# Water Use Efficiency

## Topics will include:

| | |
|---|---|
| • Current Issues in the News | Chris Phelps |
| • Southwest History | Amber Pommier |
| • Drought | Alison Magno |
| • Livestock Water Pollution | Carisa Barnett |
| • Dams | Matt Grund |
| • Water Usage | Bryan Hollis |

# Depletion of the World's Fresh Water

97% ocean (salt) water

03% freshwater

- 68.7% icecaps and glaciers
- 30.1% groundwater
- 0.3% surface water
- 0.9% other

Source: http://ga.water.usgs.gov/edu/waterdistribution.html

# Water Use

## Does the U.S. have adequate water supplies?

- 90% of total water use Nationwide is renewable surface or groundwater.
- Uneven distribution-Arid west and Southwest.
- Most irrigation withdrawals occur in the Arid western states.

Source: http://www.ers.usda.gov/publications/arei/ah712/AH7122-1.PDF

# The Colorado Water Report

Colorado State Basin Outlook Report for January, 2007

- Snowpack
  - 96% of average.
- Precipitation
  - 82% of average.
  - 2007 water year beginning October 1, 2006 statewide totals are 113% of average.
- Reservoir
  - 94% of average
  - 111% of average for San Juan, Animas, Dolores and San Miguel.
- Streamflow
  - Forecast stream flow-best condition since 1990's.
  - Possible above average runoffs.

# The Colorado Water Report: on a local scale.

San Miguel, Dolores, Animas, and San Juan River Basins.

- Current snow pack is 63% higher than snow pack measured last year.
- San Juan River Basins showed a 321% increase over January 1, 2006 figures.
- Snowpack on average is still below normal at 77% of total.
- Precipitation 116% of average for the water year (Oct 1, 2006).
- Reservoir Storage is 11% above average.
- The outlook: Good

# Local Water Issues:

## Fisherman?

### Mercury poisoning.

## Mercury tainted fish

Totten Reservoir near Cortez.
Horsetooth Reservoir near Fort Collins.
Horseshoe Reservoir west of Walsenburg.
Purdy Reservoir near Grand Junction.
Trinidad Lake near Trinidad.

# Cities and Farmers

- The 7 year debate about water quality near an end?
- El Paso and Denver buying agricultural water rights and transferring them for city use.
- “All agree Environmentalists, farm groups, and water-conservancy districts”.
- Courts will be allowed to look at downstream effects when considering applications for large changes in water use.
- Water quality testing.

Source: The Durango Herald, Thursday January 25,2007 City, Region, State

# Aridity

- Arid implies prolonged dryness, and the climate itself
- A large part of the surface of the world is arid
- Meaning that it is too dry for rain fed agriculture
- As aridity increases it makes it harder for species to adapt to the climate

# The Hopi Indians of Arizona

- Pueblo People, who once occupied a large part of the Southwest.
- The Hopi Indians were very successful in agriculture, and the used a method known as

  Dry-Farming- is the profitable production of crops, without irrigation, of land with a low average of rainfall

Source: Hack, J.T. (1942). Hopi. Retrieved February 8, 2007, from Land Use History of North America Colorado Plateau Web site: http://www.cpluhna.nau.edu/People/hopi.htm

# The Hohokam

- Used wild fruits, seeds, nuts, and roots from the desert and mountains as food sources
- Many of these desert and mountains supplied them with materials to build other useful supplies.

# Growing Food that is not well suited for this area

- Many people in this area are planting crops that are not native to this region
- These plants are usually found in regions where they do receive high amount of water through out the year

# What can be grown here in the Southwest?

- Vegetables
- Herbs
- Beans
- Grains
- Nuts
- Seeds

# In today's society

- Living in such an arid environment, many people are growing crops that are not appropriate for the land they are living on.

