

Integrated Research Projects: Managed Aquifer Storage and Recovery in Coastal Louisiana

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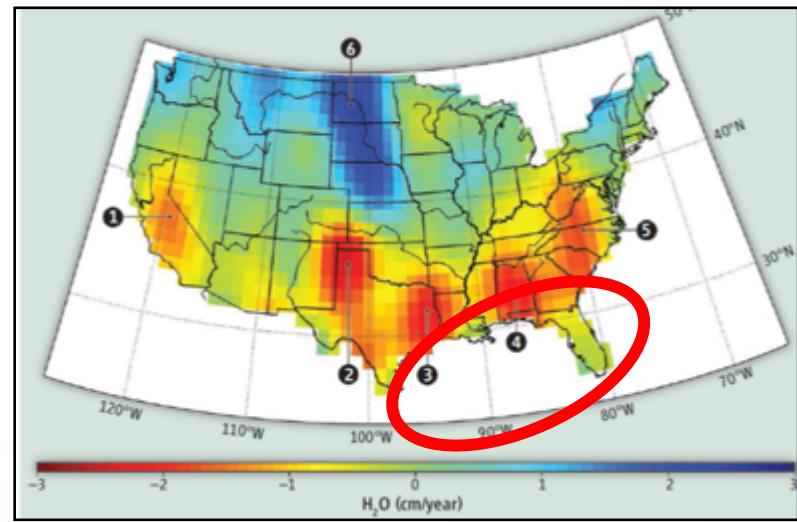


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Problem

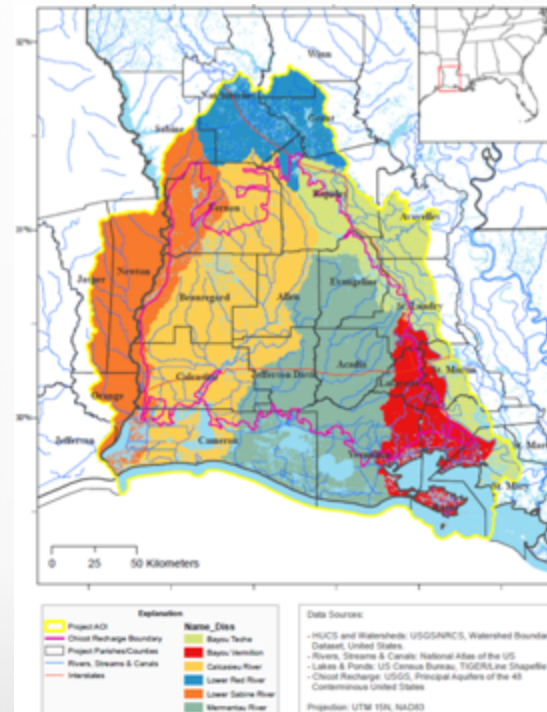
Despite relatively abundant rainfall and surface water, groundwater is being overused across the Southeastern United States. Coastal Louisiana is no exception.



GRACE satellite estimates of changes in terrestrial water storage over the last decade. (Famiglietti and Rodell, 2013, Science).

Consequences

Overuse of coastal aquifers leads to **subsidence** and **salt water intrusion**, accelerates **coastal land loss**, and devastate coastal communities through the **loss of available freshwater** for drinking and economic activities.

