Understanding Water Reuse

POTENTIAL FOR EXPANDING THE NATION'S WATER SUPPLY THROUGH REUSE OF MUNICIPAL WASTEWATER

Contents

In communities all around the world, water supplies are coming under increasing pressure as population growth, climate change, pollution, and changes in land use affect water quantity and quality.

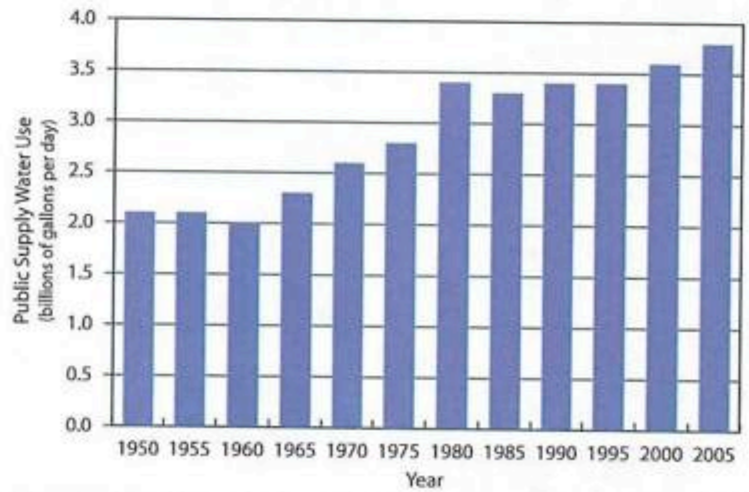
To address existing and anticipated water shortages, many communities are working to increase water conservation and are seeking alternative sources of water. Water reuse—the use of treated wastewater, or "reclaimed" water, for beneficial purposes such as drinking, irrigation, or industrial uses—is one option that has helped some communities significantly expand their water supplies.

This booklet summarizes the main findings of the National Research Council report *Water Reuse: Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater.* The report provides an overview of the options and outlook for water reuse in the United States, discusses water treatment technologies and potential uses of reclaimed water, and presents a new analysis that compares the risks of drinking reclaimed water to those of drinking water from traditional sources.

Some of the United States' fastest-growing and most populous cities are located in the nation's most arid areas, while some other areas with abundant water are only sparsely populated. For example, Las Vegas, Nevada, located in the Mojave Desert, was among the most rapidly growing U.S. cities from 2000 to 2009. People flocked to the already-parched city, despite record-low water levels at its primary water source, Lake Mead. Population growth has even led to water stresses in areas previously considered water-rich, such as Atlanta, Georgia.

Water reuse offers an opportunity to significantly expand supplies of freshwater in communities facing water shortages. Coastal areas of the United States, for example, discharge 12 billion gallons of wastewater into estuaries and oceans every day—an amount equivalent to six percent of the country's total daily water use. Reusing this water would directly augment the nation's total water supply.

Water demands from Las Vegas, Nevada, combined with years of below average precipitation have drained Lake Mead to record-low levels, leaving a white "bathtub ring" 100 feet high.



Although conservation and improvements in technology have reduced water use for some purposes, such as cooling thermoelectric power plants and other industrial uses, public (or municipal) water use continues to rise, driven in part by expanding and shifting populations. Data from Kenny et al. (2009).

REUSE, RECYCLE, RECLAIM?

Water reuse, wastewater reuse, and **water recycling** all generally mean the same thing: using treated wastewater for a beneficial purpose. The process of treating wastewater prior to reuse is called **water reclamation.**

What is Water Reuse?

In conventional municipal water systems, water from a river, lake, or aquifer is treated to meet drinking water standards before being distributed for all uses. After the water is used, the community's wastewater—the water that flows down the drain or is flushed down the toilet—is treated to remove pollutants before it is discharged into downstream water bodies.

Water reuse is the use of treated wastewater for beneficial purposes, which increases a community's available water supply and makes it more reliable, especially in times of drought.

In the United States and other countries, purple pipes are used to distinguish nonpotable distribution systems, helping to prevent cross-connections.

TYPES OF WATER REUSE

There are two main types of water reuse projects:

- **Nonpotable reuse** projects treat wastewater for specific purposes other than drinking, such as industrial uses, agriculture, or landscape irrigation. Nonpotable reuse could also include the use of reclaimed water to create recreational lakes or to build or replenish wetlands that support wildlife.
- **Potable reuse** projects use highly treated reclaimed wastewater to augment a water supply that is used for drinking and all other purposes.

Nonpotable Reuse

Nonpotable reuse systems typically have lower water quality objectives than potable systems, and the level of treatment varies depending on the end use. Nonpotable reuse usually requires a "dual distribution system"—separate systems of pipes for distributing potable and nonpotable water. Depending on the extent of a community's nonpotable water distribution system, nonpotable reclaimed water can be used for flushing toilets, watering parks or residential lawns, supplying fire hydrants, washing cars and streets, filling decorative fountains, and many other purposes.

The country's oldest dual distribution system is in Grand Canyon Village, Arizona, which has been using reclaimed water for nonpotable uses since 1926. In St. Petersburg, Florida, which began building a large-scale nonpotable reuse system in the 1970s, reclaimed water now satisfies about 40 percent of the city's total water demand, with many of the city's parks, schools, golf courses, residential lawns, fire hydrants, and commercial buildings drawing reclaimed water for nonpotable uses.

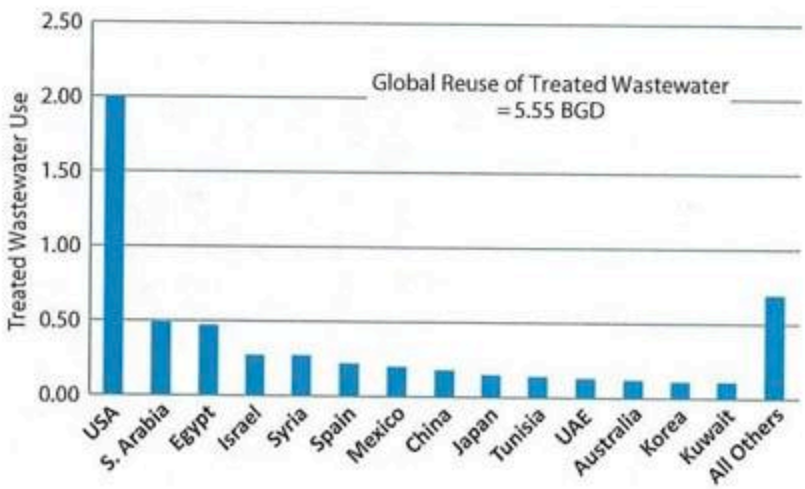
In St. Petersburg, Florida, reclaimed water is used for nonpotable purposes such as landscape irrigation.

Potable Reuse

Potable reuse systems use advanced treatment processes to remove contaminants from wastewater so that it meets drinking water standards and other appropriate water quality objectives. Typically, the highly treated reclaimed water is then released into a surface water body or aquifer (also called an environmental buffer) before being withdrawn, further treated, blended with other conventional water supply sources, and piped to homes and buildings.

Potable water reuse systems have existed in the United States for 50 years. The Sanitation Districts of Los Angeles County, for example, have been using highly treated reclaimed water to augment Southern California's potable water supply since 1962. Similar systems are in place in other locations in California and in other states, including Virginia, Texas, Georgia, Arizona, and Colorado. About half the nation's potable reuse systems have come on line during the past decade.

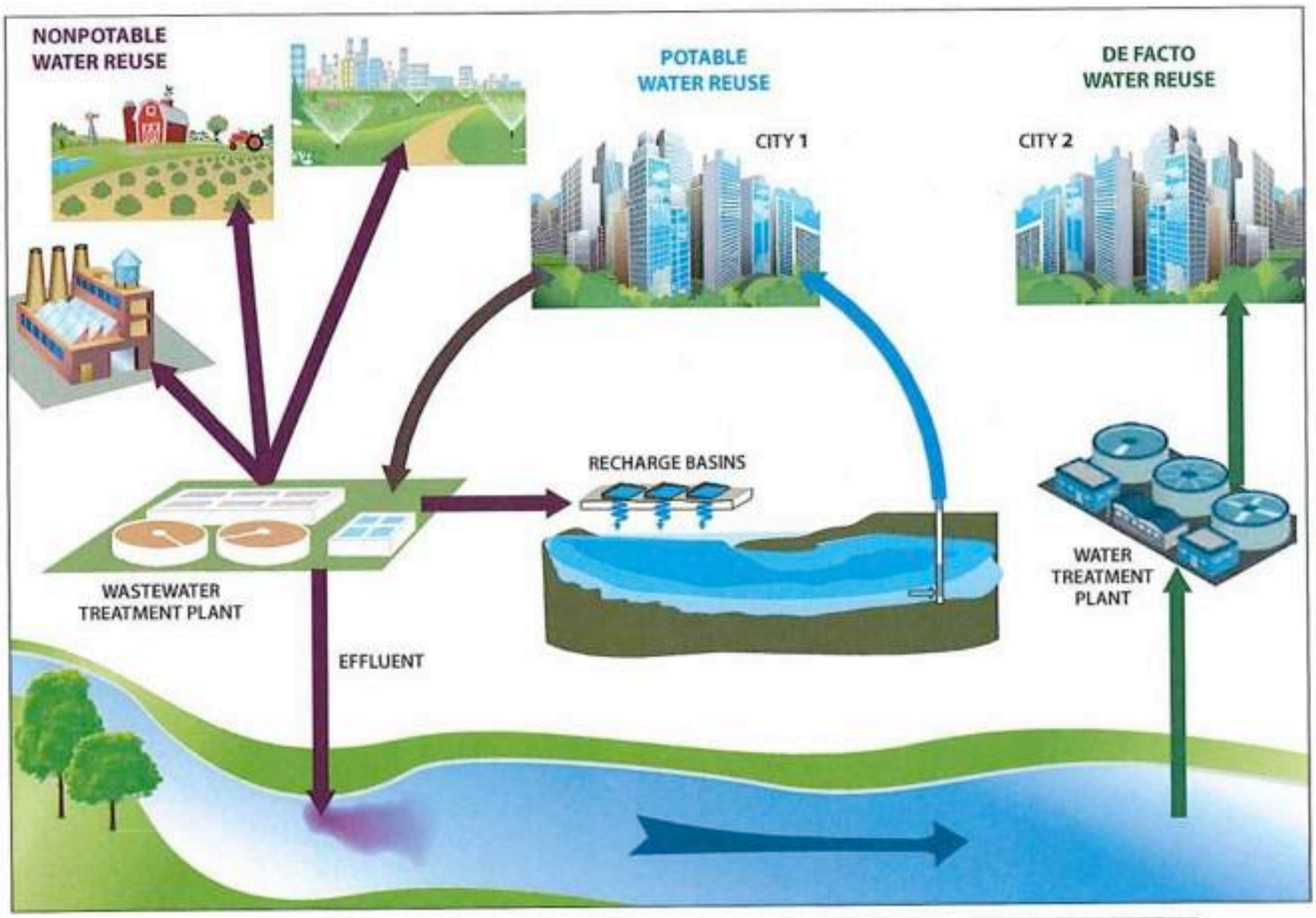
Reclaimed water at the Orange County, California, Groundwater Replenishment System is treated by reverse osmosis (left) and other advanced treatment systems before it is either injected into potable water supply aquifers or allowed to percolate into groundwater through infiltration basins (right). Producing 70 million gallons of potable water per day, the project is the country's largest potable water reuse system. It uses wastewater that would otherwise have been discharged into the Pacific Ocean.



