The Future of Water:
Will Our Data Beat Our Instincts?

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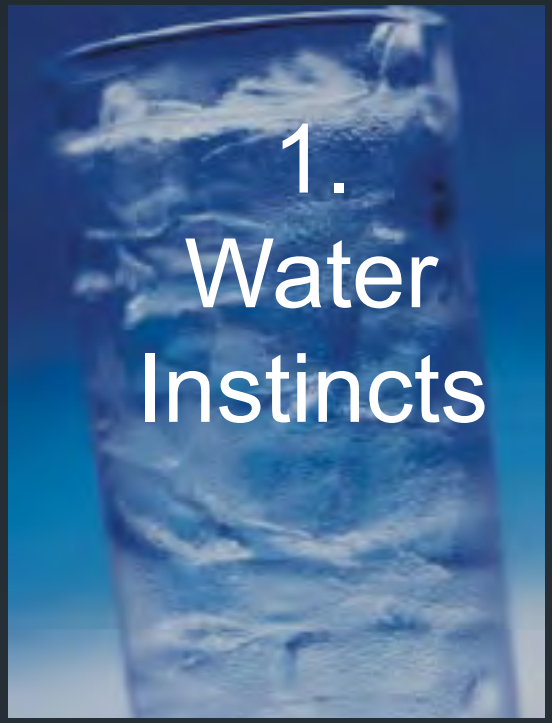
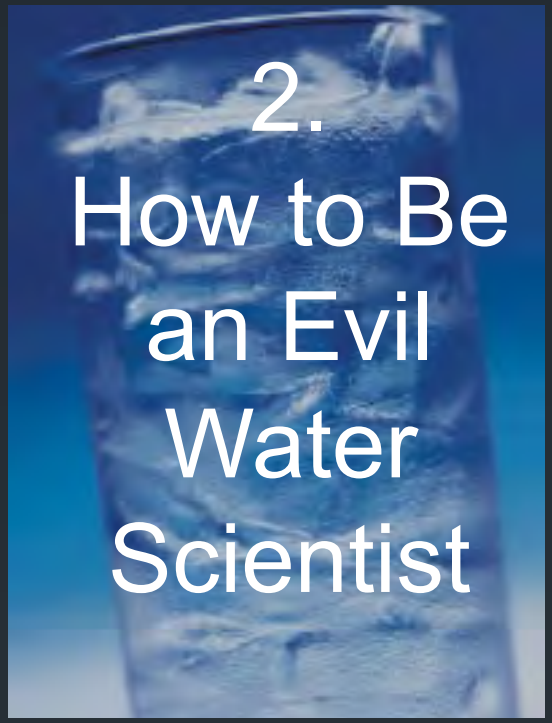
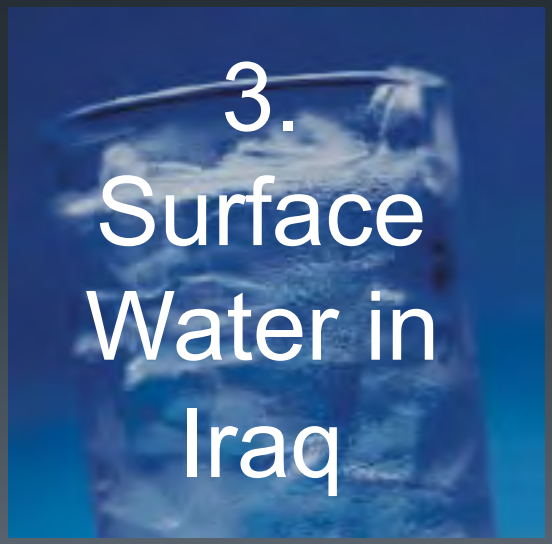
Lake Tharthar, Iraq, *photographer: Barik Al-Samarrai Photography*

A word from the OSU legal dept…

- The views on this important issue are those of Dr. Halihan, not Oklahoma State University or its school of geology
- Through in-depth research, Dr. Halihan provides vital scientific data that is helping with the study of seismic activity in our region
- We would hope this research will further the study and conversation, informing key players and decision-makers
- As a land-grant university, Oklahoma State University has an obligation to conduct research and share that research with society
- We welcome your thoughts and views on this issue


1.
Water
Instincts


2.
How to Be
an Evil
Water
Scientist


3.
Surface
Water in
Iraq


4.
Ground
water
in OZ

Instinct – “deeply filled or permeated”

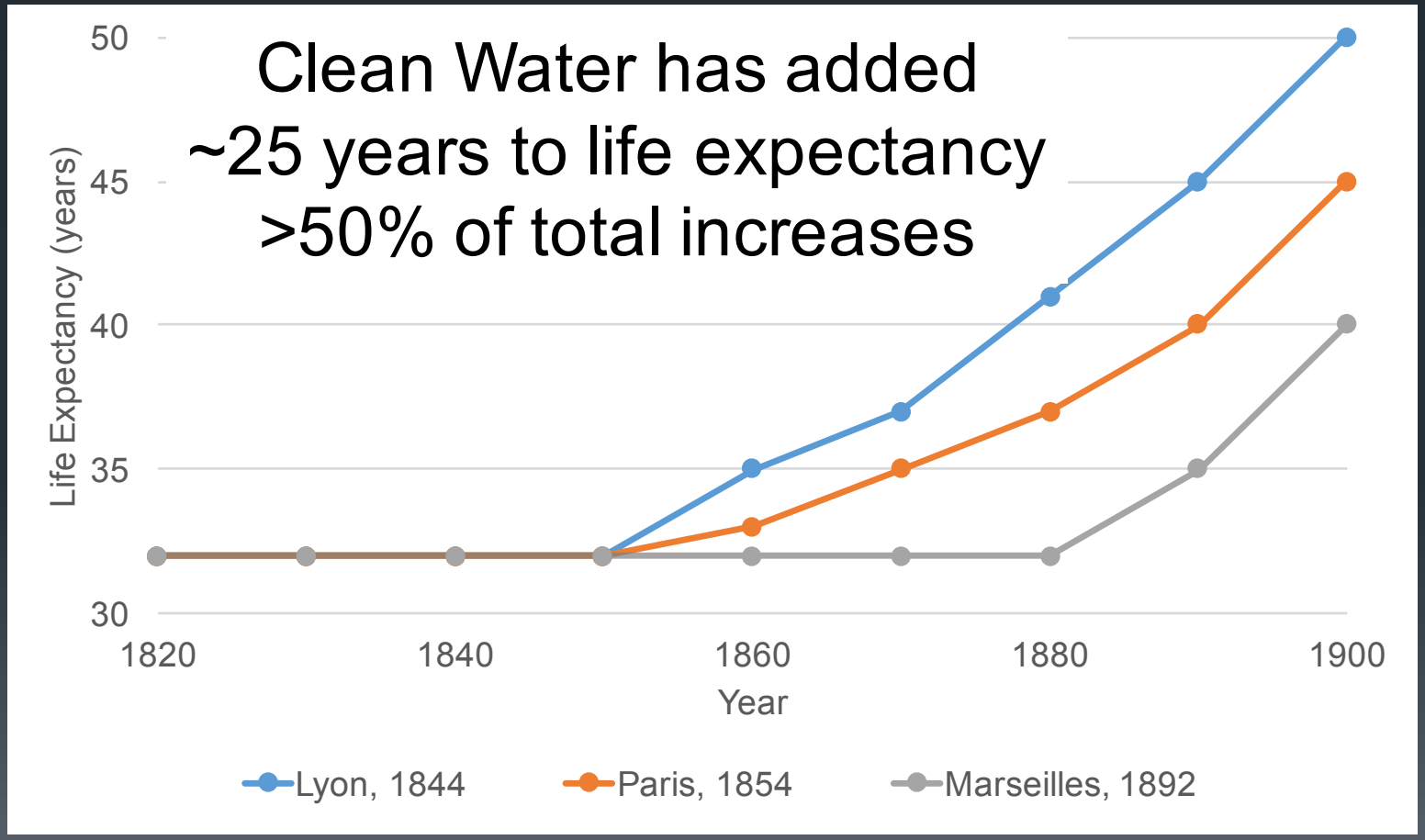
What is this a picture of?

