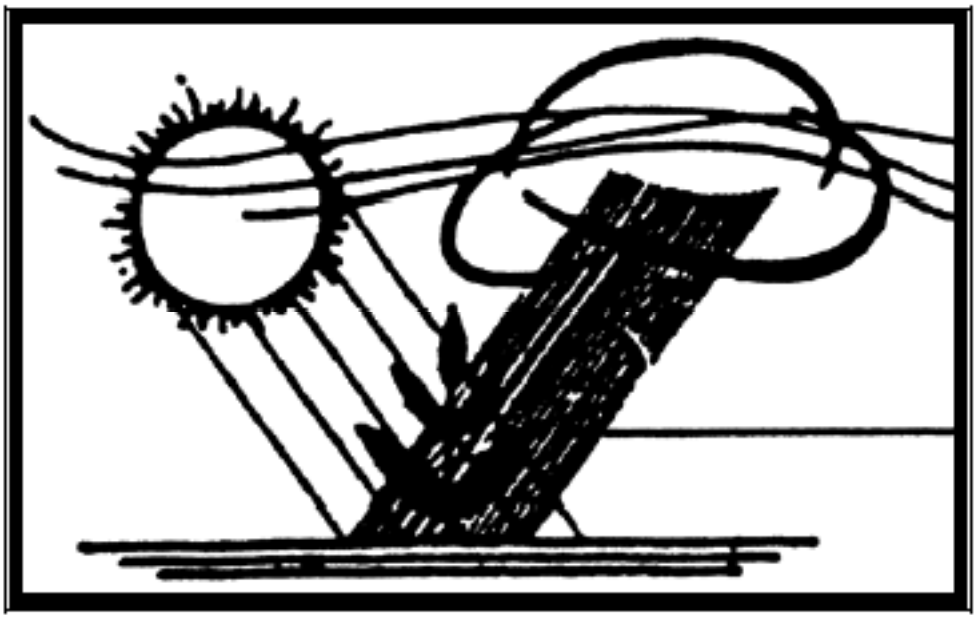
CONFERENCE PROCEEDINGS

2008
California Plant and Soil Conference

Conservation of Agricultural Resources



California Chapter of the American Society of Agronomy

Co-sponsored by the California Plant Health Association

February 5 & 6, 2008

Holiday Inn
9000 W Airport Dr
Visalia, CA 93277

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CALIFORNIA PLANT & SOIL CONFERENCE
CONSERVATION OF AGRICULTURAL RESOURCES

TUESDAY, FEBRUARY 5, 2008

10:00 **General Session Introduction** – Session Chair & Chapter President – Ben Nydam, Dellavalle Labs

10:10 **California Water Wars – Can We Reverse the Tide –** Bill Phillamore, Paramount Farming Co.

10:40 **Implementation of San Joaquin River Settlement** – Ron Jacbosma, General Manager, Friant Water Users Authority

1:10 **Who's Driving the Bus – Driving Forces Behind Food Safety Issues –** Ted Batkin, President, Citrus Research Board

11:40 Discussion

12:00 **Western Plant Health Luncheon Speaker:** Carl Winter, Director of FoodSafe Program, Ext. Food Toxicologist, UC Davis "Staying Alive—A Musical Look At Contemporary Food Safety Issues"

CONCURRENT SESSIONS (PM)

I. Spray Technology

1:30 Introduction – Session Chairs: **Ben Faber**, UCCE Ventura Co.; **Dave Woodruff**, Woodruff Ag Consulting.

1:40 **Plant Growth Hormones and the Use of Synthetic Growth Regulators in Horticultural Crops** – Don Merhaut, UC Riverside

2:00 **Uses Of Plant Growth Regulators In Tree Nut Crops** – Bob Beede, UCCE, Kings County

2:20 **Spray Technology –** Jim Coburn, Western Farm Service, Fresno, CA

2:40 Discussion

3:00 BREAK

3:20 **Zinc Movement and Distribution within a Peach Tree –** Scott Johnson, Extension Promologist, UC Kearney Agricultural Center, Parlier, CA

3:40 **Considerations in Effective Spray Coverage –** Neil O'Connell, UCCE Tulare County

4:00 **Where PGRs Are Going? –** Jim McFerson, WA Tree Fruit Research Commission

4:20 Discussion

4:30 **ADJOURN**

II. Water Supply/Irrigation/Water Quality

1:30 Introduction – Session Chairs: **Al Vargas,** CDFA**; Blake Sanden**, UCCE Kern Co.

