

## **Appendix B – Upper Clear Creek/Standley Lake Watershed Water Quality Monitoring Program**

# Upper Clear Creek/Standley Lake Watershed

## Water Quality Monitoring Plan



**April 2011**

## TABLE OF CONTENTS

<b>Abbreviations and Acronyms</b> .....	iii
<b>MONITORING PROGRAMS OVERVIEW</b> .....	1
<i>Introduction</i> .....	1
<i>Safety Considerations</i> .....	2
<b>UPPER CLEAR CREEK MONITORING PROGRAM</b> .....	3
<b><i>UCC – AMBIENT GRAB SAMPLES</i></b> .....	3
<i>Locations and Sample Schedule</i> .....	4
<i>Analytical Parameters – includes parameters for both Short and Long Schedules</i> .....	5
<i>Flow Monitoring</i> .....	6
<i>Program Coordination - Short Schedule (Thornton)</i> .....	6
<i>Sample Bottle Kit Prep- Short Schedule</i> .....	7
<i>Sampling Locations Directions and Narrative Descriptions - Short Schedule</i> .....	8
<i>Program Coordination - Long Schedule (Thornton)</i> .....	10
<i>Sample Bottle Kit Prep- Long Schedule</i> .....	11
<i>Sampling Locations Directions and Narrative Descriptions - Long Schedule</i> .....	13
<i>QA/QC Program - Long Schedule Only</i> .....	16
<b><i>UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES</i></b> .....	19
<i>Sample Locations</i> .....	19
<i>Flow Monitoring</i> .....	19
<i>Analytical Parameters</i> .....	20
<i>Program Coordination (Westminster and Golden)</i> .....	21
<i>Field Equipment</i> .....	21
<i>Autosampler Operation</i> .....	21
<i>Sample Composting</i> .....	23
<b><i>UCC AUTOSAMPLERS – EVENT SAMPLES</i></b> .....	25
<i>Program Coordination (Westminster and Golden)</i> .....	25
<i>Flow Monitoring</i> .....	25
<b>TRIBUTARY BASIN MONITORING PROGRAM</b> .....	26
<i>Locations and Sample Schedule</i> .....	26
<i>Analytical Parameters and Analytical Scheme</i> .....	27
<i>Program Coordination (Northglenn)</i> .....	28
<i>Sample Bottle Kit – Tribs Monthly and Quarterly</i> .....	28
<i>Sample Collection</i> .....	28
<i>Sampling Locations Directions and Narrative Descriptions</i> .....	30
<b><i>TRIB CONTINUOUS MONITORING</i></b> .....	31
<i>Program Coordination (Westminster)</i> .....	31
Field sampling team: Westminster.....	31
<i>Sample Locations</i> .....	31
<b><i>TRIB AUTOSAMPLER EVENT SAMPLES</i></b> .....	32
<i>Program Coordination (Westminster)</i> .....	32
<i>Flow Monitoring</i> .....	32
<i>Analytical Parameters</i> .....	33
<i>Field Equipment</i> .....	33
<b>STANDLEY LAKE MONITORING PROGRAM</b> .....	35
<b><i>SL – DAILY LAKE PROFILES</i></b> .....	35
<i>Program Coordination (Westminster)</i> .....	35

<i>Analytical Parameters</i> .....	35
<b>SL – BIMONTHLY GRAB SAMPLES</b> .....	36
<i>Locations</i> .....	36
<i>Analytical Parameters</i> .....	37
<i>Analytical Scheme</i> .....	38
<i>Program Coordination (Westminster)</i> .....	41
<i>SL Sample bottle kit</i> .....	41
<i>Sample Collection</i> .....	42
<b>SL – AQUATIC INVASIVE SPECIES MANAGEMENT</b> .....	44
<i>Eurasian Watermilfoil</i> .....	44
<i>Zebra and Quagga Mussels</i> .....	45
<b>DATA MANAGEMENT AND REPORTING</b> .....	46

## **APPENDICES**

- A Monitoring Program Rationale
- B Watershed Maps
- C Sampling Instructions and Forms
- D Sampling Location Photographs and GPS Coordinates
- E Travel times along Clear Creek
- F Program Participants Contact Information
- G Changes from the Previous Version of the Plan

## Abbreviations and Acronyms

BH/CC	Blackhawk/Central City
C	Centigrade
CC	Clear Creek
cfs	cubic feet per second
COC	chain of custody
CWQCC	Colorado Water Quality Control Commission
DI	Deionized Water
DO	Dissolved Oxygen
DRP	Dissolved Reactive Phosphorus (ortho-Phosphate-P)
EPA	U.S. Environmental Protection Agency
FHL	Farmers Highline Canal
FRICO	Farmers Reservoir and Irrigation Company
HCl	Hydrochloric acid
ISDS	Individual Sewage Disposal System
KDPL	Kinnear Ditch Pipe Line
LDMS	Laboratory Data Management System
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter
m	meter
mgd	million gallons per day
mg/L	milligrams per liter
MSCC	Mainstem Clear Creek
mv	millivolt
N	Nitrogen
NFCC	North Fork Clear Creek
NG	City of Northglenn
NPS	Nonpoint Source
NTU	Nephelometric Turbidity Units
ORP	Oxidation Reduction Potential
OWS	Onsite Waste System (ISDS)
pCi/L	picocuries per liter
P	Phosphorus
QC	Quality Control
SDWA	Safe Drinking Water Act
SFCC	South Fork Clear Creek
SLC	Standley Lake Cities
SLWQIGA	Standley Lake Water Quality Intergovernmental Agreement
SM	Standard Methods for the Examination of Water and Wastewater
TH	City of Thornton
TOC	Total Organic Carbon
TSS	Total Suspended Solids
TVSS	Total Volatile Suspended Solids
UCC	Upper Clear Creek
USGS	United States Geological Survey
Westy	City of Westminster
WFCC	West Fork Clear Creek
WMA	Upper Clear Creek Watershed Management Agreement
WQIGA	Water Quality Intergovernmental Agreement (Standley Lake)
WQS	Colorado Water Quality Standards (Regs #31 and #38)
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

## MONITORING PROGRAMS OVERVIEW

### Introduction

The quality of the water in Standley Lake has been monitored for more than two decades. Efforts to protect Standley Lake through state water quality regulations culminated in adoption of the numeric chlorophyll *a* standard for the lake in 2009. The Colorado Water Quality Control Commission (“CWQCC”) established the chlorophyll *a* standard at 4.0 µg/L with a statistically derived assessment threshold of 4.4 µg/L. The standard is based on the arithmetic average of the individual monthly average chlorophyll *a* data for samples collected during March through November in each year. Exceedance of the standard would occur if the yearly 9-month average of the monthly chlorophyll *a* average results is greater than 4.4 µg/L more frequently than once in five years. In addition, a version of the narrative standard adopted in 1993 was also retained stating that 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. The voluntary implementation of best management practices clause included in the 1993 version of the standard was eliminated from the 2009 narrative standard.

The Standley Lake Cities (“SLC”) of Northglenn, Thornton and Westminster remain committed to effective and efficient water quality monitoring in the watershed as originally agreed to in the 1993 Watershed Management Agreement. The Standley Lake Water Quality Intergovernmental Agreement (“SLWQIGA” or “WQIGA”), entered into between the SLC, details the provisions for costs sharing related to cooperative efforts regarding water quality issues in the Clear Creek Basin and Standley Lake. The WQIGA monitoring program is subdivided into three inter-related programs for which the SLC provide field sampling, laboratory analyses and data management support: the Upper Clear Creek Monitoring Program, the Tributary Basin Monitoring Program and the Standley Lake Monitoring Program.

The Monitoring Committee was formed to periodically evaluate the monitoring programs and propose appropriate modifications as necessary. The proposals are evaluated by the SLWQIGA committee prior to implementation. Representatives from the SLC, Upper Clear Creek Basin and the Tributary Basin are actively involved in committee activities as appropriate. This document details the specific requirements and responsibilities of the SLC and outlines the commitments of additional entities involved in the Standley Lake watershed monitoring programs.

Standley Lake serves as the sole drinking water source for the cities of Northglenn and Westminster and is one of several drinking water sources for the City of Thornton. The monitoring program is designed to collect samples from a variety of locations in the watershed with varying anthropogenic and natural potential sources of pollutants. The data is used for trend analysis, modeling and for numerous other applications. Interpretation of the results allows the upstream and downstream communities to work cooperatively to minimize impacts to water quality.

### Safety Considerations

The personal safety of the sampling teams is paramount in the decision making process for collection of water quality samples. At no time should personal safety be jeopardized in order to collect a sample. Environmental conditions may change suddenly and are variable throughout the watershed.

The following safety measures should be observed during all sampling activities:

- Sample collection should be performed by a two person team whenever possible.
- Weather conditions at the sampling sites should be evaluated prior to leaving the laboratory.
- Personal flotation devices should be worn if the creek water level is greater than twelve inches deep. Hydrostatically triggered, self-inflating personal flotation devices are recommended for non-lake sampling, as the device will automatically inflate if the sensor is submerged below six inches of water.
- Personal flotation devices are mandatory on Standley Lake. Lake sampling team members should be experienced swimmers.
- Wear waterproof gloves and sock liners, as appropriate.
- Exercise caution on slippery rocks, river banks and boat docks.
- Cell phones must be available during sampling, but be aware that cell phone signals are not reliable in all areas of Clear Creek Canyon.
- First aid kits must be available in all sampling vehicles, including boats. It is recommended that sampling team members be trained in basic first aid techniques.
- Supervisors are notified of the sampling team's itinerary and the expected return time to the lab. Sampling teams will notify supervisors of any delay in the expected return time.



## UPPER CLEAR CREEK MONITORING PROGRAM

The Upper Clear Creek (“UCC”) Monitoring Program is designed to provide water quality information in order to evaluate nutrient loadings from both point sources (discrete) and non-point sources (dispersed) within the Upper Clear Creek Basin.

The Upper Clear Creek Monitoring Program includes three distinct sub-programs, each designed to obtain water quality data during specified conditions:

- ambient grab samples;
- continuous stream monitoring and the automated collection of 48-hour ambient samples, and
- the automated collection of event samples.

### **UCC – AMBIENT GRAB SAMPLES**

Program Coordination: Thornton

Program Participants: Thornton, Westminster, Arvada, Golden, Upper Basin WWTPs

Grab samples are single point-in-time samples collected in-stream and at wastewater treatment plant (“WWTP”) effluents throughout the watershed. Grab samples 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. Refer to the table below for sample site locations. The rationale for selection of the specific sampling sites is included in Appendix A. A map of the watershed is included in Appendix B.

Grab samples are collected eight times during the year to correspond with seasonally varying flow conditions in Clear Creek. The *Short Schedule* is collected six times per year and includes four stream locations and the five major WWTP effluents. Grab samples are collected at the stream locations during the February, April and December events **ONLY**. Ambient autosampler samples are collected during June, July and August. Refer to the following section for more information on autosamplers. The *Long Schedule* is collected twice per year and includes 25 locations - all 16 stream locations and all 9 WWTP effluents in the program. WWTP employees collect the effluent samples, analyze the samples for field parameters (temperature, pH and dissolved oxygen), record the discharge flow, and then deliver the samples to the field sampling teams at predetermined locations. Laboratory analytical protocols limit sample collection to Monday through Thursday. Sampling is performed each year on approximately the same schedule. The exact sampling dates for the year are predetermined at the beginning of the year. Refer to the sampling table below for the approximate schedule.

