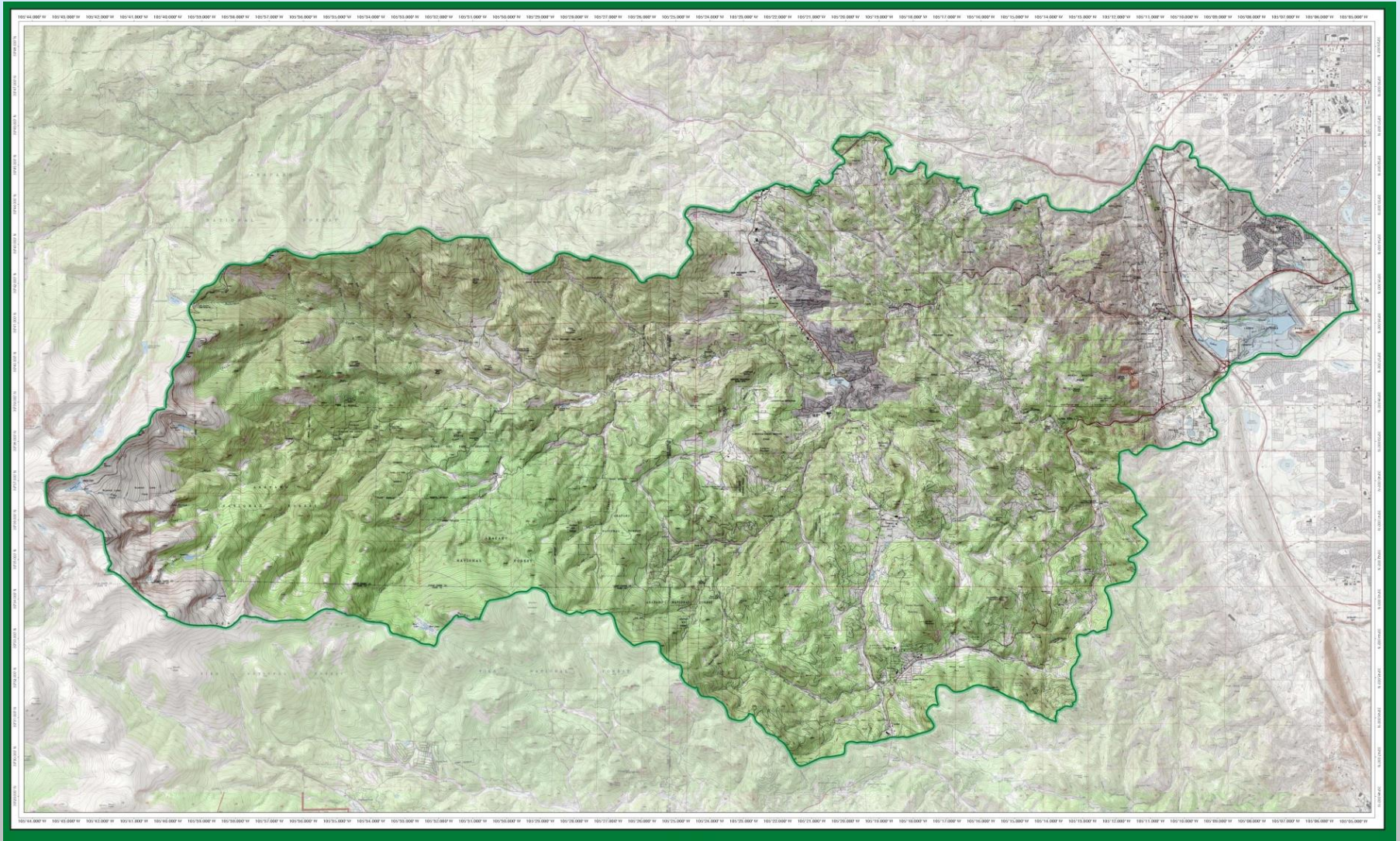


*The Bear Creek Watershed Association protects & restores water & environmental quality within the Bear Creek Watershed from the effects of land use.*

