

502

million gallons/day* of valuable water are dumped into the Pacific Ocean by Los Angeles' Hyperion Treatment Plant in El Segundo and LA County's Joint Water Pollution Control Plant in Carson.

This is enough water for over 5 1/2 million Los Angelenos!**

So how can we close the loop to reuse this water?

* Hyperion Treatment Plant has a capacity of 450 million gallons/day (mgd), but averages 275 mgd, of which 37 mgd are recycled. Joint Water Pollution Control Plant has a 400 mgd capacity, treats an average of 264 mgd, and does not supply ANY recycled water.

Sources:

Los Angeles Bureau of Sanitation // Los Angeles County Department of Public Works // US EPA // Water Reclamation District of Southern California

** Calculated at 90 gallons per capita per day based on projected conservation.

Closing the water loop takes infrastructure & policy.

Infrastructure to further filter and cleanse the effluent, and pumps and pipes to distribute the water to where it can best recharge our groundwater.

Expanding the purple pipe recycled water network isn't the answer. We're cutting back on irrigation and industrial uses too. The challenge is supplying potable recycled water for domestic use.

Policy shifts to unify the balkanized jurisdiction of the Southern California water supply system, groundwater, and sanitation systems into a single integrated system.

Plus we need to start regulating difficult to remove chemicals from consumer products such as salt, plastic microbeads, and endocrine disruptors.

Closing the loop increases Southern California's resilience by reducing our reliance on the fragile imported water supply.

Water that crosses major tectonic faults.

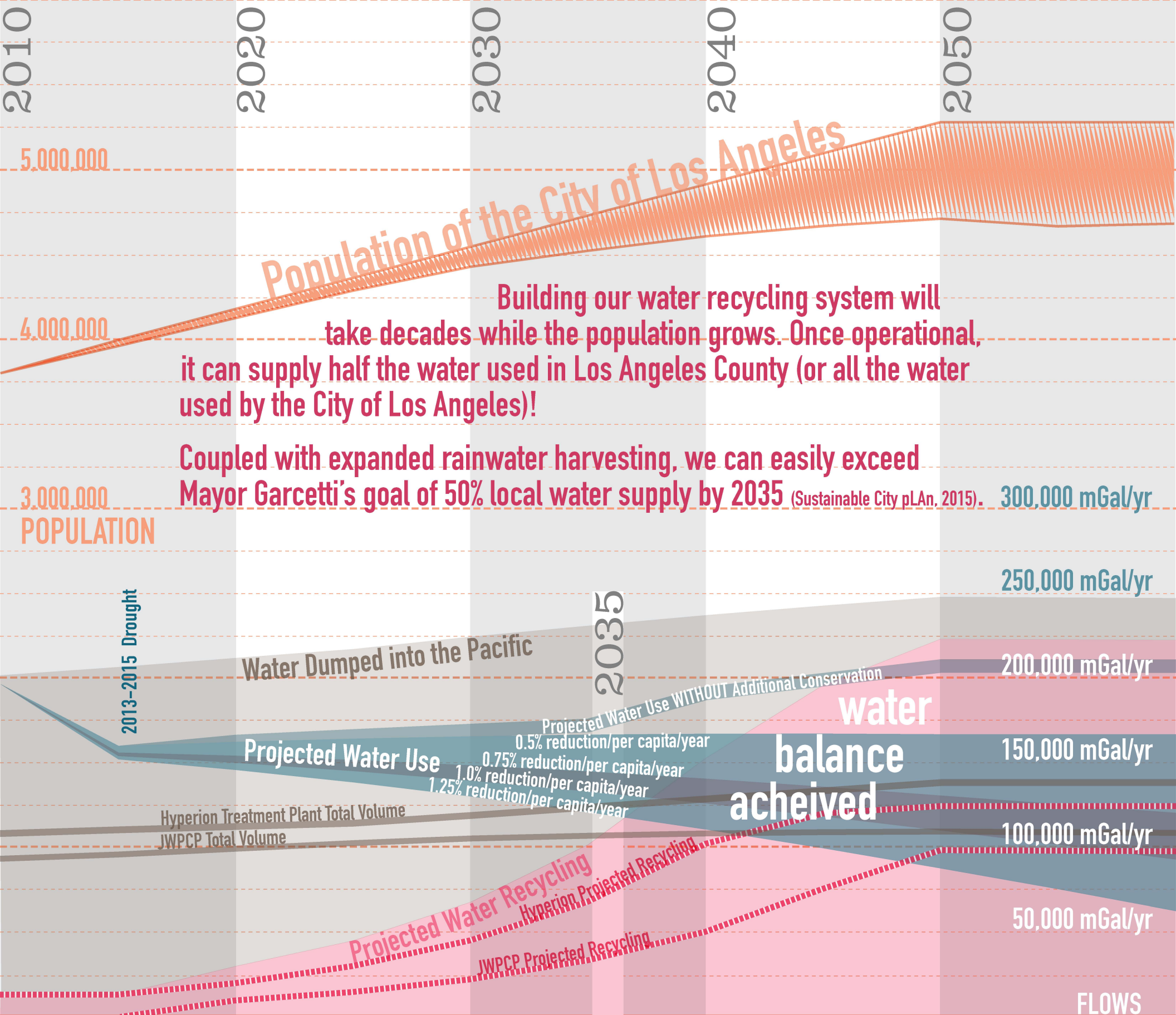
Water that flows through the unstable Sacramento Delta.

Water that takes massive amounts of energy to pump over mountains.

Water from the over-allocated Colorado River.

Water that originates in highly variable snow-packs.

Water that was stolen from nature.



These projections are based on trends in per capita water use and population growth in the City of Los Angeles, along with estimated sewage volume. 2015 has seen unprecedented reductions in water use, it is unknown if this trend will be sustained.

