In cooperation with the Mississippi Department of Environmental Quality, information regarding the Water-Supply Scenarios is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government may be held liable for any damages resulting from the authorized or unauthorized use of the information.

A Stakeholder driven approach to optimize modeling and monitoring of water resources in the Mississippi Alluvial Plain

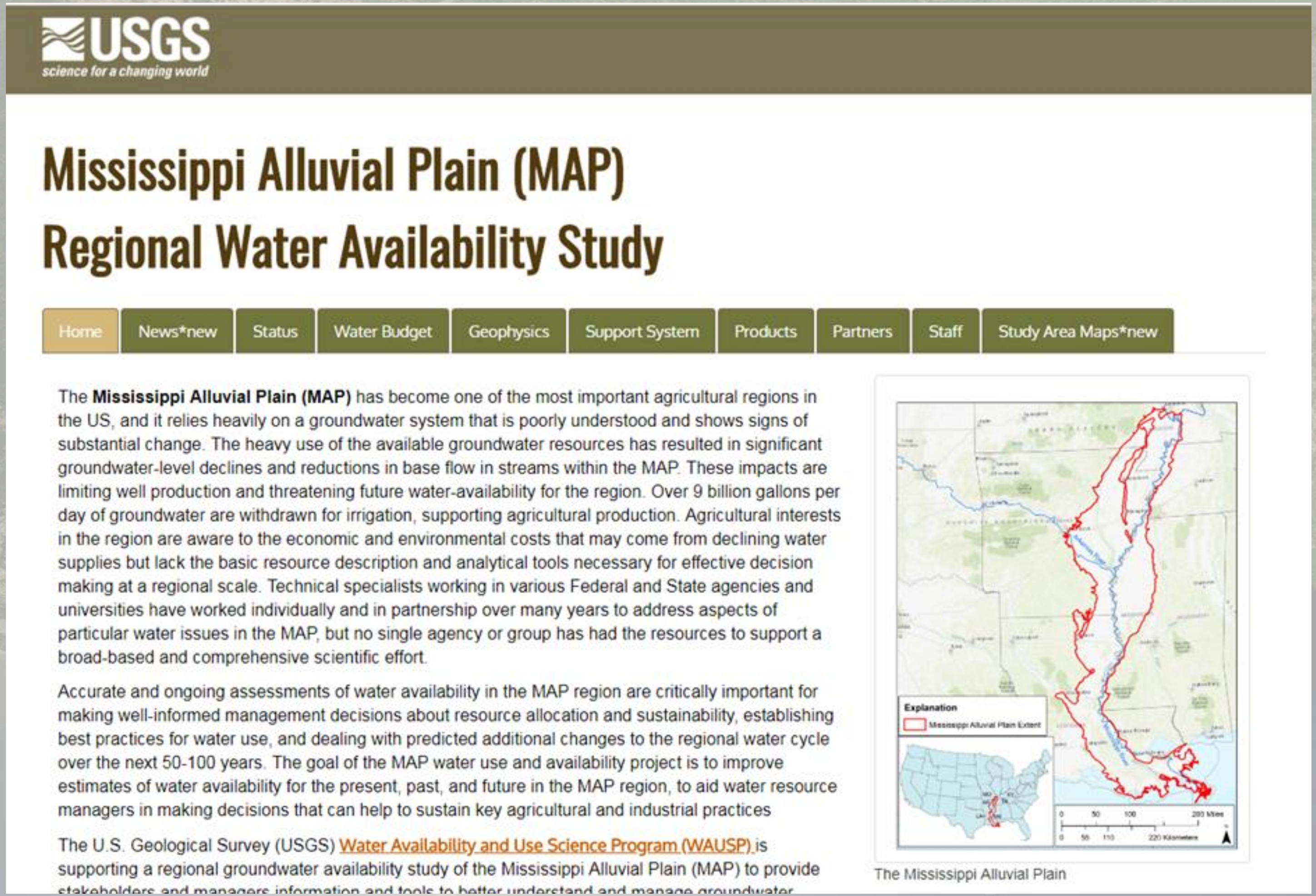
November 29, 2018

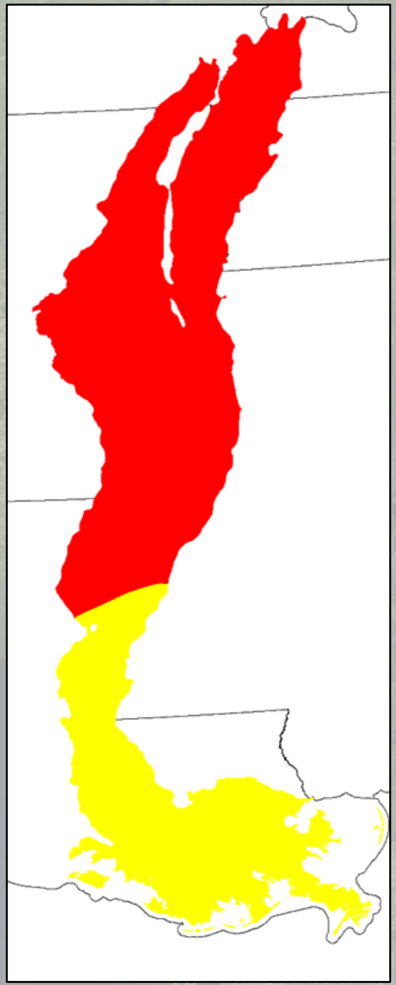
Jeannie Barlow, Wade Kress, and Connor Haugh

