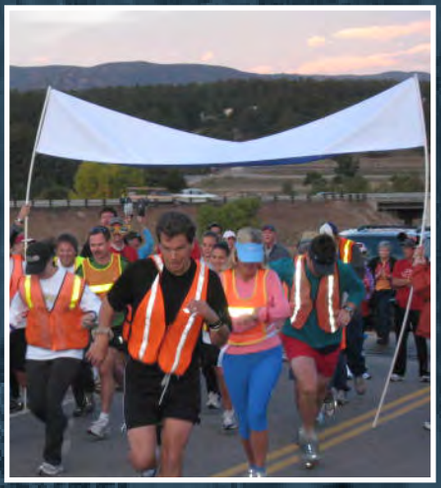
CHERRY CREEK BASIN
WATER QUALITY AUTHORITY

March 31, 2008

2007 ANNUAL REPORT ON ACTIVITIES

BROWN AND CALDWELL

2 0 0 7 ANNUAL REPORT ON ACTIVITIES



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Prepared for

CHERRY CREEK BASIN
WATER QUALITY AUTHORITY

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LAND USE AGENCIES AND UTILITIES
Within the Cherry Creek Basin

CHEERY CREEK STEWARDSHIP PARTNERS
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CONTROL REGULATION 72 REPORTING REQUIREMENTS

REG 72 REPORTING

Look for this symbol in the margin of the 2007 Annual Report to see sections that correlate to the reporting requirements, listed in Section 72.9, Reporting, of Regulation No. 72 – Cherry Creek Reservoir Control Regulation.

Control Regulation Section Number and Reporting Requirement	Section of Annual Report
Section 72.9 - Reporting	
72.9(1) Annual Report Submittal	Cover Letter
72.9(1)(a) Wastewater Facility Controls	
Monthly and annual loads	4.1.1
Permit violations	4.2
Approved site location approval applications	4.3
Effectiveness in reducing nutrient loads	4.1, 4.2
72.9(1)(b) Nonpoint Source Controls	
Sediment and erosion control permit, inspection, and enforcement actions	5.1
Construction BMPs inspection and enforcement actions	5.1
Permanent BMPs construction, inspection, and maintenance actions	5.1
Flood control facilities retrofitting, inspection, and maintenance actions	5.1
Effectiveness in reducing nutrient loads	9.5
Funding of nonpoint source control projects	5.6
Monitoring of nonpoint source control projects	9.5
Public information and education actions	7.1-7.5
72.9(1)(c) Riparian and Wetlands Protection	
Protection, enhancement and restoration actions	5.7
72.9(1)(d) Wasteload Allocation	
Temporary transfers, reserve pool allocations, and semi-urban area transfers	4.1, 6.2
72.9(1)(e) Trading Program	
Point and nonpoint source actions, including reporting TMAL reductions from Trading Program	6.1
72.9(2) Provide data and information on the following:	
Water quality monitoring	9
Point and nonpoint source loadings	4.1, 9.4
Status of compliance with discharge permit limits and conditions	4.2
Recommendations on new or proposed expansion of treatment facilities	4.3
Recommendations for improving water quality	5.6, 10
Annual report format shall provide comparability among previous years	n/a
72.9(3) Include evidence or agreements for the following:	
Financing of nonpoint source projects	5.6
Implementation of stormwater permit requirements	5.1,5.3
Adoption and implementation of BMPs by local governments	5.1
Demonstrate reasonable progress towards control of point and nonpoint sources of phosphorus	4.4, 5.8

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CONTROL REGULATION 72 TASK REQUIREMENTS

Look for this symbol in the margin of the 2007 Annual Report to see how the Authority is taking steps to meet the task requirements outlined in Regulation No. 72 – Cherry Creek Reservoir Control Regulation.

Section 72.7 Stormwater Permit Requirements

Section 72.8 Nutrient Monitoring

Section 72.9 Reporting (see page vii)

Section 72.10 Commission Review

LIST OF ACRONYMS

ac-ft	acre feet
ACWWA	Arapahoe County Water and Wastewater Authority
Annual Report	Cherry Creek Basin Water Quality Authority 2007 Annual Report on Activities
Authority	Cherry Creek Basin Water Quality Authority
BMP	Best Management Practice
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CIP	Capital Improvement Projects
COE	U.S. Army Corp of Engineers
Commission	Colorado Water Quality Control Commission
Control Regulation 72	Regulation No. 72 – Cherry Creek Reservoir Control Regulation
DESC	Drainage, Erosion and Sediment Control
Division	Colorado Water Quality Control Division
DMR	Discharge Monitoring Report
DRCOG	Denver Regional Council of Governments
Education Initiative	Cherry Creek Basin Water Stewardship and Education Initiative
EMC	event mean concentration
GESC	Grading, Erosion and Sediment Control
gpd	gallons per day
IGA	Intergovernmental Agreement
ISDS	Individual Sewage Disposal System
lbs	pounds
LID	low-impact development
mg/L	milligrams per liter
MS4	Municipal Separate Storm Sewer Systems
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
ORP	oxidation-reduction-potential
Park	Cherry Creek State Park
Partners	Cherry Creek Stewardship Partners
PRF	Pollutant Reduction Facility
Requirements	Cherry Creek Reservoir Watershed Stormwater Quality Requirements
SEMSWA	Southeast Metro Stormwater Authority
SRP	Soluble Reactive Phosphorus
TABOR	Tax Payers' Bill of Rights
TAC	Authority's Technical Advisory Committee
TMAL	Total Maximum Annual Load
UDFCD	Urban Drainage and Flood Control District
µg/L	micrograms per liter

WET	whole effluent toxicity
WQCV	water quality capture volume
WWTP	Wastewater Treatment Plant
yr	year
2007 Annual Monitoring Report	2007 Annual Aquatic Biological-Nutrient Monitoring Study and Cottonwood Creek Phosphorus Reduction Facility Monitoring

EXECUTIVE SUMMARY

The purpose of the 2007 Annual Report on Activities (2007 Annual Report) is to provide a status report on Cherry Creek Reservoir water quality and review progress made by the Cherry Creek Basin Water Quality Authority (Authority) towards achieving water quality standards in 2007. The following objectives guide the development of the Annual Report.

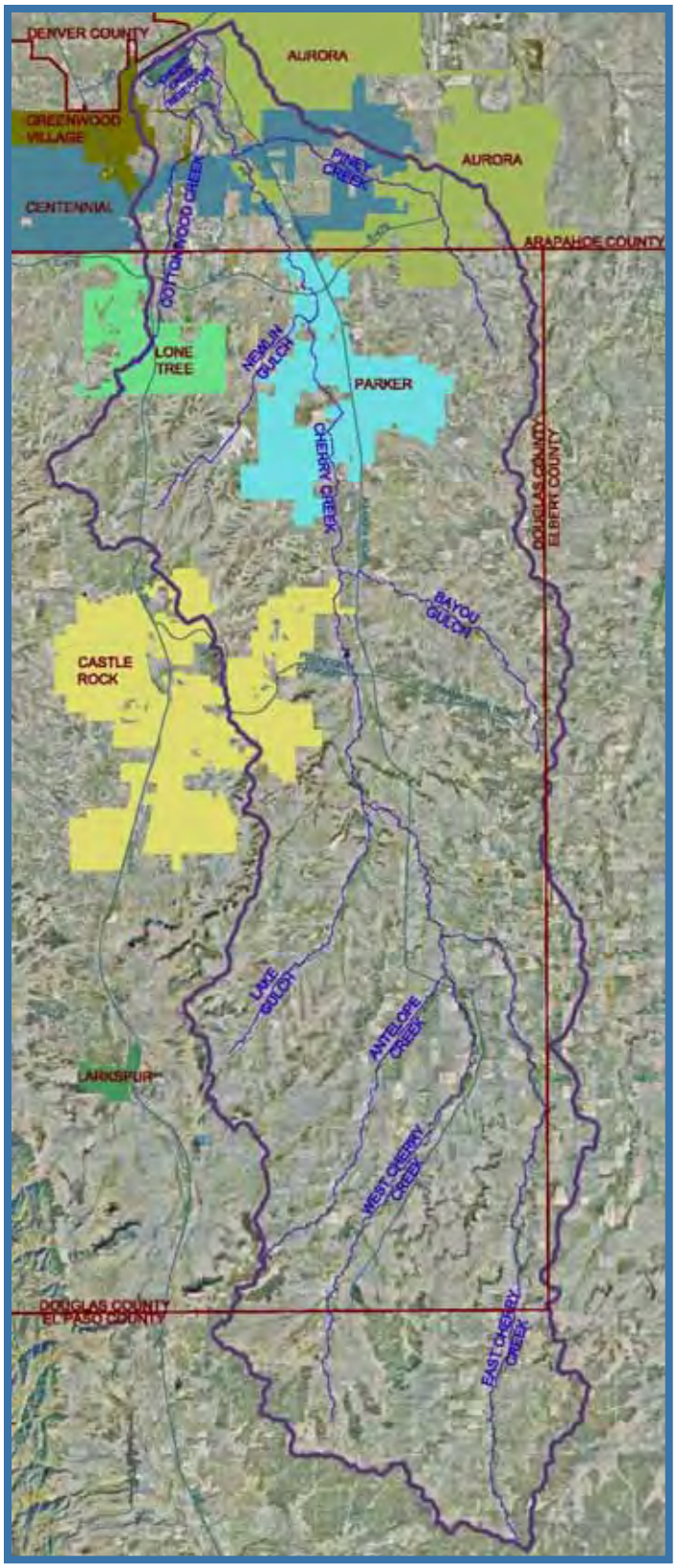
- Document the steps taken in 2007 to perform required tasks.
- Meet Regulation No. 72 – Cherry Creek Reservoir Control Regulation (Control Regulation 72) reporting requirements.
- Present the results of monitoring activities.
- Review the effectiveness of watershed management strategies.
- Provide an Executive Summary that can act as a stand-alone abbreviated report of 2007 activities and progress.

The mission of the Authority is to "maintain beneficial uses in the Cherry Creek Reservoir by preserving its water quality." Beneficial uses are those uses for which the Cherry Creek Reservoir has been assigned to protect and include: (1) aquatic life; (2) primary recreation; (3) water supply; and (4) agriculture. Authority activities discussed in the Annual Report are components of a plan directed toward meeting water quality standards, enhancing environmental health in the Cherry Creek Reservoir watershed (Figure ES-1), and implementing the phased Total Maximum Annual Load (TMAL) for Cherry Creek Reservoir phosphorus. These activities include monitoring water quality, measuring loads to the Cherry Creek Reservoir, implementing point, nonpoint, and regulated stormwater source controls and programs, conducting special study efforts required by Control Regulation 72 to update the TMAL, and discussing additional strategies for meeting reservoir water quality standards and goals in the foreseeable future. The Annual Report reviews the Authority's activities to ensure the strategies employed to meet the water quality standards and goals are appropriate and effective in the short and long term.

Status of Water Quality

In 2007, the Authority continued to implement a routine annual water quality monitoring program in the Cherry Creek Reservoir and watershed. The program monitors reservoir water quality, reservoir inflow and loading, reservoir outflow, surface and groundwater quality in the watershed, and the effectiveness of Authority pollutant reduction facilities (PRFs). Figure ES-1 presents the Cherry Creek Watershed.

Figure ES-1. Cherry Creek Reservoir Watershed Map



2007 Water Quality Summary

- Seasonal mean chlorophyll *a* of 12.6 µg/L was less than the 15 µg/L reservoir standard.
- Seasonal mean total phosphorus of 118 µg/L exceeded the reservoir goal of 40 µg/L.
- Total phosphorus load of 19,772 pounds to the reservoir exceeded the TMAL of 14,270 lbs/year.
- Cottonwood-Peoria Pond and Cottonwood Perimeter Pond PRFs demonstrated phosphorus load reduction effectiveness of 34% and 17%, respectively. The PRF load reductions at the Cottonwood Peoria Pond were an improvement over 2006 (24%); yet the PRF load reductions at the Cottonwood Perimeter Pond were not as large as in 2006 (37%).

Historical sampling of the PRFs on Shop Creek and Quincy Drainage indicate an average annual phosphorus reduction of 63% or 173 pounds (1990 to 2000) and 99% or 138 pounds (1996 to 1999), respectively.

Long-term Water Quality Summary

The Cherry Creek Reservoir chlorophyll *a* standard of 15 µg/L has only been met three times in the past 16 years, and the phosphorus goal of 40 µg/L has not been achieved in the past 16 years. The phosphorus loads have been lower than the TMAL of 14,270 pounds in 14 of the past 16 years (Table ES-1).

Figure ES-2 provides a picture of water quality concentrations, phosphorus loads, and inflow to the reservoir since 1992. This figure demonstrates how phosphorus loads track closely with inflows to the reservoir and that chlorophyll *a* and phosphorus concentrations do not necessarily have an immediate or significant response to changes in phosphorus loads. For example, load reductions that coincided with the recent drought years (2000 to 2002) did not result in a similar continuous decrease in phosphorus and chlorophyll *a* concentrations.

The Authority's watershed management strategies focus on reducing nutrient loading, both through structural and non-structural management strategies. The Authority PRF monitoring typically shows the PRFs are effective in reducing phosphorus, but the reservoir monitoring does not demonstrate immediate improvements in reservoir water quality related to watershed management strategies. The impacts of watershed management strategies are beneficial over the long term, but do not necessarily result in immediate measurable results in the reservoir. However, after many years of not meeting the chlorophyll *a* standard, the standard has been met the past two years. The reservoir has an overabundance of phosphorus and is often limited by nitrogen during the summer growing season. The Authority's work to update the reservoir model with data collected over the past six years indicates that the phosphorus to chlorophyll *a* relationship is weak, particularly during the summer growing season.

In 2007, the Authority completed the installation of an in-reservoir destratification system to artificially mix Cherry Creek Reservoir with the intent to decrease the tendency for algal blooms and lower chlorophyll *a* concentrations in the near term. The water quality benefits from the system may not be quantified for a few years, but the Authority will be monitoring its progress.

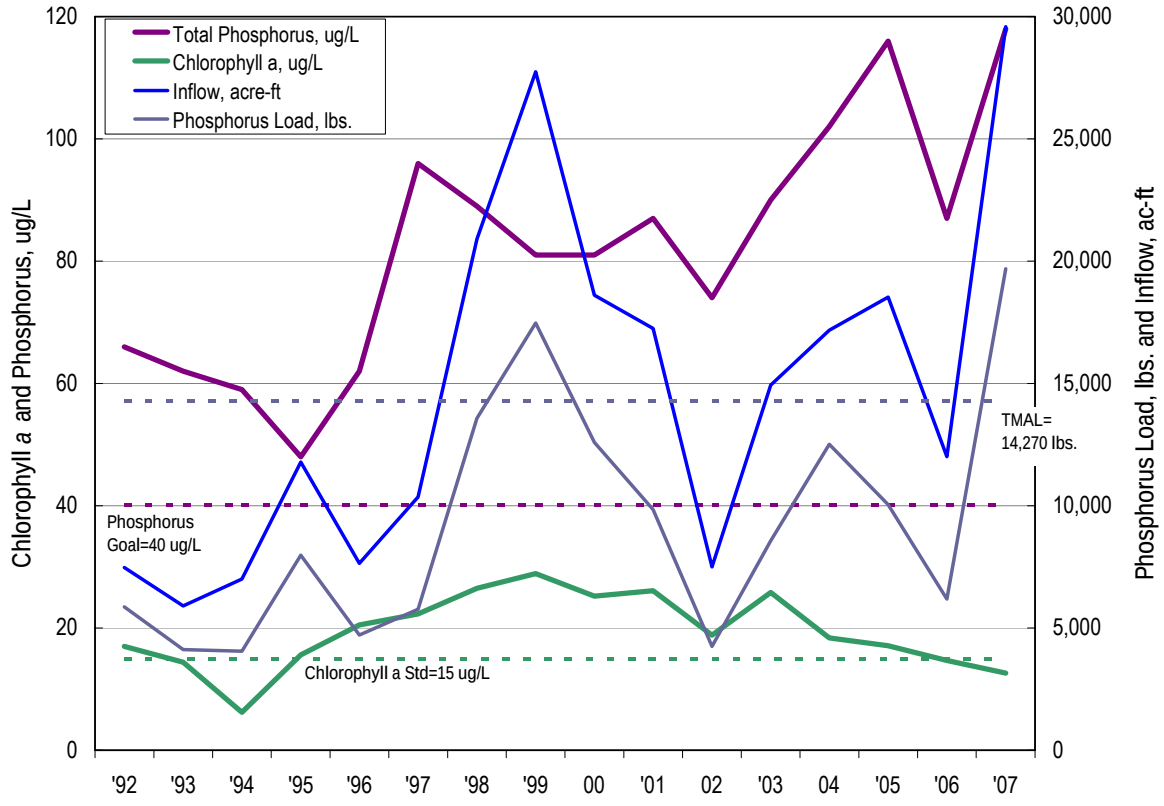
The Colorado Department of Public Health and Environment's (CDPHE) Colorado Water Quality Control Commission (Commission) adopted a phased TMAL process that would provide for the continued implementation of both point and nonpoint source control strategies. This phased approach allows the Authority to investigate impacts on reservoir water quality and formulate additional and alternative control strategies.

Table ES-1. Water Quality (July–September Average Concentration) and Total Phosphorus Load Data for Cherry Creek Reservoir, 1992 – 2007

Year	Chlorophyll *a* (µg/L)	Total Phosphorus (µg/L)	Total Nitrogen (µg/L)	Annual Phosphorus Load (lbs/yr)[1]	Annual Inflow (ac-ft) [1]	Standardized Phosphorus Load (lbs/ac-ft)	Net Phosphorus Load (lbs/yr)[2]
1992	17.4	66	970	5,364	9,210	0.58	3,921
1993	14.4	62	826	3,114	5,581	0.53	2,186
1994	15.4	59	1,144	3,784	6,998	0.54	2,729
1995	15.6	48	913	5,736	11,788	0.49	4,302
1996	18.1	62	944	4,425	7,654	0.58	3,102
1997	22.3	96	1,120	5,675	10,391	0.55	4,076
1998	26.5	89	880	13,222	20,902	0.64	9,311
1999	28.9	81	753	17,672	27,604	0.64	10,913
2000	25.2	81	802	13,788	18,611	0.74	9,362
2001	26.1	87	757	9,099	17,246	0.53	4,402
2002	18.8	74	858	3,525	7,511	0.47	1,681
2003	25.8	90	1,121	9,390	14,953	0.63	4,717
2004	18.4	102	977	8,974	17,203	0.52	5,553
2005	17.1	116	990	10,725	18,534	0.58	7,080
2006	14.7	87	914	6,492	12,799	0.51	3,206
2007	12.6	118	716	19,772	29,586	0.67	11,730
Mean	19.8	82	918	8,804	14,803	0.58	5,517
Median	18.3	84	914	7,733	13,876	0.57	4,352

Notes:
1 This represents the total load and inflow to Cherry Creek Reservoir from stream, alluvium, and precipitation.
2 The net phosphorus load is the total load to the reservoir minus the reservoir outflow load.
Bold indicates value meets the respective standard, goal, or TMAL value.

Figure ES-2. Cherry Creek Reservoir Water Quality, Load, and Inflow, 1992-2007



Background

Control Regulation 72 is established by the Commission and sets forth actions and requirements that the Authority must meet. The Commission revised Control Regulation 72 in November 2004, which became effective on December 30, 2004.

- Emphasis is placed on implementation of watershed measures to control the water quality in Cherry Creek Reservoir.
- The Cherry Creek Reservoir has a chlorophyll *a* water quality standard of 15 µg/L mean July-September concentration to be met 9 out of 10 years.
- The Cherry Creek Reservoir has a phosphorus concentration goal of 40 µg/L.

Overview of Progress Made

Although the Cherry Creek Reservoir did meet the chlorophyll *a* water quality standard for the reservoir in 2007, the Authority continues to take initiative towards meeting standards through key planning, implementation, and evaluation actions.

- Planning – Recommendations of the Watershed Plan 2003 continue to guide the Authority's Work Plan. During the budgeting process, the Authority set aside funds for stream corridor preservation partnering opportunities and a sinking fund for long-term PRF operations and maintenance.
- PRF Implementation – The Authority completed installation of the reservoir destratification system. Design of Cottonwood Creek Reclamation Phase II resumed after delays due to relocation of Peoria Street and Belleview Avenue.

- Facilitation and Coordination – The Authority worked closely with land use agencies in updating the stormwater permit requirements in the Cherry Creek basin and developing a guidance document. In addition, the Authority continued the unique program of the "phosphorus facilitator," that coordinated with local developers to implement best management practices (BMPs) that go well beyond minimum requirements.
- Education – The Authority coordinated with the Cherry Creek Stewardship Partners (Partners) to implement more avenues for education and public outreach (e.g., training, volunteer workdays, and conference).
- Monitoring – The Authority continued to monitor water quality, loads, and PRF performance to provide a means of measuring effectiveness of watershed management strategies. This information feeds back into the dynamic planning process.

Progress Made in Specific Management Programs

Listed below are specific watershed management programs that the Authority implemented in 2007 to improve watershed health and water quality, along with the associated progress made through each program.

Wastewater Facility Controls

- Wastewater facility discharges did not exceed annual permitted wasteload allocations or effluent phosphorus concentrations, with the exception of Stonegate Village Metropolitan District.
- The total annual phosphorus pounds discharged in the basin from the wastewater discharges was less than the total annual wasteload allocation.
- The Authority solicited feedback on its Site Location Approval process.

Nonpoint and Regulated Stormwater Source Controls

The Authority has made progress in meeting the requirements of Control Regulation 72 for control of nonpoint and regulated stormwater source pollution in the following ways.

- Coordinated and assisted local land use agencies in implementing Phase II stormwater permit requirements consistent with Control Regulation 72.
- Completed the fourth year of the "Phosphorus Facilitator" program to work with local developers to implement BMPs that go well beyond minimum requirements. Involved with the water quality management plans for two developers, and reviewed BMPs for an additional developer.
- The Authority has seen improvement in the incorporation of stormwater quality into development plans over the years due to raised awareness and proactive efforts of the land use agencies. The Authority reviewed 199 land use and development applications for nonpoint and regulated stormwater pollutant source impacts. Of the 199 applications it reviewed, the Authority took no exception for 82 percent of the applications. This percentage has increased since the stormwater quality requirements were developed.
- The Authority completed construction of the reservoir destratification system for in-lake management and initiated final design of Cottonwood Creek Reclamation Phase II.
- The Authority continued its process to update the Stormwater Quality Requirements in the form of a guidance document that represents the collective experience of the Authority and the land use agencies for implementing Phase II stormwater regulations and other measures to protect the water quality of the Cherry Creek Reservoir watershed.

Trading Program

- No new trade projects were proposed in 2007.

Public Education Actions and Partnerships

The Authority made progress in meeting the requirements of Control Regulation 72 for implementing public information and education programs in the following ways.

- The Cherry Creek Stewardship Partners facilitated broad community involvement and benefited long-term environmental stewardship through outreach efforts, reaching an estimated 2,019 people.
- The Authority leveraged resources by supporting the Partners and coordinating with other entities to implement the Education Initiative, a comprehensive and coordinated education strategy and action plan.
- The Authority continued the use of its website through cooperation with the Partners to facilitate the dissemination of information to parties interested in Authority activities.
- The Authority collaborated on information and education efforts with other entities with common interests and goals for the watershed.

Phased TMAL Implementation

The Authority has continued to develop and implement point, nonpoint, and regulated stormwater source controls and has worked with the Colorado Water Quality Control Division (Division) to complete one more, and make progress on the final, required investigations for the phased TMAL.

- The Authority completed the background phosphorus study, a required special study.
- The Authority continued implementation of the PRF infiltration special studies, required as part of the phased TMAL, which will be completed in 2008.
- The Authority made progress on determining phosphorus fate and transport in the watershed through the watershed model update, as well as quantifying a revised TMAL through the reservoir model update.
- The Authority and Division jointly proposed a revised rulemaking hearing schedule and milestones to prepare for the hearing in 2009.

Water Quality Monitoring

The Authority completed annual water quality monitoring and analysis for the reservoir, watershed, alluvium, and selected PRFs in accordance with the Sampling, Analysis, and Quality Assurance Work Plan.

- The Cottonwood Creek-Peoria Pond PRF showed improvement in removing total phosphorus from the stream flows in 2007, removing 34 percent of the phosphorus load.
- The Cottonwood Creek Perimeter Pond PRF showed a decrease in the phosphorus load downstream of the system, with the percent reduction in load being similar to the long-term mean (20 percent). The standardized phosphorus loads (lbs/ac-ft) also revealed that the system was effective at removing total phosphorus from Cottonwood Creek flows.
- Despite the provisional nature of the annual load data, the projected total phosphorus load to the reservoir is expected to be greater than the TMAL.
- There has been a statistically significant decrease in seasonal whole-reservoir chlorophyll *a* concentrations since 1999, with the 2007 seasonal mean concentration of 12.6 µg/L.

Results and Conclusions

The Authority recognizes the challenge of meeting water quality standards, and continues to plan, gather information, implement strategies, monitor, and reevaluate approaches to meet the challenge. The Authority has undertaken actions through a variety of programs to "maintain beneficial uses in the Cherry Creek Reservoir by preserving its water quality." These actions are components of a plan directed toward meeting water quality standards and enhancing environmental health in the Cherry Creek basin.

The 2007 reservoir data, as well as the long-term monitoring, indicate the relationship between chlorophyll *a* and phosphorus concentrations in the Reservoir (or between phosphorus concentration and load) is not as strong as originally believed when the Reservoir standard was set. With the addition of six years of reservoir data (since 2000), the Authority is updating the reservoir model to evaluate these relationships in the reservoir and refine the TMAL. Initial results of the reservoir and watershed modeling and special studies indicate the Authority stakeholders may need to consider alternative options for TMAL development and implementation.

In 2008, the Authority will finalize the reservoir and watershed model results to provide the decision-making basis for TMAL development and implementation planning as it prepares for the 2009 rulemaking hearing. As jointly proposed with the Division, the proposed TMAL schedule acknowledges that options other than a standard phosphorus load allocation to meet current chlorophyll *a* standard may need to be considered. However the Authority proceeds, it recognizes that a strong basis will be needed to propose an alternative approach. A key focus of 2008 will be evaluating and quantifying the TMAL with the reservoir modeling work and the water quality improvements that could be achieved under future scenarios using the watershed model.

The Authority's management strategies have strong focus on the watershed, including the construction of PRFs that have shown to be effective in reducing phosphorus loads. The Authority believes watershed management strategies are beneficial over the long term, but they have not resulted in immediate measurable improvements to reservoir water quality. The Authority is actively implementing an in-lake management strategy for more short-term improvements to reservoir water quality. Overall nutrient loading from the watershed is expected to increase in the future, primarily as a function of increases in stormwater runoff and stream erosion. As a result, the Authority focuses on continued reduction of nutrient loads from the watershed through watershed management strategies.

1. PURPOSE OF THE ANNUAL REPORT

The purpose of the 2007 Annual Report is to summarize activities conducted by the Authority in 2007. Authority activities are directed towards:

- Meeting water quality standards.
- Protecting beneficial uses which include aquatic life, primary recreation, water supply, and agriculture.
- Enhancing environmental health in the Cherry Creek Reservoir watershed.
- Implementing the phased TMAL.

Activities discussed in the Annual Report are components of a plan for protecting the health of the watershed, and include the following:

- Monitoring water quality.
- Measuring loads to the Cherry Creek Reservoir.
- Implementing point and nonpoint source controls and programs.
- Completing special studies to update the TMAL.
- Evaluating additional strategies for meeting water quality standards and goals in the Cherry Creek Reservoir.

The following objectives guide the development of the Annual Report.

Objective 1 – Document the Steps Taken in 2007 to Perform Required Tasks

The Authority's actions are primarily governed by Control Regulation 72, as developed by the Commission. Control Regulation 72 establishes various task requirements for the purpose of meeting water quality standards and the phased TMAL. Throughout the Annual Report, the "Steps" icon in the left margin indicates steps the Authority is taking towards completing Control Regulation 72 tasks, which are listed in the Table of Contents.

Objective 2 – Meet Control Regulation 72 Reporting Requirements

Control Regulation 72 requires that the Authority complete an Annual Report in accordance with specific reporting requirements. The Authority submits the Annual Report to the Commission for review on March 31. The Authority's activities and the Annual Report include more than what Control Regulation 72 requires for reporting. The "Reg 72 Reporting" icon indicates reporting requirements, which are listed in the Table of Contents.

Objective 3 – Present The Results of Monitoring Activities

The Authority continually monitors water quality to evaluate compliance with water quality standards, establish reservoir and watershed water quality conditions, and document changes in water quality. These monitoring efforts also provide the basis for measuring phosphorus loadings to the reservoir and evaluating the effectiveness of PRFs. The data are also utilized by the Division, Colorado State Parks Department, the U.S. Army Corp of Engineers (COE), and other interested parties.

Objective 4 – Provide a Framework For a Review of Strategies

Each section in the Annual Report concludes with a "Progress Made" section, which identifies outcomes of activities, where measurable, and reports if those activities are meeting target goals. Section 8 provides the outcomes of special studies that provide additional options for water quality improvements and Section 10 provides recommendations for directing future water quality efforts. This information provides a framework for determining if strategies employed to meet Control Regulation 72 requirements are appropriate and effective in the near and long term.

Objective 5 – Provide an Abbreviated Report of 2007 Activities and Progress Made

The Executive Summary of the Annual Report serves as a stand-alone document providing a brief summary of the Authority's activities in 2007 and progress made towards the phased TMAL. The Executive Summary can be distributed to interested agencies and individuals, and also used to supplement other reports or grant applications developed by the Authority.

2. THE AUTHORITY

The mission of the Authority is to "maintain beneficial uses in the Cherry Creek Reservoir by preserving its water quality" and, as such, is designated as a 208 Management Agency. From this mission, the Authority has developed water quality management strategies to minimize point and nonpoint pollutant sources by implementing specific programs and monitoring water quality to evaluate progress. These strategies create an effective water quality management approach, as shown on Figure 2-1.

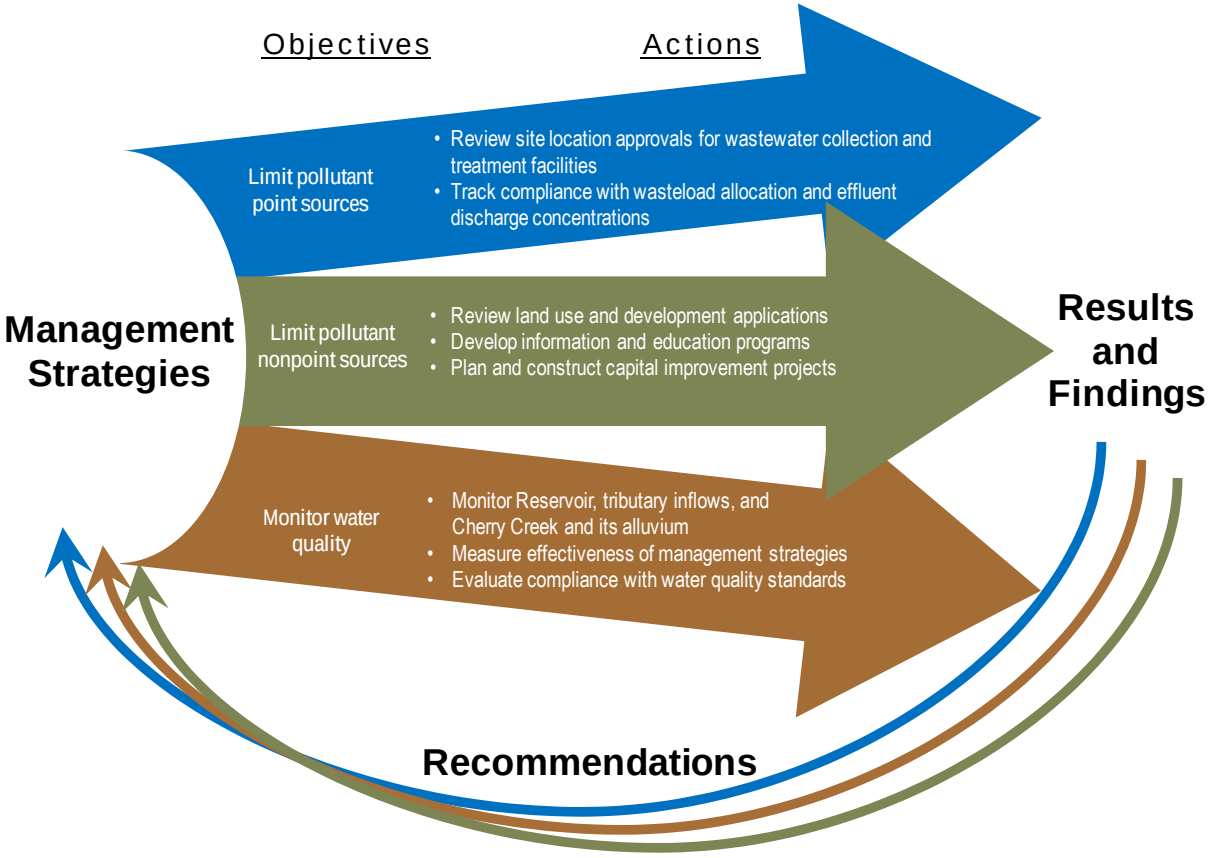


Figure 2-1. Water Quality Management Approach

This section provides information on the Authority's history, members of the Authority, 2007 annual budget and funding sources, and 2007 reference materials.