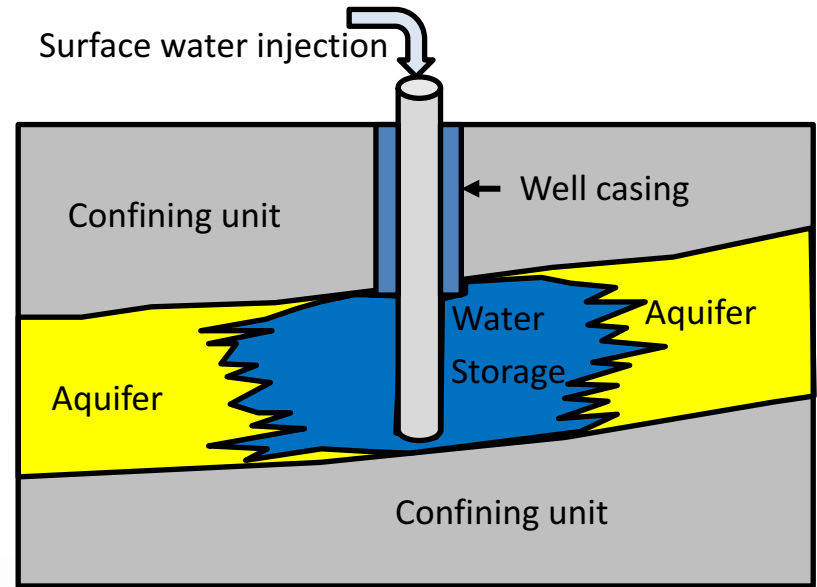


Chicot Aquifer:
Overdraft of ~350 million gallons per day (MGD);
Projected overdraft of 420 MGD by 2030;
Saltwater intrusion near the coast

Possible Solution

During high-flows (e.g., floods), clean surface water is pumped into aquifer for storage and later use during droughts and peak demands

combat subsidence and provide freshwater buffer to keep salt water intrusion at bay.



ASR Wells, City of Cocoa, FL

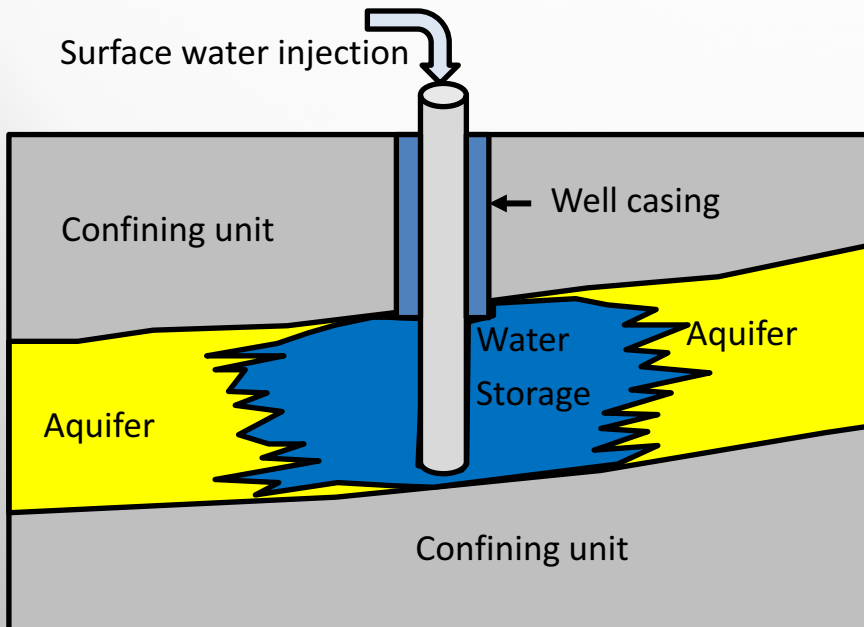
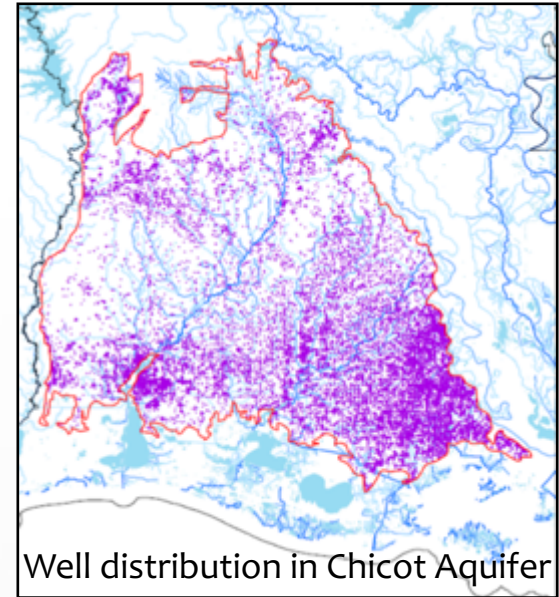


Operational ASR Sites in the US in 2013 (Source: FEMA)

Our new project: Integrated water management solutions

Developing storage capacity

Can we identify opportunities for building surface water storage capacity to benefit farmers during irrigation season but also mitigate flooding during emergencies?



Managed aquifer recharge (MAR)

Can we identify locations where we reverse pumping and effectively recharge the groundwater system with excess (flood) water?

