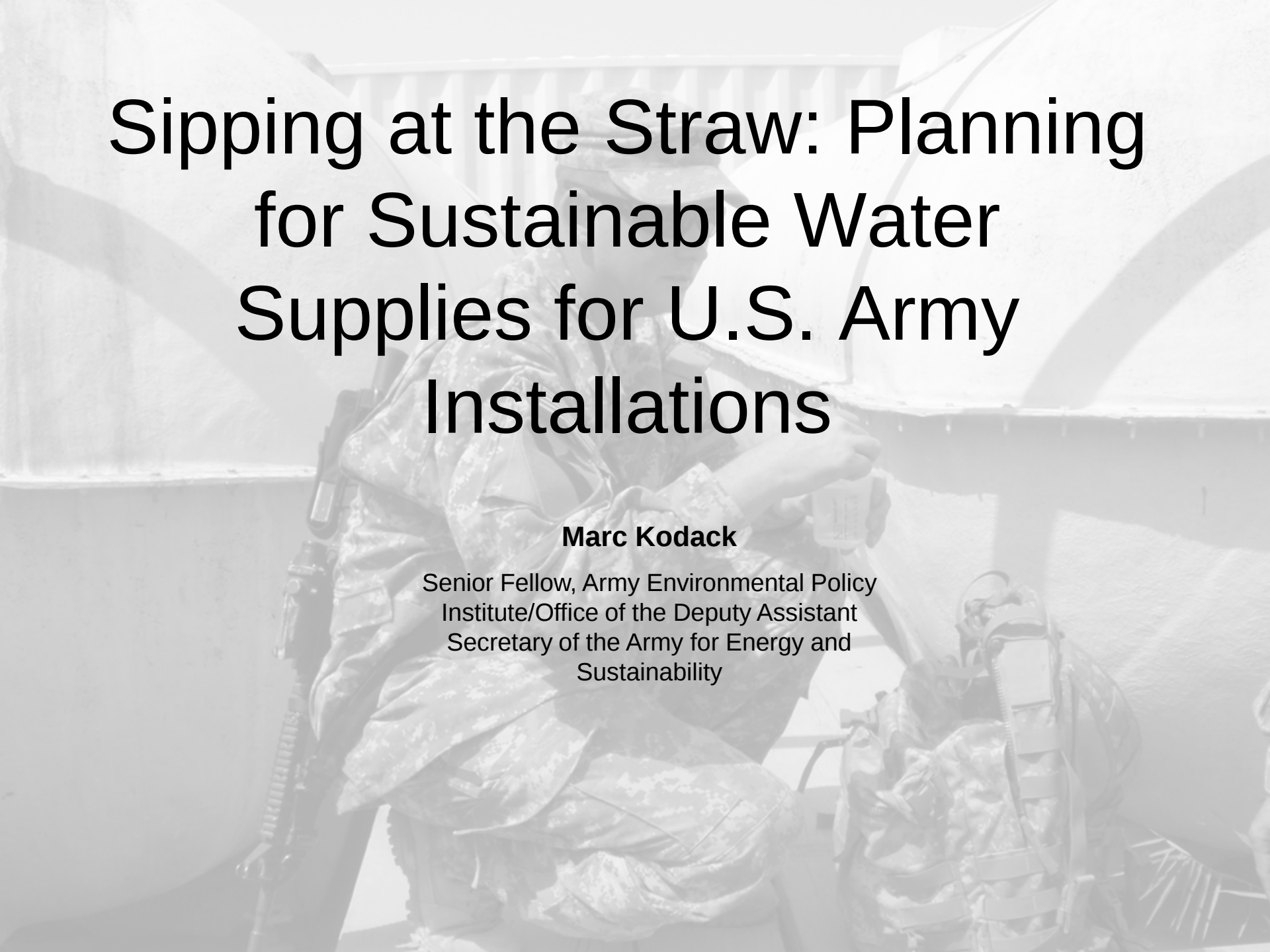




Sipping at the Straw: Planning for Sustainable Water Supplies for U.S. Army Installations