- glass ?
- water ?
- ice ?
- air ?

The very essence of instinct is that it's followed independently of reason.
Charles Darwin

http://www.greatervernonwater.ca/

Which profession adds the most to human life?



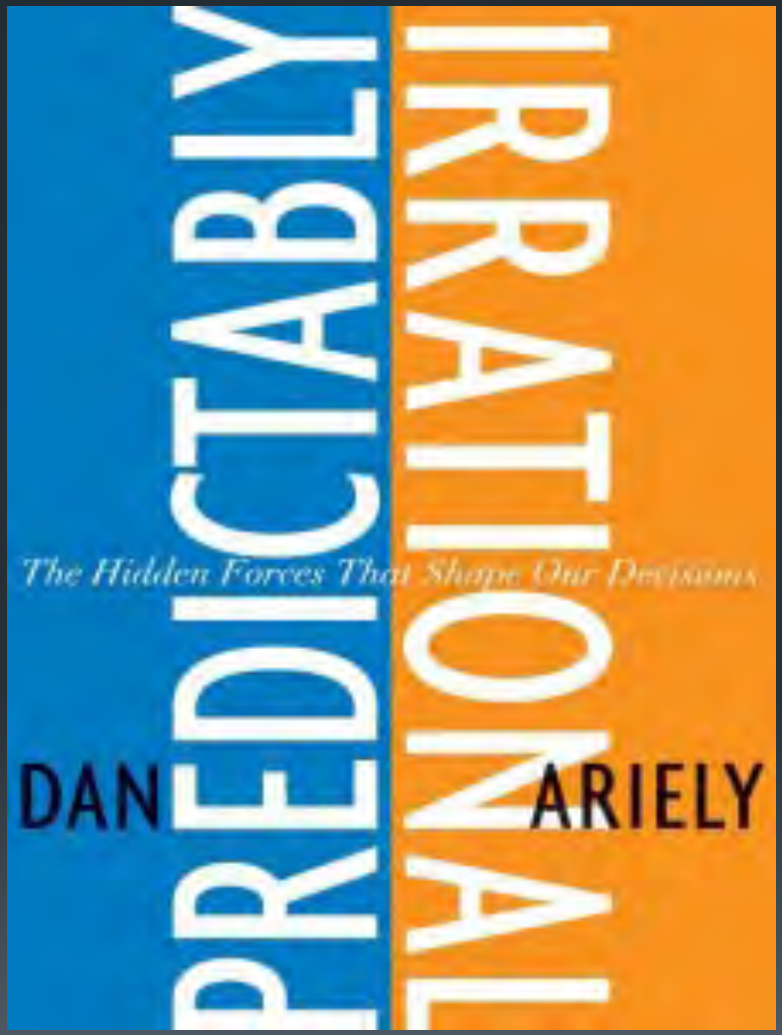
Briscoe, 1987

Pore Instincts

1. We aren't improving management of water through project investment.

2. Groundwater research is just starting.

3. Conflict in water resources management is good.



1. What are you buying?
2. How much would you pay/invest?

1) Water Instincts

Michael Friberg;
Glen Canyon Dam, AZ; propublica.org

1. What are you buying?
2. How much would you pay/invest?

1) Water Instincts

Irrigation well, NV; nevada.usgs.gov

How much for a bucket?

Surface Water – 0.12 M km^3 - \$1B/km^3

(0.72 tsp)

