

The background image is a landscape photograph. In the foreground, a wooden pier with several vertical posts extends from the bottom left towards the center. The water is calm and reflects the light from the sky. In the distance, a range of mountains is visible, with some peaks covered in snow. The sky is a mix of soft pinks, purples, and blues, indicating the time is either dawn or dusk.

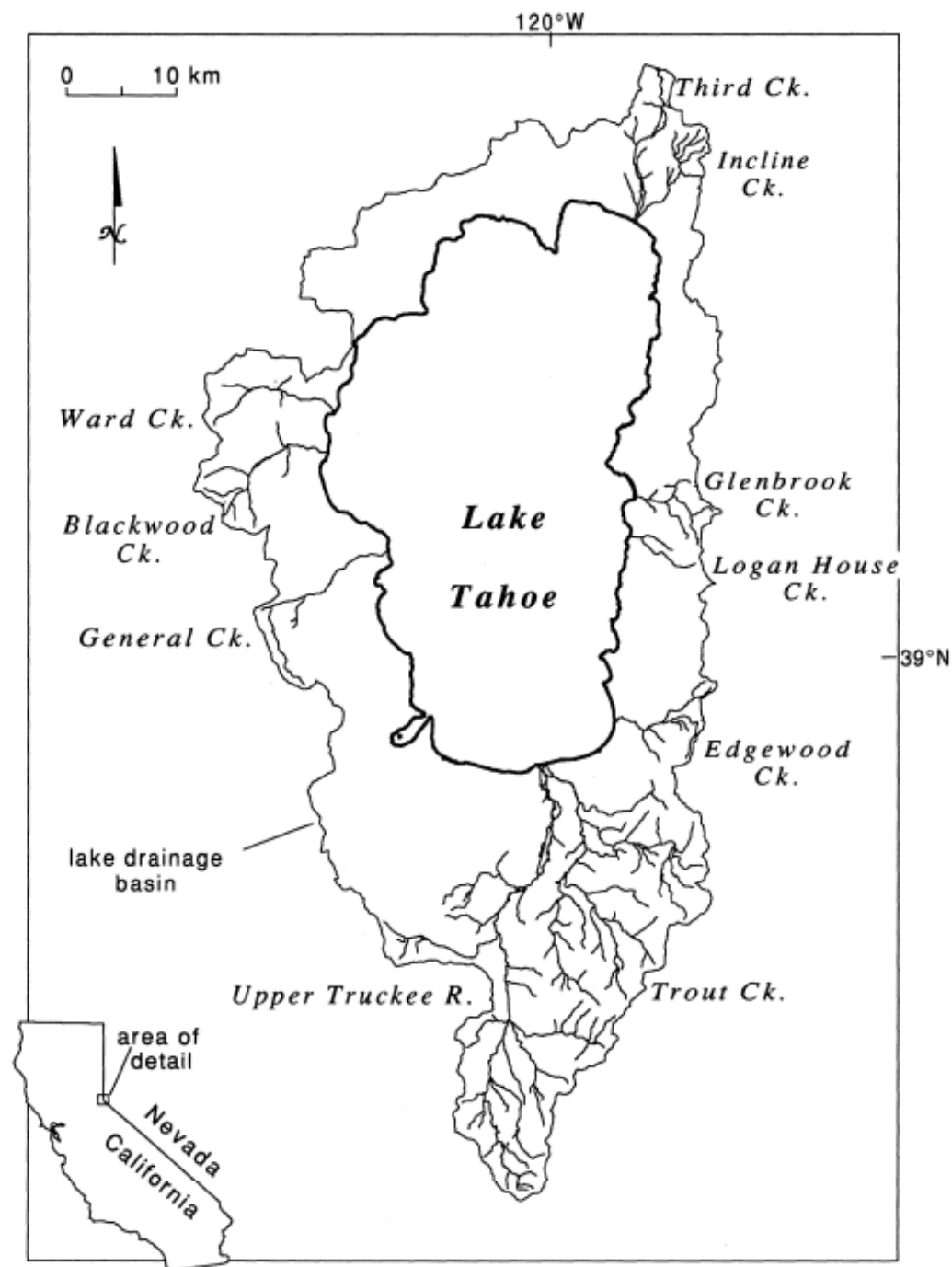
## Relating Water Quality to Watershed Attributes: A TMDL Progress Report

## Objectives:

- To develop quantitative relationships between water quality and catchment attributes
- Provide information for the TMDL water quality model

