

Water 4.0

or

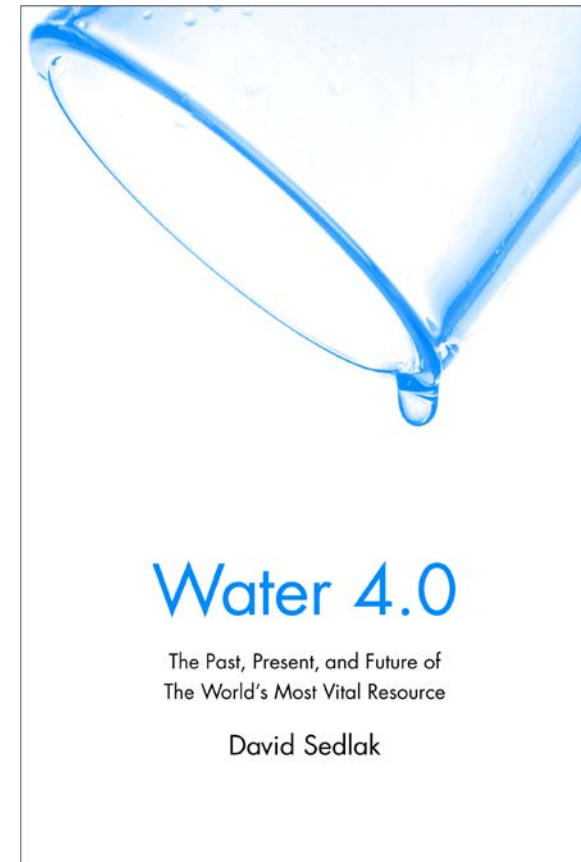
How the Golden State's Water Utilities Will Avoid a Brown Future



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INFRASTRUCTURE



David L. Sedlak
Water 101
February 18, 2014
Davis, CA

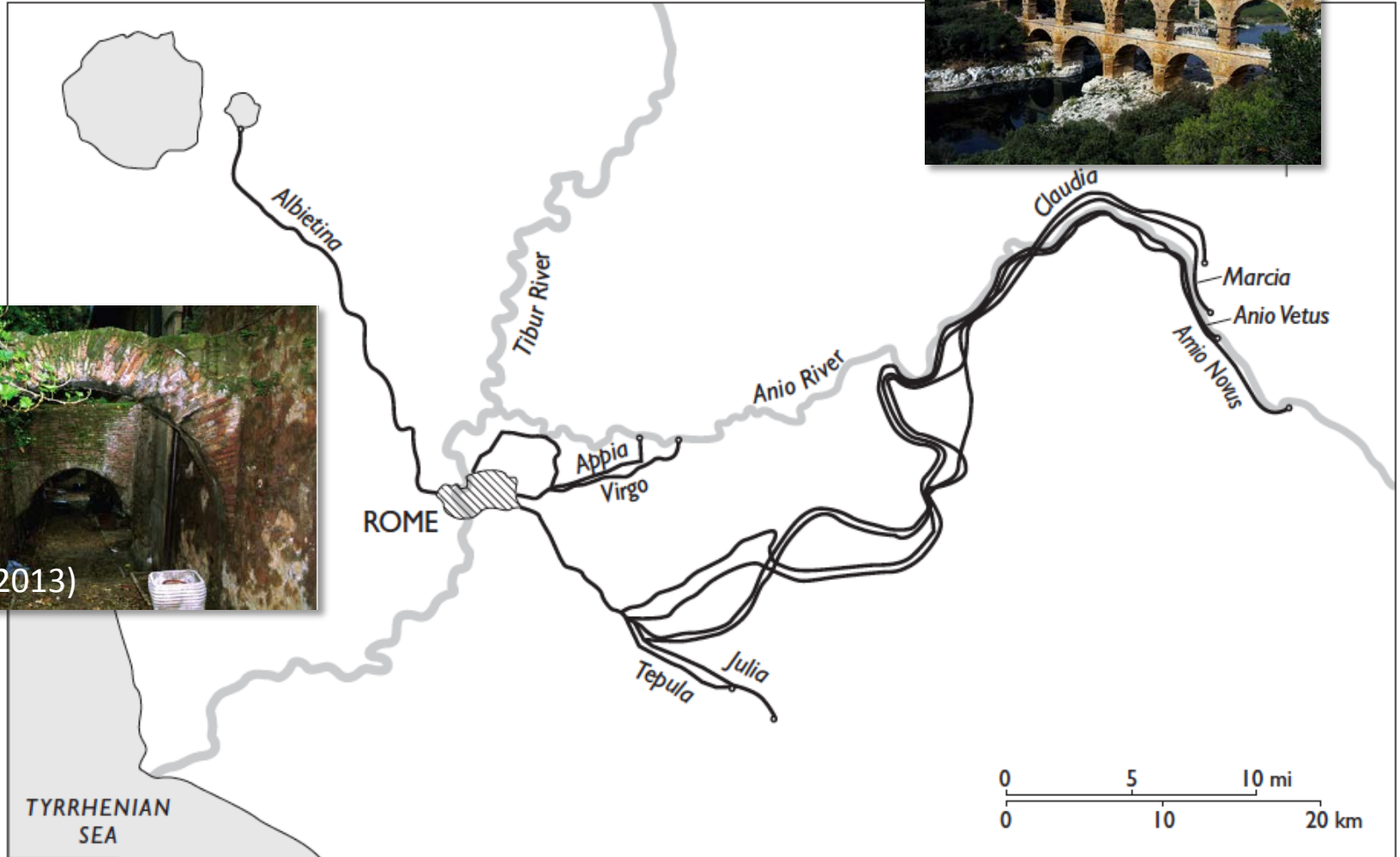




Urban Water 1.0



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Thayer (2013)

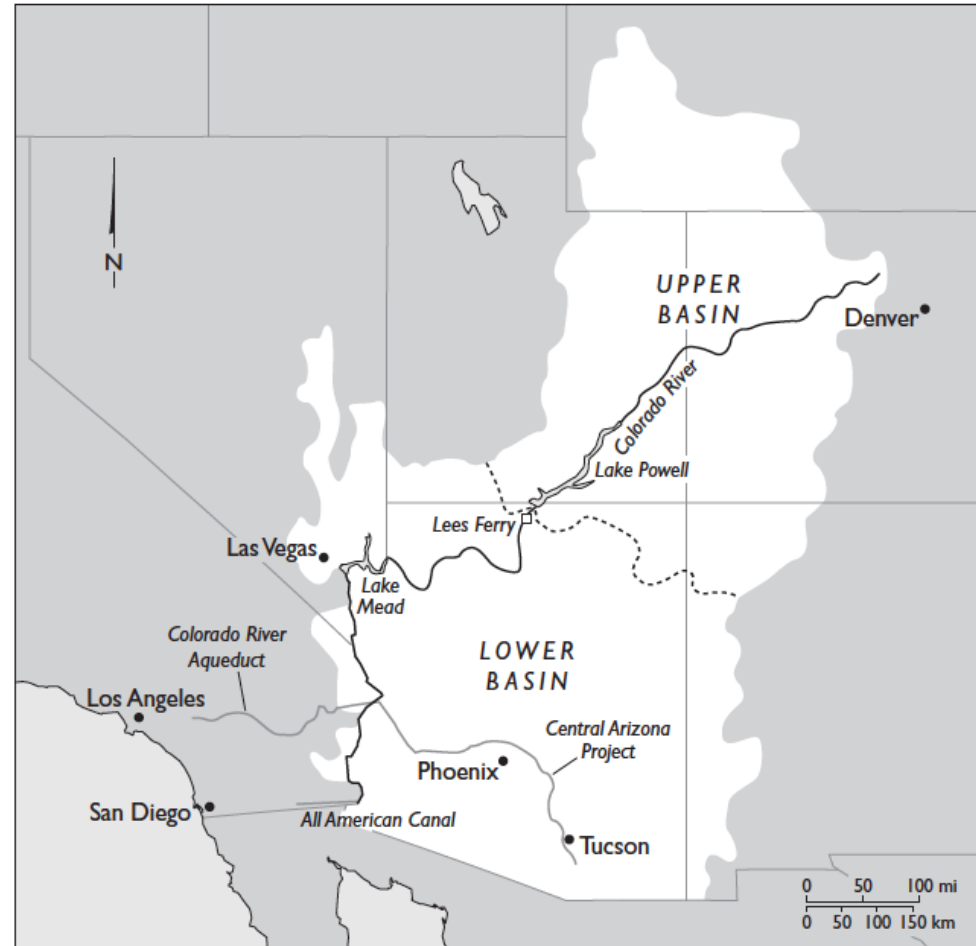


Urban Water 1.0



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New York City's Water Supply System

