

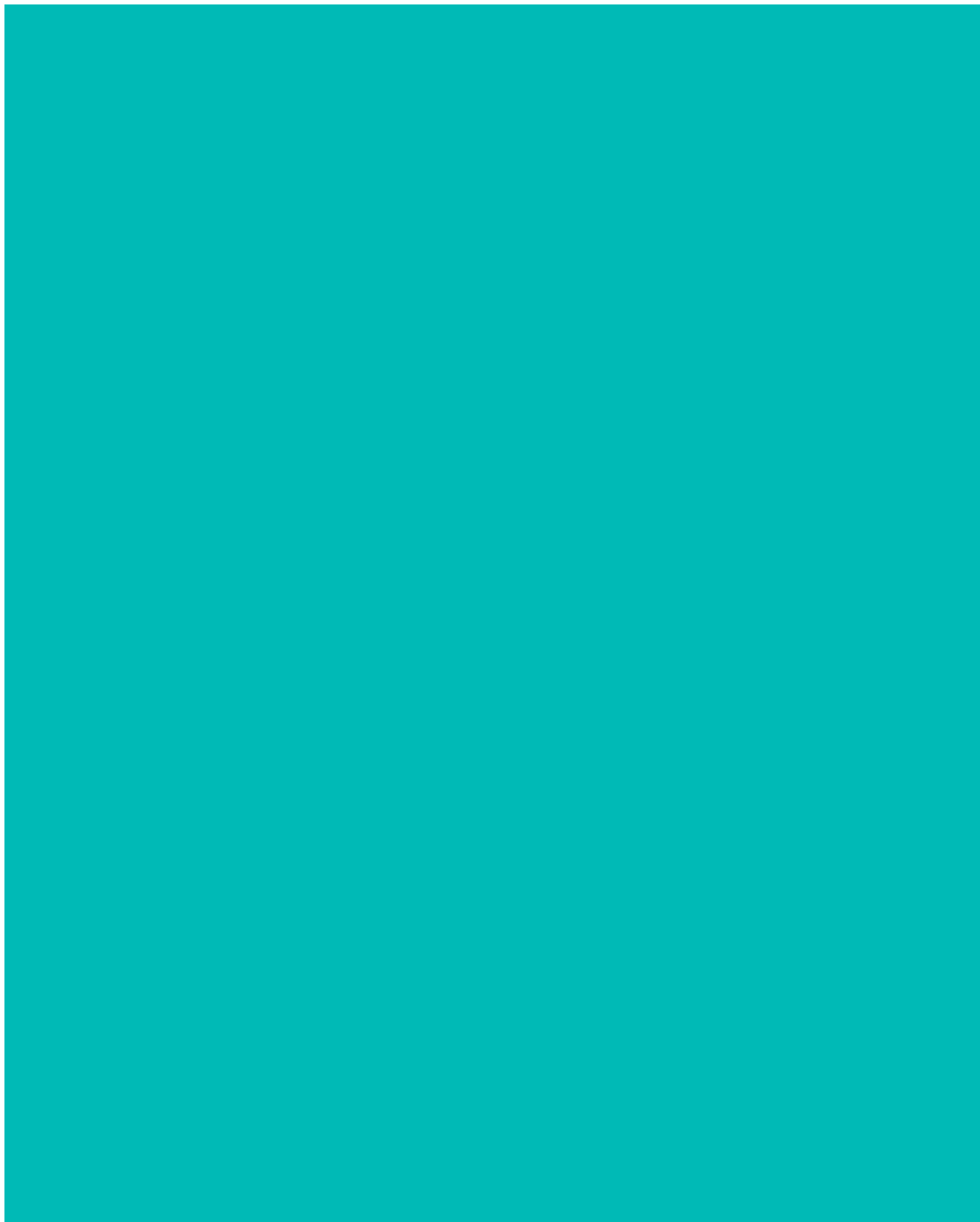
WATER CONTEXT

Brad Zuger

Project Advisors: Alexis Karolides & Daniel Williams

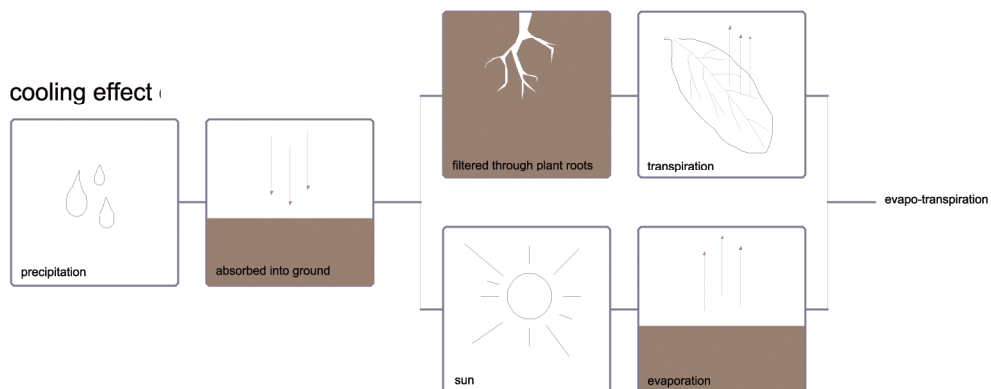
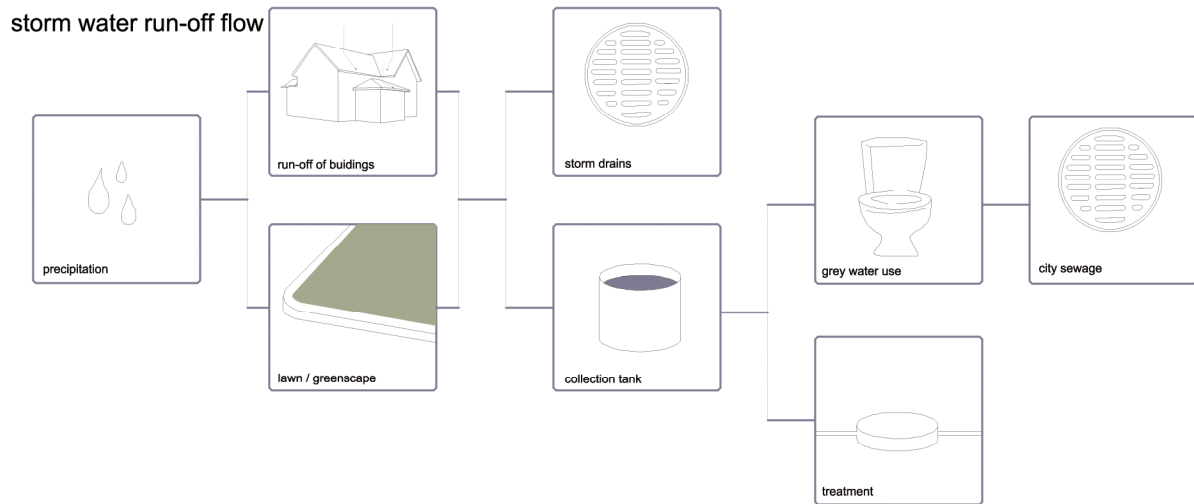
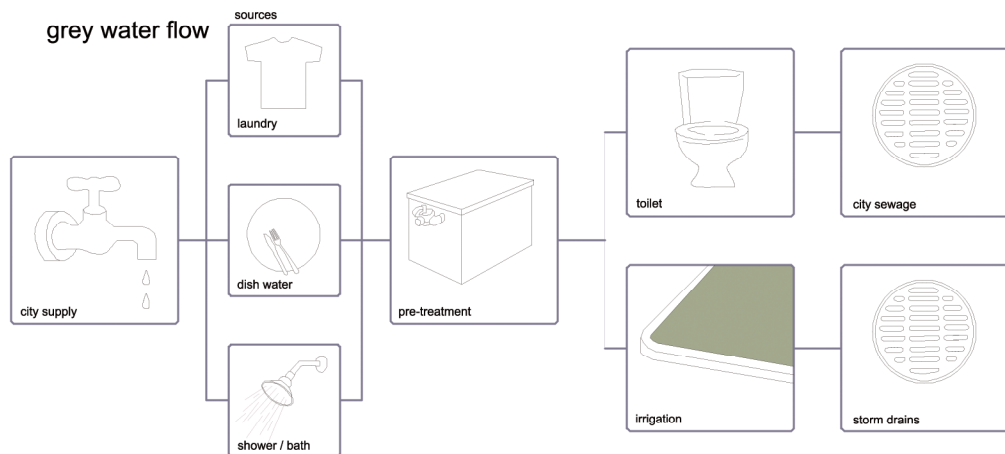
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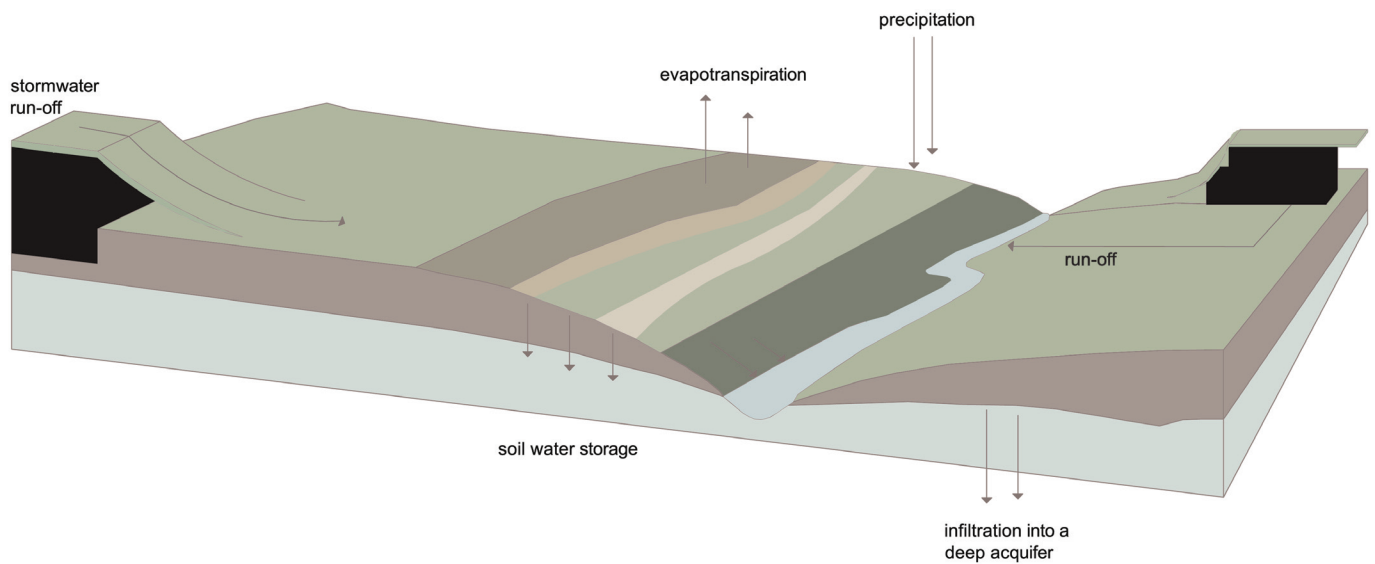
Research Fellowship



