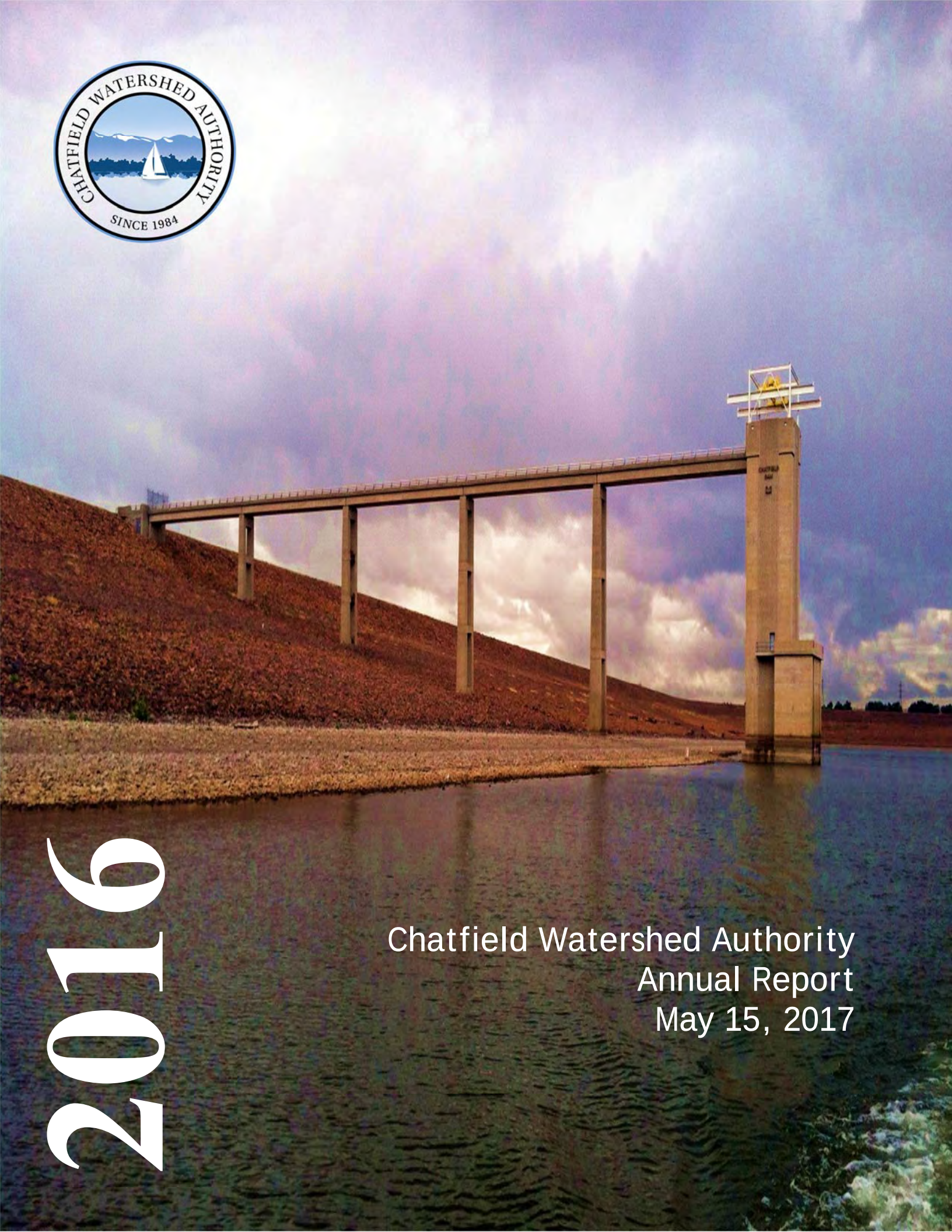
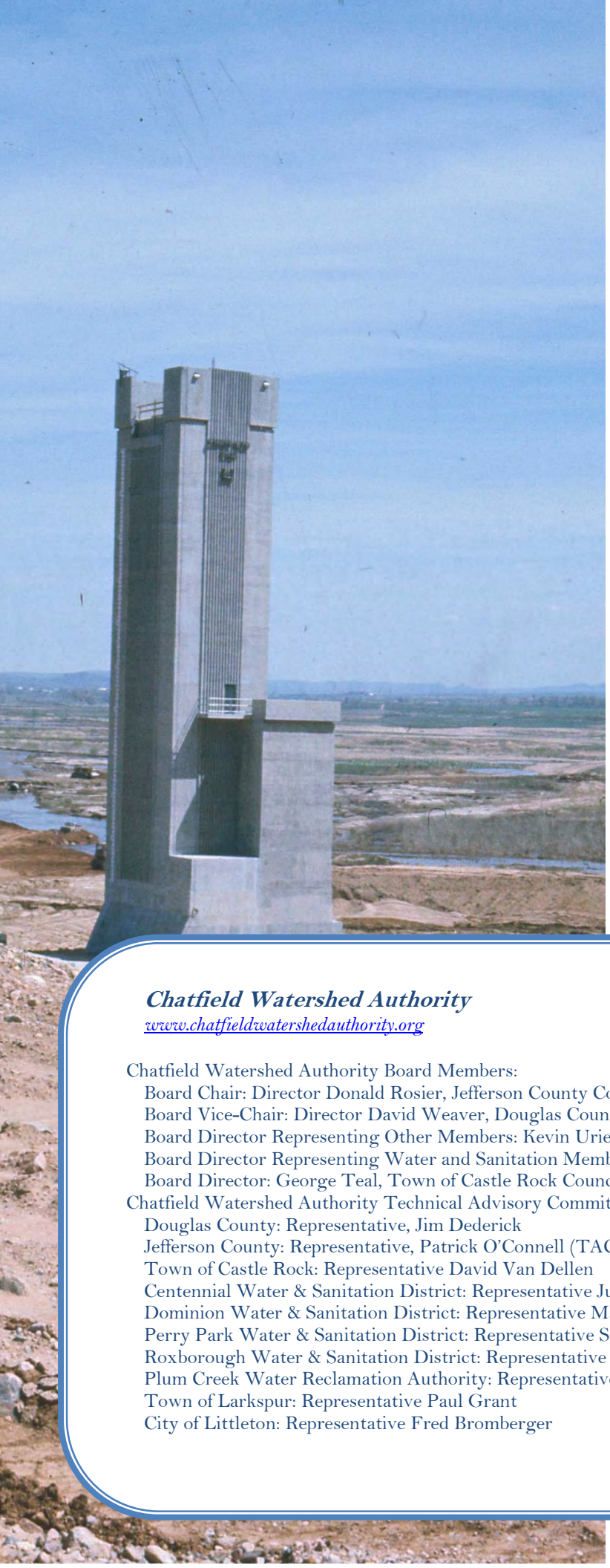


2016

Chatfield Watershed Authority
Annual Report
May 15, 2017



The Chatfield Watershed Authority

The Chatfield Watershed includes over 400-square miles and is comprised of the Plum Creek basin and South Platte River basin (from the outfall of Strontia Springs Reservoir to Chatfield Reservoir, including the Massey Draw and Deer Creek sub-basins). Figure 1 below shows the Chatfield Watershed Authority Member entities.

On April 26, 2016 the Chatfield Watershed Authority approved an amended Intergovernmental Agreement (IGA) and bylaws. The new 5-member Board of Directors is comprised of elected officials representing Jefferson and Douglas counties, Town of Castle Rock, one wastewater district representative and one representative for other members. The Board continues to implement Control Regulation #73 and meet quarterly to address policy and fiscal issues. The Technical Advisory Committee is a standing committee that meets monthly to address technical and scientific matters, serving at the pleasure of the Board. Other standing committees may be formed to address specific issues at the Board's request.

Chatfield Watershed Authority
www.chatfieldwatershedauthority.org

Chatfield Watershed Authority Board Members:
- Board Chair: Director Donald Rosier, Jefferson County Commissioner
- Board Vice-Chair: Director David Weaver, Douglas County Commissioner
- Board Director Representing Other Members: Kevin Urie, Denver Water
- Board Director Representing Water and Sanitation Members: Larry Moore, Roxborough Water & Sanitation District
- Board Director: George Teal, Town of Castle Rock Councilman

Chatfield Watershed Authority Technical Advisory Committee (TAC):
- Douglas County: Representative, Jim Dederick
- Jefferson County: Representative, Patrick O'Connell (TAC Chair)
- Town of Castle Rock: Representative David Van Dellen
- Centennial Water & Sanitation District: Representative Julie Tinetti
- Dominion Water & Sanitation District: Representative Mary Kay Provaznik (TAC Vice-Chair)
- Perry Park Water & Sanitation District: Representative Scott Monroe
- Roxborough Water & Sanitation District: Representative Ronda Sandquist
- Plum Creek Water Reclamation Authority: Representative Weston Martin
- Town of Larkspur: Representative Paul Grant
- City of Littleton: Representative Fred Bromberger

