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*Agency Secretary*

# California Regional Water Quality Control Board

## San Francisco Bay Region

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**Arnold Schwarzenegger**
*Governor*

**TO:** Bruce H. Wolfe
Executive Officer

**FROM:** Mary Rose Cassa
Toxics Cleanup Division

**DATE:** May 6, 2005

**SUBJECT:** **CALIFORNIA GROUNDWATER AWARENESS MONTH**

The intimate ties between the land, surface water, groundwater, the Estuary, and human activity must be acknowledged in order to promote wise, balanced, and sustainable use of water resources. It must also be recognized that groundwater quality and quantity are inextricably linked. Because an informed and involved citizenry is crucial to realizing groundwater protection, the Water Board's policies and plans encourage and promote research, education, and public involvement as integral parts of the groundwater protection program. Currently, more than 10 million Californians (30 percent) rely on water from public supply wells. More than 2 million Californians obtain their water from more than 600,000 private wells.

Assembly Concurrent Resolution No. 99 (Liu, 2003; attached) established May as California Groundwater Awareness Month and stated the commitment of the Legislature to protect and improve the management of this precious and limited resource. ACR No. 99 is targeted at water supply and water rights; however, protecting and improving the quality of groundwater in California deserves equal effort. Groundwater Awareness Month is a celebration of California's precious resource and an opportunity to reflect more deeply on groundwater's value and its contributions to our lives. The focus for ACR No. 99 is on water wells and water rights; however, the Water Board's Groundwater Committee believes it is important to expand the focus to embrace all issues affecting groundwater in our Region.

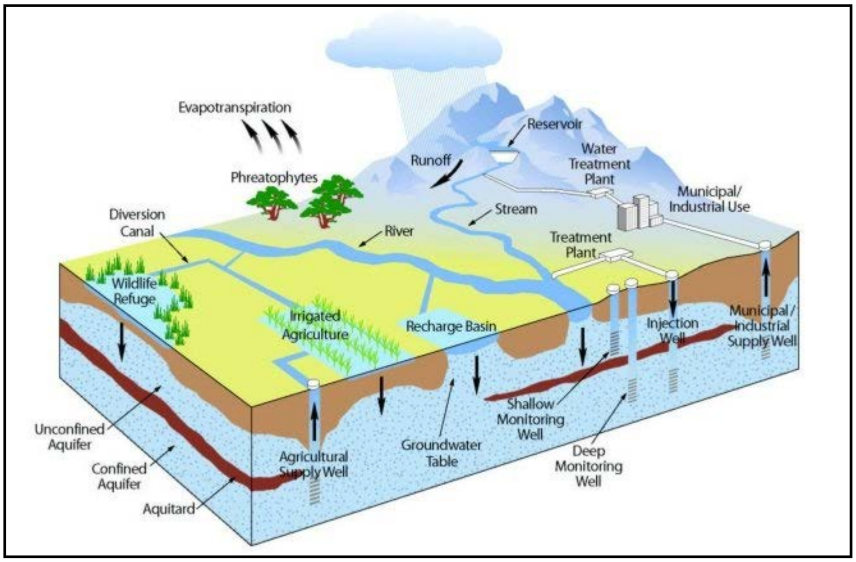
Consider the following groundwater facts:

- Groundwater provides much of the flow of many streams; often lakes and streams are "windows" to the water table. Groundwater adds billions of gallons per day to California's surface water bodies. In large part, the flow in a stream represents water that has flowed from the ground into the stream channel.
- In an average year, groundwater accounts for about 30 percent of California's urban and agricultural water supplies, and up to 40 percent in a drought year. More than 9 million

