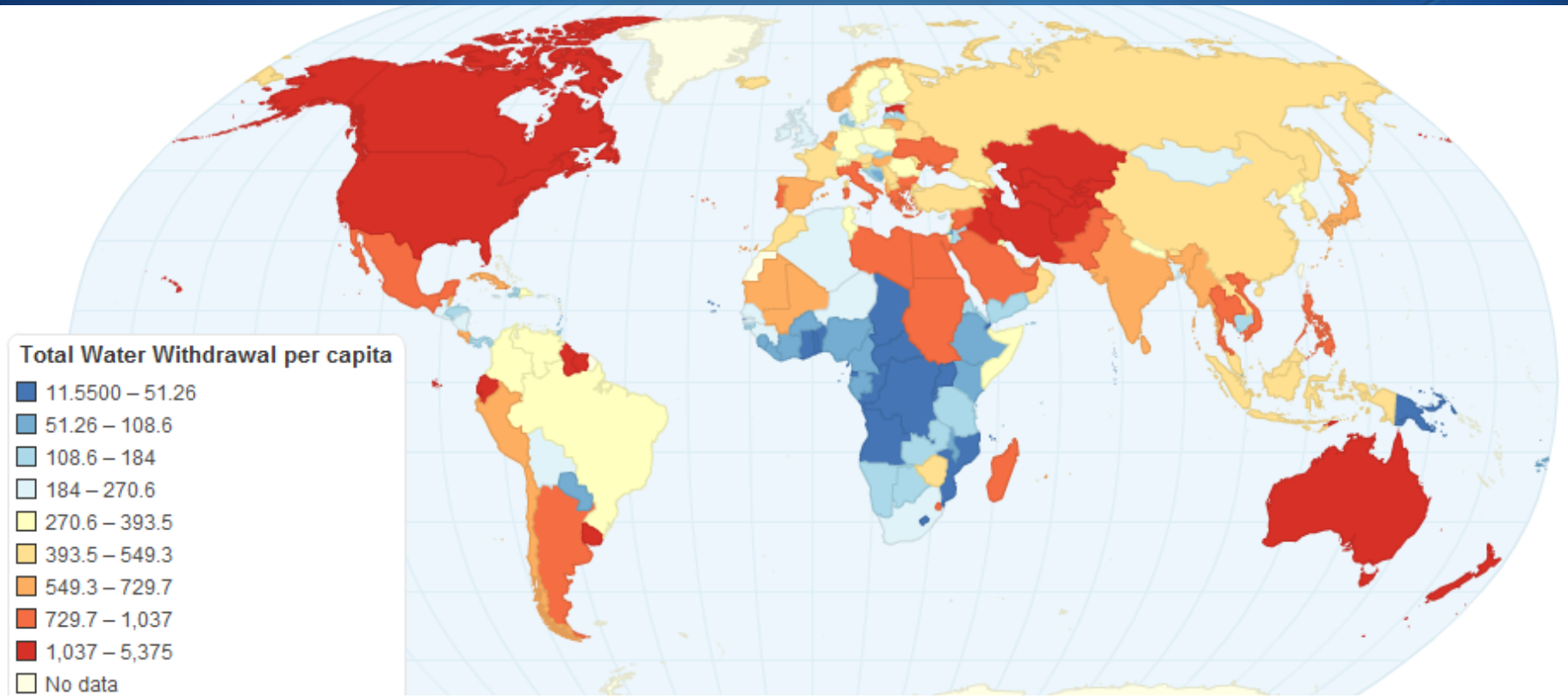
Building a Resilient Water System

California's path toward Resiliency

Outline

- Water issue globally and in San Diego
- Risks in San Diego
- Resilient Solutions for San Diego

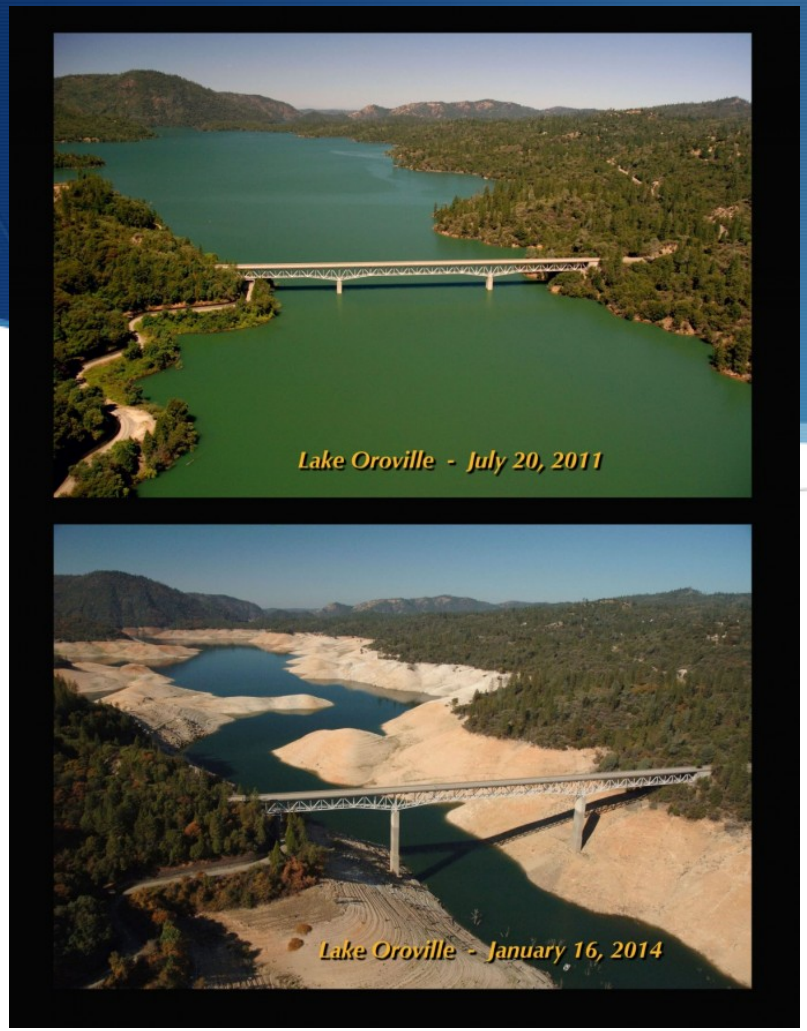
Facts on water usage globally



Source: ChartsBin

This map shows total water withdrawal per capita by country. The darker areas has the highest water withdrawal per capita.

Climate Change Effects on Water

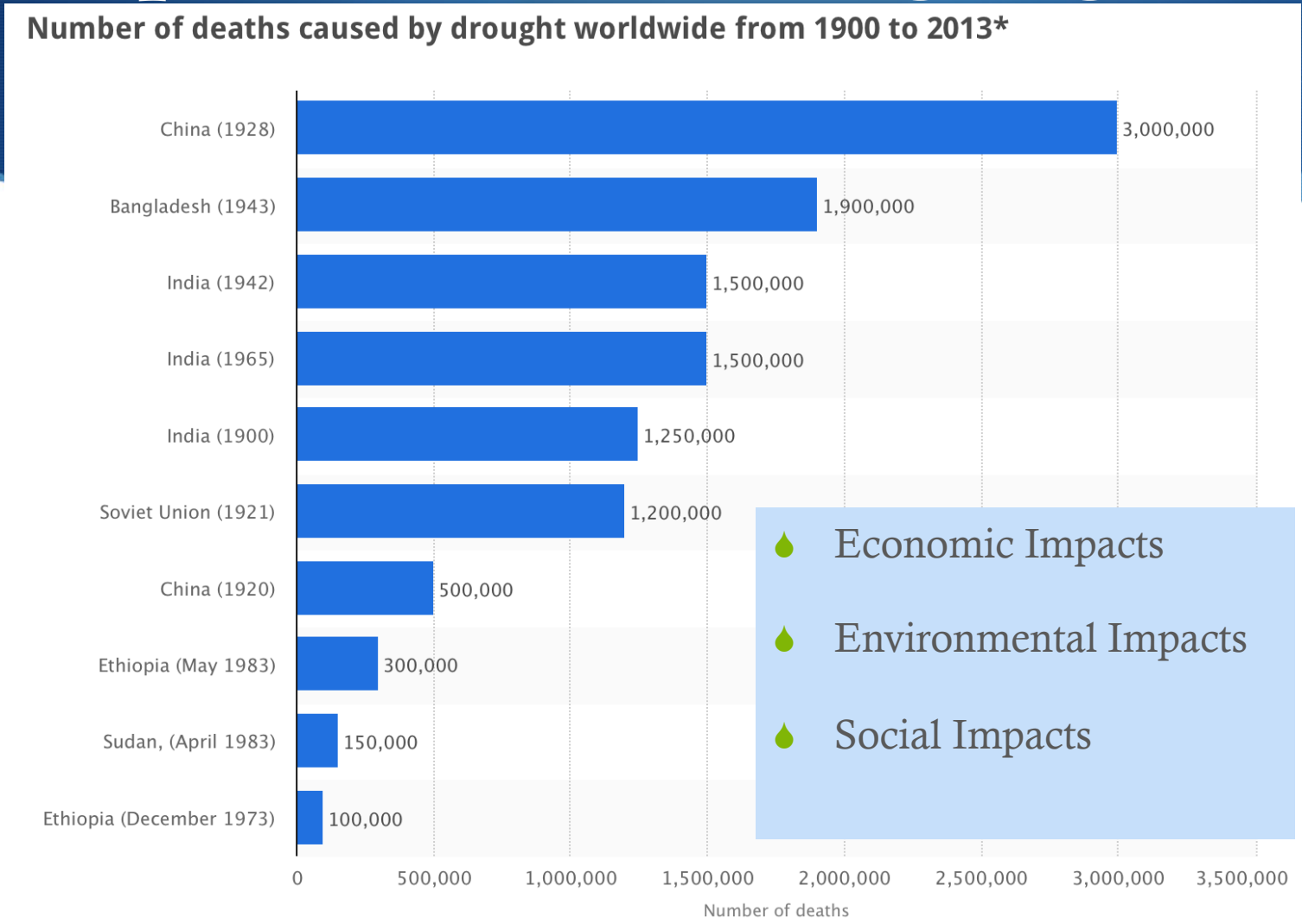


Source: 22 words

Top figure shows lake Oroville – July 2011
Bottom figure shows Lake Oroville – January 16,2014

