4.0 Overview of Water Reuse Opportunities and Public Health Protection

Water Reuse Study 2005

This section provides an overview of the types of reuse opportunities investigated in the Water Reuse Study, as well as a brief description of the treatment technology, regulatory requirements and how public health is protected when recycled water is used. Further detail on these topics is included in Appendix D of this report.

With a methodology in place and a diverse team of stakeholders and technical professionals engaged, the Water Reuse Study team's next step was to develop a slate of reuse opportunities. Opportunities were first framed within the City Council resolution authorizing the Study, which stated that the Study should evaluate "*a viable increased water reuse program, including but not limited to groundwater storage, expansion of the distribution system, reservoirs for reclaimed water, live stream discharge, wetlands development, and reservoir augmentation.*" The study team identified a list of different types of reuse project opportunities and presented these to the American Assembly and IAP for review. The opportunities were revised based on stakeholder input, and then analyzed, as shown in **Figure 4-1.**

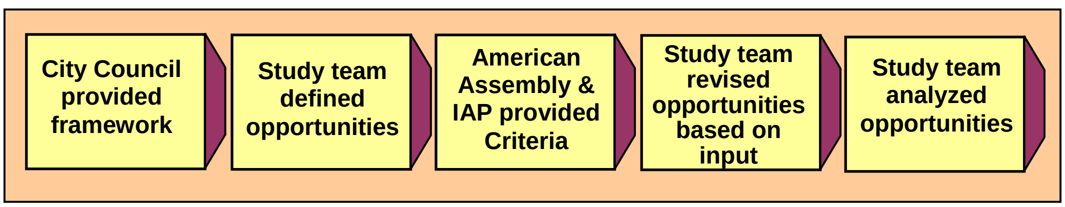

Figure 4-1 – Development of Reuse Opportunities

4.1 Stakeholder Input on Reuse Opportunities

The American Assembly and IAP were asked to weigh in on opportunities early in the project process. New opportunities could be added or existing opportunities changed. Participants could suggest revisions, alternatives, and express the need to emphasize or de-emphasize project components.

The first key input was a suggestion on how opportunities could be presented. The American Assembly suggested separating non-potable and indirect potable reuse projects to aid in analysis. In addition, the stakeholders suggested the investigation of specific uses, including:

- Residential front lawn uses
- Carwashes
- Commercial laundries

- Construction Activities, such as dust control and soil compaction
- Street Sweeping
- Toilet flushing
- Cooling Towers and Boiler Makeup Water, and
- Firefighting

The American Assembly participants also emphasized the need for recycled water *to be safe and protect public health* as the foundation of a reuse program. Therefore, this section also includes a summary of the science, technology and regulatory issues related to recycled water use. Additional information, as well as the references used herein, is included in Appendix D.

4.2 Non-potable Reuse Description and Project Types

Non-potable recycled water reuse represents the largest and most successful type of water reuse to date in California. Non-potable reuse typically uses recycled water that meets California water quality standards for uses that are not associated with drinking water, such as irrigation, industrial uses and wetlands creation. Non-potable applications have been proven safe, reliable and effective at reducing the need for potable water, particularly during peak summer months. The California State Water Resources Control Board estimates that nearly 550,000 acre-feet of water were recycled in California during 2001 (**Figure 4-2**). Appendix D includes further details on specific non-potable reuse projects.

