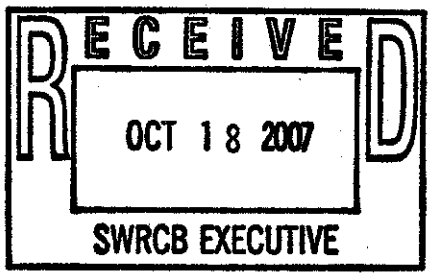
12/4/07 Bd. Mtg.
Water Recycling Policy
Deadline: 10/26/07 by Noon

From: Edo McGowan <edo_mcgowan@hotmail.com>
To: <commentletters@waterboards.ca.gov>, Elizabeth Erickson <eerickson@waterboards.ca.gov>, <woody.maxwell@venturausd.org>
Date: Thu, Oct 18, 2007 7:53 AM
Subject: Comments on Recycled water policy



To: Ms Jeanine Townsend
State of California, Water resources Control Board
Fm: Dr Edo McGowan
3152 Via Real
Carpinteria, CA 93013---(805) 684-4828

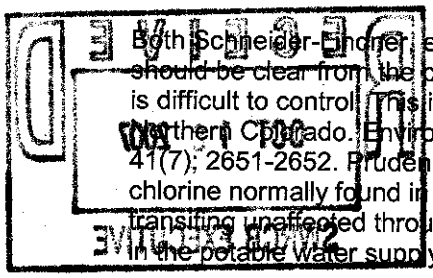
Re: Comments on Proposed Statewide Policy for Water Recycling. Antimicrobial Drugs and Community-acquired Methicillin-Resistant Staphlococcus aureus; the need for a full EIR.

I am commenting as an expert. Your environmental analysis, as contained within the staff report attached to the policy, is deficient. There is ample evidence that the pathogens and genetic material, as well as pharmaceuticals, and toxic materials contained within recycled/reclaimed wastewater have the potential to significantly adversely impact the environment and public health of the citizens of this state. I will amplify this comment at a later date. Additionally the application of recycled water and incidental runoff of recycled/reclaimed water can alter the biodiversity of soil and aquatic biota as well as wildlife. According to CEQA, if there is a disagreement among expert opinion, as supported by facts over the significance of effects on the environment, the lead agency is required to treat those effects as significant and prepare an EIR. Your staff had not included information on the impacts noted below. My credentials are attached. I am on a national WERF/EPA scientific panel looking at antibiotic resistance and pathogens, including human health impacts from sewage byproducts. The rest of my qualifications will be noted in the attached CV.

Sewage carries numerous pathogens, many of which are resistant to antibiotics, as well as other materials that impact the terrestrial and aquatic environments. Many of these constituents are not successfully removed using criteria found within Title 22. Studies dating back at least 2 decades have demonstrated that sewage treatment intensifies the development of antibiotic resistance [see for example-- Nakamura S, Shirota H. Behavior of drug resistant fecal coliforms and R plasmids in a wastewater treatment plant] Nippon Koshu Eisei Zasshi 1990 Feb;37(2):83-90]. Recycled water has been shown to carry antibiotic resistant microorganisms, many of which are human pathogens. Within the nation's media, the recent stories and articles discussing community acquired methicillin resistant Staphylococcus aureus (CA MRSA) indicate that antibiotic resistance pathogens kill more people than AIDS. Interestingly, MRSA was detected in the United Kingdom in 1961, and only months after methicillin introduction. Since then, MRSA has become a common cause of nosocomial infections worldwide. In 1993, MRSA infections emerging in the community were reported, i.e., CA MRSA. Since then, the evolution of MRSA has reached critical levels. The World Health Organization considers this a Global crisis.

The topic of resistant pathogens and transferred genetic information conferring antimicrobial (antibiotic) resistance to terrestrial and aquatic reservoirs, and subsequent impacts on man and his animals, hence wildlife has not been discussed by your staff as such relates to recycled or reclaimed wastewater. The impacts of antibiotic (drug) resistance on public and animal health can not be contested, but as a subjects are completely missing from any discussion by your board. Recycled wastewater produced under Title 22 does contain antibiotic resistant bacteria and other pathogens. The content of multiple pathogens within recycled/reclaimed water was confirmed in the WERF study by Rose, et al (2004). I find it difficult to comprehend how your staff has apparently failed to do an adequate literature review on this subject. Presumably, during a well-designed CEQA review, this material would have shown up. The fact that it has not does not bode well for the capacity of your staff and its ability to conduct a comprehensive analysis of the potential impacts of your proposed policy on public and environmental health. Thus how is this absence of information likely to affect your policy decisions? Your Board is charged with protecting public health and the environment. Your policy development, because in the main, you are a board of

laypersons, is highly dependent upon input from your staff. Policy can be easily shaped by what is NOT presented to decision-makers.



