The Lake Tahoe Atmospheric Deposition Study (LTADS)

October 29, 2004

California Environmental Protection Agency

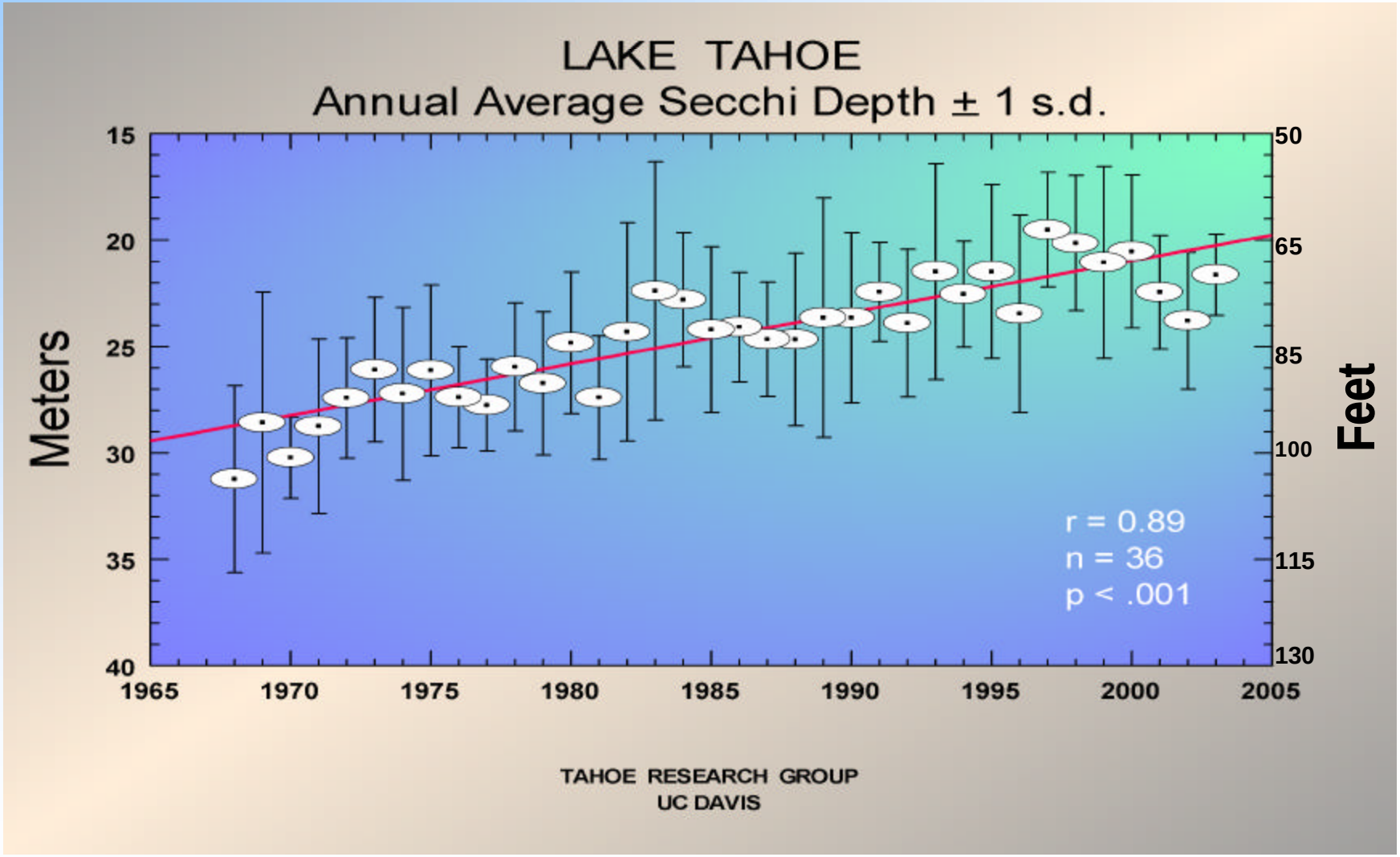
Air Resources Board

Presentation Outline

- Background
- Objectives & Study Design
- Preliminary Findings
- Next Steps

Background

The Problem: Declining Lake Clarity



Previous Work

- Tahoe Research Group's (TRG) bucket sampling program suggests that atmospheric deposition is a significant source of the algal nutrients, nitrogen (N) and phosphorus (P), to Lake Tahoe. Their estimates are:
  - 234 metric tons/yr of nitrogen (59% of total)
  - 12 metric tons/yr of phosphorus (28% of total)
  - PM in the Lake contributes to loss of clarity