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Water Challenges

- Energy/water nexus
- Balancing supply with demand
- Aging infrastructure
- Complex water rights issues
- Cost vs. price imbalance
- Quality degradation

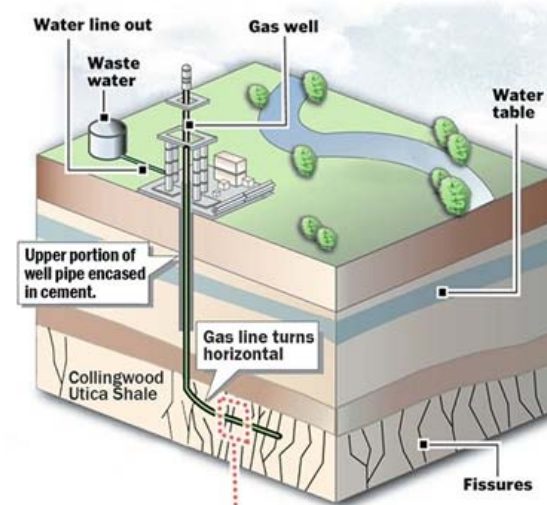




Energy/Water Nexus



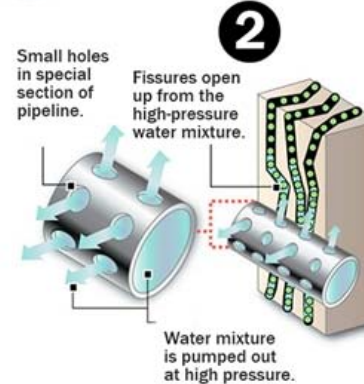
- Thermoelectric power
- Geothermal
- Biofuels
- Solar-hot water
- Hydropower
- Carbon Capture
- “Fracking”



Hydraulic Fracturing
A new way of drilling for natural gas



1. Drilling for maximum effect
The drilling turns horizontal at about 9,000 feet, hitting multiple fissures and increasing the volume of available natural gas.



2. Putting the Pressure On
A mixture of water, sand and chemicals is pumped into the pipe-line, which has small holes through which the mixture is forced. Fissures open up from the high-pressure water mixture.

