

History and Perspectives of Water Reuse

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Brown and Caldwell



History of Water Reuse

- Agricultural Irrigation
- Landscape Irrigation
- Wetlands Reuse
- Groundwater Recharge
- In-Building Urban Reuse
- Food Crop Irrigation
- Potable Reuse



Land Treatment History

- 1846 – Land farming in England and Europe
- 1881 – Pullman, Illinois spray irrigation system
- 1897 – Werribee Farm developed in Melbourne, Australia
- 1935 – Survey in US – Bakersfield, San Antonio, Fresno, Woodland, CA
- 1946 – Sprinkler irrigation of food processing and pulp and paper wastewater
- 1960's – Penn State Living Filter
- 1970's – Muskegon, Michigan and Clayton County, Georgia



Petaluma Agricultural Irrigation



Wetlands and Water Reuse



Wildlife habitat



Educational and recreational opportunities



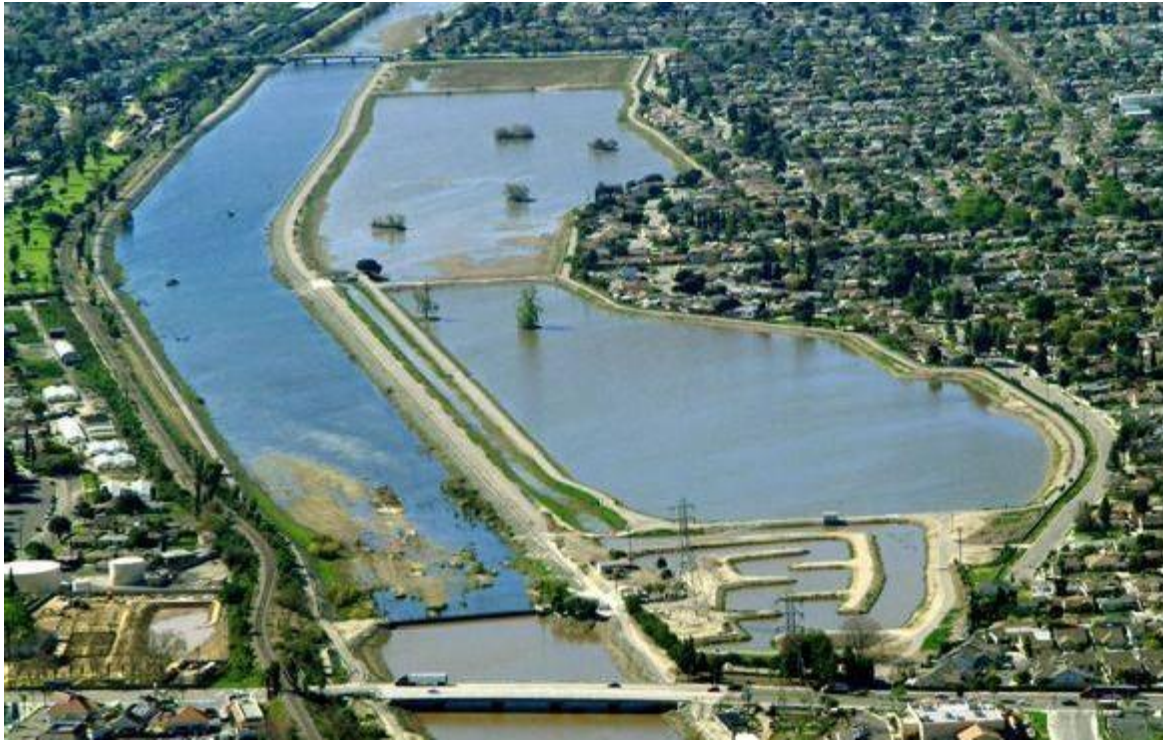
Bird watching

History of Soil Aquifer Treatment

- Over 100 years of practice
- Calumet, Michigan system operating since 1888
- Term coined by Herman Bouwer
- Denitrification of up to 93 percent of nitrogen loaded
- Organics removal depends on loading rate and detention time
- Groundwater recharge



