

The National Academies  
Division on Earth & Life Studies  
DELS Committee & Invited Guests



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FRONTLINE ISSUES

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WATER FOR U.S. CITIES:  
ENVISIONING THE 21ST CENTURY  
INFRASTRUCTURE

COOLING CLIMATE CHANGE  
WITH CARBON CAPTURE AND  
SEQUESTRATION

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*\*\*For speakers in town on Thursday night (October 27), meet Steve Parker in the lobby of the Hyatt Newport at 6:30 pm for an informal dinner with the group.*

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FRIDAY OCTOBER 28, 2011

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- 7:30 AM Meet in Hotel Lobby for transportation to The Beckman Conference Center
- 8:00 Breakfast in Dining Room of The Beckman Center
- 8:30 Welcome  
*Barbara Schaal, Chair, DELS Committee, Vice President NAS*
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- SESSION 1 WATER FOR U.S. CITIES: ENVISIONING THE 21ST CENTURY INFRASTRUCTURE
- 8:40 AM Overview: Challenges and Opportunities  
*Richard Luthy, Stanford University*
- 9:00 Discussion
- 9:10 The Soft Path to Sustainability  
*Peter Gleick, Pacific Institute*
- 9:30 Discussion
- 9:40 Expanding Supply with Reclaimed Wastewater  
*George Tchobanoglous, University of California, Davis, emeritus*
- 10:00 Discussion
- 10:10 The Greener Way: Innovations in Infrastructure and Resource Recovery  
*Ben Grumbles, Clean Water America Alliance*
- 10:30 Discussion
- 10:40 *Break*
- 11:00 Innovations in Planning and Financing  
*Jerome B. Gilbert, independent consultant*
- 11:20 Discussion
- 11:30 Facilitated Discussion: Roles for the National Research Council  
*(led by Richard Luthy)*
- 12:15 Lunch provided at Beckman

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SESSION 2	COOLING CLIMATE CHANGE WITH CARBON CAPTURE AND SEQUESTRATION
1:30	Overview <i>Lynn Orr, Stanford University</i>
1:45	Discussion
1:55	Sequestration in Forests and Agricultural Systems <i>Ben Houlton, University of California, Davis</i>
2:10	Discussion
2:20	Reducing Carbon from Electricity and Transportation <i>James Katzer, Exxon Mobile (retired) and Iowa State University</i>
2:35	Discussion
2:45	Geological Storage of Captured Carbon <i>Susan Hovorka, University of Texas, Austin</i>
3:00	Discussion
3:10	<i>Break</i>
3:30	Ocean Sequestration <i>Anthony Michaels, Proteus Environmental Technologies, LLC</i>
3:45	Discussion
3:55	Direct Carbon Capture from Air <i>David Keith, Harvard University and Carbon Engineering</i>
4:10	Discussion
4:20	Facilitated Discussion: Roles for the National Research Council <i>(led by Lynn Orr)</i>
5:00	Meeting Adjourns
6:00	Depart for Dinner at <i>Las Brisas</i> <i>(Transportation will be provided)</i>

### Barbara Schaal

Chair, DELS Committee; Vice President, The National Academy of Sciences; and Mary-Dell Chilton Distinguished Professor of Biology, Washington University of St. Louis



Dr. Barbara Schaal is vice president of the National Academy of Sciences and the Mary-Dell Chilton Distinguished Professor of Biology at the Washington University of St. Louis. Dr. Schaal's career as a leading evolutionary biologist began with a youthful fascination with plants. She is recognized for her work on the genetics of plant species, particularly

for her studies that use DNA sequences to understand evolutionary processes such as gene flow, geographical differentiation, and the domestication of crop species.

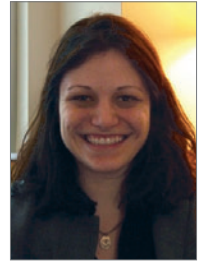
Born in Berlin, Germany, Dr. Schaal grew up in Chicago, graduated from the University of Illinois, Chicago with a degree in biology, and earned her Ph.D. from Yale University. She was on the faculty of the University of Houston and The Ohio State University before joining Washington University. Dr. Schaal has been president of the Botanical Society of America and president of the Society for the Study of Evolution. In 2005 Dr. Schaal became the first woman elected to the vice presidency of the National Academy of Sciences.

### Catherine Allen-West

Communications Officer, Division on Earth & Life Studies, National Research Council

Catherine Allen-West is a Communications Officer in the Division on Earth and Life Studies at the National Research Council in Washington, DC. Catherine graduated from American University in 2006 with a B.A. in Psychology. Previously, Catherine worked as Public Affairs Manager at the Association for Psychological Science. In

DELS, Catherine conducts outreach on the Division's reports, workshops, areas of study, and other events. This includes building connections with nongovernmental organizations, state and local groups, and businesses and foundations, and organizing public and online briefings.



### May Berenbaum

Swanlund Professor of Entomology, University of Illinois, Urbana-Champaign

Dr. May Berenbaum is Swanlund Professor of Entomology at the University of Illinois, Urbana-Champaign, where she has been a member of faculty since 1980, and head of the department since 1992. Dr. Berenbaum's research focuses on the chemical interactions between herbivorous insects and their host-plants, and the

implications of these interactions on the organization of natural communities and the evolution of species.

In addition to her research, Dr. Berenbaum is devoted to teaching and to fostering scientific literacy. She is the recipient of the 1996 Entomological Society of America North Central Branch Distinguished Teaching Award, and has authored numerous magazine articles, as well as three books about insects for the general public.

