

GRA White Paper: RECYCLED WATER FOR RECHARGE
A Growing Resource for Sustainable Groundwater Replenishment
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This paper provides an overview of the challenges being faced by groundwater agencies to replenish water supplies in the face of dwindling imported supplies and drought. Focus is placed on finding alternatives to imported water for groundwater recharge with a case study of the Central and West Coast Groundwater Basins in Southern California.

Introduction

As highlighted in the 2009 State Water Resources Control Board's (SWRCB) Recycled Water Policy¹, California is facing an unprecedented water crisis. This crisis stems from the feared collapse of the Bay-Delta ecosystem, climate change, continuing population growth, severe drought on the Colorado River and the threat of failing levees in the Delta. This new reality is severely testing California's ability to provide the clean water needed for a healthy environment, a healthy population and a healthy economy, both now and in the future. These challenges also present an unparalleled opportunity for California to move aggressively towards a sustainable water future. To this end, the SWRCB is encouraging local and regional water agencies to move toward local water sustainability by emphasizing water recycling, water conservation, improved maintenance of supply infrastructure and the capture and use of stormwater and dry-weather urban runoff.

California's water crisis means that imported river water can no longer be considered a reliable source to replenish groundwater basins. Unless other sources of recharge water can be found, substantial negative impacts to groundwater basins can be expected, including basin overdraft, land subsidence, well pumping restriction or cessation, and coastal seawater intrusion.



Imported Water is No Longer a Reliable Groundwater Replenishment Supply for Southern California

Facing reductions in imported water for groundwater recharge, groundwater management agencies are evaluating local supply alternatives. For example, the Water Replenishment District of Southern

California (WRD) and the County Sanitation Districts of Los Angeles County (CSD), are investigating a possible project in the Central Basin that will provide sustainable sources of water for replenishment in the Montebello Forebay. Specific considerations in planning this project include:

- Increasing the capture and recharge of stormwater
- Expanding the use and recharge of recycled water

¹ State Water Resources Control Board Recycled Water Policy Approved 5/14/2009. See http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/

- Developing a management plan to control salts and nutrients in groundwater, per the SWRCB's 2009 Recycled Water Policy
- Working with community stakeholders in the decision making process.

Each new potential source of replenishment water is likely to have advantages and disadvantages, including costs, energy demands, social and environmental benefits and/or impacts, implementation logistics, reliability factors, and regulatory requirements. Therefore, it is critical, beginning in the early stages of evaluation, to communicate and coordinate with groundwater agencies, the public, regulatory agencies, and other basin stakeholders to determine an acceptable course of action to identify and implement a sustainable and safe replenishment water supply.

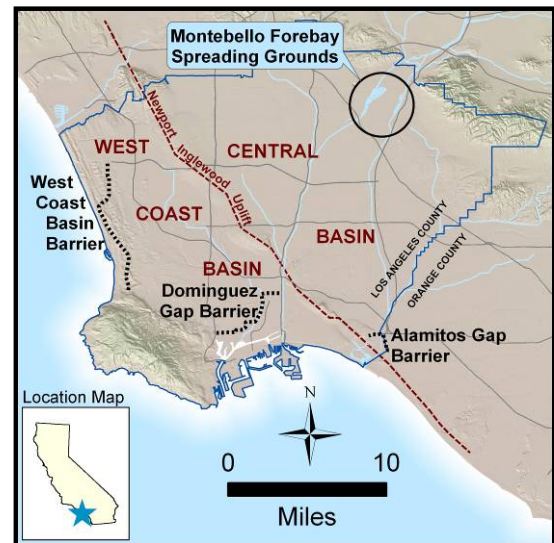
Case Study: Central and West Coast Groundwater Basins

By way of example, the Central and West Coast Groundwater Basins (CWCBs) in southern Los Angeles County are in overdraft and have historically relied on imported water to supply a portion of their groundwater replenishment. Groundwater in the CWCBs meets approximately a third of the overall water supply needs of the nearly 4 million residents and the businesses in the 43 cities overlying the basins².