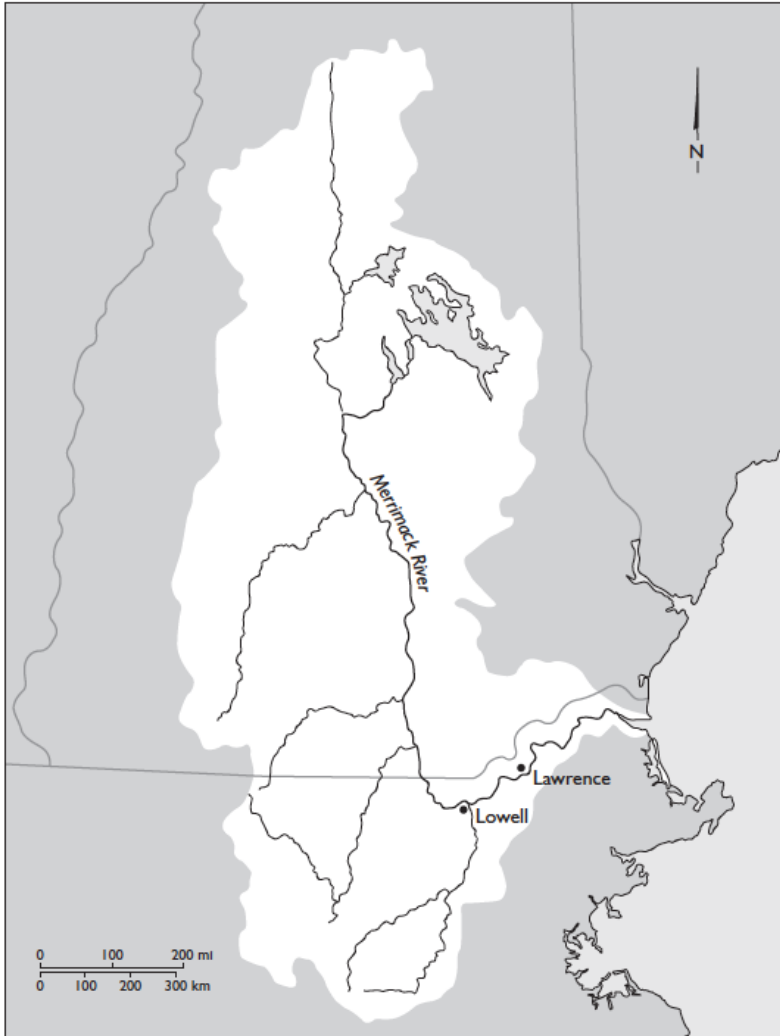




Urban Water 2.0



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DANGEROUS DRINKING WATER.
WHY LOWELL AND LAWRENCE HAVE HAD A TYPHOID FEVER EPIDEMIO.

-NY Times, March 28,

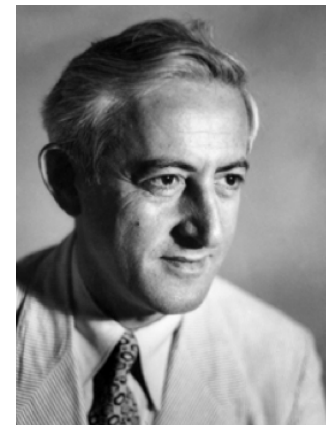
LOWELL, Mass., March 27.—The people of Lowell and Lawrence are seriously troubled as to where they shall obtain their drinking water in the future. There is enough of it, and there are millions of barrels to spare, but the water of the Merrimack River has been pronounced unfit for use unless it is boiled. Now, boiled water is



Allen Hazen
(MIT)



William Sedgwick
(MIT)



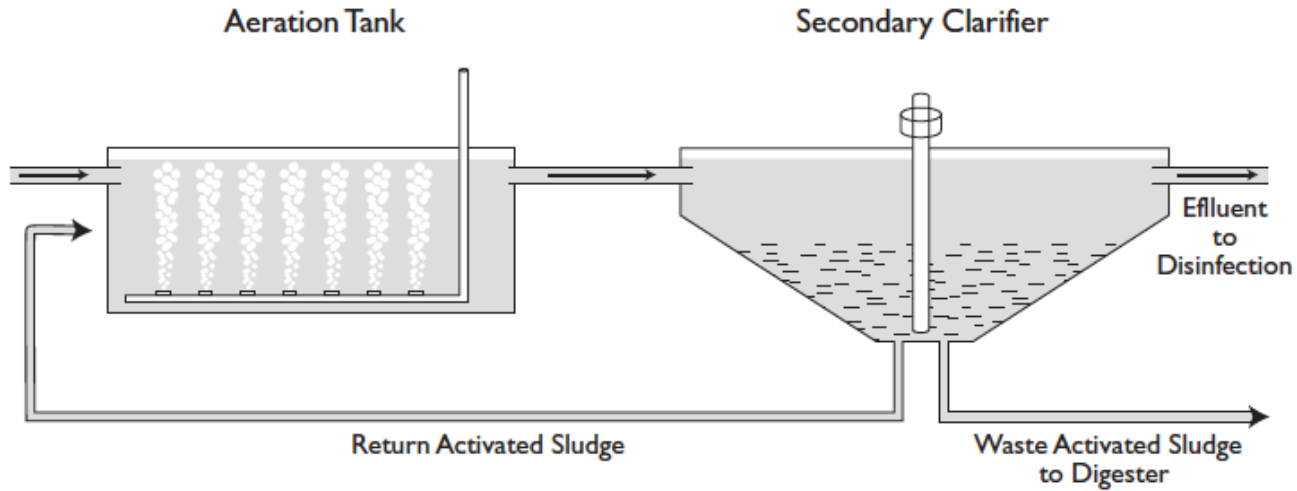
Abel Wolman
(Johns Hopkins)



Urban Water 3.0



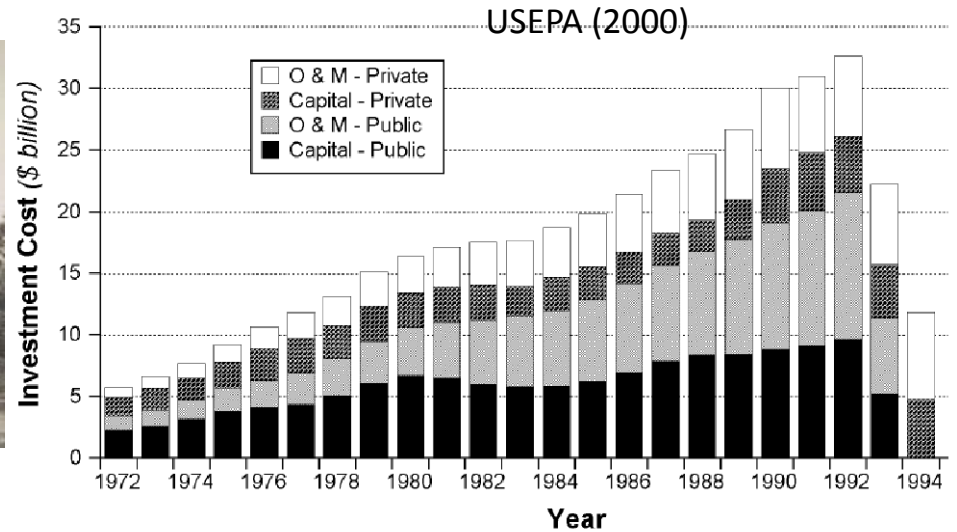
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Gilbert Fowler
(U of Manchester)



Charles Gilman Hyde
(UC Berkeley)

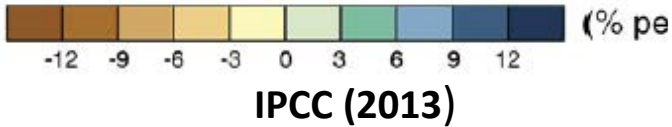
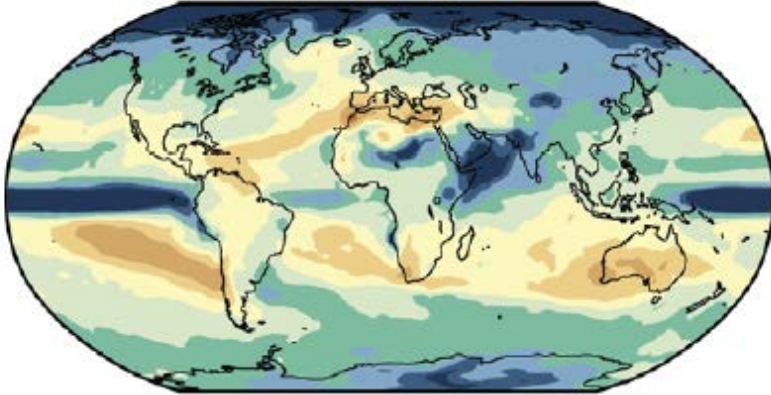




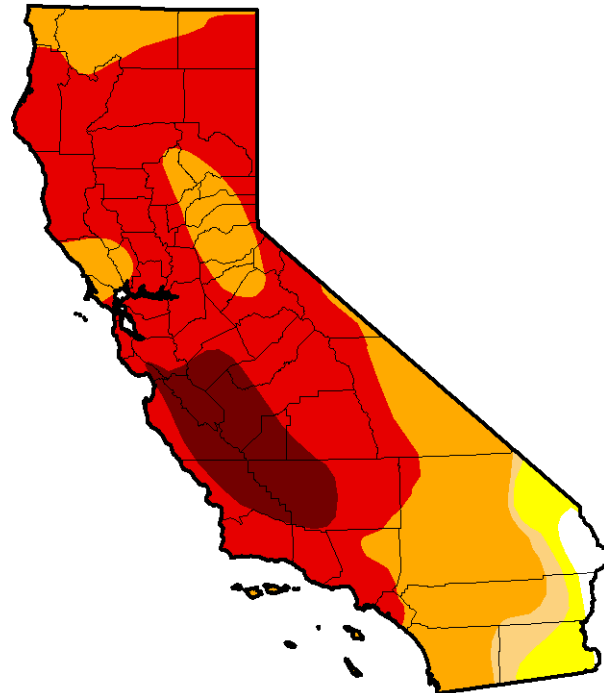
Climate Change Concerns



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U.S. Drought Monitor California



