Pesticides & Ground Water Protection

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Pesticides & Ground Water?

- There are many factors to be considered when applying pesticides. However there are many other factors to consider when rinsing pesticide containers and spray equipment at the rinse stations throughout the state.
- This class is designed to help you understand the issues facing growers and PCA's in regards to ground water contamination.

Groundwater Contamination

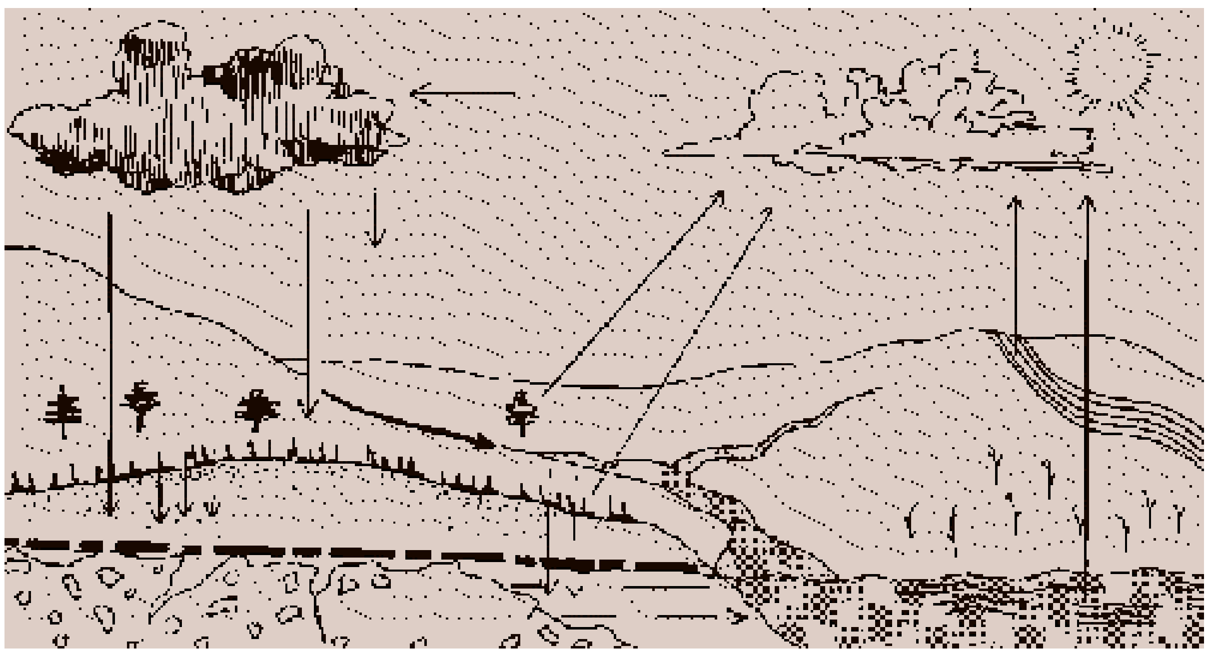
- 97% of all water on earth is salt water
- < 1% is suitable for human use
- 2/3 of fresh water is groundwater
- 1/3 is surface water (ponds, lakes, rivers)
- Groundwater is our most important source
- Stringent laws protect this resource

Groundwater

- Soil Filtration or Percolation
- Particle size
- Aquifers
- Location
- Leaching
- Direct Entry