## Data Sources

- LTIMP water quality data for 20 stations, 1993-2000
- GIS data layers from
  - US Forest Service
  - TRPA
  - USGS
  - New Information
    - IKONOS
    - Down-scaling of Met. data



## Primary LTIMP Data—Dependent variables

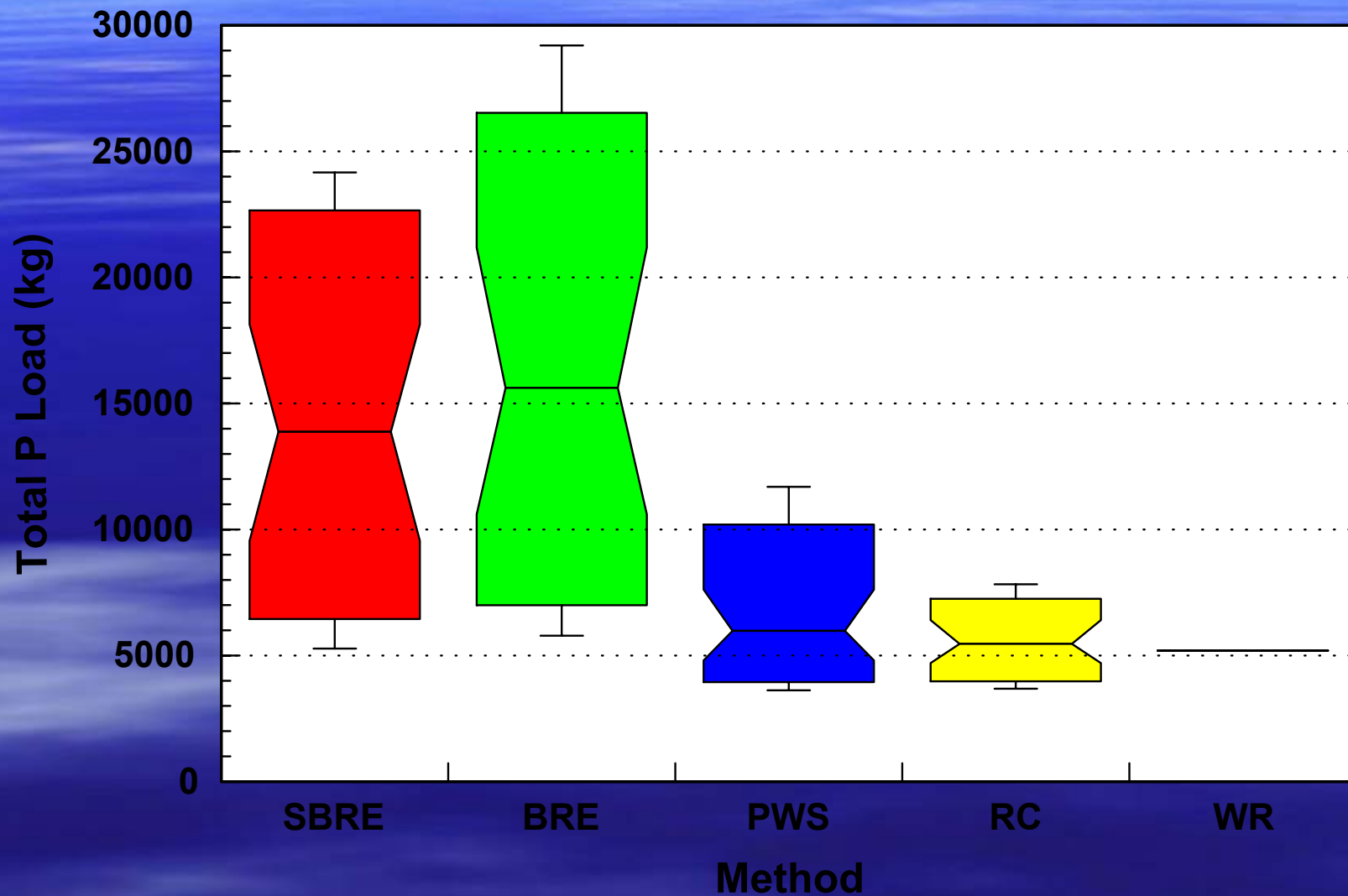
- Instantaneous concentration of:
  - Nitrate-N
  - Ammonium-N
  - TKN
  - SRP
  - Total P
  - Biol. Available Fe
  - Suspended Sediment Conc.
- Instantaneous Discharge ( $Q_i$ )
- Mean Daily Discharge ( $Q_d$ )