LA County San District's Recharge



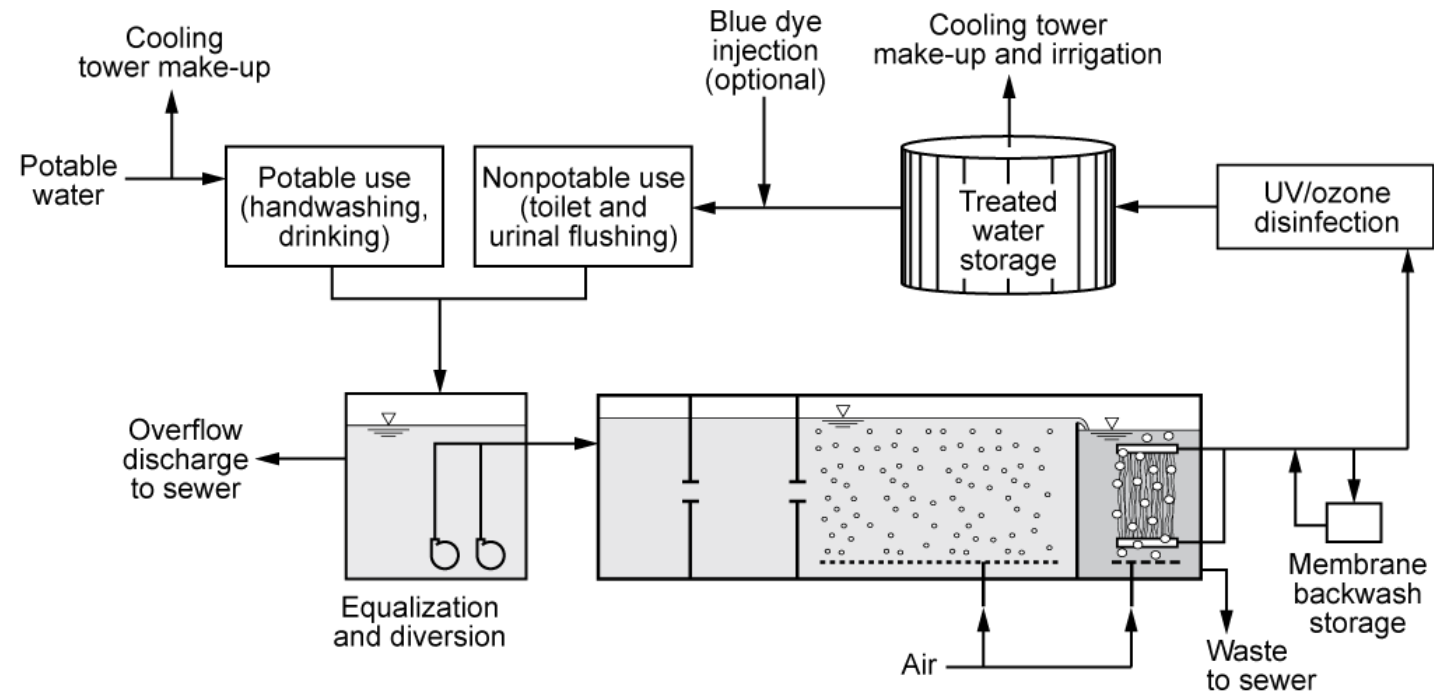
Whittier Narrows, SAT System

- Operational since 1962
- First secondary effluent, blended with stormwater and imported water
- Now disinfected tertiary, blended with stormwater and imported water
- Groundwater recharge
- Six-month travel time to nearest recovery well
- Private wells downgradient safely using the recovered water