Protecting the Environment

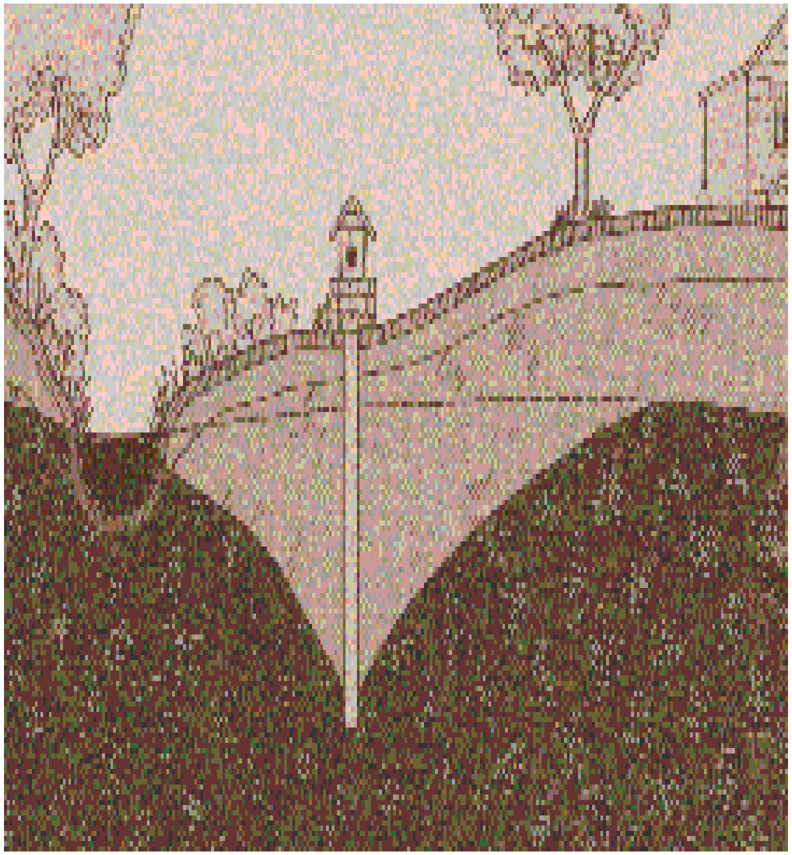
This underground water is often the forgotten element in the hydrologic system -- nature's great water recycling system. Water leaves the atmosphere as precipitation, producing stream flow in rivers and streams and also infiltrating or "*recharging*" through the topsoil and land surface to become groundwater. Evaporation returns water to the atmosphere to complete the never-ending cycle.



Groundwater Issues

- **Water situated in the water-saturated zone below the earth is called groundwater. The top of this zone (top of the darker area) is called the water table. The water table fluctuates over time and generally follows the topography of the land. Where it intersects rivers and wetlands, the groundwater often becomes surface water.**

Groundwater Issues



- A pumping well pulls groundwater in the surrounding aquifer toward it, creating something of a "valley" within the aquifer. This lowering of the water table in a cone-like shape, with the well opening at the bottom center point, is called a "*cone of depression*."

Groundwater Issues

- *Ground water contamination incidents have been reported in all parts of the United States. Contamination problems vary from region to region and are influenced by climate, population density, intensity of industrial and agricultural activities, the hydrogeology of the region, and the status and enforcement of federal and state regulations that can be used to protect ground water.*
- Larry Canter

- *It's been known since the 30's and 40's that the "filtering action" of soil and rock was often limited or even non-existent for a variety of chemicals. The potential for significant contamination of groundwater is actually a very old story.*
- Steven Amter

