

Ground-Water Availability: An Uncertain Pathway to a Sustainable Future

By

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A Sustainable Future Requires That Decisionmakers Understand the Following “Principles” :

- **Geographical and spatial scales affect water-management outcomes**
- **The hydrologic cycle must be managed as an integrated whole**
- **Net losses of water from all parts of the hydrologic cycle must be minimized**
- **Water must be conserved, captured and reused**
- **Water must be valued**

Hydrogeologists Must Provide Decisionmakers:

- **Understanding and information about:**
 - **GW systems, their interconnection with other parts of the hydrologic cycle, and**
 - **How the hydrologic cycle may be affected by natural and anthropogenic stress (see Traditional Mass-Balance)**

Hydrogeologists Must Provide Decisionmakers:

- **Understanding of how “non-traditional” additions and withdrawals of water affect “Net Availability” of water resources (see Post-Modern Mass Balance)**

Hydrogeologists Must Provide Decisionmakers:

- **Understanding of the true value of water resources--both as a commodity and as a “common good”**

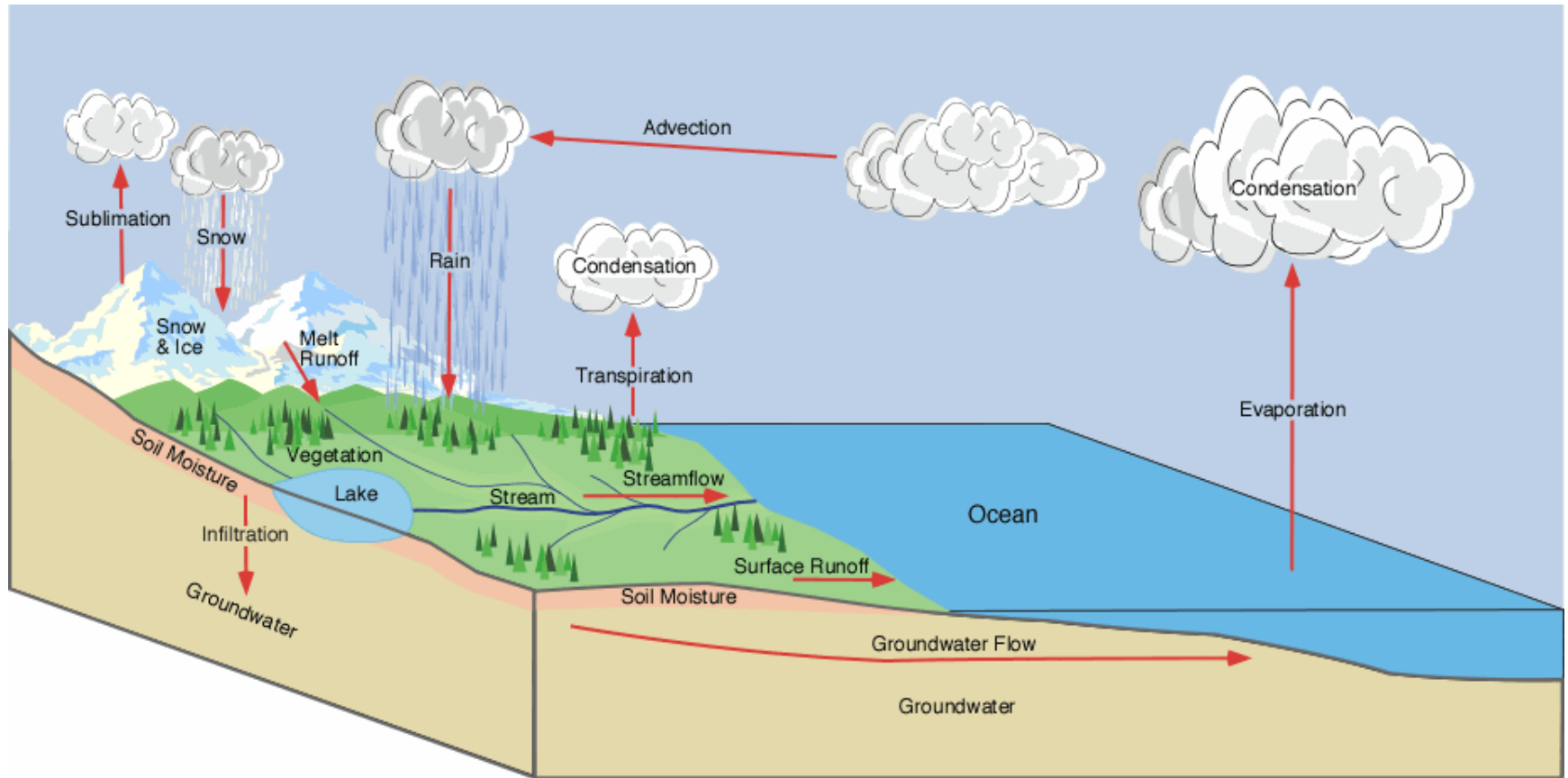
Hydrogeologists Must Provide Decisionmakers:

- **Monitoring data in order to:**
 - **become aware of potential water-resources problems in a timely manner, and**
 - **adapt management strategies as appropriate.**

Ultimately, Hydrogeologists Must Help Decisionmakers:

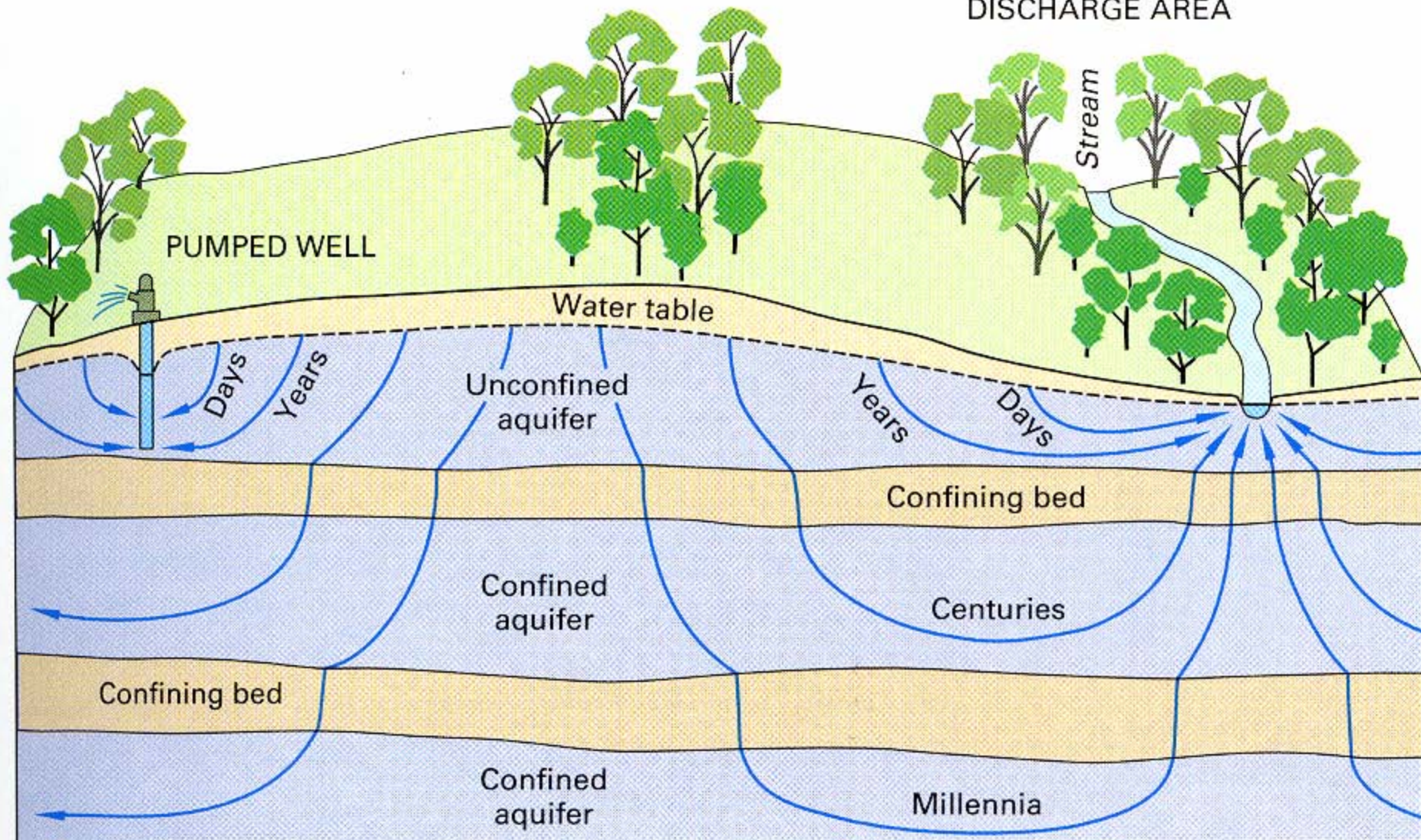
- **As they strive to develop long-term water-management strategies while, at the same time, deal with other short-term cultural, political and economic realities.**