2.1 History

The Authority was formally created in 1985 by the Colorado Legislature to preserve water quality within the Cherry Creek Reservoir watershed. Figure 2-2 provides a summary of the Authority's history pertinent to regulations. In August 2007, the Commission held an informational hearing to identify potential changes to

Control Regulation 72. Based on discussions with stakeholders, Division staff, and the Authority, the rulemaking hearing has been rescheduled to March 2009.

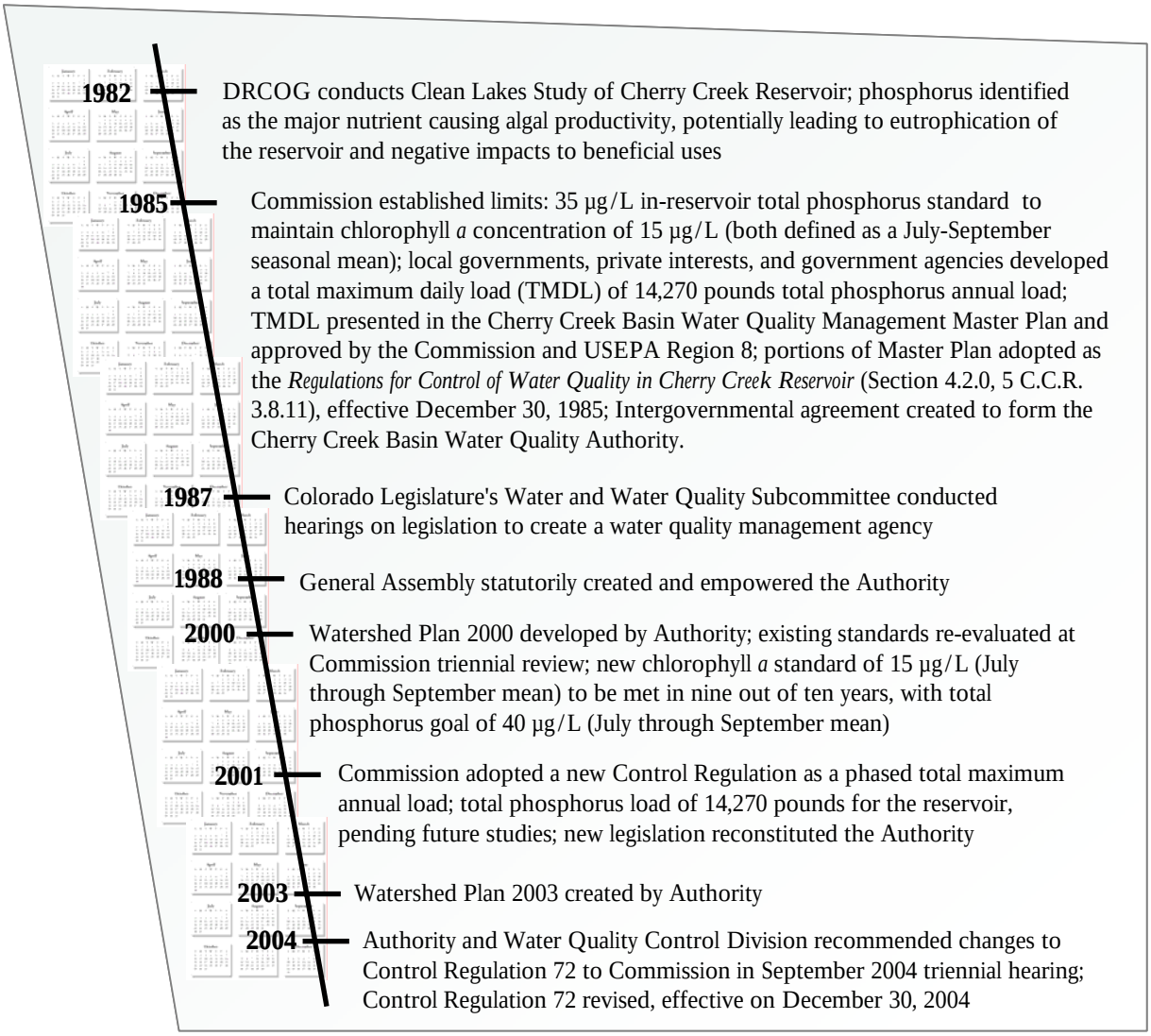


Figure 2-2. Summary of Authority History

2.2 Today's Authority

The Authority consists of a Board and Technical Advisory Committee (TAC). The Board includes representatives from the watershed land use agencies, a special districts representative, and individuals appointed by the governor. Table 2-1 lists the entities that are represented on the Board, per Control Regulation 72.

The TAC consists of members representing various agencies and interests within the Cherry Creek Reservoir watershed. The role of the TAC is to consider and report to the Board on matters of a scientific or technical nature, as directed by the Board. Table 2-2 provides a list of entities that are represented on the TAC.

Table 2-1. Authority Board Members	
Entities That Must be Represented	Number of Representatives
County (Arapahoe, Douglas)	2
Municipality[1] (Aurora, Castle Rock, Centennial, Foxfield, Greenwood Village, Lone Tree, Parker)	7
Special Districts (water and wastewater service providers)	1
Appointed by the Governor	7
Total members of Authority Board	17

1 Castle Pines North incorporated at the end of 2007 and will be added in 2008.

Table 2-2. Authority TAC Members	
Entities Represented	Number of Members
County (Arapahoe/Southeast Metro Stormwater Authority[1] (SEMSWA), Douglas)	2
Municipality (Aurora, Castle Rock, Greenwood Village, Lone Tree, Parker)	5
Special districts	1
Board appointed	2
Other (Cherry Creek State Park, City and County of Denver, COE, DRCOG, UDFCD)	5
Total members of TAC	15

1 SEMSWA was formed by an Intergovernmental Agreement (IGA) among Centennial, Arapahoe County, Arapahoe County Water and Wastewater Authority, East Cherry Creek Valley Water and Sanitation District, and Inverness Water and Sanitation District.

2.3 Work Plan

The Authority prepares a Work Plan that guides the activities of the TAC and Board. The Work Plan is a spreadsheet that lists the tasks for the calendar year. As shown on Figure 2-3, the Work Plan from December 2007 provides the following information for each task.

- Task description
- Corresponding category in the Authority's budget
- Fulfillment of appropriate Control Regulation 72 section
- Fulfillment of corresponding Watershed Plan 2003 recommendation
- Schedule for completion
- Progress status

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Figure 2-3 2007 Work Plan

(sorted by category)

Budget/Task Category	Task	Task Description	Control Regulation Section	Fulfillment of Control Regulation by:	Watershed Plan 2003 Recommendations	Month Start (first of month)	Status	Due Date
2007 Ongoing								
Meetings	Monthly Board and TAC meetings					Ongoing	Ongoing	Ongoing
Public Information and Education	Implement Cherry Creek Basin Water Stewardship and Education Initiative	Implement Information and Education Program from Needs Assessment and coordinate with stakeholders	72.6(2)	Implement Public Information and Education Program	L - Develop and implement public involvement plan; A - Consider funding options to achieve capital budget increase	Ongoing	Ongoing	Ongoing
	Update Authority website	Update Authority website				Ongoing	Ongoing	Ongoing
TAC Work Plan	Maintain and update TAC Work Plan	Update monthly and submit to TAC for review			B - Implement Watershed Plan 2003 as a coordinated management program	Ongoing	Ongoing	Ongoing
Trading Program	Review of Trade Applications	Review of Trade Applications	72.5(3)(a)	Trading program	E - Promote trading incentives	Ongoing	Ongoing	Ongoing
Land Use Applications	Review Land Use Development Applications referred to Authority	Review Land Use Development Applications referred to Authority	72.6(1)	Encouraging and ensuring adequate nonpoint source (especially	H - Encourage local gov'ts to work with developers to construct innovative	Ongoing	Ongoing	Ongoing
Site Application Review	Review of Site Applications	Review of Site Applications	72.4(4)	Effluent discharge		Ongoing	Ongoing	Ongoing
Watershed, Reservoir, and PRF Monitoring	Implement monitoring programs	Implement monitoring programs				Ongoing	Ongoing	Ongoing
2007								
Capital Projects	Cottonwood Creek Reclamation	Phase II design	72.3(4)	Construction of nonpoint source control projects	C - Fund, design, and construct high priority stream improvements	1/6/2006	In progress	2008
	Reservoir Destratification	Construction and Construction Management				10/1/2006	In progress	2007
	Advanced Water Treatment Plant	Initial permitting considerations/related to ACWWA JWPP				4/1/2007	Complete	5/2/2007
	Cherry Ck Stream Stabilization at Eco Park					TBD		
	Stream Corridor Preservation					TBD		
	Reservoir Shoreline Stabilization					TBD		
	Annual Operations and Maintenance Report	Identify operation and maintenance needs				6/1/2007	Complete	8/30/2007
	Operation and Maintenance	Annual inspection report				7/15/2007	Complete	8/31/2007
	Cottonwood Creek Reclamation	Emergency repairs				3/1/2007	Complete	6/1/2007
Public Information and Education	Annual Board tour of PRFs	Board tour of PRFs				TBD		
Reporting - 2006 Monitoring and Annual Reports	Annual Report	Including updates of: trading program activities; progress of adoption of Model Ordinance regulations; future non point source control projects; O&M activities; Public Information and Education Program; Floodplain Preservation and Conservation Easement Activities; Annual Routine Monitoring Program.	72.9, including 72.5(3)(a), 72.6(1), 72.6(2),	Gathering and updating required information (see Description) into an Annual Report		1/1/2007	Complete	3/31/2007
Reporting - 2006 Annual Report	Annual Report - TAC and WQCD provide comment on draft	TAC receives draft and provides comment	72.9	Annual Report		2/16/2007	Complete	2/22/2007
	Annual Report - Board provide comment on draft; provide approval pending comments	Board receives draft at Board meeting, provide comment in a week	72.9	Annual Report		3/6/2007	Complete	3/15/2007
	Annual Report - TAC provide comment on final draft	TAC receives draft for TAC meeting, provide comment at TAC meeting	72.9	Annual Report		3/16/2007	Complete	3/22/2007
	Annual Report - Submit final to WQCD and WQCC		72.9	Annual Report		4/9/2007	Complete	4/9/2007
Reporting - 2006 Annual Report	Present Annual Report to DRCOG WEPC	Develop summary presentation and present	72.9	Annual Report		3/31/2007	Complete	5/24/2007
Reporting - 2006 Monitoring Report	Monitoring Report - TAC provide comment	TAC receives draft for TAC meeting, provide comment at TAC meeting	73.9	Annual Report		3/8/2007	Complete	3/22/2007
Reporting - 2006 Monitoring and Annual Reports	Present Annual Report to WQCC	Develop summary presentation and present to the WQCC	72.9	Annual Report		4/9/2007	Complete	4/9/2007
Site Application	Sierra Ridge Lift Station	Site Application Review	72.4	Review wastewater facility wasteload allocations and effluent limitations		8/15/2006	Complete	1/18/2007
	Lift Station 15/Kings Pointe Interceptor	Site Application Review	72.4	Review wastewater facility wasteload allocations and effluent limitations		11/20/2006	Complete	1/18/2007
	Solicit feedback on review process					3/1/2007	Complete	8/15/2007
Phosphorus Facilitator	Phosphorus Facilitator	Develop 2007 scope of work			G - Encourage local governments to work with developers to construct innovative demonstration projects	10/1/2006	Complete	1/31/2007
	Phosphorus Facilitator	Consultant document 2006 activities			G - Encourage local governments to work with developers to construct innovative demonstration projects	2/1/2007	Complete	1/31/2007
Special studies	TMAL Actions Study 3 - Determine background phosphorus levels for revised TMAL	Conduct study	72.3(4)	Completion of tasks identified	K - Conduct special studies to optimize water quality improvements	1/19/2006	Complete	7/25/2007
	TMAL Actions Study 2 - Determine PRF phosphorus transport through infiltration	Conduct study	72.3(4)	Completion of tasks identified	K - Conduct special studies to optimize water quality improvements	2/16/2006	In progress	6/30/1905
	Determine Approach for remaining studies	Determine Approach/ for remaining studies - Implement "narrower scope" of EMC study - Watershed hydrology reference condition - Quantify ISDS loading	72.3(4)	Completion of tasks identified	K - Conduct special studies to optimize water quality improvements	TBD 11/1/07 10/1/07	In progress	2008 2008
	TMAL Actions Grant Reporting	Semi-Annual Reporting				1/2/2007	In progress	12/31/2007
TMAL Revision	Coordinate with WQCD	Coordinate with WQCD	72.10	Report to the Commission at each triennial review		1/2/2007	In progress	12/31/07
	Incorporate updated Reservoir Model	Incorporate updated Reservoir Model to evaluate revised TMAL	72.10	Report to the Commission at each triennial review		2/28/2007	In progress	2008
Triennial Review	~~Testimony and presentation~~	~~Prepare testimony and presentation, Control Regulation revisions~~	72.10	Report to the Commission at each triennial review		~~2/1/2007~~		~~4/30/2008~~
	Change date/scope of triennial review hearing	WQCD requests change in hearing scope from TMAL schedule to completed TMAL	72.10	Report to the Commission at each triennial review		3/22/2007	Complete	12/10/2007
	Coordinate with WQCD on proposed new hearing date	Jointly propose hearing date to WQCC	72.10	Report to the Commission at each triennial review		10/1/2007	Complete	12/10/2007
	~~Update Schedule for Revising TMAL~~		72.10	Report to the Commission at each triennial review		~~2/1/2007~~		~~12/31/2007~~
	~~How to address changes to WLAs as they occur~~		72.10	Report to the Commission at each triennial review		~~2/1/2007~~		~~9/1/2007~~
	~~Clarify implementation of reclaimed WW land application under CR 84 and CR 72~~		72.10	Report to the Commission at each triennial review		~~2/1/2007~~		~~9/1/2007~~
	~~Clarifications regarding the Trading Program~~	~~simplify trade ratio calcs, change in trade project ownership, clarify basis for min trade ratio of 2:1~~	72.10	Report to the Commission at each triennial review		~~2/1/2007~~		~~9/1/2007~~
	~~Minimize redundancy and potential conflicts between CR 72 and MS4 Permits~~	~~Develop proposed revisions~~	72.10	Report to the Commission at each triennial review		~~2/1/2007~~		~~9/31/2007~~
	~~Specify that Division has access to models and data~~		72.10	Report to the Commission at each triennial review		~~2/2/2007~~		~~9/31/2007~~
	~~Notice approved~~	~~Notice approved~~	72.10	Report to the Commission at each triennial review		~~1/10/2008~~		~~1/10/2008~~
	~~Notice filed~~	~~Notice filed~~	72.10	Report to the Commission at each triennial review		~~1/24/2008~~		~~1/24/2008~~
	~~Testimony~~	~~Submit testimony~~	72.10	Report to the Commission at each triennial review		~~4/30/2008~~		~~4/30/2008~~
Reservoir Model Update	Reevaluate target reservoir load	Revisit/update reservoir model to calculate target load	72.3(4)	Completing activities for revisions to the TMAL		5/1/2006	In progress	6/30/1905
Watershed Model Update	Fate and transport/watershed model update	Monthly subcommittee and review team meetings	72.3	Completing activities for revisions to the TMAL and allocations		5/26/2005	Complete	11/1/2007
	Fate and transport/watershed model update	WQCD	72.3	Completing activities for revisions to the TMAL and allocations		5/26/2005	In progress	10/31/2007
	Fate and transport/watershed model update	Model documentation	72.3	Completing activities for revisions to the TMAL and allocations		5/30/2006	In progress	12/31/2007
Long-term Funding	Overall business program and financing plan	Board develop approach			A,3 - Develop and implement an overall business program and financing plan.	1/2/2007	No activity	12/31/2007
	Identify a funding champion to generate financial resources for water quality improvement.	Board to set up process to pursue funding champion			A,1 - Identify a funding champion to generate financial resources for water quality improvement	3/1/2007	No activity	12/31/2007
	Overall business program and financing plan	Implement plan			A,3 - Develop and implement an overall business program and financing plan.	6/1/2007	No activity	12/31/2007

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2.4 Financial Matters

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The Authority receives funding for its activities primarily from property taxes, Park user fees, wastewater bill surcharges, and building permit fees. These primary sources are supplemented with funds from various grants and other fees and charges.

The Authority's budget for the 2007 calendar year was approximately $1,850,000 in revenue and approximately $2,000,000 in expenditures. Colorado State Statute § 25-8.5-111(3) dictates that the Authority must spend at least 60% of the annual authorized revenues on the construction and maintenance of PRFs. The budgeting process for PRFs is discussed in Section 5.6. The remaining 40% is allocated towards monitoring, special studies, planning documents, technical reports or memoranda, and administrative costs.

2.4.1 Funding Sources

Approximately $1,200,000 (65%) of the Authority's budgeted revenue was tax based, $360,000 (20%) was from fees and surcharges on wastewater, and $285,000 (20%) was from miscellaneous sources, such as reimbursed expenses, grants, and the trading program. Of the $285,000, $214,000 was from interest earned on the Authority's deposits, the remainder came from grant funding specific to 2007.

In 2007, the Authority was required under provisions of Article X, Section 20, of the Colorado Constitution (TABOR) to temporarily reduce its authorized mill levy. This requirement reduced the Authority's tax-based revenue by $320,000.

2.4.2 Grants

The Authority was awarded two Colorado Nonpoint Source Program grants, which were contracted on October 27, 2005. The two grant projects are the "Cherry Creek State Park Wetlands" involving the design and construction of Phase 1 of the multi-phase wetlands construction project, and "TMAL Actions" to conduct three special studies specified in Control Regulation 72. During the Cherry Creek State Park Wetlands project design in 2006, the State Engineer determined that the creation and enhancement of wetlands project would require water rights for augmentation. In addition, the Cherry Creek Reservoir surface water level has changed during recent drought years, which is anticipated to impact the success of the wetlands project. As a result, the Authority decided, in January 2007, to indefinitely delay design and construction of the Cherry Creek State Park Wetlands and to terminate the current grant-funded project.

The TMAL Actions project cost is $240,000 ($144,000 in grant funds and $96,000 in Authority matching funds). The Authority began work on the grant in 2006 and conducted the majority of the work in 2007.

2.5 2007 Reference Documents

The Authority generated documents in 2007 that serve as references for the status of water quality in Cherry Creek Reservoir, guidelines and educational material on water quality BMPs, technical sources on various aspects of water quality, and watershed planning and management strategies. Table 2-3 lists key reference documents generated by the Authority in 2007.

Table 2-3. 2007 Reference Documents
2006 Annual Report of Activities by the Cherry Creek Basin Water Quality Authority Update on activities completed by the Authority in 2006.
2006 Annual Report of Baseline Water Quality Data Collection Study for the Upper Cherry Creek Basin Flow and water quality data collected at surface and groundwater stations in the upper Cherry Creek Reservoir watershed.
2007 Annual Inspection of Pollutant Reduction Facilities Inspection of PRFs constructed by the Authority at Cherry Creek State Park to assess whether PRFs are functioning as designed and to identify routine, restorative, and rehabilitative maintenance requirements.
2008 Capital Improvement Projects Summary of potential pollutant reduction facilities.
Cherry Creek Reservoir 2006 Annual Aquatic Biological and Nutrient Monitoring Study Characterization of potential relationships between nutrient loading and reservoir productivity.
Cherry Creek Reservoir Destratification Design Documents Design drawings and specifications for the installation of a submerged focused mixing system in the reservoir to destratify the deepest portions of the reservoir, vertically mix algae to compromise their habitat and reduce production of blue-green algae, and oxidize of the deep bottom sediments to reduce the release of nutrients from the sediments into the water column.
Cherry Creek Reservoir – Revised Proposal for TMAL Schedule Schedule proposed by Division and Authority to Commission in December 2007 for Control Regulation 72 Rulemaking Hearing in 2009
Cherry Creek Reservoir Watershed Technical Appendix to Denver Regional Council of Governments (DRCOG) Metro Vision 2020 Clean Water Plan
Cherry Creek Stewardship Partners 2006 Annual Report Update on activities completed by the Partners in 2006.
Cottonwood Creek Reclamation Project Phase I Record Drawings
Depth Profile Study of Phosphorus Concentrations in the Cherry Creek Alluvial Aquifer Results of depth profiling study identified in Control Regulation 72, and discussed in Section 8.
Estimate of Nutrient Loading from Septic Systems in the Cherry Creek Basin
Phosphorus Facilitator Report (2007) Describes coordination of enhanced water quality plans in three developments.
Proposed Recommendations for MS4 NPDES Stormwater Permitting Requirements in the Cherry Creek Reservoir Basin
Reference Reach Evaluation for Cottonwood Creek Reclamation Project Evaluation to show that the proposed reclamation project is appropriately designed with respect to water use, with the intent that the State Engineers Office will view the project as acceptable without an augmentation plan.
Summary of Information Binder for Authority Board Members Summary reference information on Authority mission, guiding documents, projects, and budget.
West Cherry Creek Background Phosphorus Special Study Report Results of background study identified in Control Regulation 72, and discussed in Section 8.
Work Plan A routinely updated comprehensive schedule of activities, as prescribed by Control Regulation 72 and recommended by Watershed Plan 2003.

3. DESCRIPTION OF CHERRY CREEK RESERVOIR WATERSHED

Originally built for flood control, Cherry Creek Reservoir is owned and operated by the COE. The reservoir, with a surface area of approximately 850 acres, and surrounding land were leased to the State of Colorado for use as the Cherry Creek State Recreation Area in 1957. The 3,915-acre park almost immediately received extensive recreational use, a pattern that has continued to the present day. The park had 1.5 million visits last year (2006-7 fiscal year). The reservoir and surrounding state park serve as an important urban recreational site, providing opportunities for a variety of activities, including sport fishing, boating, swimming, bicycling, bird watching, horseback riding, and hiking. Additionally, the state park provides important wildlife habitat, including grasslands, wetlands, forests, meadows, and ponds.

Cherry Creek Reservoir was designed as a terminal stormwater storage facility, intended to hold runoff water that would then be discharged to maintain an acceptable downstream flow and a predetermined lake level. The reservoir, along with subsurface flows from below the dam, has maintained Cherry Creek downstream of the reservoir in a free-flowing condition. As a storage facility with regulated outflows, upstream flows have accumulated, over almost 50 years, sediment to depths of up to 6 meters at the outlet works with an average overall depth of almost 3 meters. The water in the reservoir undergoes chemical changes from the influences of inflows, sediments, sunlight, temperature, and wind, all of which influence algal growth.

The Cherry Creek Reservoir's watershed includes approximately 245,500 acres and 32 sub-watersheds (Figure 3-1). The northern portion of the watershed has been urbanizing over the past twenty years, especially in the sub-watersheds immediately adjacent to the reservoir. Developed land uses include high to moderate density suburban residential areas, large lot subdivisions, commercial and light industrial parks, and office buildings. Traditional agricultural and agribusiness uses are still present, but mostly in the southern upstream half of the watershed. The reservoir is currently classified for warm water aquatic life, primary recreation, water supply, and agriculture.

3.1 Water Quality History and Regulations

Figure 2-2 in Section 2, entitled Summary of Authority History, provides background information on the Authority, water quality, and changes in regulations. The Cherry Creek Reservoir chlorophyll *a* standard of 15 µg/L has only been met in three of the past 16 years, and the phosphorus goal of 40 µg/L has never been achieved in the past 16 years. However, the phosphorus loads have been lower than the TMAL of 14,270 pounds in 14 of the past 16 years. In 2007, reservoir chlorophyll *a* was 12.6 µg/L and phosphorus was118 µg/L, while the phosphorus load to the reservoir was19,772 pounds.

Watershed Plan 2003 identifies potential investigations and strategies that will help arrive at achievable goals and standards. Information from investigations and special studies, discussed in Section 8, will assist in determining how to refine the phased TMAL and identify additional control measures. In the meantime, the phased TMAL process provides a framework for the adoption of point source and nonpoint source controls that will provide protection for the reservoir.

Table 3-1 lists the current Phase I TMAL annual phosphorus allocations, per Control Regulation 72.

Figure 3-1. Cherry Creek Reservoir Watershed

Table 3-1. Phase I TMAL Annual Phosphorus Allocations	
Allocation Type	Total Phosphorus Pounds/Year
Nonpoint and Regulated Stormwater Sources	10,506[1]
Background Sources	1,170
Wastewater Facility Sources (Including Reserve Pool and Phosphorus Bank)	2,094
Industrial Process Wastewater Sources	50
Individual Sewage Disposal Systems	450
Total Maximum Annual Phosphorus Load	14,270

[1] *As part of the 2004 Triennial Review Hearing for Control Regulation No. 72, the Commission eliminated the 216 pounds allocated in the Phosphorus Bank for phosphorus trading, which limited the Trading Program. The 216 phosphorus pounds originally in the Phosphorus Bank are now accounted for in the Nonpoint and Regulated Stormwater Sources.*

3.2 Revisions to DRCOG Clean Water Plan Technical Appendix

The TAC and special districts participated in the review and provided comments to DRCOG to assist in the update to the technical appendix.

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4. WASTEWATER FACILITY CONTROLS

Wastewater and industrial process wastewater sources must have a sufficient phosphorus wasteload allocation prior to discharging in the Cherry Creek Reservoir watershed. Wasteload allocations are listed in Table 4-1, where each facility is limited to an annual allocation of phosphorus pounds that can be discharged. Wastewater utilities in the Cherry Creek Reservoir watershed are also required to meet water quality effluent limits and follow procedures for the purpose of limiting phosphorus loads that can ultimately reach Cherry Creek Reservoir. Six point source dischargers within the Cherry Creek Reservoir watershed provide centralized wastewater treatment service. Two point source dischargers are located outside the watershed, but land apply reuse water as irrigation within the watershed.

4.1 Wasteload Allocation

Wastewater treatment facilities provide phosphorus removal and treatment using either secondary treatment followed by land application or advanced wastewater treatment followed by land application or direct discharge.

4.1.1 Monthly and Annual Loading

The Colorado Discharge Permit System permits require dischargers to monitor and quantify the concentration and total pounds of phosphorus discharged. Tables 4-1 and 4-2 present the phosphorus allocations and annual and monthly loads, respectively, for the wastewater dischargers in 2007.

Table 4-1. Cherry Creek Reservoir Watershed Point Source Allocation and 2007 Point Source Phosphorus Annual Contribution[1]

Facility	Allocation (pounds)	2007 Phosphorus (pounds)[1]
Arapahoe County Water and Wastewater Authority/Cottonwood Water & Sanitation District[2]	402	239
Pinery Water and Sanitation District	304	52
Inverness Water and Sanitation District	129	61
Parker Water and Sanitation District[3]	593	206
Meridian Water and Sanitation District	113	0
Stonegate Village Metropolitan District[1]	161	485
Plum Creek Wastewater Authority[4]	25	11
City of Aurora[4]	10	
Semi-Urban Areas[3,5]	141	
Industrial Process Wastewater Sources[6]	50	
Subtotal	1,928	
Reserve Pool	216	
Phosphorus Bank	0	
Total	2,144	1,054

[1] The 2007 phosphorus pounds are preliminary as reported by the dischargers.
[2] Arapahoe County Water and Wastewater Authority (ACWWA) has 57 pounds of conditionally approved phosphorus trade credits in addition to its 402 pound allocation.

[3] In December 2005, the Authority Board approved the Parker Water & Sanitation District Wastewater Utility Plan Amendment and an allocation from the semi-urban area of 60 pounds.
[4] In 2004, phosphorus pounds were transferred from the semi-urban area allocation to the Plum Creek Wastewater Authority and the City of Aurora for Land Applications within the Cherry Creek Watershed.
[5] Semi-urban areas are potential development areas outside the DRCOG urban growth boundary or are assigned areas not affiliated with a service provider. These areas have not been included within a designated service area assigned to existing wastewater facilities that have wasteload allocations but are designated planning areas planned for urbanization after 20 years.
[6] There are currently no industrial process wastewater sources with a wasteload allocation. DirecTV is discharging in the watershed and was supposed to get a 10-lb allocation, but due to backlog, the Division has never issued a permit. Recent conversations with the Division indicate permitting may occur in 2008.

Table 4-2. 2007 Point Source Phosphorus Monthly Contribution [1]

Month	Discharges to Cherry Creek					Discharges to Lone Tree Creek
	Parker Water and Sanitation District (pounds/ month)	Pinery Water and Sanitation District (pounds/ month)	Stonegate Village Metropolitan District[3] (pounds/ month)	Inverness Water & Sanitation District (pounds/ month)	Plum Creek Wastewater Authority[2] (pounds/ month)	Arapahoe County Water and Wastewater Authority (pounds/ month)
January	10.7	7.0	6.9		0	11.7
February	11.5	5.3	86.2		0	15.5
March	16.8	4.4	240.8		0.4	10.4
April	16.7	5.1	100.3		0.6	10.6
May	18.7	4.4	6.9	8.9	1.8	11.1
June	20.2	4.0	3.6	16.1	3.1	16.9
July	22.3	4.0	2.9	15.6	1.8	17.2
August	23.4	3.2	10.6	14.1	1.2	62.8
September	17.6	3.8	2.1	7.2	0.9	23.1
October	14.8	2.9	1.0		0.8	15.4
November	17.7	4.0	10.6		0.3	24.6
December	15.9	3.8	13.7		0	19.8
Total	206.3	52.0	485.6	61.9	10.9	239.1

1 The 2007 phosphorus pounds provided are preliminary as reported by the dischargers.
2 The Plum Creek Wastewater Authority discharges in the Cherry Creek Reservoir watershed are through reuse irrigation and only occur during the irrigation season.
3 Reported discharged loads from Stonegate exceed the facility's wasteload allocation.

4.1.2 Temporary Transfer and Reserve Pool Actions

Control Regulation 72 allows the temporary transfer of the unused portion of a phosphorus wasteload allocation from an existing discharger to another facility (Section 72.5(1)). Both the transferring and receiving facilities must agree upon the temporary transfer.

There were no temporary transfers or reserve pool actions in 2007.

4.2 Wastewater Permits and Limits

Control Regulation 72 requires that the Annual Report also include wastewater facility permit violations with regard to phosphorus concentration limits and annual phosphorus loads.

In August 2007, the Division issued a notice of violation to Stonegate Village Metropolitan District (Stonegate) for exceeding total phosphorus effluent limits, as well as effluent limits for other constituents. The 30-day average total phosphorus limit of 0.25 milligrams per liter (mg/L) for Outfall 001A was exceeded twice and the 30-day average total phosphorus limit of 0.05 mg/L for Outfall 002A was exceeded four times in 2007. Stonegate reported a 30-day average total phosphorus concentration of 0.71 mg/L and 0.44 mg/L for the months of February and June, respectively, for Outfall 001A. For Outfall 002A Stonegate reported a 30-day average total phosphorus concentration of 0.58 mg/L, 1.48 mg/L, 0.56 mg/L, and 0.33 mg/L for the months of February, March, April, and May, respectively. Although not specifically identified in the notice of violation, Stonegate also exceeded its annual phosphorus wasteload allocation. To prevent future exceedances Stonegate was required to implement several mitigation strategies including repairing broken equipment and updating operation and maintenance plans. Stonegate is negotiating with other wastewater dischargers in the basin, that did not use all of their allocation, to offset its excess phosphorus load.

The wastewater utilities in the Cherry Creek Reservoir watershed have met the following Control Regulation 72 discharge requirements, with the exception described above:

By August 1, 2004 direct dischargers in the Cherry Creek Reservoir watershed must discharge phosphorus at a 30-day average effluent concentration less than 0.05 mg/L and dischargers using land application must discharge a 30-day average phosphorus concentration less than 0.05 mg/L divided by the return flow factor.

Where land application relies on lysimeters to determine phosphorus groundwater returns, the effluent concentration prior to land application shall not exceed 1.0 mg/L total phosphorus.

4.3 Site Location Approval Review

As the designated regional water quality management agency for the Cherry Creek Reservoir watershed, the Authority reviews applications for site location approval, as required by Control Regulation 72, for site location and design approval of domestic wastewater treatment works. Site location approval reviews address protection of the Cherry Creek Reservoir with respect to phosphorus, general water quality, protection of downstream water supplies, and adequacy of proposed design processes and capacity.

Applications for site location approval are reviewed to determine if the criteria in the following documents have been met.