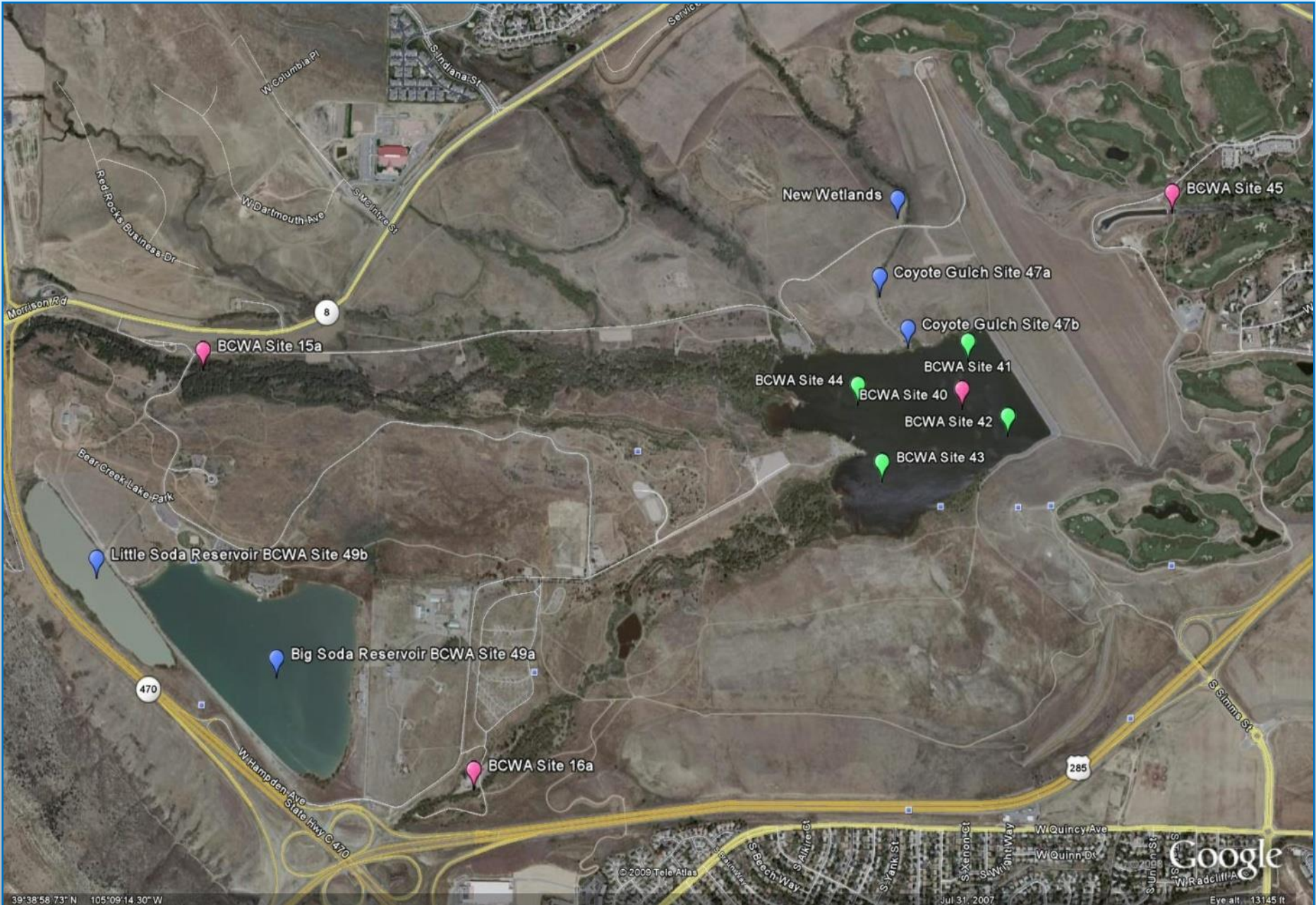




# Operational Bear Creek Watershed 2019









- 105 STREAM MONITORING SITES
- BEAR CREEK RESERVOIR
  - INFLOW TURKEY CREEK
  - INFLOW BEAR CREEK
  - OUTFLOW SITE 45
  - WADSWORTH SITE 90 INPUT BARR/MILTON
- EVERGREEN LAKE
- SUMMIT LAKE (MT EVANS)