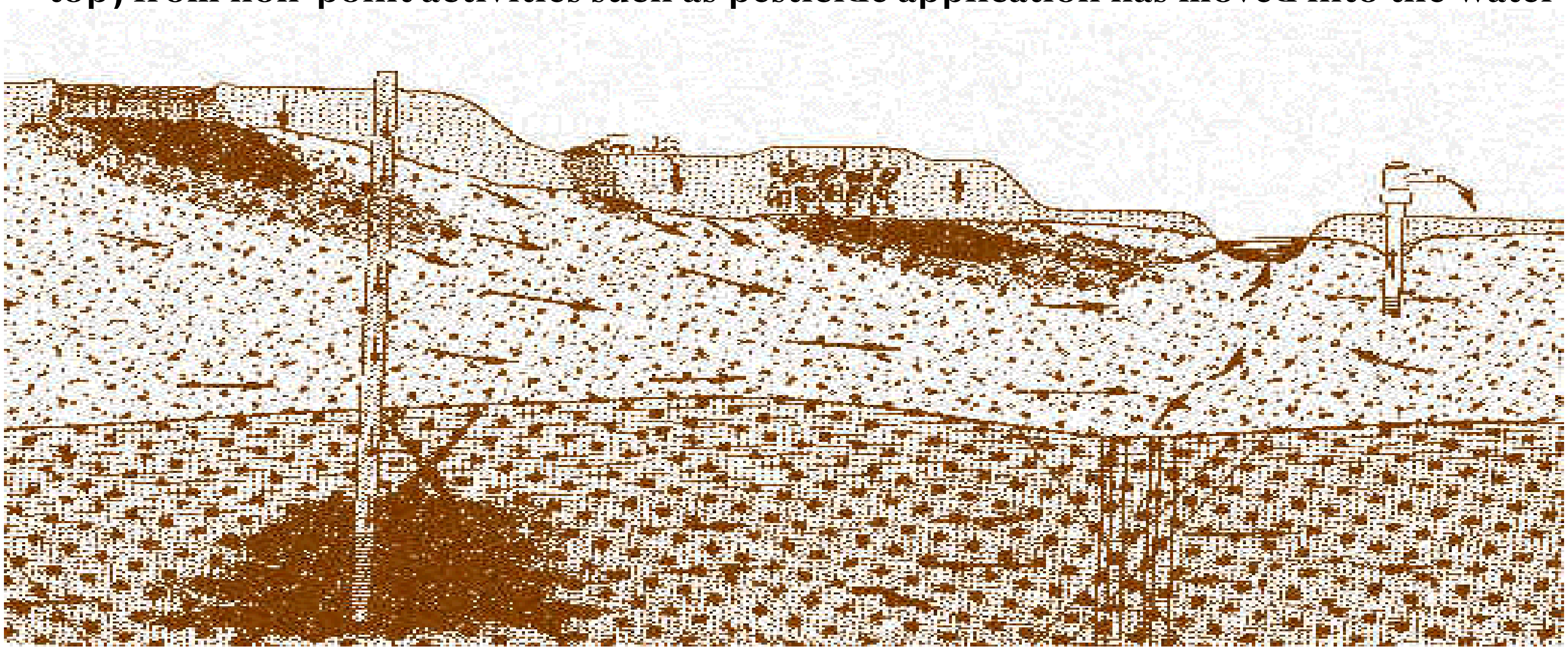
Groundwater Issues

- ***First Law of Ground Water Vulnerability:* All ground water is vulnerable.**
- ***Second Law of Ground Water Vulnerability:* Uncertainty is inherent in all vulnerability assessments.**
- National Research Council

