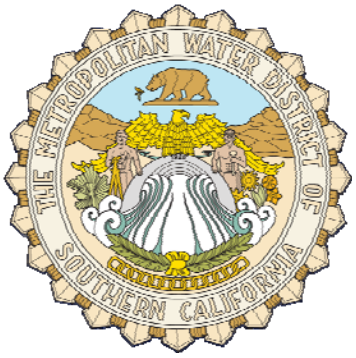

Testimony of Ric De Leon, Ph.D.
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Before the
U.S. House of Representatives
Committee on Natural Resources
Subcommittee on Water and Power

Hearing on
"The Silent Invasion: Finding Solutions to Minimize the Impacts of Invasive Quagga Mussels on Water Rates, Water Infrastructure and the Environment"

June 24, 2008

Summary of Major Points of the Testimony of Ric De Leon, Ph.D.

June 24, 2008

- Invasive zebra and quagga mussels have spread to Southwestern States in 2007 and 2008 representing the first known established populations of invasive mussels in the Western United States

- The presence and spawning of quagga mussels in the Lower Colorado River and in reservoirs located in southern California pose an immediate threat to water and power systems serving more than 25 million people in the Southwestern United States.

- The recent spread of zebra mussels into a northern California lake and a Colorado lake further indicates that if these invasive mussels are not controlled, the entire Western United States could be impacted.

- It has been estimated that zebra mussels cost the power industry $3.1 billion over the period from 1993 to 1999, while the impact on industries, businesses, and communities has exceeded $5 billion. The U.S. Fish and Wildlife Service estimates the potential economic impact at $5 billion from 2000-2010 to U.S. and Canadian water users within the Great Lakes region alone.

- The potential cost implications for the Western United States are likely to be even higher due to rapid growth and proliferation of these mussels in the extensive waterway networks of the West.

- Very rapid proliferation has been observed at Metropolitan's water intake in Lake Havasu with mussel densities at 1-2 per square meter in February 2007 to 10,000 per square meter in January 2008. The warmer water temperatures of the Southwest may be contributing to the fast increase in population density in the Lower Colorado River and infested lakes in Southern California

- Due to the risk of infrastructure colonization, Metropolitan has undertaken rapid actions for control of quagga mussels including aqueduct shutdowns, facility inspections and facility upgrades for chlorination of water entering the Colorado River aqueduct and leaving two of our water reservoirs, Lakes Mathews and Skinner which are already colonized.

- Government agencies under the Secretary of Interior have jurisdiction and expertise that are critical for an effective plan to combat invasive mussels in the West. These agencies need to provide immediate funding and resources that support a regional response to address quagga and zebra mussel infestation.

- Federal funding is urgently needed for infrastructure protection and to support research and development for more effective control of invasive mussels.

On behalf of the Metropolitan Water District of Southern California (Metropolitan), I thank Chair Napolitano and distinguished Members of the Subcommittee on Water and Power for the opportunity to appear before you this morning. My name is Ric De Leon, and I serve as the Quagga Mussel Control Program Manager for Metropolitan.

Metropolitan Background and Regional Water Supply

Metropolitan is the nation's largest provider of treated drinking water. Each day during a normal year, the district moves more than 1.5 billion gallons of water through its distribution system, delivering supplies to 26 member agencies covering a six-county service area, which encompasses 5,200 square miles in Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties. Metropolitan's member agencies then deliver to their customers a combination of local groundwater, local surface water, recycled water, and imported water purchased from Metropolitan.

Metropolitan imports water from the Colorado River and Northern California through the State Water Project. The Colorado River Aqueduct (CRA) was constructed over an eight-year period from 1933 to 1941 and expanded in 1952. The CRA is a 242 mile-long water delivery system consisting of pumping stations, canals, tunnels, siphons and reservoirs. The CRA starts at Whitsett Intake Pumping Plant at Lake Havasu where an average of 740,000 acre-feet are pumped annually for delivery into southern California. The system consists of five pumping plants (Whitsett Intake, Gene, Iron Mountain, Eagle Mountain and Hinds), 65 miles of open canals, 92 miles of tunnels (27 tunnels), 55 miles of cut-and-cover conduit, 30 miles of siphons (144 siphons) and five reservoirs (Gene Wash, Copper Basin, Lake Mathews, Lake Skinner and Diamond Valley Lake).