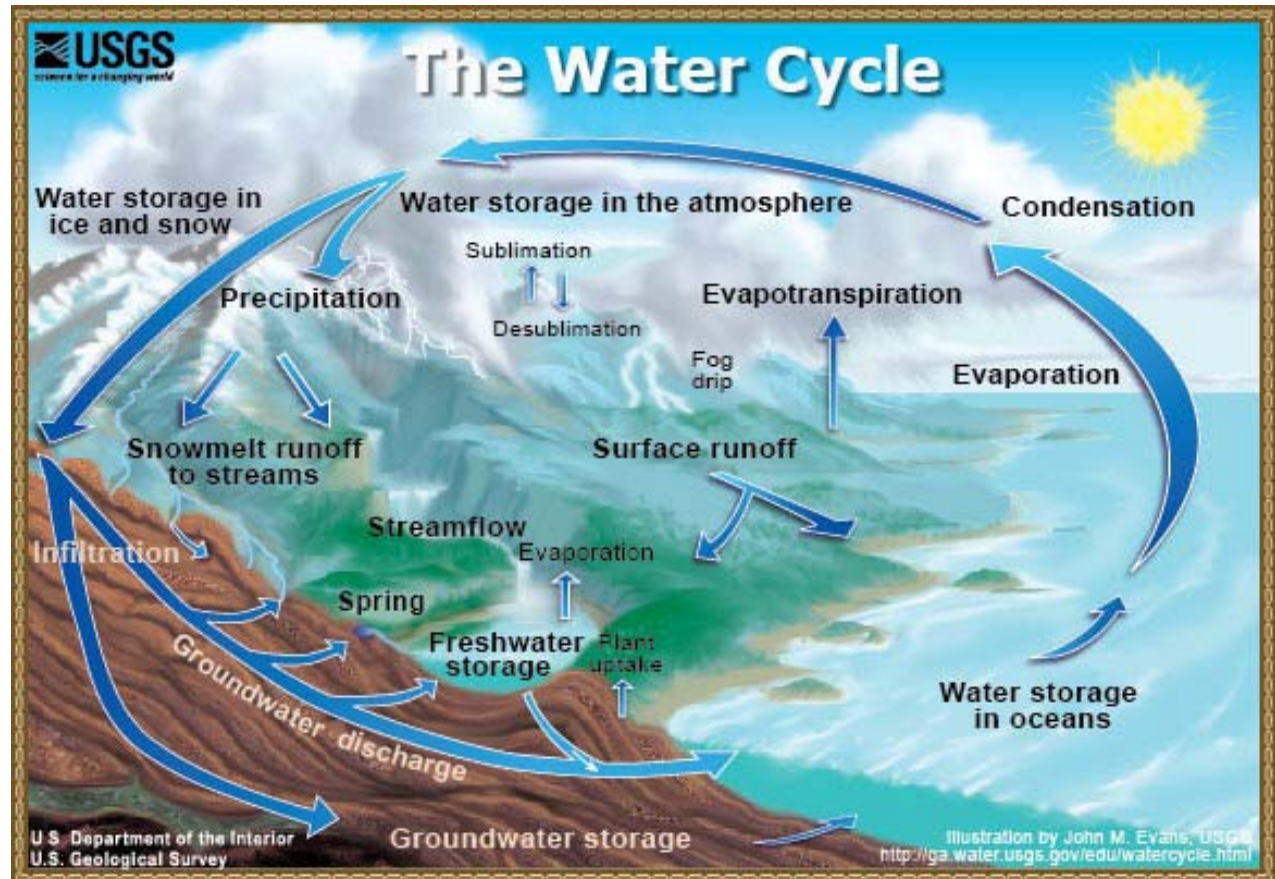


3. Increase Gas Flow
The small fissures are widened by the pressure. The water mixture is pumped back out of the well and natural gas follows back up the pipeline to the wellhead.



Regional Water Balance?

- Supply
 - Rivers
 - Aquifers
- Demand
 - Installation
 - Public Supply
 - Domestic
 - Industrial
 - Agriculture





Three states use a quarter of U.S. water

Florida, California and Texas lead the country in water usage. The government projects that at least 36 states will face water shortages within five years.