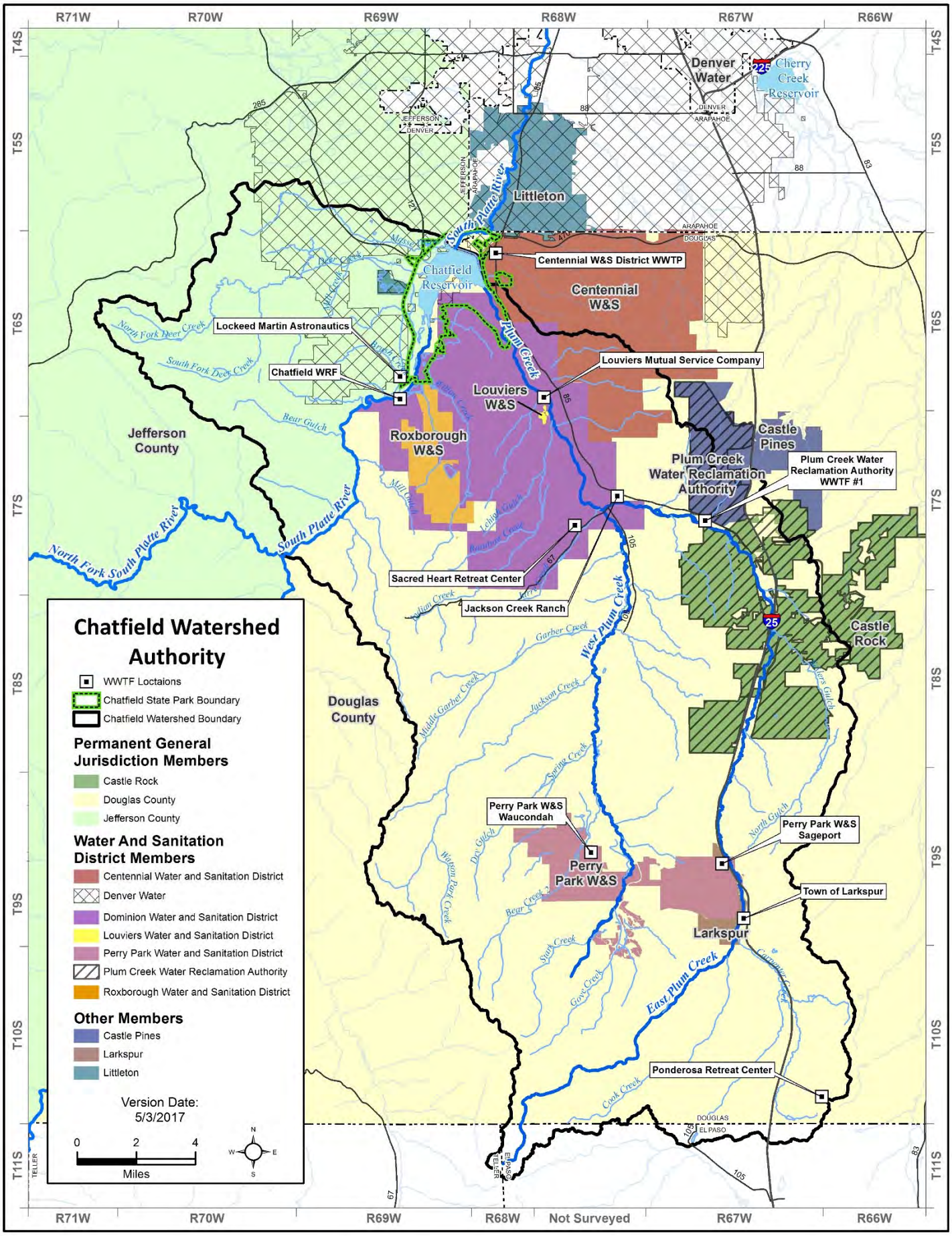


Figure 1. Chatfield Watershed Authority Member Entities

Reservoir Regulatory Compliance

In 2016, Chatfield Reservoir was in compliance with Regulation 38 chlorophyll-*a* (chl-*a*) and phosphorus standards (Regulation 38, Water Quality Control Commission 5 CCR 1002-38).

Chlorophyll-*a*

The chlorophyll-*a* standard in the reservoir is 10 µg/L, with an allowable exceedance frequency of 1 in 5 years. The Commission directed that compliance with the standard be evaluated using an assessment threshold of 11.2 µg/L. The chl-*a* growing season (July through September) average in 2016 was 16.2 µg/L, which is above the assessment threshold. However, there has only been one exceedance in the last 5 years; the reservoir remains in compliance with the standard (Figure 2).

Observed 2016 chl-*a* concentrations in Chatfield Reservoir are depicted in Figure 3. Chlorophyll-*a* levels were met for July and August, but spiked in September. The chl-*a* began to drop in October (Figure 3).

The chl-*a* concentrations observed are a function of nutrient availability from reservoir inputs and internal loading, and other conventional reservoir parameters including dissolved oxygen, temperature, and pH. Chl-*a* is composed of many types of algae. In 2016, cyanobacteria (phylum *Cyanophyta*) concentrations ranged from 64 to 5,260 algal cells/mL, with highest concentrations occurring in April (Figure 4). These algae (genera *Anabaena*, *Ankistrodesmus* and *Aphanocapsa*) typically correspond with elevated chl-*a* measurements. Specific species of cyanobacteria can convert nitrogen gas to biologically available forms of nitrogen, serving as an additional source of nitrogen to the reservoir system. Cyanobacteria were a predominant algae observed on July 11, 2016 and September 26, 2016 (Figure 5).

Total Phosphorus

The total phosphorus (TP) growing season average was 29.1 µg/L, which is below the standard of 30 µg/L, with an assessment threshold of 35 µg/L, and a 1 in 5 year allowable exceedance frequency (Figure 6). The monthly TP concentrations observed in 2016 in Chatfield Reservoir are shown in Figure 7.

A review of TP compliance with the water quality standard from 1983 to 2016 is illustrated in Figure 6. The TP growing season average has remained below the water quality assessment threshold of 35 µg/L since the standard changed in 2009.

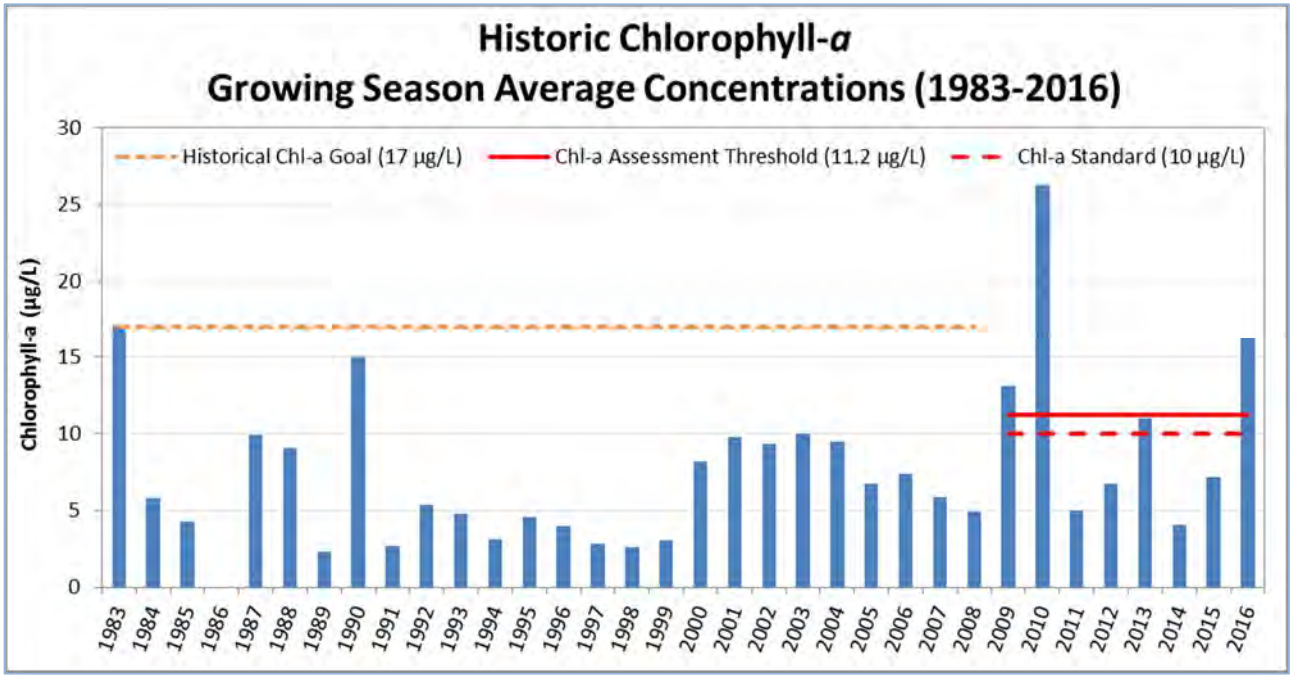


Figure 2. Growing Season Average Chlorophyll-α Concentrations, Chatfield Reservoir, 1983-2016.

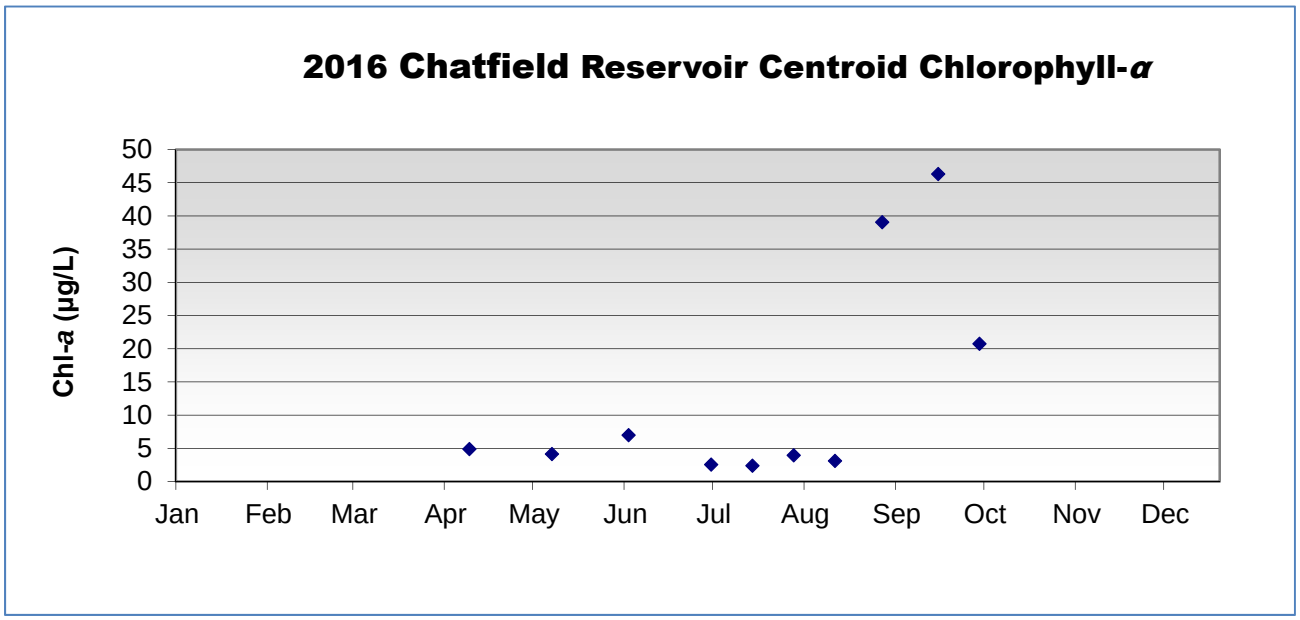


Figure 3. Monthly Chlorophyll-α Concentrations, Chatfield Reservoir, 2016.

The July-September growing season average in 2016 was 16.2 µg/L, which is above the assessment threshold of 11.2 µg/L (see Figure 2). Regulation 38 specifies an allowable exceedance frequency of 1 in 5 years; therefore, in 2016 Chatfield Reservoir continued to be in compliance with the chlorophyll-*a* water quality standard.