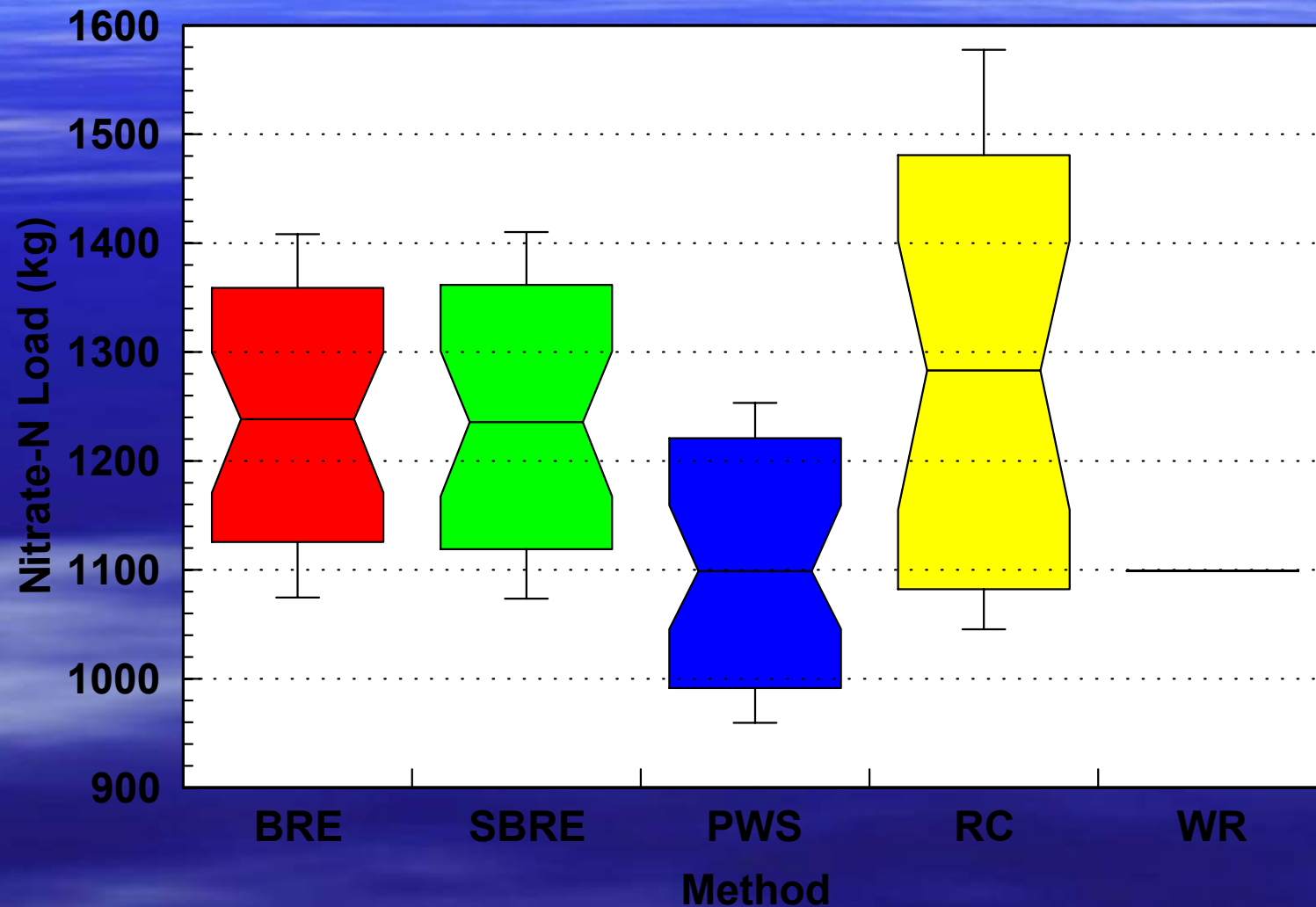
## Derived from LTIMP Data--Dependent Variables

- Discharge-weighted mean concentration at 20 stations, 1993-2000\*
  - At a station:  
 $(\sum Q_i C_i) / \sum Q_i$
  - Between stations:  
 $\sum (Q_{i2} * C_{i2} - Q_{i1} * C_{i1}) / \sum (Q_{i2} - Q_{i1})$
- Total and Ave. Ann. Load, for 20 stations
  - Period-weighted sample method, for dissolved constituents
  - Regression method for particulate constituents