USGS, Lower Mississippi-Gulf Water Science Center

Mississippi Alluvial Plain - MAP

MAP Start FY16
Project Duration: FY17 – FY21
Monitoring and Modeling





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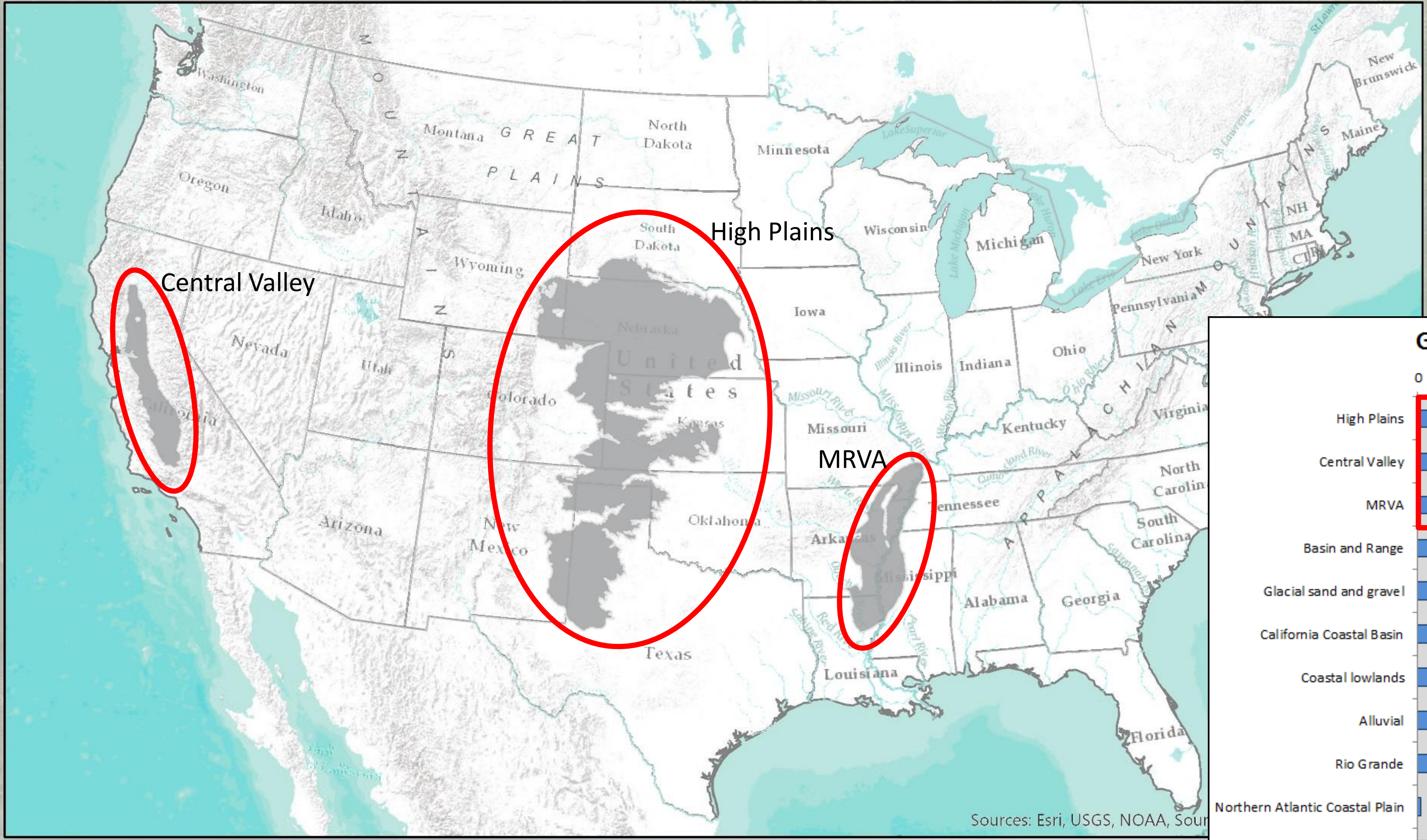
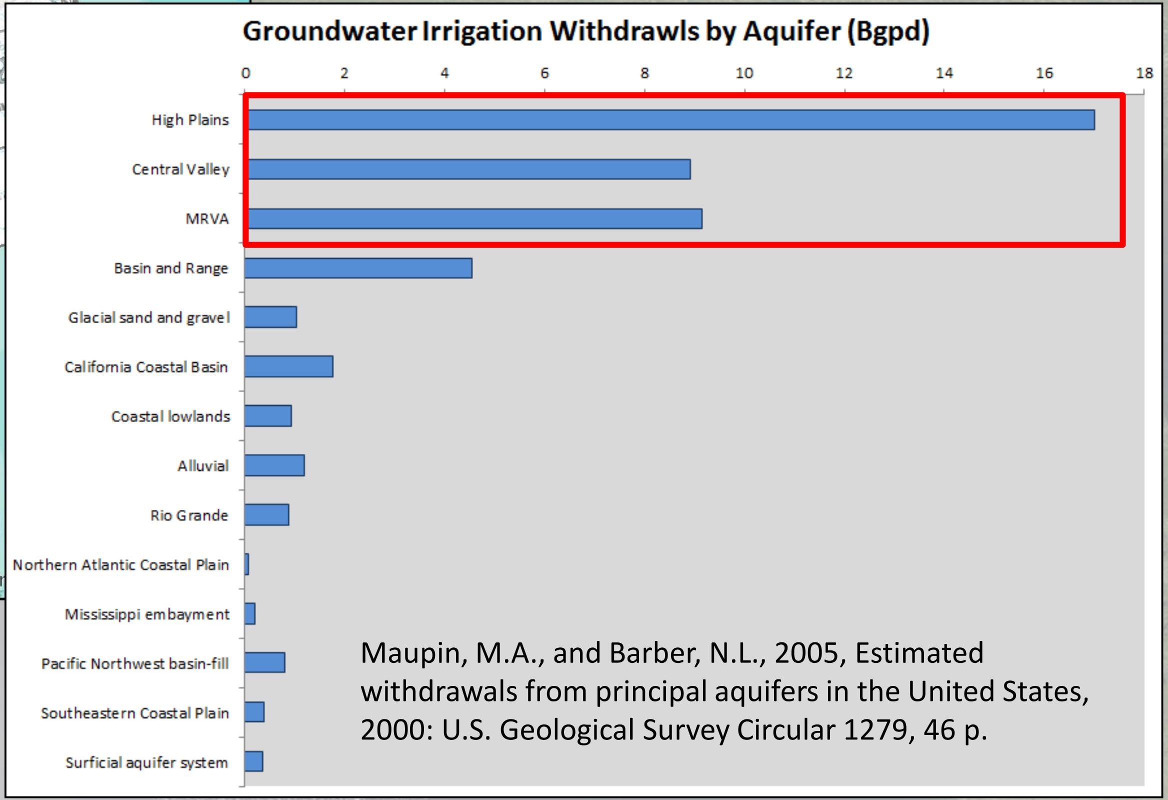
https://www2.usgs.gov/water/lmg/map