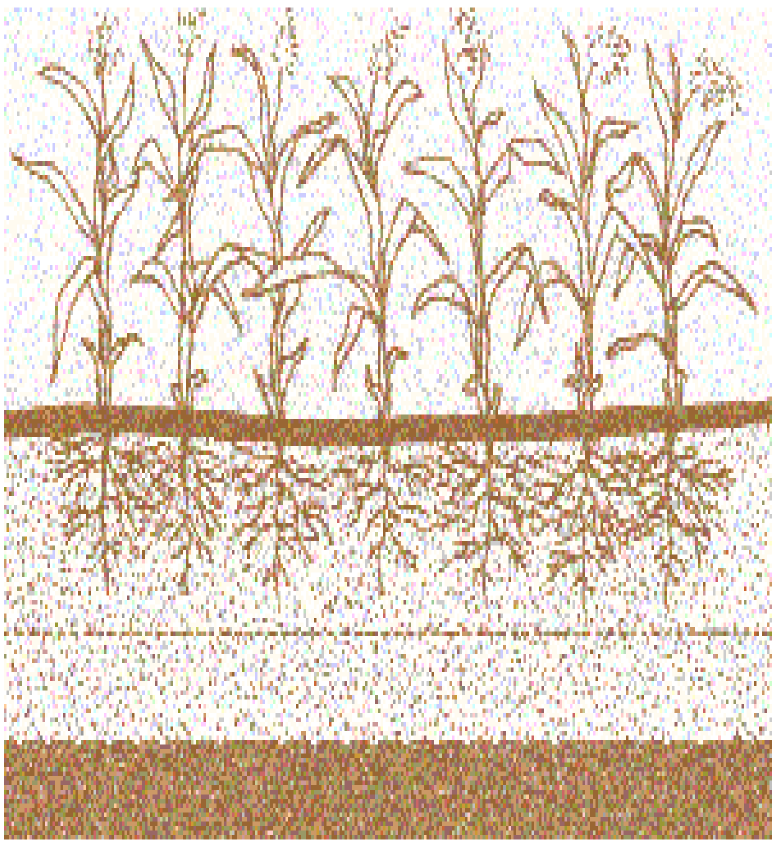
- ***...detection of a large number of volatile and nonvolatile contaminants...in both shallow and deep ground water has raised questions as to the validity of what has been called the 'filter fantasy,' i.e., that the unsaturated zone acts as a protective buffer.***
- National Research Council

Groundwater Issues

- **This diagram shows several contamination plumes. Landfill pollution (upper left) and buried waste (right) has reached the water table and is traveling in the direction of groundwater flow. Wastes injected under pressure into a deeper aquifer are flowing with and against the groundwater flow direction. A smaller plume (middle, top) from non-point activities such as pesticide application has moved into the water**



