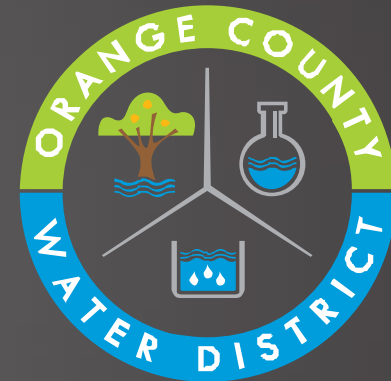




# Water Scarce Cities:

## Towards Urban Water Security Under Scarcity



SINCE 1933

**Michael R. Markus, P.E., D.WRE, BCEE, F.ASCE**  
**General Manager**

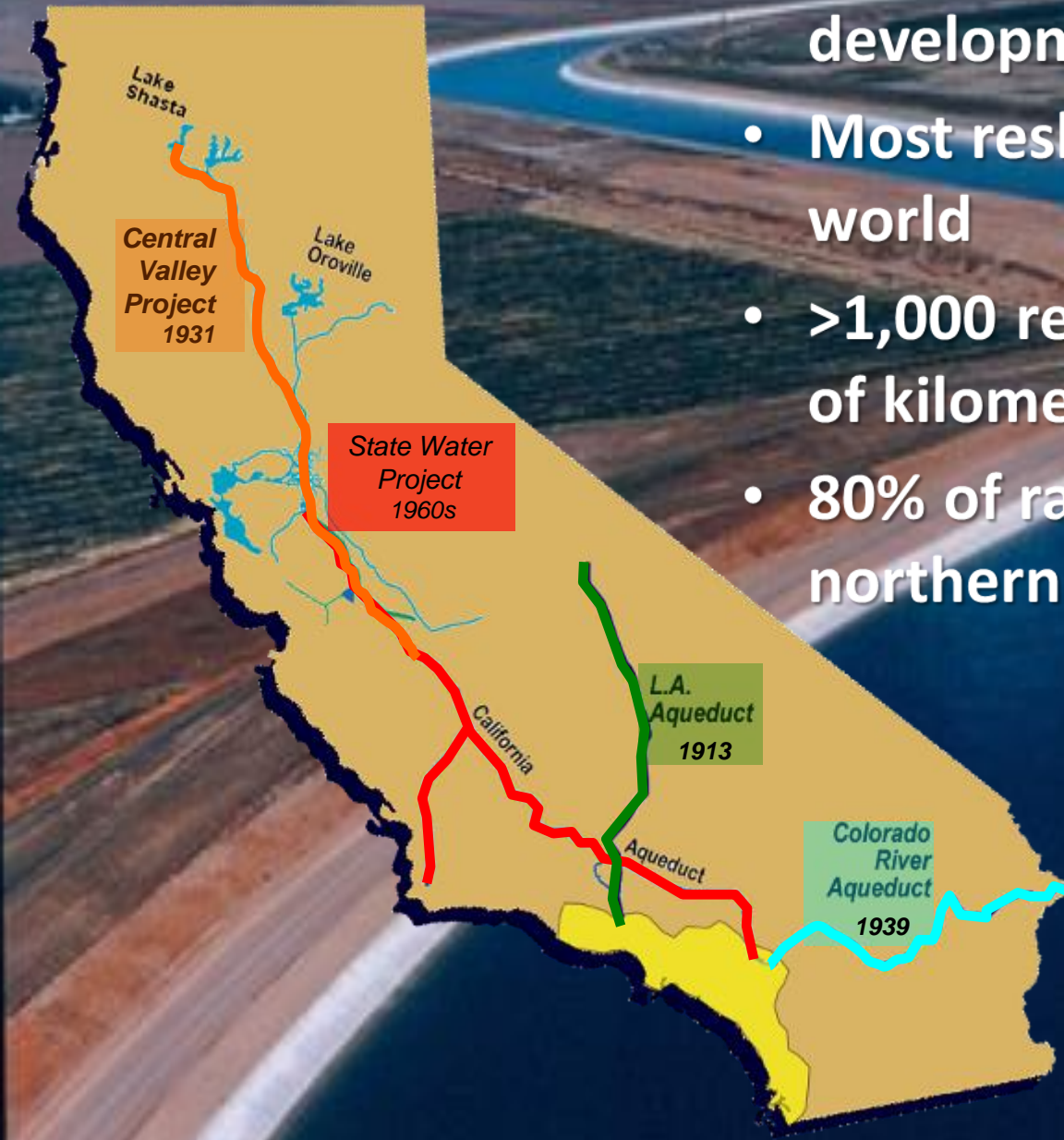
**August 30, 2017**

- California's population growth occurred in era of water development

- Most reshaped water system in world

- >1,000 reservoirs and thousands of kilometers of canals

- 80% of rainfall occurs in the northern part of the state





# SOUTHERN CALIFORNIA IS AN ARID DESERT

- Majority of population in Southern California, but majority of rainfall is in Northern California
- 350 mm average rainfall in Southern California
- Rainfall in Southern California in 2013 was 91 mm
- 2013 driest year on record



# ORANGE COUNTY WATER DISTRICT (OCWD)



- Formed in 1933 by an act of the California legislature to manage the OC groundwater basin and protect OC's rights to the Santa Ana River water
- Basin provides groundwater to 19 municipal and special water districts that serve 2.4 million customers in north and central Orange County
- Basin currently supplies 75% of the water supply for north and central OC