Ground Water

8 M km^3

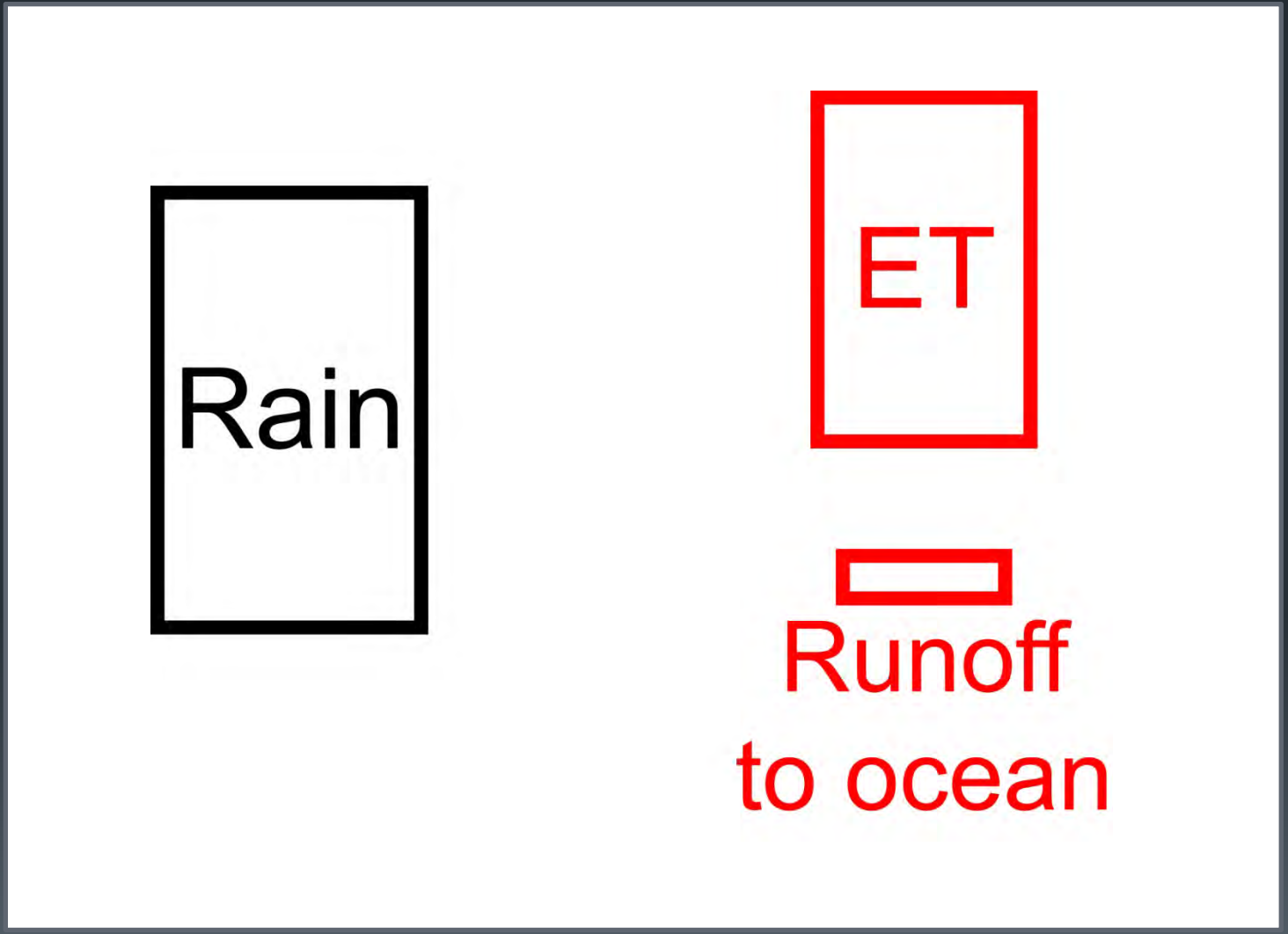
\$0.0001B/km^3

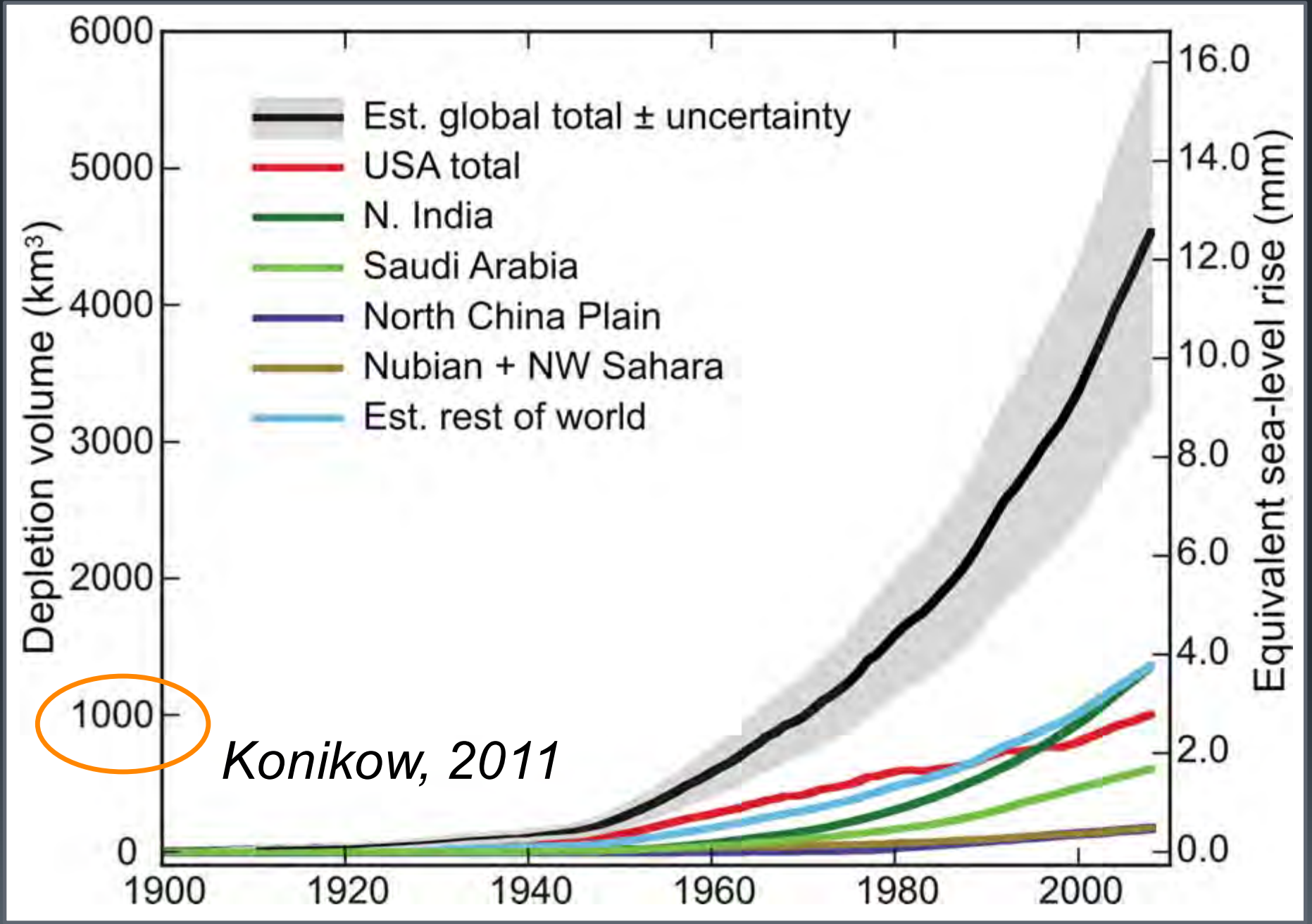
(1 cup)

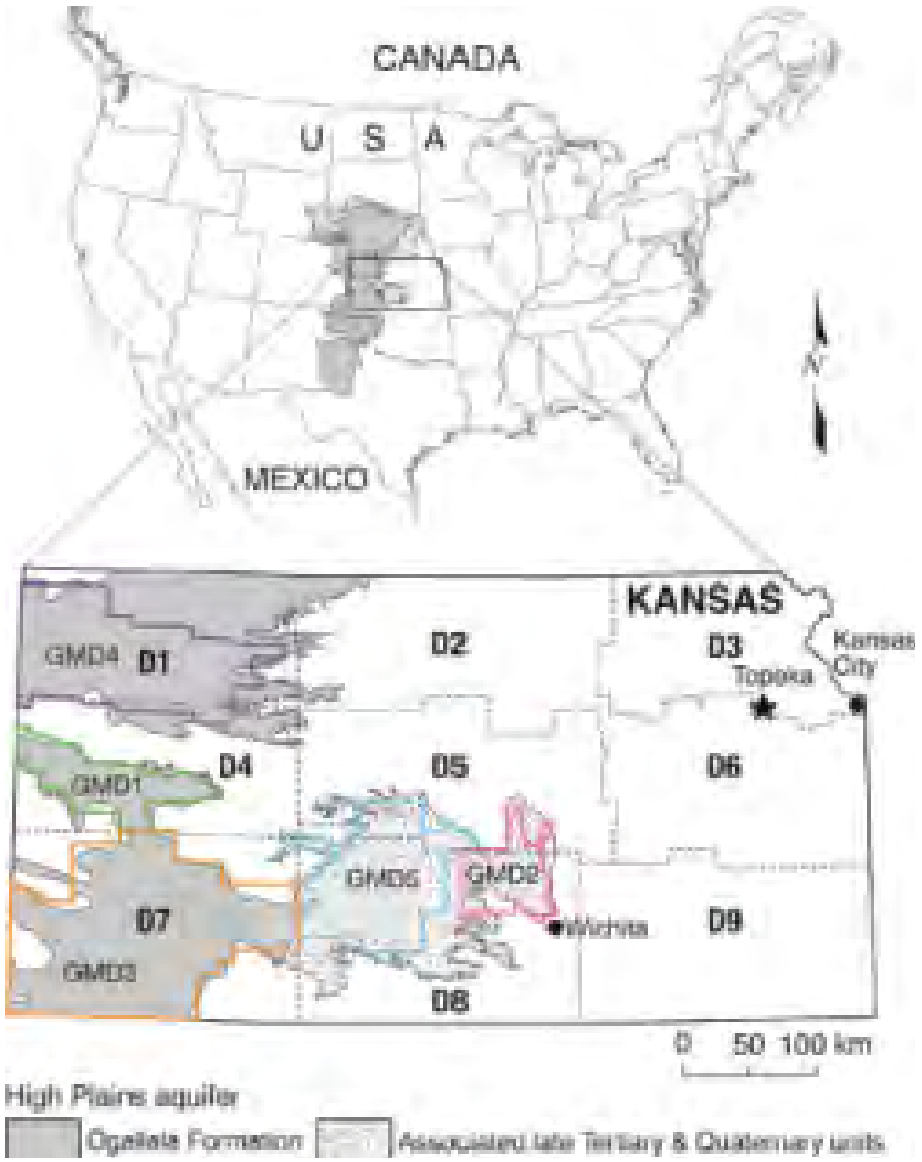
What is our biggest “use” of water?

