

Public Hearings

**TO HEAR PUBLIC COMMENTS ON WHETHER
BODY-CONTACT RECREATION
(FOR EXAMPLE, WATER SKIING & PWC USE)
SHOULD BE ALLOWED ON THE RESERVOIR
AT THE EASTSIDE RESERVOIR PROJECT**

HEMET

WEDNESDAY EVENING, JULY 29

- ✓ 7:00 PM
- ✓ James Simpson Neighborhood Center
- ✓ Community Room
- ✓ 305 E. Devonshire Ave.
Hemet

COSTA MESA

WEDNESDAY EVENING, AUGUST 5

- ✓ 7:00 PM
- ✓ DoubleTree Hotel—Orange County Airport
- ✓ Newport Beach 2 & 3 Rooms
- ✓ 3050 Bristol St.
Costa Mesa

RANCHO BERNARDO

THURSDAY EVENING, JULY 30

- ✓ 7:00 PM
- ✓ DoubleTree Carmel Highland Resort
- ✓ Berwick A Room
- ✓ 14455 Penasquitos Dr.
Rancho Bernardo

PASADENA

THURSDAY EVENING, AUGUST 6

- ✓ 7:00 PM
- ✓ DoubleTree Hotel
Pasadena
- ✓ Plaza Room
- ✓ 191 N. Los Robles Ave.
Pasadena

- Public hearing purpose & procedures on the inside front cover of this bulletin
- Maps of the public hearing locations on the back cover of this bulletin
- *Body-Contact Recreation Feasibility Report* in this bulletin
- Information about the Eastside Reservoir Project and the Metropolitan Water District of Southern California on the inside back cover of this bulletin

PUBLIC HEARING PURPOSE & PROCEDURES

PUBLIC HEARING PURPOSE

The purpose of each hearing is to give people the opportunity to express their views to the Board of Directors of the Metropolitan Water District of Southern California on whether the Board should allow body-contact recreation on the Eastside Reservoir.

Comments are invited on public health, financial, economic, environmental, social, liability, legal, or whatever other issues people think are important to the Board's decision on body-contact recreation at the Eastside Reservoir Project.

PUBLIC HEARING PROCEDURES

- (1) A Board member will chair each hearing as hearing officer.
- (2) A legal reporter will record verbatim all oral comments made at the public hearings.
- (3) Metropolitan invites people to submit written comments at the hearings.
- (4) Metropolitan will prepare a summary of the oral and written comments received by August 6 (the date of the final public hearing) and mail it to all people attending the hearings.
- (5) The legal reporter will prepare transcripts of the proceedings of each hearing and the written comments received by August 6. People may purchase copies of the full transcripts at cost (for reproduction and postage).
- (6) When hearing attendees sign in, they will be asked to complete an attendance card and indicate whether or not they wish to speak.
- (7) Each person will be limited to four (4) minutes to make initial comments.
- (8) After the hearing officer has called on all people indicating on an attendance card a desire to speak, he will open the hearing to other speakers who raise their hands. The four-minute rule will continue for each speaker.
- (9) After everyone has been give the chance to speak for this first time, the hearing officer will call on anyone who wishes to speak again. The time limit for this "second round" will be three (3) minutes for each speaker.
- (10) Prior to speaking, each person should state his or her name, address, and organizational affiliation (if any).
- (11) To the side of the hearing officer, preparers of the body-contact recreation studies summarized in this bulletin will sit at a "resource table" to brief hearing attendees on their studies and answer questions about them.
- (12) The hearing officer will close each hearing by no later than 10:00 PM. If there are people who still wish to speak, he will ask them to submit written comments.

In addition to providing written comments at the public hearings, people may submit written comments directly to the Board. Address them to:

John V. Foley, Chairman
Board of Directors
Metropolitan Water District of Southern California
P.O. Box 54153
Los Angeles, CA 90054

If you have questions about the public hearing procedures, call Metropolitan representatives:

Tim Skrove: (909) 682-9066

or

Bob Muir (213) 217-6930

**POTENTIAL BODY-CONTACT
RECREATION AT THE
EASTSIDE RESERVOIR PROJECT**

METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

**THE POTENTIAL PUBLIC HEALTH,
FINANCIAL, ECONOMIC, ENVIRONMENTAL,
LIABILITY, AND LEGAL IMPACTS FROM
BODY-CONTACT RECREATION**

JULY 1998

SUMMARY

POTENTIAL BODY-CONTACT RECREATION AT THE EASTSIDE RESERVOIR PROJECT

THE POTENTIAL PUBLIC HEALTH, FINANCIAL, ECONOMIC, ENVIRONMENTAL, LIABILITY, AND LEGAL IMPACTS FROM BODY-CONTACT RECREATION

Since 1992, the Metropolitan Water District of Southern California has worked with the community-based Eastside Reservoir Project Recreation Working Group to develop a comprehensive recreation plan that includes a diverse mix of outdoor recreation opportunities and is consistent with the 1991 Final *Environmental Impact Report* (FEIR). During the course of this development process, some members of the local community proposed including body-contact recreation (for example, swimming, water skiing, use of personal watercraft [PWC], and other forms of recreation involving direct body contact with the water) on the reservoir as part of the recreation plan. The current plan without body-contact recreation on the reservoir accommodates substantial body-contact recreation activities within lakes in the recreation areas to be constructed at both ends of the reservoir.

STUDY PROCESS

In response to members of the local community, Metropolitan initiated studies to determine the potential body-contact recreation visitation and the feasibility of allowing that use on the reservoir—assessing its potential public health, financial, economic, environmental, liability, and legal impacts.

DETERMINING THE POTENTIAL BODY-CONTACT RECREATION VISITATION

An independent firm specializing in recreation economics estimated the number of body-contact recreators possible on the reservoir consistent with facility capacity and public demand. The recreation planners developed a series of body-contact scenarios, each forecasting different numbers of body-contact recreators:

- Three graduated *recreation-activity* scenarios: (1) limited body-contact (LBC) boating;¹ (2) LBC boating plus water skiing (WS); and (3) LBC boating plus water skiing plus use of PWCs.

¹ Such boating as multi-hull sailing, canoeing, rowboating, and kayaking (situations that might involve a vessel capsizing and placing people in the water).

- Two reservoir *operational* scenarios: body-contact-recreation (1) on the full reservoir and (2) limited to the east basin only (the “divided-basin scenarios”).

The planners included the divided-basin scenarios to determine whether limiting body-contact recreation to the eastern half of the reservoir (farther away from the outlet tower) would have any effect on potential public health impacts. The steep reservoir side slopes and fluctuating water levels would make swimming beaches impractical. Community representatives said that swimming opportunities on the reservoir were not a priority concern. The studies therefore excluded swimming from the analyses.

DETERMINING THE POTENTIAL PUBLIC HEALTH IMPACTS

Metropolitan enlisted the aid of four prominent university scientists to conduct a pathogen risk assessment study to evaluate the potential health consequences for downstream consumers of treated water from the Eastside Reservoir Project subjected to body-contact recreation. The scientists developed a pathogen risk assessment model to determine if body-contact recreation would impact Metropolitan’s ability to comply with the likely requirements of the U.S. Environmental Protection Agency’s (USEPA) proposed Enhanced Surface Water Treatment Rule (ESWTR)² and to quantify any increased risk to consumers.

A review of the scientific literature identified the pathogens body-contact recreation might introduce into the water. The pathogens of primary concern in water are the enteric pathogens: bacterial, viral, and parasitic microorganisms that infect the gastrointestinal tract and thus are present in the fecal material of infected individuals. Transmission of these microorganisms is through the fecal-oral route, that is, ingestion of the feces of an infected individual or contact with fecal-contaminated inanimate objects, water, or food.

Water bodies transmit many types of **bacteria**. *Salmonella* is probably the most widely recognized enteric bacterium; it is responsible for more than 2 million cases of water- and food-borne illness in the United States every year.

Humans can shed more than 100 different types of enteric **viruses**, including poliovirus, hepatitis A virus, and rotavirus, in their feces. A significant feature of these viruses is that their only source is human waste material; animal waste does not contain viruses that can infect humans.

Protozoan parasites are the third group of enteric microorganisms. This group includes *Giardia* and *Cryptosporidium*, which studies have identified as the causative agents of an increasing number of waterborne outbreaks in recent years.

The scientists calculated the numbers of pathogens per recreator based on the incidence of infection in the population and the reported concentration of these pathogens in fecal material. At any given time, some fraction of the population is infected with an enteric microorganism and may shed it in their fecal material. The prevalence of infection varies with age and the specific pathogen. Younger children tend to have a higher incidence of infection than older individuals. An individual (1) can be infected with an enteric pathogen and can shed the organisms in his or her fecal material without showing any clinical signs of illness and (2) can shed pathogens for several weeks before and/or after clinical illness occurs.

Although infected individuals can introduce pathogens into the water from bodily secretions (for example, via saliva or respiration) and excretions (for example, urine, feces), the risk assessment model for this study only considered pathogen input from fecal material. Input of pathogens to the reservoir from fecal material can occur in two ways: from an accidental fecal release (AFR) or by shedding (the washing of residual fecal material from the skin as a result of contact with the water). Studies indicate that the majority of people in the water shed their fecal material within the

² Expected to take effect in 1999 and discussed in the full report.

first 10 to 15 minutes of contact with the water. Consequently, body-contact recreation as defined in this report includes any activity that results in contact with the water for a minimum of 15 minutes.

The scientists identified and quantified the factors that would affect pathogens once in the reservoir. They then developed a mathematical model to calculate the number of the pathogens introduced into the reservoir by body-contact recreation that would subsequently flow to the outlet tower and to downstream treatment plants.

Models have advantages over a monitoring-based process because analytical limitations and sampling biases do not affect them and they can provide a systematic evaluation of the impacts of alternative recreational scenarios on water quality. Models allow scientists to predict likely outcomes before they occur, enabling decision makers to take preventive actions as necessary. Monitoring records actual outcomes, enabling decision makers to take corrective actions as necessary. In this case, application of a model allows quantification of likely public health impacts from body-contact recreation before they occur.

The scientists ran model simulations for the six different reservoir recreation scenarios identified above. The results became input to risk assessment calculations to determine the risk of infection from pathogens to consumers of the water after treatment at a drinking water treatment plant. A Blue Ribbon Panel composed of prominent scientists and engineers, including a scientist selected by the City of Hemet, reviewed the mathematical model and overall approach. The panel concluded that the scientific approach of the model was valid, and it approved the numbers used as input to the model.

In addition to assessing the public risks under the six body-contact boating scenarios, the scientists ran the model to predict the maximum annual number of body-contact recreators allowable without the need for additional treatment (that is, stay within the expected ESWTR of 1 infection in 10,000 consumers per year).

During the course of model development, the scientists found *Cryptosporidium* to be the organism with the greatest impact upon risk to downstream drinking water consumers. This is due, in part, to the organism's ability to survive for extended periods in water environments, its resistance to inactivation by conventional disinfection practices, and the known adverse health consequences of contracting cryptosporidiosis. Moreover, treatment practices effective for *Cryptosporidium* would, in general, be equally or more effective for other pathogens. Consequently, the scientists used *Cryptosporidium* to calculate the risk assessment results and corresponding costs for additional treatment.

The scientists also calculated the health risks to reservoir body-contact recreators from consuming a small amount of reservoir water during recreation. The scientists found that rotavirus would have the greatest impact on body-contact recreators themselves.

During the course of the study, concern surfaced that increased numbers of motorized watercraft from body-contact boating might increase the level of chemical contaminants from fuel by-products, principally methyl-tertiary-butyl ether (MTBE). This compound is difficult to treat, and consumers can detect it in water at levels well below current regulatory action levels. Importantly, USEPA considers this fuel additive to be a possible carcinogen. The scientists developed an analytical model to predict MTBE concentrations with and without body-contact recreation based on expected engine discharges in the reservoir.

DETERMINING THE POTENTIAL FINANCIAL IMPACTS TO METROPOLITAN

The potential financial impacts are twofold: first, the capital and operating costs of additional water treatment that might be needed to keep pathogen levels to acceptable public health risk

levels; and second, the annual revenue and cost effects of body-contact recreation on the revenues and costs of the recreation complex's management entity.

Metropolitan concludes that the most cost-effective alternative treatment would be to provide ozone disinfection in addition to the existing treatment process. Metropolitan investigated various treatment alternatives to determine the most cost-effective means of achieving additional pathogen (especially *Cryptosporidium*) reduction. For study purposes, the cost analysis of treatment is for the Skinner filtration plant and treatment plants in the San Diego area that will receive water from the Eastside Reservoir Project. Other treatment plants receiving water from the Eastside Reservoir Project would require similar treatment.

To determine annual recreation revenues and costs, Foster Associates (Metropolitan's independent recreation economist) applied the Eastside Reservoir Project's *Financial Planning Model*, which produces income, cost, cash flow, and balance sheet figures. The model contains *inputs* of capital cost, operating costs and revenues, depreciation, and debt service and variables for interest rates, debt/equity ratios, and other elements of financing.

DETERMINING THE POTENTIAL ECONOMIC BENEFITS TO THE REGION

Metropolitan undertook two studies to estimate the potential economic benefits to the region from adding body-contact recreation on the reservoir. One was by Foster Associates, completed in 1997. Subsequently, the County of Riverside, the City of Hemet, and Metropolitan agreed to fund an independent economic study (completed in April 1998) to provide "a second opinion" on the estimated economic benefits to the region. Neither study undertook statistical estimates of uncertainty associated with the economic projections. The 1998 study did, however, examine a range of projections from "conservative" to "aggressive."

DETERMINING THE POTENTIAL ENVIRONMENTAL, LIABILITY, AND LEGAL IMPACTS

Metropolitan staff and consultants performed analyses in these three categories.

STUDY RESULTS

With respect to potential *public health impacts*, ESWTR's maximum permissible concentration of *Cryptosporidium* is expected to be 1 oocyst in 100 liters of water. Source water monitoring for this study shows that the current annual average concentration of *Cryptosporidium* in waters expected to enter the Eastside Reservoir (which includes water used for body-contact recreation at Lake Silverwood and Lake Havasu) is 0.36 oocysts per 100 liters (L). This average annual concentration can fluctuate. For study purposes, however, the 0.36 oocysts/100 L is the baseline—the projected *Cryptosporidium* concentration in the reservoir in the absence of body-contact recreation. One infection in 10,000 people is favored in the current and proposed regulatory environment. The infection baseline for the Eastside Reservoir Project for study purposes is 0.36 infections in 10,000 people.

The scientists and Metropolitan calculated the potential *public health impacts* and *water treatment costs* at 95-percent and 99-percent confidence levels. At the 95-percent confidence level, there is a 95-percent probability that annual average pathogen concentrations will be equal to or less than the predicted concentration. At the 99-percent confidence level, the probability increases to 99 percent.

The independent recreation economist estimated annual *recreation complex finances* and regional economic benefits only for the *full reservoir* non body-contact boating scenario and the *divided basin* body-contact boating scenarios. The economist did no financial analysis for the *full reservoir* body-contact recreation scenarios because they substantially increase public health risks over the *divided basin* scenarios and add so few recreators that they would have little financial impact.³

SCENARIO COMPARISON OF POTENTIAL PUBLIC HEALTH IMPACTS

- (1) Body-contact boating would increase pathogen concentrations, including *Cryptosporidium*, in the reservoir for all body-contact scenarios.
- (2) Without additional water treatment, body-contact boating would increase average annual waterborne *Cryptosporidium* infections to downstream consumers:
 - For the *full reservoir* scenarios, the public health risk would be 3.2 to 41.0 times more than baseline conditions.
 - For the *divided basin* scenarios, the public health risk would be 1.8 to 19.1 times more than baseline conditions.
- (3) Up to 81,000 body-contact recreators annually (depending on the scenario) are possible without additional treatment. This level would increase the risk of *Cryptosporidium* infections to downstream consumers by about 3 times over baseline conditions.
- (4) Less than 1 percent of the time, body-contact boating would produce daily peak *Cryptosporidium* concentrations (spikes) that would be substantially more than the corresponding average annual concentrations: 3.5 to 4.0 times higher for the *full reservoir* scenarios and 2.0 to 2.5 times higher for the *divided basin* scenarios.
- (5) All but one of the recreation scenarios would require additional treatment to comply with projected regulatory standards. The one scenario not requiring additional treatment is limited body-contact boating (for example, multi-hull sailing, canoeing, rowboating, and kayaking) confined to the reservoir's east basin.
- (6) During the summer months, up to 40 body-contact recreators per 100 (depending on the scenario) could become infected from rotavirus shed by other recreators already infected with the virus. It is not feasible to disinfect water in the reservoir to reduce the probability of infection.
- (7) Body-contact boating, particularly PWC use because of the type of PWC engine, would increase MTBE in the reservoir and violate proposed government standards. Federal and state legislation are currently under consideration to address the MTBE issue.

SCENARIO COMPARISON OF ADDITIONAL WATER TREATMENT COSTS

The location and elevation of the Eastside Reservoir Project will allow Metropolitan to deliver water from the reservoir to about 90 percent of its service area. The water could pass through one of four Metropolitan treatment plants: Skinner in Winchester, Diemer in Yorba Linda, Weymouth in La Verne, or Mills in Riverside.

³ Increases of about 17,000 boaters for the *LBC + WS* scenario (3%) and 13,000 boaters for the *LBC + WS + PWC* scenario (2%).

For study purposes (as stated above), the cost analysis of treatment was for the Skinner filtration plant and treatment plants in the San Diego area that will receive water from the Eastside Reservoir Project. The Metropolitan Board of Directors has approved a schedule calling for installing ozone disinfection equipment at the Skinner plant by 2006 to comply with the future potentially more stringent federal *Disinfectant/Disinfection By-Product Rule*, which regulates trihalomethanes (THMs), a byproduct of disinfecting water with chlorine. The estimated costs for this Skinner plant retrofit are:

- \$147.7 million in capital costs and
- \$2.9 million in annual operations and maintenance (O&M) costs, yielding
- \$15.8 million in annualized treatment costs (capital cost amortized over 20 years plus annual O&M costs).