Sources:
 California Department of Finance. *Population Projections*. // Los Angeles Bureau of Sanitation. 2014. *Annual Report*. // Los Angeles Department of Water and Power. 1908-2014. *Annual Report[s]*. // Los Angeles Department of Water and Power. 2010. *Integrated Water Resource Plan*. // Los Angeles County Department of Sanitation. 2013. *Annual Report*. // Metropolitan Water District. 2010. *Integrated Water Resource Plan*. // US Census. 2010. *Los Angeles County*. //

Pipesheds of Los Angeles

Sewage Treatment Plant (WTP) Capacity

- 0.5-10 mgd
- 10-50 mgd
- 50-100 mgd
- 100-250 mgd
- 250-500 mgd

Water Recycling Plant (WRP) Capacity

- 0.5-10 mgd
- 10-50 mgd
- 50-100 mgd
- 100-250 mgd
- 250-500 mgd

Service Zones

- LA Water Distribution Zones
- Pumped Distribution Zone
- JWPCP Service Zone
- Hyperion Service Zone
- Terminal Island Treatment Service Zone

Water Wells

- 0-500 a-f
- 500-2000 a-f
- 2,000+ a-f

Potable Water Mains

- Raw Water/Aqueducts (untreated)
- Trunk Lines & Feeders (purified)

Sanitary Sewers

- Laterals
- Interceptors

JENSEN
FILTRATION
PLANT

LAA FILTRATION
PLANT

WEYMOUTH
FILTRATION
PLANT

DIEMER
FILTRATION
PLANT

Hyperion
Treatment
Plant

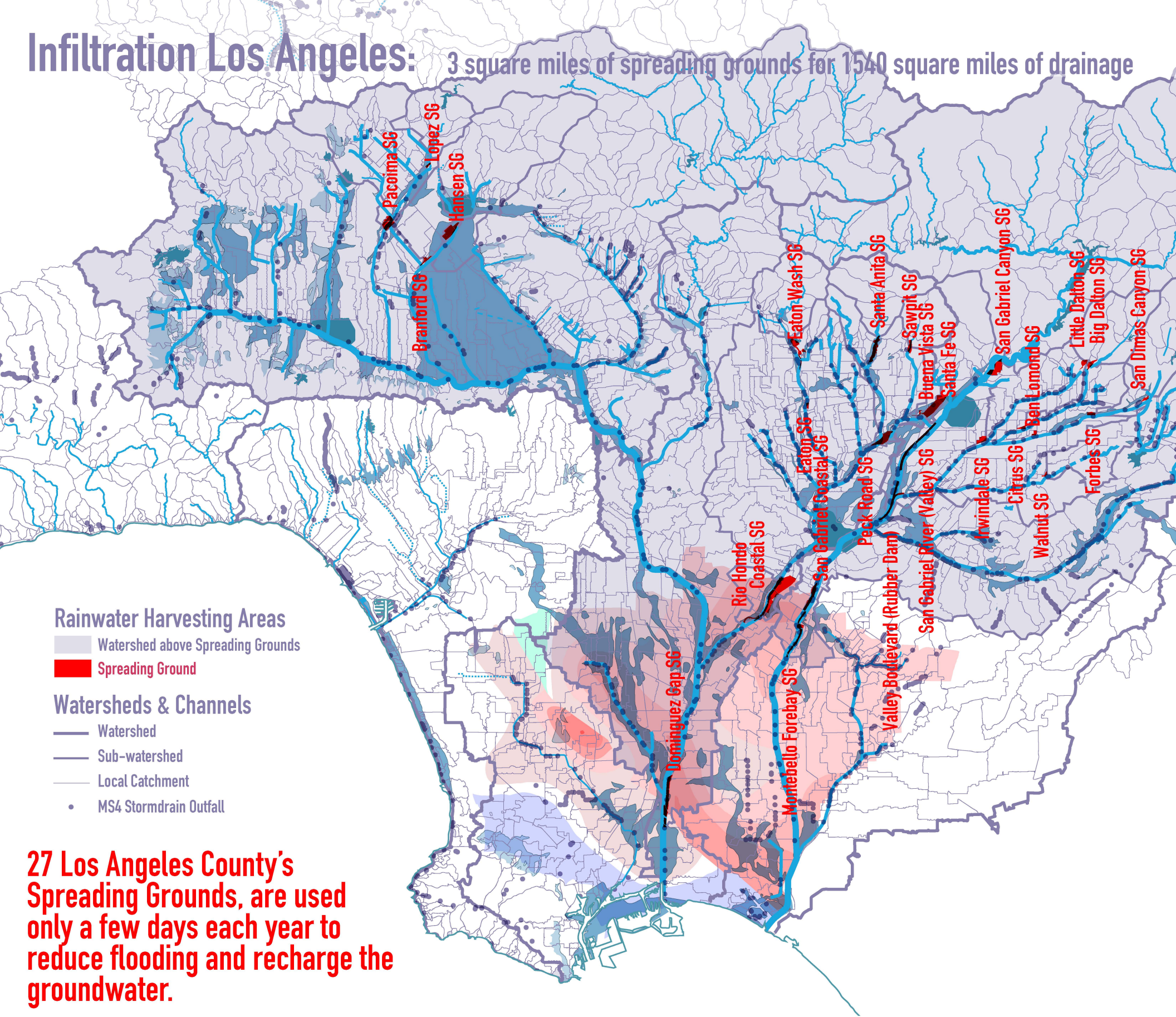
Joint Water
Pollution
Control Plant



Recycling water requires making safe connections between the potable water systems and the sanitary sewers.

