

The Lake Tahoe Interagency Monitoring Program – Sediment and Nutrient Loading and Concentration Data for Ten Indicator Streams Through Water Year 2010

Nancy L. Alvarez
U.S. Geological Survey

John E. Reuter
Patty Arneson
UCD, TERC





Funding Sources

- Cooperative Study:
 - Tahoe Regional Planning Agency
 - U.S. Geological Survey
 - In-kind Services - UCD Tahoe Environmental Research Center (TERC)
- U.S. Forest Service LTMBU

Outline

- History
- LTIMP Objectives
- Sampling Sites
- Sampling Design
- Pollutants of Interest
- Methods – UCD Load and Flow-Weighted Concentration (FWC)
- Results
- Future Work



History

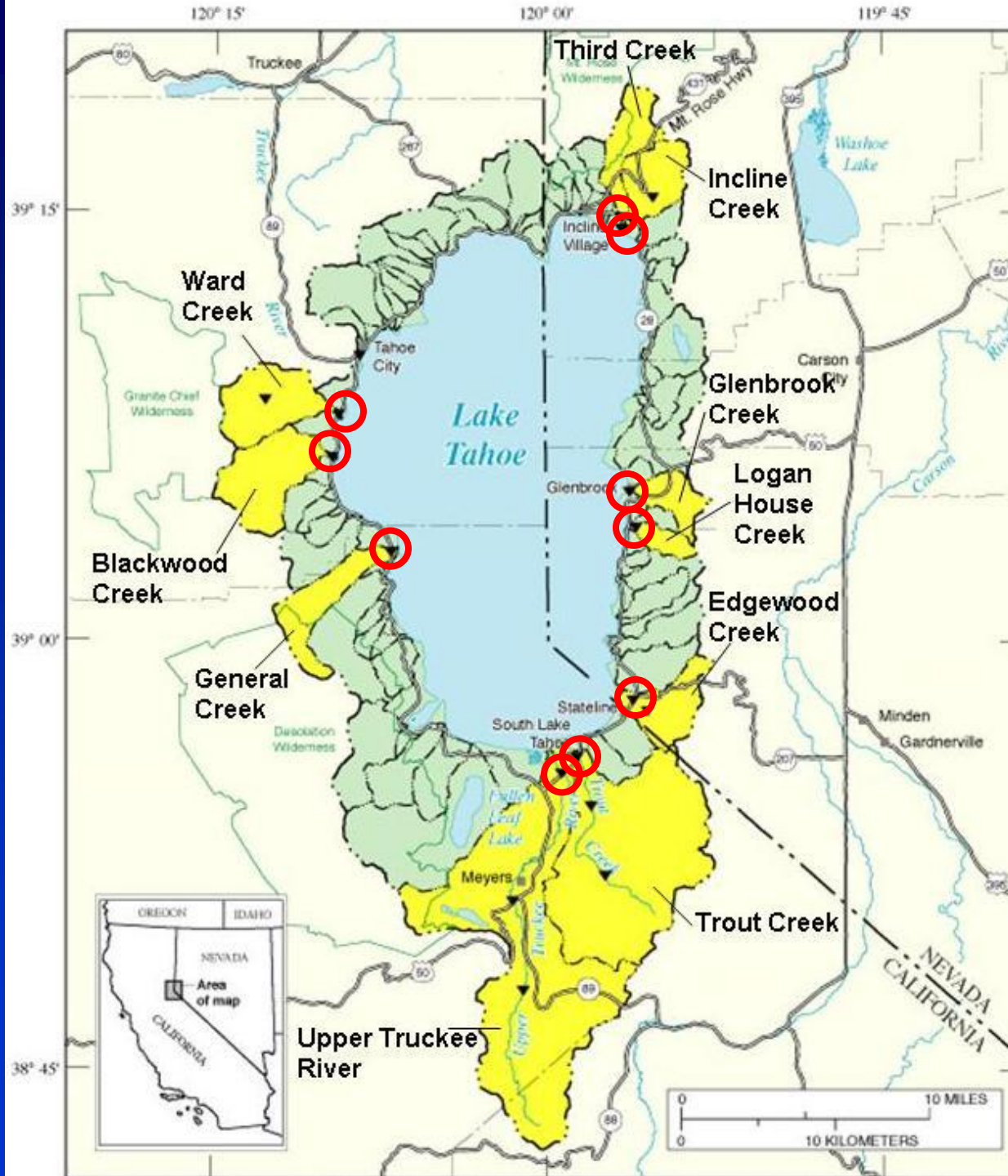
- Lake and tributary water quality monitoring started in the early 1970's
- LTIMP formed in 1978 to conduct collaborative monitoring and research efforts
- LTIMP stream monitoring began in October 1979
 - Group effort to design monitoring program
- Current program began in October 1988

LTIMP Objectives

- Primary purpose to provide long-term consistent, reliable, and accessible data on tributary water quality and streamflow
- Provide a long-term database for estimation of sediment and nutrient loads and trends from major tributary streams and minor tributaries of undisturbed basins
 - Load = Concentration x discharge x conversion factor

Sampling Sites

- 10 watersheds
- 47 % of watershed area
- ~50% streamflow to lake



Sampling Design

- Samples collected
 - Monthly
 - Storm events
 - Snow-melt runoff
- All phases of hydrograph sampled
- EWI depth integrated
- Number of samples each water year varied



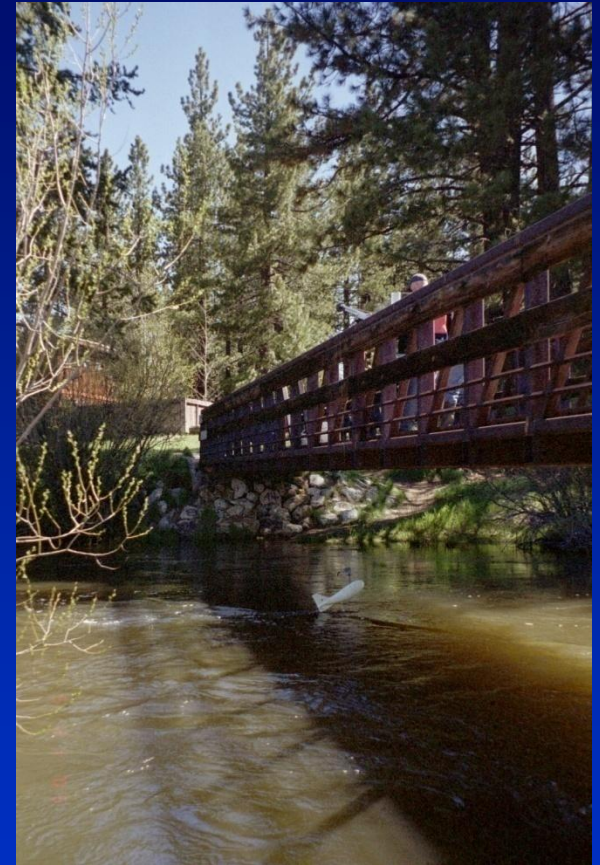
Upper Truckee R at South Lake Tahoe



12/1/04



12/31/05

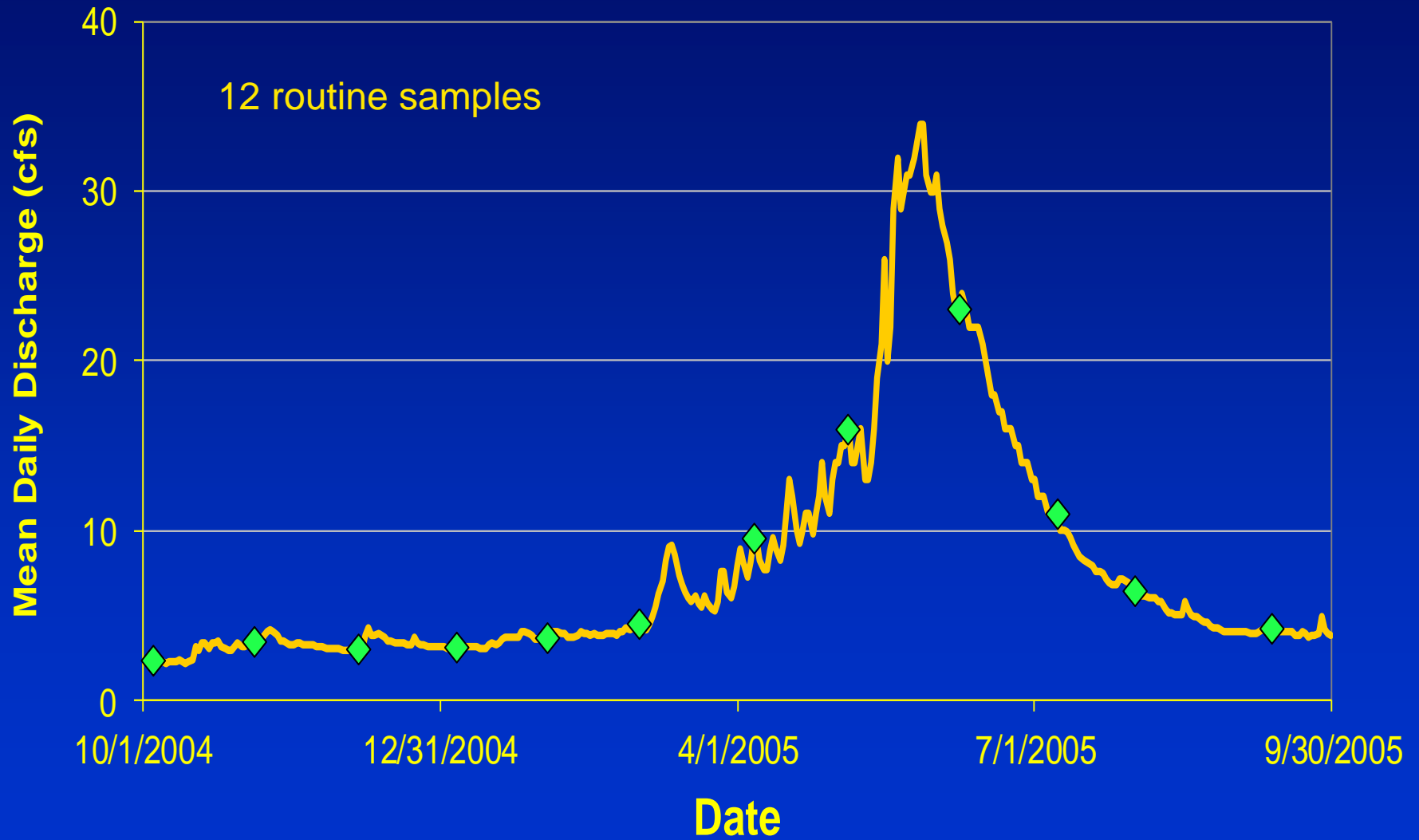


5/21/05

Incline Creek, WY 2005



Incline Creek, WY 2005



Incline Creek, WY 2005



Pollutants of Interest

- Nitrogen
 - TKN, NH_4 , $\text{NO}_2 + \text{NO}_3$
 - $\text{TN} = \text{TKN} + \text{NO}_2 + \text{NO}_3$
- Phosphorus
 - TP, SRP
- Suspended Sediment Concentration-SSC
- Particles less than 20 microns (# particles)