- Cherry Creek Basin Water Quality Management Master Plan/Control Regulation 72 (Commission, December 2004).
- Emergency Response Plan Criteria for the Cherry Creek Reservoir Watershed (Authority, March 2002).
- Regulation No. 22, “Site Location and Design Approval Regulations for Domestic Wastewater Treatment Works” (Commission, June 2004).
- Metro Vision 2020 Clean Water Plan: “Wastewater Utility Plan Guidance” (Denver Regional Council of Governments, January 2003) and “Lift Station Report Guidance and Checklist” (DRCOG, October 2000).
- Policy 96-1, “Design Criteria Considered in the Review of Wastewater Treatment Facilities” (Commission, expiration date May 31, 2007).

The Authority developed the Emergency Response Plan Criteria for the Cherry Creek Reservoir watershed to establish criteria for emergency response plans, and requires that emergency response plans are included with each application for site location approval.

In addition, the Authority performs a cursory review of the pump selection and sizing for lift stations to ensure that there were no obvious problems with the equipment proposed for the lift station. The purpose of the review is summarized as follows.

- Provide a summary and brief review of the engineering report and application for site location approval, relative to the requirements of the Authority.
- Provide opinions or best professional judgment on the thoroughness and completeness of the engineering report and application for site location approval.
- Provide opinions on whether the engineering report and application meet all criteria as defined by the control regulations.

DRCOG relies on completeness and thoroughness of review by the Authority for acceptance of the site location approval because the Authority is a designated 208 agency. The Authority did not review any lift station applications for site location approval, wastewater utility master plan amendments or wastewater treatment plant expansions in 2007.

The Cherry Creek State Park contacted the Authority, in February 2007, regarding a small lift station it would be constructing for the Park Shooting Center. Due to the small capacity (<2,000 gallons per day [gpd]), the lift station did not go through a formal Site Location Approval, but the Park did provide the Authority with drawings and engineering report for the facility. The Park is providing an emergency on-site storage tank that can store up to 40 hours of flow (approximately 3,333 gallons of storage). Wastewater flows will be treated at the East Cherry Creek Valley Water and Sanitation District, outside the watershed.

4.3.1 Site Application Follow-Ups

The Authority contacted previous applicants for feedback on the Site Location Approval review process. To assess the effectiveness of the site application review efforts, applicants who had submitted site application reviews from 2003 to 2006 were contacted and asked to provide feedback on the Authority's Site Location Approval process. Of the 12 applicants contacted by the Authority for 24 applications, four responded with feedback. A summary of the responses is provided below in Table 4-3.

Table 4-3. Summary of Feedback From Site Applicants on Site Location Approval Process

Project Name	Applicant	Ultimate Owner	Response
Cottonwood South Lift Station	Private Developer	Parker Water and Sanitation District	All comments were addressed in the final design. The following modifications were made: (1) provided an overflow containment pond, (2) provided isolation valve on by-pass around flow meter, and (3) odor problems would be monitored and mechanical fans were added to the wet well and valve/meter valve. Overflow storage was incorporated. It was difficult to address the cost and maintenance requirements for the overflow containment. The required capabilities have not been needed yet, and they don't foresee them to be needed. As-built drawings were provided.

Table 4-3. Summary of Feedback From Site Applicants on Site Location Approval Process

Project Name	Applicant	Ultimate Owner	Response
Eastern Water Treatment Plant Lift Station	Town of Castle Rock	Plum Creek Wastewater Authority (Chatfield Basin)	All comments were addressed and changes were incorporated. No design modifications were necessary. Forcemain differential flow measurements and overflow storage were provided as recommended by the Authority. It was difficult to meet the time requirements; approximately 3 months and additional budget was needed for the Authority to review, respond and approve. Not aware of positive or negative impacts from comments. As-built drawings were provided.
Valley Country Club Lift Station	Arapahoe County Water and Wastewater Authority	Arapahoe County Water and Wastewater Authority	All comments were addressed and changes were incorporated. Included a metering vault and flow meter at outfall of forcemain and dual forcemains were combined. Overflow storage was constructed for the Valley Country Club Lift Station, and design of the differential flow measurement has been delayed due to traffic congestion. Difficult to determine how much storage was required. Overall time was balanced with station redundancy. Difficult to provide power to the differential flow measurement. Addressed with solar power. Comments regarding overflow capabilities were useful. Record drawings have been provided.
Sierra Ridge Lift Station	Sierra Ridge Metropolitan District	Parker Water and Sanitation District	Plans for site are to utilize a force main system. A lift station is no longer required.

For the three respondents who continued with the lift station construction all comments and suggestions made by the Authority were incorporated into the final design. While these applicants followed the Authority's recommendations, some respondents provided constructive feedback on the review process. The Parker Water and Sanitation District noted that it was difficult to address the cost and time necessary to incorporate the Authority's suggestions. Plum Creek Wastewater Authority stated that an additional three months and associated increased budget were needed to allow the Authority to review, respond, and approve the Eastern Water Treatment Plant Lift Station. The Araphaoe County Water and Wastewater Authority stated that the comments made by the Authority on overflow capabilities were useful.

4.4 Progress Made

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- Wastewater facility discharges did not exceed annual permitted wasteload allocations or effluent phosphorus concentrations, with the exception of Stonegate.
- The total annual phosphorus pounds discharged in the basin from the wastewater discharges was less than the total annual wasteload allocation.
- The Authority solicited feedback from four applicants on the Site Location Approval process.

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5. NONPOINT AND REGULATED STORMWATER SOURCE CONTROLS

Due to the broad scope of nonpoint and regulated stormwater sources in the Cherry Creek Reservoir watershed, several programs are in place to target nonpoint and regulated stormwater source pollutant reduction. Regulated stormwater sources discharge from regulated entities under the Colorado Discharge Permit System (Control Regulation 61). Programs include regulations for stormwater controls and long-term planning for PRF construction, discussed in this section, as well as public education and outreach programs (Section 7) and Cherry Creek Reservoir and watershed monitoring.

5.1 Land Use Agency Implementation of Stormwater Permit Requirements

In 1999, the National Pollutant Discharge Elimination System (NPDES) Stormwater Phase II Rule expanded the Phase I Rule to include several of the land use agencies that are part of the Authority. Prior to 2004, the City of Aurora and the Colorado Department of Transportation (CDOT) were the only agencies in the Cherry Creek Reservoir watershed covered under the Phase I Rule. Phase II permits became effective on March 10, 2003.

The Phase II Rule requires small municipal separate storm sewer systems (MS4s) to, at a minimum, adopt BMPs for six minimum control measures, implement them to the "maximum extent practicable," identify measurable goals for control measures, show an implementation schedule of activities or frequency of activities, and define the entity responsible for implementation. These requirements fit closely with the current programs in the Cherry Creek Reservoir watershed as part of Control Regulation 72. Erosion and sediment control and post-construction BMP programs for each agency under the NPDES Phase II requirements are complimentary to the same programs required under Control Regulation 72. Phase II permittees in the Cherry Creek Reservoir watershed formed cooperative workgroups to coordinate Phase II compliance and identify opportunities for effective stormwater program implementation to minimize overlap and redundancies.

Stormwater permit reporting information was provided to the Authority by the land use agencies on the following key elements (Table 5-1).

- Sediment and erosion control permit, inspection, and enforcement actions
- Construction BMP inspection and enforcement actions
- Permanent BMP construction, inspection, and maintenance actions

Detailed information on implementation for each Phase I and Phase II permittee can be found in the Stormwater Annual Reports for MS4s submitted to the Division.

5.2 Cherry Creek Reservoir Watershed Stormwater Quality Requirements

In 2000, the Authority adopted requirements related to construction activities and post-construction control of stormwater quality in the Cherry Creek Reservoir watershed entitled the "Cherry Creek Reservoir Watershed Stormwater Quality Requirements" (Requirements). The purpose of the Requirements is to recommend implementation of substantive BMP measures to control the quality of stormwater runoff from

land disturbances on private and public property. The Requirements are necessary to reduce and maintain nonpoint and regulated stormwater sources in accordance with the TMAL set forth in Control Regulation 72. In addition, the requirements establish the minimum construction and post-construction BMPs in the reservoir watershed for all new development activities.

Table 5-1. Summary of Cherry Creek Reservoir Watershed Permit, Inspection, and Enforcement Actions

Land Use Agency[1]	Permit Inspection Actions[2]	Permit Enforcement Actions[2]	Other
Arapahoe County	Illicit discharges: 4 inspections Construction: 746 inspections (GESC) Post-construction: 122 inspections for new development BMPs and 21 inspections for permanent BMP operation and maintenance	Illicit discharges: 1 clean-up notice Construction: 36 Non-compliance follow-up inspections; 5 Re-inspection fines issued; 1 Pre-Notice of Violation letter sent Post-Construction: no enforcement actions	All entities have public education and outreach programs that include, but are not limited to: Coordination with other entities (Authority, Phase II Co-op workgroup, Partners, UDFCD). Distribution of issue-specific fact sheets and brochures to residents and commercial entities. Participation on school programs (e.g., project WET). Educational projects such as willow planting with scout troops. Web sites, hot lines, surveys, public service announcements.
Douglas County	Illicit discharges: 85 Construction: 2,398 inspections (GESC) Single-family dwelling construction: 1,581 DESC inspections No complaints regarding permanent water quality BMPs	Illicit discharges: 85 response actions Level I GESC Violations (stop work orders): 31 DESC complaint visits: 1,581	
City of Aurora	Construction: 57 inspections	Construction: 9 notices of violation	
City of Centennial	Illicit discharges: 4 inspections Construction: 433 inspections based on Erosion Control program (prior to GESC approval) Post-construction: 28 inspections for new development BMPs and 19 inspections for permanent BMP operation and maintenance	Illicit discharges: no enforcement actions Construction: 17 non-compliance follow-up inspections; 3 Re-inspection fines issued; 1 pre-notice of violation letter sent. Post-Construction: no enforcement actions	
City of Greenwood Village	Illicit discharges: 61 inspections Construction: 5,215 inspections at 667sites Post-construction: 11 BMP inspections for final construction and 71 inspections for permanent BMP operation and maintenance:	Illicit discharges: 3 actions to identify source of discharge and require responsible party to mitigate. Construction: no formal enforcement actions required Final Construction and Permanent BMP Operation and Maintenance: no enforcement actions	
City of Lone Tree	Illicit discharges: 3 inspections Construction: 24 inspections	Illicit discharges: 0 notices of violation Construction: 6 minor violations, 2 major violations	
Town of Castle Rock	Illicit discharges: 437 outfall, 6 hotline response inspections Construction: 565 inspections (GESC) and 2,417 inspections for single-family residential (DESC) Post-construction BMPs: 40 construction, 285 O&M inspections	Illicit discharges: no enforcement actions Construction: 604 notices of non-compliance issued, 1 stop work order Post-Construction: no enforcement actions	

Table 5-1. Summary of Cherry Creek Reservoir Watershed Permit, Inspection, and Enforcement Actions

Land Use Agency[1]	Permit Inspection Actions[2]	Permit Enforcement Actions[2]	Other
Town of Parker	Illicit discharges: 64 inspections Construction: 440 inspections (GESC) Post-construction: 111 inspections of detention basins	Illicit discharges: 7 reported illicit discharges. 1 citation issued, 2 cases from 2006 were settled in the courts system in 2007. In both cases, the defendants were ordered to pay a fine and for damages. Construction: 410 non-compliance notices, 12 Stop Work Orders issued, 11 Notices of Intent to Issue Stop Work Order issued. Post-construction: 322 maintenance activities	
CDOT	Illicit discharges: 0 inspections within Cherry Creek Reservoir Watershed Construction: 1 inspection (GESC) within Cherry Creek Reservoir Watershed Post-construction: Two projects within Cherry Creek Reservoir Watershed reviewed to ensure inclusion of permanent BMPS	Illicit discharges: no enforcement actions required Construction: no enforcement actions required Post-construction: no enforcement actions required	All entities have public education and outreach programs that include, but are not limited to: ▪ Coordination with other entities (Authority, Phase II Co-op workgroup, Partners, UDFCD). ▪ Participation on school programs (e.g., project WET). Web sites, hot lines, surveys, public service announcements
Castle Pines Metropolitan District	Illicit discharges: daily inspections Construction: discontinued program and relies on Douglas County for inspections Post-construction: monitored after each storm event	Illicit discharges: no enforcement actions Construction: not provided Post-construction: maintenance provided as necessary	

GESC = Grading, erosion, and sediment control (permitting/inspection process for land-disturbing activities)
DESC = Drainage, erosion, and sediment control (permitting/inspection process for detached single-family residential)
[1] The land use agencies do not separately track inspection and enforcement action within the Cherry Creek Reservoir watershed. Information provided represents actions for the entire land use agency area.
[2] Foxfield is not a phase II community and is not included in this table.

5.2.1 Update Control Regulation 72

Land use agencies within the Cherry Creek Reservoir watershed now have NPDES Phase II stormwater permits which have requirements that meet, and in some cases, exceed the Authority Requirements. As a result, the Authority and land use agencies are recommending changes to Control Regulation 72 and developing an accompanying guidance document. Proposed changes will be presented to the Commission at the 2009 rulemaking hearing. Control Regulation 72 currently includes language from the Phase II stormwater regulation (i.e., six minimum control measures) and the majority of the Authority's model ordinance (e.g., specific BMPs and submittal requirements), which was developed in 1999. Now that MS4 permits and associated programs are in place in the Cherry Creek Reservoir watershed, the Authority and land use agencies in the watershed are developing changes to Control Regulation 72 and the Authority's Stormwater Quality Requirements to accomplish the following:

- Provide the basic requirements for stormwater quality management, particularly for areas that do not have a Phase II permit or to cover specific requirements not addressed by the land use agency permit requirements (e.g., 40-acre requirement for construction, BMPs for transportation corridors, streambank stabilization).

- Simplify and remove some of the detail from the Control Regulation so that the language does not have to be changed at every rulemaking hearing to be consistent with permit language. This allows changes in technology and practices to be more easily incorporated into the requirements.
- Remove inconsistencies between the individual land use agency requirements and MS4 permits. For example, there can be confusion with two sets of requirements that differ in terminology, submittal, review, etc.
- Maintain the level of protection for the reservoir. Construction and post-construction BMPs are implemented and regulated through MS4 permits, Regulation No. 61, and Stormwater Construction Permits, and MS4 permits in the watershed were based on site-specific requirements. Changes to Control Regulation No. 72 are intended to be performance-based and maintain consistency in the watershed. MS4s permit holders have final approval of BMPs, and the BMPs must meet Division-approved MS4 permits.

5.2.2 Develop a Guidance Document

The Control Regulation 72 Section 72.7 Guidance Document will replace the Stormwater Quality Requirements and provides more detailed explanation of requirements to comply with Control Regulation 72. As the Colorado Phase II Municipal Guidance provides more specific direction for coverage under a Colorado Phase II municipal stormwater discharge permit, Guidance Document provides more detailed requirements for application, review, and technical content to comply with Control Regulation 72 Section 72.7.

The Authority is developing the Guidance Document by first comparing and then integrating the Cherry Creek Reservoir Basin MS4 permit, Authority Stormwater Quality Requirements, Control Regulation No. 61, and the Phase II Municipal Guidance document. The Authority and land use agencies collectively identified where more clarification was needed, which was intended to enhance implementation and compliance. The process has included requesting input from the Division, and to respond to specific areas the Division requested clarification, the Authority developed a position paper, or white paper, that provides recommendations for the interpretation and implementation of the NPDES stormwater requirements for MS4s within the Cherry Creek Reservoir watershed and to provide clarity and consistency in interpretation of the municipal stormwater requirements in Control Regulation No. 72 for three specific areas.

The proposed recommendations include a three-tiered requirement for post-construction BMPs for development and redevelopment. All tiers of development and redevelopment must implement construction BMPs, and post-construction requirements will increase as the intensity of the development increases, as measured by impervious surfaces. The primary distinction between new development and redevelopment is whether impervious surfaces are new (total area) or existing (increased area). The Authority, the MS4 permitted members of the Authority, and CDOT (collectively called “Permittees”) are proposing the following recommendations to clarify the permit requirements within the basin:

1. Clarify the definition of New Development and Significant Redevelopment, including highways and roadway re-construction, to include a threshold impervious value that triggers water quality capture volume (WQCV) requirements for post-construction BMPs.

2. Define when the increase in impervious area is an appropriate basis for triggering WQCV-based post-construction BMPs for Significant Redevelopment. This is not intended to apply to new development because new development has a greater opportunity to comply with all regulatory requirements.

3. Clarify the definition of maintenance activity for highways and roadways that would be an automatic exclusion under the provisions of Control Regulation No. 72 for post-construction BMPs. This language would only be for the municipal Permittees, as CDOT has obtained an automatic exclusion from the Division for maintenance activities that meet specific requirements.

The Division will review the recommendations in 2008, and then the Authority will address comments and finalize the Guidance Document, which could also serve as the basis and purpose for the Guidance Document and Control Regulation 72 revisions.

5.3 Land Use Application Review

The Authority serves as a referral agency in the land use application process for nine local land use agencies within the Cherry Creek Reservoir watershed. When a land use agency receives an application for land use or development, a copy is sent to the Authority for review. The Authority then has the opportunity to comment on the potential water quality impacts of the proposed application prior to construction and to determine whether the proposed project complies with the Authority's Requirements.

In March 1997, Brown and Caldwell, as consultant to the Authority, began providing review of land use and development applications on behalf of the Authority. Table 5-2 provides a review of the number of land use and development applications that the Authority has reviewed annually since March 1997.

Table 5-2. History of Land Use and Development Applications Reviewed by Authority

Year	Number of Land Use and Development Applications Reviewed by Authority
March – December 1997	103
1998	179
1999	135
2000	190
2001	144
2002	126
2003	156
2004	176
2005	189
2006	177
2007	199
Total	1774

In 2007, the Authority reviewed and provided comment on 199 land use and development applications. Table 5-3 provides a breakdown of the various agencies that referred land use applications to the Authority in 2007.

Table 5-3. Sources of Land Use and Development Application Referrals

Referring Agency	Number of Land Use and Development Applications Referred to Authority in 2007
Arapahoe County	11
Douglas County	45
City of Aurora	39
City of Centennial	22
CDOT	3
Greenwood Village	2
Southeast Metro Stormwater Authority	1
Town of Castle Rock	7
Town of Parker	69
Total	199

The Authority's review of each application focuses on nonpoint pollutant source impacts and water quality considerations related to the proposed project. Review comments generally fall into the categories listed in Table 5-4. The Authority took no exception for 82% percent of the land use applications reviewed, and did not recommend approval for 5%. In many of these cases, the Authority reserves the right to review future submittals to determine if recommendations were incorporated.

Table 5-4. Summary of Comments on Land Use and Development Applications in 2007

Comment Category	Number of Applications	Percent of Total Applications (199)
No exception	164	82%
No exception, minimum requirements are met	25	13%
No exception, provided additional recommendations met	7	4%
No exception, reserve right to review subsequent submittals	129	65%
No exception, previous concerns were addressed	2	1%
No exception, project is part of larger approved project	1	1%
No approval	10	5%
No approval until BMPs requirements are met	0	0%
No approval, provided recommendations	9	5%
Insufficient materials (e.g., drainage reports not provided)	1	1%
BMP recommendations only (early in application process)	0	0%
Special cases	0	0%
Comments not required (e.g., notice of annexation)	22	11%
Not in Cherry Creek Reservoir watershed	3	2%

5.4 Compliance with Cherry Creek Reservoir Watershed Stormwater Quality Requirements

The Authority's review of applications for land-use change in the Cherry Creek Reservoir watershed provides the following benefits.

1. A better understanding of where and how development is occurring in the Cherry Creek Reservoir watershed. Currently, the bulk of development is occurring in the central reservoir watershed around the Town of Parker, City of Aurora, and Town of Castle Rock in several tributaries that previously were undeveloped. This pattern points to the need to focus on preventing or minimizing erosion in the tributaries by stabilizing the tributary simultaneously with, if not in advance of, development.

2. A better understanding of how well developers are complying with Authority Requirements and improved communication with the land-use agency personnel. Previously, some community officials were unaware of the Authority and its requirements to protect the water quality in the Cherry Creek Reservoir

watershed. Currently, the Authority's review and comments are integral to the development process and a negative response from the Authority can result in changes to the land use application.

3. An opportunity for the Authority to work more closely with developers during the initial stages of land use planning to identify projects where water quality enhancements would be more appropriate. The Authority develops these opportunities through the Phosphorus Facilitator program (Section 5.5) and coordination with land use agency staff.

4. The opportunity to stress the importance of meeting minimum requirements for BMPs through negative referrals. These BMPs have resulted in implementation of better water quality plans, some of which have gone beyond minimum requirements.

5.4.1 Proprietary Best Management Practices

The Authority and local land-use agencies receive requests to utilize proprietary BMPs for erosion and sedimentation control and to substitute proprietary BMPs for the Authority's minimum BMP requirement, which is extended detention basins. The Authority relies primarily on recommendations of the Urban Drainage and Flood Control District (UDFCD), provided in the Urban Storm Drainage Criteria Manual Volume 3 Best Management Practices (UDFCD 1999), when evaluating proprietary BMPs. Referrals to the Authority have been reviewed on a case-by-case basis and the Authority has approved the use of proprietary BMPs in some cases, as a test-case for others, and not approved in other applications.

The Authority does not have the resources to properly evaluate all proprietary BMPs to make a specific recommendation on which units are acceptable and which are not. The Authority relies on the design engineer and other independent agencies, such as the UDFCD, to provide guidance, justification, and recommendations. The Authority, therefore, requires the applicant's engineer to evaluate various BMP units and recommend a specific unit based on the following criteria.

- The ability to remove floatables, oil/grease, and phosphorus. Contaminant removal efficiency should be the primary basis for selecting a unit. The standard deviation in performance differences, as stated by the manufacturer, should be considered.
- Requirements of the local jurisdictions.
- Operation and maintenance requirements that are assigned to a governmental or quasi-governmental organization. These cases will be given priority over other organizations, such as home owner associations.
- Cost is a secondary consideration for selecting one unit over the other after the other criteria are considered.

5.5 Phosphorus Facilitator

In 2007, the Authority continued the Phosphorus Facilitator program. The role of the Phosphorus Facilitator, an independent consultant, is to investigate opportunities to improve water quality by working with developers and local governments to improve land-use plans and exceed minimum requirements for immobilization of phosphorus. The development of such plans is being accomplished through a coordinated working relationship between a land use agency, a developer, and their planners and engineers (collectively called "development group"). The intent is to identify water quality opportunities within a parcel of land before a developer selects a land-use plan, and to encourage the developer to implement an enhanced water quality plan. The land use agency can provide various incentives to encourage developers to implement enhanced water quality plans. However, sometimes the developer recognizes the benefits of an enhanced water quality plan in terms of cost savings, greater open space, and good-will and implements the plan without local government incentives.

In 2007, the Phosphorus Facilitator was involved with the water quality management plans of two developers, Anthology Development and Cornerstar Development, and review of BMPs for the Ridgegate Development.

5.5.1 Water Quality Management Plans

5.5.1.1 Anthology Development

The Anthology Development site is a 3,000-acre, mixed-use development located between Hess and Stroh Roads in Parker. The Phosphorus Facilitator worked with the developer's landscape architects and civil engineer for the Anthology (formerly Stroh Ranch) development, to identify water quality management plans that could be included in the development. The opportunities include the following:

1. Construction of wetland channels in the major drainageways;
2. Grading infiltration zones near the southeast corner of the property; and
3. Miscellaneous retention facilities in the rights of way of Stroh and Chambers Roads.

The designs for phase 1 were submitted to the Town of Parker on December 3, 2007. Phase 1 included a 2,500 foot wetland channel design for Stroh Gulch. The design of the wetland channel exceeds requirements set forth by the Authority. Wetland channel concepts for Lemon and Oak Gulches were developed and the detail design is expected to occur in late 2008 and further consideration to these water quality improvements will be given at that time. The bulk of the improvements to the two largest drainageways and the design of Chambers Road south of Stroh Road will be included in future phases.

5.5.1.2 Cornerstar Development

Cornerstar Development is a commercial and multi-family housing development covering approximately 180 acres in the City of Aurora on the southwest corner of the intersection of Parker and Arapahoe roads. The Phosphorus Facilitator worked with the developers, the COE, and City of Aurora staff to identify opportunities for enhanced water quality management designs. This effort resulted in the inclusion of the following design features not typically included in commercial developments:

1. Careful grading of a 1,800-foot length of the riparian corridor of Cherry Creek;
   - Maintains the flood conveyance capacity of the Creek
   - Retains wetland areas within the low flow channel
   - Provides the opportunity for the natural evolution of additional wetlands along the 200 to 300 foot-wide eastern shoulder of the low flow channel
   - Two wetland detention ponds that will include a total of 2 acres of wetlands;
2. A 1-acre constructed wetland equipped with flow spreaders to provide additional water quality treatment of discharges from one of the wetland detention ponds; and
3. 400 foot wetland channel to accept flows from Arapahoe road and the Arapahoe/Parker road interchange.

This development is currently under construction. When completed, each of these design features will enhance the water quality of the stormwater discharges from the development and will meet the Authority's requirements for exceeding BMPs in the riparian corridor of Cherry Creek.

5.5.2 BMP Review

5.5.2.1 Ridgegate Development

Ridgegate Development is a large mixed use development along the Interstate 25 corridor in Lone Tree that includes several thousand homes in the upper Cottonwood Creek and Happy Canyon watersheds, tributaries to Cherry Creek Reservoir. Preliminary contacts have been made with the contract civil engineers for Lone Tree to identify:

1. BMPs that have been required for development
2. Opportunities for practices that go beyond the Authority's BMP requirements
3. Options for modifications to plans with representatives for the developer

This is an ongoing effort that is not expected to be completed until the end of January 2008.

5.5.3 Proposed Change in Program Focus

The Authority is working on re-evaluating the Phosphorus Facilitator program. The program has had successes at raising awareness on the importance of water quality in development projects. Since the program began, many of the duties in the Phosphorus Facilitator's scope of work that were intended to encourage incorporation of water quality treatment into development sites have become routinely integrated into the development processes of the land use agencies in the basin. As a result, the Authority will be updating the program focus in 2008.

The land use agencies expressed a real need to see some of the Phosphorus Facilitator program efforts realized in on-the-ground project examples. To date, efforts have resulted in more "plans" than actual on-the-ground projects, due in part to the uncertainly of development limiting the actual construction of any enhanced projects. Projects under the control of the land use agency can have a more definitive time table, either through the UDFCD 5-year Capital Improvement Project (CIP) List or the agencies own internal 5-year list of prioritized projects. The Authority recognizes the benefit of having successful demonstration projects with enhanced BMP approaches constructed in the near future to help sell the concepts to developers for their sites. This would help sell the concepts to developers for their site, because they have been done successfully. One option considered in 2007 for the Phosphorus Facilitator scope is to select a land use agency project that includes enhanced BMPs, that is currently in design, or will be during the year, and to develop promotional materials for the enhanced BMP approach. This would develop a product that promotes the transferability of enhanced BMPs that would not normally be part of the design and construction of the CIP project. Developed materials could include an assessing and quantifying the benefits and challenges of a design approach with and without enhanced BMPs (e.g., environmental, water quality, maintenance, construction/constructability, safety, visual, permitting, value, public perception) and a cost comparison of implementing project with and without enhanced BMPs. The Authority will be considering this and other options for the Phosphorus Facilitator program focus in 2008.

5.6 Capital Improvement Projects

REG 72 REPORTING

STEPS REG 72

In accordance with statutory requirements, the Authority must spend at least 60% of the annual budget on design, construction, operation, and maintenance of pollutant abatement projects. To meet this requirement, the Authority conducts a multi-year, CIP planning process (currently five-year projections are made) to construct potential PRF projects. Potential PRFs are identified and evaluated, and costs are estimated over the life of design and construction for the project. The five-year projections, which are part of the Authority's annual budgeting process, are separated into design, capital, land acquisition, water augmentation requirements, and operations and maintenance costs. These costs are then spread-out over a multi-year period for longer-range planning purposes, subject to available Authority funds.

The first step in the process is development of a list of all potential PRFs (called the master PRF list), which includes capital and operation and maintenance costs and potential benefits in terms of phosphorus reduction. As pollution reduction opportunities are identified during the year, they are evaluated at the conceptual level to determine costs and benefits. If project costs and benefits appear to be reasonable, the TAC recommends to the Board that the project be included on the 'master PRF list.' Once the Board approves the project for inclusion on the master list, any future work towards design and construction, also authorized by the Board, is considered to be part of capital expenses of the Authority.

The next step is to select the best projects from the master list of PRFs to be included on the three-year CIP list, as listed in Table 5-5. The TAC annually evaluates the projects on the master list and forwards recommendations to the Board for inclusion on the five-year CIP. The Board then selects projects for the five-year CIP, subject to available funds. The PRF projects that progressed during 2007 and those projects recommended for further consideration in 2008 are discussed below.

- Reservoir Destratification
- Cottonwood Creek Stream Reclamation, Phase II
- PRF operation and maintenance
- Projects projected for 2008 activity

5.6.1 Reservoir Destratification

Reservoir destratification employs aggressive and focused mixing of the reservoir with the goal of reducing algal growth and internal nutrient loading. Reservoir destratification is not specifically a PRF, because the project does not reduce external nonpoint source pollutants to the reservoir, but it is a capital improvement project identified to improve reservoir water quality.

5.6.1.1 Project Purpose

The Authority has been implementing watershed-based BMPs and constructing PRFs for 17 years. However, the chlorophyll *a* standard (15 µg/l) was exceeded from 1994 through 2005 and the phosphorus goal (40 µg/l) has been exceeded since 1992. The chlorophyll *a* standard was met in 2007 with a seasonal average of 12.6 µg/l, but the phosphorus level (118 µg/l) still exceeded the 40 µg/l goal. The reservoir has an overabundance of phosphorus. Algal growth is currently limited by nitrogen during a large part of the summer growing season. Despite the Authority's programs to reduce phosphorus loads from the reservoir watershed, it will likely take many years before phosphorus becomes the limiting nutrient and water quality benefits are seen in Cherry Creek Reservoir.

A 2004 special study of in-lake nutrient enrichment indicated that, in the 2003 growing season, nitrogen was the limiting nutrient and that artificially mixing Cherry Creek Reservoir could decrease the tendency for algal blooms and lower chlorophyll *a* concentrations. In addition, anoxic bottom water, typical of eutrophic conditions, occurs irregularly in summer despite the top-to-bottom mixing (polymixis) that occurs on windy days in shallow areas. When the reservoir is stratified, significant amounts of ammonia, iron, and phosphate are released to the deep water and subsequently to the surface waters when the lake mixes a few days or weeks later. Reservoir mixing would also move oxygen rich water from the surface to the bottom, which may reduce the release of ammonia, iron and phosphates.

While watershed management is a necessary component of the Watershed Plan 2003 and both BMPs and PRFs must be implemented along with any in-lake management techniques, reservoir destratification (i.e., mixing) could provide multiple water quality benefits over a shorter period of time than relying solely on watershed measures.