Pending finalization of the federal rule, however, Metropolitan's Board of Directors has not yet appropriated funds for the design and construction of the Skinner plant retrofit.

While ozone is effective in inactivating *Cryptosporidium*, the ozone dosage required to control THM formation at acceptable levels is not sufficient to control average annual or daily peak *Cryptosporidium* concentrations projected for most of the body-contact recreation scenarios at the Eastside Reservoir.

- (1) Metropolitan would incur **additional** costs to the currently scheduled retrofit at the Skinner plant to accommodate most of the body-contact recreation scenarios. Depending on the recreation scenario, the goal (maintain the current baseline or stay within the proposed ESWTR), and the confidence level (99% or 95%) associated with higher ozone doses to control annual average *Cryptosporidium* concentrations from body-contact recreation, Metropolitan's **additional**:
 - Capital costs ranging from \$20.6 to \$62.4 million and
 - Annual O&M costs ranging from \$820,000 to \$2.3 million would yield additional
 - Annualized treatment costs ranging from \$2.6 to \$7.7 million.
- (2) Metropolitan bases its estimates for additional treatment costs on annual average and not on daily peak *Cryptosporidium* concentrations. It would be prohibitively expensive to build ozone facilities to treat the peaks.
- (3) Other treatment plants receiving water from the Eastside Reservoir would require additional treatment similar to that at Skinner to accommodate body-contact recreation. The associated costs might be comparable to those at Skinner, depending on a number of factors including the level of pathogens introduced at those plants and the specific costs associated with each plant.

San Diego water treatment plants would also incur costs to accommodate average annual *Cryptosporidium* concentrations from body-contact recreation on the Eastside Reservoir. Depending on the body-contact recreation scenario and confidence level, the estimated capital costs to retrofit San Diego plants range from \$6 to \$43 million per plant (\$89 to \$164 million in total).

SCENARIO COMPARISON OF ANNUAL RECREATION COMPLEX FINANCES

Projections are that implementation of any of the reservoir boating scenarios (non body-contact and body-contact) would result in annual revenues to Metropolitan's recreation

management entity that would exceed the annual costs.⁴ Metropolitan is currently updating its estimated revenues and costs based on recent modifications to the recreation plan.

SCENARIO COMPARISON OF ANNUAL REGIONAL ECONOMIC BENEFITS

- (1) Metropolitan's recreation economist contractor (Foster Associates, in 1997) and an independent economic study (John Husing, in 1998)⁵ estimate direct reservoir body-contact boating expenditures on the reservoir:
- Foster estimates that body-contact recreation would annually add \$3.6 million (\$5.3 million under the non body-contact scenario rising to \$8.9 million for the body-contact scenario).
 - Husing estimates that body-contact recreation would annually add \$8.7 million (\$10.4 million under the non body-contact scenario rising to \$19.2 million for the body-contact scenario).⁶

The Foster and Husing estimates are relatively close with respect to annual boater spending on the reservoir (that is, launch, rental, angler, and storage fees). Husing's estimates of annual other boater spending (for example, store food, eating out, fishing equipment, rentals, lodging, and boat and automobile fuel) are significantly higher than Foster's estimates because Husing includes direct boater spending in the local community outside the recreation complex. Foster's estimates are for total in-park sales only.

- (2) Both studies also examined the impact of body-contact recreation on total economic activity in the region: direct spending (as summarized above) and second-round spending.⁷
- Foster estimates that body-contact recreation would annually add \$7.6 million to total economic activity (\$13.9 million under the non body-contact scenario rising to \$21.5 million for the body-contact scenario).
 - Husing estimates that body-contact recreation would annually add \$13.9 million (\$14.5 million under the non body-contact scenario rising to \$28.4 million for the body-contact scenario).

The Foster and Husing estimates are not totally comparable with respect to total economic activity. First, as stated above, Husing's projection includes spending in the local community outside the recreation complex. Second, Husing's estimate is for new spending: projected direct and second-round expenditures by (1) non-local residents and (2) local residents who, without the reservoir project, would have spent their money on recreation elsewhere. Foster's estimate is for total spending.

⁴ Not including any additional treatment costs.

⁵ A study funded by Metropolitan, the County of Riverside, and the City of Hemet.

⁶ Husing projects boater expenditures for four economic scenarios: "conservative," "cautious," "moderate," and "aggressive." He favors the "moderate" scenario, the projections presented in this report.

⁷ Second-round spending includes *indirect* effects (the income generated from the production of goods and services that direct sellers purchase) and *induced* effects (the income generated from the spending of wages, salaries, and profits by the direct and indirect sellers of goods and services).

SCENARIO COMPARISON OF ENVIRONMENTAL IMPACTS

- (1) Metropolitan is currently preparing a *Supplemental Environmental Impact Report (SEIR)* for the entire recreation plan that will analyze non body-contact recreation boating and necessary on-shore facilities to accommodate such boating.
- (2) Selection of a body-contact boating scenario would require additional environmental evaluation, the determination as to whether any new or changed impacts were significant, and the proposal of mitigation measures (if necessary) in the appropriate CEQA documentation.
 - **Water Quality.** The addition of body-contact use may result in a variety of water quality impacts not addressed in the final EIR. The new CEQA document would summarize the studies done to date.
 - **Public Safety.** Water skiing and PWC operation are generally considered to be high-risk activities, the presence of which could result in increased accidents and injuries and a greater demand for emergency medical services than projected in the final EIR. The new CEQA document would evaluate the potential impacts.
 - **Noise.** The loudest contributors to noise would be the high-horsepower engines of water ski boats and PWCs. Sensitive receptors within the reservoir watershed could include lodge guests, hikers and picnickers along the shoreline trails, and wildlife within the Southwestern Riverside County Multi-Species Reserve. Noise studies conducted to date show that there would be no significant noise impact to areas outside of the reservoir site and minimal effects within the reservoir watershed. The new CEQA document would update these findings.
 - **Biological Resources.** The Multi-Species Reserve is adjacent to the reservoir along its north and south shorelines. Metropolitan created the Reserve as mitigation for impacts to sensitive biological resources from construction and operation of the reservoir project. Binding mitigation agreements creating the Reserve assumed that reservoir recreation would minimally disturb Reserve habitat because that recreation would include only non body-contact boating. Additional environmental documentation would therefore have to include detailed studies to ensure that body-contact recreation would not jeopardize the mitigation agreements. Based on preliminary noise modeling results, an independent biologist has concluded that noise levels from body-contact boating are not likely to have a significant impact on wildlife. The noise study would have to verify this conclusion.
 - **Traffic/Circulation.** The new CEQA document would update analyses prepared on the recreation plan to consider highway traffic and circulation that body-contact recreators would add.
 - **Air Quality.** Current projections are that the addition of incremental air emissions from boats, increased motor vehicle traffic, and minor additional utility use due to body-contact activities would add a very small amount to the air emissions arising from the operations of the recreation areas. New CEQA document would update these projections.
 - **Utilities and Services.** Body-contact recreation would increase demand for medical and police services, particularly for enforcement on the reservoir. The incremental increase in recreation area visitation created by the availability of body-contact recreation would also increase the demand for utilities. This demand increase would be relatively small compared to the overall recreation

demand and should not be significant. The new CEQA document evaluate the potential impacts.

- **Growth Inducement.** The additional visitors drawn to the reservoir by the opportunity for body-contact recreation would provide an additional economic benefit in the region in terms of increases in gross sales, personal income, and local tax revenues. As a result, there might be secondary economic/growth impacts due to spending by these additional recreators. These and other considerations would require evaluation in considering the growth inducement implications of body-contact recreation.
- (3) Over the course of this study, questions have emerged with respect to the type of recreation experience on the reservoir desired by people in the surrounding communities and Metropolitan. Water skiing and PWC use would provide a substantial different experience than non body-contact boating. The public hearings on potential body-contact recreation at the reservoir will give people to opportunity to speak on this issue.

SCENARIO COMPARISON OF LIABILITY IMPACTS

- (1) The addition of water ski boats and PWCs on the reservoir would more than quintuple annual liability insurance premiums to the recreation complex management entity over the non-body-contact and limited body-contact recreation scenarios.
- (2) Reservoirs that allow water skiing and PWC use experience higher accident rates than reservoirs that allow only non body-contact boating. Although there are legal exemptions from liability for the dangers inherent in high-risk activities such as water skiing and PWC use, Metropolitan and its recreation management entity would assume some additional liability and legal defense costs from boaters if Metropolitan were to permit such high-risk uses at the Eastside Reservoir Project.
- (3) There would be some additional risk to Metropolitan resulting from potential infections to body-contact recreators in the water.

SCENARIO COMPARISON OF LEGAL IMPACTS

Implementation of any body-contact boating scenario would require a change in state law.

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POTENTIAL BODY-CONTACT RECREATION AT THE EASTSIDE RESERVOIR PROJECT

THE POTENTIAL PUBLIC HEALTH, FINANCIAL, ECONOMIC, ENVIRONMENTAL, LIABILITY, AND LEGAL IMPACTS FROM BODY-CONTACT RECREATION

Since 1992, the Metropolitan Water District of Southern California has worked with the community-based Eastside Reservoir Project Recreation Working Group to develop a comprehensive recreation plan that includes a diverse mix of outdoor recreation opportunities and is consistent with the 1991 *Final Environmental Impact Report* (FEIR). During the course of this development process, some members of the local community proposed including body-contact recreation (for example, swimming, water skiing, use of personal watercraft [PWC], and other forms of recreation involving direct body contact with the water) on the reservoir as part of the recreation plan. The current plan without body-contact recreation on the reservoir accommodates substantial body-contact recreation activities within lakes in the recreation areas to be constructed at both ends of the reservoir.

In response to members of the local community, Metropolitan initiated studies to determine the potential body-contact recreation visitation and the feasibility of allowing that use on the reservoir—assessing its potential public health, financial, economic, environmental, liability, and legal impacts. This paper presents the findings of those studies.

THE SETTING FOR POTENTIAL BODY-CONTACT RECREATION

THE EASTSIDE RESERVOIR PROJECT

In October 1991, Metropolitan's Board of Directors authorized construction of the Eastside Reservoir Project to provide over 16 million people in Metropolitan's service area with a dependable, safe, and cost-effective water supply. The project site is located in a portion of the Domenigoni and Diamond valleys southwest of Hemet.

When completed in 1999, the reservoir will hold 800,000 acre-feet of water (269 billion gallons). By almost doubling Metropolitan's water storage capacity, the reservoir will store enough water to:

- supply Metropolitan's customers for up to six months if a major earthquake were to rupture aqueducts bringing water from Northern California and the Colorado River;
- augment existing water supplies during at least two years of drought;
- augment existing water supplies to help meet peak demand during the summer months; and
- ensure the long-term availability of water for replenishing local groundwater basins.

Located between mountains to the north and south, the reservoir will have two main dams: an east dam rising 185 feet above the valley floor and a west dam rising 285 feet. A saddle dam in

the northern hills will rise 130 feet above the low point in the ridge line. Associated hydraulic structures will consist of an inlet/outlet tower, pump plant, secondary inlet, pressure control facility, release facilities, connecting tunnel, and forebay.

The reservoir will be 4,500 surface acres: 4.5 miles long and up to 2 miles wide.

THE PROJECT RECREATION PLAN

With substantial community input over the past six years, Metropolitan has refined the recreation plan of the Eastside Reservoir Project first presented in the FEIR. While the plan is consistent with the publicly funded facilities committed to in the FEIR, it now includes privately funded facilities to support the economic viability of the plan. Metropolitan is currently preparing a *Supplemental Environmental Impact Report (SEIR)* to evaluate the potential environmental impacts from the refined plan.

Several key objectives have guided the recreation complex design. The complex must be:

- Compatible with Metropolitan's water service and water quality missions.
- Compatible with the Multi-Species Reserve.
- Well managed and controlled by Metropolitan.
- A self-supporting operation.
- Responsive to community needs.
- Integrated with surrounding land forms.

The 4,500-surface-acre reservoir will provide opportunities for fishing, boating, and sightseeing via ferry boats. A northeast marina will provide boat launching, leased boat slips, rental boats, a lodge, a restaurant, and picnic areas. A southwest marina will provide boat launching, rental boats, and picnic areas.

About 80 miles of hiking, cycling, and equestrian trails will cross the entire project property, including the Multi-Species Reserve and Lake Skinner. The maintenance road around the reservoir will double as a hiking and cycling trail with several rest/view stops, some of which will also be accessible to boats during reservoir high-water conditions.

The west recreation area outside the west dam will comprise 702 acres of contoured, landscaped area surrounding 115 acres of lakes. The lakes will feature boating, sailboarding, and fishing. Designated beaches or lagoons on the lakes will provide opportunities for swimming. Other features on the west side include a commercial waterpark, commercial villages, campgrounds, picnic areas, a golf course, an equestrian center, and areas for special outdoor events and interpretive programs.

The east recreation area outside the east dam will include 1,153 acres of contoured, landscaped area surrounding an 85-acre lake. This lake will also feature boating, sailboarding, and fishing. A community pool and designated beaches on the lake will provide swimming opportunities on the east side. This recreation area will also feature golf courses, a recreation-vehicle resort, picnic areas, ball and soccer fields, commercial villages for lodging, dining, and shopping, and areas for special outdoor events and interpretive programs.

Forecasts are that, by 2010, over 2.4 million people will visit the recreation complex annually.

CURRENT METROPOLITAN PRACTICE ON BODY-CONTACT RECREATION

Metropolitan's current practice is to prohibit body-contact recreation on its reservoirs to ensure that water quality meets or exceeds all government drinking water standards. This practice

is consistent with Section 115825(b) of the California State Health and Safety Code that prohibits body-contact recreation on reservoirs in which water is stored for domestic use.¹ Water delivered by Metropolitan to its 27 member agencies serving 16 million people currently exceeds all such standards.

In 1997, the Board adopted the following policies with respect to body-contact recreation at the Eastside Reservoir:

Body-contact recreation should not:

- result in a significant adverse impact to the health and safety of water users and consumers;
- result in a significant degradation of secondary water quality standards (for example, taste and odor);
- result in unreasonable costs to consumers or member agencies resulting from potential water treatment needs;
- unreasonably impede the Eastside Reservoir Project's primary function as a domestic water supply reservoir; and
- result in significantly increased liability to Metropolitan.

POTENTIAL BODY-CONTACT RECREATION VISITATION²

Foster Associates, an independent firm specializing in recreation economics, estimated the number of body-contact recreators possible consistent with facility capacity and public demand. Metropolitan's recreation planners developed a series of body-contact scenarios, each forecasting different numbers of body-contact recreators:

- Three graduated *recreation-activity* scenarios: (1) limited body-contact (LBC) boating;³ (2) LBC boating plus water skiing; and (3) LBC boating plus water skiing plus use of PWCs.
- Two reservoir *operational* scenarios: body-contact recreation (1) on the full reservoir and (2) limited to the east basin only (the "divided-basin scenario").

The planners included the divided-basin scenarios to determine whether limiting body-contact recreation to the eastern half of the reservoir (farther away from the outlet tower) would have any effect on potential public health impacts. The steep reservoir side slopes and fluctuating water levels would make swimming beaches impractical. Community representatives said that swimming opportunities on the reservoir were not a priority concern. The studies therefore excluded swimming from the analyses.

Chart 1 summarizes the annual reservoir-based non body-contact and body-contact recreator forecasts for the year 2010. Under the non body-contact scenario (NBC), boaters would total about 383,000 per year. Depending on the body-contact boating scenario (three each for full reservoir and divided basin), the total number of boaters on the reservoir would increase by 12 to 61

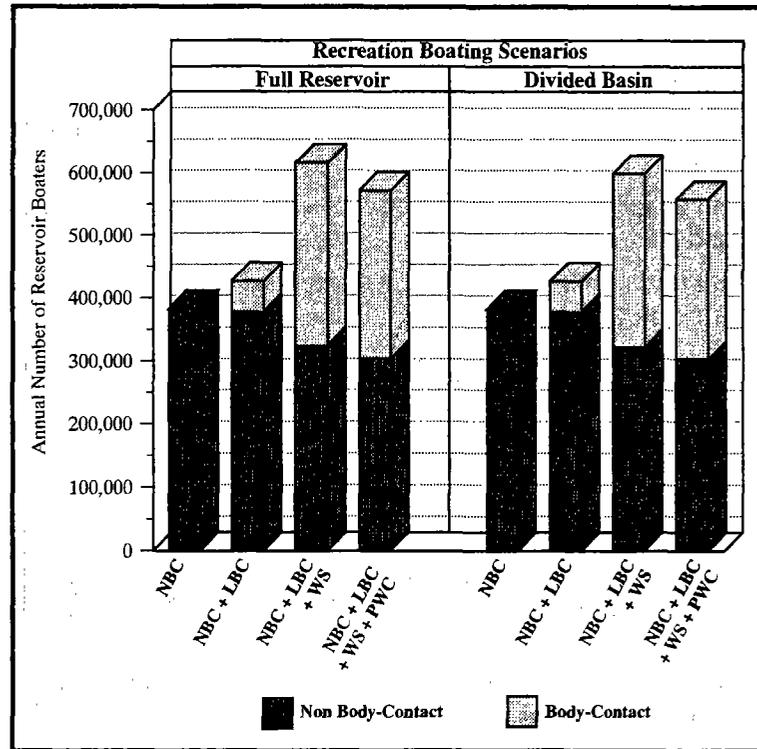
¹ Section 115840(b) of the California State Health and Safety Code permits body-contact recreation on San Diego County domestic water supply reservoirs subject to certain conditions.