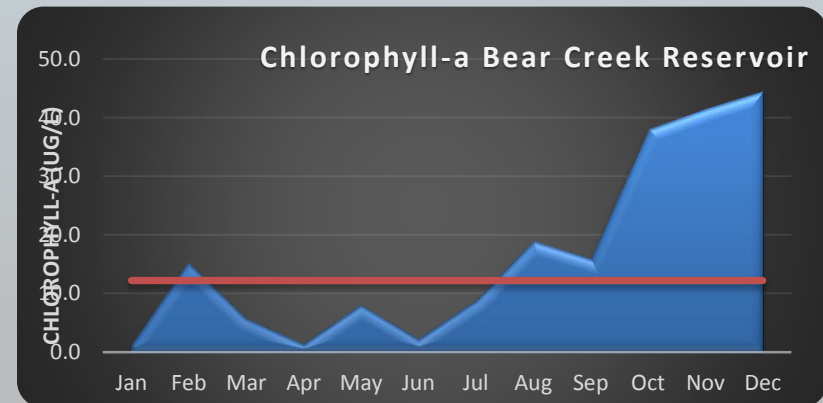


# BCWA 2018 WATERSHED PLAN

- ONLINE DECISION SUPPORT PROGRAM
- ELECTRONIC ONLINE WATERSHED PLAN
  - 37 POLICIES
  - 69 FACT SHEETS
  - 27 DATA MASTERS
  - 36 INFORMATIONAL MAPS
  - 28-YRS OF RULEMAKING & STANDARDS
  - 39 PROGRAM DOCUMENTS
  - >100 LINKED REPORTS & DOCUMENTS
  - 18 WASTEWATER MANAGEMENT SUMMARIES
  - + OTHER INFORMATIONAL, METHODS, PROGRAM GUIDANCE, TECHNICAL SERIES, SPECIAL STUDIES, ANNUAL MONITORING PLANS
- PHOTO LIBRARY
- QUARTERLY NEWSLETTER (>350)
- NPS EDUCATION
- MEMBERSHIP SPECIAL PROGRAMS



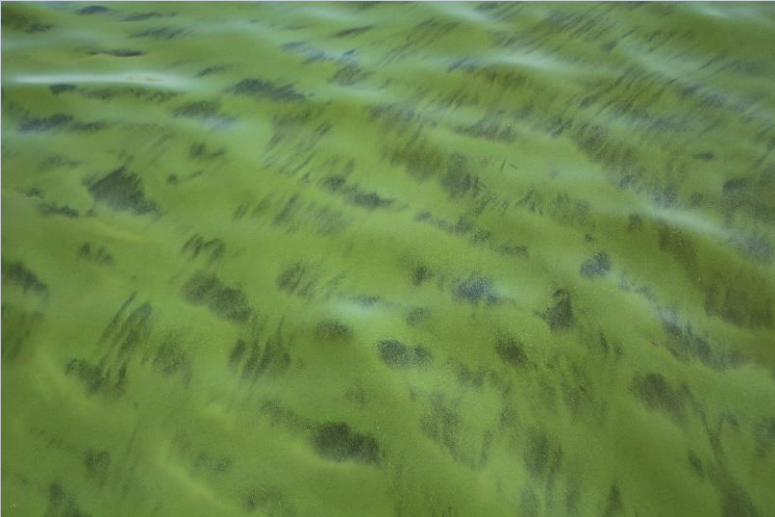
- Average seasonal total phosphorus of 61.8  $\mu\text{g/L}$  in BCR exceeds the 22.2  $\mu\text{g/L}$  goal-standard
- Average seasonal chlorophyll-a of 16.4  $\mu\text{g/L}$  was over the 12.2  $\mu\text{g/L}$  standard
- Trophic status of the reservoir remains at the Eutrophic-Hypertrophic boundary based on Carlson and Walker indices
- Seasonal average reservoir temperature (-1/2-2m) = 21.4°C with exceedances of the WAT (32) and DM (86)
- Lake aeration maintained dissolved oxygen levels (-1/2-2m) at or above 6.0 mg/L throughout most of the growing season
- Late season blue-green algal blooms
- Recreational fishing remained active





	<b>2018 Total Phosphorus Loading (Pounds)</b>				
	<b>Total TP Load</b>	<b>PS</b>	<b>%PS</b>	<b>NPS</b>	<b>%NPS</b>
<b>Turkey Creek Drainage</b>	75	39	52.2%	36	48%
<b>Bear Creek Drainage</b>	666	951	142.7%	-285	-43%
<b>Discharged into Reservoir</b>	741	990	133.6%	-249	-34%
<b>Site 45 Outflow BCR</b>	409				
<b>BCR Total Phosphorus Deposition</b>	332				
<b>Site 90 - Lower Bear Creek</b>	747				
<b>NPS load increase between 45 and 90</b>		45%	338		