# Transforming our State

- 10 acres of valuable open space and agricultural land are being developed every hour
- Which increases air and water pollution, putting a strain on our water supplies
- And in return it is destroying our wildlife habitats and land for agricultural purposes

# Drought

**Definition: A period of time where there is not enough water to support agricultural, urban or environmental water needs.**

# Different types of Droughts

**Meteorological drought**: is a prolonged period with less than average precipitation.

**Agricultural drought:** is insufficient moisture for crops or range production.

**Physiological drought:** is a condition afflicting plants that have been exposed to too much salt, preventing them form absorbing water form the soil.

**Hydrological drought:** is when the water reserves available such as aquifers, lakes, and reservoirs fall below the statistical average.

# Irrigation

**Definition:** The replacement or supplementation of rainfall with water from another source in order to grow crops.

# Types of Irrigation

**Overhead (sprinkler)**

In this type of irrigation water is piped to different locations within the field.

The water is then distributed by overhead high pressure sprinklers.

# Types of Irrigation

**Spray Head**

This is a sprinkler that sprays in a fixed pattern.

This type of sprinkler is not meant to be used at high pressures.

# Types of Irrigation

**Traveling Sprinkler**

Irrigation systems can also be mounted on moving platforms.

This system is used to irrigate areas such as small farms, sports fields, parks, pastures.

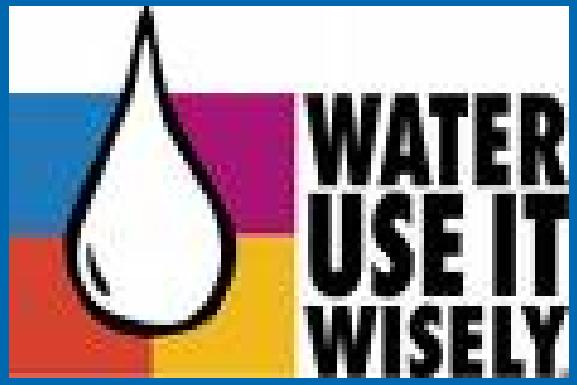
# Types of Irrigation

**Center pivot**

This is a form of overhead irrigation made up of many different pipes joined together and mounted on wheels.

This systems is common in parts of the United States where terrain is flat.

# Water saving irrigation practices




1. **Field Practice:** Techniques that keep water in the field, distribute water more efficiently across the field.

2. **Management Strategies:** Involves monitoring soil, and collecting information on water use and efficiency.

3. **System Modification:** Requires making changes to an existing irrigation system or replacing an existing system with a new one. This can be very expensive.

# Concern of Livestock Water Pollution

*Historically, agricultural impacts have been considered natural and uncontrollable

*Intensive livestock production in the 1960's led to ecological problems caused by waste

# Animal Waste

- Recognized as an Environmental Pollutant
- Livestock production in small, highly populated areas
- Large amount of waste pollutes air, soil and water

# Animal Waste in Water

- Excess Nutrients and pathogenic microbes that cause human diseases enter both surface and groundwater sources.

# Nitrogen and Phosphorus

- Nitrates in groundwater
  - *health hazard in drinking water
  - *eutrophication of waterways
- Algae “blooms”
  - *deplete water oxygen, alter food webs among other problems
  - *human dams stop silicates but allow nitrogen and phosphorus to continue, creating these blooms

- Pfiesteria Piscicida
  - *toxic dinoflagellate
  - *cause headaches, skin lesions, nausea, fatigue, disorientation, incapacitation and learning/memory problems
  - *becoming a global problem
- Disposal of Animal Waste
  - *an issue in areas of intensive swine and poultry production
  - *often used to fertilize pastures
  - *contaminates surface and groundwater with nitrogen and phosphorus

# Human Diseases

- caused by protozoan parasites in water
- Giardia Lamblia and Cryptosporidium Parvum

  *cause severe diarrhea

  *outbreaks have been linked to water pollution by cattle feces
- Milwaukee Cryptosporidium outbreak in ‘93

  *over 400,000 were affected

  *could have been caused by cattle pastures adjacent to rivers, slaughter houses or human sewage