Groundwater Replenishment at LACSD

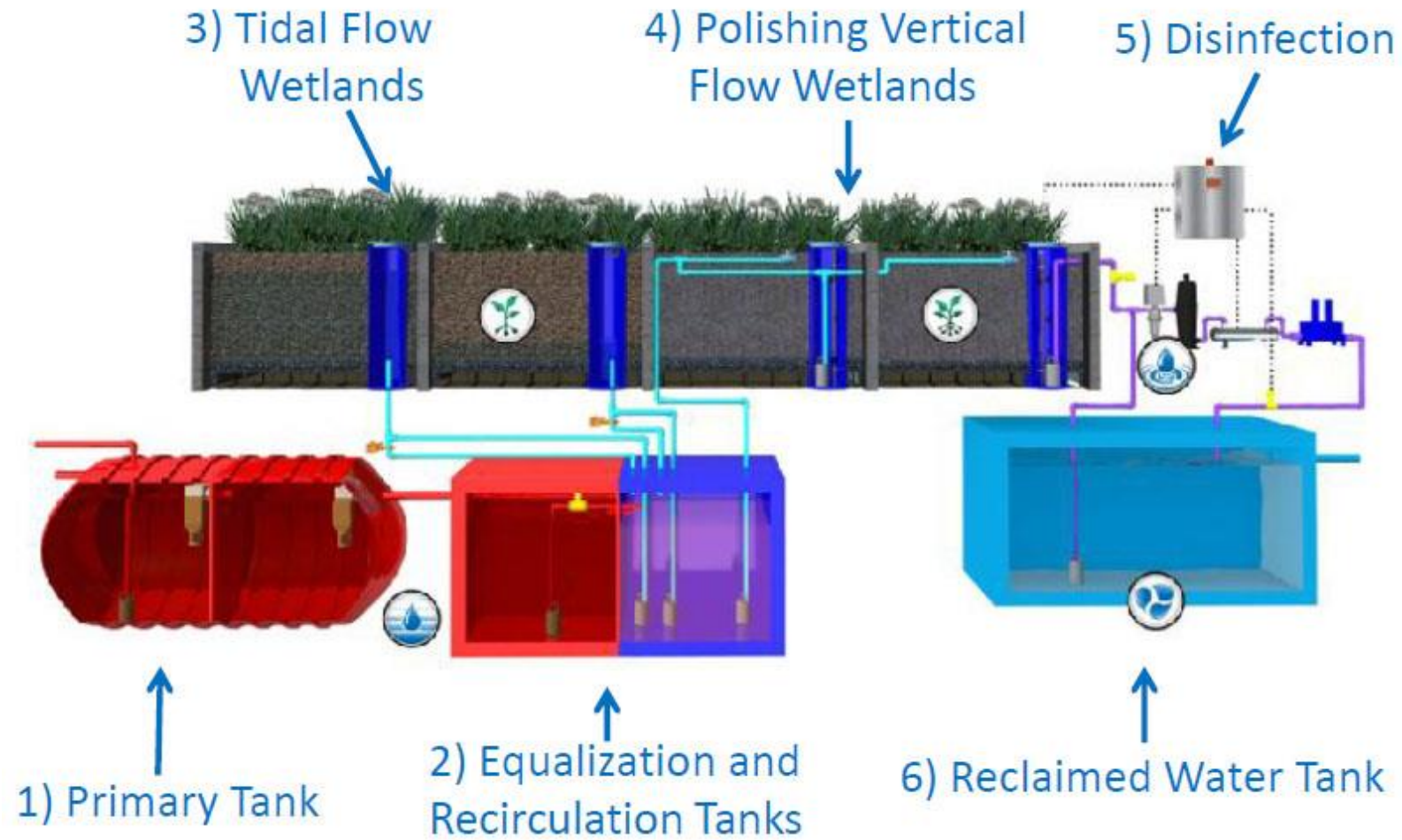
- 50,000 Acre-ft/year
- Recycled water accounts for 35% of the replenishment
- Extensive health effects study proved it safe
- Serves as the basis for current California regulations

