

US EPA ARCHIVE DOCUMENT

*Assessing the Environmental Health Impact  
of Population Growth in California: New  
Directions in Research and Training*



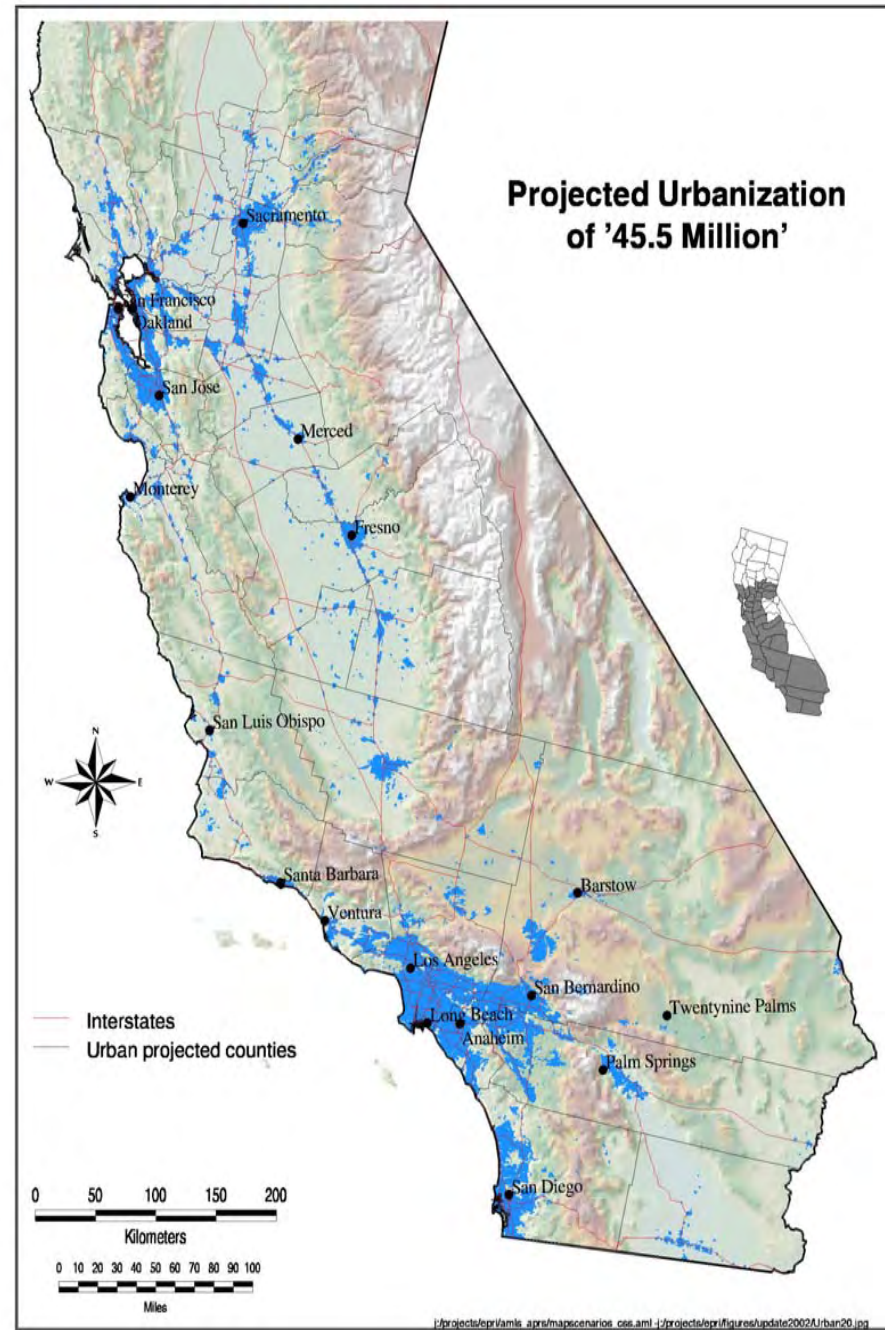
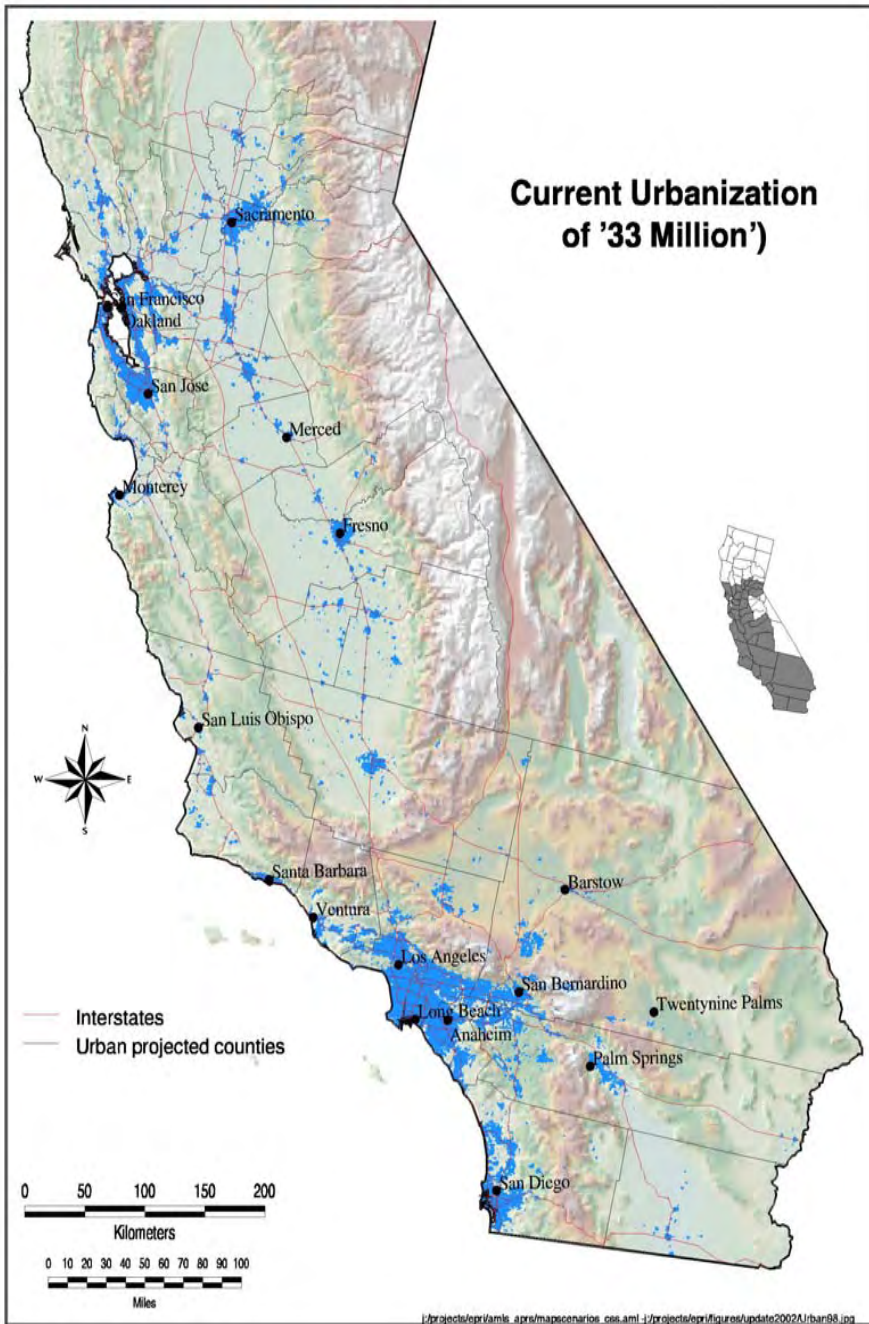
Edmund Seto  
School of Public Health  
University of California, Berkeley

## *Overview*

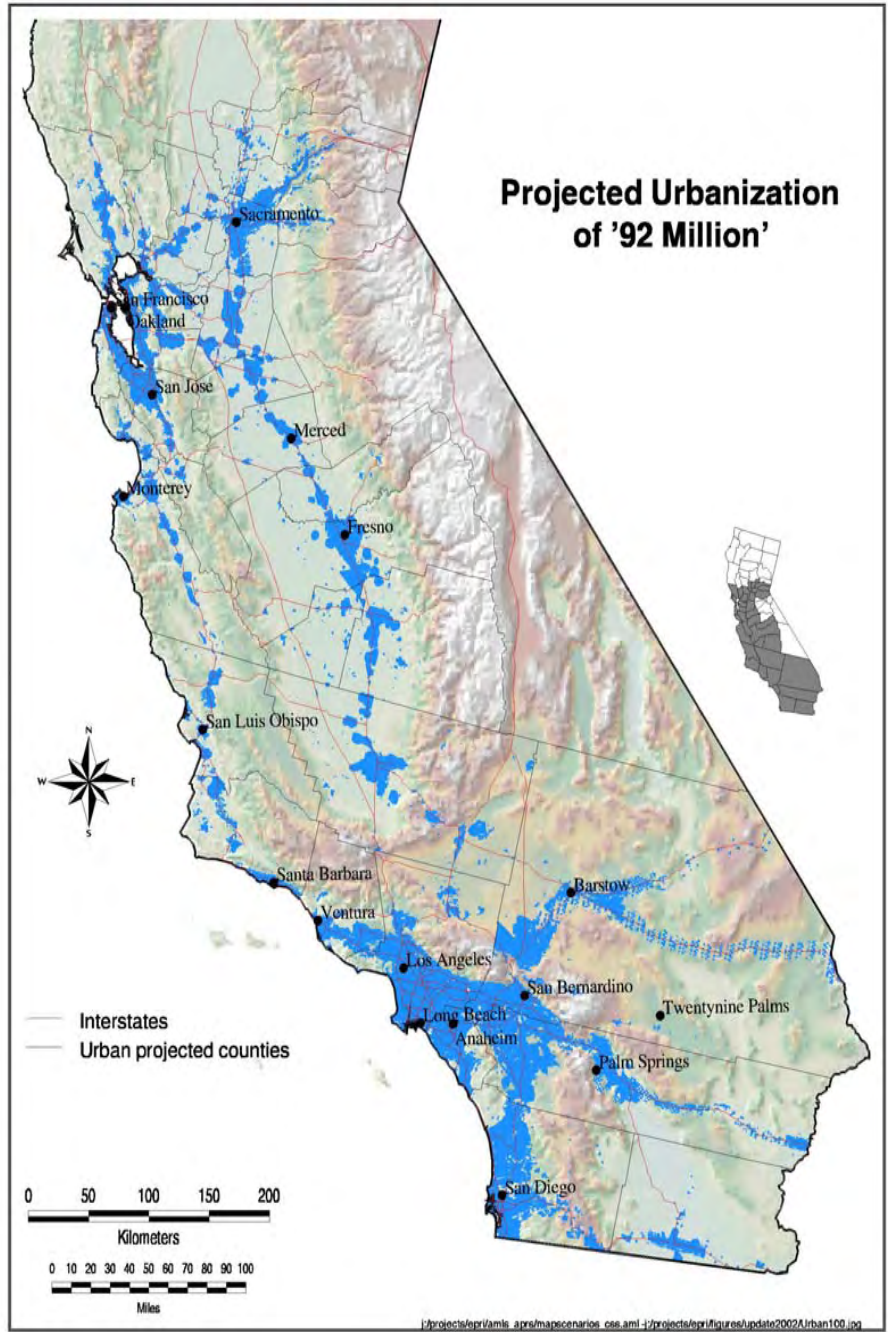
- Background
- New Interdisciplinary Programs at UC
- Demographics: past, present, and future
- Environmental Health Issues
- Urban Modeling
- Conclusion and where the program is heading

