GROUNDWATER RESOURCES ASSOCIATION
OF CALIFORNIA

CALIFORNIA GROUNDWATER MANAGEMENT

SECOND EDITION, 2005

Bachman • Hauge • McGlothlin • Neese • Parker • Saracino • Slater

Kevin Neese
1959 to 2000

This edition of California Groundwater Management is dedicated to first edition author, Kevin Neese. In addition to being a talented geologist and exceptional lawyer, or perhaps in spite of these accomplishments, Kevin became what most of us can only aspire to: a truly wonderful human being.

This handbook contains general information about law and hydrogeology of groundwater basins as they pertain to groundwater management in California. It is designed to be read and used by people of many backgrounds and differing levels of understanding and knowledge. The authors have worked to ensure that all information in this handbook is accurate as of the time of publication and is consistent with accepted standards and technology in the general groundwater resources management community. As research and practices advance, however, accepted standards may change. The opinions, analyses and recommendations expressed do not necessarily represent the opinions of any particular author, peer reviewer, federal, state or local agency, or any individual member of the Groundwater Resources Association. Readers should consult their own attorneys and technical consultants regarding the information in this document.

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Groundwater Resources Association of California

HISTORY

The Groundwater Resources Association of California (GRA) is a statewide, non-profit organization of scientists, engineers, planners, educators, attorneys, students, hydrogeologists and other professionals that focuses on all aspects of California's groundwater resources including assessment, development, recharge, quality, protection, education and management.

Since its formation in 1992, GRA has been committed to initiating and facilitating the development of viable, credible solutions for the complex issues involved in groundwater management and protection. This commitment requires that a multitude of topics and issues are investigated and are equally represented by interested and affected scientific, public and governmental constituencies. The GRA strives to provide neutral, nonpartisan forums that facilitate participation by a diverse group of professionals and stakeholders in the groundwater industry.

OBJECTIVES

- develop and promote scientific and practical educational programs that advance the understanding of the importance of groundwater resources, its management and protection;
- actively participate in the formulation of statewide policy on the development and management of California's groundwater resources, the protection of groundwater quality, the remediation of soil and groundwater, and the performance of environmental site assessments;
- develop and disseminate scientific and technical information to GRA members, legislators, regulators, planners, managers, contractors, the public and others who are involved in the development and application of policies and regulations concerning groundwater resources;
- facilitate the development of alternative technologies and standardization of methods to advance groundwater evaluation, management and protection; and
- encourage cooperation among groundwater professionals, regulators, managers, contractors and suppliers locally, statewide and nationally.

Mission

To advance and promote resource management that protects and improves groundwater in California.

915 L Street, Suite 1000
Sacramento, CA 95814
Phone: (916) 446-3626
Fax: (916) 442-0382
www.grac.org

About the Authors

STEVEN BACHMAN, PH.D.

Dr. Steven Bachman has 30 years of professional geological experience in academics, consulting and the public sector. He currently serves as Groundwater Programs Manager for United Water Conservation District, working on joint projects for Calleguas Municipal Water District, and as a professional consultant.

Dr. Bachman was a co-author on the first issue of California Groundwater Management, funded by the U.S. Environmental Protection Agency (EPA) and published by the Groundwater Resources Association (GRA). He is the Chair of the Groundwater Committee for the Association of California Water Agencies (ACWA) for 2002-2004 and lectures statewide on groundwater management and groundwater monitoring and modeling. He also serves on the State Water Resources Control Board (SWRCB) Technical Advisory Committee on the Legal Classification of Groundwater, the California Department of Health Services (DHS) Technical Advisory Panel on Drinking Water Source Protection, and the California Department of Water Resources Advisory Panel on Groundwater Management Funding.

Dr. Bachman earned his Doctorate in Geology at the University of California Davis (1979).

CARL HAUGE

Mr. Carl Hauge is Chief Hydrogeologist, retired, for the California Department of Water Resources (DWR). Mr. Hauge began his career as a scientific aide at the U.S. Geological Survey (USGS). He worked for the California Division of Mines and Geology (CDMG) where he studied earthquake analysis, urban geology, geologic publications and transitioning the Mineral Information Service into California Geology publication of CDMG. Mr. Hauge eventually returned to DWR and became involved with studies on water supply and demand, dam site exploration and construction, groundwater and land subsidence, and well construction.

Mr. Hauge was a co-author of the first issue of California Groundwater Management, funded by the EPA and published by the GRA. He is actively involved with the Association of California Water Agencies (ACWA) Groundwater Committee, and the California Groundwater Association (CGA), in addition to GRA.

Mr. Hauge earned his Bachelor of Arts in Geology from the University of California Riverside and is registered by the State of California as a Professional Geologist and Certified Engineering Geologist.

RUSSELL MCGLOTHLIN, ESQ.

