Scientific Program for Tahoe Clarity TMDL
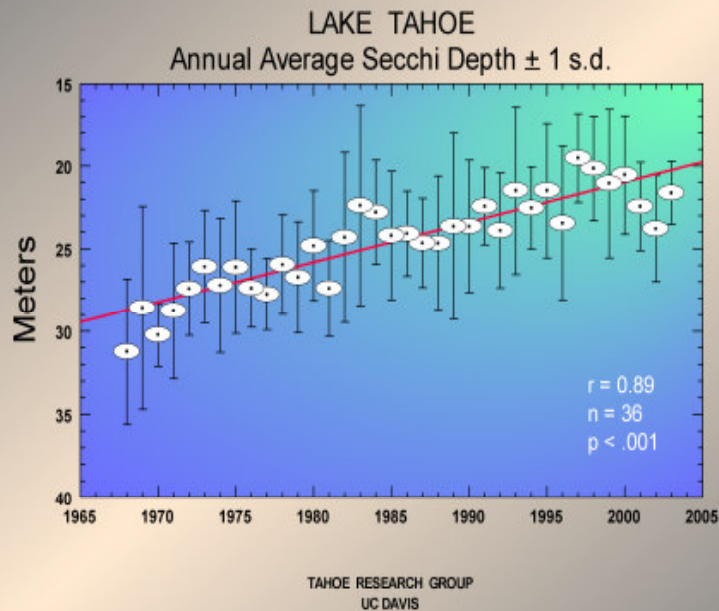
Phase 1

Tahoe TMDL Symposium - Day 1
December 9, 2004

Restoration of Declining Clarity is TMDL Target


LAKE TAHOE
Annual Average Secchi Depth ± 1 s.d.

r = 0.89
n = 36
p < .001

TAHOE RESEARCH GROUP
UC DAVIS

- Stimulation of algae by phosphorus & nitrogen

- Fine sediment (<20 µm) from erosion and dust

- Tahoe TMDL addresses interaction between 3 pollutants as they affect Secchi depth
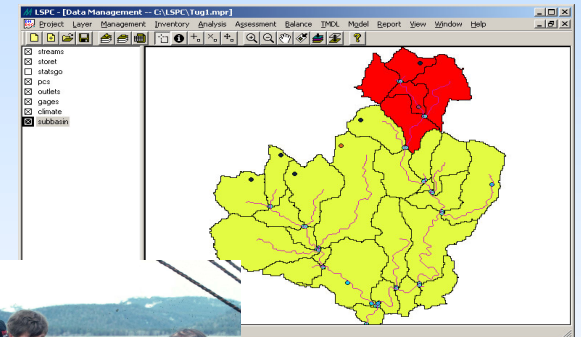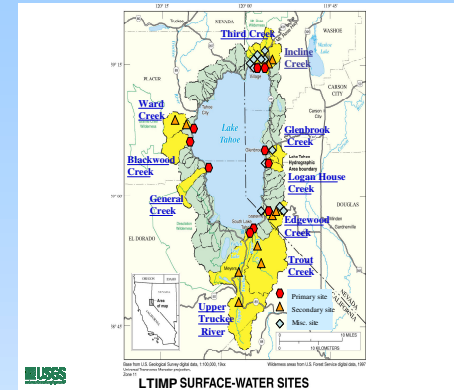
Goals of Tahoe TMDL Research Program

1. Fill in critical science gaps.

2. Integrate knowledge on air, watershed and lake processes within a modeling framework.

3. Determine science-base targets for pollutant load reduction.

4. Develop tools to guide management.

5. Establish research plan for water quality.

6. Quantify the EIP.

Science-Based Load Reduction Target
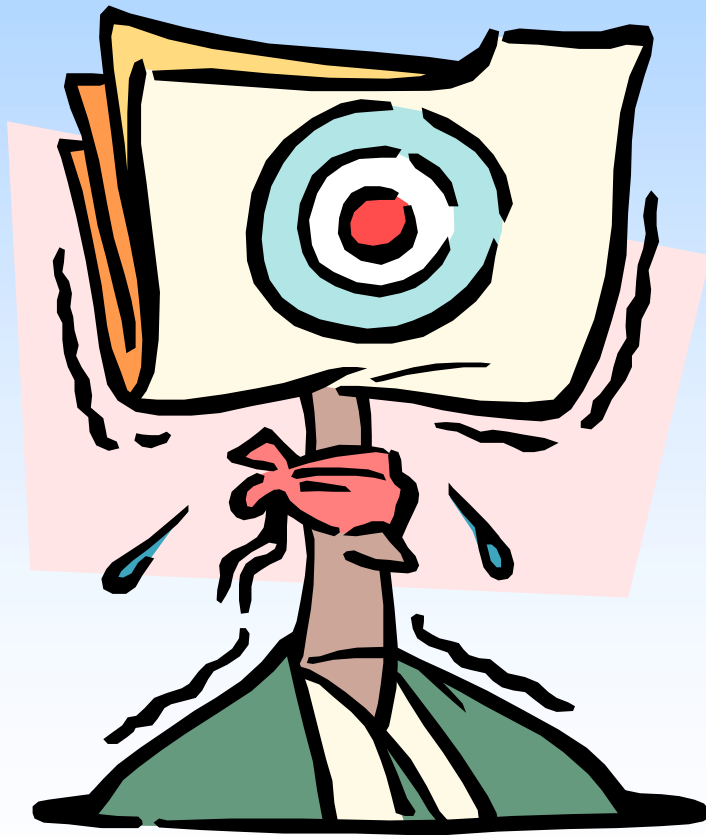
Scientific Approaches