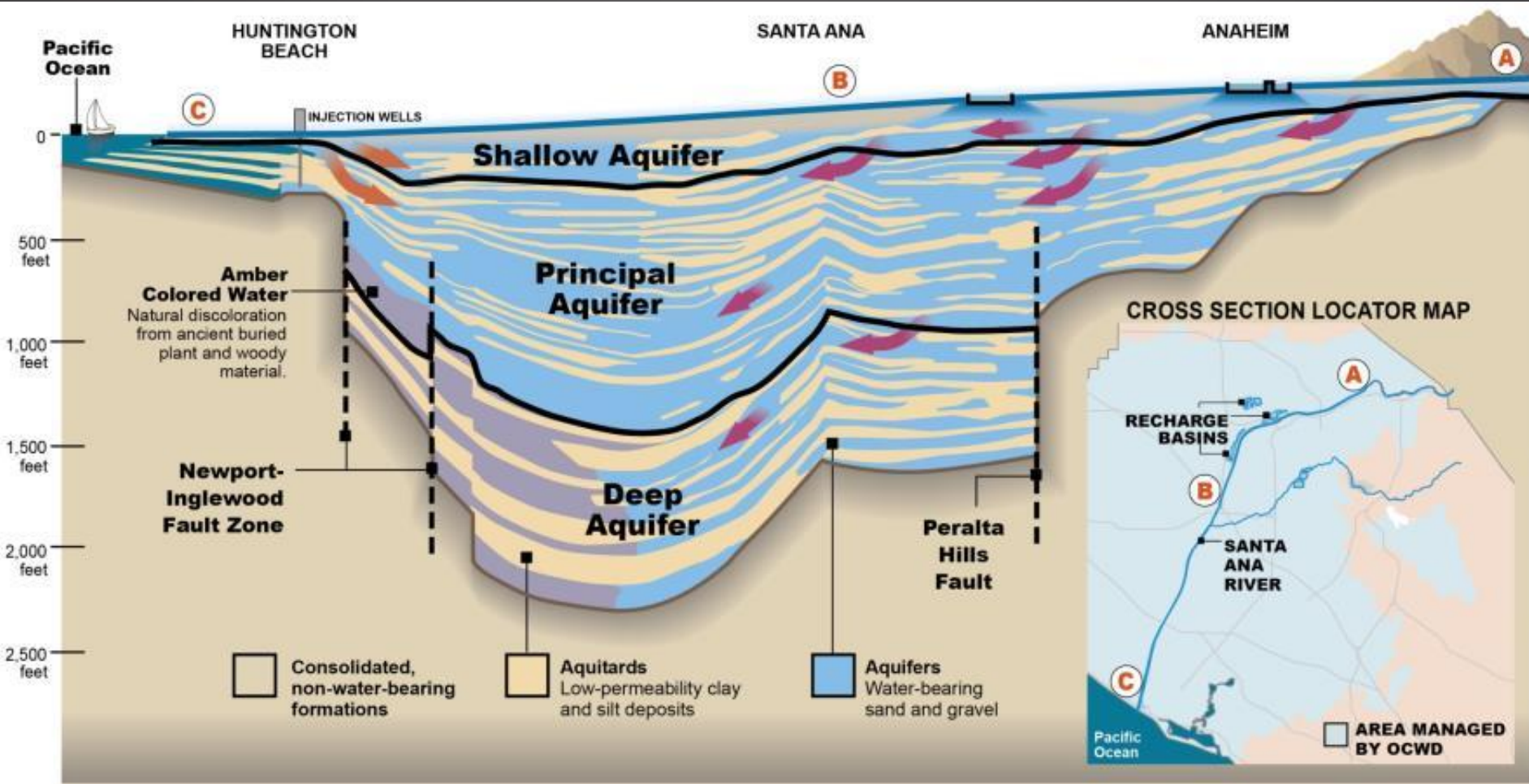


# OCWD GENERAL INFORMATION

- OCWD governed by a 10 person Board of Directors
- 7 members directly elected by the public
- 3 members appointed (Santa Ana, Anaheim & Fullerton)
- Non-adjudicated groundwater basin
- Each year the Board sets the percentage of groundwater that can be pumped (BPP)
- Each year the Board Replenishment Assessment (RA) and Basin Equity Assessment (BEA) for the cost of pumping groundwater

