WATER

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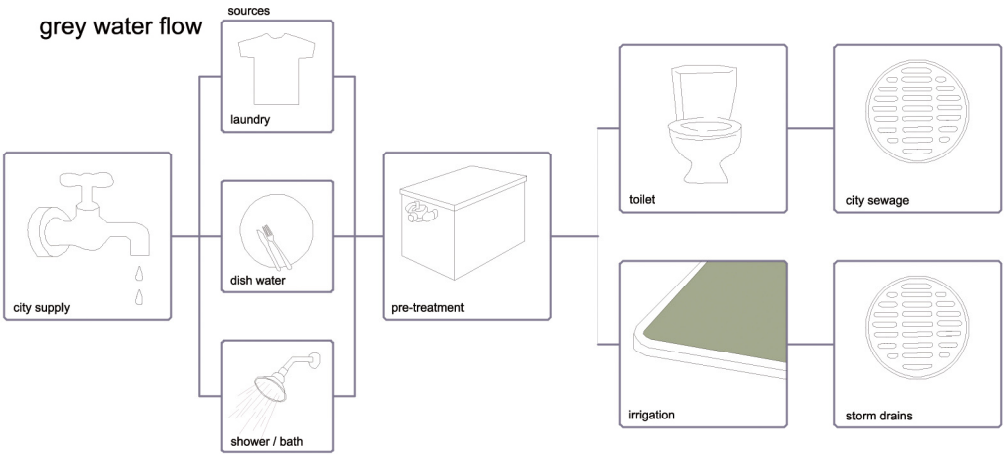
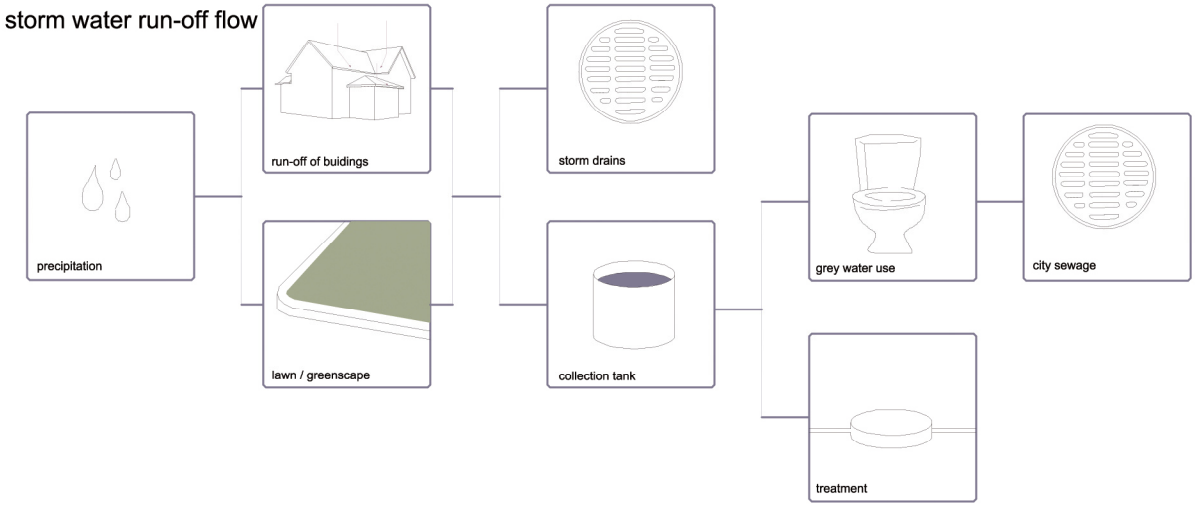
AIAS/AIA COTE

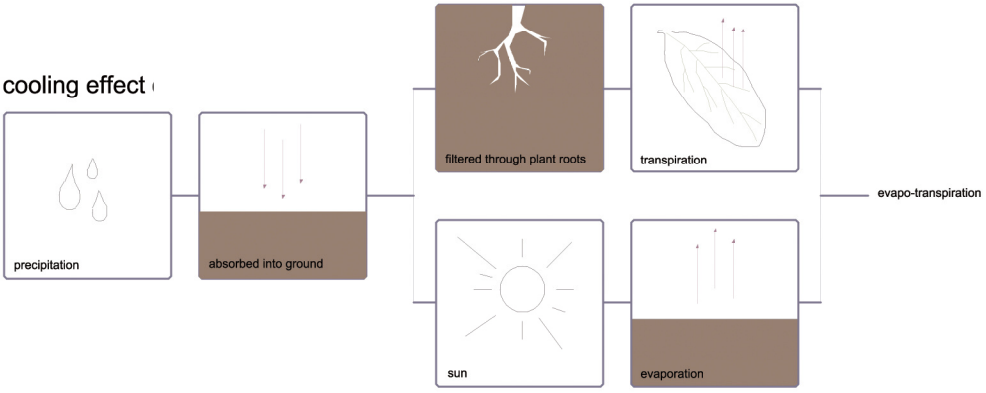
Research Fellowship

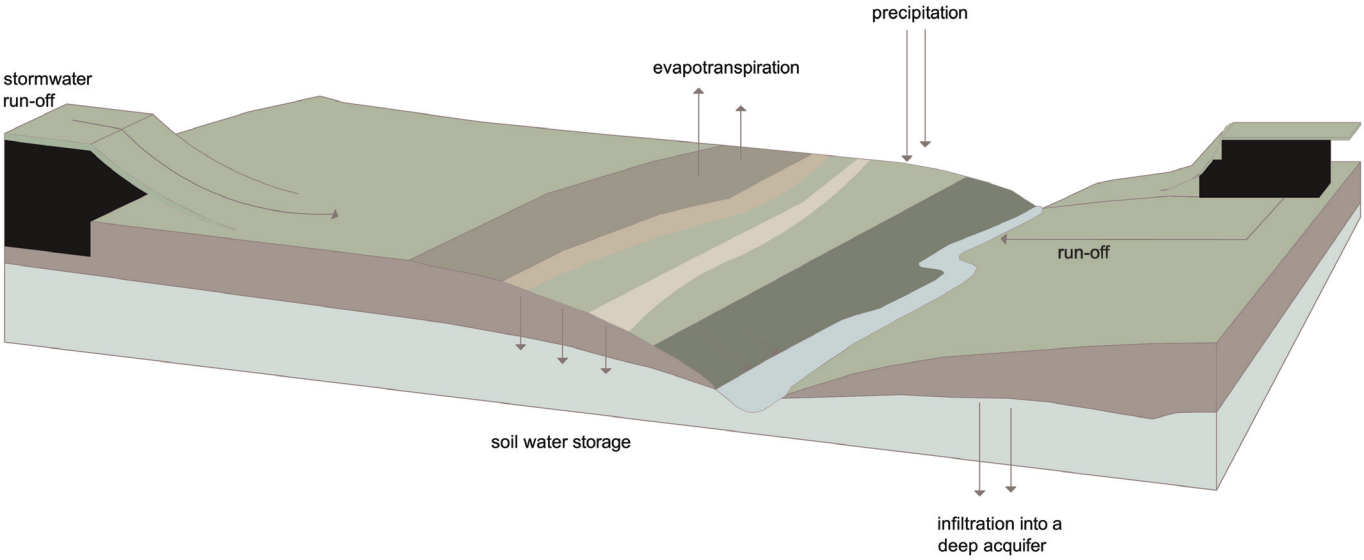
_HYDROLOGY 101

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.


grey water flow
sources
laundry
dish water
shower / bath
city supply
pre-treatment
toilet
city sewage
irrigation
storm drains


storm water run-off flow
precipitation
run-off of buidings
lawn / greenscape
storm drains
collection tank
grey water use
city sewage
treatment


cooling effect
precipitation
absorbed into ground
filtered through plant roots
transpiration
sun
evaporation
evapo-transpiration



Can water functions in the built envornment mimic natural water systems? It is important for urban designers and architects to redetermine how water is used, conserved, distributed, and replenshed in regards to the built environment.

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.