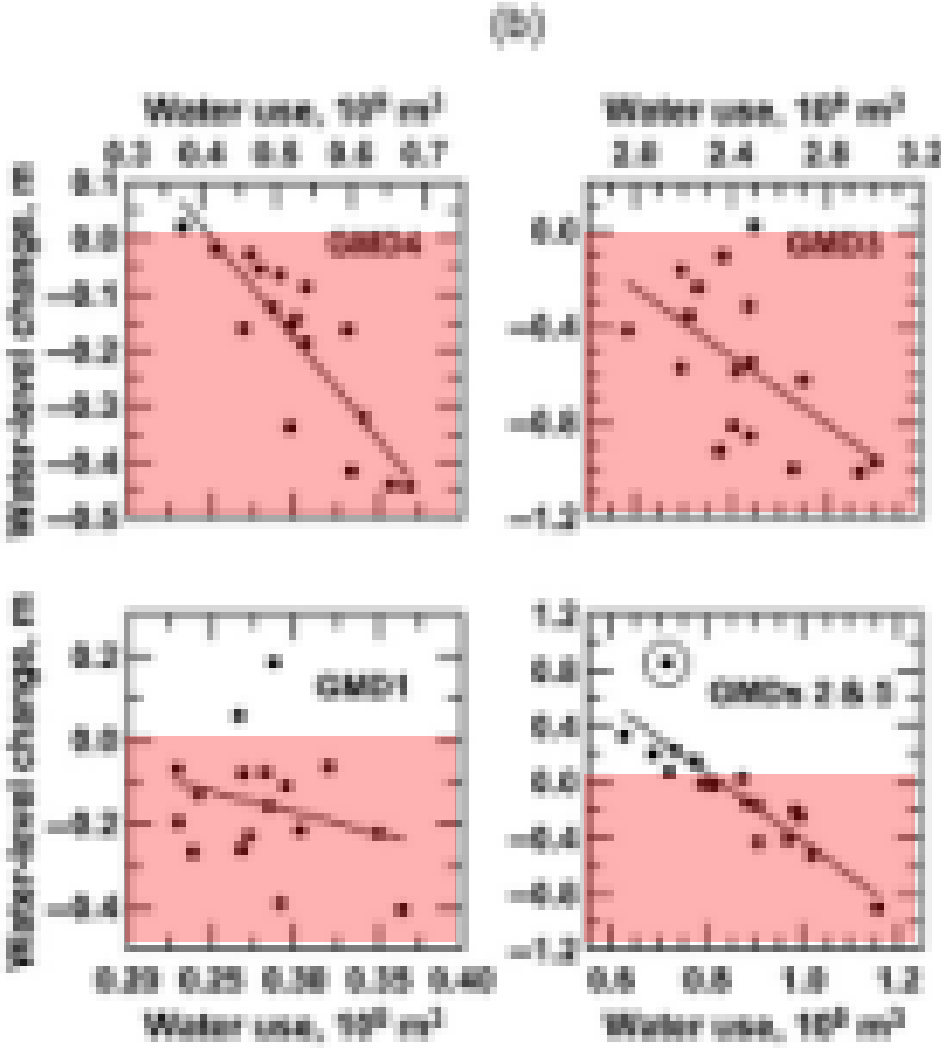
To convert it to water vapor
via irrigation (lawns, crops) and “storage”

Where is the water used?




Est. global total ± uncertainty
USA total
N. India
Saudi Arabia
North China Plain
Nubian + NW Sahara
Est. rest of world
Depletion volume (km³)
Equivalent sea-level rise (mm)
6000
5000
4000
3000
2000
1000
0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
1900
1920
1940
1960
1980
2000
Konikow, 2011





Whittemore et al., 2016

Water for sustainable human use should be in the ground.

1. No evaporation tax - salinization
2. Cheap
3. Can deal with climate variability
4. Flood control
5. Drought management
6. Can make *Electricity*

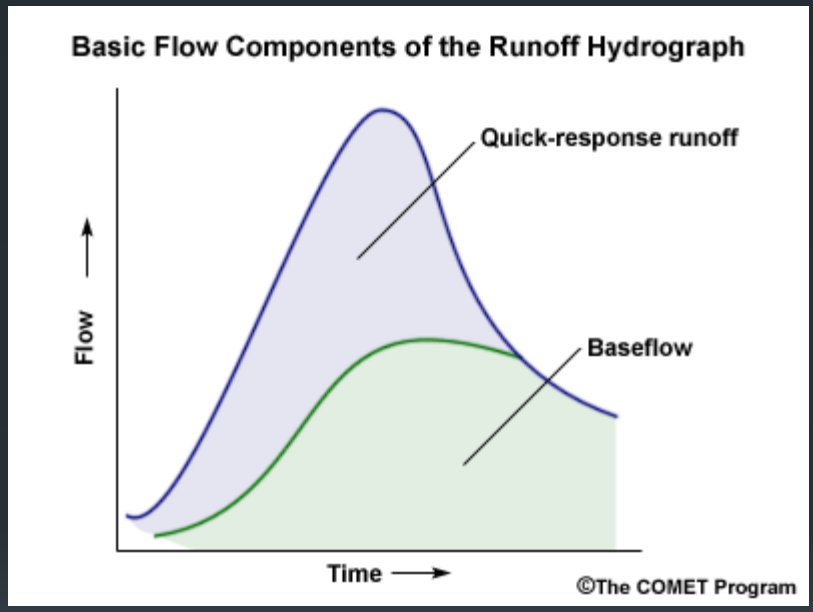
Objective, not process.

Can we design
a reduction in
evapotranspiration
in a basin?

What is a river?

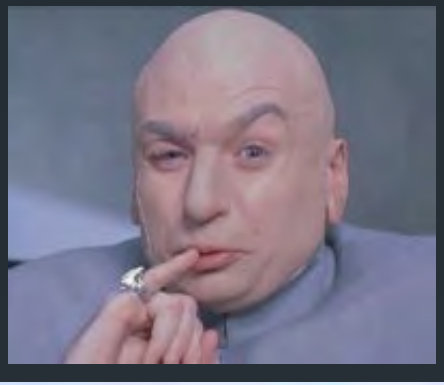
1. Flood response plus groundwater discharge
2. A linear spring (gaining) or recharge system (losing)

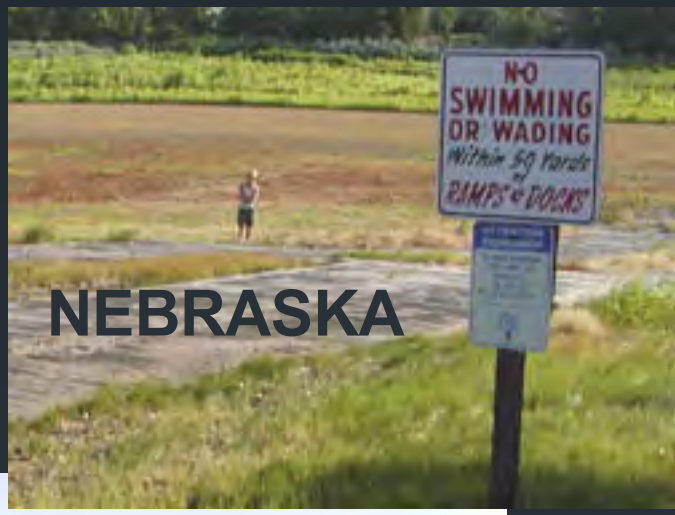
3. Recharge pulse + groundwater outcrop



http://stream2.cma.gov.cn

Difference between a reservoir and an evaporation basin?





Oklahoma City plans 29-mile water pipeline to Lake Stanley Draper to help mitigate drought

THE ASSOCIATED PRESS

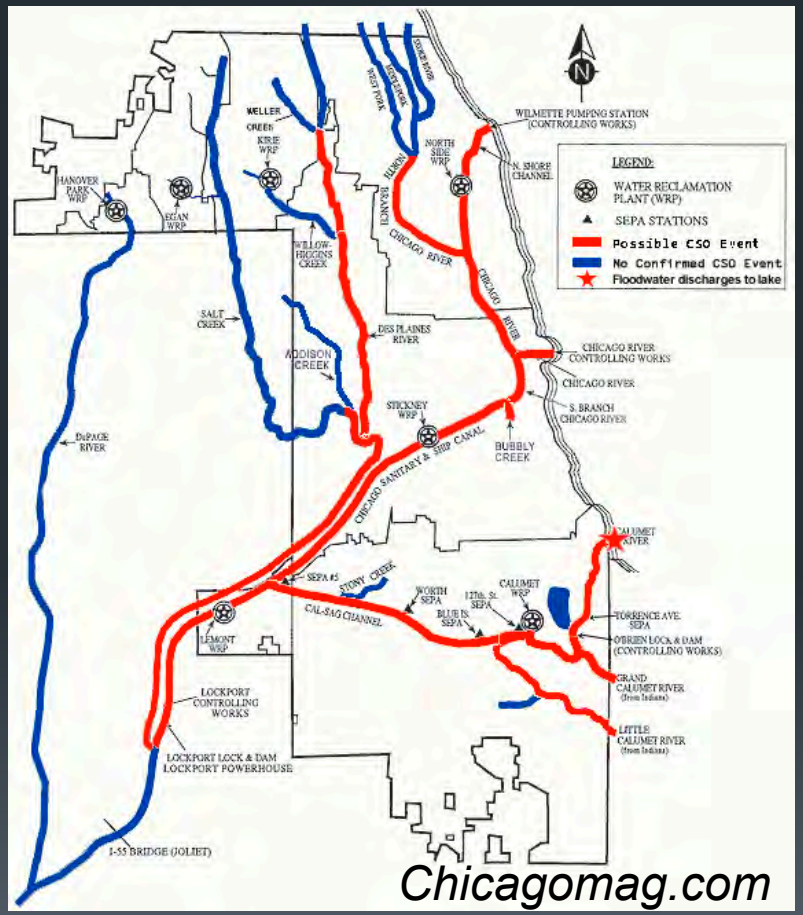
February 16, 2015

- City officials say they don't know the overall cost of the project. They say 75 percent has been completed for about $67 million.
- A city engineer says the pipeline will ease demands on Lake Hefner and Lake Overholser. He said officials will be able to better manage current and future droughts.