Estimated water withdrawals, in million gallons per day in 2000

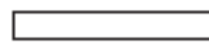
0 to 5,000

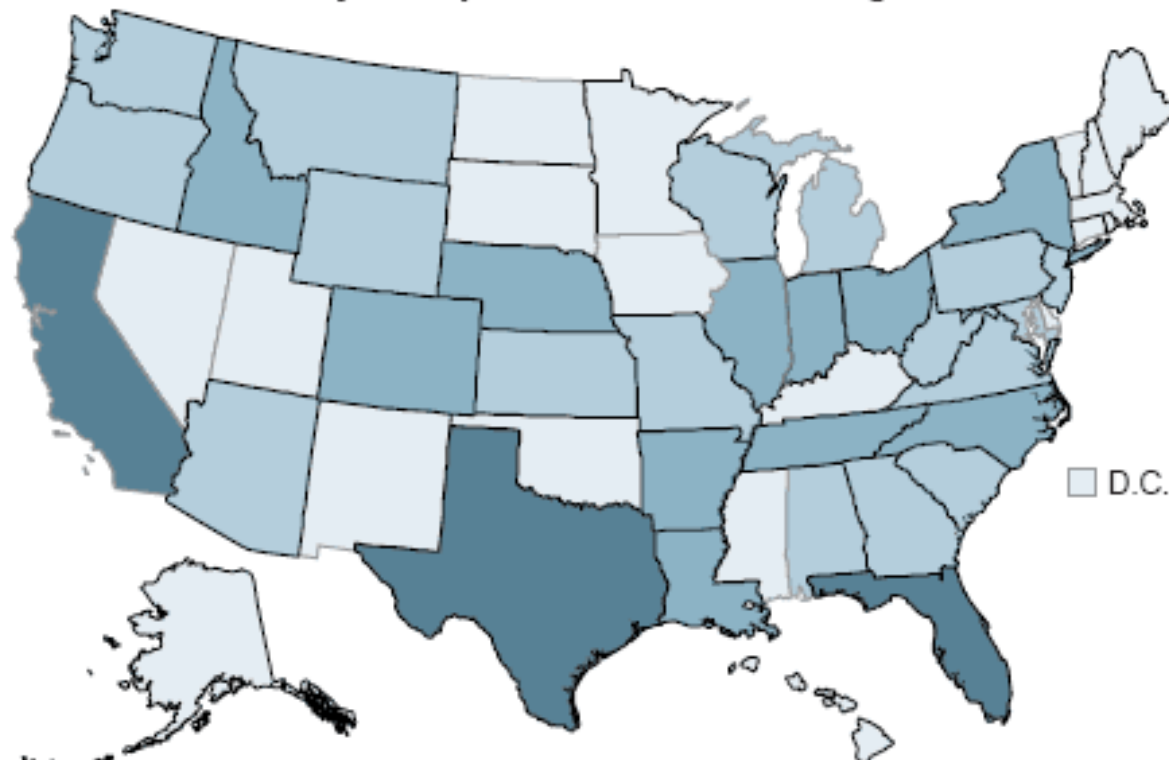
5,001 to 10,000

10,001 to 20,000

20,001 to 52,000



 Likely to experience water shortage before 2013*



* Colorado and South Carolina are statewide.
All other states are regional or local.