Urban Reuse - Intercepted In-Building Self-Contained Water Recycle System

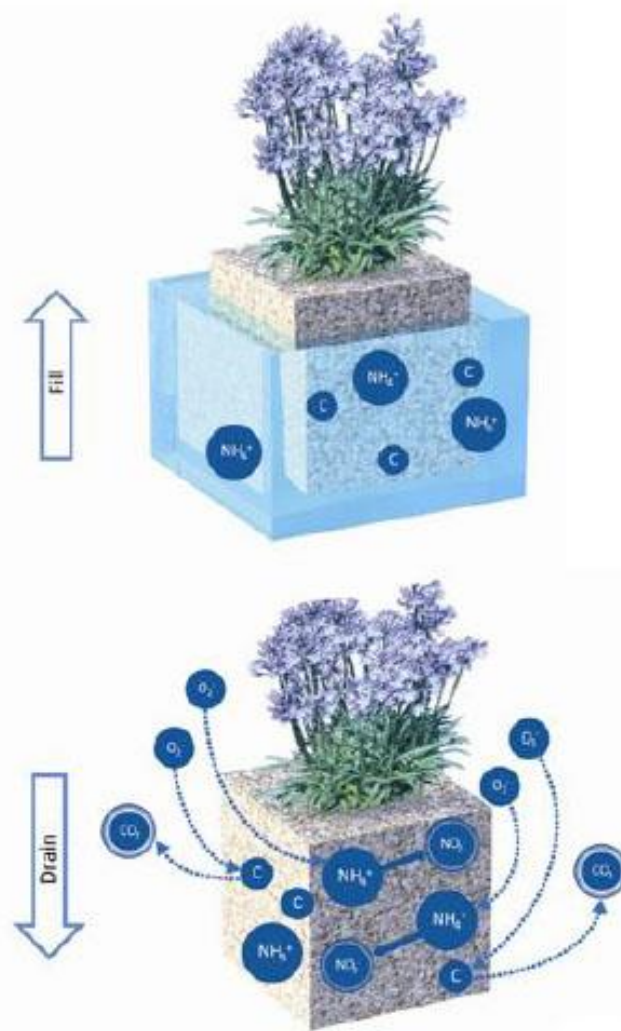


Recycled water is used for toilet flushing, landscape irrigation, and cooling water