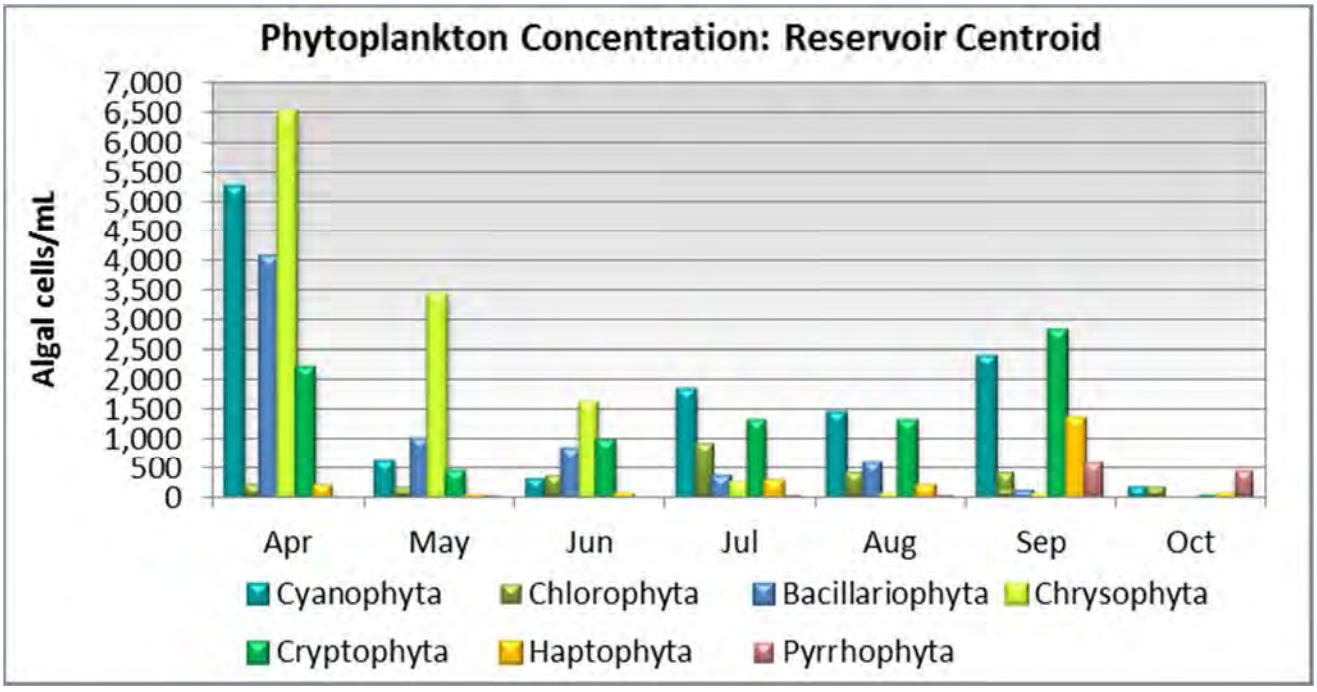


Figure 4. 2016 Phytoplankton Monthly Summary - Phytoplankton samples taken in the Reservoir during 10 sampling events from April through October 2016. Cyanophyta, also sometimes called blue-green algae, are shown to peak in April at 5,260 algal cells/mL.

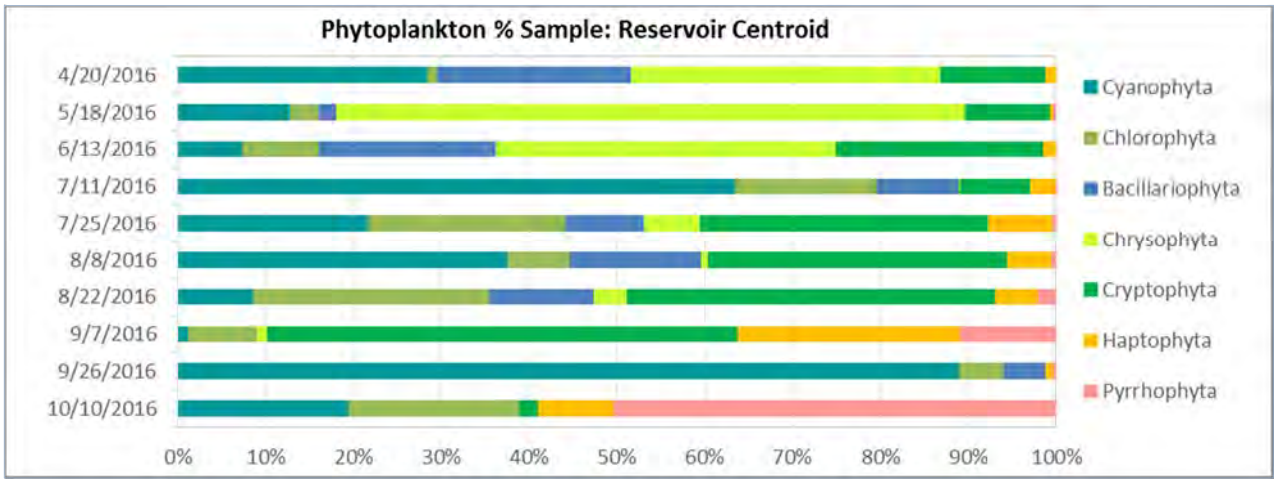


Figure 5. 2016 Phytoplankton Speciation Variability – Cyanophyta (cyanobacteria) were a predominant algae observed in July and September.

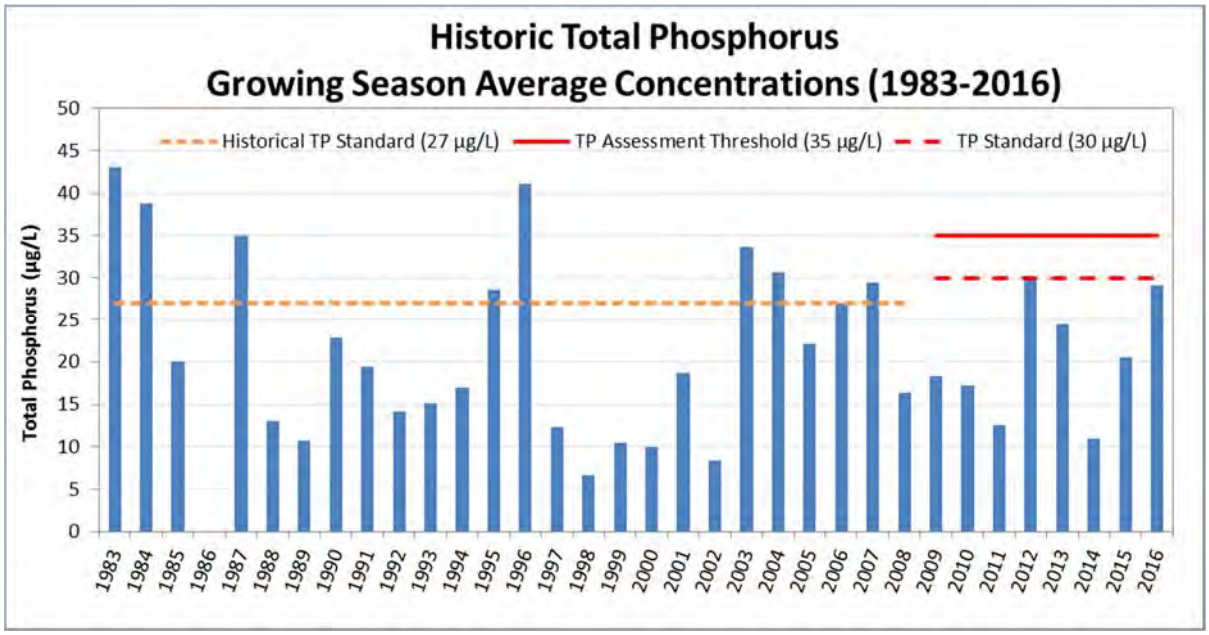


Figure 6. Growing Season Average Total Phosphorus Concentrations, Chatfield Reservoir, 1983-2016.

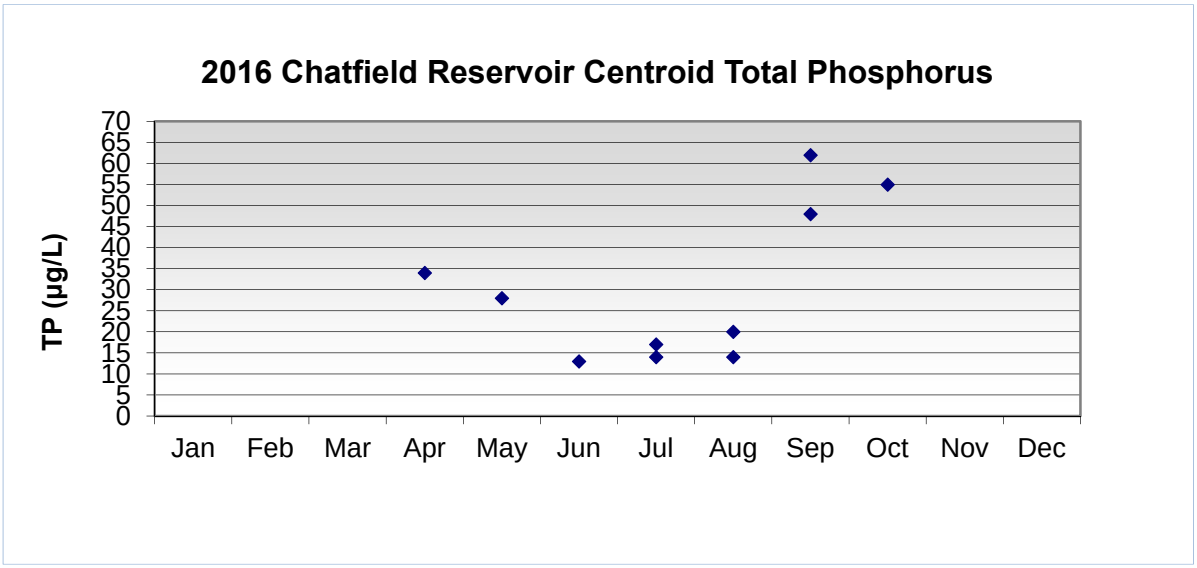


Figure 7. Monthly Total Phosphorus Concentrations, Chatfield Reservoir, 2016.

The July-September growing season average in 2016 was 29.1 µg/L, which is below the assessment threshold of 35 µg/L (see Figure 6). In 2016 Chatfield Reservoir continued to be in compliance with the total phosphorus water quality standard.

Compliance with the TMAL

The phosphorus Total Maximum Annual Load (TMAL) of 19,600 pounds/year at a median flow of 100,860 acre-feet/year was revised by the WQCC in 2009 based upon statewide reservoir data and a probabilistic model describing the linkage between watershed TP loads and in-lake TP concentrations. The WQCC acknowledged that progress towards development of revised phosphorus allocations to achieve the revised TMAL is contingent on suitable funding to support data and modeling needed to re-partition loads between the South Platte River and Plum Creek, reallocating loads within each basin, and revising wasteload allocations, as appropriate.

In 2016, the Authority completed the development and calibration/validation of a watershed model. Additional stream, precipitation, and stormwater quantity and quality data would be needed for the model to next be applied to identify TP sources, its locations, and net contributions to the Reservoir. However, the Chatfield Reallocation Mitigation Company's reservoir model (required as part of the water quality adaptive management program) needs to be developed first. The reservoir model will be used to show the results differing watershed management strategies would have on the reservoir. In 2017 and 2018, the Authority is coordinating with the Chatfield Reservoir Mitigation Company to develop a site-specific Chatfield Reservoir model.

2016 TP Concentrations – Instream and Reservoir

Observed 2016 monthly TP concentrations of South Platte and Plum Creek inflows, Chatfield Reservoir outflow and Chatfield Reservoir are depicted in Figure 8. Plum Creek TP concentrations were highest for all months of the year in comparison to measurements observed elsewhere in the watershed (except for in September when the Reservoir Outflow TP was greater than the TP concentration measured in Plum Creek).

Calculated TP Load

The 2016 annual TP load to the Reservoir totaled 31,472 pounds at an inflow of 189,711 acre-feet (see Figure 9). This is compared with the TMAL of 19,600 pounds at an inflow of 100,860 acre-feet.