According to 2008 estimates, the United States reuses a greater volume of water than any other country (shown here in billions of gallons per day, BGD), and it is ranked thirteenth among countries by per capita water reuse. Qatar and Israel have the highest water reuse per capita. Data from Jiménez and Asano (2008).

De Facto Reuse

Throughout the United States, some communities may already be reusing wastewater without even realizing it. De facto reuse occurs when a community draws water from a river or reservoir that includes wastewater from upstream communities. De facto reuse is quite common, although it has not been systematically analyzed in the United States in more than 30 years. Since last assessed, de facto reuse has likely increased as expanding cities now discharge more treated wastewater into water sources used by downstream communities. De facto reuse is particularly pronounced in dry periods, when natural water supplies are reduced and wastewater makes up a larger proportion of the water flow.



The process of treating wastewater and storing, distributing, and using reclaimed water in nonpotable, potable, and defacto reuse. In this schematic, municipal wastewater from City 1 is treated and supplied via a separate distribution system for nonpotable purposes, such as industrial cooling, agriculture, and landscape irrigation. A portion of the city's wastewater receives additional advanced treatment for potable water reuse. The highly treated water is used to recharge groundwater supplies, before it is withdrawn, disinfected, and blended with other drinking water supplies. Some of the treated wastewater effluent from City 1 is also discharged to a nearby river, where it mixes with river water and natural runoff. City 2, a downstream community, withdraws water from the river, treats it to drinking water standards, and uses the water for any purpose. Because the water drawn from the river contains a significant fraction of treated wastewater, this process is called de facto reuse.

CASE STUDY: THE TRINITY RIVER IN TEXAS

The Trinity River—the main water source for the city of Houston, Texas—provides one documented example of de facto water reuse, although it is by no means a unique situation in the United States. Dallas and Fort Worth draw water from the river's headwaters and discharge their treated wastewater downstream. During summertime and other times when the river's natural flow is reduced, the river consists almost entirely of treated wastewater as it flows away from Dallas and Fort Worth.

After a two-week southward journey, during which natural processes eliminate some trace organic contaminants, the water collects in Lake Livingston—one of Houston's main drinking water reservoirs. There it mixes with rainwater and other water in the reservoir until it is drawn into a drinking water treatment plant and distributed through Houston's taps. Over the course of a year, about half the lake's water is made up of treated wastewater from Dallas and Fort Worth. After treatment, the potable water from the Trinity River meets Environmental Protection Agency drinking water standards.

In one example of de facto water reuse, treated wastewater from Dallas/Fort Worth flows into Lake Livingston, one of Houston's main drinking water reservoirs.

Ensuring Water Quality

A community's wastewater typically contains a wide range of microorganisms and chemicals, some of which could be harmful to public health or to ecosystems. Water managers can choose from a portfolio of treatment options to design a wastewater treatment system that reduces contaminants to levels that will be acceptable for the intended uses of the reclaimed water.

Major wastewater contaminants include:

- *Pathogens.* Bacteria, viruses, and other infectious organisms enter wastewater from human excrement and other waste. Viruses with the potential to cause disease are of particular concern for potable reuse because they are very small, can be difficult to eliminate from water, and some can cause infection even at low concentrations.
- *Nutrients.* Municipal wastewaters are rich in nitrogen and phosphorus. Some forms of nitrogen can present a health risk for potable reuse if not properly treated. Excess nutrients can also cause the overgrowth of algae when reclaimed water is used to augment lakes. On the other hand, some nonpotable uses, such as irrigation, are actually enhanced by higher nutrient levels.
- *Organic chemicals.* Pharmaceuticals, natural hormones, household chemicals, and byproducts formed during the treatment process are often present in wastewater. High levels of such chemicals could pose a health risk, particularly for potable uses, unless they are effectively removed or degraded by appropriate water treatment processes.
- *Other contaminants.* Metals and salts are examples of other contaminants that could affect drinking water taste or pose a risk for human health and the environment.

Today's advanced analytical methods can detect many contaminants at extremely low levels—but the presence of a contaminant at a low but detectable concentration doesn't always mean that the water poses a significant human health or environmental risk. For example, the risk posed by a particular contaminant varies with the concentration of the contaminant, the intended use of the reclaimed water, and the degree to which people will be exposed to it. Water intended for drinking typically must meet higher quality standards than water intended for nonpotable uses. In addition, different nonpotable uses can have different treatment requirements—water used for industrial cooling might have different quality requirements than those for a lake where swimming is allowed.

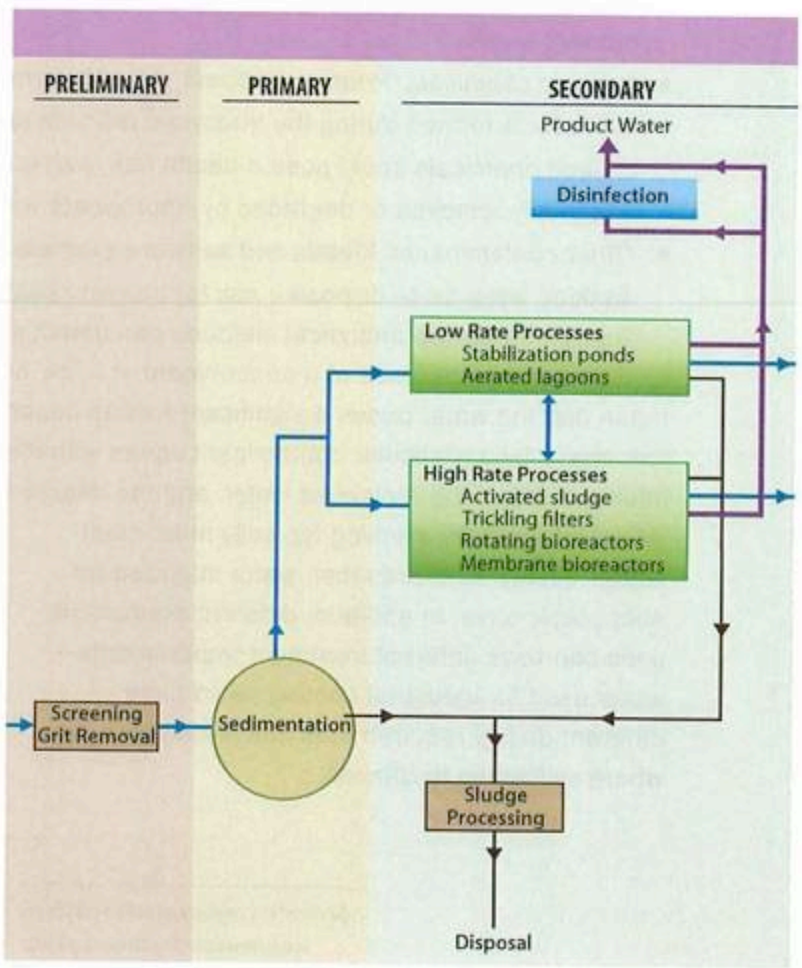
Secondary sedimentation basin in a wastewater treatment plant.

TREATMENT TECHNOLOGIES

There are a number of technologies available for treating wastewater intended for reuse, many of which can be used in combination. To choose the appropriate combination of treatment options, water managers must consider the specific contaminants that are of concern, the intended use of the water, costs, and other factors such as energy use or waste disposal options.

The National Research Council report reviewed options for ensuring water quality in water reuse projects. Because protecting public health is of utmost importance for any drinking water system, the report's authoring committee recommended potable water reuse systems include several redundant treatment elements to strengthen the reliability of the system.

In addition to redundant treatment processes, the committee recommended that water reuse systems incorporate plans for monitoring water quality and quickly responding to problems caused by equipment malfunctions, operator error, or changes in the quantity or quality of incoming wastewater. For nonpotable reuse systems, it is also important to prevent drinking water contamination from the inadvertent cross-connection of nonpotable water and potable water pipes.

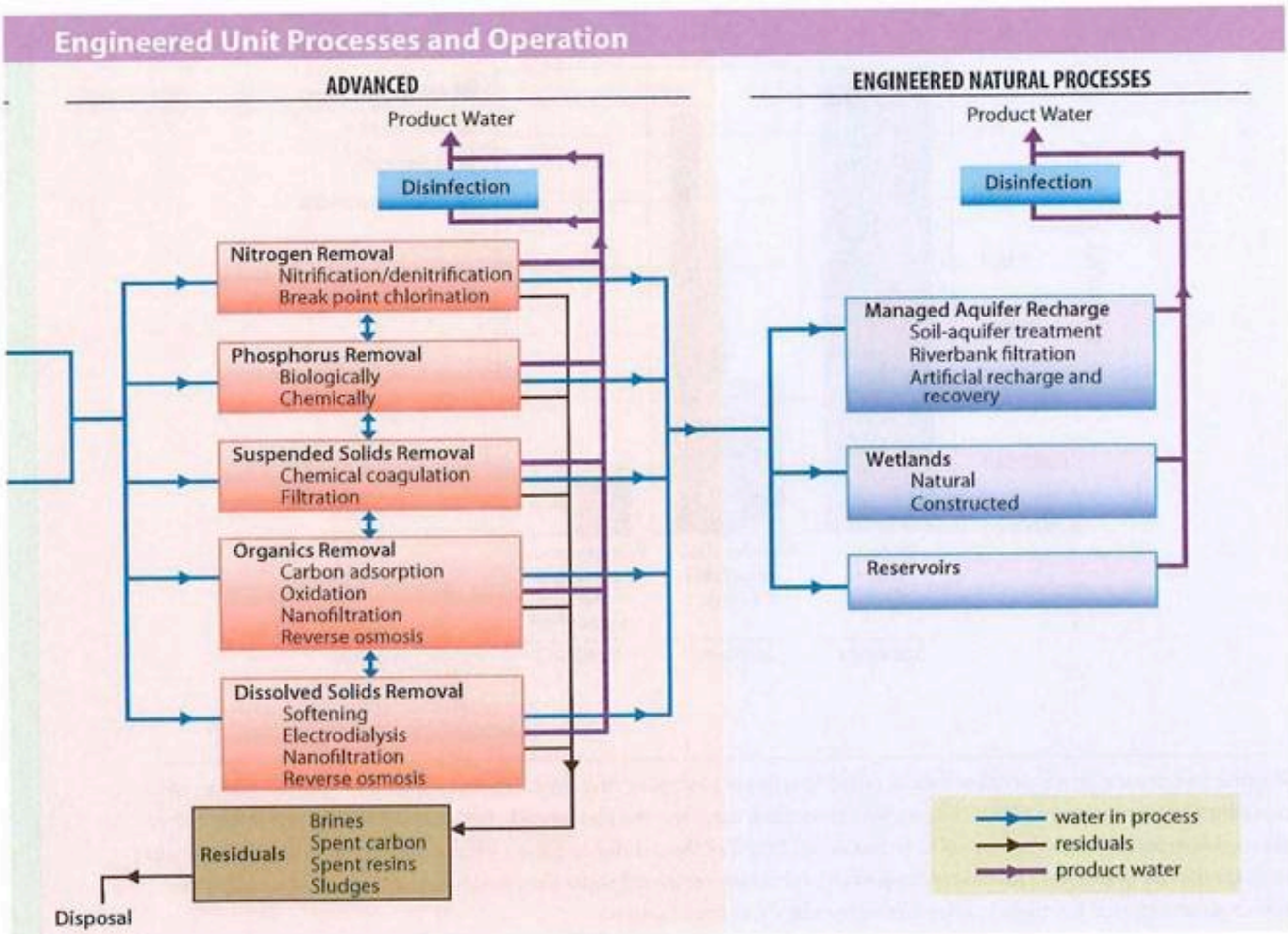


Treatment processes commonly used in water reclamation. At each stage of processing, several treatment options are available. Water managers can choose one or more of these options to create a process that will treat water to the quality needed for its intended use. Water treatment begins with preliminary and primary treatment, which targets suspended and particulate matter, followed by secondary treatment to remove biodegradable organic carbon. Water managers can then choose to proceed to advanced treatment, which provides additional removal of nutrients, trace organic chemicals, and suspended solids. Engineered natural processes allow reclaimed water to blend with water from other sources and provide additional natural treatment to further remove contaminants from the water.