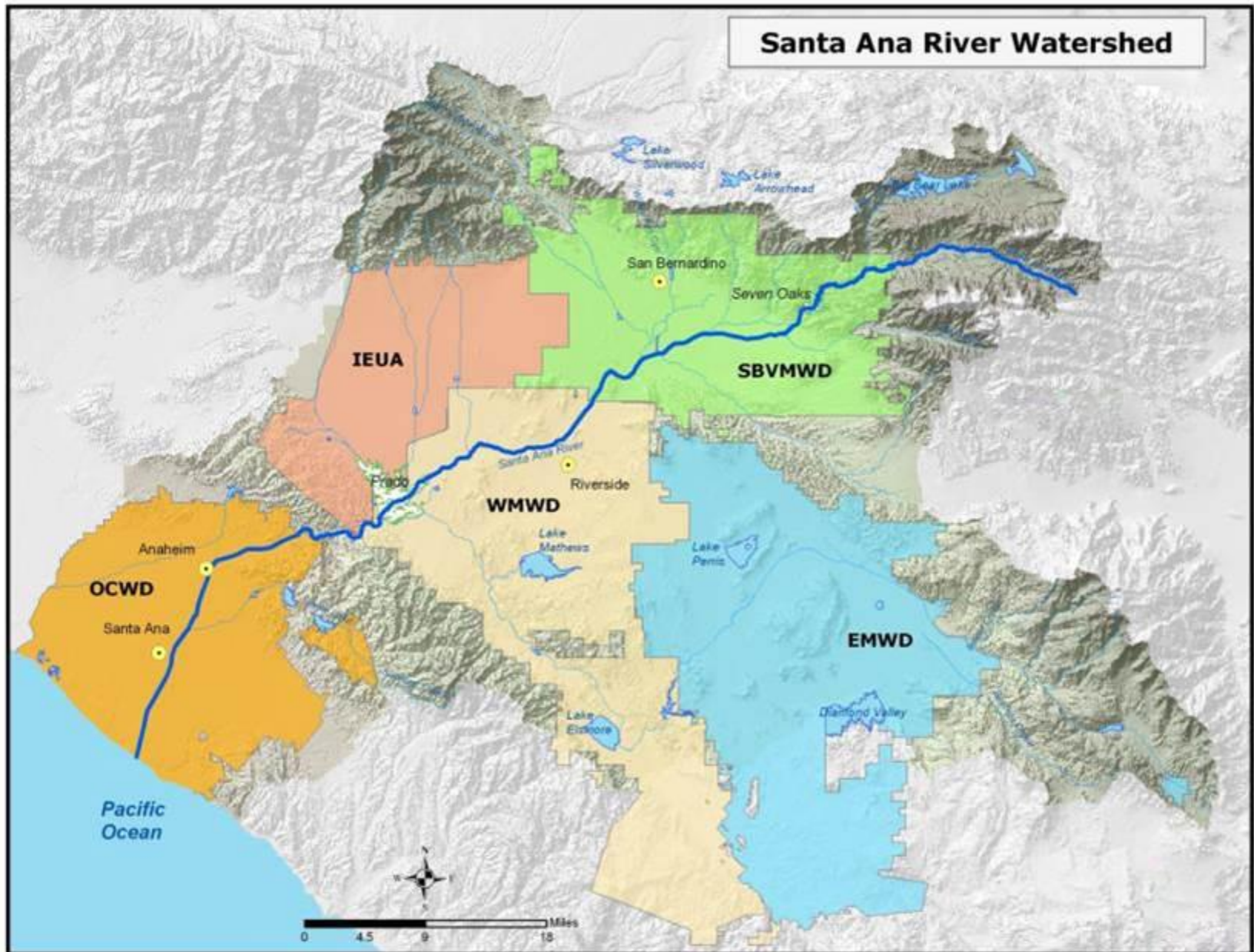


# GROUNDWATER BASIN