- **Historic Tahoe data**
- **Literature**
- **New monitoring**
- **Lab experiments**
- **Field experiments**
- **Demonstration projects**
- **Statistical analyses**
- **Modeling - with verification**
- **Best professional judgment**

TMDL Research Program

- Wholistic approach - land, air, water science + resource management + policy

- Involves >200 people

- Financial commitments of over $5,000,000

- Largest scientific effort at Lake Tahoe

- Significant at national level

- Tools will last beyond TMDL

- Model for science/management planning

Diverse Collaborative Team

- UC Davis/Tahoe Research Group

- U Nevada Reno & Desert Research Institute

- USACE, USGS, USFS, USDA NSL

- California Air Resources Control Board (CARB)

- CalTrans, NDOT

- Lahontan, TRPA, CTC, Nevada State Lands

- Consultants (Tetra Tech, Hydroikos, GeoSyntec)

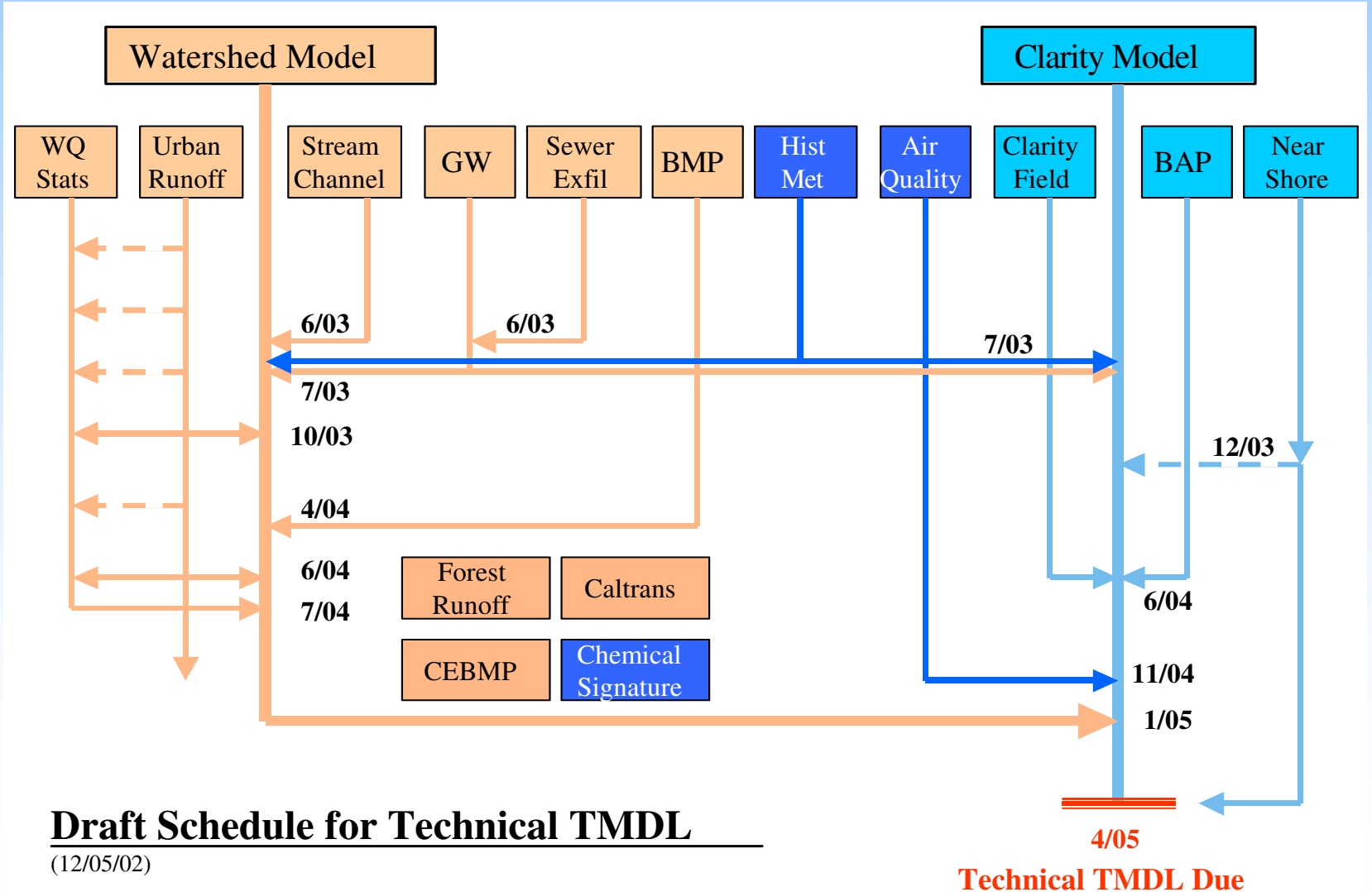- Others

New Research and Monitoring Projects

- Nearshore water quality – DRI

- Loading of fine sediment – Collective Effort

- Stream channel erosion – USDA National Sedimentation Lab

- Groundwater & Sewer line exfiltration – USACE

- Stormwater monitoring & land-use loading – TRG, DRI, Hydroikos

- Reconstruction of historic meteorology – UC Davis