Groundwater Issues

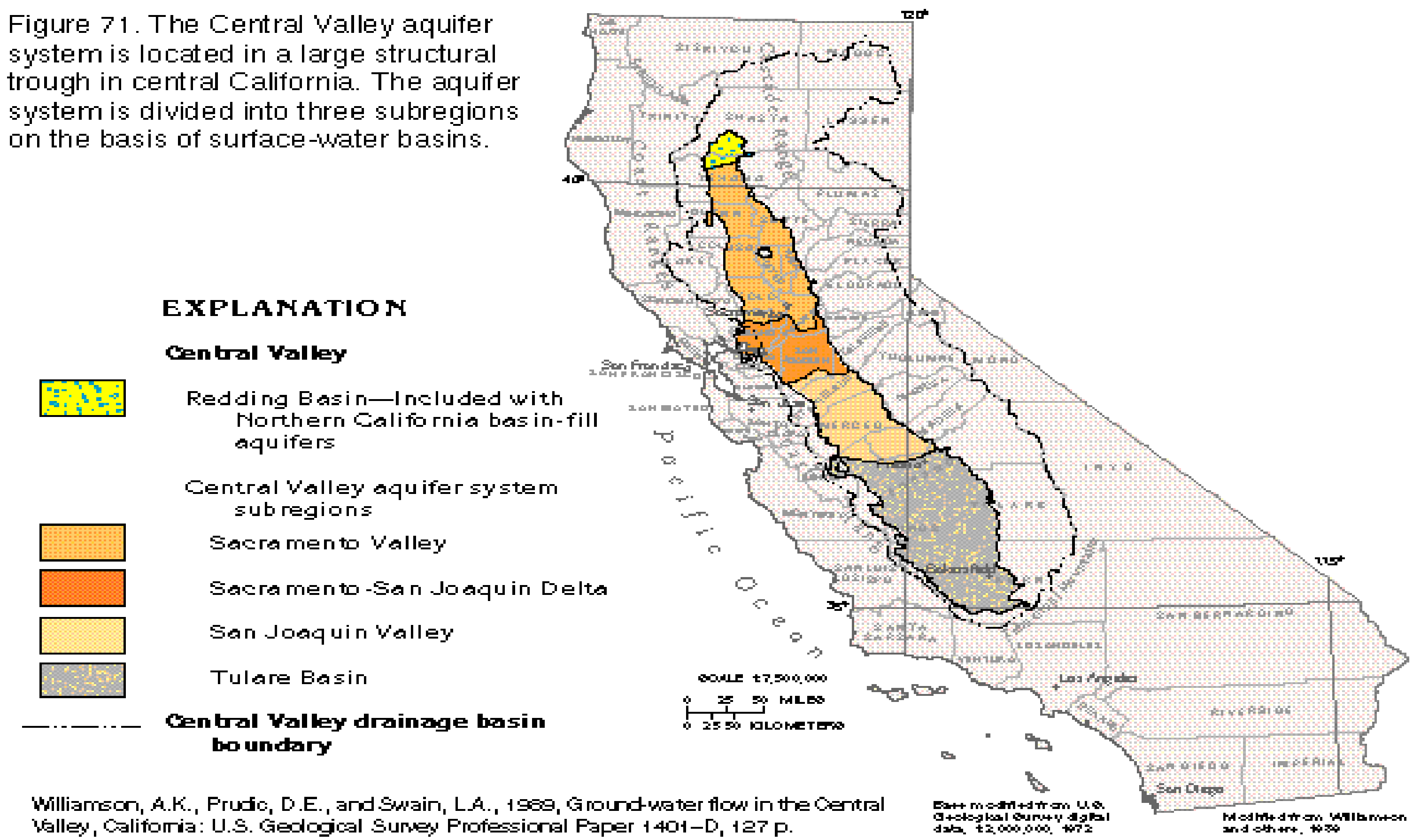


- The presence and types of vegetation may also affect pesticide movement, with more deeply rooted crops and plants capable of taking up more of a pesticide that resides in the *root zone* above the water table following application.

Groundwater Issues

Geologic Material	Flow Rate
Clean sand and gravel	100 ft/yr
Fine sand and silty sand	100 ft/yr -- 1 ft/yr
Silt	10 ft/yr - 1ft/10yrs
Gravelly till	1 ft/yr - 1 ft/100yrs
Clayey tills, greater than 25% clay	1ft/100yrs - 1 ft/10,000yrs
Sandstone	10 ft/yr
Fractured rock	10 ft/yr
Shale	1ft/100yr - 1 ft/1,000,000yrs
Dense unfractured limestone	**1 ft/1,000yrs - 1 ft/1,000,000yrs**

Central Valley Aquifer System



Central Valley Floor

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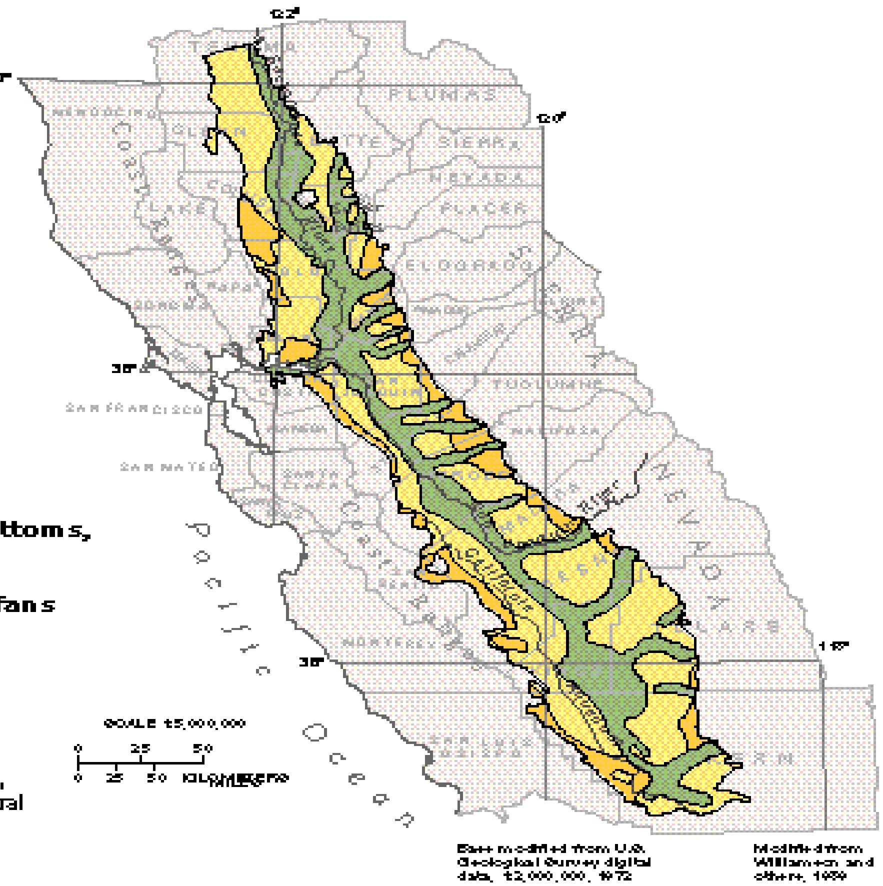
Figure 72. The valley floor is flat to slightly rolling, and consists of alluvial fans and plains, river flood plains, and dry lake bottoms. Much of the valley floor is surrounded by dissected uplands that are slightly rolling to hilly.