- Animal waste in water can cause Salmonella and E. Coli
- September ‘99—New York E. Coli Outbreak
  - *Washington County Fair
  - *Approximately 1,000 people infected
  - *Several died
  - *Heavy rain washed through manure piles; water seeped into a well.
- Diseases are likely to increase with increased livestock production in small areas

# Regulations/Legislations & Solutions

- Strict regulations concerning waste confinement and disposal
- Concentrated Animal Feeding Operations

  *operations that have documented and implemented a pollution prevention plan are eligible for permits

  *permit coverage allows for discharge into US water in case of a chronic/catastrophic storm event

- Ecological Nutrition or Precision Nutrition
  - *diet formulation
  - *use of highly digestible proteins, synthetic amino acids and bioavailable phosphorus
  - *phytases as feed additives
    - -increase phytate phosphorus in grains/plant protein supplements
    - -reduces phosphorus excretion
  - *corn varieties
    - -lower phytic acid and high bioavailability of phosphorus

- Methane Energy
  - *Methane from cow manure is extracted and transformed into electricity
  - *Hilarides Dairy in California
  - *9,900-cow farm
  - *Saved $15,547 in November electricity costs

# Dams- The Benefits and Drawbacks

- The last 50 years have seen massive investments in irrigation infrastructure, as part of a global effort to increase world food production and avoid famine
- Irrigated agriculture has been critical to supplying the food needs of an ever increasing human population
- Damming of rivers is especially common in dry, arid areas, like the Southwest U.S.

# Benefits

- Dams primarily used for agricultural irrigation provide a variety of economic goods and services:
  - Electric power
  - Flood control
  - Water supply
  - Reservoir recreation
  - Navigational services

# Negative Effects

- There are many negative effects of damming on riparian ecosystems and people
- Often times downstream aquatic and riparian ecosystems have collapsed altogether (Rood et al., 2003).
- Many aquatic and riparian species are now threatened or even endangered as a direct result of disrupting the seasonal flow of the river they depend on (Rood et al., 2003).

•Rood, S. B. , C. R. Gourley, E.M. Ammon, L.G. Heki, J. R. Klotz, M. L. Morrison, D. Mosley, G.G. Scoppettone, S. Swanson, and P. L. Wagner. Flows for the Floodplain Forests: A Successful Riparian Restoration. 2003. BioScience. Vol. 53 No. 7 pages 647-656.

# The Importance of Wetlands

- Habitat for aquatic birds, animals, plants and fish
- Biodiversity
- Food Production
- Water storage, including mitigating the effects of floods and droughts
- Groundwater recharge
- Water purification
- Nutrient cycling
- Shoreline stabilization and storm protection
- Climate change mitigation
- Aesthetic and cultural value

- Riparian and floodplain ecosystems throughout the world often support extremely rich and diverse vegetation (Rood et al., 2003)

- Riparian species are highly adapted to the natural seasonal flooding that occurs each year.

- In fact, many species depend on this high water flow for reproduction.

- The Organization for Economic Co-operation and Development (OECD) estimates that
  - the world may have lost 50% of the wetlands that existed in 1900
  - about 60% and 69% of the available wetland had been drained for intensive agriculture in Europe and North America, respectively
- Drainage for agricultural production is the principle cause

# Statistics

- According to the USGS, the irrigated area in the United States was:
  - 61,900,000 acres in 2000
  - 57,900,000 acres in 1995
- According to the USDA, the irrigated area in the United States was:
  - 55,311,236 acres in 2002
  - 56,289,172 acres in 1997
  - 49,404,030 acres in 1992