1:40 **Spatial and Temporal Trends in Nitrate Concetration in the Eastern San Joaquin Valley Regional Aquifer and Implications for Nitrogen Fertilizer Management –** Karen Burow, USGS, Sacramento, CA

2:00 **Assessing Nitrate Leaching Potential by Hazard Index –** Laosheng Wu, UC Riverside

2:20 **GIS/Aerial Imagery Applications –** Tim Stone, Britz Fertilizers

2:40 Discussion

3:00 BREAK

3:20 **Modern Concepts in the Management of Saline Soils and Irrigation Supplies** - Don Suarez, USDA Salinity Lab, Riverside, CA

3:40 **Is Drip Irrigation Sustainable Under the Shallow, Saline Ground Water Conditions of the San Joaquin Valley? –** Blaine Hanson, UC Davis

4:00 **Pistachio Salinity Tolerance and Development with Interplanted Cotton –** Blake Sanden, UCCE, Kern County

4:20 Discussion

4:30 **ADJOURN**

ADJOURN to a Wine and Cheese Reception *in the Poster Room.*

A complimentary drink coupon is included in your registration packet.

WEDNESDAY, FEBRUARY 6, 2008
CONCURRENT SESSIONS (AM)

III. Pest Management

8:30 **Introduction** – Session Chair: **Tom Babb,** CA DPR

8:40 **Department of Pesticide Regulation's Environmental Justice Pilot Project –** Pat Matteson, CDPR, Sacramento, CA

9:00 **A Recently Introduced Pest: The Light Brown Apple Moth –** William Roltsch, CDFA, Sacramento, CA

9:20 **Managing Diaprepes Root Weevil, a Polyphagous Pest –** Kris Godfrey, CDFA, Sacramento, CA

9:40 Discussion

10:00 BREAK

10:20 **Funding Opportunities for Farmers and Ranchers (EQIP) –** Alan Forkey, USDA-NRCS, Davis, CA

10:40 **Third Party Certification for Pest Management Practices –** Dan Sonke, Protected harvest, San Diego CA

11:00 **New Low Risk Pest Control Products –** Pam Marrone, CEO/Founder Marrone Organic Innovations, Inc., Davis CA

11:20 Discussion

IV. Maintaining Soil Resources

8:30 **Introduction** – Session Chairs: **Suduan Gao**, USDA-ARS; **Rob Mikklesen**, IPNI

8:40 **Sustaining Soils, Sustaining Society –** Michael J. Singer, UC Davis

9:00 **Salt Management: A Key to Irrigation Sustainability in Arid Climates –** J.D. (Jim) Oster, UC Riverside

9:20 **Challenges on Salinity Management in Irrigated Agriculture in California –** Steve R. Grattan, UC Davis

9:40 Discussion

10:00 BREAK

10:20 **The Role of Private Land Trusts in Maintaining Soil Resources –** Hillary Dustin, Land Steward, Sequoia Riverlands

10:40 **Soil Properties Influenced and Altered by Agricultural Operations in California's Great Central Valley** – Kerry D. Arroues, USDA-NRCS

11:00 **A Systems Approach to Conservation Tillage and Nutrient Management in the production of Dairy Forages** – Dino Giacomazzi, Kings County Farm Bureau

11:20 Discussion

12:00 **ANNUAL CHAPTER BUSINESS MEETING LUNCHEON**:
Presentation of Honorees, scholarship awards and election of new officers

CONCURRENT SESSIONS (PM)

V. Plant & Soil Nutrition

1:30 **Introduction –** Session Chairs: **Joe Fabry**, Fabry Ag Consulting; **Will Horwath**, UC Davis-LAWR

1:40 **N&P, High or Low in Drip Irrigated Vegetables** – Don May, UCCE, Fresno County

2:00 **Boron Nutrition of Grapevines –** W.L. Peacock, UCCE, Tulare County

2:20 **Evaluation of the Amino Sugar Soil Test for Available** N – William Horwath, UC Davis