Supply



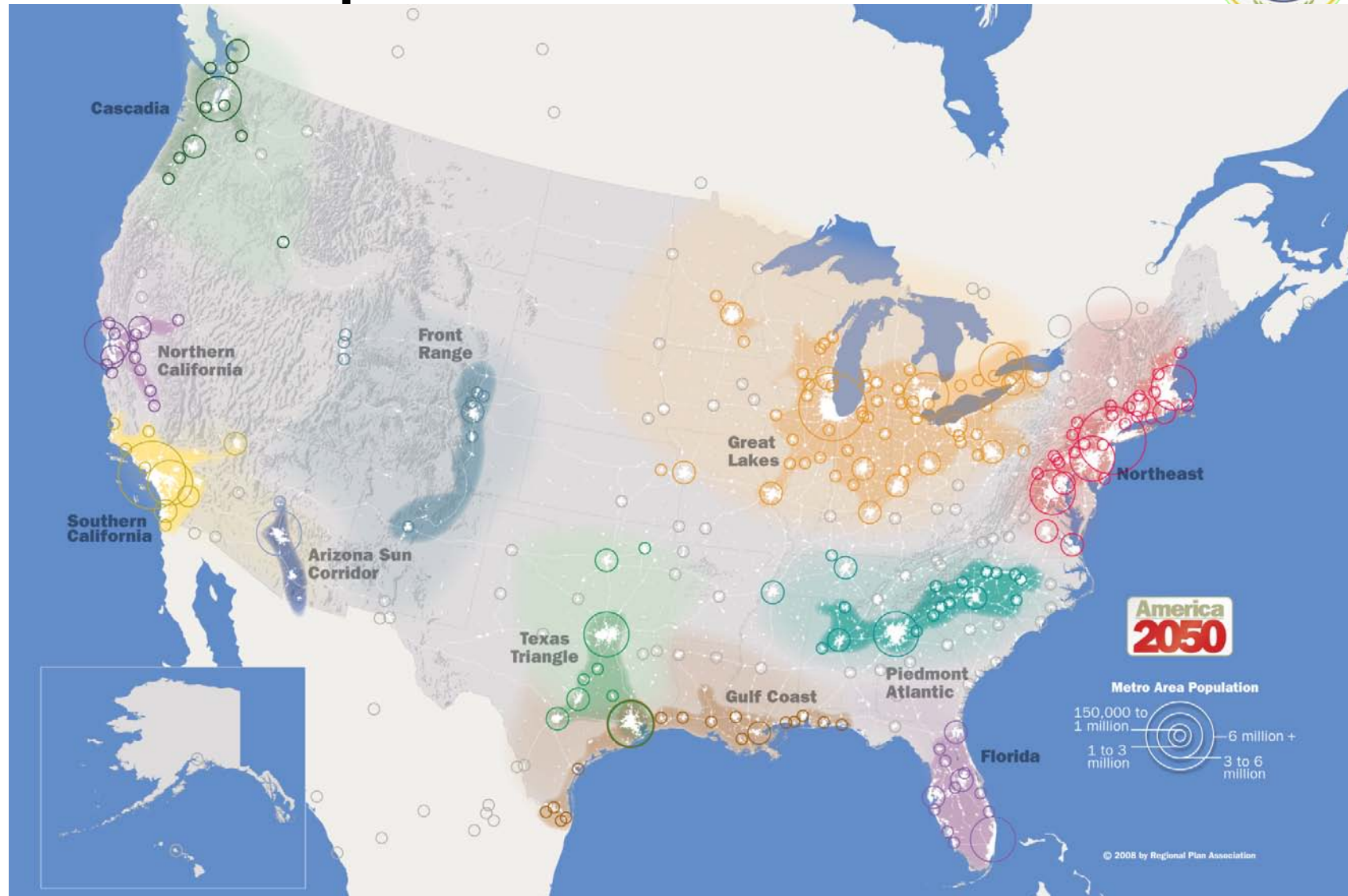
Lake Meade, AZ and NV

Supply





Population Growth

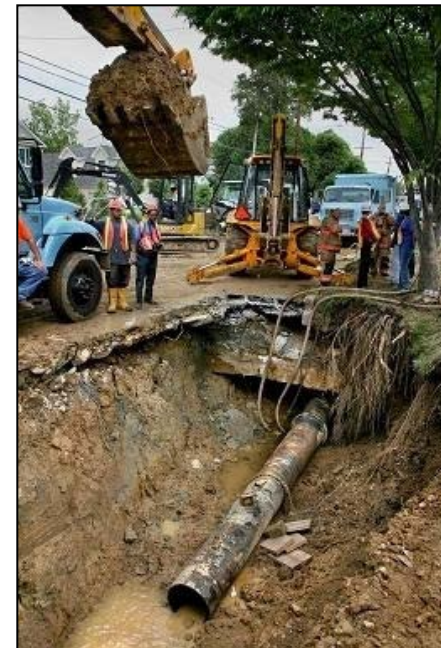


Demand



Aging Infrastructure

- 240,000 water main breaks/year
- 1.7 trillion gal/year lost costing \$2.6 B
- American Water Works Association targets 15% for unaccounted water
- Infrastructure report card: D-
- Gap analysis: \$500B shortfall by 2030