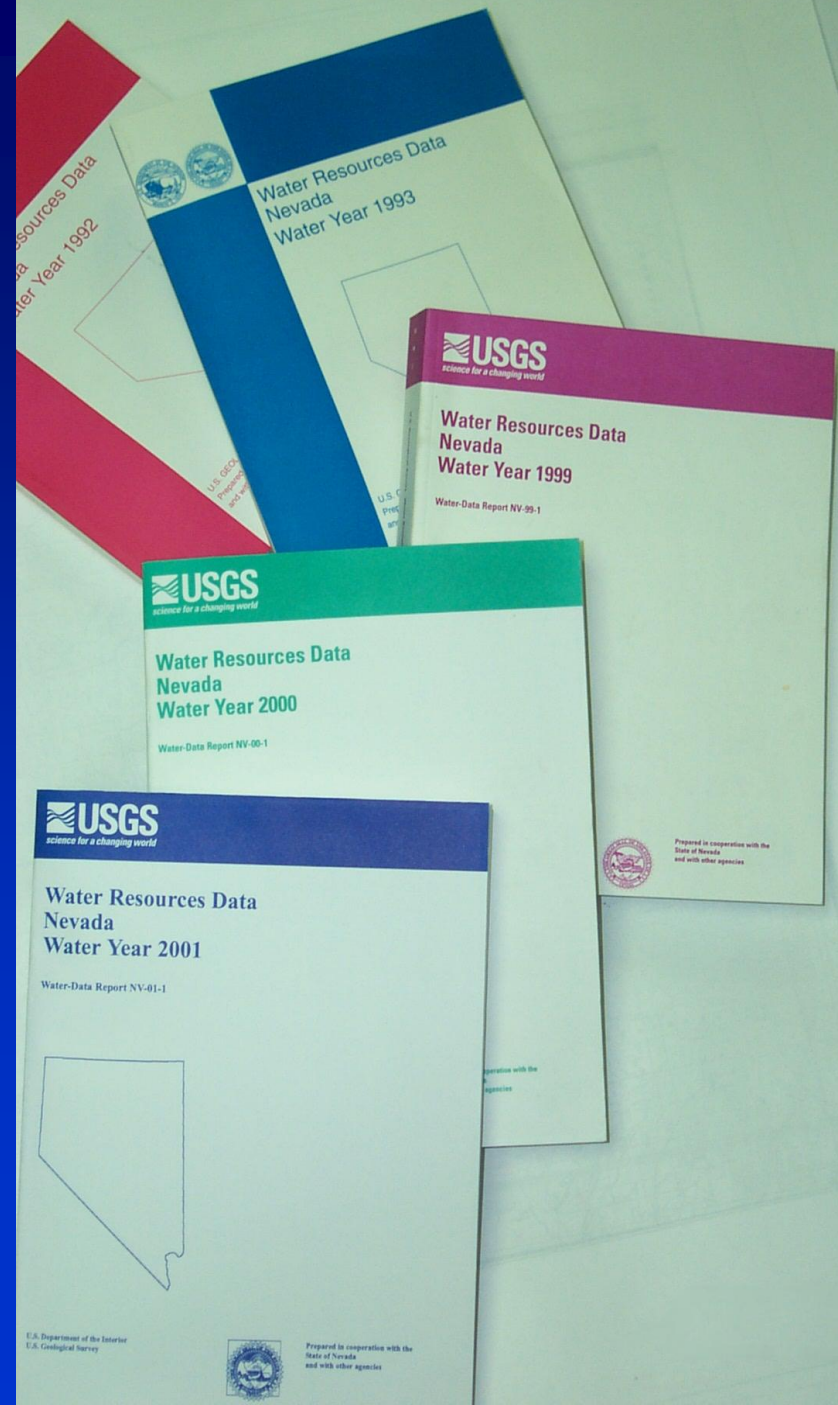
Laboratories

- UC Davis Labs in Davis, CA and Incline Village, NV
- USGS Sediment Lab



Data

- Published in annual data books
- <http://nevada.usgs.gov/>
- Published in on-line USGS database
- <http://waterdata.usgs.gov/nwis>



UCD Load Calculations

- Log of instantaneous load is regressed against log of instantaneous discharge for each water year
- Regression equation with correction for retransformation bias used with daily discharge
- Annual load = sum of daily loads for year
- Combined load = sum of annual loads for 10 streams

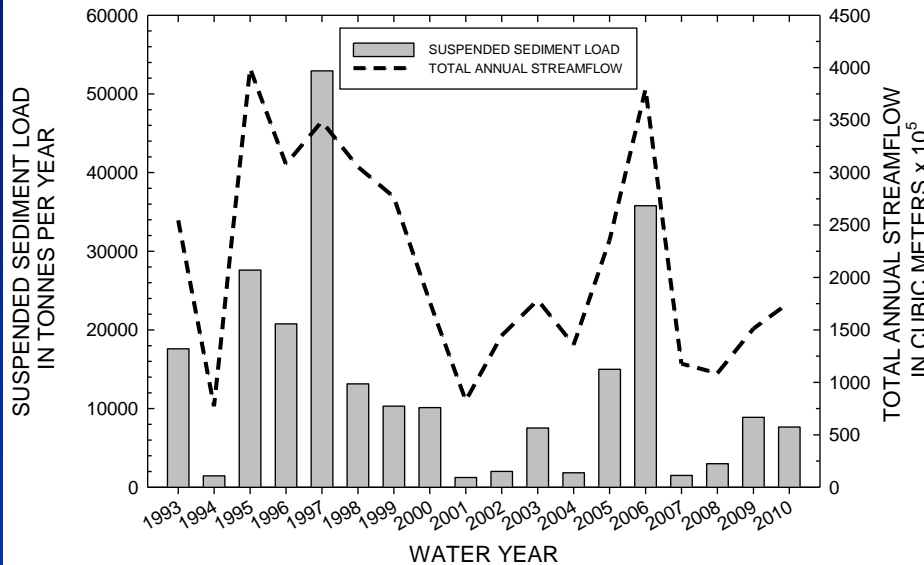
UCD Annual Flow-Weighted Concentration Calculations