February 11, 2014
(Released Thursday, Feb. 13, 2014)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	1.43	98.57	94.54	91.59	60.94	9.81
Last Week 2/4/2014	1.43	98.57	94.18	89.91	67.13	9.81
3 Months Ago 11/12/2013	2.61	97.39	96.00	84.12	11.36	0.00
Start of Calendar Year 12/31/2013	2.61	97.39	94.25	87.53	27.59	0.00
Start of Water Year 10/1/2013	2.63	97.37	95.95	84.12	11.36	0.00
One Year Ago 2/12/2013	34.53	65.47	47.18	23.72	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

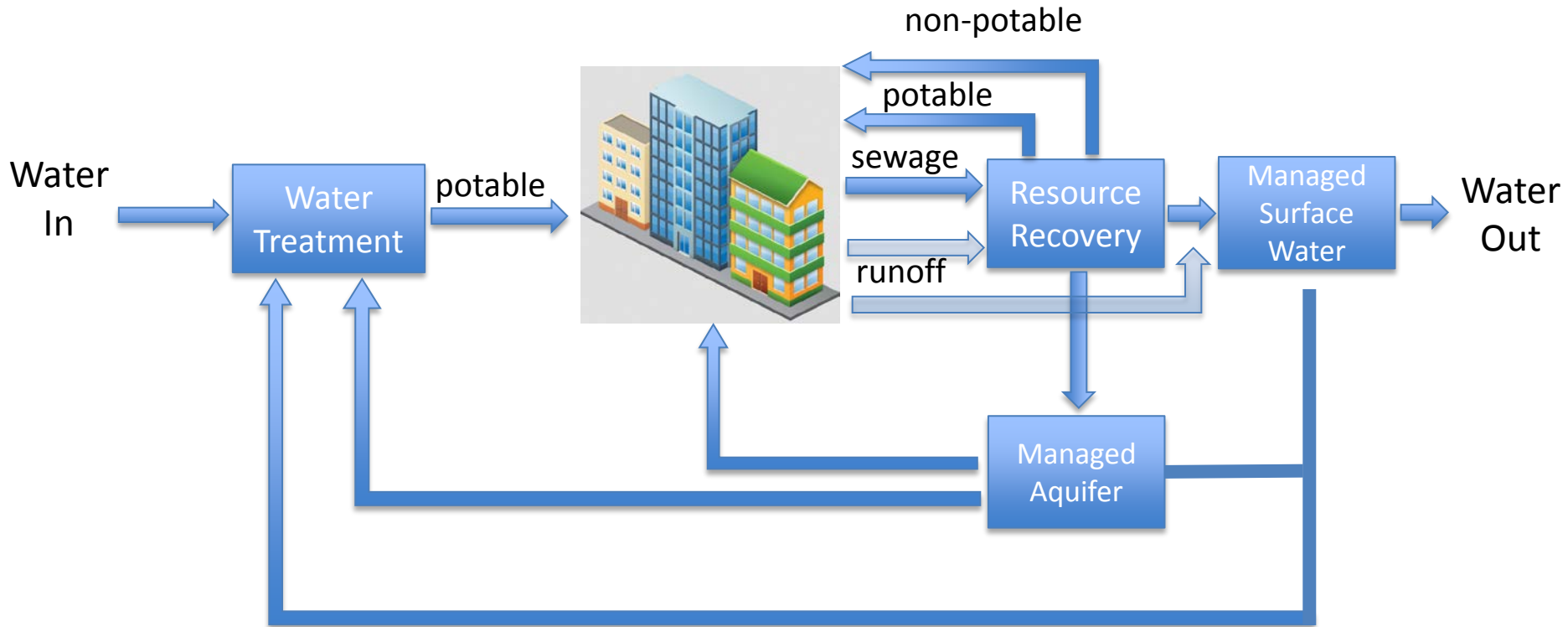
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
David Miskus
NOAA/NWS/NCEP/CPC





Water 4.0: Centralized Vision

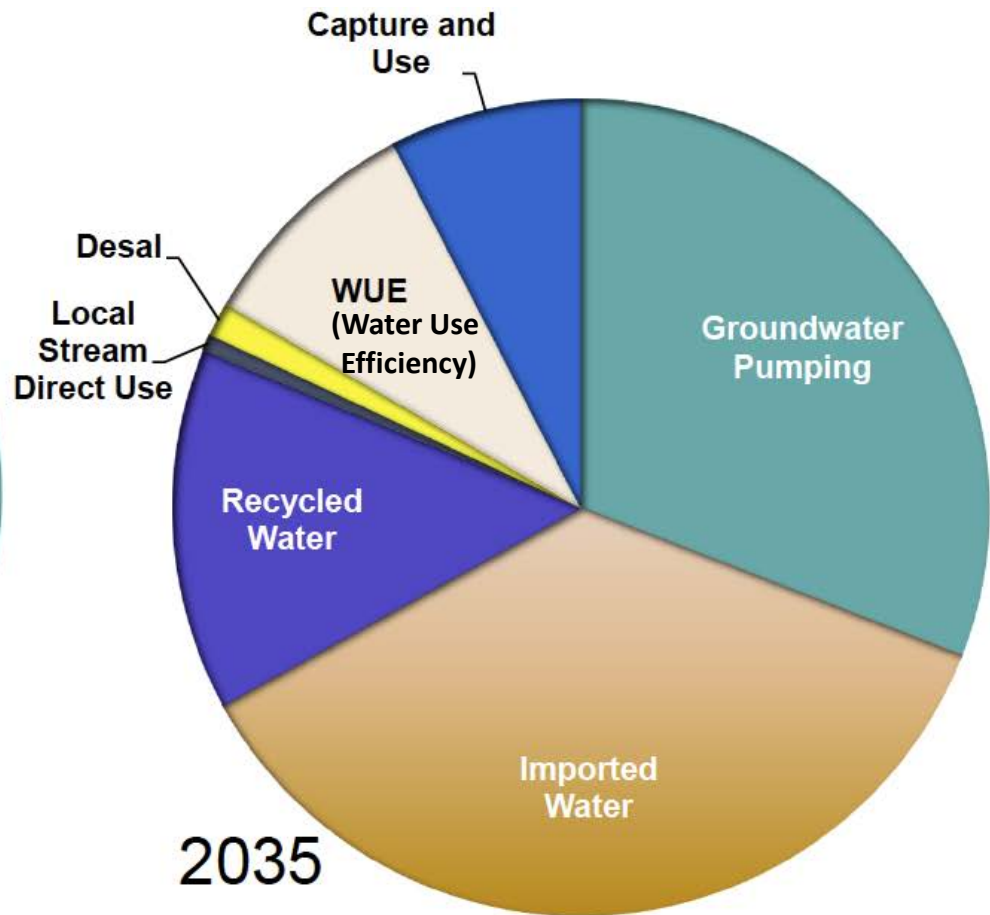
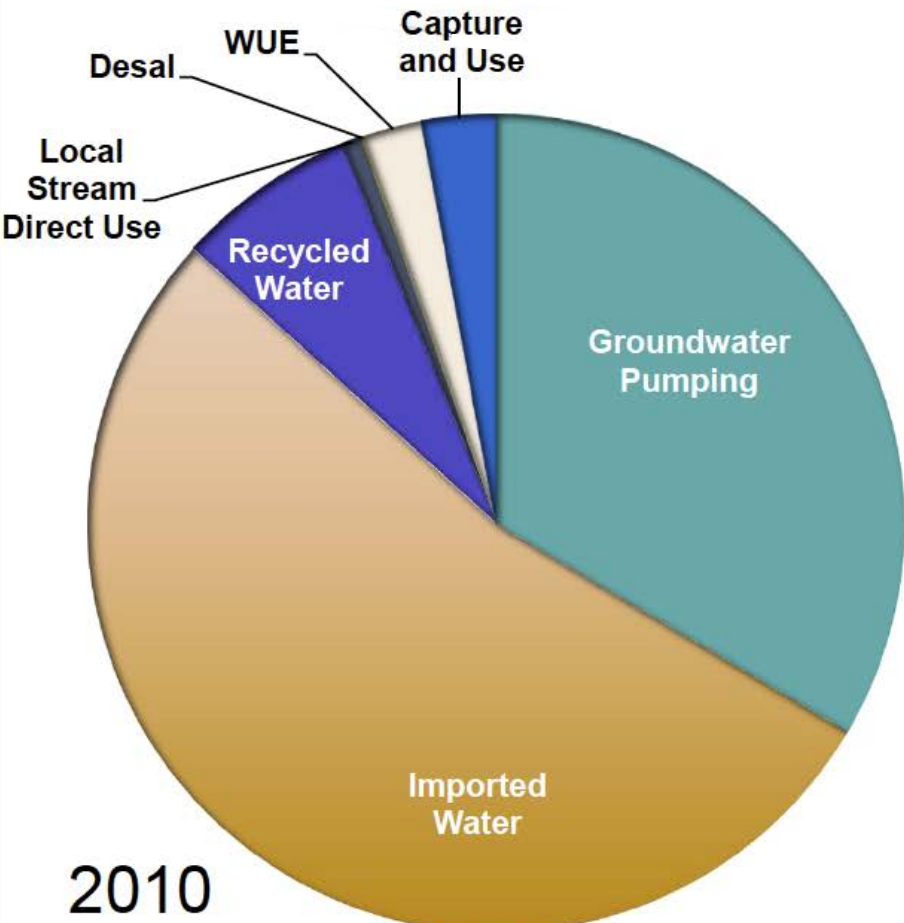




4th Revolution: LA Water Supply



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Atwater and Tyrrell (2012)



Water Reuse at West Basin



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Irrigation (Title 22)