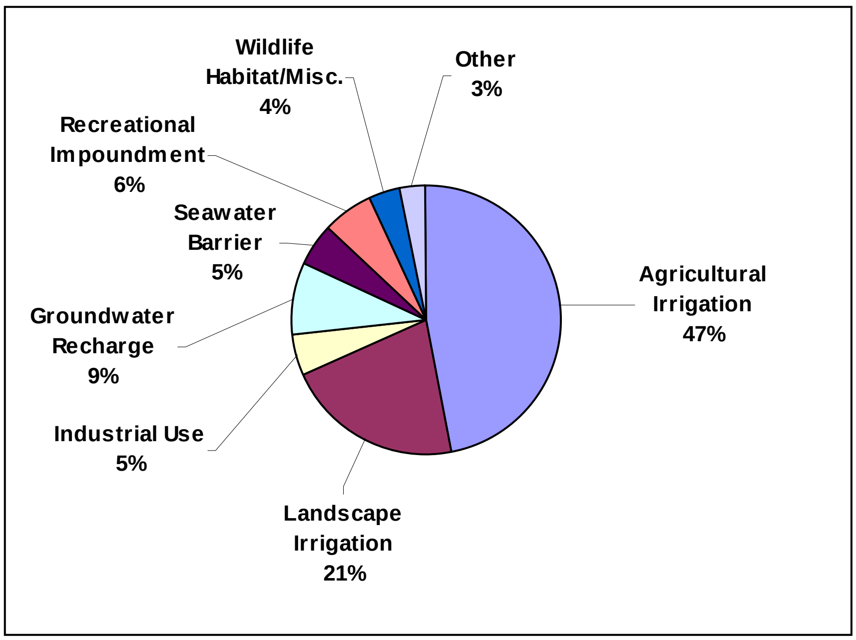

Figure 4-2 – 2001 California Recycled Water Use by Category
Source: Adapted from California State Water Resources Control Board data

Agricultural and Landscape Irrigation

As illustrated in **Figure 4-2**, the primary non-potable use of recycled water in California is irrigation. In 2001, over two-thirds of all recycled water was used for agricultural and landscape irrigation. The primary constituents of concern when using recycled water for agricultural irrigation are salinity, inorganic elements, residual chlorine, and nutrients. Although the presence of nutrients in recycled water is generally appreciated by irrigation customers and can be beneficial to plant growth, excess amounts of salinity can be harmful to plants or have long-term adverse effects on the soil.

Industrial Uses

Industrial uses account for approximately five percent of the recycled water use in California. There are a variety of industrial applications suited to recycled water. For many industries, cooling water for commercial air conditioning systems comprises the largest use of recycled water. Power plants (including geothermal energy) and refineries can use substantial amounts of cooling water. Cooling water use is also beneficial in that it typically has a more constant demand compared to landscape irrigation. Boiler water make-up is another opportunity, however the water use is typically small unless there is a large user (such as a refinery). Dual-plumbed buildings are another option where recycled water is supplied to toilets and urinals. Overall, recycled water has been proven effective throughout California for industrial applications.

Other Non-potable Opportunities

The remaining non-potable uses of recycled water represent either a much smaller amount of overall reuse potential or an application difficult to implement in San Diego. In general, these opportunities include private residential landscape irrigation, wildlife habitat enhancement (wetlands creation), recreational impoundments (lakes or ponds), and other uncommon or specialized uses.

Padre Dam Municipal Water District –
Santee Lakes Recreation Preserve uses recycled water.

Private Residence Landscape Irrigation Use: Irrigation of single-family residential lots with recycled water is allowed in California. The most notable, recent example is in Northern California's El Dorado Irrigation District, just east of Sacramento. Private residential use of recycled water has been discouraged locally by the San Diego County Department of Environmental Health because of concerns regarding homeowner maintenance and cross-connection control. To overcome these concerns for the El Dorado project, a homeowner's association was formed which manages the use of recycled water for landscape irrigation.

Recreational Impoundment and Wildlife Enhancement Uses: Environmental and recreational applications include wetland restoration and enhancements as well as incidental contact (fishing, boating) and direct contact (swimming, wading) uses. California allows recycled water use for these applications but restricts it depending upon the likelihood and degree of body contact; unrestricted recreational uses require disinfected tertiary recycled water and extra monitoring for pathogens (*Giardia*, *Cryptosporidium* and viruses). In San Diego, Padre Dam Municipal Water District uses recycled water in their Santee Lakes Recreation Preserve.

Miscellaneous Uses: Although recycled water is used elsewhere in California for fire protection, snowmaking, construction/dust control, street sweeping, car washes and commercial laundries, these uses are generally small. With the exception of snowmaking, San Diego could use recycled water for these activities if these agencies and commercial enterprises expressed interest and the activities were in the vicinity of recycled water facilities. However, these uses are insignificant compared to the other opportunities presented. At the discretion of the City and the specific potential customers, these uses may be implemented in San Diego.

4.3 Indirect Potable Reuse Description and Project Types

Whenever a wastewater treatment plant discharges to surface water or groundwater that serves as a drinking water source for downstream cities, a form of indirect potable reuse occurs. This kind of reuse of treated wastewater (not necessarily of recycled water quality) has occurred for many decades throughout the United States.