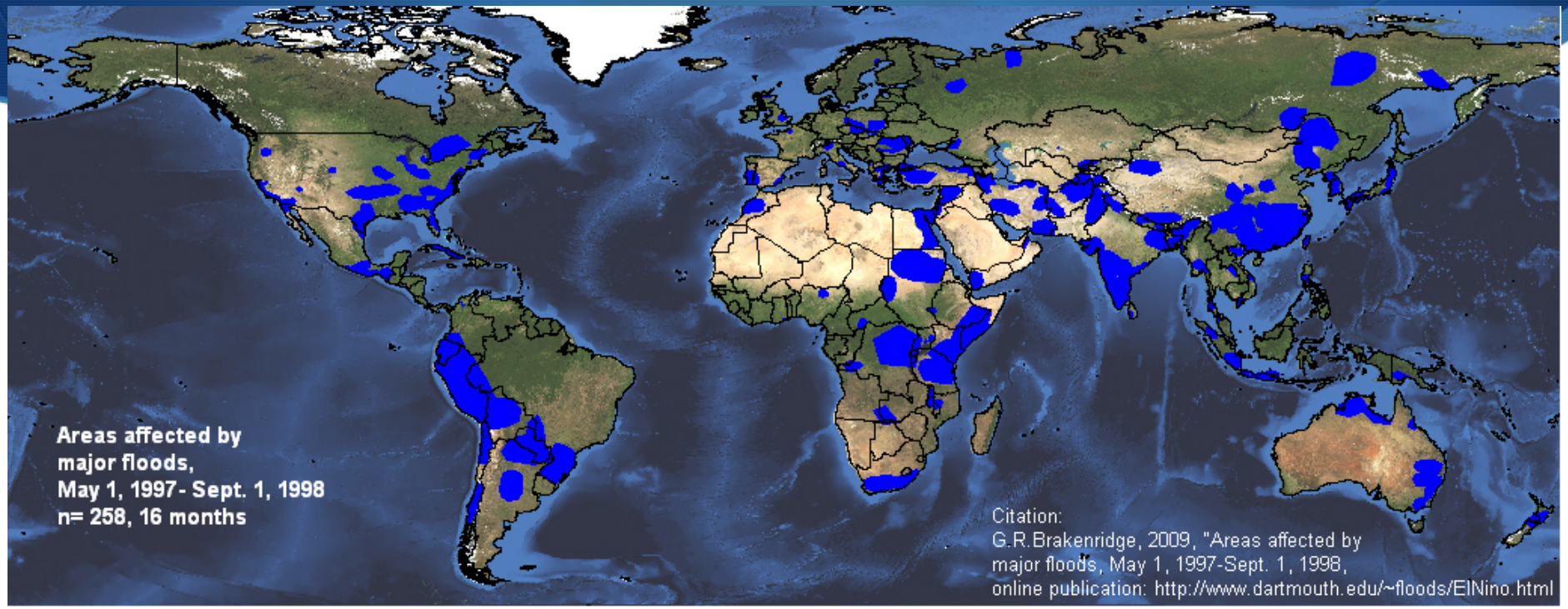
- Climate change could potentially shrink water supplies while increase water demand.
- The West has seen its rainfall decrease over the last 50 years, while experiencing serious droughts.
- At the moment about 1.6 billion people live in countries that are experiencing complete water scarcity, and this number is predicted to reach 2.8 billion people by 2025.

Impacts of the drought globally



Source: Statista

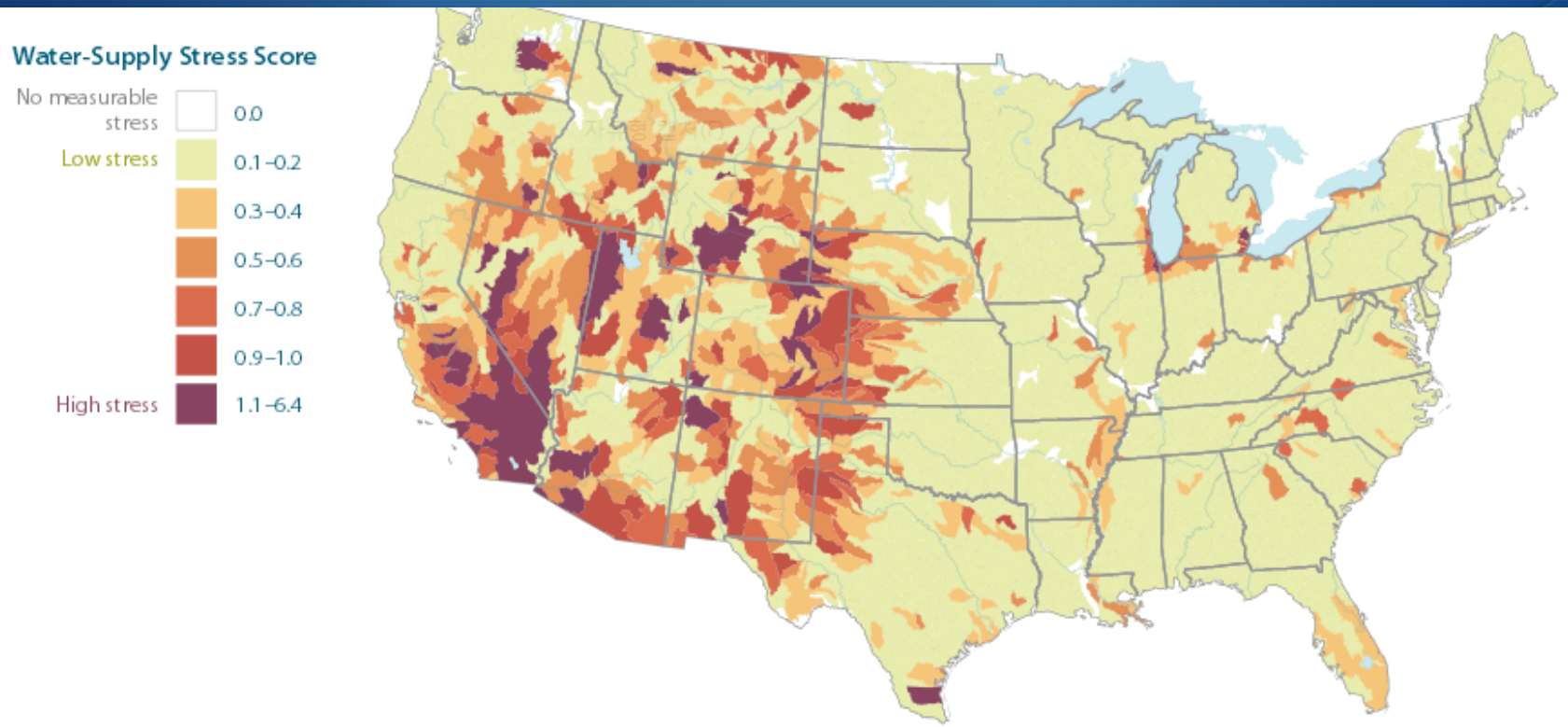
Floods throughout the world



Source: Dartmouth Flood Observatory

- Effects on El Nino on global flooding

Water-Supply Stress Score



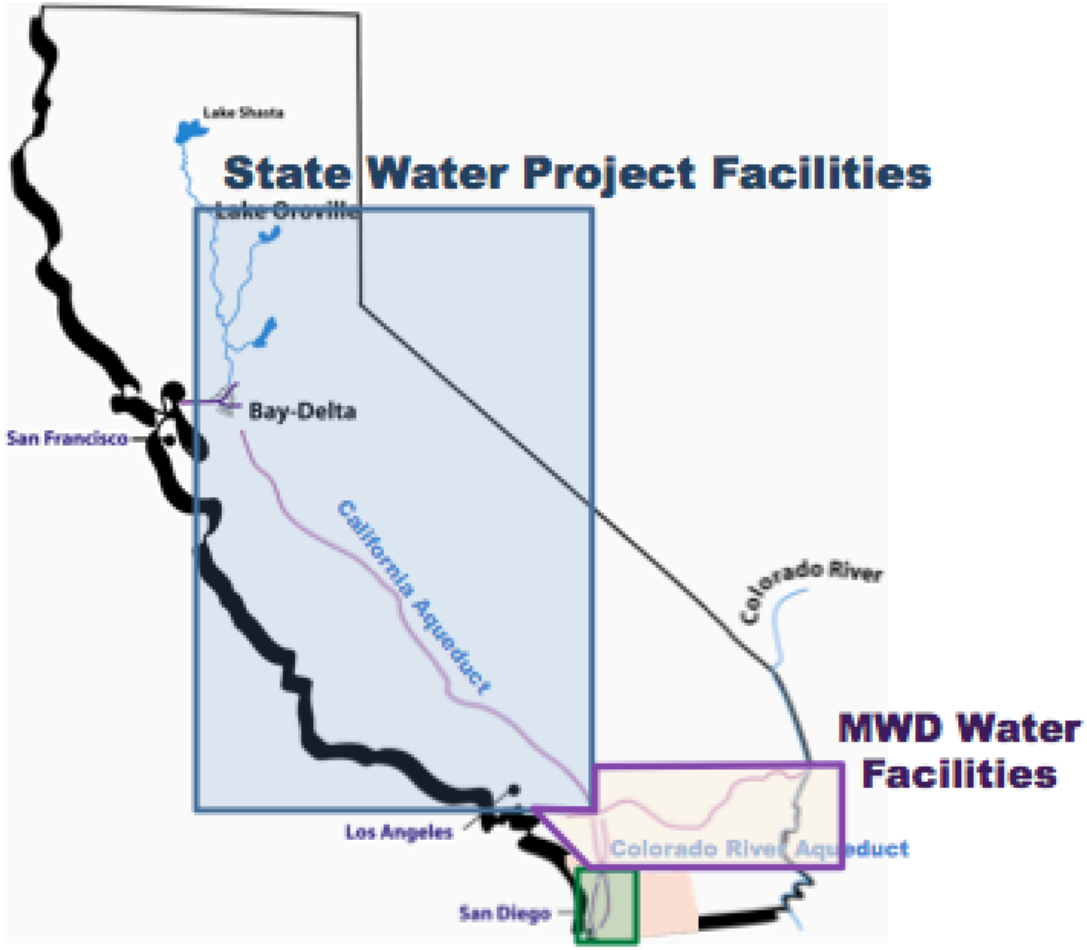
Source: Union of Concerned Scientists

Water supply to be stressed in watersheds when demand for water-by power plants, agriculture, and municipalities, for example-exceeds a threshold of 40 percent of the available average annual supply provided by local sources