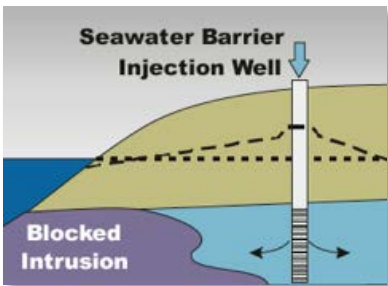
Cooling Towers



Edward C. Little Water Recycling Facility



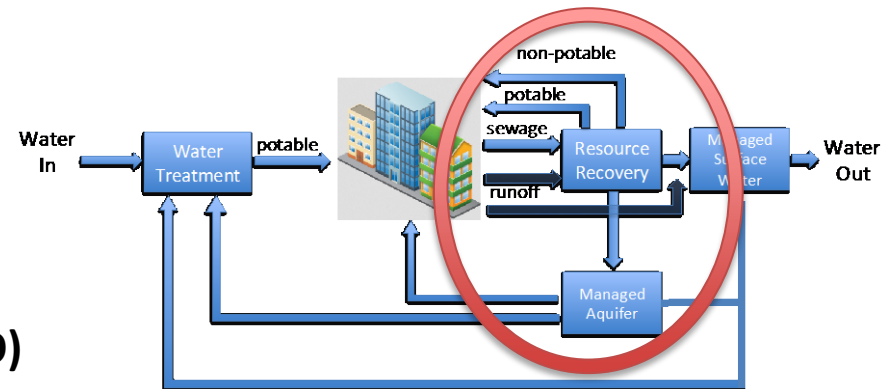
Low-Pressure Boilers (RO)



Groundwater Recharge (RO)



High-Pressure Boilers (RO)



Potable Water Reuse

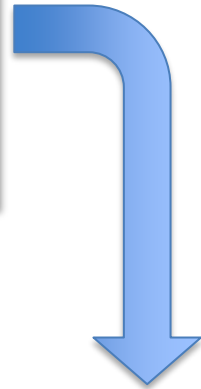
Wastewater Effluent



Reverse Osmosis



Disinfection

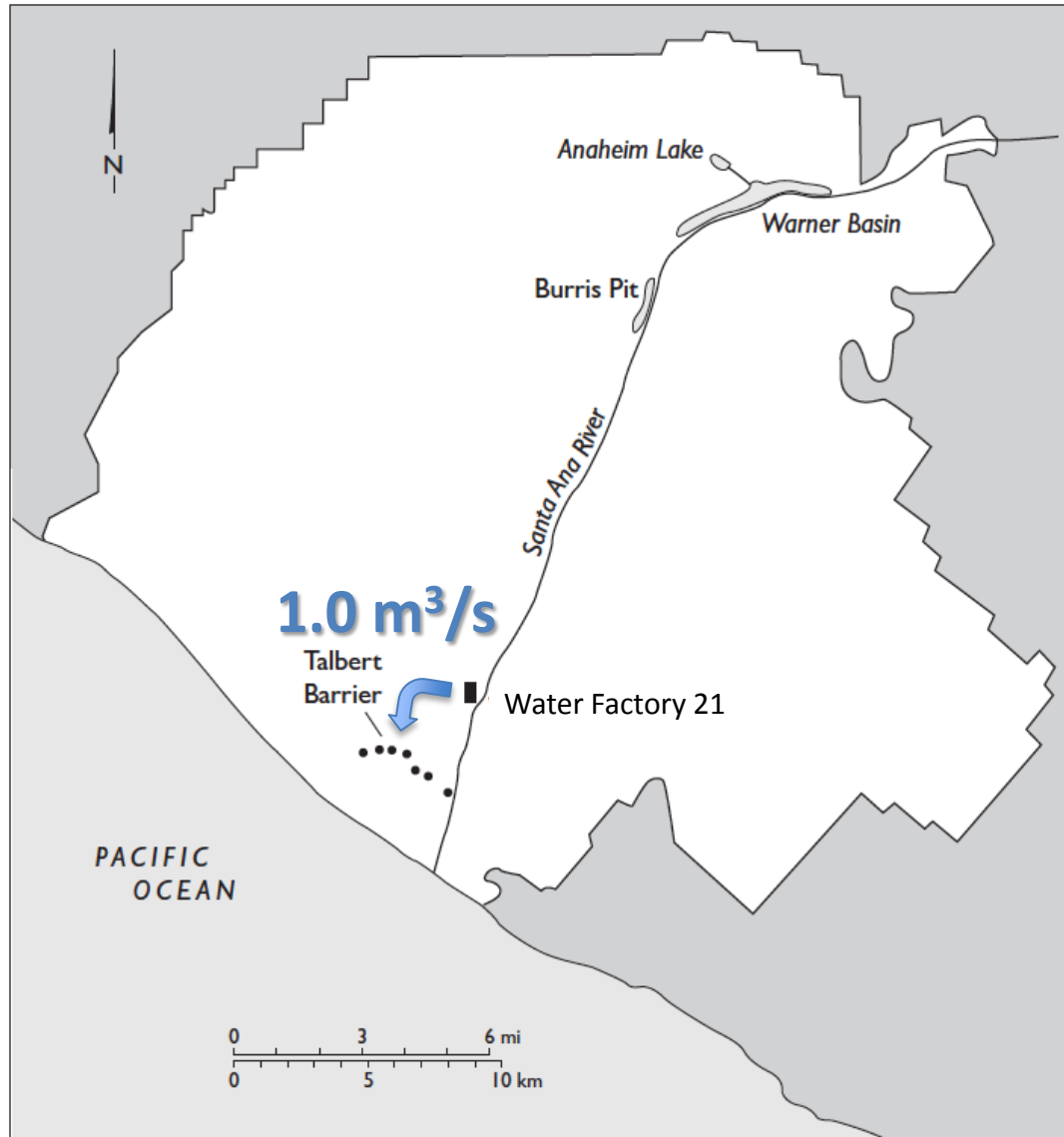


Drinking Water
Supply



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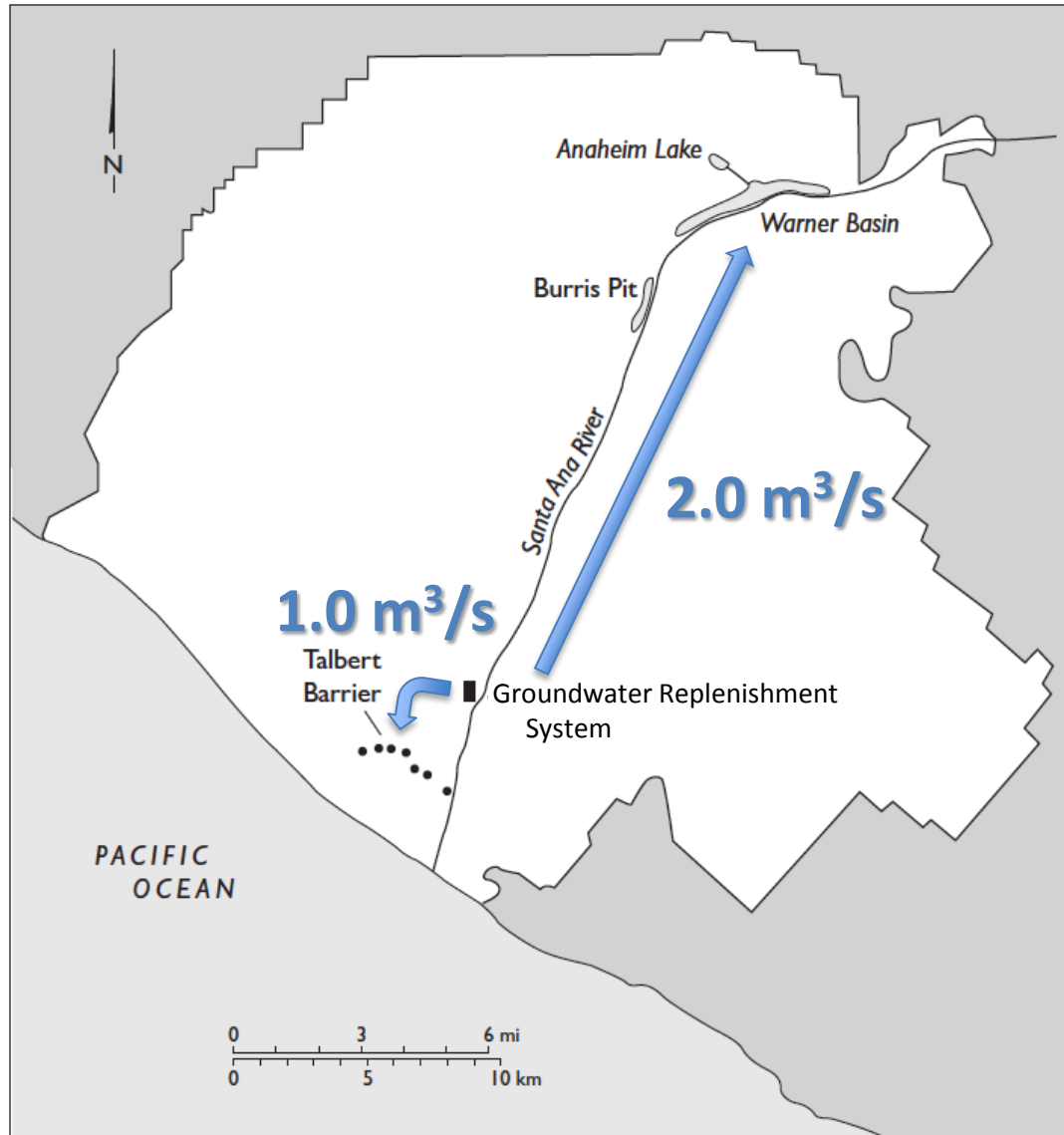
Potable Reuse in Orange County