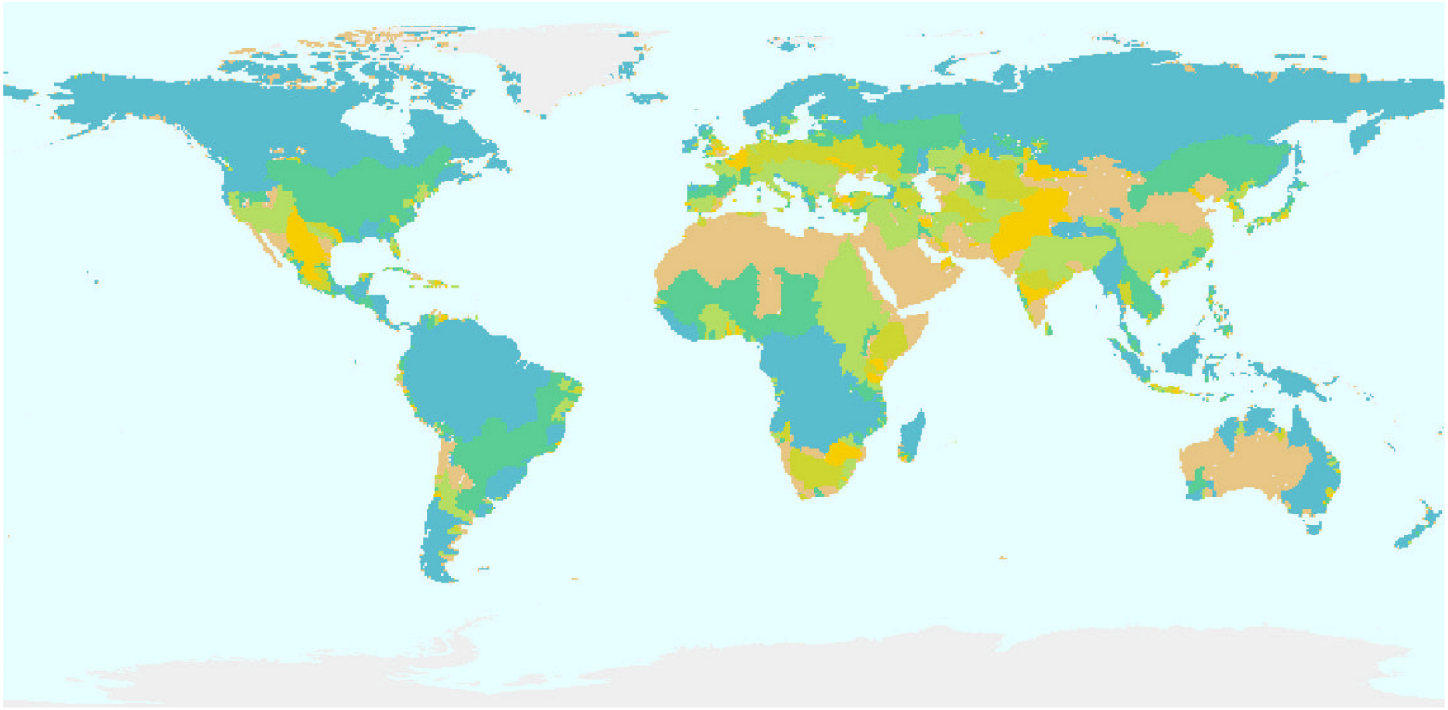
_World Water Council

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 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.

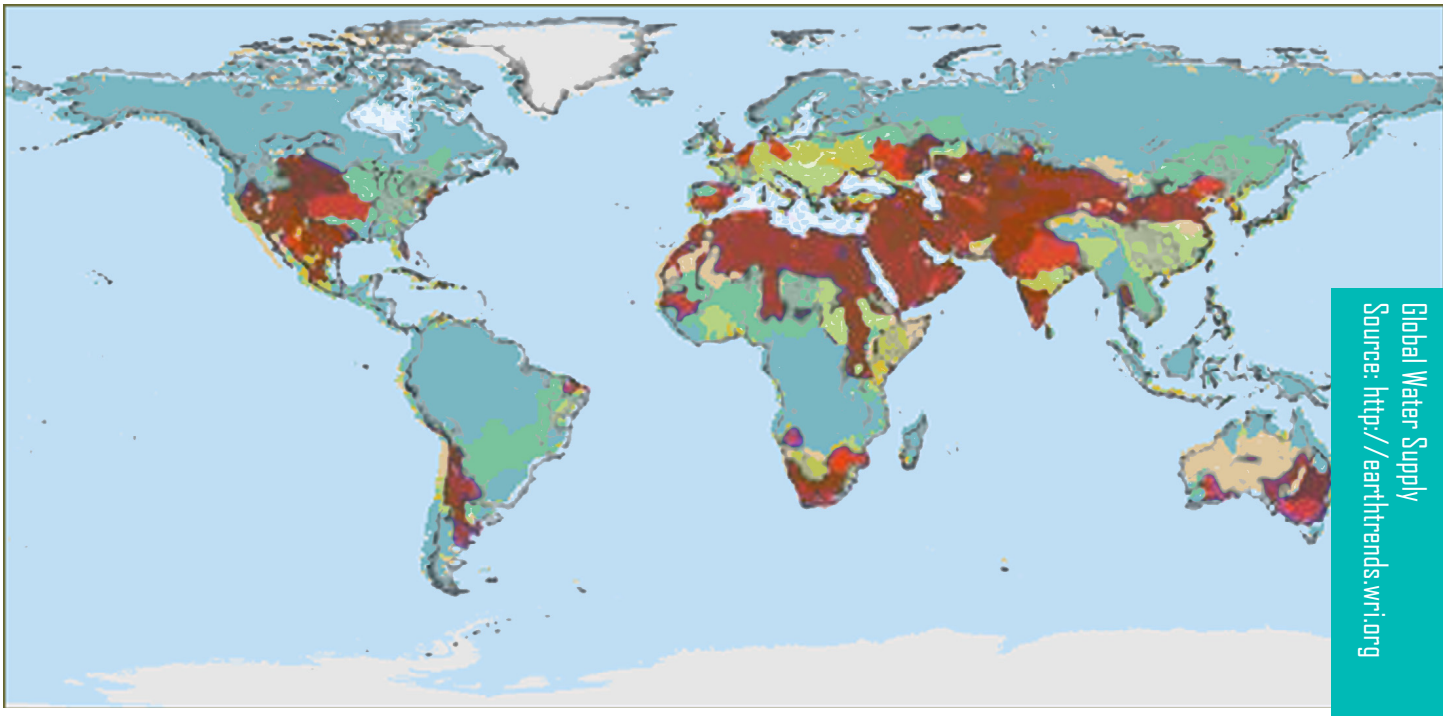
Annual Renewable Water Supply Per Person by River Basin, 1995



Map Projection: Geographic
Citation: World Resources Institute - PAGE, 2000
Notes:

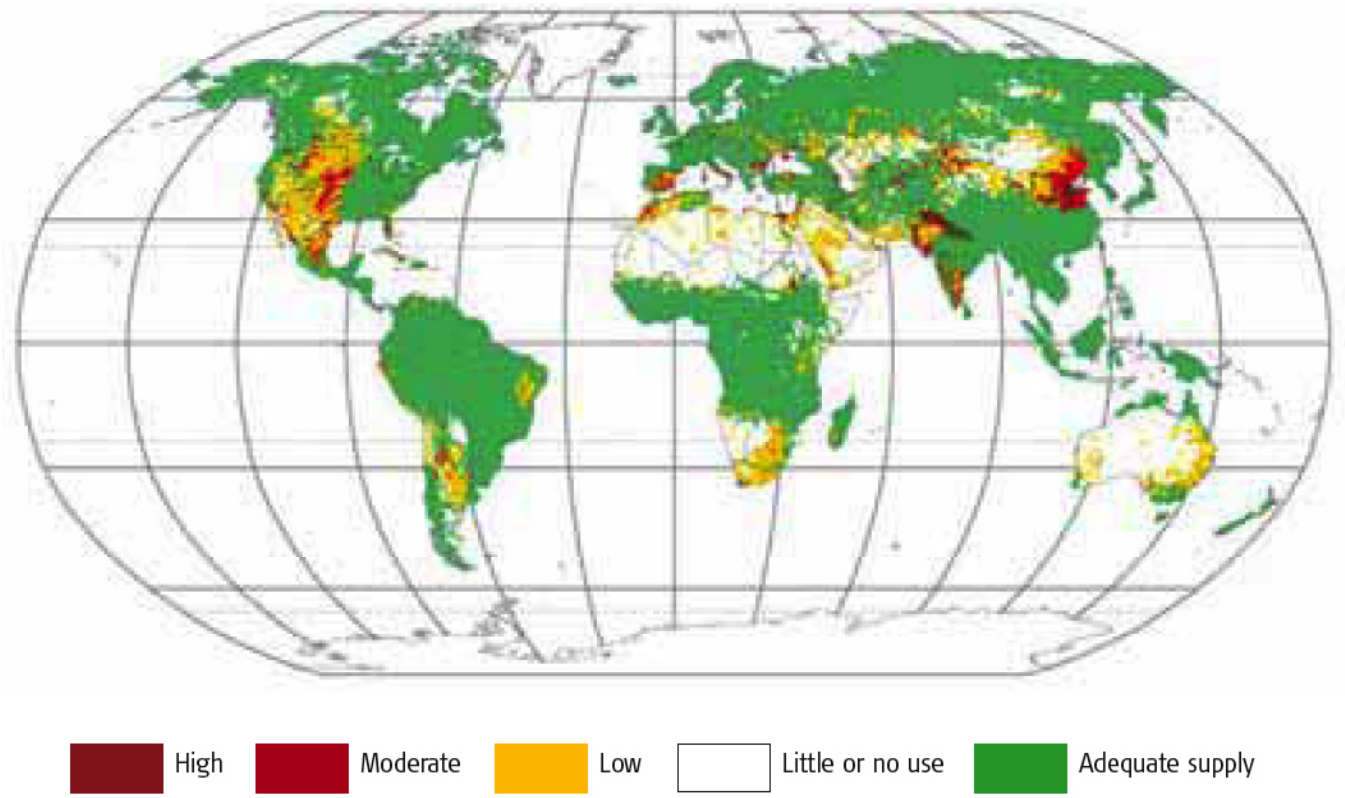
Annual renewable water (m³/person/year)
- <500
- 500 - 1,000
- 1,000 - 1,700
- 1,700 - 4,000
- 4,000 - 10,000
- >10,000
- No data