Watersheds of the South West

A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place

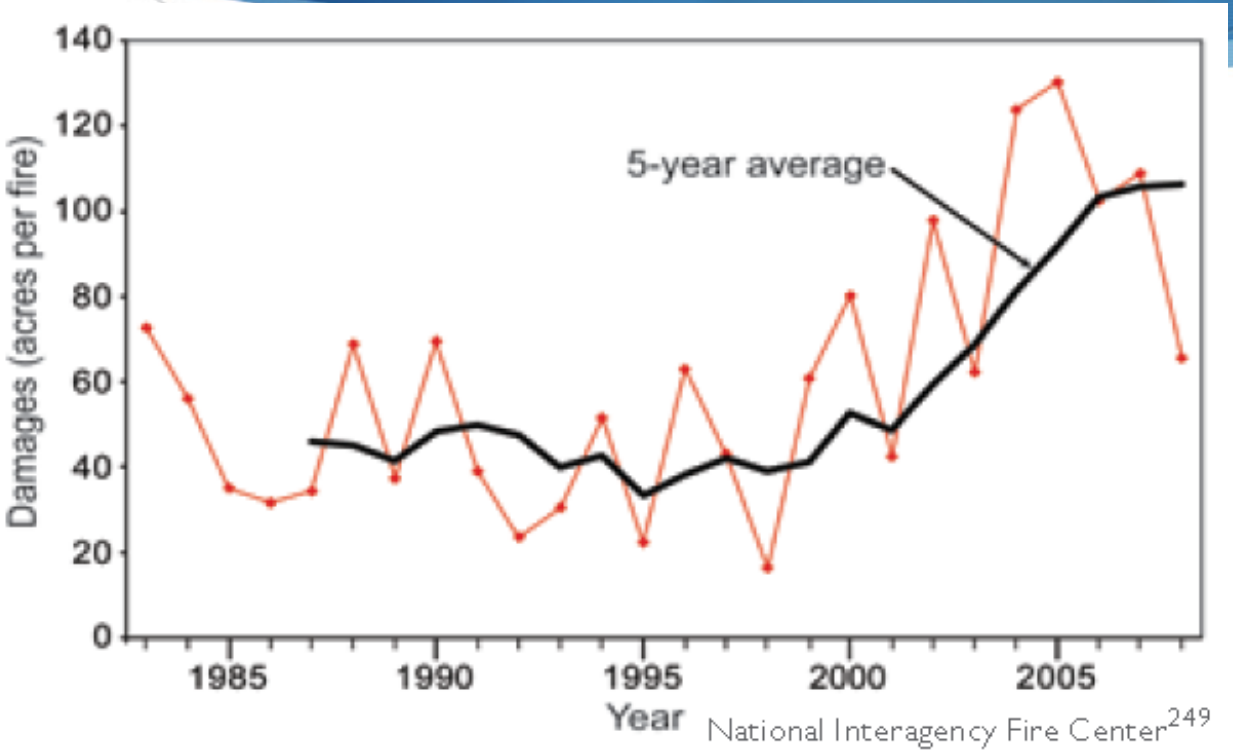
Southern California Water Sources



Source: Ken Weinberg

- Groundwater sources provide between 30 and 40 percent of supply, and the remainder is imported from the Owens Valley, the Colorado River, and the State Water Project.

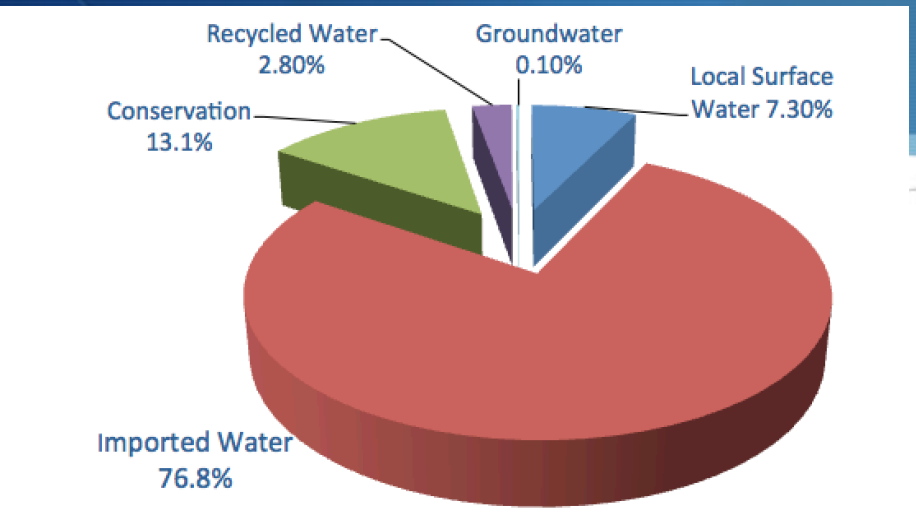
Drought leads to wildfires in Southern California



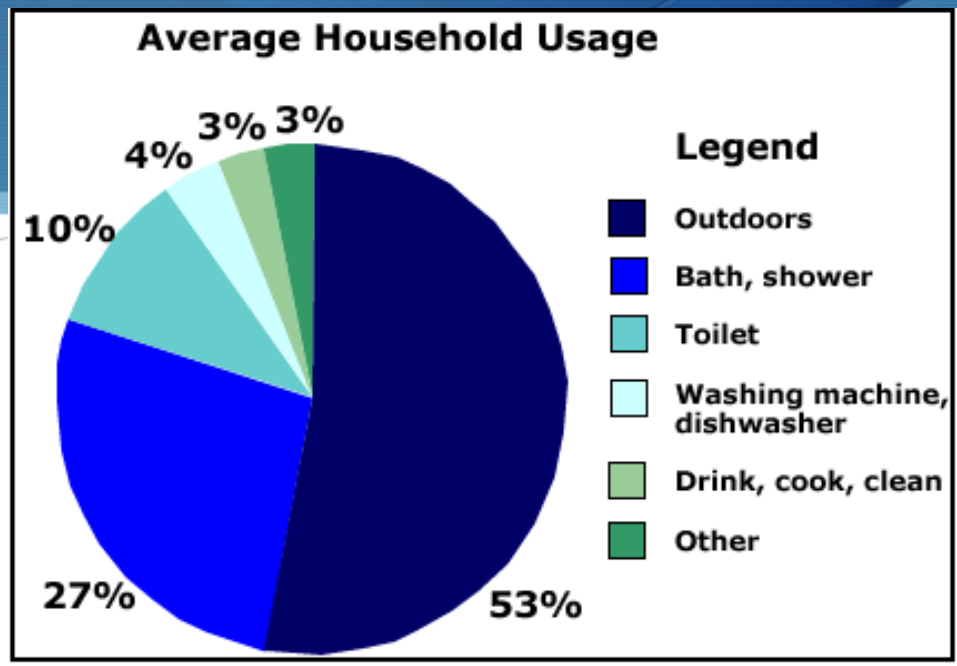
Source: Desdemona Despair

- California's most serious wildfires occurred during a drought or after a long drought when dry vegetation is the leading instigator of fires

City of San Diego's Water Supplies



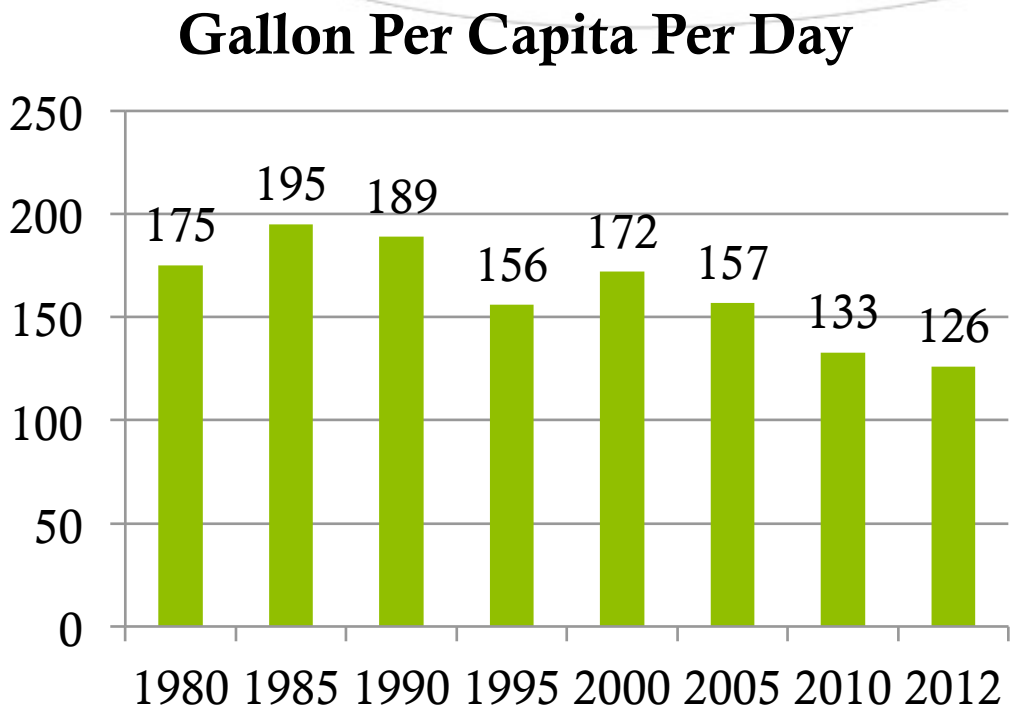
Source: Public Utilities Department



Source: Kiama Municipal Council

- Nearly 80% of San Diego's water supplies are import.
- More than 50% of household water usage is for outdoor.