Table 5-5. 2007 Three-Year Capital Improvement Projection (in thousands)

September 8, 2006

		Project Budget						Previous Expend.	Residual PRF Costs	Proposed 2007 Budget					Residual PRF Costs	Proposed 2008 Budget	Residual PRF Costs	Proposed 2009 Budget	Residual PRF Costs	Proposed 2010 Budget	Residual PRF Costs	Proposed 2011 Budget	Residual PRF Costs
Project No.	Project Title	Capital[1]	Land	Water	Total	O&M	Authority Portion	Note 11		Design[6]	Capital	Land	Water	Total		Total		Total		Total		Total	
CCR-1	Reservoir De-stratification (mixing)[10]	$ 862	$ -	$ -	$ 862	$ 50	100%	$ 372	***$ 490***	$ 45	$ 445	$ -	$ -	***$ 490***	$ -	$ -	$ -	***$ -***	$ -	***$ -***	$ -	***$ -***	$ -
CCB-1	CCSP Wetlands[5,7]	$ 1,928	$ -	$ -	$ 1,928	$ 19	100%	$ 6	***$ 1,922***	$ -	$ -	$ -	$ -	***$ -***	$ 1,928	***$ 63***	$ 1,865	***$ 63***	$ 1,802	***$ 63***	$ 1,739	***$ 63***	$ 1,676
CCB-5.1	Cherry Creek Sediment Pond at Arapahoe Road[4]	$ 4,278	$ 50	$ -	$ 4,328	$ 90	12%	$ 70	***$ 511***	$ -	$ -	$ -	$ -	***$ -***	$ 511	***$ 175***	$ 336	***$ 336***	$ (0)	***$ -***	$ (0)	***$ -***	$ (0)
CCB-5.2	Arapahoe/Douglas County Line Stream Stabilization (Parker)[17]	$ 700	$ -	$ -	$ 700	$ 1	25%	$ -	***$ 175***	$ -	$ -	$ -	$ -	***$ -***	$ 175	***$ -***	$ 175	***$ 175***	$ -	***$ -***	$ -	***$ -***	$ -
CCB-5.4	Cherry Creek Stream Stabilization at Mainstreet (Parker)[17]	$ 1,300	$ -	$ -	$ 1,300	$ 1	25%	$ -	***$ 325***	$ -	$ -	$ -	$ -	***$ -***	$ 325	***$ 325***	$ -	***$ -***	$ -	***$ -***	$ -	***$ -***	$ -
CCB-5.6	Cherry Creek Stream Stabilization at Lincoln Aveneue (Parker)[17]	$ 1,315	$ -	$ -	$ 1,315	$ 1	20%	$ -	***$ 263***	$ -	$ -	$ -	$ -	***$ -***	$ 263	***$ -***	$ 263	***$ -***	$ 263	***$ 30***	$ 233	***$ 233***	$ -
CCB-5.7	Cherry Creek Stream Stabilization at Eco-Park (Arap County)[17]	$ 294	$ -	$ -	$ 294	$ 1	20%	$ -	***$ 59***	$ -	$ 59	$ -	$ -	***$ 59***	$ (0)	***$ -***	$ (0)	***$ -***	$ (0)	***$ -***	$ (0)	***$ -***	$ (0)
CCB-5.8	Cherry Creek Stream Stabilization U/S Arapahoe Rd (Centennial)	$ 518	$ -	$ -	$ 518	$ 1	25%	$ -	***$ 130***	$ -	$ -	$ -	$ -	***$ -***	$ 130	***$ -***	$ 130	***$ 130***	$ (1)	***$ -***	$ (1)	***$ -***	$ (1)
CCB-11	Advanced Water Treatment Plant[16]	$ 4,593	$ 100	$ 100	$ 4,793	$ 69	100%	$ -	***$ 4,793***	$ 100	$ -	$ -	$ -	***$ 100***	$ 4,693	***$ 125***	$ 4,568	***$ 350***	$ 4,218	***$ 2,000***	$ 2,218	***$ 2,218***	$ -
CCB-12.1	Bowtie Phase I[9]	$ 616	$ 450	$ -	$ 1,066	$ 6	100%	$ -	***$ 1,066***	$ -	$ -	$ -	$ -	***$ -***	$ 1,066	***$ -***	$ 1,066	***$ 50***	$ 1,016	***$ -***	$ 1,016	***$ 50***	$ 966
CCB-13.2	Cottonwood Creek Reclamation[3]	$ 2,041	$ -	$ -	$ 2,041	$ 12	96%	$ 783	***$ 1,211***	$ 135	$ 1,076	$ -	$ -	***$ 1,211***	$ -	***$ -***	$ -	***$ -***	$ -	***$ -***	$ -	***$ -***	$ -
CCB-16	Stream Corridor Preservation[2]	$ -	$ 500	$ -	$ 500	$ -	100%	$ -	***$ 500***	$ -	$ -	$ 100	$ -	***$ 100***	$ 400	***$ 100***	$ 300	***$ 100***	$ 200	***$ 100***	$ 100	***$ 100***	$ -
CCB-17	Reservoir Shoreline Stabilization[13]	$ 550	$ -	$ -	$ 550	$ 5	69%	$ -	***$ 380***	$ 60	$ -	$ -	$ -	***$ 60***	$ 320	***$ 75***	$ 245	***$ 305***	$ (60)	***$ -***	$ (60)	***$ 500***	$ (560)
	SUB-TOTALS	***$ 18,995***	***$ 1,100***	***$ 100***	***$ 20,195***	***$ 257***		***$ 1,231***	***$ 11,824***	***$ 340***	***$ 1,580***	***$ 100***	***$ -***	***$ 2,020***	$ 9,810	***$ 863***	$ 8,947	***$ 1,509***	$ 7,438	***$ 2,193***	$ 5,245	***$ 3,164***	$ 2,081

Table 5-5. 2007 Three-Year Capital Improvement Projection (in thousands)

September 8, 2006

		Project Budget						Previous Expend.	Residual PRF Costs	Proposed 2007 Budget					Residual PRF Costs	Proposed 2008 Budget	Residual PRF Costs	Proposed 2009 Budget	Residual PRF Costs	Proposed 2010 Budget	Residual PRF Costs	Proposed 2011 Budget	Residual PRF Costs
Project No.	Project Title	Capital[1]	Land	Water	Total	O&M	Authority Portion	Note 11		Design[6]	Capital	Land	Water	Total		Total		Total		Total		Total	
	OPERATIONS AND MAINTENANCE									Design[6]	Capital	Power	Other	Total				$ -	$ -	$ -	$ -	$ -	$ -
	Rehabilitation Categories																						
OM-1	Restore Cottonwood Perimeter Road	$ 113	$ -	$ -	$ -	$ 113	100%	$ -	$ 113	$ 8	$ -	$ -	$ -	$ 8	$ 105	$ 105	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-2	Shop Creek Wetlands Restoration[12]	$ 200	$ -	$ -	$ -	$ 200	100%	$ -	$ 200	$ 16	$ -	$ -	$ -	$ 16	$ 184	$ 184	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-8	Cottonwood/Peoria sediment removal[14]	$ 24	$ -	$ -	$ -	$ 24	25%	$ -	$ 6	$ -	$ 6	$ -	$ -	$ 6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	SUB-TOTALS	$ 337				$ 337		$ -	$ 319	$ 24	$ 6	$ -	$ -	$ 30	$ 289	$ 289	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Restorative Categories																						
OM-3	Quincy Drain embankment	$ 2	$ -	$ -	$ -	$ 2	100%	$ -	$ 2	$ -	$ 2	$ -	$ -	$ 2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-4	East Boat Ramp riprap	$ 1	$ -	$ -	$ -	$ 1	100%	$ -	$ 1	$ -	$ 1	$ -	$ -	$ 1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-10	East Shade Shelter	$ 5	$ -	$ -	$ -	$ 5	100%	$ -	$ 5	$ -	$ 5	$ -	$ -	$ 5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-11	Dixon Grove	$ 8	$ -	$ -	$ -	$ 8	100%	$ -	$ 8	$ -	$ 8	$ -	$ -	$ 8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-5	Tower Loop	$ 13	$ -	$ -	$ -	$ 13	100%	$ -	$ 13	$ -	$ 13	$ -	$ -	$ 13	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-12	Cottonwood Perimeter Road Outlet works	$ 8	$ -	$ -	$ -	$ 8	100%	$ -	$ 8	$ -	$ 8	$ -	$ -	$ 8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-13	Shop Creek Sediment Removal	$ 25	$ -	$ -	$ -	$ 25	25%	$ -	$ 6	$ -	$ -	$ -	$ -	$ -	$ 6	$ 6	$ -	$ -	$ -	$ -	$ -	$ -	$ -
OM-6	Interpretive Signage restore	$ -	$ -	$ -	$ -	$ -	50%	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	SUB-TOTALS	$ 62				$ 62		$ -	$ 43	$ -	$ 37	$ -	$ -	$ 37	$ 6	$ 6	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	Routine Categories																						
OM-9	Sinking Fund Contribution[8]	$ 125	$ -	$ -	$ -	$ 125	100%	$ -	$ 125	$ -	$ -	$ -	$ -	$ 25	$ 100	$ 25	$ 75	$ 25	$ 50	$ 25	$ 25	$ 25	$ -
OM-7	Reservoir Destratification[8]	$ 212	$ -	$ -	$ -	$ 212	100%	$ -	$ 212	$ -	$ -	$ 11	$ 1	$ 12	$ 200	$ 50	$ 150	$ 50	$ 100	$ 50	$ 50	$ 50	$ -
	SUB-TOTALS	$ 337	$ -	$ -	$ -	$ 337		$ -	$ 337	$ -	$ -	$ 11	$ 1	$ 37	$ 300	$ 75	$ 225	$ 75	$ 150	$ 75	$ 75	$ 75	$ -
	SUB-TOTAL O&M	$ 736	$ -	$ -	$ -	$ 736		$ -	$ 699	$ 24	$ 43	$ 11	$ 1	$ 104	$ 595	$ 370	$ 225	$ 75	$ 150	$ 75	$ 75	$ 75	$ -
	GRAND TOTAL	$ 19,731	$ 1,100	$ 100	$ 20,195	$ 993		$ 1,231	$ 12,523	$ 364	$ 1,623	$ 111	$ 1	$ 2,124	$ 10,405	$ 1,233	$ 9,172	$ 1,584	$ 7,588	$ 2,268	$ 5,320	$ 3,239	$ 2,081

NOTES:

1 Includes engineering, administration, and contingency
2 Specific project not identified. Budget based on available funds.
3 WQCD 319 Grant provides $76,467. Phase I completed in 2004 at a const cost of $475,000. Portion of Ph II design completed in 2004. Ph II delayed until Peoria St. relocated. Finish design in 2006
4 TetraTech Contract = $70k + 2k. Total CIP = $4,278M (TetraTech 2006). Project budget is for CCBWQA stream stabilization portion of project as partnering with Arapahoe County and UDFCD is anticipated
5 Multi-phase project to restore and enhance wetlands along Cherry Creek. WQCD 319 Grant provides $63,800 toward total project of $159,500.
6 Includes technical feasibility, design, construction observation and administrative costs
7 Due to lowering of the operating water level in the Reservoir, project may be infeasible. Evaluate water level changes on project for future budget considerations.
8 Based on a fixed amount for each year for the period of the projection.
9 Construction of project delayed until Piney Creek stabilization is further along and until Arapahoe Road sediment pond completed.
10 Equipment bid = $301,566, installation = $455,823, total const. = $757,389 (AMEC memo 8/14/2006). AMEC services = $93,000, BC services = $11,300, Total projection = $861,689
11 Accumulative expenditures for the project, based on previous years accounting and estimate of current year expenses
12 Create greater open water to wetlands ratio for performance. First phase is to determine feasibility of effort.
13 Cost based on similar projects for east side of Reservoir, from Tower Loop to the East Boat Ramp.
14 Assume Authority provides 25% of funds, with remaining under UDFCD cost sharing with Arapahoe County for O&M
15 O&M for CCSP projects based on 2006 Annual O&M Inspection Report
16 Cost of land and water acquisition unknown. $100k used as "place holder". 2007 Budget for technical feasibility
17 Time line based on local entity CIP projections

5.6.1.2 Project History

The Authority conducted a technical feasibility investigation, including 35% level design, construction specifications, and cost estimate, in 2005 into in-lake management techniques that could be beneficial to reducing chlorophyll *a* and nutrient concentrations and increasing dissolved oxygen concentrations in the near term. The Authority considered destratification as a method to reduce algal growth by limiting its exposure to light in the photic zone. The consultant team recommended the installation of a submerged focused mixing system in that portion of the reservoir greater than 20 feet deep.

The reservoir de-stratification system is projected to achieve the following:

1. Reduce the production of blue-green algae by vertical mixing to make the habitat of the reservoir less suitable for the production of blue-green algae.
2. Decrease the seasonal mean (July-September) chlorophyll a concentrations by approximately 8 µg/L under typical year conditions.
3. Decrease annual peak chlorophyll a concentrations by up to 30 µg/L.
4. Reduce the releases of phosphorus and nitrogen nutrients from the bottom sediments into the reservoir in a typical year by 810 lbs/yr and 1,140 lbs/yr, respectively; according to the 2005 Feasibility Report for Cherry Creek Reservoir Destratification, December 5, 2005, AMEC Earth and Environmental.
5. Increase dissolved oxygen concentrations, in the deepest and most vulnerable zones of the reservoir, into the range of 5 mg/L.

The recommended system will accomplish these objectives without harming existing uses of the lake and will complement the continuing watershed-based control measures to reduce nutrient loadings to the reservoir. The capital costs for the submerged focused aeration system is $862,000, and the annual operation, maintenance and replacement costs are estimated to be $60,000. Based on these costs and an estimated annual phosphorus removal of 810 lbs/year, the phosphorus removal cost is $127 per pound of phosphorus.

5.6.1.3 Project Activity

The project was not awarded in 2006 because final plan approval from the COE was not obtained until 2007. The installation of the reservoir destratification system was completed in 2007. The submerged portions of the system were installed in May 2007 and tested in September 2007.

The project plans included a bid alternate to enlarge the access berm across part of the dam face to make the berm an official State Parks trail, with the difference in cost paid by the State of Colorado. An IGA for funding between the State and the Authority was completed in 2007.

To monitor the effectiveness of the destratification system, the Authority increased the frequency of temperature monitoring during 2007 in the reservoir by installing temperature loggers at the three monitoring locations in the reservoir. During the period from early April through October, data loggers record temperatures at 1-meter increments. In addition, the Authority also performed a monthly (July-September) oxidation reduction potential profile along the same transect used to gather oxidation reduction potential information during final design. The combination of the additional measurement and method, along with the routine monitoring of the reservoir, will help determine if Cherry Creek Reservoir is mixing and how effective the mixing has been.




5.6.2 Cottonwood Creek Stream Reclamation

The Cottonwood Creek Stream Reclamation project begins at the Perimeter Road, within Cherry Creek State Park, and extends about 11,600 feet upstream to the Cottonwood/Peoria Street PRF (completed in 2002).

5.6.2.1 Project Purpose

The primary purpose of the reclamation project is to reduce soil erosion of the streambed and stream banks, which contains phosphorus and other pollutants that makes its way into Cherry Creek Reservoir and contributes to water quality degradation in the reservoir. The project will also restore riparian vegetation, attract wildlife, and provide passive recreation opportunities, all of which are important objectives in the design approach.

Cottonwood Creek reclamation will go beyond simply stabilizing the creek in place. The design will re-create, as closely as possible, a natural, well-vegetated, functional stream system that will provide water quality, habitat, and aesthetic benefits for the Authority and the Park. Based on the Authority's experience with the Shop Creek channel, the proposed concept for Cottonwood Creek channel can reduce phosphorus loading through wetlands treatment, infiltration, and settling, in addition to immobilizing phosphorus through stream stabilization. When both phases of the Cottonwood Creek Reclamation are completed, the project is expected to cost $2,450,000 and immobilize 730 pounds of phosphorus annually, which results in an average annual cost around $350 per pound of phosphorus.

5.6.2.2 Project History

The feasibility analysis was completed in January 2003 and final design for two phases of the project began in February 2003. Phase I design from Peoria Street to the confluence with Lone Tree Creek was completed and bid in December 2003. A contract was awarded for $477,299 and construction of Phase I began in late December 2003 and was substantially complete as of May 3, 2004. Phase II design is expected to be completed in 2008 with construction beginning in 2008. A contract for Phase II was awarded in January 2008, in the amount of $1,284,000 and is projected to cost $1,400,000, which includes design, construction oversight, and administration.

The Authority has worked closely with Park staff and the Park Board to develop a concept that was acceptable to the Park. The Park Board officially approved the project at its November 2003 meeting.

Cottonwood Creek - Choke point forcing large floods to spill into the floodplain providing pollutant reduction (8-20-04)

Cottonwood Creek - Example of multi-use of a PRF (7-7-04)

5.6.2.3 Project Activity

Substantial completion of Phase I was accomplished on May 3, 2004, which is the reach from Peoria Street down to the confluence with Lone Tree Creek. Design of Phase II of the reclamation began in early 2004 by coordinating the design with the relocation by Greenwood Village of Peoria Street and the planned expansion of the shooting range on Cherry Creek State Park. Relocation of Peoria Street provided the opportunity to move Cottonwood Creek back to historic location in the valley, affecting the restoration part of the project. Expansion of the shooting range is being accommodated by relocating the main channel to the west of the range. This will reduce, but not eliminate, the flooding potential of the shooting range. Since construction of Phase II is dependent on relocation of Peoria Street, the street relocation had to be near completion before starting Phase II construction. Peoria Street realignment was substantially completed by September 2007.

Muller Engineering re-initiated final design of Phase II in October 2007, including preparation of construction drawings. Phase II extends approximately 8,600 feet from the Park perimeter road upstream to a point about 600 feet upstream of the confluence of Cottonwood Creek and Lone Tree Creek. Of this length, approximately 6,200 feet of Cottonwood Creek will be relocated to what is believed to be the historic channel location at the low point in the valley. The construction of a new road alignment for Belleview Avenue and Peoria Street out of the valley bottom made this relocation possible.

The goal of the project was to stabilize the creek banks and invert by incorporating natural riffle-pool grade control structures and riparian overbank vegetation. Water quality will be improved by reducing erosion and increasing vegetative filtering, infiltration, and wetland processes. Construction began in February 2008 and the Authority anticipates Phase II construction will be completed in 2008.

5.6.3 Projects Projected for 2008 Activity

The Authority establishes the 2008 budget in 2007. In 2008, the Authority anticipates construction of Phase II of Cottonwood Creek stream reclamation and initiating feasibility and preliminary design of the following additional capital projects:

- Cottonwood Creek Reclamation at Easter Avenue
- Cherry Creek Stream Stabilization at Eco-Park
- Cherry Creek Stream Stabilization at Vermillion Creek
- Reservoir Shoreline Stabilization at Mountain Loop Trail
- Cherry Creek Stream Stabilization at 12-Mile Park

5.6.4 Operations and Maintenance Activities

The Authority is required by statute and Control Regulation 72 to operate and maintain (or arrange for) all PRF constructed by the Authority. To this end, the Authority includes in its annual budget funds for operation and maintenance for specific facilities and, beginning in the 2004 budget (Table 5-5), has included a "sinking fund" in anticipation of future needs. For Operations and Maintenance (O&M) purposes, there are currently two IGA with State Parks, one covering operations and maintenance of PRFs within Cherry Creek State Park and the second covering Cherry Creek reservoir destratification facilities.

5.6.4.1 PRF O&M Agreement

In 2004, the Authority began drafting an agreement with the Park for maintenance of all existing and future PRF located within the Park. The agreement, which was signed on January 12, 2006, identifies requirements for routine and restorative maintenance activities and responsibilities between the Authority and the State. As a condition of the PRF agreement, the required annual inspection of PRFs located with the Park was conducted in August 2007 and recommendations were made to the Authority for consideration in the 2008 budget. Because of the relatively minor construction aspects of O&M activities, the Authority has begun

investigation of more economical alternatives to make routine and restorative repairs, such as sharing services with other governmental agencies with similar requirements.

5.6.4.2 PRF Maintenance Alternatives

In 2007, the Authority developed a contracting process to have routine and rehabilitative repairs made to the PRFs, which includes an adaptation of the UDFCD maintenance contracting process. Since rehabilitative repairs imply a more significant failure of the PRF, it is anticipated that a more formal design and bid process would be used for rehabilitative repairs. Therefore, the process applies only to routine and restorative maintenance projects.

5.6.4.3 Destratification O&M Agreement

In 2006, the Authority and the State worked together to develop an operations and maintenance agreement for the mixing facilities. This agreement again sets forth the Authority's responsibility for restorative and rehabilitative maintenance of the facilities, but also sets the long-term goal of eventual removal of the system and continued commitment by the Authority to implementing watershed management strategies. The Agreement was finalized in 2007.

5.6.4.4 Temporary Repairs to Cottonwood Creek Phase I

The Cottonwood Creek reclamation project within Cherry Creek State Park was divided into two phases. Phasing was necessary due to the Park's requirement to work out an alignment that accommodated the shooting range expansion, and the need to relocate Peoria Street to restore the alignment of the creek to its historic location. Phase I construction, completed in June 2004, included two, temporary rock-drop structures at the junction with Phase II. At that time, construction of Phase II was anticipated to begin in 2005.

Since completion of Phase I, there were several large flood events that destroyed one drop and has severely damaged the second drop (see attached photos). If the second drop were to fail, it is possible that about 1,000 feet of Phase I channel would be significantly damaged, including one drop structure. The repairs were completed within Cherry Creek State Park along Cottonwood Creek approximately 2,000 feet south-south east of the Shooting Range at the confluence of Lone Tree Creek with Cottonwood Creek.

5.7 Riparian and Wetlands Protection

REG 72 REPORTING

As described in the Section 5.6, the Authority has contributed wholly, or in part, to the construction of projects during 2007 as part of its capital improvement program that address riparian and wetlands enhancement and restoration. In addition to capital projects, the Authority's Requirements also recognize the importance of stream corridors to water quality by placing additional restrictions on development within the stream preservation area. When a land disturbance is proposed within the stream preservation area (except for implementation of water quality facilities themselves), the Authority requires additional BMPs (above minimum requirements). These additional BMP must enhance infiltration of stormwater to protect and enhance riparian habitat. In addition, the Authority's near future focus for PRFs will be more on implementing upper-basin, stream stabilization measures for Cherry Creek and its tributaries after completing projects within the Park.

5.8 Progress Made

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The Authority has made progress in meeting the requirements of Control Regulation 72 for control of nonpoint and regulated stormwater source pollution in the following ways.

- The Authority coordinated and assisted local land use agencies in implementing Phase II stormwater permit requirements consistent with Control Regulation 72.
- The Authority increased the local land use agencies understanding of Authority goals and requirements relative to water quality through development and distribution of education materials and by providing review comments on land-use change applications. The Authority reviewed 199 land use and development applications for nonpoint and regulated stormwater pollutant source impacts. Of the 199 applications, the Authority took no exception for 164 of the applications.
- Completed the fourth year of the "Phosphorus Facilitator" program to work with local developers to implement BMPs that go well beyond minimum requirements. Involved with the water quality management plans for two developers, and reviewed BMPs for an addition developer.
- The Authority completed construction of the reservoir destratification system for in-lake management and initiated final design of Cottonwood Creek Reclamation Phase II, and allocated funds for further activity during 2007. Although currently all but one PRF are located within Cherry Creek State Park, the Authority continues to focus on watershed BMPs and PRFs in the upper basin.
- The Authority continued its process to update the Authority's Stormwater Quality Requirements for consistency with Control Regulation 72 and the land use agency stormwater quality requirements developed as part of the Phase II stormwater permits. The revised document, in the form of a guidance document, represents the collective experience of the Authority and the land use agencies while implementing Phase II stormwater regulations and other measures to protect the water quality of the Cherry Creek Reservoir watershed.

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6. TRADING PROGRAM AND RESERVE POOL

The Authority initiated the Cherry Creek Reservoir watershed phosphorus trading program in 1997. The trading program allows point source dischargers and other entities requiring a load or wasteload allocation (i.e., allocatee) to receive phosphorus pounds for new or increased phosphorus allocations in exchange for phosphorus load reductions from other sources. The Authority can also sell or lease phosphorus credits through the Reserve Pool.

The Authority did not receive any new trade project applications in 2007.

6.1 Trading Program

REG 72 REPORTING

The Authority is authorized to implement and maintain a Trading Program in the Cherry Creek Reservoir watershed that allows phosphorus trading from the Phosphorus Bank. The goal of the Trading Program is to encourage and facilitate the construction of nonpoint source control projects and retrofit existing stormwater facilities with water quality enhancements that were not in the original design. Watershed-based trading is a successful water quality management strategy that will provide net reductions to the phosphorus TMAL, as well as provide additional environmental benefits in the Cherry Creek Reservoir watershed. Trading provides incentive for landowners, local governments, and allocatees to subsidize the design and construction of additional stormwater controls and phosphorus removal technologies that go beyond baseline BMPs. Watershed-based trading is a water quality management strategy that promotes incentive opportunities for entities in the Cherry Creek Reservoir watershed to implement additional phosphorus removal technologies needed to achieve the Cherry Creek Reservoir TMAL, sooner than later.

Through the Trading Program, entities in the watershed that require a load or wasteload allocation (i.e., point source dischargers, holders of wastewater reuse authorizations, entities providing land applications, industrial dischargers) can receive phosphorus pounds for new or increased phosphorus wasteload allocations from the Phosphorus Bank in exchange for phosphorus loading reductions from nonpoint source control projects that are built by the entity or third parties. These entities are also called “allocatees.” Landowners, local governments, and allocatees can construct phosphorus removal projects and receive credits for their own use or to transfer to an allocatee.

6.1.1 Trading Program Guidelines

The Authority completed revisions to the Trading Program and Reserve Pool Guidelines in 2006.

6.1.2 Tracking Trades

An example of how trades are tracked is provided in Table 6-1, which reflects the ACWWA trade project approved in 2003. ACWWA constructed a project to remove 165 pounds, and by applying a calculated trade ratio of 2.9:1, ACWWA will receive 57 phosphorus credits. For accounting, ACWWA will receive an increased allocation of 57 pounds and the nonpoint/regulated stormwater allocation will be reduced by 114 pounds, by applying a conservative 2:1 ratio (minimum allowable trade ratio). This results in a net reduction of the TMAL.

Table 6-1. Example of Tracking Trades			
Facility	Allocation		Post Trade Allocation
ACWWA/Cottonwood	402	+ 57→	459
Pinery Water and Sanitation District	304		304
Parker Water & Sanitation District	593		593
•	•		•
•	•		•
•	•		•
Semi-urban Areas	141		141
Subtotal	1,878		1,935
Reserve Pool	216		216
Trading Program (currently held pounds)	0		0
Total Point Source Allocation	2,094		2,151

Allocation Source	Allocation, lbs/yr		Post Trade Allocation, lbs/yr
Nonpoint and Regulated Stormwater	10,506	-(2 x 57)→	10,392
Background	1,170		1,170
Wastewater Facilities	2,094	+ 57→	2,151
Industrial Process Wastewater	50		50
Individual Sewage Disposal Systems	450		450
Total Maximum Annual Load	14,270		14,213

6.1.3 Trade Projects

Table 6-2 summarizes approved trade projects.

Table 6-2. Cherry Creek Basin Approved Trade Projects					
Applicant	Project Title	Destination of Trade Credits	Approved Phosphorus Credits	Trade Ratio	Conditional Approval
ACWWPID	Pond L-3 Retrofit	ACWWA	57	2.9:1	January 2004
ACWWPID	Pond W6/W7	ACWWA	28	2.5:1	February 2006

6.1.3.1 ACWWA Pond L-3 Trade Project

The Authority approved the ACWWA Pond L-3 trade project in 2003. This trade project includes retrofitting the existing stormwater dry detention pond (Pond L-3). The retrofit includes modifying the outlet works to extend the detention time from 6 to 24 hours, increasing the sediment forebay storage, and creating a micropool at the outlet. ACWWA conditionally received 57 pounds of trade credits.

ACWWA completed construction in 2005. Monitoring will begin in January 2008.

6.1.3.2 ACWWA Pond W6/W7 Trade Project Application

The Authority approved the Arapahoe County Water and Wastewater Public Improvement District (ACCWPID) trade project in February 2006.

The project was an eligible new trade project as "additions to existing development." The project combines and modifies two existing stormwater, dry-detention ponds (Pond W-6 and W-7). The modifications include adding forebays, micro-pools, modified outlet works to extend the detention time to 40 hours, and water quality capture volume to treat storm runoff from a 1.2-square mile watershed.

ACCWPID requested phosphorus trade credits from development that existed prior to January 2000. Since BMPs were not constructed during the original development activities, phosphorus removals from added BMPs are available for trading. The ACWWA Lone Tree Creek Wastewater Treatment Facility will receive 28 pounds of trade credits.

The project was completed in October 2005 at a total project cost of $1.18 million, of which $773,000 was for construction. Monitoring will begin in January 2008.

6.1.3.3 Trade Project Updates

ACCWA submitted a trade project update to the Authority on February 21, 2007 summarizing the recent monitoring activity of Pond L-3 and Pond W6/W7. Monitoring was postponed at Pond L-3 because of staff limitations, but was expected to commence later in 2007. The Maintenance Superintendent and Stormwater Coordinator will manage the collection and testing procedures and will issue requests for proposals for outside entities to process the sampled data. Monitoring for Pond W6/W7 will be postponed until spring 2008 due to budget limitations. Funds allocated for the monitoring program were transferred to the Southeast Metro Stormwater Authority for stormwater operations and maintenance. A budget specific to the Pond W6/W7 monitoring program will be planned for 2008.

Wright Waters Engineers issued a statement on March 5, 2007 verifying that the construction of Pond W6/W7 was built in accordance with the design drawings and specifications; thereby, satisfying the construction and design requirements.

6.2 Reserve Pool

The Authority is authorized to implement and maintain the sale or lease of phosphorus pounds from the Reserve Pool. The Reserve Pool includes 216 pounds of phosphorus credits from projects already constructed by the Authority (and approved by the Commission) and can be sold by the Authority to allocatees in the watershed. The Reserve Pool phosphorus credits are based on the following historic Authority projects:

- Shop Creek detention and wetlands (1991)
- Quincy Drainage detention (1995)
- East Shade Shelter streambank improvements and parking area retrofit (1995)
- Cottonwood Perimeter Road pond (near Reservoir) (1997)

The 216 pounds of phosphorus allocated to the Reserve Pool are available for transfer and may be purchased or leased from the Authority at a price established by the Authority. Pounds sold or leased from the Reserve Pool are subtracted from the Reserve Pool and allocated to the entity acquiring the pounds, for long-term or short-term use.

There were no Reserve Pool actions in 2007.

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6.3 Progress Made

No new trade projects were proposed in 2007.

7. PUBLIC EDUCATION ACTIONS AND PARTNERSHIPS

As part of the Authority's water quality management approach (Figure 2-1) and as prescribed by Control Regulation 72, the Authority is committed to providing educational programs that provide policy makers, government agencies, local land use agencies, private industry, and the general public with information and suggested actions to reduce nonpoint source pollution to Cherry Creek Reservoir.

7.1 Education Initiative

The Authority has provided staff and funding to support the Partners in developing a comprehensive and coordinated education strategy and action plan on a reservoir watershed scale. This plan was completed in 2004 and is entitled the Cherry Creek Basin Water Stewardship and Education Initiative (Education Initiative).

The purpose of the Education Initiative is to set forth the approach recommended by the Partners and the Authority. This document contains a compilation of the key education and public involvement goals, strategies, and activities that will be used to engage the community in active stewardship of Cherry Creek, parks, open space, trails, and tributaries within the watershed. In coordination with key stakeholders in the Cherry Creek watershed, the Education Initiative makes recommendations and identifies next steps for the development and implementation of a public information and education outreach program for the Cherry Creek watershed that meets the regulatory requirements of Control Regulation 72 and the objectives identified in Cherry Creek Basin Watershed Plan 2003.

7.1.1 Cherry Creek Stewardship Partners

The Partners is an association of a broad range of stakeholders actively promoting effective stewardship and providing education and outreach activities in the Cherry Creek Reservoir watershed. The Partners emerged from the first Cherry Creek Reservoir watershed forum held in the fall of 1999. The Partners bring together representatives from:

- Land use jurisdictions
- State and federal resource management agencies
- Conservation, recreation, and historic preservation groups
- Business communities
- Interested citizens

In 2007, the Authority provided $20,000 to the Partners to help implement priority activities identified in the Education Initiative. In addition to organizing and sponsoring a wide variety of activities in the Cherry Creek Reservoir watershed that support water quality goals, the Partners are frequently asked to help identify, plan, and support open space projects such as restoration of riparian areas along Cherry Creek at the Cherry Creek Valley Ecological Park, restoration support for the Cottonwood Creek PRF, and projects that provide a positive and fun spin on our watershed's recreational opportunities, such as the 2005, 2006, and 2007 "Run for the Watershed" relay race.

These projects take much time and effort in planning, coordination, and successful completion. The Partners enable watershed entities, such as stormwater permittees, the Park, and the Authority to more efficiently implement collaborative education and outreach activities. The following provides a summary of the Partners' 2007 outreach accomplishments, which are further described in the Partners' 2007 Annual Report

(www.cherry-creek.org). For more information refer to the Cherry Creek Stewardship Partners 2007 Annual Report included as Attachment A.

Table 7-1. The Partner's 2007 Outreach Accomplishments

Date	Activity	Location	Participants
Activities Enabling Participants to Get to Know the Watershed			
January	Audubon Raptor Walk	Cottonwood Creek	12
March	WEED Network Meeting	CDOW	50
April	Fertilizer 101	Tagawa Garden Center	20
	Arapahoe County Open Space	CC Crossing	44
	Goldsmith Gulch Planting Project	Cook Park	12
	CAEE Teacher Training Workshop		7
	7,000 Trees in Seven Days	Everywhere	112
June	BioBlitz	Cottonwood Creek	2
July	DBG/Habitat Monitoring/Weeds	Cottonwood Creek	25
May	DBG/Habitat Monitoring/Weeds	CC Valley Eco Park	2
Ongoing	DBG/Habitat Monitoring/Weeds	CC Crossing/17 Mile	45
		Total	331
School and Teacher Education and Training			
January	RMSEL Water Fair	RMSEL	60
February	Metro Regional Science Fair	DMNS	300
April	State Science & Engineering	CSU	350
	CCHS Science Symposium	CC High School	100
	Science Fair Presentation	CCBWQA	16
June	Aurora Project WET	Aurora	150
September	Colorado Bio Teachers Workshop	Cherry Creek	40
Ongoing	Classroom Visits & Field Trips		60
		Total	1,076
Integrating Watershed Interests			
May	Southeast Denver Duck Drop	George Wallace Park	150
	13th Annual Aurora Water Fest	Aurora Com. College	150
	'How to Maintain' LID Workshop	Sheraton DTC	126
July	Butterfly Extravaganza	Commons Park/Aurora	12
	Maintenance support July 10-August 16: 6 hour per day, 5 days per week	Cherry Creek & Castlewood Canyon SP	150
	Colorado Cares Day	Cherry Creek Reservoir	24
September	Nature as Your Neighbor	CCV Eco Park	
	Run for the Watershed	Cherry Creek Basin	
November	Annual Conference	Wildlife Experience	
		Total	612

7.1.1.1 Colorado Cares Day at Cherry Creek Reservoir


Colorado Cares About...
The Environment

"Community service and volunteerism is a fabulous way to celebrate citizenship on Colorado's statehood day, as we believe citizenship and community service go hand in hand. What better way is there to show our pride in Colorado than by giving to give back to the state and its citizens?"