THE EVOLVING ROLE OF ENVIRONMENTAL BUFFERS

In many potable reuse systems, environmental buffers such as aquifers, lakes, or wetlands serve a number of purposes. They are used to hold reclaimed water to provide additional time before it is introduced into a drinking water system and to allow it to blend with water from other sources. Environmental buffers may also provide additional natural treatment to further remove contaminants from the water, and they create psychological distance between the water's source (treated wastewater) and its destination (drinking water) by incorporating natural environments into the process.

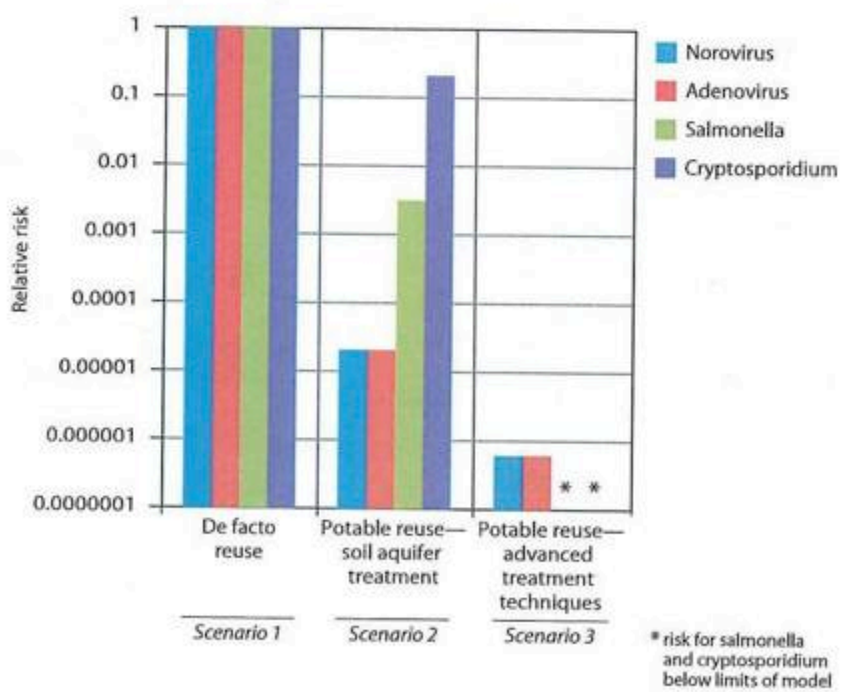
Until recently, environmental buffers were considered a core element of all potable reuse projects. However, the National Research Council committee concluded that environmental buffers do not provide any water quality services that cannot also be provided by the use of engineered processes, such as advanced treatment and constructed storage facilities. Although environmental buffers remain useful elements of water treatment systems that should be considered alongside other options, they are not essential elements to reach water quality goals. Since 2010, several potable reuse projects have been developed or proposed that do not incorporate environmental buffers.



Assessing the Risks of Potable Water Reuse in Context

The committee that wrote the National Research Council report conducted an analysis that compares the estimated risks of drinking water from two potable reuse projects to a de facto reuse scenario in which five percent of the source water comes from wastewater discharged upstream after secondary treatment. The assumed de facto reuse conditions of scenario 1 are likely typical in many places and are generally perceived as safe. In scenario 2, treated wastewater is allowed to filter slowly through surface soils into an aquifer (also called soil aquifer treatment) before potable reuse. In scenario 3, advanced treatment techniques including microfiltration, reverse osmosis, and advanced oxidation are employed before the water is injected into an aquifer and used as a source of drinking water.

The analysis compared the risks of exposure to four pathogens (adenovirus, norovirus, *Salmonella,* and *Cryptosporidium*) and 24 chemical contaminants including pharmaceuticals,



Relative risk, shown on a logarithmic scale, posed by selected pathogens in a typical de facto reuse scenario (1), compared to two potable reuse scenarios (2, 3). The smaller the number, the lower the relative risk. For example in Scenario 2, the risk of illness due to Salmonella *is estimated to be less than 1/100th of the risk due to* Salmonella *in Scenario 1. Overall, the results indicate the risk of exposure to these pathogens from drinking reclaimed water does not appear to be any higher than the risk experienced in at least some current drinking water treatment systems.*

personal care products, natural hormones, industrial chemicals, and byproducts from water disinfection processes.

The results suggest that the risk of exposure to certain microbial and chemical contaminants from drinking reclaimed water does not appear to be any higher than the risk experienced in at least some current drinking water treatment systems—and may, in fact, be orders of magnitude lower.

The analysis revealed that carefully planned potable water reuse projects should be able to provide a level of protection from waterborne illness and chemical contaminants comparable to—and, in some cases, better than—the level of protection the public experiences in many drinking water supplies across the nation. However, the committee pointed out that the analysis was presented as an example and should not be used to endorse certain treatment schemes or to determine the risk at any particular site without site-specific analysis.

Costs of Water Reuse Projects

Investing in a water reuse system is a complex decision with both costs and benefits that extend many years into the future. Generally, water reuse is more expensive than drawing water from a natural freshwater source, but less expensive than seawater desalination. In many cases, lower-cost water sources are already being used, so the cost of water reuse should be compared with the cost of any available new water sources. The costs of water reuse vary greatly from place to place depending on location, water quality requirements, treatment methods, distribution system needs, energy costs, interest rates, subsidies, and many other factors.

Potable reuse systems can be more or less expensive than nonpotable reuse systems. Nonpotable reuse may require less treatment, depending on the intended use of the reclaimed water, and can also reduce the peak demand on a potable system, which can be a huge factor on water use in arid locations. However, nonpotable reuse also typically requires a separate piping system, which can be a significant expense depending on where and how far the nonpotable water must be distributed.

Water managers should also consider non-monetary costs and benefits of reuse projects, such as increased water supply reliability in times of drought, greenhouse gas emissions, and ecological impacts, to determine the most socially, environmentally, and economically feasible water supply option for their community.

Public Preferences and Acceptability

The public is a major stakeholder in any water management decision, and community members often play an important role in making decisions about water reuse projects. As with any water project, the success or failure of a proposed reuse project can ride on public perceptions of how the project relates to public health, public finance, taste and aesthetics, land use, environmental protection, and economic growth.

Humans have a natural revulsion to water that is perceived to be contaminated, and sometimes that feeling can translate into opposition to reusing treated wastewater, even when reclaimed water is shown to be of high quality. In some cases, people may even prefer lower-quality water from a source perceived as "natural" over higher-quality water coming from an advanced wastewater treatment facility. Reclaimed water's history as wastewater causes a psychological barrier for many people that can be hard to overcome.

However, when communities are actively engaged in discussions about water reuse, the technologies and science behind it, and the overall context of water management, both the public and water managers are better equipped to engage in meaningful dialogue.

In Redwood City, California, for example, a proposed water reclamation project was temporarily stalled by opposition from a small citizens' group in 2002. In response, a task force was established that brought the two sides together to discuss the project, review reliable sources of information, and weigh alternative options. A modified reuse project was eventually approved that was widely supported by the community. As the Redwood City experience demonstrates, frequent and open communication among water managers, citizens, and governments can be critical for communities to address the concerns of the public and make informed decisions about water reuse.

Green Cay Wetlands in Palm Beach County, Florida, provide additional nutrient removal for several million gallons of highly treated wastewater per day. The water then recharges groundwater supplies. Environmental buffers, such as this one, have been important for gaining public support in past potable reuse projects.

This booklet is based on *Water Reuse: Expanding the Nation's Water Supply through Reuse of Municipal Wastewater* by the Committee on the Assessment of Water Reuse as an Approach to Meeting Future Water Supply Needs. The report was supported by funding from the Environmental Protection Agency, the U.S. Bureau of Reclamation, the National Science Foundation, the National Water Research Institute, the Centers for Disease Control and Prevention, the Water Research Foundation, Orange County Water District, Orange County Sanitation District, Los Angeles Department of Water and Power, Irvine Ranch Water District, West Basin Water District, Inland Empire Utilities Agency, Metropolitan Water District of Southern California, Los Angeles County Sanitation Districts, and the Monterey Regional Water Pollution Control Agency. Production of this booklet was supported by additional funding from the U.S. Bureau of Reclamation.

For more information relating to the report, visit:
http://nas-sites.org/waterreuse

Committee on the Assessment of Water Reuse as an Approach to Meeting Future Water Supply Needs

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Data Sources for Charts

p.2–Kenny, J., N. Barber, S. Hutson, K. Linsey, J. Lovelace, and M. Maupin. 2009. Estimated Use of Water in the United States in 2005. USGS Circular 1344. Reston, VA: U.S. Geological Survey.

p.3–Jiménez, B., and T. Asano. 2008. Water reclamation and reuse around the world. In B. Jimenéz and T. Asano, eds., Water Reuse: An International Survey of Current Practice, Issues and Needs. London: IWA Publishing, pp. 3-26.

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WATEREUSE

Water Reuse Terminology

Water reuse occurs in various ways throughout the world. It happens daily on rivers and other water bodies everywhere. If you live in a community downstream of another, chances are you are reusing its water and likewise communities downstream of you are most likely reusing your water. Scientifically- proven advances in water technology allow communities to reuse water for many different purposes, including industrial, irrigation and drinking. Your water is treated differently depending upon the source and use of the water and how it gets delivered to you. Some water agencies reuse highly treated effluent from municipal wastewater or resource recovery plants as a reliable, drought proof source of drinking water. By using advanced purification processes, they produce water that meets all applicable drinking water standards. System reliability and frequent monitoring and testing are imperative to them meeting stringent controls.

The water needs of your community, water sources, public health regulations, costs, and the types of water infrastructure in place, such as distribution systems, man-made reservoirs, or natural groundwater basins, determine if and how your reused water becomes part of your drinking water supply. Communities in El Paso, Texas and Orange County, California, for example, reuse water to replenish groundwater basins. Others, such as the Upper Occoquan Service Authority in Virginia, put it into surface water reservoirs. In these instances the reused water is blended with other water supplies and/or sits in storage for a certain amount of time before it is drawn out and gets treated again at a water treatment or distribution system. In some Texas communities, the reused water is put directly into pipelines that go to a water treatment plant or distribution system. And in Singapore the reused water is bottled directly from an advanced water purification facility for educational and celebratory purposes. Though most of the reused water is used for high-tech industry in Singapore, a small amount is returned to reservoirs for drinking water.