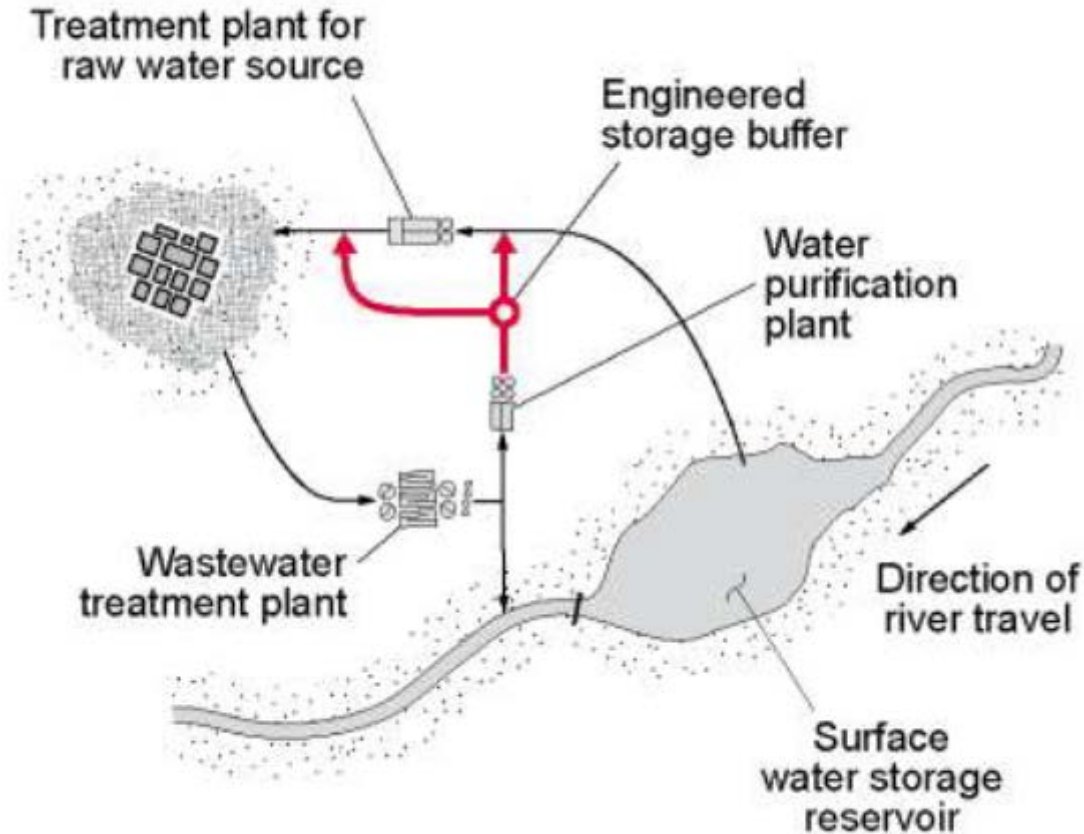
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Potable Reuse in Orange County





Next Stop: Direct Potable Reuse



Tchobanoglous (2012)



De Facto Reuse-Santa Ana River



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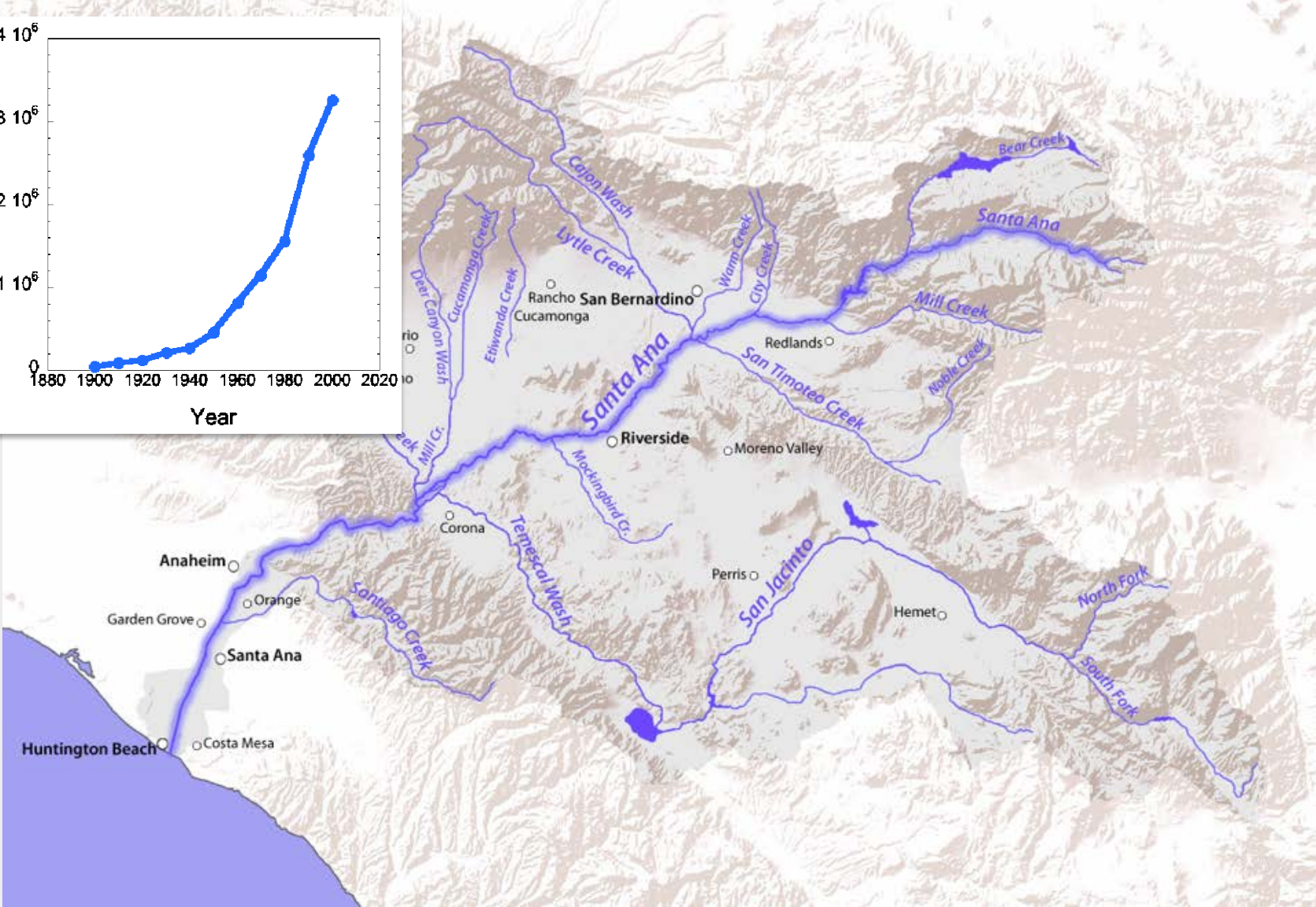
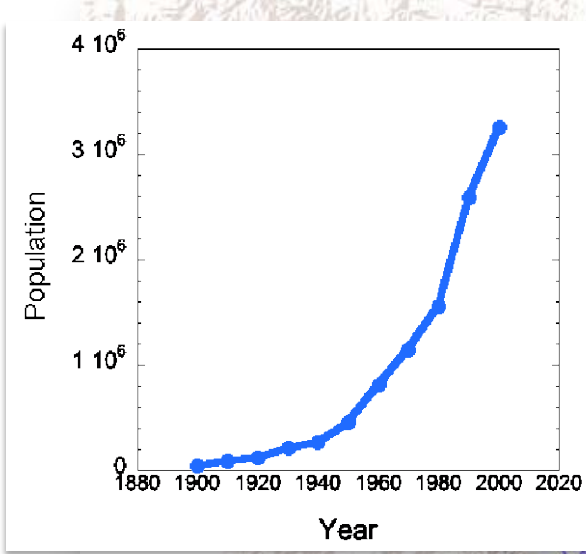