² Based on report by Foster Associates, Inc., *Reservoir Boater Projections* (May 1997 report compiling data presented to Metropolitan in January 1996)

³ Such boating as multi-hull sailing, canoeing, rowboating, and kayaking (situations that might involve a vessel capsizing and placing people in the water).

percent.⁴ Adding PWCs reduces the total number of body-contact recreators as compared to the LBC plus water-skiing scenario because PWCs carry fewer persons than water ski boats.

Chart 1. Annual Reservoir Recreator Population (2010)



Body-contact boating on the reservoir would increase annual overall recreation complex visitation an additional 2 to 5 percent, depending on the boating scenario.

Seven components were used to determine the reservoir recreator forecasts:

- Reservoir Boating Recreation Demand
- Number of Persons Per Boat
- Number of Boats Launched
- Boating Mix of Reservoir Recreation
- Calculations of Total Annual Boats and Boaters—combining numbers of persons per boat, number of boats launched, and boating mix
- Seasonal Distribution of Annual Reservoir Body-Contact Boaters
- Age Distribution of Reservoir Body-Contact Boaters

EASTSIDE RESERVOIR BOATING RECREATION DEMAND

Based on the 1992 California Department of Parks and Recreation (CDP&R) survey of outdoor recreation preferences, *Public Opinions and Attitudes on Outdoor Recreation in California*, visitation trends at State Water Project reservoirs, the location of recreation lakes in the general vicinity of the Eastside Reservoir, and projected population growth in Southern California, Foster

⁴ Chart 1 shows that, under the body-contact scenarios, body-contact boaters would displace some non body-contact boaters.

used the California Travel Cost Model to forecast boating demand at the Eastside Reservoir Project.⁵ The findings were that:

- (1) Boating visitation at State Water Project reservoirs in Southern California (Castaic, Perris, Pyramid, and Silverwood) show flat to decreasing trends in recent years because the reservoirs are operating at maximum and controlled levels.
- (2) Boaters would reach launch-lane capacity on summer weekends and holidays only under body-contact boating scenarios that include water skiing.
- (3) Reservoir capacity (surface area) at the Eastside Reservoir Project will never be exceeded because the number of launch lanes constrains access.

NUMBER OF PERSONS PER BOAT

Chart 2 displays the number of persons per boat. Foster bases these numbers on its own research and input from members of the project recreation planning team with extensive on-site recreation management experience. Foster interviewed lake patrol staff at many Southern California recreation lakes.

Chart 2. Estimated Number of Persons Per Boat

Types of Boats	Persons/ Boat
NON BODY-CONTACT BOATS	
Lane-Launched Boats	2.5
Marina-Launched Boats	2.5
Fishing Boats	1.5
Rental Boats	2.5
BODY-CONTACT BOATS	
Lane-Launched Water Ski Boats	3.5
Lane-Launched PWCs	1.5
Rental PWCs	1.0
Multi-Hull Sail Boats	2.0
Limited Body-Contact Boats	2.0
Marina-Launched Water Ski Boats	3.5

NUMBER OF BOATS LAUNCHED

Boats will be able to get on the reservoir in four ways:

	Northeast Marina	Southwest Marina
From Launch Lanes	X	X
From Marina Slips	X	
From Rental Docks	X	X
By Manual Carrying	X	X

⁵ The California Department of Parks and Recreation's 1997 updated survey of outdoor recreation preferences was not available in time for this body-contact recreation study.

The number of lanes, the hourly throughput down the lanes, and the number of hours per day that the lanes are open govern launch-lane capacity.

Under the body-contact scenarios, the hourly launch rate increases with the addition of PWCs, since owners often launch them two to a trailer. Under the divided basin scenarios, the total number of launch lanes increases by two from the full reservoir scenarios (from 16 to 18): 11 lanes to be used for body-contact boats launched from the northeast marina and 7 lanes to be used for LBC and NBC boating from the southwest marina.

Foster surveyed Southern California recreation lakes to determine average marina occupancy and the percentage of boats likely to be launched from marina slips on weekdays, weekends, and holidays. The northeast marina will have 250 marina slips.

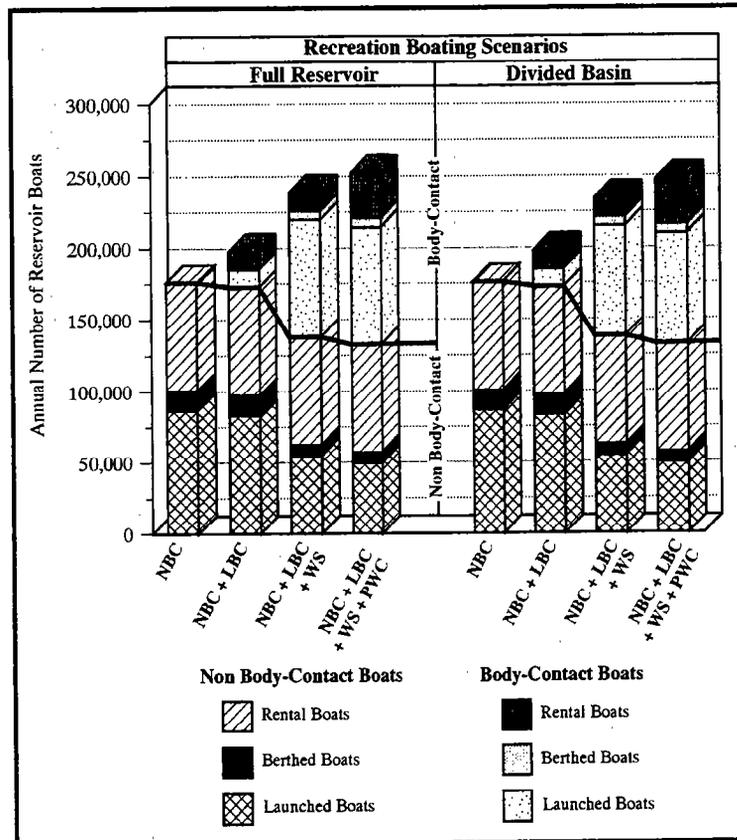
One classification of rental boats is small aluminum boats—some with outboard motors and some without—that will be used for fishing and lake exploration (all non body contact). The rental fleet would total 160 boats.

Most LBC boats will get on the water by being carried to a dock or down a launch lane ramp manually (without interfering with vehicles launched from trailers).

BOATING MIX OF RESERVOIR RECREATION

Based on demand, seasonal variations, launch capacity, and the judgments of Metropolitan’s recreation planners, Chart 3 summarizes Foster’s estimate of the mix of recreation boats that will annually be on the Eastside Reservoir for the full reservoir and divided basin recreation boating scenarios.

Chart 3. Estimated Annual Boating Mix of Reservoir Recreation



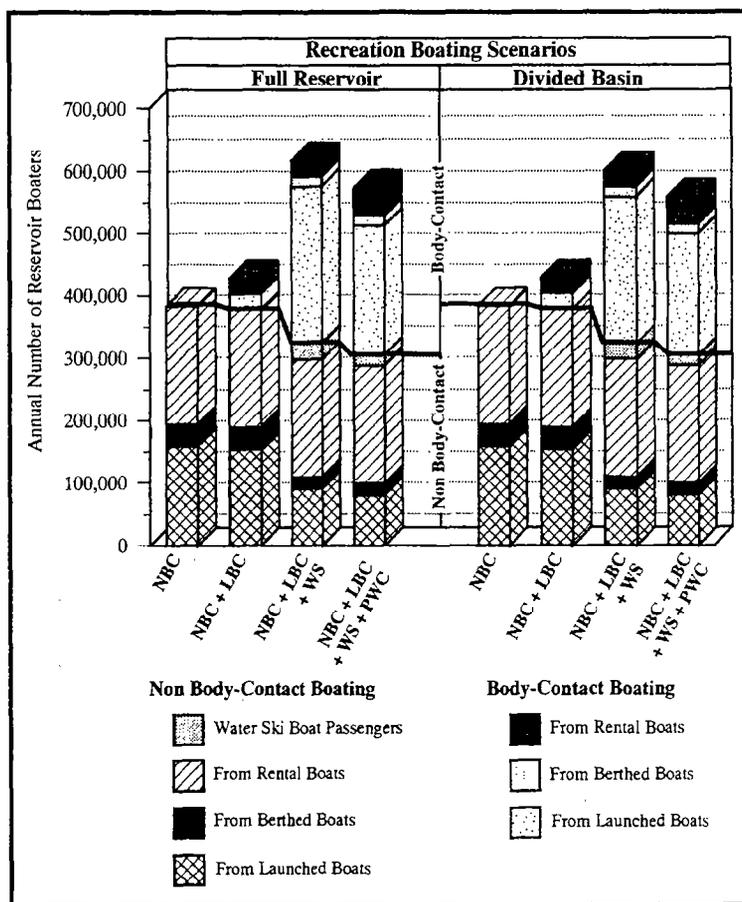
The number of non body-contact boats would not decrease under the LBC boating scenarios, since conflicts between non body-contact and LBC boating are unlikely.

Although water skiing and PWC use would increase overall reservoir boating up to 43 percent over the LBC scenario, there would be fewer non body-contact boats and LBC boats. In the educated judgment of the recreation planners, the presence of body-contact boats would discourage some non body-contact and LBC boaters from using the reservoir. Because of launch-lane capacity, marina operators would turn away some water-ski boats and PWCs on weekend days during the summer season.

CALCULATIONS OF TOTAL ANNUAL RESERVOIR BOATERS

Combining the number of persons per boat (see Chart 2) with the boat mix (see Chart 3), Chart 4 summarizes the estimated total annual reservoir boaters (by how they get on the reservoir) for the recreation boating scenarios.

Chart 4. Estimated Annual Mix of Reservoir Recreation Boaters



Implementing the full reservoir scenario including water ski boats, but not PWCs, would get the largest number of people on the reservoir annually: about 617,000 non body-contact and body-contact boaters. Adding PWCs would decrease that number by 44,000, mainly because—given launch lane capacity—PWCs (1.5 persons per vessel) would displace about 5,000 water ski boats (3.5 persons per vessel).

Limiting water skiing and PWC use to the east basin only (the divided basin scenarios) would reduce the annual number of reservoir boaters by about 2.5 percent.

SEASONAL DISTRIBUTION OF ANNUAL RESERVOIR BODY-CONTACT BOATERS

Based on professional observations of activities at Southern California reservoirs offering body-contact boating, Charts 5 and 6 project the number of *body-contact* boaters by month (Chart 5 for the full reservoir scenarios, Chart 6 for the divided basin scenarios). Projections are that about 64 percent of the body-contact boating will take place during the warm five-month peak season, May through September.

Chart 5. Monthly Distribution of Body-Contact Boaters, Full Reservoir

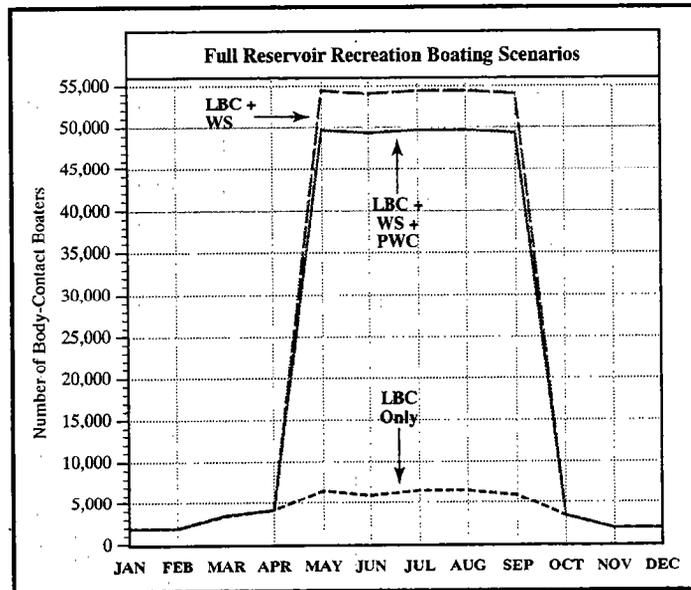
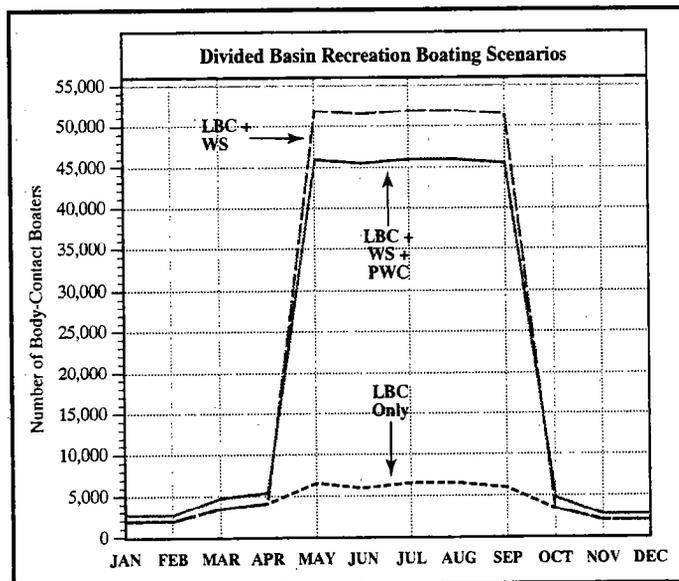


Chart 6. Monthly Distribution of Body-Contact Boaters, Divided Basin



AGE DISTRIBUTION OF RESERVOIR BODY-CONTACT BOATERS

Age distribution of the boaters is important because, as discussed below in the *Potential Public Health Impacts* section, children generally have higher incidences of infection than adults. Chart 7 shows the percentage age distribution by reservoir body-contact boating activity. Projections for ages 7 and above come from participation data reported in *Boat Ownership & Water Sports Participation in 1991* (National Marine Manufacturers Association). Estimates for children under age 7 (not included in the referenced report) come from anecdotal information provided by lake patrol personnel at three California reservoirs and the age distribution of the California population.

Chart 7. Percentage Age Distribution by Body-Contact Boating Activity

Reservoir Body-Contact Boating Activity	Percentage by Age Group			
	<7	7-11	12-17	18+
Sail Boating	5.0	4.5	10.1	80.5
Multi-Hull Sail Boating	1.0	4.9	15.7	78.4
Boat Fishing	5.0	11.6	10.3	73.2
Other Small Boating	5.0	8.6	15.3	71.1
Water Skiing	5.0	5.1	15.3	74.6
Personal Water Craft (PWC) Use	1.0	5.3	15.9	77.7

These percentages were the basis for distributing the annual body-contact boating population by age as input to the public health study.

POTENTIAL PUBLIC HEALTH IMPACTS⁶

Metropolitan enlisted the aid of four prominent scientists to conduct a pathogen risk assessment study to evaluate the potential health consequences for downstream consumers of treated water from the Eastside Reservoir Project subjected to body-contact recreation:

Scientist	Institution	Expertise
Professor Marylynn Yates, Lead	University of California, Riverside	Pathogen Survival
Professor Charles Gerba	University of Arizona	Waterborne Pathogens
Professor Joan Rose	University of South Florida	Risk Assessment
Professor Michael Anderson	University of California, Riverside	Reservoir Modeling

The scientists developed a pathogen risk assessment model (1) to determine if body-contact recreation would result in increased pathogen concentrations in the reservoir and (2) to quantify any increased risk to consumers.

A review of the scientific literature identified the pathogens body-contact recreation might introduce into the water. The scientists then calculated the numbers of pathogens per recreator

⁶ Based on a report by Marylynn Yates, PhD, Michael Anderson, PhD, Charles Gerba, PhD, and Joan Rose, PhD, *The Impact of Body-Contact Recreation in the Eastside Reservoir on 1) Pathogen Risk to Consumers and Recreators and 2) MTBE Contamination* (October 1997).

based on the incidence of infection in the population and the reported concentration of these pathogens in fecal material. They then identified and quantified the factors that would affect the pathogens once in the reservoir. The scientists then developed a mathematical model to calculate the number of the pathogens introduced into the reservoir by body-contact recreation that water would subsequently transport to the outlet tower and to downstream treatment plants.

Mathematical models have advantages over a monitoring-based process because analytical limitations and sampling biases do not affect them and they can provide a systematic evaluation of the impacts of alternative recreational scenarios on water quality. Models allow scientists to predict likely outcomes before they occur, enabling decision makers to take preventive actions as necessary. Monitoring records actual outcomes, enabling decision makers to take corrective actions as necessary. In this case, application of a model allows quantification of likely public health impacts from body-contact recreation before they occur.

The scientists ran model simulations for the six different reservoir recreation scenarios identified above. The results became input to risk assessment calculations to determine the risk of infection from pathogens to consumers of the water after treatment at a drinking water treatment plant. A Blue Ribbon Panel composed of prominent scientists and engineers, including a scientist selected by the City of Hemet, reviewed the mathematical model and overall approach. The panel (members listed below) concluded that the scientific approach of the model was valid, and it approved the numbers used as input to the model.⁷

Scientist	Institution	Expertise
Dr. Bill Bellamy, Chair	CH2MHill	Treatment/Pathogen Removal
Professor Charles Haas	Drexel University	Microbial Risk Assessment
Professor Mark Sobsey	University of North Carolina	Pathogen Occurrence
Mr. Gunther Craun	Global Consulting/Environmental Health	Waterborne Disease
Dr. Dennis Juranek	Centers for Disease Control	Epidemiology
Dr. Imad Hannoun	Flow Science Inc.	Reservoir Modeling
Dr. Steve Schaub	US Environmental Protection Agency	Regulatory Impact
Mr. Robert Hultquist	California Department of Health Services	Treatment
Ms. Julie King	Bolin Laboratories	Pathogen Detection Methods
Dr. John Connolly	Hydroqual Inc.	Reservoir Modeling
Dr. Al Dufour	US Environmental Protection Agency	Waterborne Disease
Dr. David Spath	California Department of Health Services	Treatment/Health Impacts

PATHOGENS ASSOCIATED WITH RECREATION ACTIVITIES

The pathogens of primary concern in water are the enteric pathogens. These are microorganisms that infect the gastrointestinal tract and are thus present in the fecal material of infected individuals. Transmission of these microorganisms is through the fecal-oral route, that is, ingestion of the feces of an infected individual or contact with fecal-contaminated objects, water, or food. Enteric pathogens include bacteria, viruses, and protozoa.