### Chlorophyll-a Bear Creek Reservoir



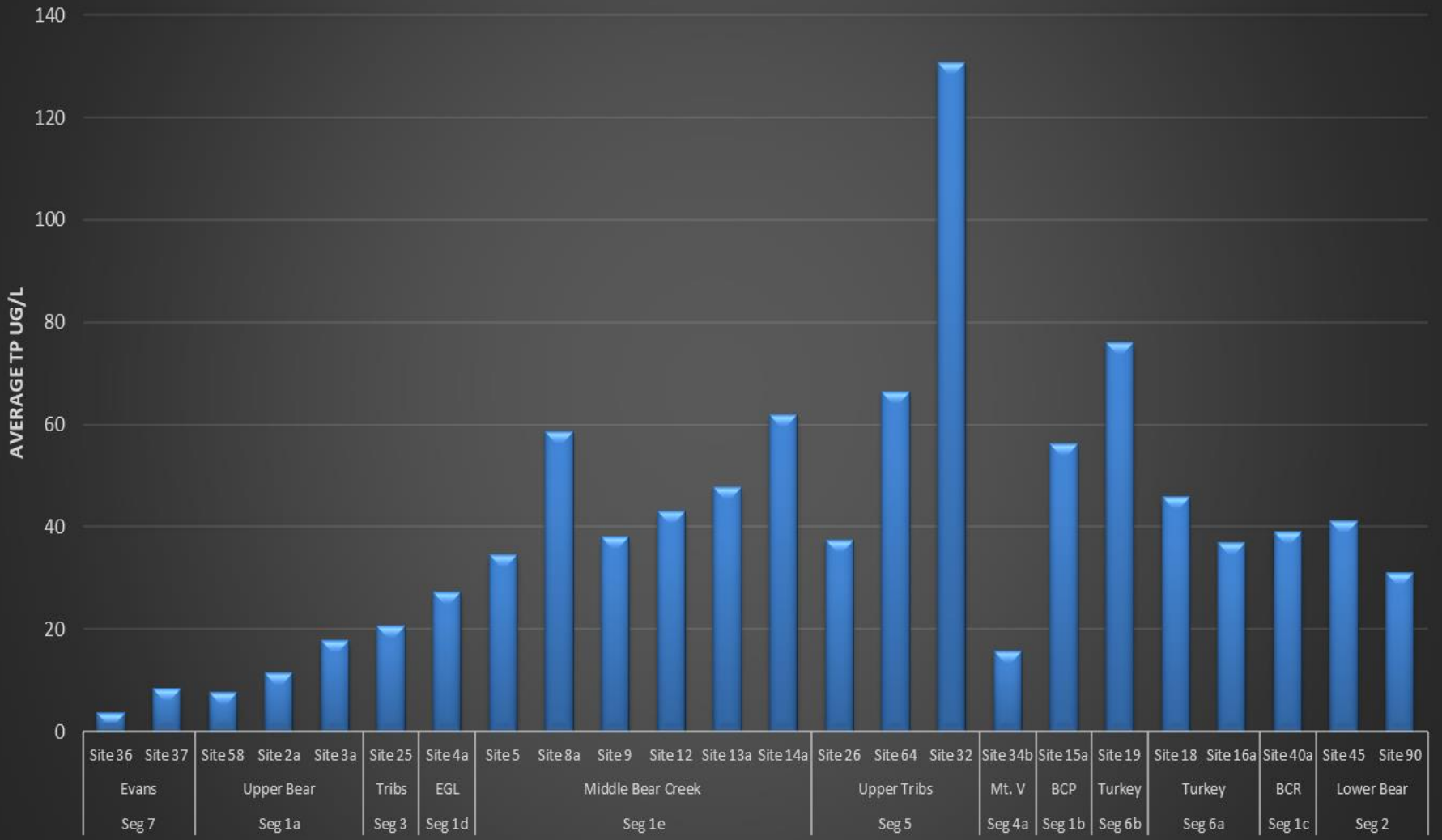


# ADAPTIVE MANAGEMENT PROGRAM

- Nonpoint Source Loading & Tracking
- Coyote Gulch - Trading
- Septic Systems – Kerr & Cub
- Tracking Management Practices
- Zoning And Planning Reviews For BMPs
- Local Presentations, Education Programs
- Flood Restoration Practices
- Assist Land-owners
- Assist Invasive Species Programs
- Green Infrastructure Projects
- Wildfire Assessment
- Source Water Protection
- Tributary Loading Studies
- Erosion Control Reviews
- Online Adaptive Management
- Climate Modeling