Both Schneider-Lindner, et al and Morse & Jackson, from different perspectives discuss resistance. It should be clear from the paper by Morse & Jackson (see below) that resistance once in reclaimed water, is difficult to control. This is amplified by the work of Pruden, et al--- Emerging Contaminants: Studies in Northern Colorado. Environ. Sci. Technol.; (Article); 2006; 40(23); 7445-7450 and comments, ES&T 2007; 41(7); 2651-2652. Pruden discusses resistant genetic material and its capacity to withstand levels of chlorine normally found in both wastewater and drinking water. Thus her group found this genetic material transiting unaffected through sewage treatment, then into and through drinking water treatment to end up in the potable water supply. That genetic information is thus available to the gut bacteria.

Biofilms can also develop within the downstream portions of an equipment train and continue to shed. This type of an issue has plagued dental offices. There are numerous reports on dental-unit water systems (DUWS) that harbor bacterial biofilms, which may serve as a haven for pathogens. Biofilms have also been established in hospital distillation units that were designed to produce sterile water for intravenous fluids. We recently ran some presumably sterile water from two pharmacies, water originating from the city's potable supply. This was presumed to have been sterilized and was used for mixing medications. It contained bacteria that were resistant to all antibiotics within our Kirby-Bauer suite except neomycin.

Thus even with fairly sophisticated systems, as noted in the Morse & Jackson paper, antibiotic resistance proves to be a problem in recycled/reclaimed water. Based on recent microbiology tests here in Santa Barbara, the state's Title 22 recycled/reclaimed water which is used for irrigation of parks and other city areas, including golf courses, does contain multi-drug resistant bacteria. In our test of this water, we also noted secondary growth at about two days within the clear areas on the Muller-Hinton plates. These clear areas were formerly too hot for bacterial growth. Thus we suspect that what we were seeing was resuscitation of viable but non-culturable (VBNC) resistant bacteria. Such cases are not part and parcel of Title 22 tests but represent a nidus to initiate genetic transfer.

The paper by Schneider-Lindner discusses the enhanced risk of acquiring MRSA when there is a history of antibiotic use. Sjolund et al. (2005) [Emerging Infectious Diseases (Vol. 11, # 9, Sept 2005 @ p. 1389 et seq] indicated that resistance in the normal flora, which may last up to four-years, might contribute to increased resistance in higher-grade pathogens through interspecies transfer.

Sjolund et al go on to note that since populations of the normal biota are large, this affords the chance for multiple and different resistant variants to develop. This thus enhances the risk for spread to populations of pathogens. Furthermore, there is crossed resistance. For example, vancomycin resistance may be maintained by using macrolides. Erythromycin is one such macrolide, is poorly controlled by sewage processing and, as discussed by Chad Kinney (see below), gets through in recycled water into the soil. There it may augment resistance in soil bacteria.

One wonders if the advancing trend in resistance noted by Schneider-Lindner, et al might not be augmented by common cultural practices found in many communities, such as using recycled/reclaimed water for irrigation? The growing need to conserve drinking water sees a rapid advancement in the use of recycled/reclaimed water.

In California, Title 22 recycled/reclaimed water is produced under a specified set of criteria established by the state's Department of Health Services, but the bulk of the studies were done circa 1977. There has been a lot of new science since that period and much of it is not reflected within the standards. Nonetheless, the criteria developed for Title 22 are applicable to processes for the entire state. Thus, if multi-antibiotic resistance is found in one system (Santa Barbara), it should be easily noted in others using the same criteria. VBNC states rapidly recover and thus lab tests used by Title 22, which do not test for VBNC, have been shown to vastly under report actual numbers. This under reporting is by several magnitudes.

The indicators used in this process are vegetative bacteria easily killed by low-level disinfection, yet the

standards do allow a certain number to remain. This strategy completely ignores the fact that more robust pathogens, those that would require high-level disinfection such as required for semi-critical medical devices, will survive and probably in greater numbers. Thus any assurance that this water is safe by using low-level disinfection susceptible indicators needs serious review. This deficiency was commented upon by Rose, et al. in the WERF report on reclaimed water (2004).