Global Hydrologic Cycle



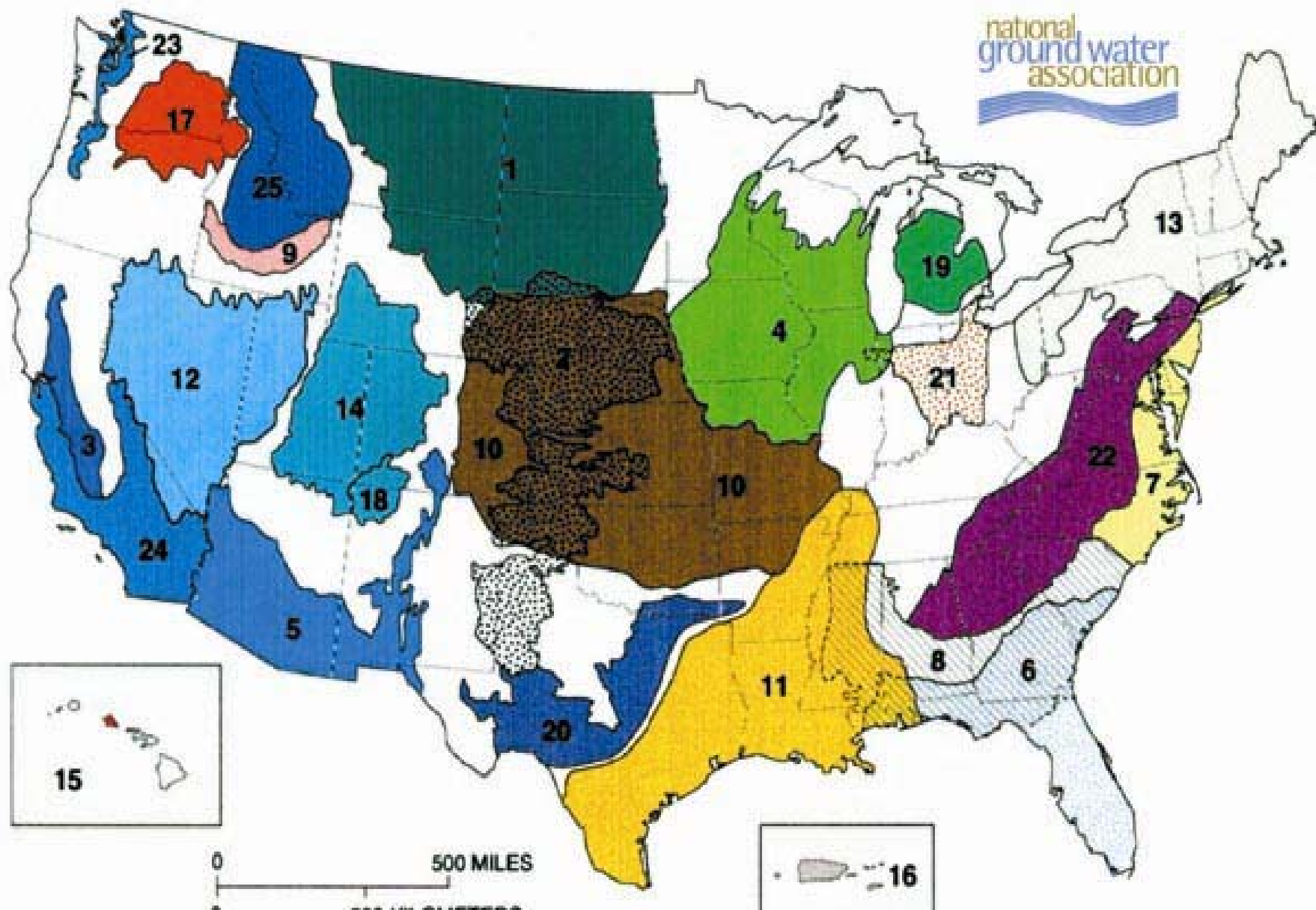
RECHARGE AREA

DISCHARGE AREA



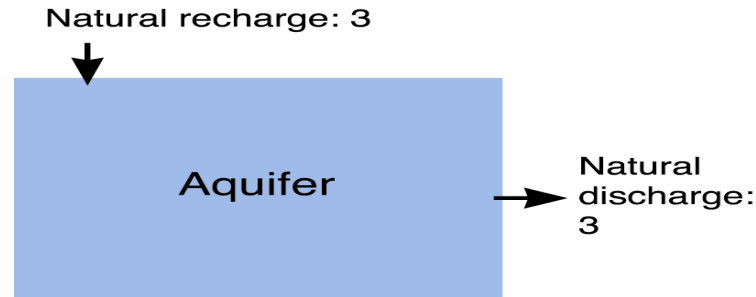
Traditional Water Balance