Definitions

There is no one-size-fits-all solution to water reuse, but there are many safe and scientifically-proven options that allow communities to sustain their local water supplies. Below are terms scientists and water experts use to describe some of these water reuse options:

- **Reused Water** is water used more than once or recycled.
- **Potable Water** is drinking water.
- **Potable Reuse** refers to reused water you can drink.
- **Nonpotable Reuse** refers to reused water that is not used for drinking, but is safe to use for irrigation or industrial purposes.

- **De-facto, Unacknowledged or Unplanned Potable Reuse** occurs when water intakes draw raw water supplies downstream from discharges of treated effluent from wastewater treatment plants/water reclamation facilities or resource recovery facilities. For example, if you are downstream of a community, that community's used water (run-off and treated wastewater) gets put back into river or stream and is delivered downstream to your community and becomes part of your drinking water supply.
- **Planned Potable Reuse** is publicly acknowledged as an intentional project to recycle water for drinking water. It can be either direct or indirect. It commonly involves a more formal public process and public consultation program than is observed with de-facto or unacknowledged reuse.
- How potable reused water is delivered determines if it is called Indirect Potable Reuse or Direct Potable Reuse.
    - **Indirect Potable Reuse** means the water is delivered to you indirectly. After it is purified, the reused water blends with other supplies and/or sits a while in some sort of storage, man-made or natural, before it gets delivered to a pipeline that leads to a water treatment plant or distribution system. That storage could be a groundwater basin or a surface water reservoir.
    - **Direct Potable Reuse** means the reused water is put directly into pipelines that go to a water treatment plant or distribution system. Direct potable reuse may occur with or without "engineered storage" such as underground or above ground tanks.

May 2014

Alternative Water Supplies

In Florida, traditional sources of fresh water (usually groundwater) are becoming increasingly limited. Between 2010 and 2030, the state's water demand is forecast to grow by about 1.3 billion gallons per day. Public water supply use is expected to account for the majority of the growth in demand. Agricultural irrigation and the other water use categories show small increasing trends as well. In many parts of the state, traditional water sources, mostly fresh groundwater, will not be able to meet these increased demands. As a result, water managers are developing alternative water supplies to help meet Florida's future fresh water needs.

What Are Alternative Water Supplies?

Alternative water supplies include seawater, brackish groundwater, surface water, storm water, reclaimed water, aquifer storage and recovery projects and any other nontraditional supply source identified in a regional water supply plan. These sources are frequently more expensive to develop and operate than traditional sources.

Development of alternative water sources has benefits beyond supplementing traditional water supplies. Source diversification creates a water supply system that is more reliable than a system that relies on a single source of supply. Diversification of water sources is an important tool in building drought resilience, increasing water supply reliability, and protecting Florida's natural environment.

Are Alternative Water Supplies Already Being Used In Florida?

Yes. During the past 20 years, Florida has been recognized as a national leader (along with California) in water reuse. In 2013, Florida used about 719 million gallons per day (mgd) of reclaimed water for beneficial purposes. Florida leads the nation in the use of desalination technology. Florida's seawater desalination plant in the Tampa Bay area is the largest such facility in North America. In addition to the use of seawater, more than 140 facilities use desalination technology to treat brackish water. Florida also is increasing use of surface and stormwater as fresh water sources.

Still, these ongoing efforts alone will not meet the projected 2030 demand. More alternative supplies, as well as increased water conservation are still needed.

How Is Florida Planning to Meet Future Water Needs?

Because it takes several years to build water facilities, planning is extremely important. Every five years, Florida's water management districts assess the ability to meet future water needs for 20 years. In areas where the water sources are deemed inadequate to meet future needs, the districts must

Water Resource
Fact Sheet Series

Available Fact Sheets

- *Florida's Water Resource Management System*
- *Minimum Flows and Levels*
- *Water Use Trends in Florida*
- *Water Conservation*
- *Alternative Water Supplies*
- *Regional Water Supply Planning*
- *Water Reservations*
- *Drought and Water Management*
- *Local Sources First*
- *Per Capita Water Use*
- *Desalination*
- *Reclaimed Water*

For More Information

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(850) 245-3166
http://www.dep.state.fl.us/water/waterpolicy/index.htm

prepare regional water supply plans that identify sufficient sources to meet future demands. These plans describe specific water supply development projects, including many alternative water supply projects, for utility consideration to meet projected demands.

Who Pays for Alternative Water Supply Projects? How Much Water Will They Provide?

The 2005 Florida Legislature concluded that incentive funding would hasten the needed development of alternative water supplies. Between 2005 and 2008, the Legislature appropriated over $217 million dollars for construction of these projects. These funds, along with matching funds from the water management districts, were awarded as grants to local water suppliers and contributed to the construction of 389 projects. Since 2009, due to state budget constraints, funding for alternative water supply projects has come only from the water management districts and local water providers.

As of the end of 2013, funded projects already have made available approximately 427 mgd of additional water for consumptive use. The districts estimate that when construction of all currently planned alternative water supply projects is complete they will help create approximately 707 million gallons per day of "new water" available for consumptive use. This amount is more than half of the additional 1.3 billion gallons per day needed by 2030.

Where Can I Get More Information?

Information on water supply planning and alternative water supplies can be found in DEP's Annual Report on Regional Water Supply Planning at:

http://www.dep.state.fl.us/water/waterpolicy/docs/2013_annual_rwsp.pdf

Information about the alternative water supply development and water conservation efforts of the water management districts can be accessed through the links at:
http://www.dep.state.fl.us/water/waterpolicy/districts.htm

Water Resource Protection

Senate Bill (SB) 536 Study

Study Requirements

SB 536, which passed in the 2014 legislative session, requires "DEP, in coordination with stakeholders shall conduct a comprehensive study and submit a report on the expansion of use of reclaimed water, stormwater, and excess surface water in this state."

- Hold a minimum of two public meetings to gather input on the study.
- Provide opportunity for public to submit written comments before submitting the report.
- Submit report to Governor, Senate President, Speaker of the House no later than December 1, 2015, that includes the following:
  - Identification of measures that would lead to the efficient use for reclaimed water.
  - Identification of environmental, engineering, public health, public perception, and fiscal constraints of expansion, including utility rate structures for reclaimed water.
  - Identification of areas in the state where traditional water supply sources are limited and the use of reclaimed water, stormwater, or excess surface water for irrigation or other purposes is necessary.
  - Recommendation of permit incentives, such as extending current authorization for long-term consumptive use permits for all entities that substitute reclaimed water for traditional water sources that become unavailable or otherwise cost prohibitive.
  - Determination of the feasibility, benefit, and cost estimate of the infrastructure needed to construct regional storage features on public or private lands for reclaimed water, stormwater, and excess surface water, including the collection and delivery mechanisms for beneficial uses such as agricultural irrigation, power generation, public water supply, wetland restoration, groundwater recharge, and waterbody base flow augmentation.

Study Team's Organizational Representatives

FDEP - Janet Llewellyn and Carolyn Voyles
DACS - Rich Buddell
FDOT - Rick Renna
NWFWMD - Leigh Brooks
SFWMD - Mark Elsner
SJRWMD - Ann Shortelle and Joanne Chamberlain
SRWMD - Tom Kiger and Carlos Herd
SWFWMD - Mark Hammond

Current Teleconference/Meeting Schedules

Work Team	Date & Time	Call-In Information/Location	Meeting Web Link(s)
Study Planning Work Group	» June 12, 10:00a-12:00p » June 26, 10:00a-12:00p	» 1-888-670-3525 » Access Code: 940-204-6397	Study Planning Workgroup Lync Meeting

Public Workshop Materials & Stakeholder Comments

Presentation materials from the SB 536 public workshops are available from the links below. Stakeholder comments, received to date, can be accessed through DEP's FTP site.

» Rules

Navigation

» Sitemap

Get ADOBE® READER®

Documents are Adobe Acrobat files, which will open in a new window, unless indicated, and require the free Reader Software.

» 2014 Public Workshop Agenda
» SB 536 Workshop Presentation SJR - November 13, 2014
» SB 536 Workshop Presentation SWF – October 29, 2014
» SB 536 Workshop Presentation NWF – October 27, 2014
» SB 536 Workshop Presentation SF – October 20, 2014
» SB 536 Workshop Presentation SR – October 8, 2014

SB 536 Study Stakeholders Email List

To become an SB 536 Study stakeholder and receive emails and updates relating to the study or to manage your current subscription, please enter your contact information below.

*Email Address

Submit

If you'd like more information, or to provide comments, email us at SB536Study@dep.state.fl.us.

Last updated: May 29, 2015

2600 Blair Stone Road M.S. 3500 Tallahassee, Florida 32399 850-245-8336 (phone) / 850-245-8356 (fax)
DEP Home | About DEP | Contact Us | Search | Site Map

An act relating to reclaimed water; requiring the Department of Environmental Protection to conduct a study in coordination with the stakeholders on the expansion of the beneficial use of reclaimed water, stormwater, and excess surface water and to submit a report based upon such study; providing requirements for the report; requiring the department to provide the public an opportunity for input and for public comment; requiring that the report be submitted to the Governor and the Legislature by a specified date; providing an effective date.

Be It Enacted by the Legislature of the State of Florida:

Section 1. Use of reclaimed water, stormwater, and excess surface water.—

(1) The Department of Environmental Protection, in coordination with the stakeholders, shall conduct a comprehensive study and submit a report on the expansion of the beneficial use of reclaimed water, stormwater, and excess surface water in this state.

(2) The report must:

(a) Identify factors that prohibit or complicate the expansion of the beneficial use of reclaimed water, stormwater, and excess surface water and recommend how those factors can be mitigated or eliminated.

(b) Identify measures that would lead to the efficient use of reclaimed water.

(c) Identify the environmental, engineering, public health, public perception, and fiscal constraints of such an expansion, including utility rate structures for reclaimed water.

(d) Identify areas in the state where traditional water supply sources are limited and the use of reclaimed water, stormwater, or excess surface water for irrigation or other purposes is necessary.

(e) Recommend permit incentives, such as extending current authorizations for long-term consumptive use permits for all entities that substitute reclaimed water for traditional water sources that become unavailable or otherwise cost prohibitive.

(f) Determine the feasibility, benefit, and cost estimate of the infrastructure needed to construct regional storage features on public or private lands for reclaimed water, stormwater, and excess surface water, including the collection and delivery mechanisms for beneficial uses such as agricultural irrigation, power generation, public water supply, wetland restoration, groundwater recharge, and waterbody base flow augmentation.

(3) The department shall:

(a) Hold two public meetings, at a minimum, to gather input on the study.

(b) Provide an opportunity for the public to submit written comments before submitting the report.

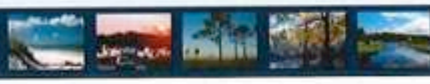
(4) The report shall be submitted to the Governor, the President of the Senate, and the Speaker of the House of Representatives no later than December 1, 2015.

Section 2. This act shall take effect July 1, 2014.

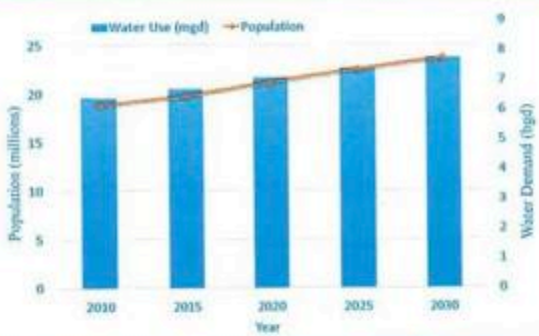
Florida Department of Environmental Protection

SB 536 Study and Report

Craig Varn
General Counsel
Department of Environmental Protection



Population & Demand Projections



Water Management District Regional Water Supply Plans

20-year Projected Water Supply Needs

	Net Demand Change	Future Demand Not Met	Future Demand Not Met after Conservation	Potential Water from AWS Projects
Statewide Total	1394 mgd	538 mgd	277-331 mgd	1981 mgd
CFWI	311 mgd	250 mgd	208 mgd	455 mgd

SB 536 (2014)

- Conduct a comprehensive study, in coordination with stakeholders, on the expansion of the beneficial use of reclaimed water, stormwater, & excess surface water.