Russell McGlothlin is an attorney with the law firm of Hatch & Parent, where he specializes in California water matters. His expertise in the field includes water right permitting, groundwater right adjudications, access to groundwater storage space for conjunctive use, water transfer issues, water quality projects, and environmental matters affecting water use. He represents private water companies, municipalities, special districts, and individual landowners with transactional negotiations, litigation, appellate proceedings and administrative agency proceedings.

Mr. McGlothlin served as a paralegal with the U.S. Department of Justice in Washington D.C. and as a clerk for Santa Barbara Superior Court Judge, J. William McLafferty. Mr. McGlothlin earned his Jurist Doctorate, with honors, from the University of Michigan Law School in 2000.

TIMOTHY K. PARKER

Mr. Parker is with the California Department of Water Resources, in Sacramento, California. He works with local agencies to assist in the planning, development, and implementation of surface water and groundwater management studies, groundwater storage investigations, and conjunctive use projects to increase water supply reliability through the coordinated use of surface water and groundwater. Prior to joining DWR, he was with the California Geological Survey conducting watershed assessments, soil erosion and mass wasting studies related to timber harvesting in the North Coast Ranges and the Sierra Nevada. He previously worked for the California Department of Toxic Substances Control (DTSC) conducting groundwater and environmental contamination assessment and remediation, primarily in the southern California area. As a private consultant, Mr. Parker concentrated on contaminant hydrogeology and solution-based approaches to Superfund site cleanup in southern California, the Central Valley, and the San Francisco Bay area.

Mr. Parker is currently a GRA Board Member, Legislative Committee Chair, and Past President (2000 through 2001). He also serves on the National Ground Water Association Regional Groundwater Resources Management Task Force, Groundwater Protection and Management Subcommittee, Superfund Task Force, and as Chair of the Theis Committee. He is a California Professional Geologist, Certified Engineering Geologist, and Certified Hydrogeologist.

ANTHONY M. SARACINO

Mr. Saracino, Director of Water Policy for The Nature Conservancy, is a recognized expert in groundwater policy and water resources management. He was formerly a private consultant for over 20 years, providing consultation to public and private clients on issues relating to conjunctive use, groundwater banking and groundwater quality protection. Mr. Saracino has worked with a variety of stakeholders to resolve complex water resource planning and management issues. He has also served as a federal and state court-appointed consultant on matters related to water quality.

Mr. Saracino was a co-author of the first issue of California Groundwater Management, funded by the EPA and published by the GRA. He is a founding board member and past president of GRA, and has served on numerous groundwater committees and panels.

Mr. Saracino is registered by the State of California as a Professional Geologist, Certified Hydrogeologist, and Certified Engineering Geologist. He earned a Master of Science in Geology from Colorado State University.

SCOTT S. SLATER, ESQ.

Scott S. Slater's practice is exclusively limited to water rights and the development and application of water law and policy. For the better part of 20 years, Mr. Slater's legal practice has concentrated on water related issues involving Water Rights, Water Utilities and Water Quality, predominantly in the Western United States. Most recently, Mr. Slater was a lead attorney for the San Diego County Water Authority (SDCWA) in negotiating the largest water transfer in U.S. history, the 110-year SDCWA/IID Colorado River Transfer presently valued in excess of $5 billion.

Mr. Slater serves as special water counsel to municipalities, private corporations, districts, and public agencies. He also serves as legal counsel for the judicially appointed watermaster in the Chino Basin adjudication, governing the water resources within California's Inland Empire for approximately 1 million people.

Mr. Slater, with Hatch & Parent in Santa Barbara, is an Adjunct Professor at the University of Pepperdine School of Law (1996-present) where he teaches Water Law. He has also taught graduate and Water Law programs at the University of California, Santa Barbara and the University of Western Australia. He has recently served as a visiting lecturer in the People's Republic of China and he is a continuing advisor on water law and policy issues to the Waters and Rivers Commission of Western Australia. His book California Water Law and Policy is the leading treatise on the subject in California.

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GRA greatly appreciates Jim Goodrich and Schlumberger Water Services for generously supplying jump-start funding to initiate the Second Edition. GRA is also indebted to the numerous other financial contributors who helped to make this Second Edition possible. Thanks also go to Harrison Phipps and Kathy Snelson, past and current GRA Executive Directors, respectively, for their support on the project. Harrison initiated the update of the first edition. Kathy helped carry on the work, and was also instrumental in getting the project completed.

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Finally, GRA recognizes the GRA Membership and the GRA Board of Directors for their continued support of the organization. Many GRA members support the organization voluntarily by participating in various regional and state-wide activities, providing groundwater management expertise and financial contributions. The members of the GRA Board of Directors also are dedicated volunteers who provide the Association with leadership and vision. Without these efforts and contributions GRA would, quite simply, not exist.

Preface to the Second Edition

Originally planned as an update to the First Edition, the Second Edition of the California Groundwater Management Handbook has been expanded to incorporate comprehensive legal and regulatory changes since the writing of the First Edition, and is completely re-organized for easy reading. It includes a new section on groundwater tools and technology, and is completely re-designed with two color internal print, graphics, and many more figures, illustrations and diagrams.