Dr. Berenbaum was the recipient of the 2009 AAAS Public Understanding of Science and Technology Award, and has also gained some measure of fame as the organizer of the Insect Fear Film Festival at the University of Illinois, an annual celebration

of Hollywood's entomological excesses. Dr. Berenbaum graduated with a B.S. degree in biology from Yale University, and she attended graduate school at Cornell University and received a Ph.D. in ecology and evolutionary biology.

### Katherine W. Bowman

Senior Program Officer, Board on Life Sciences, National Research Council

Katherine Bowman is a Senior Program Officer with the Board on Life Sciences of the National Research Council of the U.S. National Academy of Sciences. She manages studies and activities across a range of life sciences topics and participates in National Research Council (NRC) activities addressing the potential implications of developments in science and technology. She previously served at the National

Research Council, as a Program Officer with the Board on International Scientific Organizations, where she worked with international scientific unions in the biological sciences, chemistry, and radio science. Prior to becoming a Program Officer, she was a Mirzayan Science and Technology Policy Fellow working on biosecurity issues. She received her B.A. in Biology from Amherst College and her Ph.D. in Biomedical Engineering from Johns Hopkins University.

### William Y. Brown

President and CEO, Woods Hole Research Center

Dr. William Y. Brown joined the Woods Hole Research Center as president and chief executive officer in February, 2010. Previously, he was the president and chief executive officer of the Academy of Natural Sciences in Philadelphia, the nation's oldest natural history museum. Prior to this, he served as president and chief executive officer of the Bishop Museum in Honolulu, Hawaii, and science advisor to Interior Secretary Bruce Babbitt during the Clinton Administration. He serves on the DELS Committee.

Dr. Brown is a member of several honorary societies and the District of Columbia Bar. He is chairman of the Global Heritage Fund, president of the Natural Science Collections Alliance, a director of the Wistar Institute,

and a trustee of the Academy of Natural Sciences. He is a former chairman of the Ocean Conservancy, and a former director of various boards, including the Environmental and Energy Study Institute, Environmental Law Institute, U.S. Environmental Training Institute, and the U.S. Committee for the United Nations Environment Programme.

Dr. Brown earned a B.A. degree in biology from the University of Virginia, the M.A.T. degree from Johns Hopkins University, a Ph.D. in zoology from the University of Hawaii, where he was a National Science Foundation graduate fellow, and a J.D. from Harvard Law School.



### Anthony R. de Souza

Director, Board on Earth Sciences and Resources, National Research Council

Anthony R. de Souza is currently director of the Board on Earth Sciences and Resources at the National Research Council in Washington, D.C. Previously, he was executive director of the National Geography Standards Project, secretary general of the 27th International Geographical Union Congress, editor of National Geographic Research & Exploration, and editor of the Journal of Geography. He has held positions as a professor and as a visiting teacher and scholar at the George Washington University, University of Wisconsin-Eau Claire, University of Minnesota, University of California-Berkeley, and University of

Dar es Salaam in

Tanzania. He has served as a member of NRC committees. He holds B.A. (honors) and Ph.D. degrees from the University of Reading in England, and has received

numerous honors and awards, including the Medalla al Benito Juarez in 1992 and the Gilbert Grosvenor honors award from the Association of American Geographers in 1996. His research interests include the processes and mechanisms of economic development and human-environment relationships. He has published several books and more than 100 articles, reports, and reviews.



### Juan Enriquez

Managing Director, Excel Venture Management

Mr. Enriquez is the managing director of Excel Venture Management. Prior to this, he was the

founding director of the Harvard Business School's Life Sciences Project.

Mr. Enriquez is the author of the best-selling book *As The Future Catches You: How Genomics & Other Forces are Changing Your Life, Work, Health & Wealth*, which provided an early and accurate blue print of how a bio-based economy changes industries and corporations. His latest book, *The United States of America: Polarization, Fracturing, and Our Future*, which explores why some

countries are successful while others disappear, was published by Crown Business in November of 2005. He serves on the DELS Committee.

Mr. Enriquez founded Biotechnology Ventures, a successful fund that invested in highly promising life science companies such as BioTrove, a CB Health Ventures portfolio company, and Xcellerex.

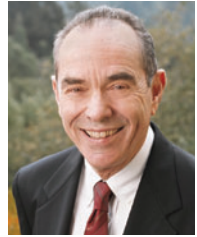
Mr. Enriquez has served on numerous boards including Cabot Corporation. He is also a world authority on the economic impact of life sciences on business, working directly with the CEOs of a number of Fortune Fifty companies, as well as various heads of state, on how to adapt to a world where the dominant language is shifting from the digital towards the language of life. He graduated from Harvard with a B.A. and an M.B.A.

## Jerome B Gilbert

Consulting Engineer, Orinda, California

Jerome B Gilbert is a consulting engineer based in Orinda, California. He has been the executive for East Bay Municipal Utility District and the California State Water Resources Control Board, and has recently been consultant to public water utilities including Seattle Public Utilities, San Diego County Water Authority, Metropolitan Water District of Southern California, and the Woodland Davis Clean Water Agency. His interests include integrated water supply and water quality planning and management, the financing of water projects, and water rates and related water conservation practices. He has led the development of

California water legislation including the Urban Water Management Planning Act and the Porter Cologne Act. He is co-author of recent publications of the American Water Works Association on alternate project delivery, and has focused on optimal lifecycle cost analysis for urban water system management. He is a member of the National Academy of Engineering and a graduate of Stanford University and the University of Cincinnati. He currently serves as chair of the International Water Association's Council of Distinguished Water Professionals.



