MANAGED AQUIFER RECHARGE (MAR) AND THE U.S. ARMY CORPS OF ENGINEERS: WATER SECURITY THROUGH RESILIENCE

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What is “Managed Aquifer Recharge” (MAR)?

(artificial recharge, water banking, aquifer storage and recovery...)

Using wells, basins, ephemeral stream beds, flood plains (bank filtration), alluvial fans...
# Technical Components of MAR

- **SOURCE WATER**
  - Quality
  - Quantity
  - Duration
  - Reliability

- **RECHARGE METHOD**
  - Land Availability
  - Aquifer Types
  - Location
  - Flood Control

- **STORAGE ZONE**
  - Duration
  - Capacity
  - Water Quality Changes

- **END USE**
  - Quality
  - Quantity
  - Duration
  - Reliability

- **RECOVERY METHOD**
  - Capacity
  - Efficient Recovery of Recharge Water

Source: US National Academy of Sciences
MAR Use is no longer “Experimental”: 1200 Locations, 50 Countries

Overall, the Need for more Storage is Key Motivator
But USACE and its Partners can use MAR for:

• **Flood risk management** – e.g., recharge of floodwaters, in combination with surface storage, can dampen the flood peak.

• **Aquatic Ecosystem Restoration** – e.g., discharging stored groundwater may help maintain timely environmental flows.

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• **Drought resilience (with partners)** – e.g., MAR can provide back-up storage for multi-year droughts when reservoir levels drop.

• **Multi-purpose urban environmental restoration projects (with partners)** – e.g., project that combines wastewater reuse, wetlands restoration, recreation, education, and MAR.

• **Salt-water intrusion prevention (with partners)** – e.g., replenishing coastal aquifers.
How could MAR be incorporated into some of the Civil Works Planning studies you’re working on right now (i.e. FRM, Eco Restoration)?

Click on the Annotation option \( \mathcal{H} \) on the left side of your screen and then use the \( \mathcal{T} \) Tool to type your response.
Are we Authorized to do this?

First general authorization explicitly addressing MAR: WRDA 2016, “Leveraging Federal infrastructure for increased water supply” included increasing the storage capacity or diverting water from the project to recharge groundwater, including ASR.

First large-scale, project-specific authorization for MAR (ASR): WRDA 2000, for Everglades Restoration. Seven of the 68 original projects involved MAR—a watershed moment.

WRDA 2007: (Project specific) The Secretary may participate with non-Federal and nonprofit entities to address issues concerning managing groundwater as a sustainable resource through the Upper Mississippi Embayment (TN, AR & MS).
AGENCY TECHNICAL REVIEW REPORT
TECHNICAL DATA REPORT
FOR THE
COMPREHENSIVE EVERGLADES RESTORATION PLAN
CERP AQUIFER STORAGE AND RECOVERY PILOT PROJECT
OKEECHOBEE AND PALM BEACH COUNTIES, FLORIDA

JACKSONVILLE DISTRICT

Review of the Everglades Aquifer Storage and Recovery Regional Study
Everglades Restoration:
After two decades of study, off the radar screen, ASR is ‘back on the table’

Would use ASR + “wetland attenuation feature” (+ to an extent, the lake itself) to improve lake levels & quantity/timing of discharges to estuaries, restore habitat, improve water supply...
"The [goal is] to determine the most beneficial and cost effective alternatives for the restoration of the hydrology and [wetlands] vegetation for the protection of the federally endangered Hine’s Emerald Dragonfly. [This includes] restoration of the groundwater recharge area..." (USACE, 2015)
Santa Ana River Basin, Southern California

Purposes: Water Supply & Drought Management in conjunction with Flood Control, & Ecosystem Restoration
During the 2010s drought, the Corps held extra water in the reservoir during flash flooding so that Orange County could capture and store as much water as possible using MAR.

MEMORANDUM FOR Commander, South Pacific Division, U.S. Army Corps of Engineers, CESPD-DE, 1455 Market Street, San Francisco, CA 94103.

SUBJECT: Approval of Temporary Exception to Dam Safety Policy Prohibiting Reallocation of Water Conservation Storage at a DSAC 3 Dam – Prado Dam, CA

3. The temporary exception allows evaluation of a deviation from the Water Control Plan at Prado Dam, due to the drought in California, in order to implement a Drought Contingency Plan. A deviation would potentially permit changing the duration or amount of water conserved behind the dam for gradual release to downstream recharge facilities prior to completing construction of the dam modification. The interrelationship of the
Edwards Aquifer, Central Texas

Source: www.edwardsaquifer.net
Combination Flood Control and MAR Dams

- From the mid-1960s to 1980s, USACE and regional cooperators identified potential dam sites near the Edwards Aquifer recharge zone for with a primary purpose of flood control but a secondary goal of recharging the aquifer.

- This dual purpose was discovered by accident in the case of a reservoir which while “constructed [in 1913] and operated for irrigation purposes became virtually ineffective during periods of moderate to severe drought because of leakage.”

Source: [www.edwardsaquifer.org](http://www.edwardsaquifer.org)
Site of pilot study of Forecast Informed Reservoir Operations (FIRO) of Lake Mendocino

Current authorized purposes: flood control, water supply, and recreation

Lower Russian River: Sonoma Water hopes FIRO + ASR will increase available water for agriculture and M&I, and to prevent seawater intrusion
USACE “engagement” with MAR is widespread

(Not all formal USACE “projects”! USACE/partners, districts/ERDC/IWR, considered/rejected...)
Challenge #1: Same Division but Different Districts/Hydrogeologic Environments
Challenge #2: Different Divisions but Similar Hydrogeologic Environments
Conclusions and Recommendations

**Conclusion**: USACE and its partners are already involved in MAR, across a broad geographic and thematic landscape, but in an *ad hoc* manner.

**Recommendation**: USACE should *enhance its internal communications* relative to MAR and conjunctive use. The creation of a community of practice, working group, and/or center of expertise may help to build such a community.

**Recommendation**: USACE should *upgrade its internal knowledge base* for potential applications of MAR in infrastructure project life-cycle management. This may include training courses for its planners, managers, economists and engineers, on-the-job training and mentoring, and conferences and workshops.
Conclusions and Recommendations

**Conclusion:** The Nation’s needs and USACE’s strategic directions (“support national security”, “deliver integrated water resource solutions”, “reduce disaster risks”, and “prepare for tomorrow”) suggest a potentially increased role for MAR in USACE water resources management.

**Recommendation:** USACE senior leadership, from Headquarters to District offices, *should encourage further evaluation* of how MAR may help USACE to deliver sustainable and resilient water management solutions.
Conclusions and Recommendations

**Conclusion**: MAR complements portions of USACE’s formal CW planning processes and new CW planning initiatives.

**Recommendation**: USACE should *consider MAR in conjunction with, not in lieu of, ongoing water resource management initiatives*. In doing so, the additional storage created in the service of multiple stakeholders will not be at the expense of primary missions like flood risk management.
Conclusions and Recommendations

**Conclusion**: USACE has much to learn from other agencies, and the private sector, about MAR.

**Recommendation**: USACE should use current interagency agreements, subcommittees and other mechanisms to conduct seminars, webinars, meetings and, potentially, cooperative research with other entities to *exchange knowledge*, experience and lessons-learned in MAR *with others outside of USACE*. 