— HYDROLOGY 101

Water is the single most important resource. Humans have available less than 0.08% of all the Earth's water. Yet over the next two decades our use is estimated to increase by about 40% (BBC News). Over the next century, water resources will become a central issue to the quality of human life forcing designers to rethink how water is used and distributed.





Can water functions in the built environment mimic natural water systems? It is important for urban designers and architects to redetermine how water is used, conserved, distributed, and replenished in regards to the built environment. Reducing water use by half may sound like a means of conservation, however, regionally this may not be enough. Designers must take a global and regional perspective when determining how and where water is used.

We use about 70% of the water we have in agriculture. But the World Water Council believes that by 2020 we shall need 17% more water than is available if we are to feed the world.

_World Water Council

Today, **one person in five** across the world has no access to safe drinking water, and one in two lacks safe sanitation.

Rise in population, inefficiency in the ways in which we use water, and pollution are all contributors of the global water crisis. Among the worst problems is the withdraw of groundwater is higher than the return.

In 1999 the United Nations Environment Programme (UNEP) reported that 200 scientists in 50 countries had identified water shortage as one of the two most worrying problems for the new millennium (the other was global warming).

— WORLD CONTEXT

On global scale water supply per capita have decreased by a third between 1970 and 1990.

In 1997, one-third of the world's population was estimated to live under water-stress conditions, while it is expected that by 2025 two-thirds of the population will do so.

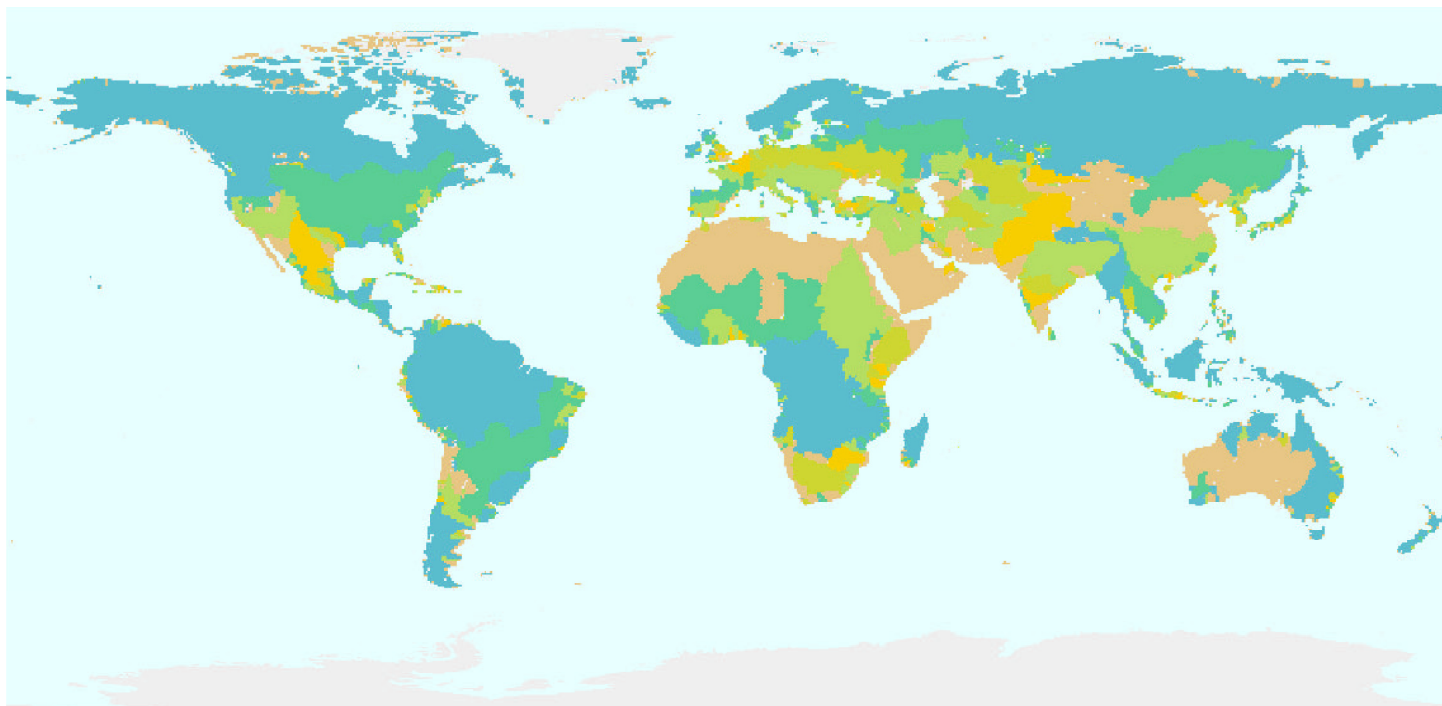
— World Water Council

There are about 300 river basins and numerous aquifers which are shared among two or more nations; competition for water among nations could become a potential source of conflict. In these situations it is of paramount importance to ensure that activities in one part of the basin are not detrimental or harmful to actual or potential uses in other parts of it.

—World Water Council

Water is politically driven and not ecologically sensitive nor integrated into a global urban perspective.