2:40 **Mineralization of Nitrogen in Liquid and Solid Dairy Manures Applied to Soil –** Stuart Pettygrove and Aaron Heinrich, UC Davis

3:00 Discussion

3:20 **ADJOURN**

VI. Food Safety

1:30 **Introduction –** Session Chairs: **Al Vargas**, CDFA; **Joe Voth**, Grimmway Farms

1:40 **Fate of Pathogens in the Environment and Implications in the Primary Production Chain of Fresh Produce** – Dr. Mark Ibekwe, USDA-ARS

2:00 **Practical Food Safety Guidelines on the Farm –** Dr. Trevor Suslow, University of California Davis

2:20 **Food Safety and the Environment: Exploring How Food Safety Concerns are Impacting Grower Efforts to Protect the Environment** – Melanie Beretti, R C D, Monetrey County

2:40 **Development of the Lettuce and Leafy Green Agreement** – Hank Glicas, Western Growers Association

3:00 Discussion

3:20 **ADJOURN**

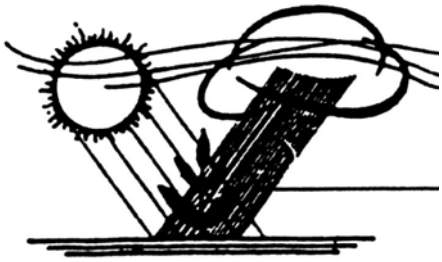
Session II

Water Supply/Irrigation/Water Quality

Session Chairs:

Al Vargas, CDFA

Blake Sanden, UCCE Kern County



Spatial and Temporal Trends in Nitrate Concentration In the Eastern San Joaquin Valley Regional Aquifer and Implications for Nitrogen Fertilizer Management

Karen R. Burow, S. Geological Survey, Placer Hall, 6000 J Street, Sacramento, CA, 95819
Phone (916)278-3087; fax (916)278-3190; email krburow@usgs.gov

Christopher T. Green, U.S. Geological Survey, Bldg. 15, McKelvey Building, 345 Middlefield Road, Menlo Park, CA 94025; , Phone (650)329-4728; fax (650)329-4463; email ctgreen@usgs.gov

Introduction

Ground-water withdrawals in the San Joaquin Valley totaled 64 million m^3/day (19 million ac-ft) in 2000, supplying about 45% of agricultural irrigation demand and about 80% of municipal supply (Hutson et al., 2004). Most of the population and ground-water use are in the eastern San Joaquin Valley, where reliance on ground water is expected to increase as a result of rapid population growth and limited surface water supplies. Protection of ground-water quality for future use requires monitoring and understanding the mechanisms controlling the long-term quality of ground water in the regional aquifer system.

Nitrate has been widely detected above background concentrations in ground water in the eastern San Joaquin Valley. Nitrate concentrations (reported as nitrogen in this paper) were above the MCL of 10 mg/L in 24% of domestic wells screened in the shallow part of the aquifer that were sampled during 1993–95 (Dubrovsky et al., 1998) and the Central Valley is one of the top three regions in the state in terms of the number of public drinking-water wells exceeding the MCL for nitrate (California State Water Resources Control Board, 2002).

To assess spatial and temporal trends in nitrate concentrations in the eastern San Joaquin Valley and to evaluate the long-term effects of nitrogen fertilizer use on ground-water quality in this region, data were evaluated at multiple spatial scales. Data from regional-scale monitoring networks were used to map the regional occurrence of nitrate and to determine whether shallow ground water containing elevated nitrate is migrating to deeper parts of the aquifer system. At the local scale, mean ground-water ages from analysis of age-dating tracers were combined with concentrations of nitrate to reconstruct nitrate inputs in recharge through time and to compare with estimated nitrogen applications. Ground-water flow and transport simulations of a typical public-supply well screened from about 100 to 400 ft below the water table were used to evaluate long-term concentrations beneath agricultural areas under different nitrogen management scenarios.