The relative TP loading from sources is typical compared to historic TP inputs. This year, TP loading from Plum Creek was 22,331 pounds, or 71% of total input, compared to 8,379 pounds from the South Platte River, or 27% of total input. Direct precipitation on Chatfield Reservoir and alluvial inflows and other direct flow sources contributed approximately 689 pounds, or 2% of total input. A comparison of the inflow and TP load contributions is presented in Figure 10.

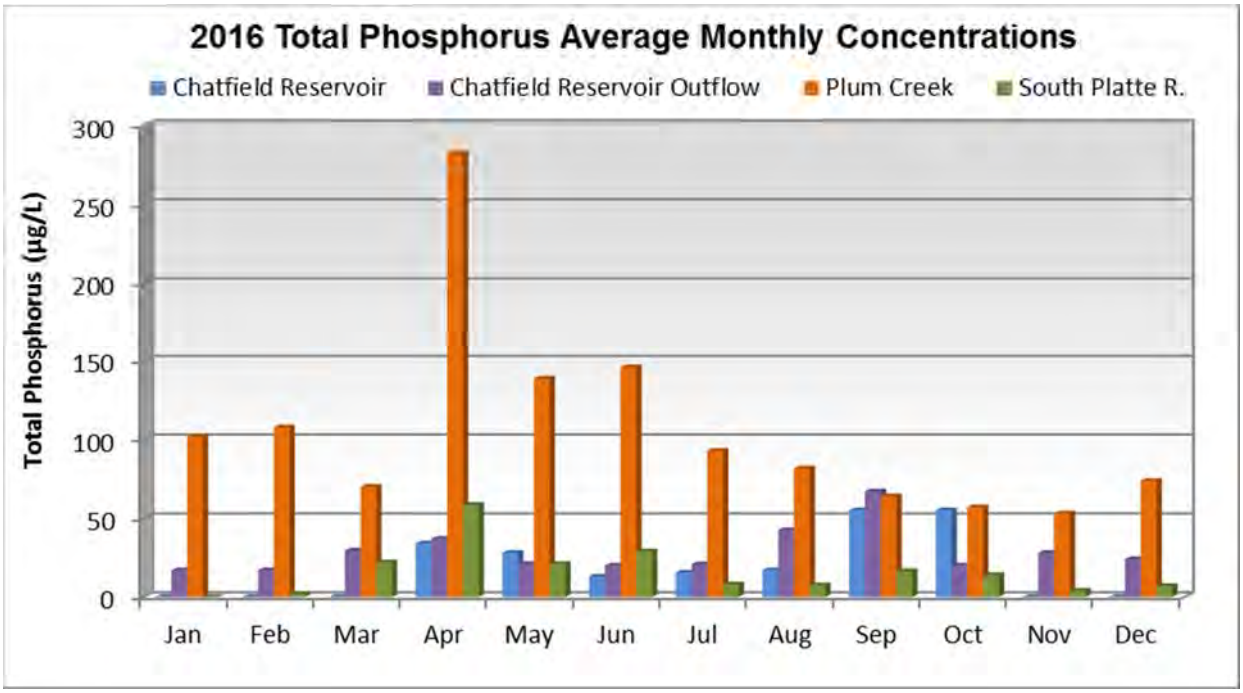


Figure 8. Average Monthly TP Concentrations in the Chatfield Watershed and Chatfield Reservoir.

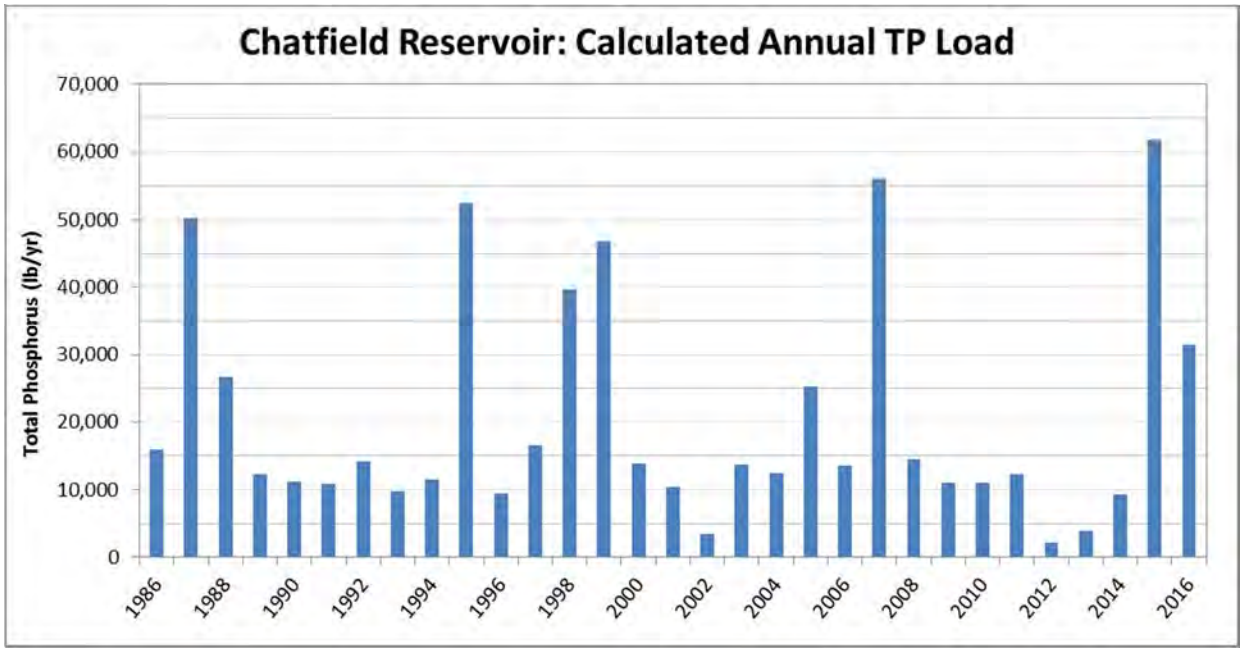


Figure 9. Calculated TP Load to Chatfield Reservoir (1986 – 2016).

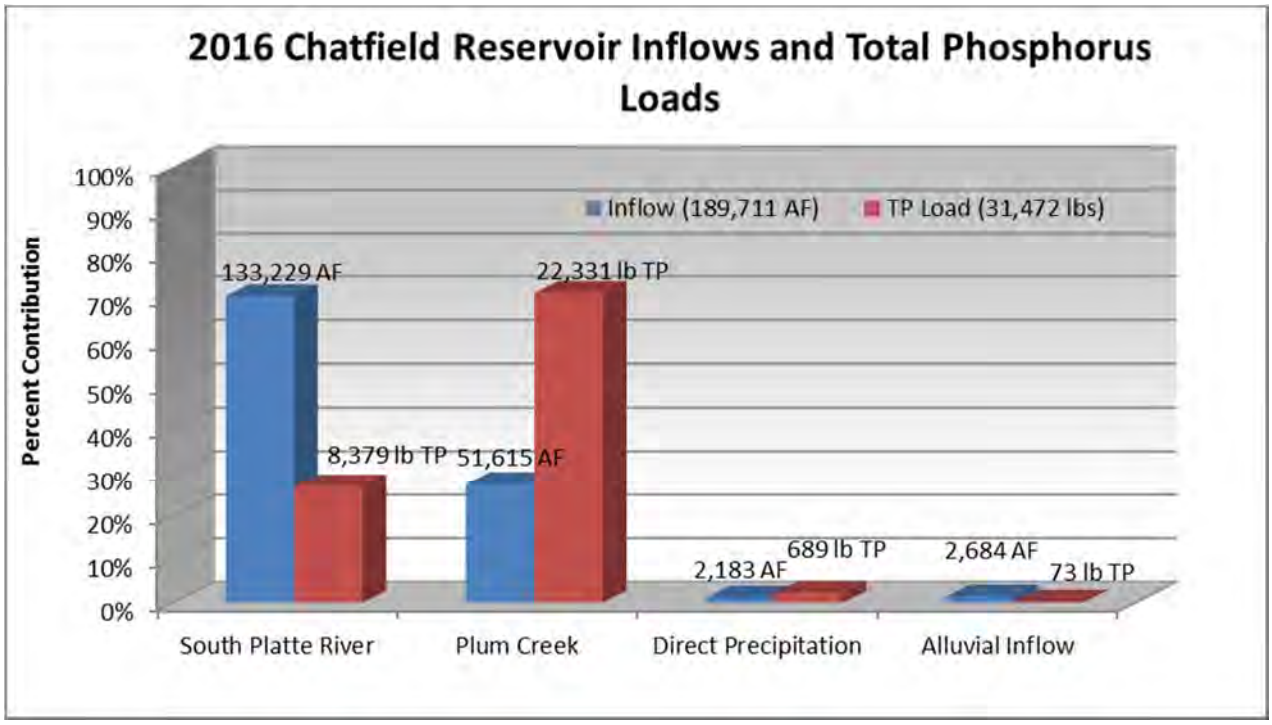


Figure 10. 2016 Comparison of Chatfield Reservoir Inflows and TP Loads.

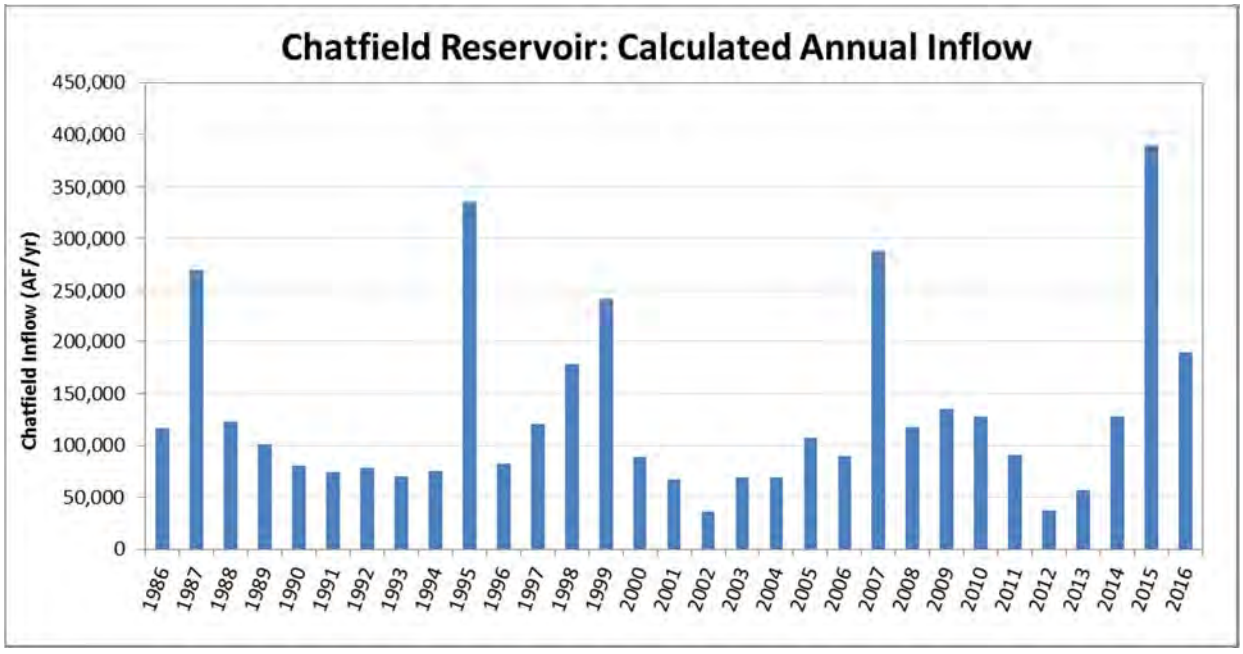


Figure 11. Chatfield Reservoir Calculated Annual Inflow (1986 – 2016).