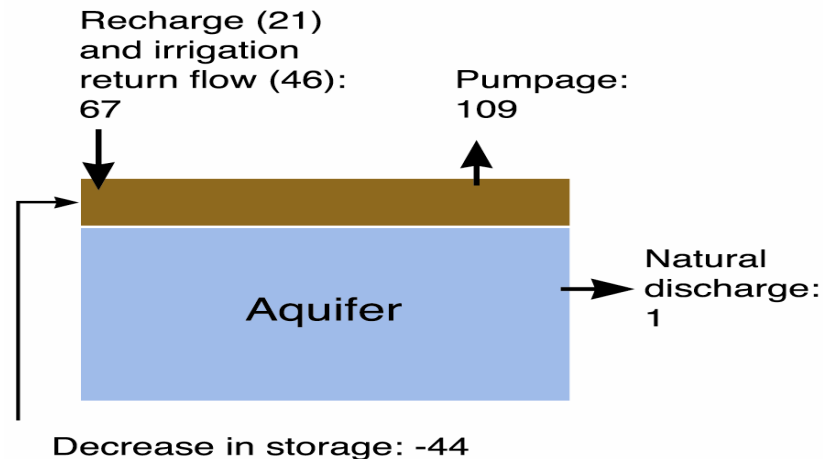


Pre-development and post-development conditions in High Plains Aquifer

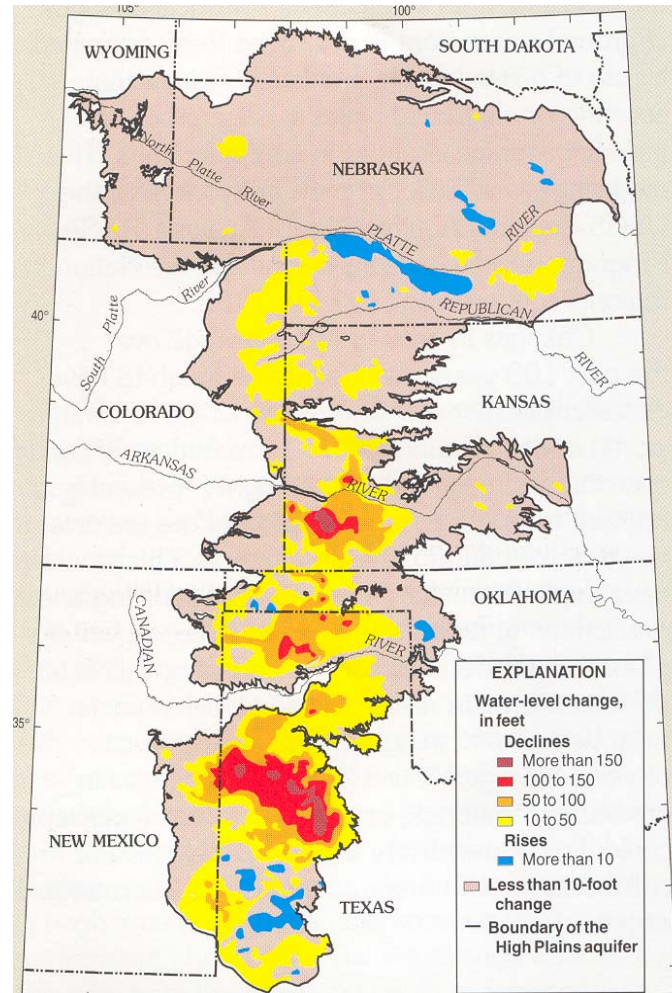
Predevelopment conditions (ca 1940)