EXPLANATION

- **Overflow lands, lake bottoms, and floodplains**
- **Low alluvial plains and fans**
- **Dissected uplands**

Williamson, A.K., Prudic, D.E., and Swain, L.A., 1989, Ground-water flow in the Central Valley, California: U.S. Geological Survey Professional Paper 1401–D, 127 p.

Central Valley Runoff

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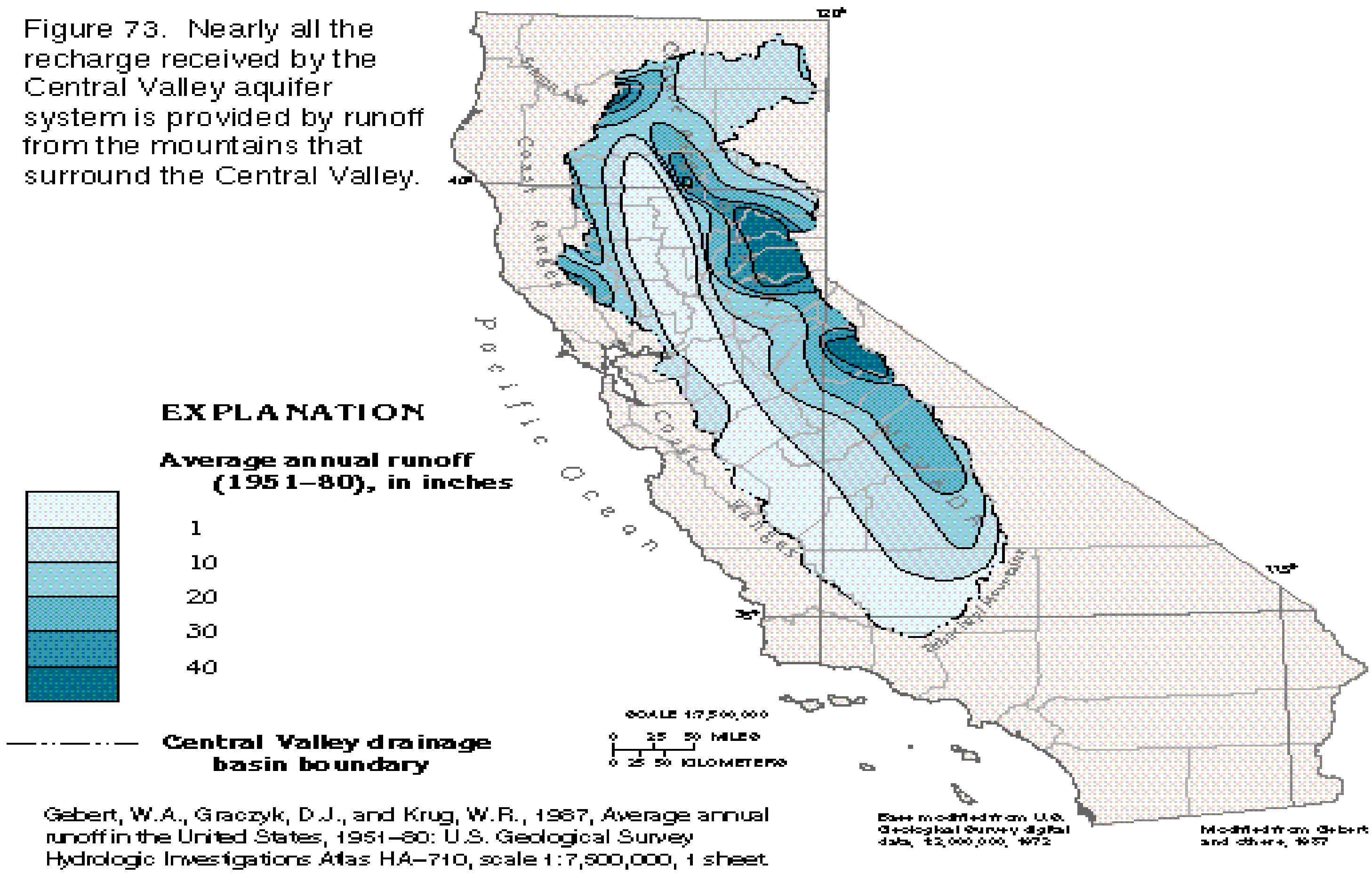