- Watershed Modeling – Tetra Tech

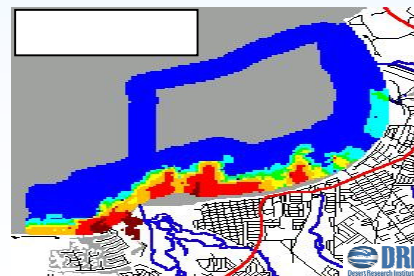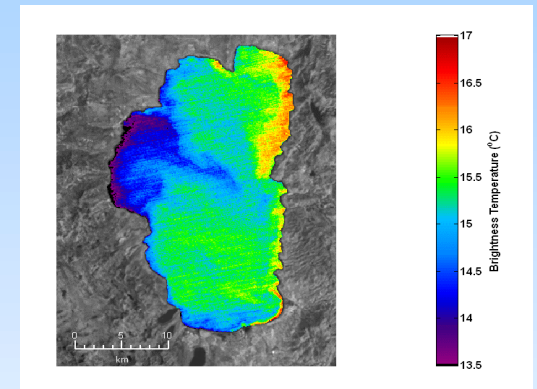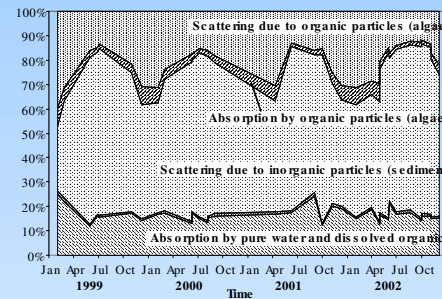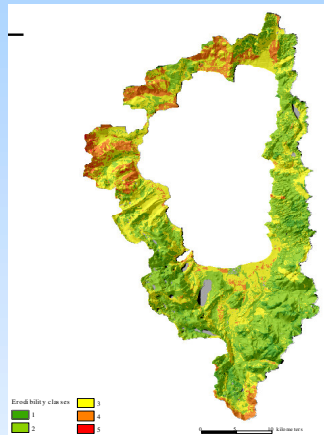- Biologically available phosphorus – UNR

New Research and Monitoring Projects

- Lake Particles: Character & loss rates – UCD

- Application of Clarity Model – UCD

- BMP evaluation and implementation feasibility – GeoSyntec Consulting

- Air quality monitoring network – CARB

- Air quality emission sources – CARB

- Modeling of atmospheric deposition – CARB

- Data management framework (TIIMS) – TRPA

Research Integration

Watershed Model

Clarity Model

WQ Stats · Urban Runoff · Stream Channel · GW · Sewer Exfil · BMP · Hist Met · Air Quality · Clarity Field · BAP · Near Shore

6/03   6/03   7/03

7/03

10/03   12/03

4/04

6/04   Forest Runoff   Caltrans   6/04

7/04

CEBMP   Chemical Signature   11/04

1/05

4/05
Technical TMDL Due

Draft Schedule for Technical TMDL
(12/05/02)

A Science Program With Many First Time Products

Widespread Use of Models

Atmospheric

- CARB - loading model
- UCD - MM5 historic climate reconstruction

Upland

- Tetra Tech - LSPC (Hydrology and Loading)
- Hydroikos - Statistical Modeling
- Geosyntech - SWMM (Pilot BMP modeling)