Reservoir Monitoring Program

The Authority maintains a monitoring program to characterize Reservoir water quality and determine regulatory compliance. Surface water samples are collected by Denver Water, Centennial Water and Sanitation District, and Colorado Parks and Wildlife (Figure 12). These locations include:

- South Platte River at Waterton Road,
- Plum Creek at Titan Road,
- South Platte River below Chatfield, and
- Chatfield Reservoir (centroid, South Platte arm and Plum Creek arm).

The constituents are monitored monthly when ice has melted off the Reservoir. During the growing season (July through September), Reservoir sampling is conducted twice monthly. To better understand reservoir dynamics, the Authority collects water column measurements, including the epiliminion and hypoliminion layers, at various depth intervals. All water quality data are available on the Authority's website, located at www.chatfieldwatershedauthority.org.

Plum Creek Watershed Monitoring Program

In 2016, the Authority continued the watershed monitoring efforts at locations illustrated in the map below. In the Plum Creek basin, watershed monitoring continues through voluntary sampling efforts by the Plum Creek Water Reclamation Authority (PCWRA).

The objective of Plum Creek monitoring program is to better characterize water quality in Plum Creek and identify potential nonpoint source pollutant sources. A variety of potential nonpoint sources have been identified in the Chatfield Watershed, including stormwater runoff from historic urbanized and rural areas, leachate from unmaintained septic systems, agricultural activities, including runoff from overgrazed agricultural lands, runoff from wildfire burn areas, runoff from impervious areas, and erosion from degraded streambanks (Chatfield Watershed Plan, May 2015).

Further data collection is needed, contingent on available resources, to identify and quantify phosphorus sources in the Plum Creek watershed.

The 2016 Plum Creek water quality observations included the following:

- Streambank Erosion: There is major streambank erosion on Plum Creek in the State Park. As depicted in the below, this eroding area is contributing significant sediment, and likely TP. As part of the mitigation for the Chatfield reallocation, a portion of this sediment of Plum Creek is proposed to be stabilized. Additional stabilization on Plum Creek will continue to be evaluated by watershed stakeholders.

- ***E. Coli*:** Consistent with 2015 year, *E. coli* measurements are higher and have less variability at EPC-11.1 (East Plum Creek above confluence with Plum Creek) compared to other sites in Plum Creek watershed. Although variability is evident at all sites, central tendency of observed *E. coli* remains below the water quality standard of 126 organisms/100 mL (Figure 13), with the exception of site PC-3.5 (Plum Creek at Titan Road) which had a median value of 190.4 organisms/100 mL. In 2015, the Authority commenced a molecular source tracking monitoring program to help understand potential sources of *E. coli* (human, horses, cattle, beaver, etc.) No sampling occurred in 2016 due to insufficient *E. coli* levels in the stream. The sources of *E. coli* in 2015 in East Plum Creek, West Plum Creek and at the inlet to the Reservoir were all from human, horses, cattle, beaver and general bacteriodetes.

- **Total Phosphorus:** TP concentration generally increased from upstream to downstream along East Plum Creek (Figure 14). There were no significant spatial trends found in West Plum Creek or Plum Creek. TP concentrations have historically been observed to be relatively high at the East Plum Creek above Plum Creek confluence, compared to other sites in Plum Creek watershed. In 2016, average TP observed at this site was 296.3 µg/L compared to the 2015 average of 220.5 µg/L. Consistent with 2015 this was the highest TP value in 2016 compared to all other sites. In 2016, all sites with the exception of WPC-10.9 (West Plum Creek upstream of Perry Park) and EPC-20.7 (East Plum Creek upstream of Larkspur) observed higher average values than they did in 2015.

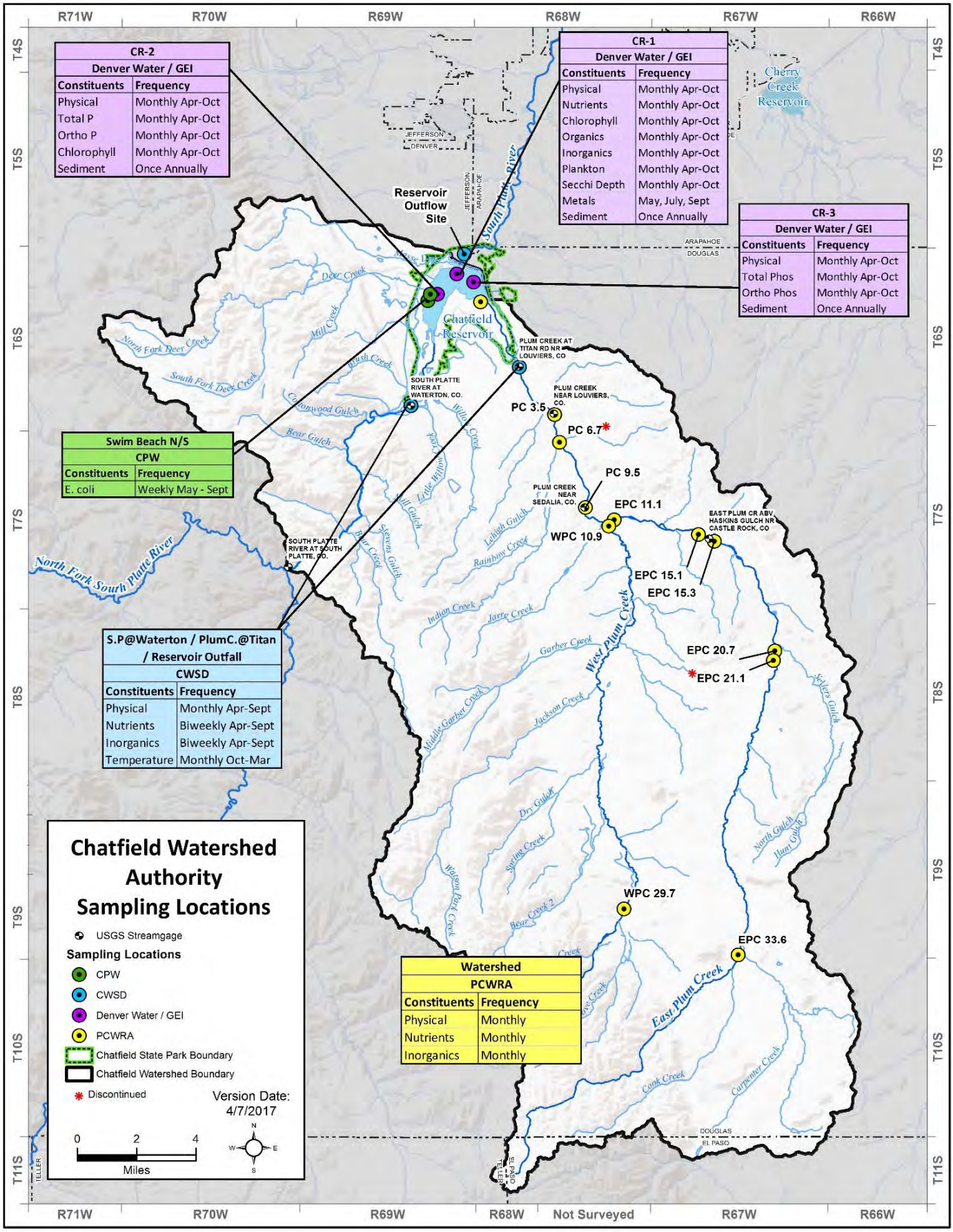


Figure 12. Chatfield Watershed Authority Sampling Locations

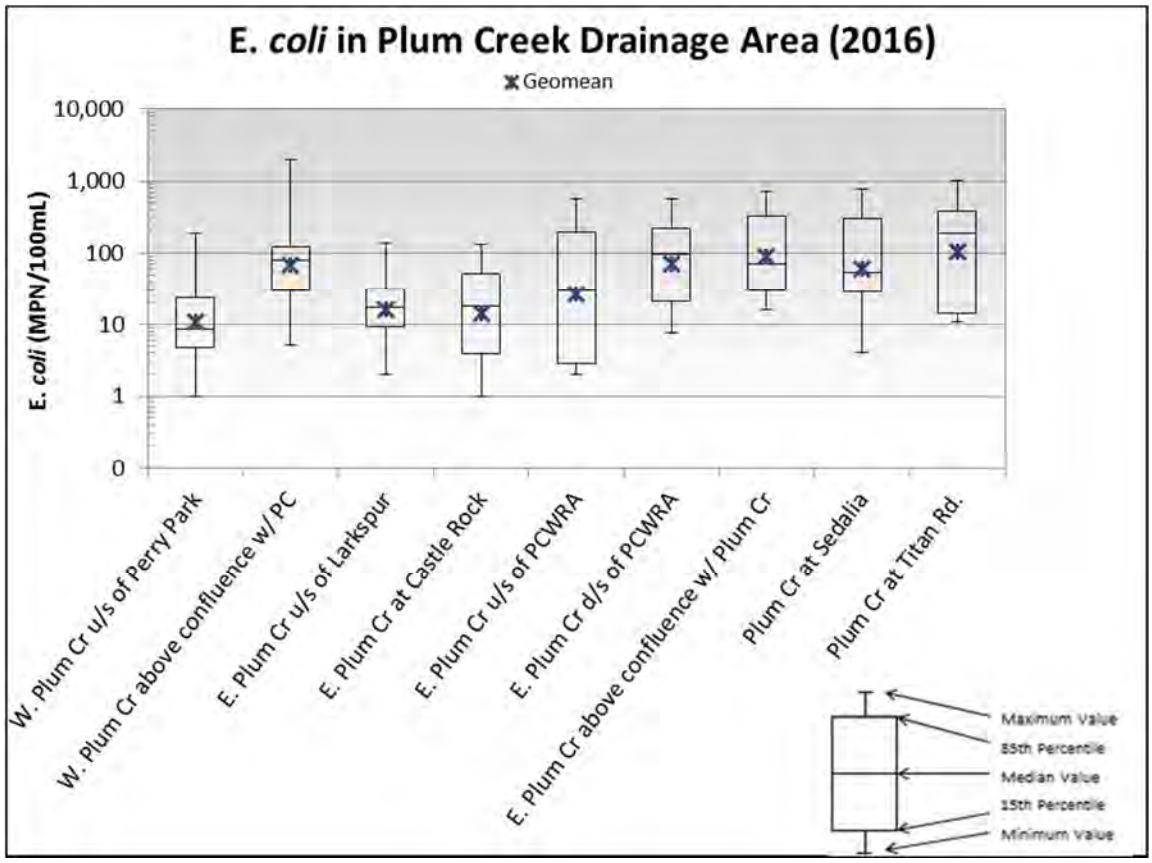


Figure 13. *E. coli* in Plum Creek Drainage Area, 2016.