De Facto Reuse-Santa Ana River



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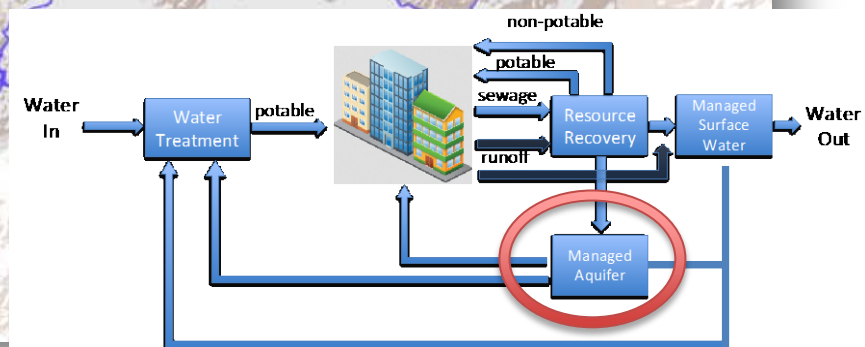
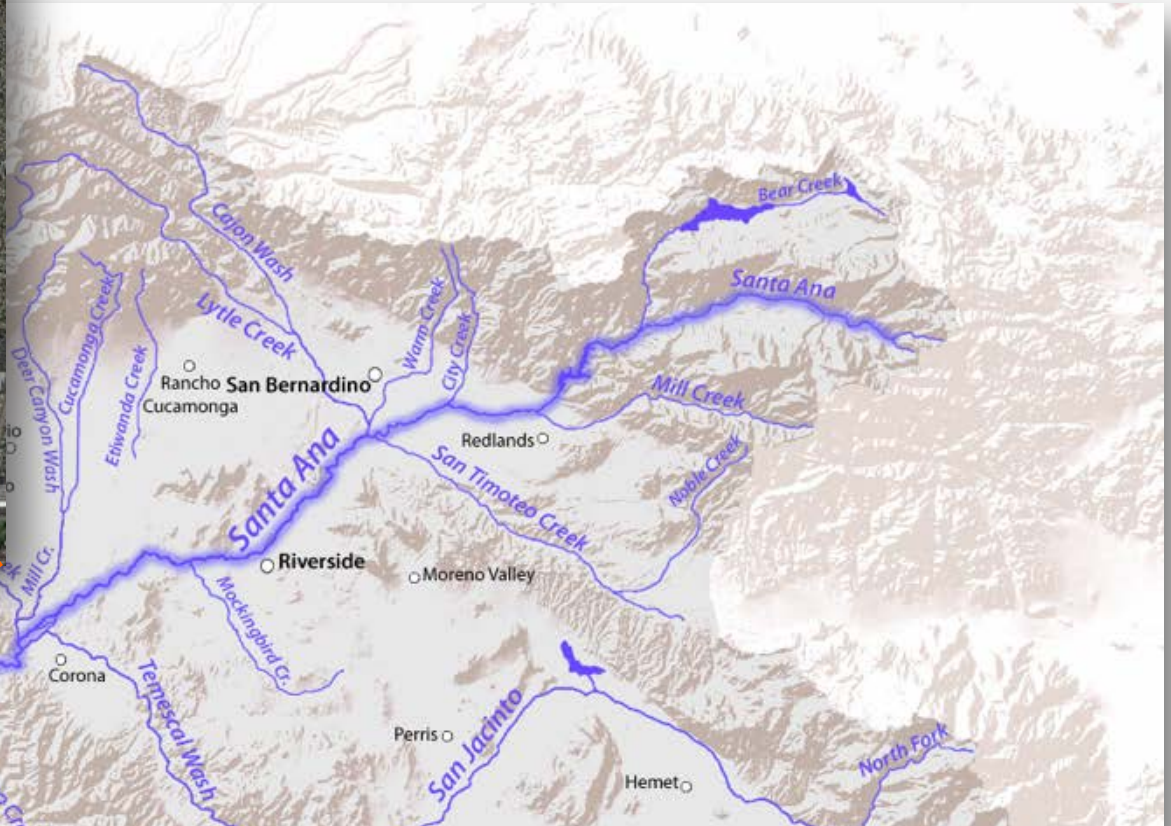


Engineering the Santa Ana



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Anaheim Lakes



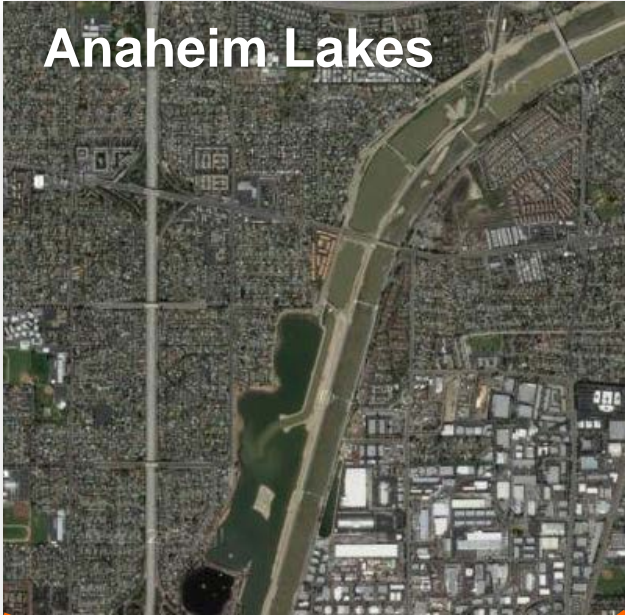


Engineering the Santa Ana

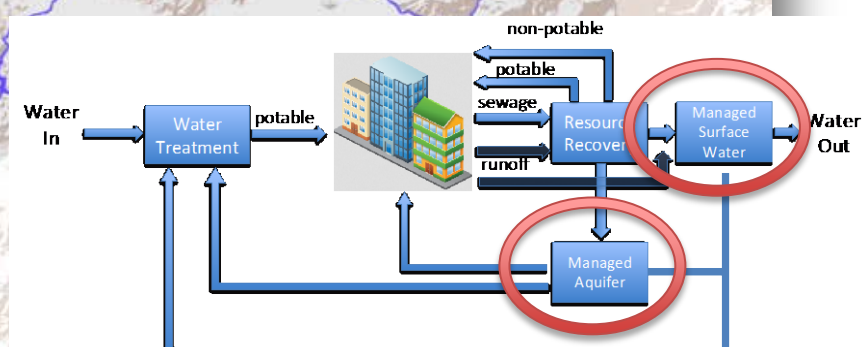
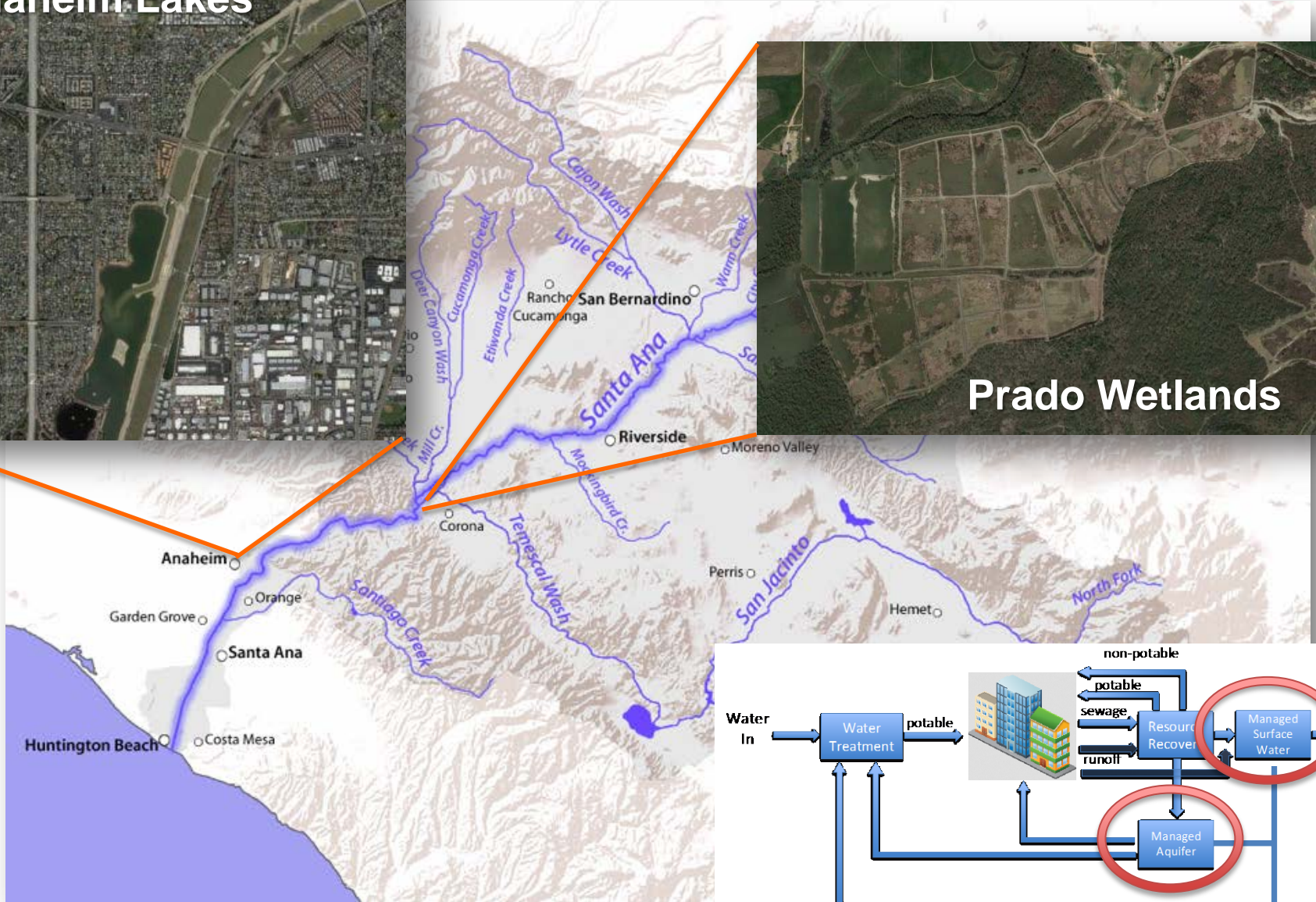