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.*

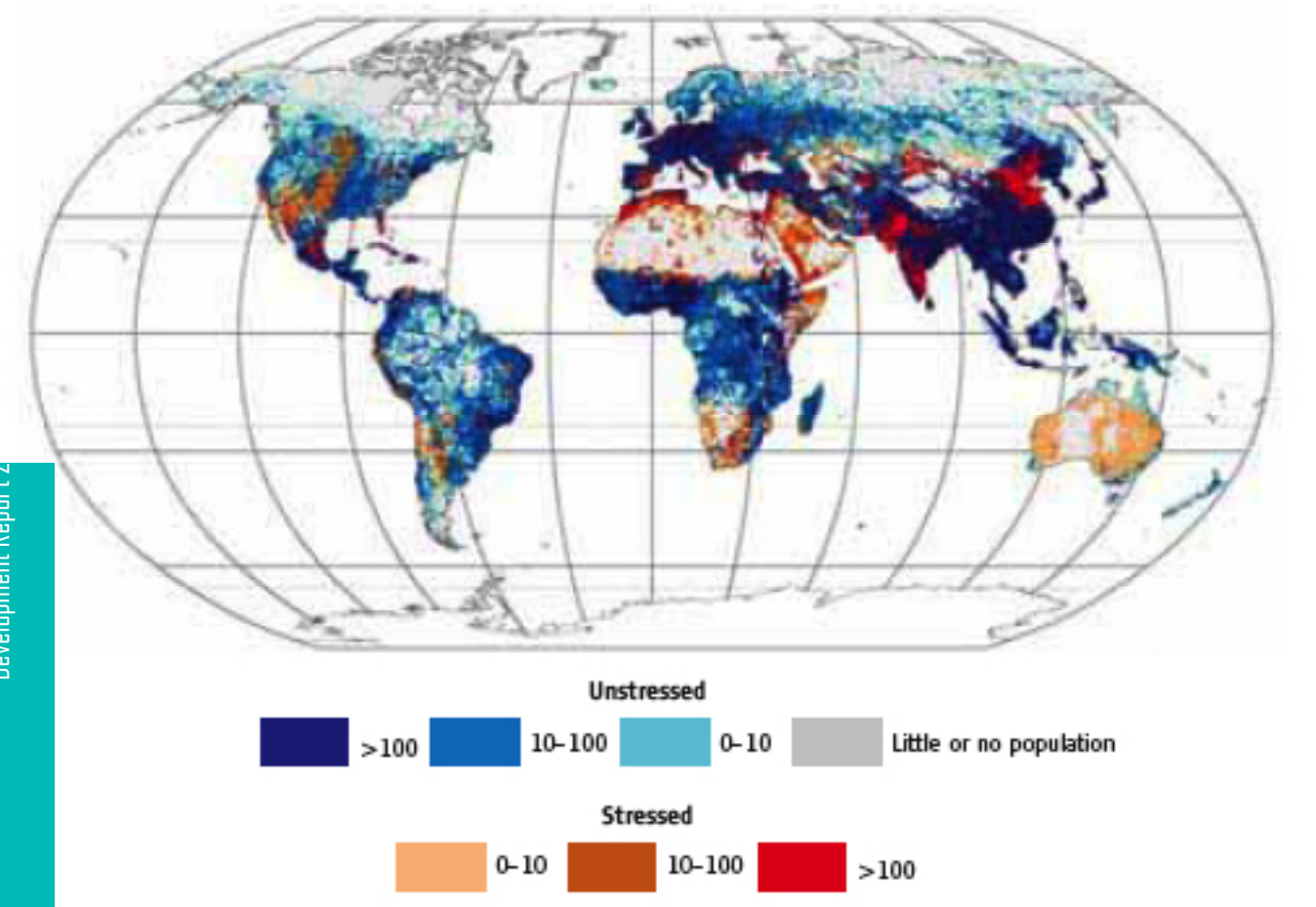


Global Water Supply
Source: http://earthtrends.wri.org

Water use in excess of natural supply (average annual)



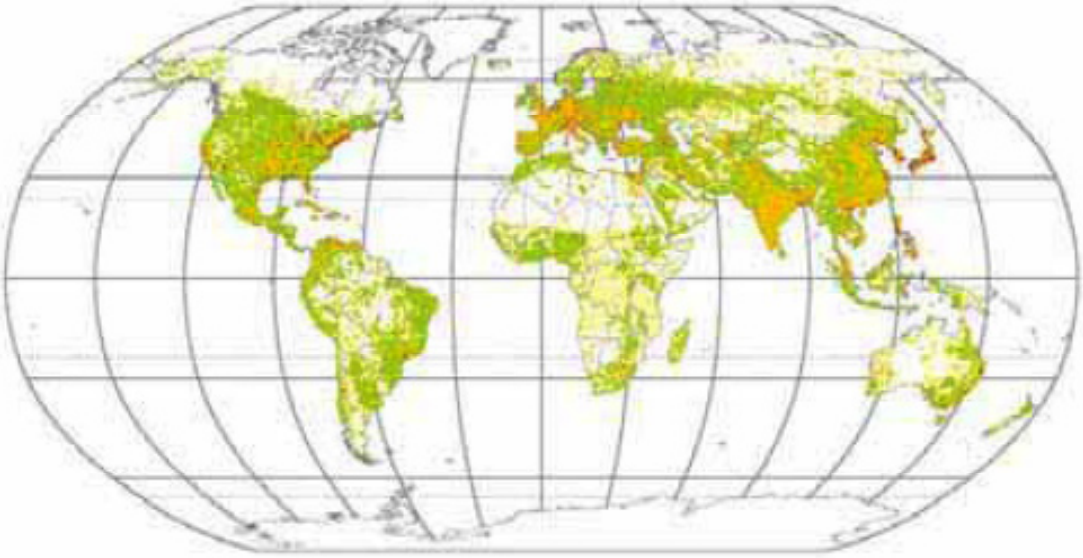
Population (in thousands) above (reds) and below (blues) water stress threshold (RWSI=0.4)



Source: The United Nations World Water Development Report 2

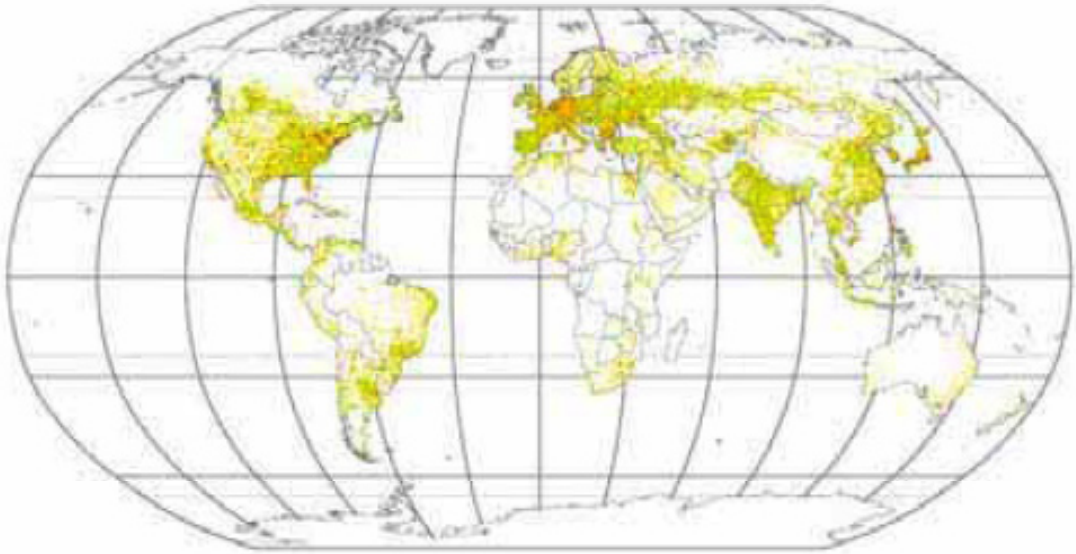
Annual domestic water use (2000) in millions of cubic meters per grid cell