Bacteria. Water transmits many types of bacteria. *Salmonella* is probably the most widely recognized enteric bacterium; it is responsible for more than 2 million cases of water- and food-borne illness in the United States every year.

⁷ Peer Review Panel Report, *Eastside Reservoir Project, Recreation Pathogen Risk Assessment Model* (January 29, 1996).

Viruses. Human feces can shed more than 100 different types of enteric viruses, including poliovirus, hepatitis A virus, and rotavirus. A significant feature of these viruses is that their only source is human waste material; animal waste does not contain viruses that can infect humans.

Protozoa. Protozoan parasites are the third group of enteric microorganisms. This group includes *Giardia* and *Cryptosporidium*, which studies have identified as the causative agents of an increasing number of waterborne outbreaks in recent years.

Charts 8 and 9 list 28 outbreaks of waterborne disease documented in the United States between 1991 and 1994 due to recreation waters.

**Chart 8. Waterborne Disease Outbreaks Among Recreators
in Natural Recreation Settings, 1991-1994**

Pathogen	# Cases	Source	Location	Month/Yr	State
Acute gastrointestinal illness	15	Creek	Private Home	Jul 92	MD
<i>Cryptosporidium parvum</i>	418	Lake	Park	Jul 94	NJ
<i>Escherichia coli</i> O157:H7	80	Lake	Park	Jul 91	OR
<i>Escherichia coli</i> O157:H7	166	Lake	Camp	Jul 94	NY
<i>Giardia</i>	4	Lake	Campground	Jul 91	WA
<i>Giardia lamblia</i>	12	Lake	Park	Jul 93	MD
<i>Giardia lamblia</i>	6	River	River	Aug 93	WA
<i>Giardia lamblia</i>	43	Lake	Swim Club	Sep 93	NJ
<i>Shigella flexneri</i>	35	Lake	Park	May 94	MN
<i>Shigella sonnei</i> *	203	Lake	Park	Jun 91	PA
<i>Shigella sonnei</i> *	23	Lake	Swimming Area	Jul 91	RI
<i>Shigella sonnei</i> *	54	Lake	Campground	Jun 92	NJ
<i>Shigella sonnei</i> *	9	Lake	Camp	Jul 92	VA
<i>Shigella sonnei</i> *	160	Lake	Park	Jul 93	OH
<i>Shigella sonnei</i> *	242	Lake	Park	Jun 94	NJ
TOTAL	1,470				
* Humans are the only source.					

**Chart 9. Waterborne Disease Outbreaks Among Recreators
in Artificial Recreation Settings, 1991-1994**

Pathogen	# Cases	Source	Location	Month/Yr	State
Acute gastrointestinal illness	61	Dunking Booth	Fair	Aug 91	MO
Acute gastrointestinal illness	100	Swimming Pool	Water Park	Aug 92	CA
<i>Cryptosporidium</i>	500	Wave Pool	Park	Jun 92	OR
<i>Cryptosporidium</i>	26	Water Slide	Park	Aug 92	ID
<i>Cryptosporidium parvum</i>	51	Swimming Pool	Motel	Apr 93	WI
<i>Cryptosporidium parvum</i>	5	Swimming Pool	Community	Aug 93	WI
<i>Cryptosporidium parvum</i>	54	Swimming Pool	Community	Aug 93	WI
<i>Cryptosporidium parvum</i>	64	Swimming Pool	Motel	Aug 93	WI
<i>Cryptosporidium parvum</i>	101	Swimming Pool	Motel	Jul 94	MO
<i>Giardia</i>	14	Swimming Pool	Park	Jun 91	MD
<i>Giardia</i>	9	Wading Pool	Day Care Center	Jul 91	GA
<i>Giardia</i>	7	Wading Pool	Day Care Center	Jul 91	GA
<i>Giardia lamblia</i>	80	Swimming Pool	Community	Jun 94	IN
TOTAL	1,072				

The outbreaks involved more than 2,500 individuals, with about half of the outbreaks associated with natural (for example, lakes) and half with artificial (for example, swimming pools) settings. In at least seven of the pool-related outbreaks, there was proper water chlorination and filtration. While humans were clearly the source of pathogens in the outbreaks associated with swimming pools, there is the potential that animal waste inputs caused some of the outbreaks (only those that involved a non-viral agent) in the natural water settings. However, there is evidence that human fecal material is responsible for some of these outbreaks. For example, 61 people, of whom 6 became hospitalized, contracted illness after swimming in a lake in which a child infected with *Shigella sonnei* had defecated. Swimming and other recreation activities in which the unintentional ingestion of water occurs are known to increase the risk of gastrointestinal illness even in non-outbreak settings.

Studies undoubtedly understate the number of waterborne disease outbreaks, since there is no requirement to report them to the National Centers for Disease Control and Prevention or any other institution.

Recreation-related pathogen loading has occurred in reservoirs in Southern California. In Los Angeles County, there have been reports of water quality degradation as a result of bather activity at Castaic Lake, Puddingstone Dam, and Santa Fe Dam. Based upon elevated fecal coliform counts, officials have periodically closed swim beaches at these lakes, and there have been reported cases of recreator-contracted illnesses. In 1985, an epidemiological study indicated that an outbreak of shigellosis, involving more than 40 people, was associated with swimming at Santa Fe Dam. Bacteriological data collected at the time of the outbreak suggested that bacterial levels increased with bather loading. In a letter to Peter Whittingham (Deputy, Fifth Supervisorial District of the County of Los Angeles), Jack Petralia (Director, Bureau of Environmental Protection) stated: "Available evidence clearly indicates that water quality deteriorates and risk for disease transmission increases with bather density. This evidence and bacteriological data collected during the past five years, by not only this Department but other public health agencies, indicate that there is substantial risk of disease transmission during periods of high bather density in fresh water swim areas."

Officials have also reported cases of shigellosis and swim beach closures in the County of Riverside in association with swimming at Lake Perris. In 1985, members of seven families contracted shigellosis from swimming in the lake. An investigation at that time indicated that defecation into the lake by an infected recreator was most likely the source. A study conducted at that time also indicated that bathers contributed to elevated coliform counts. In July 1986, officials identified six additional cases of shigellosis associated with swimming in Lake Perris. Lake operators have periodically closed their swim beaches due to contamination associated with recreation activity.

At any given time, an enteric microorganism infects some fraction of the population who may shed it in their fecal material. The prevalence of infection varies with age and the specific pathogen. Younger children tend to have a higher incidence of infection than older individuals. Based on a review of the published literature and input from the Blue Ribbon Panel, the study scientists determined the incidence of infection for enteric viruses and the protozoa *Giardia* and *Cryptosporidium*. The incidences ranged from a 2.2-percent infection rate for adults with *Cryptosporidium* to a 30-percent infection rate for children less than 12 years old with enteric viruses.

The concentration of pathogens in the fecal material of infected individuals also varies. Based on a literature review of reported concentrations of pathogens in fecal material and the recommendations of the Blue Ribbon Panel, the scientists calculated the values for the concentration of pathogens in the fecal material. Values ranged from 1 million per gram of feces for *Giardia* and *Cryptosporidium* to 10 billion per gram for rotavirus.

An enteric pathogen can infect an individual who can shed the organisms in his or her fecal material without showing any clinical signs of illness for several weeks before and/or after clinical illness occurs.

Although bodily secretions (for example, saliva or respiration) and excretions (for example, urine or feces) can introduce pathogens into the water, the risk assessment model for this study only considered pathogen input from fecal material. Input of pathogens to the reservoir from fecal material can occur in two ways: from an accidental fecal release (AFR) or by shedding (the washing of residual fecal material from the skin as a result of contact with the water).

Studies of bathers indicate that they shed the majority of the fecal material within the first 10 to 15 minutes of their contact with the water. Consequently, body-contact recreation as defined in this report includes any activity that results in contact with the water for a minimum of 15 minutes.

The scientists determined the mass of fecal material input by both shedding and AFRs in order to calculate the pathogen input:

$$\text{Number of Pathogens per Gram of Feces} \times \text{Number of Grams of Feces} = \text{Number of Pathogens.}$$

The scientists determined the mass of the average AFR to be 100 grams, based on values reported in the literature. They chose the frequency of AFR occurrence to be 1 AFR per 1,000 recreators for individuals older than 7 years of age and 1 per 150 recreators for individuals younger than 7. The scientists used their best professional judgment, with the input of the Blue Ribbon panel, to set these values, since they could not find any information in the published literature on the frequency of AFRs. However, the scientific literature does document cases of AFRs impacting public health.

In order to determine the mass of fecal material shed during water contact, the scientists used information from studies of gray water (wastewater from bathing). Combining this information with the reported concentration of fecal bacteria per gram of feces, they estimated that each person sheds about 0.1 gram of feces into the water.

They used the above information to determine the number of pathogens added to the reservoir by body-contact recreation through fecal shedding and AFRs.

DEVELOPMENT OF PATHOGEN MODEL

Based on assumptions about pathogen inputs, loss mechanisms, and transport, the scientists undertook a modeling effort to predict pathogen concentrations in the Eastside Reservoir subject to the alternative recreation scenarios.

The principle of mass balance forms the cornerstone of the model, allowing estimates of changes in the number of pathogens in the reservoir (or some volume within the reservoir) as a function of the number added and the number removed over some time interval; that is:

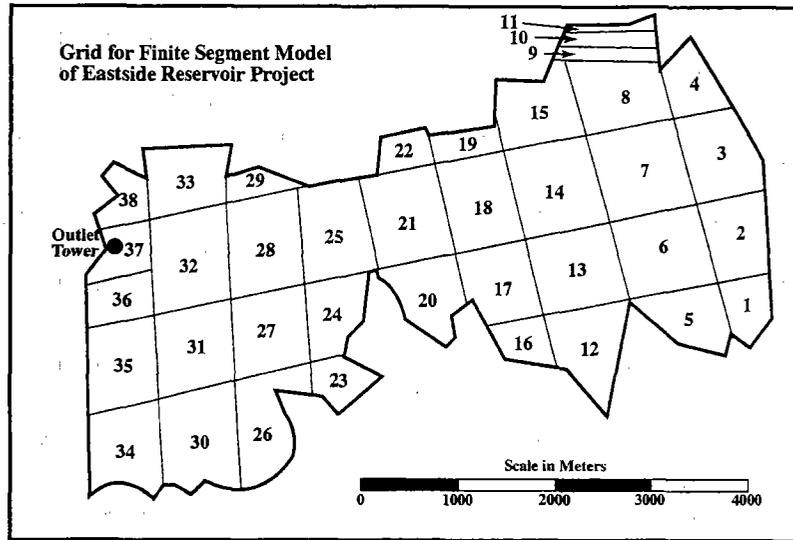
$$\text{Change in Pathogen Number} = \text{Pathogens Added} - \text{Pathogens Removed} \text{ (equation 1)}$$

Inputs resulted from recreator inputs (via fecal shedding and AFRs) and pathogens imported with the water flowing into the system. Water flowing out of the reservoir and inactivation and sedimentation losses within the reservoir would remove pathogens from the reservoir. The scientists thus rewrote the basic equation (equation 1) as:

$$\text{Change in Pathogen Number} = \text{Shedding} + \text{AFRs} + \text{Import} - \text{Export} - \text{Inactivation} - \text{Sedimentation} \text{ (equation 2)}$$

Equation 2 forms the basis for the model, using a finite-segment approach that assumes the division of the reservoir into a number of segments and describes pathogen fate in each segment. Chart 10 shows the segmentation grid used for these model calculations.

Chart 10



For modeling purposes, the reservoir contains 38 lateral segments, with each lateral segment further subdivided into an upper, epilimnetic zone and a lower, hypolimnetic zone for a total of 76 segments. Segment 37 bounds the inlet/outlet tower for the reservoir, with its lateral extent set at a likely no-use perimeter around the tower (about a 300-meter radius from the tower). The assumptions for the epilimnetic zone are 6 meters deep and uniform across the reservoir. The depth of the hypolimnetic zone depends on the local topography and total volume of the reservoir: assumed to vary seasonally about a mean annual operating volume of 600,000 acre-feet. The model assumed inflows in the winter and spring and withdrawals during the summer and fall, with the total reservoir volume peaking in late spring at 700,000 acre-feet and at a minimum of 500,000 acre-feet in late fall.

The model also took into account:

- The two main mechanisms to remove pathogens from the water: inactivation (the death of the pathogenic organism) and sedimentation.
- Wind energy and water currents that mix the surface water, tending to disperse high pathogen concentrations over time.
- Potential locations of each recreator on the reservoir: no activity in segment 37 (containing the inlet/outlet tower), all other segments for the full-reservoir scenarios, and segments 1-22 only for the divided basin scenarios.

The Blue Ribbon Panel, during the course of its review, recommended performing an uncertainty analysis for a number of variables used in the model in order to assess the consequences of using values for variables that the literature might have inadequately defined or might have a wide range of values.

The scientists made every effort to use best documented scientific values or those values recommended by members of the Blue Ribbon Panel. They built uncertainty analysis into the model by applying a *Monte Carlo* technique. For each recreator, *Monte Carlo* let the computer randomly select *any number within the range* of each input parameter to test whether that person is infected and determine which segment the person is in. Model runs totaled 5,000 simulations for each body-contact recreation scenario over two years of recreation use. Subject to these parameters, the model predicted the concentration of pathogens anywhere on the reservoir and at any time.

Chart 11 displays the variable input parameters for two pathogens, *Cryptosporidium* and rotavirus, used in the *Monte Carlo* analysis. The numbers in parentheses indicate the average values.

Chart 11. Variable Input Parameters Used in the Model Analysis

Parameter	<i>Cryptosporidium</i>	Rotavirus
Infection Rate [%]	0 - 5 (2.5)	5 - 20 (13.5)
Feces Shed—POPULATION [g/person]	0.01 - 1 (0.1)	0.01 - 1 (0.1)
Feces Shed—INDIVIDUAL [g/person]	0.001 - 10 (0.1)	0.001 - 10 (0.1)
Pathogen Content of Feces—POPULATION [g^{-1}]	$10^5 - 10^7 (10^6)$	$10^7 - 10^9 (10^8)$
Pathogen Content of Feces—INDIVIDUAL [g^{-1}]	$10^5 - 10^7 (10^6)$	$10^7 - 10^9 (10^8)$
AFR Frequency [per 1,000]	0 - 2 (1)	0 - 2 (1)
Mass of AFR—POPULATION [g/AFR]	50 - 150 (100)	50 - 150 (100)
Mass of AFR—INDIVIDUAL [g/AFR]	50 - 200 (100)	50 - 200 (100)
Inactivation Rate—EPILIMNION [day^{-1}]	0.016 - 0.15 (0.09)	0.1 - 0.5 (0.32)
Inactivation Rate—HYPOLIMNION [day^{-1}]	0.008 - 0.02 (0.01)	0.05 - 0.25 (0.16)
Recreator Use [$year^{-1}$]	0.5 - 1.5 x Recreator Projections	0.5 - 1.5 x Recreator Projections

Of particular concern is the concentration of pathogens at the outlet tower, since this will represent the concentration that will move to the treatment plant upon water withdrawal. Chart 12 shows an example of the model's prediction of the *Cryptosporidium* concentration at the outlet tower over the course of a year.

Chart 12. Example of Model Prediction of *Cryptosporidium* Concentration Over a Year Due to Body-Contact Recreation

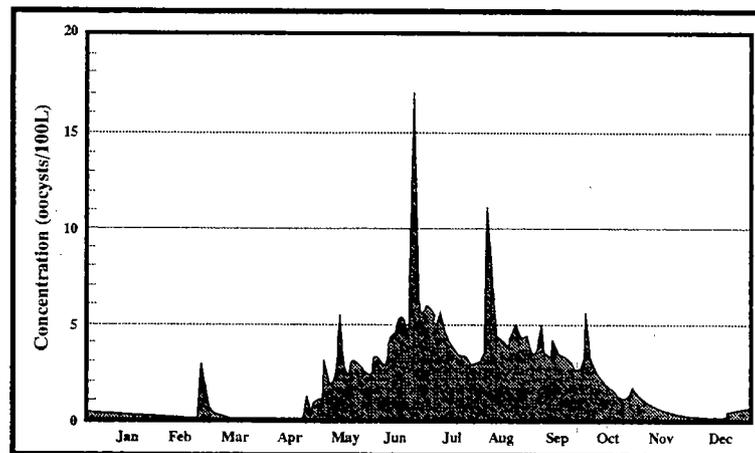


Chart 12 illustrates three features. First, under conditions of low recreator use (November through April), low concentrations generally occur near the outlet tower. Second, pathogen concentrations increase substantially during the high-use recreation season (May through September). Finally, transient peak concentrations would occur throughout the year. Of particular interest is the predicted peak in February, a time of low recreator use. It should be noted, however, that Chart 12 represents only one possible profile of pathogen concentration over time at the outlet tower in the reservoir.

REGULATORY BACKGROUND

The Surface Water Treatment Rule (SWTR), promulgated in 1989 by USEPA, regulates microbial contaminants such as *Giardia* and the enteric viruses. The State of California adopted the SWTR in 1991. This rule does not require monitoring for pathogens, but rather requires treatment sufficient for the removal of 3 logs (99.9 percent) of *Giardia* and 4 logs (99.99 percent) of enteric viruses. Conventional treatment—including pre-disinfection with chlorine, followed by coagulation, flocculation, sedimentation, filtration, and post-disinfection using chloramines as currently in effect at Metropolitan—meets all federal and state treatment requirements.