Sources:
California Department of Water Resources // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Bureau of Engineering. 2007. *Oil Fields*. // Los Angeles Department of Water and Power // Los Angeles County Sanitation District. 2000. *Sanitation Districts [map]* // Metropolitan Water District. 2009. *Service Area Map*. // Water Replenishment District of Southern California. 2014. *RGWMR*. //

Infiltration Los Angeles: 3 square miles of spreading grounds for 1540 square miles of drainage



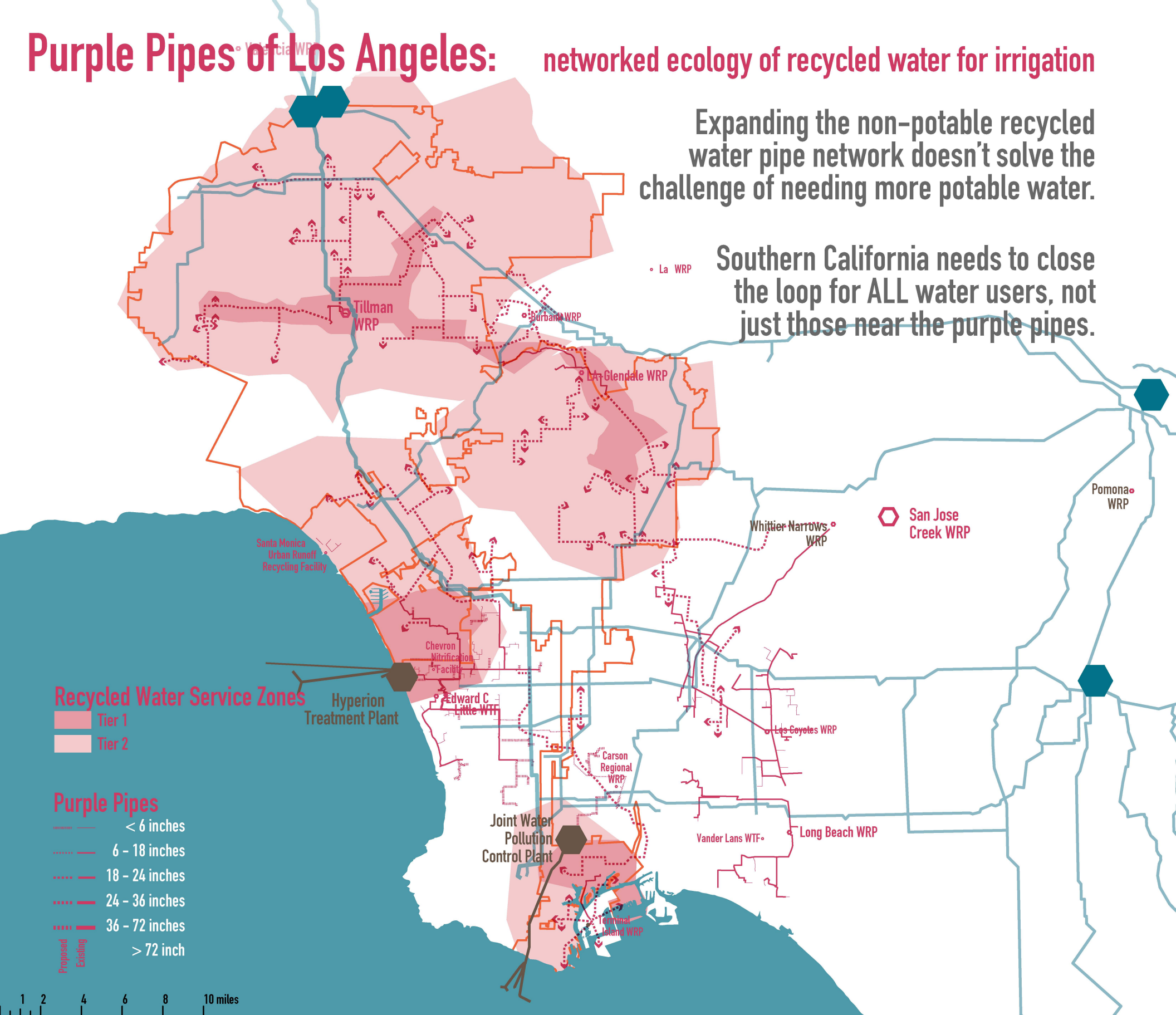
If all of them were converted to replenishing the groundwater with recycled water, they could infiltrate 600 to 800 million gallons per day on sunny days.

Sources:
California Department of Water Resources // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Department of Water and Power // Water Replenishment District of Southern California. 2014. *RGWMM*.

Purple Pipes of Los Angeles: networked ecology of recycled water for irrigation

Expanding the non-potable recycled water pipe network doesn't solve the challenge of needing more potable water.

Southern California needs to close the loop for ALL water users, not just those near the purple pipes.



Pipes used to deliver water that is not safe for human consumption are required to be colored purple,

Sources:
California Department of Water Resources // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Bureau of Engineering. 2007. *Oil Fields*. // Los Angeles Department of Water and Power // Los Angeles County Sanitation District. 2000. *Sanitation Districts* [map] // Metropolitan Water District. 2009. *Service Area Map*. // Water Replenishment District of Southern California. 2014. *RGWMR*. //

Tertiary Treatment Options

Mechanical versus Wetlands Treatment

The difference between 'Treatment Plants' and 'Reclamation Plants' is the level of treatment the water gets before being discharged or distributed. Hyperion and JWPCP only provide Secondary Treatment, so require building additional treatment works to enable recycling their effluent.

The gold standard of mechanical Tertiary Treatment is Reverse Osmosis, an energy intensive process needing 1,000 – 8,300 kWh per million gallons treated (Pacific Institute, 2013).

Reverse Osmosis would thus require 180,000 to 1,500,000 gWh per year!!!!

Alternatively, Treatment Wetlands provide a low energy/low maintenance method to polish effluent, by using plants and biofilms to metabolize toxins, drugs, and viruses.

The trade off is wetlands require about one square foot/per gallon/day, land that can be used for infiltration, and provide needed habitat for wildlife.

So treating 502 mgd would require 18 square miles of wetlands.

4.25 miles
18 square miles
11,500 acres

Finding the optimum balance between energy-use and land for Tertiary Treatment is perhaps the most significant and capital intensive piece to reaching the goal of re-using 502 million gallons per day.