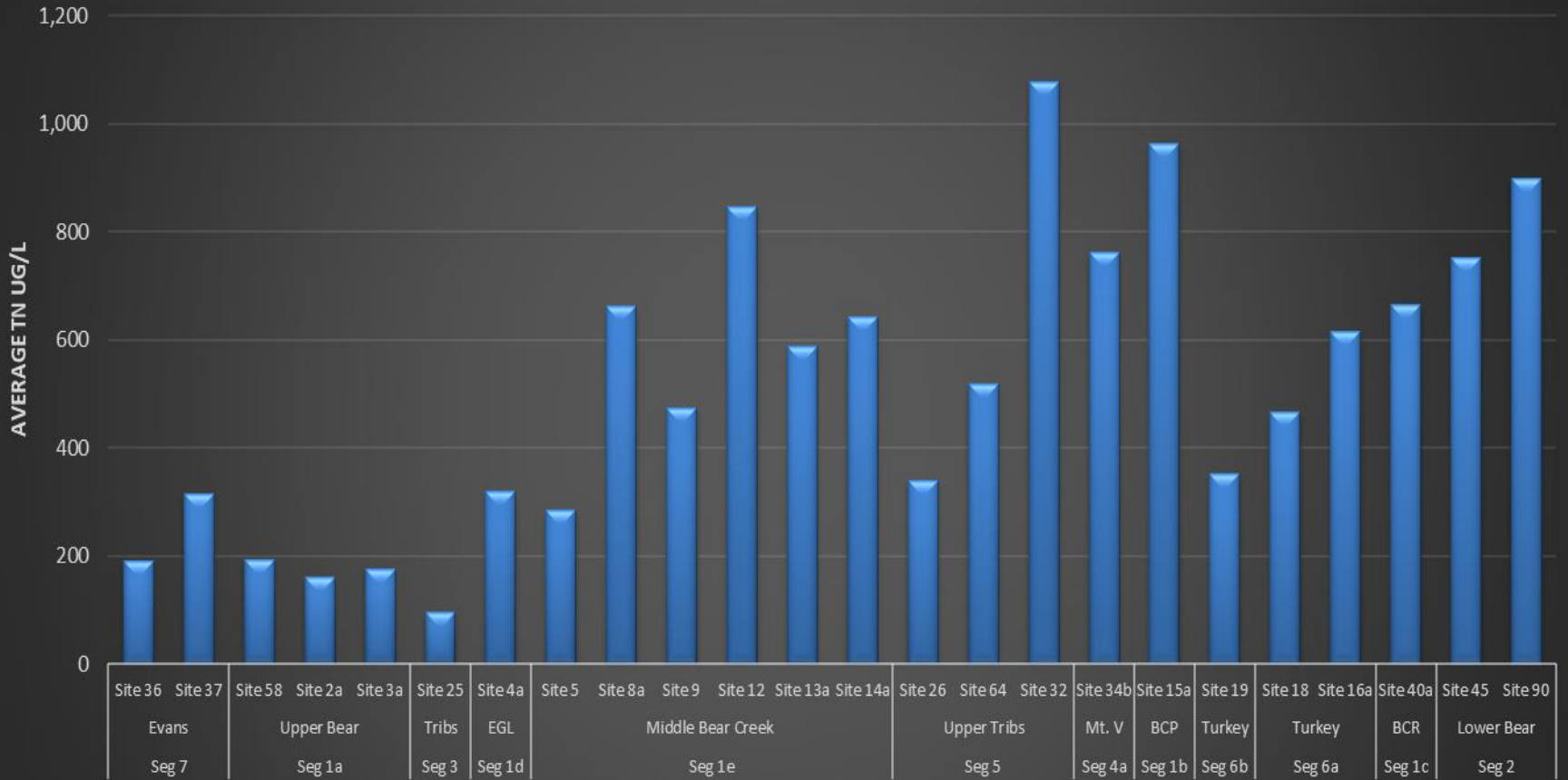


# Average Total Phosphorus Watershed





# Average Total Nitrogen Watershed



## Project Overview

- **Develop predictive models of Bear Creek watershed and reservoir**
  - Total phosphorus and total nitrogen
  - Use models to identify sources, inputs to the reservoir and reservoir dynamics
- **Define potential management scenarios to control nutrient inputs**
- **Incorporate management scenarios into models**