# A Monte Carlo Test of Total P Load by Four Methods, 200 trials using 40 Samples drawn from 132 real samples



# A Monte Carlo Test of Nitrate-N Load by Four Methods, 200 trials using 40 Samples drawn from 132 real samples





## Primary Data for Urbanized Areas—Dependent Variables

- Concentration in Flow-weighted composite samples
  - Nitrate-N
  - Ammonium-N
  - TKN
  - Total P
  - Dissolved P
  - SRP
  - SSC
- Instantaneous Discharge

## Derived Data for Urbanized Areas

- Event Mean Concentrations
- Event Discharge

## Independent Variables

### ■ Hydrology

- Mean ann. Precip. (cm) \*
- River density (km/km<sup>2</sup>) \*
- Alluvial & Riparian Rivers (pct.)\*
- Flow Regime

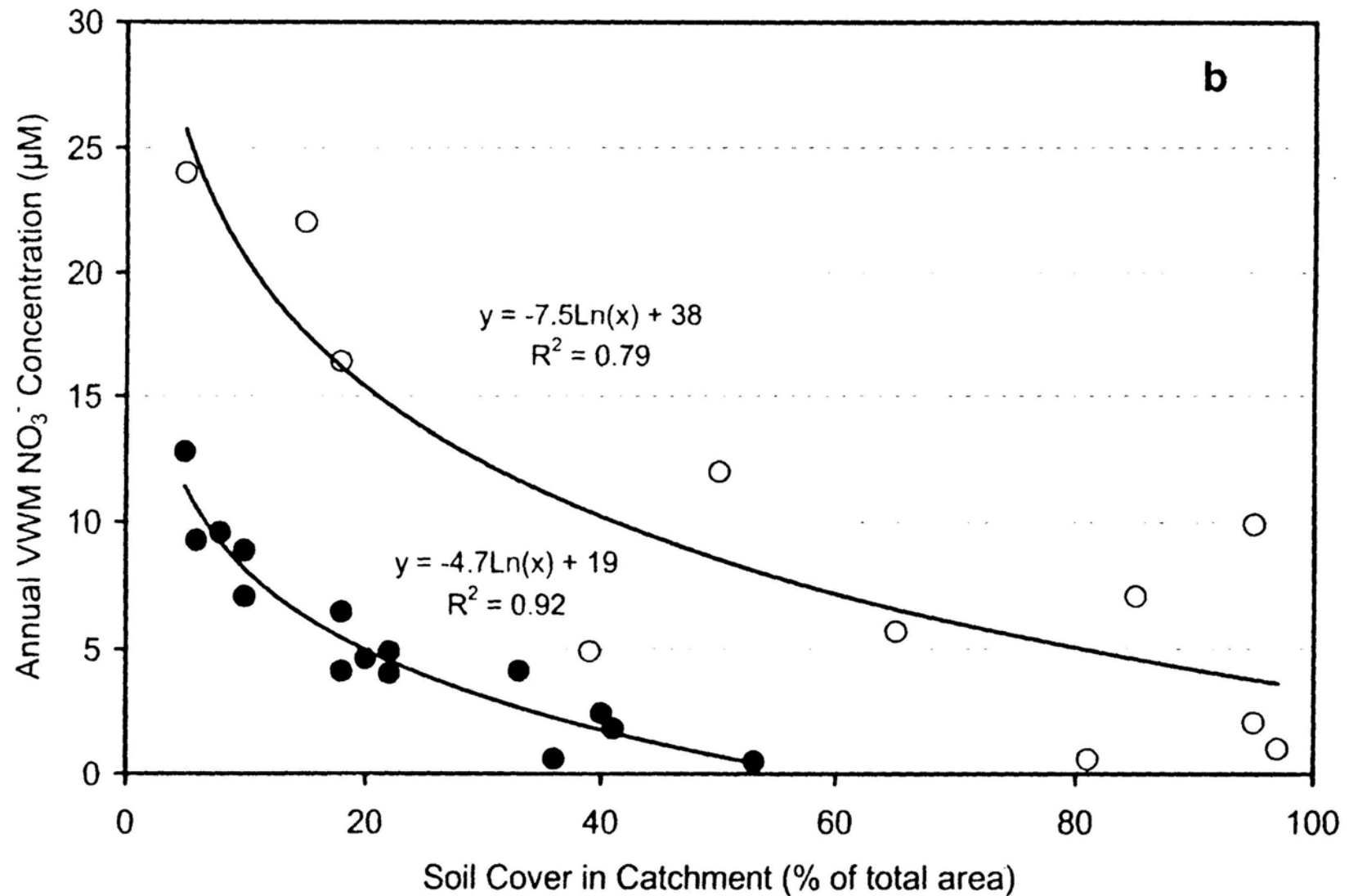
### ■ Geology/soils/geomorph.