Research Objective

Investigate **feasibility** of implementing an **water management design solutions** using small reservoirs and engineered wetlands or water treatment centers in combination with Aquifer Storage and Recovery (ASR).

Approach

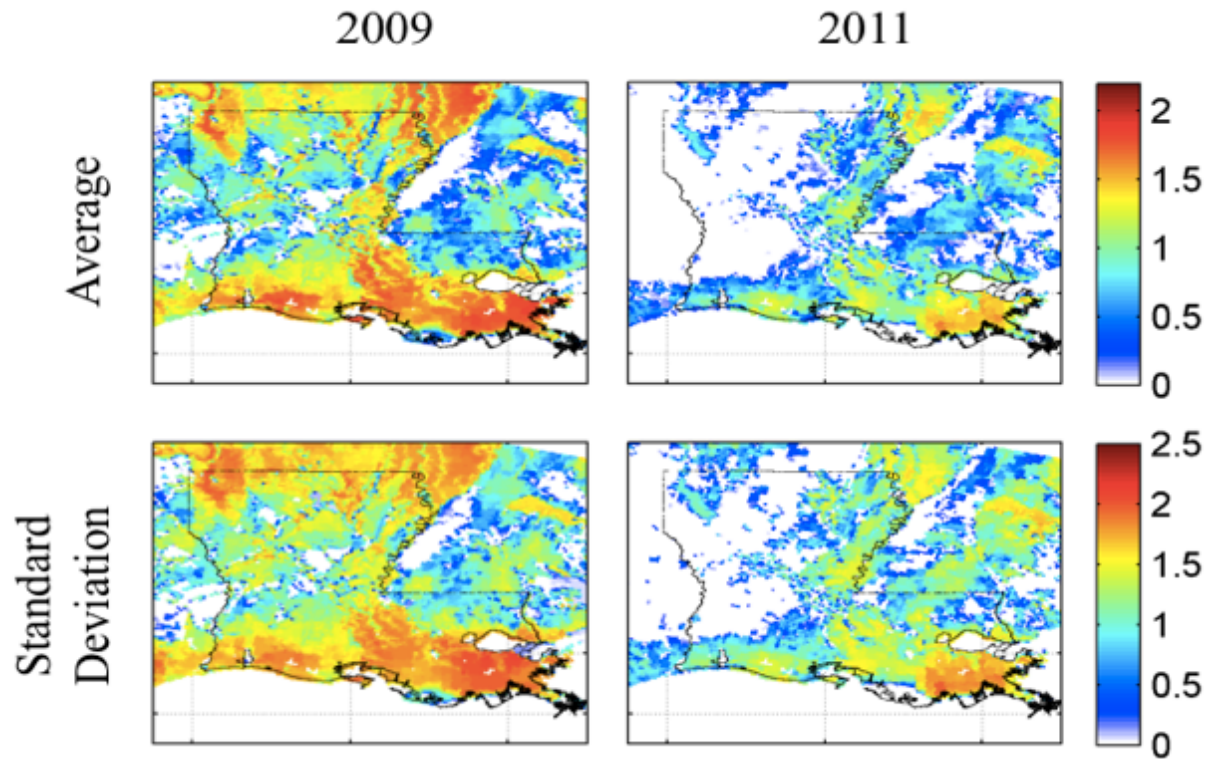
- A) Surface water hydrology
- B) Groundwater hydrology
- C) Social and economic expectations
- D) Outreach and Education



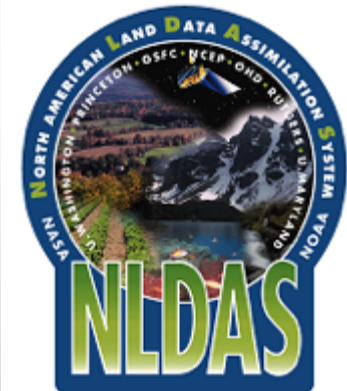
Site map of the project area showing the freshwater boundary of the Chicot aquifer and the pilot study watershed.

