

# Growing Up... with Managed Aquifer Recharge

Michael E. Campana



Figure 1: Whitewater recharge pond with wind farm, southern California. [Courtesy Maureen Perry, Coachella Valley Water District, California]

**A**s a child growing up in the 1950s suburban wilds of Nassau County, Long Island, NY, I had the usual places to explore: woods, ponds, some streams and the ubiquitous building and sewer construction sites. The latter sites were often difficult to access as they were protected by fences, security guards, dogs or all of the above. Other parts of the county had wooded hills that towered a few hundred feet above sea level. I would later learn that these were glacial moraines, but no matter – I had no easy means of transportation to the county’s North Shore and its high-end towns where these ‘mountains’ were located. So in my neck of the woods – near the South Shore – there were few exotic places to capture my imagination.

Then I discovered sumps.

These were large excavations located seemingly randomly around Nassau County, the first suburban county just east of New York City’s Brooklyn and Queens boroughs. I had seen them when visiting friends’ houses, especially those who lived in new developments, or while on my

paper route. Each sump was mysterious, occupying several acres or more, maybe 15 feet or so deep with steeply sloping sides and a concrete culvert or two emptying into it. A chain link fence topped with barbed wire enclosed each sump. But that did not stop my friends and me from exploring them, especially when they held water.

No one really could explain the sumps’ purposes to me but they did fill up quickly with water when it rained so the nascent hydrologist in me ultimately figured they must be keeping water off the streets and away from homes. The water did not usually last long; just long enough to produce mosquitoes and frogs during the summer.

## Later on

Fast forward 15 years to the early 1970s when I was a hydrology graduate student at the University of Arizona. There, I finally learned the secrets of the sumps. While researching a term paper on the water resources of Long Island I learned that Nassau County first started building sumps in the 1930s to collect stormwater. The county was starting to develop and wanted to manage the flood hazards with detention basins – sumps. Shortly thereafter someone in the county public works department realized that sumps were great for recharging the shallow unconfined aquifer that was being used for water supply. More were built specifically for that purpose. Over 700 sumps were constructed.

Alas, someone later realized that as the county developed, the sumps were recharging polluted water – loaded with septic tank effluent, runoff from streets and parking lots and other sources. The pollution, combined with a modern storm sewer system, made the sumps less desirable and unnecessary. When I visited a few of my old sumps in October 2016, they had been turned into bird sanctuaries, passive parks, ponds, etc. Some still capture stormwater, and some recharge groundwater, but since cesspools and septic tanks have been obviated by sanitary sewers, the recharged groundwater is less polluted. In addition, a lot of groundwater development in the county is focused on the deeper aquifers.



**Figure 2:** Thomas E. Levy Groundwater Replenishment Facility, southern California. [Courtesy Maureen Perry, Coachella Valley Water District, California]

## Managed aquifer recharge

So whether they knew it or not, Nassau County was an early adopter of managed aquifer recharge (MAR), the intentional recharge (typically by infiltration basins or injection wells) of aquifers for later recovery or other purposes (environmental, dilution of pollutants, streamflow augmentation, etc.). MAR is sometimes called aquifer storage and recovery (ASR; sometimes the ‘and’ is omitted) when the water is being recharged for later recovery via the same wells used for recharge. In the old days we simply called it artificial recharge (AR). In the *old old* days it was referred to as ‘cyclic storage,’ a term coined by legendary civil engineer Harvey O. Banks, the first director of the California Department of Water Resources (thanks to the University of Washington’s Steve Burges for reminding me of that). I view MAR as a general term that encompasses all of the above.

The first recorded MAR attempt in the United States is believed to be the water spreading operation conducted by the Denver Union Water Company in Colorado in 1889. California followed with successful operations initiated in 1896 (Santiago Creek) and 1900 (Santa Ana River). These and other early attempts are described in two 1930s technical publications by authors affiliated with the U.S. Department of Agriculture, A.T. Mitchelson and Dean Muckel (see <http://bit.ly/2uF9Nmj>).

It was appropriate that I learned MAR at the University of Arizona, which at the time was heavily involved in researching artificial recharge via basins and pits. My curiosity was piqued by that work and my PhD advisor, the late Gene Simpson. When I expressed interest in artificial recharge, Gene directed me to the work of Don Warner, who was at the then-University of Missouri-Rolla (now the Missouri University of Science and Technology). His specialty was AR via wells. Good stuff!

I left MAR in the late 1970s but was brought back into the fold about 30 years later, largely by my co-editor and colleague, Maria T. Gibson, who is doing her PhD dissertation on the topic and has rekindled my interest. This topical issue of *Water Resources IMPACT* is one of the results of my newfound enthusiasm. Read on for a brief overview of the articles contained herein.

## The issue

The first three articles set the stage. Frederick Bloetscher of Florida Atlantic University provides an excellent overview of ASR, some history and how it can be a valuable water management tool. He also cites some of the challenges ASR faces. Co-editor Maria T. Gibson then describes the regulatory environment that currently retards expansion of MAR on a nationwide basis. Have an aquifer that straddles state and

EPA regional boundaries and is targeted for an MAR project? You may need some luck!

Gordon McCurry then weighs in with an important publication slated for release in 2018: *The ASCE-EWRI Standard Guidelines on Managed Aquifer Recharge*. This updated (first published in 2001) volume published by the American Society of Civil Engineers – Environmental and Water Resources Institute is long overdue and will be welcomed by those involved in all aspects of the MAR industry. An outstanding team of experts was engaged for this project.

Next up is Timothy K. Parker, a California consulting hydrogeologist with much experience in MAR. Tim discusses the California MAR scene including the new Sustainable Groundwater Management Act (SGMA) and introduces the global aspects. At that point Nienke Ansems of the International Groundwater Centre (IGRAC) in The Netherlands holds court. She highlights the global scene and enumerates the actions necessary to increase global acceptance of MAR.

So you think MAR applies only to large systems? Think again! Julianne Robinson, Todd Jarvis and Desirée Tullos report on a fascinating case study of MAR using a single domestic well and a seasonal spring. Bob Mansfield then tells us of a small (2,000 customers) Oregon utility that used ASR to provide affordable storage in lieu of an aboveground storage tank. Christopher Brown concludes the case studies by elucidating a little-known aspect of MAR: that of providing some measure of water treatment. He presents two studies of nutrient removal that will be of interest to MAR wonks and others as well.

In the very last paper, yours truly speculates on the possibility of using MAR to store glacial meltwater and harvest some of that ‘excess runoff’. ■

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