Every wastewater plant discharging into the Mississippi River contributes to the water supply for downstream cities. Similarly, wastewater treatment facilities operated by cities in the Colorado River basin or in the Sacramento/San Joaquin delta discharge back to the rivers, and that water is subsequently withdrawn by the Metropolitan Water District of Southern California and distributed to water districts throughout the region. California DHS does not consider such use indirect potable reuse unless the wastewater comprises more than five percent of the total water (California DHS, Bob Hultquist, personal communication, 2005).

In this Study, indirect potable reuse (IPR) is advanced treated recycled water that is discharged into either groundwater or surface water that ultimately supplies a public drinking water system. Because it is intended for human consumption, this use receives a much higher degree of treatment than recycled water used for non-potable purposes.

The highly treated recycled water blends with the groundwater or surface water (which is usually imported water and local runoff) during a long retention time. The term “indirect” refers to the distinction that the highly treated recycled water is not plumbed directly to the potable distribution system.

All indirect reuse projects in California require extensive planning, permitting, and interaction with regulators. In IPR projects, all indications are that the finished water is of higher quality than most surface waters used as sources of drinking water in the US.

As there are no significant rivers in the San Diego vicinity, our treated wastewater is discharged to the ocean. To recycle our treated wastewater for indirect potable reuse there are three basic types of projects that could be employed in San Diego:

- Groundwater Recharge-Spreading
- Groundwater Recharge-Injection
- Reservoir Augmentation

Groundwater Recharge – Spreading

Surface spreading is a direct recharge method where recycled water is released into open basins and the water seeps down into the groundwater basin. It is used generally when enough land area is available, certain soil conditions are present, and if the groundwater basin is "unconfined", that is water moves through the basin. "Spreading of recycled water for groundwater replenishment has occurred in Los Angeles and Orange Counties for many decades. See Appendix D for further details.

Groundwater Recharge – Injection

A more complex means of adding to groundwater resources is through *injection.* Recycled water injection simply pumps the recycled water down to the groundwater, bypassing the soil percolation step. Because direct injection introduces recycled water directly into the groundwater, it does not provide the treatment benefits that percolation provides. Accordingly, the injected water must be of higher quality than that used for surface spreading. Some states require treatment to drinking water standards. "Injection of recycled water into groundwater basins has occurred in Los Angeles County (West Basin Municipal Water District) since 1995 and in Orange County since the 1970's. See Appendix D for further details.

Reservoir Augmentation

Reservoir augmentation adds highly treated recycled water directly to a water reservoir to increase the overall water supply. Water used in reservoir augmentation projects would undergo advanced treatment and disinfection. In addition to the advanced treatment, reservoir augmentation projects also allow the treated water to reside under natural environmental conditions for a period of time. This retention time provides an additional public health barrier, as natural reduction of trace contaminants due to microbial degradation, oxidation, and dilution occurs. The reservoir water would ultimately be pumped out and treated by a potable water treatment plant and used for drinking purposes. Reservoir augmentation has been in use at Occoquan, Virginia since 1978. See Appendix D for further details.

4.4 Recycled Water and Protection of Public Health[1]

Risk assessment and risk management principles form the basis of California water regulations to protect public health. These regulations cover both the required treatment and allowable uses of recycled water. A multi-barrier treatment approach is recognized as a reliable means to protect public health and provide safe and reliable water supplies.

Risk Assessment

Risk assessment has been defined as, "the characterization of the potential adverse health effects of human exposures to environmental hazards" (NRC, 1983). Health risk assessments are used to determine if a particular chemical poses a significant risk to human health and, if so, under what circumstances. Risk assessment helps regulators develop consistent, realistic, and prioritized goals for reducing exposure to toxics so that health threats to the public can be reduced to a minimum.

Risk assessments are used to determine to what extent a particular chemical or microbiological contaminant poses a risk to human health and under what circumstances.

The risk assessment process is typically described as consisting of four basic steps: hazard identification, exposure assessment, dose-response assessment, and risk characterization. Each of these steps is explained in detail in Appendix D. Government regulators turn to specialists to perform or assist with risk assessments. These specialists include scientists with degrees in toxicology (the study of the toxic effects of chemicals) and epidemiology (the study of disease or illness in populations), as well as physicians, biologists, chemists, and engineers. Risk assessments are designed to be conservative and overestimate rather than underestimate potential risks.