- Volcanic soils (pct.)\*
- Granitic Soils (pct)\*
- Area-wtd. Site Class\*
- Unwtd. Ave. slope\*
- Flowpath-wtd. Slope\*

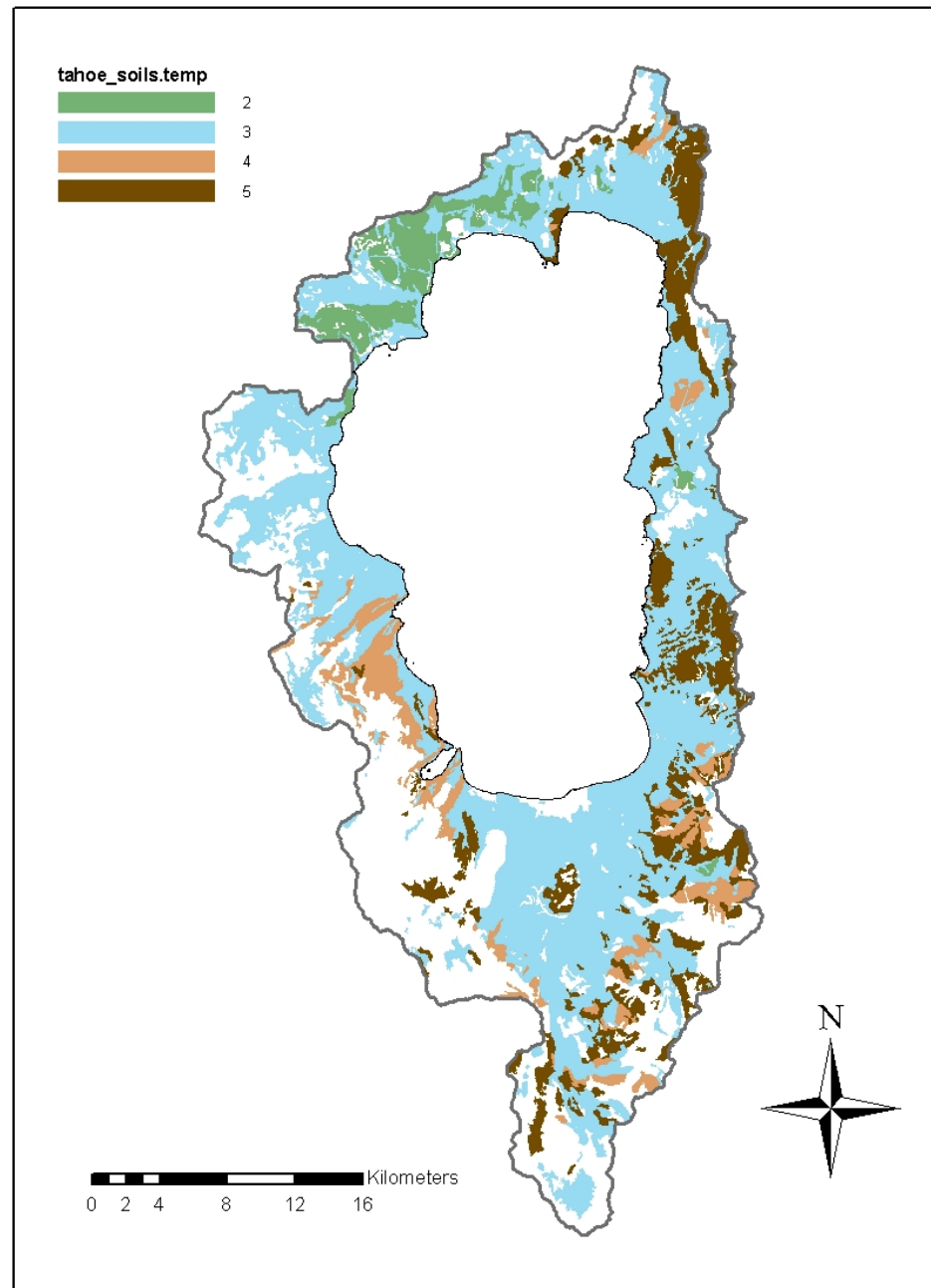
### ■ Land Use

- Low-intensity residential (pct.)\*
- Commercial/indust. (pct)\*
- Hazard class by land use (pct)
- Unimp. Dirt roads (km/km<sup>2</sup>)\*
- Residential roads (km/km<sup>2</sup>)\*
- State/Fed. Highways (km/km<sup>2</sup>)\*
- Impervious surface (pct.) from IKONOS data