Groundwater

- USACE - groundwater loading model

Stream Channel Erosion

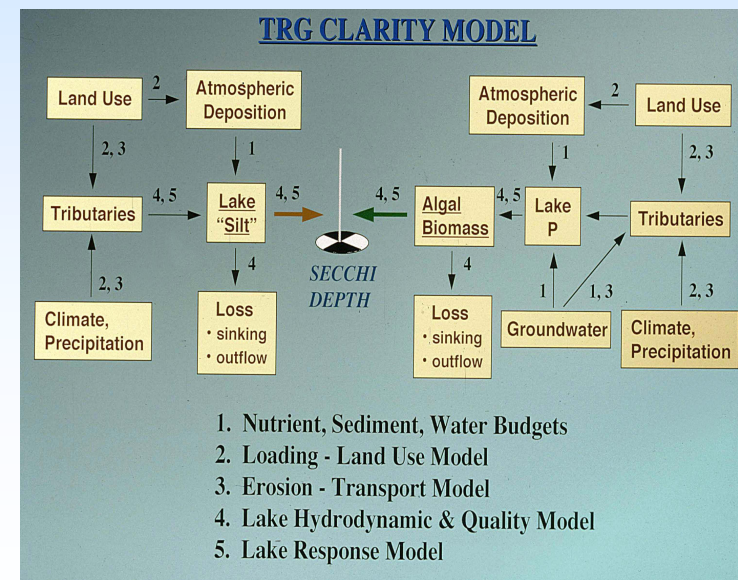- National Sedimentation Laboratory - CONCEPTS/AnnAGNPS
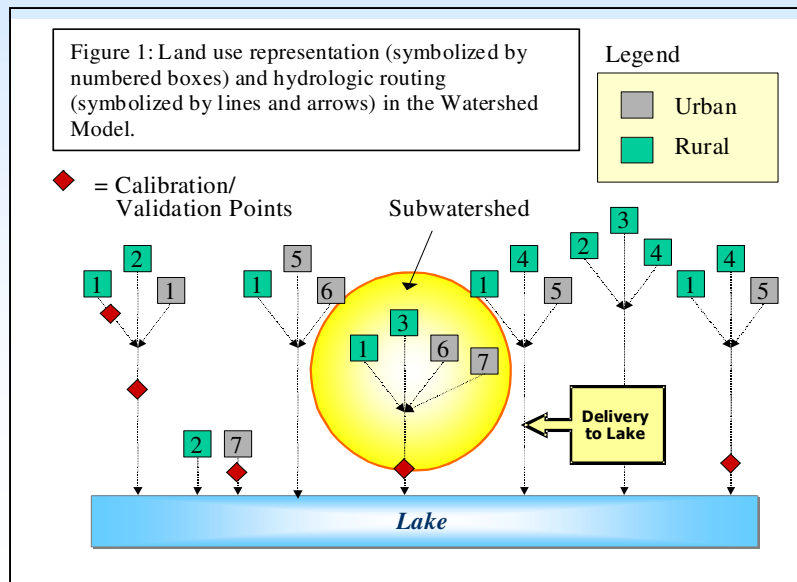
Lake Response

- UCD - Lake Tahoe Clarity Model (hydrodynamics, water quality, optical properties)
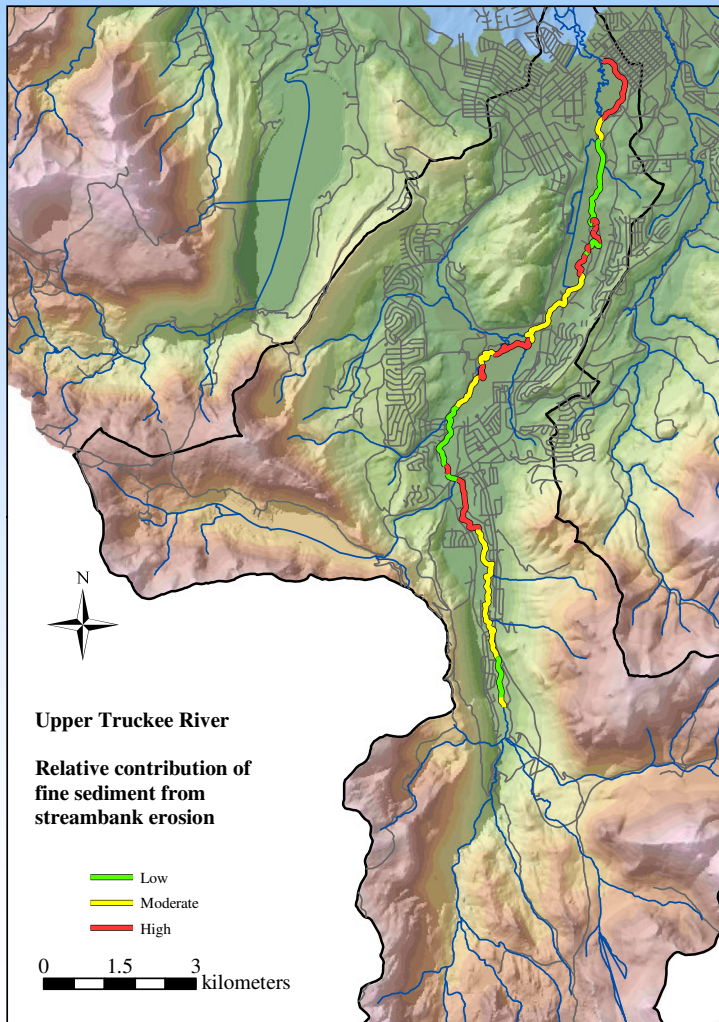
Watershed and Lake Clarity Models

These Tahoe-specific models allow us to:
(1) Estimate pollutant load from entire watershed
(2) Evaluate loading based on management scenarios
(3) Assess lake response to management actions

Figure 1: Land use representation (symbolized by numbered boxes) and hydrologic routing (symbolized by lines and arrows) in the Watershed Model.