## *Background*

- 2003 UC GIS conference – John Landis
  - ◆ Urban Growth Models for California
  - ◆ The ability to use these models to predict where 50 million Californians will live in the year 2050



# Projected Urbanization of '92 Million'



# *Framework for Looking at Emerging Environmental Issues for California*

Demographic Projections



Land-use change and urban model predictions



Risk assessment models

Environmental Health Issues

Water Demand: quantity/quality

Transportation: air quality

Potential future exposures:

pesticides

Occupational Health Issues

Public Health Issues

## *Of course it's not that simple!*

- Lots of assumptions and uncertainties involved in predicting the future, particularly over large time spans
  - ◆ Economics
  - ◆ Policy
  - ◆ Social Behavior
  - ◆ Climate
  - ◆ etc.
- But, this is what makes the topic of Growth in California such a interesting research area



## *Gathering momentum...*

- 2003 Center for Occupational and Environmental Health (COEH) Retreat
  - ◆ Paper on California's Health Future
  - ◆ An ominous future...
    - Growth of 11 million in years 2000 to 2020 (CA DOF)
    - Growth in the Central Valley by 50% 20 years
    - 30% increase in urbanized landuse over 2 years and losses of prime farmland (CA Farmland Conversion Report)
    - Number of autos projected to grow even faster than population... 450 billion VMT in 2020 (CA DOT)
    - Predicted increases in PM10 despite future emission controls (CARB)
    - Predicted average shortages of 2.4 million acre-feet of water by 2020 (CA Dept Water Res)
    - Changing Demography - Environmental injustice issues

## *Managing Growth to Manage Risks*

- The projections are based on demographic growth estimates
- Can we use urban models to explore policies that manage growth in a manner that minimizes environmental and health risks?

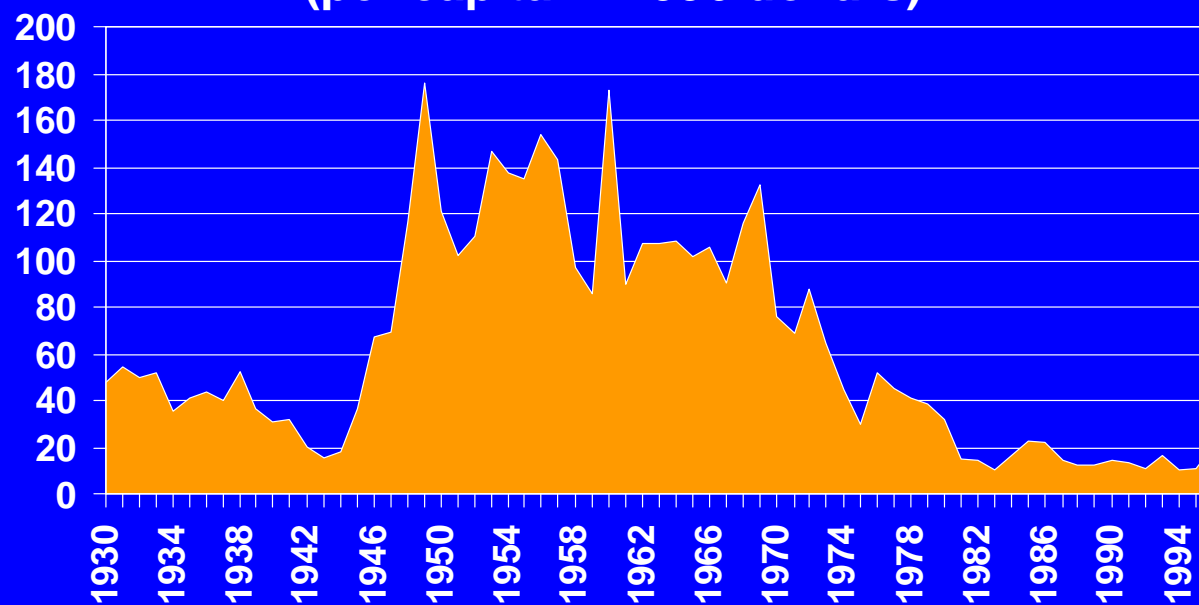
## *New programs at UC Berkeley*

- UC Toxic Substances Program
  - ◆ Lead Campus Program (Berkeley, Merced, and others?)
    - Student Research and Training
    - Interdisciplinary program made up of faculty and researchers from City and Regional Planning, Public Health, and Environmental Science Policy and Management

- Institute for Urban and Regional Development (IURD) – David Dowall
  - ◆ Berkeley Futures Grant
  - ◆ Renewing Berkeley's interest in issues related to CA urban development planning
  - ◆ Emphasis on research that will inform state and regional policy

Figure 2-4  
Capital Outlay Trails Off

Real State Capital Outlays 1930-1996  
(per capita in 1996 dollars)



David E. Dowall and Jan Whittington , *Making Room for the Future: Rebuilding California's Infrastructure*. San Francisco: Public Policy Institute of California, 2003.

## *Importance of Spatial Monitoring, Analysis, and Modeling Methods*

- Geographic Information Systems
- Remote Sensing
- Sensor Nets
- Spatially explicit Urban Models