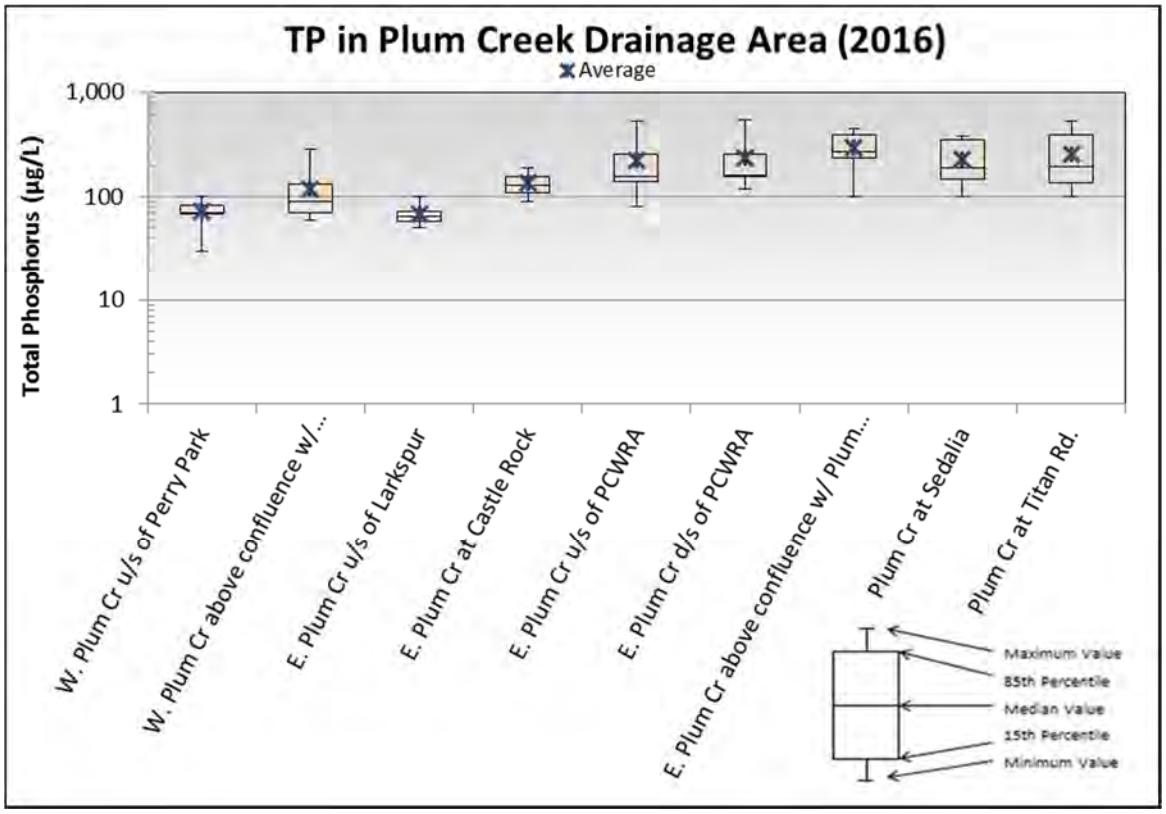


Figure 14. 2016 Total Phosphorus Variability in the Plum Creek Basin.

- **Total Suspended Solids:** The average TSS concentration (an indicator of sediment and high precipitation events) were greater in 2016 compared to the previous year. The highest average TSS concentration observed in 2016 was at East Plum Creek above the confluence with Plum Creek (350 mg/L), this was also the highest average TSS site in 2015 (134 mg/L) (Figure 15). The only site that did not increase in average TSS over the past year was site EPC-20.7 (East Plum Creek upstream of Larkspur), which was 9.9 mg/L in 2016 compared to 4.9 mg/L in 2015. Almost all of the other sites doubled if not tripled the 2015 average TSS concentration in 2016.

- **Total Phosphorus vs. Total Suspended Solids:** The relationship between TP and TSS is complex. The highest TSS and TP data collected in the watershed occurred during the spring runoff months during high flow, (April-June). Additionally, TP and TSS has an increasing trend through the watershed. The TP vs TSS relationship, along with identification of potential nonpoint sources of TP, will be further evaluated as monitoring in Plum Creek basin continues.

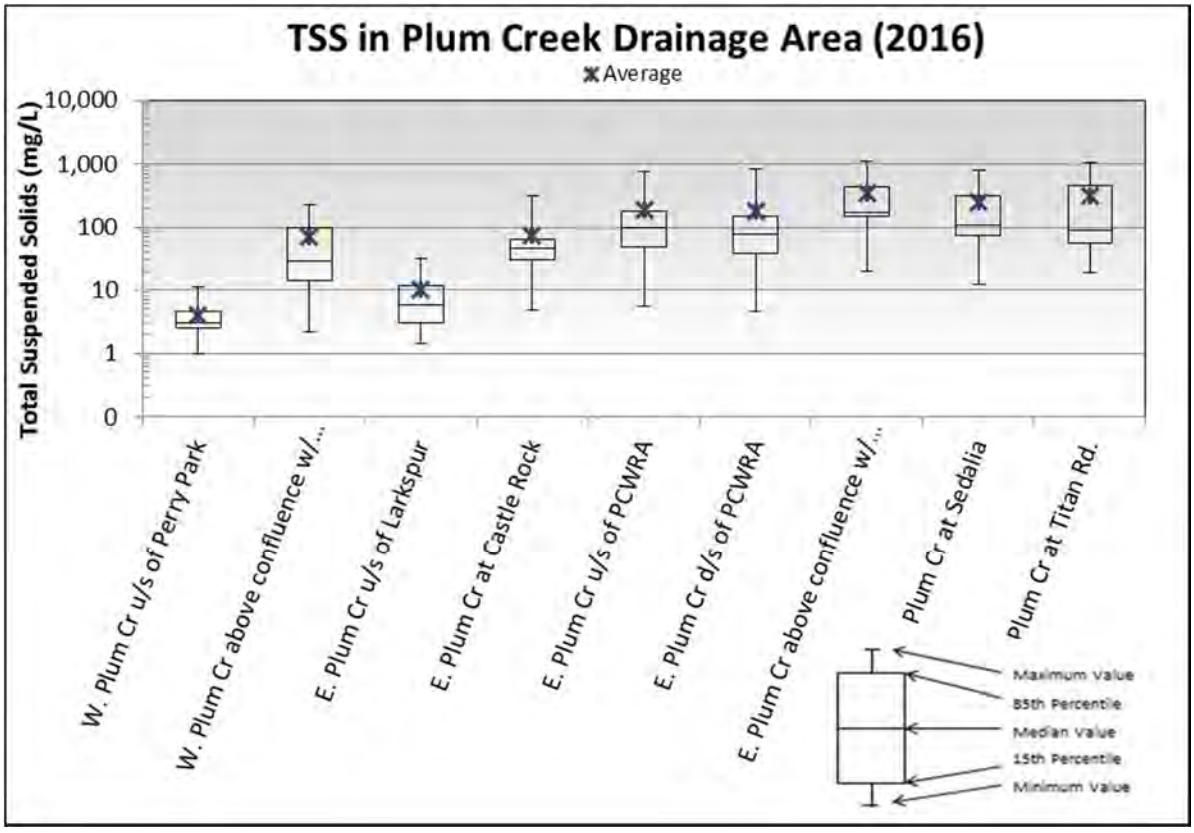


Figure 15. 2016 Total Suspended Solids Variability in the Plum Creek Basin.

Wastewater Treatment Plants

Table 1 summarizes the wastewater treatment plants (WWTPs) in the Chatfield watershed and their respective TP wasteload allocations. In 2016, reported TP discharges from WWTPs were approximately 2,433 pounds or 32% of the allowable wasteload allocation of 7,533 pounds.

Wastewater providers treat effluent to meet TP load allocations and a TP concentration pursuant to Control Regulation #73. Their monitoring and reporting of effluent discharges demonstrates compliance with their individual permits and the state regulations. During 2016, the discharges maintained their record of compliance, with every discharger in the Chatfield Watershed complying with their TP concentration limits and TP wasteload allocation.

Table 1. 2016 Phosphorus Wasteloads from WWTPs in the Chatfield Watershed

Allocation Sources	TP Wasteload Allocation (pounds)	2016 TP Loading from WWTPs* (pounds)
Plum Creek Water Reclamation Authority	4,256	2,257
Perry Park Water and Sanitation District: Waucondah	365	66.90
Perry Park Water and Sanitation District: Sageport	73	44.50
Lockheed Martin Space Systems Company	1,005	40.00
Town of Larkspur	231	18.37
Centennial Law Enforcement Foundation	30[1]	5.80
Centennial Water and Sanitation District	20	0.00
Ponderosa Retreat Center	75[2]	Lysimeter has insufficient flow for sampling[4]
Louviers Water and Sanitation District	122	No discharge[5]
Roxborough/Dominion Water and Sanitation District	1,218	No discharge[5]
Sacred Heart Retreat	15[3]	0.39
Jackson Creek Ranch	50	No reporting data available
Reserve Emergency Pool	73	Not Used
Total Phosphorus Wasteload	**7,533**	**2,433**

Notes:

*TP loading from WWTPs is from the WWTP point of discharge; the TP load discharged from WWTPs does not equate to the TP load delivered to Reservoir due to assimilation of TP and geochemical fate and transport processes in the watershed.

1. Centennial Law Enforcement Foundation water quality credits awarded pursuant to Authority's Trading Program.
2. Ponderosa Retreat Center water quality credits are subject to completing a trade project pursuant to the Authority Trading Program.
3. Temporary five-year phosphorus allocation of 15 pounds for inclusion in discharge permit; allocation obtained from Roxborough Water and Sanitation District.
4. Source: Environmental Protection Agency Integrated Compliance Information System database thorough the third quarter (October 31, 2016).
5. No discharge of wastewater effluent reported in the Chatfield watershed.

Recommendations on Clean Water Plan Amendments, New or Proposed Expansion of WWTPs, Lift Stations, and Land Use Referrals

As the 208 Management Agency, the Authority reviews Clean Water Plan (CWP) Amendments, Site Applications, Engineering Reports for new or proposed facilities to effectively manage waste treatment works and related facilities serving Chatfield Basin, and land use referral in conformance with the water quality management plan and regulatory requirements.

Site Application: The Authority reviews, comments, and makes recommendations to the Water Quality Control Division for site location applications for domestic wastewater treatment works (including lift stations and sewer lines) that are submitted to the Authority, as required by Colorado's Site Location and Design Approval Regulations for Domestic Wastewater Treatment Works (Regulation 22). Regulation 22 requires that each application for site location approval of a domestic wastewater treatment works shall be reviewed to ensure that the existing treatment works will not be overloaded when connecting new lift stations and that the proposed treatment works have been properly reviewed by all appropriate local, state, and federal government agencies and 208 planning agencies.