Gov. Bill Ritter, Jr.

Lake Appreciation Day at Cherry Creek State Park

Cherry Creek State Park (Arapahoe County)

On Saturday, July 28th, Cherry Creek State Park celebrated Lake Appreciation Day and Colorado Cares Day. The park offered several different volunteer opportunities including mullein head weed management, water quality testing, and shoreline clean up. Over 60 volunteers participated and accumulated nearly 240 volunteer hours. As part of his Colorado Cares Day commitment, Governor Bill Ritter and his wife, Jeannie Ritter, attended and took an active role in the Cherry Creek event.

These activities included a fishing program with free fishing rods for the first 30 kids and free pontoon rides as well. There were about 50 children at the fishing clinic and 40 visitors enjoyed the pontoon rides. The day provided the park with much needed volunteer assistance and some fun for all! Projects included shoreline clean-up, noxious weed removal and wetlands trail renovations. There were also leisure activities associated with the event: fishing, pontoon boat rides and a free evening program at the campground amphitheatre.

On July 28, 2007, the Partners coordinated activities at Cherry Creek State Park that celebrated Lake Appreciation Day and Colorado Cares Day. The park offered several different volunteer opportunities including mullein head weed management, water quality testing, and shoreline clean up. Over 60 volunteers participated and accumulated nearly 240 volunteer hours. As part of his Colorado Cares Day commitment, Governor Bill Ritter and his wife, Jeannie Ritter, attended and took an active role in the Cherry Creek event.

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7.1.1.2 Eighth Annual Cherry Creek Stewardship Partners Conference

The Authority, which is an active member of the Partners, contributed funding for the Partners' 8th annual conference held in November 2007. The conference theme for 2007 was "Thriving Partnerships, Effective Projects." Several TAC members have lead roles in planning and coordination of the conference and participated in the conference as session moderators, and four Authority consultants and a Board member made presentations.

7.1.1.3 Run for the Watershed

The Partners organized the second annual Run for the Watershed Relay, "Celebrating the splendor and diversity of the watershed, from the top of the basin downhill to Cherry Creek State Park." The relay spanned 50 miles with 13 race legs ranging from a 2-mile walk to a 6-mile run.

7.1.1.4 Partners Workshop for Enhanced BMP Implementation

On October 4, 2007, the Partners hosted the fourth successful workshop in the "how to" series of half-day conferences for contractors, developers, design engineers, inspectors, and government staff to promote enhancement of permanent BMPs. This year's workshop was titled "How to Maintain - Low Impact Development."

7.2 Website

The Authority website provides information and education on water quality issues within Cherry Creek Reservoir watershed and also serves as a storehouse of documents generated by, and related to, the Authority. The website can be found at www.cherrycreekbasin.org/cc_home.asp.

The website had an average of 1,700 visitors per month and a total of 9,800 visitors over the last 6 months of 2007. In addition to visitors within the United States, the Authority website has been the destination of users from ten other countries, including Canada, China, the United Kingdom, France, Germany, Israel, and the Philippines.

The 2006 Annual Report was the most frequently downloaded document, with a total of 5,000 downloads. The past annual reports and the CIP projections were among the top five most downloaded documents.

In addition to usage patterns, tracking on the website can be used to add useful content based on user queries, adjust site layout to provide a friendlier user interface, and fix problems with broken links, misnamed pages, or missing documents. Small content changes were made through the year including: adding new News items, replacing out of date documents, adding or updating content on pages, and image recompressing for faster loading of pages.

7.3 Collaboration with Other Entities

The Authority has built relationships with several entities to carry out water quality objectives.

7.3.1 Land Use Agencies

The Authority continues to work directly with the nine local land use agencies and CDOT in the Cherry Creek Reservoir watershed; activities include:

- Routine monthly TAC meetings and subcommittees to scope and coordinate special projects (e.g., Stormwater Quality Requirements revisions).
- Review of land use and development applications for compliance with Authority's Requirements (Section 5.2).

7.4 Progress Made

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- The Authority made progress in meeting the requirements of Control Regulation 72 for implementing public information and education programs in the following ways.
- The Authority leveraged resources by supporting the Partners and coordinating with other entities to implement the Education Initiative, a comprehensive and coordinated education strategy and action plan.
- The Authority continued the use of its website through cooperation with the Partners to facilitate the dissemination of information to parties interested in Authority activities.
- The Authority collaborated on information and education efforts with other entities with common interests and goals for the watershed.
- The Cherry Creek Stewardship Partners facilitated broad community involvement and benefited long-term environmental stewardship through outreach efforts, reaching an estimated 2,019 people.

8. PHASED TMAL ACTIVITIES

The Commission adopted Control Regulation 72 as a phased TMAL to provide for the implementation of point and nonpoint source requirements and controls while concurrent required investigations are implemented "to better define hydrology, phosphorus sources, chemical processes, and relative loads to the watershed and reservoir" (Commission 2004). The Commission recognized "that until additional investigations are completed, a new TMAL cannot be calculated."

Control Regulation 72 identifies 13 specific activities to provide reasonable progress in attaining water quality standards and support revisions to the TMAL. Table 8-1 provides a description and status of these activities and other studies that have since been identified. The Authority completed one study in 2007 and an additional study is ongoing.

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Table 8-1. Updated List of Activities and Proposed Priorities

Proposed Priority	Special Study	Description/Purpose	Status
1	Evaluation of phosphorus removal effectiveness of nonpoint source control	Evaluate the infiltration component of various detention/retention BMPs to determine the infiltration contribution to phosphorus loading in the watershed. Results used to estimate performance of BMPs to predict impacts of future growth and controls on phosphorus loads by the watershed model.	2007 – This study is ongoing and will be completed in early2008.
2	Depth profiling of nutrient content for groundwater	Conduct alluvial sampling at various depths to determine phosphorus concentration variation with depth of alluvium.	Completed August 2006.
3	Further quantification of soil and groundwater background phosphorous levels	Characterization of Cherry Creek water quality based on limited human influences (i.e., natural, background conditions). The results would be used to establish background as part of the TMAL source load.	Completed in 2007.
4	Further development of event mean concentrations (EMCs) for storm water flows	Characterization of storm runoff quality based on monitoring runoff of various land-uses in the Cherry Creek watershed. EMCs are used in the watershed model to predict impacts of future growth and controls on phosphorus loads.	Lower priority level as determined by Division and Authority. After discussions between the Authority and Division, the Division supported narrowing the study requirements to focus on a site-specific EMC for undeveloped land.
5	Monitoring of shallow alluvial groundwater loading in tributaries	Nature of the study undetermined at this time. Purpose is to better understand fate and transport of phosphorus for the watershed model and ultimately for determining TMAL allocations.	Lower priority level as determined by Division and Authority.
6	Quantification of individual sewage disposal system phosphorus loading	Nature of the study undetermined at this time. Purpose is to better understand fate and transport of phosphorus for the watershed model and ultimately for determining TMAL allocations.	Initial estimates of Individual sewage disposal system (ISDS) loading were developed in 2007.
7	Characterization of watershed hydrology to establish reference condition for evaluation of phosphorus loading	Develop specific set of hydrologic conditions to represent an index hydrological year such that annual phosphorus loads can be referenced to this index. Results used to adjust the TMAL for wet and dry runoff conditions.	Results of ongoing update of watershed model to provide insight to this special study.

REG 72 REPORTING

Table 8-1. Updated List of Activities and Proposed Priorities			
Proposed Priority	Special Study	Description/Purpose	Status
8	Revised calculations of background sources, industrial process wastewater sources, and individual sewage disposal systems sources of phosphorus contributions	Complete special studies and revise the watershed model to identify these point and nonpoint source components of the TMAL.	Requires the completion of other special studies and activities.
9	Reservoir study on groundwater inflow	Evaluate groundwater flow and phosphorus flux into the reservoir. This study is not required by the Control Regulation, but the Division identified this as a high priority.	Completed on February 9, 2005.
10	Reservoir nutrient studies	Determine the concentration of phosphorus in the Reservoir necessary to suppress the growth of algae by a field study of nutrient limitations.	Completed on January 22, 2004
11	Implementation of lower phosphorus effluent limits	No direct discharge with an effluent total phosphorus concentration greater than 0.05 mg/L as a 30-day average and no land application discharge of a 30-day flow-weighted average total phosphorus concentration greater than 0.05 mg/L/land application return flow factor.	Completed on August 1, 2004
12	Identify industrial process wastewater sources and associated phosphorous loading	Investigate existing industrial process type land uses to estimate contribution to phosphorus loading in Cherry Creek and to establish limits for the TMAL.	In 2003, the Authority confirmed there were no permitted industrial sources with phosphorus allocation. However, DirecTV was supposed to have an allocation in its permit; the facility permit was not completed.
13	Construct nonpoint source control projects	The Authority plans and implements a capital improvement program on an ongoing basis.	Completed Reservoir Destratification Project in 2007 and other ongoing projects.

8.1 Planning Progress for Rulemaking Hearing Review

The rulemaking hearing was initially scheduled for August 2007 and, as jointly proposed by the Authority and the Division at the 2006 informational hearing, the Authority was going to propose changes to Control Regulation No. 72, including an updated schedule for revising the TMAL. In March 2007, the Division requested the Authority present a complete revised TMAL at the August 2007 hearing. The Authority did not believe this allowed enough time to adequately develop a revised TMAL and the Division proposed moving the hearing to April 2008. The Authority still did not feel these additional few months would be sufficient to develop the revised TMAL but agreed that it would move forward and work closely with the Division to try to meet the schedule. The Authority continued to work with Division staff in making progress with watershed and reservoir modeling, completing studies that provide supporting information to the TMAL, and implementing management strategies such as capital projects for pollutant reduction and water quality improvement.

The Authority has made progress on the watershed and reservoir modeling, but the TMAL revision process includes substantial stakeholder discussion to come to agreement on the TMAL and allocations. Based on the Authority and Division proposal, the Commission scheduled a new hearing date for March 2009. The proposed schedule acknowledged other options that may need to be considered (e.g., evaluation of reservoir water quality standard), and if needed could be addressed through the Control Regulation No. 38 Rulemaking hearing process. In addition, if other options, such as changes to water quality standards are considered, this could be also be addressed at a March 2009 hearing.

8.2 Three Special Studies Funded by the "TMAL Actions" Grant

The Authority was awarded a Colorado Nonpoint Source Grant to conduct the following three implementation actions, or special studies, required for the Cherry Creek Reservoir phased TMAL.

1. Conduct depth profiling of phosphorus concentrations in the Cherry Creek alluvium.
2. Quantify phosphorus infiltration to the alluvium from pollutant reduction facilities.
3. Determine background phosphorus levels in alluvial soils, groundwater, and surface water for the revised TMAL.

The objectives of the grant project focus on fate and transport of phosphorus through the Cherry Creek Reservoir watershed, including determining soil-phosphorus equilibrium, confirming effectiveness of BMPs, and defining background phosphorus.

Contracting for the three studies began in December 2005 and January 2006.

8.3 Depth Profiling of Phosphorus Concentrations in the Cherry Creek Alluvium

Lytle Water Solutions, LLC was retained by the Authority to investigate variability in hydrogeologic and water quality conditions within the alluvial aquifer. The purpose of this study was to evaluate the heterogeneity of the Cherry Creek alluvial aquifer at four separate locations within the basin. Specifically, the study was designed to investigate the degree of stratification within the alluvial sediments and, where separate and distinct zones could be identified, to evaluate the variability in water chemistry between these separate zones. This study was completed in 2006.

8.4 Quantify Phosphorus Infiltration to the Alluvium from Pollutant Reduction Facilities

The Authority retained Lytle Water Solutions, LLC to evaluate the potential for infiltration from PRFs into the underlying alluvium and whether this phosphorus is ultimately reaching the reservoir. The Authority quantifies phosphorus immobilization through PRFs and trade projects can receive phosphorus credits for BMP removals; therefore, the study is intended to confirm the measured removals do not overestimate load reductions. The Authority had initially selected three sites for the BMP monitoring study, but due to issues with access, the study was delayed many months to investigate and select other monitoring locations. The following three projects were selected and monitoring began in October 2006.

Cottonwood\Peoria Street Detention - This site is a good example of a large, extended detention basin with wetlands, so it is considered as enhanced.

The TriMark Windemere Extended Detention Basin at Peoria Street - This BMP has reasonable access, sufficient drainage area to result in frequent storm runoff, and suitable locations for boreholes and monitoring wells. This site is a good example of a typical extended detention basin that includes a concrete trickle channel. Since concrete trickle channels will likely continue to be a standard for extended detention basins in the metropolitan area, this site is considered a good example for monitoring.

The Inverness Pond Tributary C Cottonwood Creek - This BMP has reasonable access, sufficient drainage area to result in frequent storm runoff, and suitable locations for boreholes and monitoring wells. This site is also a good example of an enhanced BMP, since it includes a "serpentine" low flow channel and wetlands in the bottom.

Quarterly reporting in 2007 indicated that phosphorus loading in the ground water beneath the BMP sites is minimal. In addition, there is little indication that there is a significant loss of phosphorus from the BMPs to the alluvium. The study will be completed in the first quarter of 2008.

8.5 Determine Background Phosphorus Levels in Alluvial Soils, Groundwater, and Surface Water for the Revised TMAL

The objective of this study is to evaluate background phosphorus levels in groundwater and surface water for the Cherry Creek Reservoir basin. The study included monitoring to evaluate a reference site that has relatively minor man-made (e.g., development) influences (West Cherry Creek above Highway 83). Monitoring was conducted for one year and included monthly and semi-monthly sampling of surface and groundwater. Due to denied access by the property owners, the initial monitoring location needed to be relocated upstream. The final selected monitoring location watershed contains approximately two-thirds (51 square miles) of the area originally proposed (87 square miles) but does not significantly change the land use distribution (primarily rural with 11% imperviousness).

This study was completed in 2007. The study did not determine the complete background load, which will be needed for the TMAL. The monitoring results indicated impacts to water quality from the relatively undeveloped subwatershed and that the water quality for this subwatershed was not significantly different from the Authority's Castlewood Canyon monitoring location. As a result, it appears the water quality data from Castlewood Canyon could be used to evaluate background conditions. The Authority is also applying information from the watershed model to evaluate background loads from the watershed.

8.6 Watershed Model Update

The Authority convened a TAC subcommittee to refine the Authority's watershed modeling and better define the change in water quantity and phosphorus as it moves from the point of origin in the watershed to Cherry Creek Reservoir (i.e., fate and transport). The subcommittee developed the following working definition for fate and transport:

The change in water quantity and quality as it moves from the point of origin in the watershed to Cherry Creek Reservoir.

The Authority identified the need to better define phosphorus fate and transport for evaluating watershed trade projects, identifying the most effective BMPs, providing input to the reservoir model for refining source loads and allocations as part of the refined TMAL.

The subcommittee determined that refining the 2000 watershed model, which predicts phosphorus loads and runoff volumes, was the best way to address fate and transport and to answer the questions regarding additional special studies. The goal of the watershed model is to provide monthly runoff volume and phosphorus loads to Cherry Creek Reservoir that better estimate:

- Annual phosphorus loads and runoff volumes for land-use conditions in the Cherry Creek Reservoir watershed.
- Effective annual phosphorus load reductions for watershed-based BMPs and individual PRFs. This knowledge will help identify, evaluate, and prioritize BMPs and PRFs in the watershed.
- Effects of pumping and point source discharges and phosphorus attenuation within the Cherry Creek alluvium. This information will help evaluate impacts of alluvial pumping and control of point and nonpoint source discharge concentrations on phosphorus loads into the reservoir.
- Potential benefits from phosphorus trades between point and nonpoint source projects.

In 2007, the Authority continued to update and calibrate the watershed spreadsheet model, which included the following primary activities:

- Integrating water supply pumping.
- Incorporating the results of the load recalculation requested by the Division.
- Incorporating Cottonwood Creek, Shop Creek, and direct flow areas that cannot be adequately modeled based on available data or without extensive additional data collection.
- Calibrating the load component to the monitored data at Cherry Creek Reservoir.
- Working with the Division on review of the model setup and operation.
- Initiating scenarios to look at impact of phosphorus addition or reduction.
- Integrating review and input from a review committee, which includes four consultants that are familiar with the watershed data and conditions and a representative from the Division.

8.7 Cherry Creek Reservoir Model Update

To prepare for the 2009 rulemaking hearing for Control Regulation 72, the Authority needs to update the existing reservoir model as part of reevaluating the target reservoir phosphorus load (i.e., TMAL). The Authority contracted with Dr. Gertrud Nurnberg of Freshwater Research to update the model. The reservoir model update includes incorporating the past five years of data and multiple study results to re-evaluate long-term trends, re-evaluate nutrient and chlorophyll *a* relationships, test the scenario model, and calculate permissible load for revising the TMAL.

In 2006, the Division requested the Authority reevaluate how external loads to the reservoir are calculated from the monitoring data. Two primary issues included: 1) how to balance the hydrology of reservoir inflows for calculating loads, and 2) how to calculate export loads (e.g., using flow and phosphorus concentrations downstream of the reservoir or using data from the reservoir near the outlet). The Authority's consultants and the Division completed discussions to resolve issues and come to a compromise 2007. Following review by the Division, the input data was revised, requiring the model to be adjusted and the long-term water quality trends to be updated. This new effort began in the summer of 2007. The reservoir model includes sedimentation, internal and external loading, and prediction of seasonal phosphorus and chlorophyll *a*.

Initial reservoir modeling results indicated a poor relationship between reservoir phosphorus and chlorophyll *a* concentrations. As a result, the reservoir modeling process considered other water quality relationships to refine the modeling. The modeling process considered initial external loading and Cherry Creek stream concentrations related to the chlorophyll *a* reservoir standard. Initial stakeholder responses were that potential Cherry Creek phosphorus load and concentration reductions could be difficult to achieve

given the knowledge of how the watershed functions and reacts. For example, reducing loads would require reduced Cherry Creek flow and phosphorus concentrations; reducing flows is not a feasible option and reducing concentrations significantly is difficult due to the nature of the stream and alluvium connection. BMPs target reductions in surface water nutrient concentrations, and the benefits from the BMPs can be masked in the short term (e.g., year) by impacts from the alluvial concentration and interaction with the surface water.

The watershed and reservoir models are used together to evaluate how to achieve the reservoir chlorophyll *a* standard. The reservoir model is used to determine the nutrient loading capacity of the reservoir to achieve compliance with the chlorophyll *a* standard, and the watershed model is used to evaluate how or whether that load can be achieved. Toward the end of 2007 the Authority began using the watershed model to run scenarios to evaluate the phosphorus loads from the watershed, such as estimating loads under developed conditions and potential load reductions through BMPs. Initial watershed modeling results indicated that scenarios assuming BMPs, specifically structural BMPs incorporated with development, may not achieve the nutrient load reductions that may be warranted to meet the reservoir water quality standard.

In 2008, the Authority will finalize the reservoir and watershed model results to provide the decision-making basis for TMAL development and implementation planning as it prepares for the 2009 rulemaking hearing. As jointly proposed with the Division, the proposed TMAL schedule acknowledges that options other than a standard phosphorus load allocation to meet current chlorophyll *a* standard may need to be considered. However the Authority proceeds, it recognizes that a strong basis will be needed to propose an alternative approach.

8.8 Progress Made

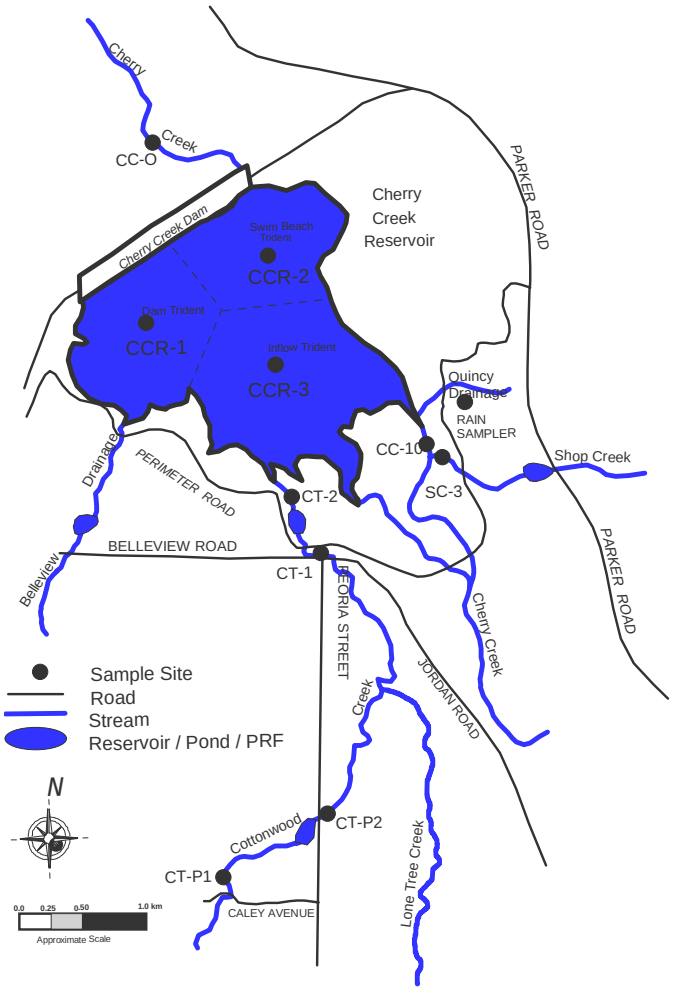
The Authority has continued to develop and implement point, nonpoint, and regulated stormwater source controls and has worked with the Division to complete one more, and make progress on the final, required investigations for the phased TMAL.

- The Authority completed the background phosphorus study, a required special study.
- The Authority continued implementation of the PRF infiltration special studies, required as part of the phased TMAL, which will be completed in 2008.
- The Authority made progress on determining phosphorus fate and transport in the watershed through the watershed model, as well as quantifying a revised TMAL through the draft reservoir model.
- The Authority and Division jointly proposed a revised rulemaking hearing schedule and milestones to prepare for the hearing in 2009.

9. WATER QUALITY MONITORING – POINT SOURCE AND NONPOINT SOURCE LOADS

The Authority continued to implement a routine annual water quality monitoring program in the Cherry Creek Reservoir and basin. The program monitors reservoir water quality, reservoir inflow and loading, reservoir outflow, surface and groundwater quality in the watershed, and effectiveness of Authority PRFs.

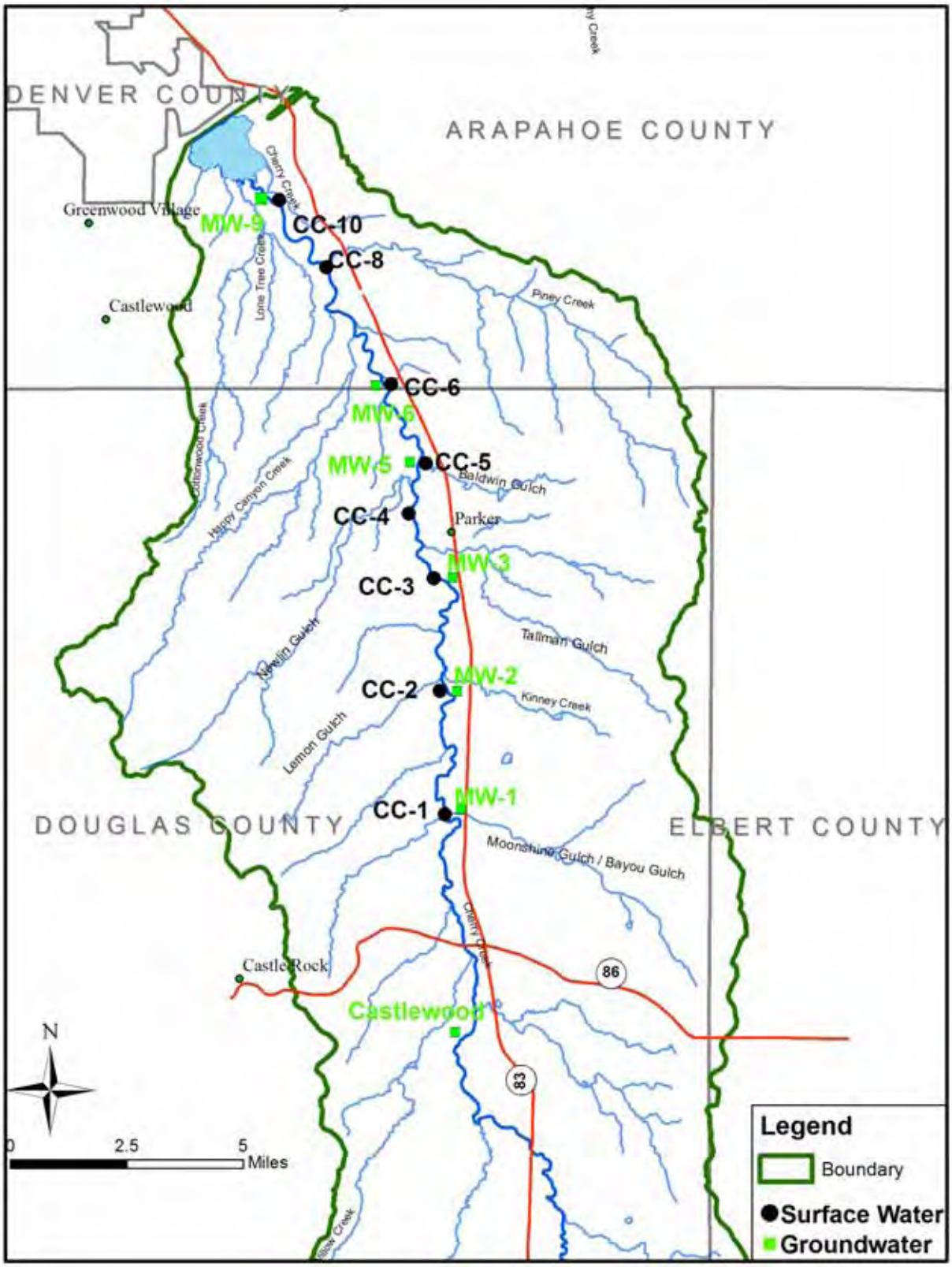
Figure 9-1. Sampling Sites on Cherry Creek Reservoir and Selected Streams



The Authority conducted reservoir and tributary sampling at ten sites in 2007, including three sites in Cherry Creek Reservoir, six sites on tributary streams, and one site on Cherry Creek downstream of the reservoir (Figure 9-1). The Authority conducts sampling at sites upstream and downstream of the Cottonwood Creek-Peoria Pond and the Cottonwood Creek Perimeter Pond to evaluate the effectiveness of these PRFs.

Watershed monitoring includes an additional seven surface water sites along Cherry Creek, from Castlewood Canyon to Cherry Creek Reservoir, and seven alluvial groundwater well locations from Franktown to Cherry Creek Reservoir (Figure 9-2). Complete data reports are provided in the Cherry Creek Reservoir 2007 Annual Aquatic Biological-Nutrient Monitoring Study and Cottonwood Creek Phosphorus Reduction Facility Monitoring Report prepared by GEI Consultants Inc. (2007 Annual Monitoring Report.), and the 2007 Water Quality Data Report – Baseline Water Quality Data for the Upper Cherry Creek Basin prepared by John C. Halepaska and Associates, Inc. More details regarding assumptions, calculations, analyses, and results are provided in the 2007 Annual Monitoring Report.

Figure 9-2. Surface Water and Alluvial Groundwater Sampling Sites in the Watershed



9.1 Summary of Long-term Cherry Creek Reservoir Water Quality

Presented below is a summary of water quality in Cherry Creek Reservoir as determined by various constituents. This summary is based on the past sixteen to twenty years of monitoring, as presented in the 2007 Annual Monitoring Report. Data are untransformed and generally represent whole-lake mean values with estimates of variation. However, data used in statistical analyses may be transformed depending upon the distributional characteristics of the data. If the transformation did not improve normality, the untransformed data were used in subsequent analyses.

9.1.1 Chlorophyll *a*

- Whole-lake chlorophyll *a* concentrations varied greatly throughout 2007, ranging from 3.3 µg/L in early October to 50 µg/L in mid-January. The annual mean chlorophyll *a* concentration was 18.5 µg/L.
- The 2007 summer mean chlorophyll *a* concentration was 12.6 µg/L, which is less than the July-September chlorophyll *a* standard of 15 µg/L (Table 9-1). This is the second year that the standard has been met since 1994 and only the fourth occurrence in last sixteen years of monitoring. While the summer mean chlorophyll *a* concentration has varied greatly over the long term (1992-2007), there has been a significant decreasing trend ($p<0.001$) in summer mean chlorophyll *a* concentration since 1999.

Table 9-1. Water Quality (July–September Average Concentration) and Total Phosphorus Load Data for Cherry Creek Reservoir, 1992 – 2007

Year	Chlorophyll a (µg/L)	Total Phosphorus (µg/L)	Total Nitrogen (µg/L)	Annual Phosphorus Load (lbs/yr) [1]	Annual Inflow (ac-ft/yr) [1]	Standardized Phosphorus Load (lbs/ac-ft)	Net Phosphorus Load (lbs/yr) [2]
1992	17.4	66	970	5,364	9,210	0.58	3,921
1993	14.4	62	826	3,114	5,851	0.53	2,186
1994	15.4	59	1,144	3,784	6,998	0.54	2,729
1995	15.6	48	913	5,736	11,788	0.49	4,302
1996	18.1	62	944	4,425	7,654	0.58	3,102
1997	22.3	96	1,120	5,675	10,391	0.55	4,076
1998	26.5	89	880	13,322	20,902	0.64	9,311
1999	28.9	81	753	17,672	27,604	0.64	10,913
2000	25.2	81	802	13,788	18,611	0.74	9,362
2001	26.1	87	757	9,099	17,246	0.53	4,402
2002	18.8	74	858	3,525	7,511	0.47	1,681
2003	25.8	90	1,121	9,390	14,953	0.63	4,717
2004	18.4	102	977	8,974	17,203	0.52	5,553
2005	17.1	116	990	10,725	18,534	0.58	7,080
2006	14.7	87	914	6,492	12,799	0.51	3,206
2007	12.6	118	716	19,772	29,586	0.67	11,703
Mean	19.8	82	918	8,804	14,803	0.58	5,517
Median	18.3	84	914	7,733	13,876	0.57	4,352

Notes:

1 The annual phosphorus load represents the total load to the reservoir from stream, alluvium, and precipitation. The COE monitors inflow as a function of change in storage (i.e., reservoir volume) based on changes in reservoir level, measured outflow, precipitation, and evaporation.

2 The net external phosphorus load is the total load to the reservoir minus the reservoir outflow load.

Bold indicates value meets the respective standard, goal, or TMAL value.

9.1.2 Phosphorus

- Whole-lake total phosphorus concentrations ranged from 76 µg/L in early October to 155 µg/L in late August. The 2007 annual mean total phosphorus concentration was 106 µg/L.
- The 2007 summer mean total phosphorus concentration was 118 µg/L, which exceeded the seasonal phosphorus goal of 40 µg/L. The seasonal mean total phosphorus concentrations have varied greatly over the years, with the 2007 mean total phosphorus concentration being considerably greater than the long-term median of 84 µg/L. In contrast to chlorophyll trends since 1999, the summer mean phosphorus concentrations have revealed a significantly increasing trend. Cherry Creek Reservoir has exceeded the current seasonal goal in all years since 1989.

9.1.3 Nitrogen

- Whole-lake total nitrogen concentrations ranged from 0.59 mg/L in early August to 1.40 mg/L in mid January. The 2007 annual mean total nitrogen concentration was 0.86 mg/L.
- The 2007 summer mean total nitrogen concentration was 0.72 mg/L and is considerably less than the long-term median value. There is not a total nitrogen goal or standard for Cherry Creek Reservoir. The mean summer total nitrogen concentration has also varied greatly over the long term, and since 1999 has revealed a significant increasing trend.

9.1.4 Transparency

- Lake transparency values (as measured by Secchi depth) in 2007 ranged between 0.69 m in late April to 1.53 m in late May. The summer mean Secchi depth was 1.07 m similar to the long-term mean value of 1.05 meters. [Note: A Secchi disk is lowered into the water to measure transparency or clarity of the water. The Secchi depth is the depth at which the disk is no longer visible from the surface.]