Risk Management

Risk managers rely on risk assessments when making regulatory decisions, such as setting water quality standards. Risk managers are responsible for protecting human health and they consider technological, economic, social, and political factors when arriving at their decisions.

Risk assessment and risk management principles are used to set drinking water standards.

Setting and Enforcing Standards

Risk assessment and risk management principles are used by both federal and state drinking water regulators. The Safe Drinking Water Act of 1974 requires the EPA to set drinking water standards. In addition, EPA has developed many Drinking Water Health Advisories that provide guidance on many unregulated contaminants. The World Health Organization also produces Guidelines for Drinking Water Quality with comprehensive coverage of health-based values for water components, as well as providing management principles for providing safe drinking water.

[1] The risk assessment and risk management discussion was drawn and adapted from *A Guide to Risk Assessment*, California Office of Environmental Health Hazard Assessment

States are also free to set their own standards, but state standards must be *at least as stringent as the federal standard*. California drinking water standards are set by the California DHS using risk assessment information developed by the California Office of Environmental Health Hazard Assessment (OEHHA). California typically sets more stringent drinking water standards than those established by EPA. California DHS sets drinking water Maximum Contaminant Levels (MCLs) that carefully balance the health benefits with permit compliance feasibility/cost using the best available information. Water recycling projects that involve human contact (including drinking water) must meet these standards. California DHS typically includes drinking water MCL compliance requirements in the operating permits for recycled water projects that involve potential human contact. California DHS can take enforcement action where compliance is not achieved.

In addition to establishing drinking water MCLs, California DHS has developed enforceable regulations and guidance for recycled water projects. These are part of the permit issuance process the California regulatory agencies require cities and water districts to follow prior to gaining approval for a recycling project to operate. The RWQCB issues the permits. California DHS consults to the RWQCB and approves the public health and treatment requirements. The California DHS evaluates every proposed water reuse project on a case-by-case basis to assure that the proposed treatment method, distribution, and monitoring produces recycled water that meets the permit requirements and protects public health.

Multiple-barrier treatment methods are used to reliably meet standards and protect public health.

Indirect potable reuse projects are required to have advanced water treatment methods and the greatest number of barriers.

Multiple-Barrier Approach to Public Health Protection

A multi-barrier water treatment approach is a proven means of protecting public health. Numerous, but not all contaminants are regulated in drinking water and recycled water. The reason some contaminants are not regulated is because either monitoring methods do not exist, are too complicated for routine monitoring, or there is no reason to believe the contaminants are present to begin with. California DHS regulators manage this uncertainty by using what is referred to as a *multiple-barrier treatment* approach (Velz, 1970, AWWA, 1987). This means that several treatment processes in the sequence can remove the contaminants of concern.

The multi-barrier approach is used for both drinking water treatment and recycled water treatment (Davies et al, 2003; Luna et al, 2004). It includes source control (pretreatment), use of multiple water treatment processes and water quality monitoring and surveillance. The basis of this approach is to ensure that there are prudent checks and balances in place to minimize the risk of failure and, ultimately, prevent exposure of consumers to unsafe water. A major advantage of the use of multiple-barrier water treatment methods is that the methods can also be effective at removing unknown contaminants.

Source Control

An increasingly important additional barrier against unknowns is the use of pretreatment, or source control. Source control requirements are part of the permit process and identify and minimize the introduction of contaminants into the wastewater that must then be removed through treatment. The City of San Diego Metropolitan Wastewater Department (MWWD) regulates the quality of the wastewater that enters the wastewater system through an enforceable Industrial Wastewater Control Program (City of San Diego, 2005; EPA, 1992). The program is a joint effort between the City of San Diego, other agencies served by the system, and local industry. The program issues discharge permits, performs inspections, conducts wastewater monitoring, and enforces discharge standards at businesses and industries throughout the service area.

Similarly, the Orange County Sanitation District (OCSD) is adopting an enhanced source water control program that expands the list of pollutants of concern entering the treatment plant to include regulated and newly discovered drinking water contaminants. The OCSD will provide treated wastewater as the source water for the Orange County Water District's advanced treatment Groundwater Replenishment Project.