Additionally, because the issue of viable but non-culturable bacteria is not recognized by Title 22, and with rapid regrowth of the VBNC bacteria, one can see how a community might be sprinkling quite a bit of antibiotic resistance around the town through the use of recycled/reclaimed water. How much of this may have been a part of the backdrop for the levels found by Schneider-Lindner? A further confounder in this is found in the drift of pathogens noted from sprinkler irrigated systems. There are numerous papers on drift of pathogens related to sprinkler irrigation. For an analysis on aerosol drift see also Review of Aerosol Transmission of Influenza A Virus by Raymond Tellier in CDC's EID.

Irrigation with most recycled/reclaimed water is conducted at night. In the summer months, most people leave windows open during this period, thus drift into homes with sleeping occupants is likely. Rusin and Gerba looked at the transfer of pathogens from common household objects to finger to mouth. Drift from sprinkler systems into homes and onto surfaces thus warrants consideration. The distances attainable by aerosol drift are impressive, and as an aside thought, this allows a recycled/reclaimed water stem to be weaponized (see for example CDC's EID-- Potential Biological Weapons Threats Mark G. Kortepeter and Gerald W. Parker)

Additionally, because of its nutrient levels, astonishingly high levels of bacteria within biofilms will grow in the delivery pipes, easily exceeding 10/9th CFU/sg cm/individual types of bacteria. These biofilms shed and thus what may show as acceptable levels one day may be completely out of compliance on another when the biofilm is disrupted. This issue has plagued tracking of Legionella, which are easily established within pipes carrying nutrient rich recycled/reclaimed water.

Now, the issue is not between health and the need to conserve water---rather it is between what is safe and what is not. Until your Board sits up and recognizes this, the problem of community acquired antibiotic resistance may continue.

Since 2002, or 2003, our teaching hospital has been making it a rule to give vancomycin before certain surgical procedures. Vancomycin, not a benign drug by any stretch of the imagination, was until recently held in reserve as the drug of last resort. Using vancomycin in this way may carry resistance to the sewers and thus contribute to advancing levels of drug resistant pathogens within a community. Its use as a routine prophylactic will see more rapid development of resistance and flushing it to sewers will see it picked up and redistributed via recycled/reclaimed water back into the community's environment. Think we might have a revolving door?

Here is the problem. The standards in most areas are badly dated. The typical indicators used may not be reflective of what is actually there. The literature is very clear---coliform counts are not necessarily reflective of the public health risks.

I am suggesting that a scientifically valid review be undertaken. The state's DHS, or what ever it is currently called, should seek the help of the CDC which, with the assistance of EPA and USGS, have the capacity to undertake such an analysis. The results should be made available for review. This should be accomplished prior to adopting any new policy on recycled/reclaimed water, especially if that policy promotes incidental runoff and in essence, a policy that further deteriorates the current controls over recycled/reclaimed water. Because of the policy's allowance for down-playing incidental runoff, the impacts on distant terrestrial and aquatic species must be included. These niches may represent lending libraries for pathogens and genetic material, including genetic shifts, as well as potentially showing cumulative adverse impacts on biodiversity. None of this is considered in the staff's environmental review. There is basically nothing wrong with the use of recycled/reclaimed wastewater if it is properly treated. The operative word and issue at hand is PROPERLY. Current standards appear not to be protective.
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Antibiotic Resistance in two Water Reclamation Systems for Space Applications
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Abstract The purpose of this research was to evaluate the antibiotic resistance in two water reclamation systems developed from space missions. The first system is a small-scale water reclamation system operated at Johnson Space Center designed to reclaim wastewater during long-term space missions. The second system was a scaled-down version of the Johnson Space Center system operated at Texas Tech University. Antibiotic resistance patterns to 10 antibiotics were investigated before and after controlled doses of amoxicillin were added to the water reclamation systems. The results of this study indicate that bacteria in all systems were resistant to many antibiotics including beta-lactam antibiotics and a beta-lactam, beta-lactamase inhibitor combination, amoxicillin with clavulanic acid.
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Audra Morse1 ContactOfAuthor1ContactOfAuthor1and Andrew Jackson1
(1) Department of Civil Engineering, Texas Tech University, Lubbock, Texas 79409-1023, USA
Abstract The overall objective of this research was to determine the fate of amoxicillin in two wastewater reclamation systems containing biological and physical/chemical treatment processes. The results of this study indicate that amoxicillin is easily removed in a biological wastewater treatment system (< 0.05) in the midreaches of an industrially perturbed stream, but no such pattern was apparent in an undisturbed reference stream. The highest relative frequency of resistance was found at the confluence of a tributary draining a nuclear reactor and industrial complex. Antibiotic resistance increased with distance upstream from the confluence and was positively correlated (r2 = 0.54, P = 0.023) with mercury concentrations in the sediments. When the data for two years were compared, this pattern was stable for streptomycin resistance (paired t test, P < 0.05) but not for kanamycin resistance (P> 0.05). Our results imply that heavy metal pollution may contribute to increased antibiotic resistance through indirect selection.