Legend
- Urban
- Rural

◆ = Calibration/ Validation Points

Subwatershed

Delivery to Lake

Lake

TRG CLARITY MODEL

Land Use — Atmospheric Deposition — Tributaries — Lake "Silt" — SECCHI DEPTH — Algal Biomass — Lake P — Tributaries — Land Use — Atmospheric Deposition — Climate, Precipitation — Loss • sinking • outflow — Groundwater — Climate, Precipitation

1. Nutrient, Sediment, Water Budgets
2. Loading - Land Use Model
3. Erosion - Transport Model
4. Lake Hydrodynamic & Quality Model
5. Lake Response Model

Stream Channel Erosion

Upper Truckee River

Relative contribution of
fine sediment from
streambank erosion

Low
Moderate
High

0   1.5   3
kilometers

First time that total
sediment and fine
sediment loading from
stream channels has
been studied.

Could be an important
source at certain
locations

Stream Particle Size Distribution

- First time measured in Tahoe basin
- Focuses on particle sizes that most affect Secchi depth
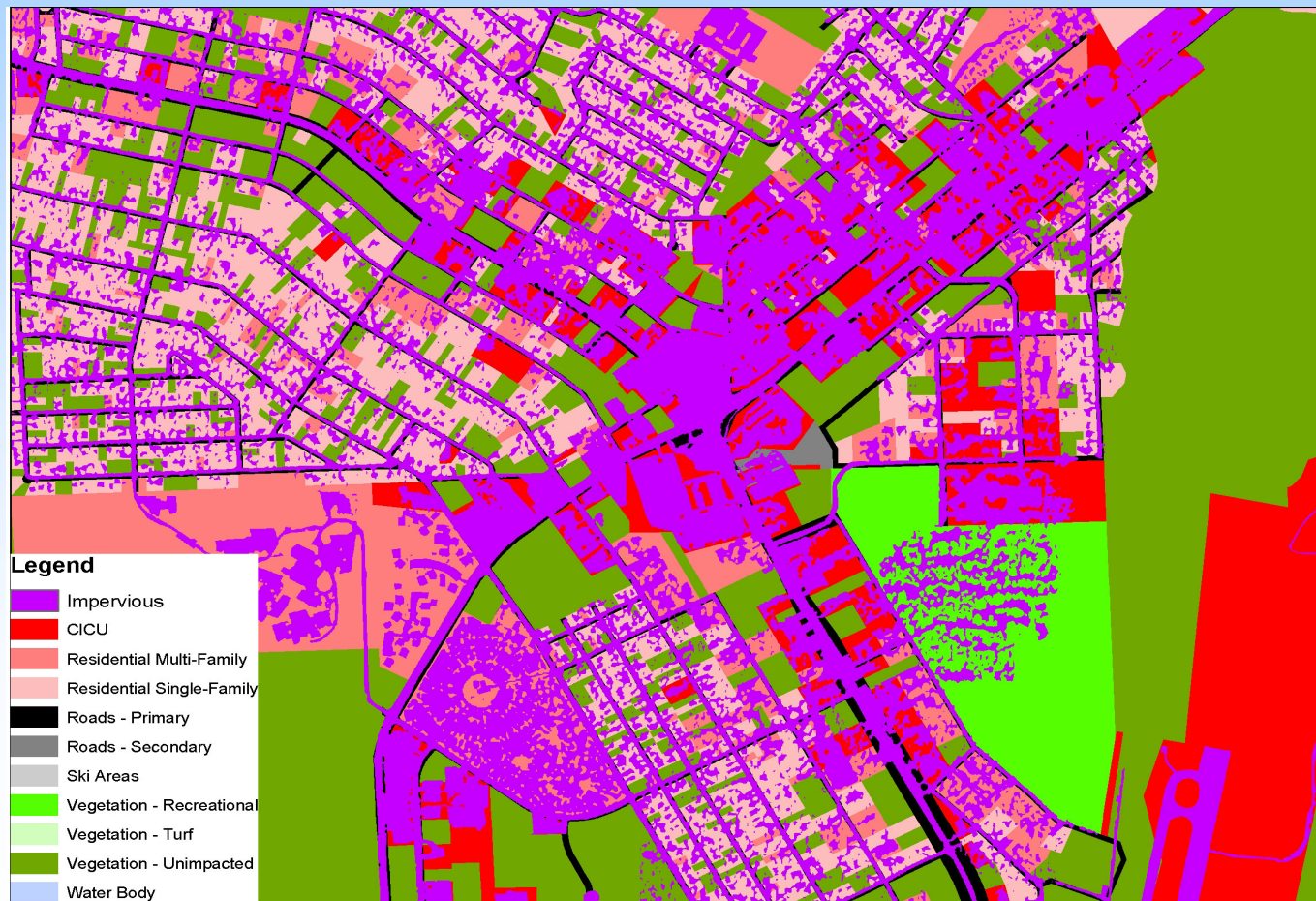- Used in both watershed and lake clarity models