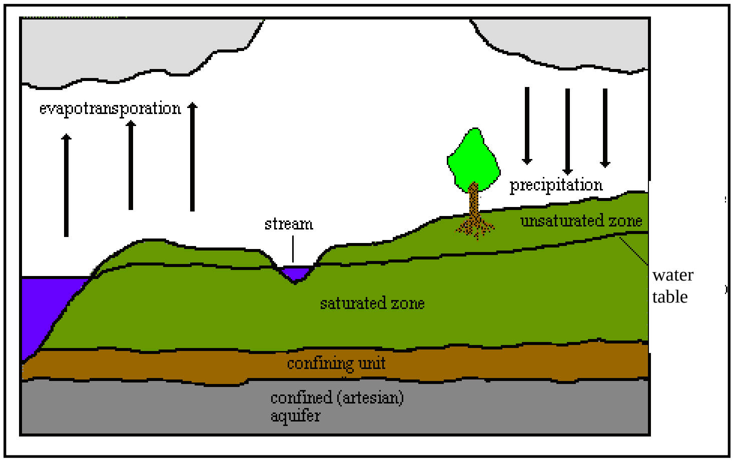
Californians – nearly one in three – rely solely on groundwater to meet their needs. Along California's central coast 90 percent of the drinking water comes from groundwater.

- Groundwater is tapped through wells placed in water-bearing soils and rocks beneath the surface of the earth. There are more than 200,000 of these wells serving California households, cities, business, and agriculture every day.
- One ton of groundwater used by industry generates an estimated $14,000 worth of output.

**HYDROLOGIC CYCLE**




Groundwater is a component of the **hydrologic cycle**. In simple terms, water or one of its forms - water vapor and ice - can be found at the earth's surface, in the atmosphere, or beneath the earth's surface. The hydrologic cycle has no beginning or ending location; however, it is often thought of as beginning in the oceans. Water evaporates from a surface water source such as an ocean, lake, or through transpiration from plants. The water vapor may move over the land and condense to form clouds, allowing the water to return to the earth's surface as precipitation (rain or snow). Some of the snow will end up in polar ice caps or in glaciers.




Most of the rain and snowmelt will either become overland flow in channels or will infiltrate into the subsurface. As water begins to seep into the ground, it enters a zone that contains both water and air, referred to as the **unsaturated zone** or **vadose zone**. Some of the infiltrated water will be transpired by plants and returned to the atmosphere, while some will cling to particles surrounding the pore spaces in the subsurface, remaining in the unsaturated zone. The rest of the infiltrated water will move gradually, driven by gravity, into the **saturated zone** of the subsurface, becoming groundwater. From here, groundwater will flow toward points of discharge such as rivers, lakes, or the ocean to begin the cycle again.

Water moves through the unsaturated zone into the **saturated zone**, where all the interconnected openings between rock particles are filled with water. It is within this saturated zone that the term "groundwater" is correctly applied.

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*Fiction*: Groundwater is often thought of as an underground river or lake. Only in caves or within lava flows does groundwater occur this way. Instead, groundwater is usually held in porous soil or rock materials, much the same way water is held in a sponge.

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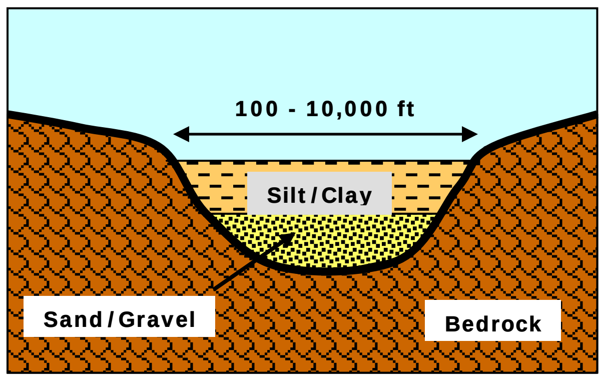
**GROUNDWATER IN CALIFORNIA**




Example of alluvial fill

Most of California's groundwater occurs in material deposited by streams, called **alluvium**. Alluvium consists of coarse deposits, such as sand and gravel, and finer-grained deposits, such as clay and silt. In an alluvial environment, the coarse deposits usually provide the best source of water and are termed aquifers. The finer-grained clay and silt deposits are relatively poor sources of water and can inhibit or retard groundwater flow. These are referred to as aquitards. California's groundwater basins usually include one or a series of alluvial aquifers with intermingled aquitards. Although alluvial aquifers are most common in California, other groundwater development occurs in fractured sedimentary and crystalline rocks, fractured volcanics, and limestones.