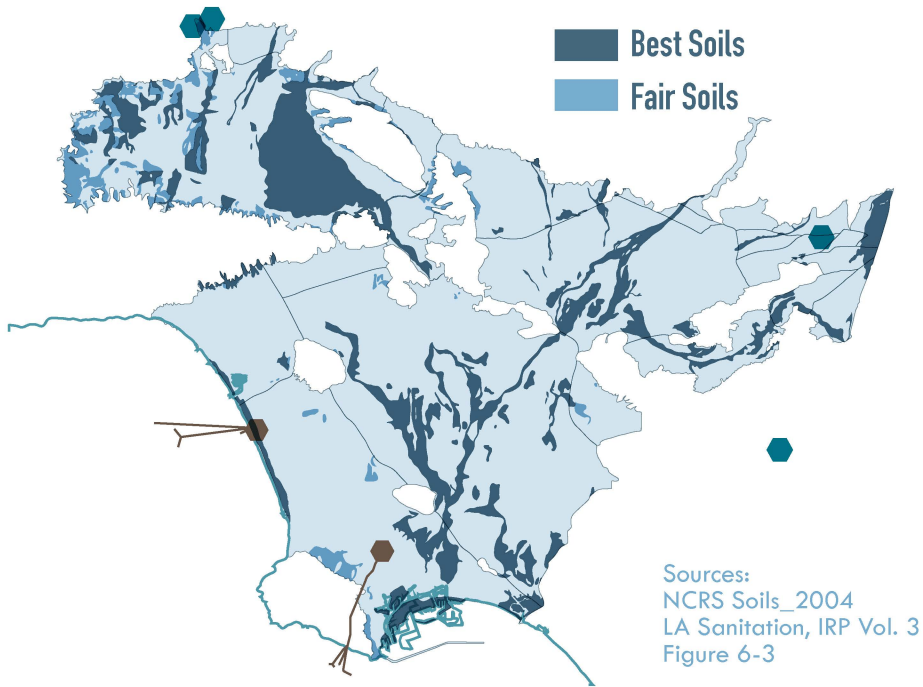
1 2 4 6 8 10 miles

Sources:

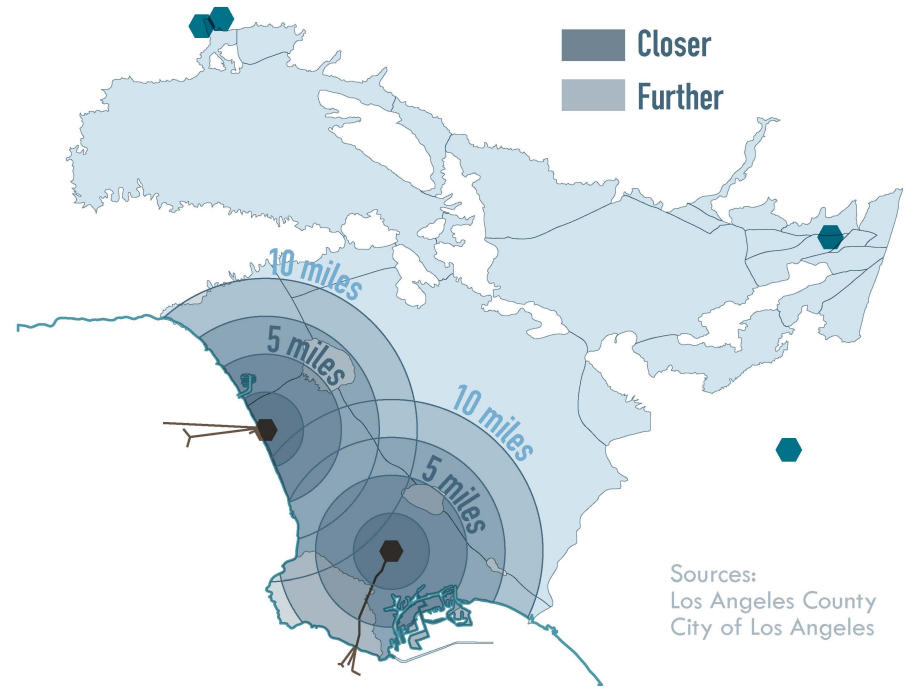
California Department of Water Resources // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Bureau of Engineering. 2007. *Oil Fields*. // Los Angeles Department of Water and Power // Los Angeles County Sanitation District. 2000. *Sanitation Districts [map]* // Metropolitan Water District. 2009. *Service Area Map*. // Pacific Institute, 2013 // Water Replenishment District of Southern California. 2014. *RGWMR*. //