**UCC – AMBIENT GRAB SAMPLES**

**Locations and Sample Schedule**

Sample ID	Flow Gage	Sample Location *	Early Feb Mon	Early Apr Tues	Late May Thurs	Mid Jun Weds	Mid Jul Mon	Mid Aug Tues	Mid Oct Weds	Early Dec Thurs
CC05	Staff gage	MSCC at Bakerville			X				X	
CC10	Recording gage	SFCC upstream of the lake			X				X	
CC15	Staff gage	WFCC below Berthoud			X				X	
CC20	Recording gage	WFCC below Empire			X				X	
CC25	Recording gage	MSCC above WFCC			X				X	
CC26	Recording gage	MSCC at Lawson Gage	X	X	X				X	X
CC30	Staff gage	Fall River above MSCC			X				X	
CC34		MSCC above Chicago Creek			X				X	
CC35	Recording gage	Chicago Creek above Idaho Springs WTP			X				X	
CC40	Recording gage **	MSCC below Idaho Springs WWTP (Kermits)	X	X	X				X	X
CC44	Staff gage	NFCC above BH/CC WTP intake			X				X	
CC45		NFCC above original BH/CC WWTP			X				X	
CC50	Recording gage	NFCC above confluence with MSCC	X	X	X				X	X
CC52		Beaver Brook at the mouth			X				X	
CC53		Soda Creek at the mouth			X				X	
CC60		MSCC at Church Ditch Headgate	X	X	X				X	X
CC1A		Loveland WWTP			X				X	
CC3A		Georgetown WWTP	X	X	X	X	X	X	X	X
CC5A		Empire WWTP			X				X	
CC7A		Central Clear Creek WWTP	X	X	X	X	X	X	X	X
CC8A		St Mary's WWTP			X				X	
CC12A		Idaho Springs WWTP	X	X	X	X	X	X	X	X
CC13B		BH/CC WWTP	X	X	X	X	X	X	X	X
CC14A		Henderson Mine WWTP			X				X	
CC15A		Eisenhower Tunnel WWTP	X	X	X	X	X	X	X	X

\* MSCC = Mainstem Clear Creek  
SFCC = South Fork Clear Creek  
BH/CC = Blackhawk/Central City

WFCC = West Fork Clear Creek  
NFCC = North Fork Clear Creek

WTP = Water Treatment Plant  
WWTP = Wastewater Treatment Plant

\*\* The recording gage at CC40 is operated and maintained by Clear Creek Consultants on behalf of UCCWA.

Note: Sampling schedule translation = Early Feb Mon means early in the month of February on a Monday.  
Exact sampling dates are scheduled each year in advance by the coordinator.

**UCC – AMBIENT GRAB SAMPLES**

*Analytical Parameters – includes parameters for both **Short** and **Long** Schedules*

Analyte	Analytical Method Reference	Reporting Limit	Responsible Laboratory
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster
Nitrate/Nitrite as N	SM 4500-NO3 I	0.01 mg/L	Westminster
Ammonia as N	SM 4500-NH3 H	0.01 mg/L	Westminster
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn
Ortho-phosphate as P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn
Total Organic Carbon (TOC)	SM 5310 B	0.5 mg/L	Thornton
Total Suspended Solids	SM 2540 D	1 mg/L	Thornton
Temperature	SM 2550 B	0.1 °C	Field Teams/Golden
pH	SM 4500-H+ B	0.1 Std Units	Field Teams/Golden
Conductivity	SM 2510 B	1 µS/cm	Field Teams/Golden
Turbidity	SM 2130 B	0.1 NTU	Field Teams/Golden
Dissolved Oxygen	SM 4500-O G	0.1 mg/L	Field Teams/Golden
Stream Flow	Gage readings	1 cfs	USGS/ Clear Creek Consultants
Stream Height	Staff gage reading	0.1 ft	Field Teams
WWTP Discharge Flow	Flow Meter readings	0.01 mgd	WWTPs

Table Notes: 1) SM refers to the 21<sup>st</sup> Edition of Standard Methods for the Examination of Water and Wastewater.  
 2) Reporting limits are matrix dependent and may be increased for complex matrices.  
 3) TOC is analyzed on samples from sites CC05, CC20, CC26, CC35, CC40, CC45, CC50, CC52, CC53, and CC60 during the **Long** Schedule events. TOC is analyzed on grab samples from sites CC26, CC40, CC50 and CC60 during the **Short** Schedule events in Feb, April and Dec **ONLY**.

## **UCC – AMBIENT GRAB SAMPLES**

### Flow Monitoring

Various mechanisms are employed throughout the watershed for monitoring the hydrological conditions at strategic locations. USGS real-time recording gages are installed at CC10, CC20, CC25, CC26, CC35, CC50 and CC61 (Clear Creek at Golden). USGS staff gages are in place at CC05, CC15, CC30 and CC44. The staff gage readings are recorded to the nearest 0.1 foot and may be converted to stream flow using the USGS calibration rating established for the location. The recording gage at CC40 is operated and maintained by Clear Creek Consultants on behalf of UCCWA.

The WQIGA provides financial support for the USGS gages at CC05 at Bakerville (staff gage) and CC26 at Lawson (recording gage).

Wastewater treatment plant effluent discharge flows are provided by the individual WWTPs at the time of sample collection.

## **UCC – AMBIENT GRAB SAMPLES**

### Program Coordination - *Short Schedule (Thornton)*

#### Two weeks before the scheduled Clear Creek sampling date:

- Call Westminster and Northglenn to request enough prepared sample bottles from each lab for at least the next **two** sampling events. Contact and coordinate the sampling team. Make sure that there are two samplers available and one set of field meters (turbidity, pH, conductivity and DO). Refer to the Program Participants Contact Information list in Appendix F for sampling personnel options.
- Prepare sample bottle kits as directed below. Each sample bottle kit contains enough prepared sample containers for sampling at one location. Prepare nine sample kits for each event: four for the Creek Team, one for BH/CC to be delivered to SouthWest Water, one for Idaho Springs, and three for AAA Operations in Dumont which includes one kit to be picked up by CDOT for the Eisenhower Tunnel WWTP.
- Deliver bottle kits for the next sampling event at least one week prior to the event.

Sample Bottle Kit Prep- *Short Schedule*

Destination	Quantity	Volume	Bottle Type	Parameter	Laboratory	Additional Documentation
AAA - Dumont  (AAA collects samples at CC3A and CC7A. CDOT will pick up kit and sample CC15A.)	3	1L	Rectangular plastic	Phosphorus series	Northglenn	2 - Instructions (one for each WWTP)  3- COC (AAA will complete one COC for each sample location and CDOT will complete one COC for CC15A)
	3	500 mL	Plastic jug	TSS	Thornton	
	3	250 mL	Rectangular plastic	Nitrogen series	Westminster	
SouthWest Water  (Collects samples at CC13B)	1	1L	Rectangular plastic	Phosphorus series	Northglenn	2 - Instructions and COCs (one for each WWTP)
	1	500 mL	Plastic jug	TSS	Thornton	
	1	250 mL	Rectangular plastic	Nitrogen series	Westminster	
Idaho Springs  (Collects sample at CC12A)	1	1L	Rectangular plastic	Phosphorus series	Northglenn	Instructions and one COC
	1	500 mL	Plastic jug	TSS	Thornton	
	1	250 mL	Rectangular plastic	Nitrogen series	Westminster	
Clear Creek Team – Feb April and Dec <b>ONLY</b>  (Collects samples at CC26, CC40, CC50 and CC60)	4	1L	Rectangular plastic	Phosphorus series	Northglenn	Instructions, four COCs and one field data sheet
	4	500 mL	Plastic jug	TSS	Thornton	
	4	250 mL	Rectangular plastic	Nitrogen series	Westminster	
	4	40 mL	Glass vial	TOC	Thornton	

- Table Notes:
- 1) Phosphorus series includes total P and dissolved ortho-phosphate-P (also referred to as DRP).
  - 2) Nitrogen series includes total N, ammonia-N and nitrate/nitrite-N.
  - 3) The additional documentation forms are included in Appendix C.

**On Clear Creek sampling day (Short Schedule):**

- Additional steps for Feb, April and Dec events **ONLY**:
  - Calibrate turbidity, pH, conductivity, and DO meters in the lab. Ensure all probes and meters are working properly before leaving the lab. Take aliquots of the standards into the field to check instrument calibration as necessary.
  - Fill the three bottles for quality control blanks with deionized water at the laboratory.
  - Thornton prepares the sample kits for the Clear Creek Team.
  - At each sample location, collect samples and analyze for pH, temperature, DO, conductivity, and turbidity. Complete the COC and record all results on the Field Data Sheet (refer to Appendix C).
- Pick up WWTP samples for all events.
- The field samples are returned to the Thornton Lab and refrigerated or frozen (nitrogen only). The samples are relinquished to Westminster (nitrogen) and Northglenn (phosphorus) and the COCs are signed appropriately. The original copies of the COCs are retained by Westminster and Northglenn.
- Original field data sheets and copies of the COCs are retained by the City of Thornton for permanent archive.

**UCC – AMBIENT GRAB SAMPLES**

**Sampling Locations Directions and Narrative Descriptions - Short Schedule**

Sampling Frequency: Feb, April, June, July, Aug, Dec (Note: Grab samples at stream sites CC26, CC40, CC50 and CC60 are collected during the Feb, April and Dec events **ONLY**. WWTP effluent samples are collected during all six events.)

Sample bottles: Creek sites (Feb, April and Dec **ONLY**): One 1 liter rectangular (phosphorus series), one 500 mL (TSS), one 250 mL (nitrogen series) and one 40 mL glass vial (TOC)

WWTPs: One 1 liter rectangular, one 500 mL and one 250 mL

**POINT**

**DIRECTIONS AND DESCRIPTION OF LOCATION**

CC26 Travel westbound I-70 to exit at Lawson. Travel frontage road through Lawson. Immediately before the I-70 overpass, on your right, is a parking area. Sample creek at USGS gage and sampling station by bridge. [RECORDING GAGE] **Sample TOC**

Dumont **AAA Operations in Dumont: CC7A (Central Clear Creek), CC3A (Georgetown WWTP) and CC15A (Eisenhower Tunnel) samples.** Continue east down Hwy 308. Drive down past the service shops. Turn right at Mill Creek Road. Address is 48

Mill Creek Road. It's the warehouse-like building across from the Dumont Post Office. Operators to drop samples off by 10:00 am.

- CC40 Traveling eastbound on I-70 take US 6 exit. Pull off in parking area just east of the off ramp. (Kermits Restaurant is across the road) Sample approx. 100 yards east of stop sign below USGS recording gage. [CC12A \(Idaho Springs\)](#): Idaho Springs operator to meet at Kermits to drop off samples. They should have called to arrange a meeting time. [RECORDING GAGE] **Sample TOC**
- CC13B Travel Hwy 119 eastbound toward US 6. Proceed to the new BH/CC WWTP five miles down the road. The new WWTP is on your left side. Meet the BH/CC operator in the main office building to pick up [CC13B \(BH/CC WWTP\)](#) samples. The operator will follow you down to CC50 and give you two extra bottles there for collection of split samples.
- CC50 Travel Hwy 119 eastbound toward US 6. Approximately 2 miles downstream of the Black Hawk/Central City WWTP and ¼ mile upstream from intersection is a pullout area to the right immediately before the junction. Sample at the USGS recording gage. [RECORDING GAGE] **Sample TOC**
- CC60 Approximately 1 mile west of intersection of Hwy 58 and US 6. Park in the pullout on the south side of highway and walk (or drive) downhill to the Church Ditch diversion structure. Go across the bridge and sample from the main stem of Clear Creek. Do not sample from Church Ditch. **Sample TOC**

Photographs of the sampling locations and GPS coordinates are included in Appendix D.

**UCC – AMBIENT GRAB SAMPLES**

Program Coordination - Long Schedule (Thornton)

Two weeks before the scheduled Clear Creek sampling date:

- Call Westminster and Northglenn to request enough prepared sample bottles from each lab for at least the next **two** sampling events. Contact and coordinate the sampling team. Make sure that there are two samplers available and one set of field meters (turbidity, pH, conductivity and DO) for each Creek Team. Refer to the Program Participants Contact Information list in Appendix F for sampling personnel options.
- Prepare sample bottle kits as directed below. Each sample bottle kit contained enough prepared sample bottles to collect samples at one location. Prepare 25 bottle kits: 8 kits each for Creek Teams A and B, 7 kits for AAA Operations in Dumont (includes one each for CDOT, Henderson Mine and Empire WWTP), one for Idaho Springs, and one for SouthWest Water in Arvada. CDOT will pick up a sample kit from AAA Operations for sampling at the Eisenhower Tunnel WWTP.
- Deliver bottle kits for the next event at least one week prior to the first sampling day. Notify Empire at least one week prior to sampling to schedule for Creek Team A to stop in Empire to pick up the samples.