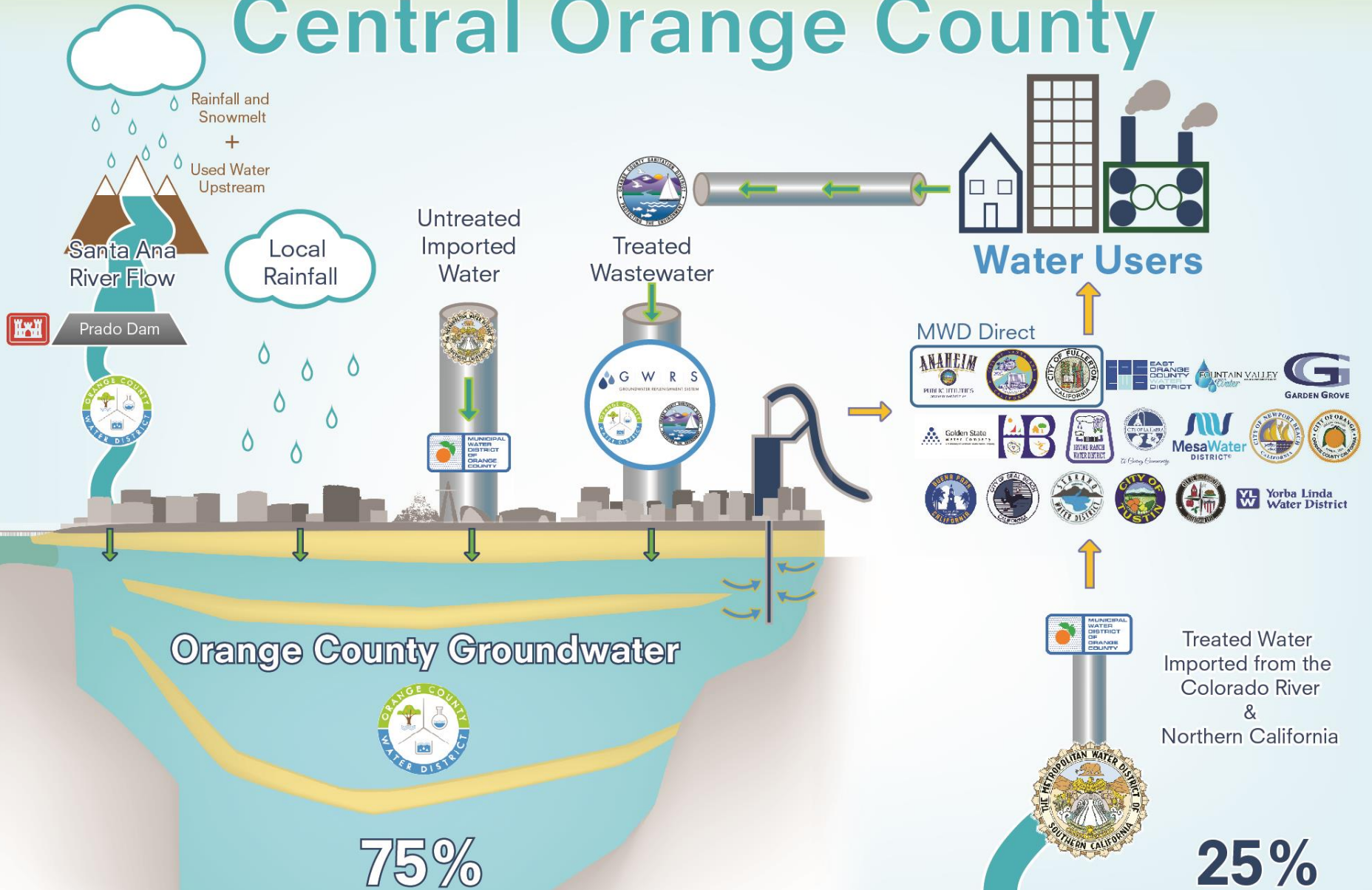




### Santa Ana River Watershed