- Annual FWC
 - Total annual load divided by total annual streamflow

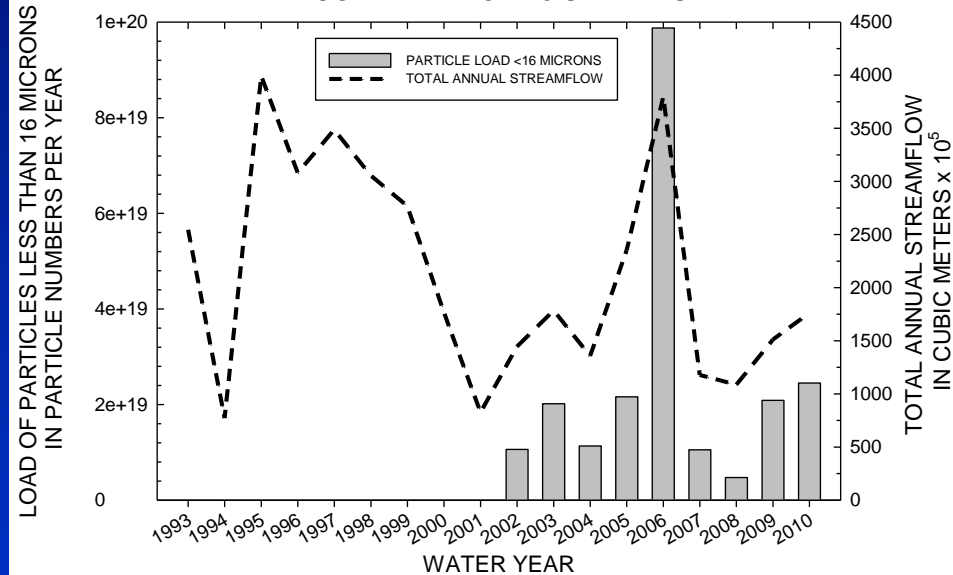


Sediment Annual Load

ANNUAL SUSPENDED SEDIMENT LOAD
COMBINED FOR 10 STREAMS

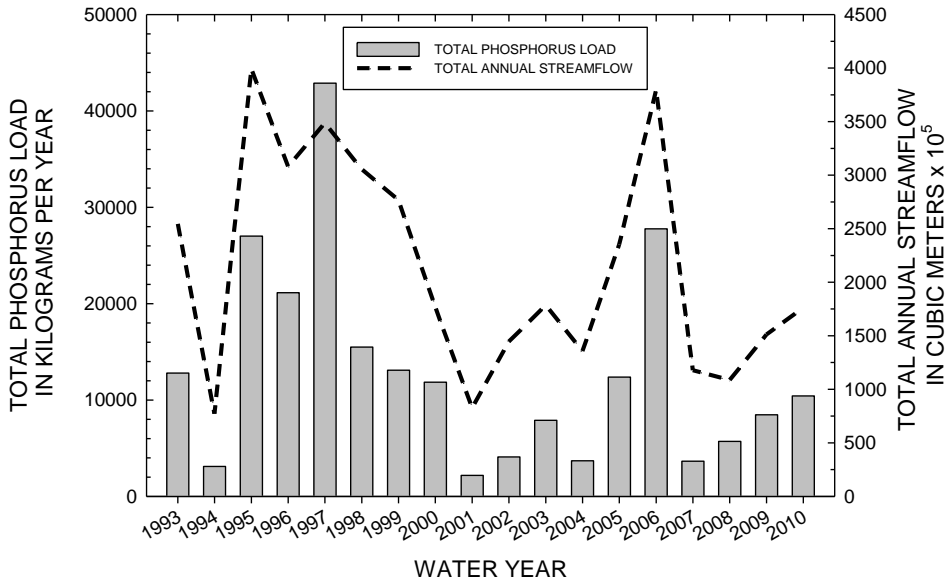


ANNUAL PARTICLE LOAD LESS THAN 16 MICRONS
COMBINED FOR 10 STREAMS

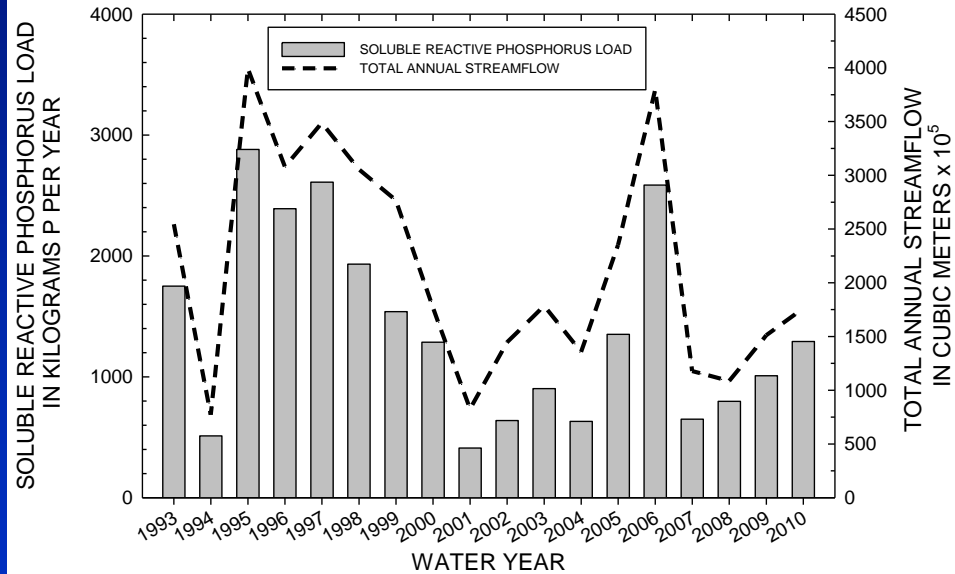


Phosphorus Annual Load

ANNUAL TOTAL PHOSPHORUS LOAD
COMBINED FOR 10 STREAMS

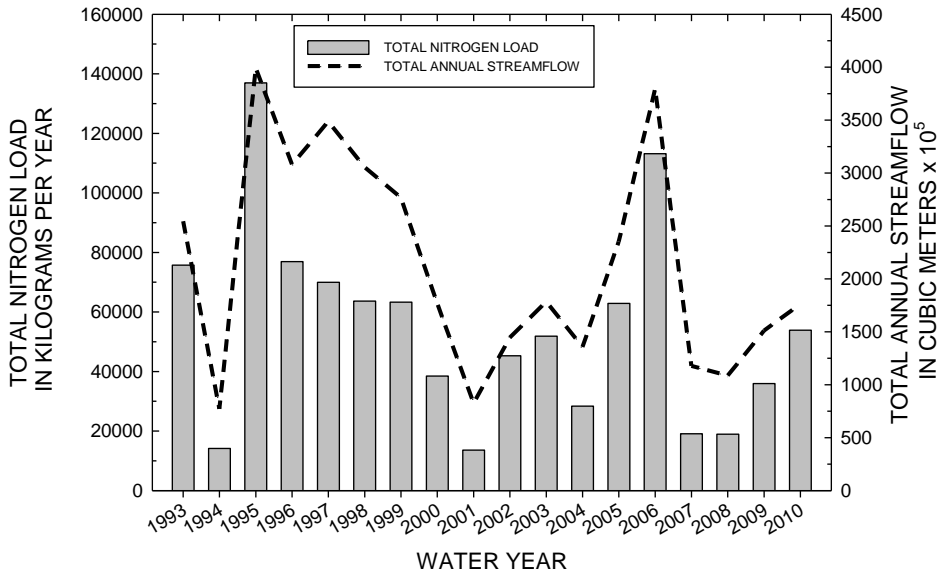


ANNUAL SOLUBLE REACTIVE PHOSPHORUS LOAD
COMBINED FOR 10 STREAMS

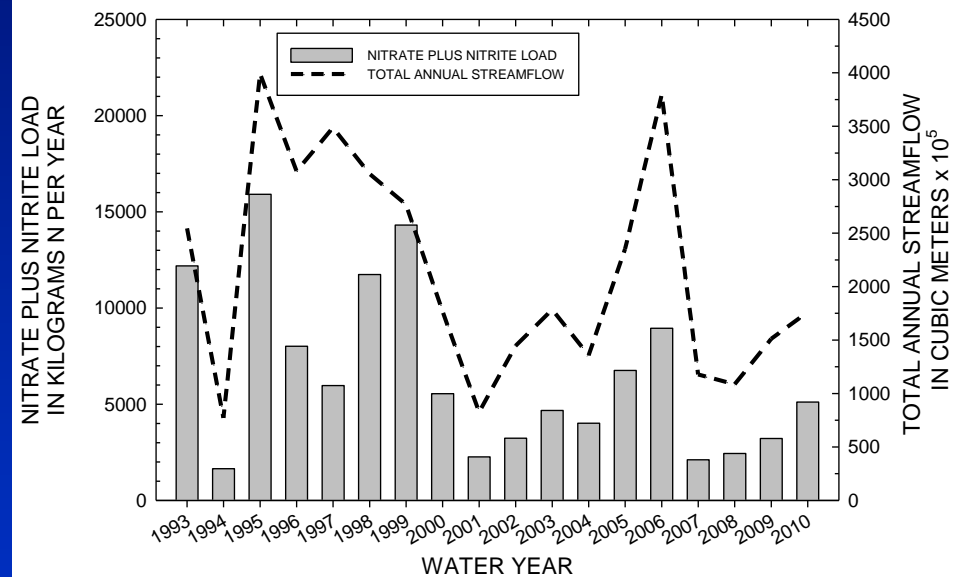


Nitrogen Annual Load

ANNUAL TOTAL NITROGEN LOAD
COMBINED FOR 10 STREAMS



ANNUAL NITRATE PLUS NITRITE LOAD
COMBINED FOR 10 STREAMS



Largest Contributors

Blackwood Creek

Upper Truckee River



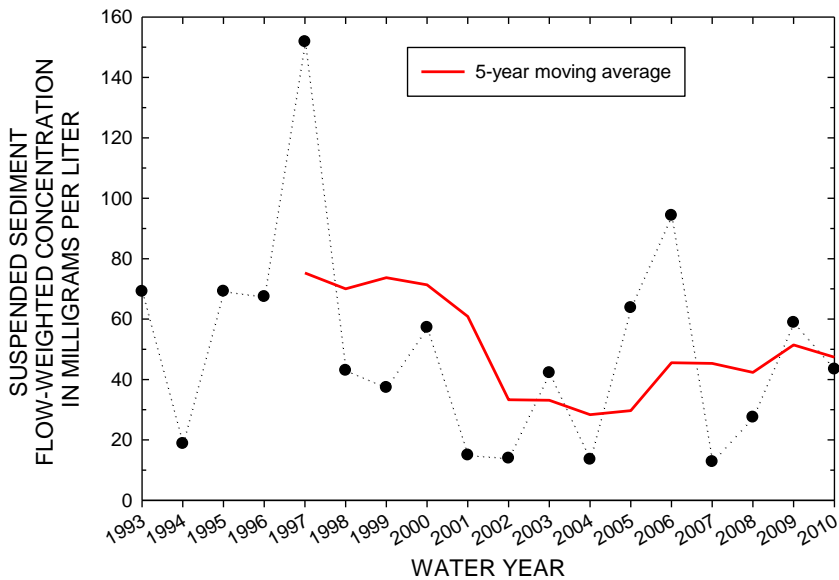
December 31, 2005
Photo by Scott Hackley



