

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

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April 2020

Managed Aquifer Recharge and the  
U.S. Army Corps of Engineers

*Water Security through Resilience*

2020-R-0x



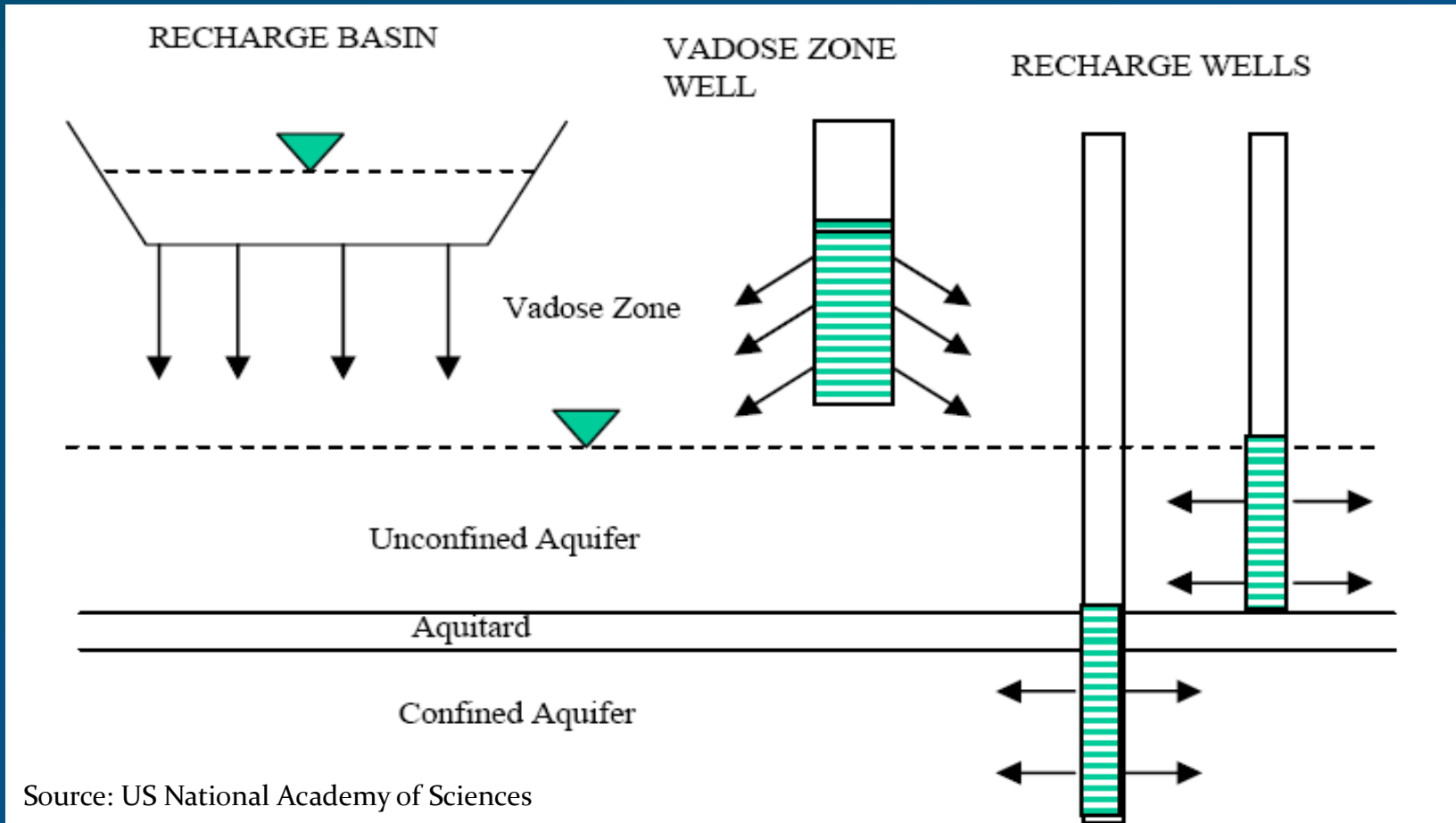
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[www.iwr.usace.army.mil](http://www.iwr.usace.army.mil)