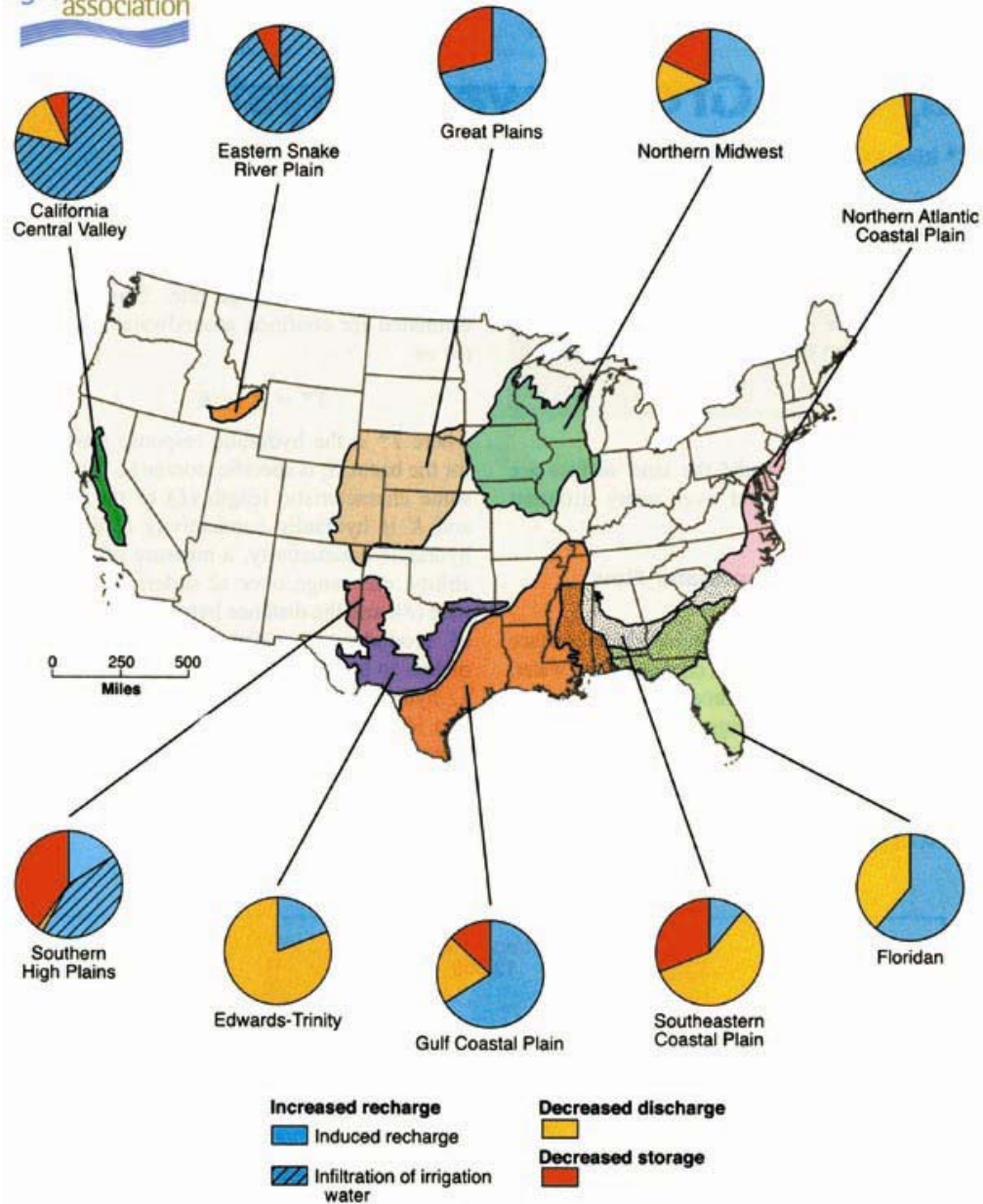


*Development conditions
(1960-1980 average)*

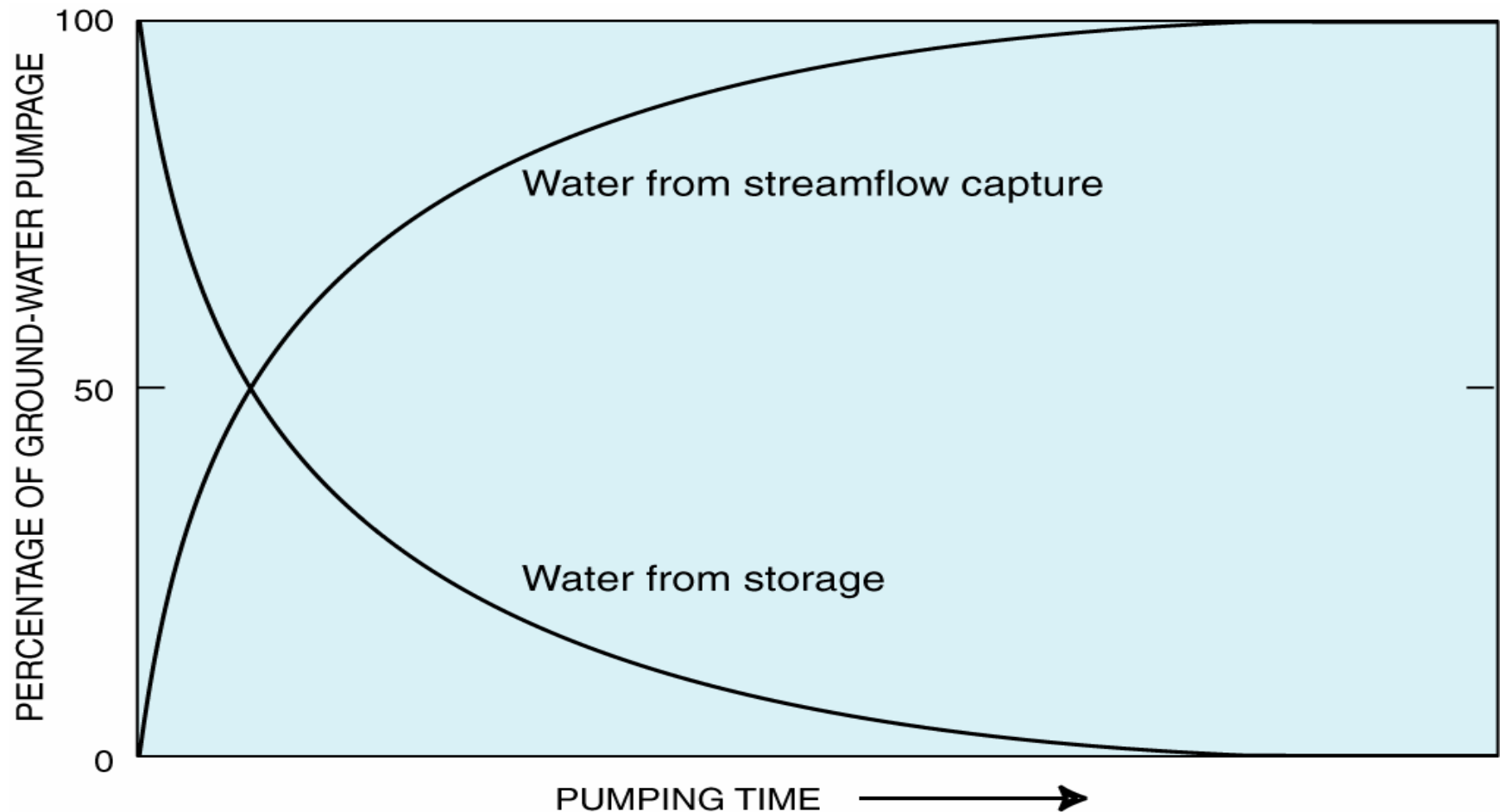


Changes in Ground-Water Levels High Plains Aquifer





Sources of Water to a Pumped Well



Paradise Valley study area