## Peter H. Gleick

Co-founder and President, Pacific Institute

Peter H. Gleick is co-founder and president of the Pacific Institute. His research and writing address

the critical connections between water and human health, the hydrologic impacts of climate change, sustainable water use, privatization and globalization, and international conflicts over water resources.

Dr. Gleick was named a MacArthur Fellow for his work. He was dubbed a “visionary on the environment” by the BBC, and elected an Academician of the International Water Academy, in Oslo, Norway, and member of the U.S. National Academy of Sciences. He serves on the boards of numerous journals and organizations, and is author of many scientific papers and seven books, including the biennial water report, *The World's Water*, and *Bottled and Sold: The Story Behind Our Obsession with Bottled Water*.



**Ben Grumbles**  
President, Clean Water  
America Alliance

Ben Grumbles is president of the Clean Water America Alliance, a not-for-profit educational

organization based in Washington, DC, and committed to uniting people and policies for water sustainability throughout the country. His career in water and environmental policy spans 25 years, serving the public and teaching law students and environmental professionals. Most recently, he led Arizona's Department of Environmental Quality on air quality and climate change, energy policy and waste management, water efficiency, and wastewater recycling. Regional priorities included protecting the Grand Canyon, Colorado River, and Arizona-Mexico border environment.

Mr. Grumbles served as Assistant Administrator for Water at the U.S. Environmental Protection Agency in 2003–2008. He launched EPA's water efficiency labeling program, WaterSense, and initiatives on green infrastructure, water and climate change, and pharmaceuticals. He carried out and defended the nation's clean water, drinking water, ocean and coastal, and wetlands laws and worked on great water-body collaborations from coast to coast.

From 1985 to 2001, he served in the U.S. House of Representatives in various environmental counsel and staff director roles for the Transportation and Infrastructure Committee and Science Committee. His focus was on water and its connections to people, wildlife, agriculture, and energy. Mr. Grumbles serves on various boards and committees, including the Water Science and Technology Board of the National Academy of Sciences; Solutions from the Land, an educational nonprofit forging integrated and sustainable policies for agriculture, forestry, and conservation in the U.S. and globally; and the nominating committee of the Stockholm Water Prize administered by the Stockholm International Water Institute. He is also a former board member and current supporter of River of Words, a national nonprofit committed to connecting kids to their watersheds and imaginations through poetry and art.

Ben has a Masters degree in environmental law from George Washington University Law School, a J.D. from Emory University Law School, and a B.A. from Wake Forest University. He was born and raised in the Beargrass Creek watershed of the Ohio River, Louisville, Kentucky, four miles east of Churchill Downs. Ben, his wife Karen, and their two children live and play in the Spout Run watershed of the Potomac River, Arlington, Virginia.



**Benjamin Z. Houlton**  
Assistant Professor,  
Biogeochemistry  
and Global Ecology,  
University of California,  
Davis

Benjamin Z. Houlton holds degrees in Chemistry (B.S.),

Engineering (M.S.), and Ecology and Evolutionary Biology (Ph.D.). After completing his doctorate at Princeton University in 2005, Dr. Houlton spent two years working as a postdoctoral scholar at the Carnegie Institution for Science at Stanford University, also spending time as a visiting scientist at CSIRO's Division of Marine and Atmospheric Research in

Australia. Dr. Houlton's research interests center on interactions between the physical and living components of the earth system; his work has deepened our understanding of the connections between soil microorganisms and the chemistry of the atmosphere, rocks and the nutrient cycles that sustain plant growth and carbon storage on land, and forecasts of Earth's climate into the future. His research has been featured in NPR's "Morning Edition,"

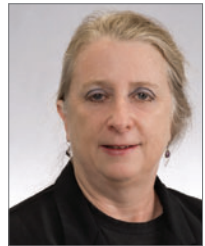
BBC's "The Naked Scientists," the Discovery Channel, MSNBC, the *Christian Science Monitor*, and *Nature*, among others. He has won several awards for his research, including the Gene E. Likens Award from the Ecological Society of America. Currently, Dr. Houlton holds the position of assistant professor of biogeochemistry and global ecology in the Department of Land, Air and Water Resources at the University of California, Davis.

### Susan D. Hovorka

Senior Research Scientist, Bureau of Economic Geology, Jackson School of Geosciences, University of Texas at Austin

Susan D. Hovorka is a Senior Research Scientist at the Bureau of Economic Geology, Jackson School of Geosciences, at The University of Texas at Austin. She has a B.A. in geology from Earlham College and an M.A. and Ph.D. from the University of Texas. She has worked on diverse topics related to water quality protection, waste storage in bedded salt, and reservoir characterization. Her current research focuses on assessment of effectiveness of subsurface geologic sequestration of CO<sub>2</sub> as a mechanism for reducing atmospheric greenhouse gas emissions. Hovorka is the principal investigator of the Gulf Coast Carbon Center, an industry/academic partnership working on economically viable approaches to geologic sequestration of CO<sub>2</sub>. She is the project lead for the "Early" test of the Southeast Regional Carbon Sequestration Partnership (SECARB) which has monitored

injection of 3 million tons of CO<sub>2</sub> at Denbury's Cranfield Field. She recently lead a research team in completing the two-phase Frio Pilot, a first U.S. field test of storage of CO<sub>2</sub> in brine-filled sandstones also funded by the U.S. Department of Energy's National Energy Technology Laboratory (NETL). Both of these projects have recently been recognized by the international Carbon Sequestration Leadership Forum.