Today, I am here to provide testimony on the recent invasive mussel infestation in four Western States with the Lower Colorado River as the centerpiece infested waterway.

Invasive zebra and quagga mussels spread west of the 100th Meridian in 2007 and 2008. The 100th Meridian has historically been considered as the line of longitude in the United States that represented the boundary between the moist east and the arid west. The term has been adapted by the 100th Meridian Initiative which is a cooperative effort between state, provincial, and federal agencies to prevent the westward spread of zebra mussels and other aquatic nuisance species in North American. The presence and spawning of quagga mussels in the Lower Colorado River and in reservoirs located in southern California pose an immediate threat to water and power systems serving more than 25 million people in the Southwestern United States. The recent spread of zebra mussels into a northern California lake and a Colorado lake further indicates that if these invasive mussels are not controlled, the entire Western United States could be impacted.

Zebra mussels (*Dreissena polymorpha*) were introduced into the Great Lakes area of North America in the mid-1980s in the fresh-water ballast of a transoceanic ship traveling from Eastern Europe. Quagga mussels (*Dreissena bugensis*), a related species to the better-known zebra mussels and indigenous to the Ukraine, were similarly introduced to the Great Lakes in the late 1980s. Although the introduction of these two species into drinking water supplies does not typically result in violation of drinking water standards, invasive mussel infestations can adversely impact aquatic environments. If unmanaged, invasive mussel infestations have been known to severely impact the aquatic ecology of lakes and rivers; clog intakes and raw water conveyance systems; reduce the recreational and aesthetic value of lakes and beaches; alter or destroy fish habitats; and render lakes more susceptible to deleterious algae blooms. These organisms currently infest much of the Great

Lakes basin, the St. Lawrence Seaway, and much of the Mississippi River drainage system. It has been estimated that zebra mussels cost the power industry $3.1 billion over the period from 1993 to 1999, while the impact on industries, businesses, and communities has exceeded $5 billion. The U.S. Fish and Wildlife Service estimates the potential economic impact at $5 billion from 2000-2010 to U.S. and Canadian water users within the Great Lakes region alone.

The potential cost implications for the Western United States are likely to be even higher due to rapid growth and proliferation of these mussels in the extensive waterway networks of the West. Effective and decisive actions are needed from agencies within the Department of Interior to prevent invasive mussels from spreading into neighboring watersheds, waterways, and lakes in the West which will only lead to even greater economic losses, irreversible ecological impacts, and long-term costs incurred in areas already infested.

Risk in the Western United States

The presence and spawning of quagga mussels in the Lower Colorado River system from Lake Mead through Lake Havasu, other downstream locations, and in reservoirs located in southern California pose an immediate threat to water and power systems affecting more than 25 million people in the Southwestern United States. This threat is now exacerbated by the recent discovery of zebra mussels in San Justo Lake in northern California and in El Pueblo Reservoir in Colorado. Effective and decisive actions are needed from agencies within the Department of Interior to prevent the mussels from spreading into neighboring watersheds, waterways, and lakes in the west which will only lead to even greater economic losses, irreversible ecological impacts, and long-term costs incurred in areas already infested.

Bureau of Reclamation, Water and Power Infrastructure

Now that invasive mussels have moved west of the 100th Meridian, infrastructure systems of major water and power providers in five of the Bureau of Reclamation's Regions are at risk. The Lower Colorado River Region is the most impacted to date with quagga mussels infesting major water and power operations along the Lower Colorado River, including Hoover, Davis and Parker Dams. Also impacted are the Upper Colorado and the Mid-Pacific Regions with invasive mussels infesting one lake in Colorado, Lake Powell in Utah, and in one lake in northern California. The presence of mussels in these lakes presents the risk of spreading to nearby waterways, including potential spread to major water systems in California, including the State Water Project, the Central Valley Project, and aqueducts serving northern California. The Pacific Northwest Region and portions of the Great Plains Region are also at risk of invasive mussel infestation.