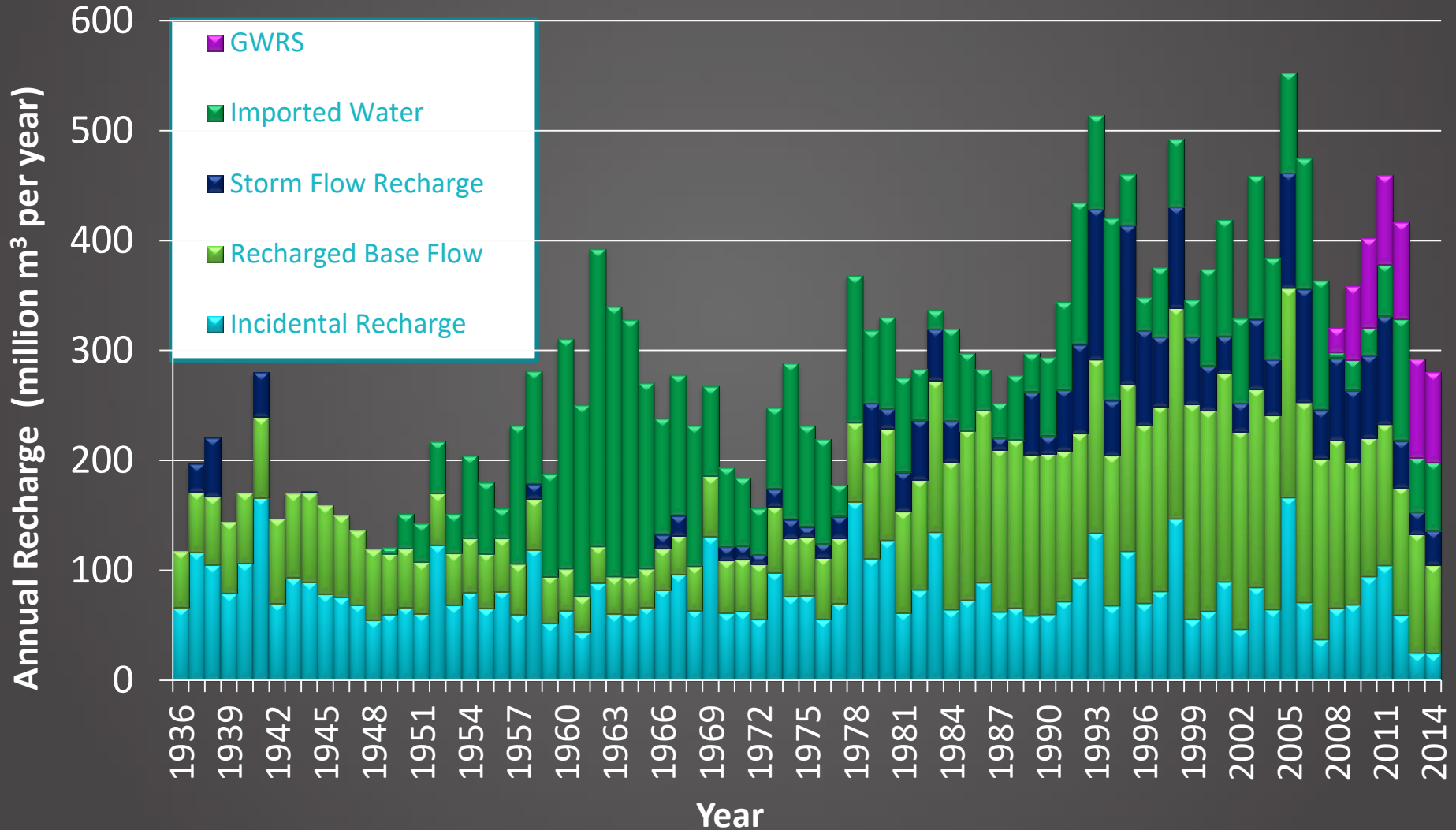
# The Water Cycle in North and Central Orange County