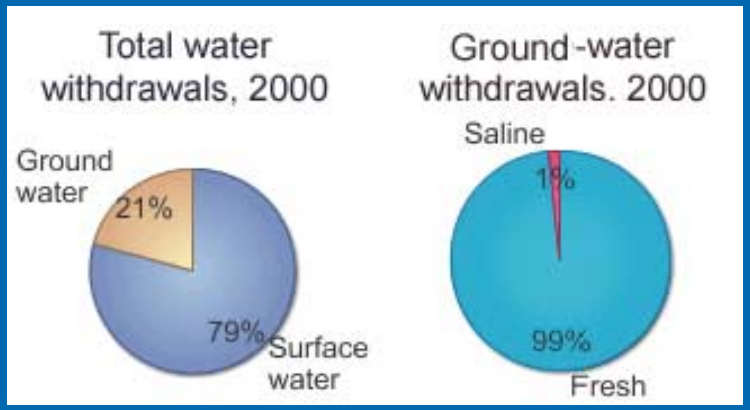
- In the future dam construction should be carefully planned, keeping in mind the ecological and social effects

# Water Usage

**How the United States Uses its Clear Liquid Resource**

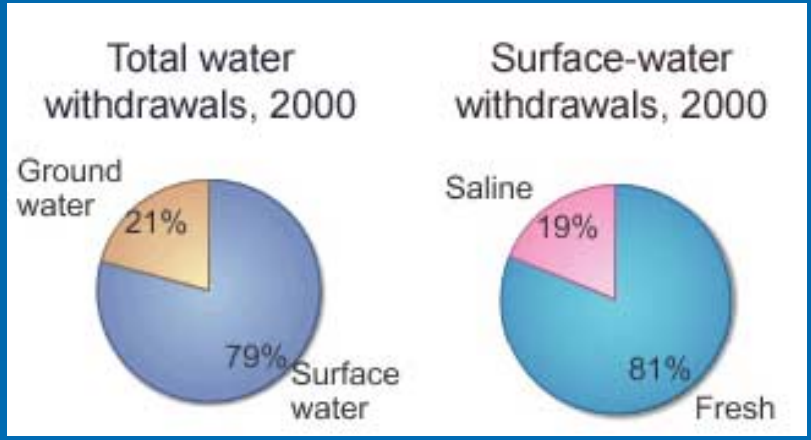
# Ground Water

- Found underground in the Water Table
- 21 % of water used in the U.S. in 2000 was ground water
- Ground water costs more $ and time to access
- Areas with little surface water rely heavily on ground water



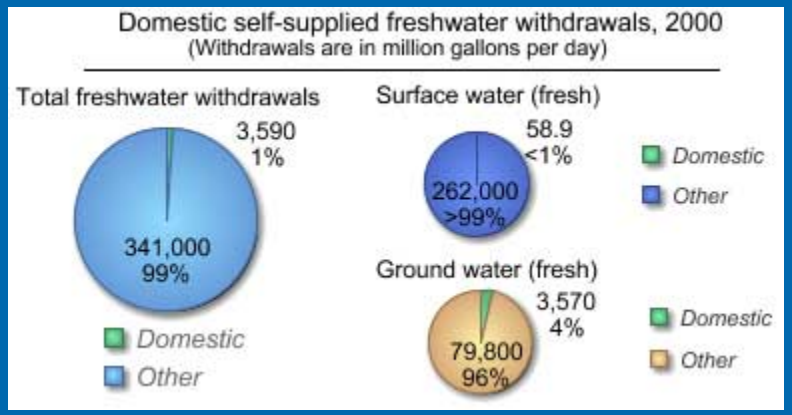
# Surface Water

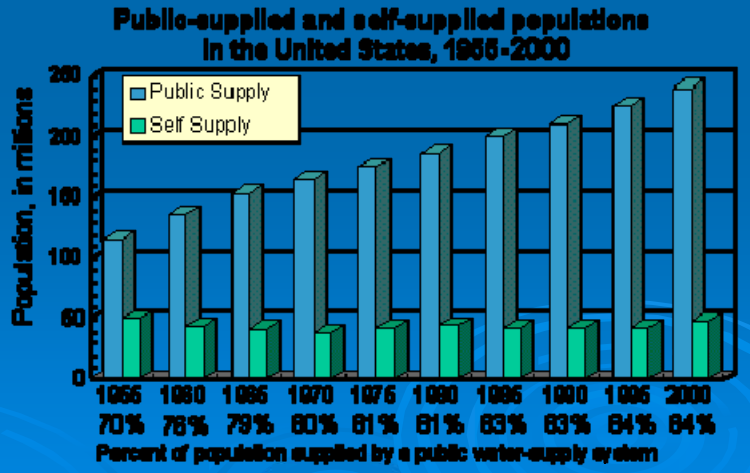
- Water Collecting on the ground or in a stream, river, lake, sea or ocean (wikipedia.org)
- 79 % of water used in the U.S. in 2000 was from surface water
- Less $ than ground water and usually easier to come by