Stakeholders & Study Participants

- Tahoe Regional Planning Agency (TRPA)
- Lahontan Regional Water Quality Control Board
- Nevada Division of Environmental Protection
- U.S. EPA
- U.S.D.A. Forest Service

Total Maximum Daily Load (TMDL)

- Water quality is one of TRPA's Environmental Thresholds
- Technical TMDL (Summer 2005)
  - Set allowable loads of N, P, and PM to the Lake
  - Determine sources
  - Model lake clarity
- Final TMDL (Spring 2008)
  - Allocate permissible loads from sources
  - Outline options for pollutant reductions
  - Implementation plan

LTADS Objectives & Study Design

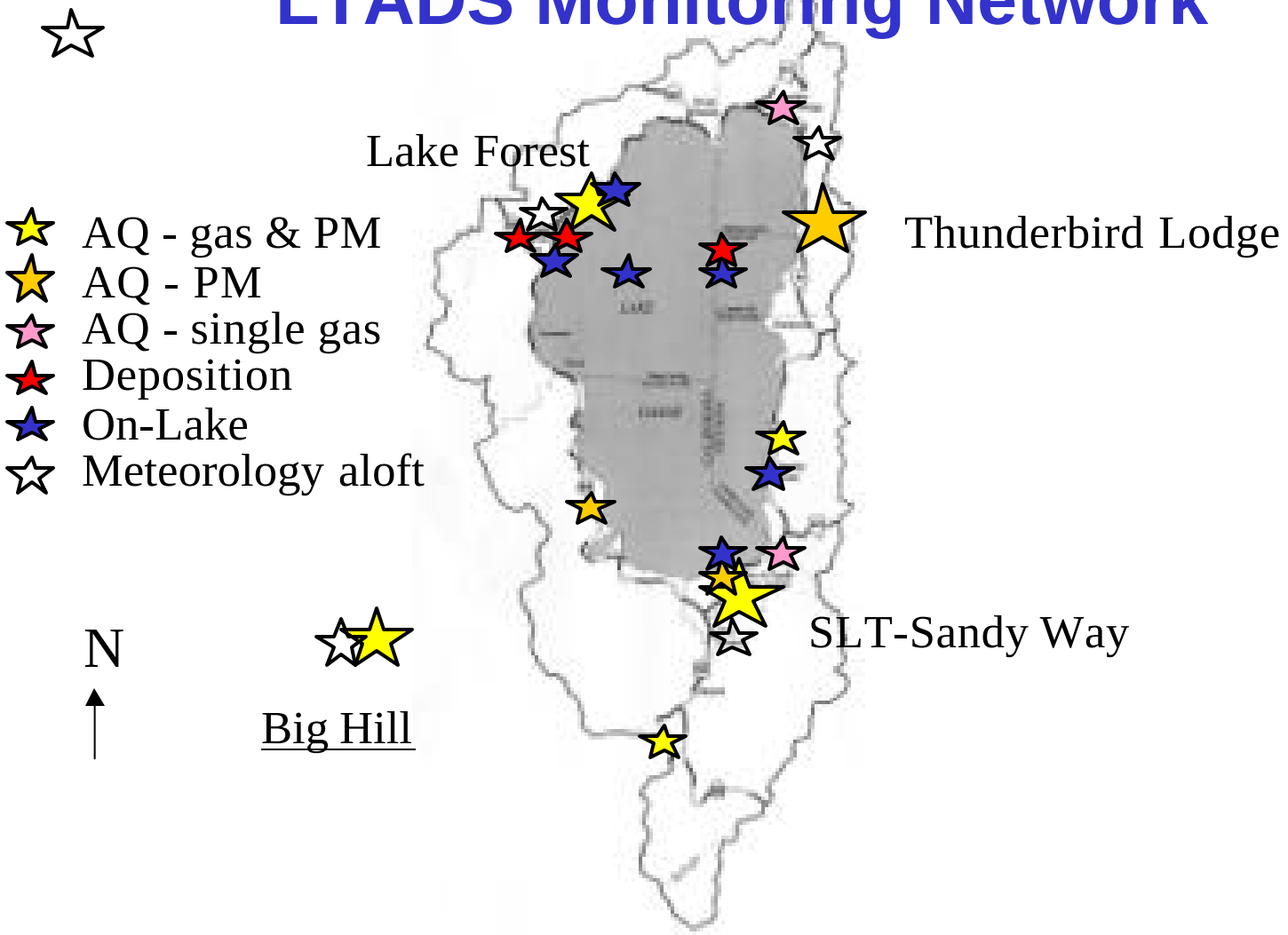
LTADS Objectives

- Meet the needs of Lahontan RWQCB & TRPA
- Water Clarity & Atmospheric Deposition
  - Dry deposition of nitrogen, phosphorus and particles