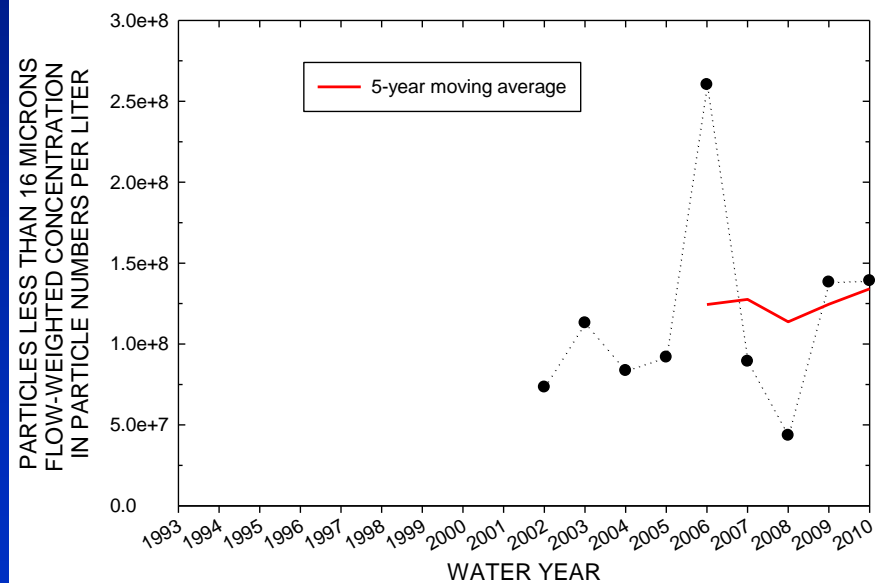
January 2, 1997
Photo by Tim Rowe

Sediment Annual Flow-Weighted Concentration

SUSPENDED SEDIMENT
FLOW-WEIGHTED CONCENTRATION
FOR 10 STREAMS

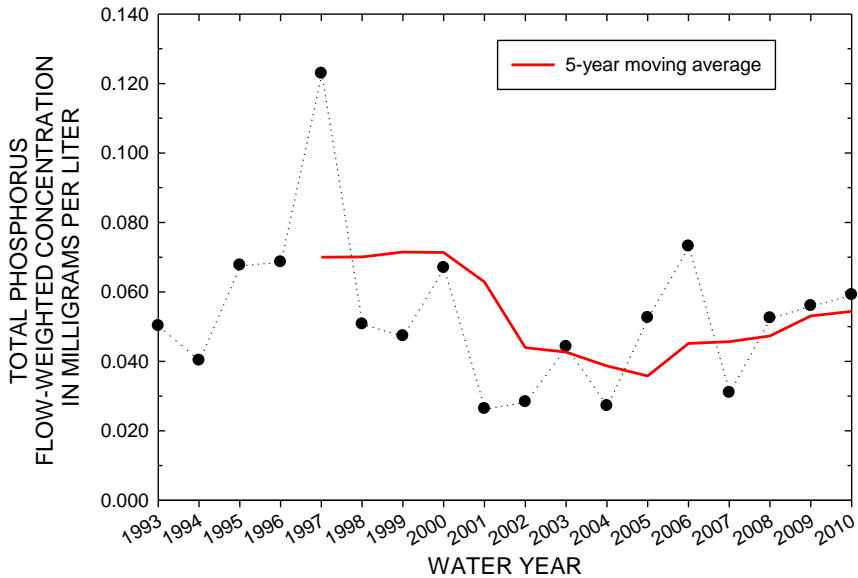


PARTICLES LESS THAN 16 MICRONS
FLOW-WEIGHTED CONCENTRATION
FOR 10 STREAMS

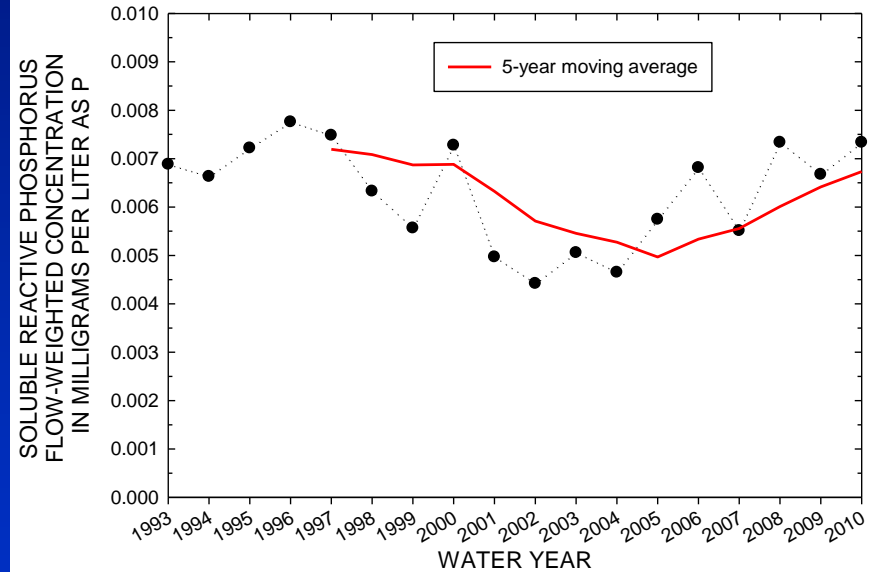


Phosphorus Annual Flow-Weighted Concentration

TOTAL PHOSPHORUS
FLOW-WEIGHTED CONCENTRATION
FOR 10 STREAMS

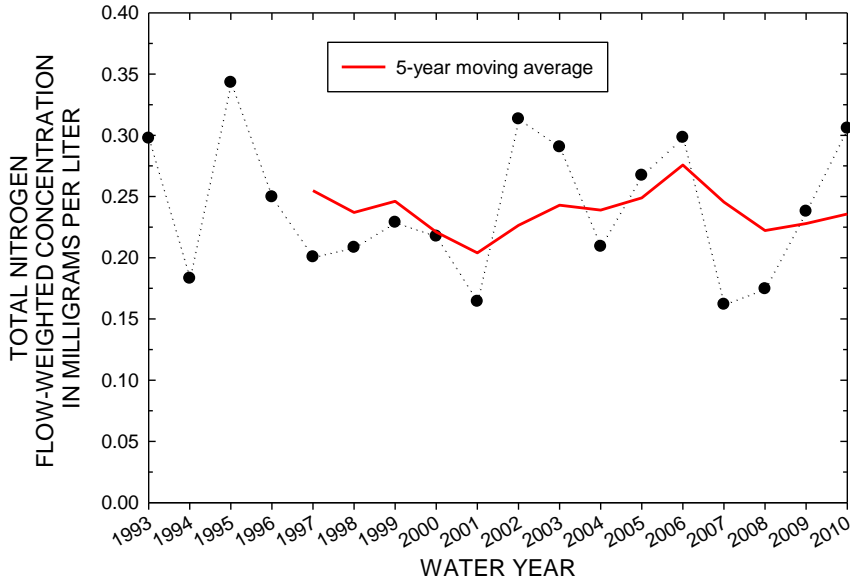


SOLUBLE REACTIVE PHOSPHORUS
FLOW-WEIGHTED CONCENTRATION
FOR 10 STREAMS

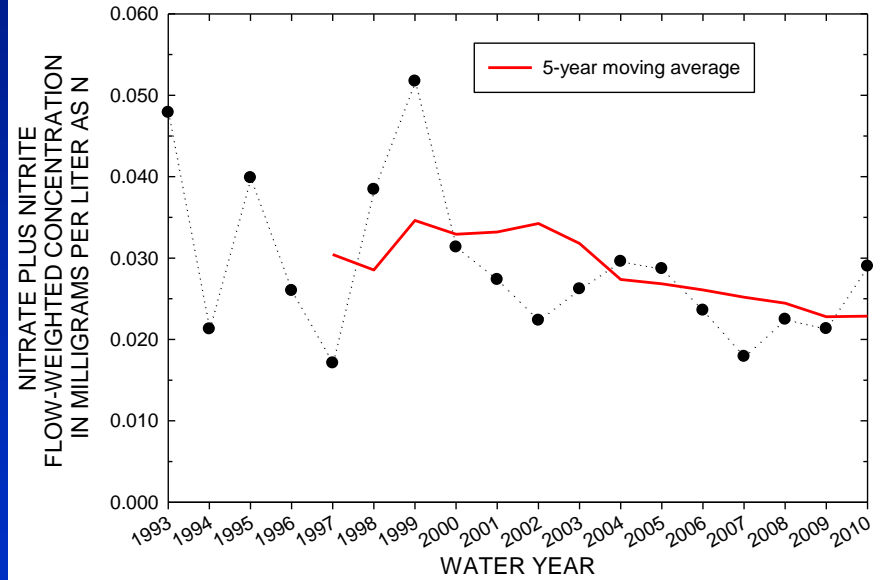


Nitrogen Annual Flow-Weighted Concentration

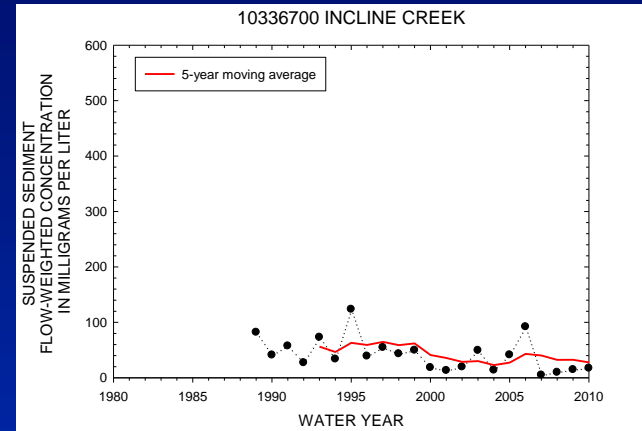
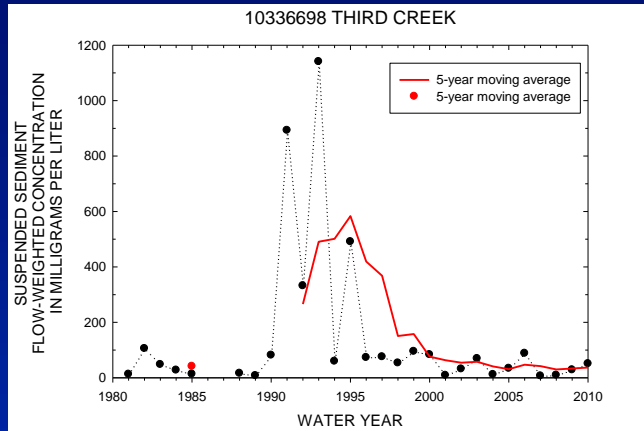
TOTAL NITROGEN
FLOW-WEIGHTED CONCENTRATION
FOR 10 STREAMS



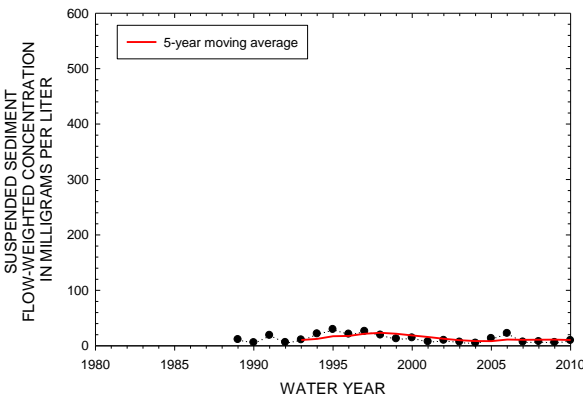
NITRATE PLUS NITRITE
FLOW-WEIGHTED CONCENTRATION
FOR 10 STREAMS



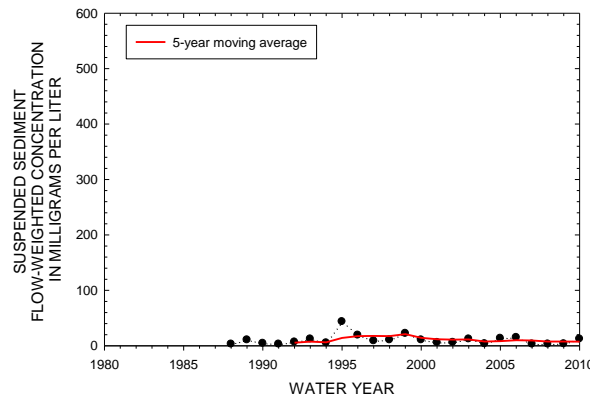
Suspended Sediment Annual FWC



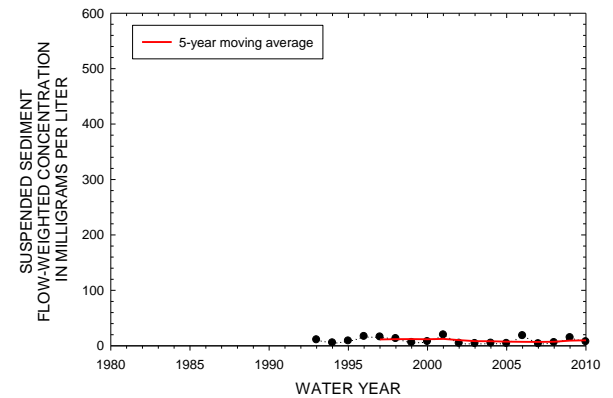
10336730 GLENBROOK CREEK



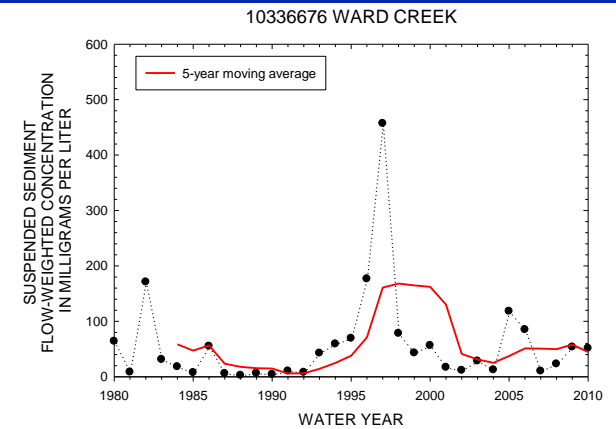
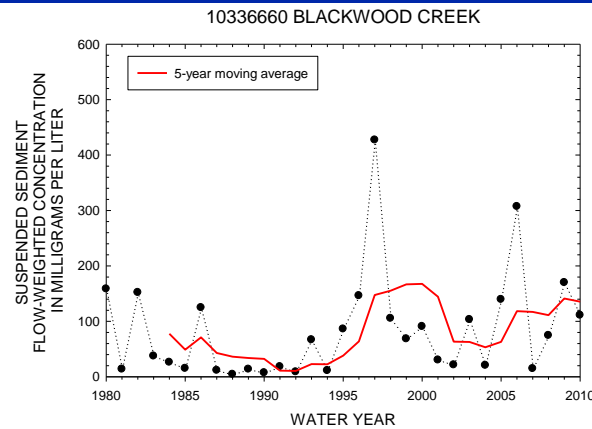
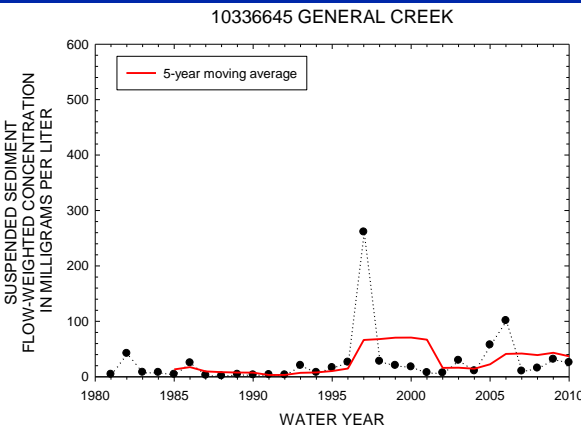
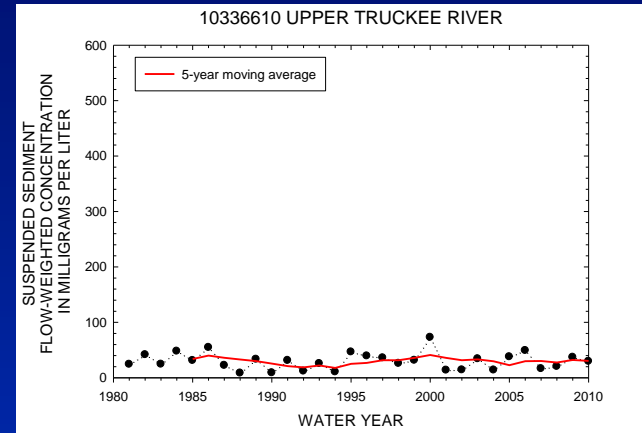
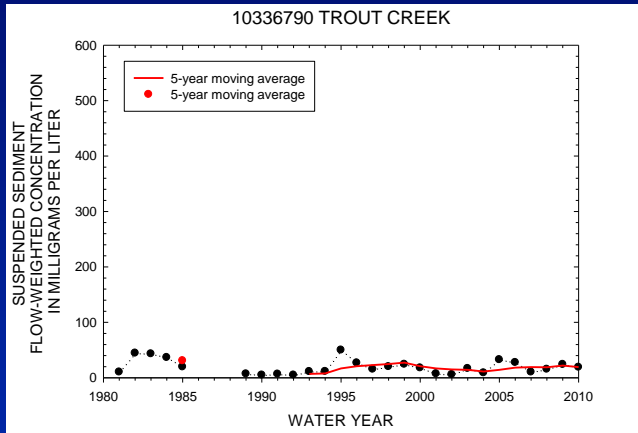
10336740 LOGAN HOUSE CREEK