# *California Demographics*

Past, Present, and Future

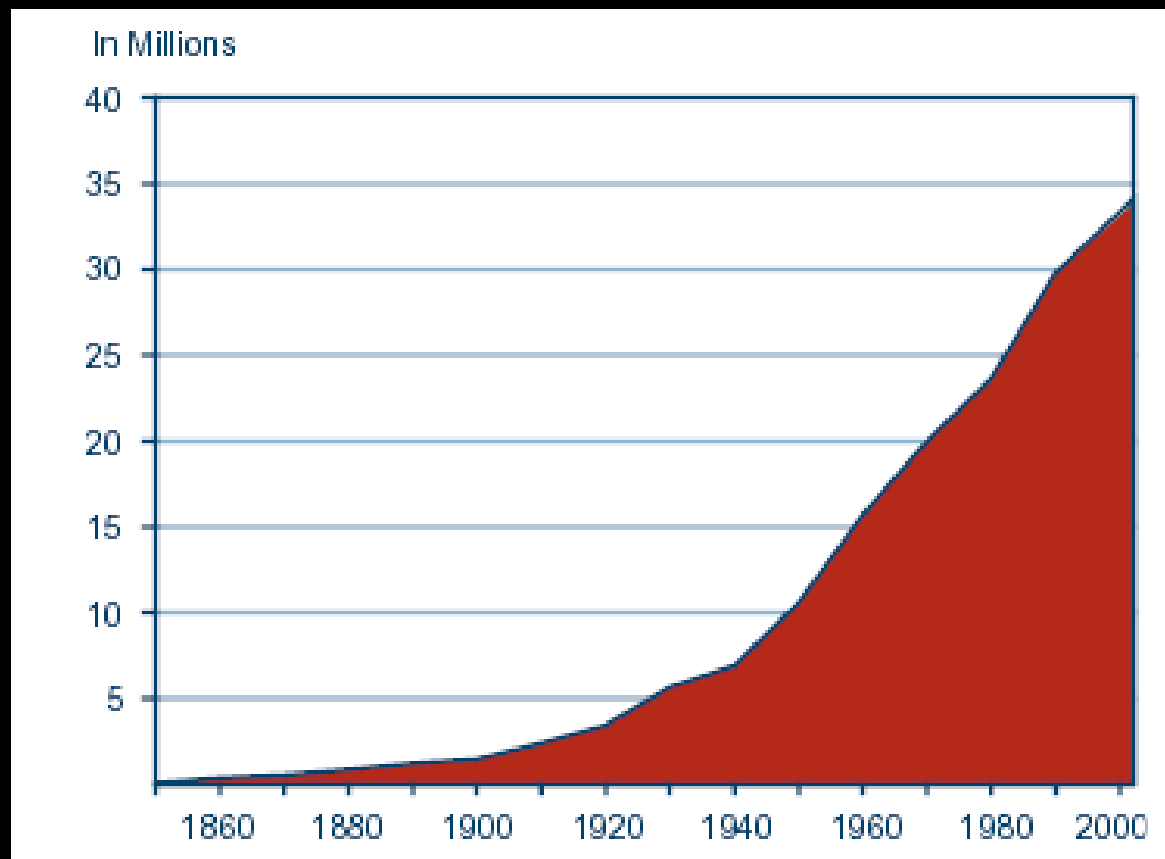
## *Sources*

- US Census
- CA DOF
- Roland Lee and Hans Johnson at Berkeley
- Social Security



# *History of high growth*

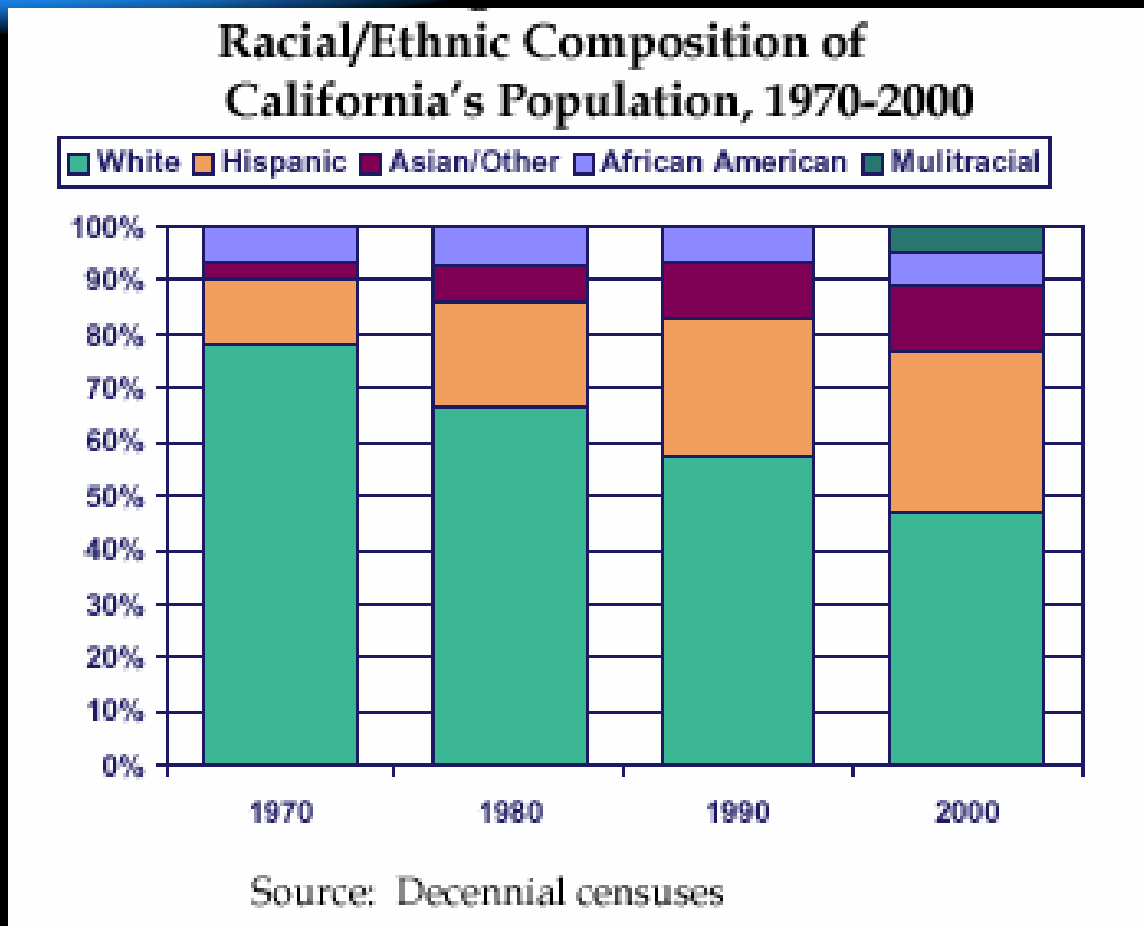
## Population



2002 Cal Facts

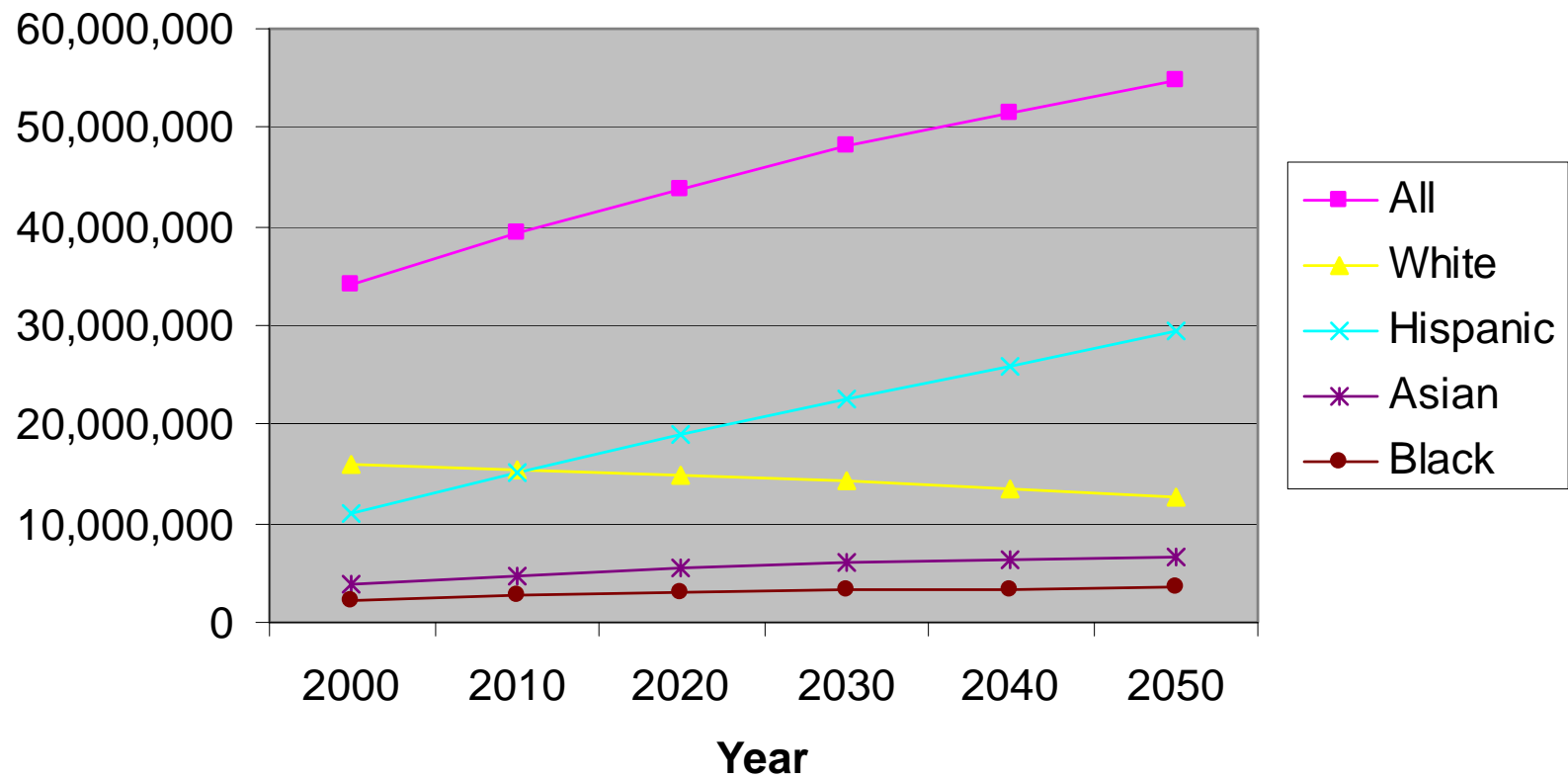
Legislative Analyst's Office, December 2002

# Racial/Ethnic Makeup



California's Demographic Future  
 Hans P. Johnson, Public Policy Institute of California

# Population Projections



State of California, Department of Finance, *Population Projections by Race/Ethnicity, Gender and Age for California and Its Counties 2000-2050*, Sacramento, California, May 2004.

## *The Baby Boomers turn 80*

- Generally, California has a young population – younger than the US as a whole, which is younger than most industrialized nations.
- Globally, fertility is falling. This is no different in California despite having higher immigration, and ethnic composition, with these groups having higher fertility.
- But just like with the rest of the US, the Baby Boom generations are reaching old age.

## *Elderly in California*

- LA Basin and SF Bay Area accounts for 2/3 elderly population of the state
- According to the Dept of Finance projections, the number of elderly will increase by 172% over the next 40 years.
- By 2040 the SF Bay Area population will be the oldest in California

## *The needs of the elderly*

- Many needs rise with age.
- Ratio of older people to working age people, costs of services and resources for the elderly (SS and Medicare), ratio to children and potential caregivers.
- More productive elderly populations – labor capacity equal to people 5 years younger in the 1960s.
- Demands for jobs, and occupational health issues?

## *Regional Differences*

- Inland areas have had faster growth rates than coastal areas for over 30 years.
- The Inland Empire (Riverside and San Bernardino Counties) projected to double in roughly 20 years. 3.3 Million in 2000 to 5.5 million by 2020. (CA DOF).
- Growth spill over from Bay Area into the San Joaquin Valley.
- Despite fast inland growth, over 60 percent of population in 2040 will still be along the coast, and in terms of absolute population numbers, San Diego and Bay Area will have large growth
- SF Bay Area getting old

## *Two Californias*

- Phil Angeledes – State Treasurer
- Among the most serious of those challenges is the widening disparity in economic opportunity across the State — which threatens to create a future of “two Californias.” Many Californians and many communities are not sharing in the benefits of these times of bounty.
- Inequities of economic opportunity



## *Immigrants*

- California has largest immigrant population in US, 8.1 million, 25% of state
- 1980 1.3 million immigrants  
1990 6.4 million immigrants
- Majority Hispanic and Asian Pacific Islander
- Long history of not only international immigration, but also domestic interstate immigration

## *Malthusian debate*

- Economy
- Job availability
- Cost of living
- Housing prices
- Societal norms
  
- Environmental Carrying Capacity

## *Importance of Jobs and the economy*

- All projections assume continuing large international immigration to California, and there's no evidence to argue against this.
- However during the economic recession of the 90s there was actually migration away from California, particularly Los Angeles
- Peak unemployment in California in 1993
- While today, the flow of domestic immigration is once again positive into California, it is worth questioning the assumptions that are used in the projections.

## *Environmental Carrying Capacity*

- Clean environment (air, water, soil) as a limited resource
- As populations grow we potential use up this resource
- How much pollution can we individually and as a society tolerate?

## *Exploring the uncertainties*

- Fertility data
  - ◆ To what extent will fertility rates decline?
- Immigration
  - ◆ What policies?  
Prop 187 Anti-immigration Law
  - ◆ Continued attractiveness of California?
  - ◆ New technology?
- Mortality data
  - ◆ Life expectancies of 150?
  - ◆ New diseases – AIDS, MDRTB

# *Growth and Environment*

Air and Water

## *Population relationship to air quality*

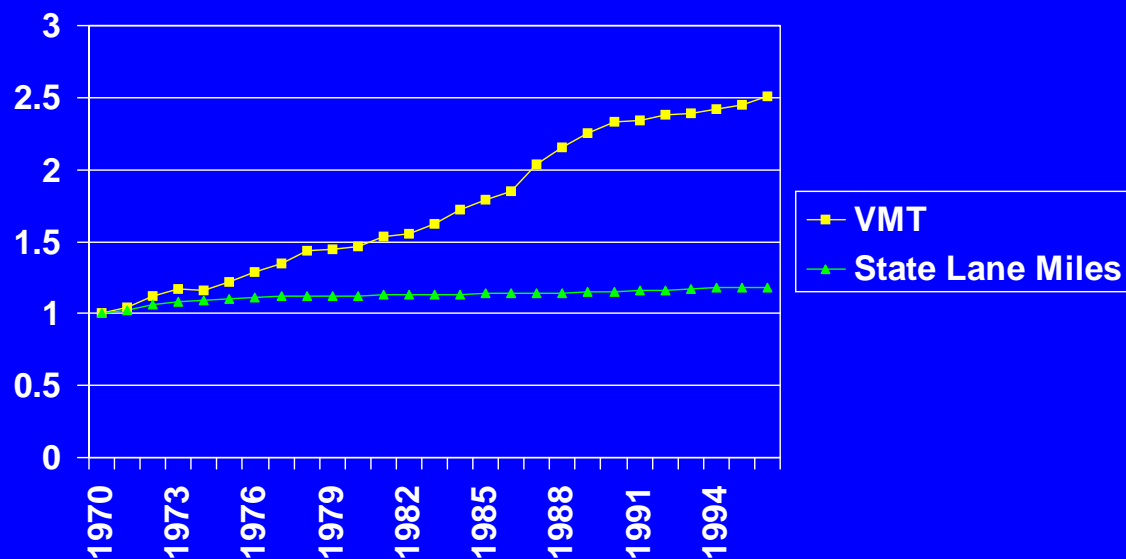
- Since air pollution is generally the result of human activity, air quality is related to growth and land-use changes.
- Californian's love their cars!
- Mobile emissions depend upon the density and spatial relationships of homes, jobs, schools, and businesses
- Growth rate of automobiles greater than population rate
- Projected continued increases in VMT (450 billion miles in 2020 according to CA DOT)

- Two rapidly growing areas (Inland Empire and San Joaquin Valley) already have some of the worst air quality
- Higher poverty rates, lower education... less capacity to deal with problems.