- 0
- <1
- 1–10
- 10–100
- >100



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

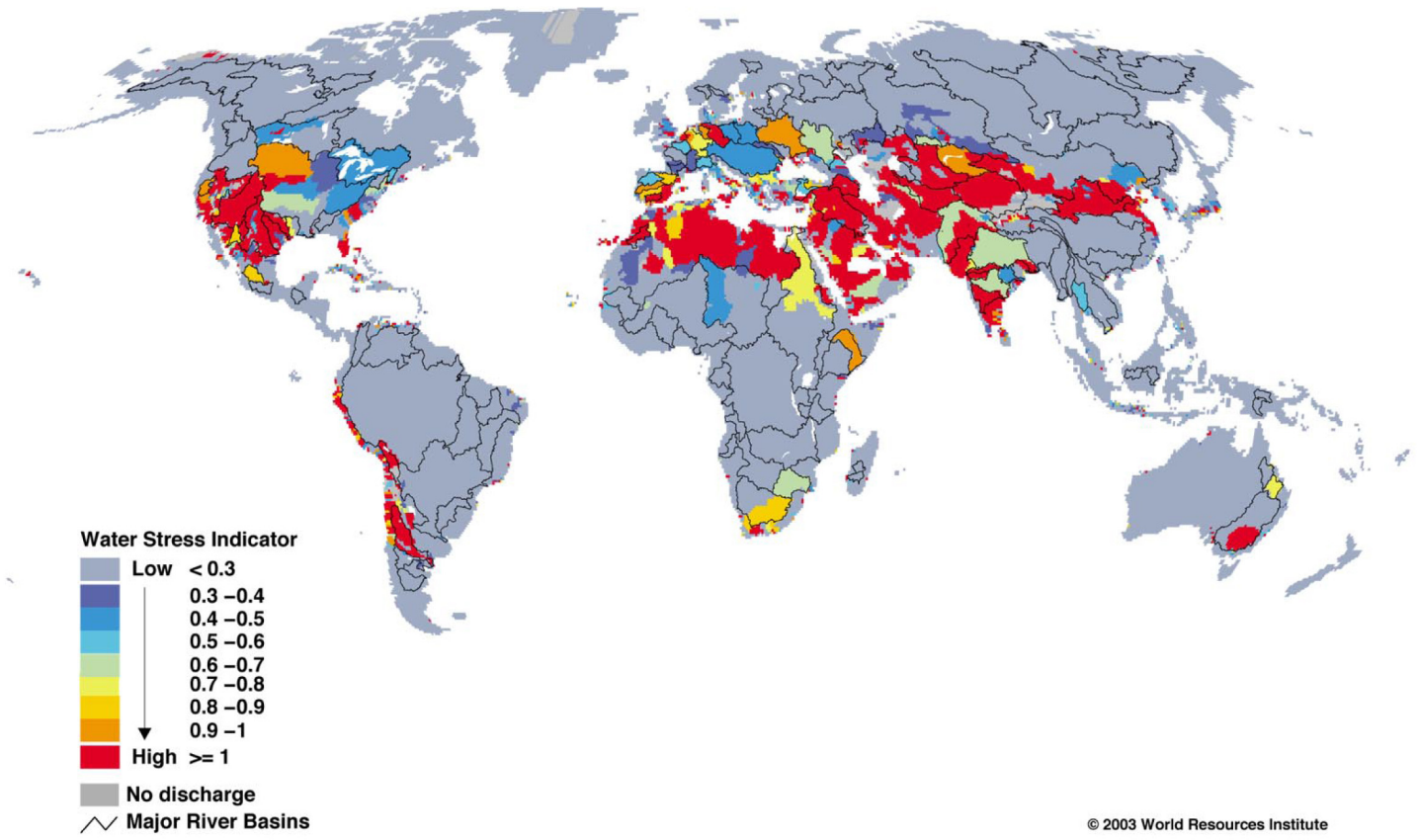
- 0
- <5
- 5–50
- 50–500
- >500



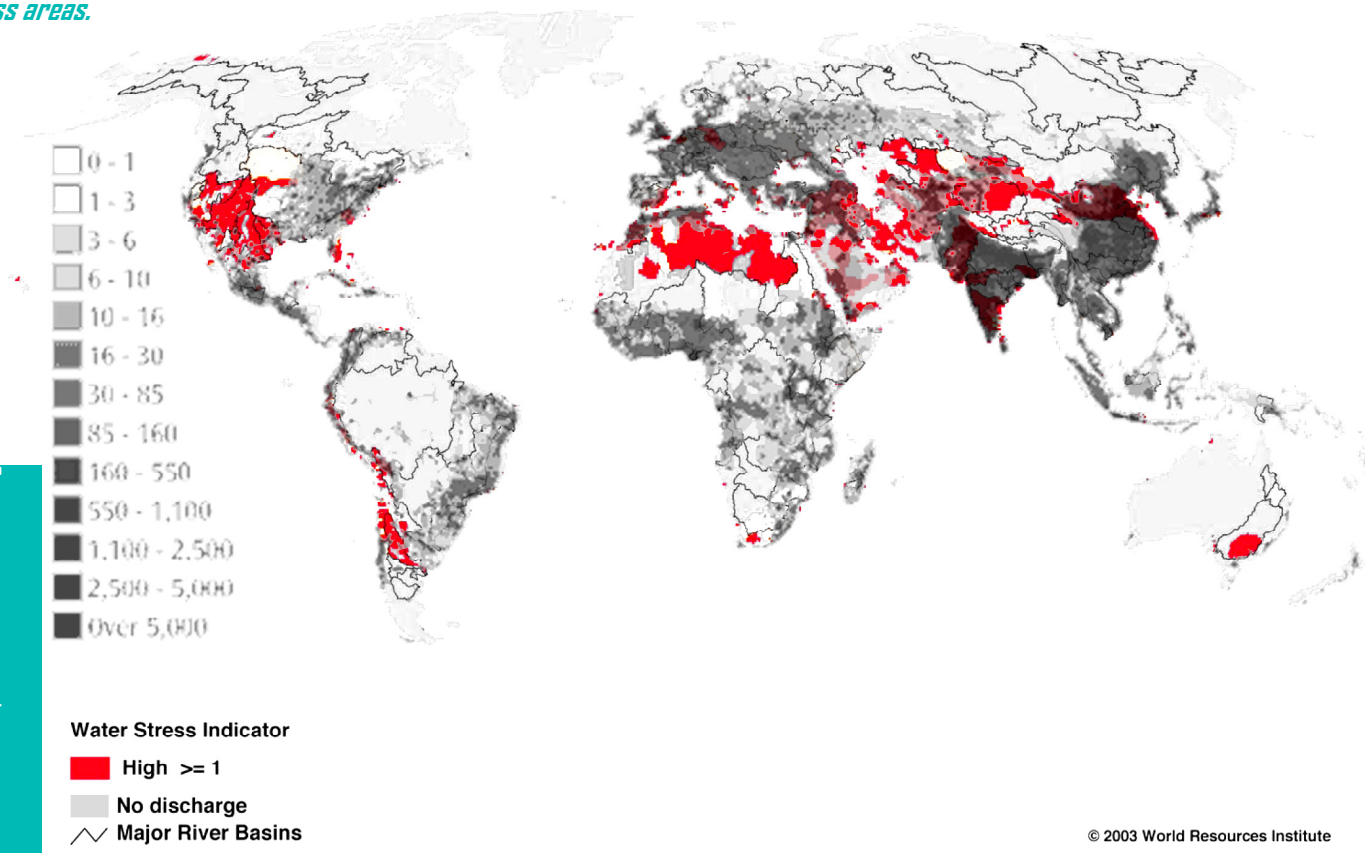
As shown in the maps above, a broad spectrum of water use arises, with high levels associated with dense settlement and advanced levels of economic development. Maps of water use such as these can be linked with those depicting water supply to define patterns of water scarcity and stress.

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

Source: The United Nations World Water Development Report 2



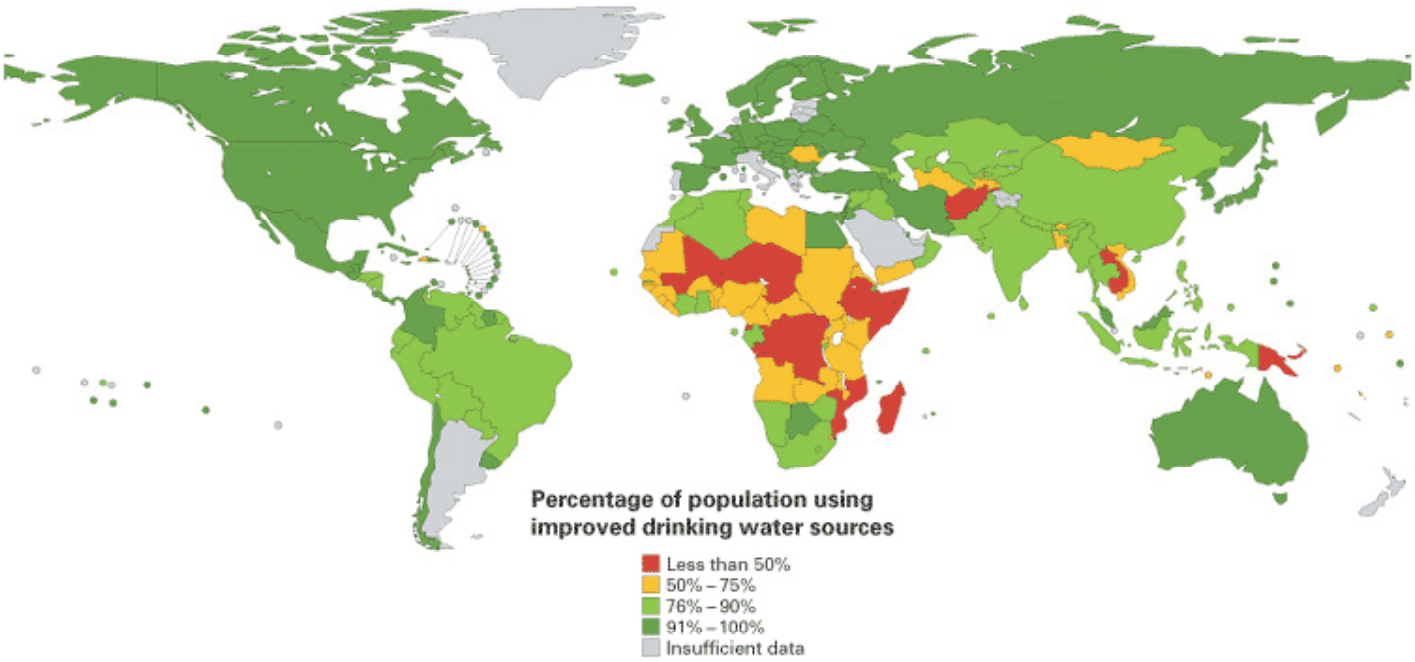
Global population overlayed with water stress (in red) - ***Globally, the highest population areas do not correlate with the highest water stress areas.***



Global Water Stress
Source: http://earthtrends.wri.org

Good water coverage attained in most regions

Figure 1 Coverage with improved drinking water sources in 2002



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 Water Quality
Source: www.unicef.org