Recharge Opportunities

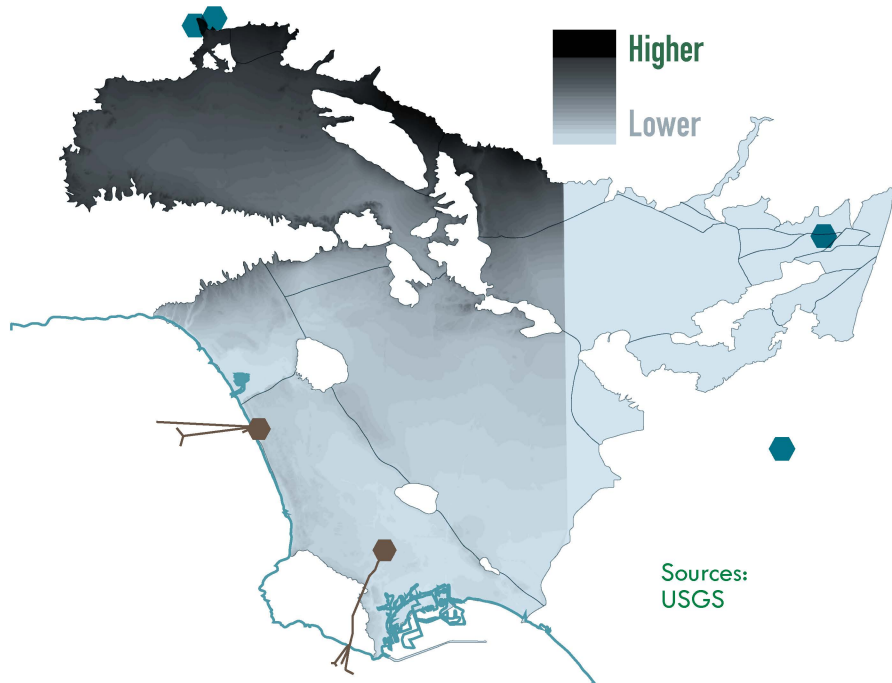
Soil Infiltration Rate



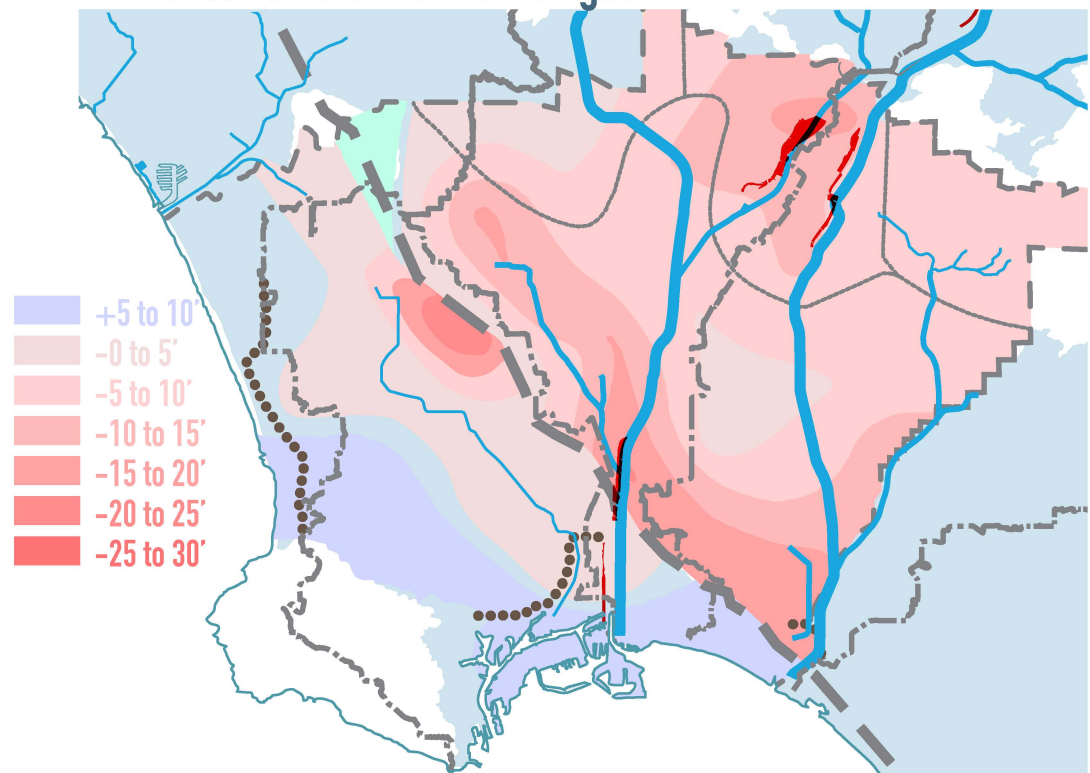
Proximity to Hyperion and JWPCP



Elevation 30 Feet Contours (Pumping Energy)



Groundwater Level Changes

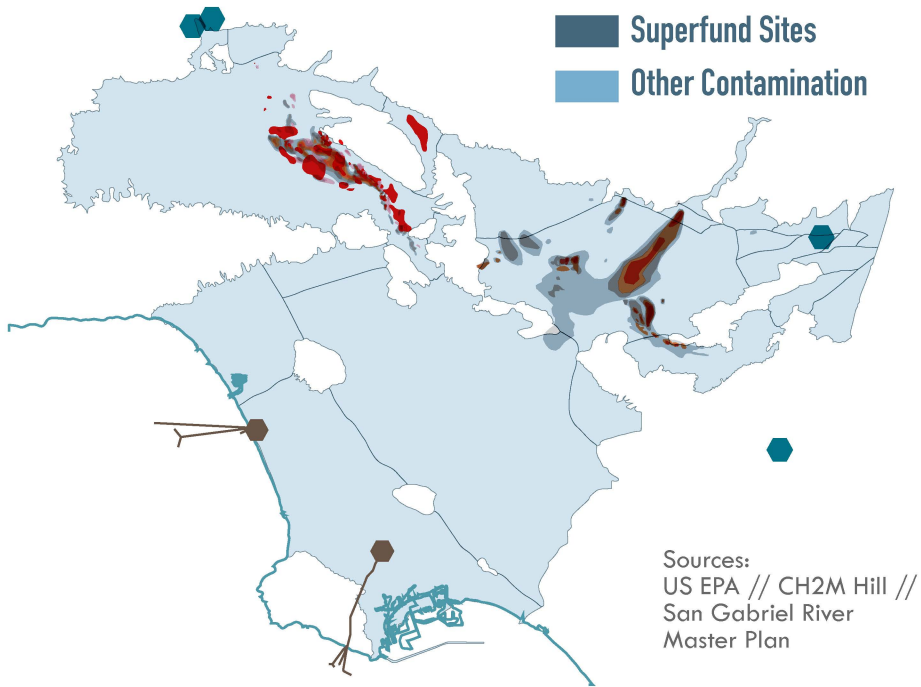


Locate places above porous soils (to minimize the area required), as close to Hyperion and JWPCP (to limit the cost of the pipes), and as close to sea level as possible (to the energy required for pumping).