The Department of Health Service's Division of Drinking Water and Environmental Management established the California Drinking Water Source Assessment and Protection (DWSAP) Program to provide information to communities that wish to develop local programs to protect their sources of drinking water. The DWSAP Program has two primary elements – Source Water Assessment and Source Water Protection.

A **source water assessment,** required by Section 1453 of the 1996 amendments to the federal Safe Drinking Water Act, is an evaluation of a public drinking water source to determine the human-caused activities to which the source is most vulnerable. Since 1997, DHS, with the assistance of 34 counties, the California Rural Water Association and more than 500 water systems completed assessments for nearly all the public drinking water sources in the state. As of December 31, 2004, California has completed assessments for 16,152 drinking water sources from 7,543 public water systems. The top Potential Contaminating Activities identified in

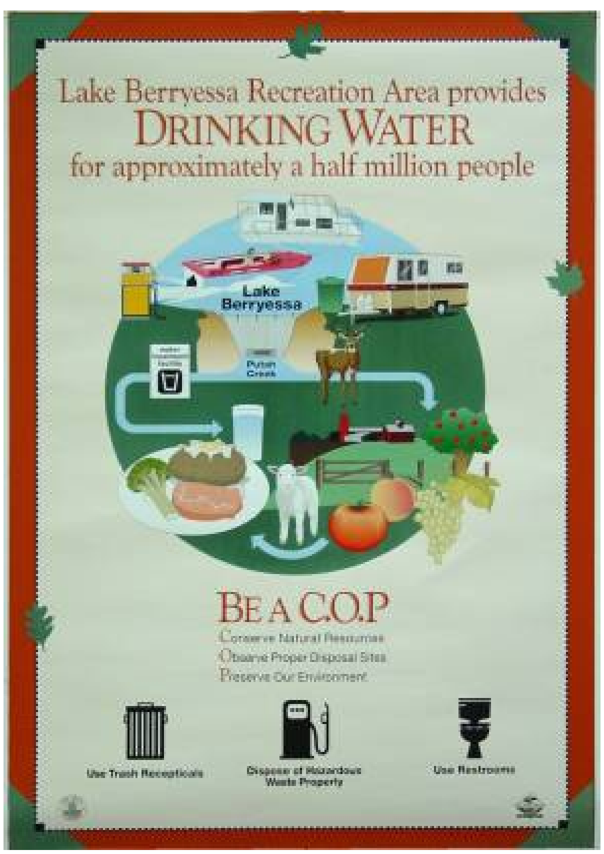
California include septic systems, sewer collection systems, surface water recreation, and gas stations/automotive facilities.

**Table 1. Overall Status of Source Water Assessments, as of September 30, 2003**

| Water System Type | No. of Public Water Systems | % Complete | No. of Groundwater Sources | % Complete | No of Surface Water Sources | % Complete |
|---|---|---|---|---|---|---|
| **Community** | 2,962 | 91 | 8,988 | 94 | 708 | 82 |
| **Non-Transient** | 1,448 | 95 | 1,866 | 96 | 85 | 93 |
| **Transient*** | 3,031 | 96 | 3,472 | 97 | 218 | 89 |
| **Total** | 7,441 | 94 | 14,326 | 95 | 1,011 | 85 |

*A rest area or campground may be considered a transient water system. Source: DWR

**Source water protection** (SWP) is the most cost-effective method to ensure the safety of the drinking water supply. Protecting the source from contamination is part of a "multi-barrier" approach to providing safe drinking water. Because treatment alone cannot always be successful in removing contaminants, protecting the source improves public perception of the safety of drinking water.