Daily per capita use of water in residential areas:

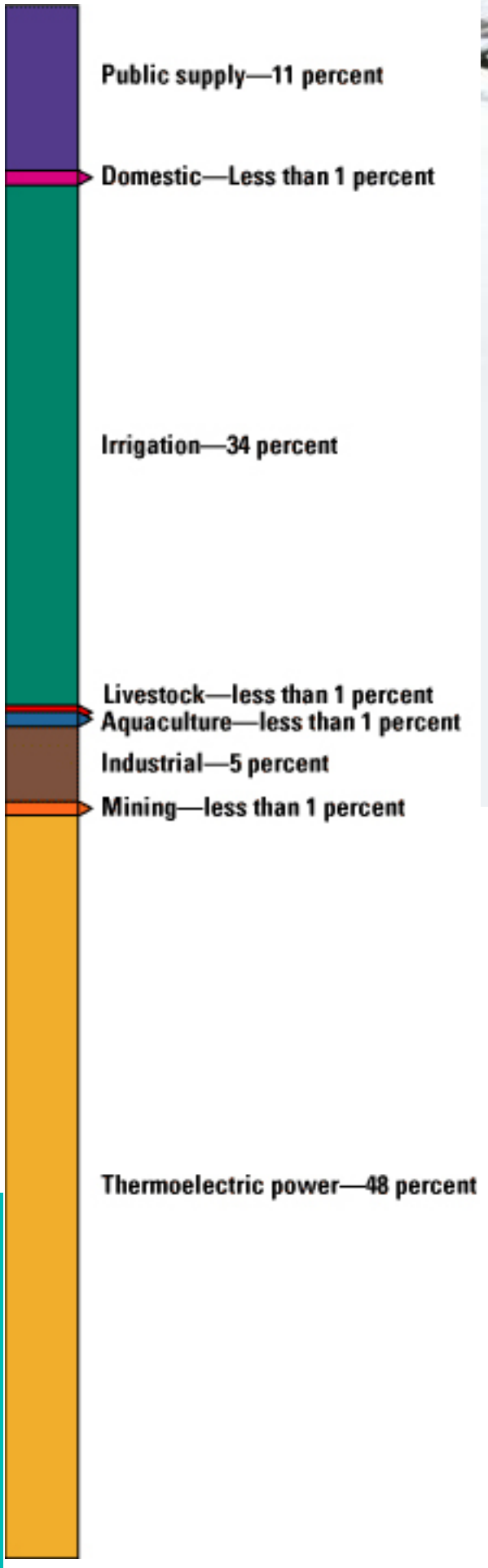
- 350 liters in North America and Japan
- 200 liters in Europe
- 10-20 liters in sub-Saharan Africa

_World Water Council

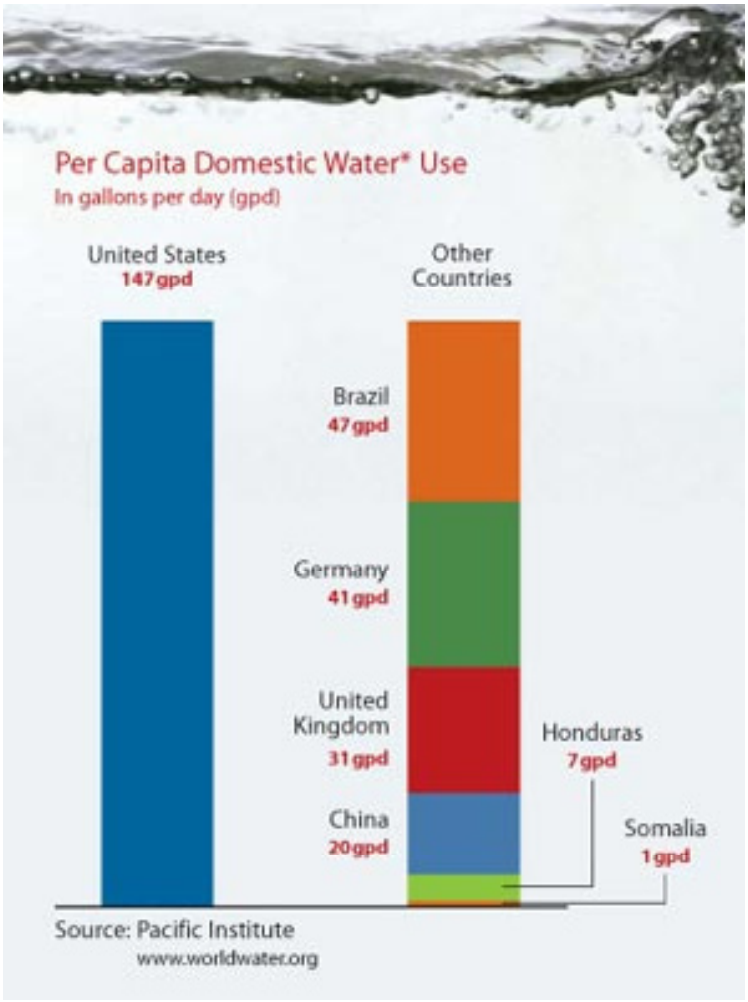
_LOCAL CONTEXT

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.