Occurrence of nitrate in the regional aquifer

Regional spatial and temporal trends in nitrate during the last two decades vary according to the position of the sampled wells in the regional ground-water flow system. Nitrate concentrations are highest and most variable near the water table, and variability and concentration decrease with depth (Burow et al., 2007) (fig. 1). In areal networks of monitoring wells screened near the water table in agricultural areas, nitrate concentrations in the 2000s ranged from 0.04 to 34 mg/L, with a median of 16 mg/L (Burow et al., in press). Nitrate concentrations were greater than the MCL in 67% of the wells. Nitrate concentrations in the

2000s in the shallow part of the aquifer system at depths of domestic wells (fig. 1) ranged from <0.05 to 75 mg/L, with a median of 6.4 mg/L. Nitrate concentrations were greater than the MCL in 29% of sampled domestic wells, indicating that domestic drinking-water supplies have been significantly affected by nitrate concentrations. In the 2000s, nitrate concentrations deeper in the aquifer, where public-supply wells are typically screened, ranged from 0.5 to 9.9 mg/L, with a median of 3.7 mg/L.

The largest increases in nitrate concentrations during the last decade were in the shallowest wells; the median increase in nitrate concentration decreased with depth (Burow et al., in press) (fig. 1). In the monitoring wells screened near the water table in agricultural areas, median nitrate concentrations increased from 11 to 14 mg/L in oxic wells during the last decade, although the increase was not statistically significant. In the shallow part of the aquifer system at depths of the domestic wells, median nitrate concentrations increased significantly from 6.1 to 7.3 mg/L in oxic wells during the last decade. In the deep part of the aquifer where public-supply wells are screened the median nitrate concentration increased significantly from 3.4 to 3.7 mg/L during the last decade. A large database of historical nitrate concentration data from wells in the shallow and deep parts of the aquifer was constructed to evaluate long-term changes in nitrate concentrations (Burow et al., in press). These data also show that nitrate concentrations have increased over the last several decades in both the shallow and deep parts of the aquifer, with concentrations increasing more gradually at depth. In view of the widespread occurrence of nitrate concentrations over the MCL in the shallow part of the aquifer and increasing concentrations with depth, a quantitative evaluation of the decadal-scale fate and transport of nitrate in the eastern San Joaquin Valley is needed to design mitigation strategies for the high concentrations in the shallow part of the aquifer and to protect future water supplies tapping the deep part of the aquifer.

Sources of nitrate

The observed decrease in nitrate concentrations with depth is consistent with an increase in nitrogen fertilizer applications over time. Initial nitrate concentrations in recharge and corresponding nitrogen fertilizer applications increased over time in three separate local-scale studies near 1) Fresno (fig. 2a) (Burow et al., 2007), 2) Modesto (fig. 2b) (Burow et al., in press), and the Merced River (fig. 2c) (Green et al., in press(a)). Manure applications were included in the nitrogen input curve for the site near the Merced River because of nearby confined animal operations. Analysis using county-level nitrogen applications and a wide range of chemical data from sampling vertical monitoring well transects showed that reconstructed nitrate concentrations are consistent with 50% of the applied nitrogen reaching the water table. Similar temporal trends and leaching fractions (typically 30 to 50%) have been reported for agricultural recharge in other areas in the United States (Böhlke and Denver, 1995; Böhlke, 2002; McMahon et al., 2006). Nitrogen application data (Ruddy et al., 2006) and isotopic data from the local-scale studies (Green et al., in press(b); McMahon et al., in press) indicate that nitrogen fertilizer is the dominant source of nitrate in modern ground water, although locally in areas with confined animal operations, manure inputs (Ruddy et al., 2006) could increase expected nitrate concentrations in recharge by as much as 38 to 66%. Septic inputs of nitrogen to ground water can be locally significant; however, septic density is sparse in comparison to the area of fertilized crops in the study area. Atmospheric deposition of nitrogen is low.

Persistence of nitrate and mixing processes in the regional aquifer

Physical processes such as dispersion and mixing affect nitrate concentrations as nitrate moves deeper in the ground-water system. In deep, long-screened wells, low nitrate concentrations may be caused by the increased mixtures of ages of ground water with depth (Weissmann et al., 2002). In these wells, young, high-nitrate ground water is mixed with older, low-nitrate ground water, resulting in low observed nitrate concentrations. As the proportion of young, high-nitrate ground water increases in the deep part of the aquifer, concentrations of nitrate are expected to increase.