Q-wtd. Mean Nitrate-N Concentration,  
Sierra Nevada (●) and Rocky Mountains (○)  
(Sickman *et al.*, 2002)

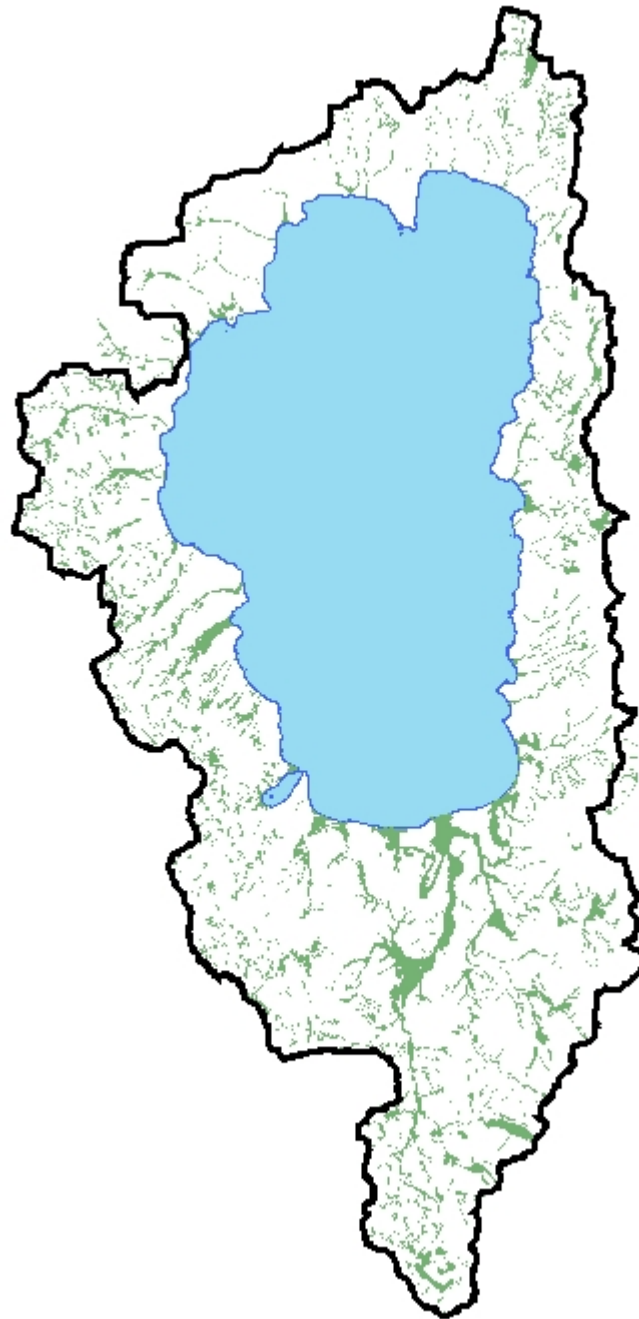


## Site Class (Rogers, 1974)