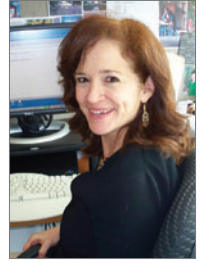
Hovorka is also active in facilitating exchange between applied scientists and the broader public, with a focus on pre-college students and teachers, and is co-investigator for the STORE education program—Sequestration Training, Outreach, Research and Education—to promote better understanding of CO<sub>2</sub> sequestration science and engineering technology.

### Nancy F. Huddleston

Communications Director, Division on Earth & Life Studies, National Research Council

Nancy Huddleston has led communications efforts at the National Academies' Division on Earth & Life Studies since 2002. Nancy and her team produce and disseminate a wide range of print and multimedia products based on reports and also manage the division's brand and online strategy. Nancy

brought 15 years experience in corporate communications and media relations in the telecommunications industry. She holds a B.A. in Chemistry from Kenyon College and a Masters degree in music from Catholic University of America.



### Katharine Jefferts Schori

Presiding Bishop of the Episcopal Church.

Dr. Katharine Jefferts Schori was elected presiding bishop of the Episcopal Church in June 2006. In this role, she serves as chief pastor and primate to the Episcopal Church's members in 16 countries and 110 dioceses. Over the course of her nine-year term, Bishop Jefferts Schori will initiate and develop policy for the Episcopal Church. She has been vocal about the Episcopal Church's mission priorities, including the United Nation Millennium Development Goals, issues of domestic poverty, climate change and care for the earth, as well as the ongoing need to contextualize the gospel.

Prior her role as presiding bishop, Dr. Jefferts Schori served as bishop of Nevada. During this time she became an active, instrument-rated pilot—a useful

skill when traveling between the congregations of the diocese of Nevada. Before her time in Nevada, Dr. Jefferts Schori

was a priest, university lecturer, and hospice chaplain in Oregon. She earned her Master of Divinity in 1994 from the Church Divinity School of the Pacific, and was ordained as a priest in that year.

Dr. Jefferts Schori began her career as an oceanographer. She holds a B.S. degree in biology from Stanford University, an M.S. and Ph.D. in oceanography from Oregon State University. Her research focused on squid and oysters. In the 1990s, Dr. Jefferts Schori worked as an oceanographer for the National Marine Fisheries Service. She serves on the DELS Committee.



### Stephanie E. Johnson

Senior Program Officer, Water Science and Technology Board, Division on Earth & Life Studies, National Research Council

Stephanie Johnson is a senior program officer with the Water Science and Technology Board. Since joining the

National Research Council in 2002, she has served as study director for ten studies, including studies on desalination, water reuse, and water security. Dr. Johnson received a B.A. from Vanderbilt University in chemistry and geology and an M.S. and a Ph.D. in environmental sciences from the University of Virginia.

### James H. Johnson, Jr.

Professor Emeritus of Civil Engineering and former Dean of the College of Engineering, Architecture, and Computer Sciences, Howard University;  
Chair of the National Advisory Council for Environmental Policy and Technology

Dr. James H. Johnson, Jr. is professor emeritus of civil engineering and former dean of the College of Engineering, Architecture, and Computer Sciences at Howard University, and was appointed chair of the National Advisory Council for Environmental Policy and Technology in February 2010. He is a member of the DELS Committee.

Dr. Johnson previously served at Howard as chair of the Department of Civil Engineering and interim associate vice president for research. His research interests include the treatment and disposal of hazardous substances, the evaluation of minority environmental policy issues and the development of environmental curricula and strategies to increase the pool of

underrepresented groups in the science, technology, engineering, and math disciplines. From 1996-2002, he oversaw the activities of the Engineering Coalition of Schools for Excellence and Leadership in Education, a



National Science Foundation-funded consortium. From 1989-2002, he was the associate director of the EPA-sponsored Great Lakes and Mid-Atlantic Center for Hazardous Substance Research.

Dr. Johnson is currently chair of the Anne Arundel Community College board of trustees in Maryland, and serves on several university, private sector, and research center advisory committees. Dr. Johnson received his B.S. from Howard University, M.S. from the University of Illinois and Ph.D. from the University of Delaware.



**James R. Kater**  
 Manager, Strategic  
 Planning and Program  
 Analysis, ExxonMobil  
 Research and  
 Engineering Company  
*(retired)*, and Iowa State  
 University

James R. Kater is a member of the U.S. National Academy of Engineering, and he has recently worked on several technology studies at the National Research Council resulting in formal reports, including *Resource Needs for Fuel Cell and Hydrogen Technologies*, *Alternative Liquid Transportation Fuels from Coal and Biomass*, *Plug-in Hybrid Electric Vehicles*, and *Alternatives to Replace the Indian Point Nuclear Plants*. As a Visiting Scholar at MIT (2004 to 2007), he was the executive editor/director of the MIT study on *The Future of Coal in a Carbon Constrained World* (2007). He retired from ExxonMobil in 2004 and independently consultants on energy.