For over 50 years, local agencies such as WRD, CSD, Los Angeles County Department of Public Works (LADPW), and member agencies to the Metropolitan Water District of Southern California



Central and West Coast Basins in Southern LA County



Detailed View of Central and West Coast Basins

(MWD) have taken steps to prevent overdraft and replenish the aquifer system. The first step was to build a water conservation system that allows for the capture, storage, and recharge of precipitation, imported water, and recycled water at spreading grounds located in the Montebello Forebay. Another step was to build seawater barrier injection wells along the coast to block seawater intrusion

² Water Replenishment District of Southern California, 2009, Engineering Survey and Report, Updated May 1, 2009

and replenish the aquifers. In addition to these physical activities, the courts have also set limits on the amount of groundwater that can be pumped.



Rio Hondo Spreading Grounds for Groundwater Recharge



Seawater Barrier Injection Well

Historically, three water types have been used for replenishment in the CWCBs: stormwater, imported water, and treated municipal wastewater (also known as recycled water or reclaimed water). Stormwater includes local runoff from rainfall that is collected behind dams in the San Gabriel Mountains to prevent flooding in downstream communities. Imported water is river water from Northern California or from the Colorado River that is transported to the Los Angeles area through aqueducts, canals, and river channels. Recycled water comes from local water reclamation plants that purify wastewater so that it meets or exceeds state and federal drinking water standards and is safe to use. The water reclamation plants use at least three stages of purification, which are an accelerated version of natural processes. Some water reclamation plants also provide an additional (fourth) purification step using a membrane process that removes excess salts and other constituents. The following table illustrates how much of each type of water is used annually to replenish the CWCBs.

**Average Annual Amounts of Replenishment Water at Constructed Facilities
Central and West Coast Groundwater Basins (WRD, 2009)**

Type of Water	Central Basin (Acre-feet)	West Coast Basin (Acre-feet)
Stormwater (captured precipitation)	54,000	0
Imported Northern California & Colorado River Water from MWD	21,000	10,000
Recycled Water	53,000	17,000

While the aforementioned water sources have generally been sufficient to replenish the CWCBs for the last 50 years, identification, development, and expansion of water replenishment sources has become critical due to the shrinking availability of imported river water and increasing water demands. Capturing and using more stormwater and recycled water for groundwater replenishment are obvious options to meet this diminishing imported water challenge, and some of the projects being implemented or explored are discussed below.

Stormwater

Stormwater has been used successfully as a source for groundwater recharge in the Central Basin since the late 1930s. Use of this resource has expanded over time through the development of dams and storage reservoirs. Several new projects have been completed over the past several years to further increase the amount of stormwater used for replenishment. These projects include removing oil companies' facilities from behind the Whittier Narrows Dam to avoid flooding of their equipment and to allow the capture of more stormwater, constructing new rubber dams in the San Gabriel River to capture more stormwater, and removing sediment from the spreading grounds to enhance infiltration rates to recharge more stormwater. These projects have increased stormwater capture by about 6,600 acre-feet.



Rubber Dams are an Effective and Environmentally Friendly Means to Temporarily Block River Flows to Induce Groundwater Recharge

Examples of upcoming projects to increase stormwater conservation include 1) construction of a new stormwater delivery pipeline to optimize operational flexibility between spreading facilities, 2) installation of new production wells near the spreading facilities to lower the water table mound and create additional vadose zone space for increased stormwater capture, and 3) increasing the water capture (conservation) pool behind the Whittier Narrows Dam to regulate stormwater releases to the spreading facilities.