Irrigators or humidifiers?

http://www.asaltum.com

Why did you send all our water out of the city instead of saving it?



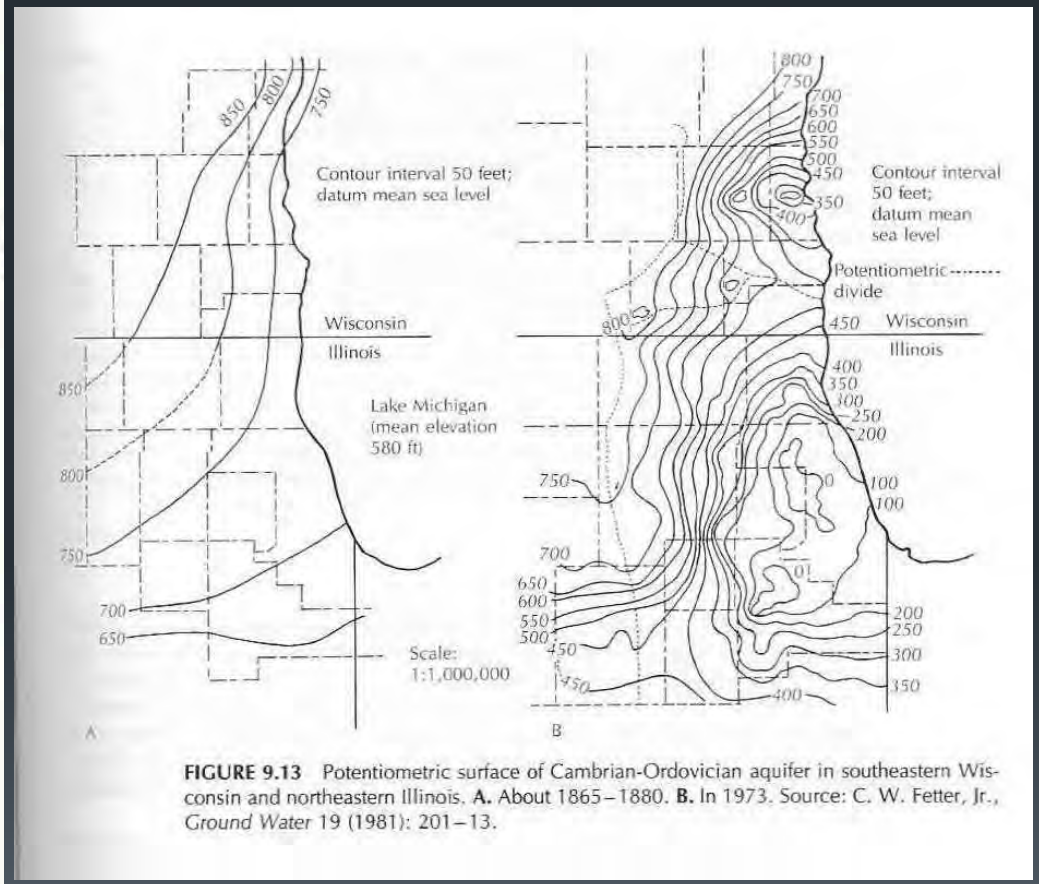
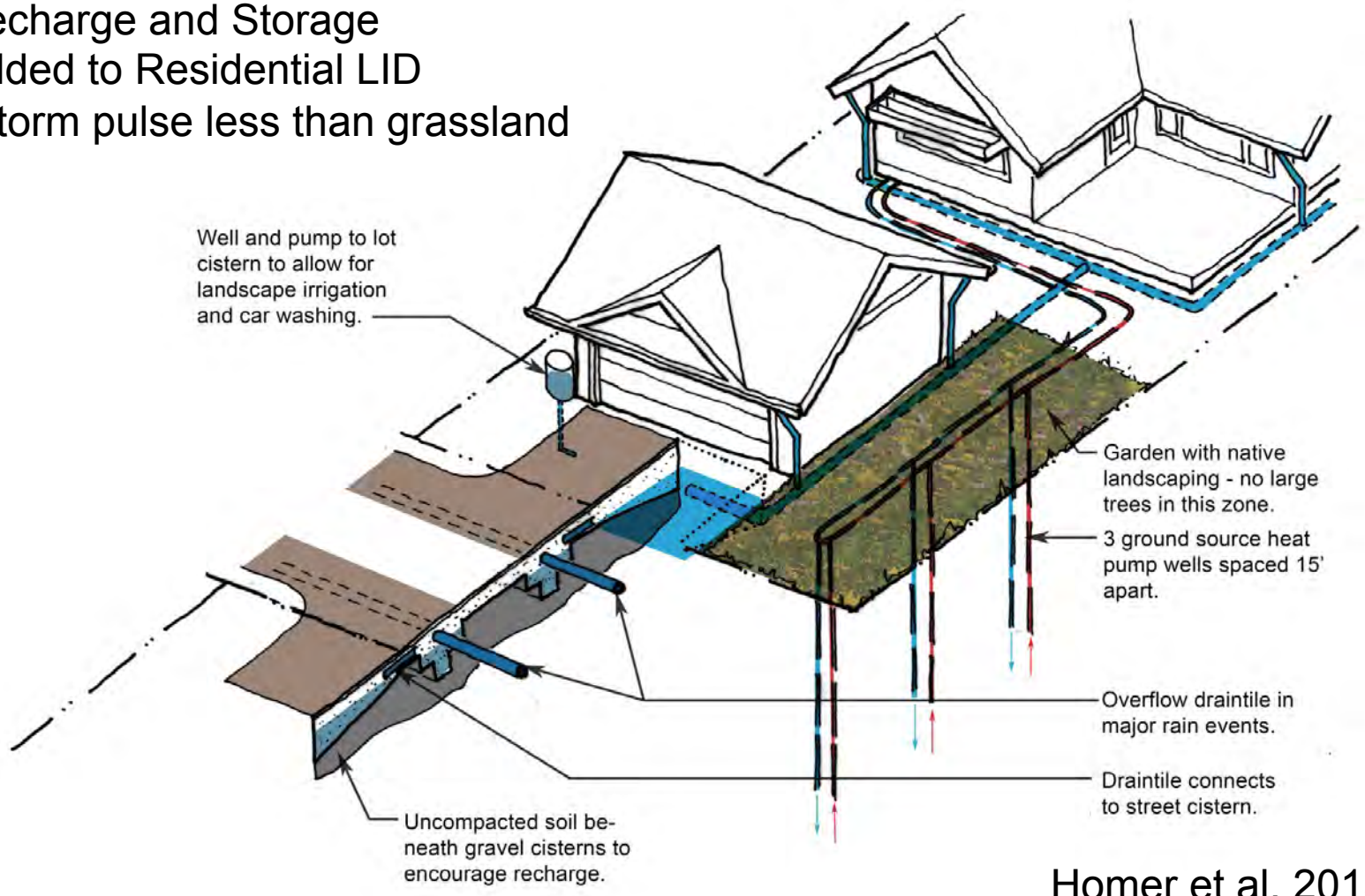


FIGURE 9.13 Potentiometric surface of Cambrian-Ordovician aquifer in southeastern Wisconsin and northeastern Illinois. **A.** About 1865–1880. **B.** In 1973. Source: C. W. Fetter, Jr., *Ground Water* 19 (1981): 201–13.