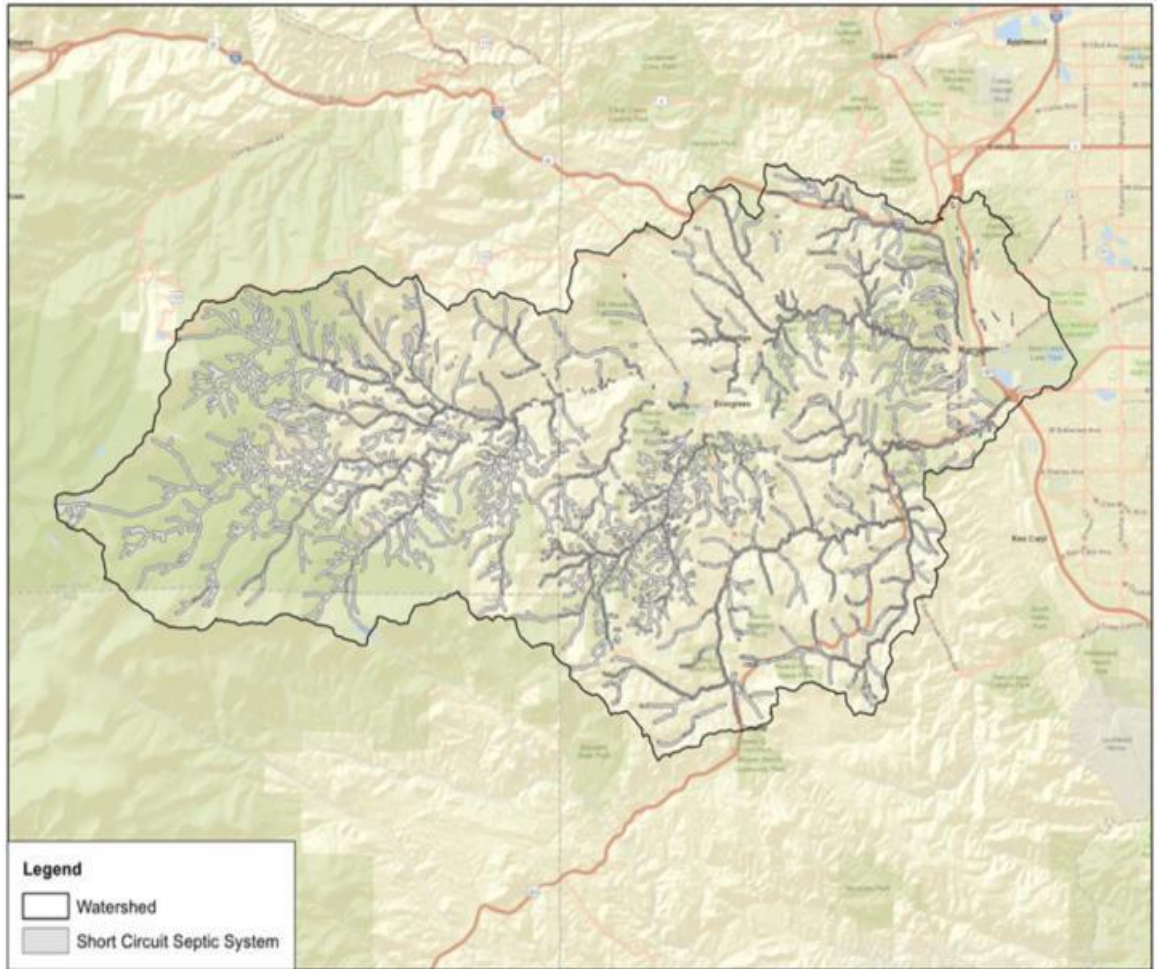
## Source Quantification

- **Watershed model includes**
  - Land use water and nutrient runoff
  - Point source inputs
  - On-site Wastewater Treatment Systems (OWTS)
- **Can “turn off” sources to quantify the total delivered load**
  - Ran model for 1998-2016 simulation period