*Sample Bottle Kit Prep- Long Schedule*

Destination	Quantity	Volume	Bottle Type	Parameter	Laboratory	Additional Documentation*
AAA – Dumont  (AAA collects samples at CC1a, CC3a, CC7a and CC8a. Empire, Henderson Mine, and CDOT will pick up kit at AAA and sample CC5a, CC14A, and CC15a, respectively.)	7	1L	Rectangular plastic	Phosphorus series	Northglenn	7 - Instructions (one for each WWTP)  7 – COCs (AAA will complete one COC for each sample. CDOT will complete the COC for CC15a)
	7	500 mL	Plastic jug	TSS	Thornton	
	7	250 mL	Rectangular plastic	Nitrogen series	Westminster	
SouthWest Water  (Collects samples at CC13b)	1	1L	Rectangular plastic	Phosphorus series	Northglenn	Instructions and COC
	1	500 mL	Plastic jug	TSS	Thornton	
	1	250 mL	Rectangular plastic	Nitrogen series	Westminster	
Idaho Springs	1	1L	Rectangular plastic	Phosphorus series	Northglenn	Instructions and COC
	1	500 mL	Plastic jug	TSS	Thornton	
	1	250 mL	Rectangular plastic	Nitrogen series	Westminster	
Clear Creek Team A  (Collects samples at CC25, CC05, CC10, CC34, CC35, CC52 and CC53. Meets AAA in Dumont for sample transfer)	8	1L	Rectangular plastic	Phosphorus series	Northglenn	One set of: Instructions, four COCs and one field data sheet
	8	500 mL	Plastic jug	TSS	Thornton	
	8	250 mL	Rectangular plastic	Nitrogen series	Westminster	
	5	40 mL	Glass vial	TOC	Thornton	
Clear Creek Team B  (Collects samples at CC15, CC20, CC26, CC30, CC40, CC44, CC45, CC50 and CC60) Meets Idaho Springs, Empire, Henderson, and Blackhawk for WWTP samples.)	8	1L	Rectangular plastic	Phosphorus series	Northglenn	One set of: Instructions, four COCs and one field data sheet
	8	500 mL	Plastic jug	TSS	Thornton	
	8	250 mL	Rectangular plastic	Nitrogen series	Westminster	
	5	40 mL	Glass vial	TOC	Thornton	
QC	4	2 L	1:1 HCl rinsed Rectangular plastic	QC spikes and dups for Golden	Golden	QC sampling done by Team A in May and Team B in October.
	1 (blank)	1 L	Rectangular plastic	Phosphorus series	Northglenn	
	1 (blank)	250 mL	Rectangular plastic	Nitrogen series	Westminster	

- Table Notes:
- 1) Phosphorus series includes total P and dissolved ortho-phosphate-P (also referred to as DRP).
  - 2) Nitrogen series includes total N, ammonia-N and nitrate/nitrite-N.
  - 3) The additional documentation forms are included in Appendix C.

**On Clear Creek sampling day (Long Schedule):**

- Calibrate turbidity, pH, conductivity, and DO meters in the lab. Ensure all probes and meters are working properly before leaving the lab. Take aliquots of the standards into the field to check instrument calibration as necessary.
- Fill the three bottles for quality control blanks with deionized water at the laboratory.
- Prepare a minimum of two coolers with ice and your team's sample bottle kit. The Creek Team chosen for QC sampling must also include in the field sample bottle kit: field blank bottles (nitrogen and phosphorus), one field duplicate cubitainer, and at least 4 two-liter bottles for QC samples. Thornton prepares both sample kits for Clear Creek Teams A and B and will provide the extra materials needed for the QC sampling in the appropriate sample kit.
- Meet your sampling team partner at the designated location (usually City of Golden Public Works).
- At each sample location, collect samples and analyze for pH, temperature, DO, conductivity, and turbidity. Complete the COC and record all results on the Field Data Sheet (refer to Appendix C). Temperature, pH, and DO are analyzed by the WWTP operator at each plant and the data is recorded on the COC. Each sampling team will analyze their respective WWTP samples for turbidity, conductivity and other missing field parameters upon arrival at the Golden Laboratory. Samples will be collected at all creek sites for nitrogen series, phosphorus series and TSS. TOC samples are collected only at designated creek sites: CC05, CC20, CC26, CC35, CC40, CC45, CC50, CC52, CC53, and CC60.
- The Clear Creek Team selected for QC sampling will randomly select four creek sites. Collect one sample (2-liter HCl rinsed bottle) at four randomly selected creek sites for preparation of the spike and duplicate nutrient QC samples by Golden Laboratory staff.
- Complete the COC for the QC samples.
- Return to the Golden Lab when sampling is completed. Relinquish the QC samples to the Golden Lab staff.
- Golden Lab staff prepares one duplicate and one spike sample for total nitrogen and total phosphorus from the four QC samples.
- Analyze and complete any missed field parameters as allowable.
- Make two copies of each team's field data sheet: one of each for Golden and one of each for Westminster.
- The field samples and prepared QC samples are returned to the Thornton Lab and refrigerated. The samples are relinquished to Westminster (nitrogen) and Northglenn (phosphorus) and the COCs are signed appropriately. The original copies of the COCs are retained by Westminster and Northglenn.
- Original field data sheets and copies of the COCs are retained by the City of Thornton for permanent archive.

**UCC – AMBIENT GRAB SAMPLES**

**Sampling Locations Directions and Narrative Descriptions - Long Schedule**

**Clear Creek Team A**

Sampling Frequency: late May, mid Oct

Sample bottles: Creek sites: One 1 liter rectangular (phosphorus series), one 500 mL (TSS), one 250 mL (nitrogen series) and one 40 mL amber glass vial (TOC, as required)

WWTPs: One 1 liter rectangular, one 500 mL and one 250 mL

<u>POINT</u>	<u>DIRECTIONS AND DESCRIPTION OF LOCATION</u>
CC25	Travel west on I-70 approximately 0.8 miles west of mile marker 232. Pull off the highway on the right side immediately beyond the guardrail for the bridge structure. Walk down the hill to the creek. Sample immediately downstream of the box culvert across from the recording gage located downstream. [RECORDING GAGE]
CC05	I-70 westbound to Exit 221 (Bakerville) Exit; go south back over Interstate (left) Park at call box. Take sample upstream of parking area, read gage located downstream. [Read the <b>STAFF GAGE</b> and record on the field data sheet]. <b>Sample TOC</b>
CC10	I-70 eastbound to Georgetown. Begin at intersection of 6 <sup>th</sup> and Rose in Georgetown. Go 2.2 miles up Guanella Pass Road (go to the first lake). U-turn by the lake inlet and park on the right side of road. Sample from stream above lake inlet point. [RECORDING GAGE]
CC26	Travel eastbound I-70 exit at Lawson. Travel frontage road through Lawson. Immediately before the I-70 overpass, on your right, is a parking area. Sample creek at gage and USGS sampling station by bridge. [RECORDING GAGE] <b>Sample TOC</b>
Dumont	<b>AAA Operations in Dumont:</b> <b>CC1A (Loveland), CC7A (Central Clear Creek), CC3A (Georgetown WWTP), CC8A (St. Mary's WWTP) and CC15A (Eisenhower Tunnel)</b> samples. Proceed under the highway. Turn right at the intersection onto Hwy 308. Drive down pass the service shops. Take a right at Mill Creek Road. Address is 48 Mill Creek Road across from the Dumont Post Office. There is no sign on the warehouse-like building. The operators were asked to drop samples off by 10:00 am. Please measure conductivity, turbidity, and any missed parameters on WWTP sample in Golden.

- CC34 From I-70 (either direction) Exit 240 (Chicago Creek), pull off in the small parking area on the other side of the bridge. Sample the main stem of Clear Creek upstream of Chicago Creek across from the Forest Service Building.
- CC35 Continue approx. 3.7 miles on Hwy 103. Pull off on the right shoulder just past the green roofed house that looks like a barn (on the left). Cross road and sample creek at recording gage. [RECORDING GAGE] **Sample TOC**
- CC52 Exit I-70 eastbound at Beaver Brook/Floyd Hill (Exit #247). Turn Left to the north frontage road (US Hwy 40). Travel east approximately 2.4 miles. Pull off to the side of road and sample Beaver Brook at this point. **Sample TOC**
- CC53 Continue travelling east bound 0.3 miles and cross the second white bridge. Exit immediately on the right to Soda Creek Drive. Park on the right. Sample Soda Creek upstream of the bridge. **Sample TOC**

Photographs of the sampling locations and GPS coordinates are included in Appendix D.

### **Clear Creek Team B**

Sampling Frequency: late May, mid Oct

Sample bottles: Creek sites: One 1 liter rectangular (phosphorus series), one 500 mL (TSS), one 250 mL (nitrogen series) and one 40 mL amber glass vial (TOC, as required)

WWTPs: One 1 liter rectangular, one 500 mL and one 250 mL

### POINT DIRECTIONS AND DESCRIPTION OF LOCATION

- CC15 Travel west on US 40 through Empire. Begin at Empire Dairy King and continue 6.0 miles west on US 40. There is a large pullout on the creek side of highway with a large tree in the middle of the pullout. Sample directly below the tree at the creek. Staff gage is along the north bank of stream next to a tree at the stream's edge. [Read the **STAFF GAGE** and record on the field data sheet]
- Empire East on US40 to Empire. Meet Empire, Henderson Mine, and Idaho Springs operators at the Tomato Convenience Store in Empire at 9:30 am. **CC5A (Empire WWTP), CC12A (Idaho Springs WWTP) and CC14A (Henderson Mine WWTP).**
- CC20 Returning back through Empire eastbound, travel along the road\ramp from US 40 to Westbound I-70. Immediately after turning onto road\ramp, there is a large open space on right side of road\ramp. Park in open space and cross road to the Colorado Dept. of Transportation (CDOT) fence enclosing their maintenance yard. Enter fence and sample approx. 100 feet downstream of bridge at recording gage. [RECORDING GAGE] **Sample TOC**

- CC30 East on 1-70. Exit 238 (Fall River Road/St. Mary's Glacier) Approx. 100 yards up Fall River Road, there is a small turnout on right by a wooden support wall. Cross road and sample creek at staff gage. [Read the STAFF GAGE and record on the field data sheet]
- CC40 Traveling eastbound on I-70 take US 6 exit. Pull off in parking area just east of the off ramp. (Kermits Restaurant is across the road) Sample approx. 100 yards east of stop sign below recording gage. [RECORDING GAGE] **Sample TOC**
- CC44 Continue east on US 6 to 119. Drive west on 119 to Black Hawk. From the Black Hawk intersection travel westbound approx. 1 mile on Hwy 119. There is a small wooden building and parking area on the left side of the road. This is the Black Hawk water intake. Walk approx. 100 feet upstream and sample at staff gage. [Read the STAFF GAGE and record on the field data sheet] Sample near the staff gage.
- CC45 Turn around and drive east on 119. Turn off side of road right right after Mill Street. Sample just upstream of the old Black Hawk WWTP. *Note: we are no longer grabbing splits for Blackhawk at CC45.* **Sample TOC**
- CC13B Travel Hwy 119 eastbound toward US 6. Proceed to the new BH/CC WWTP 5 miles down the road. The new WWTP is on your left side. Meet the BH/CC operator in the main office building to pick up **CC13B (BH/CC WWTP)** samples. The operator will follow you down to CC50 and give you two extra bottles there for collection of split samples.
- CC50 Continue Hwy 119 eastbound toward US 6. Approximately 1 mile downstream of the Black Hawk/Central City WWTP and ¼ mile upstream from intersection is a pullout area to the right immediately before the junction. Sample at the recording gage. [RECORDING GAGE] **Sample TOC**
- CC60 Approximately 1 mile west of intersection of Hwy. 58 and US 6. Park in the pullout on the south side of highway and walk down (or drive) downhill to the Church Ditch diversion structure. Go across the bridge and sample from the main stem of Clear Creek. Do not sample from Church Ditch. **Sample TOC**

Photographs of the sampling locations and GPS coordinates are included in Appendix D.