Reclaimed Water


Surface Water Storage

Specific Requirements

- Identify factors that prohibit or complicate this expansion and recommend how those factors can be mitigated or eliminated.

Specific Requirements

- Identify areas in the state where traditional water supply sources are limited and the use of reclaimed water, stormwater, or excess surface water is necessary.

Specific Requirements

- Determine the feasibility, benefit, and cost estimate needed to construct regional storage features for the beneficial use of reclaimed water, stormwater, and excess surface water.

General Requirements

- Hold a minimum of two public meetings to gather input on the study.
- Provide opportunity for public comment before submitting the report.
- Submit report to Governor, Senate President, Speaker of the House no later than December 1, 2015.

Tasks - Completed

1. Form Subject Areas Work Teams
   a. Reclaimed Water
   b. Stormwater
   c. Excess Surface Water
   d. Storage (2) – Reservoirs; ASR & Dispersed Water Mgmt
2. Establish Stakeholder Communication – Website and Email Address
3. Conduct On-line Survey
4. Hold Public Workshops - Survey Results, Comments

Planning Workgroup Members

DEP	SFWMD
DACS	SJRWMD
DOT	SRWMD
NWFWMD	SWFWMD

Subject Area Work Team Leaders

Reclaimed Water
Rick Nevulis (SF)

Storage - Reservoirs
Mark Hammond (SWF)

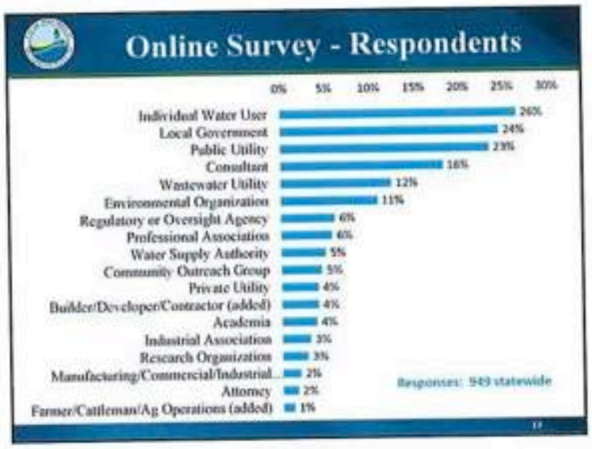
Excess Surface Water
Ann Shortelle (SR)

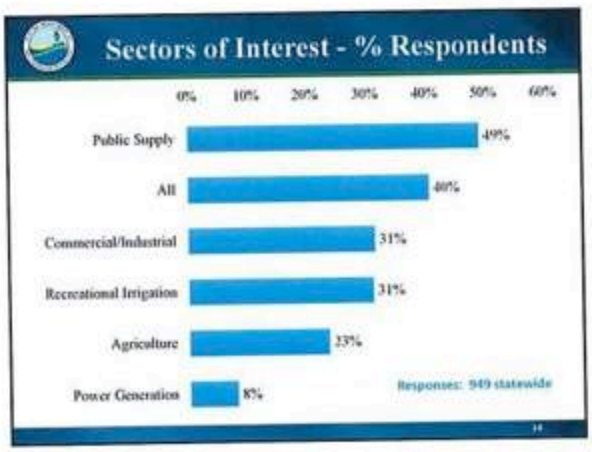
Storage – ASR/Dispersed
Bob Verrastro (SF)

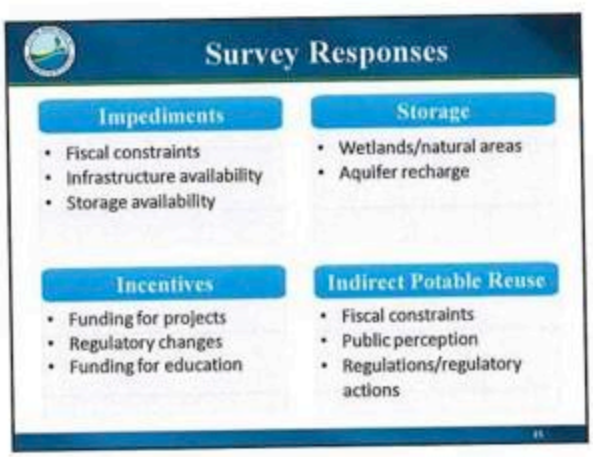
Stormwater
- Joanne Chamberlain (SJR)
- Rick Renna (DOT)

Tasks - Ongoing

5. Hold work team meetings, Meet with stakeholders, Prepare draft study report	November 2014 - July 2015
6. Post draft report on web, Hold public workshops for comment	August, 2015
7. Prepare final report	August – November 2015
Submit report to the Governor and the Legislature	**NLT December 1, 2015**


Online Survey - Respondents
0% 5% 10% 15% 20% 25% 30%
Individual Water User 26%
Local Government 24%
Public Utility 23%
Consultant 16%
Wastewater Utility 12%
Environmental Organization 11%
Regulatory or Oversight Agency 6%
Professional Association 6%
Water Supply Authority 5%
Community Outreach Group 5%
Private Utility 4%
Builder/Developer/Contractor (added) 4%
Academia 4%
Industrial Association 3%
Research Organization 3%
Manufacturing/Commercial/Industrial... 2%
Attorney 2%
Farmer/Cattleman/Ag Operations (added) 1%
Responses: 949 statewide


Sectors of Interest - % Respondents
0% 10% 20% 30% 40% 50% 60%
Public Supply 49%
All 40%
Commercial/Industrial 31%
Recreational Irrigation 31%
Agriculture 23%
Power Generation 8%
Responses: 949 statewide


Survey Responses
Impediments
• Fiscal constraints
• Infrastructure availability
• Storage availability
Storage
• Wetlands/natural areas
• Aquifer recharge
Incentives
• Funding for projects
• Regulatory changes
• Funding for education
Indirect Potable Reuse
• Fiscal constraints
• Public perception
• Regulations/regulatory actions

SB 536 Study Report

- In-depth discussion of:
  - Reclaimed water
  - Stormwater
  - Surface Water
  - Storage options
    - Reservoirs
    - ASR
    - Aquifer Recharge
    - Dispersed Water Management

SB 536 Study Recommendations

- Statewide
  - Statutory changes
  - Regulatory changes
  - Funding
  - State Actions
- Regional
  - Specific opportunities or areas of focus
  - Potential projects or project concepts
  - Recommended pilot projects

Highlights of Draft Recommendations

FUNDING: Continued alternative water supply funding partnerships are critical.

Highlights of Draft Recommendations

REGULATORY:

- Revisions to UIC Rules to facilitate ASR and Aquifer Recharge with reclaimed water, stormwater and surface water
- Establish clear rules and procedures for Direct Potable Reuse
- Revisions to ERP rules to encourage and promote stormwater reuse.
- Evaluate revisions to DEP reclaimed water rules to facilitate supplementation with stormwater

Highlights of Draft Recommendations

AGENCY ACTIONS:

- Establish a Stormwater Coordinating Committee (based on model of Reuse Coordinating Committee) with DEP/WMDs/DOT
- Ensure stormwater is considered as part of Regional Water Supply Planning process
- To better identify opportunities, improve coordination between wastewater, ERP (stormwater) and CUP permitting programs

Highlights of Draft Recommendations

EDUCATION/OUTREACH:

- Institute a statewide education/outreach program for reclaimed water, particularly indirect and direct potable reuse
- Develop educational materials on nutrient content and value of reclaimed water for reuse customers
- Continued outreach to agricultural producers on stormwater harvesting

Contact Information

- SB 536 Study Web Site:
  http://www.dep.state.fl.us/water/reuse/study.htm
- Email: sb536study@dep.state.fl.us

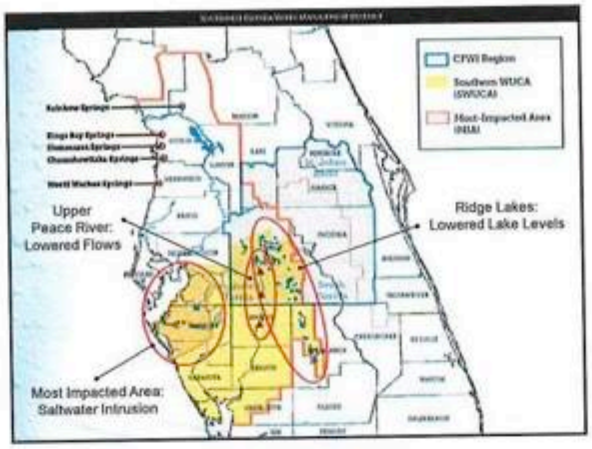
Questions?

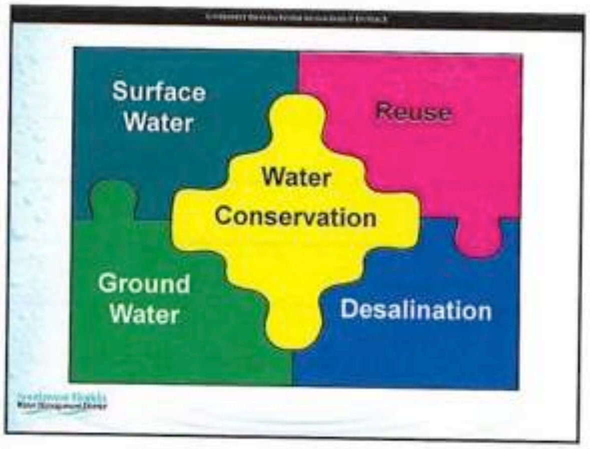
Regional Water Resource Challenges and the Role of Reuse from a Regulatory Agency
(Southwest Florida Water Management District)

Brian Armstrong, PG
Assistant Executive Director

Discussion Topics

- Resource concerns
- AWS at the District
- Financial trends
- Conservation
- The future
- Regulatory challenges

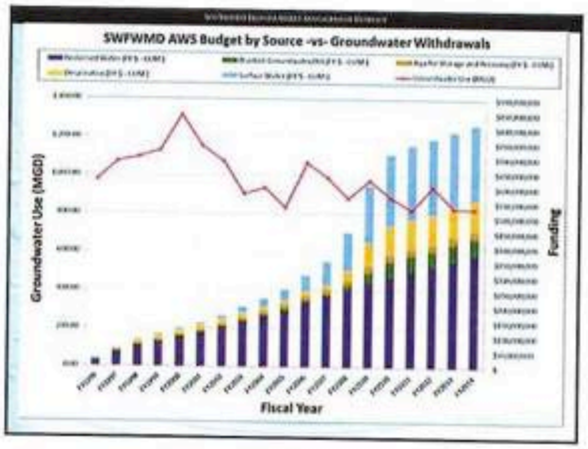




District AWS Projects

2005 to Current Budgeted Projects

Project Type	# of Projects	Total Cost (Mil/$)	District Match (Mil/$)	Quantity at Build Out (MGD)
Reclaimed Water	98	$474	$204	59
ASR	13	$35	$14	0.8
Brackish Groundwater	10	$282	$55	52.5
Surface Water	14	$556	$227	64.9
Seawater Desal	1	$85	$42.5	35
Stormwater Water	0	No Projects Funded During Time Horizon		
Total	136	$1,432	$542.5	212.2