Water Purveyors in the West

Approximately 1,800 water systems rely on surface water from rivers and lakes west of the 100th Meridian serving 47.5 million people. These systems are potentially at risk from invasive mussel infestations and consequently may incur costs associated with their control if mussel proliferation continues in Western waterways. In addition to large aqueducts and conveyance systems that could be impacted, approximately 1,200 treatment plants operate in the Western United States and each one could potentially incur costs for facility improvements and annual maintenance. Water purveyors in the west also own and operate major aqueduct systems for the conveyance and storage of drinking water and irrigation water.

Economic Costs in the West

Total estimated costs for invasive mussels in the Eastern United States including ecological damage range from $100 to $500 million dollars per year. The cost to water conveyance, water treatment, and the power industry has been estimated at $100 million per year. The U.S. Fish and Wildlife Service estimated the potential economic impact at $5 billion from 2000 to 2010 within the Great Lakes Region alone. Annual expenditures in the East Coast increased 75-fold between 1989, the early stages of the infestation, and 1995 from a fully established infestation in the region and expansion of the mussels (O'Neill, 1997, New York Sea Grant Institute).

A 1995 National Zebra Mussel Information Clearinghouse Study indicates an average annual cost of $214,360 per water treatment facility. Given that there are approximately 1,200 water treatment facilities in the Western United States that utilize surface water, potential economic impacts to water treatment plants west of the 100th Meridian could be in excess of $250 million per year if invasive mussel spread is not controlled

Economic impacts on waterways and facilities operated by the Bureau of Reclamation in the Western States are likely to be very significant. For example, the potential economic impact for upgrades to 13 hydropower facilities in the Columbia River Basin alone have been estimated at $23.6 million with estimated chemical costs of $1.3 million per year. Over 25 million people receive water from the lower Colorado River, an area already infested by quagga mussels. While the impacts of mussel infestation on storage and conveyance facilities differ among agencies taking water from the river, based on Metropolitan's experience it is likely that these agencies will also spend significant amounts of money to minimize damage associated with quagga mussels.

Regional economic impacts are also likely to be significant. Metropolitan receives approximately 740,000-800,000 acre-feet of water per year from the Colorado River and will spend $10-15M annually in operations and maintenance costs to address quagga mussel infestation in its Colorado River Aqueduct and terminal reservoirs. Initial capital costs for design and installation of facilities for mussel control are $7.2M; however, it is anticipated that these costs will be substantially higher over the next few years. Other agencies in California treating Colorado River water include the Imperial Irrigation District (2.8M acre-feet); Coachella Valley Water District (320,000 acre-feet); and the Palo Verde Irrigation District (400,000 acre-feet). Other major users of lower Colorado River water outside of California include the Central Arizona Project (up to 2.2M acre-feet) and Southern Nevada Water Authority (300,000 acre-feet). While the impacts of mussel infestation on storage and conveyance facilities differ among agencies, based on Metropolitan's experience it is likely that these agencies will also spend significant amounts of money to minimize damage associated with quagga mussels

Currently, quagga mussels have been only detected in the southern California area; however, zebra mussels have been recently detected in northern California. While considerable effort should be made to contain the spread of these mussels, based on the experiences in the Great Lakes region the potential for widespread mussel infestation is high. The State Water Project moves approximately 3 million acre-feet a year and the Central Valley Project handles approximately 6 million acre-feet. If quagga and/or zebra mussels began to proliferate in these systems, the cost of control measures would be significant.