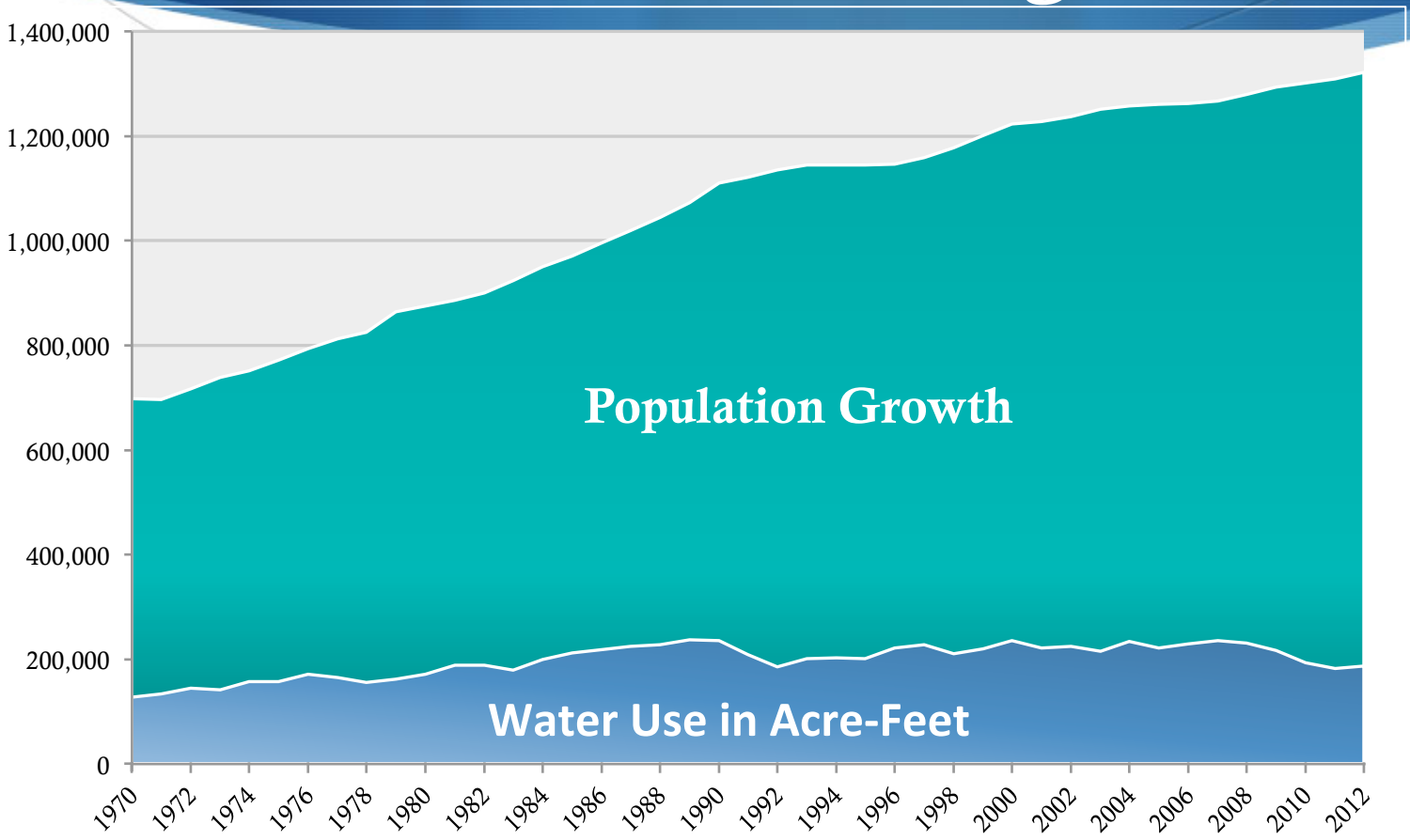
How much do we use and how much does it cost?



Source: Public Utilities Department

- in the US, water is used excessively because it is only ⅔ cent per gallon, which is too cheap.
- 160 gallons/day/capita of water is being consumed in the U.S, twice as much as Australia, Israel and other industrialized nations.

The good news: Population vs. Water use in San Diego



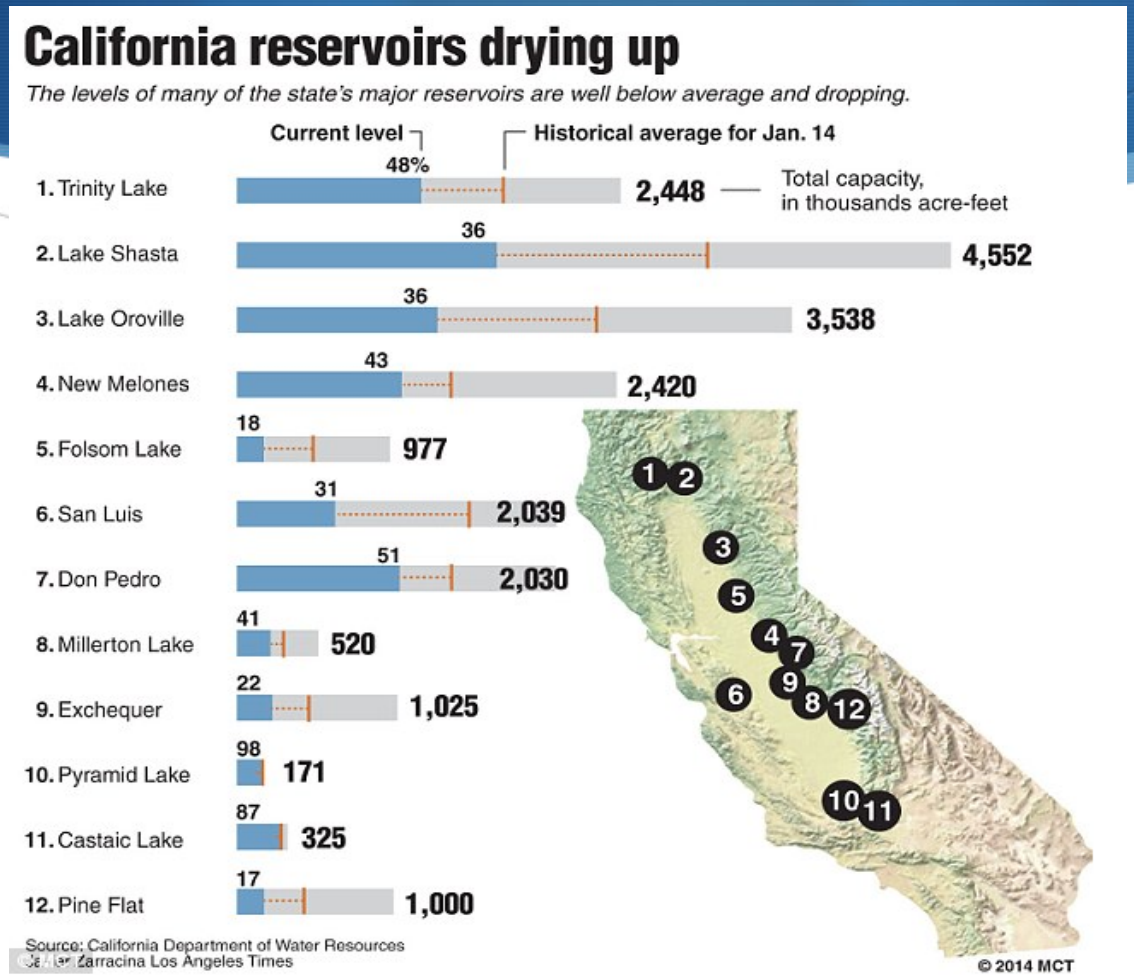
Source: Public Utilities Department

For 40 years, our population have grown twice but our water usage is consistent.

Water Risks in San Diego

GENI Resilient Cities Project 2014

Risk: Reduced Water Supply



A Cause of the Reduced Water Supply

- **The lack of rain causes drier climate and hotter temperatures.**
- **The water supply is shortened due to evaporation of bodies of water.**

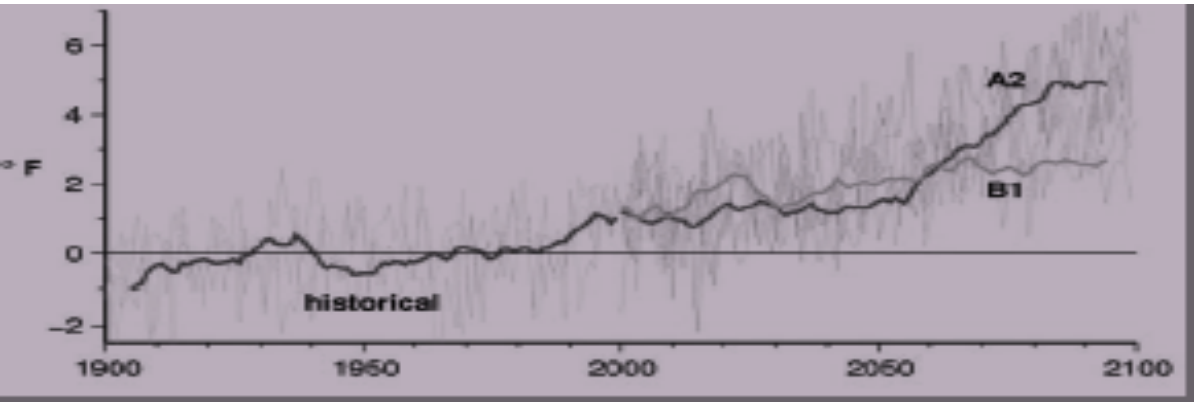
Source: The San Diego Foundation

Source: abc News10

Climate in San Diego will be hotter and drier

- **Global temperatures are expected to increase by 2050 - twice the amount of temperatures recorded in the past 40 years.** Source: University of San Diego

Projected annual temperatures for San Diego County over the next several decades



"By 2050, San Diego County will experience significantly warmer average temperatures throughout the year. The A2 scenario represents temperatures if global greenhouse gas emissions continue to increase. The B1 scenario represents a significant reduction in global emissions."
Source: *The San Diego Foundation*

Temperature Change: Now and Future

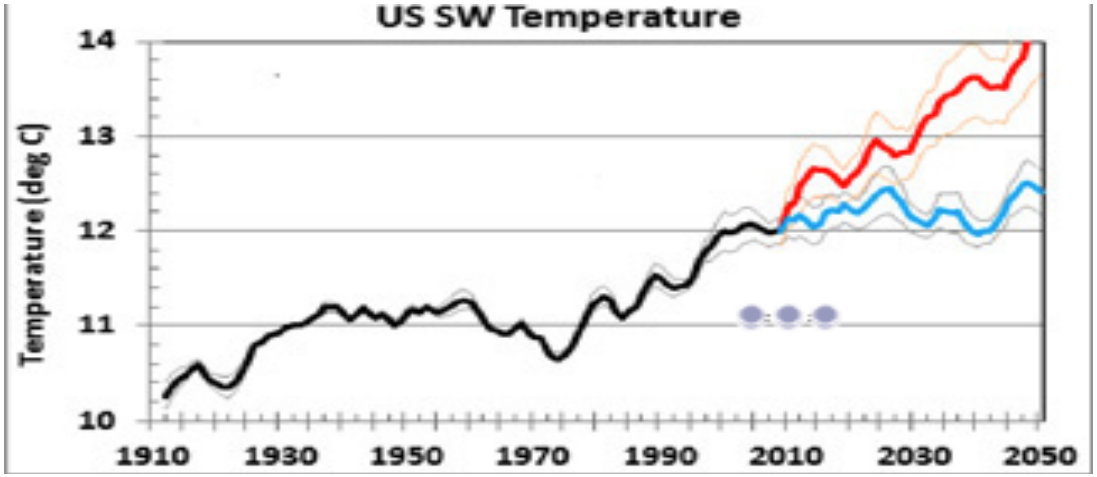
- **Climate change and increased temperatures are reducing:**

