Aquifer Storage and Recovery

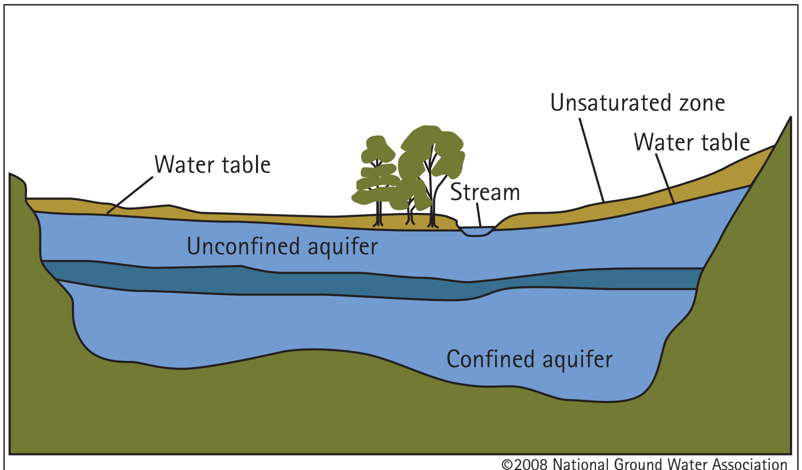
Water supply shortages are occurring now and are expected to occur more widely in the future. Aquifer storage and recovery (ASR) is a tool to help achieve water supply reliability and sustainability.

Introduction

Groundwater is a critical component of this nation's water resources. Globally, groundwater resources dwarf surface water supplies. But because groundwater is out-of-sight, the resource is often forgotten or misunderstood.

Approximately 78 percent of community water systems, and nearly all of rural America, use groundwater-supplied water systems. In many parts of the country, surface water supplies are seasonal or unavailable, and groundwater is the only practical source of water supply. Groundwater also feeds streams and rivers, especially during periods of drought or low flow, providing environmental benefits. Approximately 42 percent of the nation's agricultural irrigation water is obtained from groundwater.

While surface water and groundwater supplies are dwindling because of drought and water quality degradation, water demand to meet municipal, industrial, agricultural, and environmental uses is increasing. These pressures and many other contributing factors, including unpredictable future water supplies, changing flow and hydrologic patterns, limited surface storage capacities, and environmental challenges of constructing new dams and reservoirs, have led water managers to consider and explore alternative approaches to manage water supplies. A number of alternatives have emerged as viable and efficient tools for water managers to integrate and increase water supplies and provide better reliability, including improved water use efficiency, increased conservation, the use of recycled water, and managed aquifer recharge.



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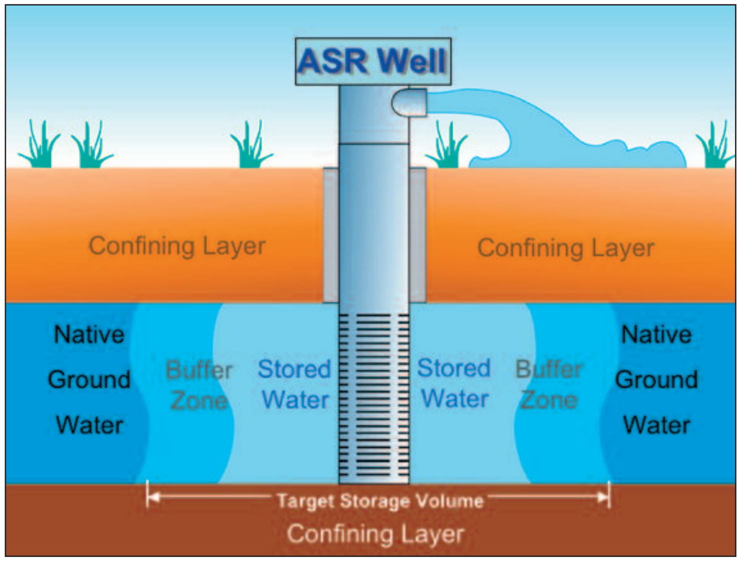
What is managed aquifer recharge and how does ASR relate to that?