# What is “Managed Aquifer Recharge” (MAR)?

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

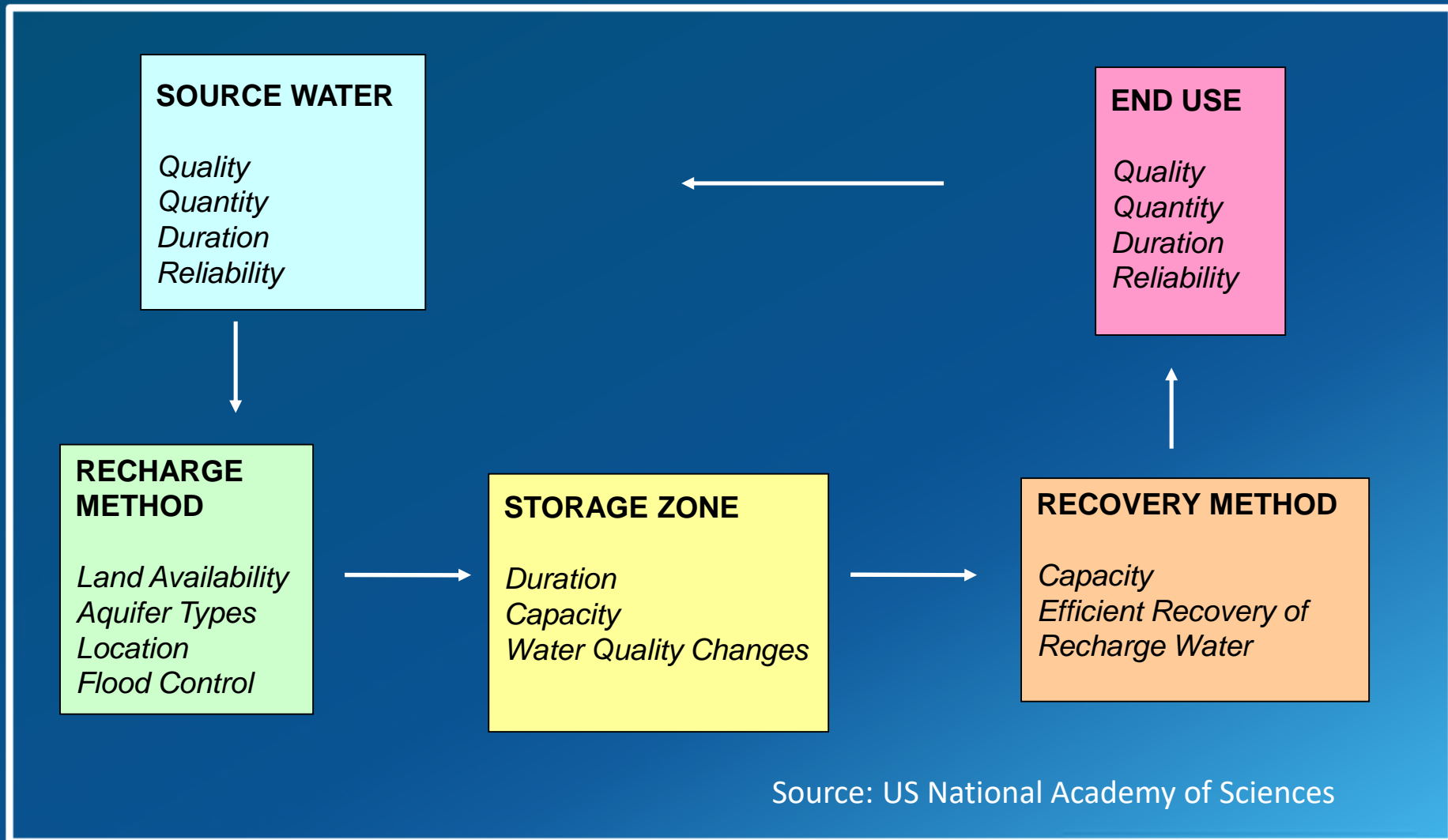


Source: US National Academy of Sciences



Using wells, basins, ephemeral stream beds, flood plains (bank filtration), alluvial fans...

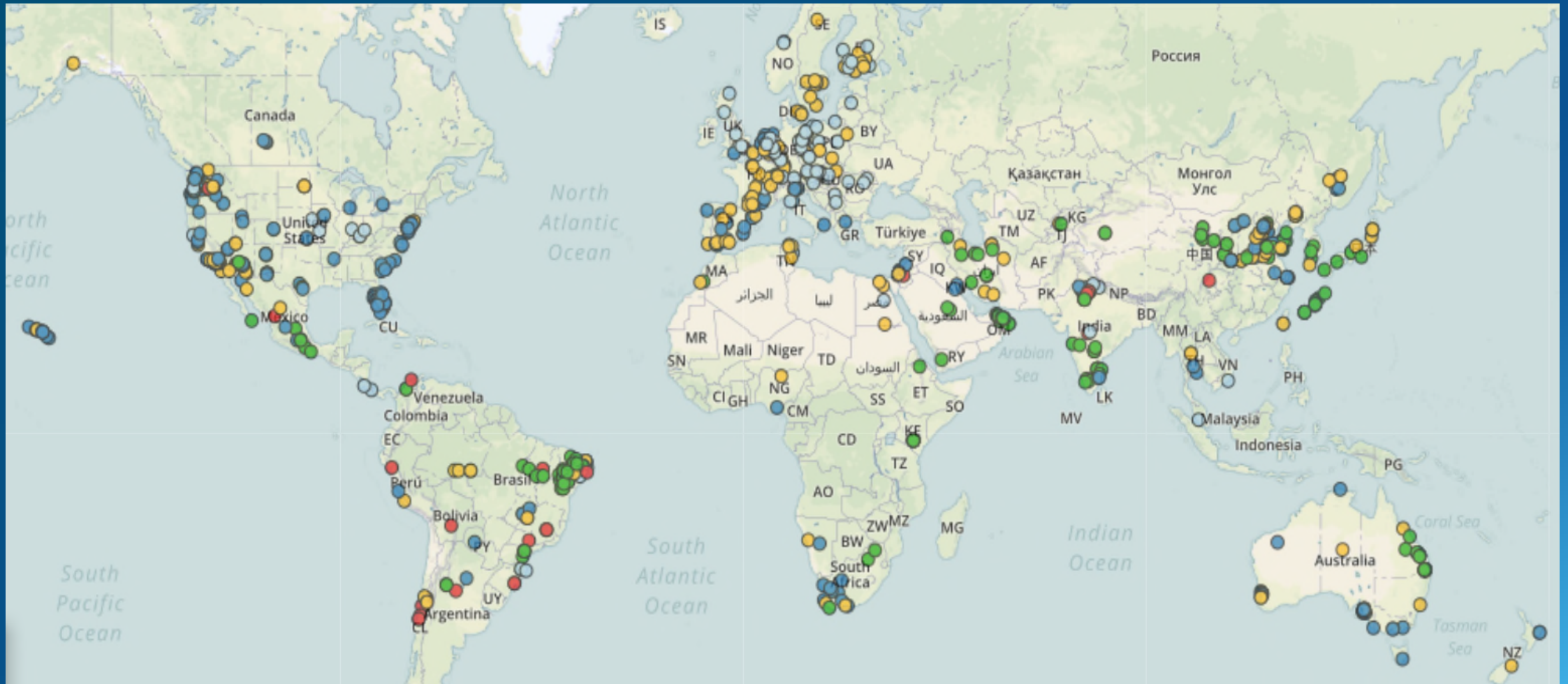
# Technical Components of MAR



Source: US National Academy of Sciences



# MAR Use is no longer “Experimental”: 1200 Locations, 50 Countries



Global MAR Inventory. Source: IGRAC (under UNESCO’s auspices)  
(<https://ggis.un-igrac.org/ggis-viewer/viewer/globalmar/public/default>)



## 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.



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How could MAR be incorporated into some of the Civil Works Planning studies you're working on right now (i.e. FRM, Eco Restoration)?