Monthly Particle Loads for Blackwood Creek WY 2002
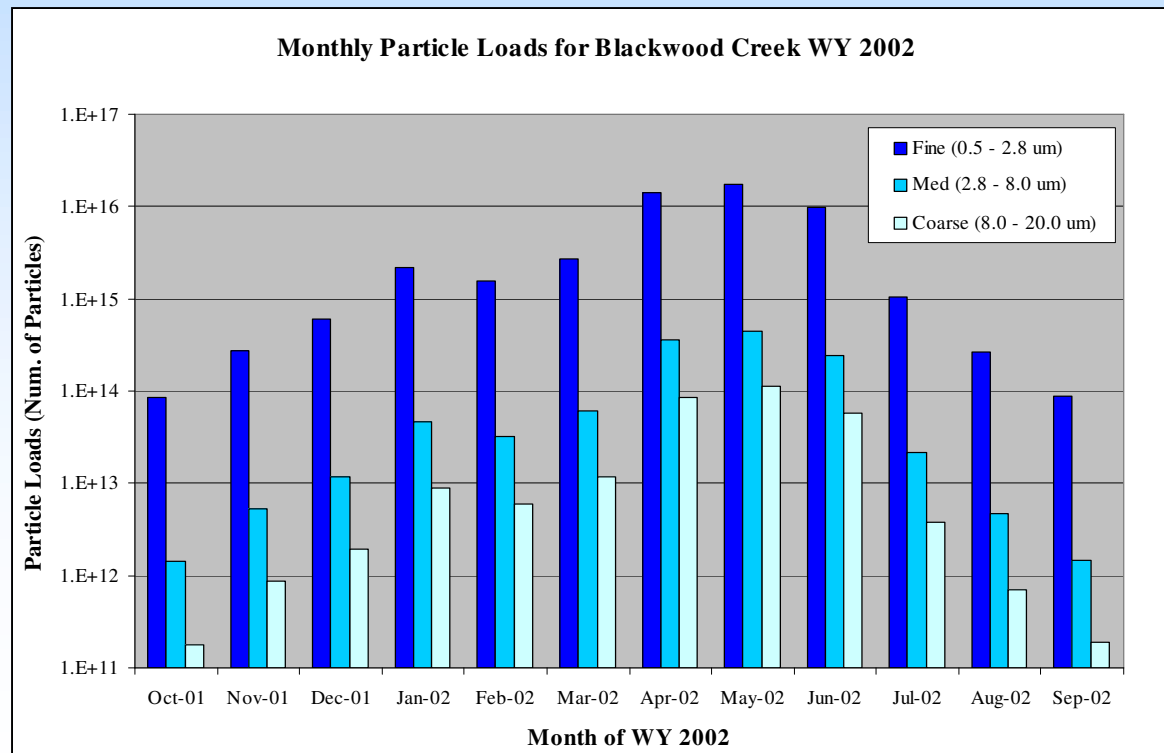
Stormwater Monitoring

- First basin-wide monitoring program for SWM
- Similar scope as LTIMP
- Covers a variety of land uses

Meteorological Stations
TMDL SWM Sites
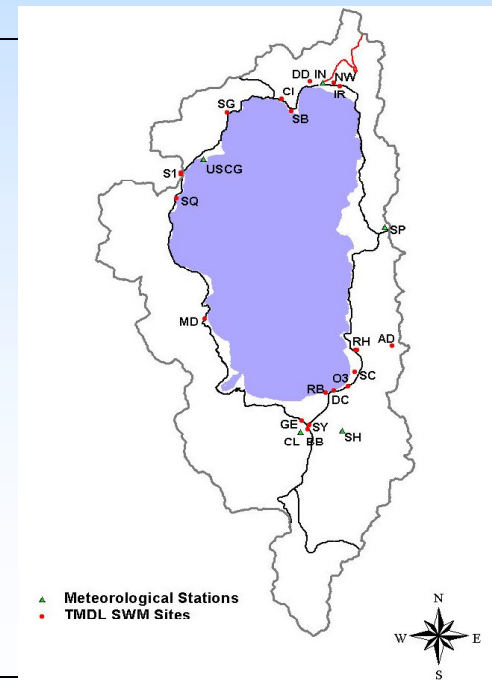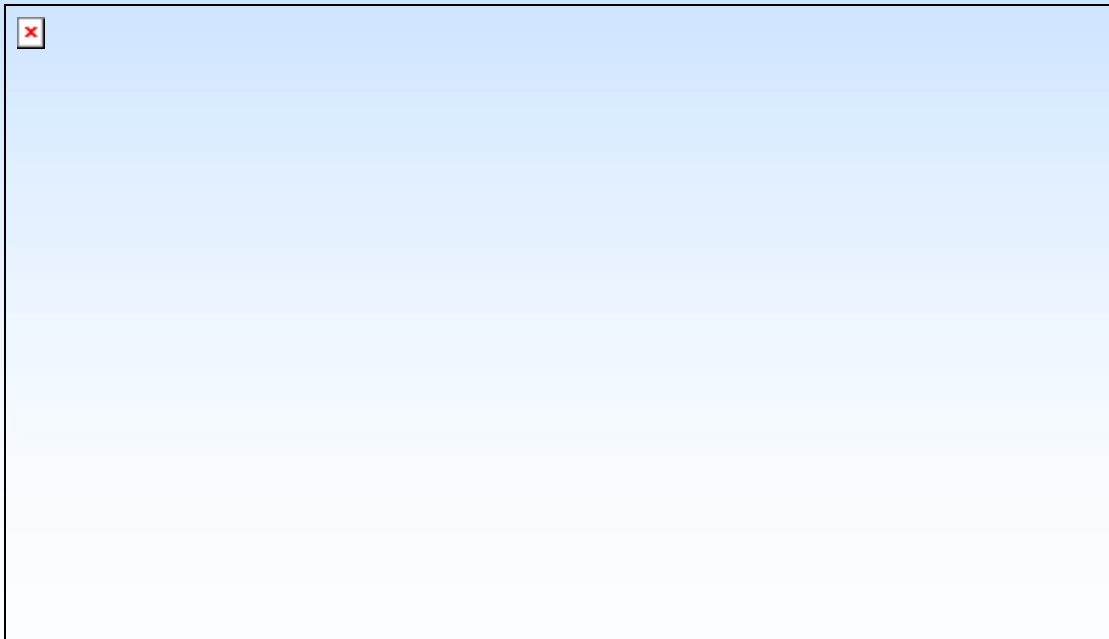
Reliable GIS Land-Use Layers