Managed aquifer recharge replenishes groundwater supplies by capturing available water (during wet periods, during periods of low demand, or water that would be lost otherwise) and storing it in underground reservoirs called aquifers. ASR is one technique, among others, to convey and store this water underground, in this case through wells for later recovery through the same well or a nearby production well.



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What are some of the potential beneficial uses and features of ASR?

Twenty-six different applications of ASR have been implemented or planned to date. Examples include:

- Drinking water ASR systems are used to provide a more stable water supply during drought.
- ASR is employed as a supplement to surface water supplies to meet peak periods of water demand.
- Stored water is released during dry periods to augment minimum stream flows and to maintain lake levels, thereby benefiting ecosystems.
- ASR is recharging aquifers, augmenting agricultural water supplies in some parts of the country that are experiencing declining water levels in aquifers.
- Industrial water users are benefiting from ASR storage of cold water in winter or hot water in summer, to modulate cooling water temperatures for industrial process control.

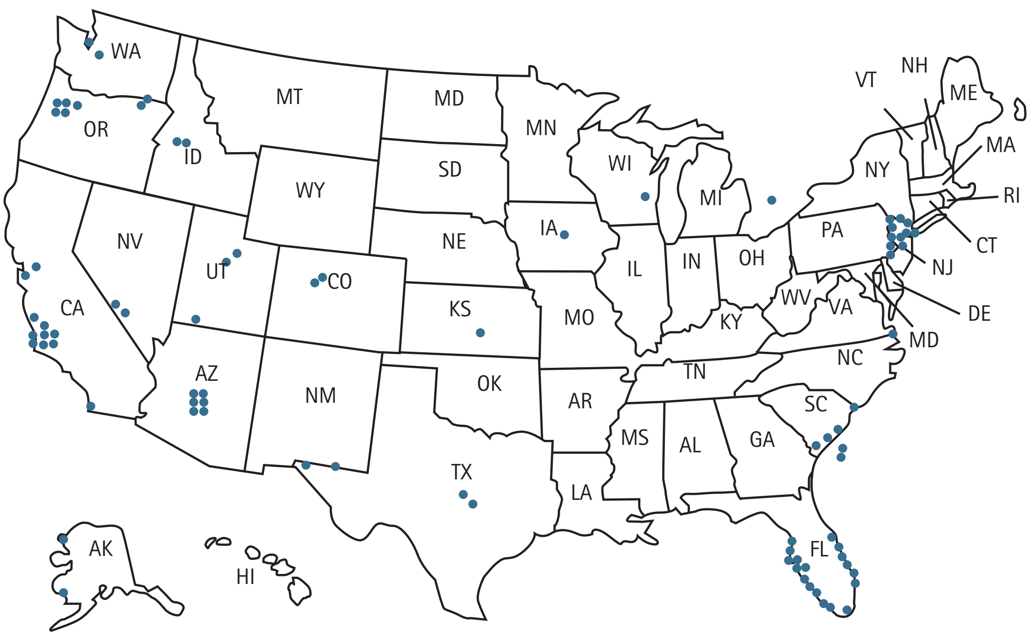
Some of the potentially advantageous features of ASR include:

- There is no evaporative loss of water volume in ASR systems.
- The small footprint of ASR facilities makes it appropriate for existing built-out urban and suburban settings or for ecosystems where threatened and endangered species are a concern.
- Water quality can improve through ASR with regard to nutrients or aesthetic qualities (color, turbidity) in some systems.
- ASR enhances the utilization of brackish aquifers. Recharging a brackish aquifer with fresh water can improve water levels, reduce salinity, and increase water supply.
- ASR, depending on the situation, may be more cost-effective than above-ground storage in reservoirs.

How widespread is the use of ASR wells?

The first ASR well began operation in Wildwood, New Jersey, in 1969. In 2009, a U.S. EPA inventory identified 542 ASR wells nationwide that are operational or capable of being operational. ASR wells are located in nine of the ten EPA regions and their number has more than quadrupled since 1999.

At Least 90 Operational ASR Wellfields in the United States—April 2009



Source: G. David Pyne, ASR Systems

How are ASR wells regulated?