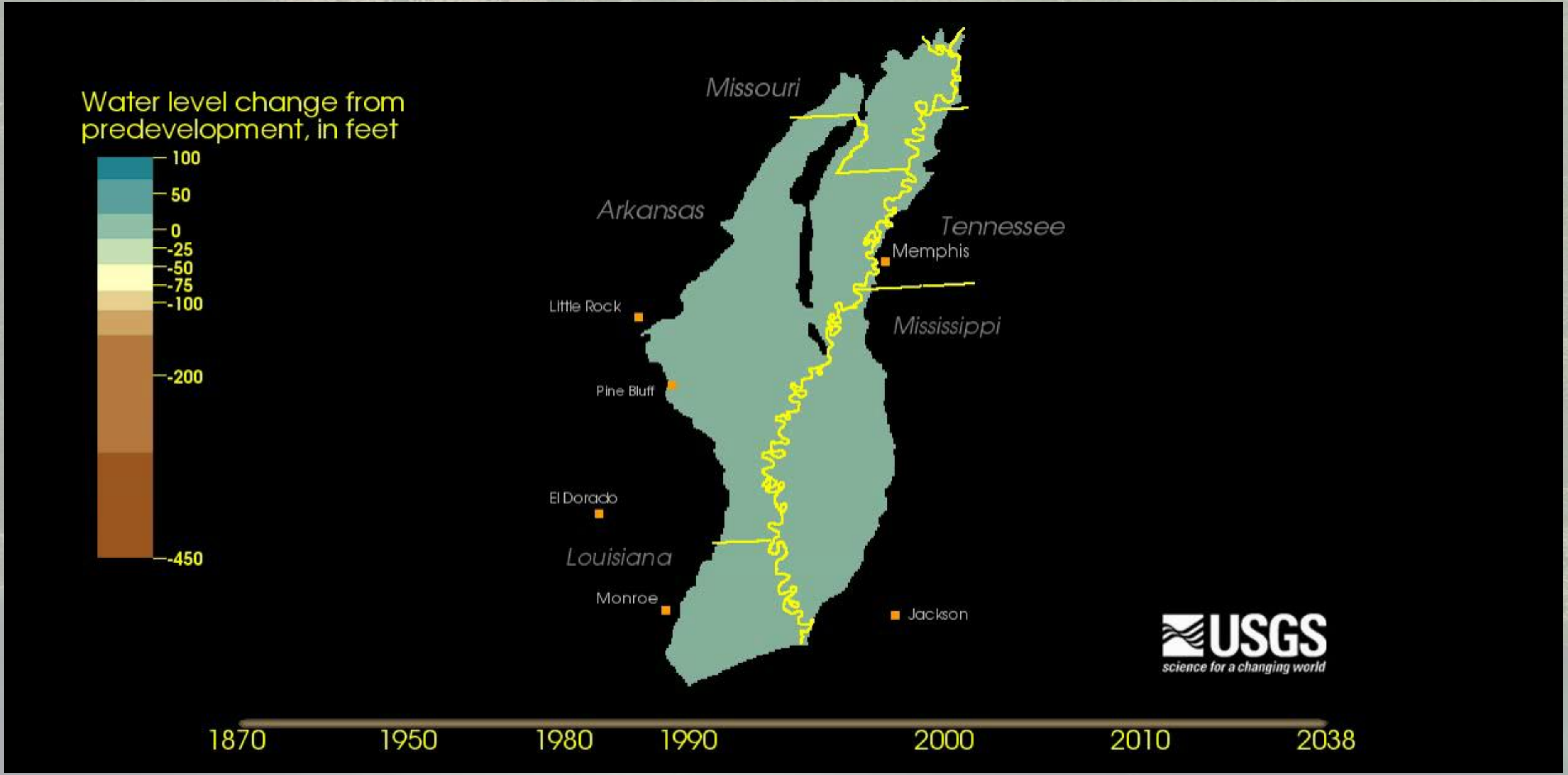
Principal Aquifers – Water Use



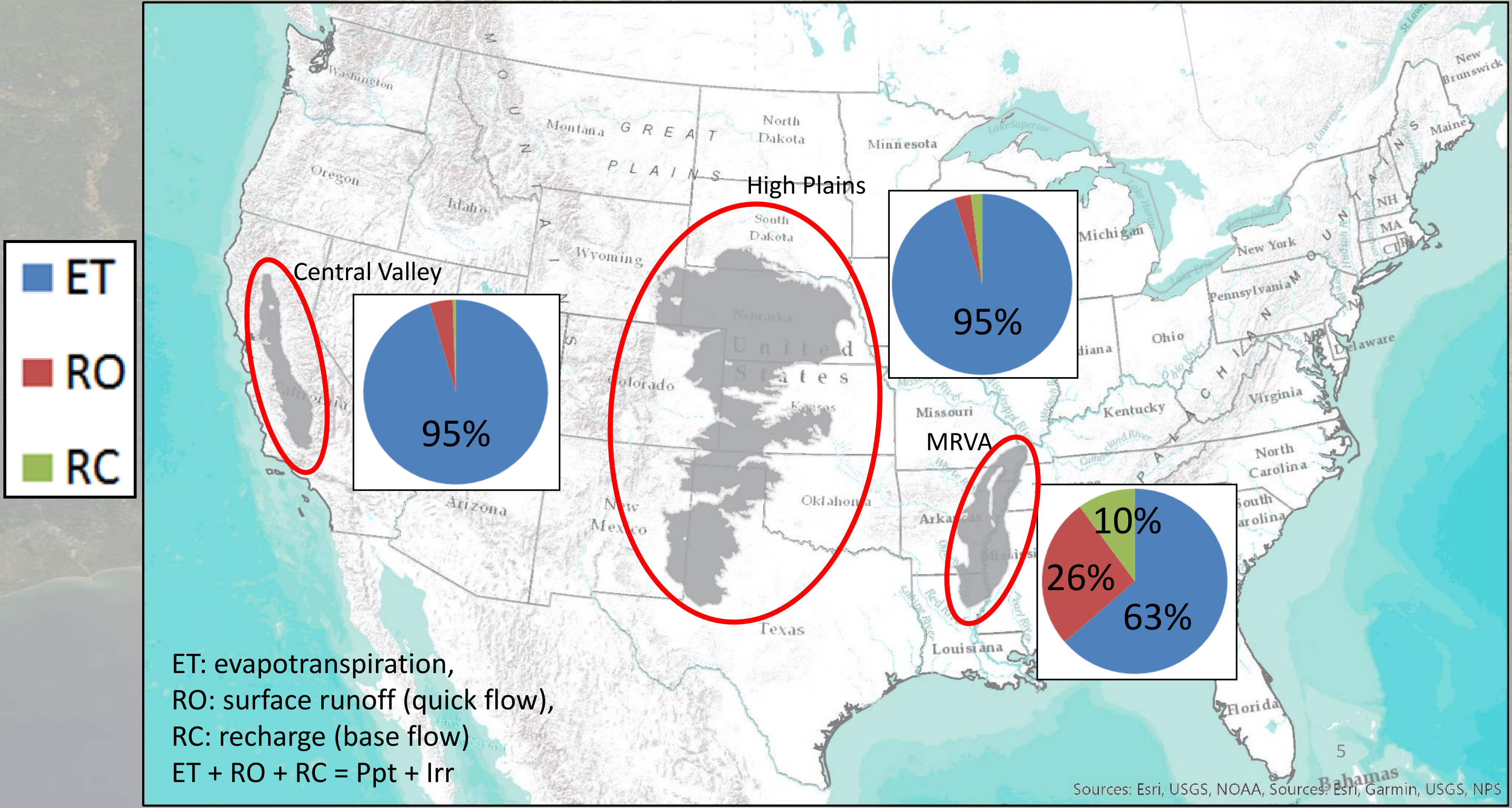


Maupin, M.A., and Barber, N.L., 2005, Estimated withdrawals from principal aquifers in the United States, 2000: U.S. Geological Survey Circular 1279, 46 p.