Annual Renewable Water Supply Per Person by River Basin, 1995



Map Projection: Geographic

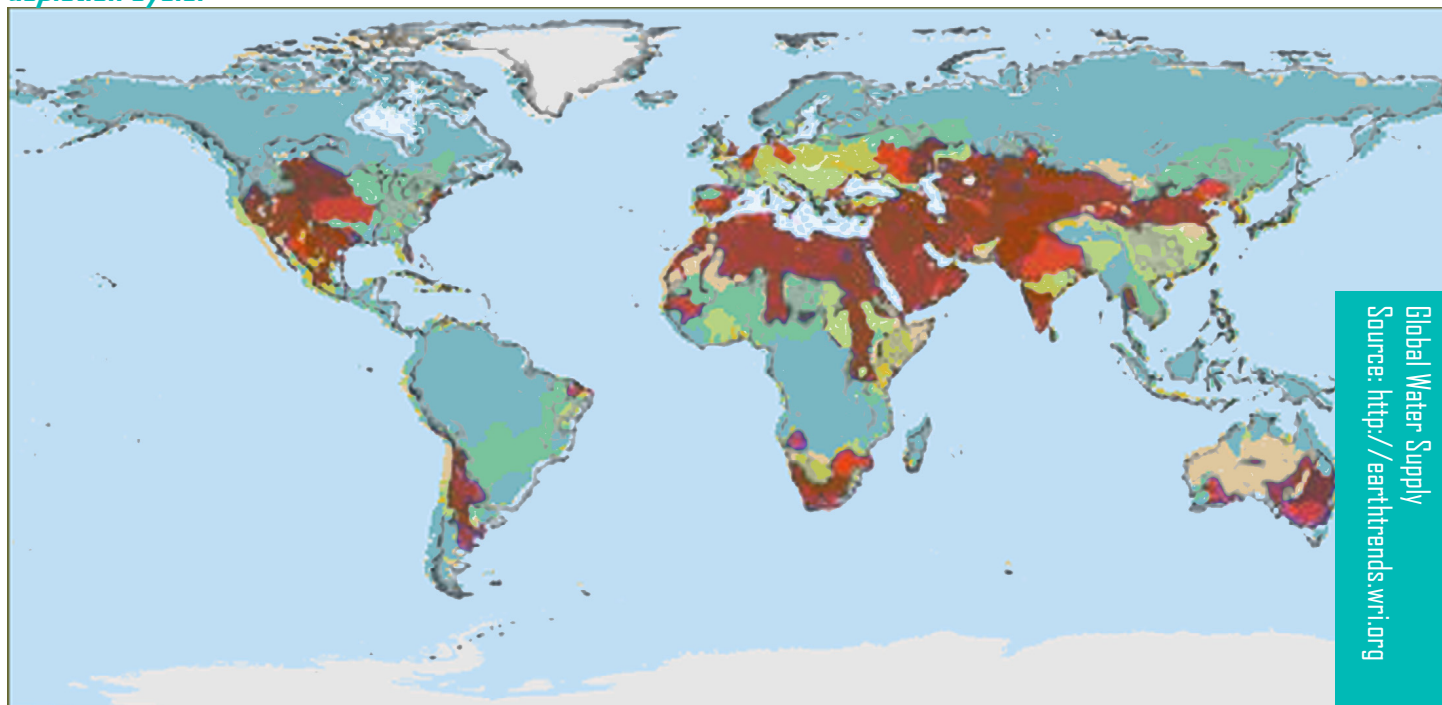
Citation: World Resources Institute - PAGE, 2000

Notes:

Above: Annual Water Supply

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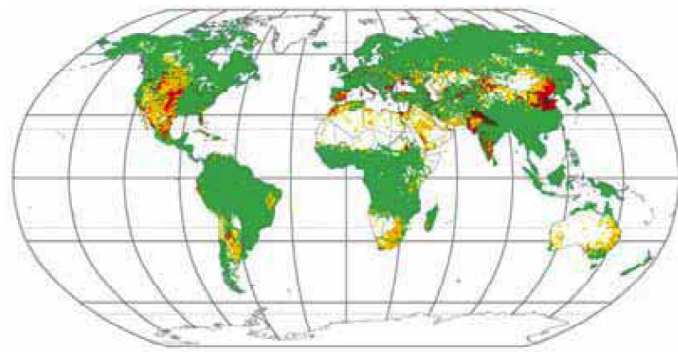
Below: Water supply transposed with water stress (in red) - *Globally, the highest water supply is in distant locations to the highest stress. This requires additional energy to clean, distribute, and store water which adds to the water depletion cycle.*



Global Water Supply
Source: <http://earthtrends.wri.org>

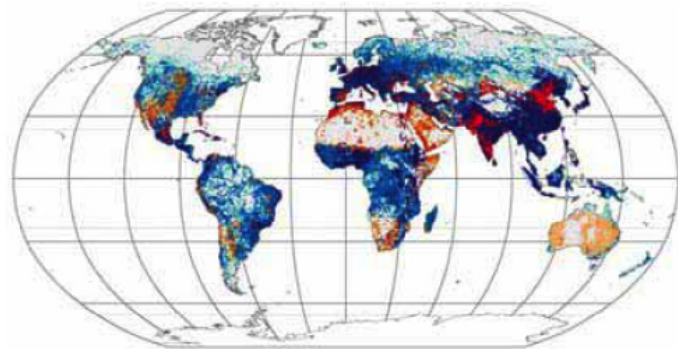
Availability of water is critical. Quality is essential. It is important that we are using water at a rate equal to the recovery of water and at the same time, taking measures to keep our water clean.

Water use in excess of natural supply (average annual)



High Moderate Low Little or no use Adequate supply

Population (in thousands) above (reds) and below (blues) water stress threshold (RWSI=0.4)



Top Right: Global Water Stress-Areas where we are using more water than is available.

Unstressed
>100 10-100 0-10 Little or no population
Stressed
0-10 10-100 >100

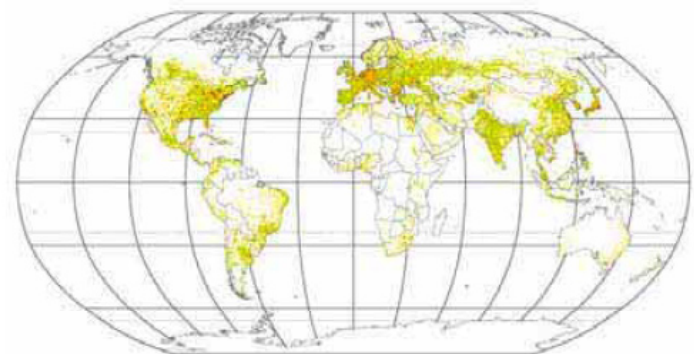
Annual domestic water use (2000) in millions of cubic meters per grid cell

0
<1
1-10
10-100
>100



Annual industrial water use (2000) in millions of cubic meters per grid cell

0
<5
5-50
50-500
>500



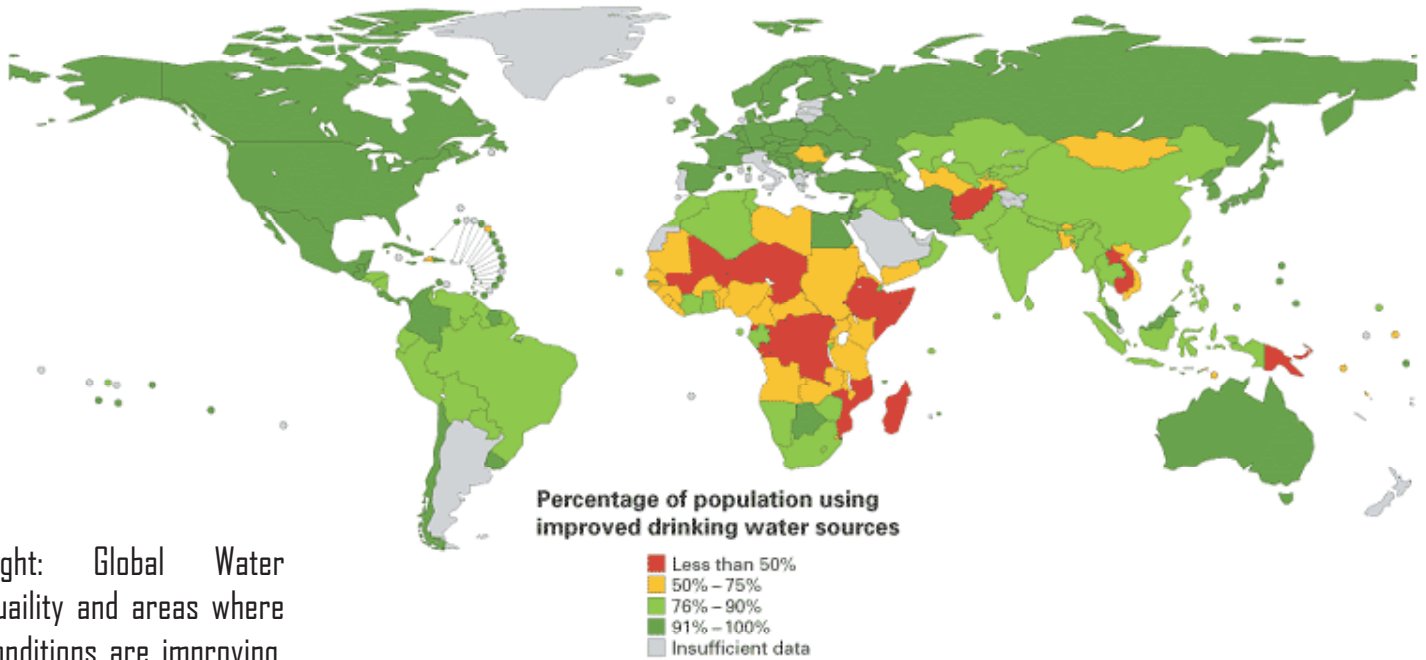
As shown in the maps above, a broad spectrum of water use arises, with high levels associated with dense settlement and advanced levels of economic development. Maps of water use such as these can be linked with those depicting water supply to define patterns of water scarcity and stress.