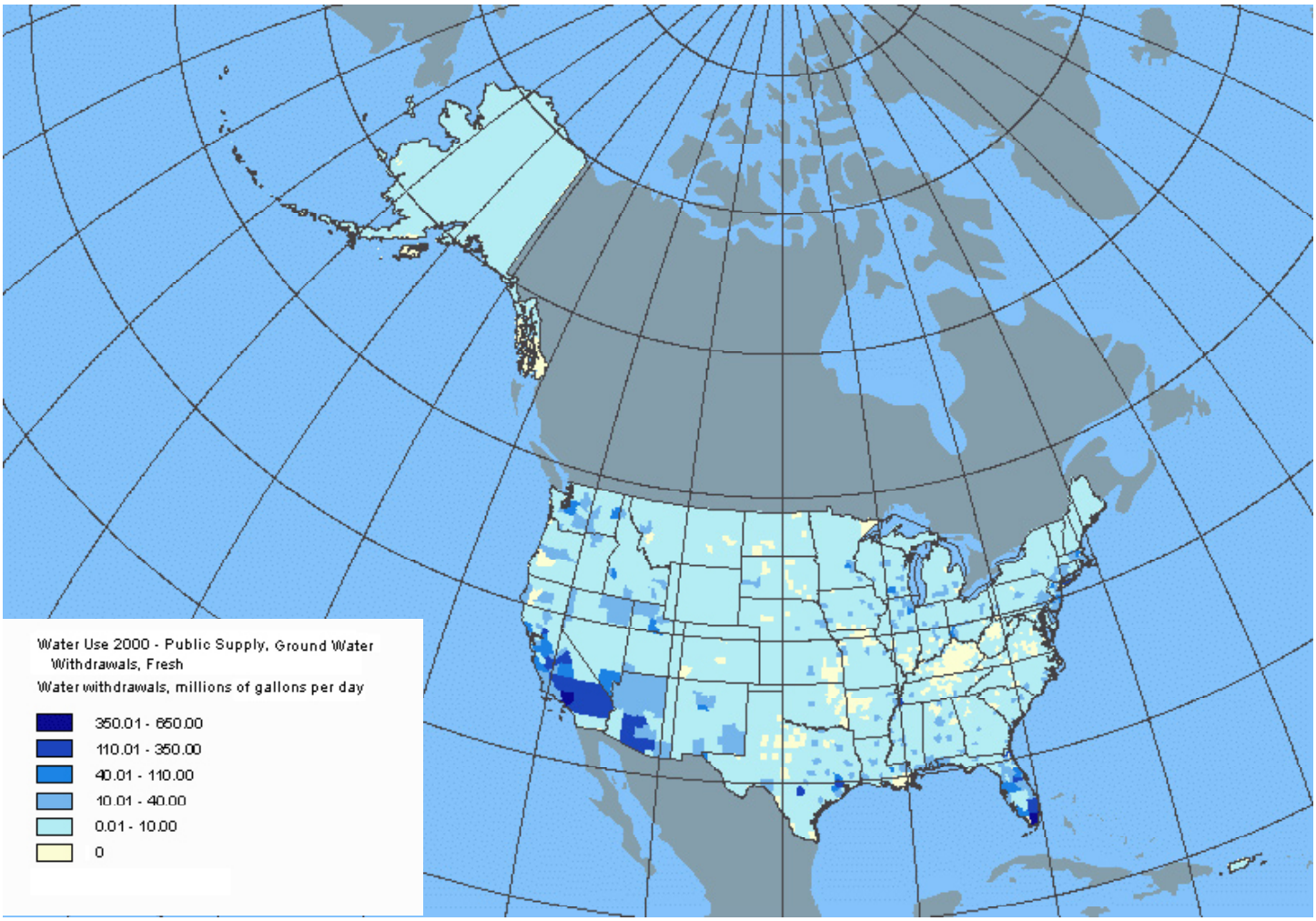
_BBC News



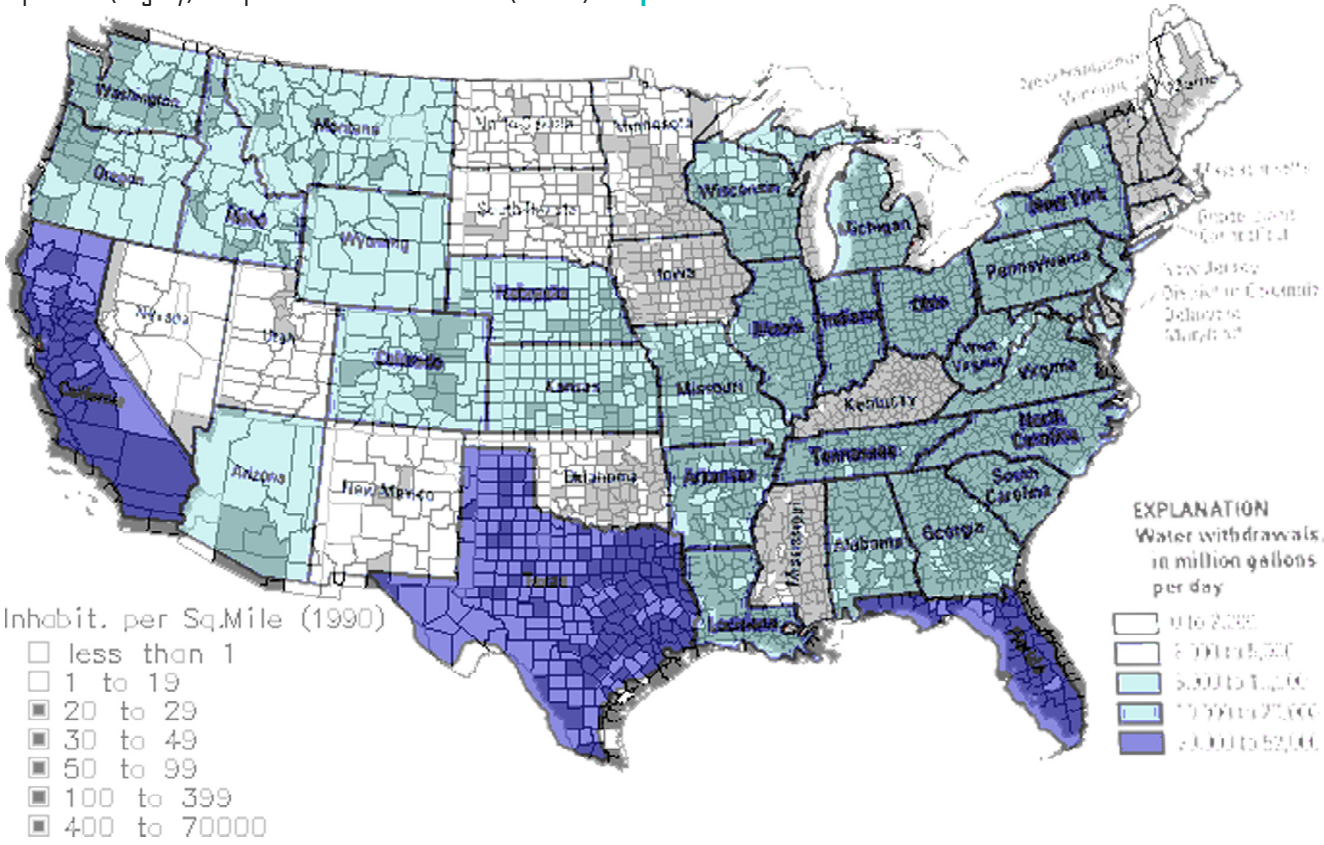
U.S. Water Use
Source: US Geological Survey



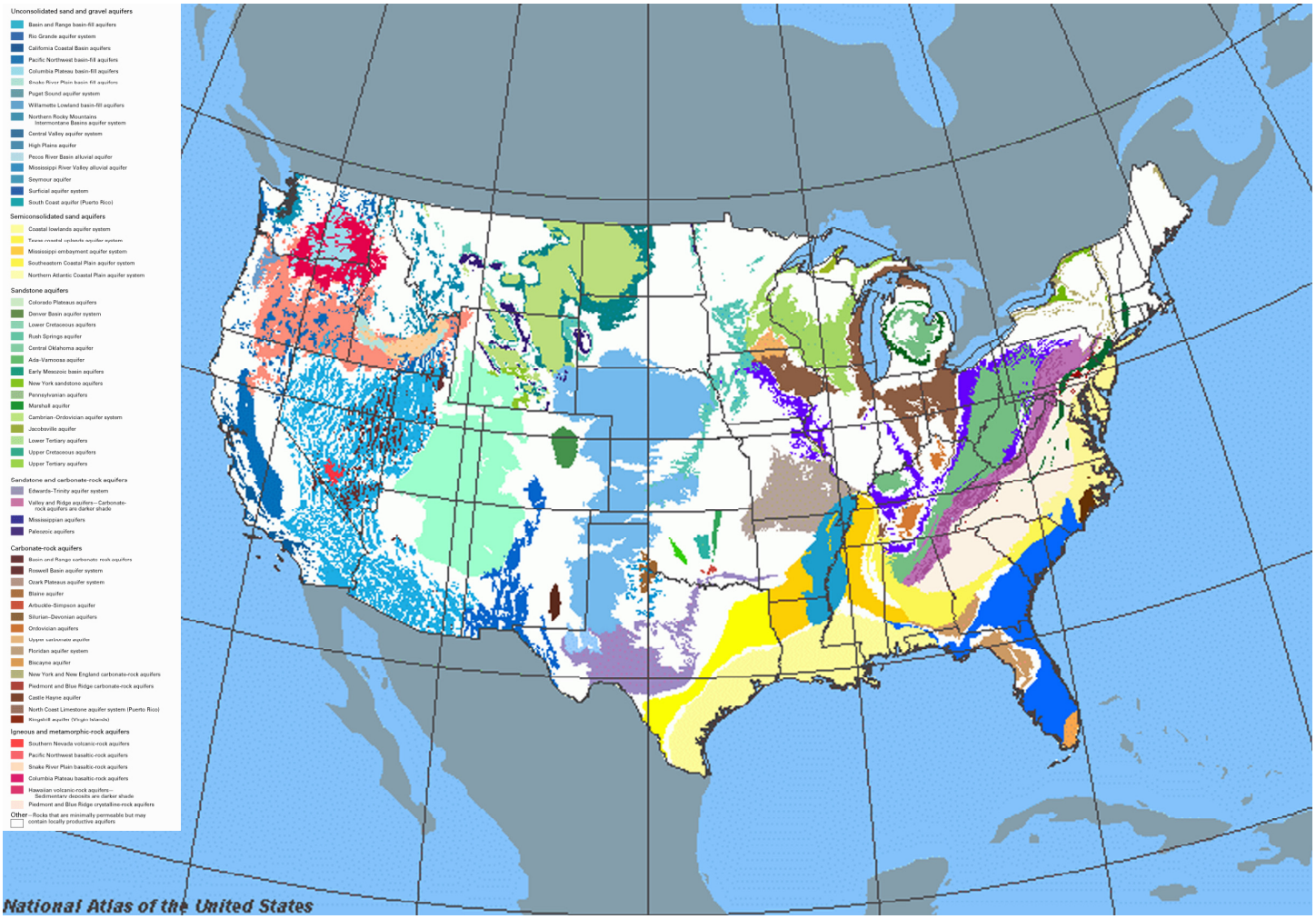
Water consumption includes more than just the residential and personal intake, but also a significant amount of water usage goes to building needs and agriculture.



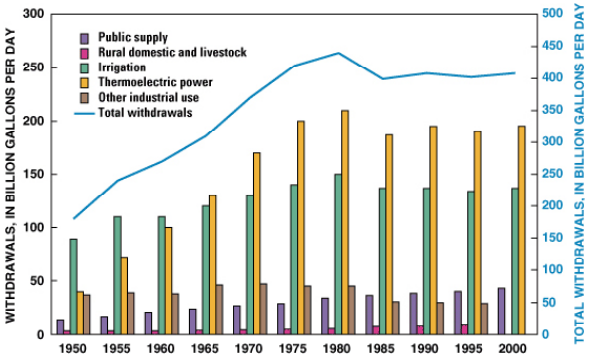
Population (in grey) compared to Water Withdrawl (in blue) - **Population size does not correlate with amount of withdraw**