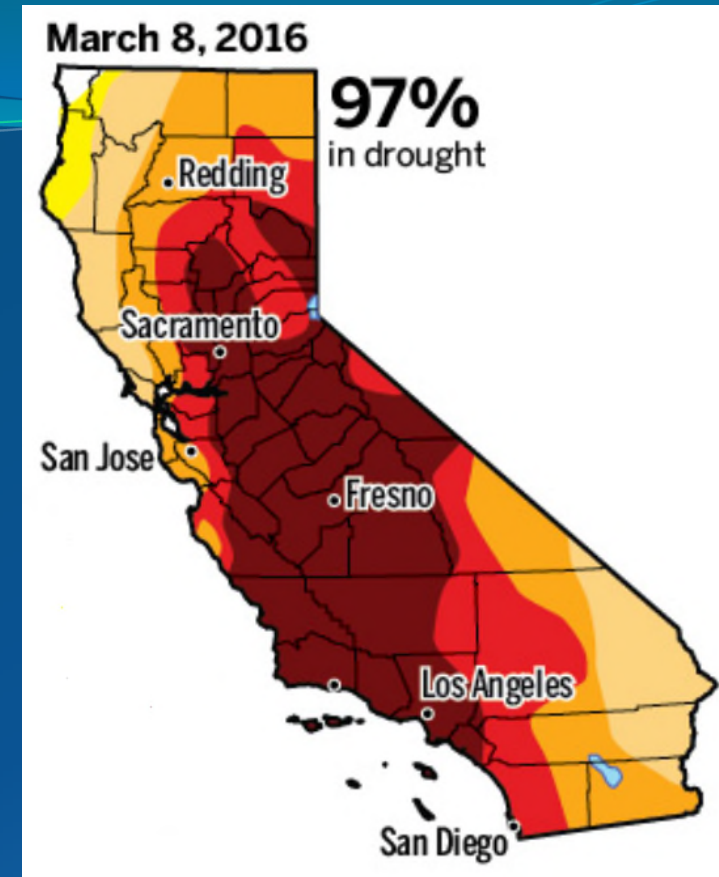
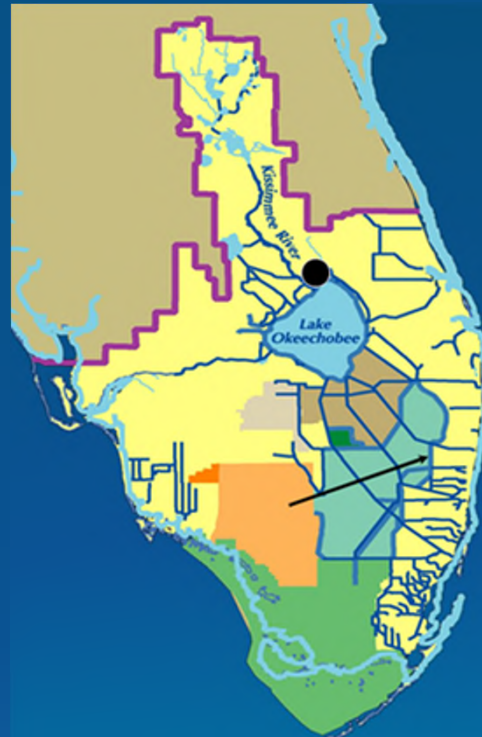
Click on the Annotation option  on the left side of your screen and then use the T<sub>T</sub> Tool to type your response.



# 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)

*Aquifer Storage and Recovery in the Comprehensive Everglades Restoration Plan*

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

REGIONAL ISSUES IN  
**AQUIFER STORAGE  
AND RECOVERY**  
FOR  
**EVERGLADES  
RESTORATION**

A Review of the ASR Regional Study  
Project Management Plan of the  
Comprehensive Everglades Restoration Plan