Source: Water Systems Analysis Group, University of New Hampshire. Datasets available for download at <http://wwdrillsr.unh.edu/>

Right: Global Water Use

Good water coverage attained in most regions

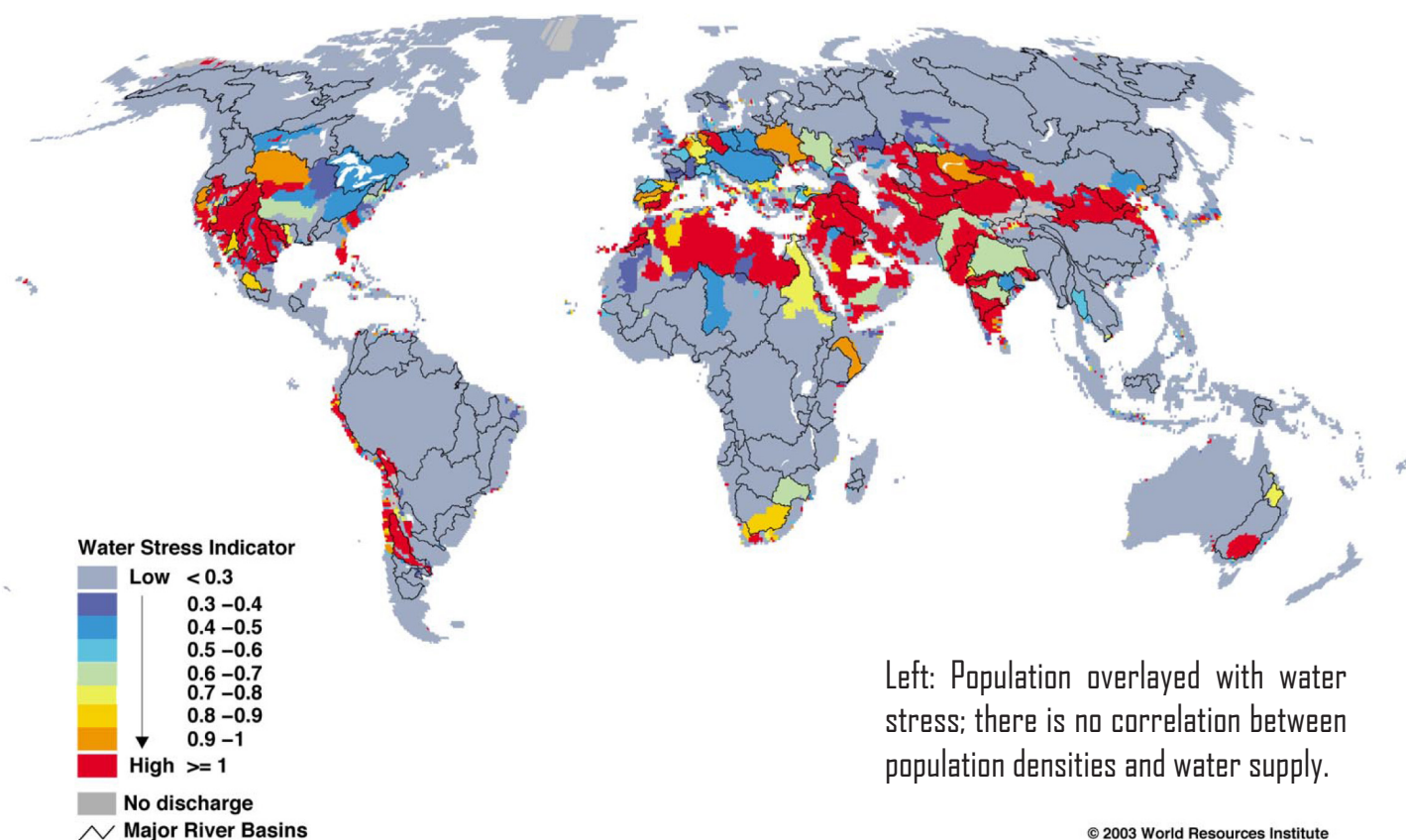
Figure 1 Coverage with improved drinking water sources in 2002



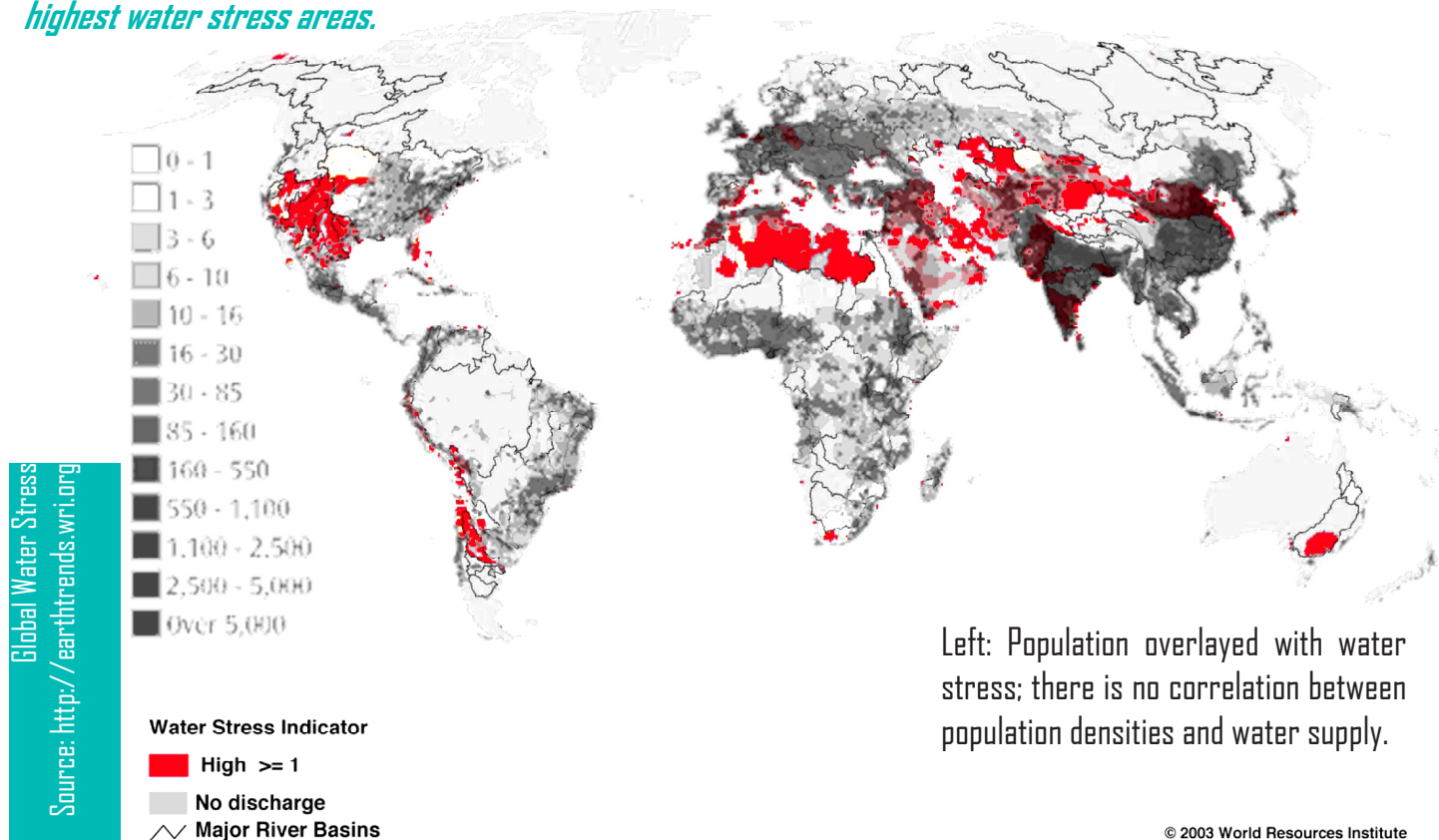
Right: Global Water Quality and areas where conditions are improving.