1. Rainfall

2. Colorado River flow

3. Sierra Nevada snowpack.

Source: Cary Lowe, City of San Diego Water Policy Implementation Task Force



- **These temperature changes will likely result in more frequent and prolonged heat waves that are more humid followed by less cooling at night.**
- **Source: University of San Diego**

Source: Los Alamos National Laboratory, 2013

Wildfires

Source: KTTV News, Los Angeles

- 9 fires that occurred in May of 2014

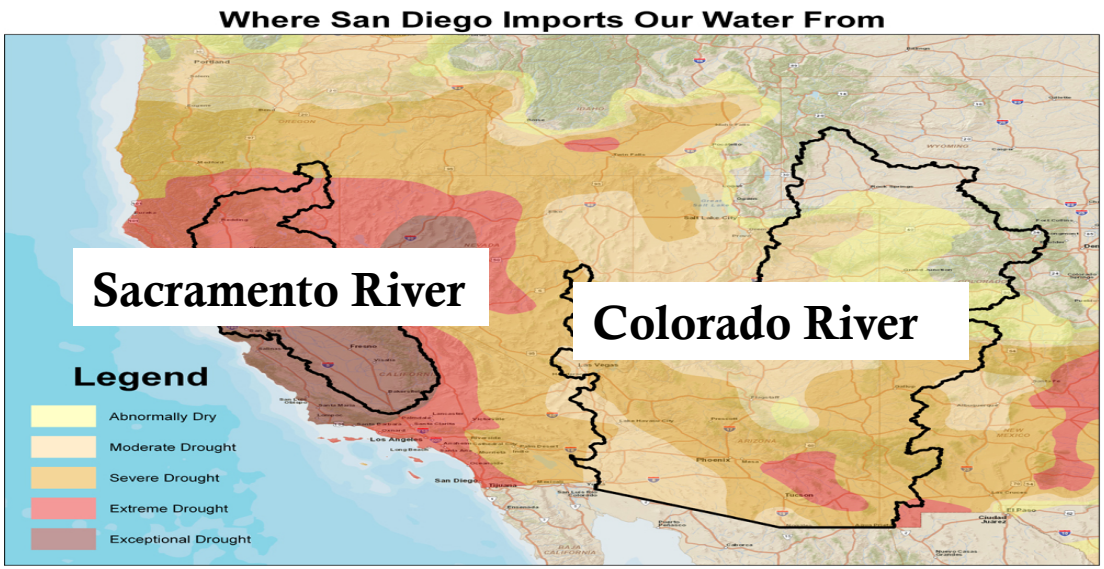
Potential for Wildfires

- **27, 527 Acres burned in San Diego from this year's wildfires.**
- **Dryness from severe drought caused an early start to the fire season in May of this year.**

Source: U-T San Diego, 2014

Risk: the entire southwestern region is in drought

- **Between 85- 90% of San Diego's drinking water comes from Colorado River and Northern California (is imported), while only 10% comes from local rainfall.**
- **Source: City of San Diego**



- **San Diego draws from watersheds that are nearly 100% affected by drought.**
- **All of California is in exceptional drought, the largest within the last 150 years**

Source: City of San Diego

Source: Travis Pritchard, San Diego CoastKeeper

Risks in Agriculture

- **Agriculture is the 5th largest industry in San Diego County.**

Water Encyclopedia

- **Agricultural non-point source pollution seems to be a major contributing risk to San Diego's agriculture, moving with rainfall or snowmelt, containing various nutrients that impair bodies of water used for agricultural purposes.**

Sources: Diane DeJong, *Journal of Extension*

How is San Diego building a Resilient Water System?

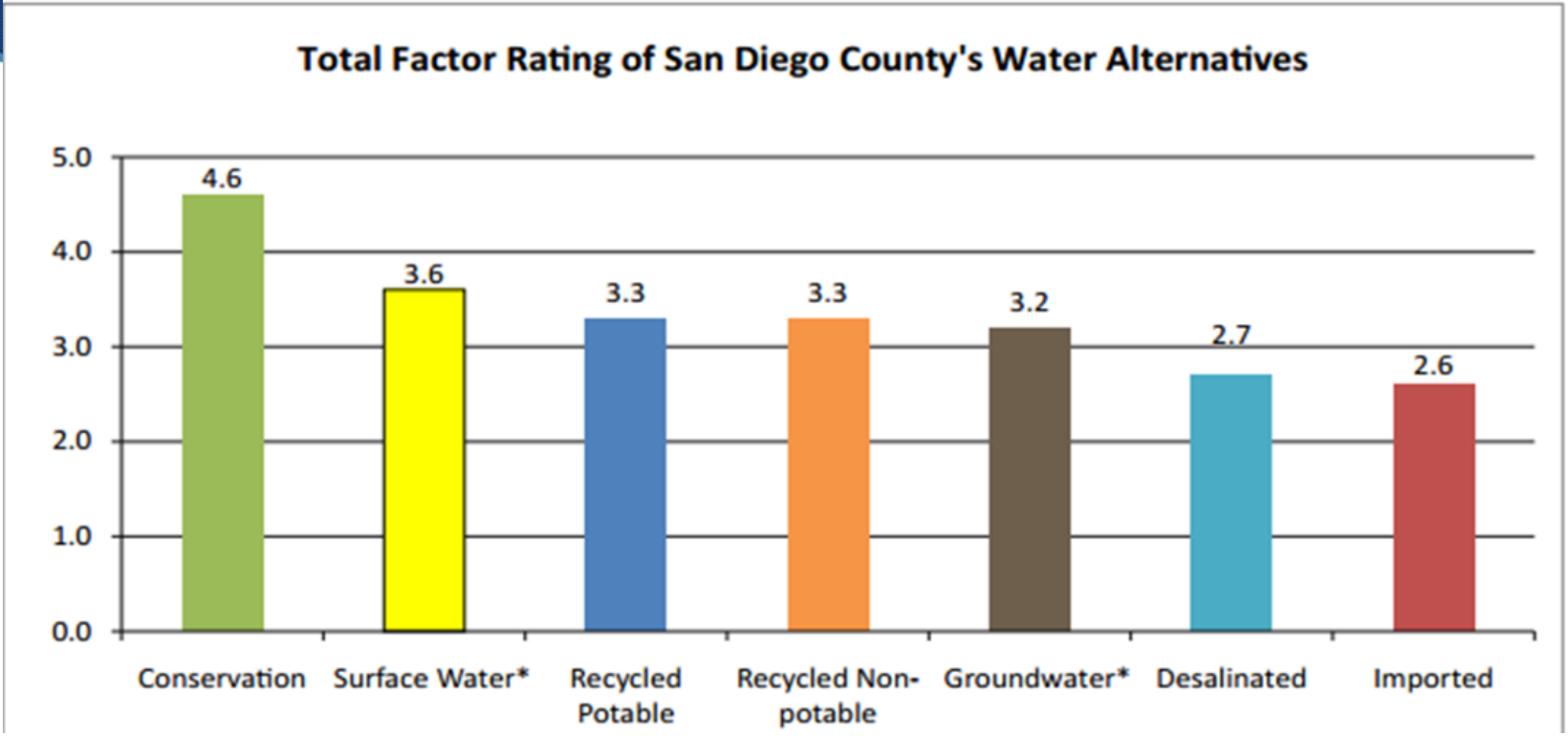
Why Resiliency?

"For the water sector, these ideas imply moving beyond 'engineering resilience', and **beyond the traditional 'predict and withstand' approach for extreme conditions**, towards a much **more dynamic and flexible system**. However, there is inevitable tension here – namely, **can these ideas fit within a system that relies heavily on inflexible assets like pipes and treatment plan?**"

–Dr. Heather Smith, fellow at Cranfield University, UK

"Understanding Resilience: Implications for the Water Sector"

What are our options to address the risks?



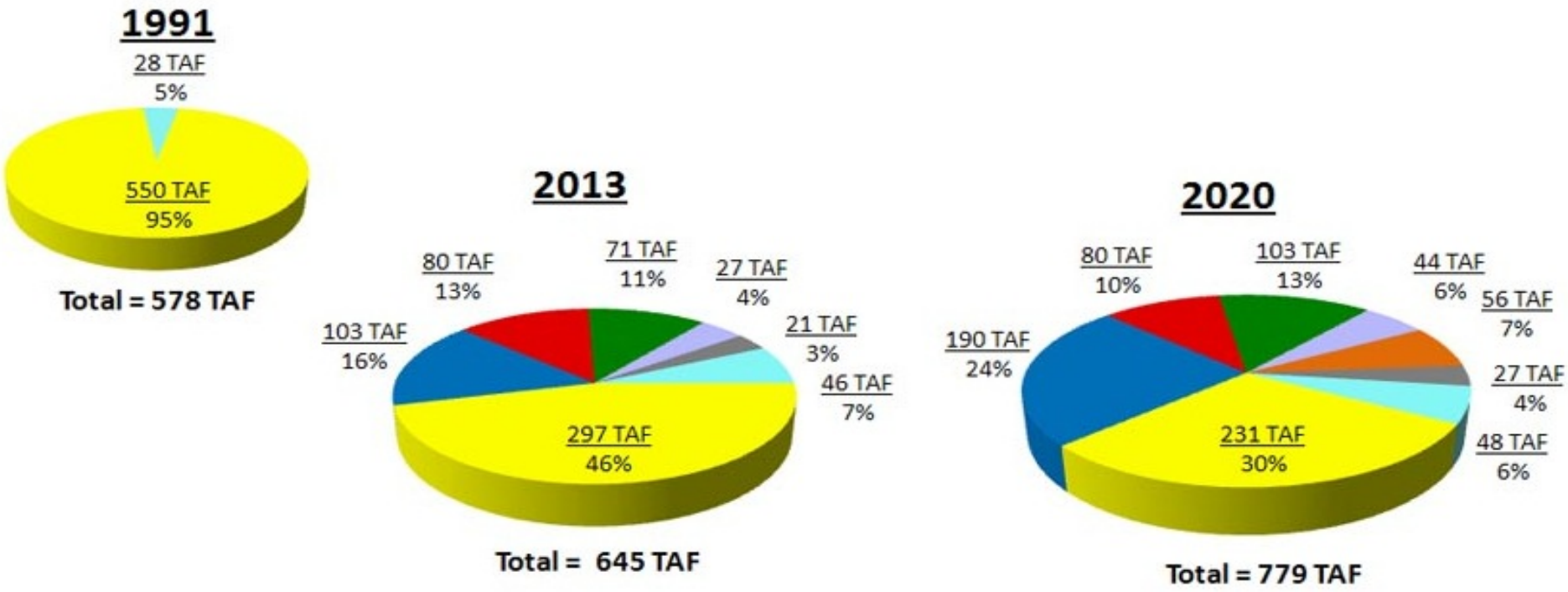
Ranking of potential water supply alternatives with conservation being our best option, according to a study done by the Equinox Center.