  - Source Attribution
    - Source categories
    - Out-of-basin, In-basin
  - Uncertainty
- Ozone Levels and Effect on Forest Health

LTADS Study Design

- Field Study Measurements (Nov 2002 - Dec 2003)
  - Air quality
  - Meteorology
  - Deposition by TRG
- Data Analysis (Mar 2004 - Feb 2005)
- Modeling
  - Build on Central California studies
- Improve the Emissions Inventory
- Peer Review

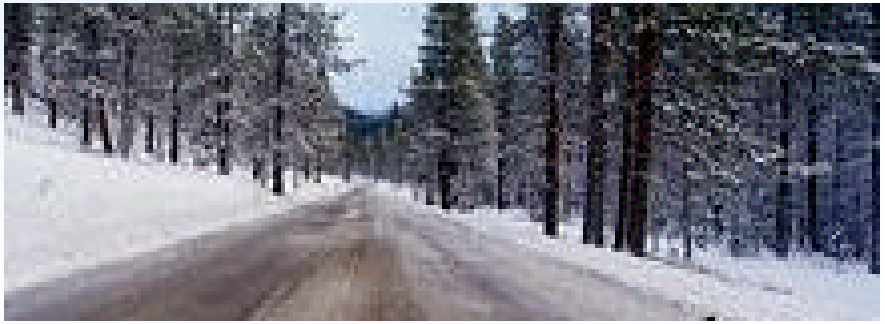
LTADS Monitoring Network



Special Challenges

Emission Inventory Improvement

- Source Sampling
  - Prescribed Fires
  - Neighborhood Wood Smoke
  - Paved/Unpaved Road Dust
  - Sanding/de-icing
  - Motor Vehicles
- Activity Characterization
  - Prescribed & Wild Fires
  - Wood Burning
  - Sanding/de-icing
  - Motor Vehicles