Living Machine



Tidal Flow Wetland

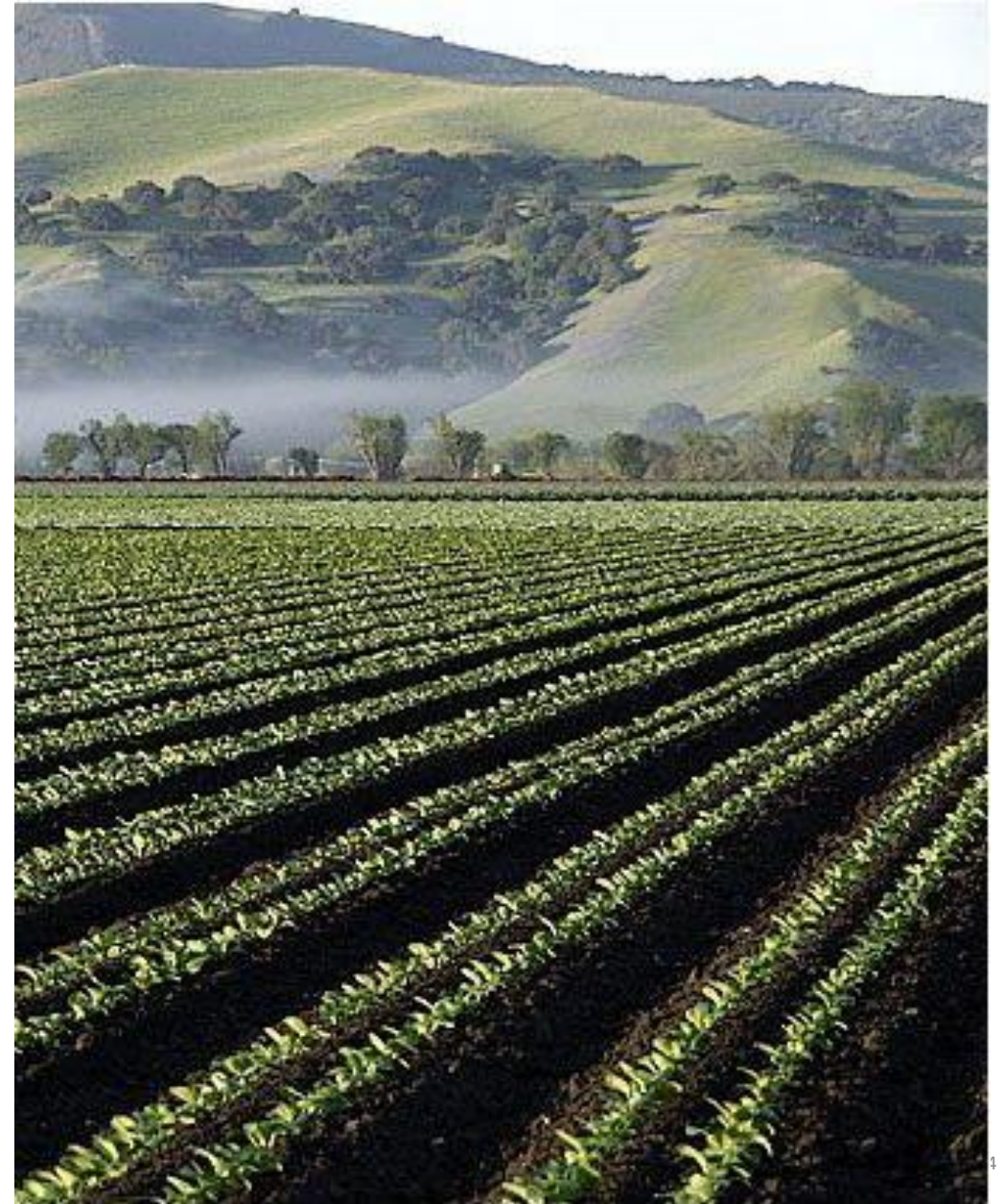


Polishing Vertical Flow Wetlands



Monterey Field Research

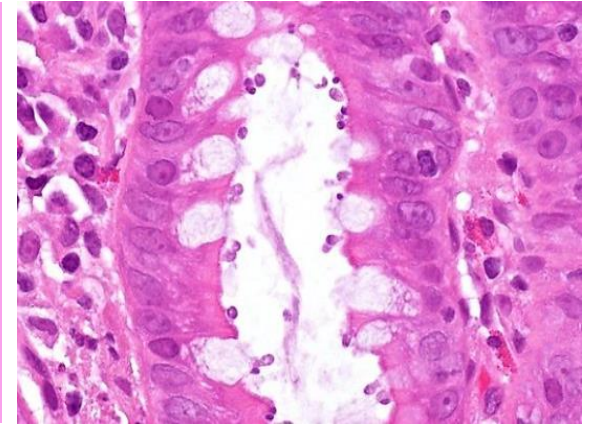
- Five Years of Field Research/Demo
- Three Water Types
- Four Fertilizer Rates
- Six Types of Food Crops
- Four Replications
- 96 Random Plots
- Thousands of Samples
- Analysis of Variance



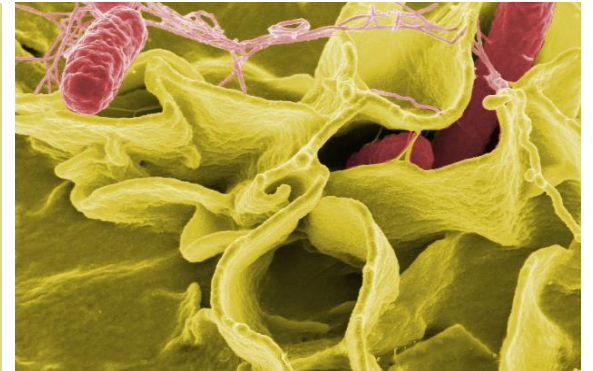
Food Safety Study

- No viable microorganisms of public health concern
- Cryptosporidium and Giardia similar or lower than from raw or treated drinking water sources
- No E. Coli 0157:H7 or Legionella in raw sewage
- Salmonella, Cryptosporidium & Cyclospora absent or in low numbers in raw sewage

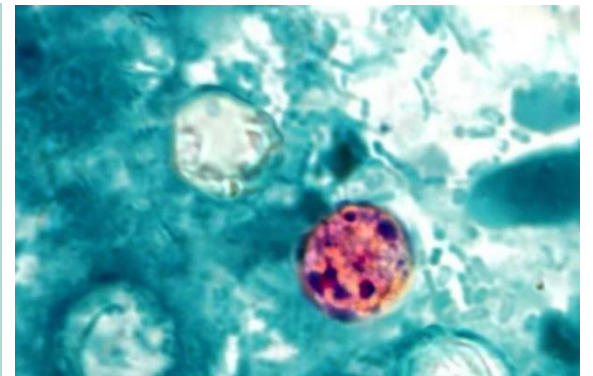
Cryptosporidium



Salmonella



Cyclospora



No documented case of illness EVER

Due to Recycled Water
(WRA & SWRCB)



September 2006 Spinach E. coli Incident



Would you use recycled water?

Would you eat
these crops?

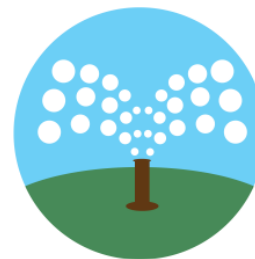
Yes!

Safe!

- Meets Leafy Greens and Organic Farming
- Diversity—Independent Source
- Sustainable — Drought Tolerant Supply
- Inexpensive as New Water Source
- Plant Nutrients
- No Yield Loss

Uses of Recycled Water

- Agricultural Irrigation
- Landscape Irrigation
- Toilets & Urinals
- Construction
- Concrete
- Street Sweeping
- Power Plants & Boilers
- Impoundments



- Cooling Towers
- Manufacturing
- Environmental Uses
- Groundwater Recharge
- Seawater Intrusion Barrier
- Indirect Potable Reuse
- Fire Fighting
- Car Washing