1.1 billion people lack access to safe drinking water. 2.6 billion people lack adequate sanitation. 1.8 million people die every year from diarrheal diseases, including 90 % of children under 5. This situation is no longer bearable.

_World Water Council



Global population overlaid with water stress (in red) - *Globally, the highest population areas do not correlate with the highest water stress areas.*



Daily per capita use of water in residential areas:

- 350 liters in North America and Japan
- 200 liters in Europe
- 10-20 liters in sub-Saharan Africa

_ World Water Council

Daily indoor per capita water use in a typical single family home is 69.3 gallons (260 litres). Overall use falls into the following categories:

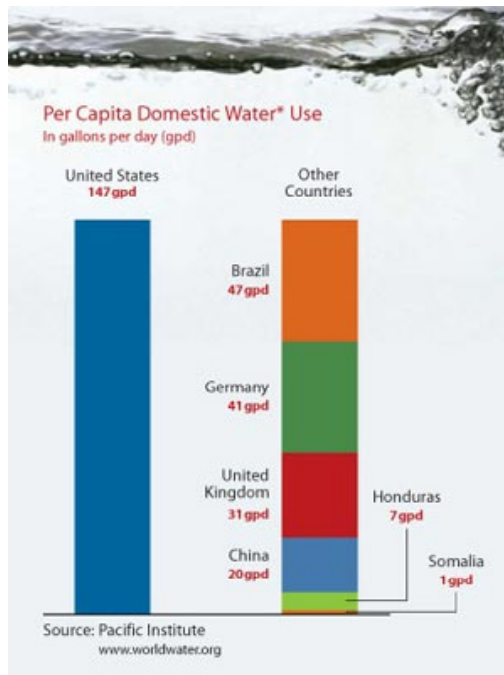
- * body cleanliness:
 - Toilets - 26.7%
 - Baths - 1.7%
 - Showers - 16.8%
- * washing:
 - Clothes Washers - 21.7%
 - Dishwashers - 1.4%
- * Faucets - 15.7%
- * Leaks - 12.7%
- * Other Domestic Uses - 2.2%

_ AWWA Research Foundation

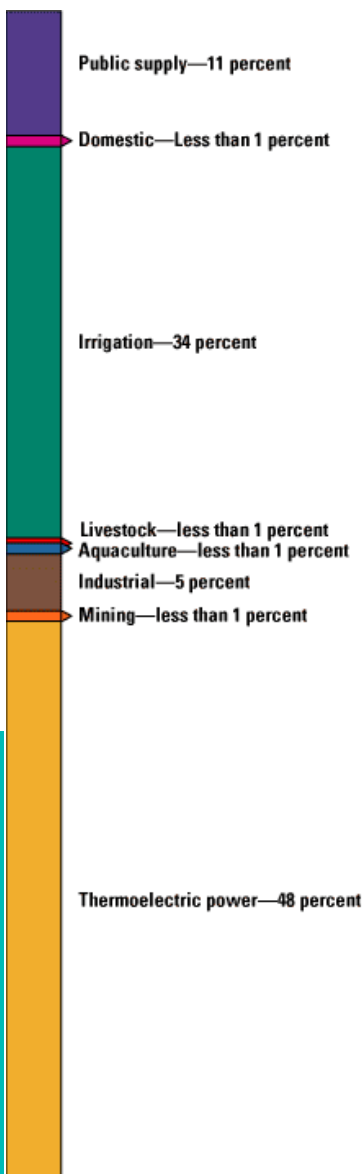
_LOCAL CONTEXT

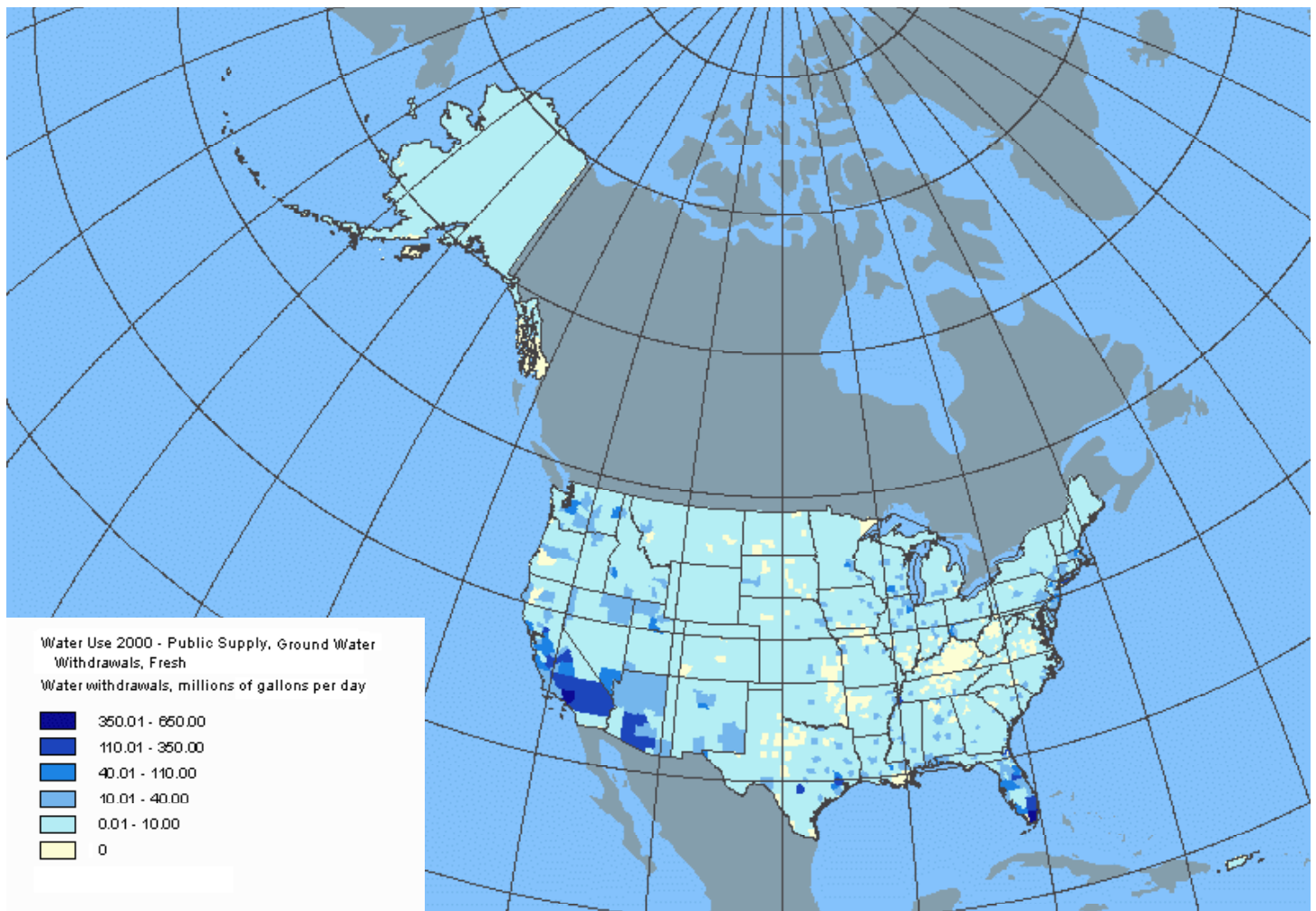
Ninety-five percent of the United States' fresh water is underground. As farmers in the Texan High Plains pump groundwater faster than rain replenishes it, the water tables are dropping. North America's largest aquifer, the Ogallala, is being depleted at a rate of 12 billion cubic metres (bcm) a year. Total depletion to date amounts to some 325 bcm, a volume equal to the annual flow of 18 Colorado Rivers.