4.5 Water Treatment Technology

There are many different treatment methods that can be linked together to provide water treatment for recycled water uses. These methods are selected and placed in sequence in a treatment plant depending on the required water quality needed. The level of treatment is guided by the need to be protective of public health *and* the quality of water needed for the specific use. A more detailed description of water treatment methods and additional references is included in Appendix D.

Water treatment methods can be used to remove or reduce broad classes of contaminants including:

- Microorganisms (disease-causing bacteria, viruses and protozoa),
- Organic chemicals (pesticides, herbicides, trace contaminants),
- Inorganic chemicals (metals, nutrients, and minerals)
- Physical measurements (color, turbidity, and odor)
- Radiologicals (radioactive substances)

Recycled water treatment methods are specifically designed and sequenced to reduce the amount of these contaminants to levels that consider the end use and protect the public health. Importantly, the treatment methods also provide multiple barriers to remove other similar contaminants. The effectiveness of removal depends on the method selected and how it is designed operated and maintained. The general ability of each of the treatment methods to address classes of contaminants in water is shown in **Table 4-1**.

Table 4-1
Water/Wastewater Treatment Removal of Contaminants

Treatment Method	Contaminant Class						
		Pathogens					
	Particles	Bacteria	Viruses	Parasites	Inorganics	Organics	Radionuclides
Pretreatment	✓				✓	✓	✓
Primary Treatment	✓					✓	
Secondary Treatment	✓					✓	
Tertiary Treatment	✓	✓	✓	✓	✓	✓	✓
Microfiltration	✓	✓		✓			
Ultrafiltration	✓	✓	✓	✓		✓	
Reverse Osmosis	✓	✓	✓	✓	✓	✓	✓
Ion Exchange					✓		✓
Ozone		✓	✓	✓		✓	
UV + hydrogen peroxide		✓	✓	✓		✓	
Granular Activated Carbon						✓	
Soil Aquifer Treatment	✓	✓	✓	✓		✓	
Wetlands	✓				✓	✓	
Chlorine Disinfection		✓	✓				

Non-potable reuse applications generally use source control, primary treatment, secondary treatment, tertiary treatment, and chlorine disinfection. Special uses like industrial boiler water supply may require additional treatment to remove inorganic minerals that might damage the boiler.

Indirect potable reuse projects incorporate more advanced water treatment methods (often including additional pretreatment) because the water will ultimately be consumed by people. California DHS requires reverse osmosis and UV+peroxide in indirect potable reuse projects to address health concerns related to trace organic contaminants, such as pharmaceuticals and personal care products (PPCPs). The City of San Diego has many years of experience testing reverse osmosis treatment. Initial results from current tests of both of these technologies indicate that together, these processes can reduce trace contaminants in water to below the detection limits of sensitive test methods.

The studies conducted to date support both non-potable and indirect potable reuse as feasible options for the City of San Diego that can be implemented in a fashion that protects public health. Importantly, while both non-potable and indirect potable reuse are supported by and allowed under California regulations, successful implementation of projects has only occurred where there is community and political support.

4.6 Regulations and Public Health Issues Associated with Non-potable Reuse

City of San Diego Mandatory Use Ordinance

San Diego City Council adopted the Mandatory Reuse Ordinance (O-17327) on July 24, 1989. The ordinance states in part, *"Recycled water shall be used within the City where feasible and consistent with the legal requirements, preservation of public health, safety and welfare, and the environment."* On December 9, 2002, San Diego City Council passed Resolution R-297487 authorizing City staff to work in conjunction with the Public Utilities Advisory Commission (PUAC) to develop specific criteria to be applied in determining which particular properties would be required to use recycled water for suitable and approved purposes. Customers whose property lines are contiguous with the City's recycled water pipeline alignments and who use significant amounts of potable water for irrigation or industrial uses are likely to be subject to the pending criteria. The pending criteria were taken into consideration in the development of non-potable reuse opportunities.

Mandatory Reuse Ordinance
"Recycled water shall be used within the City where feasible and consistent with the legal requirements, preservation of public health, safety and welfare, and the environment."