NATIONAL RESEARCH COUNCIL  
OF THE NATIONAL ACADEMIES



Review of the Everglades  
Aquifer Storage and Recovery  
Regional Study

NATIONAL RESEARCH COUNCIL  
OF THE NATIONAL ACADEMIES

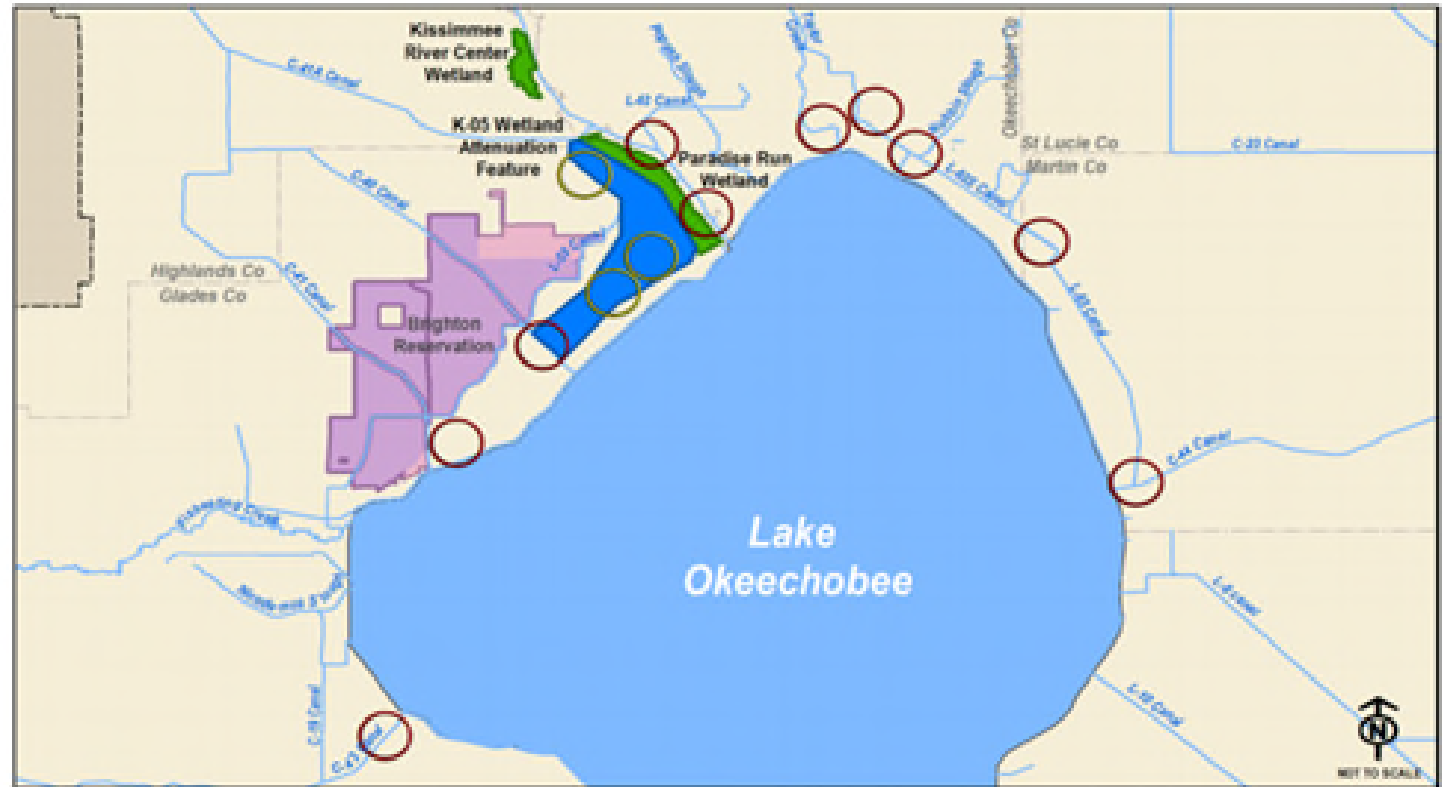


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IWR



**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...

# Lockport Prairie Nature Preserve, IL



USACE (2015)



“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)



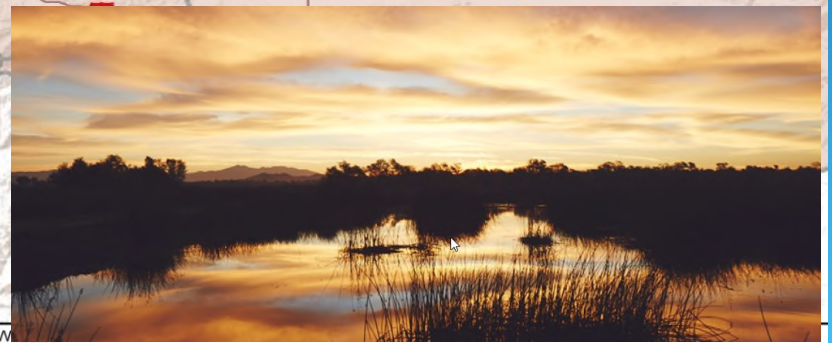
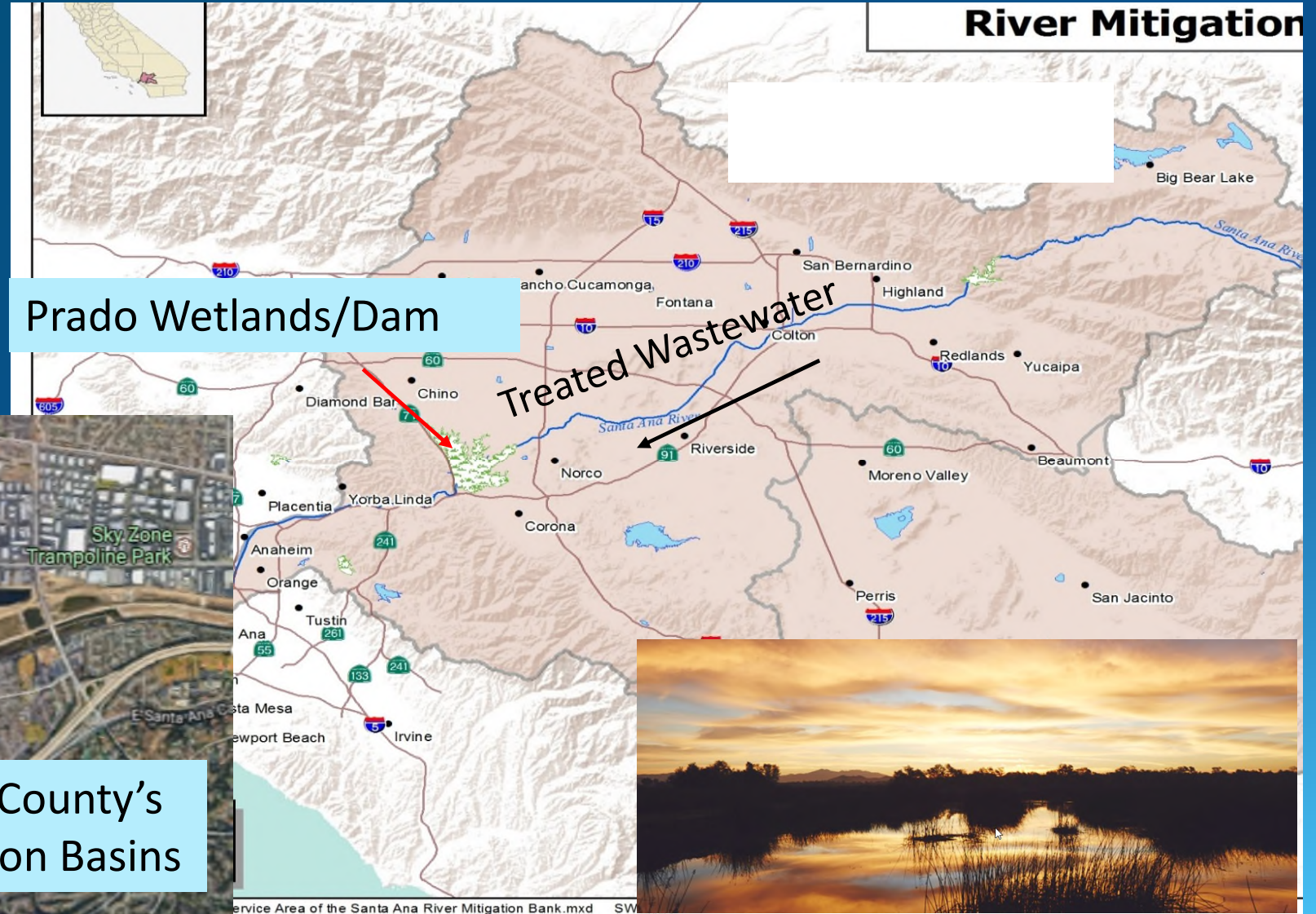
FWS