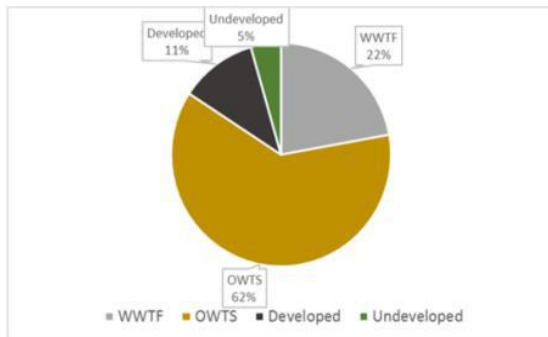
# OWTSSs

- NHD streams with 200 foot buffer as recommended by BCWA
- Erased buffered NHD streams from intersected Census Block data
- Intersected buffered NHD streams with intersected Census Block data

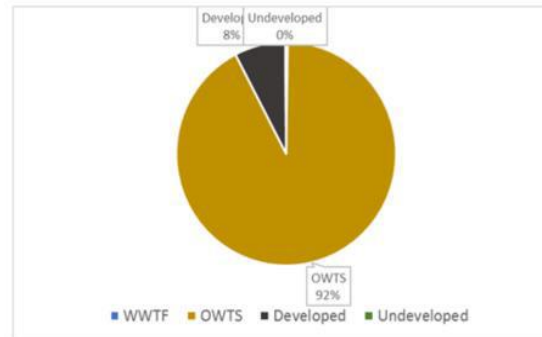


# Total Nitrogen Source Identification

## Bear Creek

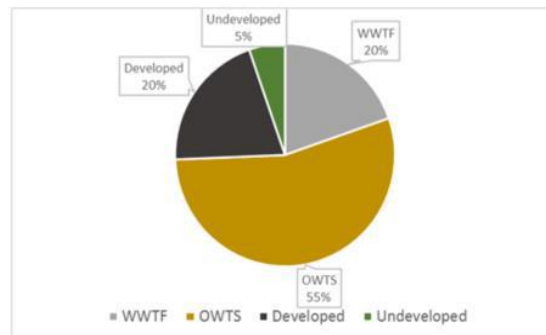


## Turkey Creek

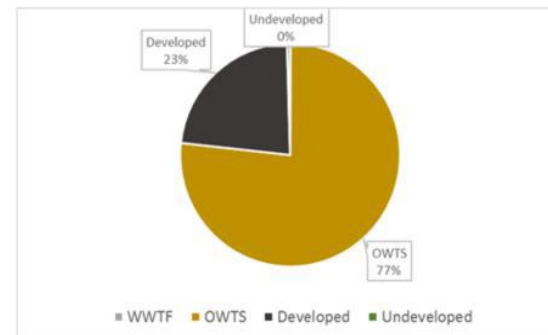


# Total Phosphorus Source Identification

## Bear Creek



## Turkey Creek

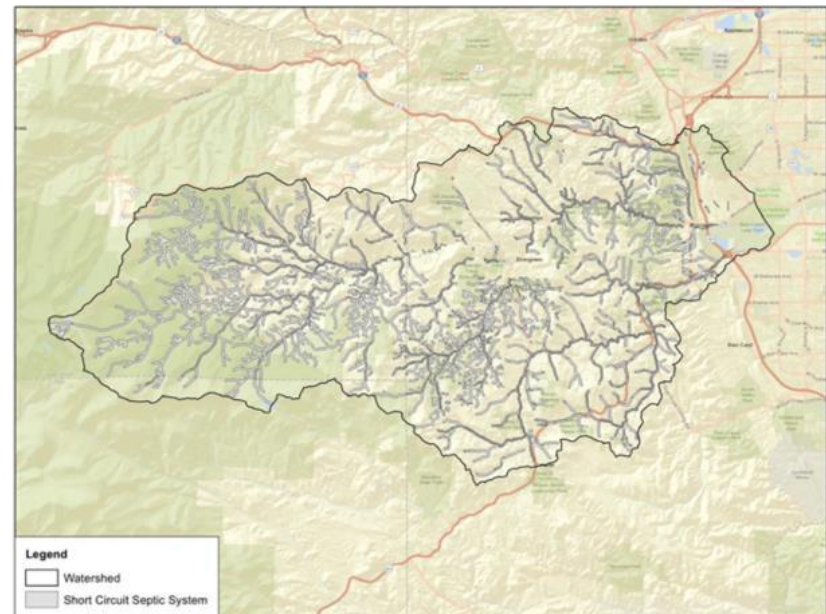




Scenario	Median Annual Delivered TN Load (lb)	Percent Change	Median Annual Delivered TP Load (lb)	Percent Change
WWTP @ TP 1.0 mg/L			863	+8%
WWTP @ TP 0.2 mg/L			767	-4%
WWTP @ TP 0.05 mg/L			748	-7%
WWTP @ TIN 15 mg/L TP 0.7 mg/L	18,850	+11%	823	+3%
WWTP @ TIN 7 mg/L TP 0.7 mg/L	17,210	+1%	823	+3%
WWTP @ TN 2.0 mg/L	16,440	-4%		