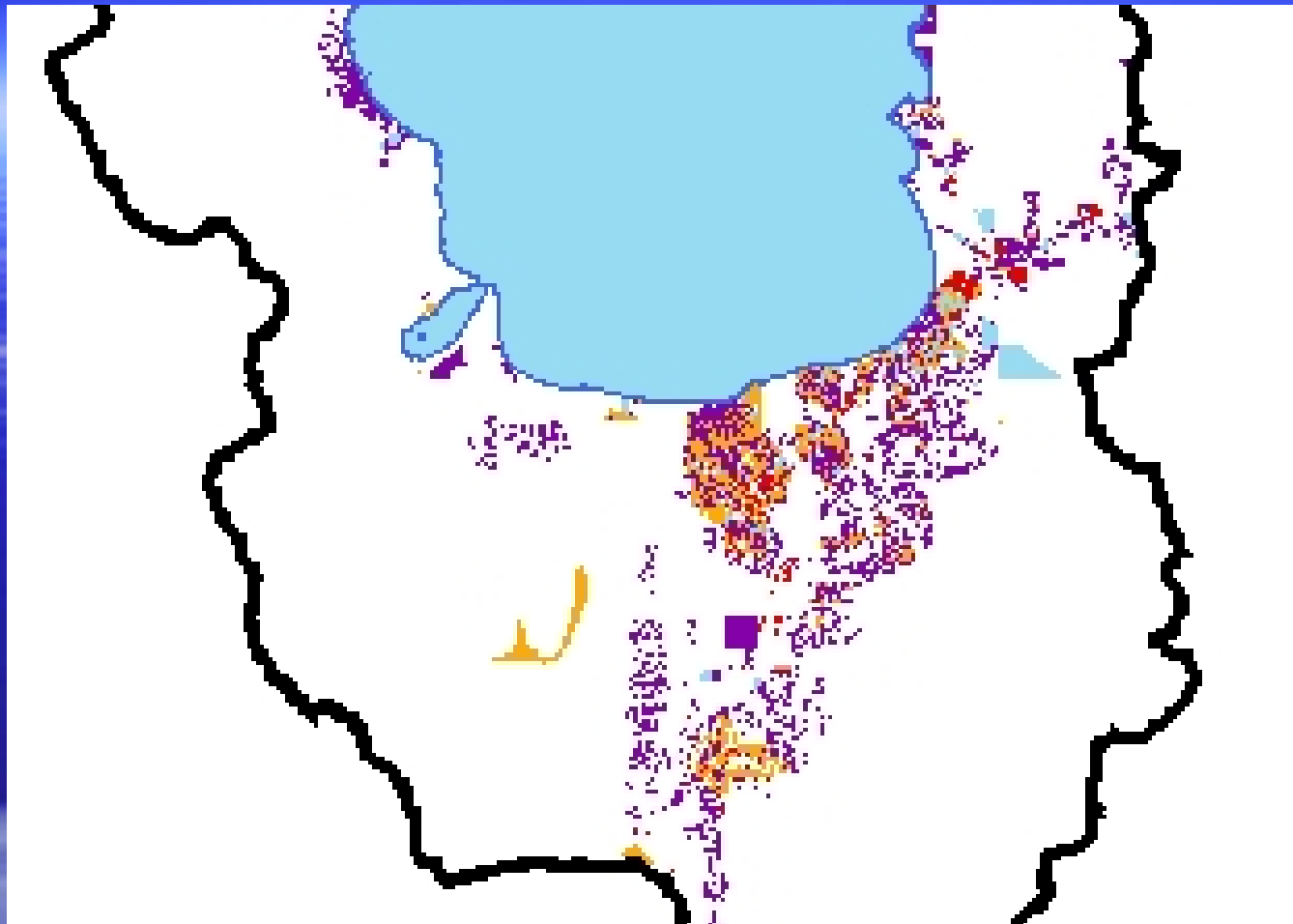




Riparian Zones







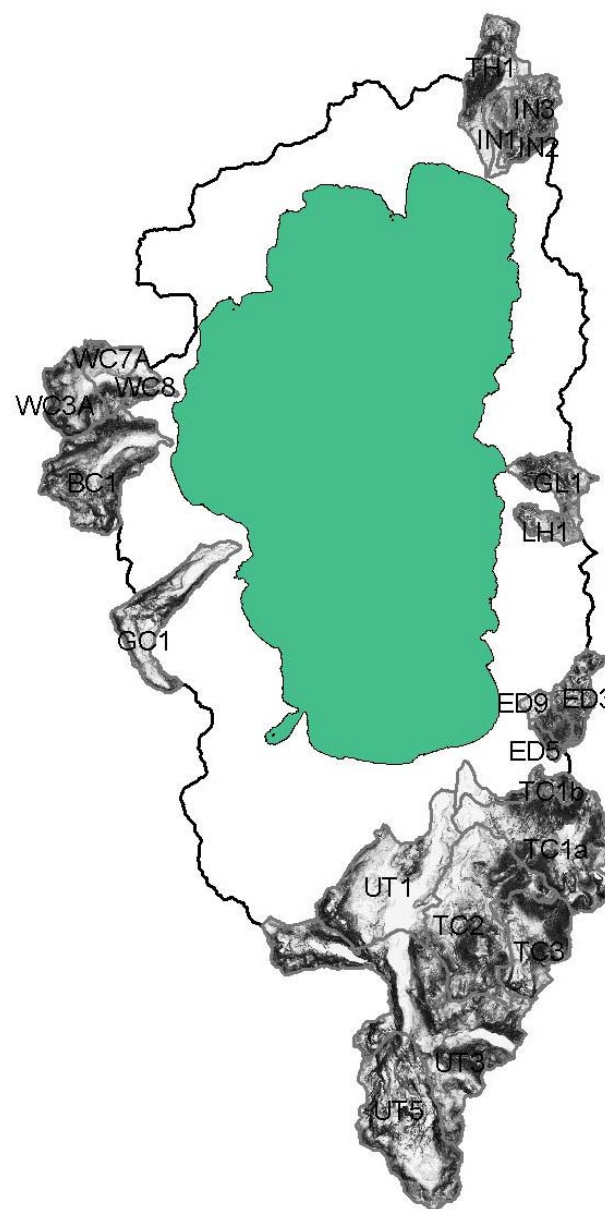
Land Use Catagories, from TRPA

Red= Commercial

Yellow = mixed urban

Blue, Purple = residential