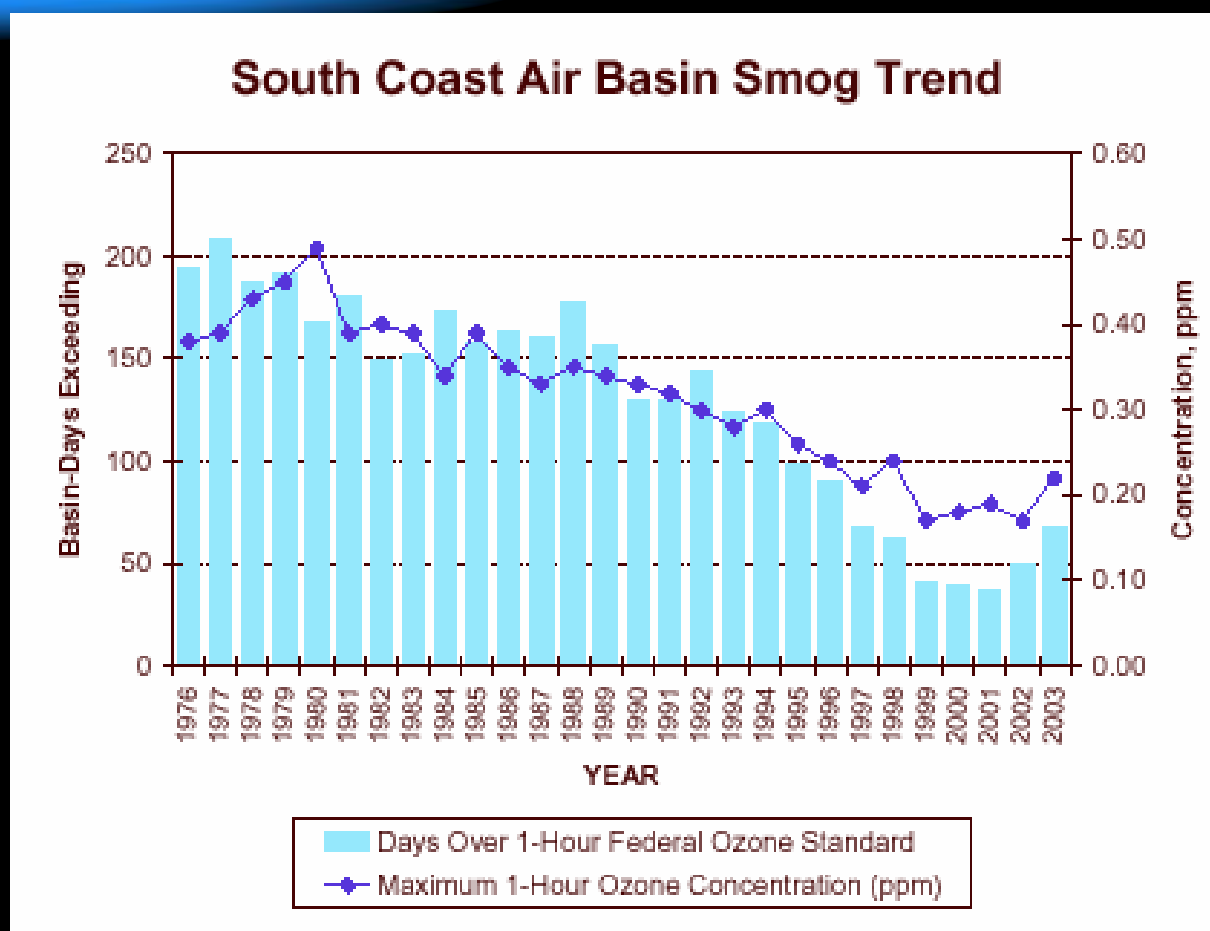


# *Continued Congestion or New Roads?*

Figure 2-12  
VMT and State Lane Mile Trends, 1970-2000,  
Indexed 1970=100



# Historical Air Quality Trends



South Coast Air Quality Management District  
<http://www.aqmd.gov/smog/o3trend.html>

- Historical perspective of CA's air quality:  
<http://www.arb.ca.gov/html/brochure/history.htm>
- Based on 2004 CA Almanac of Emissions and Air Quality (CARB) projected decreases in CO, NOX, ROG despite population increases due to emission controls
- PM10 & 2.5 however are projected to increase primarily due to area-wide sources, as well as increased road dust from increased VMT
- Currently over 99% of Californians are exposed to levels of PM10 that exceed state standards at least part of the year