What We Do and Why

Four Areas of Responsibility

Reclaimed water is critical to the mission of managing water and related natural resources

Funding and Benefits

Began funding reclaimed projects in 1987

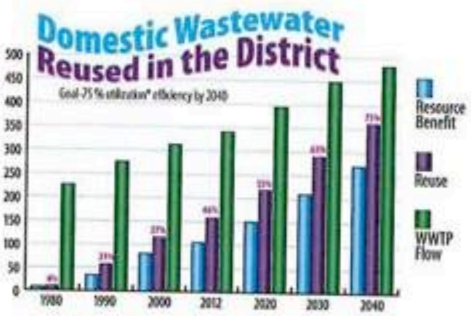
- 357 projects funded
- 310 projects completed
- $408M leveraged $956M
- 950 miles of pipelines
- 245 MGD reuse capacity
- 109 – 131 MGD benefits ($7 - $8 capital)
- 10% of Districtwide water use

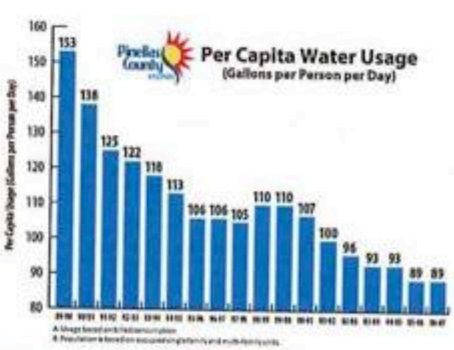
Reclaimed Water Facts

- 106,000 residences
- 203 golf courses
- 471 parks
- 168 schools
- 8 power plants
- 2 additional power plants (2015)
- 8,000 acres of agriculture

Reclaimed Water

- 157 mgd beneficial reuse out of 340 mgd (FDEP)
- 482 mgd beneficial reuse out of 1606 mgd (FDEP)
- 2,240 mgd reuse out of 32 **billion** gpd (USEPA)





What's Next? Opportunities for Enhancement

Northern Springshed Reuse

- Constructed wetlands
- Denite filters (active & passive)
- Septic tanks to sewer
- Industrial reuse projects
- Traditional reuse projects

Potable Reuse

- Indirect augmentation of raw water sources

Reuse Recharge/Augmentation

- Clearwater IPR Injection 3 mgd
- Central Pasco RIBs 5 mgd
- Winter Haven RIBs 2.7 mgd
- East Hillsborough RIBs 25 mgd
- Hillsborough SHARP/NW Injection 16 mgd
- Tampa Wetland/Augmentation 20 mgd

Potable Reuse

- Direct pipe-to-pipe

Future AWS

- Direct Potable Reuse (DPR)
  - Windhoek, Namibia 5.6 mgd (1969)
  - Cloudcroft, New Mexico PUReWater Project 0.1 mgd (initial 2007 and expanding 2015)
  - Singapore NEWater Project 50.0 mgd (initial 2003 and expanded 2010)
  - Beaufort West, South Africa Karoo DPR Project 0.5 mgd (2011)
  - Colorado River Municipal Water District's Big Spring Texas DPR Project 2.0 mgd (2013)
  - Wichita Falls Texas DPR Project 5.0 mgd (2014)

Purified Water: *The Future of AWS?*

- Direct Potable Reuse (DPR)
  - Purified Water is a Viable Option
    - *WateReuse California 2011 Direct Potable Report*
  - In many parts of the world, DPR may be the most economical and reliable method of meeting future water supply needs
    - *USEPA 2012 Guidelines for Water Reuse*
  - DPR can meet or exceed all drinking water standards, is safe for direct human consumption and is comparable in costs to most alternative water supplies
    - *WateReuse 2014 The Opportunities and Economics of Direct Potable Reuse*
  - 685 mgd of potential DPR in Florida in 6 coastal counties
  - Increased construction of "DPR" supplies around the world

Regulatory Challenges

- AWS project timelines to WUP condition due dates
- Modification of AWS receiving WUPs
- AWS projects are contracted through suppliers
- AWS metering and monitoring
- Appropriate AWS information in WUP application
- Notification to the District when standby quantities are being used
- Continued use of AWS after WUP ownership transfers
- Conjunctive AWS use
- Potable AWS use

The Drought...and Drought Proof Solutions for California: How Fit for Purpose Water Fit's In

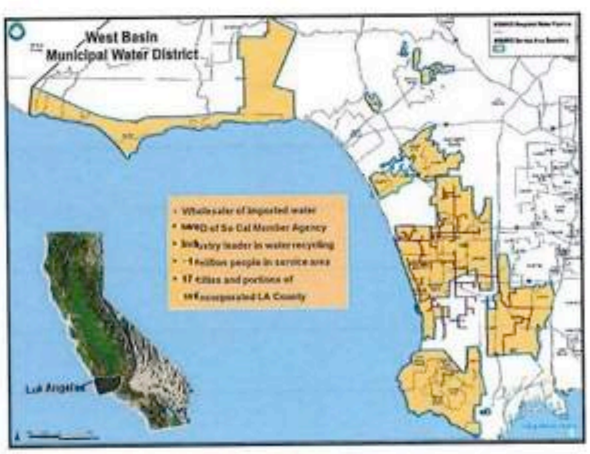
The Role of WateReuse in our Water Supply Portfolios

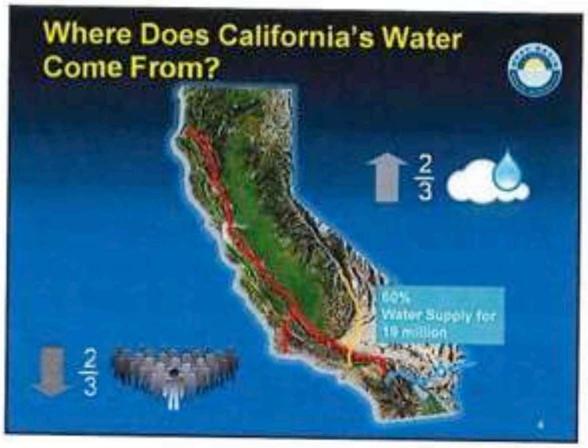
July 7, 2015

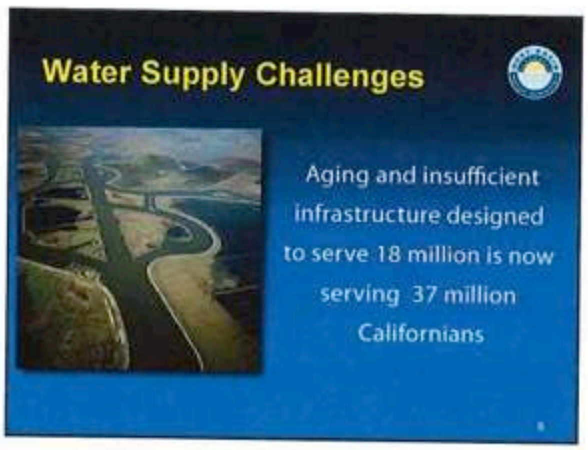
Outline

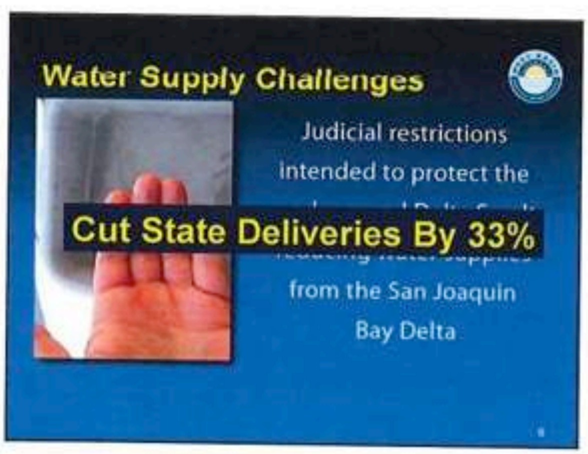
1. Where does water in CA come from?
2. CA Drought – "The Ugly"
3. 2015 Winter – "The Bad"
4. West Basin Story
5. Drought Proof Solutions – "The Good"
6. Greatest Challenge
7. Lesson Learned

2

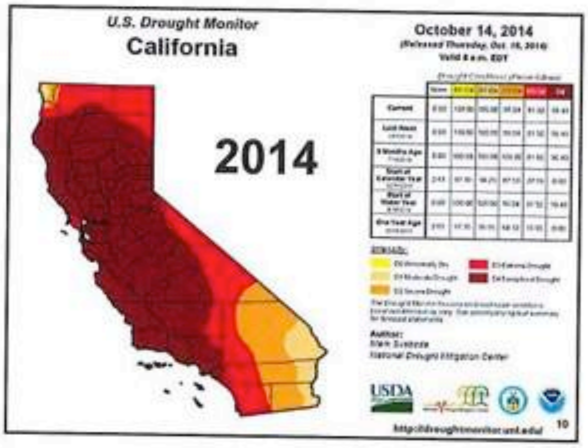


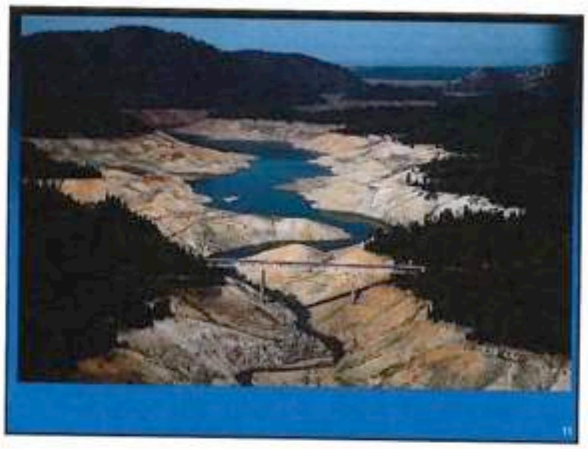

Where Does California's Water Come From?
60% Water Supply for 19 million


Water Supply Challenges
Aging and insufficient infrastructure designed to serve 18 million is now serving 37 million Californians


Water Supply Challenges
Judicial restrictions intended to protect the
Cut State Deliveries By 33%
from the San Joaquin Bay Delta

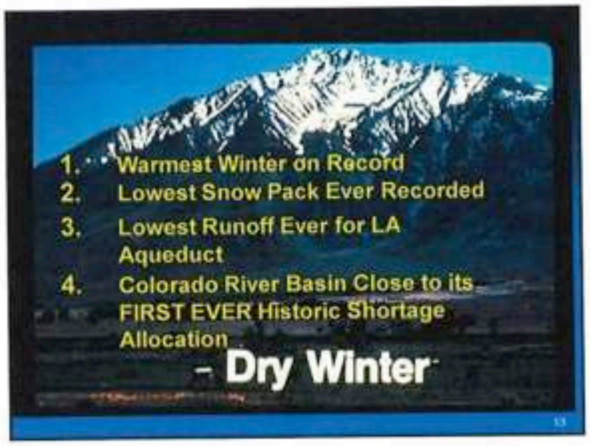
California Drought: "The Ugly"