_BBC News

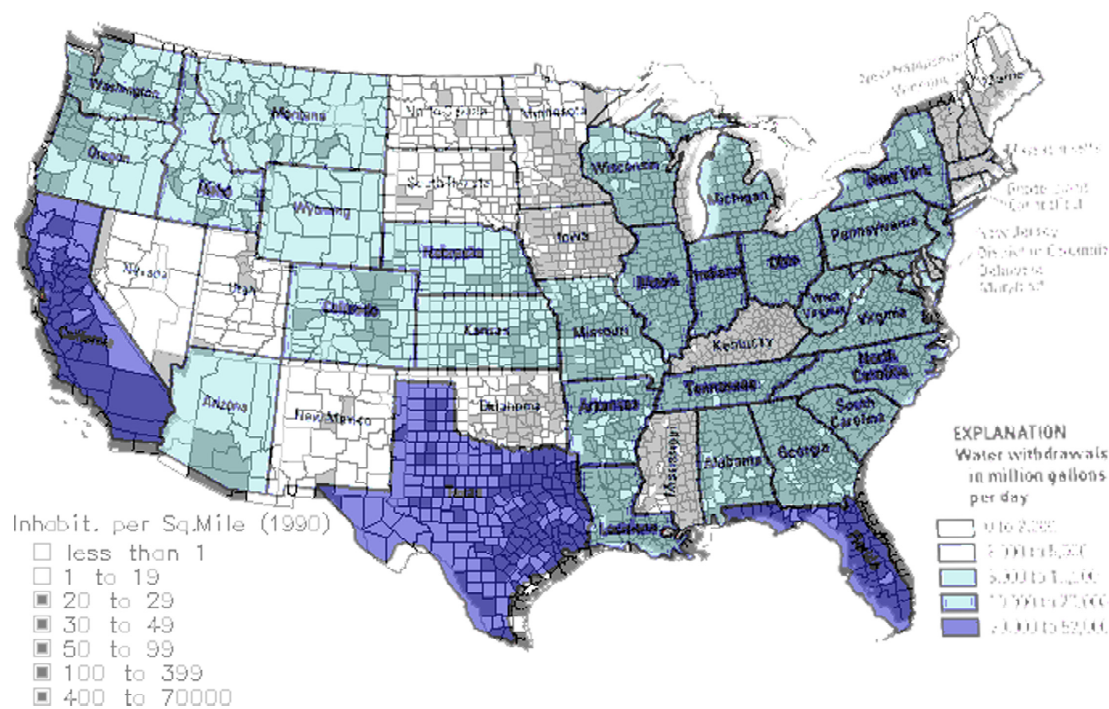


Water consumption includes more than just the residential and personal intake, but also a significant amount of water usage goes to building needs and agriculture. Today we are using more and more water.

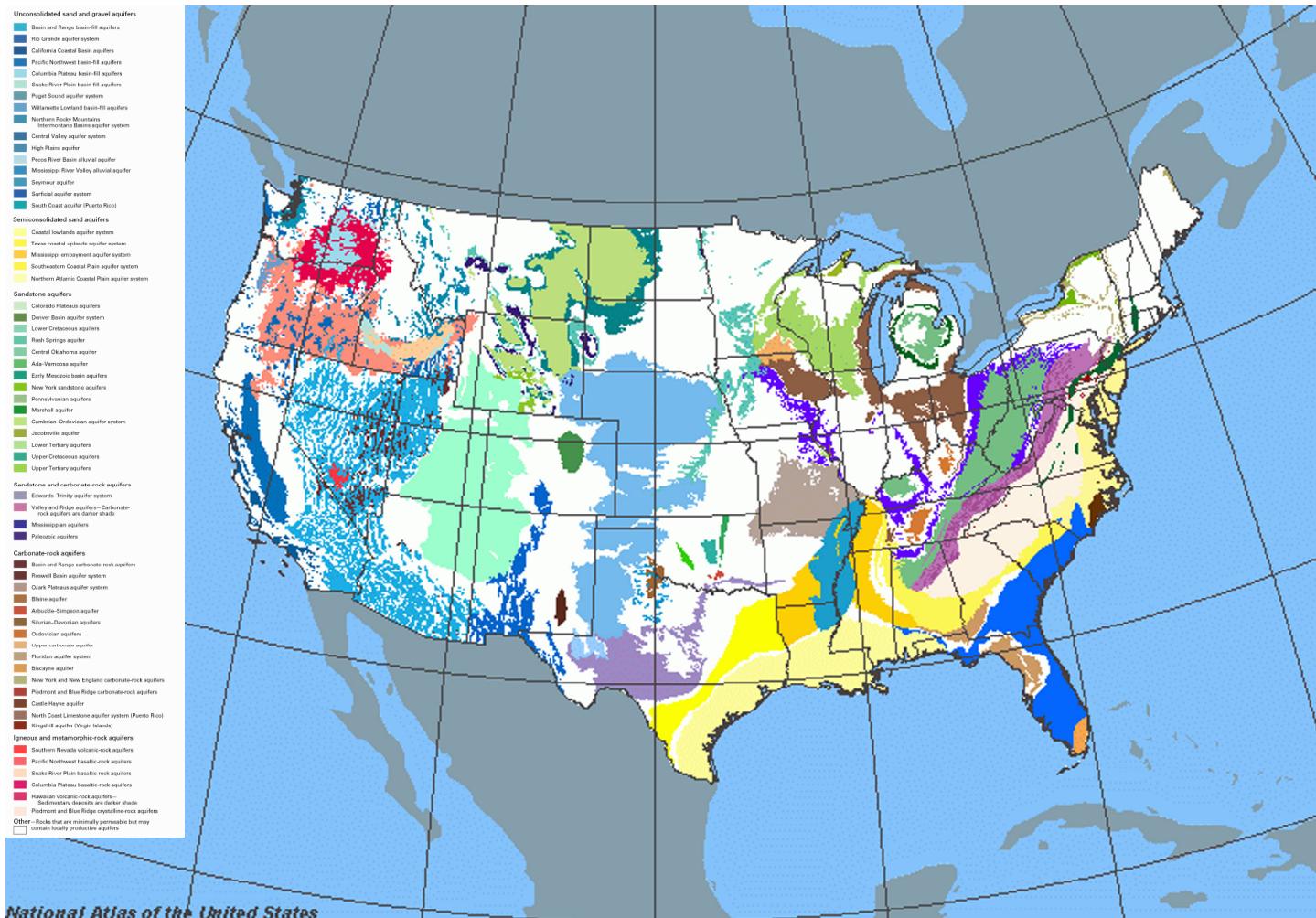




Population (in grey) compared to Water Withdrawal (in blue) - **Population size does not correlate with amount of withdraw**



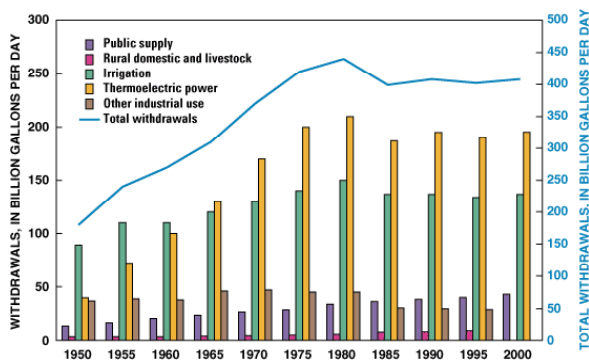
Above: US population in greyscale with amount of water withdrawals in color. The highest water withdrawals are not near the largest populations which is using high amounts of energy to transport.