In 2016, The Authority reviewed the Castle Pines Village Filing # 40 Lift Station project for compliance with the Chatfield Reservoir Control Regulation No. 73. Under this regulation, the Authority is to implement the total maximum annual load allocation for total phosphorus loading to the Reservoir. The project connects to the PCWRA treatment facility. The allowed annual phosphorus wasteload for the PCWRA treatment plant is 4,256 pounds per year. The Authority worked with the applicant and PCWRA to ensure that it has adequate design capacity to treat the wastewater conveyed by the new lift station, and the facility will not require an expansion or modifications to its existing treatment processes in order to receive the additional wastewater. The "additional flow" is a component of existing Castle Pines Metro District capacity and will not impact the plant's design capacity.

Land Use Referrals: In 2016, The Authority reviewed five land use referrals from Douglas County, Castle Rock, and the Town of Larkspur. The Authority reviewed the projects for compliance with the Chatfield Reservoir Control Regulation No. 73. The following land use referrals were reviewed and commented on:

- Town of Larkspur Truck Stop (Commercial),
- Douglas County Roxborough Downs Filing 2, 5th Amendment (Residential),
- Douglas County Castle Pines Village Filing No. 40 (Residential),
- Douglas County Sterling Ranch Preliminary Plan No. 2 (Residential),
- Town of Castle Rock Industrial Park (Commercial)

The Authority took no exception to the above projects, because the projects complied with Control Regulation No. 73.

Regulated Stormwater Sources

Table 2. Summary of 2016 MS4 Permit Activities

Land Use Agency	Permit Inspection Actions			Permit Enforcement Actions		
	Illicit Discharges	Construction	Post Construction	Illicit Discharges	Construction	Post Construction
Douglas County	7	4,076	109	1	47	21
Jefferson County	9	1,173	4	9	34	0
Town of Castle Rock	19	3,699	363	13	1,145	2
City of Littleton	0	9	5	0	0	0

Notes: Castle Pines Metro District inspection and enforcement action data incorporated in Douglas County reporting; City of Castle Pines MS4 boundary predominately in the Cherry Creek Basin; only a very small portion is located in the Chatfield Watershed.
Town of Castle Rock inspected and enforcement action data includes data from the Cherry Creek Basin. Town of Castle Rock MS4 boundary is predominately in the Chatfield Basin; about two-thirds of the Town is located in the Chatfield Watershed.

Colorado's stormwater permit program requires control of stormwater runoff in all Phase I and Phase II Municipal Separate Storm Sewer Systems (MS4) entities. These requirements are separate and distinct from the Chatfield Control Regulations, but complement the TMAL's purpose. Through the efforts of the MS4's, rate payers have spent significant funds to address water quality through implementing projects to mitigate impacts from urban stormwater runoff.

Authority members with Phase I and II MS4 permits in the Chatfield Basin include (as shown in Figure 16):

- Statewide General Permit (COR090000)
  - Jefferson County
- Non-Standard General Permit COR070000)
- Cherry Creek Reservoir General Permit (COR080000)
  - Douglas County
  - City of Castle Pines
  - Town of Castle Rock
- Individual/Other Permit
  - City of Littleton
  - Castle Pines Metropolitan District
  - Colorado Department of Transportation

General MS4 permits require the permittee to develop programs that meet six minimum control measures:

- Public education and outreach on stormwater impacts
- Public participation and involvement
- Detection and elimination of illicit connections and discharges
- Construction site stormwater runoff control
- Post-construction stormwater management in development and redevelopment
- Pollution prevention/good housekeeping for municipal operations

MS4 permits require implementation of best management practices (BMPs) to reduce pollutants discharged to the "maximum extent practicable." A summary of 2016 MS4 permit inspection and enforcement metrics are provided in Table 2.

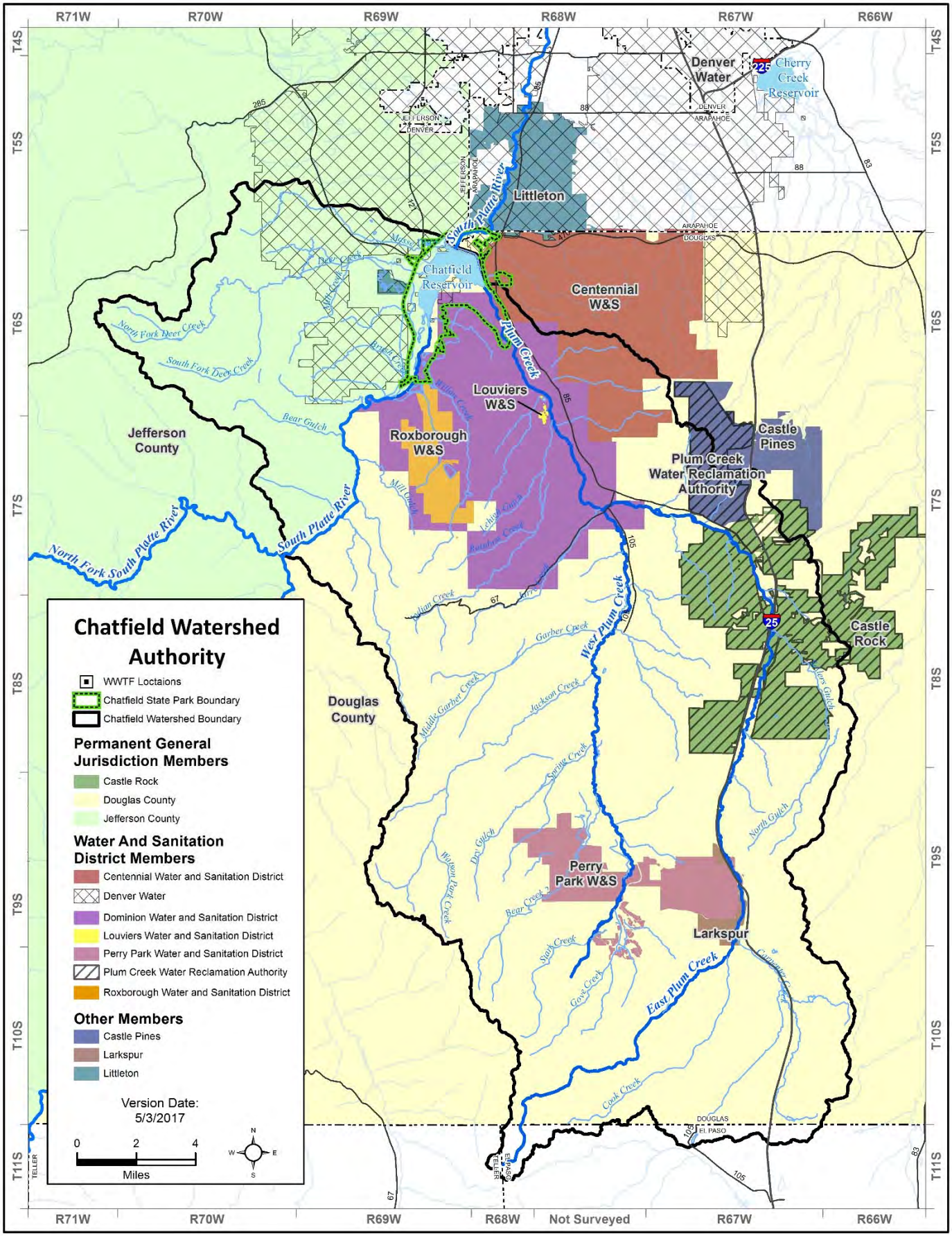


Figure 16. Chatfield Watershed MS4s

Education and Outreach

Jefferson County MS4 Program: Jefferson County participated in a number of public events to reach diverse audiences for their MS4 and floodplain management programs, including providing opportunities for residents and visitors in the watershed to learn and be involved in environmental stewardship and programs that promote water quality. The County has a comprehensive storm sewer outfall map to trace sources of potential illicit discharges and illegal dumping in the watershed. Jefferson County continues to participate with Rooney Road Recycling Facility and in 2016 the facility collected over 604,000 pounds of household hazardous waste. Household hazardous waste (includes electronic waste, household chemicals, paints, propane cylinders and automotive products) materials collected at the Rooney Road Recycling facility since 1994 total more than 6,278,498 pounds of potential surface water and ground water pollutants. This process keeps materials out of septic systems and helps reduce illegal dumping in the watershed.

Jefferson County also maintains an erosion and sediment control program as part of their MS4 permit. The county maintains a small-site erosion control manual that explains the basic principles of erosion control and illustrates techniques to control sediment from small development sites. Jefferson County has an inspection program for illicit discharges, construction activities, and includes post-construction Inspections.

Douglas County: Douglas County, through a county Co-op program, has created the "One Thing is Clear… our creeks, rivers and lakes depend on you" public awareness program. The interactive website provides information for Douglas County residents on how they can work to keep pollution out of their water ways. Additional information can be found on the Douglas County's website on various topics related to Stormwater and Pollution Control.

Town of Castle Rock: The Authority helped to sponsor the Town of Castle Rock's annual "Spring Up the Creek" public outreach event. Spring Up the Creek is a community event to preserve our waterways by removing trash that collects along the stream banks. The 2016 theme was "Don't Trash Where You Splash!" which included 180 volunteers, 192 bags of trash. The event solicited the help from community volunteers to clean up debris along East Plum Creek, Sellars Gulch, and tributaries to the Meadows.

Progress to Promote Water Quality Protection

While funding sources remain very limited, the Authority's collaborative role seeks out partnerships to support our water quality goals now and in the future. In 2016, donations and in-kind services from Authority members to support progress to promote water quality protection included:

- Adopted and implemented an amended Intergovernmental Agreement (IGA) and bylaws to strengthen the governmental structure of our organization including commencing a 5-member Board of Directors comprised of elected officials representing Jefferson and Douglas counties, Town of Castle Rock, one wastewater district representative and one at-large representative and implementing a Technical Review Committee to address technical and scientific matters, serving at the pleasure of the Board. Continued to implement the Chatfield Watershed Plan (completed in May 2015).
- Completed the Chatfield Watershed model in June 2016. As the Authority collects more data, it may discuss using the model to run scenarios to predict the effect of specific water quality controls or projects.
- Monitored Plum Creek to support modeling and nonpoint source identification.
- Collaborated with Chatfield Reservoir Mitigation Company (CRMC) regarding data collection to support upcoming future reservoir modeling efforts. The Authority collaborated with the CRMC to select a modelling consultant, gather data for the model, and data quality control/quality assurance.

Chatfield Watershed Plan

In 2015, the Authority adopted the Watershed Plan. While data collection and modeling are a priority in understanding water quality processes in the Reservoir and Watershed and developing the new TMAL, there is still a need to holistically address nonpoint source water quality issues in Chatfield Reservoir and its Watershed to protect water quality now and in the future.