Currently, USEPA is in the process of modifying the SWTR to address new concerns associated with microbial and chemical contaminants. The earlier rule did not address protozoa such as *Cryptosporidium*. However, the revised rule, the Enhanced Surface Water Treatment Rule (ESWTR), will most likely have treatment and possibly monitoring requirements for *Cryptosporidium*. Proposed modifications to the SWTR range from no changes to actual log removal requirements for *Cryptosporidium* and other pathogens. In light of major outbreaks of cryptosporidiosis, it appears likely that USEPA will mandate specific treatment requirements to control exposure to this organism.

USEPA would most likely base ESWTR treatment requirements upon annual source water concentrations of *Cryptosporidium* and would require 1, 2, or 3 logs of additional treatment for source water *Cryptosporidium* concentrations of 1 to 9 oocysts/100 liters (L), 10 to 99 oocysts/100L, and >99 oocysts/100L, respectively. Conventional treatment would most likely achieve approximately 3 logs of removal. Consequently, source water *Cryptosporidium* concentrations exceeding 1 oocyst/100L would require a change in Metropolitan's treatment processes. Expectations are that the final date for promulgation of the ESWTR, while not yet resolved, will be by 1999 (with approximately three years for implementation by each state).

RISK ASSESSMENT

Risk assessment is a valuable tool used to estimate adverse effects associated with particular activities (in this case consuming water from the Eastside Reservoir Project) and is an essential component of risk management. The four fundamental steps used in a formal risk assessment include: (1) hazard identification, (2) dose-response determination,⁸ (3) exposure assessment, and (4) risk characterization. For this situation, the hazard is the presence of enteric viruses and the protozoa *Giardia* and *Cryptosporidium* in water. Dose-response data from human feeding studies are available for the microorganisms of interest.

The scientists used results from the reservoir model calculations to predict the number of organisms to which the consumer would be exposed for the various recreation scenarios. The scientists assumed that Metropolitan would treat all water leaving the reservoir at one of its water treatment plants. In addition, the scientists assumed that current Metropolitan treatment operations would decrease the number of pathogens in the water: *Giardia*—99.9 percent (3 log) removal; viruses—99.99 percent (4 log) removal; and *Cryptosporidium*—99.68 percent (2.5 log) removal.

The scientists used the dose-response models developed for each microorganism, USEPA's standard exposure level of 2 liters of water consumed by each person per day, and the results of the reservoir modeling effort to calculate the risk to consumers for the various recreation scenarios. Exposure to pathogens can lead to four different endpoints: no effect, infection, clinical illness, or death. To be consistent with the manner in which risk assessments are performed by USEPA, the scientists calculated the risk of infection from a given organism on an annual basis.

⁸ The pathogen amount (dose) required to cause infection (response).

During the course of model development, the scientists found *Cryptosporidium* to be the organism with the greatest impact on risk to downstream drinking water consumers. This is due, in part, to the organism's ability to survive for extended periods in water environments, its resistance to inactivation by conventional disinfection practices, and the known adverse health consequences of contracting cryptosporidiosis. Moreover, treatment practices effective for *Cryptosporidium* would, in general, effectively control other pathogens. Consequently, the scientists base the risk assessment results and corresponding costs for treatment in this report on *Cryptosporidium*.

MODEL RESULTS

Predicted Annual Cryptosporidium Concentrations and Associated Annual Risks to Consumers. The scientists present results as the predicted annual pathogen concentration at the reservoir's outlet tower. They determined pathogen concentrations at the Skinner filtration plant influent to be 91 to 99 percent of the concentration at the outlet tower due to the short transit time to the Skinner plant and the low rate of the pathogen's inactivation. In addition, they calculated the associated annual risk to consumers relative to a baseline level under both full basin and divided basin recreation scenarios.

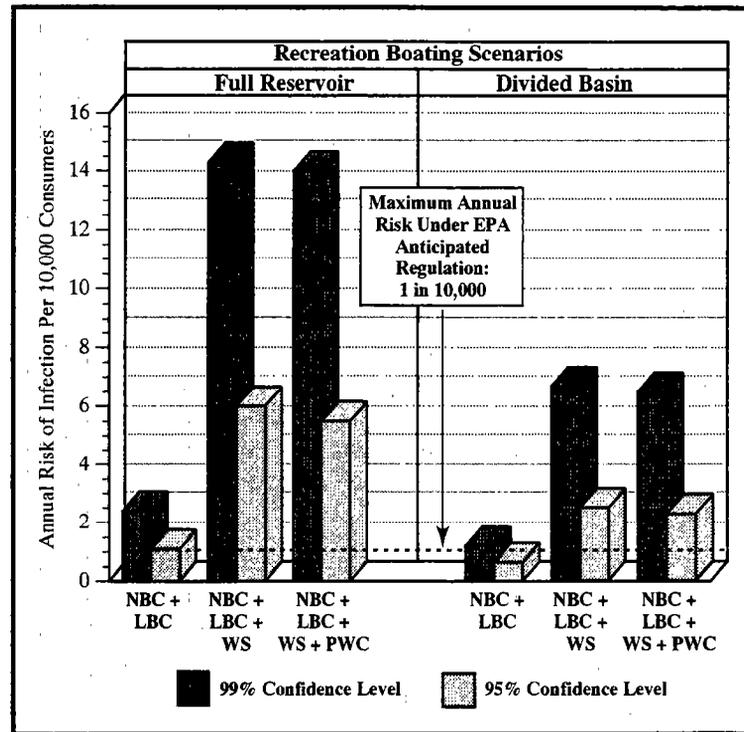
Source water monitoring for this study shows that the current annual average concentration of *Cryptosporidium* in waters expected to enter the Eastside Reservoir (which includes water used for body-contact recreation at Lake Silverwood and Lake Havasu) is **0.36 oocysts per 100 liters (L)**. This average annual concentration can fluctuate. For study purposes, however, the 0.36 oocysts/100 L is the baseline—the projected *Cryptosporidium* concentration in the reservoir in the absence of body-contact recreation. One infection in 10,000 people is favored in the current and proposed regulatory environment. The infection baseline for the Eastside Reservoir Project for study purposes is 0.36 infections in 10,000 people.

Concentrations exceeding 1.0 oocyst/100 L may require additional treatment under the proposed ESWTR. Irrespective of the ESWTR, increasing the concentration to 1.0 oocyst/100 L would also increase the annual risk to the consumer by a factor of 2.78 compared to the current exposure with a baseline concentration of 0.36 oocyst/100 L.

The scientists and Metropolitan calculated the potential *public health impacts* and *water treatment costs* at 95-percent and 99-percent confidence levels. At the 95-percent confidence level, there is a 95-percent probability that annual average pathogen concentrations will be equal to or less than the predicted concentration. At the 99-percent confidence level, the probability increases to 99 percent. The choice of the confidence level is important because it defines the probability that the concentration in the reservoir will exceed some concentration used in assessing the level of treatment required to meet current and proposed risk standards.

Chart 13 summarizes the impact of the proposed body-contact recreation scenarios.

Chart 13. Potential Annual Risk of Infection Associated with Body-Contact Recreation



Under *full reservoir use*, all proposed recreation scenarios would require additional treatment to comply with anticipated requirements of the ESWTR. The annual risk of infection associated with the predicted annual average concentration without additional treatment ranged from:

- 2.4 to 14.3 per 10,000 consumers, with a relative risk ranging from 6.9 to 41.0 times baseline at the 99-percent confidence level.
- 1.1 to 6.0 per 10,000 consumers, with a relative risk ranging from 3.2 to 17.1 times baseline at the 95-percent confidence level.

As an example, based on an estimated service area served by the Skinner plant containing 3.5 million people, the model predicts that there is a 95-percent probability that the annual number of additional infections due to body-contact recreation would be up to 385 to 2,100, depending on the recreation scenario.⁹ Without body-contact recreation, the model predicted the theoretical number of infections in the community to be up to 126 per year.

If Metropolitan were to restrict body-contact recreation to the east basin only (*divided basin use*), the proposed 50,100 limited body-contact scenario would not require additional treatment at the 95-percent confidence level, although the annual risk would be 1.8 times the current baseline. All other *divided basin* scenarios would require additional treatment. The annual risk of infection associated with the predicted annual average concentration without additional treatment for the *divided basin* scenarios ranged from:

- 1.2 to 6.7 per 10,000 consumers, with a relative risk ranging from 3.5 to 19.1 times baseline at the 99-percent confidence level.

⁹ At the 99-percent confidence level (*full reservoir*), the predicted additional infections would be up to 840 to 5,005 per year.

- 0.6 to 2.5 per 10,000 consumers, with a relative risk ranging from 1.8 to 7.2 times baseline at the 95-percent confidence level.

As an example, under the *divided basin* scenarios, the model predicts that there is a 95-percent probability that the annual number of additional infections in the Skinner service area due to body-contact recreation would be up to 224 to 875, depending on the recreation scenario.¹⁰

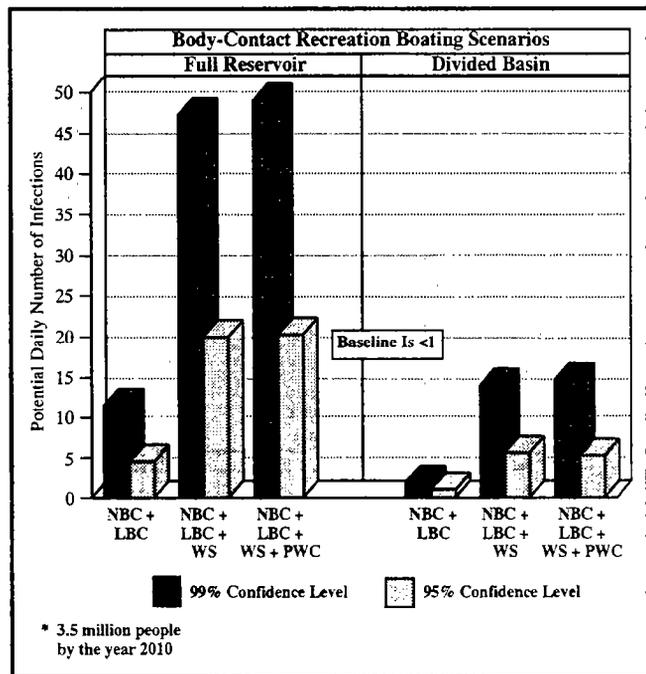
In addition to assessing the public health risks under the six body-contact boating scenarios, the scientists used the model to predict the maximum number of body-contact recreators allowable without the need for additional treatment (that is, stay within the expected ESWTR rule of 1 infection in 10,000 consumers per year):

	99% Confidence	95% Confidence
Full Reservoir Use	12,500	32,000
Divided Basin Use	27,000	81,000

Without additional treatment, allowing these levels would increase the risk of infection from *Cryptosporidium* to downstream water users by about 3 times above baseline conditions, while staying within the ESWTR.

Predicted Peak *Cryptosporidium* Concentrations and Associated Daily Risks to Consumers. In addition to the *annual average* concentrations, the model predicted *peak* daily concentrations at the outlet tower and the associated daily risks for each of the 5,000 simulations conducted for each scenario. Chart 14 summarizes the potential peak daily consumer *Cryptosporidium* infections in the Lake Skinner Plant service area from reservoir recreation.¹¹

Chart 14. Potential Daily Consumer *Cryptosporidium* Infections in the Lake Skinner Plant Service Area from Reservoir Recreation



¹⁰ At the 99-percent confidence level (*divided basin*), the predicted additional infections would be up to 420 to 2,345 per year.

¹¹ Based on an estimated population of 3.5 million by the year 2010.

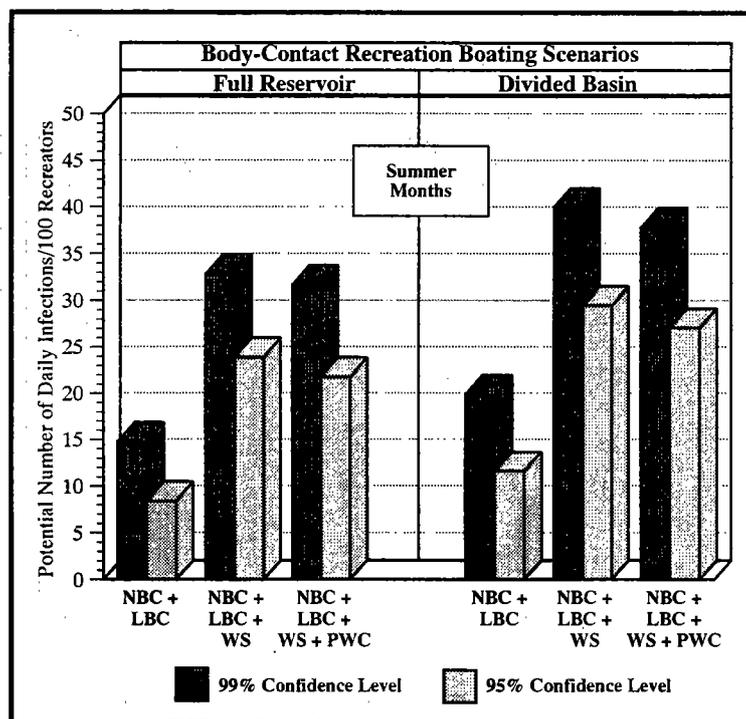
Peak concentrations (spikes) are rare events, but they do occur. Monitoring between 1994 and 1997 recorded two *Cryptosporidium* spikes in 180 water samples (1.1%) collected at Metropolitan's filtration plant influents: 127 oocysts/100L at the Jensen plant in May 1995 and 247 oocysts/100L at the Mills plant in February 1996. The model for the Eastside Reservoir Project predicts such spikes 1 percent or less of the time at the Eastside Reservoir.

While it is unlikely that USEPA will base regulatory requirements on peak concentrations, these events are relevant because they define the maximum concentrations that might enter the water treatment plant, resulting in sporadic episodes of waterborne illnesses.

RECREATOR-CONTRACTED INFECTION

In addition to the risk to downstream consumers of drinking water from the Eastside Reservoir, body-contact recreation can also pose a risk to recreators in the reservoir. The scientists performed a risk assessment calculation to determine the risk to recreators, assuming a single ingestion of 30 milliliters (ml) of water (about 1 ounce) during recreation. Some researchers have assumed that bathers ingest 100 ml of water during recreation. However, the scientists considered 30 ml to be a reasonable assumption for the types of body-contact recreators expected at the Eastside Reservoir. The scientists assumed recreator exposure to microorganism concentrations occurring in any sector of the reservoir. The daily risk to recreators of acquiring an infection from *Cryptosporidium* was relatively small (less than 1 per 100 recreators). However, the daily risk to recreators of acquiring an infection from rotavirus was significant, as shown in Chart 15.¹²

Chart 15. Potential Daily Risk to Recreators of Acquiring a Rotavirus Infection from Ingesting Reservoir Water



¹² The scientists did not run the model for all pathogens that might affect body-contact recreators.

During the summer months under *full reservoir* usage, the model estimates that:

- From 15 to 33 per 100 body-contact recreators (at the 99-percent confidence level) could become infected after consuming reservoir water.
- From 8 to 24 per 100 body-contact recreators (at the 95-percent confidence level) could become infected.

The relative numbers of infected body-contact recreators would be higher under the *divided basin* scenarios (up to 40 per 100) because the recreators would be confined to a smaller area. Higher body-contact recreation activity and proximity to sites of extremely concentrated pathogens (for example, recreating in a site recently contaminated with an AFR) would increase the probability of contracting an infection by pathogen microorganisms. Under peak events, the numbers could be about 2 times higher.

It is not feasible to disinfect the reservoir to reduce these infection rates.

CHEMICAL CONTAMINANTS ASSOCIATED WITH BODY-CONTACT RECREATION

The current recreation plan for the Eastside Reservoir would include boats, many of them motorized. Accidental spills during fueling operations and incomplete engine combustion would introduce fuel contaminants into the reservoir. Most gasoline components (for example, benzene, toluene, ethylbenzene, and xylenes) are very volatile and would most likely dissipate rapidly before entering the outlet tower. However, levels of fuels entering the reservoir from boating accidents or major spills could result in concentrations exceeding state and federal standards, thereby requiring modifications to reservoir operations.

The principal fuel contaminant of concern is methyl tertiary-butyl ether (MTBE), an oxygenate used in most of California's reformulated gasoline. The MTBE additive makes gasoline burn more cleanly and completely—thereby emitting less carbon monoxide into the air. The State Air Resources Board requires the use of reformulated gasoline year-round in California.

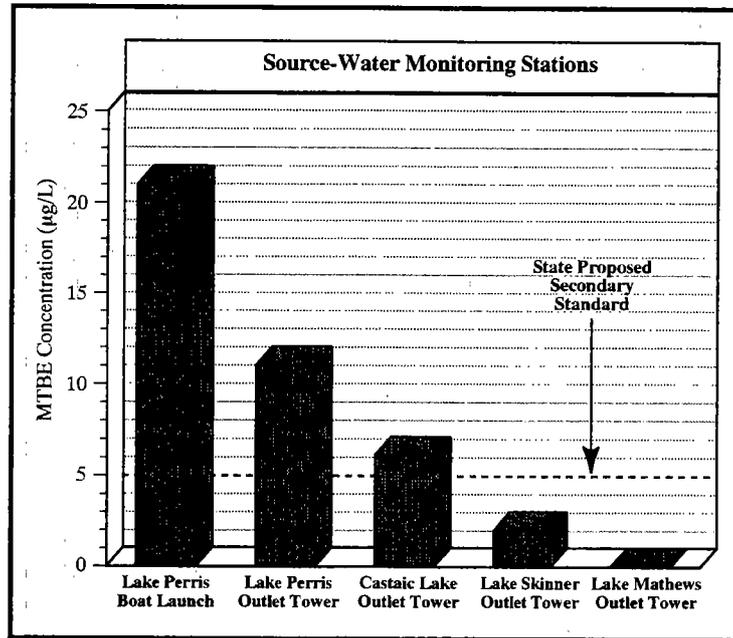
Now considering this fuel additive to be a possible carcinogen, USEPA has issued a draft Drinking Water Advisory for MTBE of 20 to 40 micrograms per liter ($\mu\text{g/L}$),¹³ based on projected consumer taste and odor recognition. The State of California Department of Health Services (CDHS) has set an action level of 35 $\mu\text{g/L}$ and issued a Notice of Proposed Rulemaking to include MTBE on the *Unregulated Chemical Monitoring List for Drinking Water* of the California Code of Regulations. Studies have shown that taste and odor thresholds for MTBE, of particular concern to water consumers, are in the range of 5 to 193 $\mu\text{g/L}$. The CDHS has proposed a secondary standard (which deals with taste and odor) for MTBE of 5 $\mu\text{g/L}$.