Source: "San Diego's Water Sources: Assessing the Options" Equinox Center

Current solutions of San Diego

- Diversification of water
- Recycle wastewater
- Storm Water Development Plans
- Desalination

Increasing San Diego County's Water Supply Reliability through Supply Diversification



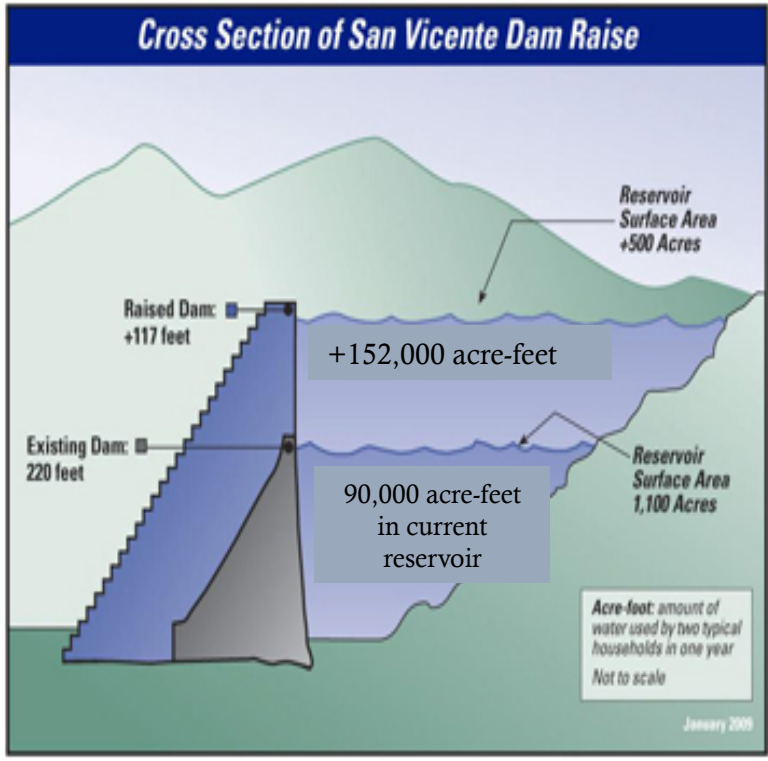
TAF=Thousand Acre-Feet

Source: San Diego County Water Authority

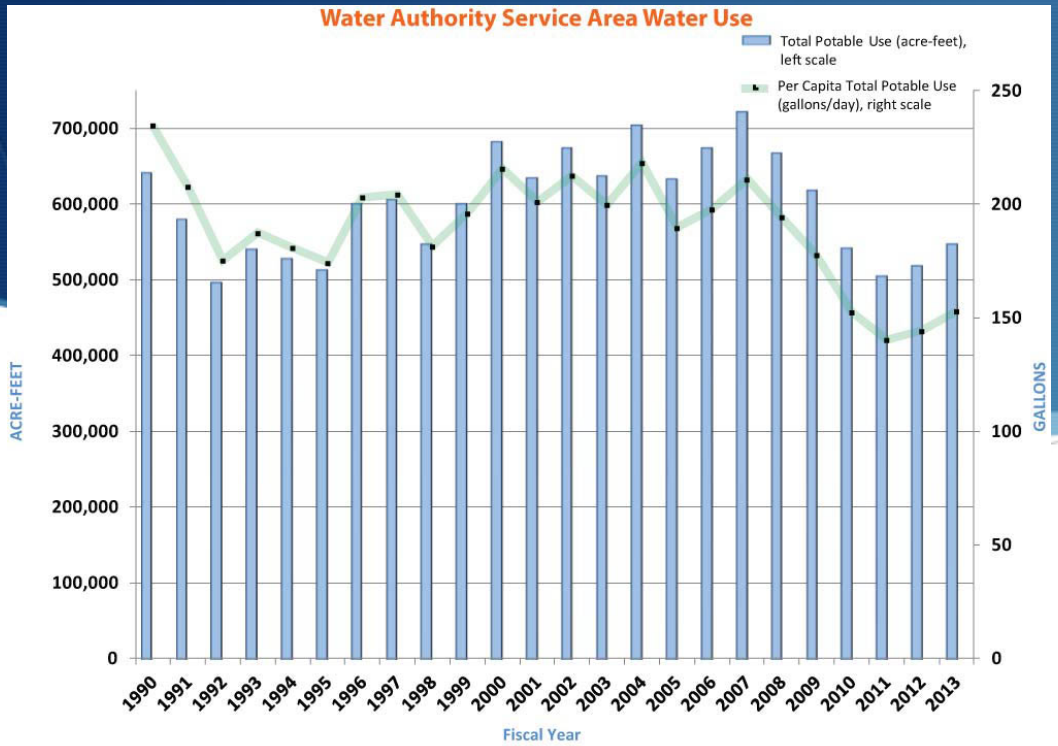
A Resilient Solution
The San Vicente Dam

- San Vicente Dam was created as a reservoir
- The dam originally stood at 220 feet
- Able to store 90,000 acre-feet of water

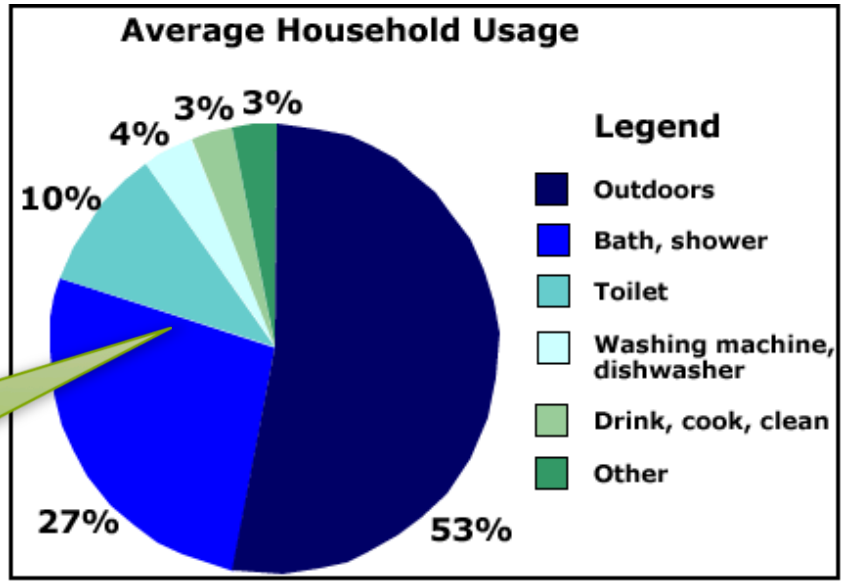
San Vicente Dam Raise



Water Consumption in San Diego



Water use in San Diego per year. Bars measures acre feet (left) and line measures gallons (right).
Source: San Diego County Water Authority



Can we reuse all of this water? We are trying to!

Recycling Waste Water

North County Reclamation Plant

- 1st large scale reclamation plant
- Treats 30 million gallons of wastewater per day
- Non-potable water used for irrigation

North County Reclamation Plant located in Mira Mesa.
Source: City of San Diego Public Utilities

Advanced Water Purification Facility

Advanced water facility in north county San Diego (La Jolla). The filtration systems are shown.
Source: purewatersd.org

Benefits:

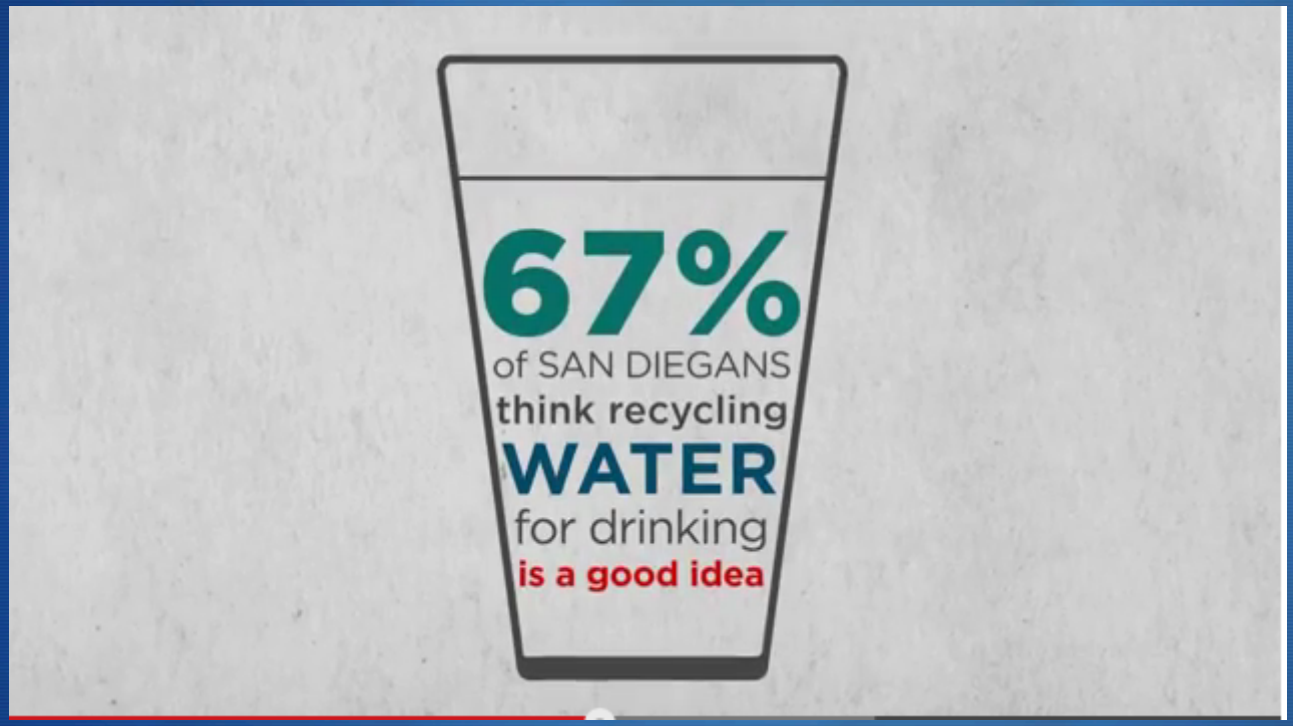
- Local supply
- Less cost and energy than imported water