Recycled Water

Tertiary-treated recycled municipal wastewater has been successfully used as a source for groundwater recharge in spreading facilities in the Central Basin since 1962. Extensive regulatory oversight and regulations apply to this activity to ensure protection of public health and the environment. Recycled water recharge regulations have periodically changed as new information became available. Currently, the recycled water recharged in the Montebello Forebay Spreading Grounds must be blended with stormwater, imported river water, and/or other dilution sources to produce a mixed source that contains no more than 35% recycled water on a 5-year running average. This is a project-specific requirement utilizing draft regulations by the California Department of Public Health (CDPH)³ and under permit by the Los Angeles Regional Water Quality

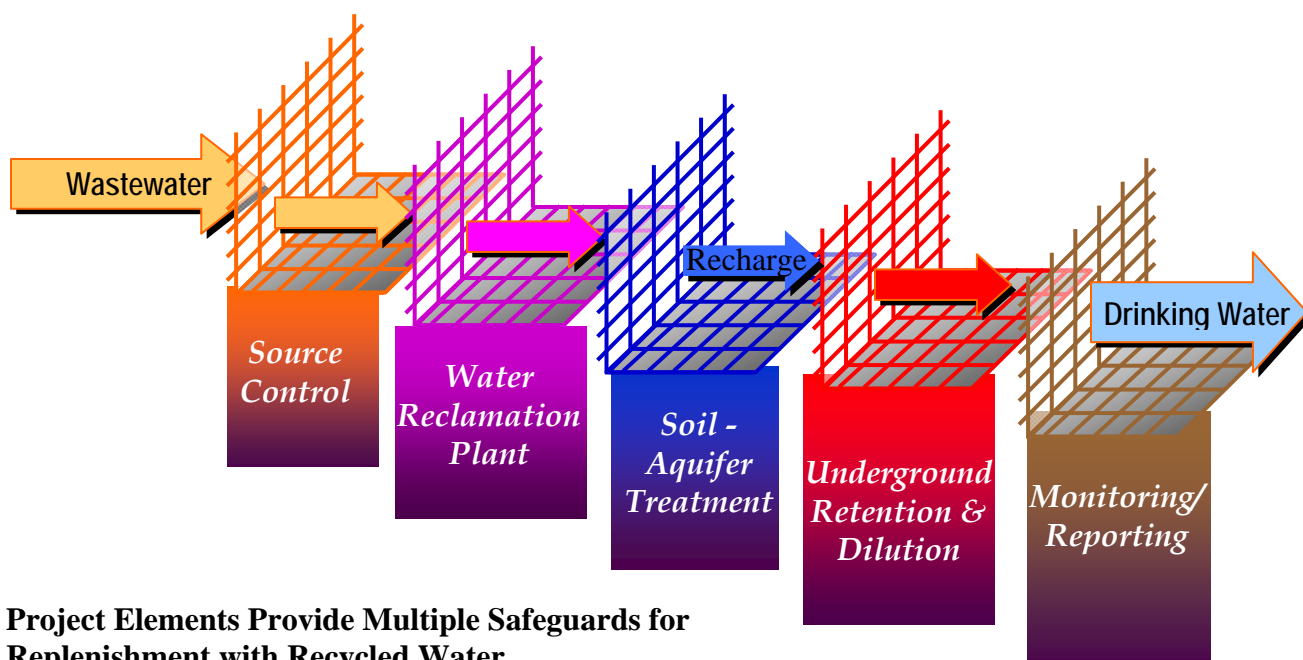
³ California Department of Public Health, 2008, Draft Groundwater Recharge Reuse Regulations, August 5, 2008, accessible on the CDPH web site:

<http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Recharge/DraftRechargeReg2008.pdf>