A source water protection poster for Lake Beryessa in Napa County

SWP measures are practices to prevent contamination of groundwater and surface water that are used or potentially used as sources of drinking water. These include non-regulatory measures, such as Best Management Practices (BMPs), and regulatory methods. BMPs are standard operating procedures that can reduce the threats that activities at homes, businesses, agriculture, and industry can pose to water supplies. BMPs, besides protecting water supplies, can sometimes increase the aesthetic beauty and value of residential and commercial properties.

Without adopting any new ordinances or regulations, communities can be successful in protecting water supplies. Non-regulatory measures include:

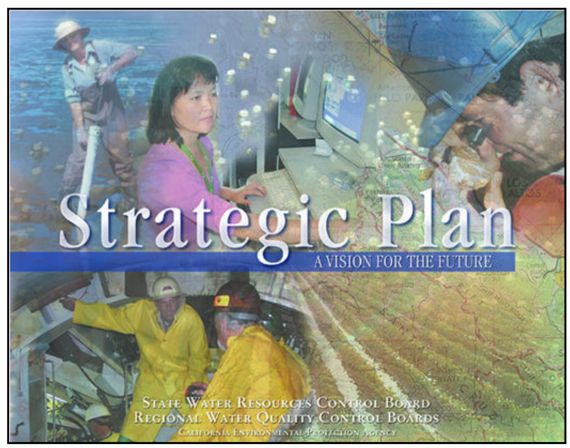
- Good housekeeping practices at water sources and at industries, businesses, and homes;
- Public education;
- Land management to minimize release or runoff of contaminants;

- Purchase of land, development rights, or easements;
- Man-made systems and devices to prevent release of contaminants;
- Emergency response planning.

Regulatory measures are appropriate when non-regulatory methods do not work, when the contamination threat is particularly significant, or when federal, state, or regional regulations are not strong enough for local issues. Regulatory measures include:

- Land use controls;
- Subdivision growth controls;
- Zoning;
- Land use prohibitions;
- Regulations and permits;
- Construction and operating standards;
- Permit requirements;
- Public health regulations.

**GROUNDWATER AND THE STRATEGIC PLAN**




One of the six goals of the State and Regional Water Boards' Strategic Plan is, "Groundwater is safe for drinking and other beneficial uses." Key strategies for achieving this goal include the following:

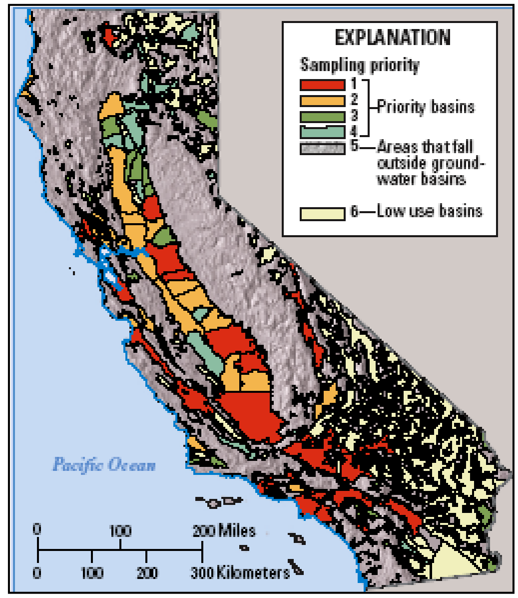
- Develop, promote, and implement innovative aquifer protection approaches
- Identify long-term threats to groundwater and focus efforts to implement appropriate pollution prevention and remediation activities
- Coordinate with other agencies that share a role in groundwater resources
- Promote cross-program communication and data sharing to identify threats to drinking water sources

Key projects to implement these strategies include the Drinking Water Well Project, Septic Systems Project, Seawater Intrusion Project and Brownfields Project.