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Anaheim Lakes



Prado Wetlands





Open Water Unit Process



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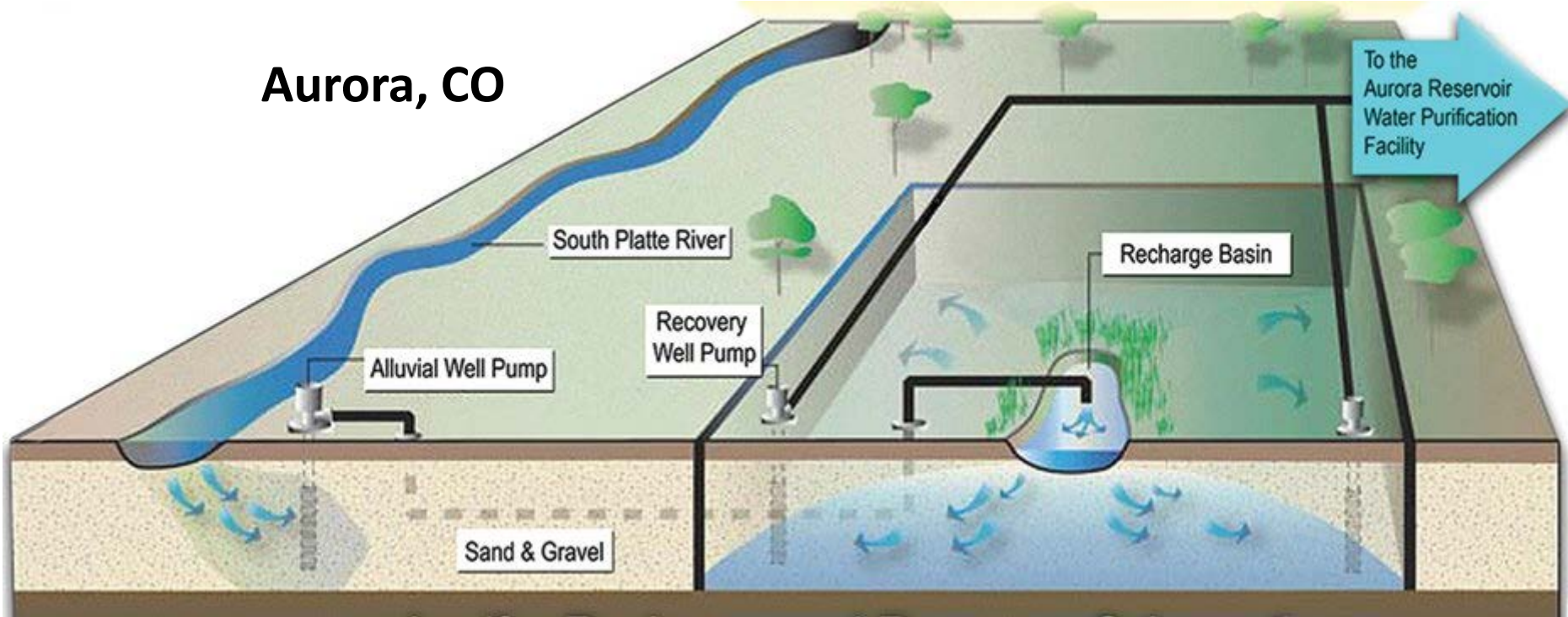


Advanced Aquifer Recharge



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Aurora, CO

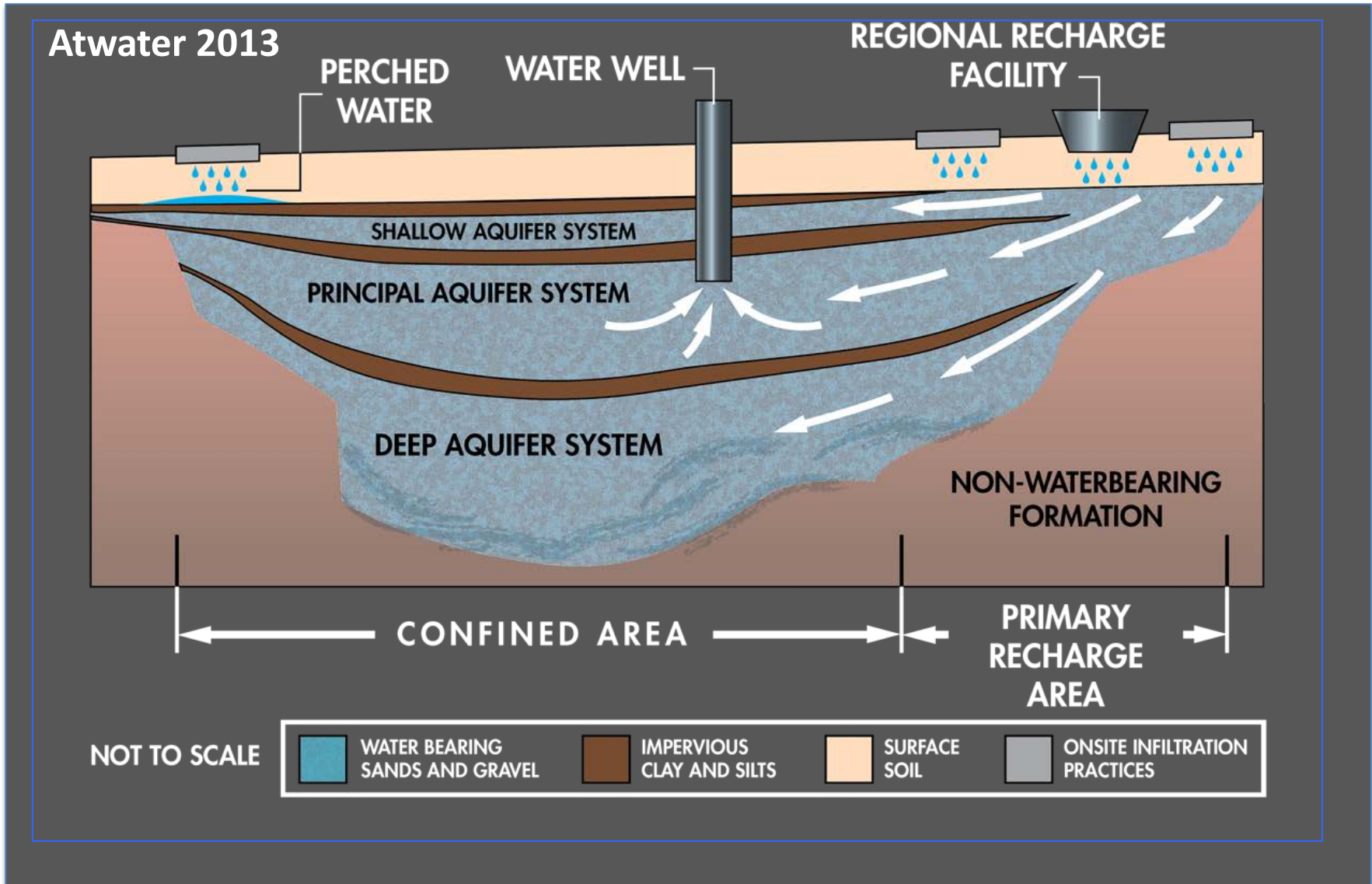




Runoff Capture and Use



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Urban Runoff as Water Supply



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**Rory M. Shaw
Wetland Park
(Burbank, CA)**



Urban Runoff as Water Supply



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**Rory M. Shaw
Wetland Park
(Burbank, CA)**

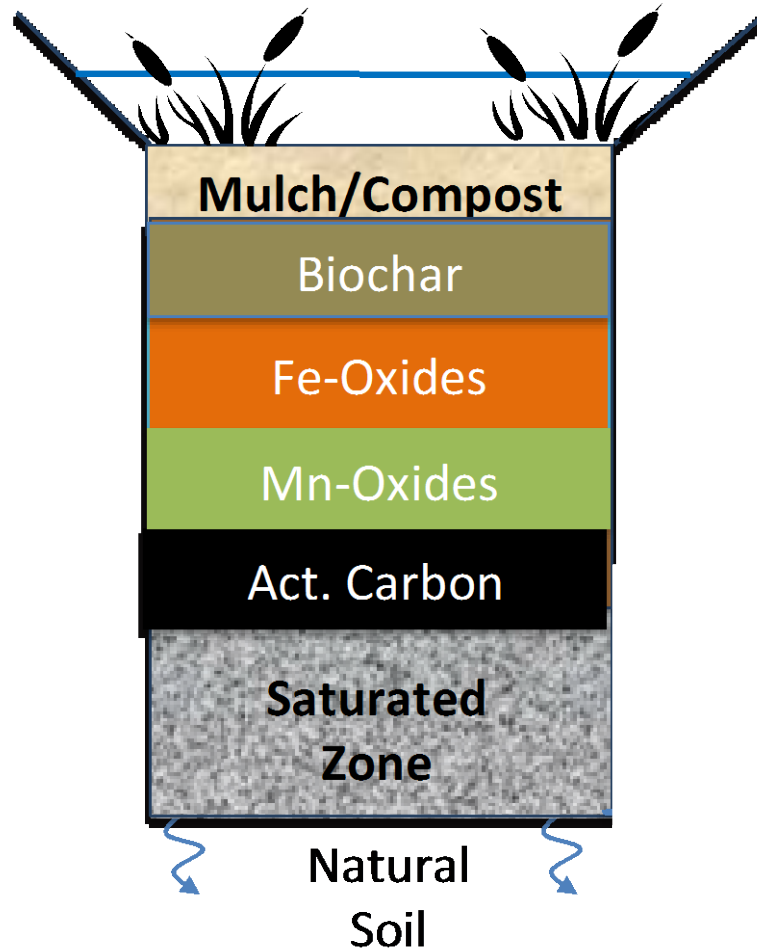




Passive Geomedia Treatment



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Groundwater



What About Water 4.1?