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COMPREHENSIVE RESUME

Edward McGowan

Ph.D. In international water resources, Degree in Medicine-- Keck School of Medicine, USC. Medical licenses with States of Arizona, California, and Texas with board certification in Primary Care and Surgery, subspecialty in dermatology and tissue regeneration research with hyperbaric oxygen.

Current Specialty: Medical Geo-Hydrology --Environmental Medicine and Emerging Infectious Disease---

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MEDICAL GEO-HYDROLOGY is defined as the science dealing with man-made wastes and their interaction with geological and hydrological factors including the consequent effects on the health of man, animals and the environment. Medical Geo-hydrology is therefore a broad and complicated subject requiring interdisciplinary contributions from numerous scientific fields.

CAPACITY: Forty-years' experience in development and direction of local, regional, and international programs relating to health aspects of water quality, vector control, the analyses and disposal of hazardous materials, and the use of water as a weapon of mass destruction.

Program/policy development included law and its machinery pertaining to environmental health aspects of hazardous waste and toxic materials. Key Qualifications: Presented and defended agency positions before US Federal, state and UN bodies. Negotiated with and advised domestic and foreign governments as well as domestic banks, official banks, and bilateral lenders. Prepared, presented, or commented upon issues for technical, fiscal, and policy committees. Drafted environmental law for several African nations.

Advisory panels: National Academies NRC, Library of Congress, and the UN.

Dr. McGowan is computer-literate, has worked with GIS, has excellent investigative, report writing and presentation skills, and superior cross-cultural communication and team-working skills.

Examples of accomplishments: 1) Established concept, design criteria and conducted environmental review--national toxicants disposal in The Sudan and Somalia for USAID. 2) Initiated the national toxic materials monitoring system for Ethiopia as consultant to the World Bank. Document became new paradigm for USAID Country-wide

Environmental Profiles 3) Updated and rewrote the Ventura County Regional Water Quality Management Program under Section 208 of the US Clean Water Act; 4) Drafted the guidelines leading to national environmental standards for Uganda under a World Bank program. 5) Experience in the clean up on Superfund sites in Ventura and Kern Counties. 6) Prepared several Phase 1 assessments for regional lenders and developers. 7) Letters of patent—toxic materials handling equipment. 8) Reports to government highly instrumental in establishing predecessor to Cal EPA. 9) Program design as well as technical and policy evaluations of vector, locust, and malaria control programs for Botswana, Burundi, Djibouti, Eritrea, Ethiopia, The Gambia, Kenya, Indian Ocean States, Lesotho, Madagascar, Mauritius, Mozambique, Pemba, Rwanda, Senegal, Seychelles, Somalia, Sudan, Swaziland, Tanzania, Uganda, Zambia, Zanzibar, Zimbabwe.

EXPERIENCE, in Toxic Materials: United States-Federal level: a) USEPA task force Region 9 pesticide pollution studies, b) USDA/USFS Toxic materials analyses and contamination site review, including abandoned mine sites for the 1.7 million acre Los Padres National Forest. c) National Institute of Health studies on pesticide toxicity related to disposal, d) US Patent for toxic materials transfer equipment. State Level: a) Team leader for University of California studies and grants related to toxicology, b) Author of major studies prepared for the Office of the California Legislative Analyst including pesticides, regional planning including the San Francisco Bay Conservation and Development Commission and Tahoe Regional Planning Agency Area, animal health, and dairy cattle. c) Member of Director's Pesticide Advisory Committee of California Department of Food and Agriculture. Local level: a) Water Quality Planner for Section 208 of US Clean Water Act, Ventura County including its rewrite, b) Author of the Santa Barbara County Right to Know guidelines pertaining to hazardous materials and toxic waste, c) Several Phase 1 Environmental Reviews for lending industry. Appointed to board of Sacramento/Yolo Mosquito Abatement District.