The City of San Diego's proposed Mandatory Reuse Ordinance criteria would require new buildings, constructed in proximity to the recycled water system, with cooling tower or boiler makeup water needs exceeding 5 AFY to plumb these facilities for recycled water. Some existing recycled water customers have already converted their sites. New development that meets the proposed criteria would be identified in the tentative map approval process and required to use recycled water. In addition, the City is evaluating dual plumbing for new schools, commercial, industrial and government buildings to provide recycled water to toilets and urinals. If pursued, the requirement would apply to new buildings in excess of 55 feet in height, projected to have at least 800 occupants or encompass 80,000 square feet. One new building in San Diego has been dual plumbed and another is pending inspection and approval.

Recycled Water Regulations for Non-Potable Uses

Section 13521 of the Porter-Cologne Act grants California DHS the authority to set criteria for recycled water use where such use would require specific protection of public health. As a result, DHS developed comprehensive uniform regulations that establish acceptable uses of recycled water, water quality, and treatment process requirements to ensure that recycled water use does not pose health risks. DHS also requires engineering reports, reporting and record keeping, and design documents to ensure operational reliability of treatment. These requirements are regulated under Title 22 of the California Administrative Code (Title 22, California Code of Regulations, §60301 *et seq.*) and enforced by the California RWQCBs.

Each RWQCB issues permits for individual projects to conform to the regulations and recommendations adopted by California DHS.

California has a number of definitions for differing grades of recycled water based on level of treatment and effluent water quality criteria. The allowable uses for each of these levels of recycled water treatment are listed in **Table 4-2**. The City's NCWRP and SBWRP provide disinfected tertiary recycled water, the highest quality of recycled water for non-potable uses as defined in Title 22.

Table 4-2
Allowable Non-potable Uses based on Title 22 Treatment Level

Types of Recycled Water Use	Recycled Water Treatment Level		
	Disinfected Tertiary	Disinfected Secondary	Undisinfected Secondary
Urban Uses and Landscape Irrigation			
Fire Protection	✓		
Toilet and Urinal Flushing	✓		
Irrigation of Parks, Schoolyards, Residential Landscaping	✓		
Irrigation of Cemeteries, Highway Landscaping		✓	
Irrigation of Nurseries		✓	
Landscape Impoundment	✓	✓*	
Agricultural Irrigation			
Pasture for Milk Producing Animals		✓	
Fodder and Fiber Crops			✓
Orchards (no contact between fruit and recycled water)			✓
Vineyards (no contact between fruit and recycled water)			✓
Non-Food Bearing Trees			✓
Food Crops Eaten After Processing		✓	
Food Crops Eaten Raw	✓		
Commercial/Industrial			
Cooling & Air Conditioning – w/ cooling towers	✓	✓*	
Structural Fire Fighting	✓		
Commercial Car Washes	✓		
Commercial Laundries	✓		
Artificial Snow Making	✓		
Soil Compaction, Concrete Mixing		✓	
Environmental and Other Uses			
Recreational Ponds with Body Contact (Swimming)	✓		
Wildlife Habitat/Wetland		✓	
Aquaculture	✓	✓*	
Groundwater Recharge			
Seawater Intrusion Barrier	✓*		
Replenishment of Potable Aquifers	✓*		

* Restrictions may apply

Source: WaterRecycling 2030, California's Recycled Water Task Force, June 2003.

Health and Safety of Non-Potable Uses

California has a long track record of producing safe recycled water for non-potable uses. Non-potable treatment requirements and regulations use the risk assessment/risk management principles and multi-barrier treatment approach described previously to provide the appropriate levels of treatment and health protection for this specific use. Full – body contact (such as swimming) is allowed with tertiary treated Title 22 water.

Key public health concerns related to the safety of non-potable water have included the safety of playfields and parks irrigated with recycled water. As part of a WateReuse Foundation study (Crook, 2005), the author conducted an extensive literature search on the safety of non-potable use of recycled water. The study concluded that the irrigation of parks, playgrounds, athletic fields, and schoolyards with highly treated and disinfected reclaimed water is safe, and does not present any known health risks to children or others who frequent those sites that are measurably different than risks associated with irrigation using potable water.

4.7 Regulations and Public Health Issues Associated with Indirect Potable Reuse

Recycled Water Regulations for Indirect Potable Reuse

The only form of indirect potable reuse currently regulated in California is groundwater recharge, with the permit approval process under the auspices of the local RWQCB. California DHS has developed draft regulations for groundwater recharge and uses those regulations as guideline in setting parameter for other types of indirect potable reuse projects. California DHS provides recommendations to the RWQCB regarding the acceptability of indirect potable reuse projects and uses the draft recharge reuse regulations as a key part of the approval process.