He was manager of Strategic Planning and Program Analysis for ExxonMobil Research and Engineering Company. Before that he

was Vice President, Technology, in the Office of the Chief Technology Officer, Mobil Oil Corporation, with primary responsibilities for forward-looking evaluations of technology and environmental developments, issues and trends, and their impacts. Before joining the Central Research Laboratory of Mobil Oil in 1981, Dr. Kater was a professor of chemical engineering at the University of Delaware and the first director of the Center for Catalytic Science and Technology there.

Dr. Kater has more than 80 publications in technical journals, holds several patents, and co-authored and edited several books. He received a B.S. degree from Iowa State University and a Ph.D. in chemical engineering from MIT, and is currently an Affiliate Professor of Chemical Engineering at Iowa State University. He is also working with Dr. Robert Williams and his energy analysis group at Princeton University on coal and biomass conversion to power and liquid fuels. Over the past six years he has made several trips to India and trips to China and Japan to talk about use of coal.

## David Keith

Gordon McKay Professor of Applied Physics, School of Engineering and Applied Sciences, Harvard, and Professor of Public Policy, Harvard Kennedy School

David Keith has worked near the interface between climate science, energy technology, and public policy for 20 years. He took first prize in Canada's national physics prize exam, won MIT's prize for excellence in experimental physics, and was listed as one of TIME magazine's Heroes of the Environment 2009. David's academic appointments are at Harvard, where he

serves as the Gordon McKay Professor of Applied Physics in the School of Engineering and Applied Sciences (SEAS) and Professor of Public Policy at the Harvard Kennedy School. David divides his time between Boston and Calgary where he serves as President of Carbon Engineering, a start-up company developing industrial scale technologies for capture of CO<sub>2</sub> from ambient air.



### Jose I. Lozano

Chairman and CEO, Alianza Marketing and Media; Principal, Lozano Enterprises

Mr. Jose I. Lozano is chairman and chief executive officer of Alianza Marketing and Media, and a principal at Lozano Enterprises, a private investment firm that lends business expertise to start-up companies. In addition, Mr. Lozano serves as vice chairman and executive vice president of ImpreMedia LLC, a print media publishing company focused on the distribution of Spanish language newspaper and online news. He was instrumental in the formation of ImpreMedia, which merged Los Angeles-based *La Opinión* with New York's *El Diario/La Prensa* and brought the nation's two largest Spanish-language newspapers under one umbrella.

Before this, Mr. Lozano was chief executive officer and publisher of *La Opinión* from 1986 until 2004. Under Mr. Lozano's leadership at *La Opinión*, the newspaper refocused its editorial direction by concentrating on local issues, the newspaper was

graphically modernized and successfully launched *La Opinión Digital*, the online edition of the newspaper. As publisher of *La Opinión*, the newspaper achieved growth rates that far exceeded other newspapers and made it among the fastest growing daily newspapers in the United States.

Lozano is active in the industry and community, and has served on several boards including the Public Broadcasting System and the University of Southern California's Annenberg School for Communications, and the American Advertising Foundation board. Currently, he serves as director of the board of trustees of REI. Additionally, he serves on the board of trustees for Children's Hospital Los Angeles and The Skadden Fellowship Foundation, and he is a member of the DELS Committee.



### Richard G. Luthy

Silas H. Palmer Professor and Senior Fellow, Woods Institute for the Environment, Stanford University

Richard G. Luthy is the Silas H. Palmer Professor and Senior Fellow at the Woods Institute for the Environment at Stanford University. His area of teaching and research is environmental engineering and water quality with application to water reuse and management of contaminated sediments. His work focuses on persistent and bio-accumulative contaminants like PCBs, pesticides, and mercury, and emerging

contaminants like perfluorinated compounds. Professor Luthy is a past chair of the National Research Council's Water Science and Technology Board and he served on various NRC committees. He is a former president of the Association of Environmental Engineering and Science Professors, a registered professional engineer, and a member of the National Academy of Engineering.



**Whitney MacMillan**  
Chairman Emeritus, Cargill, Inc.

Mr. Whitney MacMillan is chairman emeritus of Cargill Inc., an international marketer, processor, and distributor of agricultural, food, financial, and industrial products and services, where he served for more than 40 years. During that period he saw the business grow from \$10 billion to \$33 billion via diversification, and he eventually led Cargill to become the largest privately held company in the world.

Mr. MacMillan pursues his interests in international agricultural policy, feeding the world's population, and economic growth and stability in developing countries. An executive fellow and teacher of corporate strategy at the University of St. Thomas Graduate School of Business in Minnesota, Mr. MacMillan lectures on investment issues as they relate to corruption and the rule of law.

From 1997 to 1998, Mr. MacMillan was one of two co-chairs reviewing sixteen international agriculture research centers for The World Bank. He also chaired the Investment Services



Policy Advisory Committee, during which time the committee wrote the investment sections for both the United States–Canada Free Trade Agreement and later for the North American Free Trade Agreement.

Mr. MacMillan is a director of numerous international organizations, including Winrock International, the Rural Development Institute, The American Assembly, The Trilateral Commission, the East-West Institute, and the Hubert H. Humphrey Institute of Public Affairs. He received a B.A. from Yale University. Mr. MacMillan serves on the DELS Committee.



**Davis Masten**  
Chair, President's Circle of the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine and the National Research Council; Distinguished Visiting Scholar, Media X, Stanford University.