**GROUNDWATER AMBIENT MONITORING AND ASSESSMENT (GAMA) PROGRAM**

To address concerns about groundwater quality and public supply well closures due to the detection of chemicals, such as the gasoline additive MTBE, solvents from industrial sources, and more recently perchlorate, the Supplemental Report of the 1999 Budget Act and later the Groundwater Quality Monitoring Act of 2001 (AB 599 – Statutes of 2001) required the State

Board to develop a comprehensive **ambient groundwater monitoring plan**.  This plan also addresses one of the four key groundwater projects identified in the Strategic Plan.



GAMA Priority Basins in California

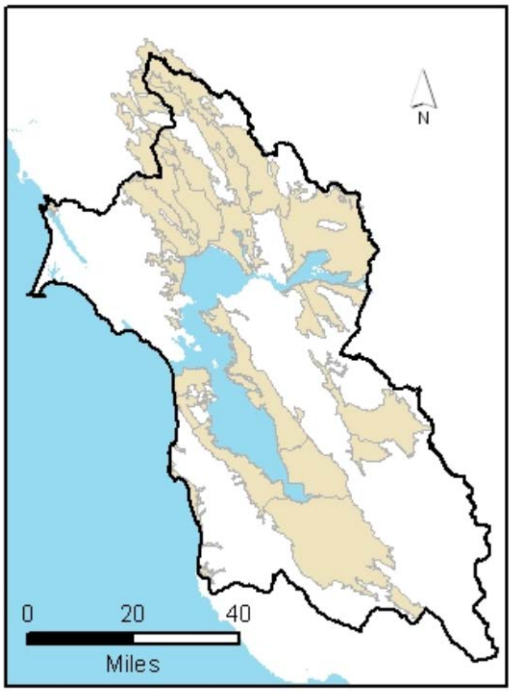
The primary objective of the Groundwater Ambient Monitoring and Assessment (GAMA) Program is to comprehensively assess statewide groundwater quality and gain an understanding about contamination risk to specific groundwater resources. The Groundwater Quality Monitoring Act of 2001 (Sections 10780-10782.3 of the Water Code) resulted in a publicly accepted plan to monitor and assess the quality of all priority groundwater basins that account for over 90 percent of all groundwater used in the state. The plan builds on the existing GAMA Program and prioritizes groundwater basins for assessment based on groundwater use. Groundwater basin assessments are planned across the state and represent areas in all ten hydrologic basins.

To facilitate a statewide, comprehensive groundwater quality-monitoring and assessment program most efficiently, uniform and consistent study-design and data-collection protocols are being applied to the entire state. The GAMA Program monitors groundwater for a broad suite of chemicals at very low detection limits, including exotic chemicals such as wastewater chemicals and pharmaceuticals. Monitoring and assessments for priority groundwater basins are to be completed every ten years, with trend monitoring every 3 years. The State Board is collaborating with the U.S. Geological Survey (USGS) and Lawrence Livermore National Laboratory (LLNL) to implement the GAMA Program.

The GAMA Program has divided the state into 35 priority basin study units.  As of February 2005, the program has completed sampling in three of the study units:  San Diego, North San Francisco Bay, and North San Joaquin Valley.  Assessment reports are posted on the GAMA website (www.waterboards.ca.gov/gama/) as they are completed.

**GROUNDWATER USE, PROTECTION, AND MANAGEMENT IN THE SAN FRANCISCO BAY REGION**

Groundwater accounts for about 20 percent of drinking water supply in the San Francisco Bay Region, and up to about 40 per cent in the South Bay.  Despite the tremendous urban development in the Region, groundwater use accounts for only about 5 percent of the Region's estimated average water supply for agricultural and urban uses.  The Santa Clara Valley, Napa-Sonoma Valley, Livermore-Amador Valley, and Petaluma Valley groundwater basins are the more heavily utilized basins in the Region.  In general, groundwater quality throughout most of the Region is suitable for most urban and agricultural uses with only local impairments.  The primary constituents of concern detected in groundwater are total dissolved solids, nitrate, boron, and organic compounds. From 1994 through 2000, 485 public supply water wells were sampled in 18 of the 33 basins and subbasins in the Region. Results indicate that 410 wells, or 85 percent, met the state's primary Maximum Contaminant Levels (MCLs) for drinking water. Seventy-five wells, or 15 percent, had constituents that exceeded one or more MCL.