Paradise Valley study area
Humboldt River drainage area



EXPLANATION

-  Basin fill
-  Consolidated rock
-  Boundary of active model

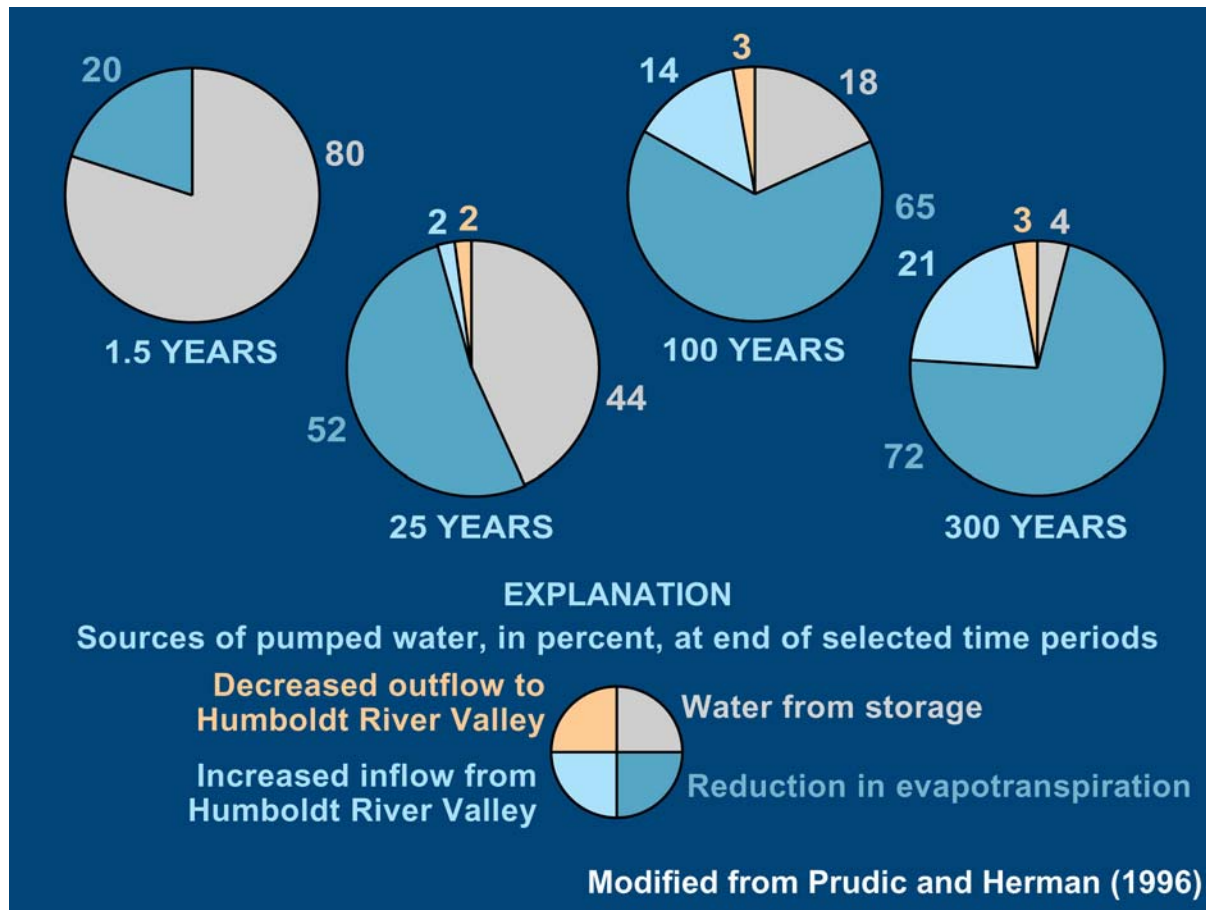
0 5 KILOMETERS
0 5 MILES

Winnemucca

Humboldt River