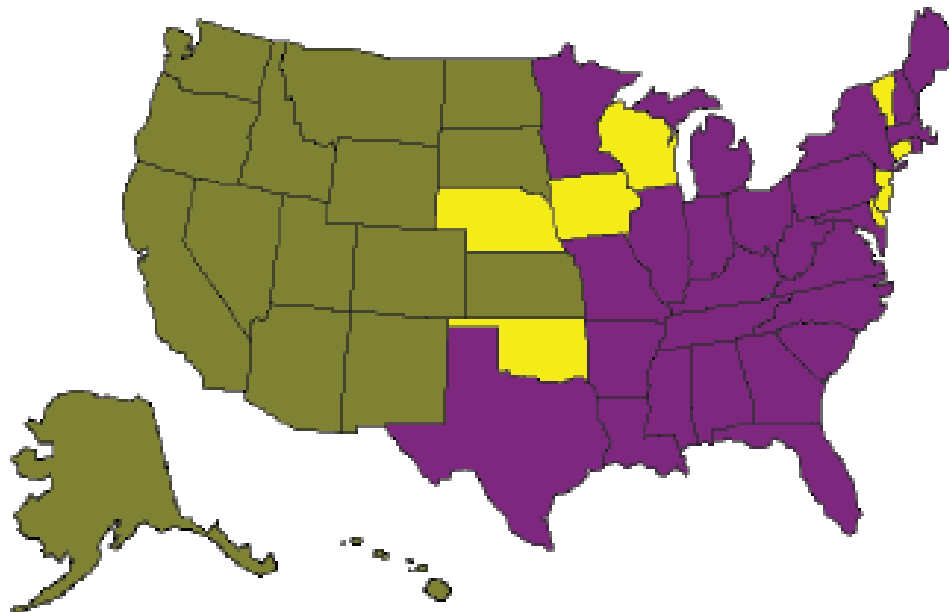




Complex Water Rights

- Regulated Riparian
- Prior Appropriation

Legal Allocation of Water: 48% (shown in purple) of the 50 states allocate water by riparian rights of landowners and 38% (shown in green) by prior appropriation doctrine (the right to use the water). The other states (shown in yellow) have a mix of laws or some other type of authority.





Quality Degradation

Degraded water cannot be considered a viable source

Contaminants in Drinking Water

The Safe Drinking Water Act regulates 91 contaminants. Here are four that, when consumed over long periods, even at the legal limit, are associated with cancer, according to government assessments. Maps show 25 water systems with the highest detection levels.* To find data for your water system, visit nytimes.com/contaminants.

ARSENIC A metal that enters water through erosion of natural deposits and runoff from electronics processing and treated wood.

Total organic and inorganic

KEY

- 25 water systems with the highest detection levels.*
- Labeled systems have violated the Safe Drinking Water Act, according to E.P.A. data.



Cancer risk:

1 in 600

Lifetime ingestion at the U.S. legal limit.

U.S. legal limit: 10 parts per billion

CHROMIUM Used in the production of metal alloys. Chromium can degrade to hexavalent chromium. Some studies indicate that as much as 80 percent of the chemical in water is hexavalent chromium, a carcinogen.

The top 25 shown are for total chromium



1 in 600

(Hexavalent chromium)

100 parts per billion

PERC A chemical used in dry cleaning and factories.

Tetrachloroethylene or perchloroethylene



1 in 12,000

5 parts per billion

URANIUM A radioactive element commonly found in most rocks; used for power generation and weapons manufacturing.

Uranium 234, 235 and 238 combined



1 in 16,666

30 parts per billion

*Highest averages from 2004-08 for communities with at least 5,000 people, and at least 10 test samples.

Note: Maps do not include results for five states that did not supply data (Georgia, Kansas, Louisiana, Mississippi and Tennessee) and one state (California) that was excluded because some water systems test for contaminants before water is treated.