International—

Bali: For U.S. Consulate, analysis of potential public health issues arising from municipal expansion and sewage disposal over shallow groundwater.
Ethiopia: Co-team leader & environmental scientist on World Bank review of Ethiopia's nation-wide rural and agricultural expansion. Preparation of Bank's environmental document, EIA for USAID under NEPA, and authored the Country-wide Environmental Profile (CEP). Last document was duplicated and distributed to all USAID missions as new paradigm. Successfully argued before Government of Ethiopia, the need for its national toxicants monitoring system and public health monitoring.
The Gambia: As UC international faculty, under UC Santa Cruz contract with USAID, undertook analysis of river-basin development of the Gambia River. Analyzed health and economic effects of proposed development and effect on near-shore marine environment from pollution and sewage arising from West African watersheds. Analysis of program impacts on waterborne disease, sanitation, and vector control programs. Provided guidance to the University of California for its program of training medical mid-level clinicians in Senegal, The Gambia, and in three other African nations. Authored

the Country-wide Environmental Program (CEP), a nation-wide equivalent of an EIR, for The Gambia, and published on water quality, waterborne disease, and fisheries.
Somalia: Mission Environmental Officer and de facto Health Officer for opening of new USAID Mission following Russian withdrawal in the 1970s. Development of toxic materials clean-up program for entire country. Analyzed river-basin development schemes as well as regional groundwater development and borehole programs. Developed, designed, and evaluated refugee settlements and designed pilot refugee housing programs. Prepared all environmental documents during tenure, including the nation's primary health care delivery project. Analysis of serum-vaccine lab proposal and camel cold-chain vaccine transport program. Reviewed national primary health care and training programs and wrote rural primary health care delivery program for nation. Reviewed and designed programs for vector control and water-borne diseases, their programs and staff training. Authored CEP and analysis of diminishing biodiversity.
Uganda: Assisted nation with establishment of its law and policy for development of the Uganda National Environmental Standards in: water resources/quality, soils and soil erosion, biodiversity, air resources/quality, and issues relating to medical waste. Issues included expansion of public health programs including those for sewage disposal.

FOREIGN SERVICE RESERVE OFFICER: USAID'S REGIONAL ECONOMIC DEVELOPMENT SUPPORT OFFICE AS REGIONAL ENVIRONMENTAL OFFICER FOR EASTERN AND SOUTHERN AFRICA, an area encompassing 22 African nations. As Environmental Advisor to the Department of State's regional office in Nairobi and U.S Rep to UNEP, I looked at numerous programs and was involved in high-level UN meetings on the World's environmental issues.

Botswana Soil and water resources: Appraisal of transboundary, technical, policy, and institutional constraints affecting the nation's rivers and ground water resources, food security, municipal and industrial pollution, and its agriculture development. Authored two papers on subjects of transboundary water issues and soils as integral parts of the nation's Five-year National Development Plan.
Burundi Lake Tanganyika: Industrial and agricultural pollution - risk of species extinction; analysis and policy development, analysis of agricultural pesticides use, storage, and intrabasin pollution and drainage. Presentation of papers at the *Symposium on Resource Use and Conservation of the African Great Lakes*, held in Bujumbura, Burundi, in 1989.
Comoros Agroforestry: Movement of pesticides in soils and natural resource pathways. Integration of activities affecting complicated, island watershed hydrology.
Djibouti :Regional fertilizer and agricultural chemicals policy for the Inter- Governmental Authority of Drought and Development, with recommendations for basin-wide analysis.
Kenya: Country-wide agricultural and rural market infrastructure development. Scope of work (SOW) for major agricultural chemicals control and training program. Private Voluntary Organizations' (PVO) water projects: technical public health and environmental analysis of ground water development for project supplying 140 boreholes. Analysis of farm chemicals and urban run-off transport in the interbasin and near shore environments.