## Statewide NO<sub>x</sub> Emission Trends

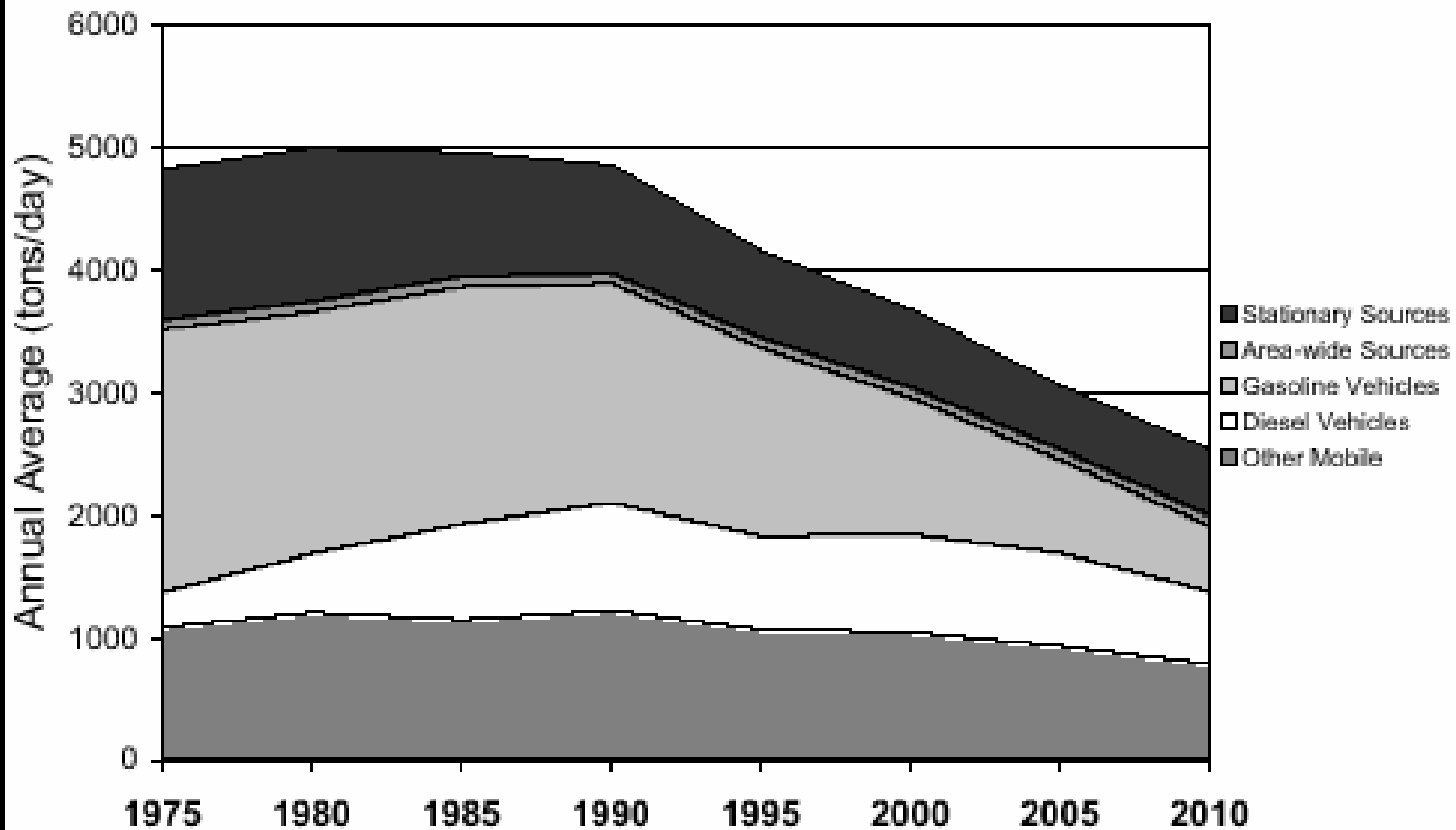


Figure 3-2

## Statewide ROG Emission Trends

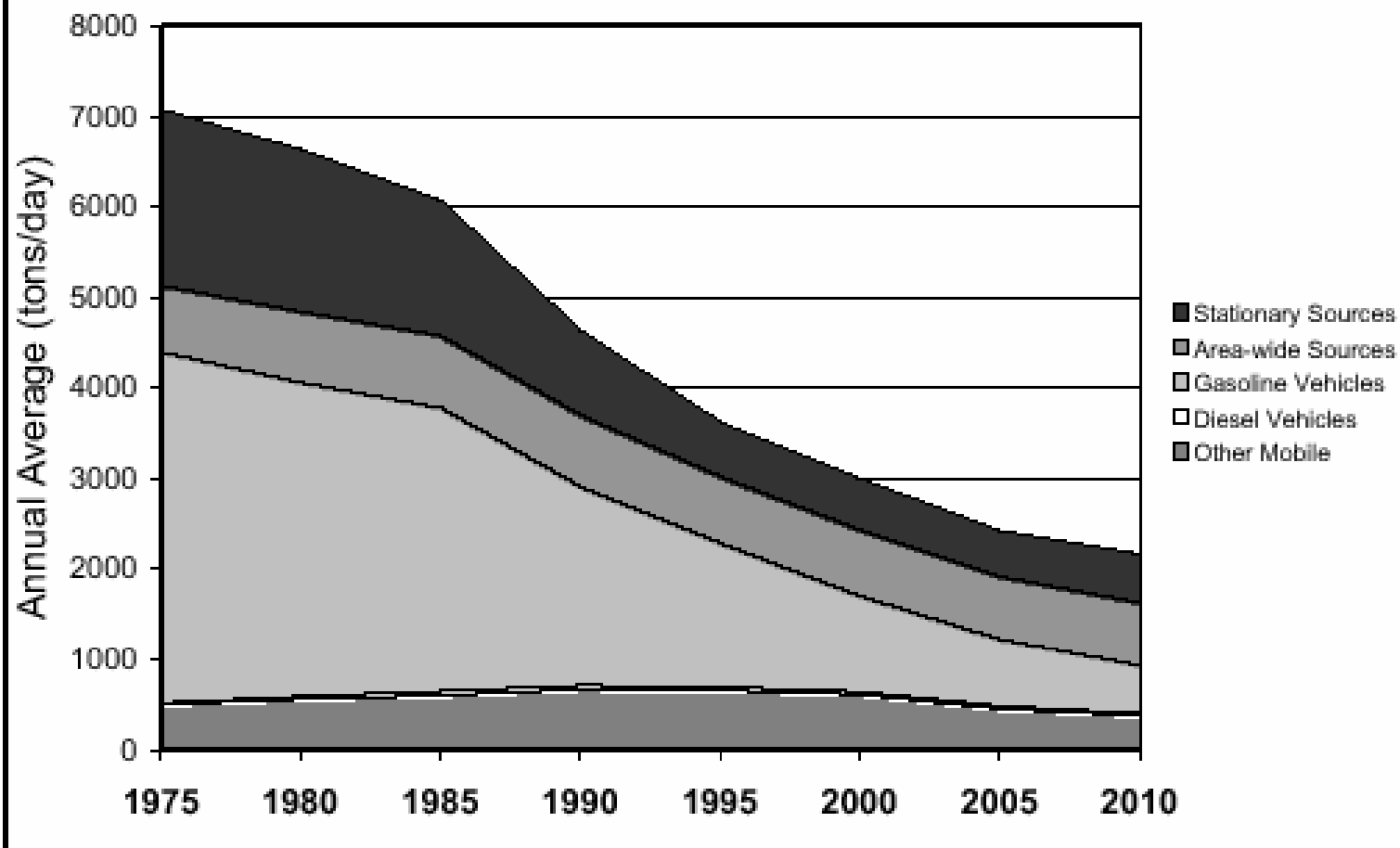
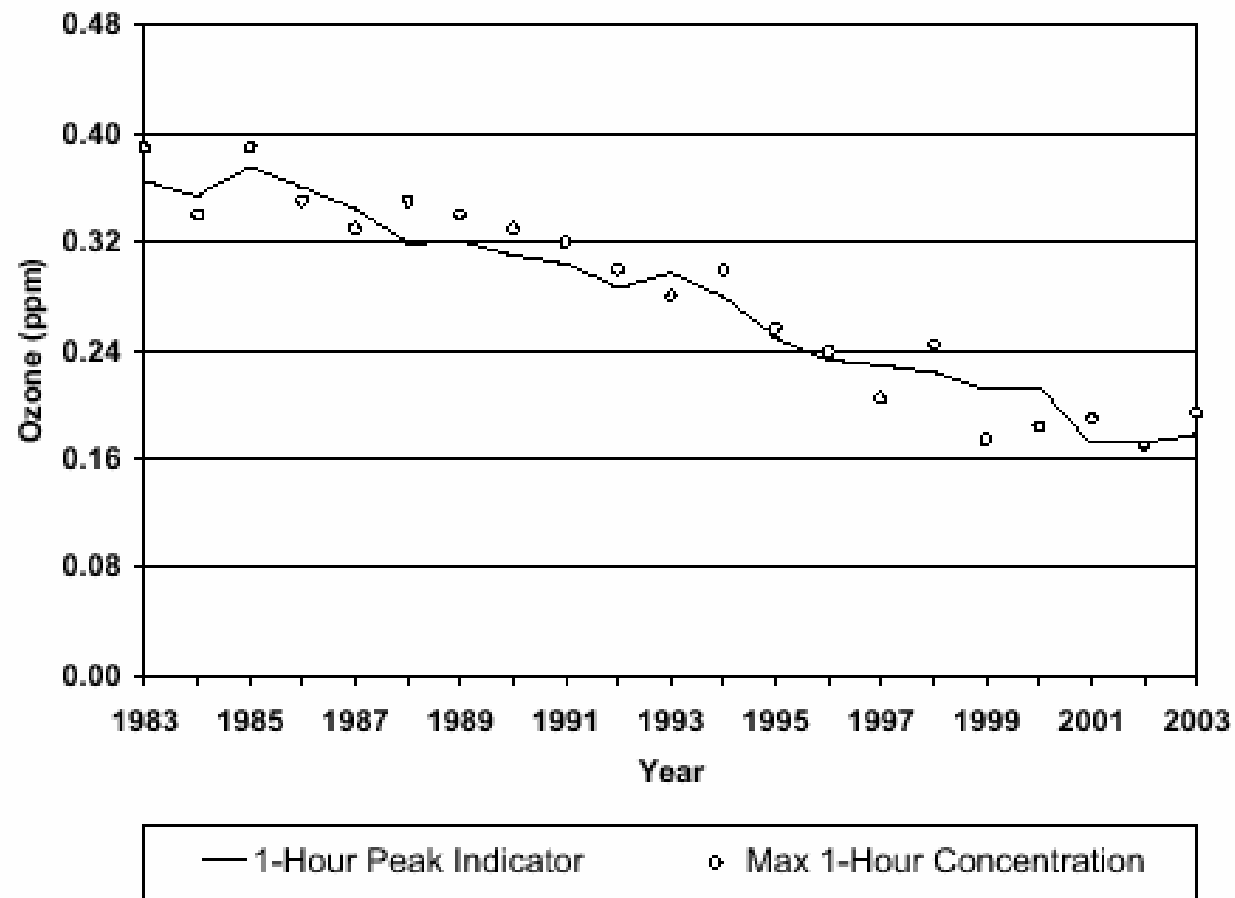