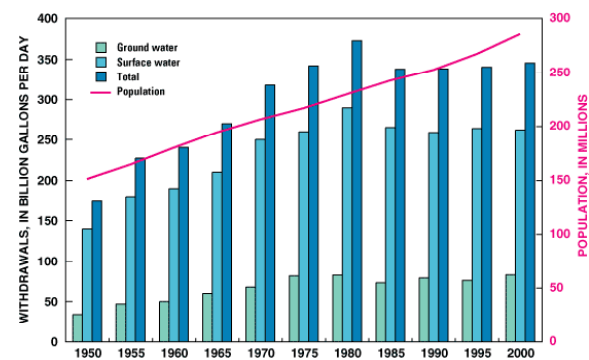
National Atlas of the United States

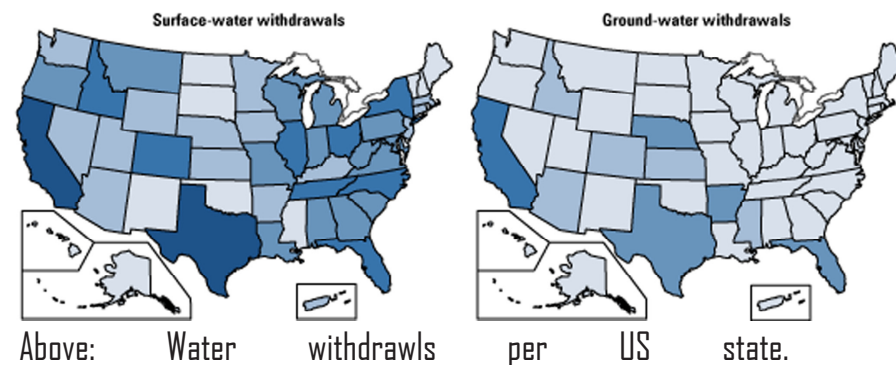
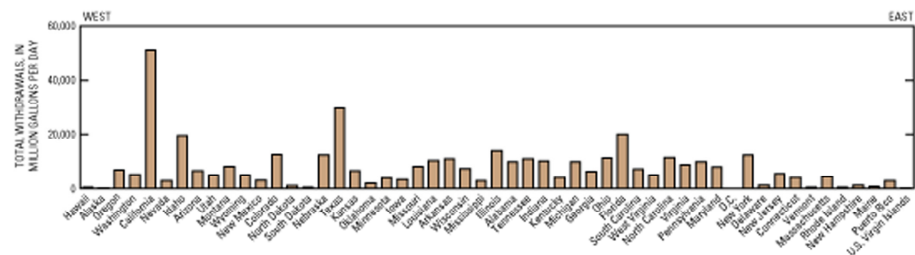
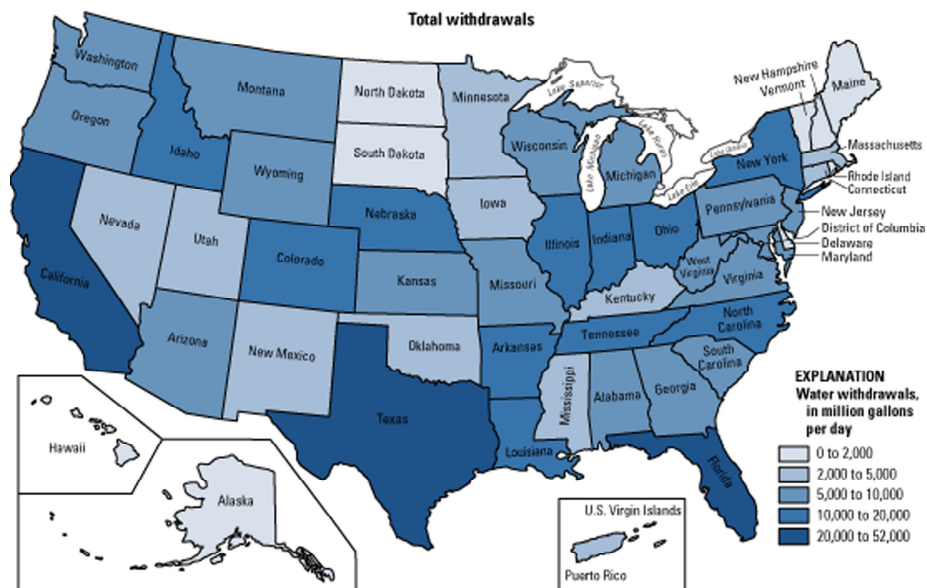
Above: Different means of water availability in the US.

Trends in total water withdrawals by water-use category, 1950-2000



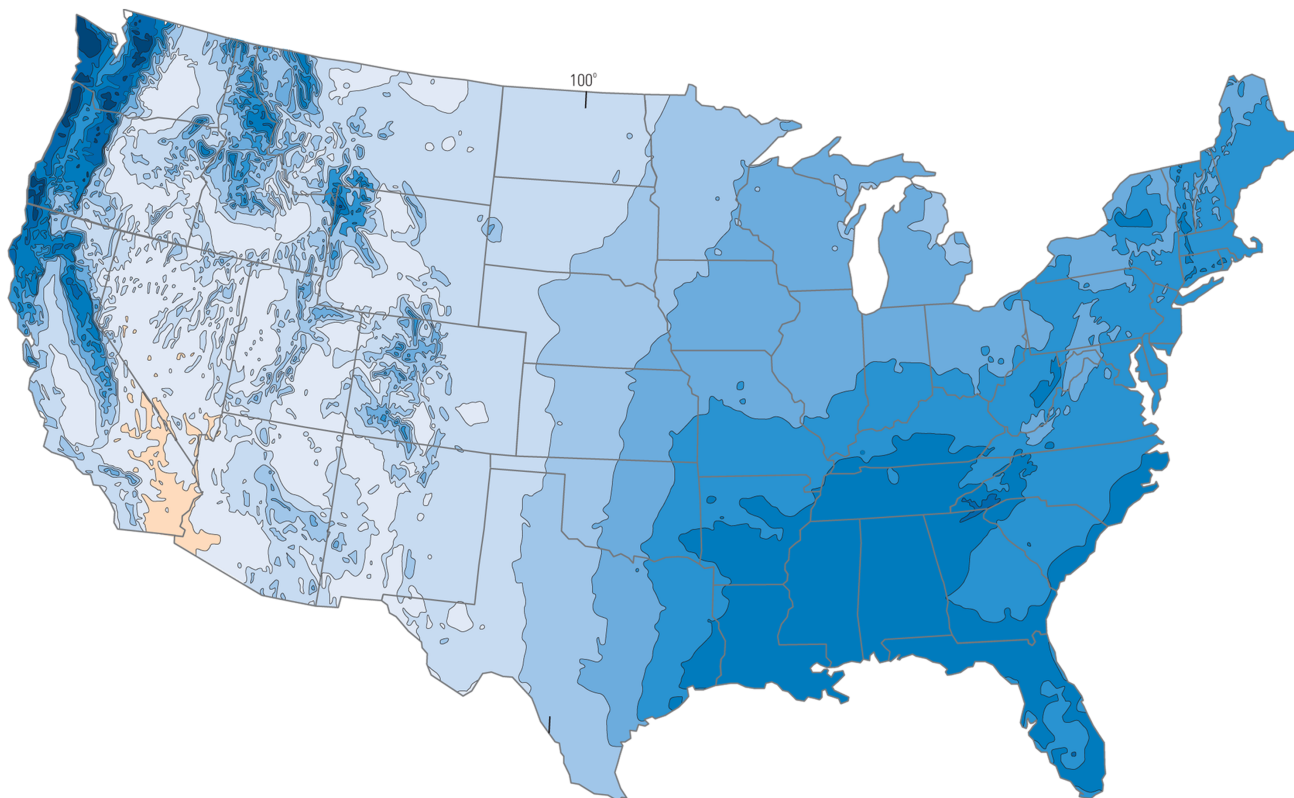
Trends in population and freshwater withdrawals by source, 1950-2000





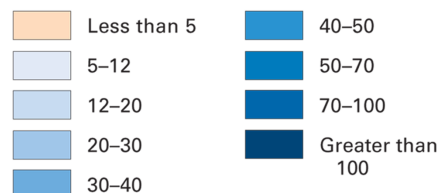
Water is like a savings account rather than a checking account. Constant withdrawal without replenishing the account will leave it empty.

— Dan Williams



EXPLANATION

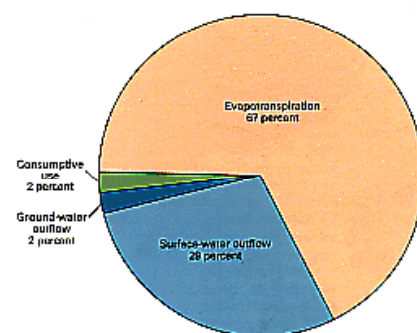
Mean annual precipitation, in inches



Above: Mean Annual Precipitation in the US

Mean annual precipitation for the contiguous United States, 1890 to 2002. (Source: National Oceanic and Atmospheric Administration, National Climatic Data Center).

Water is not available at all times of the year in all regions. Storage is an important consideration when harvesting rainwater. In addition, the ecological requirements of the water cycle require most rainwater. Consumptive use should usually only be below 2 percent.