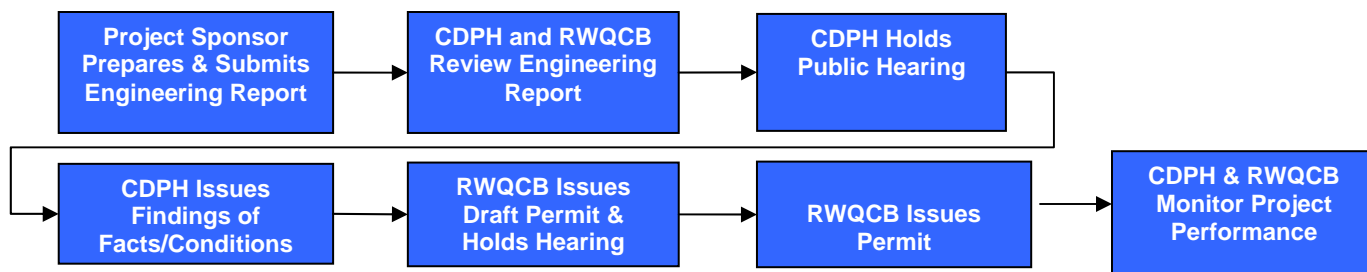
Control Board (LARWQCB). Given that significant amounts of wastewater that could be recycled are currently discharged to the ocean, options for using additional recycled water are being explored as it is proven to be a safe and reliable source of replenishment water.

Recycled water has also been used in the CWCBs as a source of supply for the three seawater barriers since 1995. For these projects, additional purification technologies, including reverse osmosis, have been employed to ensure that stringent water quality standards are met before recycled water is injected into the aquifer system. Furthermore, rigorous monitoring is conducted routinely with regulatory agency oversight. The West Coast Basin Barrier has been approved to use entirely recycled water. The other two barrier projects use a blend of 50% recycled water and 50% imported water. Plans are being made for these two barrier projects to move towards 100% recycled water; this would make all three barrier projects more reliable for seawater intrusion protection and less dependent on imported water supplies.

Groundwater recharge using recycled water is regulated by the CDPH, the SWRCB, and the local Regional Water Quality Control Boards (RWQCB). These agencies have established regulations and policies that rely on a “multi-barrier” approach made up of a combination of controls that work together to ensure the recycled water protects public health and groundwater quality and ensure the groundwater can be used beneficially for all of its intended purposes, such as for drinking water or agricultural irrigation. This approach incorporates source control and pollution prevention, the use of appropriate purification processes, quality standards, controls on the amount of recycled water that may be used, and studies and monitoring for each project such as groundwater tracer studies, numerical modeling, mass balance calculations, and analysis for not only constituents with maximum contaminant levels but those with notification levels or other chemicals of emerging concern such as pharmaceuticals and personal care products.