Surface Hydrology:

A) Analysis of Water Availability for ASR

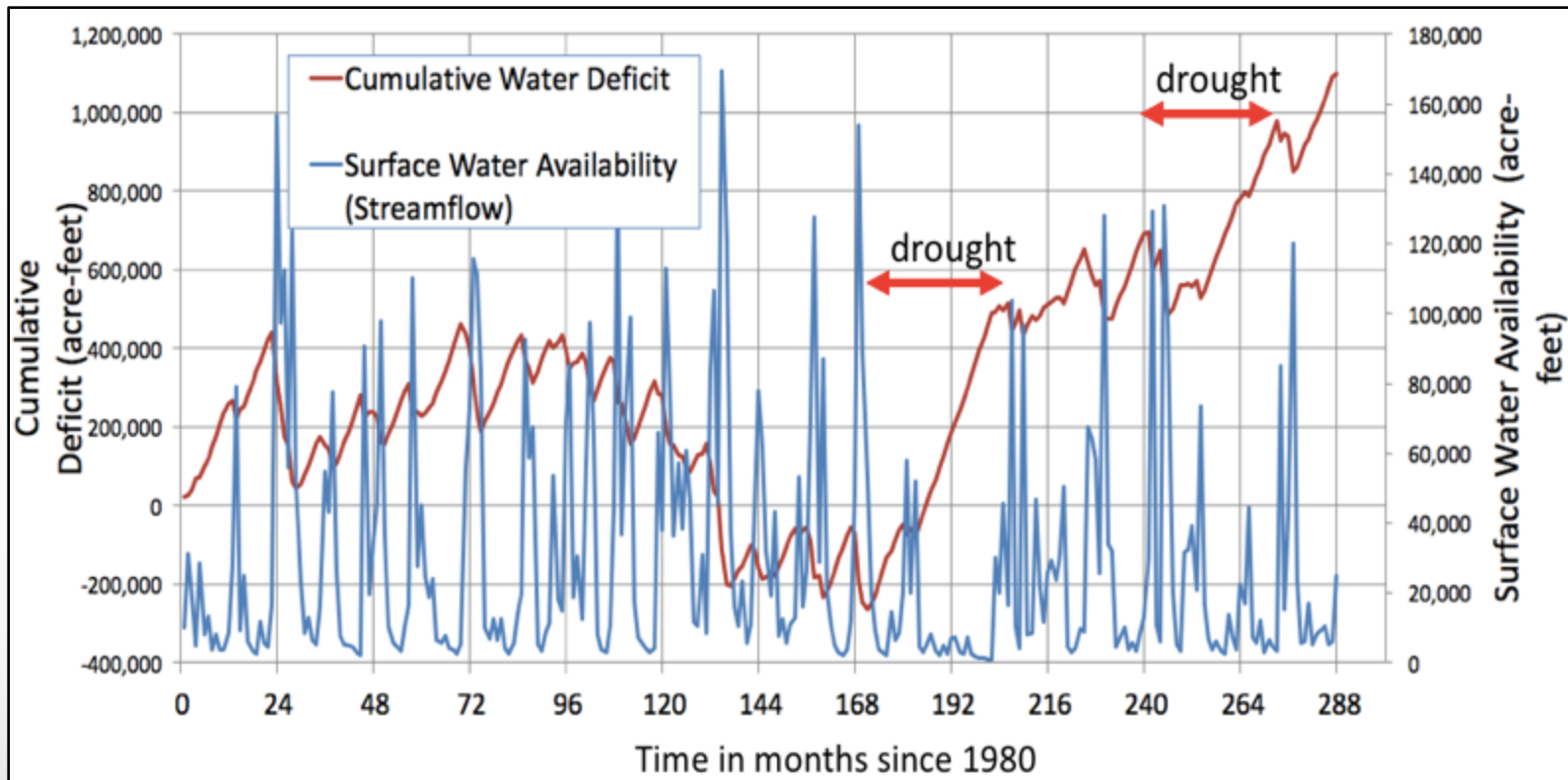


Mean and variability of monthly surface runoff over Louisiana using the NLDAS system for two example years. Units are in logarithmic scale of mm/month.