# 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



DEPARTMENT OF THE ARMY  
U.S. ARMY CORPS OF ENGINEERS  
441 G STREET, NW  
WASHINGTON, DC 20314-1000

REPLY TO  
ATTENTION OF

CECW-CE

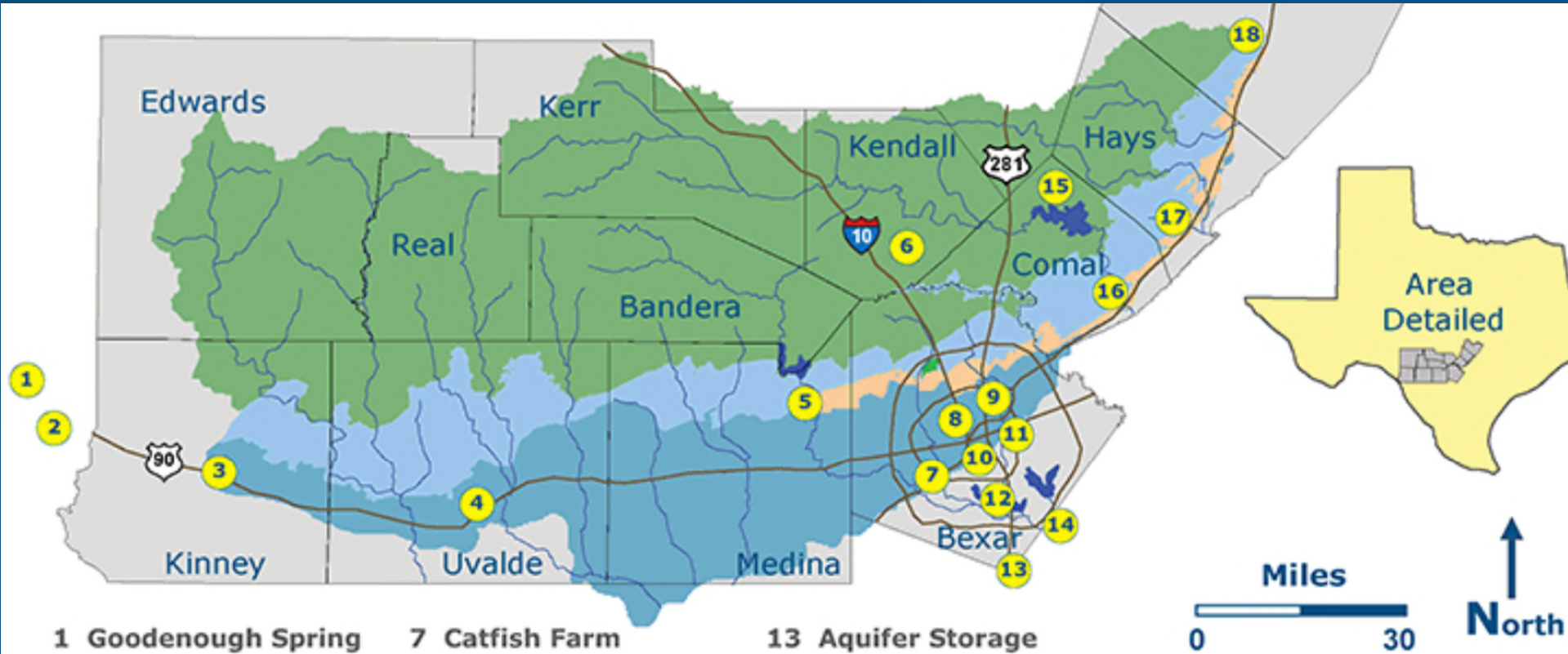
FEB 18 2014

MEMORANDUM FOR Commander, South Pacific Division, U.S. Army Corps of Engineers, CESPDE, 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