# Domestic Water Use

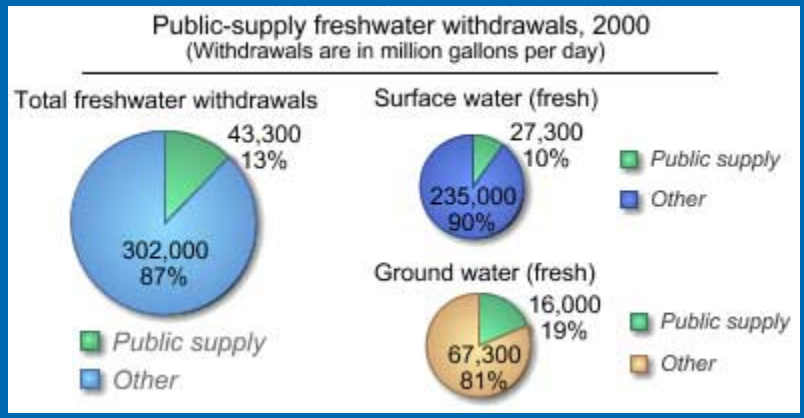
- Only 1 % of all the total freshwater used was domestic
- 1 % total from surface water
- 4 % total from ground water
- Reliance on public water has steadily increased
- Domestic water use has remained the same