Surface Hydrology:

B) Analysis of Water Deficit/Surplus with and without ASR

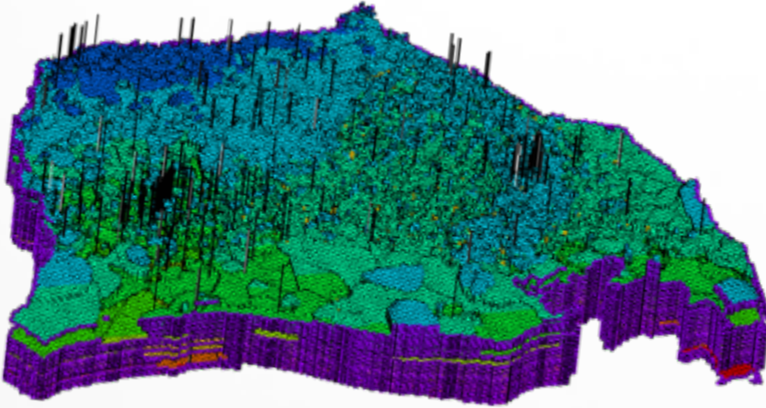


Cumulative water deficit using monthly streamflow and water demands in an irrigation-dominated catchment in southwest LA. Similar analysis will be conducted after the addition of ASR to examine potential benefits for capturing water during wet years and alleviating water stresses during droughts.

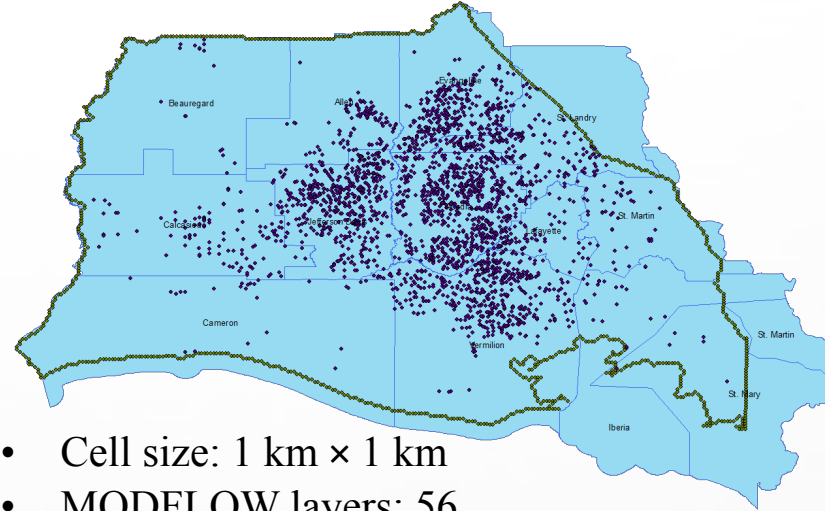
Groundwater Hydrology (LSU Team):

A) Development of a localized groundwater model

211 USGS groundwater observation wells



2680 Pumping wells



- Cell size: 1 km × 1 km
- MODFLOW layers: 56
- Simulation period: 2004-2015



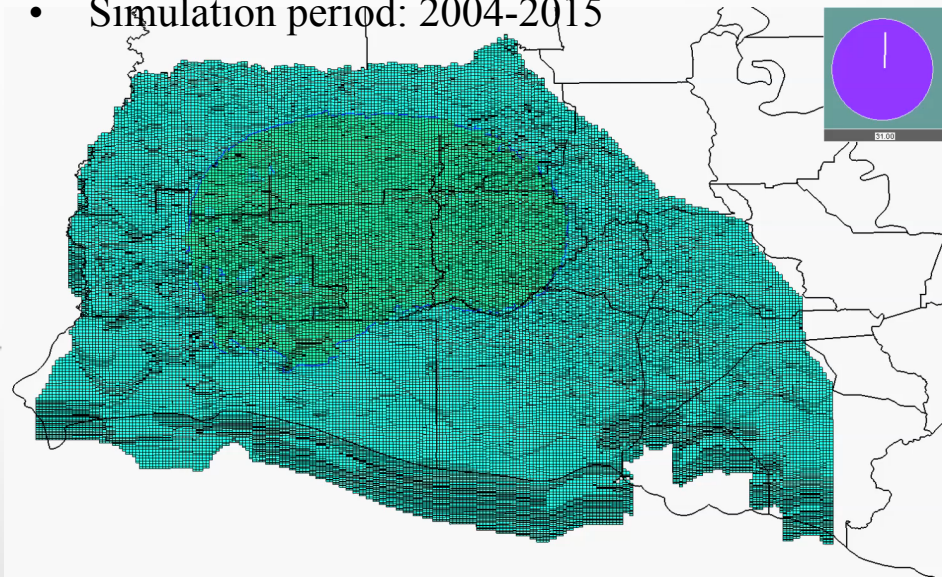
Side plane view at west of Chicot aquifer



North-south cross section at the middle of Chicot aquifer



Side plane view at east of Chicot aquifer



Groundwater Hydrology:

B) Development of an ASR management model

A simulation-optimization approach to evaluate and optimize potential ASR operation efficiency.