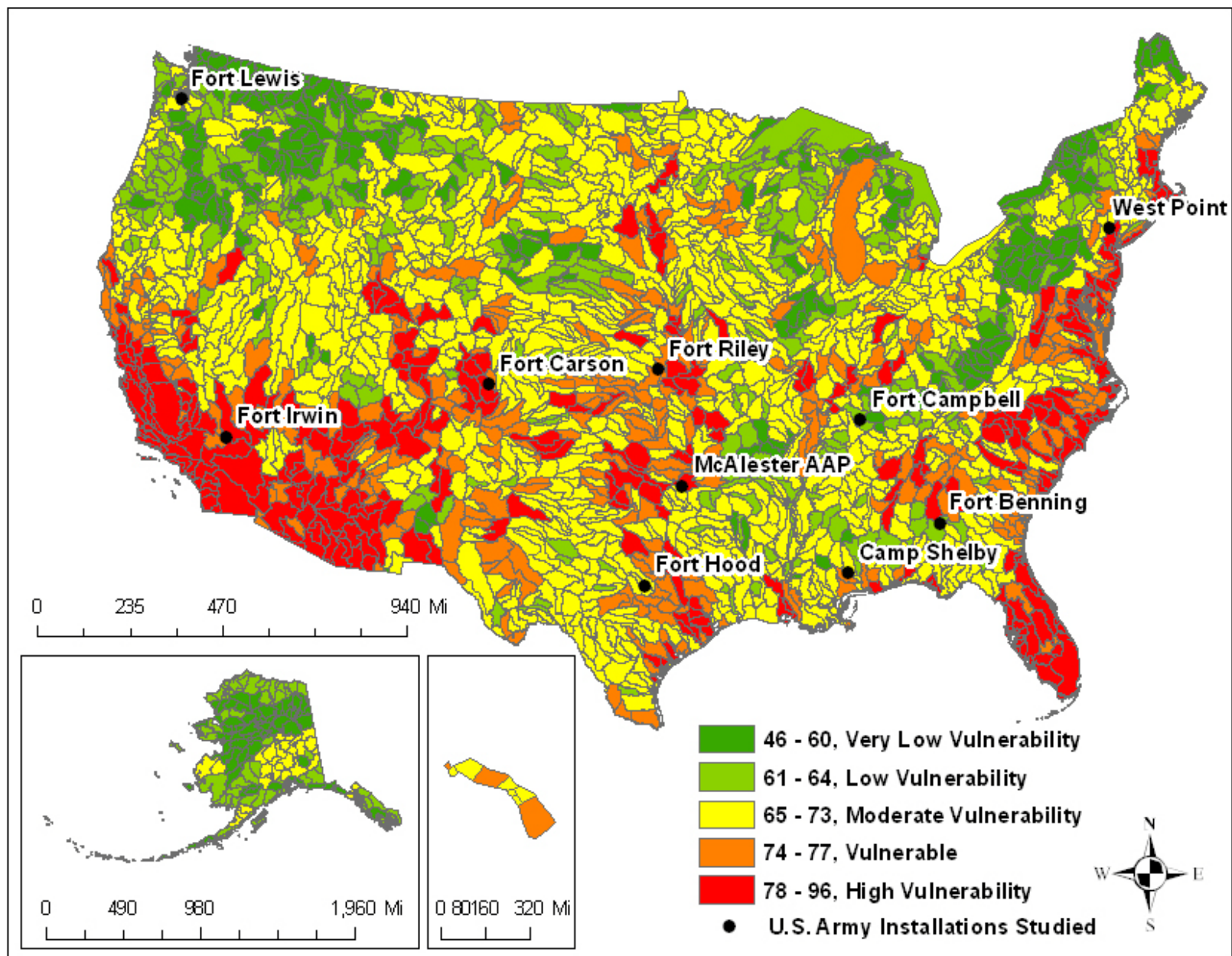
Sources: Environmental Working Group; Environmental Protection Agency; California Office of Environmental Health Hazard Assessment; National Academy of Sciences



Long-term Regional Studies with Broad Applicability

- Assess 30-year water supply and demand for sample of Army installations
 - Method developed in 2009 at two pilot studies
 - Applied to 10 domestic and 3 overseas installations

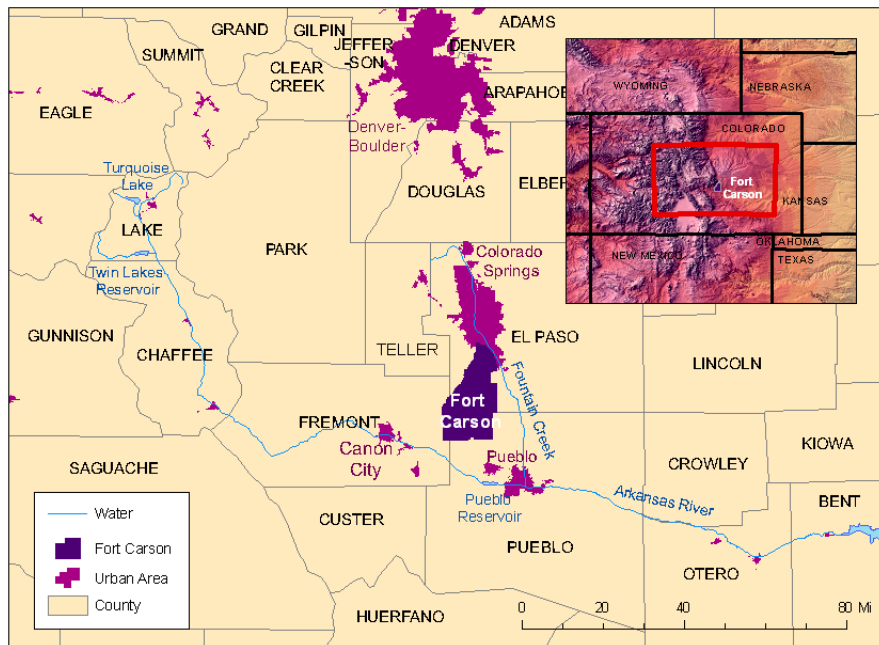
Fort Bliss, TX
Fort Bragg, NC
Camp Shelby, MS
McAlester AAP, OK
Fort Benning, GA
West Point, NY
Fort Hood, TX
Fort Carson, CO
Fort Campbell, TN/KY
Fort Riley, KS
Joint Base Lewis-McChord, WA
Fort Irwin, CA
USAG Humphreys, Korea
USAG Grafenwoehr, Germany
USAG Vicenza, Italy