Studies have also shown that MTBE is present in some California reservoirs from recreation watercraft use, accidental fuel spills, and stormwater runoff. Metropolitan has conducted 15 months of compliance monitoring for MTBE in its source and finished waters. Chart 16 shows the average surface MTBE levels in Metropolitan's source waters.¹⁴

¹³ A "Drinking Water Advisory" level a range of concentrations of a substance in drinking water that would ensure consumer acceptance of the water and provide a large margin of safety from toxic effects. The Advisory gives guidance to communities that may have drinking water contaminated with MTBE.

¹⁴ Based on data current as of publication of this document.

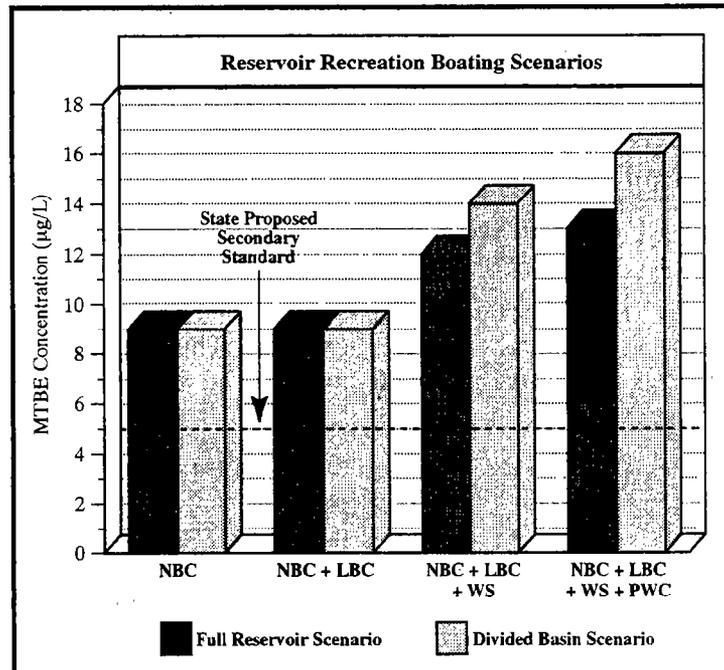
Chart 16. Average Surface MTBE Levels in Metropolitan's Source Waters



The majority of MTBE in surface water supplies most likely comes from the conventional two-stroke engines used in many recreation watercraft. Among the three reservoirs, the data show that only Lake Skinner (which has a relatively low level of recreation boating) and Lake Mathews (which has no recreation boating) would be in compliance with the proposed secondary standard. Metropolitan's Water Quality Division is continuing studies at the source water reservoirs at different depths and locations to understand the occurrence and fate of MTBE.

Given proposed actions by the federal and state regulatory agencies, data collected from source water reservoirs, and public concern about MTBE, the scientists developed an analytical model to predict MTBE concentrations in the Eastside Reservoir. The model assumed that MTBE input to the reservoir would be a function of the number of boats on the water and the MTBE emission rate per each type of boat and that removal would be by a volatilization reaction. The greatest recreation boat emitters of MTBE at the reservoir would be vessels powered by conventional two-stroke engines (mainly PWCs and small motorboats). Chart 17 displays the model's predictions for all the reservoir recreation scenarios during the summer months.

Chart 17. Predicted MTBE Concentrations on the Eastside Reservoir (Summer Months)



The model indicates that the average summer MTBE levels in the upper portion of the water column would range from 9 to 16 µg/L, depending on the number of motorized boats in each recreation scenario. Thus, no scenario would comply with the state's proposed secondary standard during the summer months. Projections of winter MTBE concentrations were at 2.6 to 3.9 µg/L (within the proposed standard).

Removing MTBE from surface water is difficult and expensive because this fuel additive vaporizes less efficiently and is adsorbed more slowly than other gasoline components.

Metropolitan could employ other options to ensure that MTBE levels stay under the state's proposed secondary standard for taste and odor (and therefore well under the proposed action level for health) at the Eastside Reservoir, such as banning fuel containing MTBE or watercraft powered by conventional two-stroke engines.

POTENTIAL FINANCIAL IMPACTS TO METROPOLITAN

ESTIMATED TREATMENT COSTS ASSOCIATED WITH POTENTIAL BODY-CONTACT RECREATION

The location and elevation of the Eastside Reservoir Project will allow Metropolitan to deliver water from the reservoir to about 90 percent of its service area. The water could pass through one of four Metropolitan treatment plants: Skinner in Winchester, Diemer in Yorba Linda, Weymouth in La Verne, or Mills in Riverside.

For study purposes, the cost analysis of treatment was for the Skinner filtration plant and treatment plants in the San Diego area that will receive water from the Eastside Reservoir Project.

The Skinner plant provides an example of the potential costs of treatment due to body-contact recreation at the reservoir.

The Metropolitan Board of Directors has approved a schedule calling for installing ozone disinfection equipment at the Skinner plant by 2006 to comply with the future potentially more stringent federal *Disinfectant/Disinfection By-Product Rule*, which regulates trihalomethanes (THMs), a byproduct of disinfecting water with chlorine.¹⁵ Metropolitan's current disinfectant is chlorine. The ozone dosage at Skinner (and all the other plants) will be 2.0 milligrams per liter (mg/L) in order to comply with the disinfection by-products standards.

Pending finalization of the federal rule, however, Metropolitan's Board of Directors has not yet appropriated funds for the design and construction of the Skinner plant retrofit.

Cryptosporidium is of greater concern than any other pathogen that may be introduced into the Eastside Reservoir through body-contact recreation. This organism is difficult to remove from water due to its small size and its resistance to conventional disinfectants such as chlorine and chloramines.

While ozone is effective in inactivating *Cryptosporidium*, the ozone dosage required to control THM formation at acceptable levels is not sufficient to control average annual or daily peak *Cryptosporidium* concentrations projected for most of the projected body-contact recreation scenarios at the Eastside Reservoir. Depending on the scenario, the confidence level (99% or 95%), and the goal (to maintain current *Cryptosporidium* baseline conditions or to meet proposed ESWTR regulations), the ozone dosage would range up to 5.0 mg/L, as shown in chart 18.

Chart 18. Treatment Ozone Dosage Required for the Eastside Reservoir Project Body-Contact Recreation Scenarios

Scenario & # of Body-Contact Boaters	To Maintain Baseline		To Meet the ESWTR	
	99% Conf	95% Conf	99% Conf	95% Conf
FULL RESERVOIR USE				
Limited Body-Contact Boating (LBC): 50,100	4.0	4.0	4.0	3.0
LBC + Water Ski (WS): 292,435	5.0	4.5	5.0	4.0
LBC + WS + PWC: 267,325	5.0	4.5	5.0	4.0
Regulatory Limit: 12,500 (99%); 32,000 (95%)	3.0	3.0	-	-
DIVIDED RESERVOIR USE				
Limited Body-Contact Boating (LBC): 50,100	4.0	3.0	4.0	0.0
LBC + Water Ski (WS): 277,185	4.5	4.0	4.0	4.0
LBC + WS + PWC: 254,955	4.5	4.0	4.0	4.0
Regulatory Limit: 27,000 (99%); 81,000 (95%)	3.0	3.0	-	-

At the 99-percent and 95-percent confidence levels, all body-contact recreation scenarios would require higher ozone doses in order to maintain Metropolitan's current average annual *Cryptosporidium* baseline conditions for source water of the Eastside Reservoir Project of 0.36 oocysts per 100 L and the current risk level of 0.36 infections in 10,000 people.

At the 99-percent confidence level in order to meet the expected ESWTR of 1 *Cryptosporidium* oocyst per 100 L, Metropolitan would not require additional treatment for two of the eight scenarios:

¹⁵ USEPA has classified trihalomethanes as probable human carcinogens.

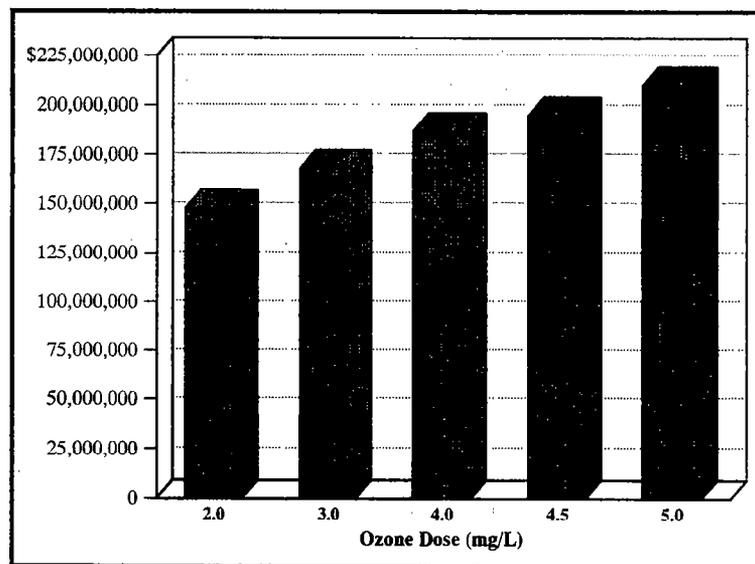
- *Full reservoir use*, number of annual body-contact boaters of all types limited to 12,500; and
- *Divided basin use*, number of annual body-contact boaters of all types limited to 27,000.

At the 95-percent confidence level in order to meet the expected ESWTR, Metropolitan would not require additional treatment for three of the eight scenarios:

- *Divided basin use*, limited body-contact boating only (50,100 annual LBC boaters);
- *Full reservoir use*, number of annual body-contact boaters of all types limited to 32,000; and
- *Divided basin use*, number of annual body-contact boaters of all types limited to 81,000.

The estimated capital cost to retrofit the Skinner plant to ozone with a dosage of 2.0 mg/L to comply with the expected disinfection by-products standards is \$147.7 million. Chart 19 compares capital costs of retrofitting with dosages of 2.0, 3.0, 4.0, 4.5, and 5.0 mg/L.

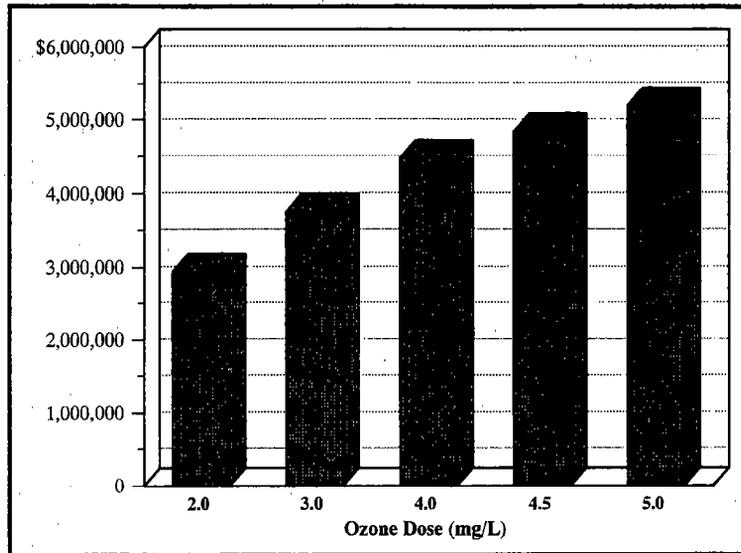
Chart 19. Estimated Capital Treatment Costs Associated with Eastside Reservoir Project Body-Contact Recreation Scenarios



Assuming that Metropolitan retrofits the Skinner plant with ozone by 2006 to reduce disinfection by-products to acceptable levels, the estimated additional capital costs associated with higher ozone dosages to control *Cryptosporidium* from body-contact recreation would be \$20.6 million (3.0 mg/L dose) to \$62.4 million (5.0 mg/L dose).

Chart 20 compares the estimated annual operations and maintenance (O&M) costs for each of the five dosage levels.

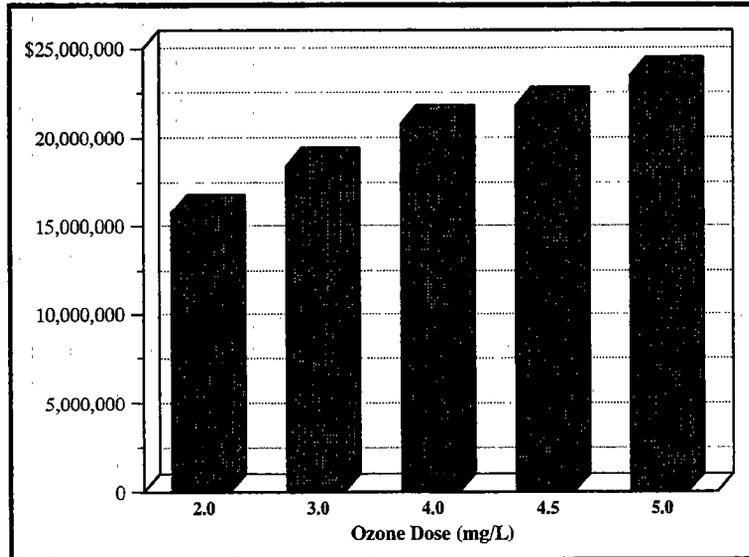
Chart 20. Estimated Annual O&M Treatment Costs Associated with Eastside Reservoir Project Body-Contact Recreation Scenarios



The estimated annual O&M costs at the 2.0 mg/L level are \$2.9 million. The estimated additional O&M costs associated with higher ozone dosages to control *Cryptosporidium* from body-contact recreation would be \$820,000 (3.0 mg/L dose) to \$2.3 million (5.0 mg/L dose).

Chart 21 compares the estimated annualized costs for each of the five dosage levels.¹⁶

Chart 21. Estimated Annualized Treatment Costs Associated with Eastside Reservoir Project Body-Contact Recreation Scenarios



The estimated annualized treatment costs at the 2.0 mg/L level are \$15.8 million. The estimated additional annualized treatment costs associated with higher ozone dosages to control

¹⁶ Annualized costs equal capital costs amortized over 20 years plus the annual O&M costs.

Cryptosporidium from body-contact recreation would be \$2.6 (3.0 mg/L dose) to \$7.7 million (5.0 mg/L dose), depending on the boating scenario and the confidence level.

Metropolitan based the above calculations of additional treatment costs on the model's predictions of the *average* annual *Cryptosporidium* concentrations and not the *maximum* annual concentrations that, for the *full reservoir* and *divided basin* scenarios, could be as high as 200 and 100 oocysts per 100 L, respectively. Daily peak *Cryptosporidium* loading events are also a concern. The model predicted maximum daily peak events under the *full reservoir* and *divided basin* scenarios at 2,500 and 525 oocysts per 100 L, respectively. It would be prohibitively expensive to build ozone facilities to treat these high oocyst levels. The statistical probability of these high levels occurring is less than 1 percent.

Other treatment plants receiving water from the Eastside Reservoir would require additional treatment similar to that at Skinner to accommodate body-contact recreation. The associated costs might be comparable to those at Skinner, depending on a number of factors including the level of pathogens introduced at those plants and the specific costs associated with each plant.

The treatment cost calculations do not include two additional factors. First, increasing the ozone dosage to achieve greater log inactivation of oocysts may result in the violation of bromate regulations. Bromate is an inorganic disinfection byproduct formed during the ozonation of waters containing bromide. USEPA has determined that it is a probable human carcinogen. Excessive bromate levels can be controlled by pH adjustment in the treatment process at an additional annual chemical cost of \$7 to \$12 per acre-foot.

Second, the calculations are for the Skinner filtration plant only and do not include additional treatment costs for San Diego filtration plants that will receive Eastside Reservoir water. Those plants would not necessarily benefit from *Cryptosporidium* treatment at the Skinner plant, since the San Diego Water Authority purchases both treated water from Skinner and untreated water that will be stored in the Eastside Reservoir.¹⁷

To estimate the potential additional treatment costs at San Diego's nine water treatment plants, Metropolitan reviewed available data with respect to plant treatment capabilities and *Cryptosporidium* concentrations at plant influents. Metropolitan then applied the same procedures in estimating costs that it used in developing the cost estimates for the Skinner plant.

In order to meet the expected ESWTR of 1 *Cryptosporidium* oocyst per 100 L, only one of the nine San Diego treatment plants (the R.A. Wesse facility in Oceanside) would need retrofitting with ozone due to body-contact recreation at the Eastside Reservoir. The estimated capital cost for this facility is \$8 million.

In order to maintain San Diego treatment plant baseline conditions (*Cryptosporidium* concentrations at plant influents without body-contact recreation on the Eastside Reservoir), all nine treatment plants would require retrofitting to ozone. The estimated capital costs range from \$6 to \$43 million per plant (\$89 to \$164 million in total), depending on the confidence level and body-contact recreation scenario.

Metropolitan bases the above estimates of San Diego treatment plant costs on limited *Cryptosporidium* monitoring data and generalized treatment cost assumptions. More accurate cost estimates would require additional monitoring data and information about site-specific treatment modifications at each of San Diego's treatment plants.

¹⁷ The cost of untreated water is less than the cost of treated water.