Mr. Davis Masten is chair of the President's Circle of the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine and the National Research Council; is a Distinguished

Visiting Scholar to the Media X program at Stanford University; and advises the graduate design program at the California College of the Arts. He also serves on the DELS Committee.

Previously, Mr. Masten was a principal at Cheskin Associates. He first joined Cheskin in 1975, working closely with founder and market research pioneer Louis Cheskin. For more than 25 years, Mr. Masten has applied his expertise to projects in retail, packaging, interactive environments, corporate positioning, branding and industrial design. During his time at Cheskin, Mr. Masten

created customer-inspired breakthroughs for leading companies ranging from Pepsi and Hershey Foods to Microsoft and HP.

Mr. Masten has served on the board of Mattson & Co., the top U.S. food and beverage development company run by

TEDizen Steve Gundrum, and has advised Carena, Ooga Labs and Affinity Labs as an investor. He is a founding team member of Medpedia and has served on the boards of the Children's Discovery Museum of San Jose and TRUSTe.

### Anthony Michaels

Managing Director, Proteus Environmental Technologies, LLC; Chief Science Advisor, Pegasus Capital Advisors

Anthony (Tony) Michaels is co-founder and managing director of Proteus Environmental Technologies and chief scientist at Pegasus Capital Advisors. Proteus creates economic value through novel connections between business opportunities and universities. In partnership with Pegasus Capital Advisors, it has a hybrid private equity-venture capital investment strategy to find and commercialize transformative environmental technologies that solve major environmental challenges in large markets. Pegasus is a private equity investor with a very successful record for building profitable companies that are leaders in sustainability. Dr. Michaels also advises large and small companies on corporate sustainability and access to new environmental markets. Proteus creates and manages a portfolio of companies with environmental technologies in renewable energy, sustainable seafood and clean water.

Before entering business in 2008, Dr. Michaels had an academic career in environmental and ocean sciences. In 1996 he was

the founding director of the University of Southern California Wrigley Institute for Environmental Studies. The Wrigley Institute is an interdisciplinary home for environmental scholarship

across the University and works to make that research relevant, usable, and understandable to decision-makers in society, business, and governments. Among his many board positions, Dr. Michaels has been chair of the Council of Environmental Deans and Directors, the Catalina Island Conservancy, and the National Science Foundation's Advisory Committee on Environmental Research and Education. He is on the board for the National Council for Science and the Environment and the Global Institute on Sustainability at Arizona State University. Dr. Michaels was educated at the University of California, San Diego, the University of Arizona (B.S., M.S.) and the University of California, Santa Cruz (Ph.D.). In the past 20 years he has published 100 scholarly papers.



### Jeffrey Mosher

Executive Director, National Water Research Institute

Jeff Mosher is executive director of the National Water Research Institute, a public-private partnership in Fountain Valley, California, with the mission of creating new sources of water through research and technology and protecting the freshwater and marine environments. Among his other responsibilities, Mr. Mosher manages the Institute's research program and communicates the results of research to the water community and public.

Mr. Mosher has worked in the water industry for more than 18 years. Prior to joining NWRI, he spent three years with the WateReuse Foundation, an educational, nonprofit organization that serves to increase awareness and understanding of recycled water and to facilitate the development of technology to improve recycling and desalination. He directed the Foundation's multi-million dollar research program and was also Director of Technical Services for the WateReuse Association, a non-profit trade organization representing water reuse agencies.

Mr. Mosher worked for the Association of Metropolitan Water Agencies from 1999 to 2002 as Director of Technical Services,

where he spearheaded technical support for the Association, which represents large municipally owned drinking water systems. He helped establish and coordinate a national advisory committee

on water utility security prior to the September 11, 2001, terrorist attacks on the United States.

Over the years, Mr. Mosher has provided scientific and technical support on a variety of water-related issues, such as human risk assessments, chemical and microbial occurrence in water, the fate and transport of contaminants in the environment, water treatment technology performance evaluations, and economic cost and benefit analyses. He worked for 10 years as an environmental consultant in water quality, regulation, and policy. In addition, he worked three years in technical services in the manufacturing industry.

Mr. Mosher received a B.S. in chemistry from the College of William and Mary and an M.S. in environmental engineering from George Washington University. He currently lives in Orange County, California.



## Warren R. Muir

Executive Director, Division on Earth and Life Studies, The National Academies

Warren Muir is Executive Director of the Division on Earth and Life Studies of the National Academies. Chartered by the U.S. Congress in 1863 to honor top scientists, engineers, and doctors with membership, the National Academies are a non-governmental, non-advocacy, non-profit national organization. Each year the National Academies produce hundreds of independent, expert, consensus reports on science and technology issues that have been requested and funded by federal, state, and local government programs and private foundations. The Division on Earth and Life Studies includes 12 boards that produce reports on all aspects of the environment; the life, geological, and chemical sciences and technology; agriculture; natural resources; radiation; laboratory animals; and disasters. This division oversees the many activities of the Academies related to climate change.

Dr. Muir received his B.A. from Amherst College. He was awarded M.S. and Ph.D. degrees in Chemistry from Northwestern University. He has postdoctoral training in epidemiology from The Johns Hopkins University.

From 1971-77, he was Senior Staff Member for Environmental Health for the Executive Office of the President, Council on Environmental Quality. Dr. Muir served at the U.S. Environmental Protection Agency from 1977 to 1981, first as Deputy Assistant Administrator for Testing and

Evaluation and then as Director of the Office of Toxic Substances.