### **UCC – AMBIENT GRAB SAMPLES**

#### ***QA/QC Program - Long Schedule Only***

Duplicate and spike quality control samples are prepared from creek samples collected during the Clear Creek Long Schedule sampling events for selected nutrients and are analyzed by Westminster (total nitrogen) and Northglenn (total phosphorus). The QC samples are prepared by the City of Golden at their laboratory on the day of sampling. Four creek locations are randomly selected for preparation of the QC samples. One duplicate and one spike are submitted to each laboratory. 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 nutrient concentrations. The analytical procedure for QC preparation is detailed below:

#### **SOP - QC Preparation for Clear Creek Studies**

##### Night before:

- Soak 2 1-Liter Class A volumetric flasks with 1:1 HCl. One flask will be used to make up fresh Nitrate Standard and the other will be used for spiking the selected Clear Creek sample (with both nitrate and phosphorus spikes).

##### The Morning of Sampling Day:

- Remove 5 mg/L Phosphorus standard from fridge to warm to room temperature. This standard is prepared by the City of Northglenn and is stable for 3 months. It is usually in a 125 ml brown glass bottle.
- Remove 100 mg/L Nitrate-N standard from fridge. It is stored in a 125 ml brown Nalgene bottle. This standard is prepared fresh by the City of Golden each time. The method to prepare a 100 mg/L NO<sub>3</sub>-N standard is in Standard Methods, 21st Ed., page 4-120.
- **To Prepare Fresh Nitrate-N Standard**
  - Thoroughly rinse out one of the HCl acid soaked 1-Liter flasks to prepare the fresh standard in.
  - Fill flask with 200-300 mL DI water
  - Weigh out 0.7218 grams of KNO<sub>3</sub> and add to flask. (KNO<sub>3</sub> is stored in the desiccator with bacteria media).
  - Dilute to 1-Liter volume with DI and mix thoroughly.
  - Discard old standard and refill bottle with fresh standard. Rinse bottle out with fresh standard 2-3 times before filling. Record new prep date on bottle.
- Prepare 4 sample bottles for spike and duplicate samples. Bottles used for spike and duplicate prep are provided by the city of Thornton and are the square plastic 16 ounce “milk type” bottle. They are pre HCl washed and stored in the cabinet above the wastewater sink.

Two labs receive spike and duplicate samples from this program:

- Northglenn for low level total phosphorus analysis.
- Westminster for total nitrogen analysis.

The bottles are marked with consecutive numbers from month to month, year after year. Refer to the last sample set numbers in the brown Clear Creek Quality Control Log Book (above Vicki's desk) and mark new bottles with the next consecutive number set (##). Mark the 4 bottles with the following information:

- City of Northglenn - P(##) - Spike for Phosphorus, Date of sampling.
- City of Northglenn - D(##) - Duplicate for Phosphorus, Date of sampling.
  
- City of Westminster - N(##) - Spike for Nitrogen, Date of Sampling.
- City of Westminster - D(##) - Duplicate for Nitrogen, Date of sampling.

#### When Samples Arrive in Golden's Lab:

Certain 2 Liter samples from Clear Creek sites will have been randomly selected by the sampling team as "QC" samples.

- Select ONE of these as the QC sample (**spike and duplicate**) and set aside. Record which site was chosen in the QC log book.

This sample will be spiked with both Nitrogen and Phosphorus at concentrations within the analytical ranges of Northglenn's and Westminster's labs.

The "**spiked sample**" will be made in the remaining HCl rinsed volumetric flask, and will use up 1 liter from the 2 liter bottle.

The remaining 1 liter volume will be split into the "**duplicate sample**" bottles for both labs.

#### ▪ To Prepare Spiked Sample

- Rinse out the remaining 1-Liter volumetric flask with DI.
- Then rinse flask with a small portion of the selected QC Creek sample - 2 times.
- Refer to the last sampling to determine new spike volumes.

*\*Spike amounts for Phosphorus are usually within the 1.75 to 3.0 ml volume range for a total spiked concentration of 0.00875 mg/L to 0.015 mg/L, i.e.,*

**1.75 mL of 5 mg/L phosphorus standard in 1 liter = 0.00875 mg/L concentration spiked**

*\*Spike amounts for Nitrogen are usually within a 1.5 to 3.0 ml volume range for a total spiked concentration of 0.15 mg/L to 0.3 mg/L, i.e.,*

**1.5 mL of 100 mg/L nitrogen-N standard in 1 liter = 0.15 mg/L concentration spiked**

- Mix the Clear Creek sample well and pour approximately 500 mL into pre-rinsed flask.
- Add determined spike volumes of both standards to flask. Mix well.
- Dilute to volume with additional Creek sample finalizing volume with a pipet. (It is too hard to bring it to volume by pouring from the 2 liter container!)
- Mix well and pour into 2 bottles labeled for spike samples ("N" and "P").

**To Prepare Duplicate Sample**

- Thoroughly mix remaining Clear Creek sample
- Pour into 2 bottles labeled for duplicates (“D”).

Record the following information in the brown "Clear Creek QC" book:

1. the time the samples arrived at Golden
2. the new consecutive sample numbers
3. the Clear Creek sample site number that was selected for preparation of the QC samples
4. the volumes spiked for phosphorus and nitrogen

Generate new chain of custody forms for the 4 new samples. One form can be filled out for both Westminster and Northglenn labs. Sampling teams will deliver samples to respective labs. Copies of previous chain of custody forms are in the lower file drawer in drinking water cabinet.



**UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES**

**Program Coordination (Westminster and Golden)**

Field Sampling Teams: Westminster, Thornton, Golden, Arvada

Permanent autosampler sites were selected at strategic locations in the watershed in order to assess diurnal variations in water quality in Clear Creek. The 48-hour ambient composites are collected with programmable automatic sampling devices. Each of the 24 sample bottles represents a two hour time period, resulting from collecting equal volumes of sample in each of two consecutive hours; therefore, 48 hours of samples are collected in 24 bottles. The 24 discrete samples are composited into two 24 hour samples on a time weighted basis (i.e. equal sample volumes are taken from 12 discrete autosampler bottles and combined into a single composite sample.) Additional discrete or composite samples may be submitted for analysis based on anomalies noted in field observations for the individual autosampler bottles.

Ambient samples are collected approximately seven times per year on a monthly schedule starting in April and ending in October. Ambient autosampler sample collection will correlate with the Clear Creek grab sample program during the months of April, June, July and August whenever possible. The schedule for the ambient sampling is based on clear weather predictions and is staggered at different times during the week, including weekends.

Analytical probes and data logging equipment are active at the autosampler sites year-round to continuously monitor in-stream conditions for temperature and conductivity. From April through October, or as weather conditions permit, additional probes are deployed for pressure (depth), turbidity and pH. YSI multi-probe sondes are deployed at CC26 and CC49. The sample locations are equipped with data loggers for remote monitoring of water quality conditions in the watershed.

**UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES**

**Sample Locations**

CC AS 26	Mainstem of CC at USGS Lawson gage
CC AS 49	Mainstem of CC above the confluence of the North Fork
CC AS 50	North Fork of CC above confluence of Mainstem of CC at USGS gage
CC AS 59	Mainstem of CC above Golden and Church Ditch diversions

**UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES**

**Flow Monitoring**

USGS gages will provide the average daily flow associated with each of the two 24-hour composite samples for the ambient autosamplers. Data will be obtained directly from the gage stations at CC26 and CC50 to correlate with CC AS 26 and CC AS 50. Flow data from the gage at CC40 will be used to correlate to CC AS 49 because there are no significant inflows to or diversions from Clear Creek between CC40 and CC AS 49.

The flow data associated with CC AS 59 is considered to be an estimated flow. The flows diverted to the City of Golden water plant and the Church Ditch will be added to the gage flows recorded at the USGS gage at CC61 (Clear Creek at Golden) to estimate the flow at CC AS 59.

**UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES**

**Analytical Parameters**

Analyte	Analytical Method Reference	Reporting Limit	Responsible Laboratory
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster
Nitrate/Nitrite-N	SM 4500-NO3 I	0.01 mg/L	Westminster
Ammonia-N	SM 4500-NH3 H	0.01 mg/L	Westminster
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn
Ortho-phosphate-P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn
Total Suspended Solids (TSS)	SM 2540 D	1 mg/L	Thornton
Total Organic Carbon (TOC)	SM 5310 B	0.5 mg/L	Thornton
pH	SM 4500-H+ B	0.1 Std Units	Field Teams
Temperature	SM 2550 B	0.1 °C	Field Teams
Conductivity	SM 2510 B	1 µS/cm	Field Teams
Turbidity	SM 2130 B	0.1 NTU	Field Teams
Total and Dissolved Cadmium	EPA 200.7	0.001 mg/L	Golden
Total and Dissolved Copper	EPA 200.7	0.005 mg/L	Golden
Total and Dissolved Iron	EPA 200.7	0.007 mg/L	Golden
Total and Dissolved Lead	EPA 200.7	0.011 mg/L	Golden
Total and Dissolved Manganese	EPA 200.7	0.001 mg/L	Golden
Total and Dissolved Zinc	EPA 200.7	0.005 mg/L	Golden
Stream Flow	Gage readings	1 cfs	USGS/UCCWA/Golden/ FRICO

- Table Notes:
- 1) SM refers to the 21<sup>st</sup> Edition of Standard Methods for the Examination of Water and Wastewater.
  - 2) Reporting limits are matrix dependent and may be increased for complex matrices.
  - 3) EPA recommended holding times less than 72 hours may not be met due to the extended sampling routine.
  - 4) Samples collected for nutrients (nitrogen and phosphorus) with a turbidity reading of greater than 100 NTU shall be diluted prior to analysis and may be analyzed as a spiked sample in order to evaluate digestion efficiency. Highly turbid samples may be split with a commercial laboratory to confirm nutrient concentrations.

## [UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES](#)

### Program Coordination (Westminster and Golden)

#### Field Equipment

##### **Equipment Installed At Autosampler Locations**

- Permanent and tamper-proof enclosure box with lock
- American Sigma 900, 900 Max or other automated sampler
- Power supply – solar panel, rechargeable battery or direct power
- Sample tubing long enough to reach from the autosampler to the streambed. Probes must be contained in protective piping secured in the creek bed
- Dedicated field probes for turbidity, temperature, conductivity and pH
- Depth/velocity flow sensor
- Recording gage at CC26 – Operated and maintained by USGS
- Staff gage at CC50
- Rain gage at CC59
- 24 discrete HCl rinsed autosampler bottles with caps. Bottles must be numbered and inserted in the designated position in autosampler (positions numbered 1 through 24)
- Continuous recording datalogger
- Cellular modem and antenna at CC26, CC50 and CC59

## [UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES](#)

### Autosampler Operation

On a monthly basis between April and October, autosamplers will be set to collect time-weighted discrete samples for a 48 hour period. The autosamplers are strategically located in order to correlate stream flow with the chemical water quality data collected on the samples. In order to associate the relative impacts of the point and nonpoint pollutant sources located between the sample stations, it is advisable to observe the same “slug” of water at both the upstream and downstream locations. Using the “time of travel” study conducted by USGS in 1999, the downstream autosamplers can be delayed for a predetermined time based on in-stream flow velocity. The time of travel considerations will permit comparing the same “slug” of water at both locations and facilitate pollutant impact assessments.

The time of travel estimates table is included in Appendix E.

### **Autosampler Setup:**

Equipment required:

- 24 discrete HCl rinsed autosampler bottles with caps
- Keys and/or tools to access autosampler enclosure.
- Field data collection/station audit sheets.