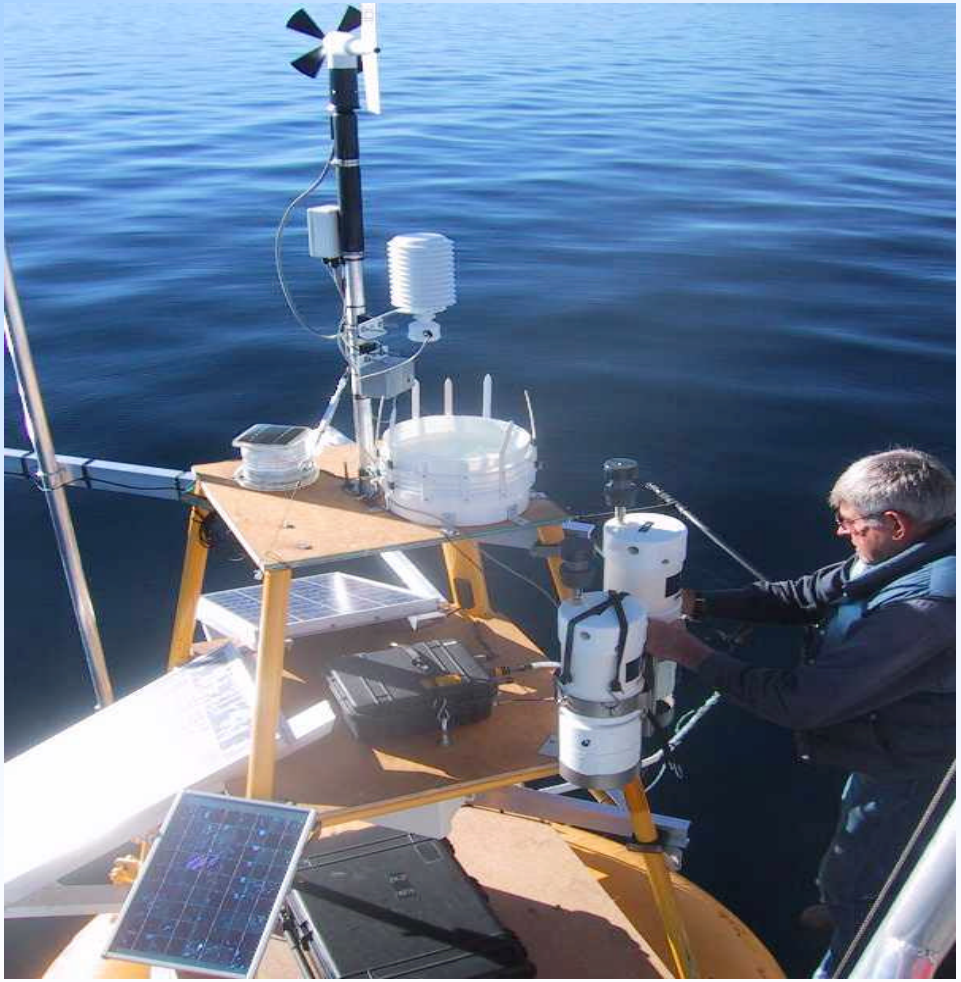
LTADS Products

- Annual and seasonal, spatially resolved dry deposition estimates of nitrogen, phosphorus, and PM
- An inferential source allocation for major sources
- Relative contribution of transport from outside the air basin to observed ozone, nitrogen, phosphorus, and PM
- Assessment of impacts of ozone on forest health

Peer Reviewers
(selected by UC Office of the President)

- Professor Keith Stolzenbach, UC Los Angeles
- Professor Gail Tonnesen, UC Riverside
- Professor Akula Venkatram, UC Riverside
- Professor Anthony Wexler, UC Davis

Preliminary Findings



Estimates of Deposition to Lake Tahoe

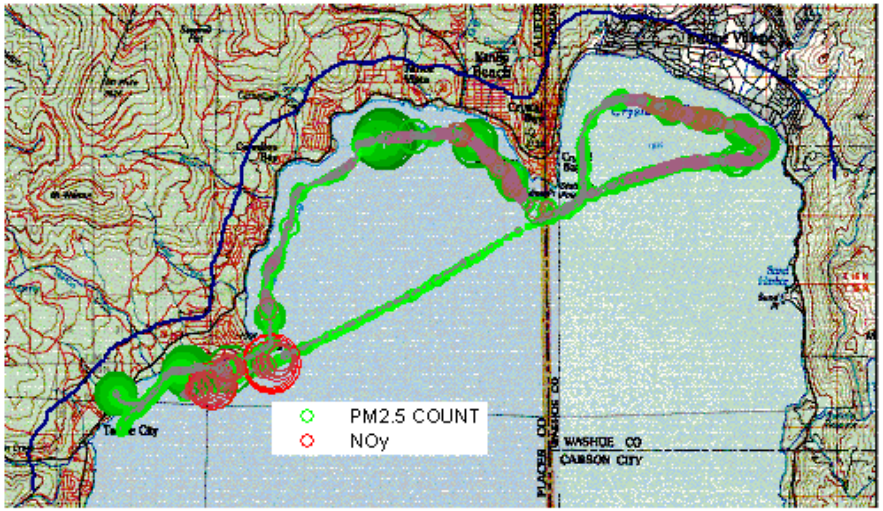
(metric tons/year)