From 1981 until he joined the staff of the Academies in 1999, he was President of the Hampshire Research Institute and of

Hampshire Research Associates, Inc. and was principal investigator and/or author on many studies on risk assessment, pollution prevention, toxic chemicals in commerce, and environmental data. During that time he also was a member of the adjunct faculty of The Johns Hopkins School of Hygiene and Public Health. Prior to joining the staff of the National Research Council, Dr. Muir chaired two NRC committees and was a member of three others.

In 2003, Dr. Muir received the National Academies Community Service Award. In 1992, HRH Queen Elizabeth conferred upon him the title Officer Brother (O.St.J.) and in 1996 the rank of Commander (C.St.J.) in The Most Venerable Order of St. John of Jerusalem. In 1992 he was part of a team that won the U.S. Environmental Protection Agency Administrator's Award for Pollution Prevention and the US EPA Region 2 Pollution Prevention Award. Dr. Muir received the USEPA Outstanding Service Award in 1980. Dr. Muir is chair of the board of HasNa, a U.S. non-profit friendship/peace organization active in Northern Ireland, Cyprus, and Turkey. He is also chair and executive director of the Cyprus Friendship Program.





**Philip Needleman**  
Interim President,  
Danforth Plant Science  
Center; Scientific  
Partner, Prospect  
Venture Partners

Dr. Philip Needleman is interim president of the Danforth Plant Science Center and scientific partner with Prospect Venture Partners. Previous roles include chairman of research and development of Pharmacia, chief scientific officer of Pharmacia Corporation, chief scientist at Monsanto, president of Searle Pharmaceutical Company, and chairman of the department of pharmacology at Washington University in St. Louis.

Dr. Needleman has garnered numerous honors and awards including the Research Achievement Award from the American Heart Association (1988), Washington University's Distinguished Faculty Award (1987), the Industrial Research Institute

Medal (2001), and the NASA Award for the Industrial Application of Science (2005). In 1987, Dr. Needleman was elected to the National Academy of Science.

Dr. Needleman is a member of Washington University board of trustees, the Barnes-Jewish Hospital board, Saint Louis Science Center and the Plant and the Coalition of Plant & Life Sciences. In 2002, he was appointed special Advisor to the president for Research and Development at Ben-Gurion University of the Negev, and has joined the University's Advisory committee for the creation of a National Institute for Biotechnology.

Dr. Needleman received his B.S. in pharmacy and M.S. in pharmacology from the Philadelphia College of Pharmacy and Science, his Ph.D. in pharmacology from the University of Maryland Medical School, and was a postdoctoral fellow at Washington University Medical School.

### Franklin M. Orr, Jr.

Keelen and Carlton Beal Professor in Petroleum Engineering, Department of Energy Resources Engineering, and Director, Precourt Institute for Energy, Stanford University

Lynn Orr is the Keelen and Carlton Beal Professor in Petroleum Engineering in the Department of Energy Resources Engineering and director of the Precourt Institute for Energy at Stanford University. He served as dean of the School of Earth Sciences from 1994 to 2002 and as director of the Global Climate and Energy Project from 2002 to 2008. He joined Stanford in 1985. Previously, he was employed by the

U.S. Environmental Protection Agency in Washington, D.C., Shell Development Company in Houston, and the New Mexico Institute of Mining and Technology in Socorro. He holds a Ph.D. from the University of Minnesota and a B.S. from Stanford University, both in Chemical Engineering. He is a member of the National Academy of Engineering and the Board of Directors of the Monterey Bay Aquarium Research Institute.



## Stephen D. Parker

Director, Water Science and Technology Board, Division on Earth & Life Studies  
National Research Council

Stephen D. Parker, Director of the Water Science and Technology board, has been with the National Research Council since 1982, when he was hired to help found the Water Science and Technology Board. He has been director (now senior director) of WSTB since its creation and over the years has also held concurrent part-time positions with the NRC, including director of the Board on Natural Disasters, associate director of the Commission on Geosciences, Environment, and Resources, and (currently) RSO/Scholar on a cross-Academies study designed to assess and help improve risk-based decisions at the Department of Homeland Security. With the WSTB, Mr. Parker is responsible for study programs in a broad range of water related and natural resources topics, such as aquatic ecology and restoration; ground water science, technology, and management; hydrologic science; water quality and water resources management; pollution control; drinking water systems, and other related topics. Some recent, selected publications on which he did principal NRC staff work include *Envisioning the Agenda for Water Resources Research in the Twenty-first Century*, *Inland Navigation System Planning: The Upper Mississippi River-Illinois Waterway*, *Investigating Groundwater Systems on Regional and National*

*Scales, and Hydrologic Science Priorities for the U.S. Global Change Research Program: An Initial Assessment*. Parker was educated in hydrology and civil engineering at the University of New

Hampshire; his technical expertise lies principally in hydrologic engineering and water resources systems analysis. Prior to joining the NRC in 1982, he was in charge of river basin planning studies at the Federal Energy Regulatory Commission (1979-82). From 1972-79, he was with the New England Division of the Army Corps of Engineers, where he reached the level of chief of hydrologic engineering; the focus of his technical work included water quality, flood and drought, and hydropower system studies. From 1970-72, Parker was employed by Anderson-Nichols consulting engineers in Boston where he worked on water supply oriented projects. In 1969-70, Mr. Parker served in the U.S. Navy in Vietnam, where he commanded a river patrol boat. He is a certified Professional Hydrologist, a member of the research advisory board of the National Water Research Institute, and active as a member of the American Institute of Hydrology and American Water Resources Association.