Cooperative effort with TRPA, USFS, CTC and others to make layers compatible for modeling

Legend

- Impervious
- CICU
- Residential Multi-Family
- Residential Single-Family
- Roads - Primary
- Roads - Secondary
- Ski Areas
- Vegetation - Recreational
- Vegetation - Turf
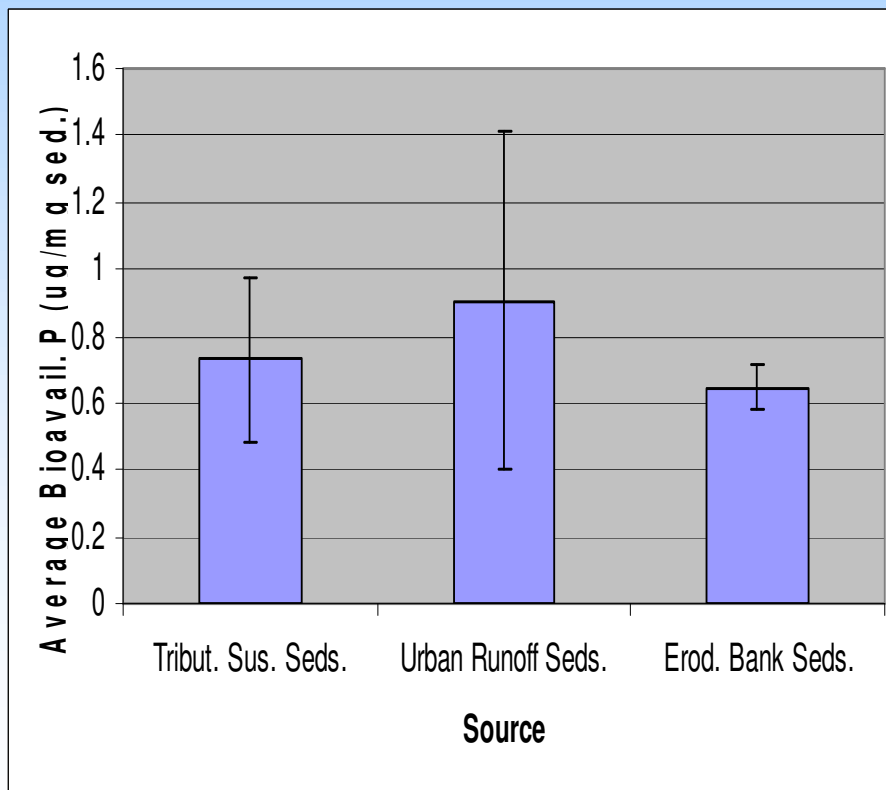- Vegetation - Unimpacted
- Water Body