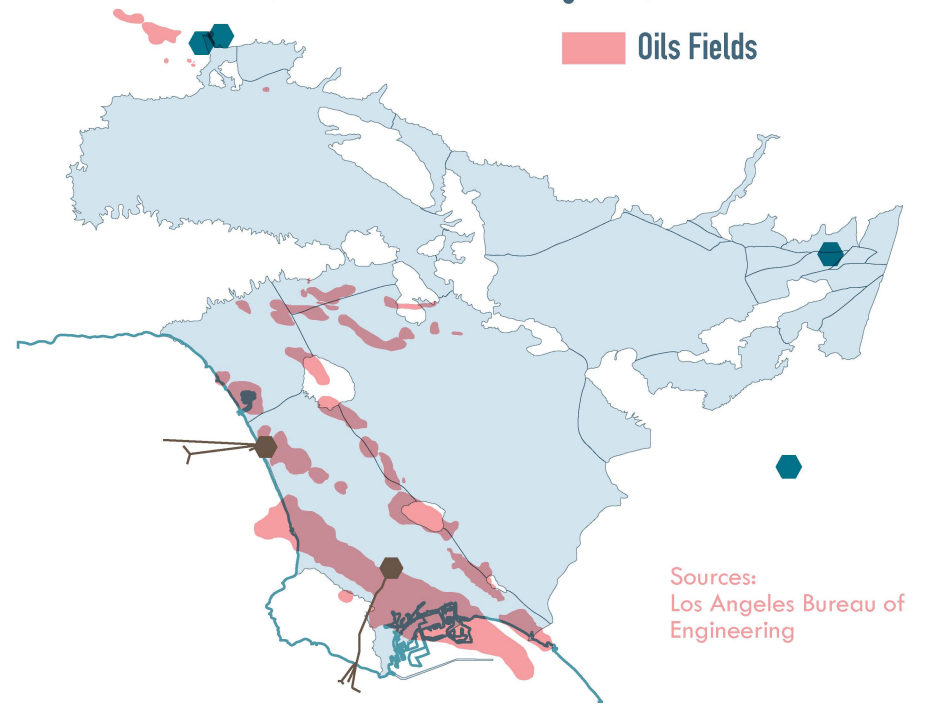
Sources:
 California Department of Water Resources // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Bureau of Engineering. 2007. *Oil Fields*. // Los Angeles Department of Water and Power // Los Angeles County Sanitation District. 2000. *Sanitation Districts* [map] // Metropolitan Water District. 2009. *Service Area Map*. // Water Replenishment District of Southern California. 2014. *RGWMR*. // US Geologic Service

Recharge Constraints

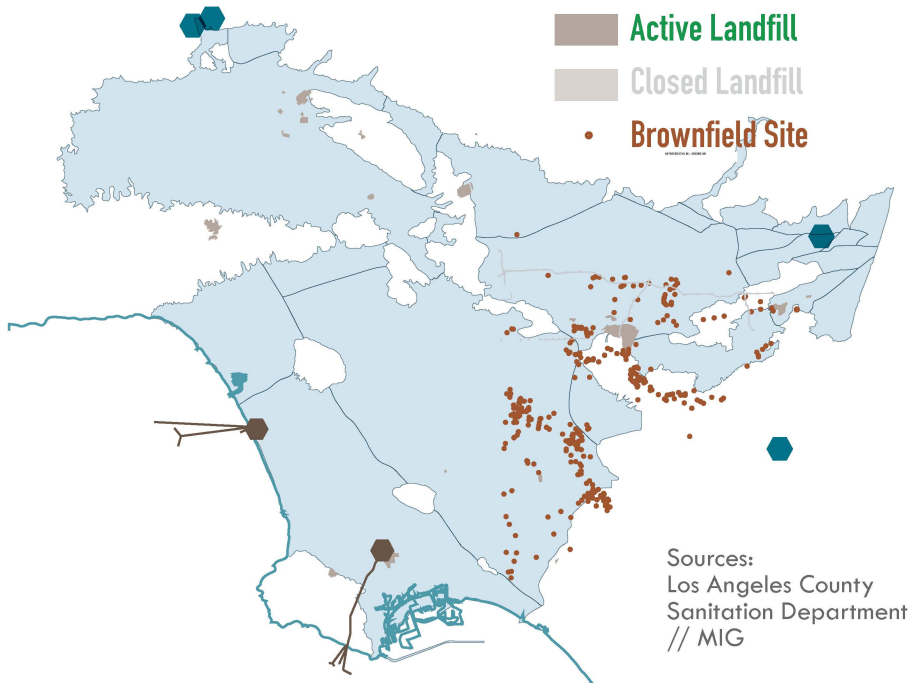
Groundwater Contamination



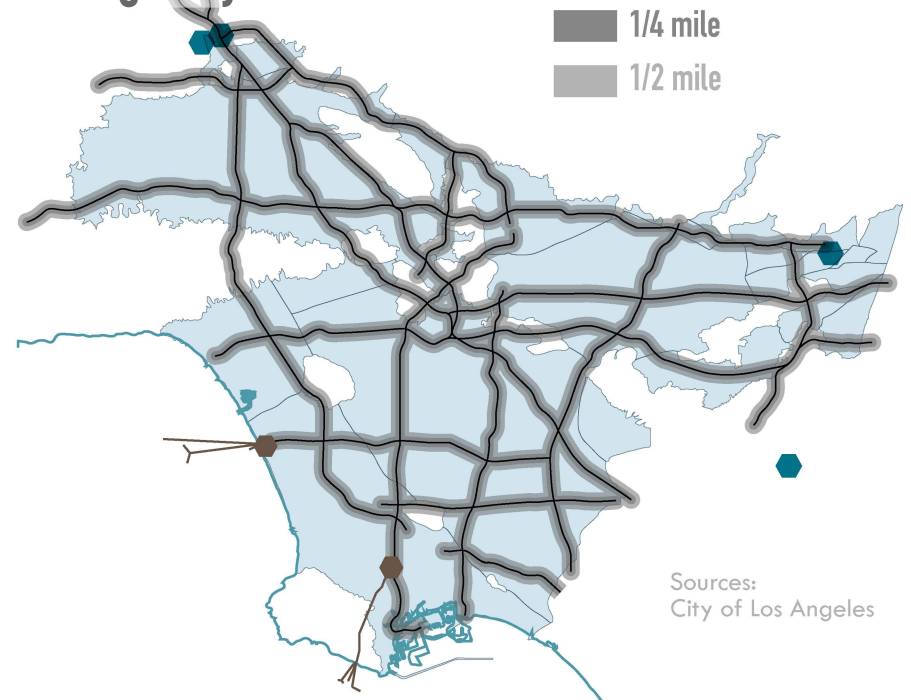
Oil Fields (Methane, VOC, & Fracking Risks)



