Aquifer Storage and Recovery Update

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Presentation Overview

- Background
- Notable ASR System results
- ASR in CERP
  - Issue Team (1999)
  - Regional Study
  - CERP Pilot studies
- River of Grass Phase II Considerations
Technology in use for several decades

- Artificial recharge of aquifers has been employed in the U.S. since 1940’s
- First United States ASR water supply system built in Wildwood, New Jersey, in 1968
- Several states have multiple ASR systems
- ASR underway in Canada, England, the Netherlands, Israel, and Australia
- Most ASR applications are for municipal water supply
- Florida may be first application for ecosystem restoration
ASR Well Fields Operating in the U.S. (78)
Permitted ASR well fields operating in Florida (13)
Hydrogeology of South Florida

Targeting the Upper and Middle Floridan Aquifer
Floridan Aquifer Zones

Upper Floridan  Middle Floridan  Lower Floridan
ASR Bubble Cross-Section

ASR Bubble (Top View)

Total Storage Volume

ASR Well

Native Groundwater

Mixed Zone

Stored Water

Water Quality Changes:
- Filtration
- Dispersion
- Dilution
- Biological
- Geochemical

“Reactive Zone,” or “Zone of Discharge”

Monitor Wells

[Diagram showing ASR Bubble with various labeled parts such as ASR Well, Native Groundwater, Mixed Zone, Stored Water, Total Storage Volume, and Monitor Wells.]

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Las Vegas ASR

- Treated drinking water, from Colorado River at Lake Mead
- 64 wells
  - 42 dual-purpose
  - 22 recharge
- 103 mgd recharge capacity
- 157 mgd recovery capacity
- 81 billion gallons currently stored (250,000 ac-ft)
The Peace River ASR

- Ozone treated surface water
- Expanded to 20 mgd
- Operating under a Consent Order and Administrative Order

- Largest ASR system in eastern U.S. at 20 mgd
- 21 ASR wells
- Arsenic exceeded 10 ppb standard, but is declining

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West Palm Beach ASR at Clear Lake

- Single high capacity well with potential 10 mgd capacity
- City is pursuing an Aquifer Exemption to allow recharge without chlorine disinfection to reduce trihalomethanes
Marco Lakes ASR

- Largest system in SFWMD
- 1.7 billion gallons currently stored, since 1997
- 6 operating wells, 9 mgd capacity
- Treated creek water, pumped to ~750’ bls
- Arsenic not an issue during operational period (arsenic standard changed during operational period- 50 to 10 ppb)
Boynton Beach ASR

- Initial recovery (1992) efficiencies were low
- Higher recovery with continued cycles
- Development of a Target Storage Volume (with 100% recovery)
- Arsenic not an issue during period of operation
Characterize quality and variability of source water
Study regional hydrology of Floridan aquifer
Determine critical pressure for rock fracturing
Identify local and regional changes in Floridan aquifer flow patterns
Water quality changes in aquifer
Potential affects on mercury bioaccumulation
Relationships among ASR storage interval properties, recovery rates, and recharge volume
- Groundwater model under development – will be running scenarios later this year
- Water from canals and lakes requires filtration and disinfection prior to recharge
- Risk of fracture potential can be reduced by low injection pressures less than 200 psi and well spacing
- Initial ecological studies indicate that the recovered water is not toxic to aquatic organisms in the laboratory
- Preliminary mercury studies indicate that recovered water does contain increased mercury concentrations
- Final Report due by 2013
Two CERP ASR Pilots in Operation

- Caloosahatchee Basin
- Lake Okeechobee
- Kissimmee
- Hillsboro
- WCA 1
- Hillsboro ASR
- Kissimmee ASR
Kissimmee River ASR Pilot

- Good recovery
- No toxicity or bioaccumulation
- Arsenic exceeded 10 ppb during cycle 1, did not in cycle 2, now in cycle 3
- Phosphorus reduction from >100 to <20 (cycles 1 & 2)
- Now into cycle #3
- Sand filter with ultraviolet disinfection (UV)
- Effectiveness of UV is affected by canal water quality variability
Hillsboro ASR Pilot

- Fit within a canal right-of-way
- Surface footprint of about \( \frac{1}{4} \) acre
- In 90 days, this system will store 1,350 ac/ft
- One pump pushes water into the aquifer at 80 psi
Hillsboro ASR Pilot

- Began cycle testing in January 2010
- Mechanical filter with UV disinfection
- ASR wells to be integrated into Site 1 Impoundment
- High-capacity well (8 mgd) - will need fewer wells here than planned
- Arsenic exceeded 10 ppb in cycle 1 (now in cycle 2)
The Site 1 Impoundment: ASR Levee design

Hillsboro Pilot

Provided 100x1,000 ft. cut-outs for ASR clusters
Hydrogeologic Conditions in ROG Planning Area

- Floridan aquifer continuous in the EAA region
- Expect conditions to be transitional between Kissimmee and Hillsboro Pilot sites
- Well logs from several other borings confirm condition of Floridan aquifer
U.S. Sugar Test Well

- Constructed in 1992
- Small diameter well
- Transmissive limestone found in middle Floridan Aquifer
  - Flow zones found at ~1,350'
  - Apparent 5 mgd capacity
  - Chlorides in middle Floridan about 1,500 ppm
River of Grass Planning

- Move forward incrementally
- Potential for cluster of 10 wells in the upper and middle Floridan Aquifer provide ~ 150 ac-ft/day
- Cost to install ~$45M (wells, intake/discharge structure, piping, treatment and pumping systems)
- Annual O&M ~ $1.5M and $3M for electricity, well maintenance, operation, monitoring and compliance (monitoring decreases over time)
Questions?

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Reviving the river of grass

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

RESTORATION PLANNING