Objectives:

- (1) maximizing surface water stored in aquifer,
- (2) minimizing injection time,
- (3) minimizing excessive GW level increase during recharging,
- (4) minimizing excessive GW level decrease during recovery.

Potential Applications:

- (1) provide recommendations to stakeholders on where, how many wells, well spacing, pumping rates, and operation time.
- (2) provide information on influence zone of each ASR well, change in GW level over a cycle of operation, and % of injected water captured during recovery.



Bolivar Recycled Water ASR Trial site on the Adelaide Plains, SA. 2002

Social & Economic Aspects:

(A) Interviews with people currently using ASR systems

- Gather experiences on implementation challenges; risks, costs and benefits; changes to aquifer conditions
- acceptance/rejection by community; unanticipated consequences.



(B) Focus groups with local stakeholders

- determine potential support for ASR; how support may depend on actual use of water (e.g., irrigation, industrial or drinking).
- explore feasibility of implementation from technical, economic and regulatory perspectives:
 - How might an ASR impact property values?
 - How might an ASR impact land-use patterns?
 - What are the energy costs associated with ASR?
 - What monitoring will be required to avoid unforeseen water-quality problems on groundwater resources?
 - What concerns about implementation are likely to result in resistance?

Social & Economic Aspects:

(C) Research into economic opportunities

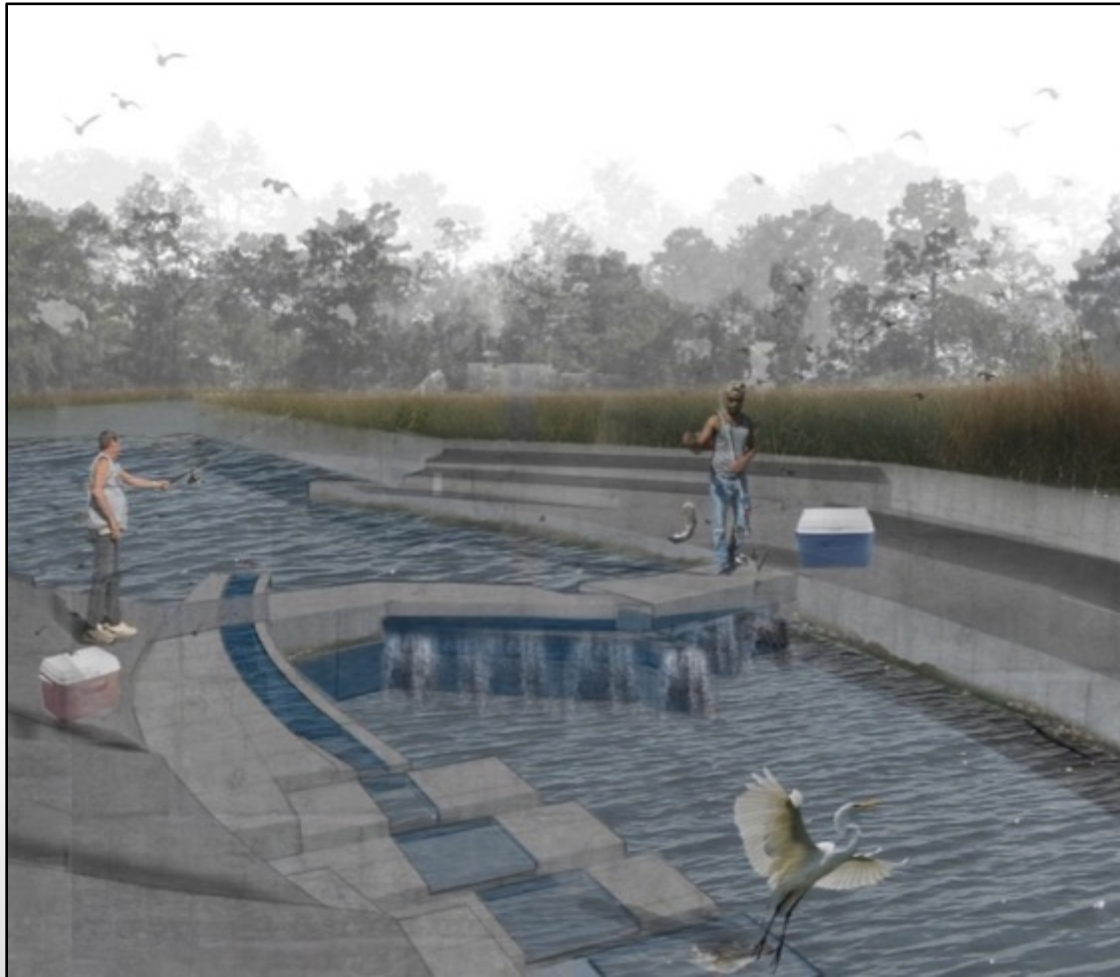
identify revenue options for farmers to offset cost of ASR units.