BODY-CONTACT RECREATION'S FINANCIAL IMPACT ON METROPOLITAN'S RECREATION REVENUES AND COSTS

The 1997 projections produced for this study showed that implementation of any of the reservoir boating scenarios (non body-contact and body-contact) would result in annual revenues to Metropolitan's recreation management entity that would exceed the annual costs.¹⁸ The 1997 projections further showed that while fees from body-contact recreation would increase annual overall recreation complex revenues to the recreation management entity by up to 8.9 percent, costs would increase more rapidly for sufficient patrol and control of body-contact operations and liability insurance premiums. Current data are not now available because Metropolitan is in the process of updating its estimated revenues and costs for the entire recreation complex.

POTENTIAL ECONOMIC BENEFITS TO THE REGION¹⁹

Metropolitan undertook two studies to estimate the potential economic benefits to the region from adding body-contact recreation on the reservoir. One was by Foster Associates, completed in 1997. Subsequently, the County of Riverside, the City of Hemet, and Metropolitan agreed to fund an independent economic study (completed in April 1998) to provide "a second opinion" on the estimated economic benefits to the region. Economist John Husing conducted the 1998 study.²⁰ Neither study undertook statistical estimates of uncertainty associated with the economic projections. The 1998 study did, however, examine a range of projections from "conservative" to "aggressive."

Chart 22 compares the Husing and Foster estimates of annual direct spending from reservoir recreator boating in the local economy for two recreation scenarios: non body-contact boating on the full reservoir and water skiing and PWC use on the east basin only (one of the divided basin scenarios).²¹ Both Foster and Husing conclude that the differences between the full reservoir and divided basin scenarios are economically insignificant.

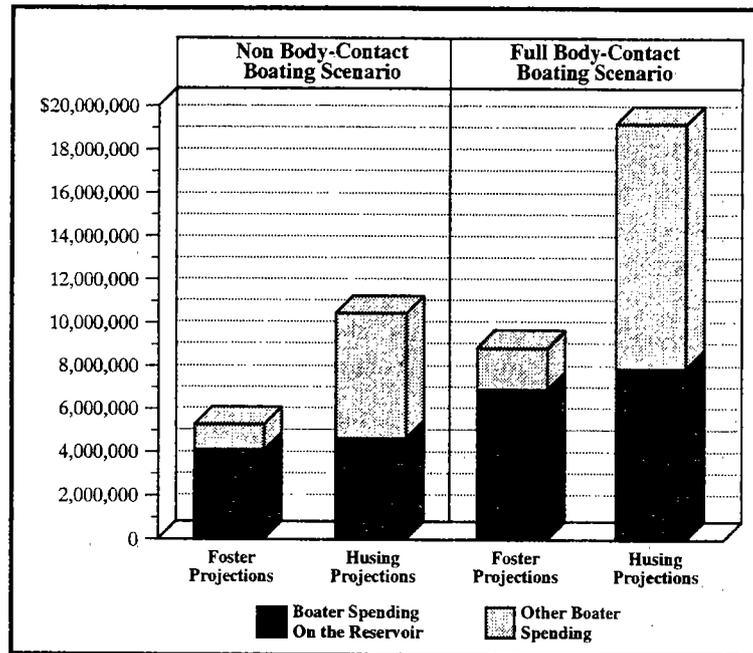
¹⁸ Not including any additional treatment costs.

¹⁹ Report by Foster Associates, Inc., *Recreation Financial and Economic Projections* (May 1997).

²⁰ John Husing, PhD, *Economic Impact on Boat Body Contact at the Eastside Reservoir* (April 1998).

²¹ Husing projects boater expenditures for four economic scenarios: "conservative," "cautious," "moderate," and "aggressive." He favors the "moderate" scenario, the projections presented in this report.

Chart 22. Estimates of Annual Direct Reservoir Boater Spending in the Local Economy: Foster and Husing Reports



The Foster and Husing estimates are relatively close with respect to annual boater spending on the reservoir (that is, launch, rental, angler, and storage fees). Husing's estimates for the boater spending are almost \$1 million higher than Foster's estimates mainly because Husing forecasts 21,000 more body-contact boats (and 46,000 more body-contact recreators) annually than Foster does.²² Husing benefited from 1997 surveys of public opinions and preferences about outdoor recreation that were not available to Foster when it made its estimates for this study. The 1997 surveys project a stronger demand for water skiing and PWC use in Southern California than did the earlier surveys available to Foster for this study. Both reports assume that the reservoir would reach boating capacity on summer weekends and holidays. Husing projects more body-contact boating on the non-capacity summer weekdays than Foster does.

Husing's estimates of annual other boater spending (for example, store food, eating out, fishing equipment, rentals, lodging, and boat and automobile fuel) are significantly higher than Foster's estimates because Husing includes direct boater spending **in the local community outside the recreation complex**. Foster's estimates are for total in-park sales only.

Looking at total direct boater spending in the region:

- Foster estimates that body-contact recreation would annually add \$3.6 million (\$5.3 million under the non body-contact scenario rising to \$8.9 million for the body-contact scenario).
- Husing estimates that body-contact recreation would annually add \$8.7 million (\$10.4 million under the non body-contact scenario rising to \$19.2 million for the body-contact scenario).²³

²² Metropolitan has made no assessment to determine the extent to which the 46,000 additional body-contact recreators (18%) would increase the public health risk to water consumers or reservoir recreators.

²³ Husing's preferred economic scenario among four that he evaluated.

Both studies also examined the impact of body-contact recreation on total economic activity in the region: direct spending (as summarized above) and second-round spending.²⁴

- Foster estimates that body-contact recreation would annually add \$7.6 million to total economic activity (\$13.9 million under the non body-contact scenario rising to \$21.5 million for the body-contact scenario).
- Husing estimates that body-contact recreation would annually add \$13.9 million (\$14.5 million under the non body-contact scenario rising to \$28.4 million for the body-contact scenario).

The Foster and Husing estimates are not totally comparable with respect to total economic activity. First, as stated above, Husing's projection of the number of body-contact boaters is higher, and he includes spending in the local community outside the recreation complex. Second, Husing's estimate is for **new** spending: projected direct and second-round expenditures by (1) non-local residents and (2) local residents who, without the reservoir project, would have spent their money on recreation elsewhere. Foster's estimate is for **total** spending.

Comparison of the two studies does not take into account estimated spending in the total recreation complex. Metropolitan has committed \$58 million in capital funds to build the recreation complex at the Eastside Reservoir Project. Projections are that private and other public sources will eventually bring the total public/private investment in the recreation complex to \$200 million. The great majority of that investment will be for a wide variety of recreation facilities in the east and west recreation areas below the two dams.

Projections are that annual total recreation complex visitation will be at least 2.4 million people by 2010 without body-contact recreation on the reservoir. Reservoir boaters would account for 16 percent of the visitors. Under the body-contact recreation scenarios, reservoir boaters would account for up to 24 percent of the total visitors, depending on the scenario. Under all of the reservoir recreation boating scenarios, reservoir boating would account for a minority of total recreation complex visitors—an important fact in determining the overall economic benefits to the region from adding body-contact recreation.

In general, however, both Metropolitan and Foster accept Husing's projections of the annual economic benefits to the local community from reservoir boating.

POTENTIAL ENVIRONMENTAL IMPACTS

Metropolitan is currently preparing a *Supplemental Environmental Impact Report* (SEIR) for the entire recreation plan that will analyze non body-contact recreation boating and necessary on-shore facilities to accommodate such boating.

The final project EIR and its addenda that have, to date, provided California Environmental Quality Act (CEQA) clearance for the project have assumed that there would be no body-contact recreation on the reservoir itself. Selection of a body-contact boating scenario would require additional environmental evaluation, the determination as to whether any new or changed impacts were significant, and the proposal of mitigation measures (if necessary) in the appropriate documentation under CEQA.

²⁴ Second-round spending includes *indirect* effects (the income generated from the production of goods and services that direct sellers purchase) and *induced* effects (the income generated from the spending of wages, salaries, and profits by the direct and indirect sellers of goods and services).

This is due to the fact that:

- There would be a substantial change in the operational use of the reservoir.
- Body contact activities could result in impacts that the project EIR did not consider. These impacts could be more severe than those addressed in the project EIR.
- Under some scenarios, these new effects could be significant.
- New mitigation measures might be required to reduce new impacts.
- New significant impacts might not be able to be reduced to a level of non-significance by the application of these mitigation measures.

CEQA would require additional environmental clearance documentation, in the form of an Initial Study/EIR Addendum or possibly a Supplemental EIR, to determine the potential effects of body-contact uses on water quality (public health issues), water treatment requirements, public safety, noise, traffic, air quality, utilities and services, and growth inducement. Many of the studies summarized in this document would contribute to determining the nature and magnitude of these effects, and to determining if any necessary mitigation, particularly for water quality, is feasible or cost effective.

WATER QUALITY

The addition of body-contact use may result in a variety of water quality impacts not addressed in the final EIR, as amended. Most important of these are viruses and protozoans that cause disease and fuel contaminants such as MTBE, a possible carcinogen and potential source of undesirable water taste and odor. The presence of these constituents in the reservoir water could in turn increase potable water treatment requirements (these issues are discussed more thoroughly elsewhere in this document). The new environmental clearance document would summarize the studies done to date.

Evaluation would include the feasibility of providing a level of treatment that preserves public health and avoids significant degradation of the quality of Metropolitan's drinking water in accordance with the proposed ESWTR. The difference in treatment cost associated with the addition of body-contact activities should reflect only that increment required due to the change in water quality caused by body-contact on the reservoir and not the whole cost increase associated with meeting the new standards. Whether or not a significant impact remains after feasible treatment is added is contingent upon the amount of body-contact recreation permitted and the level of water treatment deemed necessary and feasible.

PUBLIC SAFETY

Water skiing and PWC operation are generally considered to be high-risk activities, the presence of which could result in increased accidents and injuries and a greater demand for emergency medical services at the Eastside Reservoir Project. The demand for such services is an additional impact upon the surrounding community that provides paramedics and hospital facilities. Environmental analysis would include an evaluation of the significance of these impacts, including the projected rate of injuries and the demand on the communities' medical resources.

NOISE

The loudest contributors to noise would be the high-horsepower engines of water ski boats and PWCs. The high-pitched noise of high-revving two-stroke engines would be a continuous presence on the reservoir during the hours of the day when permitted. Sensitive receptors within the reservoir watershed could include lodge guests, hikers and picnickers along the shoreline trails, and wildlife within the Multi-Species Reserve.

A noise study prepared by independent consultants utilized noise data gathered at Lake Perris and Lake Skinner to calibrate a model that simulated future noise levels at the Eastside Reservoir Project under the non body-contact and full body-contact recreation scenarios both within the reservoir watershed and in the surrounding area, including the planned east and west recreation areas. The noise study demonstrated that there would be no significant noise impact to areas outside of the reservoir site and minimal effects within the reservoir watershed. Even without considering the substantial noise barrier effects of the intervening topography, projected noise levels for the areas below the dams and beyond the hills that confine the reservoir would be below the noise standards set by the County of Riverside for daytime hours. However, even with the relatively low forecast noise levels, intermittent ski boat and PWC noise during the day might disturb certain hikers and picnickers coming to the reservoir to seek a pastoral experience. There will be no personal boating activity on the reservoir after dusk for safety and security reasons.

BIOLOGICAL RESOURCES

The 13,000-acre Southwestern Riverside County Multi-Species Reserve is adjacent to the reservoir along its north and south shorelines. Metropolitan created the Reserve as mitigation for impacts to sensitive biological resources from construction and operation of the reservoir project. There are comprehensive and binding mitigation agreements with respect to the Reserve among Metropolitan, the California Department of Fish and Game, the US Fish and Wildlife Service, the Riverside County Habitat Conservation Agency, and the Riverside County Regional Park and Open Space District. These agreements, embodied in the Multi-Species Habitat Conservation Plan (October 1992), assumed that reservoir recreation would minimally disturb Reserve habitat because that recreation would include only non body-contact boating.

Additional environmental documentation would therefore have to include detailed studies to ensure that body-contact recreation would not jeopardize the mitigation agreements. The studies would include a noise study to establish the threshold of significant impacts to wildlife using the reservoir and the development of control measures, if necessary, to prevent or mitigate significant impacts.

Based on preliminary noise modeling results, an independent biologist who has been working with Metropolitan on Reserve issues has concluded that noise levels from body-contact boating are not likely to have a significant impact on wildlife. The noise study would have to verify this conclusion.

In addition to noise, biological studies would have to address concerns about increased access into the Reserve due to increased shoreline access. The studies would also examine management plans for reservoir recreation to ensure the strict control of access to the Reserve by body-contact recreators in order to prevent or mitigate any potential adverse impacts.

TRAFFIC/CIRCULATION

The environmental clearance document for body-contact recreation would have to update analyses prepared by independent consultants on the recreation plan to consider highway traffic and circulation that body-contact recreators would add.

AIR QUALITY

Current projections are that the addition of incremental air emissions from boats, increased motor vehicle traffic, and minor additional utility use due to body-contact activities would add a very small amount to the air emissions arising from the operations of the recreation areas—not considered to significantly increase overall air quality impacts. The environmental clearance document for body-contact recreation would validate this assessment.

UTILITIES AND SERVICES

Body-contact recreation would increase demand for medical and police services, particularly for enforcement on the reservoir. The additional rules necessary for minimizing liability and reducing noise impacts from ski boat and PWC operation would place an additional burden on patrol boats. The incremental increase in recreation area visitation created by the availability of body-contact recreation would also increase the demand for utilities. This demand increase would be relatively small compared to the overall recreation demand and should not be significant. An environmental clearance document would, however, evaluate the potential impacts.

GROWTH INDUCEMENT

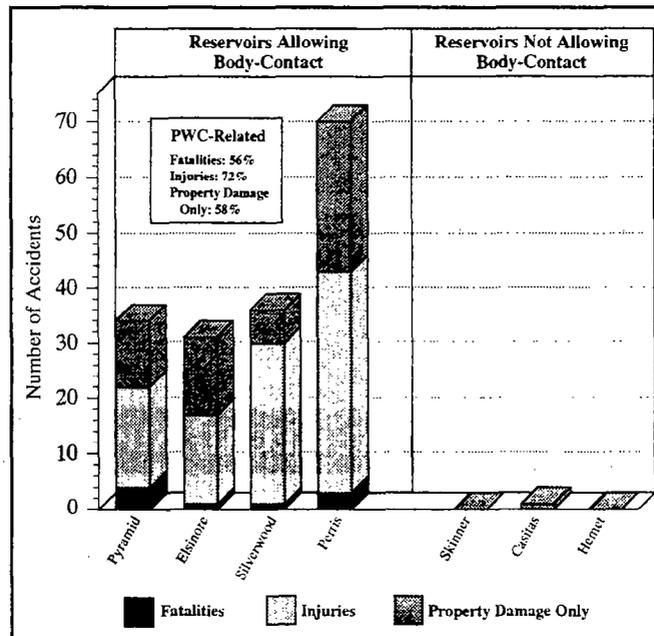
Based on the economic forecast data included in this report, the additional visitors drawn to the reservoir by the opportunity for body-contact recreation would provide an additional economic benefit in the region in terms of increases in gross sales, personal income, and local tax revenues. As a result, there might be secondary economic/growth impacts due to spending by these additional recreators. These and other considerations, such as the effect of higher water treatment costs due solely to body-contact recreation, would require evaluation in considering the growth inducement implications of body-contact recreation.

POTENTIAL LIABILITY IMPACTS

PERSONAL INJURY

Metropolitan has expressed concern about its liability if personal injury were to result from body-contact recreation on the reservoir. Chart 23 compares boating accidents over a two-year period at seven Southern California reservoirs that allow recreation boating.

Chart 23. Boating Accidents at Selected Southern California Reservoirs (1995-96)



The chart indicates that body-contact boating does cause substantially more accidents than non body-contact boating. The main concern is about PWC use. The California Department of Boating and Waterways reports that boating accident injuries are at an all-time high. In 1996, 850 accidents were reported to the department involving 537 injuries, 56 fatalities, and \$2.2 million in property damage. PWCs accounted for 16 percent of the vessels registered in California, but were involved in 45 percent of the 1996 boating accidents and 55 percent of the injuries. Operator inexperience was the number-one cause of PWC-related accidents, figuring in about half of these accidents. In collisions between PWCs and other vessels, the PWC operator was nearly three times as likely to be exclusively at fault. The number of youth operators (those under 18 years of age) involved in accidents, accidents involving them, and injuries and fatalities resulting from these accidents have risen from 1995. Operator inexperience was a factor in 68 percent of accidents involving youth operators. By comparison, operator inexperience was a factor in only 33 percent of accidents involving operators of all ages. In collisions with adults, youth operators were twice as likely to be exclusively at fault. Ninety-three percent of youth operators involved in accidents were operating PWCs. Of these youth operators, 65 percent were under the age of 16.²⁵

In 1997, the American Medical Association cited PWC safety as a nationwide problem. Based on national estimates, injuries associated with PWC use have increased fourfold from an estimated 2,860 in 1990 to more than 12,000 in 1995. During the same period, there was a three-fold increase in the number of PWCs in operation, from approximately 241,500 in 1990 to an estimated 760,000 in 1995. The rate of injuries related to PWCs treated in emergency departments was about 8.5 times higher than the rate of emergency-department-treated injuries from motorboats.²⁶

The PWC industry is trying to address this safety problem, which it believes results mainly from inadequate education for PWC operators. In February 1998, the Personal Watercraft Industry Association introduced model legislation for state legislatures to consider, calling for mandatory education for all PWC operators and a minimum age of 16 for all operators. The states of Connecticut, New Jersey, and Maryland, which already have such legislation, report substantial decreases in PWC injuries as a result.