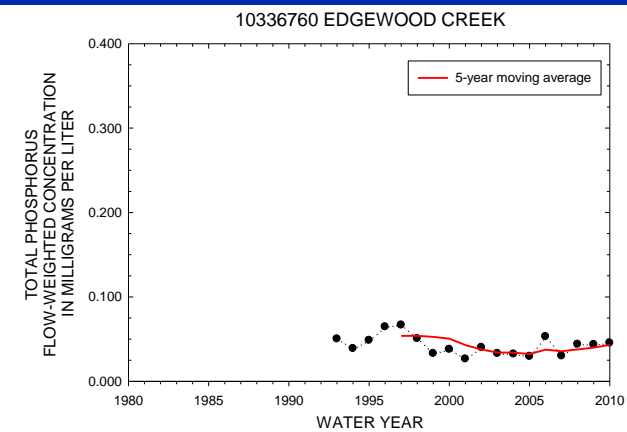
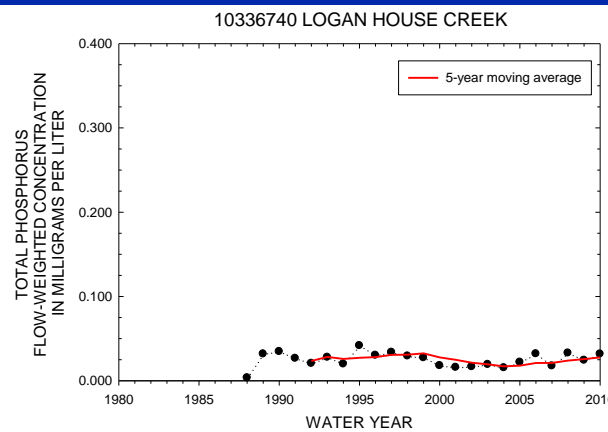
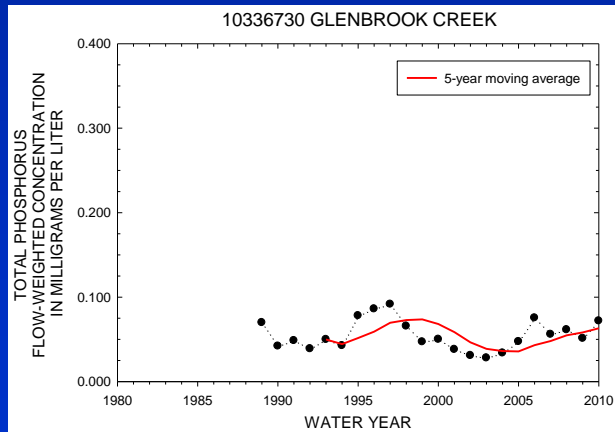
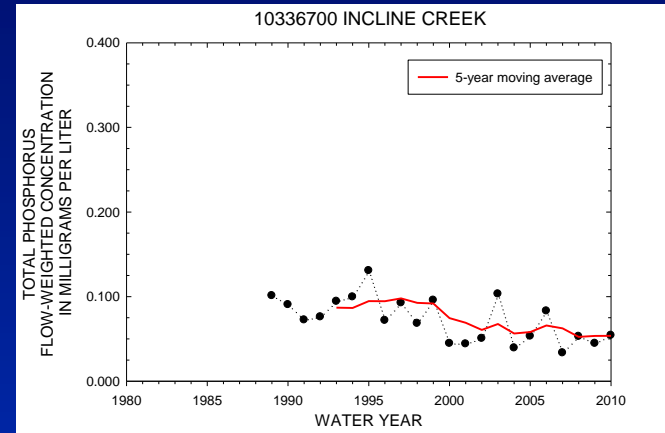
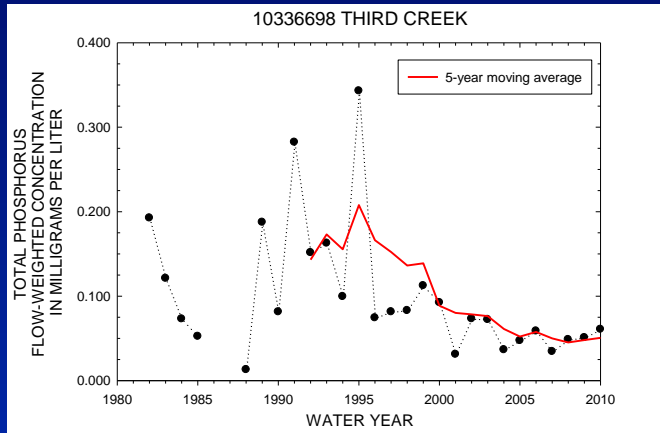
10336760 EDGEWOOD CREEK



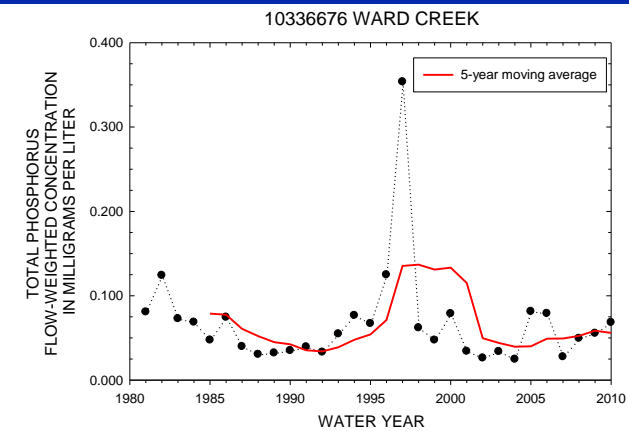
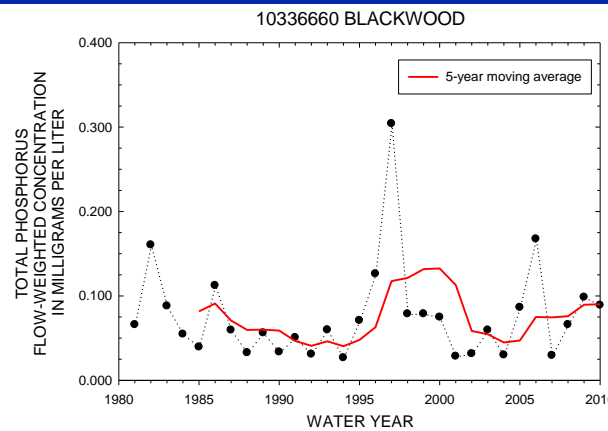
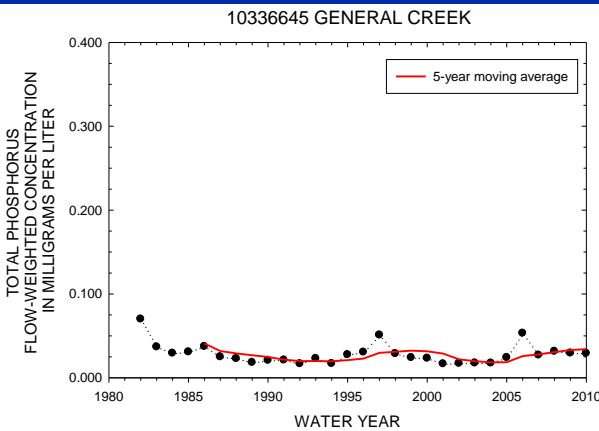
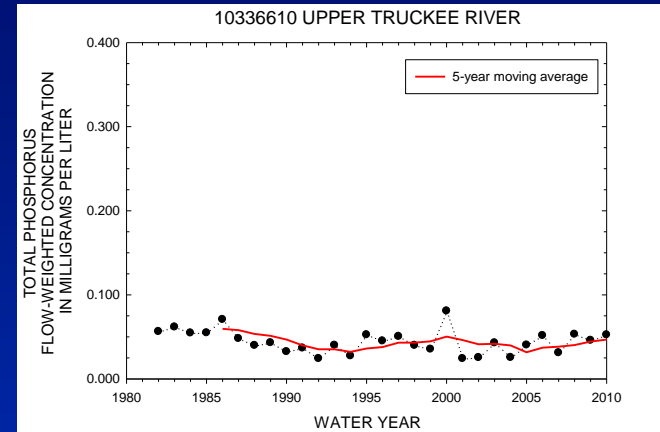
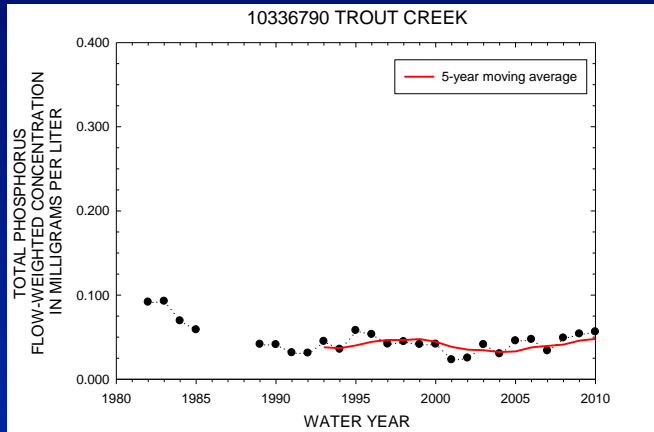
Suspended Sediment Annual FWC



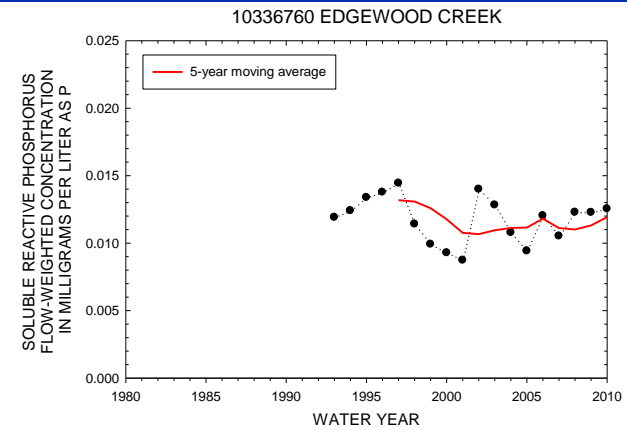
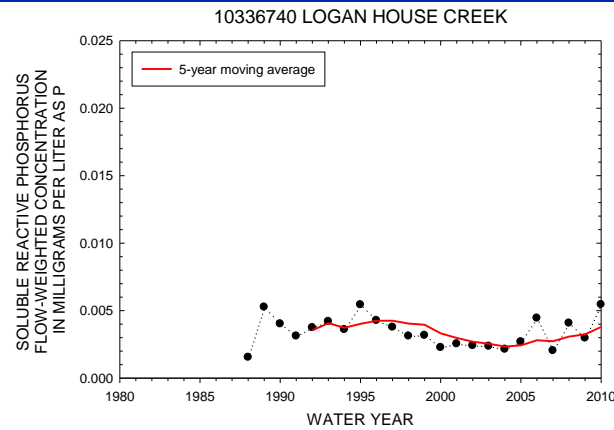
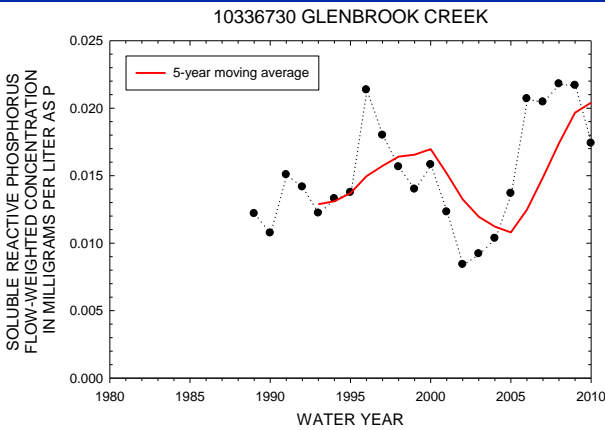
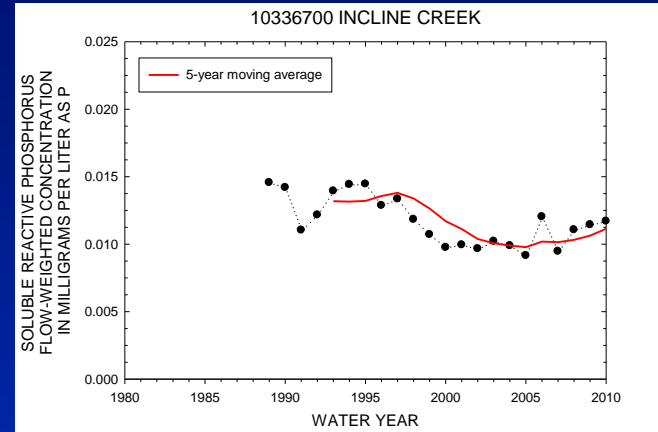
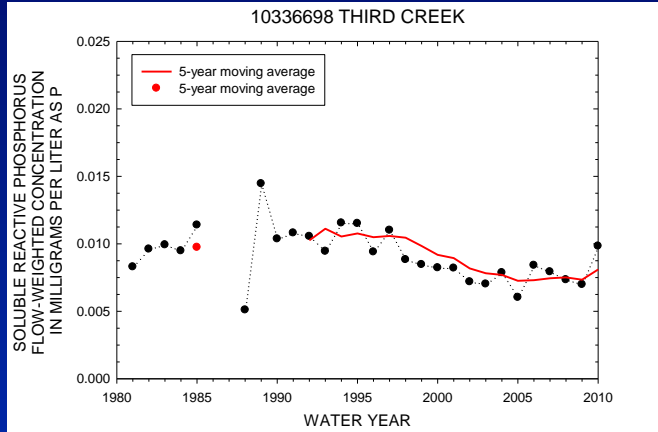
Total Phosphorus Annual FWC