Central Valley geology

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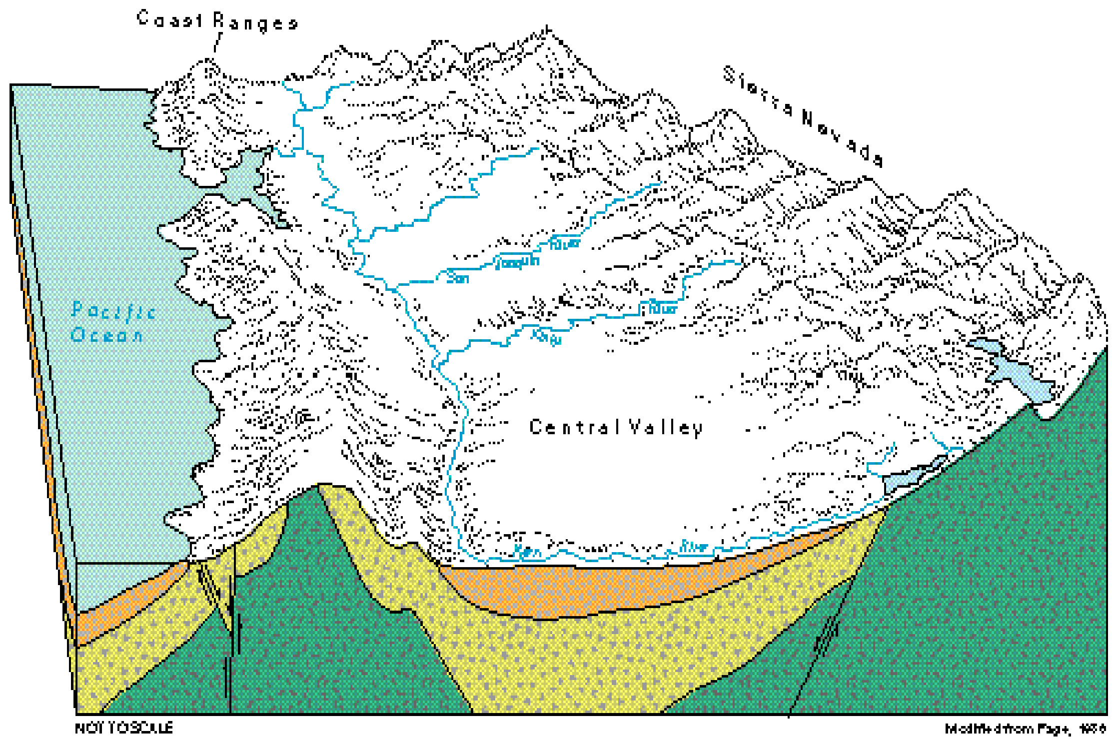
Figure 74. The Central Valley is a large structural trough that has been partially filled by marine sediments and continental deposits. The Sierra Nevada, which forms most of the eastern boundary of the valley, is the edge of a huge tilted granite block. The Coast Ranges, which form most of the western boundary, consist, for the most part, of folded and faulted marine rocks.