Region 2 Groundwater Basins

Pursuant to Regional Water Board Resolution No. 89-39, almost all the Region's groundwaters are considered to be existing or potential sources of drinking water. With limited resources, the Water Board must concentrate its groundwater protection and management efforts on the most important groundwater basins. Increased demand on these groundwater resources has become evident in the rapidly developing Bay Area. Years of drought and two decades of discoveries of groundwater pollution have resulted in impacts or impairment to portions of these basins. Some municipal, domestic, industrial, and agricultural supply wells have been taken out of service due to the presence of pollution. Some of the basins have also been affected by over-pumping, resulting in land subsidence and saltwater intrusion.

Such pressures on groundwater resources require that comprehensive environmental planning and management practices be developed and implemented for each individual basin by all concerned and affected parties. The Water Board fosters this concept with the following groundwater protection and management goals for the San Francisco Bay Region.

Groundwater program goals include the following:

- Identify and update beneficial uses and water quality objectives for each groundwater basin.

- Regulate activities that impact or have the potential to impact the beneficial uses of groundwaters of the Region.

- Prevent future impacts to the groundwater resource through local and regional planning, management, and education.

Discharges of solid, semisolid, and liquid wastes to landfills, waste piles, surface impoundments, and land treatment facilities can create sources of pollution affecting the quality of waters of the state. Discharges of wastes to waste management units require long-term containment or active treatment following the discharge in order to prevent waste or waste constituents from migrating to and impairing the beneficial uses of waters of the state. Pollutants from such discharges may continue to affect water quality long after the discharger has stopped discharging new wastes at a site, either because of continued discharges from the site or because pollutants from the site have accumulated in underlying soils and are migrating to groundwater.

Landfills for disposal of municipal or industrial solid waste (solid waste disposal sites) are the major categories of waste management units in the region. But there are also surface impoundments used for storage or evaporative treatment of liquid wastes, waste piles, and land treatment facilities where semi-solid sludge from wastewater treatment facilities and liquid wastes from refinery operations are discharged for biological treatment. The Water Board issues waste discharge requirements to ensure that these discharges are properly contained to protect the Region's water resources from degradation and to ensure that the dischargers undertake effective monitoring to verify continued compliance with requirements.

The Water Board has identified over 5,400 sites with confirmed releases of constituents of concern that have polluted or threaten to pollute groundwater. Sources of pollution at these sites include leaking underground storage tanks and sumps; leaking aboveground tanks; leaking pipelines; surface spills from chemical handling, transfer or storage; poor housekeeping; and illegal disposal. Cleanup at these sites involves the following:

- After a full evaluation of the nature and extent of groundwater pollution caused by releases at a site, the Water Board approves groundwater and soil cleanup concentrations appropriate for that site.

- Groundwater cleanup concentrations are based on beneficial uses of the water body and water quality objectives. The concentration range for cleanup concentrations is high quality "background" or between "background" and numerical limits that implement all applicable water quality objectives, including the more restrictive of Maximum or Secondary MCLs for groundwaters with a beneficial use of municipal and domestic supply.

- Soil cleanup concentrations are also usually background. Where soil cleanup concentrations remain above background, soil cleanup concentrations are established based upon acceptable health risks, if appropriate, and to ensure that any residual mobile pollutants generated would not cause groundwater or surface water to exceed applicable water quality objectives. Minimal dilution may be considered.

- Certain chemicals in groundwater, such as benzene, perchloroethylene (dry cleaning solvent) and others, can volatilize and travel through the soil, eventually entering the air in buildings through cracks in basement walls or slab floors. This process can result in significant risks to residents and building occupants, even in areas where groundwater is not otherwise used for drinking. Groundwater cleanup concentrations must also take into account volatilization of constituents into indoor air.