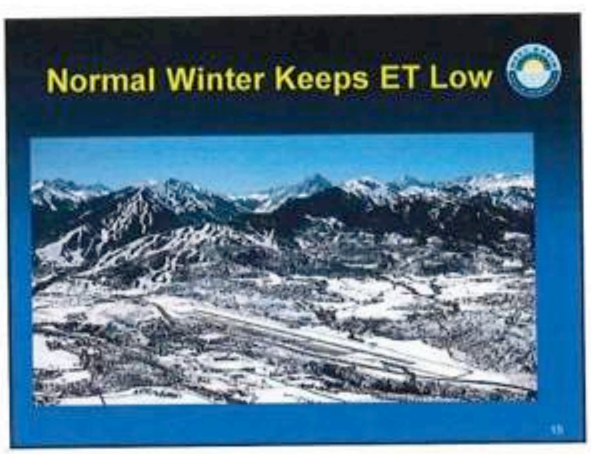


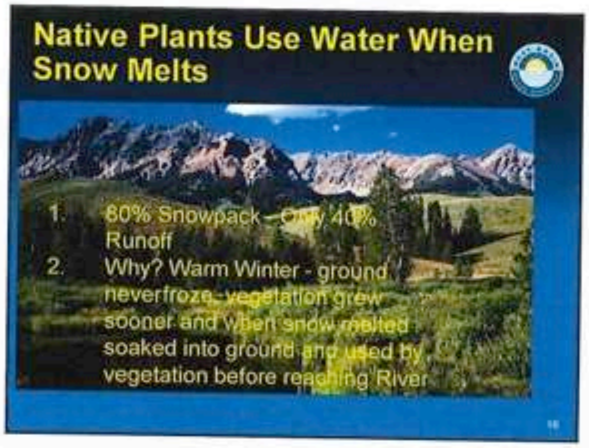
2015 Winter
"The Bad"

12


1. Warmest Winter on Record
2. Lowest Snow Pack Ever Recorded
3. Lowest Runoff Ever for LA Aqueduct
4. Colorado River Basin Close to its FIRST EVER Historic Shortage Allocation
- Dry Winter


Colorado River Basin
WY
UT
NV
CO
CA
NM
AZ
UPPER BASIN
LAKE POWELL
LEE FERRY
LAKE MEAD
LOWER BASIN
LAKE MOHAVE
LAKE HAVASU
COLORADO RIVER DELTA
GULF OF CALIFORNIA
MEXICO
14


Normal Winter Keeps ET Low


Native Plants Use Water When Snow Melts
1. 80% Snowpack – Only 40% Runoff
2. Why? Warm Winter - ground neverfroze- vegetation grew sooner and when snow melted soaked into ground and used by vegetation before reaching River

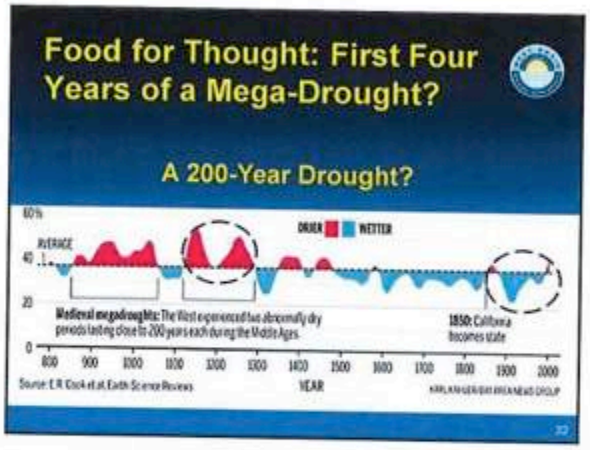

April 1, 2015 Snowpack
First Time Ever Statewide Mandatory Cut in Urban Usage - 25%


ENTERING
CALIFORNIA
BRING YOUR OWN WATER

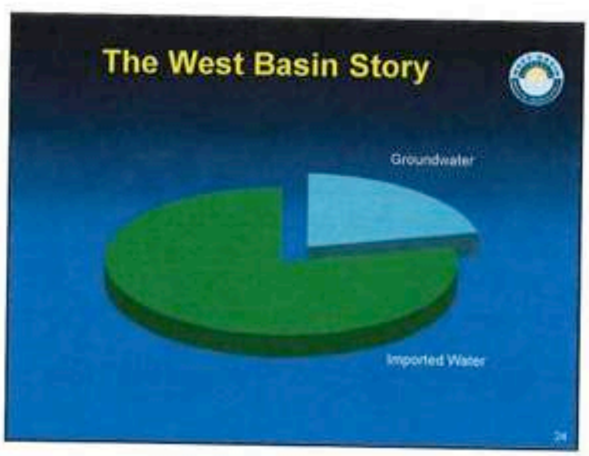

SERIOUS DROUGHT
HELP SAVE WATER


We Will Be Rationing Water Soon!

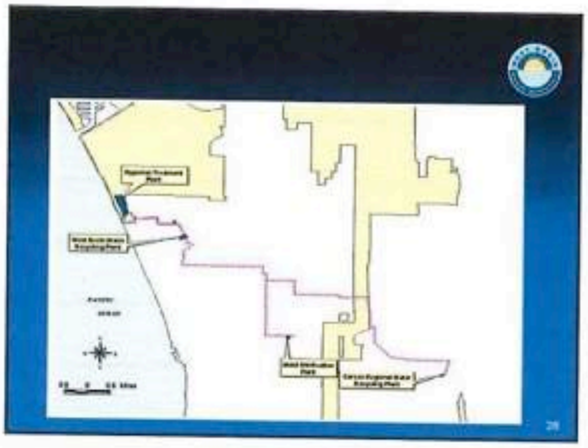

MWD/Region invested $12B in Storage Reliability

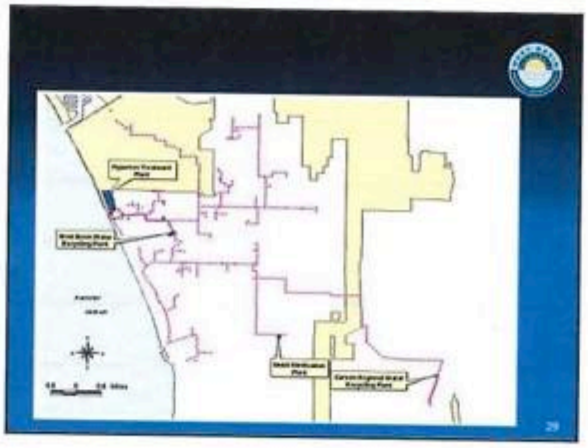

Food for Thought: First Four Years of a Mega-Drought?
A 200-Year Drought?
60%
DRIER
WETTER
AVERAGE
40
20
0
Medieval megadroughts: The West experienced two abnormally dry periods lasting close to 200 years each during the Middle Ages.
1850: California becomes state
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
Source: E.R. Cook et al. Earth Science Reviews
YEAR

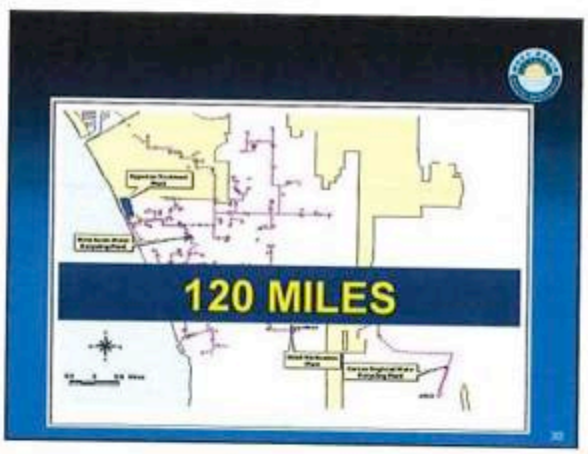

Cannot Use Recent Past to Predict the Future
Is This the New Normal?

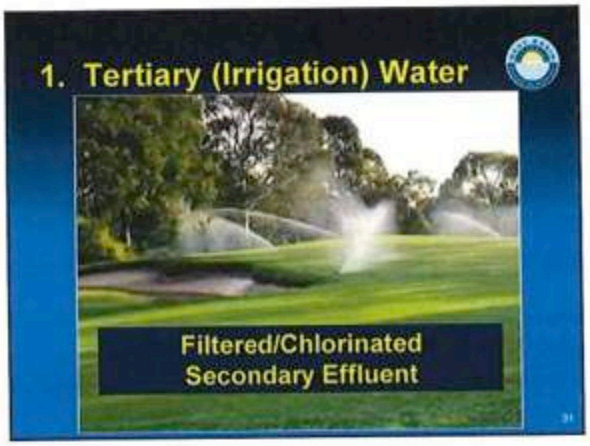

The West Basin Story
Groundwater
Imported Water

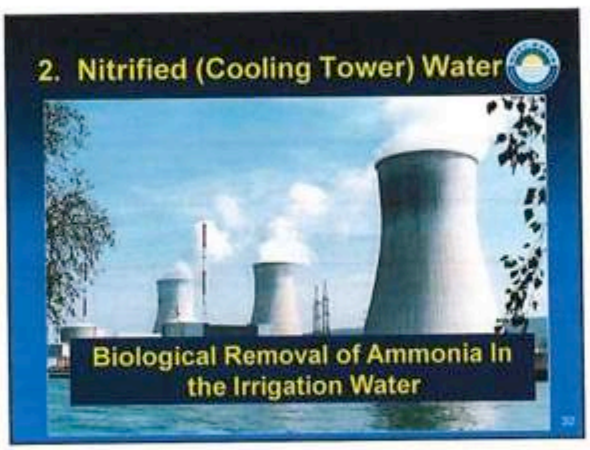
Edward C. Little Water Recycling Facility





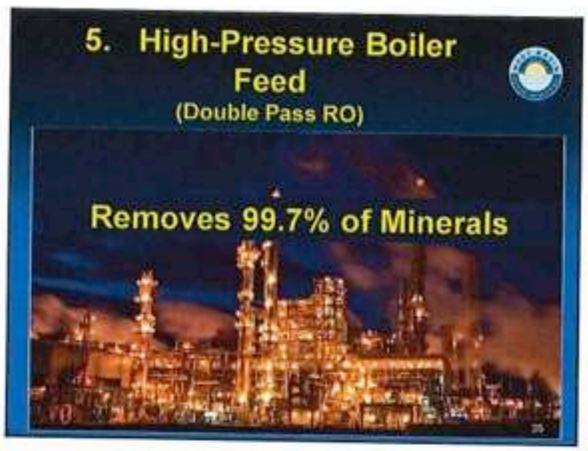

120 MILES


1. Tertiary (Irrigation) Water
Filtered/Chlorinated
Secondary Effluent


2. Nitrified (Cooling Tower) Water
Biological Removal of Ammonia In
the Irrigation Water


3. Low-Pressure Boiler Feed
(Single Pass RO)
Removes 97% of Minerals


4.
Indirect Potable Reuse
Ozone/ Micro Filtration/Reverse Osmosis/UV Peroxide
West Coast
WEST
CENTRAL
Removes 98% organics, 97% minerals and oxidizes remaining organics
Map Area
Dominguez Gap
41 Wells
Los Alamitos
35 Wells


5. High-Pressure Boiler Feed
(Double Pass RO)
Removes 99.7% of Minerals


Designer Waters
3
Indirect Potable Reuse: Barrier
Saved 165 Billion Gallons of Water
Reverse Osmosis: Single Pass
2
Nitrified Water
5
Reverse Osmosis: Double Pass

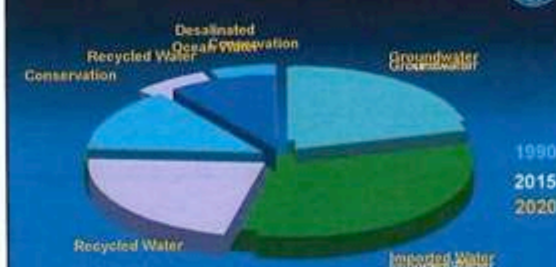
Designer Water No. 6

Tertiary Membrane Bioreactor

"What Does the Public Think?"