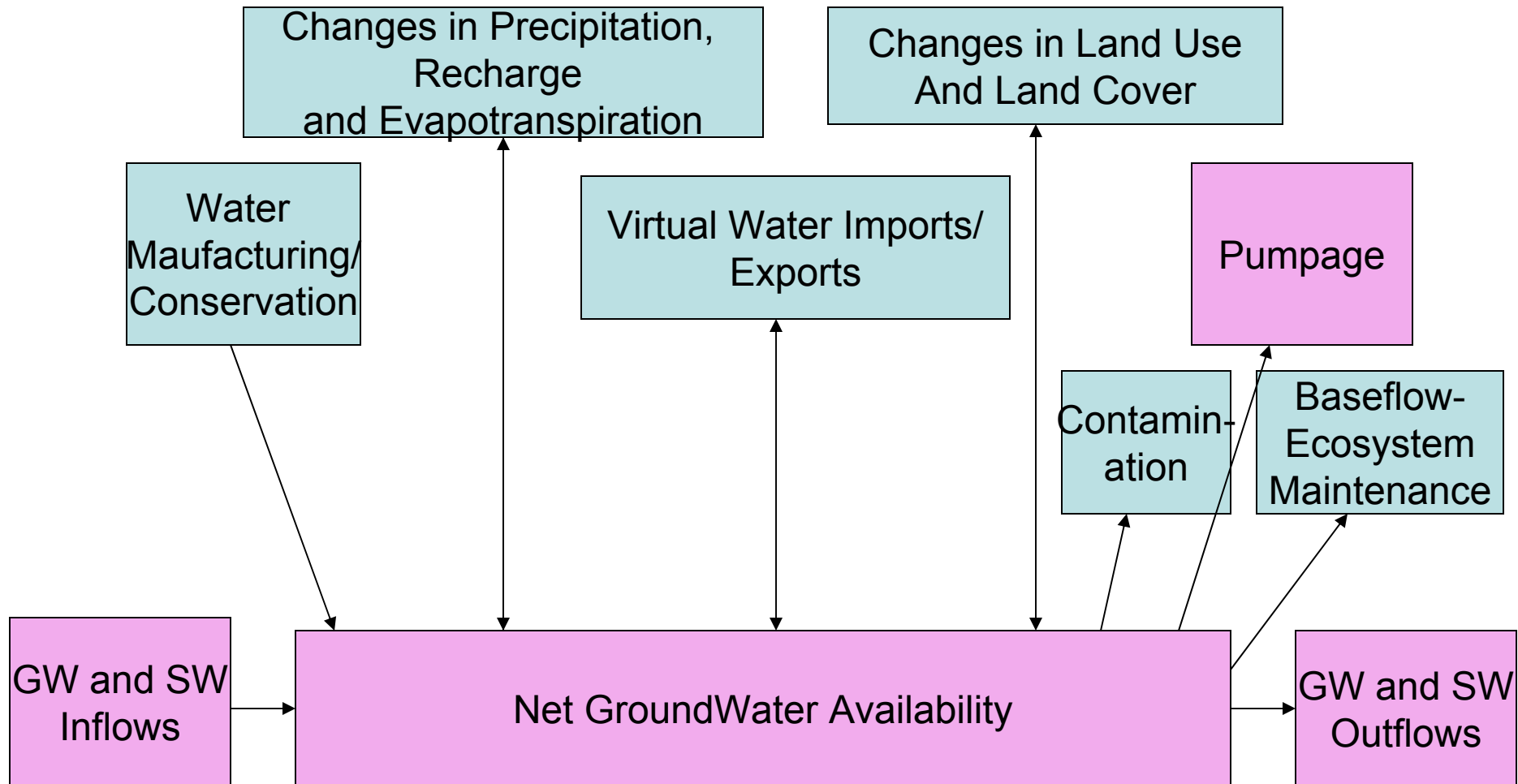
Modified from Prudic and Herman (1996)

Sources of Water to a Pumped Well



Post-Modern Water Balance

(From the Perspective of Groundwater)



Water as Natural Capital after C. Lant (personal comm.)