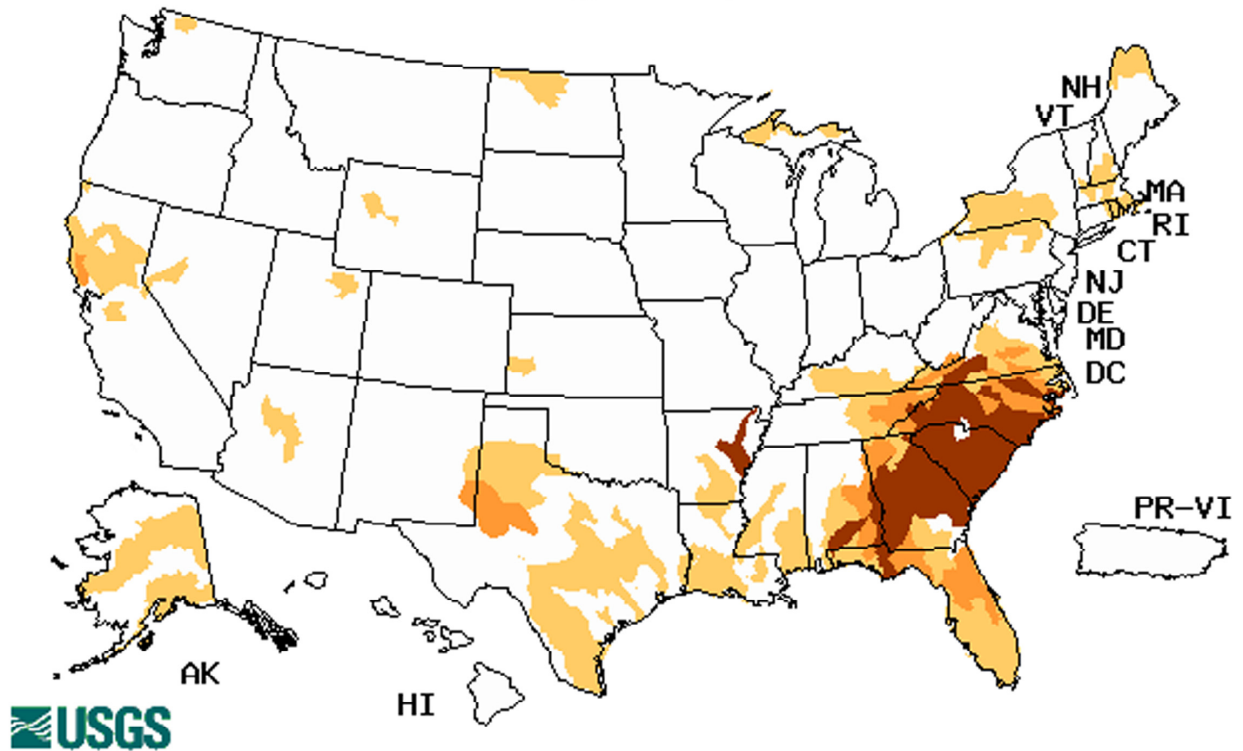




Above: Climatic Regions in the US

Different regions and climates require different approaches to sustaining water. When you run out of water, it is impossible to replenish the source immediately. Design strategies must rely on regional water availability as a basis for design.

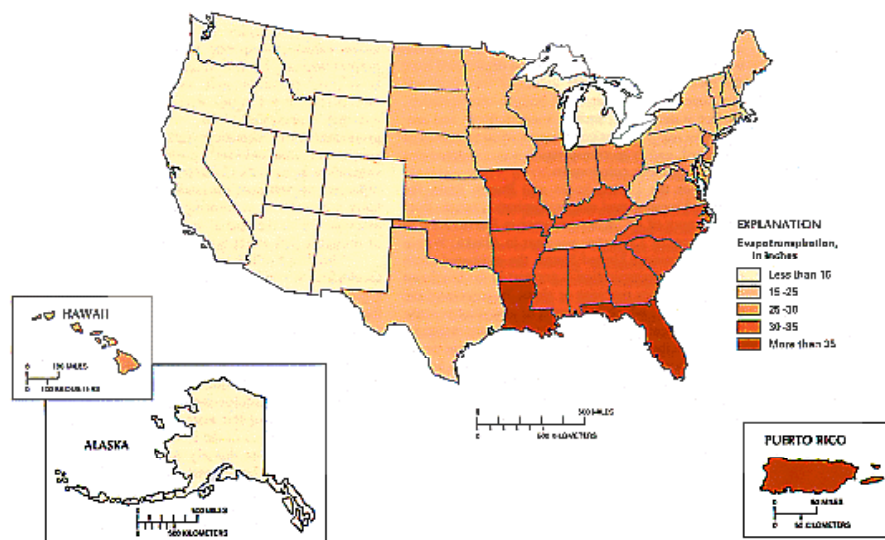
Thursday, June 12, 2008



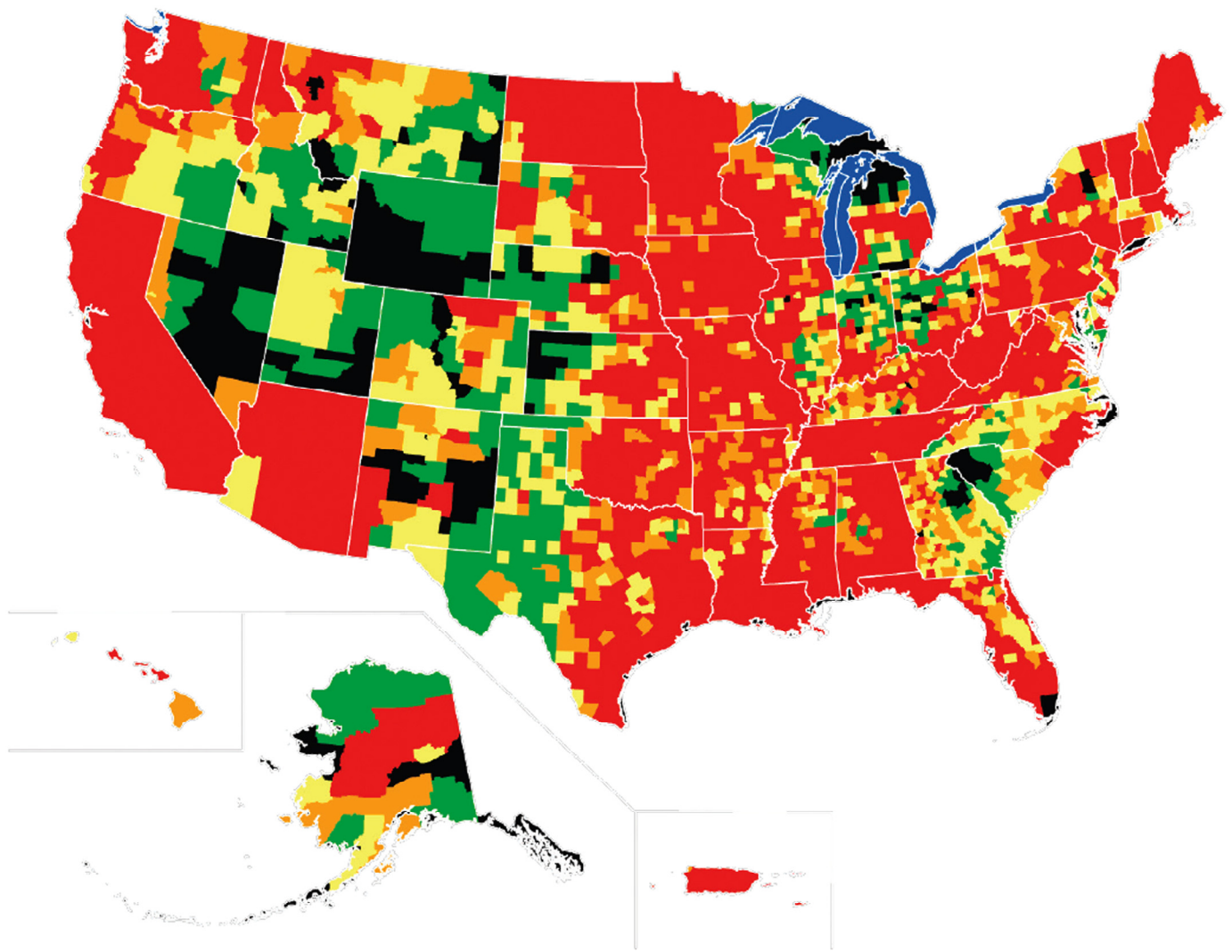
Explanation - Percentile classes				
Low	≤ 5	6-9	10-24	Insufficient data for a hydrologic region
Extreme hydrologic drought	Severe hydrologic drought	Moderate hydrologic drought	Below normal	

Above: Drought map for June 2008

While drought affects some areas at different times of the year, other area's water supply and quality is being threatened by poor planning which does not allow for the recycling of water.



Above: Evapotranspiration Map for US, USGS



Above: Flooding disasters in the US

On average, floods kill about 140 people each year and cause \$6 billion in property damage.
_USGS

WATER SUSTAINABILITY

Water sustainability relies on regional water availability. It is important that the amount of water consumed is replenished without depleting the existing water supply. As distribution of water often requires high uses of energy, water should be a resource highly dependent on regional conditions.

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