# SOURCES OF WATER FOR THE BASIN





# GROUNDWATER REPLENISHMENT SYSTEM (GWRS)

- 378,500 m<sup>3</sup>/d advanced water purification facility
- Takes sewer water that otherwise would be discharged to the ocean, purifies it to near distilled quality and then recharges it into the groundwater basin
- Provides a new 127 million m<sup>3</sup> per year source of water, which is enough water for nearly 850,000 people
- Operational since January 2008 (265,000 m<sup>3</sup>/d) expanded May 2015 (113,500 m<sup>3</sup>/d)
- Largest potable reuse project in the world





# MICROFILTRATION (MF) PROCESS



- 465,600 m<sup>3</sup>/d Siemens CMF-S Microfiltration System
- Tiny, straw like hollow fiber polypropylene membrane
- Removes bacteria, protozoa, and suspended solids
- 0.2 micron pore size
- In basin submersible system



# REVERSE OSMOSIS (RO) PROCESS



- 378,500 m<sup>3</sup>/d Reverse Osmosis System
- 3 stage: 78-48-24 array
- Hydranautics ESPA-2 Membranes
- Recovery Rate: 85%
- Removes dissolved minerals, viruses, and organic compounds (incl. pharmaceuticals)
- Pressure range: 10 – 14 bar



# ADVANCED OXIDATION (AO) PROCESS



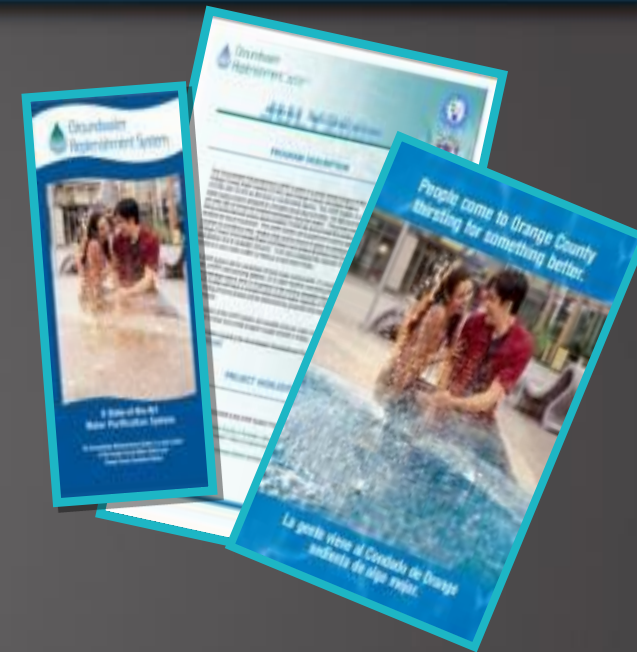
- 378,500 m<sup>3</sup>/d Trojan UVPhox System
- Low Pressure – High Output lamp system
- Destroys trace organics
- Uses Hydrogen Peroxide to create an Advanced Oxidation Process
- After treatment, water is so pure (and aggressive) that minerals (lime) are added back into the water





# PUBLIC OUTREACH

- Many projects stopped by public and political opposition
- Outreach began early, more than 10 years prior to start-up
- Researched public concerns
- Face-to-face presentations
- Community leaders
- Measured effects of outreach
- Community support
- Outreach continues today, assisted by media interest
- No active opposition





# BENEFITS OF GWRS

- Creates a new local water supply
- Reuses a wasted resource
- Increases water supply reliability
- Costs less than water from the Colorado River and the State Water Project
- Uses one-half the energy it takes to import water and one-third the energy to desalinate seawater
- Improves quality of water in the basin



# GWRS SUCCESS

- 40+ awards
- National & international media attention
- 36,000+ visitors



## AS SEEN ON







# KEEP LOOKING AHEAD

- Maximize water reuse throughout California and around the globe
- Maximize water efficiency and conservation measures
- Clean-up, protect and preserve natural water sources such as:
  - Rivers and aquifers
- Have the political courage to execute visionary solutions





# TACK SÅ MYCKET

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