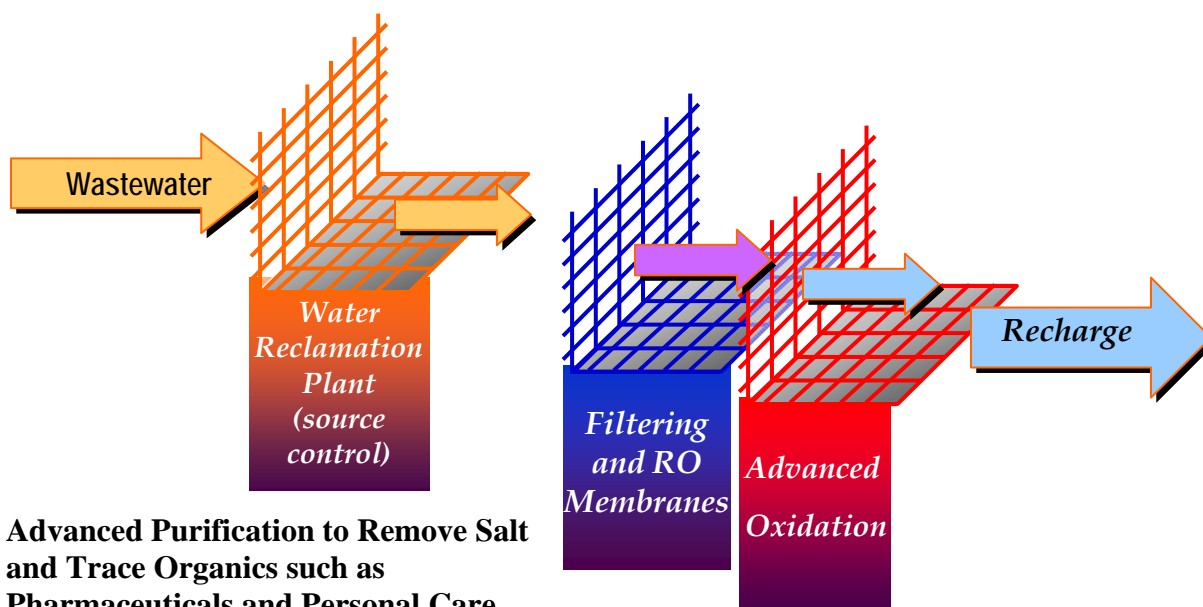


The process for receiving approval from the CDPH and RWQCB to operate a recycled water recharge project is very rigorous. Each project is carefully evaluated with regard to the mandated controls with information on the project documented in an Engineering Report. Each project must go through two public hearings, one held by CDPH and one held by the RWQCB, before a permit to operate a project can be issued. The CDPH has developed a set of Recycled Water Recharge regulations which are in Draft form receiving public review and comment (see Footnote 2, above). The key steps in the approval process are shown below.



Steps For Regulatory Approval and Oversight of Projects

One consideration of expanded use of recycled water for groundwater recharge is additional (or advanced) purification, such as membranes that physically remove constituents from water. Membrane purification helps reduce salt in the basin and removes organic compounds; this further safeguards the quality and integrity of the aquifer system. Other purification processes that could be added include advanced oxidation which destroys organic compounds.



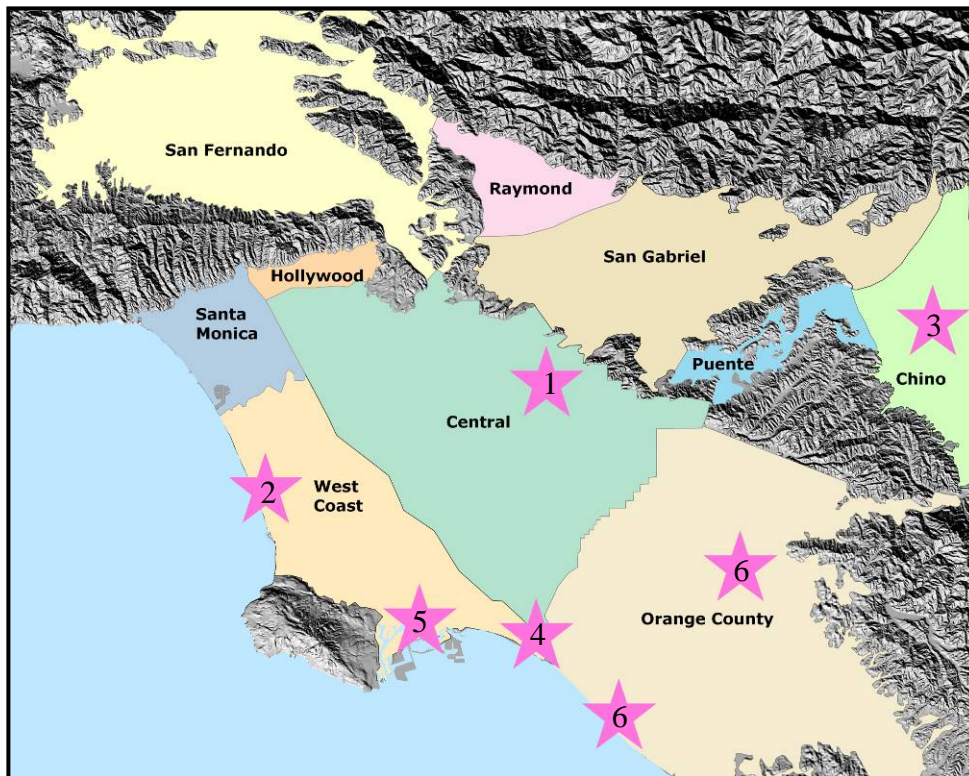
Advanced Purification to Remove Salt and Trace Organics such as Pharmaceuticals and Personal Care Products