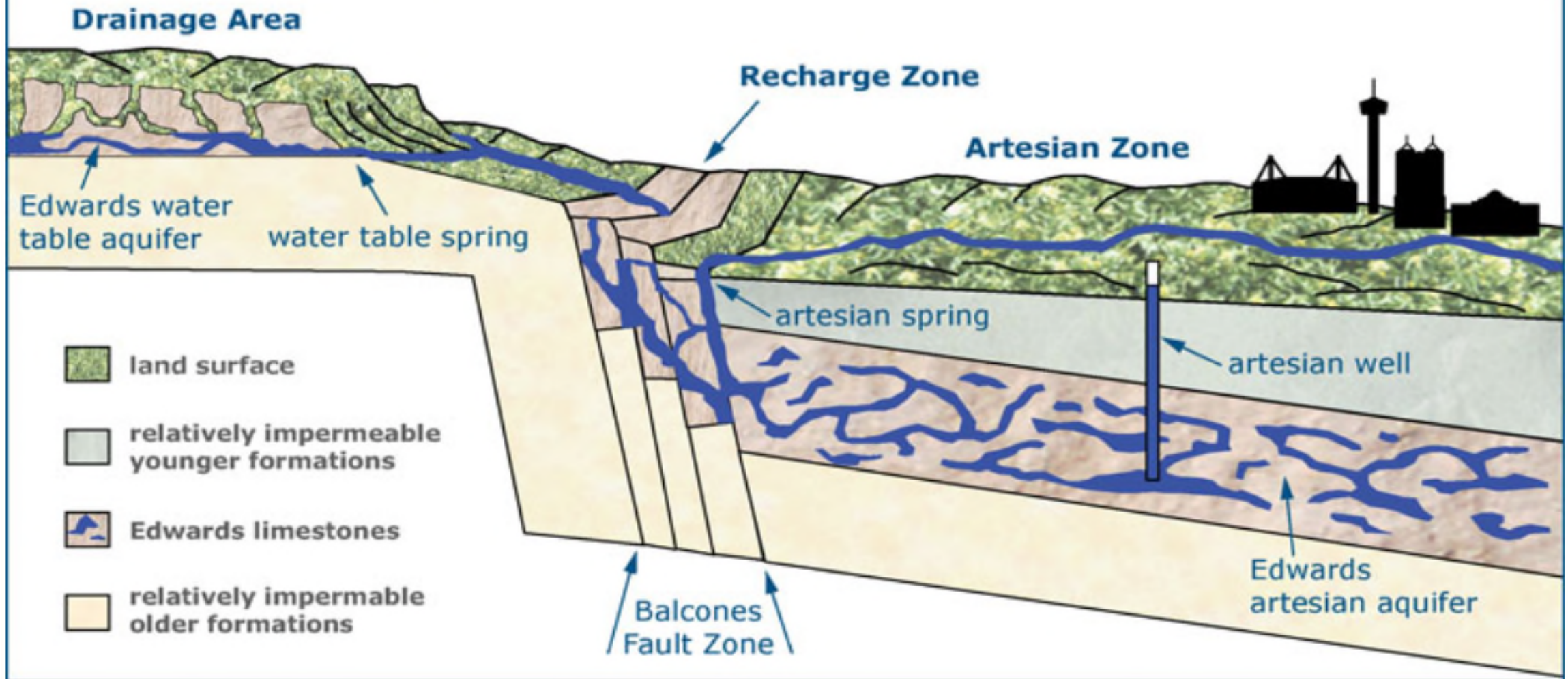


- |                      |                       |                         |
|----------------------|-----------------------|-------------------------|
| 1 Goodenough Spring  | 7 Catfish Farm        | 13 Aquifer Storage      |
| 2 San Felipe Springs | 8 San Pedro Springs   | 14 Using Recycled Water |
| 3 Las Moras Springs  | 9 San Antonio Springs | 15 Canyon Lake          |
| 4 Leona Springs      | 10 Hot Wells Hotel    | 16 Comal Springs        |
| 5 Medina Lake        | 11 J-17 Index Well    | 17 San Marcos Springs   |
| 6 Faults and Caves   | 12 San Antonio River  | 18 Barton Springs       |

Source: [www.edwardsaquifer.net](http://www.edwardsaquifer.net)



# Typical Cross-Section of the Edwards Aquifer



Source: [www.edwardsaquifer.net](http://www.edwardsaquifer.net), after Ekhardt 2007



## Combination Flood Control and MAR Dams

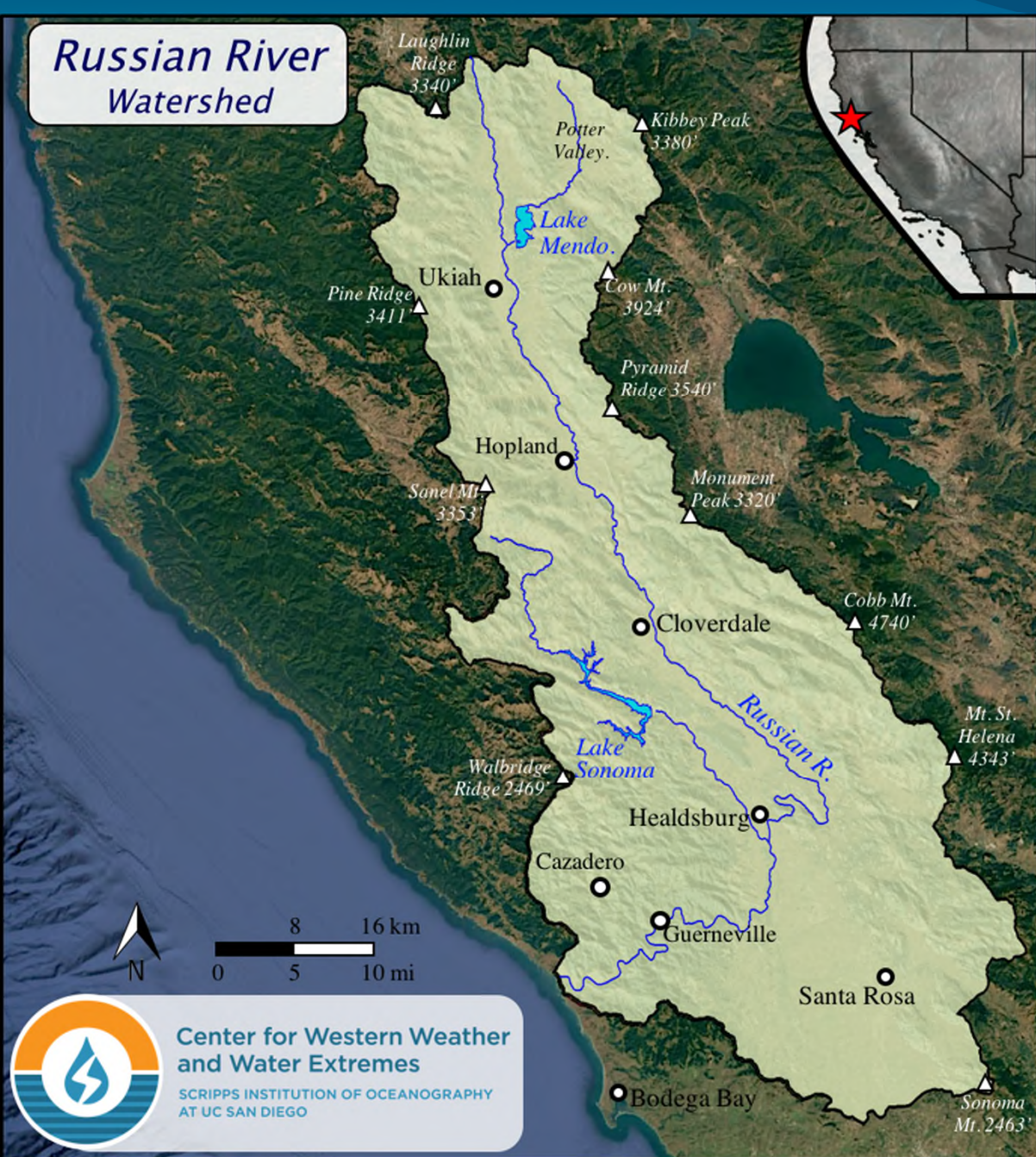
- From the mid-1960s to 1980s, USACE and regional cooperators identified potential dam sites near the Edwards Aquifer recharge zone for with a primary purpose of flood control but a secondary goal of recharging the aquifer.
- This dual purpose was discovered by accident in the case of a reservoir which 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)