2) How to be an Evil Water Scientist

Increasing recharge (decreasing flooding) by design

Recharge and Storage
Added to Residential LID
-Storm pulse less than grassland

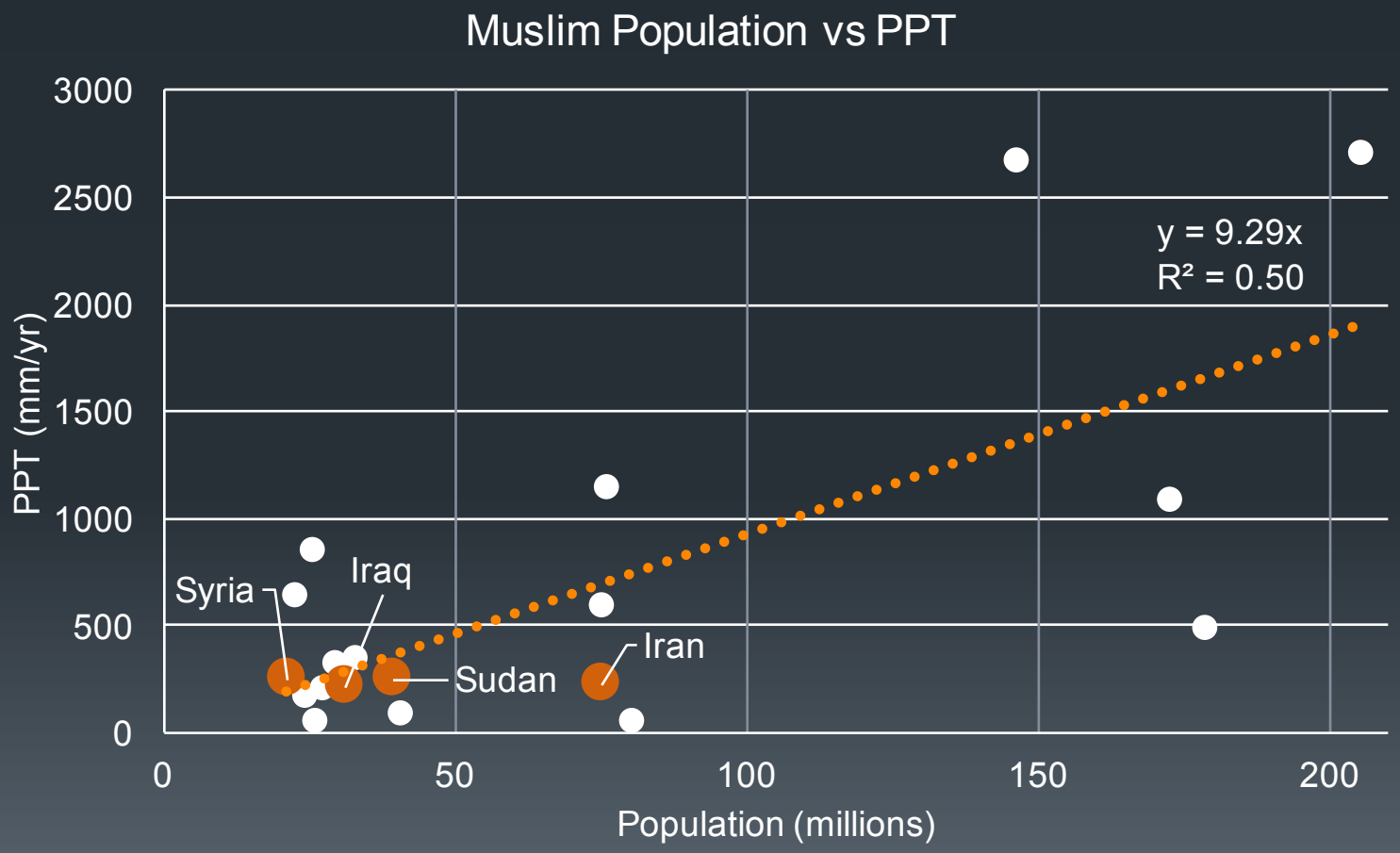


Homer et al, 2015

Dr. Khayyun Rahi

3) Surface water in Iraq

Iraqi Water Supply



Salinization of the Euphrates/Tigris

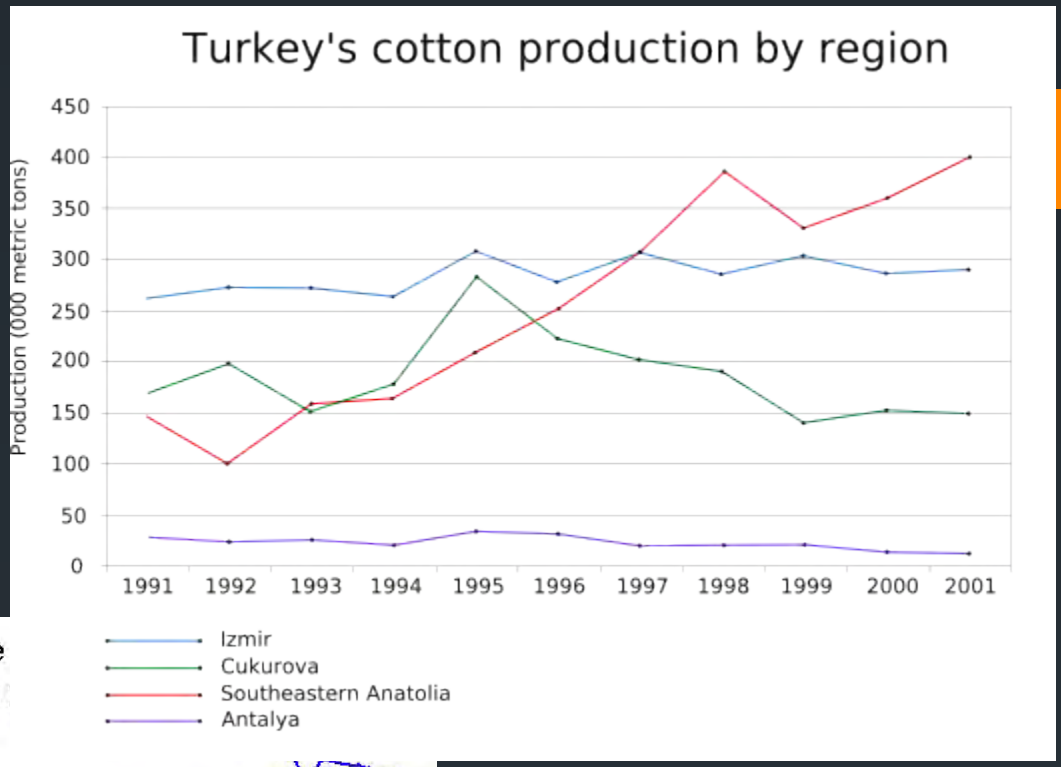
- 1960's GAP project in Turkey – 22 dams