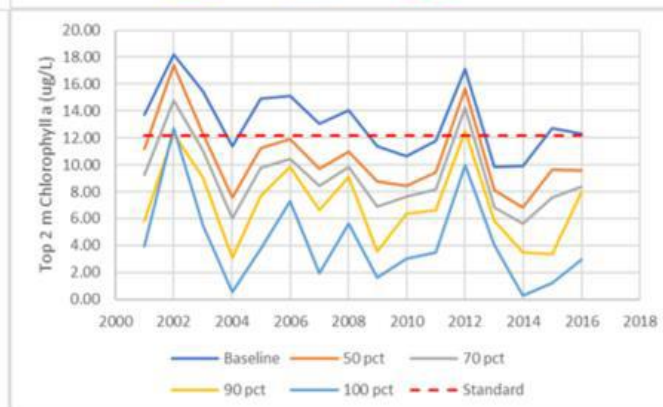
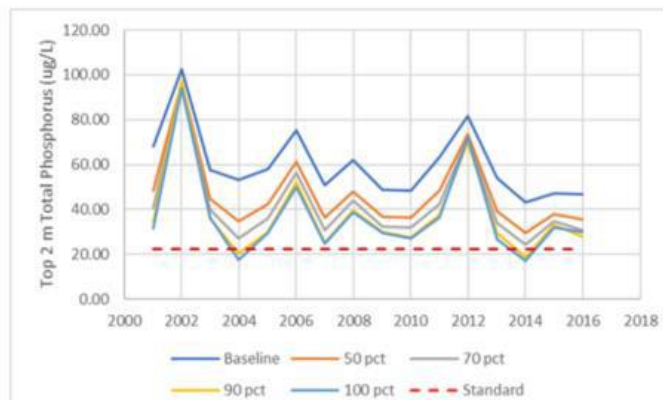
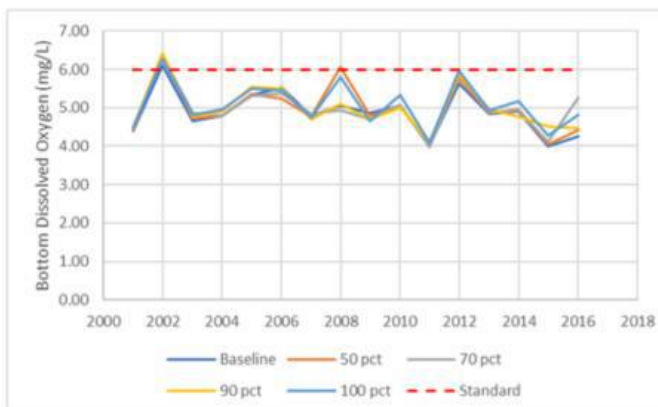
## OWTS Sensitivity

- Assumed OWTS inputs within the 200' buffer were reduced
- Assumed flows from OWTS were  $\frac{1}{2}$  of the baseline model
- Delivered TN loads reduce by 37%
- Delivered TP loads reduce by 29%



# External Source Evaluation

- Reduce watershed nutrient inputs
  - 50, 70, 90 and 100 percent



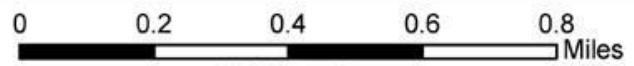
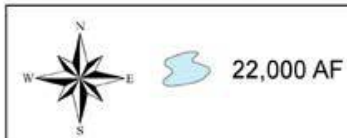
## External Load Summary

- Reducing external loads can help reduce TP and chlorophyll
- Reducing loads alone, can't solve those issues

## Sediment Load Summary

- Reducing sediment loads can help reduce TP and chlorophyll
- Reducing loads alone, can't solve those issues





NAD 1983 Zone 13N  
 Storage Data Provided by DWR  
 Spatial Data Created by CWCB



**COLORADO**  
 Colorado Water  
 Conservation Board  
 Department of Natural Resources