Setup Procedure:

1. Unlock sample enclosure and remove sampler head. Set aside without disturbing or bumping the distributor arm.
2. Load uncapped bottles in the correct positions in the bottom of the sampler.
3. Secure bottles in place with the retaining ring. Store caps in a ziplock bag inside the autosampler until sample collection.
4. Replace sampler head and lock in place. Use care to ensure the distributor arm is set above the first bottle.
5. Program the sampler according to manufacturer's instructions to collect two sequential 350 mL to 450 mL samples in each of 24 one-liter bottles in a 48 hour period.
6. Record station/equipment information on field sheet.
7. Make sure the autosampler program is set to **RUN** before locking the enclosure.
8. The autosampler may be set up a day or two ahead of programmed start time.

### **Sample Collection**

Additional equipment required:

- Keys and/or tools to access autosampler enclosures
- Large cooler with ice to collect sample bottles
- 24 pre-cleaned, HCl rinsed, discrete sample replacement bottles
- Field data sheets/station audit sheets
- Chain of custody forms
- Laptop with Loggernet software and data cable (9 pin serial cable with SC32B adapter) if retrieving data directly from datalogger
- 2 or 3 pre-cleaned, HCl rinsed, Nalgene composite sample bottles if compositing in the field
- Two-liter Nalgene bottles (washed and rinsed with 1:1 hydrochloric acid) for compositing samples
- 250 mL graduated cylinder (washed and rinsed with 1:1 hydrochloric acid) for compositing samples

- Prepared sample bottles provided by participating Cities for nutrients, solids and metals analyses
  - 1 L square plastic – phosphorus series (Northglenn)
  - 250 mL plastic – nitrogen series (Westminster)
  - 500 mL plastic bottle – TSS (Thornton)
  - 250 ml round plastic – total and dissolved metals (Golden)
- Chain of Custody Forms – Refer to Appendix C
- Field Sampling Form - Refer to Appendix C

#### Sample Collection Procedure:

1. Unlock enclosure and remove sampler head.
2. Retrieve date/time information from autosampler if required. To collect sample history on American Sigma samplers, press <Change/ Halt> button, press <time/read> button for 5 seconds. The sample collection time for the first sample will appear. Record data on the field sheet. Press <yes> for next sample time to appear. Continue until all data is recorded.
3. Record station/equipment information on field sheet.
4. Make note of any samples with high turbidity determined by visual observance or data obtained from the datalogger.
5. Cap bottles and place in a cooler with ice for transport to Golden lab for compositing.  
Optional compositing of samples in the field is performed by pouring off equal volumes into two-liter pre-cleaned bottles. Refer to the Sample Compositing Procedure Step 1. Save remaining volume of any high turbidity samples to take back to the lab. Pour remaining sample on the ground.
6. Clean out autosampler base and reload with a new set of pre-cleaned bottles.
7. During storm season, reset sampler for event triggered monitoring between the monthly sampling events.
8. Take all samples to the Golden Water Quality Laboratory for compositing, splitting, distribution and wet chemistry analysis of pH, turbidity and conductivity.

#### **UCC AUTOSAMPLER 48-HOUR AMBIENT SAMPLES**

##### *Sample Compositing*

1. Composite samples in the laboratory if compositing was not performed in field. Shake sample bottles and pour equal volumes of sample from the first 12 bottles into a composite bottle marked “A”. Shake sample bottles and pour equal volumes of sample from the remaining 12 bottles into a composite bottle marked “B”.
2. Perform turbidity, pH and conductivity measurements on composited samples. Enter data on the Sampling Form.
3. Use the well mixed composites (A and B) to fill the appropriate bottles for the Northglenn, Thornton, Westminster and Golden labs.

4. If any discreet bottle(s) appears to have an unusually high turbidity and enough sample is available, analyze for turbidity and conductivity. Record on Sampling Form. If there is enough sample, pour the high turbidity discreet samples into separate nutrient and solids bottles for individual analysis.
5. Complete the COCs.
6. Deliver and relinquish to each city their respective samples (Westminster-nitrogen series, Thornton-TSS and TOC, Northglenn-phosphorus series) and sign COCs as appropriate.
7. Original field data sheets and COCs are retained by the Cities of Westminster and Golden for permanent archive.
8. Samples are created in the web-accessible Tribal data system by Westminster for data entry and results archive.

**UCC AUTOSAMPLERS – EVENT SAMPLES**  
Program Coordination (Westminster and Golden)

Field Sampling Teams: Westminster, Thornton, Golden, Arvada

The event autosampler program was initiated in 2006 to assess the pollutant concentrations mobilized during significant snow melt (runoff) or rain events at 48-hour ambient locations CC AS 49 and CC AS 59. Automated sample collection of stormwater may be triggered based on changes in ambient turbidity, conductivity, stage height, or rain gage readings, depending on the autosampler location. The autosamplers are currently set to trigger when the 30 minute running average exceeds a predetermined turbidity level (typically 100 NTU). The autosampler at CC AS 59 triggers based on a combination of change in stream depth, precipitation and turbidity in order to eliminate triggering autosampler event sampling that might be associated with localized human disturbances in the creek (placer mining). Autosamplers trigger independently depending on the localized conditions in the watershed. The autosampler collects discrete samples every 15 minutes until the parameter that triggered the event returns to the ambient condition or until the maximum number of samples is collected. The discrete samples may be analyzed individually or multiple discrete samples may be composited based on the field observations. As necessary, refer to the previous section for instructions on compositing samples from autosamplers.

Storm event samples are analyzed for the same suite of analytical parameters listed in the previous section for the 48-hour ambient samples. Samples may not be analyzed within the EPA recommended holding time for some parameters based on the random nature of the storm event triggering.

**UCC AUTOSAMPLERS - EVENT SAMPLES**  
Sample Locations

CC AS 26 Event	Mainstem of CC at USGS Lawson gage
CC AS 49 Event	Mainstem of CC above the confluence of the North Fork
CC AS 50 Event	North Fork of CC above confluence of Mainstem of CC at USGS gage
CC AS 59 Event	Mainstem of CC above Golden and Church Ditch diversions

**UCC AUTOSAMPLERS – EVENT SAMPLES**  
Flow Monitoring

Westminster and Golden will obtain the 15 minute interval flow data from the USGS gage at CC61 (Clear Creek at Golden) to correlate to CC AS 59. The average event flow will be calculated to correspond to the specific time-event composited samples. If the 15 minute interval flow data is not available, the average daily flow will be associated with the event. The average daily flow at UCCWA gage CC40 will be used to correlate with CC AS 49. The flow data will be entered into the LDMS to be used for loadings calculations for storm events.

## **TRIBUTARY BASIN MONITORING PROGRAM**

The Standley Lake Tributary Basin Monitoring Program is designed to provide water quality information for evaluation of the nutrient loadings from non-point sources in the Standley Lake Tributary Basin. The only point source discharge between CC60 on the main stem of Clear Creek and the canal diversions to Standley Lake is the Coors cooling basin return flow.

Three tributaries (the terms trib and canal are interchangeable) divert Clear Creek water to Standley Lake: the Church Ditch, the Farmers Highline (“FHL”) Canal and the Croke Canal. The trib monitoring locations were selected to assess the relative loadings to the canals from areas within unincorporated Jefferson County and the city limits of Golden and Arvada. Denver Water supplies Westminster with a small quantity of water via the Kinnear Ditch Pipeline (“KDPL”) which enters Standley Lake after passing through a wetlands area located west of 96<sup>th</sup> Ave and Alkire Street. The upstream and downstream locations near the wetlands are monitored when there is flow through the pipeline. The Denver Water raw water sources include Gross Reservoir and Coal Creek.

Trib samples are collected year-round on a monthly basis. All tributaries flowing at a rate that allows collection of a representative sample will be monitored.

The Church Ditch delivery structure at Standley Lake was relocated in 2008 from the west side of the lake to the south side of the lake in order to avoid the potential for significant stormwater impacts to the lake. The former Church Ditch monitoring location at Standley Lake (T-09) was abandoned in 2009 when the new delivery structure (T-27) became operational.

The raw water pipeline at Semper (T-24) is monitored monthly. The raw water pipeline at NWWTP (T-25) is monitored only when the Semper facility is offline.

### **TRIB SAMPLES**

#### **Locations and Sample Schedule**

<b>Sample ID</b>	<b>Sample Location *</b>	<b>Every month of the year when flowing**</b>
T-01	Church Ditch at Headgate on MSCC	X
T-02	FHL at Headgate on MSCC	X
T-03	Croke Canal at Headgate on MSCC	X
T-04	Croke Canal at Standley Lake	X
T-11	FHL at Standley Lake	X
T-22A	Kinnear Ditch Pipeline (KDPL) above wetlands	X
T-22D	Kinnear Ditch Pipeline (KDPL) downstream of wetlands	X
T-24	Raw Water Pipeline at Semper	X
T-25	Raw Water Pipeline at NWWTP	X
T-27	Church Ditch delivery structure at SL (est. 2009)	X

\*MSCC = Mainstem Clear Creek

\*\* Exceptions noted in paragraph above the table.



## TRIB SAMPLES

### Analytical Parameters and Analytical Scheme

Analyte	Analytical Method Reference	Reporting Limit	Responsible Laboratory	Monitoring Frequency
Temperature	SM 2550 B	0.1 °C	Field Team	Monthly
pH	SM 4500-H+ B	0.1 Std Units	Field Team	Monthly
Conductivity	SM 2510 B	1 µS/cm	Field Team	Monthly
Turbidity	SM 2130B	0.1 NTU	Field Team	Monthly
Dissolved Oxygen	SM 4500-O G	0.1 mg/L	Field Team	Monthly
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn	Monthly
Ortho-phosphate as P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn	Monthly
Total Suspended Solids (TSS)	SM 2540 D	1 mg/L	Thornton	Monthly
Total Organic Carbon	SM 5310	0.5 mg/L	Thornton	Monthly
E. coli	SM 9221 D	1 cfu/100mL	Thornton	Monthly
Total and Dissolved Iron	EPA 200.7	0.02 mg/L	Thornton	Monthly
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Thornton	Monthly
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Thornton	Monthly
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster	Monthly
Nitrate/Nitrite as N	SM 4500-NO3 I	0.01 mg/L	Westminster	Monthly
Ammonia as N	SM 4500-NH3 H	0.01 mg/L	Westminster	Monthly
UV-254	SM 5910 B	0.001 cm <sup>-1</sup>	Westminster	Monthly
Gross Alpha and Gross Beta	EPA 901.1	0.1 pCi/L	Westminster	Quarterly
Dissolved Barium	EPA 200.8	0.002 mg/L	Thornton	Quarterly
Dissolved Beryllium	EPA 200.8	0.001 mg/L	Thornton	Quarterly
Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Thornton	Quarterly
Dissolved Chromium	EPA 200.8	0.001 mg/L	Thornton	Quarterly
Dissolved Copper	EPA 200.8	0.002 mg/L	Thornton	Quarterly
Dissolved Lead	EPA 200.8	0.0005 mg/L	Thornton	Quarterly
Dissolved Nickel	EPA 200.8	0.005 mg/L	Thornton	Quarterly
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Thornton	Quarterly
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Thornton	Quarterly
Total and Dissolved Silver	EPA 200.8	0.0005 mg/L	Thornton	Quarterly
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Thornton	Quarterly
Chloride	SM 4500-Cl G	5 mg/L	Thornton	Quarterly
Sulfate	SM 4500 SO4 E	10 mg/L	Thornton	Quarterly
Total Hardness (as CaCO <sub>3</sub> )	EPA 130.2	5 mg/L	Thornton	Quarterly

- Table Notes:
- 1) SM refers to the 21<sup>st</sup> Edition of Standard Methods for the Examination of Water and Wastewater.
  - 2) Reporting limits are matrix dependent and may be increased for complex matrices.
  - 3) Quarterly parameters are analyzed in March, June, September and December at all sampled locations.
  - 4) UV-254 is analyzed monthly at Standley Lake inflows when flows are greater than 10 cfs (T-4, T-11, T-22D and T-27 when sampled) and the pipelines (T-24 and T-25 when sampled).
  - 5) Samples collected for nutrients (nitrogen and phosphorus) with a turbidity reading of greater than 100 NTU shall be diluted prior to analysis and may be analyzed as a spiked sample in order to evaluate digestion efficiency. Highly turbid samples may be split with a commercial laboratory to confirm nutrient concentrations.