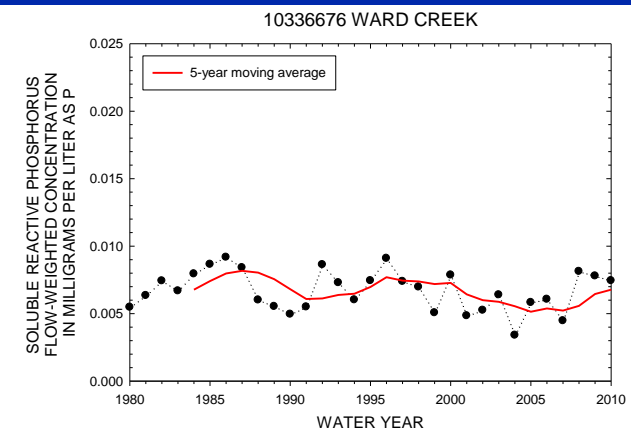
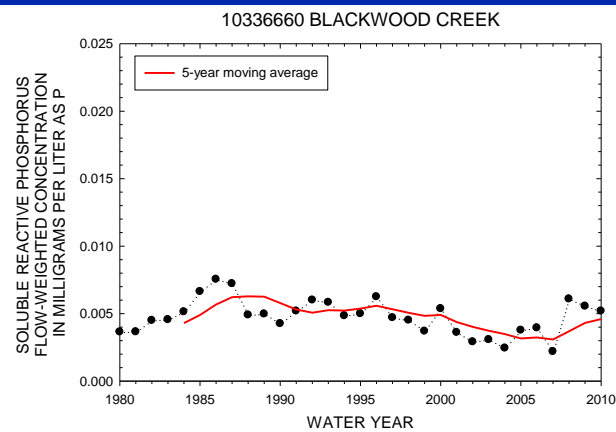
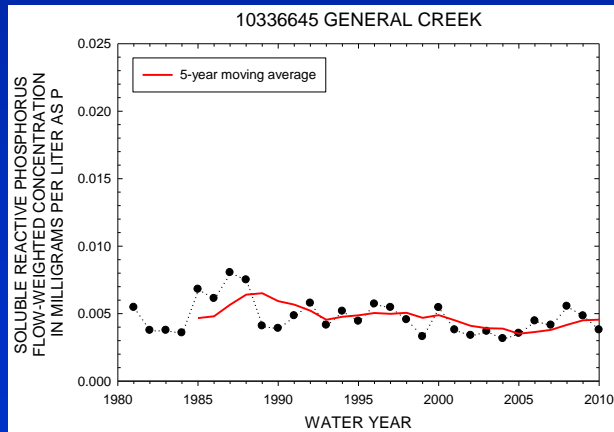
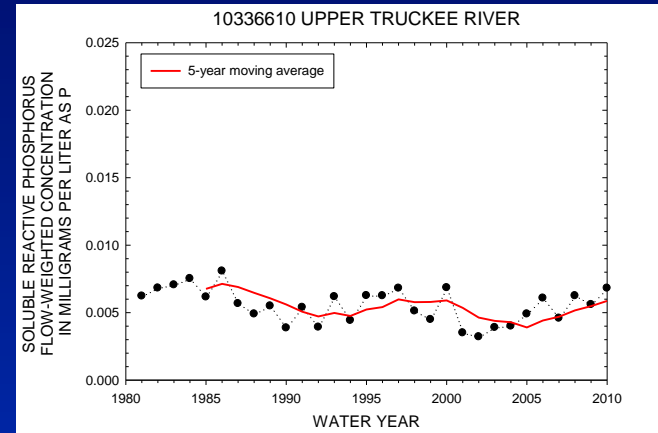
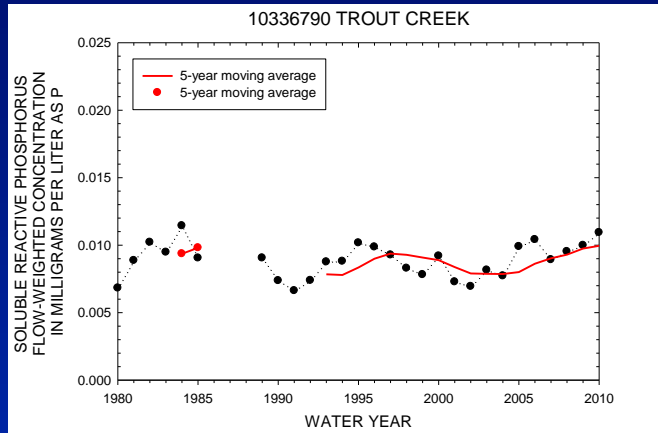
Total Phosphorus Annual FWC



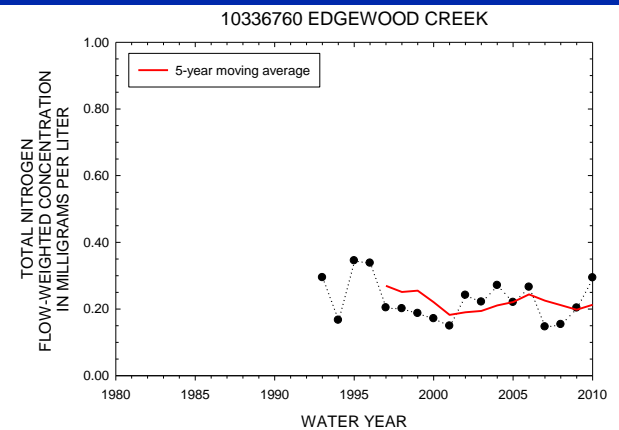
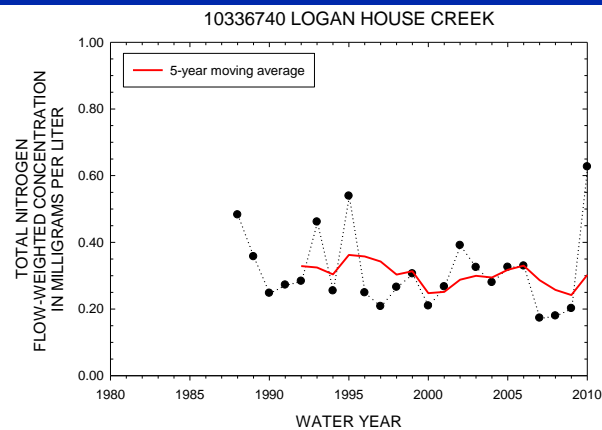
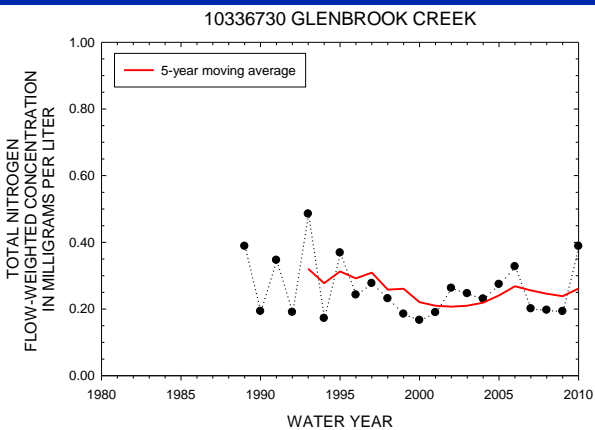
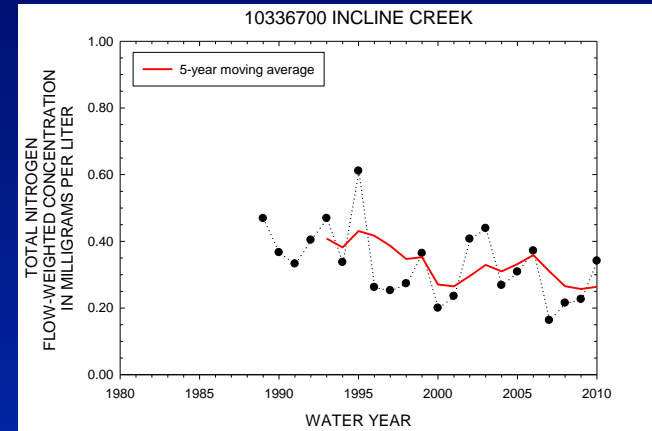
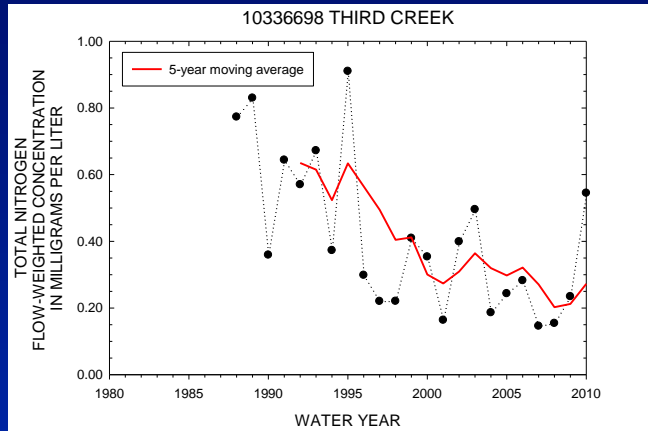
SRP Annual FWC