Landfills & Brownfields (potential contamination)



Highways (Lead Contaminated Soil)

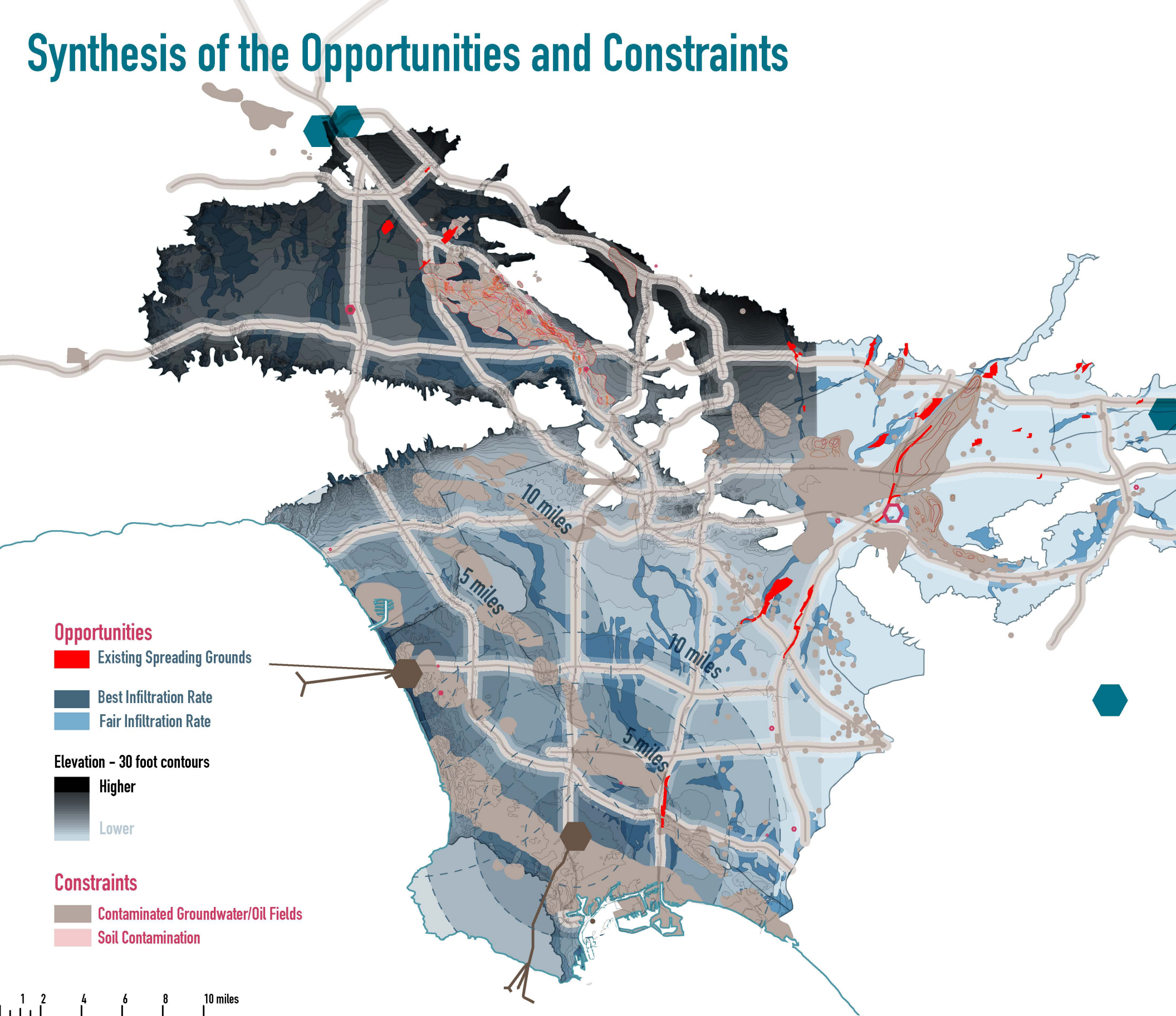


1 2 4 6 8 10 miles

Avoiding contaminated groundwater and the risk of contamination limits available sites.

Sources:
 California Department of Water Resources // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Bureau of Engineering. 2007. *Oil Fields*. // Los Angeles Department of Water and Power // Los Angeles County Sanitation District. 2000. *Sanitation Districts* [map] // Metropolitan Water District. 2009. *Service Area Map*. // Water Replenishment District of Southern California. 2014. *RGWMR*. // US Geologic Service

Synthesis of the Opportunities and Constraints



The best sites for recharging the groundwater will be close to Hyperiona and JWPCP (to control costs), at a low elevation (to save pumping energy), with clean soils that have the best infiltration rates, above clean groundwater (so we can use the water).

Sources:
California Department of Water Resources // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Bureau of Engineering. 2007. *Oil Fields*. // Los Angeles Department of Water and Power // Los Angeles County Sanitation District. 2000. *Sanitation Districts* [map] // Metropolitan Water District. 2009. *Service Area Map*. // Water Replenishment District of Southern California. 2014. *RGWMR*. //

Recharge City

Infiltrating 502 million gallons/day requires 1,500 to 2,000 acres. This is double the area of the Montebello Forebay and Rio Hondo Coastal Spreading Grounds combined.

1.5 miles
2 miles

Finding a single 1.5 miles by 1.5 miles to 2.0 miles parcel in the densely developed metropolis may be impossible.