## TRIB SAMPLES

### Program Coordination (Northglenn)

Before the scheduled Tributary sampling date:

- Ensure an adequate supply of sample containers is available from Thornton. Westminster's bottles will be picked up at Westminster on sampling day before the start of sampling at T-24.
- Label the Trip blank bottle and fill with laboratory DI water.
- Calibrate the pH and DO meters.
- Analyze the Trip Blank for pH and DO.
- Pack Trip Blank in cooler to monitor field activities for phosphorus contamination.

### Sample Bottle Kit – Tribs Monthly and Quarterly

Quantity	Volume	Bottle Type	Parameter	Laboratory
9	500 mL	Rectangular plastic	Phosphorus series	Northglenn
1 (Trip blank)	500 mL	Rectangular plastic	Phosphorus series	Northglenn
9	500 mL	Plastic	TSS, Total Hardness, Chloride, Sulfate	Thornton
9	40 mL	Glass vial	TOC	Thornton
9	250 mL	Glass	E. coli	Thornton
9	125 mL	Plastic	Total Metals	Thornton
9	125 mL	Plastic	Dissolved Metals	Thornton
9	250 mL	Plastic	Nitrogen series, UV-254	Westminster
9	1 L	Plastic	Rads	Westminster

Table Note: Additional sites are sampled quarterly for metals; otherwise only four bottles are required for monthly monitoring for total metals and four bottles for dissolved metals.

### Sample Collection

Equipment required:

- Key to access T-2.
- Gate Code for access at T-22A.
- Field data book.
- Cooler with blue ice or ice.
- Trip blank filled with DI.
- Sample bottles as detailed above
- Bucket for sample collection
- pH and DO meters and probes
- Ballpoint pen

- Waterproof marker
- Chain of custody forms
- NOTE – Four wheel drive vehicle recommended for sampling due to steep inclines at some locations and potentially rugged or muddy conditions.

Sample collection procedure:

1. Meet with Westminster staff at Semper. Drop off bottles for Westminster staff to collect sample at T-25.
2. Starting with T-24, collect field samples in the order detailed below for each location where water is flowing.
3. Rinse the sample bucket with the field sample water repeatedly at each location before collecting the sample.
4. Collect enough volume of the field sample in the bucket to fill all sample bottles for the location.
5. Fill the appropriate sample bottles from the bucket.
6. Label the sample bottles with location, date and time of collection.
7. Analyze the sample in the field for pH, DO and temperature. Record data in the field notebook.
8. Repeat the process at each location.
9. Return to Westminster's Semper WTP to receive T-25 sample from Westminster staff. Sign COC and keep the original copy of the COC.
10. Leave an unsigned copy of the Thornton COC at Westminster so the samples can be logged into the Tribal database by Westminster staff.
11. Complete the COCs and relinquish custody of the samples to Westminster staff. Sign COC and keep a copy of the COC. Leave the original COC with the samples.
12. Return to Northglenn Lab and analyze samples for conductivity and turbidity on calibrated meters. Record data in the field notebook.
13. Contact Thornton to pick up collected field samples. Request replenishment of bottles for the next sampling event as needed.
14. Relinquish samples to Thornton and sign COCs. Retain a copy of the COC. Thornton takes possession of the original COC.
15. Northglenn retains a copy of all COCs and field documentation for permanent archive.

## TRIB SAMPLES

### Sampling Locations Directions and Narrative Descriptions

Tributary sampling occurs generally in an upstream to downstream fashion. Samples are collected at designated locations when water is flowing.

#### Trib 24

T-24 is located at Westminster's Semper Water Treatment Plant at 8900 Pierce Street. The sample is collected from the RAW water tap in the Operator's Laboratory. Do NOT increase the flow at the tap at this location. First tap on the left labeled 24.

#### Trib 22A

T-22A is the upstream sample point on the Kinnear Ditch pipeline. It is accessed through a gate located at Hwy. 72 and Plainview Rd. A key is required to access the location. The sample point is approximately 0.2 miles from Plainview Rd. Sample is taken at the flume just before the beginning of the pipeline.

#### Trib 1

T-1 is located at the Church Ditch headgate on Clear Creek. This site is accessed via Hwy 6 approximately 0.5 miles west of Hwy 93. There is a diversion from Clear Creek above this location which diverts water from Clear Creek and runs it parallel to the Creek. There are two gates at this location one sends water back into Clear Creek and the other is the Church Ditch headgate. Sample is taken from the bridge just above both gates.

#### Trib 2

T-2 is located at the Farmers Highline headgate on Clear Creek.

The site is accessed behind the Coors office building at the end of Archer St. Sample is taken from the bridge just inside the gate. Sample the downstream side of the headgate if it is open or on the upstream side if the headgate is closed (Clear Creek side).

#### Trib 3

T-3 is located at the Croke Canal headgate on Clear Creek.

This site is on Coors property. It is along the frontage road through Coors, on the east side of a small "pond". Sample the downstream side of the headgate if it is open or on the upstream side if the headgate is closed (Clear Creek side).

#### Trib 22D

T-22D is on the Kinnear Ditch Pipeline between 96<sup>th</sup> Ave and 88<sup>th</sup> Ave on Alkire St.

The sample is taken just downstream of the culvert on the east side of Alkire St.

#### Trib 04 and Trib 11

The Croke Canal (T-04) passes UNDER the Farmers Highline (T-11) in the area just west of 86<sup>th</sup> and Kipling prior to entering Standley Lake. The Farmers Highline passes OVER the Croke in a concrete structure. Sample the Croke on the south side of the Farmers Highline concrete structure. Sample the Farmers next to the white autosampler housing box.

#### Trib 25

Located at Westminster's Northwest Water Treatment Plant located at 104<sup>th</sup> & Wadsworth. The sample is collected by Westminster from the raw water tap on the west wall in the membrane filter gallery. Sample only if T-24 is not running.

Trib 27

Located on the south side of Standley Lake at the Church Ditch delivery structure. This sampling location was activated in 2009.

Photographs of the sampling locations and GPS coordinates are included in Appendix D.

**TRIB CONTINUOUS MONITORING**

**Program Coordination (Westminster)**

Field sampling team: Westminster

A YSI multi-parameter sonde and data logging equipment are deployed year-round at the trib location where the Farmers Highline Canal (T-11) crosses over the Croke Canal (T-04), provided there is sufficient flow in one of the canals. A sonde was also installed at the new Church Ditch inlet (T-27) in 2009 and operates under similar conditions. The probes provide continuous in-stream monitoring of pH, ORP, temperature, depth (pressure transducer), conductivity and turbidity. Remote access to the data logger data facilitates monitoring of water quality at these inflow locations to Standley Lake. The FHL/Croke station is also equipped with a tipping-bucket rain gauge.

**TRIB CONTINUOUS MONITORING**

**Sample Locations**

CC AS T04	Croke Canal approximately 0.5 mile from Standley Lake inlet
CC AS T11	Farmers Highline Canal approximately 0.5 mile from Standley Lake inlet
CC AS T27	Church Ditch at Standley Lake inlet

Table Note: Historical data from these locations are available as part of the Clear Creek Canal Program which was eliminated in 2008. The sample location identifications associated with the Clear Creek Canal Program have been retained.

### TRIB AUTOSAMPLER EVENT SAMPLES

#### Program Coordination (Westminster)

Field Sampling Teams: Westminster

The event autosampler program was initiated on the Tributaries in 2009 at CC AS T11 to assess the pollutant concentrations mobilized during significant snow melt (runoff) or rain events at the location closest to Standley Lake. Automated sample collection of stormwater is triggered based on a turbidity reading of 100 NTU. The autosampler may also be activated remotely to begin sampling immediately or programmed to start sampling at a designated time in an attempt to capture the downstream effects of a storm in the upper watershed based on time of travel. The autosampler collects discrete samples every 15 minutes until the ambient condition drops below the trigger level or until the maximum number of samples is collected. The discrete samples may be analyzed individually or multiple discrete samples may be composited based on the field observations.

Trib Autosampler Event Samples are only collected at CC AS T11. First flush samples may be collected at all three Trib Autosampler Continuous Monitoring locations described in the previous section.

Refer to Appendix E for the time of travel data for the Farmers Highline Canal. Time of travel studies have not been performed on the Croke Canal or to the relocated Church Ditch inlet structure.

### TRIB AUTOSAMPLERS EVENT MONITORING

#### Sample Location

CC AS T11 Event	Farmers Highline Canal approximately 0.5 mile from Standley Lake inlet
-----------------	--

Table Note: Historical data from this location is available as part of the Clear Creek Canal Program which was eliminated in 2008. The sample location identifications associated with the Clear Creek Canal Program have been retained.

### TRIB AUTOSAMPLER EVENT SAMPLES

#### Flow Monitoring

Westminster will obtain the canal flow data from FRICO. The average daily flow data corresponding with the time-event composited samples will be entered into the LDMS to be used for loadings calculations for storm events.

**TRIB AUTOSAMPLER EVENT SAMPLES**

**Analytical Parameters**

Analyte	Analytical Method Reference	Reporting Limit	Responsible Laboratory
pH	SM 4500-H+ B	0.1 Std Units	Field Teams
Temperature	SM 2550 B	0.1 °C	Field Teams
Conductivity	SM 2510 B	1 µS/cm	Field Teams
Turbidity	SM 2130 B	0.1 NTU	Field Teams
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster
Nitrate/Nitrite-N	SM 4500-NO3 I	0.01 mg/L	Westminster
Ammonia-N	SM 4500-NH3 H	0.01 mg/L	Westminster
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn
Ortho-phosphate-P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn
Total Suspended Solids (TSS)	SM 2540 D	1 mg/L	Thornton
Total Organic Carbon (TOC)	SM 5310 B	0.5 mg/L	Thornton
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Thornton
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Iron	EPA 200.7	0.02 mg/L	Thornton
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Thornton
Canal Flow	Weekly Dam Report	1 cfs	FRICO

- Table Notes:
- 1) SM refers to the 21<sup>st</sup> Edition of Standard Methods for the Examination of Water and Wastewater.
  - 2) Reporting limits are matrix dependent and may be increased for complex matrices.
  - 3) EPA recommended holding times less than 72 hours may not be met due to the extended sampling routine.
  - 4) Samples collected for nutrients (nitrogen and phosphorus) with a turbidity reading of greater than 100 NTU shall be diluted prior to analysis and may be analyzed as a spiked sample in order to evaluate digestion efficiency. Highly turbid samples may be split with a commercial laboratory to confirm nutrient concentrations.

**TRIB AUTOSAMPLER EVENT SAMPLES**

**Field Equipment**

**Equipment Installed At Autosampler Location**

- Permanent and tamper-proof enclosure box with lock
- American Sigma 900, 900 Max or other automated sampler
- Power supply – solar panel, rechargeable battery or direct power
- Sample tubing long enough to reach from the autosampler to the streambed. Probes must be contained in protective piping secured in the creek bed

- Dedicated field probes for turbidity, temperature, conductivity, ORP, pressure transducer (depth) and pH
- 24 discrete HCl rinsed autosampler bottles with caps. Bottles must be numbered and inserted in the designated position in autosampler (positions numbered 1 through 24)
- Continuous recording datalogger
- Meteorological data acquisition equipment (e.g. rain gauge or anemometer)
- Cellular modem and antenna

**Autosampler Operation and Setup, and Sample Collection and Compositing**

Refer to the UCC Autosampler 48-HR Ambient/Event sections for directions; however, Westminster will collect and composite the samples at the Semper Water Treatment Facility.



## **STANDLEY LAKE MONITORING PROGRAM**

Standley Lake is a storage reservoir that serves as the raw drinking water source for the SLC. Over 250,000 consumers rely on Standley Lake for their drinking water. The Standley Lake (“SL”) Monitoring Program is designed to provide water quality information in order to evaluate internal loadings in Standley Lake and the effects of nutrient reduction measures and best management practices on the trophic status of Standley Lake. Regularly spaced and frequent sampling is necessary to provide sufficient data for monitoring trends for the analytes used to evaluate trophic status including dissolved oxygen, chlorophyll and nutrients.