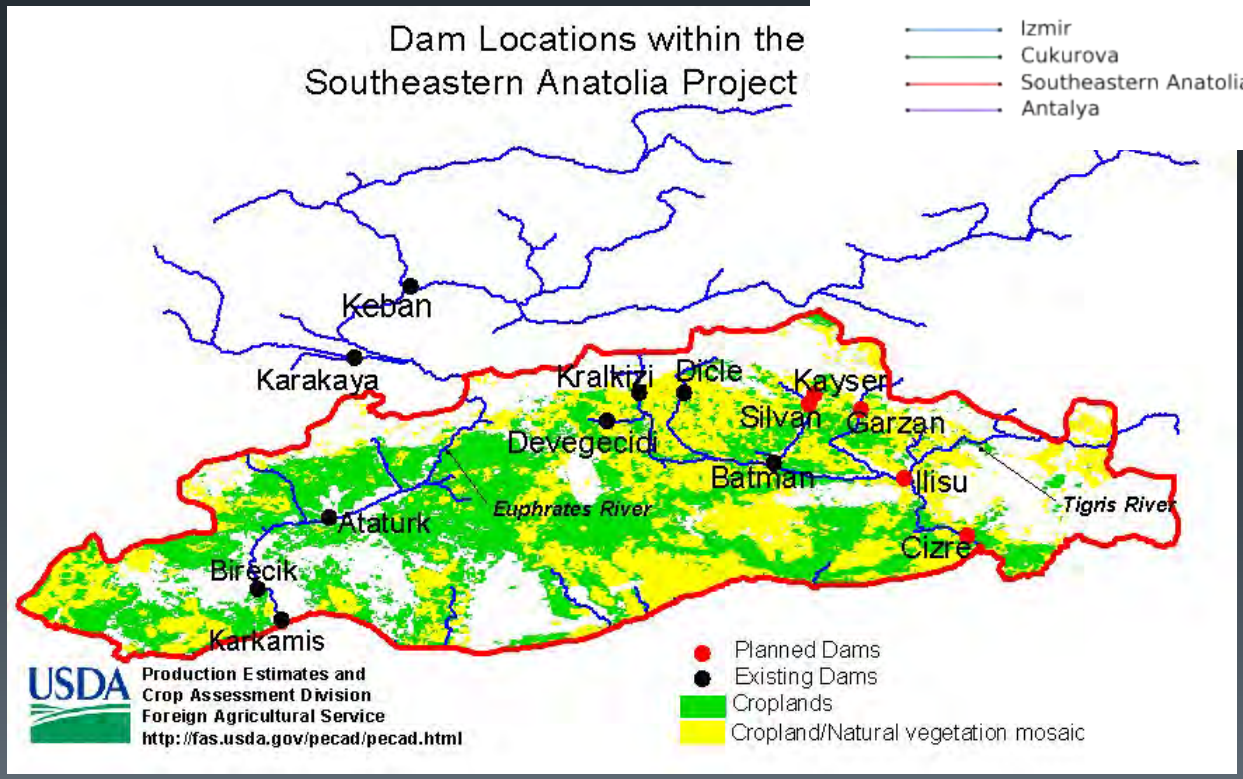
"The project rests upon the philosophy of sustainable human development, which aims to create an environment in which future generations can benefit and develop."

Social Effects of GAP project: Wikipedia

3) Surface water in Iraq

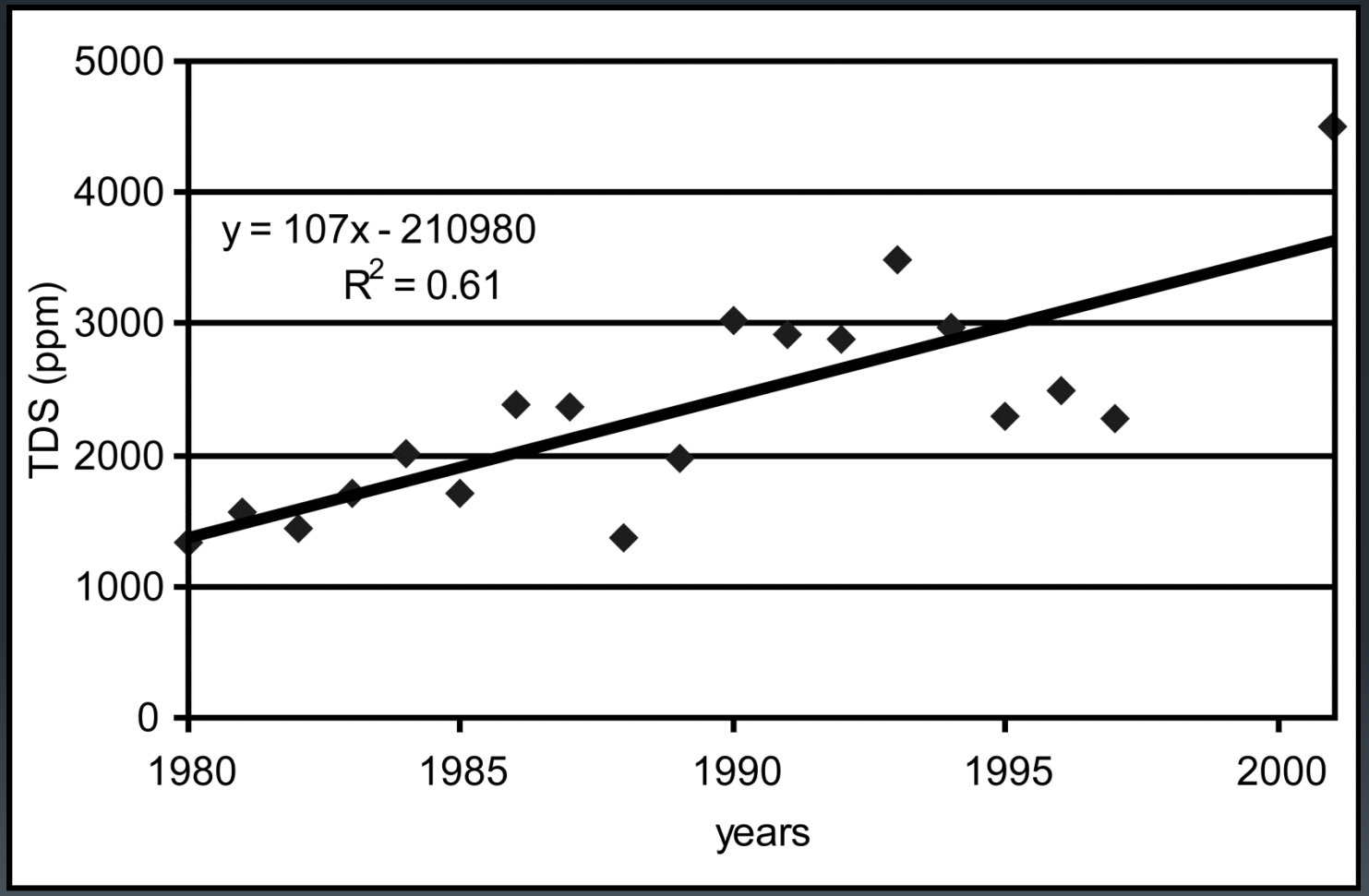
Turkish Cotton Production – 4x





"Turkey-cotton-by-region". Licensed under CC BY-SA 3.0 via Commons - https://commons.wikimedia.org/wiki/File:Turkey-cotton-by-region.png#/media/File:Turkey-cotton-by-region.png