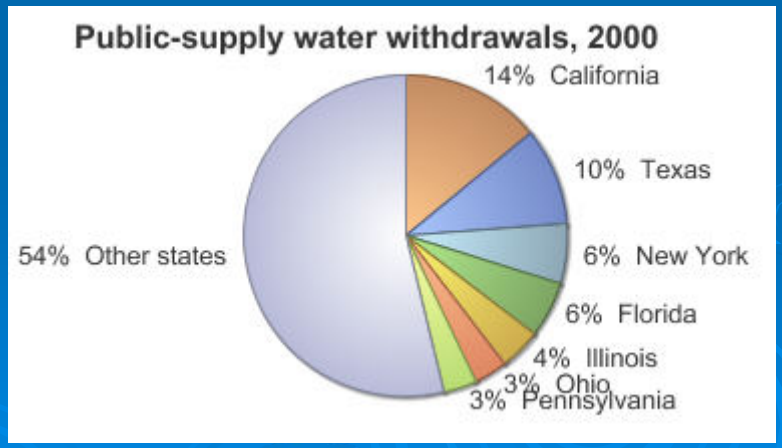


# Public Water Use

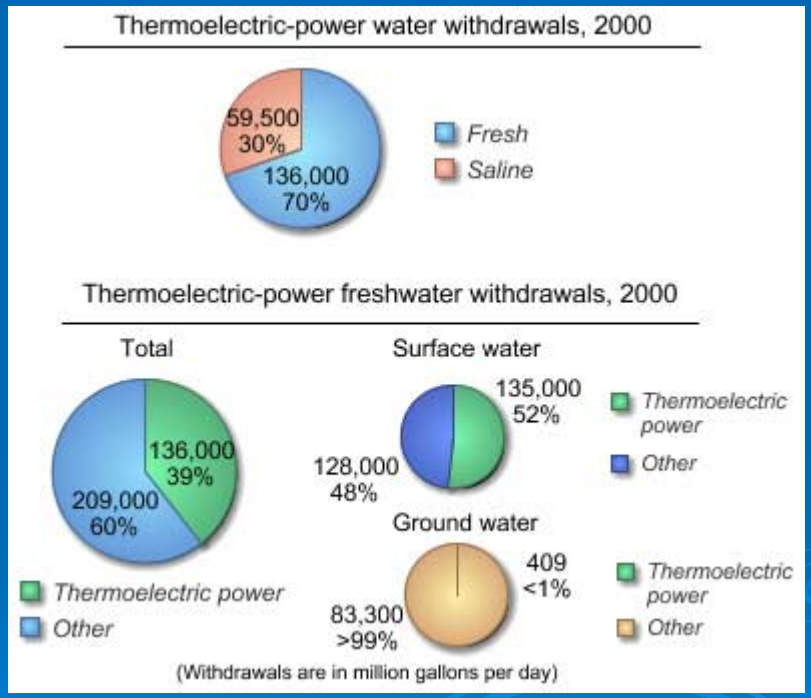
- Public water supply accounts for 13 % of total water used in U.S.
- California, Texas, New York, Florida and Illinois are the top 5 users of public water



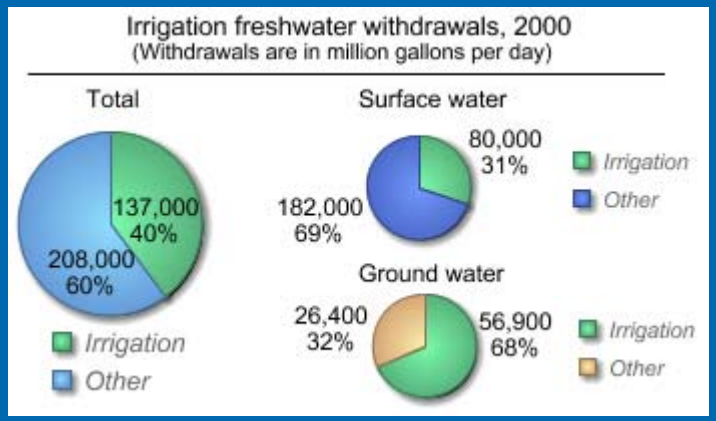
# Thermoelectric-Power

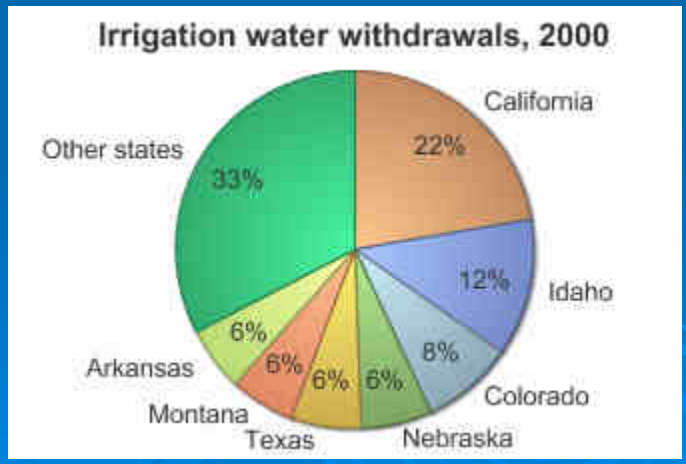
- 39% of all fresh water was used for thermoelectric power in 2000
- That includes 52 % of all surface water
- Only 1 % of ground water is used for thermoelectric-power



# Irrigation Uses

- 60 % of all freshwater is used for irrigation
- Irrigation uses 31 % of the U.S. surface water
- Irrigation uses 68 % of all the ground water in the U.S.
- California, Idaho, Colorado, Nebraska and Texas are the top 5 users of irrigation water