- *Water Restoration Certifications* for freshwater restoration projects
- *Environmental Quality Incentives Program (EQUIP)*
 - Master Farmer Program
 - National Water Quality Initiative (NWQI)
 - Gulf of Mexico Initiative (GoMI)
- Ecotourism/Agritourism for supplemental incomes



Conceptual Designs & Visualizations

Develop pilot-site renderings, analytical diagrams and visualizations, and use it disseminate to engage policy makers and stakeholders in ASR discussion



Water Quality Aspects

Water quality is an important consideration for ASR (e.g., Arthur et al., 2005; Muniz et al., 2005; Borrok et al., 2017).

The necessary quality of surface water used for recharge depends largely on the ultimate use of the groundwater and the possibility of recharge water affecting drinking water resources.

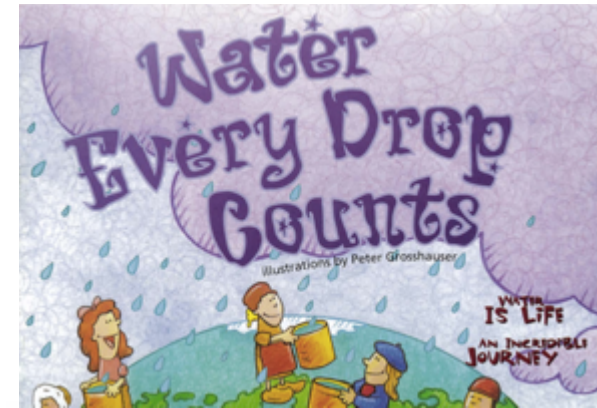
We plan to do a preliminary assessment of surface water quality in this region using existing data from LDEQ

We will additionally examine the feasibility of ASR within the deeper Evangeline aquifer system where water quality is of limited concern in the deeper aquifer system (not used for drinking water in this region).

We also plan to investigate feasibility of adding a water treatment component (e.g., sock filters sand and/or charcoal filters) that would clean water to drinking water standards prior to injection.

Another possibility might be to use existing treated water discharged from nearby municipalities in ASR design.

Outreach & Education



- We want to engage stakeholders in creating and implementing a more sustainable water-management plan for coastal Louisiana.
- Begin by assessing knowledge base on wetland filtering and storage, and ASR topics among stakeholders.
- Recruit experts (researchers, consultants, water managers) to speak to public about water storage alternatives
- Provide resources such as fact sheets, graphics, web resources, and visualizations to public, utilities, municipalities, and other water officials.
- Work Office of Conservation, Parish boards and commissions, LA Water Resources Commission, Louisiana State Law Institute

Partnerships



- LSU AgCenter Marine Extension Agent
- Louisiana Sea Grant Law & Policy Program
- LSU AgCenter Master Farmer Program Coordinator
- Ground Water Management Advisory Task Force for the state of Louisiana
- Vermilion Soil and Water Conservation District.
- Cypress Engineering and Development Group
- Chenier Plain Coastal Protection and Restoration Authority
- Rockefeller Wildlife Refuge
- State Conservationist with NRCS
- Local non-profit organizations
- Vermilion Soil and Water Conservation District