Microbial reduction can remove nitrate in geochemically reduced environments with sufficient organic content. Concentrations of nitrate in the regional aquifer are expected to generally persist over time because the aquifer sediments have low organic content and ground water is typically oxic (Burow et al., 1998; Burow et al., 2007; Jurgens et al., unpublished data, 2007). In the aquifer beneath Modesto, excess N_2 concentrations systematically increased with depth at multiple well nests, implying that small amounts of denitrification occurred in the aquifer even though it was generally oxic (McMahon et al., in press). Denitrification has also been reported in ground water in the vicinity of the Merced River (Domagalski et al., in press; Green et al., in press(b)). At that site, denitrification accounted for removal of as much as 50% of the nitrate in 31 years of reaction time.

Implications for management of nitrogen inputs

Based on estimates of ground-water age in the deep part of the aquifer, current concentrations of nitrate in public-supply wells likely reflect the fertilizer application rate and management practices of 40 to 50 years ago mixed with older waters prior to significant fertilizer use (Burow et al., in press). Therefore, concentrations of nitrate will likely increase as the proportion of young water contributed to these wells increases with time. Simulations using a detailed flow and transport model of a typical public-supply well indicate that for current nitrate input concentrations at the water table in agricultural areas of 15 mg/L, nitrate concentrations across the range of about 100 to 400 ft below the water table in the aquifer would approach the MCL of 10 mg/L within the next several decades (fig. 3).

Because geochemical reactions do not significantly affect nitrate concentrations between the root zone and the water table, controlling high nitrate concentrations in shallow ground water is dependent on physical factors, such as nitrogen fertilizer applications and recharge rates (Green et al., in press(a)). For example, increased fertilizer efficiency, resulting in the reduction of nitrogen inputs at the water table from current levels by 33% over 20 years could reduce nitrate concentrations sufficiently to maintain concentrations below the MCL (fig. 3). However, nitrate concentrations will continue to increase for 20 years after the reduction in input because of the lag time between the change in management and response in the deep aquifer. Whether or not measures are adopted to decrease nitrogen inputs at the water table, continued monitoring of nitrate concentrations in the regional aquifer at multiple scales provides the data necessary to assess management alternatives and to address the efficacy of measures adopted in the future.

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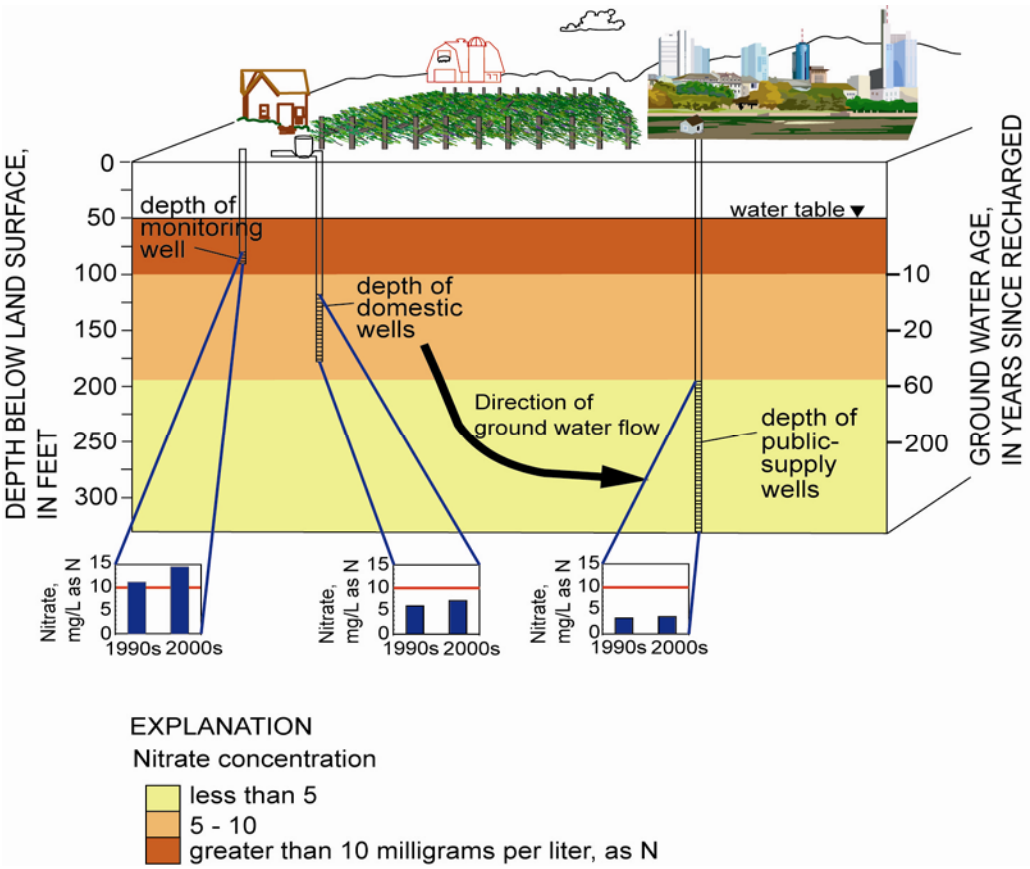