The main water quality monitoring efforts on Standley Lake include:

- Daily top to bottom lake profiles
- Bimonthly grab samples
- Zooplankton tows
- Invasive species monitoring and control

### **SL – DAILY LAKE PROFILES**

#### *Program Coordination (Westminster)*

The sampling location in Standley Lake (Site 10-00) is situated near the outlet structure. The lake site was selected based on the lengthy historical record of water quality monitoring data and because the water is drawn from the lake at this location via pipelines to the SLC’s water treatment plants. Sampling at varying depths in the lake provides extensive information for use in drinking water treatment process decisions and evaluating water resource management options.

Standley Lake is monitored at Site 10-00 using an automated profiler equipped with a multi-probe sonde four times each day from early spring to late fall for the analytes listed in the following table. The profiler is removed from the lake prior to freezing of the lake surface. Refer to the watershed map in Appendix B for the location of the SL monitoring location. The solar powered unit collects data from the surface of the lake to within five feet off the bottom and every meter in between. The profiler data is accessible via the internet and provides a depth-integrated profile of the lake water quality.

### **SL – DAILY LAKE PROFILES**

#### *Analytical Parameters*

<b>Analyte</b>	<b>Analytical Method Reference</b>	<b>Reporting Limit</b>
Temperature	SM 2560 A	0.01 °C
pH	SM 4500-H+ B	0.01 Std Units
Conductivity	SM 2510 B	1 µS/cm
Turbidity	SM 2130 B	0.1 NTU
Dissolved Oxygen	YSI (optical probe)	0.01 mg/L
Chlorophyll	YSI (electrode)	0.1 µg/L
ORP	SM 2580 A	0.1 mv

**SL – BIMONTHLY GRAB SAMPLES**

Program Coordination: Westminster

The same sampling location in Standley Lake (Site 10-00) is used for both the daily lake profiles and the bimonthly grab samples. Sampling at varying depths in the lake provides extensive information for use in drinking water treatment process decisions and evaluating water resource management options. Refer to the watershed map in Appendix B for the location of the SL monitoring location.

**SL – BIMONTHLY GRAB SAMPLES**

Locations

Grab samples are collected twice each month from March through November, but the sampling may be extended during the winter if the lake is not frozen. The raw water pipeline at Semper (T-24) may be sampled for a subset of the routine analytical parameters when the lake is frozen or when safety of the sampling team is a concern (i.e. high winds, frozen boat dock ramp, etc).

<b>Sample Identification</b>	<b>Sample Location</b>
SL 10-00	SL surface
SL 10-PZ	SL at two times the Secchi depth
SL 10-70	SL at five feet off the bottom. (Approximate depth of 60 ft when lake is full at gage height 96)
SL 69-00	SL surface at the boat dock
T-24	Semper raw water pipeline. T-24 is approximately 10 ft higher than SL 10-70.

**SL – BIMONTHLY GRAB SAMPLES**

**Analytical Parameters**

Analyte	Analytical Method Reference	Reporting Limit	Responsible Laboratory
Temperature	SM 2550 B	0.1 °C	Field Team
pH	SM 4500-H+ B	0.1 Std Units	Field Team
Conductivity	SM 2510 B	1 µS/cm	Field Team
Turbidity	SM 2130 B	0.1 NTU	Field Team
Dissolved Oxygen	YSI (optical probe)	0.1 mg/L	Field Team
ORP	YSI (electrode)	1 mv	Field Team
Chlorophyll	YSI (electrode)	0.1 µg/L	Field Team
Secchi Depth	Secchi disk	0.1 meter	Field Team
Total Nitrogen	SM 4500-NO3 I	0.02 mg/L	Westminster
Nitrate/Nitrite as N	SM 4500-NO3 I	0.01 mg/L	Westminster
Ammonia as N	SM 4500-NH3 H	0.01 mg/L	Westminster
Gross Alpha and Gross Beta	EPA 900.0	0.1 pCi/L	Westminster
Zooplankton	SM 10900	1 per L	Westminster
Algae	SM 10900	1 per mL	Westminster
Chlorophyll <i>a</i>	SM 10200-H	1.0 µg/L	Westminster
UV-254	SM 5910 B	0.001 cm <sup>-1</sup>	Westminster
Total Phosphorus	SM 4500-P E	0.0025 mg/L	Northglenn
Ortho-phosphate as P (dissolved) or DRP	SM 4500-P E	0.0025 mg/L	Northglenn
Total Organic Carbon	SM 5310 B	0.5 mg/L	Thornton
Total Suspended Solids	SM 2540 D	1 mg/L	Thornton
Total and Dissolved Arsenic	EPA 200.8	0.001 mg/L	Thornton
Total and Dissolved Barium	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Beryllium	EPA 200.8	0.001 mg/L	Thornton
Total and Dissolved Cadmium	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Chromium	EPA 200.8	0.001 mg/L	Thornton
Total and Dissolved Copper	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Iron	EPA 200.7	0.02 mg/L	Thornton
Total and Dissolved Lead	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Manganese	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Molybdenum	EPA 200.8	0.002 mg/L	Thornton
Total and Dissolved Nickel	EPA 200.8	0.005 mg/L	Thornton
Total and Dissolved Selenium	EPA 200.8	0.005 mg/L	Thornton
Total and Dissolved Silver	EPA 200.8	0.0005 mg/L	Thornton
Total and Dissolved Zinc	EPA 200.8	0.020 mg/L	Thornton
Total Mercury	EPA 245.1	0.0002 mg/L	Thornton
Total Hardness (as CaCO <sub>3</sub> )	EPA 130.2	5 mg/L	Thornton
E. coli	SM 9221 D	1 cfu/100mL	Thornton
BTEX	EPA 524.2	0.5 µg/L	Thornton

Table Notes: 1) SM refers to the 21<sup>st</sup> Edition of Standard Methods for the Examination of Water and Wastewater.  
2) Reporting limits are matrix dependent and may be increased for complex matrices.

**SL – BIMONTHLY GRAB SAMPLES**

Analytical Scheme

The analytical scheme for Standley Lake was designed to capture the biological, physical and chemical changes occurring in the lake ecosystem throughout the year. Seasonality plays an important role in lake dynamics and subsequently, on the water treatment processes. The table below details the variable analytical scheme, with the caveat that weather patterns may require modification to the plan. Rads (Gross Alpha and Gross Beta) and metals are collected before and after run-off, and before and after lake turnover, which are both subject to annual fluctuation.

Month	Lake Sample Location	Analytes													
		Hand Profile	Secchi depth	Rads	E coli	Zooplankton	Nutrients	Metals	Algae	Chlorophyll <i>a</i>	TOC	TSS	Total Hardness	BTEX	UV-254
January 1 <sup>st</sup> week	10-00	X	X	X	X	X									
	10-PZ			X			X	X	X	X	X	X		X	
	10-70	X		X	X		X	X			X	X	X		
	T-24								X	X				X	
January 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X		X	X				X	
	10-70	X					X							X	
	T-24								X	X				X	
February 1 <sup>st</sup> week	10-00	X	X		X	X									
	10-PZ						X		X	X	X	X		X	
	10-70	X			X		X				X	X	X	X	
	T-24								X	X				X	
February 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X		X	X				X	
	10-70	X					X							X	
	T-24								X	X				X	
March 1 <sup>st</sup> week	10-00	X	X	X	X	X									
	10-PZ			X			X		X	X	X	X		X	
	10-70	X		X	X		X				X	X	X	X	
	T-24								X	X				X	
March 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X		X	X				X	
	10-70	X					X							X	
	T-24								X	X				X	
April 1 <sup>st</sup> week	10-00	X	X		X	X									
	10-PZ						X		X	X	X	X		X	
	10-70	X			X		X				X	X	X	X	
	69-00												X		
	T-24								X	X				X	
April 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X		X	X				X	
	10-70	X					X							X	
	T-24								X	X				X	

Month	Lake Sample Location	Analytes													
		Hand Profile	Secchi depth	Rads	E coli	Zooplankton	Nutrients	Metals	Algae	Chlorophyll <i>a</i>	TOC	TSS	Total Hardness	BTEX	UV-254
May 1st week	10-00	X	X		X	X									
	10-PZ						X		X	X	X	X		X	
	10-70	X			X		X				X	X	X		X
	T-24								X	X					X
May 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X		X	X					X
	10-70	X					X								X
	69-00													X	
T-24								X	X						X
June 1 <sup>st</sup> week	10-00	X	X	X	X	X									
	10-PZ			X			X	X	X	X	X	X			X
	10-70	X		X	X		X	X			X	X	X		X
	T-24								X	X					
June 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X		X	X					X
	10-70	X					X								X
	69-00													X	
T-24								X	X						X
July 1 <sup>st</sup> week	10-00	X	X		X	X									
	10-PZ						X		X	X	X	X			X
	10-70	X			X		X				X	X	X		X
	T-24								X	X					
July 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X	X	X	X			X		X
	10-70	X					X	X					X		X
	69-00													X	
T-24								X	X						X
August 1 <sup>st</sup> week	10-00	X	X		X	X									
	10-PZ						X		X	X	X				X
	10-70	X			X		X				X	X			X
	T-24								X	X					
August 3 <sup>rd</sup> week	10-00	X	X	X		X									
	10-PZ			X			X	X	X	X			X		X
	10-70	X		X			X	X					X		X
	69-00													X	
T-24								X	X						X
September 1 <sup>st</sup> week	10-00	X	X		X	X									
	10-PZ						X		X	X	X	X			X
	10-70	X			X		X				X	X			X
	T-24								X	X					

Month	Lake Sample Location	Analytes													
		Hand Profile	Secchi depth	Rads	E coli	Zooplankton	Nutrients	Metals	Algae	Chlorophyll <i>a</i>	TOC	TSS	Total Hardness	BTEX	UV-254
September 3 <sup>rd</sup> week	10-00	X	X	X		X									
	10-PZ			X			X	X	X	X			X		X
	10-70	X		X			X	X					X		X
	69-00													X	
	T-24								X	X					X
October 1 <sup>st</sup> week	10-00	X	X		X	X									
	10-PZ						X	X	X	X	X	X	X		X
	10-70	X			X		X	X			X	X	X		X
	T-24								X	X					X
October 3 <sup>rd</sup> week	10-00	X	X	X		X									
	10-PZ			X			X	X	X	X			X		X
	10-70	X		X			X	X					X		X
	69-00													X	
	T-24								X	X					X
November 1 <sup>st</sup> week	10-00	X	X		X	X									
	10-PZ						X		X	X	X	X	X		X
	10-70	X			X		X				X	X	X		X
	T-24								X	X					X
November 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X		X	X					X
	10-70	X					X								X
	T-24								X	X					X
December 1 <sup>st</sup> week	10-00	X	X	X	X	X									
	10-PZ			X			X		X	X	X	X	X		X
	10-70	X		X	X		X				X	X	X		X
	T-24								X	X					X
December 3 <sup>rd</sup> week	10-00	X	X			X									
	10-PZ						X		X	X					X
	10-70	X					X								X
	T-24								X	X					X

- Table notes:
- 1) Hand Profile includes analysis of temperature, pH, conductivity, turbidity, DO, chlorophyll and ORP at the surface of the lake and at the bottom of the lake using the sonde.
  - 2) Rads includes Gross Alpha and Gross Beta.
  - 3) Metals includes the total and dissolved forms of As, Ba, Be, Cd, Cr, Cu, Fe, Pb, Mn, Mo, Ni, Se, Ag and Zn, and total Hg. **Metals for the 3rd week of July and the 1st week of October consist of ONLY total and dissolved arsenic.**
  - 4) Nutrients include the phosphorus series and the nitrogen series analytes. Phosphorus series includes total P and dissolved ortho-phosphate-P (also referred to as DRP). Nitrogen series includes total N, ammonia-N and nitrate/nitrite-N.
  - 5) Total Hardness is reported as CaCO<sub>3</sub>.