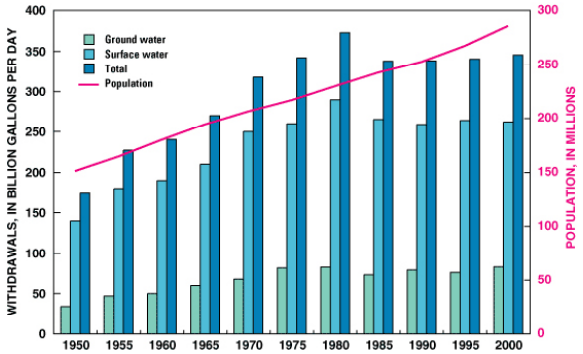
US Water Use
Source: National Atlas



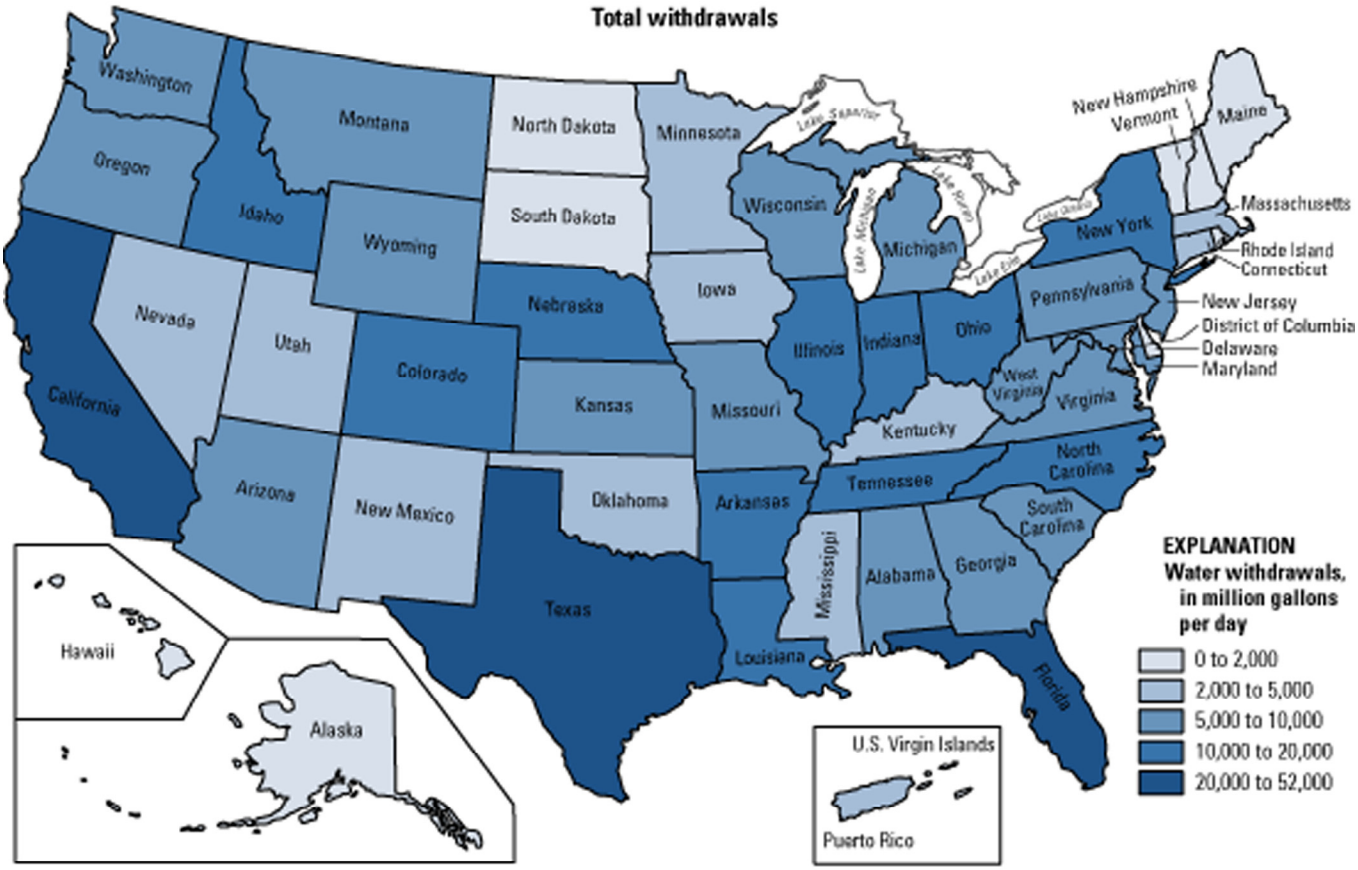
Trends in total water withdrawals by water-use category, 1950-2000

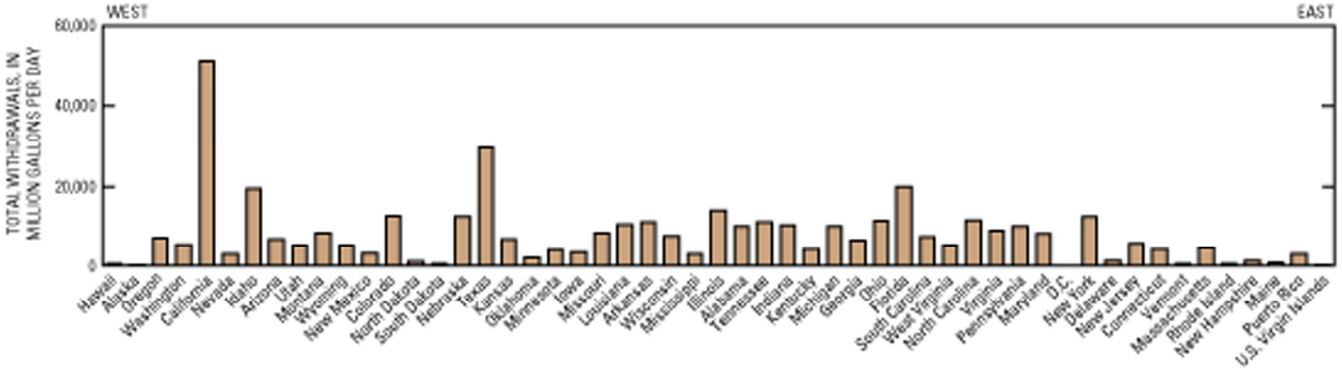


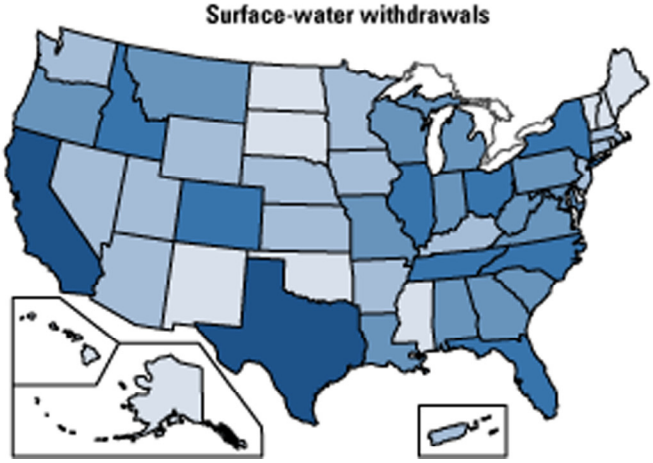
Trends in population and freshwater withdrawals by source, 1950-2000



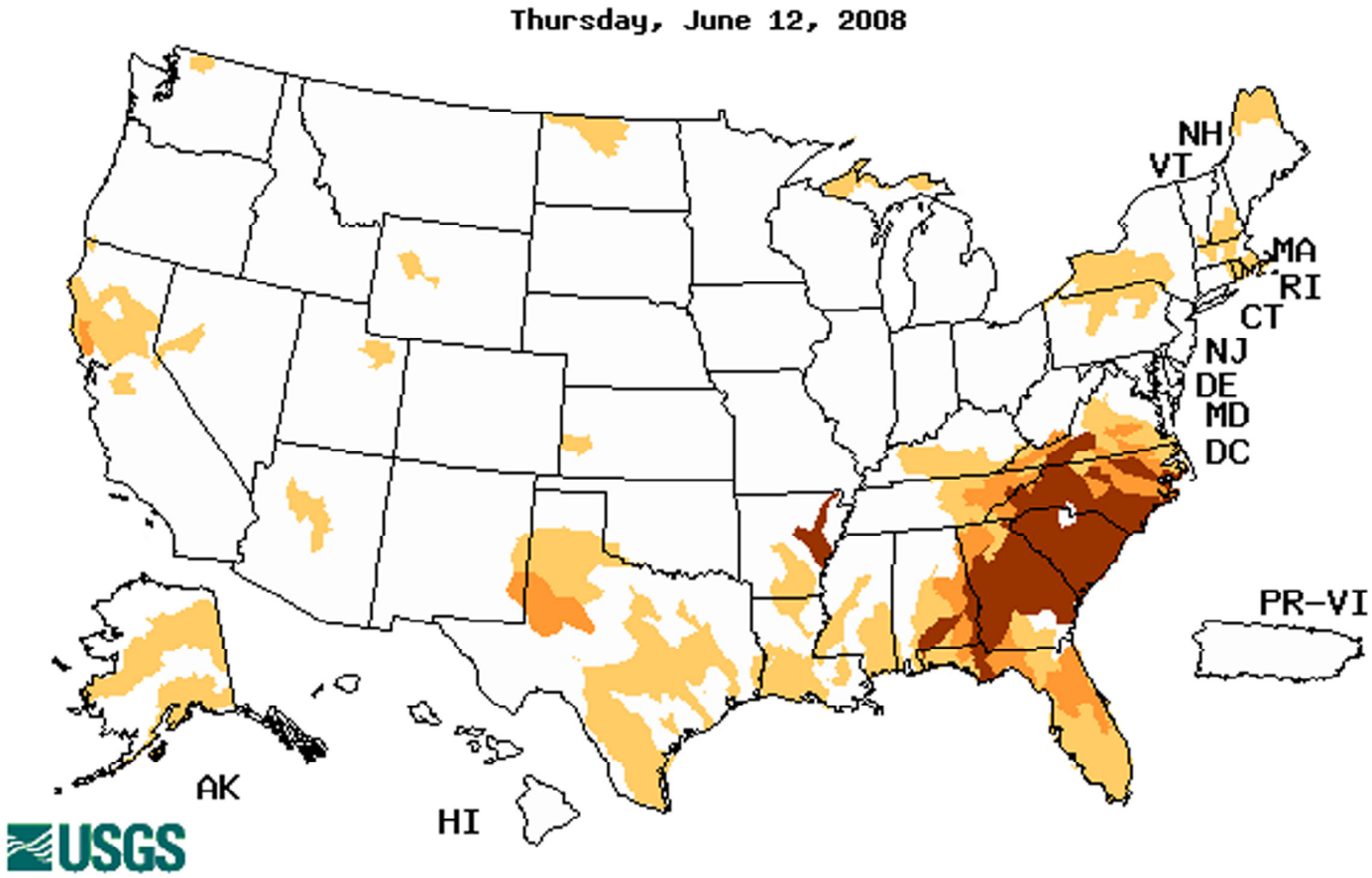
Water Use 2000 - Total Ground and Surface Water Withdrawals, Fresh and Saline
Source: US Geological Survey