9.1.5 Temperature and Dissolved Oxygen

- Periodic thermal stratification was observed in the reservoir in 2007. During periods of stratification, the lower layers of the reservoir experienced decreased dissolved oxygen concentrations (e.g., <5 mg/L). Low dissolved oxygen concentrations were also observed during the summer season when the lake was not thermally stratified.

9.1.6 Phosphorus Loading

The Cherry Creek and Cottonwood Creek loads are based on flow that is normalized to the COE inflow.

- The 2007 total external phosphorus load is 19,772 lbs, and is greater than the phased TMAL of 14,270 lbs.
- The long-term median annual total phosphorus load is 7,733 lbs/yr for the past sixteen years (Table 9 1), meeting the phased TMAL each year, except for 1999 and 2007. The phased TMAL (referred to as a TMDL prior to May 2001) exceedances in both 1999 and 2007 are related to substantially increased inflows (Table 9 1).
- The 2007 total inflow (29,586 ac-ft/yr) and total phosphorus load (19,772 lbs/yr) are the greatest observed values over the sixteen year monitoring period.

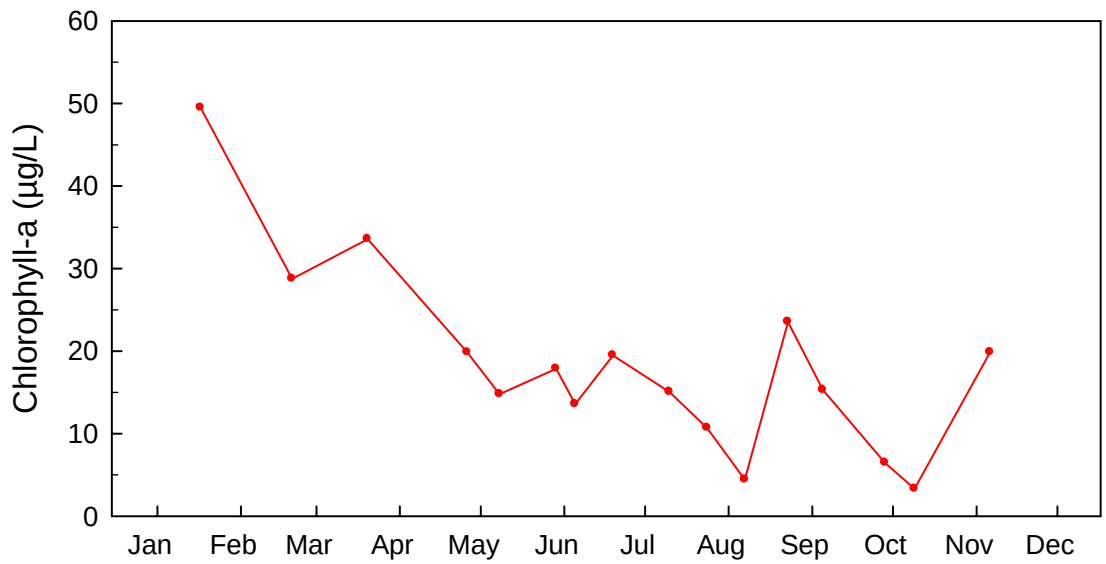
9.2 Cherry Creek Reservoir - Summary of 2007 Data

Presented below is a summary of 2007 water quality data for various constituents. This information is also summarized in the 2007 Annual Monitoring Report.

9.2.1 Chlorophyll *a*

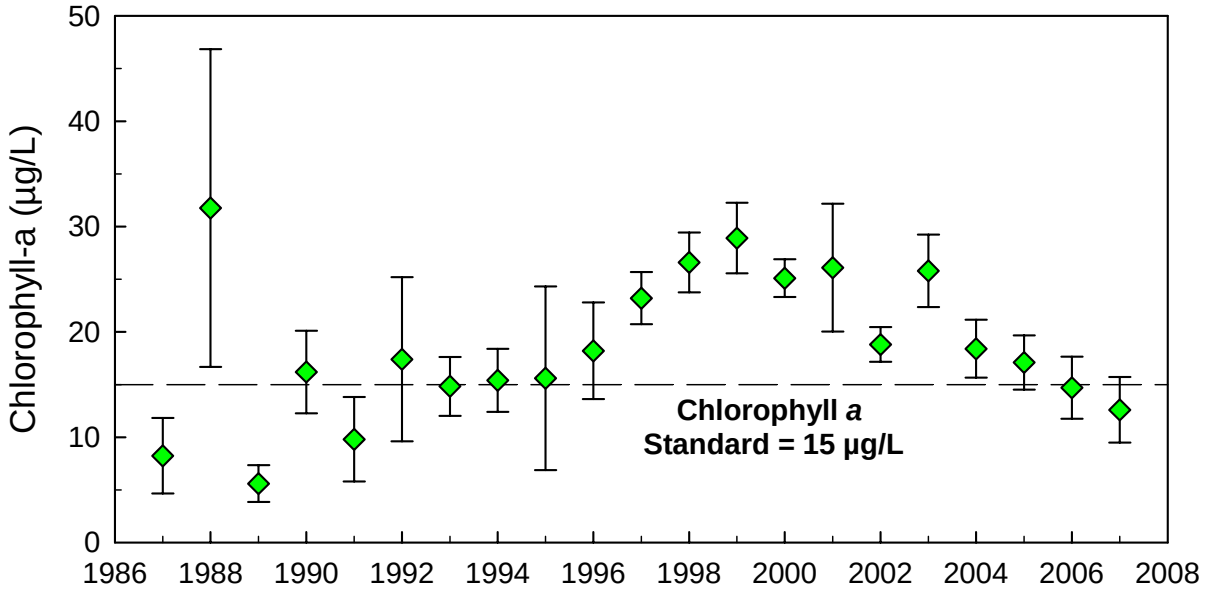
The annual pattern of chlorophyll *a* concentrations revealed the greatest levels (34 to 50 µg/L) during the winter ice-on period and the transition to ice-off in mid-March (Figure 9 3). From late April to early September, chlorophyll *a* concentrations often were less than 20 µg/L, and in early August a whole-lake mixing event, due to summer storms, greatly reduced the whole-lake chlorophyll *a* concentration to 4.4 µg/L. In late August, following the whole-lake mixing event, chlorophyll *a* concentrations returned to 24 µg/L. The annual mean chlorophyll *a* concentration of 18.5 µg/L is similar to the 2006 value and represents the lowest annual value since 1997. The July through September mean chlorophyll *a* concentration was 12.6 µg/L, and is the second year since 1994 that chlorophyll *a* levels met the reservoir standard.

Figure 9-3. Concentration of Chlorophyll *a* (µg/L) in Cherry Creek Reservoir, 2007



The long-term chlorophyll *a* record shows considerable variability within and among the seasons, with the standard being met in only six of the past 21 years. Since 1987, there has been no significant trend in the July through September mean concentration of chlorophyll *a* in Cherry Creek Reservoir (Figure 9-4). However, since 1999 there has been a steady decline in the seasonal mean chlorophyll *a* concentration.

Figure 9-4. Seasonal Mean (July to September) Chlorophyll *a* Concentrations Measured in Cherry Creek Reservoir, 1987 to 2007

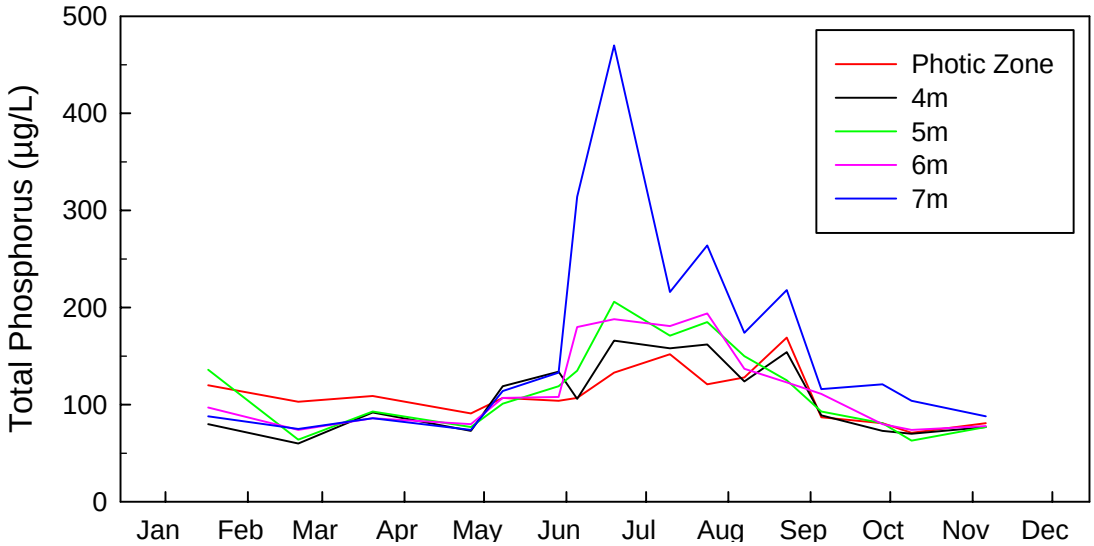


Note: Error bars represent a 95% confidence interval around each mean.

9.2.2 Phosphorus

Nutrient profile samples collected in 2007 showed a well-mixed reservoir in spring and fall. There were extended periods of nutrient release from bottom sediments from June through late August as evidenced by increasing total phosphorus concentrations with increasing depth (Figure 9-5). During a portion of this period (June and July) the total dissolved phosphorus fraction in the 7 m water layer accounted for 66 to 81% of the total phosphorus content, indicating that phosphorus was being released from the sediments during that time.

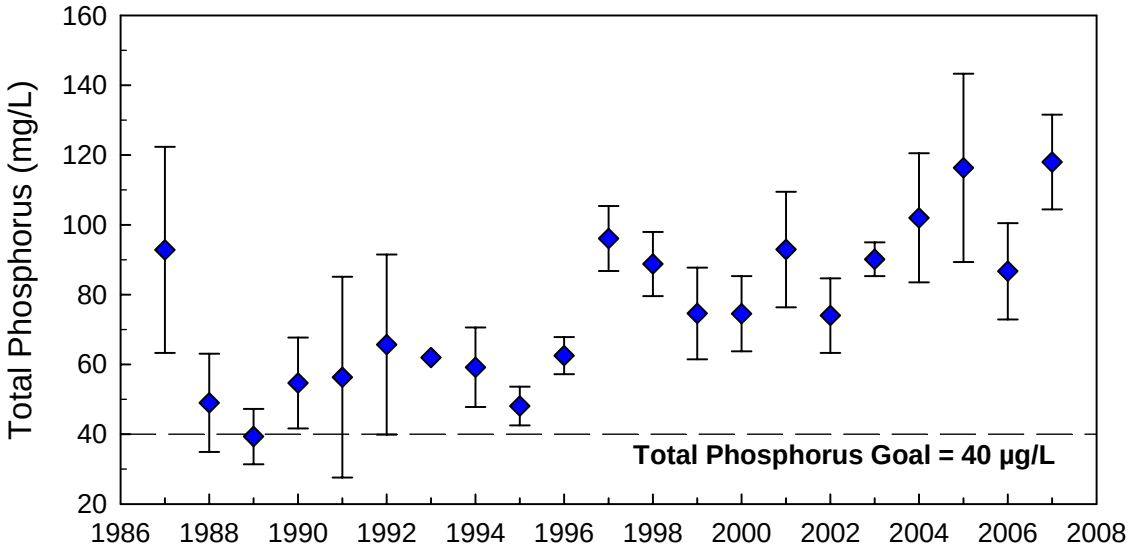
Figure 9-5. Total Phosphorus Concentrations Measured in Cherry Creek Reservoir, 1987 to 2007



Routine monitoring data collected since 1987 indicate an increasing trend ($p < 0.01$) in the summer mean concentration of total phosphorus (Figure 9-6). In 2007, the summer mean concentration of total

phosphorus was 118 µg/L, which is considerably greater than the long-term (1987 2007) median value of 84 µg/L, and the goal of 40 µg/L.

Figure 9-6. Seasonal Mean (July to September) Total Phosphorus Concentrations (µg/L) Measured in Cherry Creek Reservoir, 1987-2007



Note: Error bars represent a 95% confidence interval around each mean.

9.2.3 Temperature and Dissolved Oxygen

Analysis of past Cherry Creek Reservoir temperature profiles indicates that stratification occurs when there is a >2°C difference between surface and bottom temperatures. Differences of approximately 1°C suggest a recent mixing event. Using these criteria, Cherry Creek Reservoir was investigated for periods of stratification using the continuous temperature record at depths for Site CCR-2 (11 May to 8 October) and anoxic levels (Figure 9-7 and Figure 9-8). By the time the temperature loggers were deployed on 11 May 2007, the reservoir was thermally stratified, with periodic thermal stratification periods occurring through early August. Substantial mixing events occurring on May 23rd, June 6th, June 26th, July 13th, August 5th, and August 24th; however, on many events the reservoir did not appear to completely mix the bottom waters. By early June, the deeper water layers of the reservoir began to exhibit low dissolved oxygen concentrations (<5mg/L). Even though the reservoir experienced mixing events due to precipitation or wind, low dissolved oxygen levels persisted in the deep water layers until August 5th when the reservoir experienced a complete mixing event.

Figure 9-7. Temperature (°C) Profiles Recorded During Continuous Monitoring at Site CCR 2 in 2007
(highlighted areas represent thermal stratification and duration)

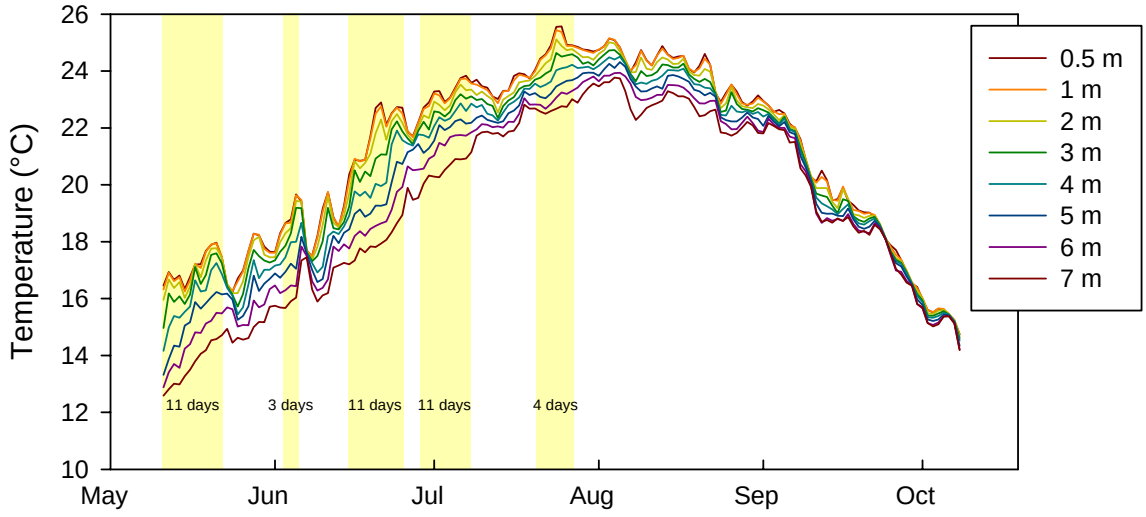
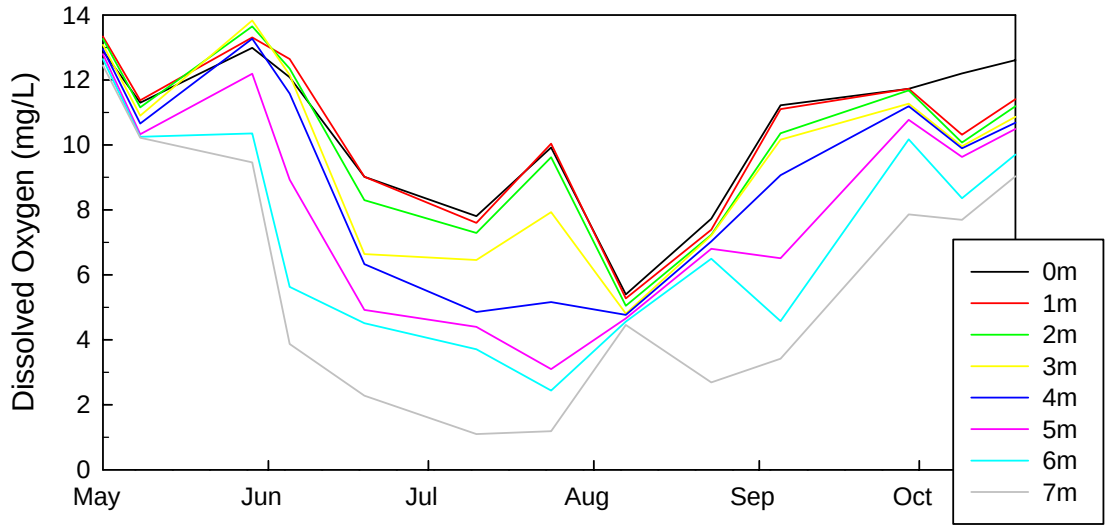


Figure 9-8. Dissolved Oxygen (mg/L) Profiles Recorded During Routine Monitoring at Site CCR 2 in 2007



9.3 Cherry Creek Mainstem Monitoring

The Cherry Creek mainstem watershed monitoring was initiated in 1994 (Phase I Baseline Water Quality Data Collection Study) and is conducted by John C. Halepaska and Associates, Inc. The monitoring includes semi-annual sampling at seven surface water sites and six alluvial groundwater sites along Cherry Creek for the following constituents.

- Nitrate
- Ammonia
- Total dissolved phosphorus
- Total phosphorus (surface water only)
- Soluble reactive phosphorus (SRP)
- Chloride
- Sulfate

The sampling frequency over the years was reduced from monthly monitoring to semiannual monitoring (May and November) in 2003. Table 9-2 shows the list of water quality monitoring sites for the Cherry Creek mainstem. Sites shown in gray were not sampled during the 2007 sampling events. Surface water and groundwater sites are paired at the same location and given corresponding numbers (e.g., CC-1 and MW 1). A summary of surface and groundwater monitoring data is provided in the following sections.

Table 9-2. Quality Monitoring Stations for Cherry Creek Mainstem

Site	Description
Surface Water Location (upstream to downstream)	
Castlewood	0.2 mile north of the USGS Cherry Creek near Franktown gaging station
CC-1	1 mile south of Scott Road
CC-2	¾ mile south of Stroh Road
CC-3	1 mile south of West Parker Road (no longer a water quality sampling location)
CC-4	½ mile south of Lincoln Avenue
CC-5	½ mile north of Lincoln Avenue (not sampled; inaccessible due to construction)
CC-6	On Arapahoe/Douglas County Line
CC-7	¾ mile south of Arapahoe Road (no longer a water quality sampling location; abandoned in 2000 due to development)
CC-8	½ mile north of Arapahoe Road
CC-9	In the Park near Nature Center. In 2002, site replaced by CC-10 (GEI)
Groundwater (upstream to downstream)	
MW-1	Monitoring well adjacent to Pinery production well #6
MW-2	Monitoring well E-2 downgradient of Pinery discharge
MW-3	Parker KOA production well
MW-4b	Parker NPDES monitoring well M-3 (no longer a water quality sampling location)
MW-5	Monitoring well adjacent to Arapahoe Loyd #2 production well
MW-6	Monitoring well adjacent to Arapahoe Race #1 production well
MW-7	Monitoring well adjacent to Arapahoe Ford #2 production well (no longer a water quality sampling location; abandoned in 2000 due to development)
MW-8	Arapahoe Deem production well (no longer a water quality sampling location)
MW-9	Monitoring well in Park near Nature Center
Kennedy	Denver production well adjacent to Kennedy Golf Course (downstream from reservoir and not included in the following data analyses)

9.3.1 Soluble Reactive Phosphorus

- The SRP concentrations in the underlying alluvial aquifer range from <0.082 to 0.54 mg/L with a median of 0.17 mg/L (1994-2007). Figure 9-9 and Figure 9-10 present annual average alluvial SRP concentrations.
- The SRP concentrations in Cherry Creek range from <0.20 to 0.37 mg/L with a median of 0.16 mg/L (1994-2007). Figure 9-11 and Figure 9-12 present annual average surface water SRP concentrations.
- Trends in SRP over time (1994 to present) indicate a decreasing trend for the most upstream surface water and groundwater sites and an increasing trend at the most downstream groundwater site (Table 9-3).

Table 9-3. Summary of Soluble Reactive Phosphorus Temporal Trend Analysis

Site	Type	Trend	Slope (mg/L per year)
Castlewood	Upstream surface water	Yes, decreasing	-0.002
CC9/CC10	Downstream surface water	No	
MW-1	Upstream groundwater	Yes, decreasing	-0.002
MW-9	Downstream groundwater	Yes, increasing	0.003

Note: To minimize the effects of seasonality, the Seasonal Kendall tau test was applied, which is a nonparametric test for trend (i.e. uses the relative magnitude of the data rather than the actual values) and removes seasonal cycles.

- Spatial trend evaluations to determine whether SRP concentrations are significantly different between upstream and downstream sites and surface and groundwater sites are summarized in Table 9 4.

Table 9-4. Spatial Differences in Soluble Reactive Phosphorus

Site	Spatial Difference in SRP Concentration?
Surface water upstream and downstream (Castlewood and CC9/CC10)	Yes, downstream>upstream
Groundwater upstream and downstream (MW-1 and MW-9)	Yes, upstream>downstream
Upstream surface water (CC1) and upstream groundwater (MW-1)	Yes, groundwater>surface water
Downstream surface water (CC9/CC10) and downstream groundwater (MW-9)	Yes, groundwater>surface water

Note: A Mann-Whitney test, which is a nonparametric test for determining if two sets of observations come from the same distribution, was conducted at a 99% confidence level to determine spatial differences. Non-detect values were set equal to the detection limit.

Figure 9-9. Average SRP Concentrations in Cherry Creek Groundwater as a Function of Location

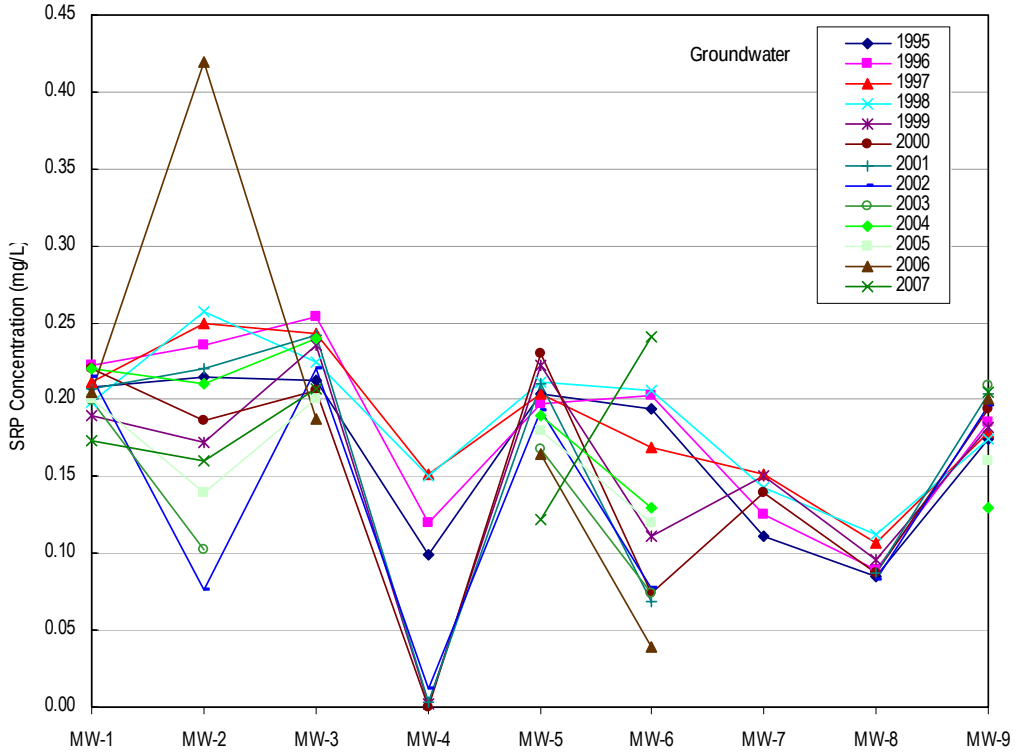


Figure 9-10. Average SRP Concentrations in Cherry Creek Groundwater as a Function of Time

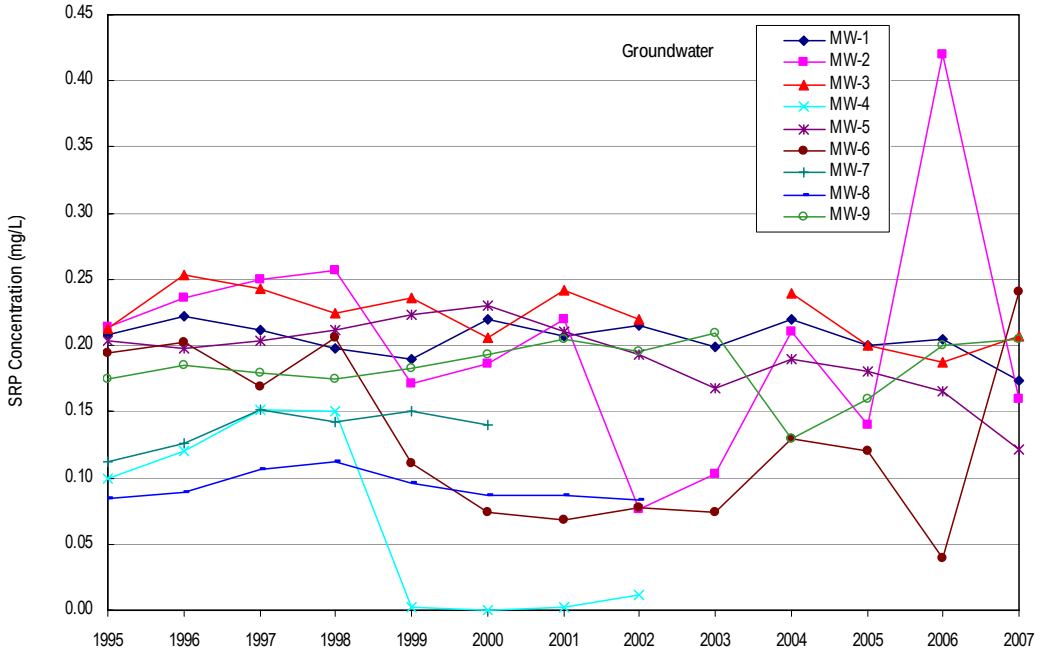


Figure 9-11. Average SRP Concentrations in Cherry Creek Surface Water as a Function of Location

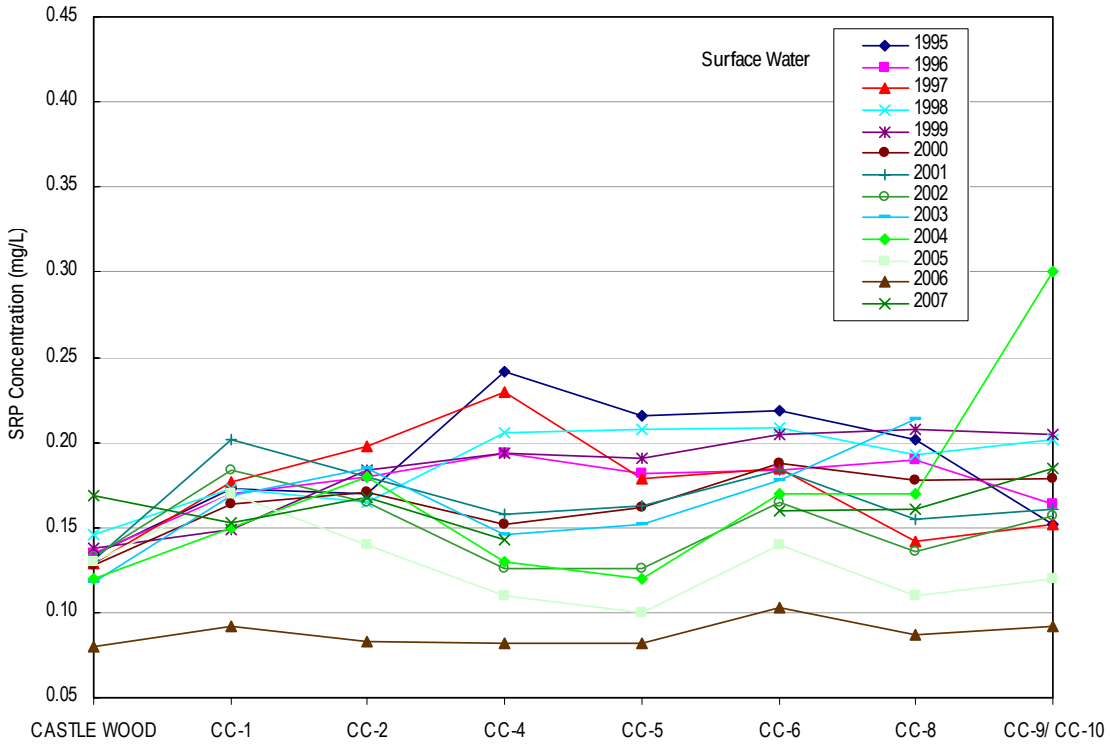
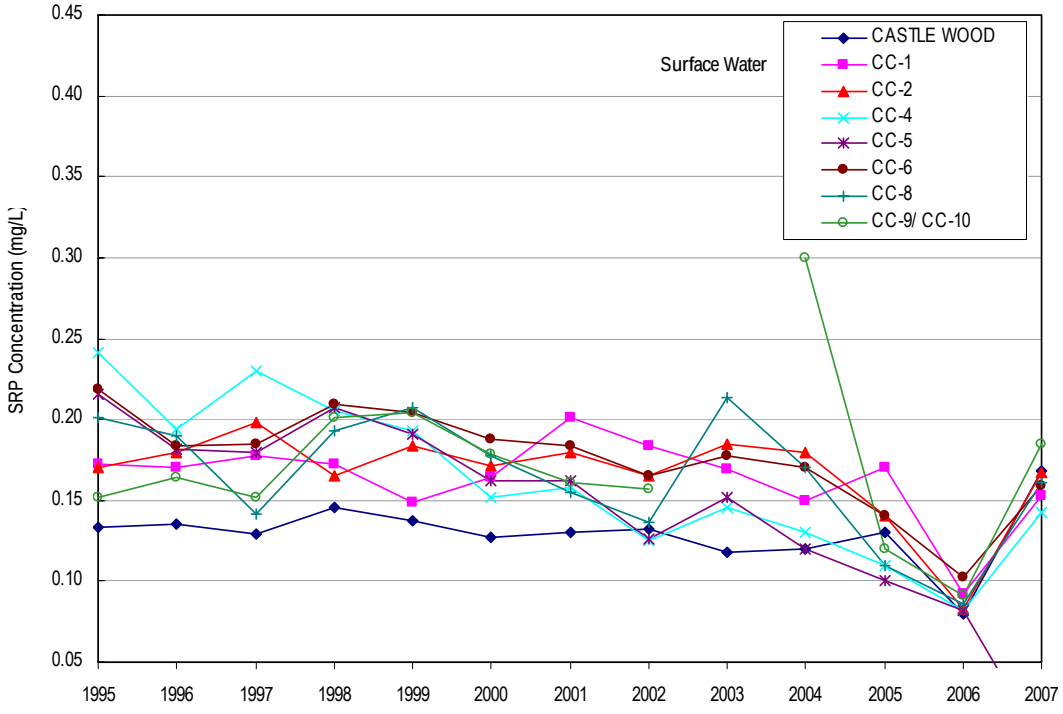


Figure 9-12. Average SRP Concentrations in Cherry Creek Surface Water as a Function of Time



9.3.2 Nitrate

- The nitrate concentrations in the underlying alluvial aquifer range from <0.1 to 12.10 mg/L with a median of 0.70 mg/L (1994-2007). Figure 9-13 and Figure 9-14 present annual average alluvial nitrate concentrations.
- The nitrate concentrations in Cherry Creek range from <0.01 to 16.7 mg/L (the maximum from 2006) with a median of 0.49 mg/L (1994-2007). Figure 9-15 and Figure 9-16 present annual average surface water nitrate concentrations.
- As shown in Figure 9-13, there are fluctuations in nitrate concentration between sampling sites, which is not expected since nitrate is conservative and does not attenuate over distance except from dispersion and biological assimilation. The shallow water table may facilitate assimilation of nitrate by riparian plants.
- Trends in nitrate over time (1994 to present) indicate increasing trends for the most upstream and downstream Cherry Creek sites and decreasing trends for the most upstream and downstream alluvial aquifer sites (Table 9-5).