Sustainable Development? – 4x



Euphrates TDS contents at Al Nassiriah, Iraq

Rahi and Halihan, 2010

Lake Tharthar

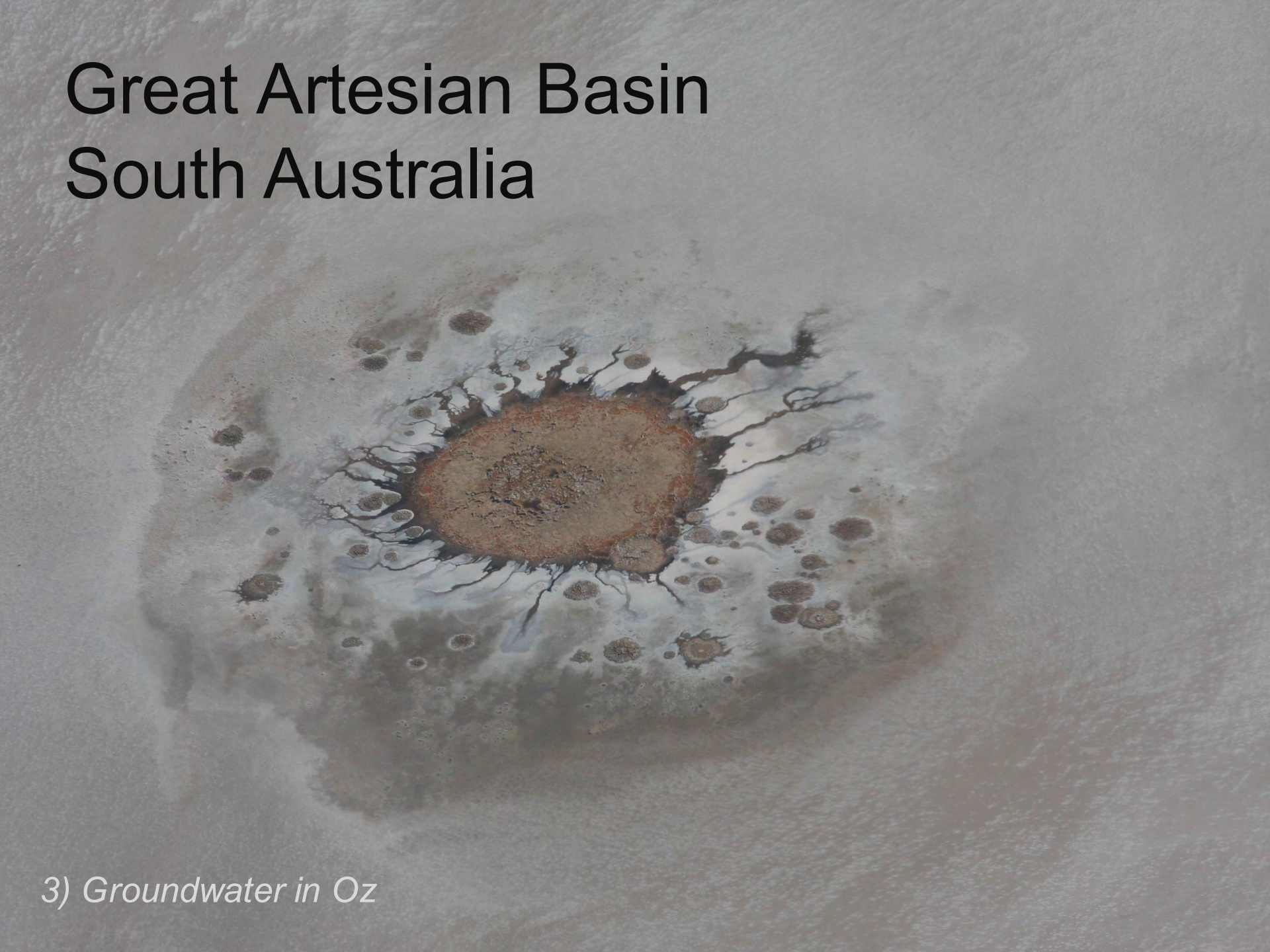
- Former Wadi, transfers water from Tigris to Euphrates
- Annual Evap ~3 bcm
- Equal to domestic use of Iraq

photographer: Barik Al-Samarrai Photography

ISIS: an effect of cotton?

http://www.economist.com/blogs/graphicdetail/2014/06/daily-chart-9

Great Artesian Basin
South Australia

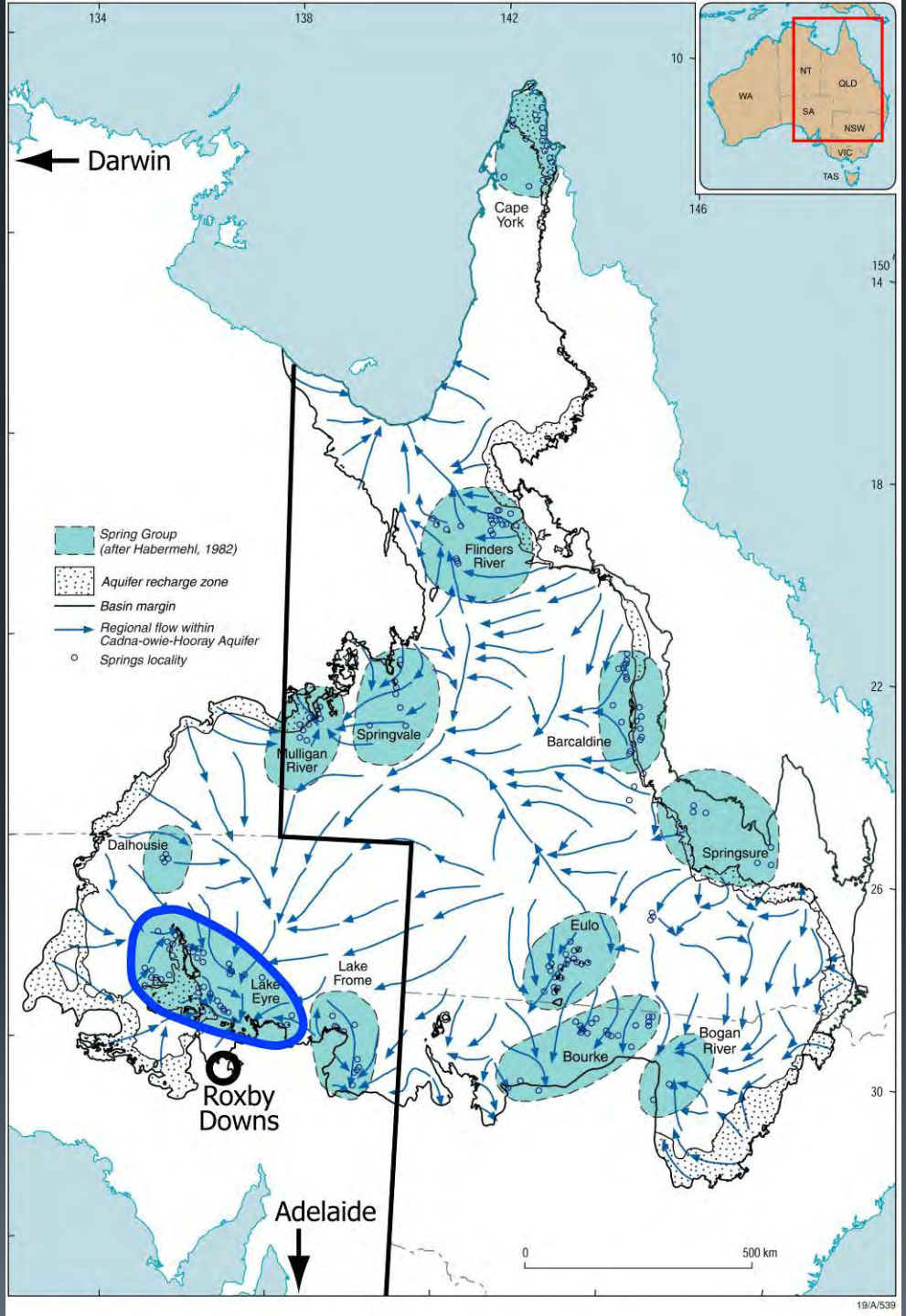


Olympic Dam/ Roxby Downs

Owned by BHP Billiton

- World's largest uranium deposit (4500 tons)
- 4th largest copper (220K tons/yr)
- 5th largest gold
- Significant amounts of silver

- 1500 permanent/1500 contractor employees
- Uses groundwater from the GAB (35 ML/day)
- Largest industrial user of GW in Sth hemi



THE GAB

GROUNDWATER STORAGE

8,700 million ML

largest storage in Australia

GROUNDWATER SALINITY

40 – 50 % Potable

(< 1000 mg/L)

BASIN SIZE

1,735,300 km^2

22% of Australia

~ 4x the Ogallala

Can Data Beat our Instincts?

1. Focus on Recharge – include power if needed to drive economics
   - Flood structures → recharge structures
   - Eliminate surface reservoirs – "unused" or high evap
2. Make high ET affect cropping choices
   - Don't plant cotton in the desert
   - Don't raise corn to burn in your tank while losing groundwater
3. Tell a lawyer…

Questions?