The Underground Injection Control (UIC) program, authorized by the federal Safe Drinking Water Act, regulates injection wells, which include ASR wells. Either the state or U.S. EPA regional office oversees the regulation of ASR wells under the UIC program, dependent on whether the state has been delegated authority from U.S. EPA for these wells. Some states have adopted additional regulations specifically for ASR wells. In some cases, these state requirements are more stringent than the federal regulations.

What are some of the obstacles and challenges to implementing an ASR project?

The major obstacles and challenges to widespread implementation of ASR projects are primarily legal and institutional in nature. The list includes a mix of both federal and state issues, such as:

- Regulatory complexity, with sometimes overlapping federal and state laws and regulations.
- The inclusion of ASR within the same classification as waste injection wells, even though ASR involves storing water for later beneficial use.
- Ownership rights to the water stored in the subsurface via an ASR project are being debated in the courts.
- Allocation of water rights, as well as the ability to transfer water and water rights, varies across the country.

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Additional challenges to the use of ASR include financial and scientific hurdles. For example, it is difficult for a small utility to justify large capital outlays if it is not certain that an operational permit can be obtained for an ASR facility. Subsurface characterization to confirm that an aquifer is suitable for ASR can be expensive.

Where are there case studies that can be looked to?

While challenges remain and obstacles must be overcome, there are examples of ASR projects around the country that can be looked to and learned from.

California:

The Monterey Peninsula Water Management District, in conjunction with California American Water Company, has been operating ASR wells in Monterey since 2001 to store seasonally available treated surface water from the Carmel River to both recharge the Seaside Ground Water Basin in the winter and reduce adverse fisheries impacts on the river during the summer by recovering the water to meet demands instead of depleting river flows.

Las Vegas:

With 42 ASR wells, 22 injection wells, 103 million gallons per day (mgd) recharge capacity and 157 mgd of recovery capacity, this is the largest ASR wellfield in the world. Treated drinking water is stored at a high recharge rate during a brief period at the end of each calendar year when it would otherwise be lost from the water system under the state's water rights accounting program.

Las Vegas Valley Water District, Nevada, operates the largest ASR wellfield with 42 ASR wells. Total recovery capacity is 157 mgd.

New Jersey:

Among the many ASR wellfields in New Jersey, the oldest is at Wildwood. Operational since 1969, treated drinking water is stored in four ASR wells during most of the year. On July 4 weekend when tourists from New York and other areas go to the beach at Wildwood, local water demand increases dramatically. A significant portion of this short-term increase in demand is met from ASR storage.

Oregon:

A tremendous amount of ASR activity is under way in Oregon. One of the most interesting projects is in eastern Oregon where farmers capture seasonally available stream flow, filter it through shallow sands to improve its quality, then recharge it through ASR wells into a basalt aquifer that was previously depleted due to decades of agricultural groundwater production at rates exceeding natural recharge. The resulting sustainable water supply will enable agricultural operations to continue.

Texas:

San Antonio Water System's Twin Oaks Aquifer Storage and Recovery Facility withdraws water from the unconfined Edwards Aquifer in wet weather when water is abundant, and stores it in the confined Carrizo sandstone aquifer south of the city. With over 60,000 acre feet of drinking water stored and 55 mgd of recovery capacity, the facility proved itself to the community in 2006 to 2009 when the region experienced extreme drought.

Summary

ASR is a tool to help address the current and future need for a reliable, sustainable water supply.

The National Ground Water Association is a not-for-profit professional society and trade association for the groundwater industry. Our 13,000 members from all 50 states include some of the country's leading public and private sector groundwater scientists, engineers, water well contractors, manufacturers, and suppliers of groundwater-related products and services. The Association's vision is to be the leading groundwater association that advocates the responsible development, management, and use of water.

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For Additional Information

National Academy of Science Prospects for Managed Underground Storage of Recoverable Water
http://books.nap.edu/openbook.php?record_id=12057&page=R1

National Ground Water Association Aquifers Storage and Recovery Information Exchange:
http://www.ngwa.org/gwscience/ASR/egws.aspx

U.S. Environmental Protection Agency ASR Policy Considerations:
http://www.epa.gov/safewater/uic/class5/pdf/study_uic-class5_classvstudy_fs-aq_rechrg_wells.pdf