### Keegan Sawyer

Associate Program Officer, Board on Life Sciences, National Research Council

Dr. Keegan Sawyer is an Associate Program Officer with the Board on Life Sciences at the National Research Council of the National Academy of Sciences. Dr. Sawyer joined the NRC in 2008 and has worked on a variety of projects in environmental health and life sciences. She currently serves as a co-lead for the Standing Committee on Emerging Science for Environmental Health Decisions, which fosters discussion about the impact of new and emerging scientific findings and approaches in such fields as epigenetics, computational toxicology, and exposure science on public health decisions. Dr. Sawyer is also involved in projects related to convergence of chemical and biological sciences and issues surrounding public engagement in the life sciences. Immediately prior to BLS, Dr. Sawyer served as an associate program officer for the Board on Environmental Studies and Toxicology. For that Board, she was the project director for the Committee on Acute Exposure Guideline Levels (AEGLS)

which provides technical advice to Environmental Protection Agency on the development of public exposure limits for hazardous



airborne chemicals. She also assisted with several of the Board's projects that led to the reports titled *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use* (2009), *Acute Exposure Guideline Levels for Selected Airborne Chemicals: Volume 9* (2010) and *Volume 10* (2011), and *Review of the Environmental Protection Agency's Draft IRIS Assessment of Tetrachloroethylene* (2010). Before coming to the National Research Council, Dr. Sawyer worked at the University of California, Davis and the California Department of Fish and Game conducting aquatic biomonitoring of California waterways. She received her B.S. in Environmental Biology from the University of California, Davis (1999) and her MS (2002) and Ph.D. (2008) in Public Health from the University of North Carolina, Chapel Hill.

### Elton B. Sherwin

Senior Managing Director, Ridgewood Capital; Author

Mr. Elton B. Sherwin is senior managing director at Ridgewood Capital, part of The Ridgewood Companies, a leading private equity firm with offices in Ridgewood, New Jersey; Palo Alto, California; and Houston, Texas. For more than 27 years, the Ridgewood Companies have sponsored investment programs that have raised over

\$2.6 billion for investments in oil & gas exploration and production, renewable electric power generation and infrastructure projects, information technology and most recently, energy technologies. In addition, Mr. Sherwin is the author of the book *Addicted to Energy – How to Save our Economy and Our Climate*.

Prior to founding the Ridgewood Capital Palo Alto office in 1999, Mr. Sherwin established the West Coast office of Motorola Ventures. During his tenure at Motorola, he

led investments in Online Anywhere (sold to Yahoo!) and in SnapTrack (sold to Qualcomm). Earlier in his career, Mr. Sherwin spent twenty years at IBM and Motorola where the products he developed won numerous awards. The U.S. Patent Office has granted him eight patents.

Mr. Sherwin's first book, *The Silicon Valley Way*, is used by entrepreneurs and university

programs around the world. He is an occasional guest speaker on energy policy and entrepreneurship at Stanford University.

Mr. Sherwin is a member of the board of directors of Peregrine Semiconductors, Scintera Networks, Ethertronics, NRG Dynamix, Pixim, and Atempo. Elton received a B.A. from the University of California at Berkeley.

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### James Irvine Swinden

Vice-President, Joan Irvine Smith and Athalie Richard Clarke Foundation

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### Gregory H. Symmes

Deputy Executive Director, Division on Earth and Life Studies, National Research Council

Gregory H. Symmes serves as deputy executive director of the National Research Council's Division on Earth and Life Studies. Dr. Symmes helps oversee NRC programs in the broad areas of geosciences, life sciences, chemical sciences, and the environment, as well as subjects such as climate change, nuclear and radiation studies, laboratory animal research, ocean studies, water resources, and disaster response. He has directed NRC programs and studies on a wide range of science and technology policy issues, including climate change; science and technology needs for the Department of Energy's radioactive waste

management efforts; science and technology for sustainability; the environmental impacts of hardrock mining; competitive research within the U.S.

Department of Agriculture; and scientific peer review. Before joining the NRC in 1995, Dr. Symmes served as a research assistant professor and postdoctoral associate in the Department of Earth and Space Sciences at the State University of New York at Stony Brook. He received his Ph.D. in geology from the Johns Hopkins University and his B.A. summa cum laude in geology from Amherst College.

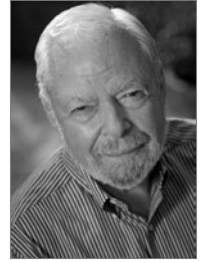


### George Tchobanoglous

Professor Emeritus, Department of Civil and Environmental Engineering, University of California, Davis

For over 35 years, George Tchobanoglous taught courses on water and wastewater treatment and solid waste management at the University of California, Davis, where he is professor emeritus in the Department of Civil and Environmental Engineering. He has authored or co-authored over 475 publications, including 22 textbooks and engineering reference books. His textbooks have been used extensively in universities worldwide both in English and in translation. In 2003, he received the Clarke Prize

from the National Water Research Institute. In 2004, he was inducted into the National Academy of Engineering. In 2005, he received an Honorary Doctor of Engineering degree from the Colorado School of Mines. He received a B.S. in Civil Engineering from the University of the Pacific, an M.S. in Sanitary Engineering from the University of California, Berkeley, and a Ph.D. in Environmental Engineering from Stanford University.



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