Table 9-5. Summary of Nitrate Temporal Trend Analysis

Site	Type	Trend	Slope (mg/L per year)
Castlewood	Upstream surface water	Yes, increasing	0.007
CC9/CC10	Downstream surface water	Yes, increasing	0.040
MW-1	Upstream groundwater	Yes, decreasing	-0.040
MW-9	Downstream groundwater	Yes, decreasing	-0.243

Note: To minimize the effects of seasonality, the Seasonal Kendall tau test was applied, which is a nonparametric test for trend (i.e. uses the relative magnitude of the data rather than the actual values) and removes seasonal cycles.

- Spatial trend evaluations to determine whether nitrate concentrations are significantly different between upstream and downstream sites and surface and groundwater sites are summarized in Table 9-6.

Table 9-6. Spatial Differences in Nitrate

Site	Spatial Difference in Nitrate Concentration?
Surface water upstream and downstream (Castlewood and CC9/CC10)	Yes, downstream>upstream
Groundwater upstream and downstream (MW-1 and MW-9)	No
Upstream surface water (CC1) and upstream groundwater (MW-1)	Yes, groundwater > surface water
Downstream surface water (CC9/CC10) and downstream groundwater (MW-9)	Yes, groundwater > surface water

Note: A Mann-Whitney test, which is a nonparametric test for determining if two sets of observations come from the same distribution, was conducted at a 99% confidence level to determine spatial differences. Non-detect values were set equal to the detection limit.

Figure 9-13. Average Nitrate Concentrations in Cherry Creek Groundwater as a Function of Location

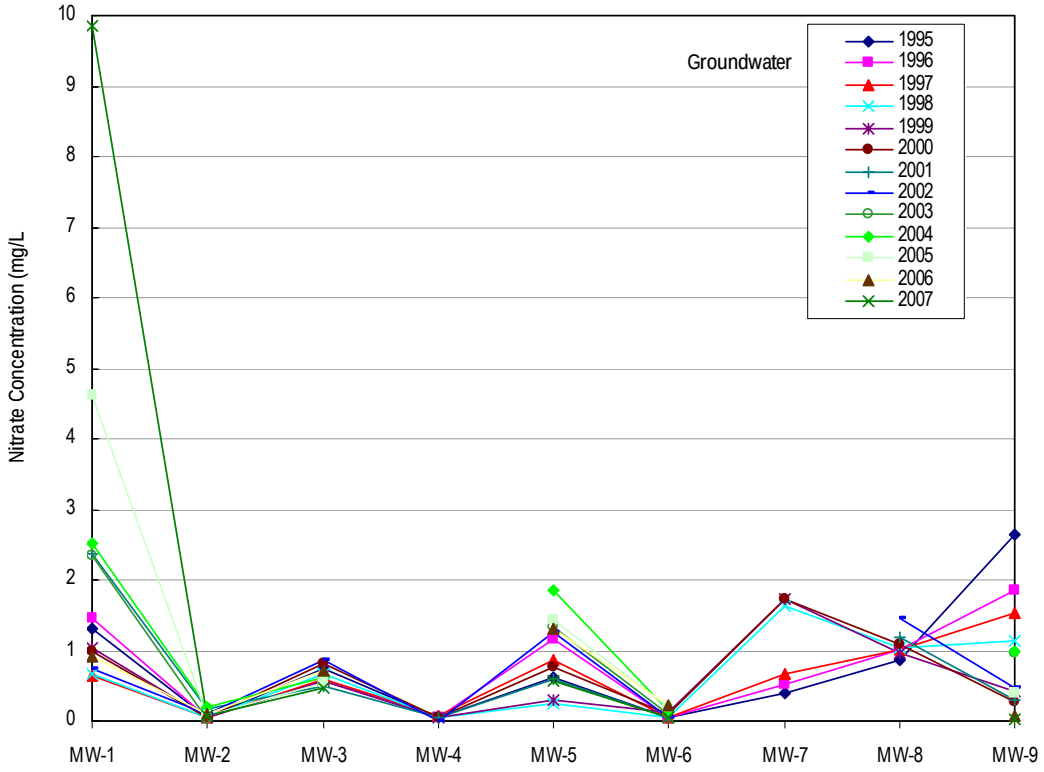


Figure 9-14. Average Nitrate Concentrations in Cherry Creek Groundwater as a Function of Time

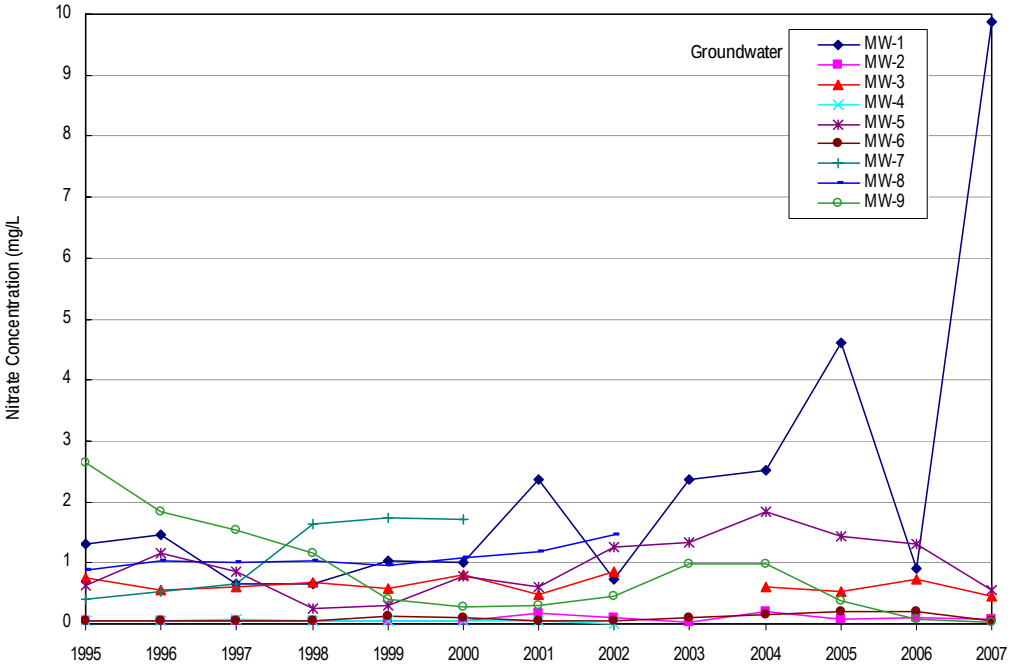


Figure 9-15. Average Nitrate Concentrations in Cherry Creek Surface Water as a Function of Location

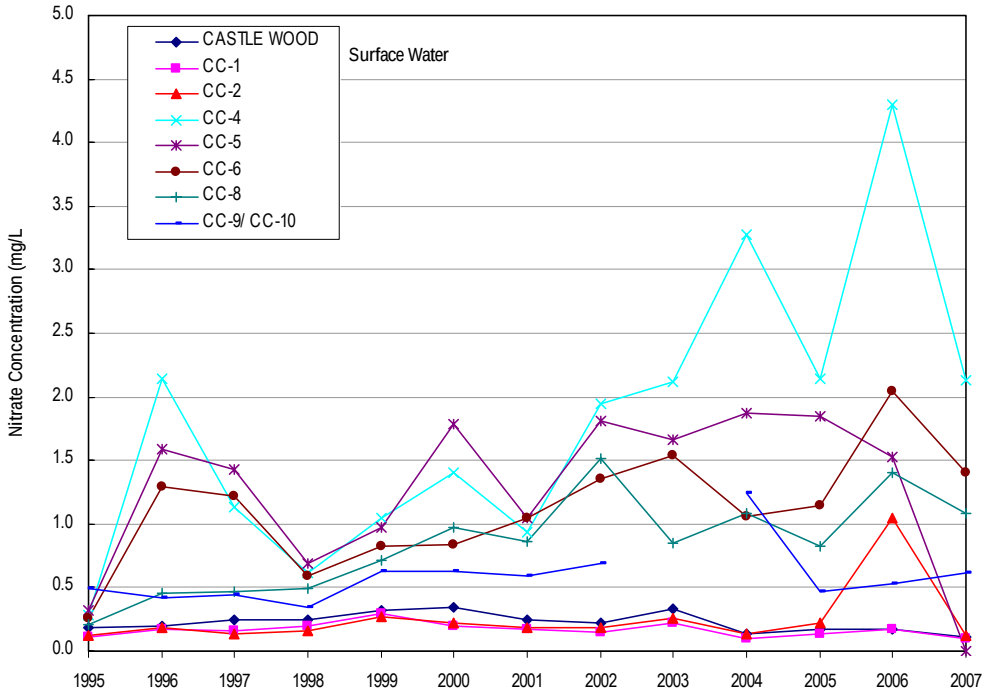
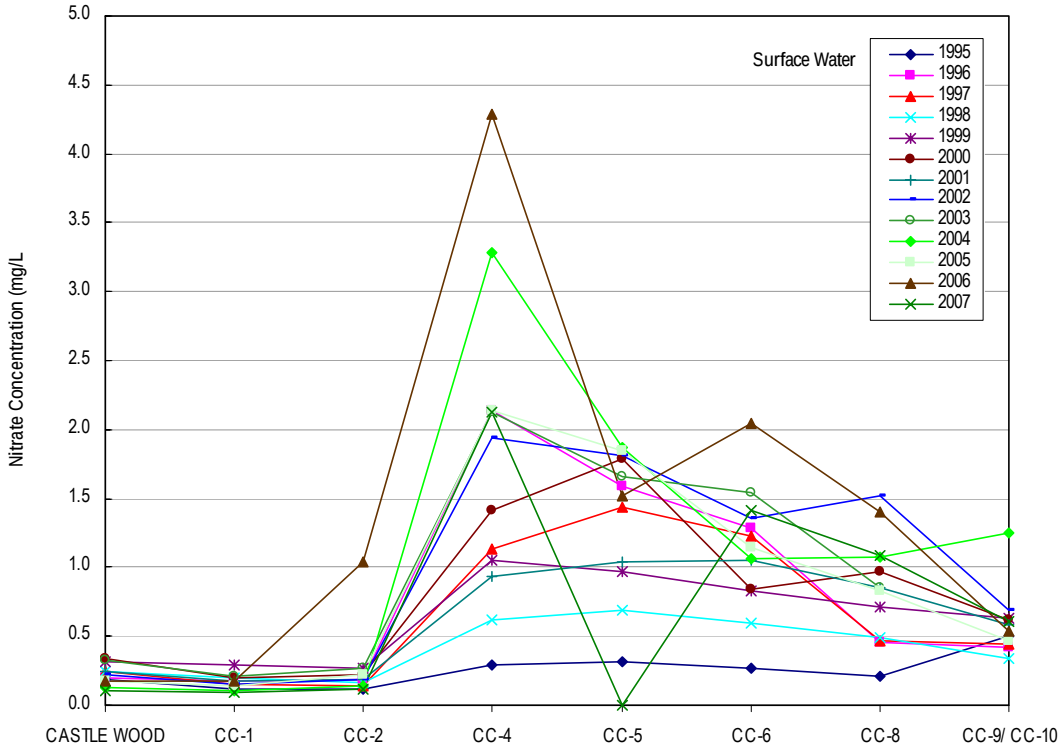


Figure 9-16. Average Nitrate Concentrations in Cherry Creek Surface Water as a Function of Time



Nutrients that can limit or enhance algal growth in a reservoir have many sources, either within the reservoir (internal loading) or from outside the reservoir (external loading). Fish and plankton excrement, direct sediment re-supply, and the decay of organic matter are all internal sources of nutrients in a reservoir. Based on past modeling efforts, net internal phosphorus loading to Cherry Creek Reservoir has been estimated to be 4,000 lbs/yr (Nürnberg and LaZerte 2000). Recent studies evaluating internal loading using a variety of methodologies suggest phosphorus loading ranges between 810 lbs/yr and 1,590 lbs/yr (AMEC et al. 2005), and alluvial phosphorus loads of approximately 1,170 lbs/yr (Lewis et al. 2005). Note that the phased TMAL of 14,270 lbs/year set in the May 2001 hearing does not include internal loads.

During the past few years, there has been extensive dialogue with the Division regarding the calculation of phosphorus loads when placed in the context of long term modeling and the predictive use for control regulation usage. From these discussions, a methodology was agreed upon that would create some continuity among Colorado reservoirs with control regulations in place, and also create a long term database using consistent methodologies based on contemporary scientific understandings. The historical external load data presented in this report has been revised using this current methodology, thus comparisons to contemporary data are appropriate. The long-term statistics have changed slightly from past reports and reflect the current understanding of the system and methodologies.

External sources of nutrients include inflow from streams and precipitation, which carry nutrients from soil erosion, agricultural and residual runoff, treated wastewater, and airborne particulates. Phosphorus loading was determined for several primary sources in 2007, including the tributary streams Cottonwood Creek, Cherry Creek, and Shop Creek, as well as from precipitation and alluvium, as summarized below.

9.3.3 Inflowing Streams

Total phosphorus loading to the reservoir from surface flows of Cherry Creek, Cottonwood Creek, and Shop Creek was estimated at 18,408 lbs in 2007 (Table 9-7). The standardized phosphorus concentration was 0.67 lbs/ac-ft, which is greater than the long-term median value of 0.56 lbs/ac-ft (Figure 9-17).

Inflow data, measured as the change in reservoir elevation by the COE, was heavily influenced by large storm flow events in April, May, June, and August 2007 (Figure 9-18). The total inflow for 2007 was 29,586 ac-ft which is the highest observed flow during the 16 year monitoring period, and is considerably greater than the long-term median of 13,876 ac-ft/yr.

Table 9-7. Estimated Net Phosphorus Loading (lbs/yr) into Cherry Creek Reservoir, 1992 to 2007

Data Source	Shop Creek	Cherry Creek	Cottonwood Creek	Subtotal for Streamflows*	Cherry Creek Alluvium	Direct Precipitation	Total External Load	Cherry Creek Export	Net Load
1992	105	3,142	408	3,925	1,010	429	5,364	1,443	3,921
1993	69	1,524	179	1,773	1,027	314	3,114	928	2,186
1994	100	2,437	164	2,700	857	227	3,785	1,055	2,730
1995	73	2,251	1,402	4,160	1,015	561	5,736	1,434	4,302
1996	95	2,467	599	3,161	916	349	4,425	1,323	3,102
1997	145	3,110	884	4,139	1,033	487	5,659	1,599	4,060
1998	162	9,963	1,633	11,840	1,033	449	13,322	4,010	9,311
1999	--	11,788	1,314	16,167	1,033	471	17,672	6,759	10,913
2000	--	10,714	1,644	12,357	1,033	398	13,788	4,426	9,362
2001	--	5,642	1,820	7,707	1,033	359	9,099	4,697	4,402
2002	--	1,815	505	2,320	916	288	3,525	1,843	1,681
2003	--	6,337	974	7,934	1,033	423	9,390	4,673	4,717

Table 9-7. Estimated Net Phosphorus Loading (lbs/yr) into Cherry Creek Reservoir, 1992 to 2007									
Data Source	Shop Creek	Cherry Creek	Cottonwood Creek	Subtotal for Streamflows*	Cherry Creek Alluvium	Direct Precipitation	Total External Load	Cherry Creek Export	Net Load
2004	--	5,710	1,753	7,486	1,033	454	8,974	3,421	5,553
2005	--	7,843	1,502	9,345	1,033	346	10,725	3,644	7,080
2006	--	3,813	1,272	5,084	1,033	375	6,492	3,287	3,206
2007	--	16,142	2,133	18,408	1,033	331	19,772	8,042	11,730
Mean	107	5,919	1,137	7,407	1,005	391	8,803	3,287	5,516
Median	100	4,727	1,293	6,285	1,033	386	7,733	3,354	4,352

*Includes Ungaged Residual Load .

Figure 9-17. Long-Term Trends in Total Phosphorus Load (lbs/yr), Inflow (ac-ft/yr), and Standardized Phosphorus Load (lbs/ac-ft) from Cherry Creek Reservoir, 1992 to 2007

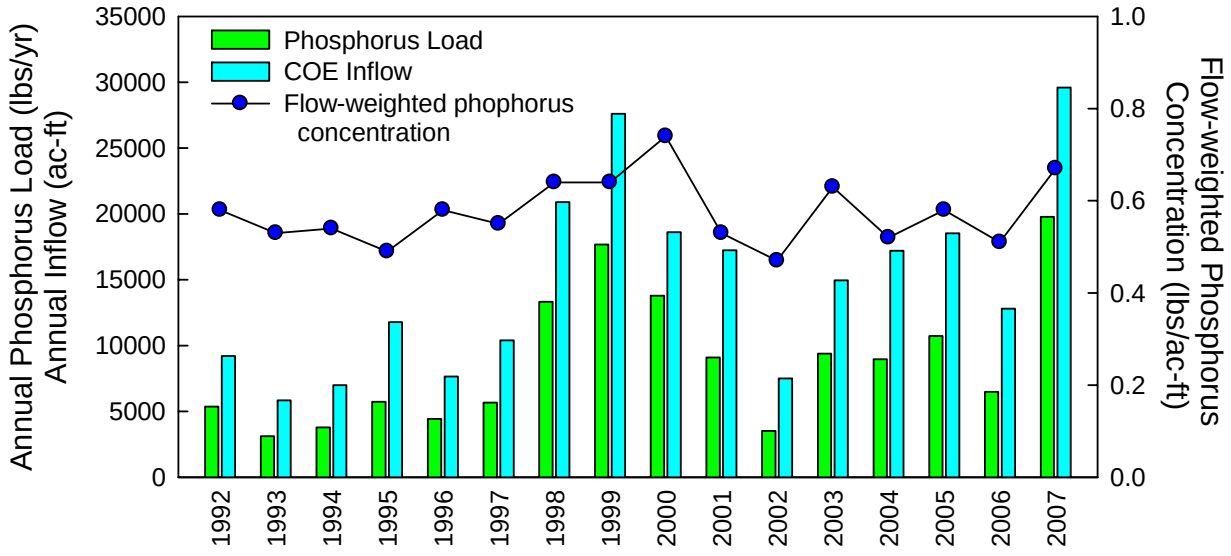
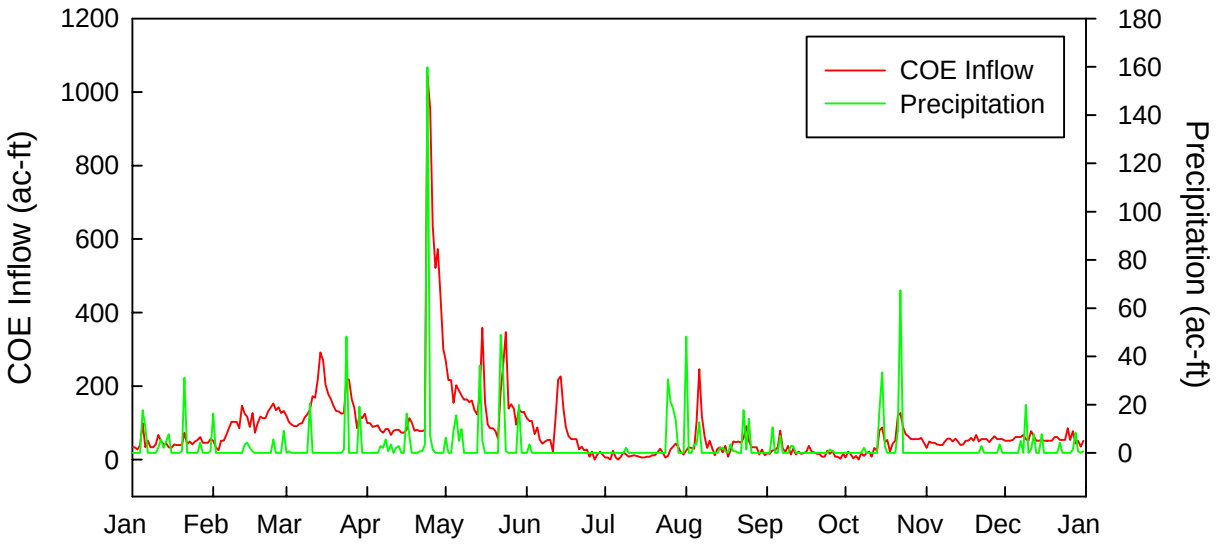


Figure 9-18. Comparison of Direct Precipitation on the Reservoir and Inflow for 2007



9.3.4 Precipitation

Total annual precipitation in 2007, as measured by the KAPA rain gage located at Centennial Airport approximately 4.3 miles due south of Cherry Creek Reservoir, was 14.8 inches (Figure 9-18). This value is slightly less than the long-term mean (1987-2007) of 17.2 inches.

Given the approximate surface area of Cherry Creek Reservoir (852 acres), and the long-term (1995-2005) median total phosphorus concentration (116 µg/L) for precipitation events, total phosphorus loading was estimated to be 331 pounds for 2007.

9.3.5 Outflow

The COE daily outflow and monthly total phosphorus concentrations from the outlet structure at the base of the dam near Interstate Highway I-225 were used to estimate the total phosphorus export of 8,042 lbs from the reservoir via the outflow structure in 2007 (Table 9-7).

9.3.6 Alluvial Phosphorus

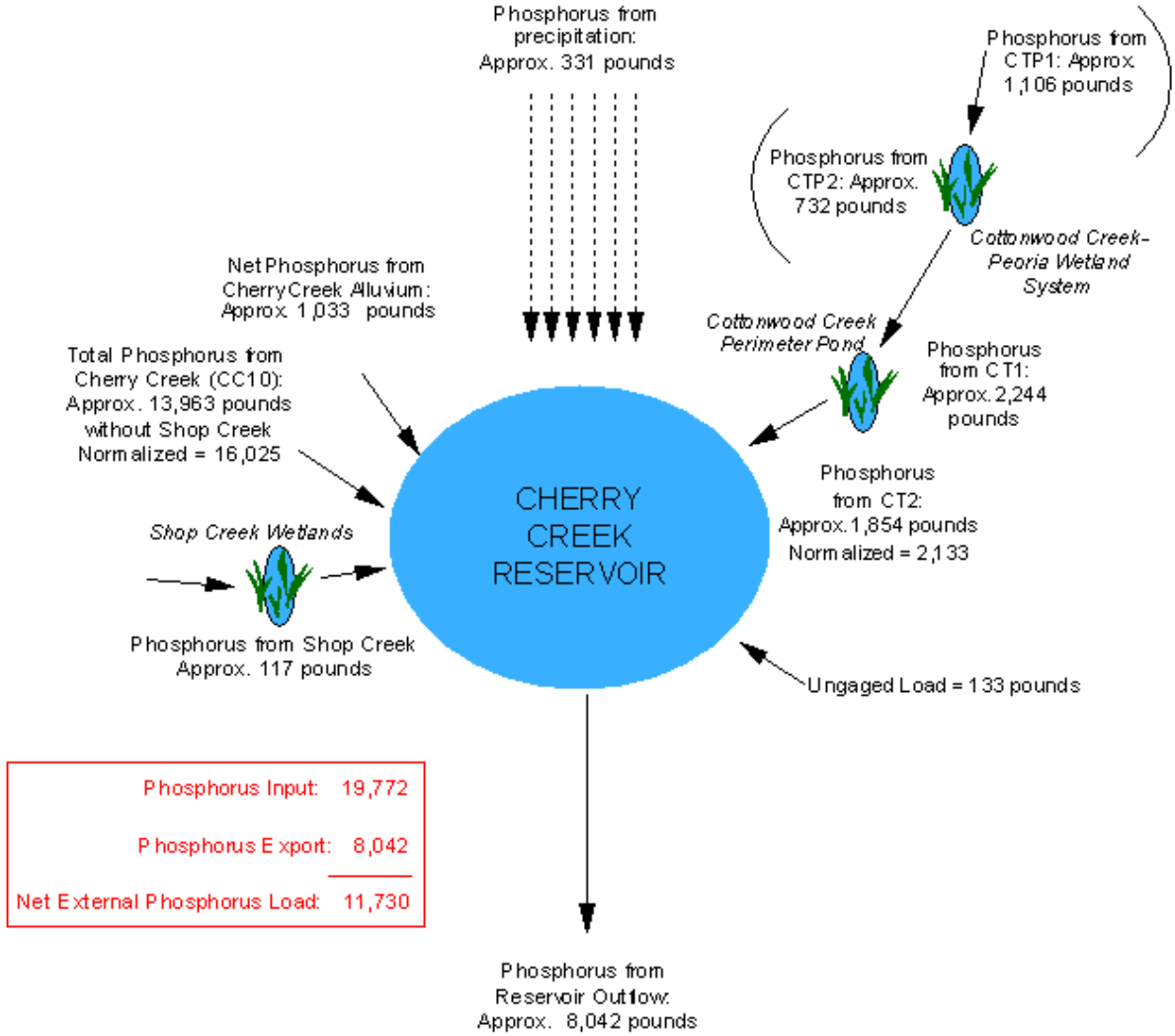
The alluvial phosphorus load for 2007 is 1,033 lbs. The 2007 load estimate utilizes a constant alluvial water budget value of 2,000 ac-ft/yr (Lewis et al. 2005, Saunders Division personal communication) and a long-term median total dissolved phosphorus concentration from MW-9 of 190 µg/L.

9.3.7 Mass Balance Loadings for Phosphorus

In general, the phosphorus load budget for Cherry Creek Reservoir is comprised of phosphorus inflow (influent streams, precipitation, and alluvium) and reservoir outflow. During 2007, phosphorus contribution from precipitation was an estimated 331 lbs, influent streams contributed 18,408 lbs, and alluvial inflow contributed 1,033 lbs (Figure 9-19) for a total load of 19,772 lbs. Outflow from the dam contained an estimated 8,042 lbs in 2007. After totaling the additions and losses, the net loading of phosphorus was estimated at 11,730 lbs during 2007 (Table 9-1). The 2007 standardized phosphorus load (lbs/ac-ft) is similar to the range of values observed in previous years (Table 9-1 and Figure 9-19).

Notably, while the 2007 phosphorus load is the largest on record, the mean summer chlorophyll *a* value in 2006 was 35% less than the long-term mean value.

Figure 9-19. Mass Balance Diagram of Phosphorus Loading in Cherry Creek Reservoir, 2007



Reservoir inflow and load data are provisional.

9.4 Evaluation of PRFs

PRF effectiveness is gauged by monitoring the concentration of phosphorus and suspended solids and the phosphorus loading upstream and downstream of each facility. The effectiveness of the pollution reduction facilities constructed on Cottonwood Creek increased in 2007, with the overall percent reduction in loads greater than the long-term percentages.

9.4.1 Cottonwood Creek-Peoria Pond

This structure came on line midway through 2002. As such, the values from 2002 represent less than a full calendar year (i.e., only July - December 2002). In 2007, the mean total phosphorus concentration both

upstream and downstream of the PRF was considerably different (Table 9 8), as well as the total suspended solids. The PRF appeared to be very efficient in reducing suspended solids and phosphorus. The flow-weighted phosphorus concentration upstream of the PRF was 0.49 lbs/ac-ft, while the flow-weighted concentration downstream of the system was 0.36 lbs/ac-ft. The total phosphorus load downstream of the PRF system was reduced by 34%.

Table 9-8. Annual Historical (2002 to 2007) Total Phosphorus and Total Suspended Solids Concentrations through the Cottonwood Creek-Peoria Wetlands System

Parameter	Year	Sampling Sites		Difference	Percent Reduction
		CT-P1	CT-P2		
Average Total Phosphorus Concentration (µg/L) (baseflow and storm samples combined)	2002	138	152	+ 14	(10)
	2003	101	92	- 9	9
	2004	142	123	- 19	13
	2005	92	101	+9	(9)
	2006	132	133	+1	(1)
	2007	179	125	-54	30
	Mean	131	121	-10	5
Average Total Suspended Solids (mg/L)	2002	66	79	+ 13	(20)
	2003	31	34	+ 3	(10)
	2004	87	53	- 34	39
	2005	47	51	+4	(9)
	2006	38	47	+9	(24)
	2007	79	42	-37	47
	Mean	58	51	-7	4
Loading of Total Phosphorus (lbs)	2002	142	89	-53	37
	2003	628	620	-8	1
	2004	839	897	+58	(7)
	2005	621	633	12	(2)
	2006	705	533	-172	24
	2007	1,106	732	-374	34
	Mean	674	584	-90	15

9.4.2 Cottonwood Creek Perimeter Pond

During 2007, the mean concentration of total phosphorus decreased from 213 to 148 µg/L after passing through the PRF system (Table 9-9). The mean concentration of total suspended solids also decreased from 81 mg/L upstream to 71 mg/L downstream of the pond. The total phosphorus load decreased downstream of the pond, from 2,244 lbs to 1,854 lbs, with the flow-weighted phosphorus concentration showing a similar reduction, 0.58 lbs/ac-ft to 0.43 lbs/ac-ft. The reduction in the flow-weighted phosphorus concentration indicates that this PRF continues to be effective in reducing total phosphorus loads to Cherry Creek Reservoir.

Table 9-9. Annual Historical (1997 to 2007) Total Phosphorus and Total Suspended Solids Concentrations through the Cottonwood Creek Stormwater Detention Pond

Parameter	Year	Sampling Sites		Difference	Percent Reduction
		CT-1	CT-2		
Annual Average Total Phosphorus Concentration (µg/L) (baseflow, storm samples combined)	1997	200	133	-67	34
	1998	289	210	-79	27
	1999	158	157	-1	1
	2000	187	149	-38	20
	2001	165	114	-51	31
	2002	146	143	-3	2
	2003	144	129	-15	10
	2004	212	151	-61	29
	2005	180	142	-38	21
	2006	170	161	-9	5
	2007	213	148	-65	31
	Mean	188	149	-39	19
Annual Average Total Suspended Solids (mg/L)	1997	207	87	-120	58
	1998	311	129	-182	59
	1999	267	68	-199	74
	2000	96	64	-32	33
	2001	79	43	-36	46
	2002	130	79	-51	39
	2003	84	62	-22	26
	2004	155	77	-78	50
	2005	126	66	-60	48
	2006	86	95	9	(9)
	2007	81	71	-10	12
	Mean	147	76	-71	40
Annual Loading of Total Phosphorus (lbs)	1997	2,359	614	-1745	74
	1998	1,556	1070	-486	31
	1999	1,140	984	-156	14
	2000	1,617	1057	-560	35
	2001	1,181	1212	31	(3)
	2002	636	801	165	(26)
	2003	1,356	864	-492	36
	2004	2,023	1433	-590	29
	2005	1,575	1725	150	(10)
	2006	1,924	1220	-704	37
	2007	2,244	1,854	-390	17
	Mean	1,601	1,167	-434	21

9.5 Historical Sampling of the PRFs on Shop Creek and Quincy Drainage

Historical sampling of the PRFs on Shop Creek and Quincy Drainage indicates efficient phosphorus removal in these streams. Shop Creek was monitored from 1990 to 2000 and revealed an average phosphorus load reduction of 173 lbs, equating to an average of 63% reduction in load. Quincy Drainage was even more efficient with 99% reduction in loads over the period of 1996 through 1999. The average phosphorus load reduction was 138 lbs.

9.6 Status of Water Quality

In 2007, the July through September mean chlorophyll *a* content in Cherry Creek Reservoir was 12.6 µg/L, which met the standard of 15 µg/L. This standard has only been met four times in the past sixteen years, although this was the second consecutive year. The seasonal mean of total phosphorus (118 µg/L) exceeded the current goal of 40 µg/L. The 2007 annual phosphorus load was 19,682 which exceeded the phased TMAL of 14,270 lbs, due in large part to the extreme storm flows in late April. The April total phosphorus load, represents 26% of the total annual phosphorus load to the reservoir.

9.7 Progress Made

- The Authority completed annual water quality monitoring and analysis for the reservoir, watershed, alluvium, and selected PRFs in accordance with the Sampling, Analysis, and Quality Assurance Work Plan.
- The Cottonwood Creek-Peoria Pond PRF showed improvement in removing total phosphorus from the stream flows in 2007, especially when compared to 2005 data. The flow-weighted phosphorus concentration (lbs/ac-ft) was less downstream of the pond as compared to flow-weighted concentrations upstream of the system.
- The Cottonwood Creek Perimeter Pond PRF showed a large decrease in the phosphorus load downstream of the system, with the percent reduction in load being considerably greater than the long-term mean. The flow-weighted phosphorus concentration (lbs/ac-ft) also revealed that the system was effective at removing total phosphorus from Cottonwood Creek flows.
- The total phosphorus load to the reservoir exceeded the TMAL, and is largely due to the extreme storm flows in late April.
- There has been a statistically significant decrease in seasonal whole-reservoir chlorophyll *a* concentrations since 1999, with the 2007 seasonal mean concentration of 12.6 µg/L.

10. IMPLEMENTING WATERSHED PLAN 2003 RECOMMENDATIONS

Recommendations and specific opportunities for improving water quality can be found in the Watershed Plan 2003. The Watershed Plan 2003 and recommendations were developed by an independent consultant under the direction of the Authority. The Board has adopted the Watershed Plan 2003 and will consider these recommendations. Listed below are the recommendations provided in the Watershed Plan 2003 and progress made during 2007.