## Russian River Watershed



## Lake Mendocino and Russian River, Northern California

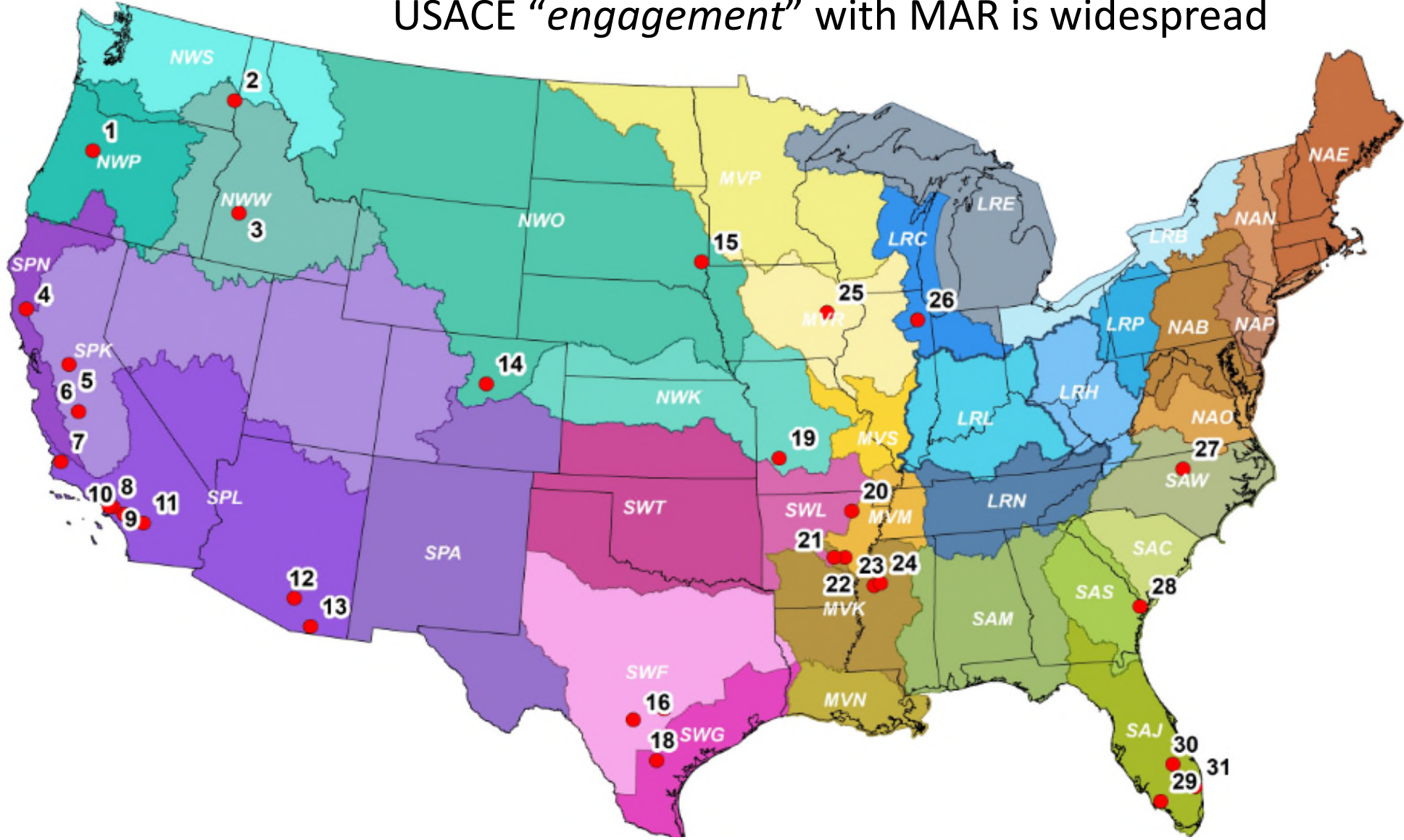
Site of pilot study of Forecast Informed Reservoir Operations (FIRO) of Lake Mendocino