Fort Carson, CO

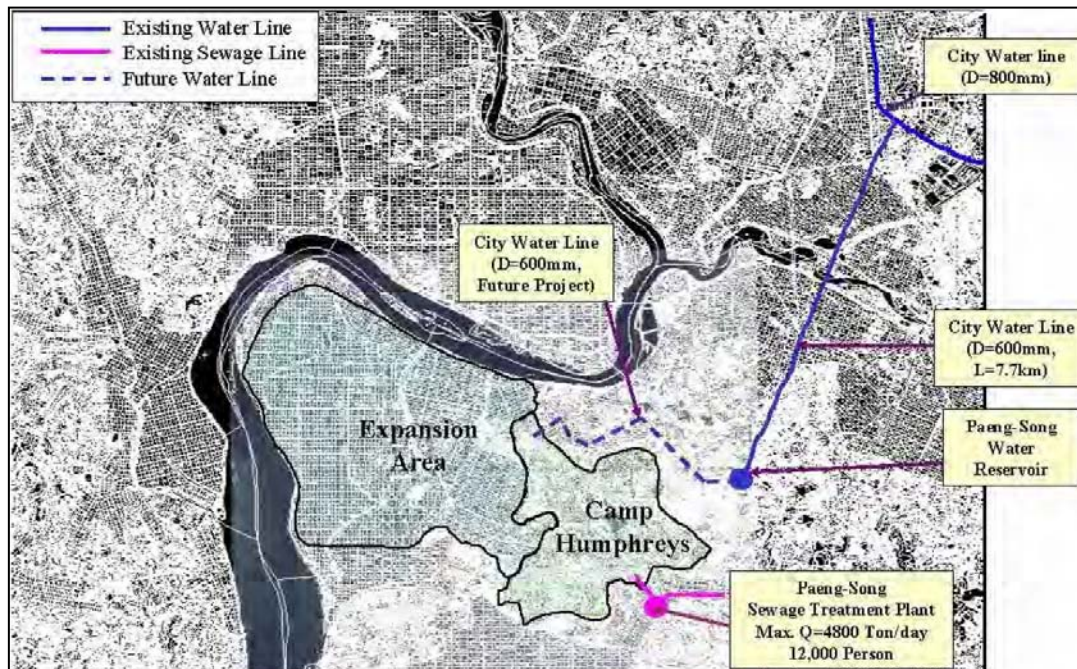
- Award winning water conservation program
 - Alternative sources, recycling, and reclamation
- Regional over appropriation of water resources
- Climate change may lead to declines in runoff, higher temperatures, and earlier snowmelt
- Increasing infrastructure costs





USAG Humphreys, South Korea

- Increasing demand
- Fluctuating supply
- Lack of access to relatively abundant water resources
 - Natural patterns of seasonal and regional water distribution
 - Condition of distribution systems
 - Topography



- Water quality
 - Non-point source pollution
 - Wastewater treatment
- Water storage planning
- Climate change: temperature rise, increased variability of precipitation



General Observations

- Need installation of more water meters
- Water rights may be limiting factors for some installations
- Climate change will exacerbate scarcity in arid regions and affect availability in historically wet regions
- Need aggressive leak detection program
- Need long-term strategy for water management
 - Army water security strategy
 - Regional solutions
 - Identifying embedded water in supply chain



Abrams Tank





Abrams Major Suppliers





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Report will be posted on <http://www.aepi.army.mil>