	Favor
1. Voluntary conservation	91%
2. Recycled water	81%
3. Ocean-water desalination	75%
4. Build new dams	63%
5. Increase imported water	56%
6. Mandatory conservation	48%
7. Increase the price of water	32%

West Basin Water Supply Portfolio



"The Good" Drought Proof Solution – Water Recycling

40

Water Use In California

1. 40 Million AF Year (MAF)
   - 32 MAF Agriculture
   - 8 MAF Urban
     - ~3.5 MAF Sanitation

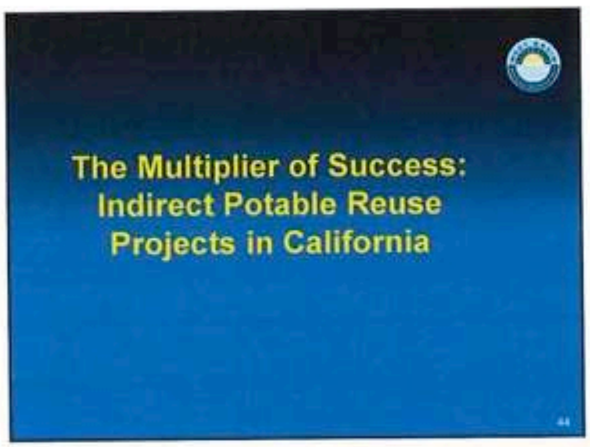
41

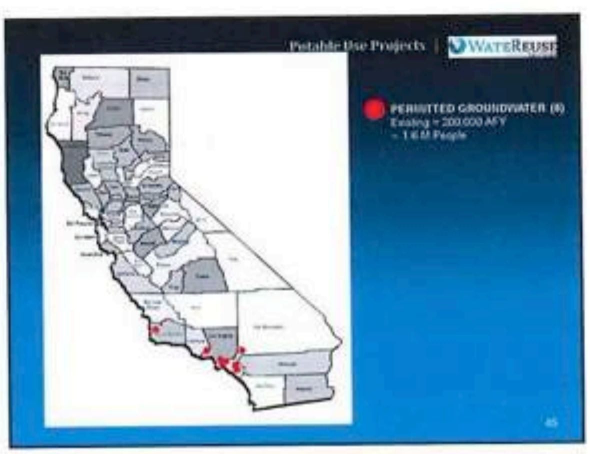
What is the Potential for Water Recycling?

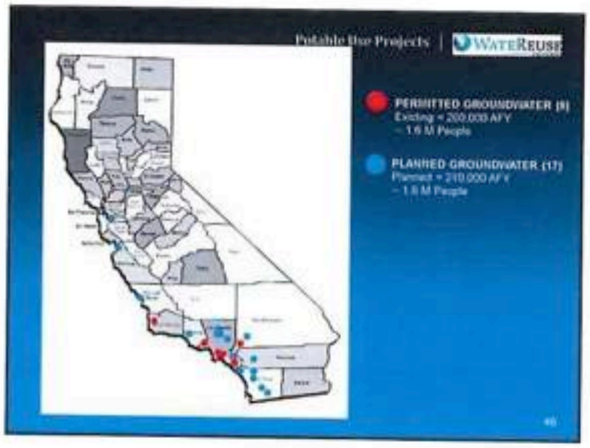
- 1.64 Billion Gallons/Day
- 25% = 410 MGD
- 3.5 million people

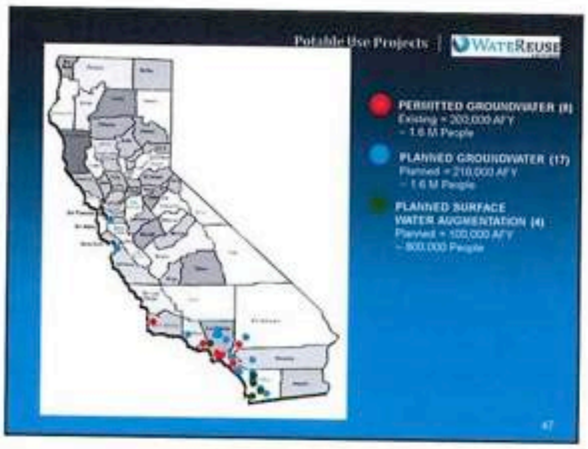
42


Indirect Potable Reuse Concept
WW Treatment
Urban Water Use
Water Treatment
Nature
AWT =
RO + UV
43


The Multiplier of Success:
Indirect Potable Reuse
Projects in California
44


Potable Use Projects
WATEREUSE
PERMITTED GROUNDWATER (8)
Existing = 200,000 AFY
~ 1.6 M People
45





"What is Next?"

- CA SB-918 Signed into law on September 30, 2010
- Requires Health Dept. to *investigate the feasibility of DIRECT POTABLE REUSE* and to provide a final report to the CA legislature by December 31, 2016

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What Lessons
Have We Learned Along the Way?

- Up to 100,000 elements in water
- Research has shown for a compound to pass through RO membranes:
  1. Water Soluble
  2. Low Molecular Weight (<100 Daltons)
  3. Non-polar (No +, - charge)

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Water Is Water?

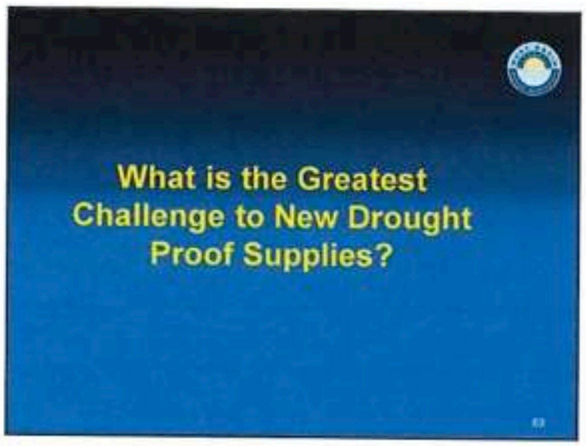
1. The same amount water exists as it did 4.5 billion years ago.
2. Every molecule has been used, cleaned and reused.
3. And every molecule has mingled with bad things and today we have the technology to clean and separate water molecules.
4. And in the process we can create water that can do anything

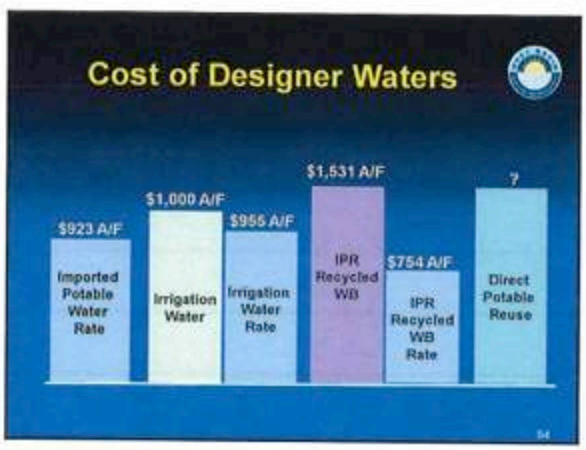
50

Direct Potable Reuse
Concept

51

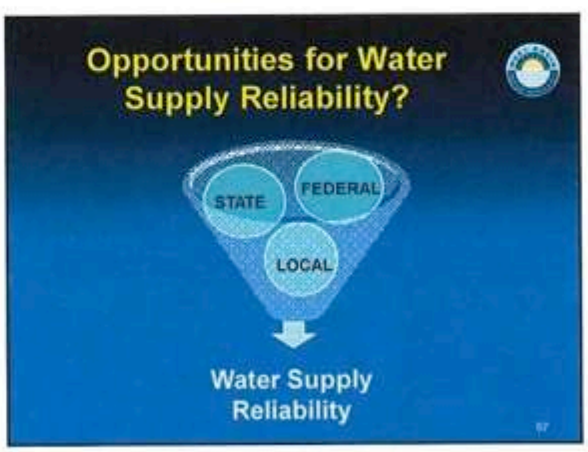

Don't you want spaceship technology in your local community?

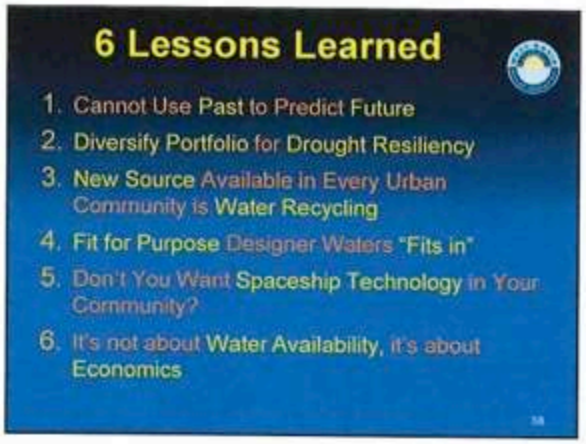

What is the Greatest Challenge to New Drought Proof Supplies?

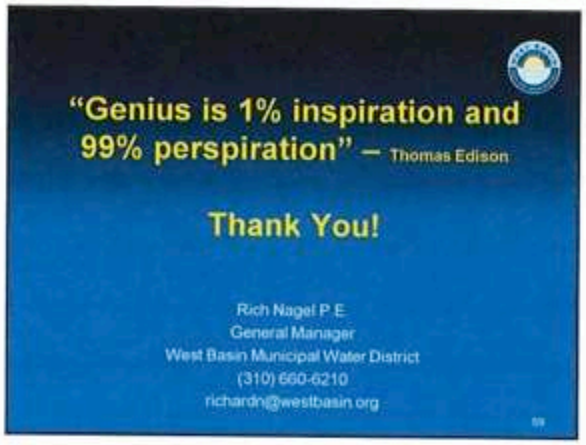

Cost of Designer Waters
$923 A/F
Imported Potable Water Rate
$1,000 A/F
Irrigation Water
$955 A/F
Irrigation Water Rate
$1,531 A/F
IPR Recycled WB
$754 A/F
IPR Recycled WB Rate
?
Direct Potable Reuse


How Did We Pay For
Water Recycling Facilities?
$601 Million
State- $9 Million
Federal- $85 Million
Customer- $119 Million
Regional- $118 Million


Q:What is our
most
expensive
glass of water?
A:The one you
don't have.


Opportunities for Water
Supply Reliability?
STATE
FEDERAL
LOCAL
Water Supply
Reliability


6 Lessons Learned
1. Cannot Use Past to Predict Future
2. Diversify Portfolio for Drought Resiliency
3. New Source Available in Every Urban Community is Water Recycling
4. Fit for Purpose Designer Waters "Fits in"
5. Don't You Want Spaceship Technology in Your Community?
6. It's not about Water Availability, it's about Economics


"Genius is 1% inspiration and 99% perspiration" – Thomas Edison
Thank You!
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