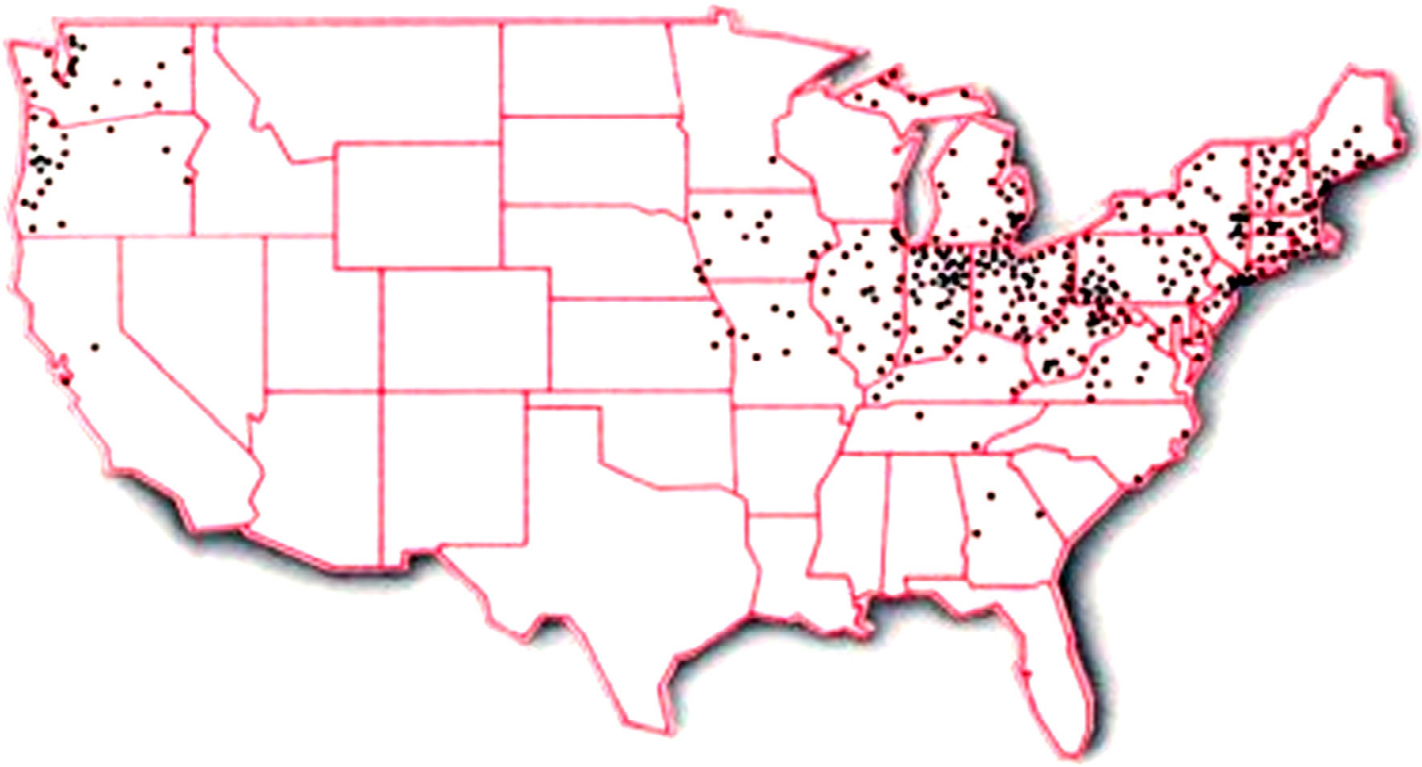


Estimated Use of Water in the United States in 2000
Source: US Geological Survey



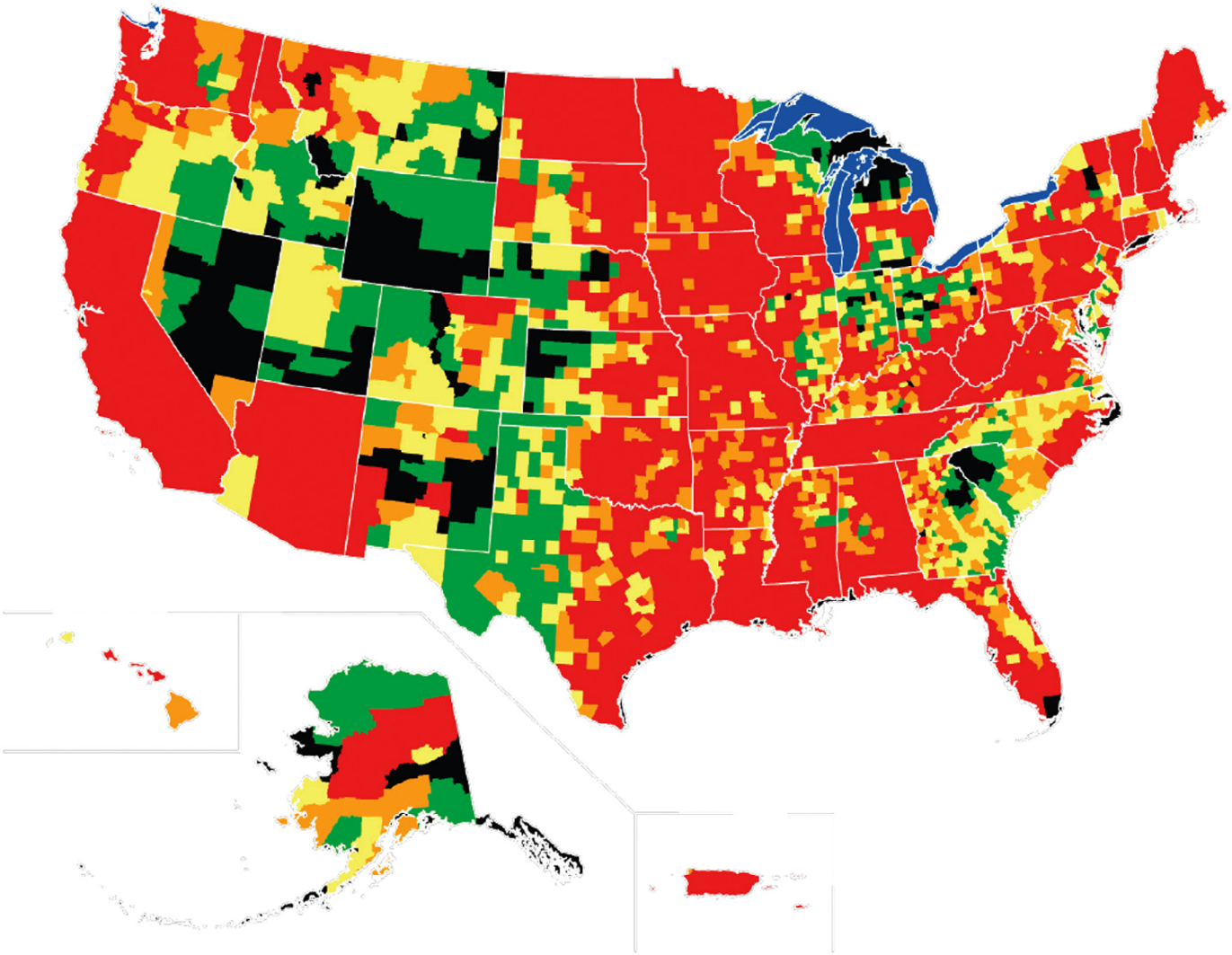
Explanation - Percentile classes				
Low	<=5	6-9	10-24	Insufficient data for a hydrologic region
Extreme hydrologic drought	Severe hydrologic drought	Moderate hydrologic drought	Below normal	

Map of below normal 7-day average streamflow
Compared to historical stream flow
Source: US Geological Survey



Combined storm and sanitary sewer systems in the U.S.

Combined Sewer Overflows
Source: http://cfpub.epa.gov
US Environmental Protection Agency



Presidential Disaster Declarations
Related to Flooding in the United States
Source: US Geological Survey

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

_RESOURCES

Labs, Kenneth and Donald Watson, FAIA. Climatic Design: Energy-Efficient Building Principles and Practices. New York: McGraw-Hill Book Company, 1986.

McHarg, Ian. Design with Nature. New York: The Natural History Press, 1969.

National Atlas. <http://www.nationalatlas.gov>

Olgyay, Victor. Design with Climate: Bioclimatic Approach to Architectural Regionalism. Princeton: Princeton University Press, 1963.

Outwater, Alice. Water: A Natural History. New York: HarperCollins, 1996.

U.S. Geological Survey. "Water Resources of the United States." <http://water.usgs.gov>

World Meteorological Organization. "World Hydrological Cycle Observing System." <http://www.whycos.org>

World Resources Institute. "Earthtrends: The Environmental Information Portal." <http://earthtrends.wri.org>

World Water Council. <http://www.worldwatercouncil.org>