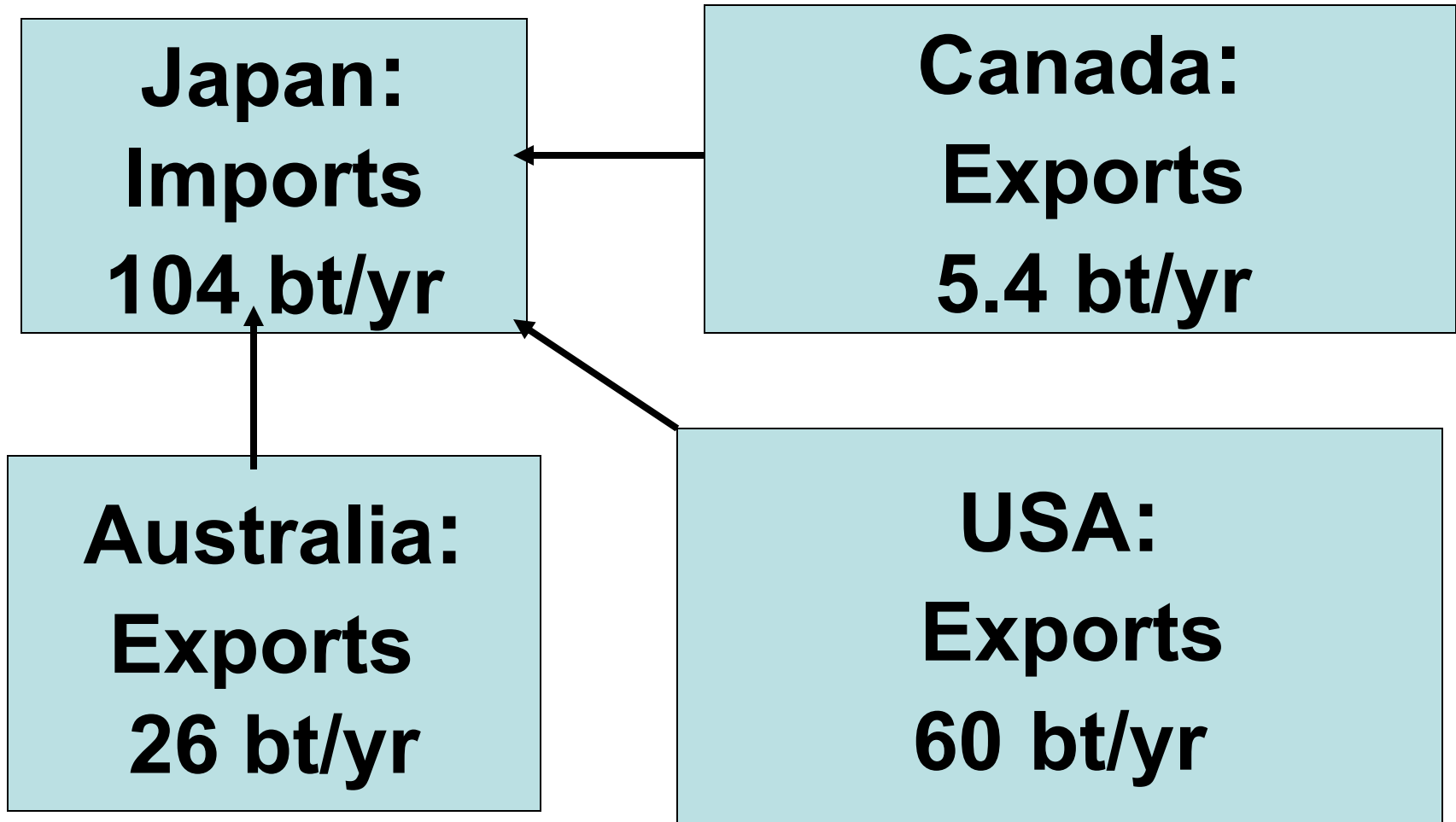
- “The global annual value of (water-dependent) ecosystem services is about \$33 trillion, compared with a global economic output of \$31 trillion”
- Thus, the emerging battle: Water as natural capital vs. water for supply

Virtual Water:

The total amount of water consumed in the production of farm, livestock and industrial products

Japan's Virtual Water Trade

Domestic Supplies= 89 bt/yr (98)



The Emerging Role of the Hydrogeologist

Narasimhan (2003) “The human element is likely to become increasingly daunting as our limited ground water resources come under increasing competitive pressures....”

UNESCO (2003) “Water professionals need a better understanding of the broader social, economic and political context, while politicians need to be better informed....”

Uncertain Pathway to a Sustainable Future