Figure 1. Nitrate concentrations and well depths in areal well networks sampled by the U.S. Geological Survey in the eastern San Joaquin Valley, California (Burow et al., 2007; Burow et al., in press).

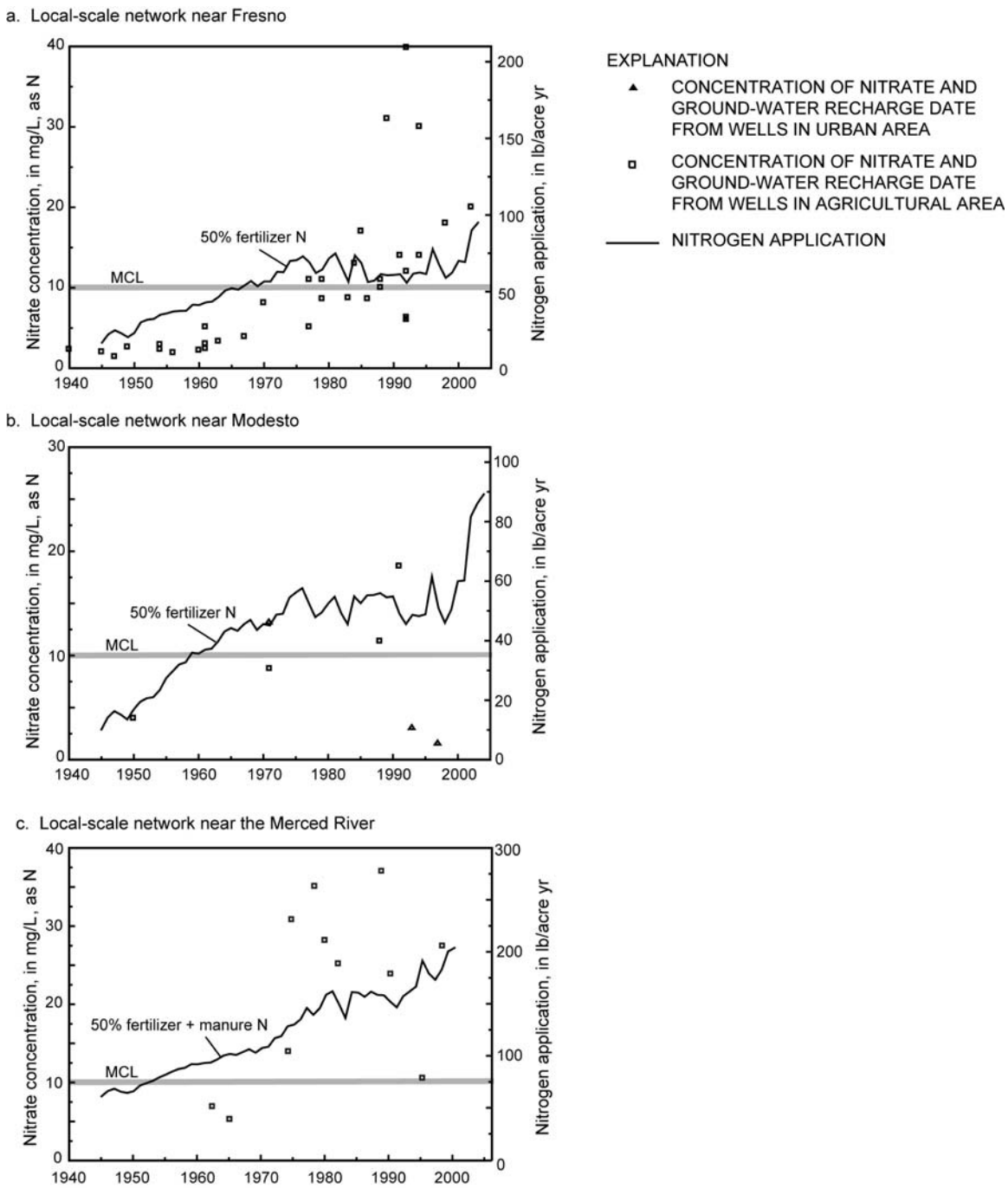

Figure 2. Estimated concentrations of nitrate in recharge and observed concentrations of nitrate in monitoring wells in (a) Fresno, California, (b) Modesto, California, and (c) near the Merced River, California. Nitrogen applications in (c) include manure. Observed concentrations of nitrate are plotted against corresponding dates of groundwater recharge. Estimated concentrations of nitrate