Madagascar. Environmental Impact Analysis of country's research program. Impact of nation's rice practices on currently degrading environment and rise of vector borne and water-borne disease with consequent impact on public health. Analysis for development of farm roads into pristine remaining natural areas with subsequent soil erosion and impact on fragile biodiversity. Analysis of off- gassing from degrading rice fields and effect on global climate.
Malawi: Impact of toxic materials transport across African basin lake from development of three ports. Risk analysis of major upset on Basin Lakes. **Mauritius**: Industrial Park for Heavy Polluters. Technical feasibility and environmental analyses for industrial waste water treatment systems. Produced SOW for island's multi-project and water quality management plan and sewage.
Mozambique: Private sector mechanized agriculture. Analysis of commodity import program and subsequent toxicants transport with impact on nation's natural aquatic/near-shore resources and public health.
Rwanda: Development of environmental and policy analysis and national watershed design and policy for expansion of agriculture in areas of high relief and geological instability. Discussion of fisheries and transport of toxic materials in national and transboundary waterways.
Somalia: Toxic materials disposal, Jubba Dam Project, final evaluation of JESS/JUDAS dam/agricultural expansion, refugee resettlement and public health issues. Several smaller projects relating to failing septic tank fields, health, and wildlife.
The Sudan: Drafted national toxic materials destruction and disposal program and analysis of potential for toxicant transport in deep geologic fracture fabric and consequent impact on ground water. Evaluation of Desert Locust Pesticide Program.
Swaziland: Pre-feasibility analysis of nation's industrial sector development and impact on human health, complex biodiversity, and water quality. Institutional, policy, and law/machinery analyses. Author of Country Development Strategy Statement for US Congressional presentation.
Tanzania: Assessment of host country capacity for long range planning, land use planning and environmental analyses. Review of institutional training, policy constraints, and capacity to undertake rural road construction.
Zambia: Environmental impact and policy analysis of Kafue-Lasaka transport corridor improvement program. Special emphasis on potential for toxic spill and consequent movement of toxicants to Kafue sanctuary and its biodiversity. **Zanzibar**. Policy and technical analysis for continuation of malaria control program. Analysis of hospital and health capacity and policy. Review of island's groundwater pollution from industrial sources. SOW for removal and destruction of hazardous materials and disintegrating and abandoned pesticides (50 tons) stored within basement of state hospital.
Zimbabwe: Kafue River rail bridge relocation. Environmental, policy, and biodiversity analyses.

POSITIONS IN THE UNITED STATES.

BIOENGINEERING COORDINATOR. Sandia National Laboratory UCLA/Sepulveda VA Medical Center research for medical devices in tissue regeneration and wound care

with hyperbaric oxygen and capillary bed pressures. Clinical instructor in geriatric teaching hospital, Sepulveda Medical Center, following completion of fellowship.

DERMATOLOGY CLINICIAN, Kaiser Sunset Hospital, Los Angeles.

WATER QUALITY/AGRICULTURAL PLANNER. Ventura County. Among the top agricultural production areas in the US, rewrote and expanded the Section 208 Regional Water Quality Control Plan, pursuant to U.S. Clean Water Act. The 208 Plan controls and coordinates region-wide NPDES requirements and sewer district impacts to land and water. Also Chief of Staff, Ventura County Agricultural Committee.
GEOLOGIST. USDA US Forest service. Water resource analysis and toxic materials analyses of 1.7 million acre national forest. Stream habitat and fishery analyses. Road and dam construction analysis. Environmental policy analysis. **TOXIC MATERIALS SPECIALIST**. County of Santa Barbara. Author of government and industry guidance documents in toxic materials and hazardous waste for county's Right to Know under SARA Title III and other US law. Result judged to be best of California counties. Policy and institutional capacity analysis.
CHIEF TOXIC MATERIALS CONSULTANT. Land/ground water contamination analysis for local industry and regional banks.
ASSISTANT ADMINISTRATIVE ANALYST. California Legislative Analyst's Office and staff to Joint Committee on the Budget. Items included Resources Agency departments such as Agriculture and animal disease programs, Natural Resource Planning Agencies such as Lake Tahoe and the San Francisco Bay, Fish & Game. Major works published in areas of pesticide regulation and toxic materials. Other works included studies on animal health and dairy industry, including zoonotic diseases as well as general budgetary analyses of state and county programs and departments.

PROFESSIONAL LICENSES: Medical licenses with States of Arizona, California, and Texas with board certification in Primary Care and Surgery, Registered Environmental Assessor, USOPM Geologist, Agricultural Inspector, Registered Sanitarian, Registered Environmental Health Specialist, College Instructor, Clinical Instructor in Geriatrics and hospital administration, Agricultural Pest Control Advisor. FAA Pilot.

Bibliography of publications available upon request.