Chapter 1, Introduction, *now contains more general information on California groundwater management, and has been expanded to include a description of California's physical setting, statewide surface water distribution system, and hydrogeologic provinces and basic metrics. Added to the chapter are discussions of the tragedy of the commons and sustainability as they pertain to groundwater.*

Chapter 2, Groundwater Hydrology, *has expanded technical information and includes additional graphic illustrations of the concepts. A new section has been added on surface water and groundwater interaction and an additional section that discusses the importance of hydrogeologic characterization in groundwater management has been included. Also new are sections on the importance of short- and long-term groundwater level information and basin yield, both of which provide the basis for analysis of the aquifer over time for groundwater management decisions. The information on groundwater hydrologic regions was removed and we refer the reader to California Department of Water Resources Bulletin 118 "California's Groundwater" (DWR 2003).*

Chapter 3, Groundwater Quality*, incorporates updated regulatory information on some of the most common natural and anthropogenic constituents in groundwater. Detailed sections have been included on arsenic, radon, chromium, perchlorate, and methyl tertiary butyl ether (MTBE). A section has been added on total maximum daily loads (TMDLs), and the importance of groundwater managers being involved in the TMDL development and implementation process. Additionally, a section has been added at the end of this chapter to provide information on the statewide comprehensive groundwater quality monitoring program being implemented in California by state and federal agencies.*

Chapter 4, Protecting Groundwater Quality *has been updated and now incorporates information on California's Drinking Water Source Assessment and Protection (DWSAP) Program, including program goals, TurboSWAP (the computer program available from DHS to generate the necessary electronic assessment forms for groundwater sources), methodologies and approaches. There is also more information on source assessment analytical methods, vulnerability ranking, protection and management measures.*

Chapter 5, Developing and Implementing a Groundwater Management Plan *has been re-organized and expanded to include more information on the nexus of groundwater management with comprehensive and general plans and county planning, procedural requirements and public hearings. Also incorporated are the required components of Senate Bill 1938, the Groundwater Management Act of 2001, including public involvement, management objectives, monitoring, monitoring protocols, and management of groundwater levels, surface water and groundwater quality, and subsidence. Additional components recommended in DWR Bulletin 118 are also included.*

Chapters 6 & 7 *include Information on California's groundwater legal and institutional framework and updated with the current case law (as of this writing).* ***Chapter 6, Groundwater Law and Rights,*** *provides information on the historical development and current character of California groundwater law, technical and legal perspectives on subterranean streams, groundwater rights, and safe yield and overdraft. This chapter also contains narrative discussion on well interference, material injury, physical solutions, groundwater storage space for conjunctive use, groundwater*

transfers, environmental requirements, and public trust. ***Chapter 7, Groundwater Management Institutions****, provides details on the options for groundwater management governance.*

Chapter 8, Tools and Technology, *is new, and is focused on providing summary information on basic and advanced groundwater tools and technology currently available to assist in groundwater management planning and implementation. The first sections include information on data management, and groundwater level and groundwater quality monitoring (including graphical methods for general minerals, isotopes and environmental tracers, age dating and contaminants as tracers). Methods for determining basin yield and the interaction of surface water and groundwater, and unsaturated zone monitoring tools are also included. There are sections on borehole characterization, including geophysical logging tools and advanced wireline methods, well pumping and aquifer tests, and depth specific sampling of wells. Finally, the section on groundwater analytical tools includes geographic information systems (GIS), geostatistics, groundwater modeling, geochemical modeling and remote sensing.*

Tim Parker
GRA Project Manager
Second Edition

AUTHORS

Second Edition:

Steve Bachman, United Water Conservation District

Carl Hauge, California Department of Water Resources (retired)

Russell McGlothlin, Hatch and Parent

Tim Parker, California Department of Water Resources

Anthony Saracino, The Nature Conservancy

Scott Slater, Hatch and Parent

First Edition:

Steve Bachman, United Water Conservation District

Carl Hauge, California Department of Water Resources

Kevin Neese, Hatch and Parent

Anthony Saracino, Saracino-Kirby-Snow

PEER REVIEWERS

David Abbott, Todd Engineers

George Bayse, Downey, Brand, Seymour & Rohrer

Ron Davis, Santa Clara Valley Water District

Rob Donlan, Esq., Ellison & Schneider

David Guy, Northern California Water Association

Rick Iger, Kern County Water Agency

Debra Man, Metropolitan Water District of Southern California

Kevin B. McGillicuddy, Roscoe Moss Company

Joseph Scalmanini, Luhdorff and Scalmanini, Consulting Engineers

Brenda Southwick, California Farm Bureau Federation

David Spath, Division of Drinking Water & Environmental Management

DOCUMENT PRODUCTION TEAM

Tim Parker, GRA Project Manager

Andrea Elliott, Elliott Communications, Senior Technical Editor

Laurie Ahlf, DesignStyles, Owner/Designer

Karen Schapp, Fruitridge Printing

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