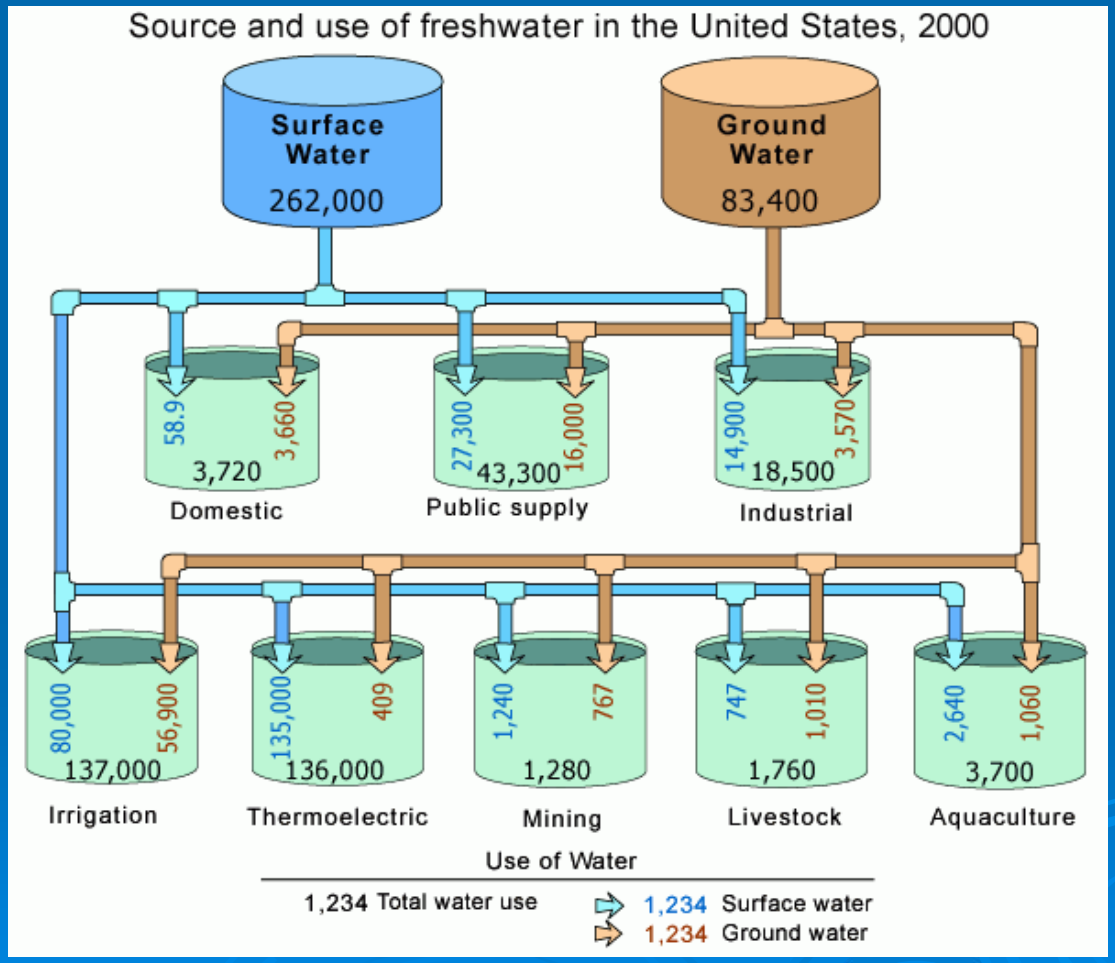



# Other Uses

- Live stock, industry and mining together use 7 % of the U.S. freshwater
- Industry uses 5 %, mining uses 1 %, and surprisingly live stock only uses 1 % of all freshwater in the U.S.

Pulp and paper mill, St. Marys, Georgia, USA
Credit: Alan M. Cressler, USGS

# How Water is Used



# Conservation

- Estimates of water use for 2000 indicate that about 408 billion gallons per day were use
- Conservation practices are important to keep up with the demand on water now and for the future
- For Further Reading on Conservation See:
- www.WEF.org
- www.WEF.org
- www.swcs.org
- www.usbr.gov/waterconservation

# The end of Water Use Efficiency.

Thank you.

Carissa Barnett
Matt Grund
Alison Magno
Chris Phelps
Bryan Hollis
Amber Prommier