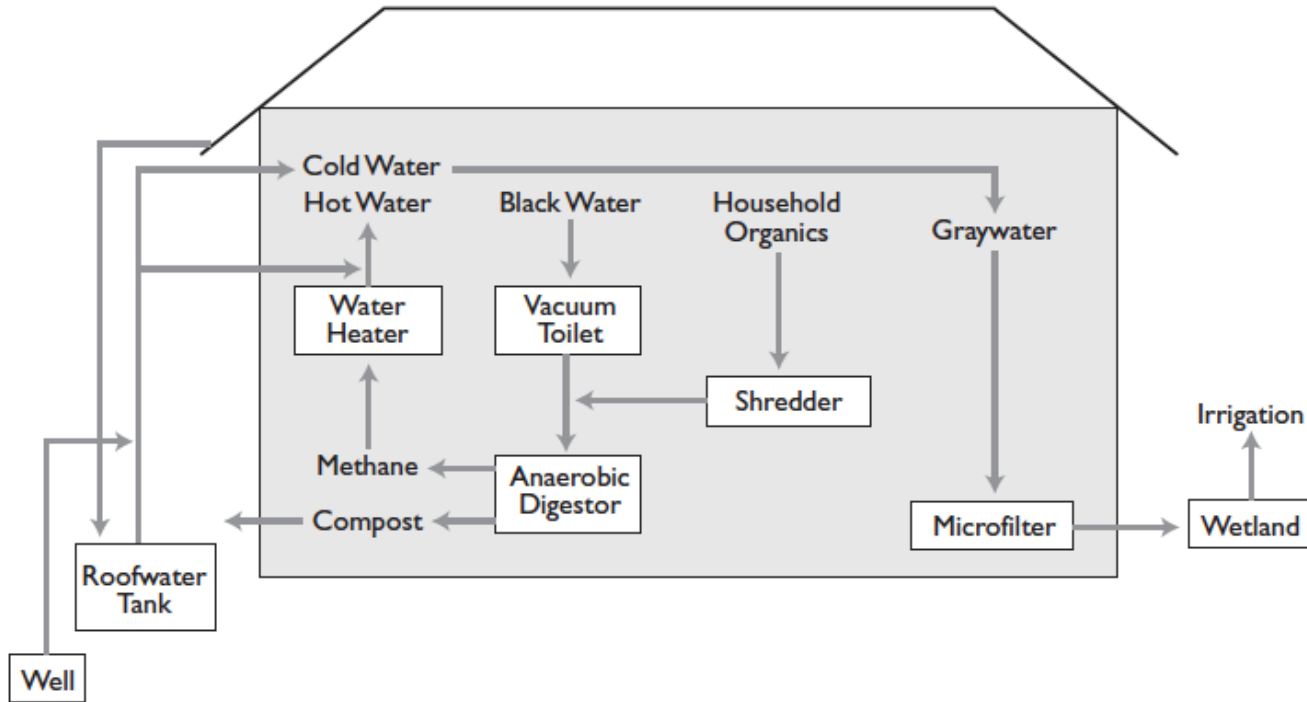
- **More...**
 - **Potable Reuse**
 - **Stormwater Harvesting**
 - **Water Use Efficiency**
- **Recovering Polluted Groundwater**
- **Off-the-Grid Developments**
- **Greywater, Roofwater, Perched Water**
- **Seawater Desalination**



Off-the-Grid Buildings



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Distributed Water Reuse



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Irrigation



Potable Reuse



Groundwater Recharge



Toilet Flushing

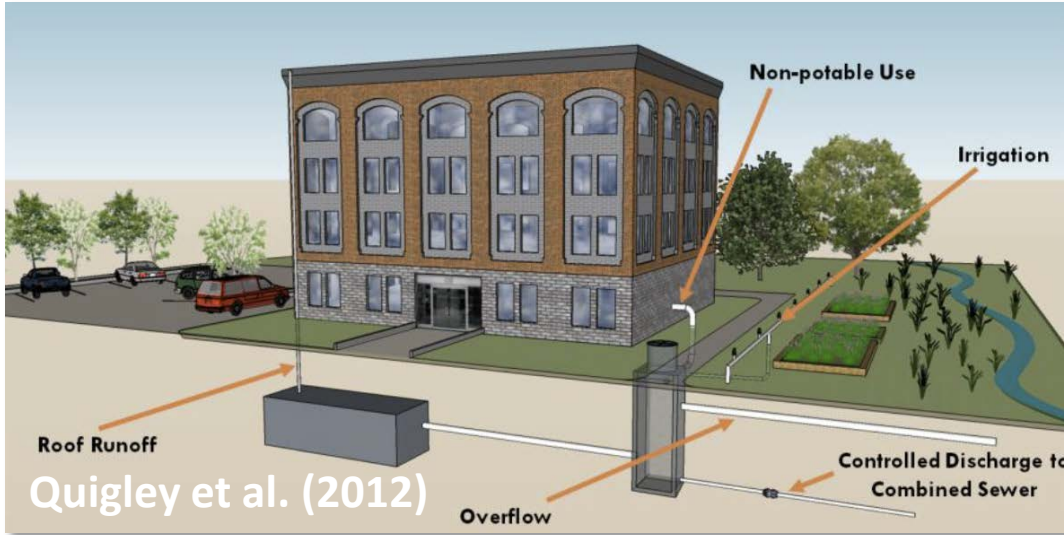




Green Roofs/Green Streets



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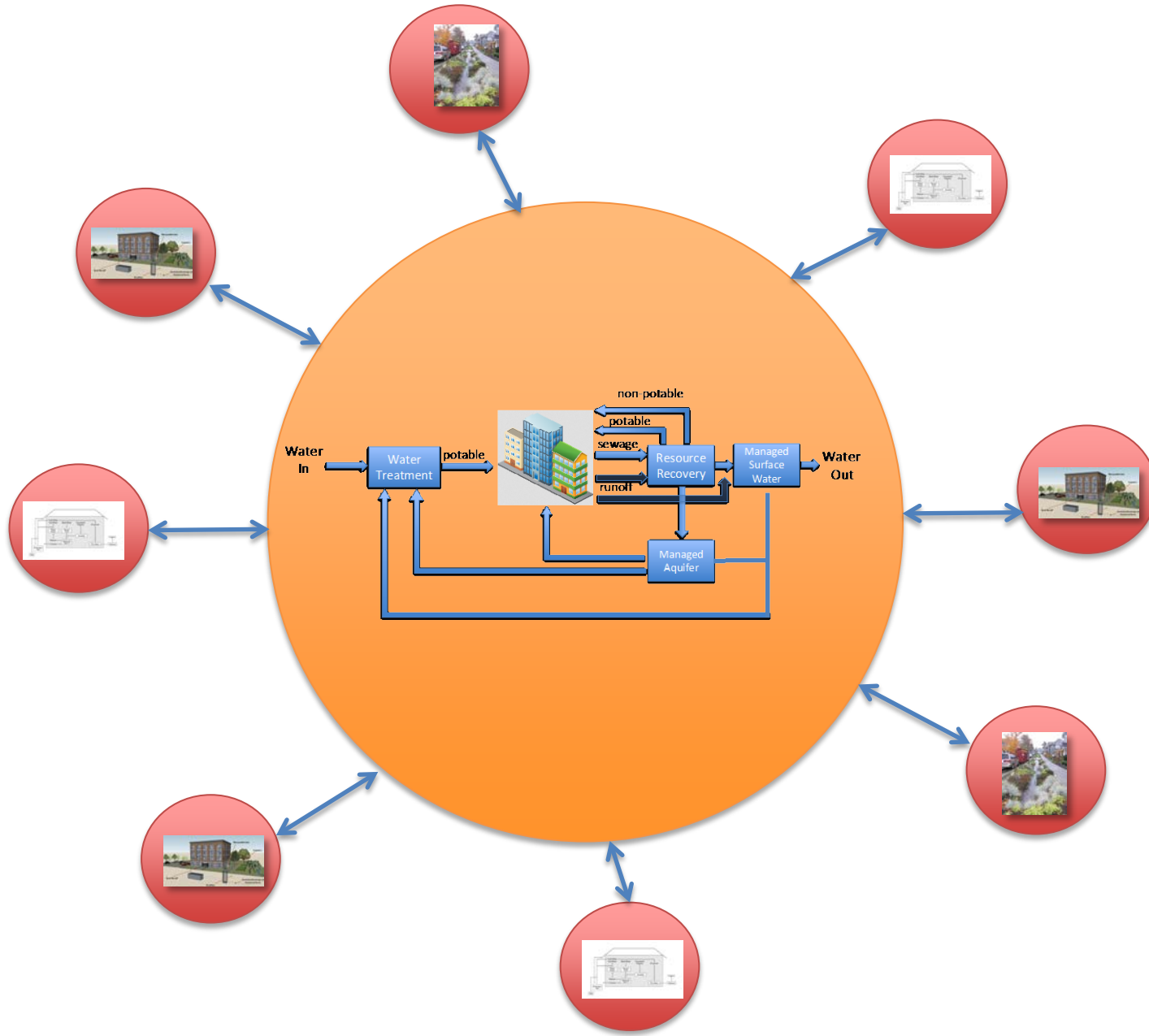




A Hybrid Approach



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Final Thoughts



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- **Preparing California for the Fourth Revolution**
 - Priming the Pump
 - No Regrets Planning
 - Windows of Opportunity

- **Importance of Research**
 - Enhancing Performance of Centralized Systems
 - Enabling Decentralized Systems
 - Understanding Hybrid Systems



Acknowledgments



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UC Berkeley

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- Kara Nelson

Stanford University

- Craig Criddle
- Richard Luthy

Colorado School of Mines

- Tzahi Cath
- Jörg Drewes (now TUM)
- Josh Sharp

Eawag/ETH Zürich

- Christian Binz
- Bernhard Truffer



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www.renuwit.org