Figure 3-3

## Statewide Ozone Trend



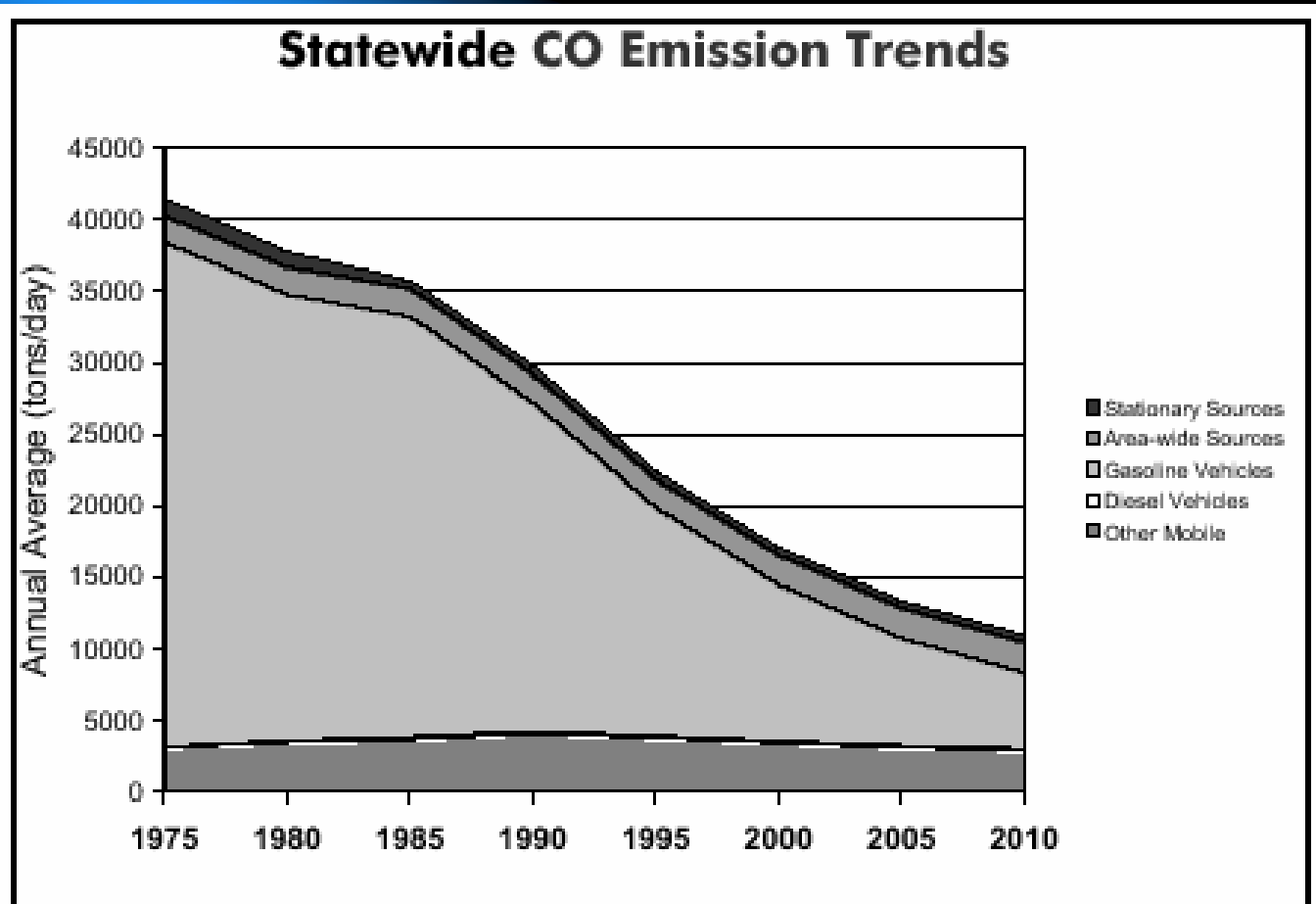


Figure 3-9

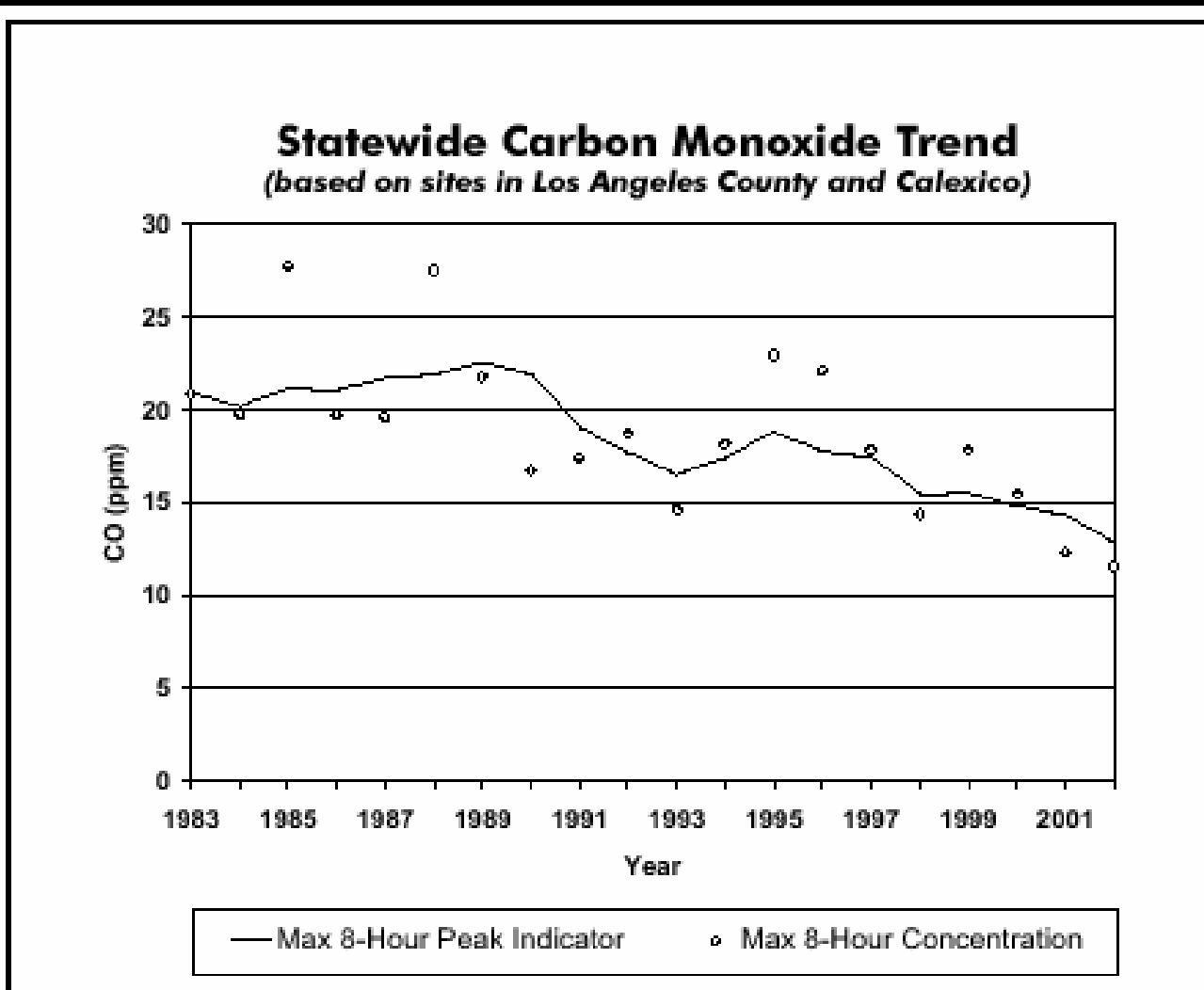


Figure 3-10



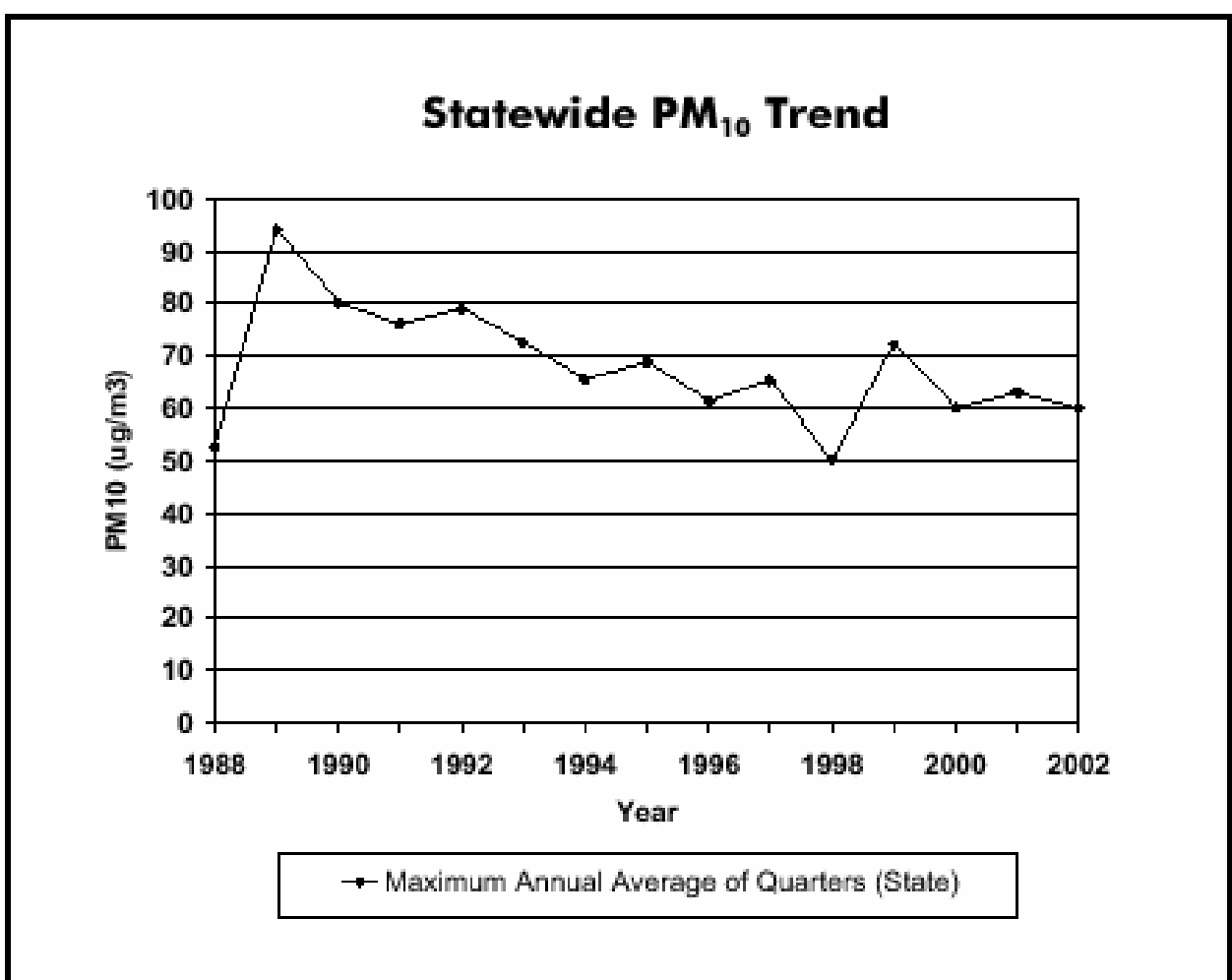


Figure 3-8

## Statewide Directly Emitted PM<sub>10</sub> Emission Trends

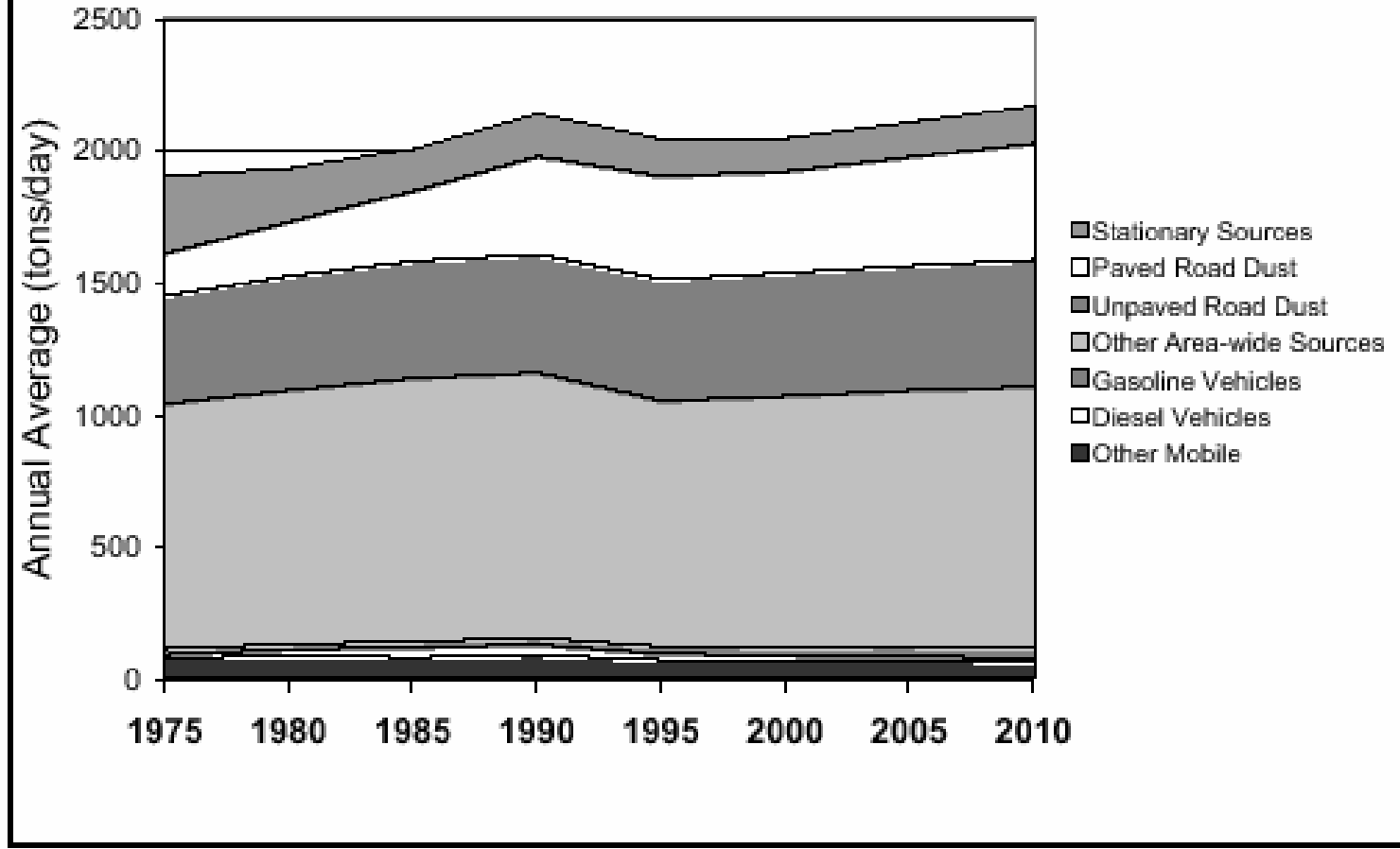


Figure 3-6

## Statewide Directly Emitted PM<sub>2.5</sub> Emission Trends

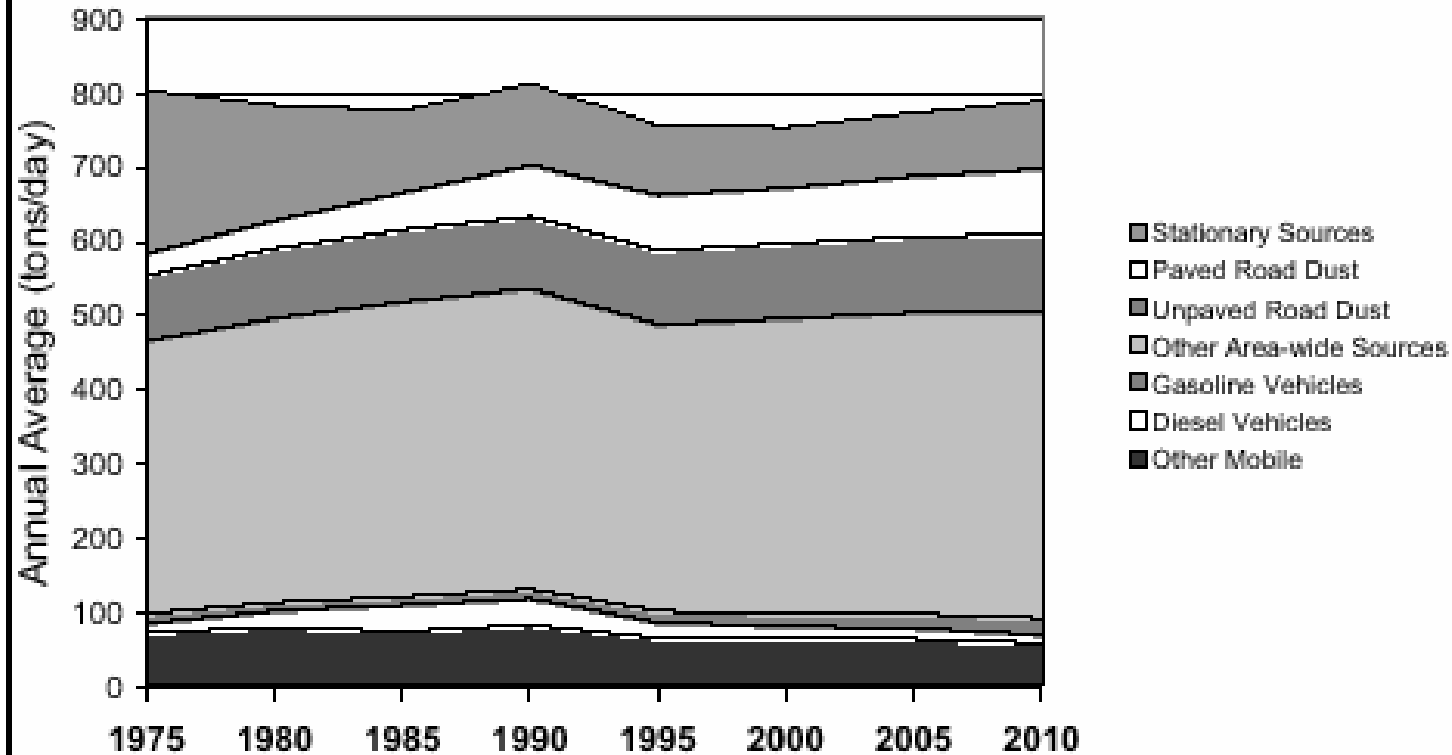


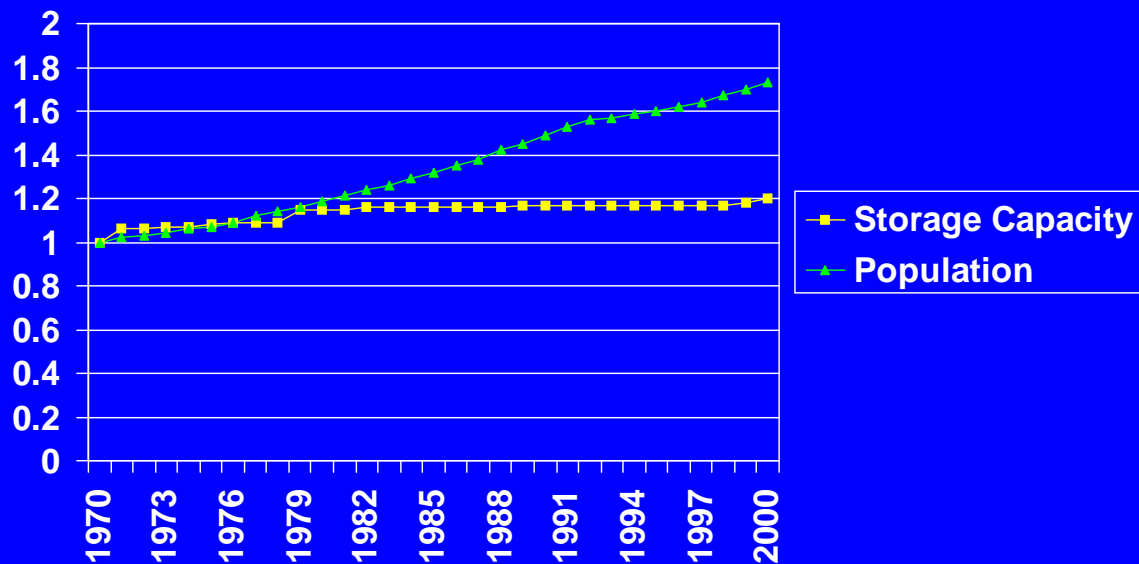
Figure 3-7

## *A look at water*

- California has a uniquely diverse landscape, whose natural water resources need to support not only a growing human population, but also important agriculture and industry.
- Spatially heterogeneous sources of water... more water in north, more demand in south

# Historical Water Resource Trends

Figure 2-13  
Water Storage Capacity (Acre feet) and Population  
Trends, 1970-2000, Indexed 1970=100

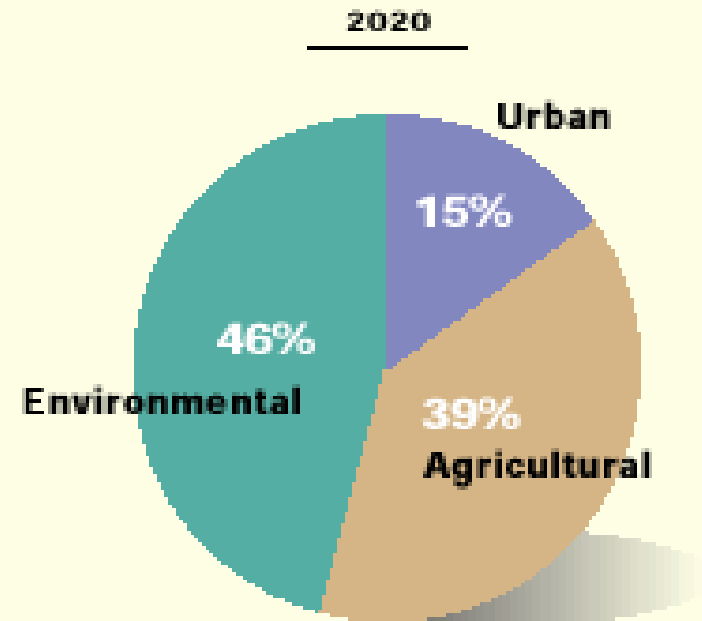
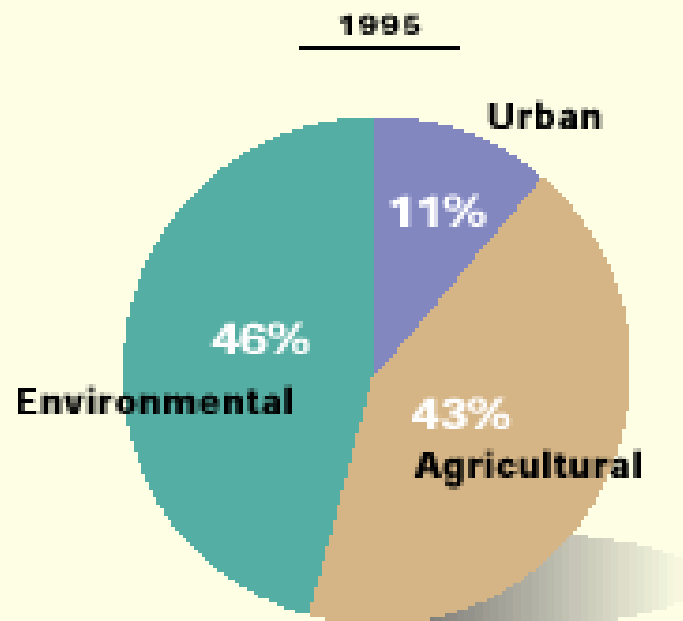


- New large water projects not foreseeable in the future due to technical, economic, or environmental reasons.
- Incremental increases in water supply not enough to keep up with population growth

## Summary of Key Statistics

Shown below for quick reference are some key statistics presented in the Bulletin. Water use information is based on average water year conditions. The details behind the statistics are discussed in Chapter ES4.

	<i>1995</i>	<i>2020 Forecast</i>	<i>Change</i>
Population (million)	32.1	47.5	+15.4
Irrigated crops (million acres)	9.5	9.2	-0.3
Urban water use (maf)	8.8	12.0	+3.2
Agricultural water use (maf)	33.8	31.5	-2.3
Environmental water use (maf)	36.9	37.0	+0.1



# *The California Water Plan Update BULLETIN 160-98*

- Forecasts increased shortages by 2020—2.4 maf in an average water year and 6.2 maf in drought years. The water management options identified as likely to be implemented could reduce those shortages to 0.2 maf in average water years and 2.7 maf in drought years.