Although there are legal exemptions from liability for the dangers inherent in high-risk activities such as water skiing and PWC use, Metropolitan would assume some additional liability and legal defense costs if such high-risk uses were permitted at the Eastside Reservoir Project.

The addition of water ski boats and PWCs on the reservoir would more than quintuple annual liability insurance premiums over the non body-contact and limited body-contact recreation scenarios.

PUBLIC HEALTH

There may be some additional risk of liability to Metropolitan resulting from any increase in diseases to water consumers and to reservoir body-contact recreators resulting from contamination in the water caused by body-contact recreation.

POTENTIAL LEGAL IMPACTS

Existing State law concerning body-contact recreation was the result of a concerted effort in the mid-1950s to open publicly owned reservoirs to recreation uses. In 1957, several bills to

²⁵ California Department of Boating and Waterways, press release, May 27, 1997.

²⁶ *Journal of the American Medical Association*, August 27, 1997.

that end were introduced in the State legislature. One of the main concerns of public water purveyors was public health. Other concerns included who should decide for or against recreation use, administration, cost (particularly concerning increased treatment costs), and potential liability. The result of this process was inclusion of new sections (4050 through 4055) in the California State Health and Safety Code in 1957, which were recodified as Sections 115825 - 115850 in 1994. With one exception, the Health and Safety Code prohibits body-contact recreation in reservoirs in which water is stored for domestic use. The sections provide:

115825. (a) It is hereby declared to be the policy of this state that multiple use should be made of all public water within the state, to the extent that multiple use is consistent with public health and public safety.

(b) Except as provided in Section 115840, recreation uses shall not, with respect to a reservoir in which water is stored for domestic use, include recreation in which there is bodily contact with the water by any participant.

115830. All water supply reservoirs of a public agency, whether heretofore or hereafter constructed, shall be open for recreation use by the people of this state, subject to the regulations of the department.

115835. Unless the context otherwise requires, the following definitions shall control the construction of this article:

(a) "Multiple use" includes domestic, industrial, agricultural, and recreation uses.

(b) "Public agency" means the state or any city, other than a chartered city, county, public district, or other public institution.

(c) "Reservoir" does not include ditches, canals, or any similar type of water distributing facility.

115840. (a) In San Diego County, recreation uses shall not, with respect to a reservoir in which water is stored for domestic use, include recreation in which there is bodily contact with the water by any participant, unless both of the following conditions are satisfied:

(1) The water subsequently receives complete water treatment, including coagulation, flocculation, sedimentation, filtration, and disinfection, before being used for domestic purposes.

(2) The reservoir is operated in compliance with regulations of the department, as provided in Section 115830.

(b) The recreation use may be subject to additional conditions and restrictions adopted by the entity operating the water supply reservoir, if the conditions and restrictions do not conflict with regulations of the department and are designed to further protect or enhance the public health and safety.

115845. The public agency operating any water supply reservoir that is open for recreation use pursuant to this article may charge a use fee to cover the cost of policing the area around the reservoir, including the cost of providing the necessary sanitary facilities and other costs incidental to the recreation use of the reservoir.

115850. This article does not apply to terminal reservoirs for the supply of domestic water.

Two of the City of San Diego's reservoirs (El Capitan and San Vicente) allow water skiing and PWC use under Section 115840. No other reservoir in the state covered by Section 115825 (b) allows water skiing and PWC use.

In 1961, as part of the Burns-Porter Act, Section 12944 was added to the State Water Code for State Water Project facilities, as follows:

Use of water for body contact sports: (a) In the operation of reservoirs, other than terminal reservoirs from which water is supplied for domestic use without purification treatment after withdrawal from such reservoirs, constructed under this chapter, the department [The California Department of Water Resources], to the extent that is compatible with public health and safety requirements, shall permit the use of water for body contact sports.

As a result of Section 12944, State Project reservoirs are open for body-contact recreation.

If Metropolitan were to decide to allow body-contact recreation on the reservoir at the Eastside Reservoir Project, a change in state law would be required because:

- 115825 (b) of the California State Health and Safety Code, which covers the Eastside Reservoir Project, prohibits body-contact recreation.
- Section 12944 of the State Water Code, which provides for body-contact recreation in State Water Project reservoirs, does not apply to the Eastside Reservoir Project.

APPENDIX

GLOSSARY OF SCIENTIFIC AND TECHNICAL TERMS

Bacteria. Single-celled microorganisms that vary in terms of their form and structure, oxygen and nutritional requirement, and power to move spontaneously. They may be free-living, saprophytic (growing on or deriving nourishment from dead or decaying organic matter), or pathogenic (causing disease in plants or animals).

Carcinogen. A chemical, physical, or biological substance that is capable of causing cancer.

Chloramine. Any of several compounds containing nitrogen and chlorine. An unstable colorless liquid that decomposes in alcohol and air, it is used as an antiseptic and an oxidizing or chlorinating agent.

Chlorine. When added to water, this greenish-yellow toxic gas combines with the water to form hypochlorous acid (a water purifier and disinfectant) that then ionizes to form hypochlorite ion.

Coliform. Of or relating to bacteria that commonly inhabit the intestines of humans and other animals. Total coliforms (all coliforms) and fecal coliforms are indicator organisms.

Cryptosporidium. A parasitic protozoan found in the intestinal tracts of humans and other animals that causes cryptosporidiosis, which is characterized by severe diarrhea in humans. First recognized as a human pathogen in 1976. *Cryptosporidium* is hard to detect and very resistant to water disinfectant chemicals. Very low levels of *Cryptosporidium* oocysts in water may result in infection. There is no effective medication for cryptosporidiosis, which can be life-threatening to persons with suppressed immune systems.

Enteric. Of or relating to the intestine.

Epidemiological studies. Dealing with the causes, distribution, and control of disease.

Epilimnetic zone. The relatively warm and uniformly mixed upper-most layer of the water in a reservoir. Pathogens survive longer in the epilimnetic zone.

***Escherichia coli* (E. coli).** A bacterium normally found in the intestinal tracts of humans and other animals and existing in numerous strains, some of which are responsible for diarrheal diseases. A significant cause of diarrhea. An indicator organism, since its presence in water is an indication of recent fecal contamination from humans and other animals.

Gastroenteritis. An inflammation of the mucosa of the stomach and intestine-caused by viruses, bacteria, or an intolerance of specific foods.

Giardia. A parasitic protozoan found in the intestinal tracts of humans and other animals.

Hepatitis A virus. An enteric virus typically transmitted through the consumption of water or food contaminated with human feces.

Hypolimnetic zone. The colder lower-most layer of the water in a reservoir.

Inactivation. The loss of a pathogen's ability to complete an infection.

Indicator organism. A microorganism used to indicate the presence of, or act as a surrogate for, the behavior of disease-causing microorganisms.

Log. Logarithm. The power to which a base, usually 10, must be raised to produce a given number. For example, $10^3 = 1,000$.

Methyl tertiary-butyl ether (MTBE). The principal oxygenating compound used to reformulate gasoline, particularly in California.

Microbiology. The scientific study of organisms too small to be seen by the naked eye (for example, protozoans, viruses, and bacteria).

Microorganism. A general term for any microscopic organism (for example, protozoans, viruses, and bacteria).

Oocyst. The environmentally resistant form of Coccidian parasites (for example, *Cryptosporidium*).

Ozone. A pungent, unstable blue gas used in the purification of drinking water and as an oxidizing agent.

Parasite. An organism that grows, feeds, and is sheltered on or in a different organism while usually harming the host.

Pathogen. Any virus, bacteria, protozoan, or other microorganism that causes disease.

pH. The negative power of the hydrogen ion concentration.

Poliovirus. An enterovirus causing poliomyelitis.

Protozoa. A large group of single-celled, usually microscopic organisms (such as amoebas).

Recreator day. One person entering a recreation facility on a single day. The person may participate in one or more activities.

Rotavirus. An enteric virus that is the major cause of gastroenteritis, especially in infants and newborns.

Salmonella. Any of various rod-shaped bacteria of the genus *Salmonella*, many of which are pathogenic—causing food poisoning, typhoid, and paratyphoid fever in humans and other infectious diseases in domestic animals.

Salmonellosis. Any infection caused by *Salmonella*. More than 2 million cases annually in the United States.

Shigella. Any of various rod-shaped bacteria of the genus *Shigella*, which includes some species that cause diarrhea (3% of the cases reported annually in the United States).

Trihalomethane (THM). One of the family of organic compounds, derivatives of methane, which are formed when chlorine reacts with acids from plant material.

Two-stroke engine. Comprising an internal-combustion engine cycle, completed in two strokes, in which the piston compresses the fuel mixture on one side and receives the thrust of the previously compressed gases on the other side during the first stroke and then draws in a fresh charge on one side while expelling gasses on the other side during the second stroke. Contrasted with a **four-stroke** engine, comprising an internal-combustion engine cycle that is completed in four strokes: a suction or induction stroke, a compression stroke, an expansion or power stroke, and an exhaust stroke.

Virus. Any of various simple microscopic parasites of plants, humans, animals, and bacteria that often cause disease. Viruses depend totally on living cells for reproduction.

Volatile organic chemical. A chemical that evaporates easily. Benzene, THMs, ethylbenzene, and toluene are volatile organic chemicals.

Volatization. The vaporization of a substance by a heat transfer or the lowering of pressure.

THE EASTSIDE RESERVOIR PROJECT

In October 1991, the Board of Directors of the Metropolitan Water District of Southern California authorized construction of the Eastside Reservoir Project to provide over 16 million people in Metropolitan's service area with a dependable, safe, and cost-effective water supply. The project site is located in a portion of the Domenigoni and Diamond valleys southwest of Hemet.

When completed in 1999, the reservoir will hold 800,000 acre-feet of water (269 billion gallons). By almost doubling Metropolitan's water storage capacity, the reservoir will store enough water to:

- supply Metropolitan's customers for up to six months if a major earthquake were to rupture aqueducts bringing water from Northern California and the Colorado River;
- augment existing water supplies during at least two years of drought;
- augment existing water supplies to help meet peak demand during the summer months; and
- ensure the long-term availability of water for replenishing local groundwater basins.

Located between mountains to the north and south, the reservoir will have two main dams: an east dam rising 185 feet above the valley floor and a west dam rising 285 feet. A saddle dam in the northern hills will rise 130 feet above the low point in the ridge line. Associated hydraulic structures will consist of an inlet/outlet tower, pump plant, secondary inlet, pressure control facility, release facilities, connecting tunnel, and forebay.

The reservoir will be the largest drinking water reservoir and freshwater lake in Southern California: 4,500 surface acres (4.5 miles long and up to 2 miles wide).

The project includes:

- a new outdoor recreation complex with fishing and boating, large parks outside the east and west dams, and an extensive trail system; and
- environmental reserves with more than 16,000 acres to protect and enhance the area's rare and endangered plants, birds, and animals.

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Metropolitan was formed in 1928 under an enabling Act of the California Legislature. Historically, Metropolitan has provided supplemental water to the Southern California coastal plain to add to local water supplies developed by surface catchment, groundwater production, and wastewater reclamation.

Metropolitan delivers this supplemental water to 27 member agencies through a regional network of canals, pipelines, reservoirs, treatment plants, and associated works.

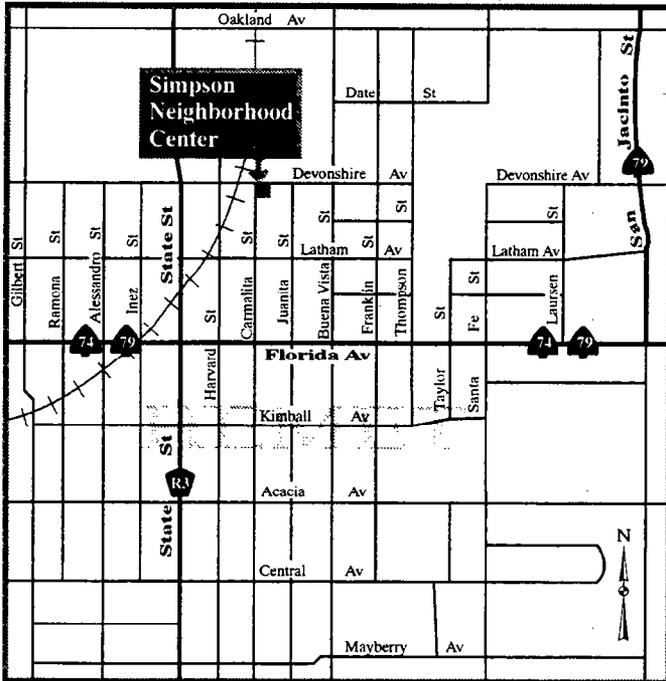
Metropolitan receives water from the California Aqueduct of the State Water Project and from the Colorado River Aqueduct and their terminal reservoir facilities for distribution to about 250 cities and unincorporated communities within a 5,135-square-mile service area covering portions of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties.

The mission of the Metropolitan Water District of Southern California is to provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way.

PUBLIC HEARING LOCATIONS & PARKING INFORMATION

HEMET

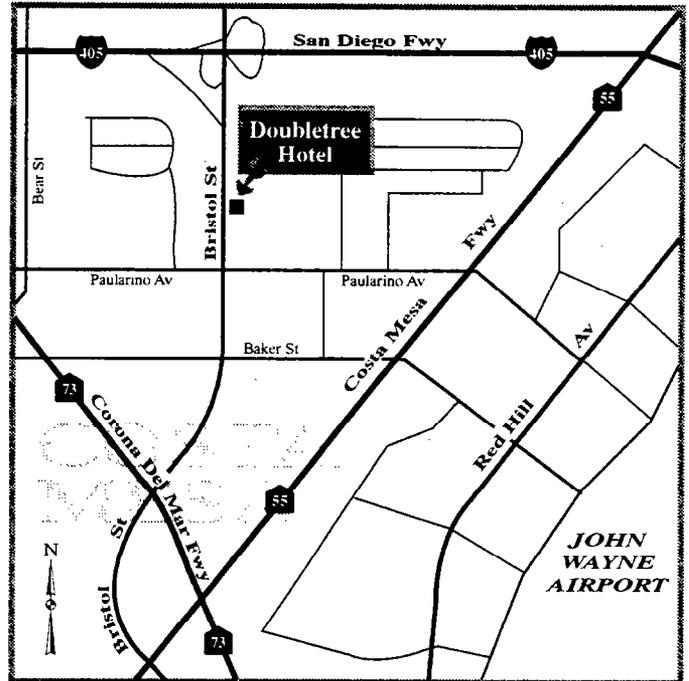
WEDNESDAY EVENING, JULY 29



Free Parking. Enter on Devonshire Ave.

COSTA MESA

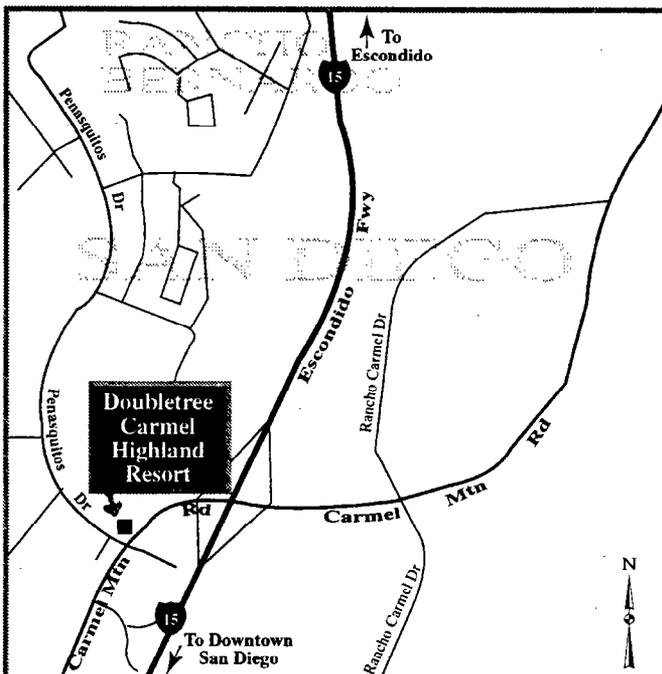
WEDNESDAY EVENING, AUGUST 5



Validated Self-Parking. Enter on Bristol St.

RANCHO BERNARDO

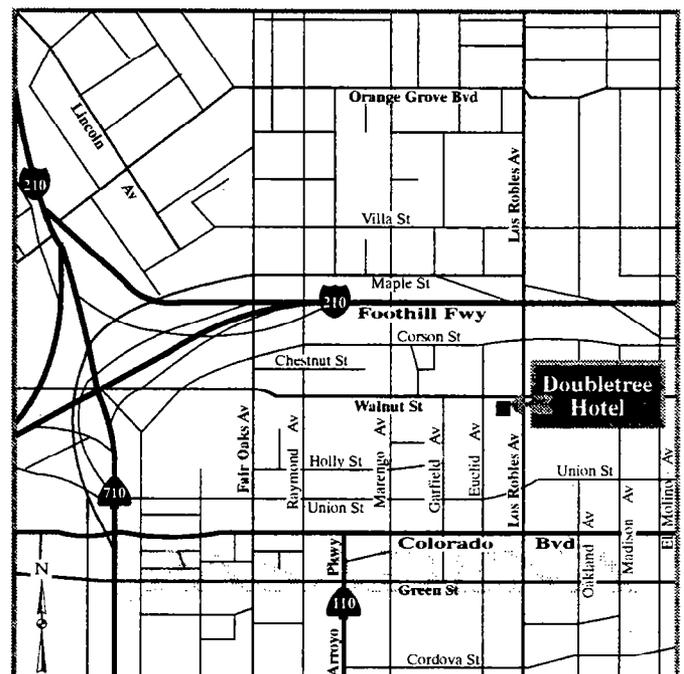
THURSDAY EVENING, JULY 30



Free Parking. Enter on Penasquitos Dr.

PASADENA

THURSDAY EVENING, AUGUST 6



Validated Self-Parking. Enter on Union St.