Metropolitan's Quagga Mussel Control Plan

Although a number of controls for invasive mussels have been reported in the literature, current drinking water and environmental regulations limit the options available for implementation. Metropolitan developed a quagga mussel control plan (QMCP) incorporating enhanced detection, surveillance, and mitigation strategies. The QMCP will be conducted in at least three phases. Phase I addressed immediate quagga mussel detection, surveillance, and mitigation strategies for the first seven months of the mussel infestation. Phase II consists of infrastructure upgrades and a comprehensive, multi-year approach for mussel management, and Phase III will address long-term needs and cost minimization strategies.

Phase I Activities

The Scope of Phase I of the QMCP consisted of: (1) Increased surveillance of Metropolitan's source water conveyance systems for adult mussels by diver and maintenance personnel inspections and detection of larvae by water sampling and analysis. Surveillance of the State Water Project (SWP) will be coordinated with the Department of Water Resources (DWR) and Metropolitan staff will encourage Fish and Game to conduct surveillance of other local lakes and reservoirs; (2) Investigative studies to assess mussel transport and settling in our conveyance systems, primarily the CRA, and development of improved detection and viability methods to assess the results of control measures. These studies are necessary to determine the type and frequency of treatment that will be needed to deter settling of mussels in critical structures and reduce further spread of mussels; (3) Vulnerability assessment of Metropolitan's raw water conveyance systems to establish a risk-based prioritization of facilities for preventive infrastructure upgrades and control measures; (4) Feasibility studies for managing recreational facilities at Diamond Valley Lake and Lake Skinner; (5) Development and implementation of control strategies for the CRA system to control the spread of mussels into our system; and (6) Studies to evaluate alternative screen designs for the intake screens at Whitsett, and the other four pumping plants along the CRA.

Phase II Activities

Interim Chlorination Systems

The presence and spawning of quagga mussels in the lower Colorado River from Lake Mead through Lake Havasu poses a threat to Metropolitan and other Colorado River water users due to the potential to continuously seed water conveyance systems with mussel larvae. Chlorination is the most frequently used means to control mussel larvae entering water systems. To date, Metropolitan has appropriated $7.2 M to upgrade chlorination facilities in the aqueduct and at two additional locations in its system, the outlets of Lakes Mathews and Skinner. It is likely that additional upgrade costs will be incurred for these facilities.

Long term permanent disinfection systems will need to be designed for control of mussels throughout Metropolitan's and other water systems in the Western United States. The use of sodium hypochlorite, chlorine dioxide, calcium hypochlorite, gaseous chlorine, potassium permanganate, and ultraviolet light will need to be considered by impacted systems for mussel control in their systems. The relative merits of each disinfectant type will need to be weighed in terms of effectiveness at mussel larvae control, regulatory limits for disinfection by-product formation, facility upgrades, storage, chemical and maintenance costs.

Isolation Barriers

Isolating portions of a water system can be used to conduct mussel control or treatments in smaller sections of a water system. Such localized treatments may include spot-chlorine or molluscicide treatments, use of low oxygen conditions and other approaches antagonistic to mussels. Hydraulic isolation barriers such as drop-gates, valves, floating bulkheads, or stop-logs may be utilized to isolate segments of a water system for treatment, potentially avoiding a complete shutdown of a water system. The installation of hydraulic isolations for control of mussels will require facility upgrades. Metropolitan has appropriated $387,000 for conceptual design of isolation barriers. Additional funds will be appropriated in the near future for design and construction.

Mobile Chlorination Equipment

Continuous chlorination of water entering the CRA at Copper Basin is essential to control the spread of mussel larvae. However, this application only inactivates free-floating larvae entering the aqueduct from Copper Basin, and due to chlorine residual dissipation, does not prevent downstream propagation of existing adult mussel populations. Although large portions of the aqueduct were dewatered and dried in two separate shutdowns to kill attached adult mussels, some siphons and tunnels could not be fully drained, given the limited time available for the shutdowns. Because attached mussels in these sections were not inactivated by desiccation they continue to propagate larvae downstream. For these difficult-to-reach areas, continuous chlorination for a two- to three-week duration becomes the most feasible control option.