In addition to compliance with maximum contaminant levels, California DHS draft regulations place additional requirements on indirect potable reuse projects. These include control of contaminants at the source, multi-barrier treatment methods to control pathogens, inorganic and organic contaminants; treatment standards, recharge methods, extraction well location, and monitoring requirements (see Appendix D for more details). DHS will not issue a recommendation for project approval unless the proponent provides extensive evidence that the project will not detrimentally affect human health. The DHS recommendations are based on treatment provided, effluent quality and quantity, spreading area operations, soil characteristics, hydrogeology, residence time, and distance to withdrawal.

A City groundwater or reservoir augmentation project would begin with treated recycled water from the North City or the South Bay Water Reclamation Plants, which would then undergo advanced treatment including membrane filtration, reverse osmosis, and disinfection. As described in Section 4.4, these combined treatment methods have been shown to be very effective barriers against contaminant passage.

As long as the project meets all DHS treatment and reservoir management requirements, introduction of highly treated recycled water into a drinking water source reservoir could be permitted.

Preliminary discussions with DHS representatives (January 2005) indicated that any proposal for a reservoir augmentation project would need to consider recent changes made to the Draft Ground Water Recharge regulations (State of California, December 2004). As described above, the new draft regulations have requirements on organic contaminants (total organic carbon), inorganic contaminants (nitrogen), and source control. In addition, the RWQCB may add more requirements for inflows to a reservoir, particularly with regard to nitrogen. DHS would likely require two treatment barriers for each type of contaminant. As long as the project *meets all DHS treatment and reservoir management requirements*, introduction of highly treated recycled water into a drinking water treatment plant source reservoir could be permitted.

Health and Safety of Indirect Potable Reuse

Permitted indirect potable reuse projects are carefully regulated and protect the public health through:

- Use of advanced water treatment methods that reliably remove contaminants of concern.
- Careful operation and maintenance of those methods.
- Use of multiple monitoring systems to ensure consistently high quality water is produced.

With regard to indirect potable reuse health and safety issues, the most comprehensive assessment to date was conducted by the National Research Council (NRC) (*Issues in Potable Reuse: The Viability of Augmenting Drinking Water Supplies with Reclaimed Water, 1998).*

The report referenced several large-scale health-effects studies of recycled water covering both microbiological and chemical contaminants (Windhoek, South Africa; Los Angeles County, CA; Washington, D.C.; Denver, CO; San Diego, CA; and Tampa, FL), noting that these studies identified *no obvious adverse health effects associated with indirect potable reuse in the specific projects examined.* These studies varied widely in approach and should be considered individually (and are discussed further in Appendix D). There are also design drawbacks in each of these studies, which limit their individual and overall usefulness to assess health risks. The studies varied considerably from combinations of simple screening and chemical identification studies to toxicology testing. Only the Denver and Tampa studies addressed a broad range of toxicological concerns.

Nonetheless, the report included several important observations:

- Current projects and studies have demonstrated the capability to reliably produce water of excellent measurable quality.
- In communities using reclaimed water where analytical testing, toxicological testing, and epidemiological studies have been conducted, significant health risks have not been identified.
- The best available current information suggests that the risks from indirect potable reuse projects are comparable to or less than the risks associated with many conventional supplies.

The general conclusion of the NRC report was that "planned, indirect potable reuse is a viable application of reclaimed water—but only when there is a careful, thorough, project-specific assessment that includes contaminant monitoring, health and safety testing, and system reliability evaluation**."**

Based upon experiences elsewhere in the State, and given adherence to permit conditions, the full range of recycling alternatives (from non-potable to indirect potable reuse) could be permitted by the regulatory agencies in the San Diego area.

Indirect potable reuse projects have been implemented in several communities. The available human health studies are sufficient to convince the California DHS (and other regulatory agencies) that highly treated recycled water can be safely consumed by humans through indirect potable reuse projects. In California, the West Basin Municipal Water District (El Segundo), the Orange County Water District (Fountain Valley), and the County Sanitation Districts of Los Angeles County (Montebello Forebay) currently operate indirect potable reuse projects. The latter reuse project started in 1962. Additional studies and community experiences are discussed in Appendix D.