Regional Reliance on Recycled Water. Recycled water has served as a critical resource to replenish and protect groundwater in Southern California for over 45 years. There are six permitted projects that use recycled water for groundwater recharge in spreading basins or for seawater barrier projects (see table and map below).

Given the dwindling state and local water resource picture, additional local jurisdictions are moving forward with initiatives to use recycled water for groundwater recharge. In an effort closely related to the replenishment activities in the Central Basin, the Upper San Gabriel Valley Municipal Water District and the San Gabriel Valley Municipal Water District are exploring recycled water as a source of replenishment in the Main San Gabriel Groundwater Basin. The City of Los Angeles has included groundwater recharge as part of the City’s 20-year Water Plan “Securing LA’s Water Future.” The plan calls for an aggressive, multi-pronged approach to meet the new water demands of a growing population; it combines short-term steps to conserve water with long-term investment in water-efficient technology, water recycling, and improvements in the groundwater supply. The City of Los Angeles intends to meet future demands by increasing recycled water use by 50,000 afy by 2019.

Permitted Recycled Water Recharge Projects in Southern California

Project	Map #	Amount of Recycled Water Acre-feet/Year	Project Start Date
Montebello Forebay Groundwater Recharge Project (Spreading Basins)	1	50,000	1962
West Coast Basin Barrier Project (Injection)	2	14,000	1994
Chino Basin Groundwater Recharge Project (Spreading Basins)	3	21,000	Phase I 2005 Phase II 2007
Alamitos Barrier Project (Injection)	4	3,360	2005
Dominguez Gap Barrier Project (Injection)	5	5,600	2006
Orange County Groundwater Replenishment System (Spreading Basins and Seawater Barrier Injection Wells)	6	72,000	2008



Groundwater Recharge and Seawater Barriers using Recycled Water is Prevalent in Southern California

Conclusions

Recycled municipal wastewater, either from tertiary or advanced treatment, is an important water source for groundwater recharge. Regulatory requirements for groundwater recharge using recycled wastewater must be followed to ensure protection of the water resource. In the face of declining groundwater levels across the state due to numerous factors, the need for increased artificial replenishment sources, including recycled water, is becoming more and more apparent. Consistent state guidelines are needed to promote, encourage, and expedite the permitting process for the safe use of recycled water for groundwater recharge while ensuring the protection of the water supply for humans and the environment.

The State of California recognizes the need for consistent guidelines. In 2009, the SWRCB adopted a Recycled Water Policy. The primary goal of the Policy is to reduce uncertainty regarding the regulatory requirements for recycled water use by providing a uniform interpretation of state statutes, regulations, and policies. One of the main provisions in the Policy is for the development of regional salt/nutrient groundwater management plans within five years that provide holistic, watershed-based control of these constituents and management of all sources of salts and nutrients as necessary to protect water quality.

The CDPH is also finalizing its Draft Groundwater Recharge Reuse Regulations which will become the blueprint for any new spreading or injection project using recycled water for groundwater replenishment. Water agencies across the state who are interested in augmenting their groundwater supply with recycled water will benefit from engaging the public, CDPH, and RWQCB early in project development to reach agreements on project goals and compliance details. Such actions will ensure an expedited permitting process in part due to public confidence enhanced through outreach, education, and regulatory approval. Recycled water must be considered a valuable resource rather than a wastewater product.

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