Mobile chlorination equipment will provide the ability to periodically chlorinate short reaches of tunnels and siphons. The equipment will be stationed at the targeted facility to apply a controlled dosage of chlorine for two to three weeks. Exposure to chlorine has been shown to be effective for the control of adult mussels when consistently applied for 14 to 21 days. This ability to chlorinate a targeted facility for short durations (two to three weeks) using mobile chlorination equipment will enhance Metropolitan's ability to control mussel growth. Metropolitan has appropriated $450,000 to purchase mobile chlorination equipment.

Integrated Pest Management (IPM)

Integrated Pest Management (IPM) is a strategy developed by the U.S. Department of Agriculture to provide a science based decision-making process that identifies and reduces risks from pests and pest management-related strategies. While IPM was originally conceived to control food/crop-associated pests (e.g., insects), Fish and Game, U.S. Fish and Wildlife Service, and Metropolitan are collaboratively developing a similar approach that can be used to address quagga mussel infestation. Specifically, staff plans to evaluate tactical IPM control measures aimed at: (1) Changing environmental conditions in the CRA or in Metropolitan's reservoirs that will promote a suboptimal or antagonistic environment for quagga mussel attachment, growth or proliferation; (2) Identifying physical or mechanical processes to deter attachment or remove quagga mussels from surfaces; (3) Promoting the use of biological controls such as predators, parasites or diseases targeted to suppress or kill larvae or adult quagga; and (4) Applying oxidative chemical controls (i.e., chlorine) or non-oxidative controls (i.e., molluscicides). Limnological and flow pattern studies will be conducted to assess the feasibility of modifying environmental conditions such as oxygen demand, temperature, and pH to control mussels in Metropolitan's reservoirs. In addition, studies of surface treatments which may deter attachment, and of molluscicide use, will be conducted under laboratory

and field conditions. The results of these studies will be used to design infrastructure improvements for long-term management of quagga mussels.

Although IPM provides a framework for activities over several years, immediate actions will need to be prioritized in response to the progress of the infestation over time, and resources will need to be focused on the locations most affected. In addition, IPM strategies will need to be adapted to address the various components of Metropolitan's conveyance system. Based on an initial vulnerability assessment, Metropolitan's system can be divided into five separate environments for mussel colonization: (1) Whitsett Intake pumping plant; (2) Pumps and adjoining pipes at the other pumping plants; (3) Open canals; (4) Siphons and tunnels; and (5) Reservoirs. Each of these components provides a different environment for colonization by quagga mussels; thus, specific control tactics will be developed and applied accordingly.

Phase III Activities

The objective of Phase III will be to implement prioritized long-term infrastructure upgrades identified by work conducted in Phase II and optimize costs. Phase III will also incorporate, as appropriate, strategies for management of quagga mussels as identified by on-going work in Phase II and/or results from external research. It will be necessary to modify operational practices and control strategies as additional information becomes available.

Federal assistance is needed for effective control.

Government agencies such as The U.S. Bureau of Reclamation (Bureau), The U.S. Fish and Wildlife Service, The U.S. Geological Survey, and The National Park Service have jurisdiction and expertise that are critical for an effective plan to combat invasive mussels in the West. These agencies need to provide immediate funding and resources that support a regional response to address quagga and zebra mussel infestation. This funding would provide urgently needed infrastructure protection and would support research and development for more effective control of invasive mussels. In addition,

- The Federal Government should provide reimbursement for facility upgrades, chemicals, and operating equipment costs incurred by water and power systems impacted by the Colorado River quagga mussel infestation. Also, a funding mechanism needs to be developed for infrastructure upgrade grants for long-term control of invasive mussels.

- Federal research funds are needed to understand the biology of invasive mussels in the West and for the application of invasive mussel control options in western water utilities.

- Federal support is needed for a congressional earmark for the American Water Works Research Foundation (AwwaRF) in support of projects identified in the April 2008, Quagga and Zebra Mussel Control Strategies Workshop for Western U.S. Water Facilities.

- Federal funding is also needed for Colorado River Contractors to conduct research for cost-effective control of invasive mussels in large aqueduct systems with canals, multiple pumping stations and reservoirs.