Source	ARB	TRG
Dep Type	Dry only	Dry + Wet
Nitrogen	100 - 200	234
Phosphorus	1 - 7	12
PM	1,300 - 2,100	—

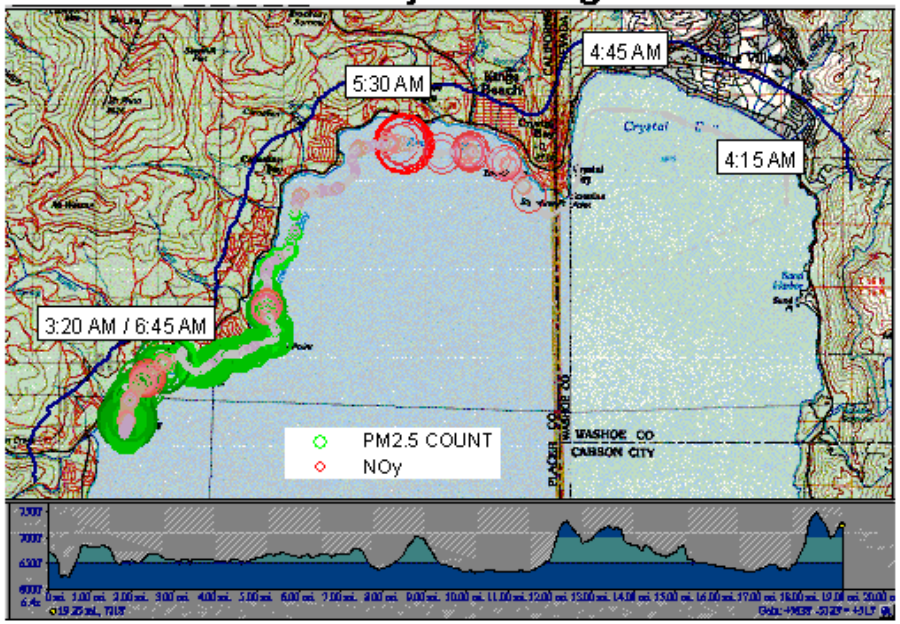
Wet vs. Dry Deposition

- TRG estimates wet deposition may be responsible for ~ half of total deposition of nitrogen.
- California Acid Deposition Monitoring Program (CADMP) measured wet and dry deposition in the 1990s.
  - If data from 3 rural sites is extrapolated to Lake Tahoe total nitrogen deposition would be 50 -100 metric tons/year.
  - Wet and dry deposition of nitrogen were roughly comparable
- LTADS initial estimate of dry deposition of nitrogen is reasonably similar to TRG's estimate

Particle Counts and NOy - Evening Cruise 07-09-2003



Particle Counts and NOy - Morning Cruise 07-10-2003



On-Lake Experiment July 9 -10, 2003

- Vehicle exhaust and wood smoke near population centers in evening
- Drainage flushes shore zone overnight
- Vehicle exhaust precedes smoke in morning
- Effect confined to near-shore

Ozone and CO

	Ozone		Carbon Monoxide	
Standard	**Level**	**Status**	**Level**	**Status**
Federal 1-hour	0.12 ppm		35 ppm	
Federal 8-hour	0.08 ppm		9 ppm	
State 1-hour	0.09 ppm		20 ppm	
State 8-hour	0.070 ppm*		9.0 ppm	
Lake Tahoe 8-hour CO			6 ppm	