Source: *City of San Diego*

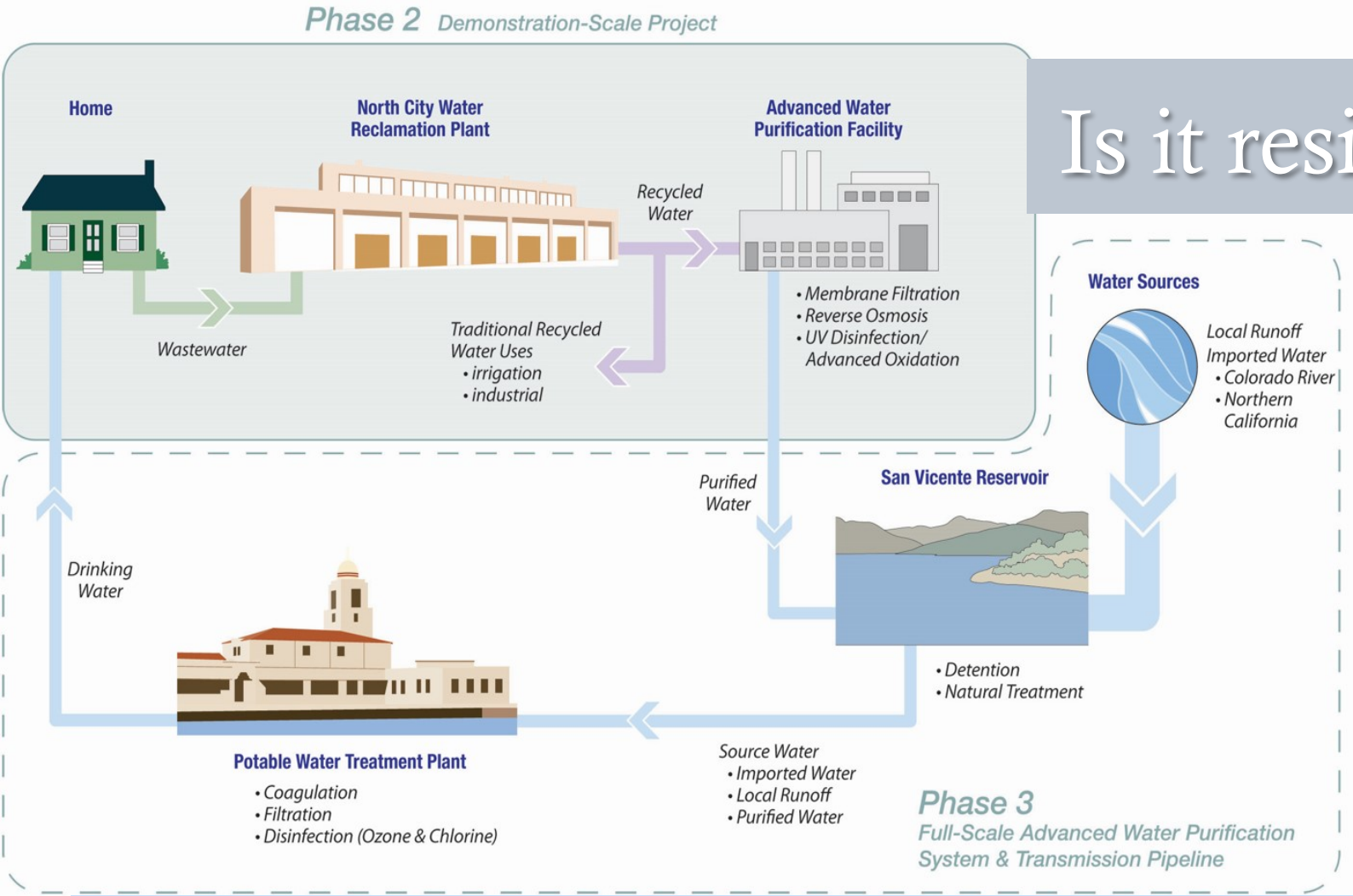
- Purifies water even more than reclamation plant!
- 3 Filtrations:

1. Membrane filtration
2. Reverse osmosis
3. UV/advanced oxidation

”It’s Perfectly Clear”



Is it resilient?



Yes: Meets 40% of City's needs

No: Need to develop pipeline plan and alternative to San Vincente as the environmental buffer

Source: Cary Lowe *City of San Diego Water Policy Implementation Task Force*

Storm Water Development Plans

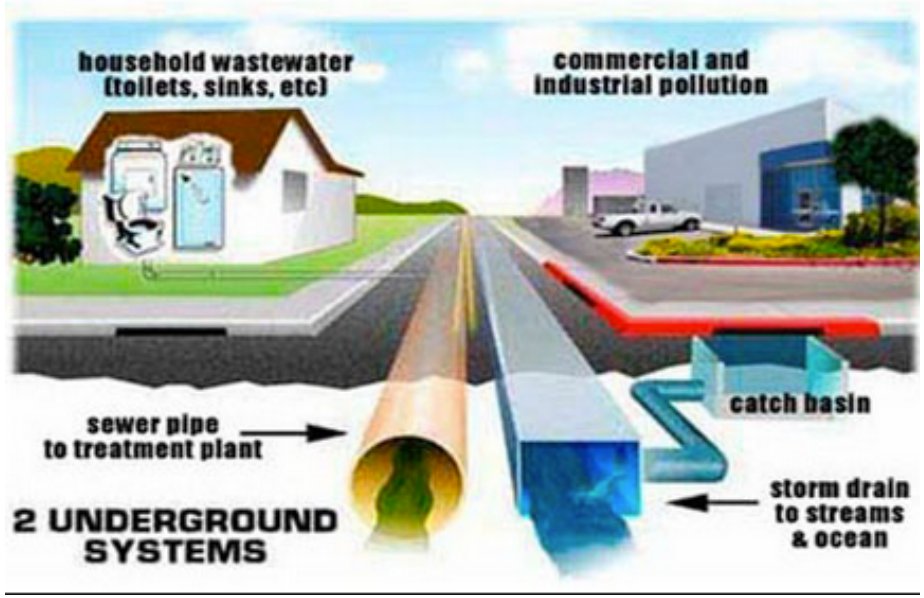
Manages and prevents urban runoff

- Urban runoff = biggest threat to water quality in San Diego

4 Primary tools of storm water management:

- Paving, channeling, storage, filtration

Storm water crew cleaning channel in Sorrento Valley 2012.
Source: Union Tribune San Diego



San Diego has 2 underground systems for our storm water management.
Source: San Diego Think Blue

Proactive approach to flooding in city

Is it addressing the problems?

- Ensures safe and healthy water quality in lakes, rivers, and oceans
- Increasing storm water drainage system

Construction of Avenida de la Playa drainage system increase on May 26, 2014.
Source: La Jolla light newspaper

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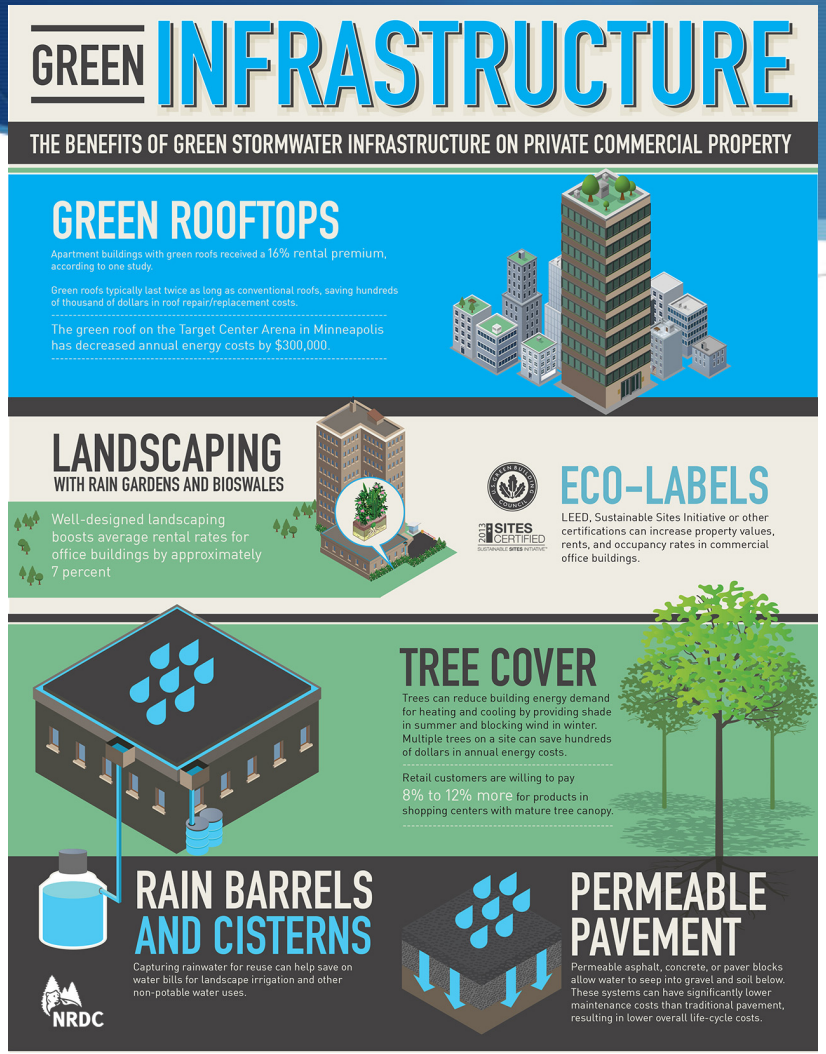
San Diego's stormwater bill: $4 billion

Nobody really knows the price tag of California's new standards

By Dan McSwain 5 P.M. FEB. 17, 2014 PRINT COMMENTS 8

- But "Channel and collect" is not enough

Future suggestions



- Green Infrastructure
- Reuse storm water

What is Desalination?