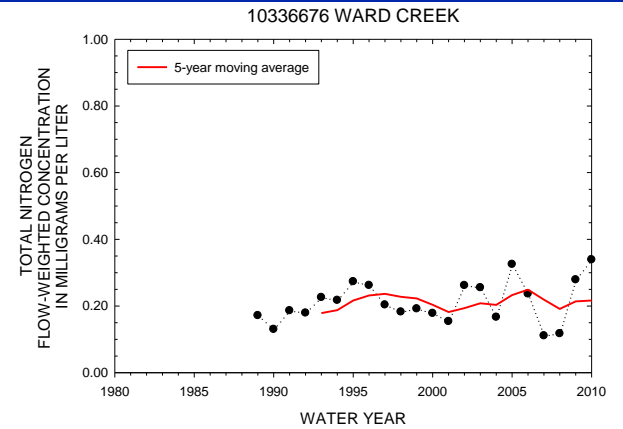
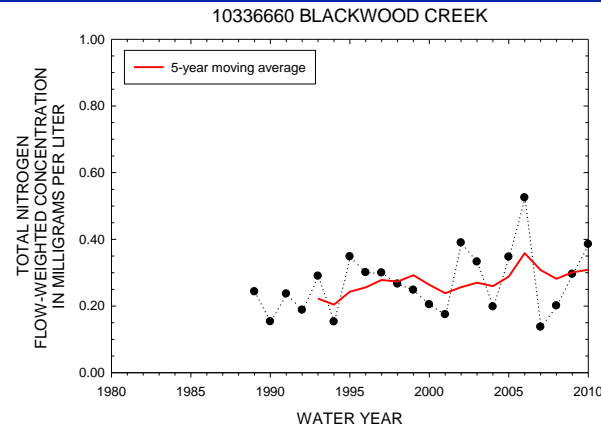
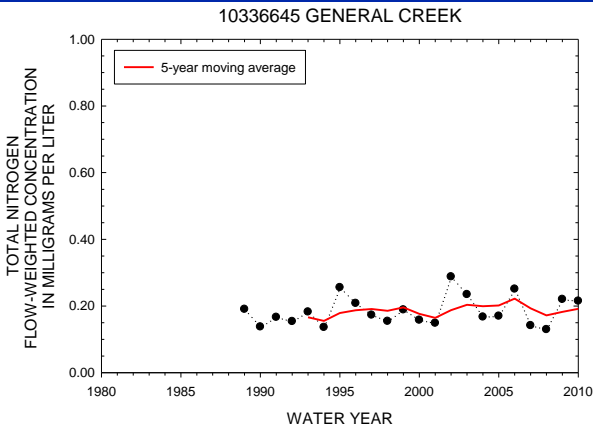
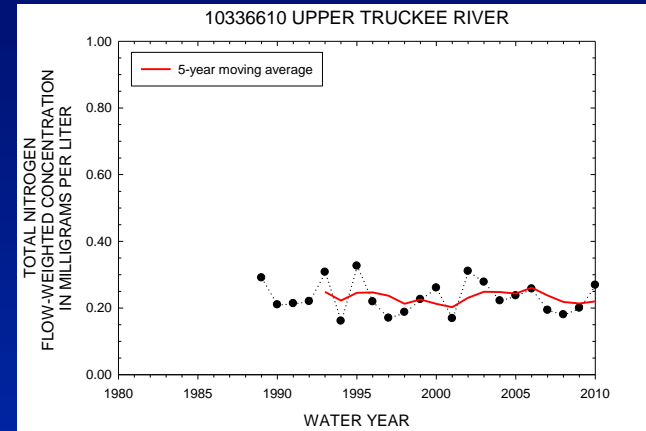
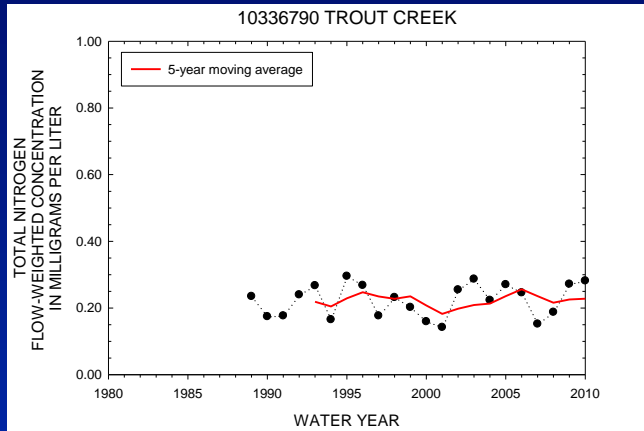
SRP Annual FWC



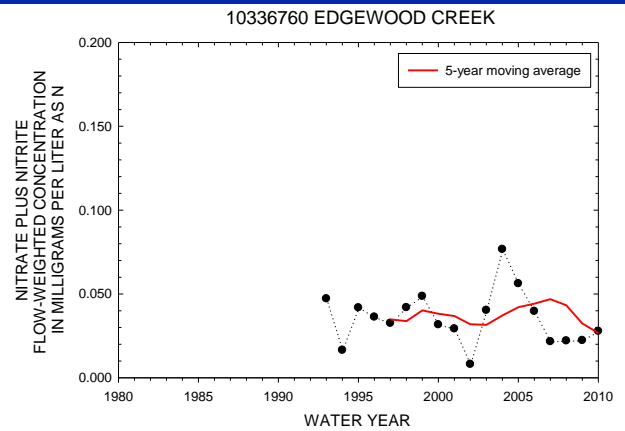
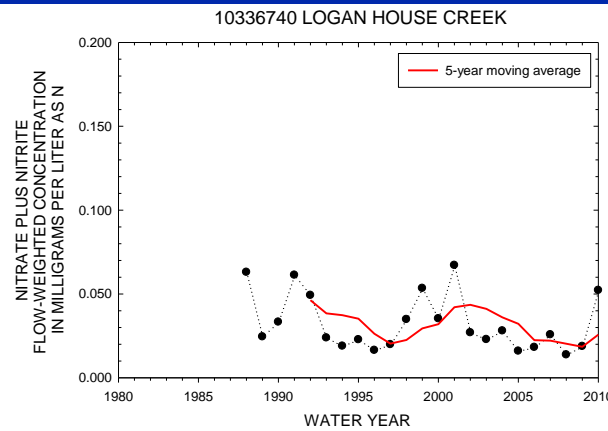
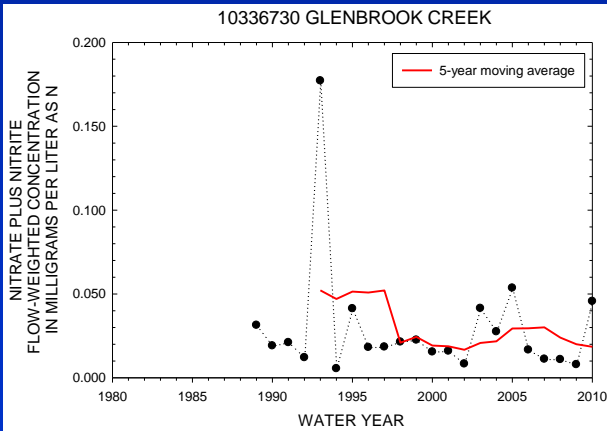
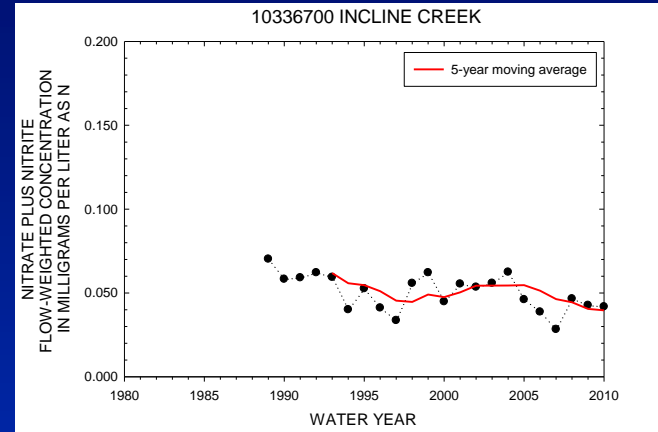
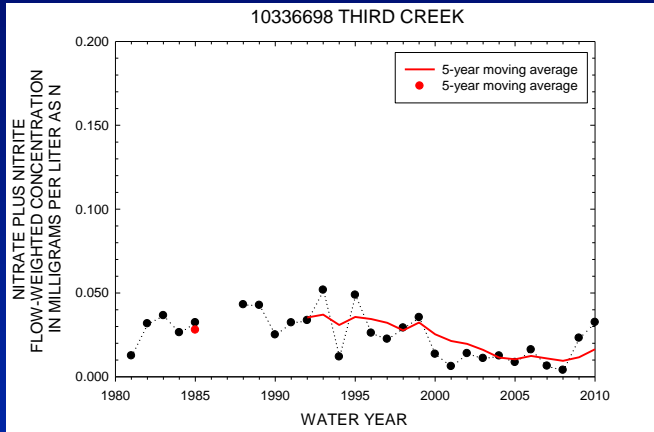
Total Nitrogen Annual FWC



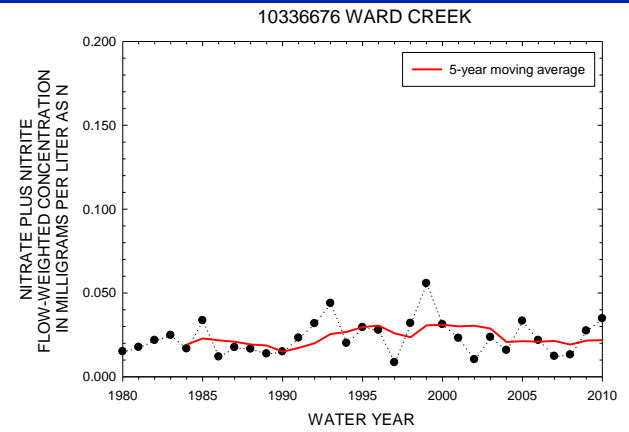
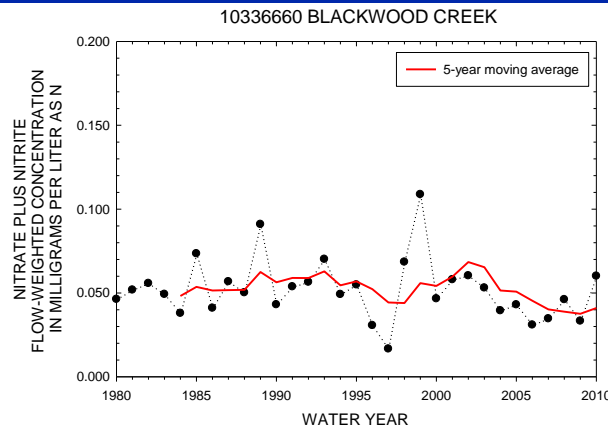
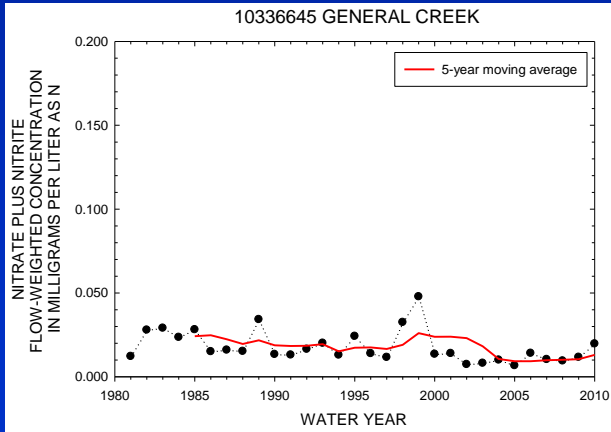
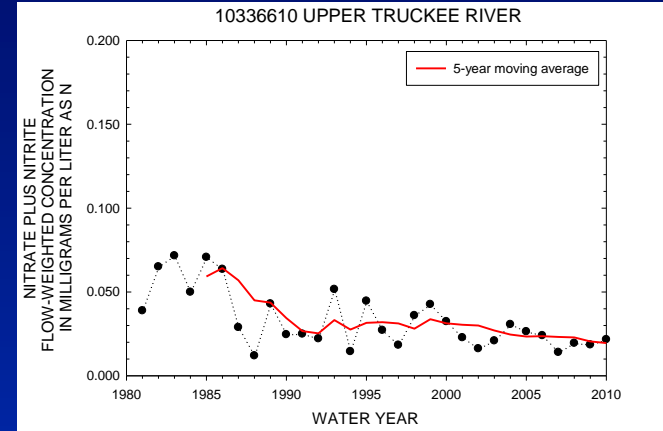
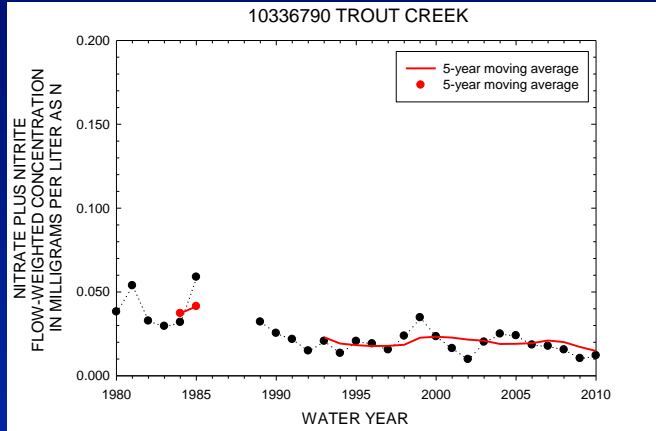
Total Nitrogen Annual FWC