EXPLANATION

- **Continental deposits**
- **Marine sediments**
- **Crystalline rock**
- **Fault**—Arrows show relative direction of movement



Page, R.W., 1986, Geology of the fresh ground-water basin of the Central Valley, California, with texture maps and sections: U.S. Geological Survey Professional Paper 1401–C, 54 p.

Factors Influencing Contamination

- Nature of chemical (persistent vs. mobile)
- Soil types (sand, loam, or clay)
- Geological formations (gravel, layers)
- Organic material
- Soil factors: temperature, pH, moisture, dissolved salts, soil organisms

Irrigation issues

- Timing - Early morning best time stops evaporation and improves efficiency
- Field Capacity -Amount of water held in pore space by capillary action
- Pore Space - The openings between soil particles, which fill with water or air
- Available water - Water that can actually be extracted by the plants
- Wilting point - Occurs when plants have extracted all the available water
- Evapotranspiration - The loss of water through evaporation and transpiration
- Irrigation needs - Are determined by observing plants and monitoring the soil
- Methods - Basin, sprinkler, low-volume soaker hose, and drip systems
- Conservation - Efficient system, Irrigate when needed, Proper plant selection

Off Target Movement

- Droplet size
- Nozzle size and angle
- Pressure (pressure increase x 4 = output increase x 2)
- Encapsulation
- Speed of movement
- Humidity
- Inversion (warm air between 2 cool air layers) Dangerous under 1000’
- Volatility (from liquid to gas), Persistence (binding tightly to soil)
- Adjuvants

Soil Texture

- Inches of available water per foot of soil
- sand - 0.5 to 1.0 inch per foot
- Sandy loam - 1.0 to 1.5 inch per foot
- clay loam - 1.5 to 2.0 inch per foot
- clay - 2.0 to 3.0 inch per foot

Field Practices to Consider

- Leave a buffer zone around treated fields to protect sensitive areas.
- Apply rinseate back to the treated field, don't just drain the pesticides out onto the ground.
- Always fill the spray tank half full before adding the chemicals to avoid overflows and spillage.
- Always leave space between the filling hose and the tank to prevent possible back-siphoning into the well.
- Consider installing a closed mixing system to eliminate worker exposure and spills.

Field Practices to Consider

- Triple rinse all containers and pour the rinseate into your spray tank before filling
- If there is any solution remaining in the tank after completing the spray job. Dilute the rest and apply to the treated field.
- Avoid overfilling the spray tank; spills can move into sensitive areas.
- Don't mix or load on hard-packed soil or on pavement where run-off can move into waterways.
- Mix and load on a site that does not run-off to the soil surrounding it.

Field Practices to Consider

- Load and clean sprayers away from wells or in areas with leaching potential.
- Know your soil type for leaching potential and for run-off issues.
- Make an assessment of your working environment for any potential for contamination.
- Always clean sprayers near the application site so the rinseate can be reapplied to the field.
- Always train applicators to consider these field practices to avoid ground water contamination.