- Millions of gallons are pumped from the ocean and is treated many times
- Brine, the wastewater created from desalination, is mixed with other waste water and returned into the ocean

Source: San Diego County Water Authority

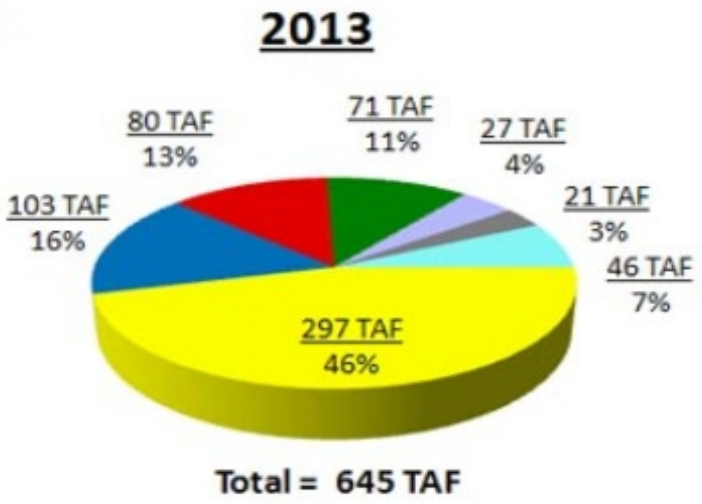
Drinking From The Sea

Poseidon's Desalination Plant in Carlsbad

- 50 million gallons of desalinated seawater per day
- 8% of total water supply for the county will be provided from this desalination plant by 2020
- 300,000 San Diegans will be provided with drinking water by 2020

Advantages of The Desalination Plant

- Economic benefits for the region
  - Reliable water supply
  - More jobs created
- High quality water
- Local control of water resources
  - Resilient from natural disasters



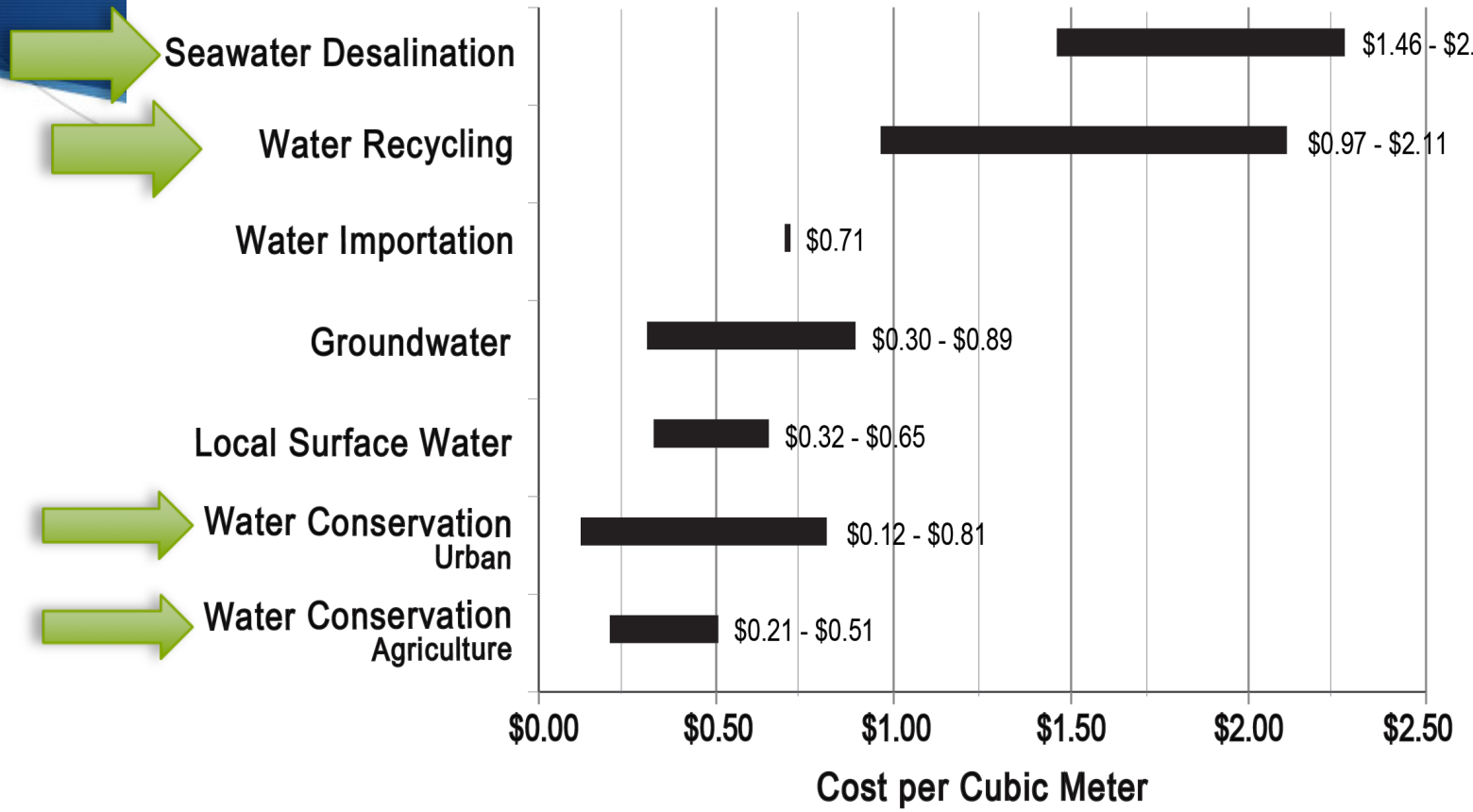
Disadvantages of the Desalination Plants

- Very energy intensive process
  - Requires more energy than other water supplies
  - More $$$ is needed to run the plant
  - Increase in Green house gases into the atmosphere

- Negative environmental impacts
  - Withdrawing water can cause sea life impingement and microbial entrainment
  - Depositing brine back into the ocean can be harmful to the marine life.

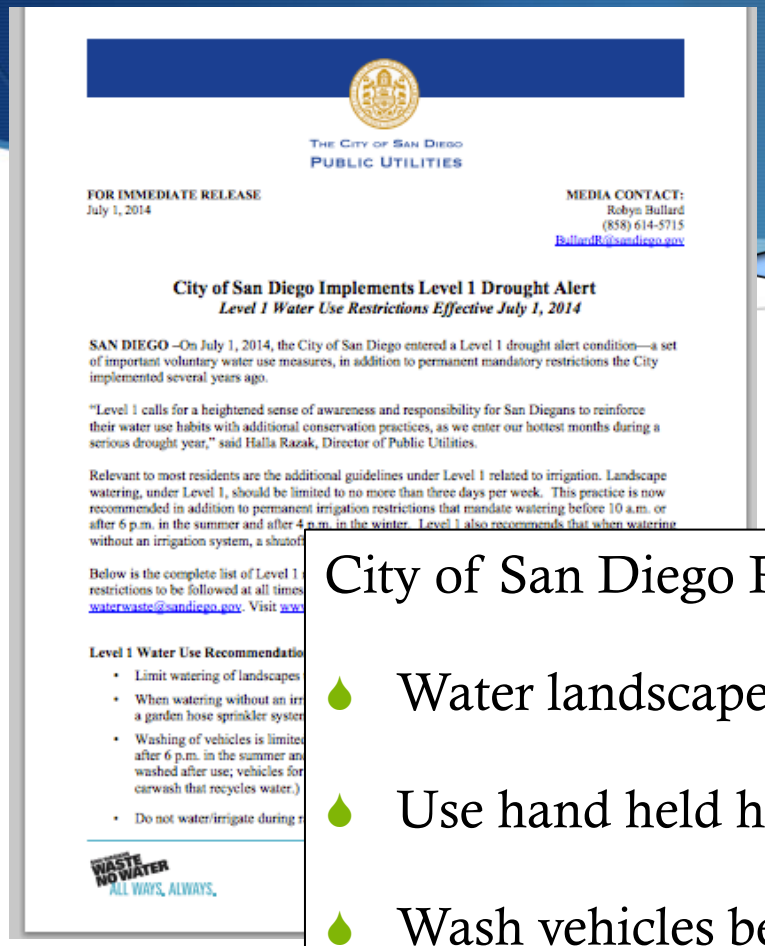
Fish swimming away from water withdrawal of a desalination plant.

Comparison of costs of future water supply solutions



All of these are solutions but urban and agriculture water conservation is the most cost effective.
Source: Brian Richter The Nature Conservancy and University of Virginia

Household Level: Conservation is Key



THE CITY OF SAN DIEGO
PUBLIC UTILITIES

FOR IMMEDIATE RELEASE
July 1, 2014

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City of San Diego Implements Level 1 Drought Alert
Level 1 Water Use Restrictions Effective July 1, 2014

SAN DIEGO –On July 1, 2014, the City of San Diego entered a Level 1 drought alert condition—a set of important voluntary water use measures, in addition to permanent mandatory restrictions the City implemented several years ago.

"Level 1 calls for a heightened sense of awareness and responsibility for San Diegans to reinforce their water use habits with additional conservation practices, as we enter our hottest months during a serious drought year," said Halla Razak, Director of Public Utilities.

Relevant to most residents are the additional guidelines under Level 1 related to irrigation. Landscape watering, under Level 1, should be limited to no more than three days per week. This practice is now recommended in addition to permanent irrigation restrictions that mandate watering before 10 a.m. or after 6 p.m. in the summer and after 4 p.m. in the winter. Level 1 also recommends that when watering without an irrigation system, a shutoff

Below is the complete list of Level 1
restrictions to be followed at all times
waterwaste@sandiego.gov. Visit ww

Level 1 Water Use Recommendatio

- Limit watering of landscapes
- When watering without an irr
a garden hose sprinkler syste
- Washing of vehicles is limite
after 6 p.m. in the summer an
washed after use; vehicles for
carwash that recycles water.)
- Do not water/irrigate during

WASTE NO WATER
ALL WAYS, ALWAYS.

"Waste No Water" Level 1 Drought Alert **effective July 1, 2014**

City of San Diego Recommends:

- Water landscapes < 4 times per week
- Use hand held hose with shut off valve
- Wash vehicles before 10 AM or after 6 PM during summer

Need a change in consciousness

"Every thing you do with water, you will need to do more efficiently…we need to create a new water conservation ethic"

– Cary Lowe *TEDxTalk 2012*

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