Reconstructed Historical Meteorology

Needed to drive watershed model & other models
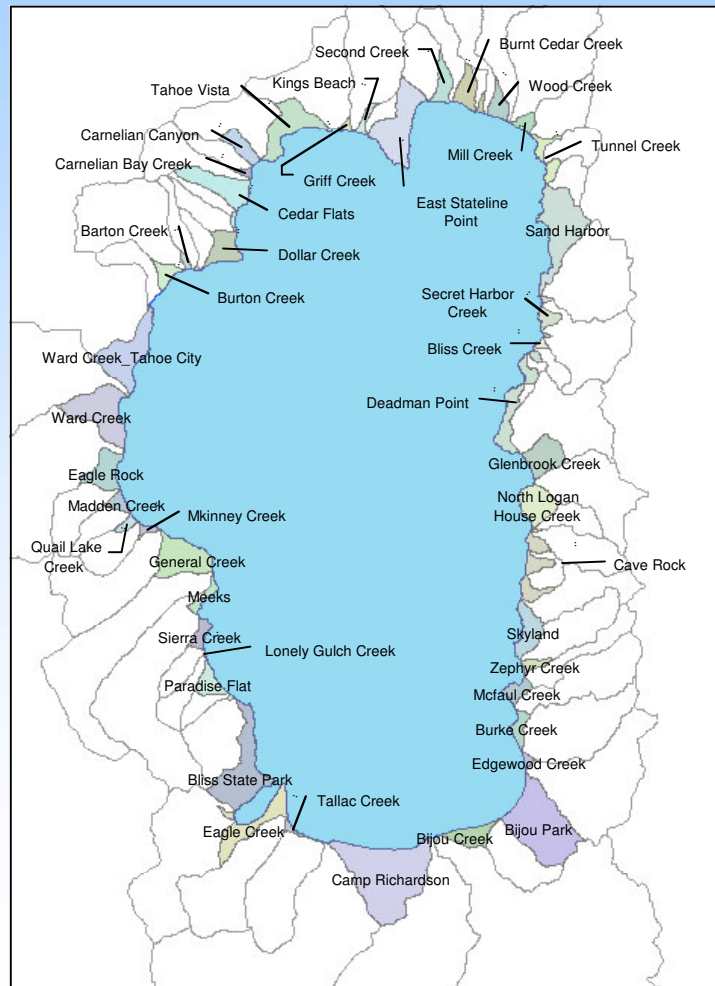when applied in forecasting mode
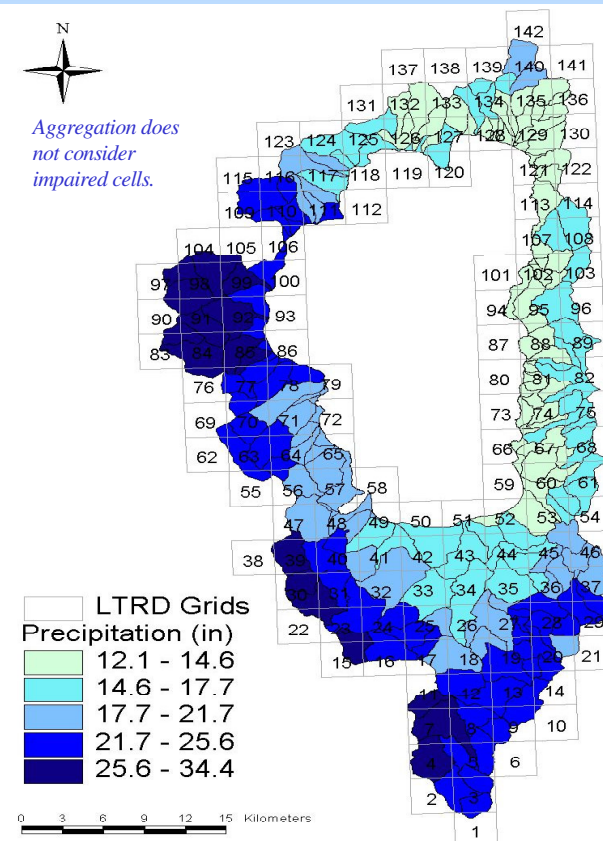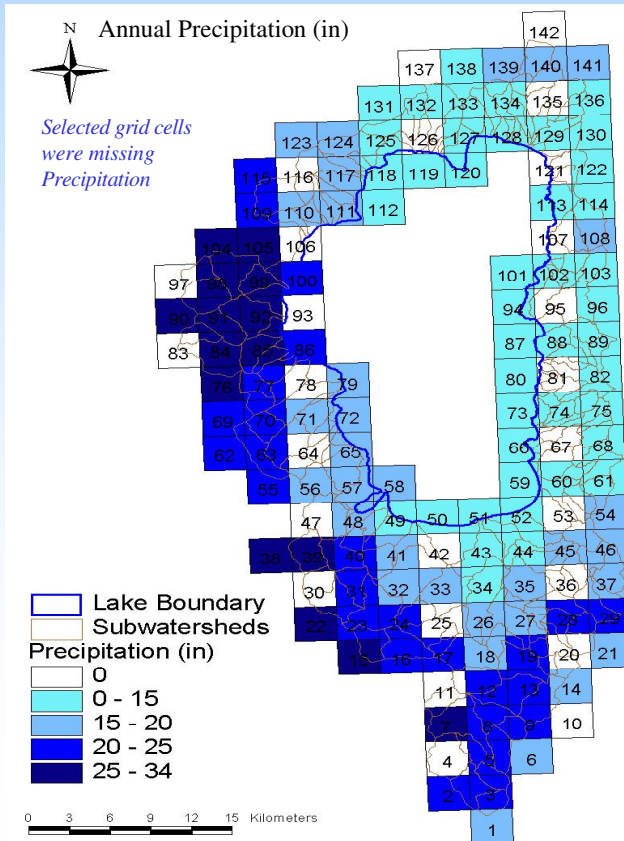
Biologically Available Phosphorus

- First measurements done at Tahoe

- Not routinely preformed

- Input to Clarity Model

- Helps target priority P-reduction projects

Basin-Wide BMP Effectiveness Modeling

Data on stormwater concentration, expected effluent concentration from Tahoe BMPs, and runoff are used to model pollutant reduction from intervening zones basin-wide

Ending Comments

Phase 1 TMDL Research Program has (will be) successful in achieving all its stated goals:

1. Fill critical science gaps.

2. Integrate knowledge within a modeling framework.

3. Science-base targets for pollutant load reduction.

4. Tools to guide management.

5. Research plan for water quality.

6. Quantify the EIP.