**SL – BIMONTHLY GRAB SAMPLES**

**Program Coordination (Westminster)**

**SL Sample bottle kit**

The sample containers required for each monitoring event varies depending on the parameters to be analyzed. Westminster will assemble sample bottle kits for each event. The following table details the sample containers for various parameters.

<b>Parameter</b>	<b>Volume</b>	<b>Bottle Type</b>	<b>Laboratory</b>
Phosphorus series	1L	Rectangular plastic	Northglenn
Nitrogen series, UV-254	250 mL	Rectangular plastic	Westminster
Rads	1 L	Plastic	Westminster
Zooplankton	250 mL	Plastic	Westminster
Algae	1 L	Plastic	Westminster
Chlorophyll <i>a</i>	1 L	Brown plastic	Westminster
Total metals, Total Hg	500 mL	Plastic	Thornton
Dissolved metals	500 mL	Plastic	Thornton
TOC	40 mL	Glass vial	Thornton
TSS, Total Hardness	500 mL	Plastic jug	Thornton
E. coli	250 mL	Glass	Thornton
BTEX	40 mL	Glass vial	Thornton
BTEX trip blank	40 mL	Glass vial	Thornton

- Table Notes:
- 1) A trip blank is required to be prepared when field samples are collected for BTEX. The trip blank is comprised of a pre-cleaned glass vial filled with DI and is used to monitor for volatile organic contamination during transport and lab storage prior to analysis. Analysis of the trip blank is only required when any of the BTEX analytes are detectable in the field samples.
  - 2) Phosphorus series includes total P and dissolved ortho-phosphate-P (also referred to as DRP).
  - 3) Nitrogen series includes total N, ammonia-N and nitrate/nitrite-N.
  - 4) Rads includes: Gross Alpha and Gross Beta
  - 5) BTEX includes: benzene, toluene, ethyl benzene and total xylenes

## **SL – BIMONTHLY GRAB SAMPLES**

### **Sample Collection**

#### **Equipment**

Pontoon Boat  
Marking Pen – Waterproof  
Depth Finder  
Secchi Disk  
Log book and pen  
Van Dorn bottle  
Labeled sample bottles (refer to individual monitoring plans)  
Churn sample splitter  
PZ tube sampler  
Ice packs  
Coolers  
Chain of Custody forms  
YSI 6600 Sonde - calibrated  
YSI 650 Meter and cable  
Handheld anemometer/% Relative humidity meter  
Cellular phone  
GPS unit  
Digital camera  
Boat Tool Kit  
Laptop computer – fully charged with communication cable and “console” application installed.  
Water pitcher and wide bristle brush for cleaning sonde cage  
Jackets, hats, gloves or other protective clothing as appropriate for the weather conditions  
First aid kit  
Personal flotation devices (one per person)  
Survival Suits – yellow (1 hr protection) and orange (1/2 hr protection) -as appropriate  
Profiler enclosure key  
Boat Anchor(s)  
Key for boat ramp during off-season  
Zooplankton tow net – 63 µm

#### **Sample collection procedure**

##### At Laboratory

- Prepare and label all required sampling containers.
- Complete basic information on the chain of custody (COC) forms.
- Update the YSI 6600 file names using the format XXMMDDYY, where XX denotes the field sampling program identification (e.g. SL, CC, RC, etc), MM denotes the month, DD denotes the day and YY denotes the year.
- Notify laboratories about the sampling event and schedule sample pickup.
- Assemble the sampling equipment and load into the truck.
- Calibrate the sonde.



## **Sampling on Standley Lake**

### Van Dorn Bottle

- The Van Dorn bottle provides a means of collecting water samples at selected depths below the surface. It is made of an open-ended plastic cylinder that is attached to a rope, and lowered to any desired depth.
- Each end of the cylinder is fitted with a rubber cover. The Van Dorn bottle is attached to the length of rope, marked in 0.1 m increments, with the covers pulled out and attached to the trigger device.
- The depth of the lake is determined using the sonde. The bottle is lowered to a depth one meter above the bottom of the lake.
- A metal weight called a "messenger" is attached to the rope above the bottle. The water sample is taken by dropping a weighted "messenger" down the rope. When the weight hits the triggering device on the upper Van Dorn bottle, the catch releases the rubber end covers. The two covers are pulled together and seal off the ends.
- When the bottle has been closed, it is pulled to the surface.
- Water samples from the Van Dorn bottle are transferred to the appropriate sample containers.
- The Van Dorn sampler has a four liter capacity. If the volume of sample required is greater than the Van Dorn sampler can hold, multiple sample volumes can be collected and combined in the churn. The churn and churn spigot should be rinsed out with new sample water prior to sample collection in order to prevent cross-contamination from prior samples. Once the churn contains enough sample, it is thoroughly mixed and the sample is dispensed into the required sample containers.
- Sample containers are labeled with sample location, date and time of sample collection and the sampler's initials. The label should indicate any preservative in the sample container.
- Full sample containers are placed in coolers with ice packs until they are returned to the laboratory.

### PZ Tube Sampler

- The PZ (photic zone) sampler is used to sample a column of water from the surface of the lake to the depth of the photic zone. Photic zone is defined as twice the secchi depth. The PZ sampler is comprised of a churn sample splitter connected to a polypropylene tube equipped with a quick release connector on one end and a check valve on the other end.
- Measure the secchi depth through the floor port on the pontoon boat. Do not wear sunglasses. Record data in the logbook.
- Hook up the quick release connector end of the tube to the churn.
- The tube is marked in 0.5 meter lengths. Lower the end of the tube with the check valve into the water until it is at the depth of the photic zone.
- Pull the tube up out of the water and hold the end with the check valve upside-down at a height over your head, until the tube drains down to floor level, then quickly drop the check-valve end of the tube back into the water vertically to the depth of the photic zone. The water entering the end of the tube will push the air bubble and prior sample into the churn as the tube is lowered into the water. Use the first collected volume of sample to rinse the tube and churn. Waste the sample back to the lake. Start collecting the second volume of sample.

- Repeat step 7.4.2.5 until sufficient quantity of sample has been collected in the churn. The capacity of the churn is 12 liters.
- Once the churn contains enough sample, it is thoroughly mixed and the sample is dispensed into the required sample containers.
- Sample containers are labeled with sample location, date and time of sample location and the sampler's initials. The label should indicate any preservative in the sample container.
- Sample containers are placed in a cooler with ice packs until they are returned to the laboratory.

#### Surface Sampling

- Surface sampling is accomplished through the floor port of the pontoon boat. Sample containers are dipped into the water until full to collect samples.
- Sample containers are labeled with sample location, date and time of sample collection and the sampler's initials. The label should indicate any preservative in the sample container.
- Sample containers are placed in a cooler with ice packs until they are returned to the laboratory.

#### Zooplankton Tows

- Zooplankton samples are collected at SL-10 using a 63  $\mu\text{m}$  tow net.
- A vertical tow sampling methodology involves lowering the tow net to the bottom of the lake and retrieving it at a slow speed of approximately one foot per second up to the surface.
- The zooplankton collected in the net are washed into a 250 mL sample bottle using multiple DI water rinses to ensure all organisms in the net are transferred to the sample container. The final volume in the bottle is not required to be consistent.
- The sample depth is recorded on the sample bottle along with date and location.

### **SL – AQUATIC INVASIVE SPECIES MANAGEMENT**

#### Eurasian Watermilfoil

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.

Eurasian milfoil weevils have been stocked in the lake (on the west side) on three occasions from 2004 through 2006. The weevil larva bore into the stem of the milfoil which damages the plant. If an adequate weevil population can be sustained at Standley Lake, the weevils may be able to control the spread of the milfoil. Annual surveys of weevil populations in the lake are performed by contractors.

In 2007 the SLC initiated a pilot study on Standley Lake using two solar pond aerators to investigate the theory that continuous aeration will oxidize the sediment and deprive the milfoil of nutrients. Samples were collected and analyzed for nutrients to assess nutrient reduction at the aerator sites compared to other sites in the lake. The solar aerators were removed in the fall of 2009. The results of the study were inconclusive as there was an overall reduction in milfoil growth throughout the lake in 2009.

Bathymetric studies are performed on Standley Lake during the early summer for mapping the submerged aquatic vegetation in order to assess milfoil growth and the effectiveness of the remedies.

### Zebra and Quagga Mussels

Zebra and quagga mussels are non-native, aquatic invasive species that are introduced to new water bodies by the unintentional transfer of organisms from an infested water body via boats or fishing bait. Aquatic mussels cause serious damage to the ecosystem and result in costly control procedures for drinking water treatment facilities. Both zebra and quagga mussels were discovered in 2008 in a few of Colorado's lakes. Prevention of aquatic mussel infestation is key to protecting Standley Lake. An intensive boat inspection and decontamination program was initiated in 2008 to protect the lake from new invasive species. No live aquatic baits are allowed at Standley Lake.

Standley Lake is monitored for aquatic mussels every two weeks using the zooplankton tow procedure described previously. The tows are performed at the lake inlets, SL-10, and the boat ramp/outlet area. Several invasive species have a planktonic life stage and sampling with the plankton nets will provide early warning of infestation. Substrate samplers are made up of a float, rope, plastic plates and an anchor weight. A plate is located at every 10 feet of depth from the surface to the bottom of the lake at various locations. The plates and ropes are checked every two weeks for aquatic mussel growth. A plate or rope that feels like sand paper will be scraped and examined under the microscope for veligers (zebra or quagga mussel larvae). All the tow net sites have a substrate sampler located in the same place for comparison.

Shoreline surveys are performed when the water level is at the lowest for the year. A shoreline survey consists of walking the shoreline by the boat ramp, and outlet area looking for adult mussels attached to any hard substrate.

## **DATA MANAGEMENT AND REPORTING**

The City of Westminster is responsible for administration of the Tribal database used jointly by the WQIGA partners. The database is commonly referred to as the 3-City database which is used for archival of monitoring data collected for all programs detailed in this document except the lake profile data. The IGA partners have access to the system via an internet host site.

The City of Westminster logs in all samples collected by the various sampling teams. The coordinated sample creation effort reduces interpretation errors and subsequent reporting inconsistencies. Each IGA partner is responsible for analytical results entry for their assigned analyses into the Tribal database. Personnel are encouraged to document any changes to previously saved analytical data in the Tribal system. On a quarterly basis, a peer review team, comprised of at least one representative from each of the SLC, meets to evaluate the data and identify possible errors or data anomalies. Each city makes corrections to the database and submits a final version of the data. The Tribal database is current to within six months.

Data results from this program, along with other reporting requirements as stated in the Joint Agreement, will be reported to the Colorado Water Quality Control Commission on an annual basis. Only data collected during the normal sampling schedule is included in the annual report. The data is reported in tabular and graphic formats. Data interpretation is not part of the annual Clear Creek Watershed Agreement report; however, trends are identified for key trophic status parameters.

Each laboratory must retain all records (i.e. field notebooks and logs, instrument logs, bench sheets, instrument printouts, electronic data files, chain of custody forms, etc.) pertaining to the monitoring programs until the SLC IGA representatives jointly, in writing, authorize disposal of the records.

The periods of record for monitoring data are summarized in the following table:

Program	Period of Record	Available Format
Clear Creek Grabs	1994 – 2001	MS Access/Excel
	2002 – current	Tribal
Clear Creek Grabs - EPA Metals Data	1994 – current	MS Excel
Clear Creek Autosamplers Ambient	2006 – current	Tribal
Clear Creek Autosamplers Event	2006 – current	Tribal
Standley Lake Tributaries – grabs and autosamplers (includes data for the program formerly called Clear Creek Canals)	1988 – 2001	MS Access/Excel
	2002 - current	Tribal
Standley Lake	1988 – 2001	MS Access/Excel
	2002 - current	Tribal

Table Notes: The 3-City Tribal database contains phosphorus data from 1999-current, all Thornton data from 2001-current and all Westminster data from 2002-current.