- Proactive measures are required to protect Chatfield Reservoir for its designated uses for the long term. High quality surface water is essential to sustain growth and development in the watershed.
- Nonpoint sources potentially impact water quality. Nonpoint sources in the watershed may include degraded streambank erosion, runoff over agricultural lands, seepage from unmaintained septic systems located in the floodplain, and wildfire burn areas.

The Watershed Plan prioritizes the additional monitoring, data collection, studies, and projects, contingent on funding, to address water quality concerns. The draft Watershed Plan provides a starting place to define water quality issues, solve potential nonpoint problems, with the goal of promoting water quality for high value water uses; drinking water supplies, recreation, aquatic life, and agriculture.

Watershed Modeling

In 2016, the Chatfield Watershed Model was completed, with some additional data collection and modeling needs identified. FORTRAN (HSPF) was chosen as the model. The model utilized topography, landuse, meteorological data, soils, hydrology, diversions and return flows, water quality data, and atmospheric deposition data inputs. The purpose of the Watershed Model was to determine phosphorus loading in the Chatfield Watershed and have a tool to predict pollutant loads and source identification. The model identified the following:

Total Phosphorus: The simulated total phosphorus load to Chatfield reservoir was compared to the phosphorus load estimated in the Authority's annual reports. The simulated phosphorus loads on the South Platte River and Plum Creek are slightly underestimated compared to the reported annual loads (percent bias -6.2% and -0.9%, respectively). In general the simulated phosphorus loads are less variable than the annual loads reported in the Authority's annual reports. This is especially true for the load from Plum Creek in 2007, where the reported phosphorus load is two times greater than the simulated load. The annual total phosphorus load for the South Platte River and Plum Creek are shown in Figures 17 and 18 below.

Next Steps: The watershed model is calibrated to simulate baseflow scenarios. However, additional data collection and model refinement may be required. The watershed model will also need to be used in conjunction with CRMC reservoir model, after the CRMC model is completed. Continuation of sampling efforts along Plum Creek is underway. Additionally, the need for further information on stormwater sampling and sediment nutrient concentration sampling for further watershed refinement is under consideration.

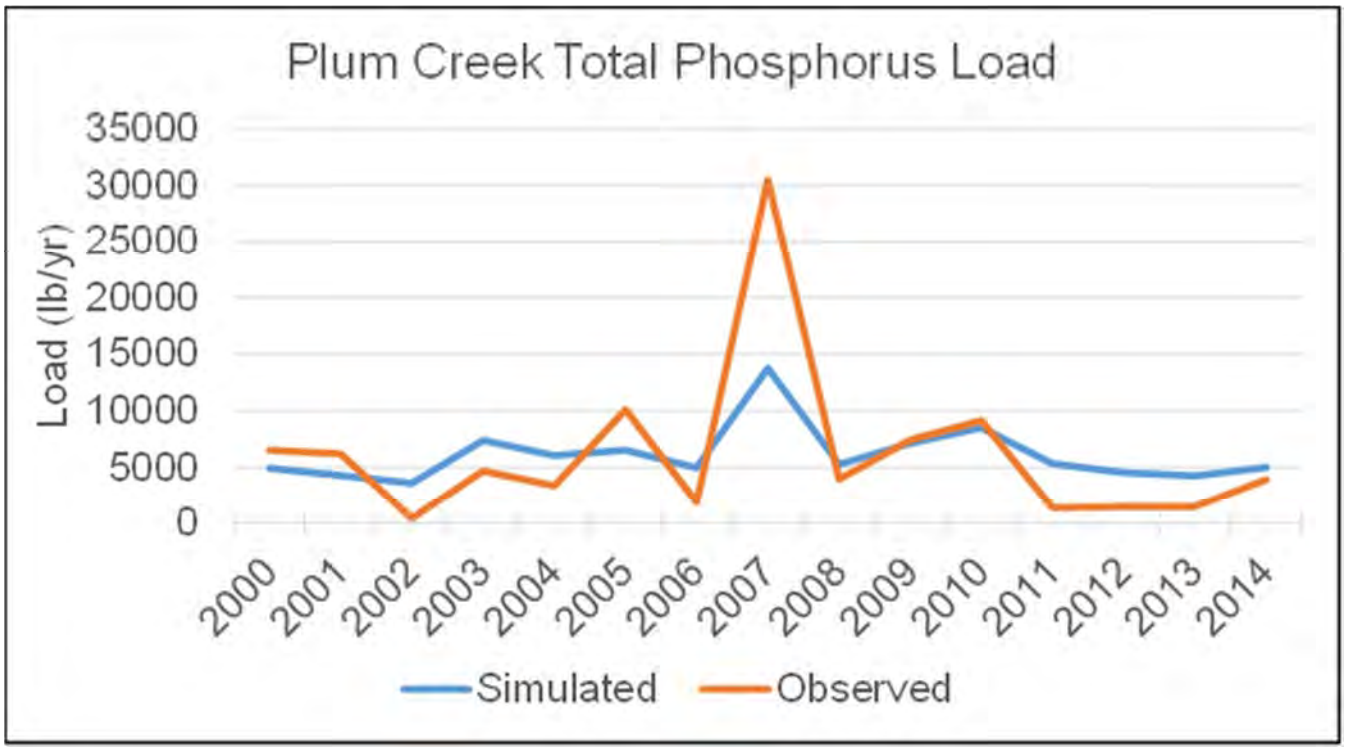


Figure 17. 2016 Chatfield Watershed Model Plum Creek Simulated versus Observed Total Phosphorus Loads (2000-2014)

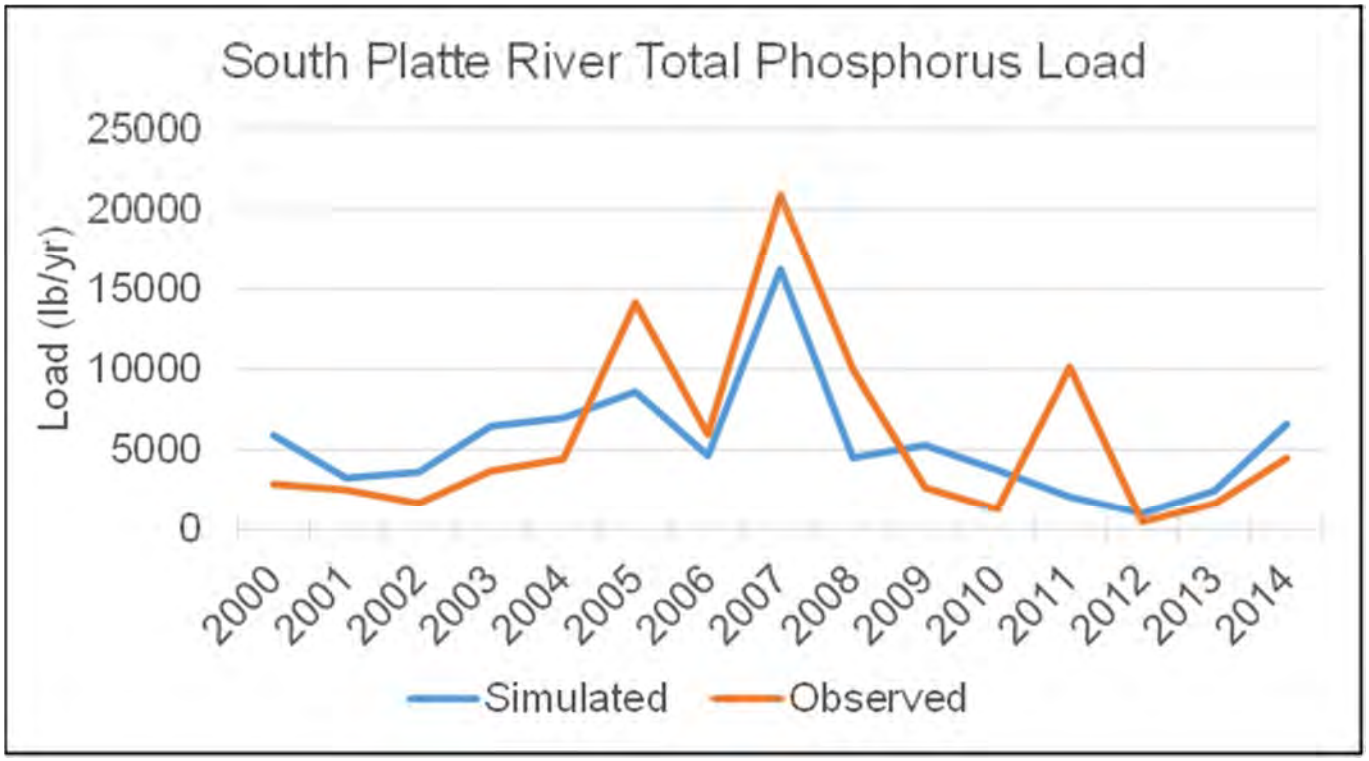


Figure 18. 2016 Chatfield Watershed Model South Platte River Simulated versus Observed Total Phosphorus Loads (2000-2014)

Chatfield Reservoir Mitigation Company (CRMC) Collaborations

In 2016, the Authority continued to collaborate with the CRMC on data collection efforts pursuant to the Memorandum of Understanding between the two agencies to support the revised TMAL in the coming years. The Authority currently serves on the Chatfield Reservoir Model Coordination Committee to coordinate in the development of the reservoir model. The Authority helped to select the reservoir modeling consultant and has provided all watershed data and information to the CRMC.

Reservoir Modeling

In 2016, the CRMC initiated the Chatfield Reservoir Model. The CRMC selected Hydros Consulting, Inc. to develop the reservoir model. Modeling efforts are underway in 2017. The Memorandum of Understanding between the CRMC and the Authority provides collaborative data collection efforts for developing the model to strengthen our understanding of total phosphorus fate and transport mechanisms and inputs to the reservoir.

Chatfield Watershed Authority

www.chatfieldwatershedauthority.org

Member Entities:
Douglas County
Jefferson County
Town of Castle Rock

Water and Sanitation Members:
Centennial Water & Sanitation District
Dominion Water & Sanitation District
Louviers Water & Sanitation District
Perry Park Water & Sanitation District
Roxborough Water & Sanitation District
Plum Creek Water Reclamation Authority

Other Members:
Castle Pines Metropolitan District
City and County of Denver
Town of Larkspur
City of Littleton

Ex-Officio Participants:
Colorado Agricultural Leadership Foundation
Colorado Parks and Wildlife Commission
Colorado Department of Transportation
Colorado Water Conservation Board
Ken Caryl Ranch Master Association
The Law Enforcement Foundation
Ponderosa Retreat
Sacred Heart Retreat
Tri-County Health Department
U.S. Army Corps of Engineers
Chatfield Reservoir Mitigation Company, Inc.
Water Quality Control Division

Management
Leonard Rice Engineers, Inc.

Website
Hughes and Stuart Sustainable Marketing

Financials
TWS Financial, Inc.

Photographs
U.S. Army Corps of Engineers, Omaha District,
Tri-Lakes Project Office
Leonard Rice Engineers, Inc.
The Town of Castle Rock
Muller Engineering Company

CHATFIELD WATERSHED AUTHORITY
SINCE 1984