quality BMP's designed to mitigate impacts caused by stormwater drainage entering the canals, and
- 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.

In 2009, the Church Ditch Water Authority constructed a flow separation/bypass structure at the intersection of the Church Ditch and Little Dry Creek (Figures 26 and 27). The project separated Church Ditch water delivery flow from Little Dry Creek stormwater
The goals of the project included:

- Separate flows in the Church Ditch from flows in Little Dry Creek
- Provide for a flushing structure from the Church Ditch into Little Dry Creek
- Complete a design that is compatible with future remote operations

The goals were met by conveying the Church Ditch under Little Dry Creek in a concrete box culvert. A gate upstream of the crossing will allow for flushing into Little Dry Creek. The total cost of the project exceeded $259,000.

Figure 26. Old ditch structure. Ditch in center of the photo with Little Dry Creek inflows on bottom right.

Figure 27. New Church Ditch separator at Little Dry Creek. Ditch is diverted under Little Dry Creek through the structure on the left. The sandout gate on the right returns water to Little Dry Creek in the background.

City of Arvada

A significant portion of the Standley Lake canal basin lies within the City of Arvada. For almost two decades, Arvada has improved stormwater quality by returning flows into natural drainage ways and by developing a comprehensive Stormwater program. In 2008, 81% of the acreage draining into canals that feed Standley Lake was returned to its historic drainage basin with the cooperation and financial support of Arvada and the Standley Lake Cities.

In addition to returning flows to natural pathways, Arvada has continued to focus on improving the quality of runoff through the operation of a Municipal Separate Storm Sewer System (MS4) stormwater program. A major component of this program is related to active construction site erosion control. In 2009, 1087 erosion and sediment control inspections were conducted on 84 active construction sites. As a result of these inspections, 24 notices of violation and 3 stop work orders were issued until sites met runoff control requirements. Further, 5 Show Cause hearings were held to notify developers that action may be taken to remedy their noncompliant site.

In addition to active construction sites and temporary erosion control BMPs, the City of Arvada carries out inspection and enforcement related to post-construction, permanent BMPs. In 2009, 9 new permanent BMPs were implemented in Arvada and 76 existing permanent BMPs were inspected. After inspection, corresponding reports that identified noncompliant issues needing to be addressed were sent to owners of the stormwater conveyance.

Arvada continues to operate an illicit discharge detection and elimination program. In 2009, 21 written notices of violation were issued, resulting in 5 summonses to appear in court and 1 monetary penalty being issued to responsible parties. Arvada annually conducts dry-weather screening inspections of outfalls into our waterways to identify potential sources of illicit discharges and if necessary, eliminate them.

Pollution Prevention is another ongoing component of Arvada's stormwater protection efforts. City facilities with runoff control plans are inspected twice annually. In 2009 more than 45 employees attended pollution prevention training at the City's Street Maintenance and Wastewater facilities. The training focuses on preventing and mitigating any potential contamination sources from City facilities. Training also includes spill response procedures specific work in the field. In 2009, Arvada designated Wastewater personnel as first responders in the case of off-hours emergencies that could threaten surface water quality.

Public Education and Outreach is a major component of Arvada's Stormwater program and is intertwined with all of the previously mentioned activities. Education for contractors, City personnel, citizens, and students is provided by the City on an on-going basis. This ensures that the public is aware that City storm drains flow directly to waterways and certain activities can contaminate those waterways. The City provides the public with various resources to increase their awareness, such as adopt-a-street or trail program, storm drain marking, household hazardous chemical disposal and recycling, and brochures and demonstrations that are focused on preventing stormwater pollution.

Arvada is dedicated to protecting stormwater quality in order to protect the environment within Arvada and to ensure that activities in Arvada do not contribute significantly to water degradation downstream.