Unweighted Slope

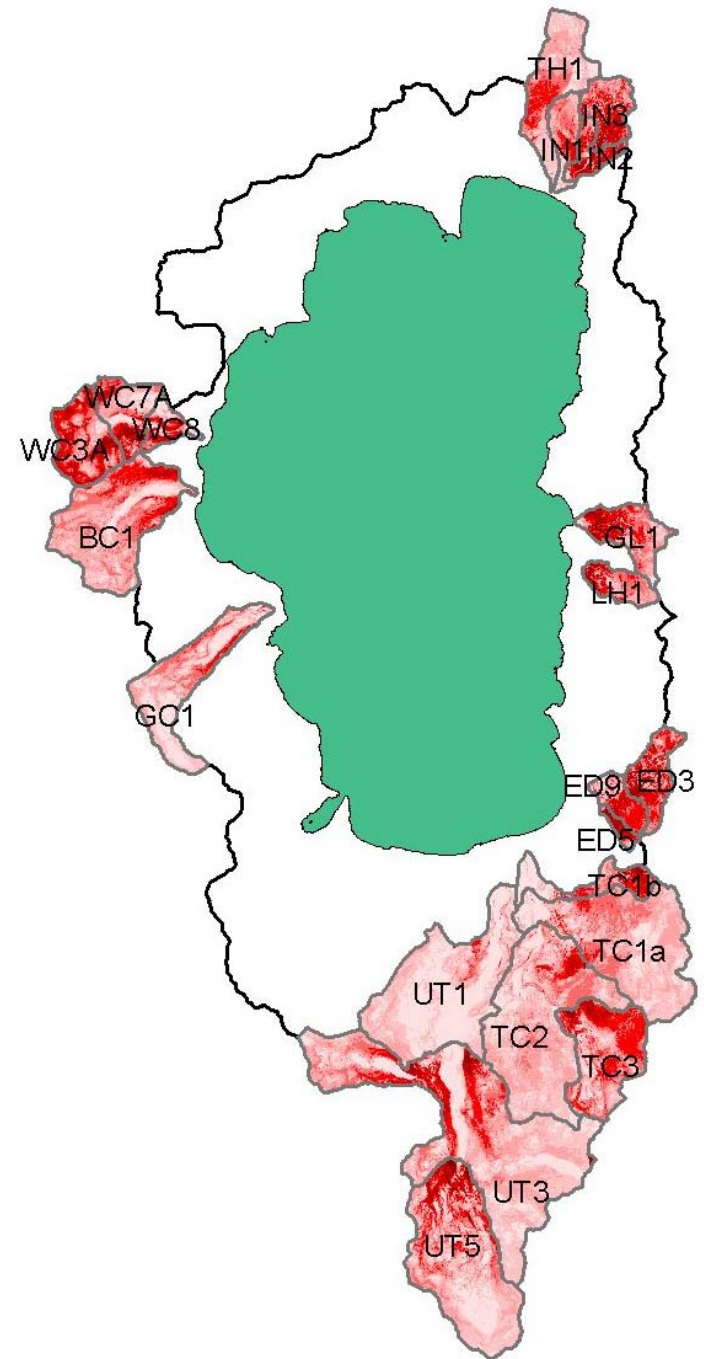


## Flowpath Length-Discounted Slope

$$S' = S * e^{-KL}$$

(L=Hydrologic flowpath length, m

$$k=10^4)$$



Unweighted – Weighted Slope