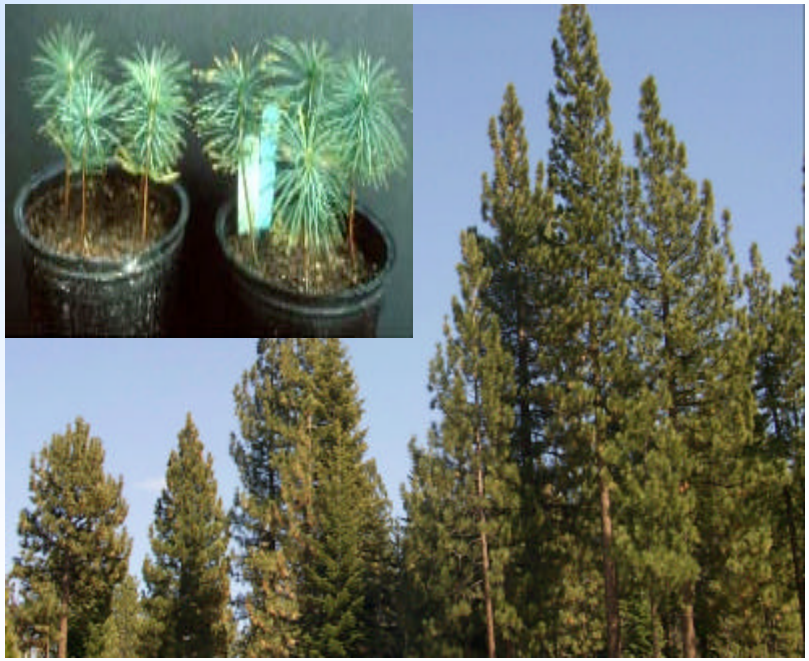
* potential standard under review and consideration

Particulate Matter

	PM10		PM2.5	
Standard	**Level**	**Status**	**Level**	**Status**
Federal 24-hour	150 µg/m^3		65 µg/m^3	
Federal Annual	50 µg/m^3		15 µg/m^3	
State 24-hour	50 µg/m^3		-	-
State Annual	20 µg/m^3		12 µg/m^3	

Forest Health & Ozone

- Evaluation of Ozone & Nitric Acid Vapor Distribution & Effects on Conifer Forests in the Lake Tahoe Basin & Eastern Sierra Nevada
  - Surveys of ozone injury conducted at 25 sites in basin in 2002
  - 23% of the pines in this area showed slight injury
  - Average injury 17 out of 100



Transport Estimate

- NO_X - transport is unlikely
- Coarse PM - largely local sources
- Fine PM - local sources and possibly a regional background including transport of phosphorus from Asian soil
- Ozone - extent of transport is under investigation

Emission Inventory Improvement

- **Improvement of the PM Emission Inventory for the Lake Tahoe Region, UC Riverside**
  - Produced improved estimates of PM emissions from wood burning & improved fleet characterization
- **Lake Tahoe Source Characterization Study, Desert Research Institute**
  - Will provide Tahoe specific profiles for residential wood smoke, road dust and sanding/de-icing materials
  - Will also develop road dust emission factors

Next Steps

Next Steps

- Deliver initial deposition estimates to lake clarity modelers - November 2004
- Complete data analysis - January 2005
- Develop source identification and transport assessment - February 2005
- Summarize field study - Spring 2005

Summary

- LTADS is the most comprehensive study of the impacts of atmospheric deposition on Lake Tahoe to date
- Atmospheric deposition appears to be a significant source of N to the Lake
- Local sources of nitrogen & coarse PM are important
- Analysis is continuing

Acknowledgements

- ARB's Monitoring & Laboratory Division
- ARB's Planning & Technical Support Division
- Tahoe Regional Planning Agency
- Lahontan Regional Water Quality Control Board
- Tahoe Research Group
- U.S. EPA
- U.S.D.A. Forest Service
- Nevada Division of Environmental Protection
- UC Berkeley, UC Davis, UC Riverside, DRI, NOAA
- Peer Reviewers

Thank you