## *Colorado River*

- Apportioned 4.4 maf/yr, using 5.3 since Arizona and Nevada were using their apportionment, and didn't complain.
- Now both Nevada and Arizona need their water supplies from the Colorado R.
- What will we do?

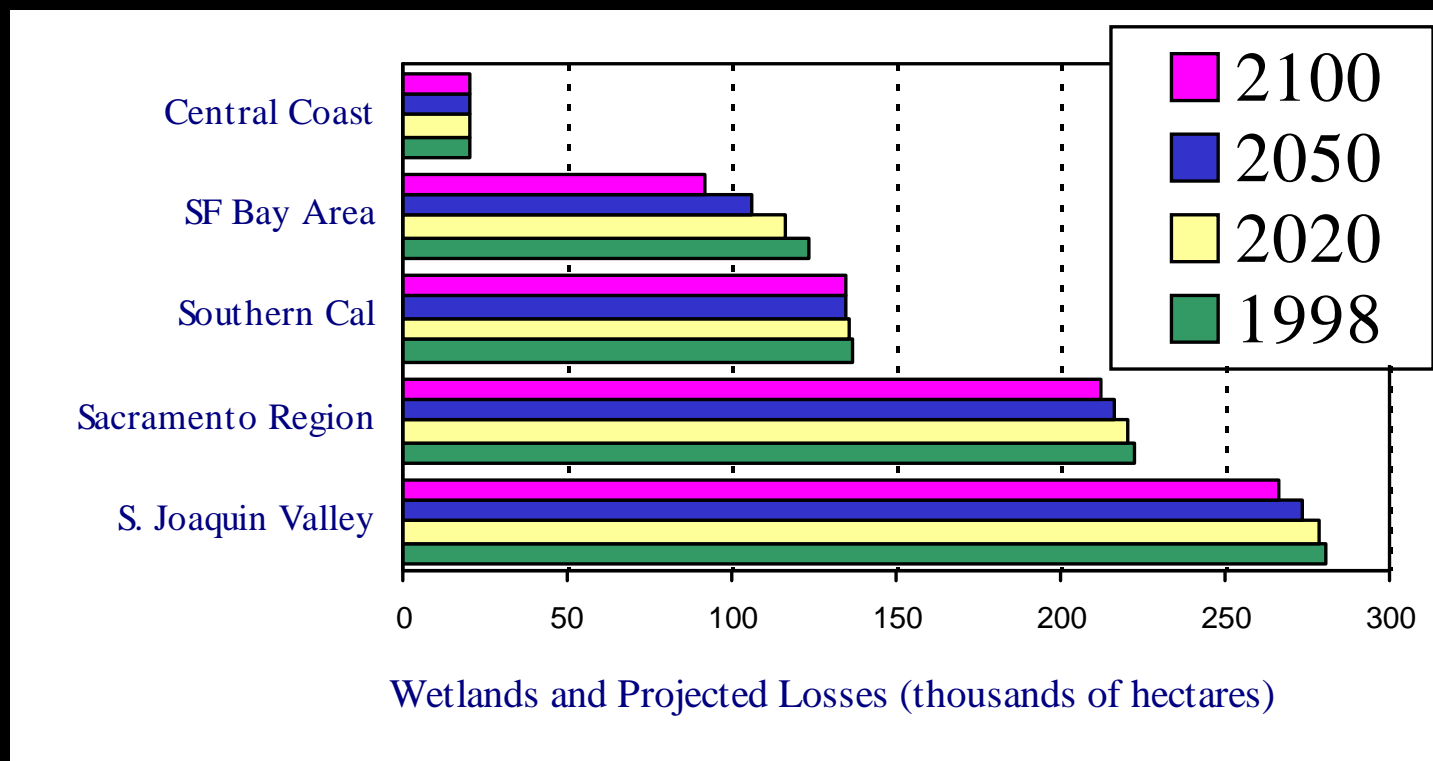
## *Other uncertainties*

- Over larger time frames the issue of climate change and droughts become very relevant
- Sustainability issues
- Safety issues: recycling and reuse, contamination

## *Other Issues besides air and water*

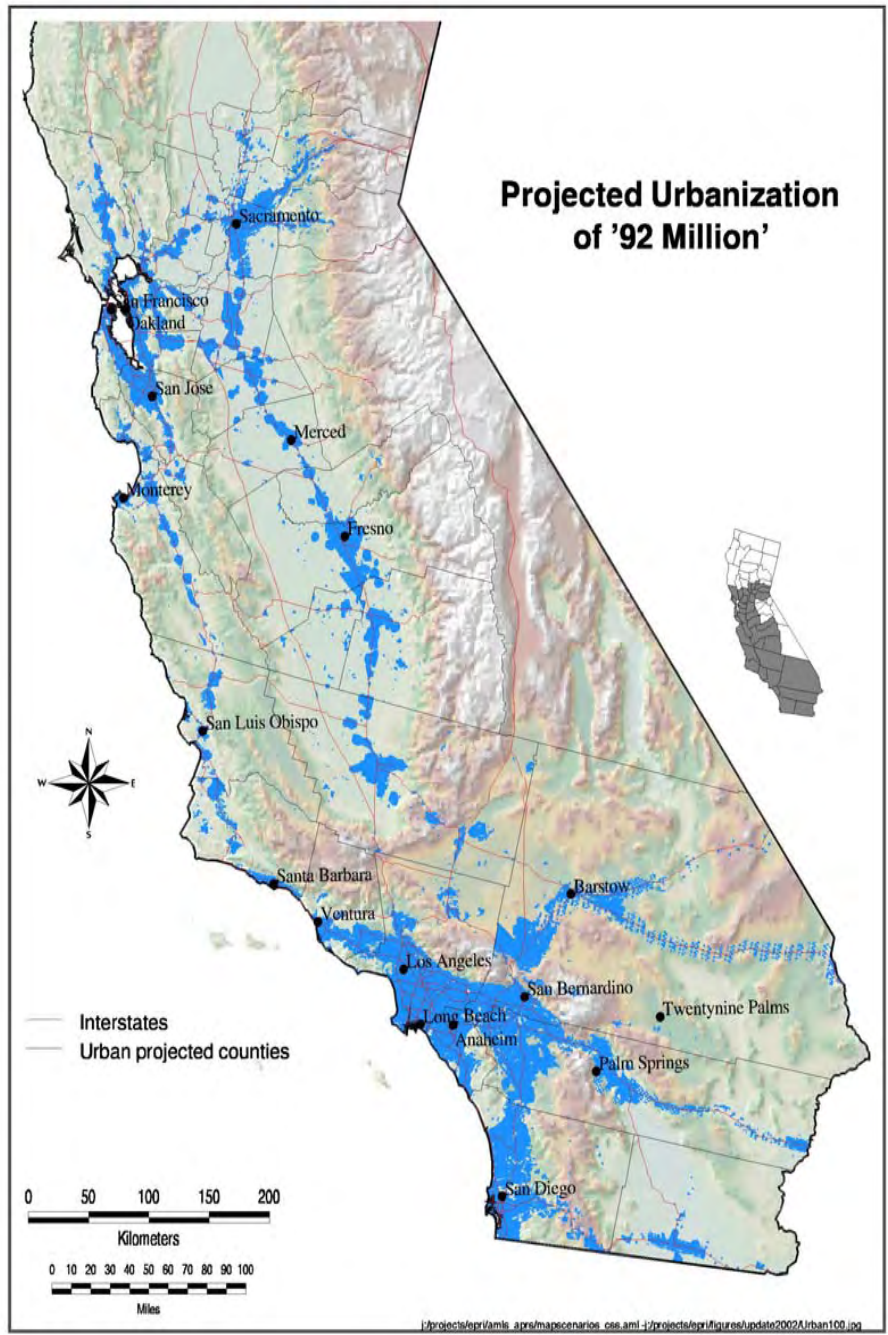
- Human and physical services
  - ◆ Increased elderly and ethnic diverse populations
- People living around toxics
  - ◆ Infield development, brownfield redevelopment
  - ◆ Pesticide exposures
- Infectious Diseases
  - ◆ Diverse populations, higher densities, increasingly connected
- Inequalities of the “Two Californias”
- Impact on Ecosystems and Habitats

Wetlands Losses due to Projected Urban Growth, by Region, 1998-2100.



# *Urban Growth Models*

A horizontal brushstroke in a vibrant blue color, tapering to a point on the right side, positioned below the title.



## *Growth and Landuse Models*

- Urban systems are complex
  - ◆ Social centers
  - ◆ Mixed landuse
  - ◆ Transportation
  - ◆ Infrastructures
  - ◆ Technology

- Resources are scarce
  - ◆ Conflicting values and priorities
  - ◆ Economic, environmental, social political feasibility of certain landuse
- Hence, models have been developed to try and integrate the stakeholder's visions and requirements, and reduce the uncertainties involved in the development and planning process.



- Such models have a relatively short history
  - ◆ Transportation models of the 1960s
  - ◆ More spatially explicit models of the 1990s
  - ◆ Importance of new spatial technology
    - GIS, RS, better access to data

## *The California Urban Futures Model*

- Bottom-Up population growth submodel
- Spatial Database
- Spatial Allocation submodel
- Annexation-Incorporation submodel

## *Bottom-Up population growth submodel*

- Demand side of the model
- Linear regressions that predict growth based on historical trends, current size, outward expansion potential, and growth policies
  - ◆ Separate equations for cities and counties

## *Spatial Database*

- Supply side of the model
- Includes the geometry, location and attributes of developable land
- Environmental, land use, zoning, current density, and accessibility (transportation)
- This is where GIS/RS comes into the picture

## *Spatial Allocation submodel*

- Series of procedures for allocating population demand to the available supply of land
- A scoring system that prioritizes which lands are more desirable and would be developed first, profit maximizing criteria
- Unallocated demand can spillover

## *Annexation-Incorporation submodel*

- Decision rules for annexing newly developed areas into existing cities or for making new clusters of developments into new cities

## *Scenario based approaches*

- The model runs are completely dependent upon the assumptions put in place.
- This can be seen as a benefit, as it allows us to assess the variability of outputs associated with different policy or planning scenarios

## *For example...*

- How would development occur under a “business as usual” scenario?
- Maximum environmental protection scenario?
- Smart growth- compact city scenario?
  
- What scenarios would alleviate transportation and air quality issues?
- Minimize toxic exposures?



## *Feedback*

- This scenario based approach potentially allows for feedback from risk assessment work to influence city and regional planning.
- The prevention of the problem, rather than band-aid fixes later on.

## *In conclusion and coming up soon...*

- Colloquium series starting this fall at UC Berkeley first looking at demographic trends and assumptions
- Inviting all scholars and policy makers
- The future of the student training and research program