Nitrate+Nitrite Annual FWC



Nitrate+Nitrite Annual FWC



West Shore Streams

Ward Creek 12-31-05



Photos by Scott Hackley

General Creek 12-31-05



Blackwood Creek 3-12-03

Photo by Tim Rowe

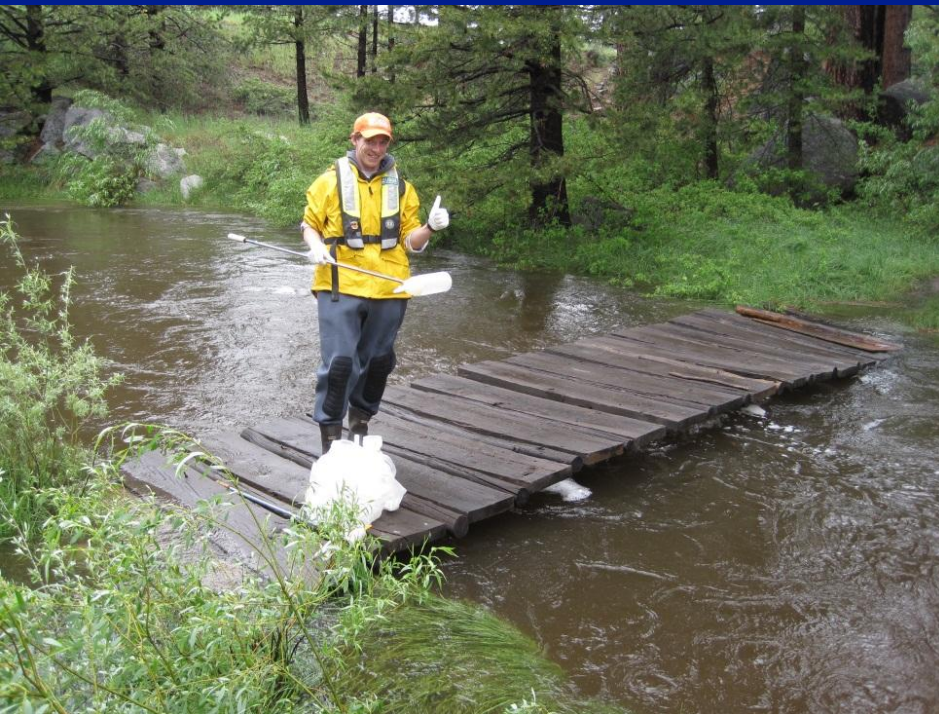


Future Work

- Continue to work on statistical methods for loads, FWC and trends
- Tributary monitoring has “new” objectives
- Starting WY12 monitoring 7 streams for water quality at 7 near mouth sites
- Starting WY12 monitoring 9 streams for streamflow with 11 gages

Questions

Trout at Pioneer Trail



June 29, 2011

Third Creek



June 6, 2010

“New” Goal Objectives

- Goal: Tributary monitoring program will collect, analyze and report long-term, consistent, reliable and accessible data on pertinent tributary water quality parameters and streamflow
- Objectives for data collection, data access, data evaluation, program administration.

“New” Goals/Objectives

- Data Collection-
 - TMDL progress
 - Nearshore conditions
 - Support State/TRPA water quality standards
 - Streamflow for restoration projects
 - Streamflow for flood forecasting and extreme hydrologic events

“New” Goals and Objectives

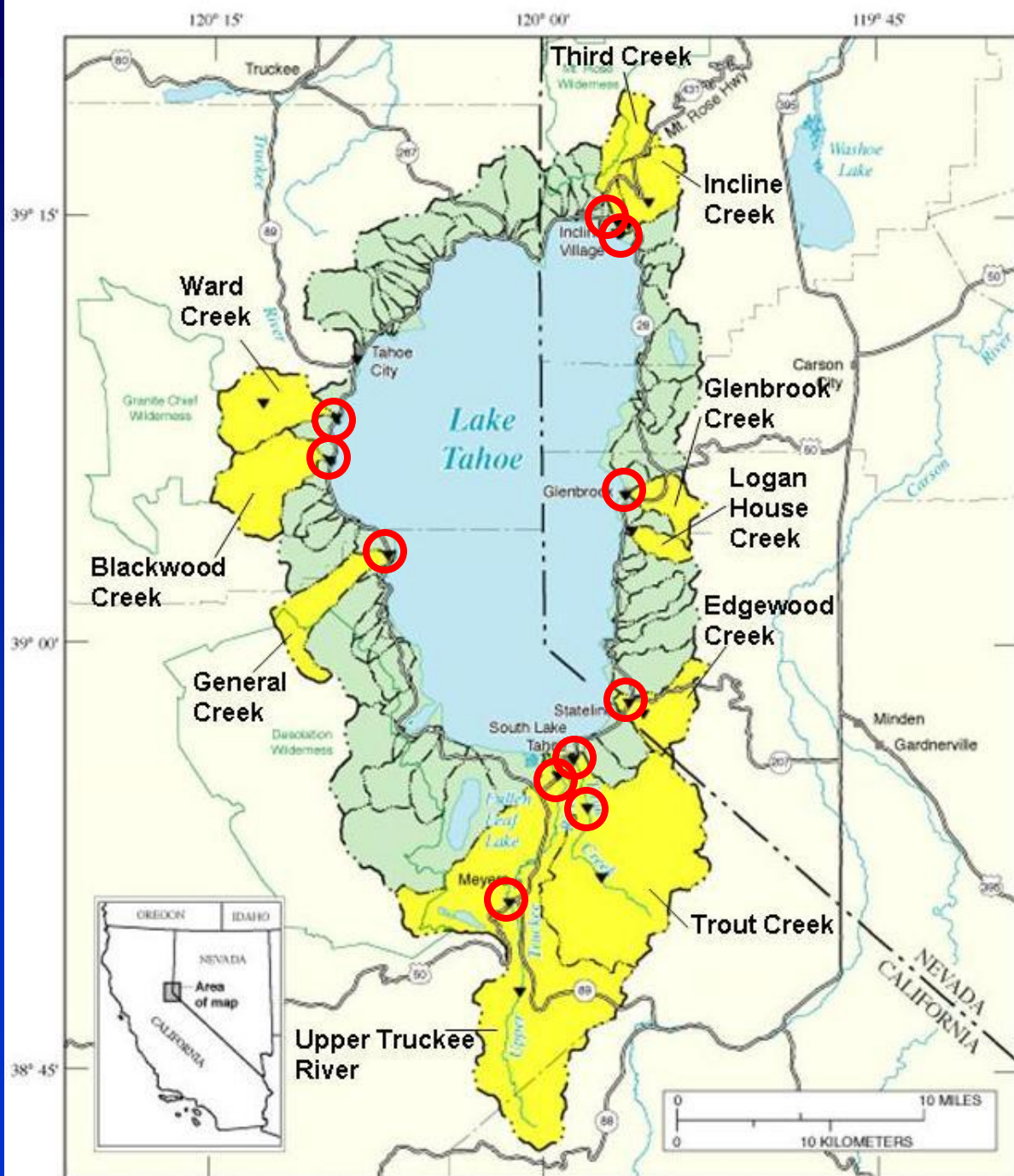
- Data Access: Provide access to the data
- Data Evaluation:
 - Evaluate annual pollutant concentrations and loads relative to adopted water quality standards and objectives.
 - Evaluate changes in streamflow (peak, timing, volumes)

“New” Goals and Objectives

- Program Administration objectives-
 - Follow Tahoe Status and Trend Monitoring Evaluation Program
 - Develop and flow a monitoring and evaluation plan
 - Annual Findings Report

WY2012 Stream Network

- 11 gages
- 9 watersheds
- 47 % of watershed area
- ~50% streamflow to lake

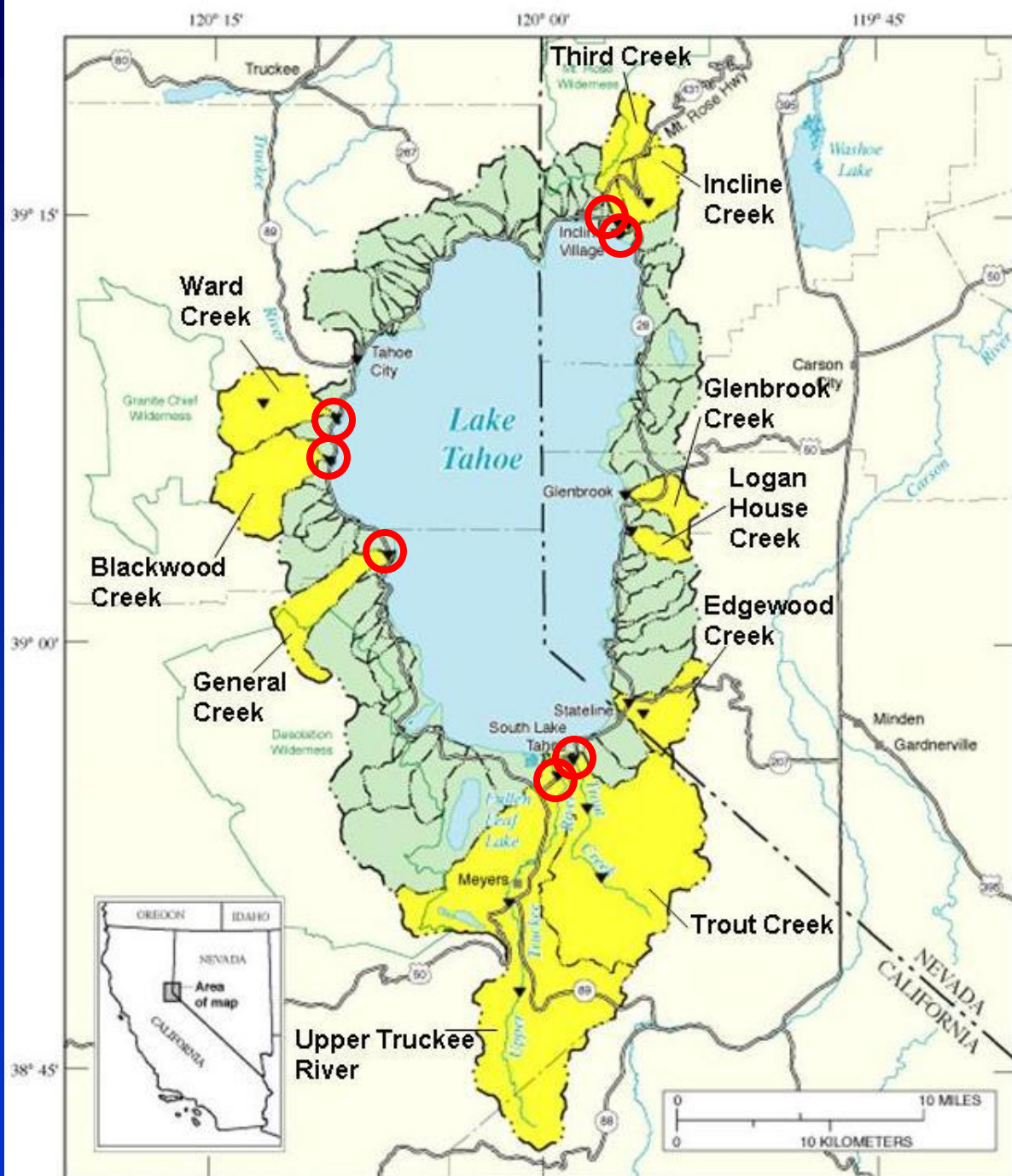


Base from U.S. Geological Survey digital data, 1:100,000, 19xx
Universal Transverse Mercator projection,
Zone 11

Wilderness areas from U.S. Forest Service digital data, 1997

WY2012 Stream Network

- 7 QW sites
- 7 watersheds
- 47 % of watershed area
- ~50% streamflow to lake



Base from U.S. Geological Survey digital data, 1:100,000, 19xx
Universal Transverse Mercator projection,
Zone 11

Wilderness areas from U.S. Forest Service digital data, 1997