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

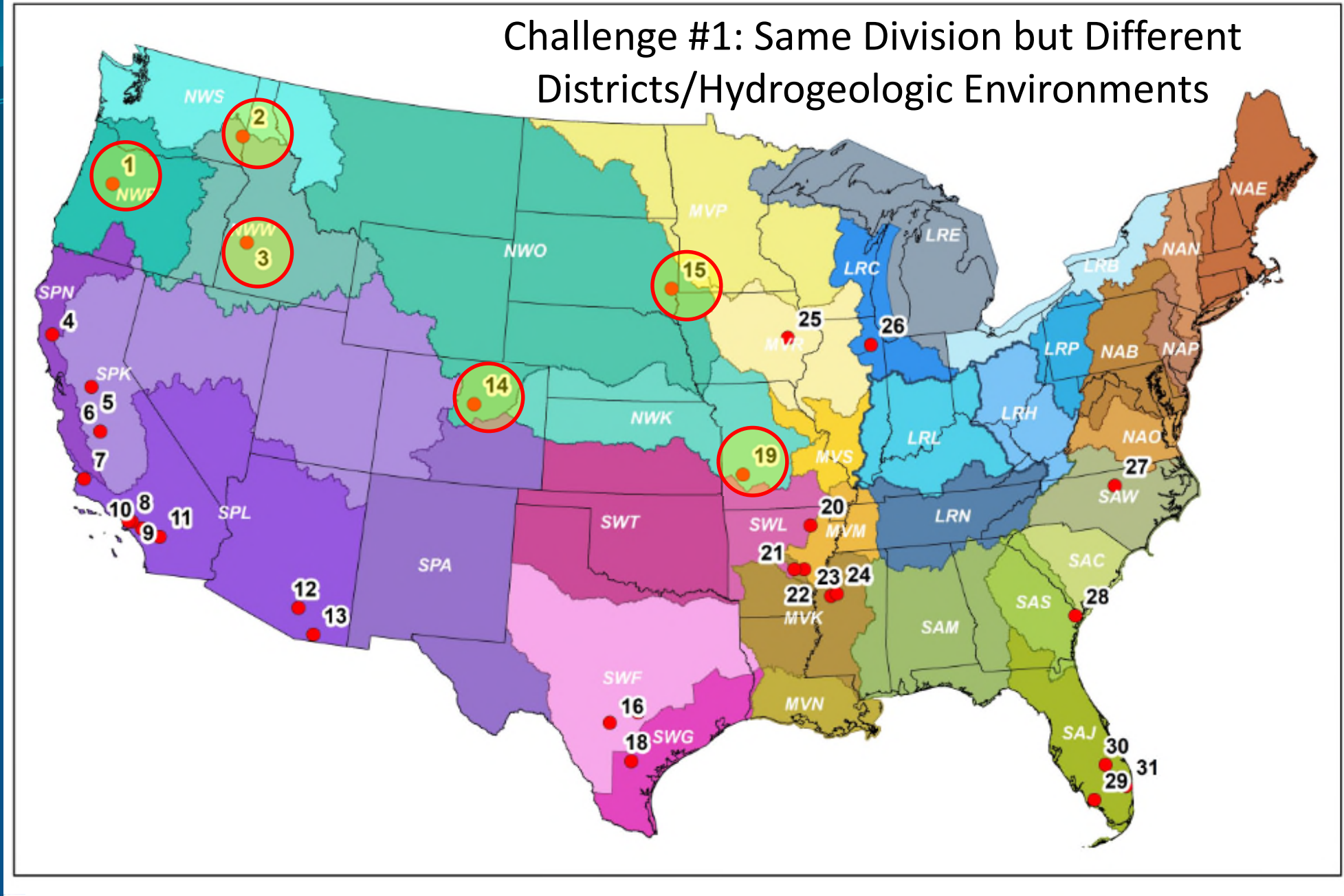


(Not all formal USACE "projects"! USACE/partners, districts/ERDC/IWR, considered/rejected...)

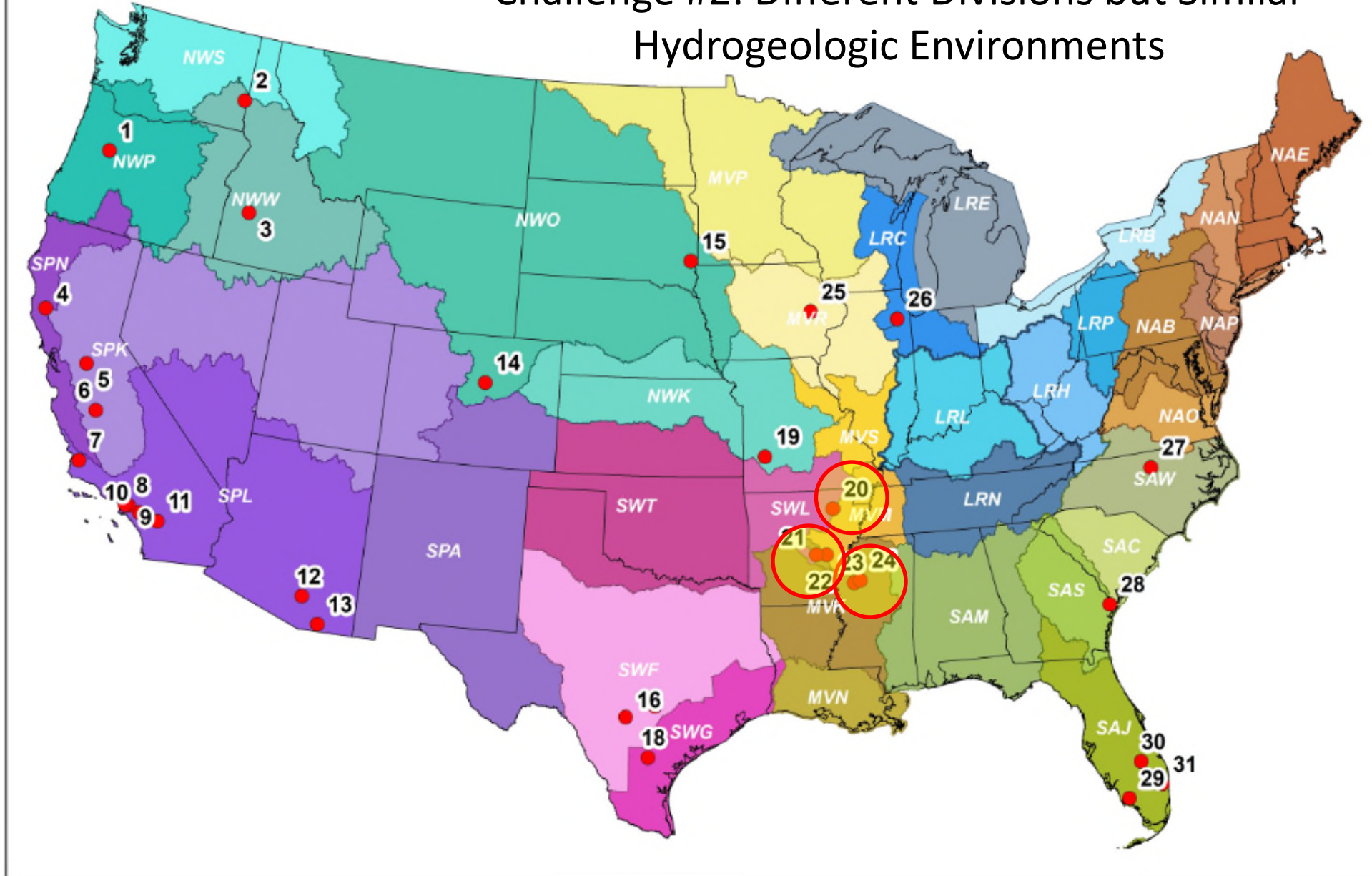




# Challenge #1: Same Division but Different Districts/Hydrogeologic Environments



## 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.



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## 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.



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## 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.



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## 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*.



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**QUESTIONS?**



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