Perchlorate has recently attracted attention as a chemical of concern in groundwater, particularly in Region 3. Scientific and policy issues surrounding perchlorate will be the subject of a

National Ground Water Association Regulatory Roundtable on May 26, 2005, in San Francisco (see http://ngwa.org for details).

The following findings are drawn from the Water Board's current regulatory experience in cleaning up polluted sites and threats to groundwater:

- Available options for removing polluted groundwater or treating it in place are limited.
- Recent research, much of which is being confirmed at sites within the Region, demonstrates that using pump-and-treat technology removes pollutants from groundwater and controls pollutant mass migration. However, in some cases, pump-and-treat technology is not adequate to meet low-concentration groundwater objectives because the costs and time frames may be prohibitive.
- Groundwater pollution cleanup is lengthy and requires significant resources of both the discharger and the regulator. Preventing discharges to land and groundwater ("pollution prevention") is the best strategy to conserve those financial and human resources required for cleanup.
- Risk assessment and management techniques can provide the Water Board with a quantitative estimate of risks to assist in decision-making.
- An inflexible, resource-intensive approach, such as that required for federal Superfund sites, is not the most cost-effective, considering the multitude of existing and potential sources of groundwater pollution requiring cleanup.
- Institutional controls, such as deed restrictions, are an additional mechanism to protect beneficial uses and public health and safety. Guidance from the U.S. EPA and the Department of Toxics Substances Control is considered in setting institutional controls.

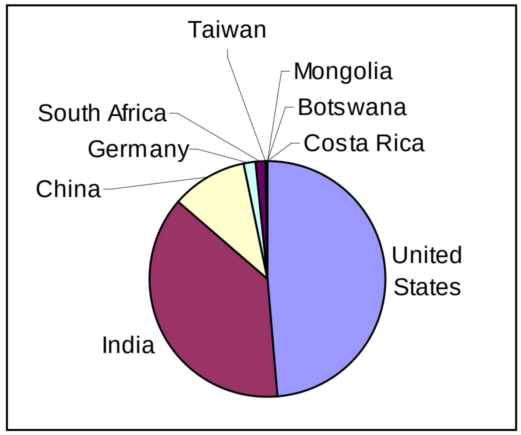
**THE NATIONAL AND GLOBAL PERSPECTIVE**

Groundwater is a significant national and global water supply source. Nationally, the amount of groundwater storage dwarfs our present surface water supply. At any given moment groundwater accounts for 20 to 30 times more than the amount in all the lakes, streams, and rivers of the United States. Groundwater is also an important source of surface water. It adds about 492 billion gallons per day to U.S. surface water bodies. Its contribution to the overall flow of rivers and streams in the U.S. may be as large as 50 percent, and it is a major source of water for lakes and wetlands.

Groundwater is tapped through wells placed in water-bearing soils and rocks beneath the surface of the earth. Of the total 341 billion gallons of fresh water used each day in the U.S., groundwater is estimated to be 76.4 billion gallons, or 22 percent. There are nearly16 million water wells in the U.S., supplying groundwater for public supply, private supply, irrigation, livestock, manufacturing, mining, thermoelectric power, and other purposes.

The National Ground Water Association has determined that 47 percent of the U.S. population depends on groundwater for its drinking water supply from either a public source or private well. In the Asia-Pacific region, 32 percent of the population is groundwater-dependent; in Europe, 75 percent; in Latin America, 29 percent; and in Australia, 15 percent. More than 200,000 public supply wells in the United States are used for public distribution systems. In comparison, more than 15 million individual households are served by private wells. Approximately 800,000 boreholes are drilled in the U.S. annually. The construction of these vitally needed water supply systems involves the use of more than 19,000 drilling rigs by an estimated 8,000 groundwater contracting firms. The U.S. is the largest water well market in the world:

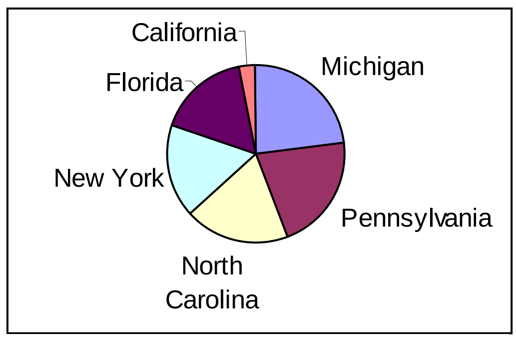
- United States - 15.9 million wells
- India - 12.3 million
- China - 3.4 million
- Germany - 500,000
- South Africa - 500,000
- Taiwan - 37,100
- Mongolia - 27,000
- Botswana - 7,500
- Costa Rica - 5,000




Water Well Markets Around the World

Private household wells constitute the largest share of all water wells in the U.S. Other kinds of wells are used for municipal systems, industry, agriculture, and water quality monitoring. Michigan, with 1,121,075 households served by private water wells, is the largest state market, followed by:

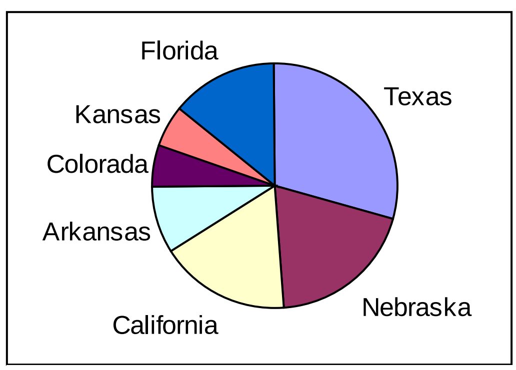
- Pennsylvania - 978,200 households
- North Carolina - 912,100
- New York - 824,300
- Florida - 794,500
- California - more than 150,000




Private Household Wells in the U.S.

Irrigation accounts for the largest use of groundwater in the U.S. - 49 billion gallons. Texas leads the nation in the number of irrigation wells with 122,000. Other leading irrigation well states are:

- Nebraska - 80,000 irrigation wells




Irrigation Wells in the U.S.

- California - 71,500
- Arkansas - 37,300
- Colorado - 23,000
- Kansas - 22,400
- Florida - 59,100

**SUMMARY**

By declaring May as Groundwater Awareness Month, the Legislature has created an important statewide tool for raising awareness among government officials and the public about their role as stewards of one of California's most precious natural resources. Although groundwater is a renewable resource that, to some extent, is replenished naturally, it also requires active management to ensure adequate supply and protect beneficial uses. California's increasing population places a continuing stress on the quantity and quality of groundwater. Recent bond measures have provided substantial funding for groundwater protection and storage, and programs have been implemented to encourage and assist local agencies in managing and protecting groundwater resources. This Board has been very active and diligent in ensuring ongoing protection of the groundwater resources in the Region.

In addition to the Water Board, other useful sources of information regarding groundwater in California include the Department of Water Resources, the Groundwater Resources Association of California, the California Water Well Association, the Water Education Foundation, the Association of California Water Agencies, the California Groundwater Association, the Water Resources Center Archives, county health departments, county agricultural extension agents, the U. S. Environmental Protection Agency and the U. S. Geological Survey.

**REFERENCES**

California Water Awareness Campaign
http://www.wateraware.org

Department of Water Resources
http://www.water.ca.gov/

Groundwater Resources Association of California
http://www.grac.org

National Groundwater Association
http://www.ngwa.org

San Francisco Bay Regional Water Quality Control Board
http://www.waterboards.ca.gov/sanfranciscobay/

State Water Resources Control Board
http://www.waterboards.ca.gov

**ATTACHMENT**
Assembly Concurrent Resolution No. 99 - Relative to Groundwater Awareness Month.