Recharge Targets

Target Infiltration Zones

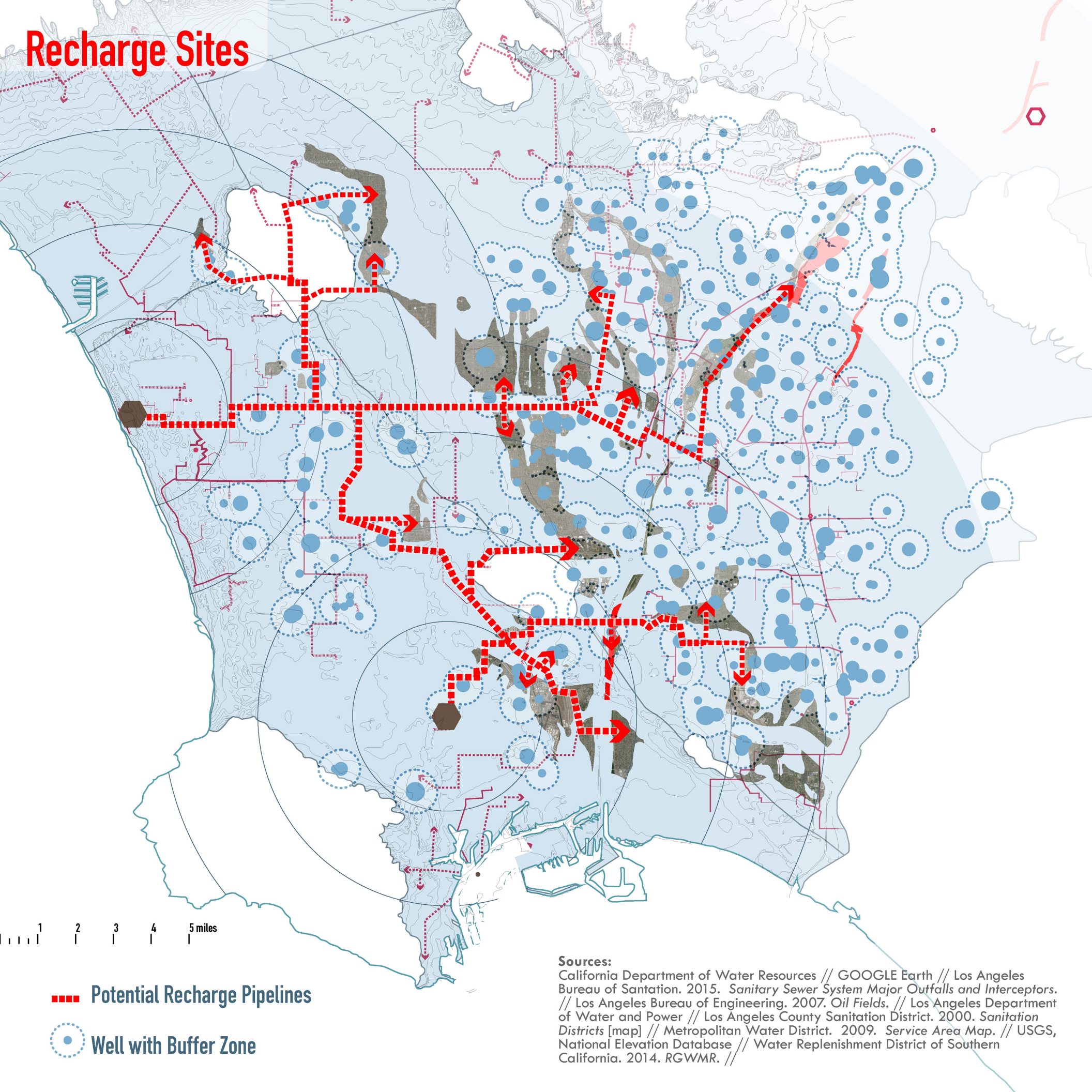
There are certainly hundreds of smaller parcels available, like underutilized parking lots, powerline easements, abandoned golf courses, or even median strips.

1 2 4 6 8 10 miles

Sources:

California Department of Water Resources // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Bureau of Engineering. 2007. *Oil Fields*. // Los Angeles Department of Water and Power // Los Angeles County Sanitation District. 2000. *Sanitation Districts* [map] // Metropolitan Water District. 2009. *Service Area Map*. // USGS, National Elevation Database // Water Replenishment District of Southern California. 2014. *RGWMR*.

Recharge Sites



■ Potential Recharge Pipelines

● Well with Buffer Zone

Sources:
California Department of Water Resources // GOOGLE Earth // Los Angeles Bureau of Sanitation. 2015. *Sanitary Sewer System Major Outfalls and Interceptors*. // Los Angeles Bureau of Engineering. 2007. *Oil Fields*. // Los Angeles Department of Water and Power // Los Angeles County Sanitation District. 2000. *Sanitation Districts* [map] // Metropolitan Water District. 2009. *Service Area Map*. // USGS, National Elevation Database // Water Replenishment District of Southern California. 2014. *RGWMR*. //

Los Angeles County has fragmented jurisdictions over water:

10.1 Million People
88 Cities
18 Municipal Water Districts
10 Private Water Companies
5 Irrigation Districts
7 Adjudicated Groundwater Basins
3 Water Recycling Agencies
3 Stormwater/Flood Control Agencies
plus
A myriad of State and Federal Agencies

**Collaboration is needed, not
competition to close the loop.**

Sources:

California Department of Water Resources // Central Basin Watermaster // City of Los Angeles Bureau of Engineering // City of Los Angeles Bureau of Sanitation // City of Los Angeles Department of Water and Power // Los Angeles County Bureau of Engineering // Los Angeles County Waterworks // Metropolitan Water District // Puente Basin Watermaster // San Gabriel Basin Watermaster // Six Basins Watermaster // US Census // USGS // Upper Los Angeles River Association // Water Replenishment District of Southern California // West Basin Watermaster

2 4 8 12 16 20 miles