- Consider various funding options to achieve capital budget increase of $2 million to $4 million annually.
  - The Board is focusing on meeting the 60% spending requirement for capital projects and does not currently need to increase revenues for capital projects.
  - Implement the Cherry Creek Reservoir Watershed Plan 2003 as a coordinated management program.
  - Watershed Plan 2003 recommendations are incorporated into the Work Plan and assist in prioritizing and determining activities for completion.
- Fund, design, and construct high priority stream improvements.
  - The Authority included funds in the 2007 annual budget for potential stream corridor preservation partnering opportunities.
- Design and construct additional pollutant reduction facilities.
  - Completed construction of the reservoir destratification project.
  - Re-initiated final design for Phase II of the Cottonwood Creek Reclamation PRF.
  - Completed repairs on Cottonwood Creek Reclamation Phase I project.
  - Began design for repairs to the existing PRFs,
- Promote trading incentives and request removal of the 216-pound trading cap.
  - The Authority initiated consideration of potential trading opportunity from future advanced water treatment plants and modified operation.
  - 2004 revisions to Control Regulation 72 removed the 216-pound trading cap.
- Encourage all land use agencies to adopt and implement the stormwater policy and design criteria outlined in the Authority's Requirements.
  - Made significant progress in a cooperative effort with the land use agencies and CDOT to develop a guidance document to assist with implementation of MS4 permit program.
- Encourage local governments to work with developers to construct innovative demonstration projects.
  - Completed fourth year of Phosphorus Facilitator program and began considering changes to the program to facilitate more opportunities for construction enhanced and innovative BMPs.
  - The Partners coordinated a training program for land use and development professionals.
- Encourage local governments to provide developer incentives to preserve and enhance stream corridors.
  - Continue to review land use applications and provide land use agencies and developers with comments and recommendations consistent with the Authority's Requirements.

- Explore options to reduce septic system loading in Cherry Creek.
  - 2004 revisions to Control Regulation 72 prohibit individual sewage disposal systems within the 100-year floodplain.
- Promote reuse of wastewater through land application.
  - 2004 revisions to Control Regulation 72 and the trading program provide support for reuse projects.
- Conduct special studies to optimize water quality improvements.
  - Completed the required background phosphorus study.
  - Continued third study quantifying potential phosphorus infiltration from BMP projects.
- Develop and implement a comprehensive public involvement plan.
  - Continued support the Partners in implementing its significant efforts through the Education Initiative.
- Consider participation in several federally funded programs that support sustainable agriculture and habitat protection and restoration.
  - No specific activity in 2007.
- Coordinate with other stormwater Phase I and II entities and efforts.
  - The Authority regularly interfaces with land use agencies and stormwater permittees to answer questions and provide guidance for enhanced BMPs.
- Collaborate with other private and public interest groups to leverage funding mechanisms to meet watershed goals.
  - The Authority coordinated with the Partners' efforts and activities to promote education and outreach in the watershed for water quality enhancements.

Cherry Creek Reservoir met the chlorophyll *a* standard in 2007, but the reservoir did not meet the accompanying phosphorus concentration goal. The phosphorus loading to the reservoir continues to be below the TMAL. The 2007 reservoir data, as well as the long-term monitoring indicate the relation between chlorophyll *a* and phosphorus concentrations (or between phosphorus concentration and load) needs consideration. With the addition of five years of reservoir data (since 2000), the Authority is updating the Reservoir model to evaluate these relationships in the reservoir, refine the TMAL, and evaluate the achievable load reductions in the watershed.

The Authority's management strategies have focused on the watershed, including the construction of PRFs that have shown to be effective in reducing phosphorus loads. The Authority believes watershed management strategies are beneficial over the long term, but they have not resulted in immediate measurable improvements to reservoir water quality. The Authority completed construction of the reservoir destratification system, which will be in operation for the 2007 growing season. This project is intended to help achieve more continued short-term improvements to reservoir water quality in conjunction with the Authority's continued efforts to develop and implement watershed management strategies as a priority.

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ATTACHMENT A

Cherry Creek Stewardship Partners 2007 Annual Report

Cherry Creek Stewardship Partners

2007 Annual Report

"Providing a forum for promoting stewardship of the Cherry Creek Watershed" *January 2008*

2007 in Review: Partners Outreach in Action!

Hawk Walk on Cottonwood Creek, January 27th: *A dozen + Red Tail Hawks were spotted on this 3rd annual winter outing with the Denver Audubon Society.*

RMSEL Water Fair, January 18th: *The students took the Partners EdKit tools and presented their findings to fellow classmates, teachers, parents, and Partner volunteers.*

Metro Regional Science Fair, February 14 & 15: *The Partners provided judging & awarded prizes on behalf of ACWWA, the CCBWQA & the SPLASH Group.*

Barr Lake and Milton Reservoir Stakeholders, February 27th: *Partners presented to the group, sharing our perspective of developing a watershed organization, sharing who and what we are, and how and why we formed our organization.*

Cherry Creek High School Science Symposium, April: *Another Partners effort to encourage students to "connect with nature" in their science studies.*

State Science & Engineering Fair, CSU, April: *The Partners were on hand to emphasize the integration of watershed interests and science curriculum.*

Fertilizer 101, Tagawa Gardens, April : *Partners manned a booth and shared knowledge of appropriate fertilizer application in the Cherry Creek Basin (p-reduction).*

Science Fair Projects at CCBWQA Board, April 19th: *The winning science projects awarded a cash prize on behalf of the CCBWQA were presented to the Board.*

CC @ 17-Mile House Park, April 14th: *Working with ArapCo Open Space, friends and SouthCreek HOA next-door neighbors planted over 500 shrubs along Cherry Creek.*

CO Assoc. of Environmental Educators Teacher Training, April 27-29: *Hands-on training for area teachers, using stormwater quality as an educational tool.*

7,000 Trees in 7 Days, April 21-28: *Planted over 200 trees & shrubs along CC.*

Southeast Denver Duck Drop, George Wallace Park, May 6th: *Another chance to get young and old involved in water resource concepts with this fun activity.*

14th Annual Aurora Water Festival, May 10th: *Hosted classroom activities for over 120 students on macroinvertebrates as indicators for WQ, using real bugs!*

Training for Enhanced BMP Implementation, Workshop #4, May 16th: *Last in a series of 4 "How to" workshops to assist design engineers, developers, and government staff in maintaining permanent WQ BMPs(see WQ Committee, page 3).*

Denver Botanical Garden staff & VOC @ CC Valley Eco Park, May: *Developed program for training volunteer crew leaders in weed mitigation techniques.*

Goldsmith Gulch Planting Project, June 8th: '*Women in Design' volunteers planted over 25 trees & shrubs and completed a rained-out April planting event.*

Bio Blitz, June: *Partners hosted an inventory and record-keeping effort monitoring fauna & flora species along Cottonwood Creek.*

4th Annual Project WET Training, Aurora, June: *Provided resource support for local area teachers highlighting Partners EdKit and local field trip opportunities.*

Fountain Creek Vision Task Force, June 15th: *Partners presented to the group, sharing our perspective of developing a watershed organization, who and what we are.*

30th Annual Butterfly Count, July 2-8: *Robert Michael Pyle returned to "The Thunder Tree" to mark this special anniversary.*

Colorado Cares Day, July 28th: *Cherry Creek State Park, CC Marina & Yacht Club, and CCBWQA hosted the Governor and many volunteers for a day of harvesting weeds and connecting 'kids of all ages' with nature again.*

Cherry Creek and Castlewood Canyon state parks, summer 2007: *The Partners planned, hosted and supervised several maintenance support activities with over 150 Americorps and NCCC youth volunteers, re-building trails, cleaning up the riparian areas, pulling weeds, planting, you name it, these student volunteers did it!*

CO Biology Teachers Assoc. Workshop, September 7&8: *Qualified professional training for educators with extensive activities for K-12 classrooms and tours of Reuter-Hess, Prairie Canyon, CC State Park, and CC Valley Eco Park.*

"Nature as your Neighbor", CC Valley Eco Park, September 22nd: The Partners hosted a volunteer effort to highlight the importance of watershed education, with special emphasis on the Red Hawk Ridge Elementary school adjacent to the park.

3rd Annual Run for Watershed, September 29th: *see article, page 2.*

9th Annual Watershed Conference, "*Thriving Partnerships, Effective Projects*", November 3rd: *see article, page 2.*

"Get to Know your Watershed – West Middle, Swansea, PS1, Runyon, and Morey schools, throughout 2007: *Partners **"Edkit"** outreach effort, with classroom activities and outdoor program including monitoring and inlet labeling.*

Partners "Party" with Local Youth

What happens when over 100 teenagers descend on Cherry Creek State Park and Castlewood Canyon State Park? They 'party' as only the Partners can party: repair and maintain trails, clear snags and fallen trees, create brush piles as habitat, identify and remove noxious weeds, as well as plant and maintain native riparian and grassland vegetation and restore habitat. With the leadership of seasoned Americorps teams, 2007 was the Summer of Service for 100 local 14-17 year-olds, under the leadership of Casey Davenhill, Partners Coordinator. This Americorps crew learned the skills, techniques, safety and discipline needed to complete varied watershed projects, including maintaining ~2 miles of trail and 10+ acres of riparian habitat.

As a special project, an elite Americorps team with support from Bill Ruzzo, P.E. for CCBWQA and Craig Wolfe, GEI Consultants, developed a process to test the effectiveness of harvesting wetland plants to remove phosphorus. Over a two day period, using their own ingenuity and borrowed hip-waders, the team removed approximately 1,000 lbs. (453.59 kg) of Lesser Duckweed (Lemna minor) from the Shop Creek Pollutant Reduction Facility (PRF). The Duckweed sample contained approximately 0.8% total phosphorus by mass (dry weight), removing approximately 1 lb. (.4536 kg) of phosphorus from the basin.

The Partners want to thank Mike Range, Joe Marquez and Greg Galvez of Cherry Creek State Park, Jason Anderson of Castlewood Canyon State Park, Cindy Thrush of UDFCD and Lesley Roper of Denver Parks Dept. for their helpful, smiling (laughing?) support of Summer of Service. We look forward to the Summer of Service 2008 when Americorps and Jr. NCCC will return to provide more brain and muscle power for stewardship of the Cherry Creek Watershed.

Americorps Volunteers

"At home if I saw a spider I would freak out…but I've got at least three spiders crawling on me right now and I don't even care." Americorp student, commenting on her summer experience

Cherry Creek Stewardship Partners

Casey Davenhill, Watershed Coordinator *casey@cherry-creek.org*
% Colorado Watershed Network, P.O. Box 21935, Denver, Colorado 80221
303-345-1675 (ph) 303-744-1752 (fax) www.cherry-creek.org

The Cherry Creek Stewardship Partners mission is to provide a forum for promoting stewardship of the Cherry Creek watershed.

The *Partners* is an informal association of a broad range of stakeholders actively promoting effective stewardship of Cherry Creek and other local watersheds. The *Partners* bring together land use jurisdiction staff, state and federal resource management agencies, conservation, recreation, and historic preservation groups, the business community, and interested citizens. Please contact us if any of the Partners working groups are of interest.

Executive Committee – Administration and strategic planning. *Chair: Bob Toll, 720-874-6500*

Education and Outreach Committee – Active in citizen outreach and education; host community meetings. *Chair: Darren Mollendor, 303-446-3588*

Water Quality Committee – Promotes watershed sustainable approaches; assists the CCBWQA TAC. *Chair: Lanae Raymond, 303-858-8844*

Open Space, Habitat and Trails Committee – Coordinates stewardship aspects of recreational trails, noxious weeds, and resource management; host volunteer days. *Chair: Toby Sprunk, 303-660-7334*

2007 Conference

9th Annual Conference: ***Thriving Partnerships, Effective Projects***

Friday, November 2, 2007 @ the Wildlife Experience, @ Peoria and Lincoln

The Partners have solidified their role of providing a forum for stewardship opportunities by hosting an **annual conference** where participants have the opportunity to consider ways to coordinate and integrate projects and activities that affect water resources in the watershed. The focus for the conference in 2007 was the sharing of tools to design, construct and permit effective projects in the Cherry Creek watershed and beyond. General sessions included:

- **Effective Project Collaboration**: Rising costs of capital projects and less General Fund and CIP budget make it imperative to find other sources of funding for these valuable stream restoration projects. We heard about making CIP dollars go farther.
- **Effective Project Construction**: Recent work by UDFCD, and other stakeholders on project specifications to assist in meeting project goals were presented, including specs for water control, sediment control for channel work, and re-vegetation specs for permit compliance.
- **Effective Project Design:** Wetlands generation and water rights, permit approvals and channel work, and construction projects and TMDL requirements are synergistic components with implications that need to be addressed during design. Consultants shared their efforts to date.

All of this information & the wonderful atmosphere of the Wildlife Experience!

Also at the conference, Partners awards were presented by the conference committee to two very worthwhile recipients, **Mohamed Sherif**, South Creek neighborhood (Volunteer Award); and **Alan Schwartz**, a Science teacher at West Middle School in Greenwood Village (Educator Award). Casey Davenhill was recognized for her continuing all-encompassing efforts on behalf of the Partners. In addition, the Partners took this chance to recognize the **2007 "Run for the Watershed" award winners** (*see below*). Also, **Bill Ruzzo**, Basin Authority consultant, distributed CASFM "Grand Award for Excellence" plaques for the *Cherry Creek Stream Restoration at the 17-Mile House Park* project.

We hope you were able to participate in the conference in 2007, and invite you to join us again in 2008, so please mark your calendar for **November 7, 2008** and join us! Thanks again to the conference planning committee, especially Joan Howerter, ICEC (logistics & registration); Lanae Raymond, SEMSWA (conference development & content, poster exhibits and silent auction); Paul Hindman, UDFCD (insurance); Susan Brown, Valerian (silent auction); Bob Toll, State Parks (awards), and Casey Davenhill (logistics, awards, & registration).

Contact: Lanae Raymond @ lraymond@semswa.org

Conference attendees @ the Wildlife Experience, 2007

Cherry Creek "Run for the Watershed"

The Partners hosted their 3rd Annual Cherry Creek **"Run for the Watershed" Race** through the beautiful Cherry Creek watershed. The relay race, a rally award format 50 miles in length, traversed Douglas and Arapahoe counties, sprinting through Parker, Centennial, Greenwood Village, and Denver before heading into Cherry Creek State Park for the finish. The Race Committee, led by **Bob Toll and Paul Hindman**, with logistics assistance from Casey Davenhill & Lanae Raymond, were thrilled with the increase in participants over the 2006 race, welcoming 16 teams in 2007. The limit is 20 teams total, so please register early for 2008 race!

All participants felt like they were winners at the end of the race, but some were recognized with an award at the finish line festivities, including:

- Overall Relay Winner: **ICON**, *Craig Jacobson, Captain*
- 2nd Overall Winner: **Design Concepts**, *Kurt Munding, Captain*
- 3rd Overall Winner: (tie) **UDFCD**, *Paul Hindman, Captain and* **City/County of Denver**, *Alan Polonsky, Captain*
- Fastest Finish: **City/County of Denver**, *Alan Polonsky, Captain*
- Annual "Spirit Award": (tie), ***UDFCD***, *Paul Hindman, Captain and* ***ICON***, *Craig Jacobson, Captain*

The race date in 2008 is **September 28th.** A flyer will be available early in 2008 to allow plenty of trainingtime…hope to see you on the trails!

Contact: Bob @ rtoll@co.arapahoe.co.us

CC Basin Authority TAC Collaboration Update

Joint efforts undertaken by the Technical Advisory Committee of the Cherry Creek Basin Water Quality Authority and the Partners in 2007 include the following:

- **Enhanced Permanent BMP Workshop** for developers, design engineers, and local government staff: several TAC members and consultants were presenters at the 2007 workshop on maintenance (*see WQ Committee*).
- **Metro Regional & Colorado State Science Fair**; **Colorado Biology Teachers Workshop; and the CAEE Teachers Workshop**: *the Partners Education Committee and several TAC members judged science fairs and hosted science teachers at workshops and during field trips to Plum and Cherry creeks, and for Project WET "Discover a Watershed" training.*
- **3rd Annual 'Run for the Watershed'**: *several TAC members organized teams to participate in the 50 mile relay race (see article, this page).*
- **9th Annual Cherry Creek Watershed Conference**: *several TAC members and technical consultants were featured speakers, including talks about the Reservoir Destratification project; the proposed changes to Control Reg 72, and several stream stabilization project efforts (see article, this page).*
- **Cherry Creek Watershed Classroom and Field Trip Implementation Kit:** *the Partners continued implemented the* ***"EdKit",*** *approved by the Basin Authority for use in Cherry Creek in 2004.*

The Basin Authority Board approved the Partners $20,000 budget request for continued collaboration with the TAC in 2008 to deliver a practical water quality message to residents of the Cherry Creek watershed.

Cherry Creek at 17-Mile House Park N

CC Project Wins Award

At the Colorado Association of Stormwater and Floodplain Managers (CASFM) annual conference in September, the **Cherry Creek Restoration @ 17-Mile House Park** stream stabilization project won the **Grand Award for Engineering Excellence**. The project team included several Partners: **Lanae Raymond**, SEMSWA; **Jim Wulliman**, Muller Engineering; **Deb Keamerer**, The Restoration Group; and **Paul Hindman**, UDFCD. Bill Ruzzo presented the award at the November annual conference

The design concept for this reach of Cherry Creek went beyond simply stabilizing the creek in place. The stabilization design solution had a goal of reclaiming the creek as a shallow prairie stream while 'laying light on the land', making it hard to tell where construction occurred and where it didn't. The grade controls were chosen to emulate natural features, so a rock-mix that more closely resembles natural "riffle" formations was used. These drop structures mimic naturally occurring pool-riffle formations. Restoration of the project area's ecology and vegetation was addressed by raising the channel bed and associated water table back up to its pre-incised condition, and by more frequent conveyance of creek flows into a newly contoured secondary channel. This approach enabled the project team to moderate Cherry Creek flows to regularly irrigate a far greater area of the floodplain than would otherwise occur, thereby restoring and enhancing the area. This reclamation approach is being utilized elsewhere in the basin, with several projects in Parker underway. Congrats to the team!

Cherry Creek Stewardship Partners

2007 Accomplishments

Trail Building

2007 "Run for the Watershed" Relay Race

9th Annual Cherry Creek Conference

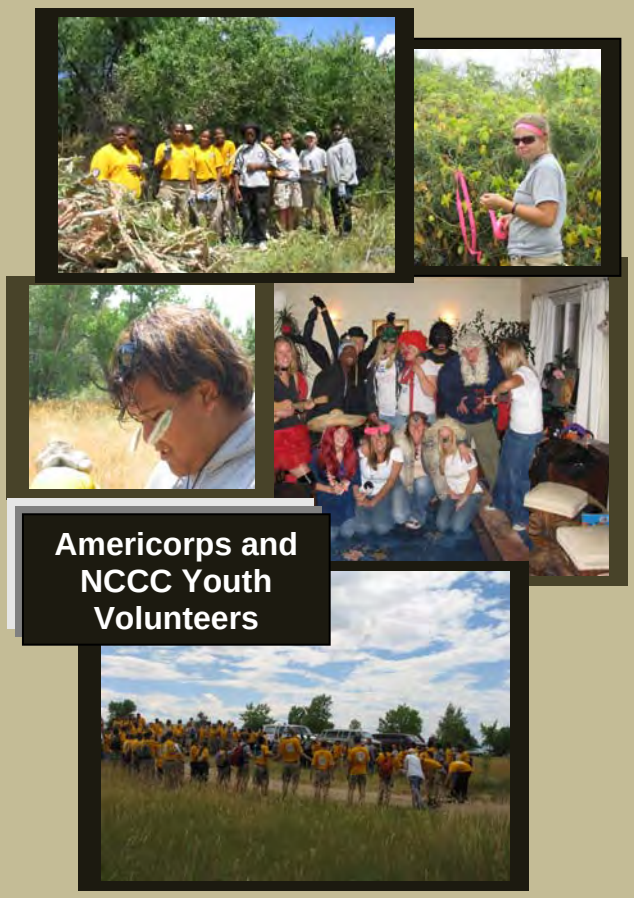
MS4 Permittee Assistance

Cherry Creek Stewardship Partners

2007 Accomplishments

Biology & CAEE Teacher Workshops

Watershed Stewardship



Americorps and NCCC Youth Volunteers

2007 Youth Science Fairs

Water Quality Committee

The Water Quality Committee finished up the series of "How to" workshops in 2007 with their 4th workshop presentation. The committee determined in 2005 that it was just not good enough to *talk* about the possibilities with enhanced BMPS, it was necessary to get at the "how to" in terms of BMP selection, design, installation, inspection and maintenance. This meant preparing workshops for developers, design engineers, and government staff to promote the enhancement of permanent BMPs. The **'How to'** workshops included the following topics:

- ✓ **"Let's Talk: It's not 'Business as Usual': How to incorporate water quality into a constrained site and be better off"** - BMP selection, Aurora Doubletree, 10/05;
- ✓ **"Warning! Design Danger Ahead! Solutions for Effective Design of Permanent BMPs"** – BMP designs, Lone Tree SE Marriott, 5/06;
- ✓ **"Constructing Permanent BMPs: If You Build It, THEY Will Come"** – BMP installation & inspections, Hyatt DTC, 10/06; and
- ✓ **"It's a Keeper: Maintaining Permanent BMPs in the 'Ensure' Environment"** – BMP maintenance, Sheraton DTC, 5/07.

The integration of the Partners committee activities with the **State MS4 WQ Permit holders**' "measurable goal" efforts continues to be a focus of the Water Quality Committee. The three Partners committees highlighted on this page have a distinct approach to carrying out their specific mission, but more often than not, the missions have a focal point of water quality. Healthy open space relies on the quality of the habitat, which in turn relies on the quality of the surface streams; trail users want to be in a healthy riparian area as they recreate, which, again, requires a healthy stream; educating our youth and older citizens about water resources in terms of the 'watershed they live in' naturally brings in water quality issues as we integrate watershed interests with everyday activities. In 2008, the Water Quality Committee will continue to find ways to integrate all the Partners activities, to highlight riparian water quality. Also in 2008, the Committee will re-look at the 2004 Smart Growth for WQ Report to see how we are doing on the specific recommendations, and what more we can do.

Contact Lanae @ llraymond@semswa.org

Committee Reports

Education & Outreach Committee

The Education Committee, including partners from Denver, Aurora, Arapahoe and Douglas counties, as well as experienced science teachers and engineers, continued to emphasize science activities that used the 'environment to educate'. Several science education activities were a part of the **RMSEL Water Fair, Metro Regional Science Fair, CSUState Science & Engineering Fair, Cherry Creek High School Science Symposium, CO Association of Environmental Education Teacher training, Aurora Project WET, and the CO Biology Teachers Workshop.** These various classroom visits, field trips and symposia allowed the sharing of resources to promote "stormwater quality" education. Participants enjoyed a richer experience that promoted the 'messages of stewardship', integrating watershed interests, use of best management practices (BMPs), and overall protection of our water resources. The Partners goal of "connecting kids with nature" is starting to be fully realized.

In 2007, the committee continued to refine their **"EdKit"**, a classroom and field trip implementation project tool to enhance school activities. Access to the various creeks and streams in the Cherry Creek basin help us to explain the importance of individual actions to protect our water. The opportunity to demonstrate concepts of science, engineering and civics is the essence of 'Environmental Education'. All ages can improve their observation skills, learn about the natural world and get some fresh air and exercise by taking a stroll along Cherry Creek or by visiting our two fabulous state parks.

In 2008, the group will be hosting guided tours of the CC Valley Eco Park (CCVEP) and the 17-Mile House Park to introduce the CCVEP Activity and Teachers' Guide, the "Passport to the Senses" Activity and Teachers' Guide, as well as the "Biomimicry" Activity and Teacher's Guide. Also in 2008, the group will continue to increase the exposure of their **'EdKit'** program to other area schools and civic groups, as well as continue the science fair and symposia education efforts. If these activities are of interest, please think about joining the committee in 2008. Please check the website for a list of activities @ www.cherry-creek.org.

Contact Casey @ casey@cherry-creek.org

The Partners "EdKit" in action at a local creek

In 2007, the Open Space Committee continued their legacy of varied on-the-ground activities, including field trips and volunteer efforts, with activity participants ranging from 2 dedicated volunteers to over 500 strong. Their busy year started in January with the **Audubon Raptor Walk** at **Cottonwood Creek**, a totally inspiring annual event. Then it was time for the **WEED Network** meeting in March at the **CO Department of Wildlife**, followed by a **"Fertilizer 101"** booth and presentation for local residents at **Tagawa Garden Center in April**. Also in April, over 40 volunteers headed out to the **17-Mile House Park @ Cherry Creek Crossing** to do a little shrub planting at the newly completed stream restoration project. **Denver's "7,000 Trees in 7 Days"** in April was an opportunity for the group to participate with a massive tree planting effort, followed by a planting project at **Goldsmith Gulch**. A joint project to complete a habitat monitoring and weed pulling effort with volunteers from the **Denver Botanical Gardens** was conducted at both the **Cherry Creek Valley Ecological Park** and **Cottonwood Creek** in spring and summer 2007. A **Bio Blitz** (part of a statewide census of plants, animals & insects) was also held at **Cottonwood Creek**, in June, for the second year in a row. **Commons Park** was host to a "**Butterfly Extravaganza"** in July. Also in July, the Committee helped organize a **"Colorado Cares Day"** effort at the **Cherry Creek State Park Reservoir** in conjunction with the Cherry Creek Basin Water Quality Authority, Colorado Lakes and Reservoir Management Association (CLRMA), and the Cherry Creek Marina and Yacht Club, as part of **Lake Appreciation Month**. Governor Ritter, family and staff participated in the fun event that brought the concept of healthy habitat in our watersheds right to the outstretched hands of the kids in attendance. Throughout the summer months, and into the fall, **maintenance support** was performed at **Cherry Creek** and **Castlewood Canyon state parks** with the assistance of over **150 NCCC and Americorps volunteers**. **"Nature as Your Neighbor"** was the theme for volunteer activities at both the **Cherry Creek Valley Eco Park** in September and the **17-Mile House Park** in November, the latter bringing over 10 **Southcreek HOA** members in direct contact with watershed habitat efforts right in their neighborhood.

We thank FrontRange Earth Force, Americorps and NCCC, Jr. recruits, and our faithful members who demonstrated that reasonably organized, supervised and motivated volunteers can help us meet our goal of supporting cooperation by sharing resources and knowledge in practical, active ways. The Open Space, Habitat & Trails Committee would like to invite you to join the group for the many and varied field activities scheduled in and around Denver. In 2008, the Committee will:

Sweaty, but happy, volunteers at April 14th "planting day" at 17-Mile House Park Crossing, Cherry Creek

- Co-host a **Weed Conference** in February with the Water Quality Committee
- Demonstrate restoration and management techniques promoting important natural functions of the watershed that provide many public benefits by enhancing water quality,
- Offer volunteer opportunities for community groups and individual interested parties;
- Continue a 'range management' project which has implications for agricultural practices in the Cherry Creek basin

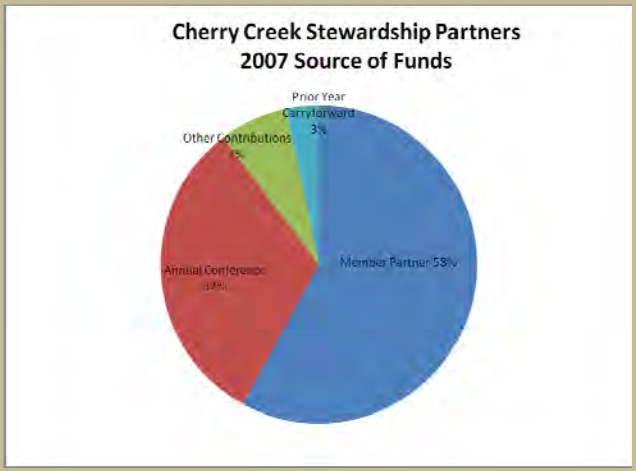
Contact Toby Sprunk @ tsprunk@douglas.co.us

Open Space, Habitat & Trails Committee

"Colorado Cares Day" at the Cherry Creek State Park with Governor Ritter

Cherry Creek Stewardship Partners
2007 Annual Report
January 2008

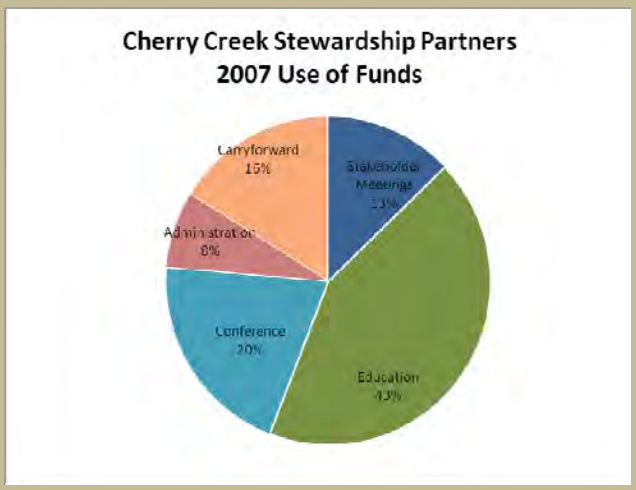
Partners 2007 Financial Data



The Pie Charts to the left present relative income (Source of Funds) and expenditures (Use of Funds) for the various projects & programs of the Cherry Creek Stewardship Partners for 2007.

Our Work Plan is broken down into several main categories, including: Education and Outreach, Annual Conference, Stakeholder Meetings & Website, and Administration (detailed below). We continue to receive financial support from our member partners, including the Cherry Creek Basin Water Quality Authority, as well as the many land use agencies in the watershed. In 2007, the CBWQA provided $17,000 of our member funds, with the remaining $20,000 of operating funds provided by MS4's, interested corporations, special districts, and others. We will continue to seek funds from our members, and State and Federal grants, as we continue our mission of providing a forum for basin information, stewardship education and regional collaboration.

For more information on any of our programs you may check our website, www.cherry-creek.org or contact Casey Davenhill at casey@cherry-creek.org.



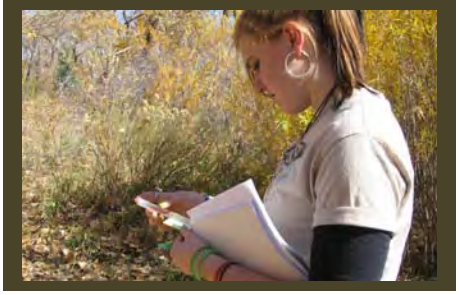
SOURCE OF FUNDS		USE OF FUNDS	
Member Contributions	$37,000*	Education & Outreach	$26,837
Annual Conference	$20,291	Annual Conference	$12,693
Other funds	$4,500	Stakeholder Mgs/Website	$7,937
Carryforward	$2,091	Administrative	$4,680
		Carryforward	$10,036
*CCBWQA contributed	$17,000		
Total	$63,882	Total	$62,183

Partners Assist MS4's in Watershed

In 2007, the Partners assisted the 11 regulated Phase I and Phase II MS4 communities that have ties to the Cherry Creek & South Platte watersheds, including Denver, Aurora, Glendale, Littleton, Greenwood Village, Centennial, Parker, Castle Rock, as well as the counties of Arapahoe and Douglas, and Cherry Creek State Park. Efforts ranged from hosting public events for education and public participation purposes, like the **Enhanced BMP workshop** (Program 5), and the **Annual Conference**, the **Run for the Watershed**, and the **Aurora Water Festival** (Programs 1 and 2), to implementing educational programming for area schools and civic groups, like the **Science Fairs, Project WET**, and in-school efforts @ **West Middle, Swanswa, PS1, Runyon and Morey schools**, and **Girl Scout Troop #XXX** (Programs 1 & 2) using the Partners **"EdKit"**. The Partners goal for 2008 is to formalize this educational program for the new 5 year permit term and make it available to the MS4 communities.

Contact Casey @ 303-345-1675

Educational outreach to students in 2007



Join us….

We invite you to join us as the Partners continue to provide stewardship opportunities for all manner of organization, agency, business or citizen. Visit our website, www.cherry-creek.org, and join us at our next Forum, Conference or Volunteer Day. We do need your financial support and have identified levels of support as follows:

- Community Group/Nonprofits: $100 - $500
- Special Districts/Other: $350 - $500
- Corporations: $500 - $1,000
- Groups with Educational Mandate: $500 - $2,000
- MS4 Permittees: $2,000 - $5,000
- Conference support: $150 - $3,000 (depending on activity sponsored)

If any of the activities in this Annual Report interest you, give Casey a call or email her at casey@cherry-creek.org. We look forward to working with you!

Cherry Creek Stewardship Partners

2007 Annual Report

"Providing a forum for promoting stewardship of the Cherry Creek Watershed"

January 2008

CHERRY CREEK BASIN
WATER QUALITY AUTHORITY

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ANNUAL REPORT ON ACTIVITIES