from applications represent 50% of the nitrogen fertilizer applications (plus manure at Merced River site) divided by the area of fertilized land, dissolved in 0.6 m/yr of recharge in Fresno and 0.4 m/yr in Modesto and near the Merced River.

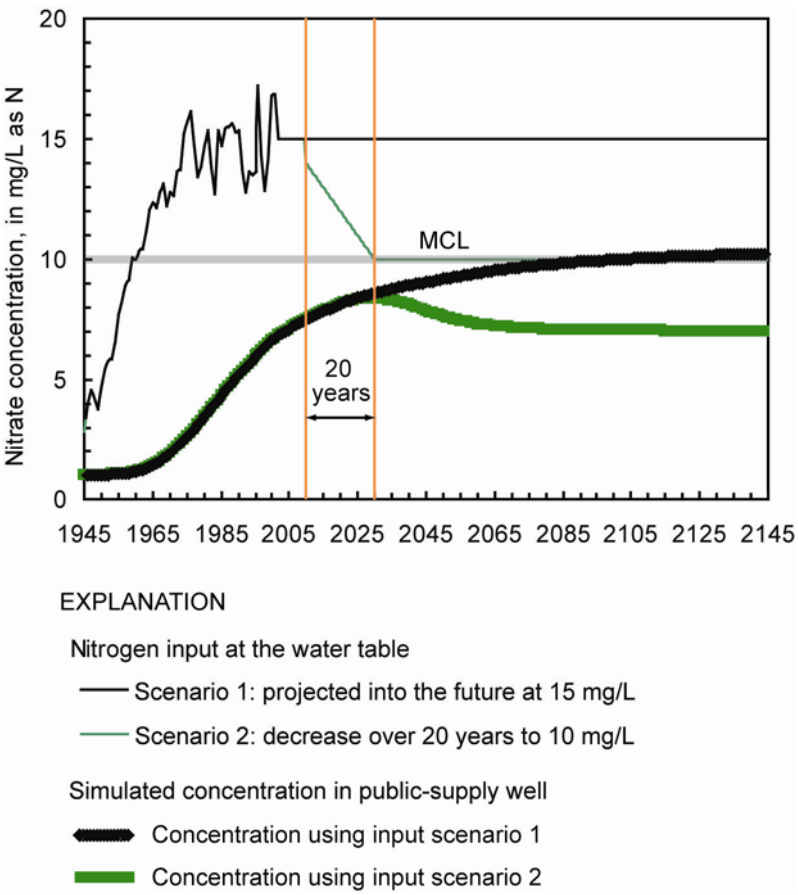

Figure 3. Simulated long-term concentrations of nitrate in a typical public-supply well in the eastern San Joaquin Valley, California. Concentration in public-supply well assumes 100% agricultural land in contributing recharge area; well screen depth about 100 to 400 ft below the water table; first-order denitrification rate constant = 0.005/yr.