GW Level Declines



Principal Aquifers – Water Budget



ET: evapotranspiration,
RO: surface runoff (quick flow),
RC: recharge (base flow)
ET + RO + RC = Ppt + Irr

MAP Team

USGS
3 Mission Areas
13 Centers/Branches
~60 People
~20 FTE
3 Contractors

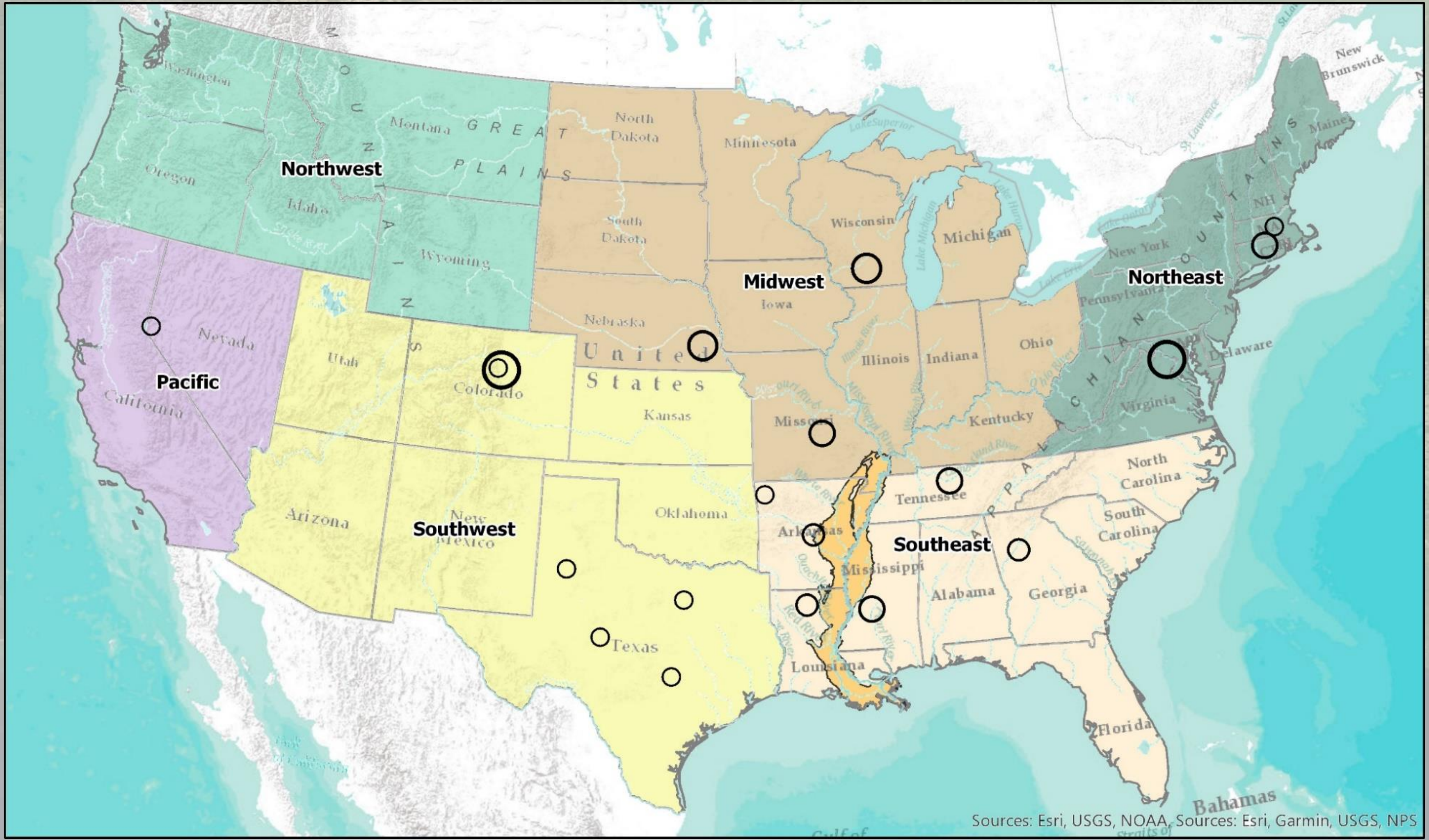
Watermark Numerical Computing

HydroGeophysics Group
AARHUS UNIVERSITY

CGG
Passion for Geoscience

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Fisher Delta Research Center
University of Missouri



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The Nature Conservancy

USDA Agricultural Research Service

LSU AgCenter Research · Extension · Teaching

DOTD LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

UNIVERSITY OF ARKANSAS

THE UNIVERSITY of MISSISSIPPI

FARMERS ADVOCATING RESOURCE MANAGEMENT DELTA F.A.R.M.

STATE

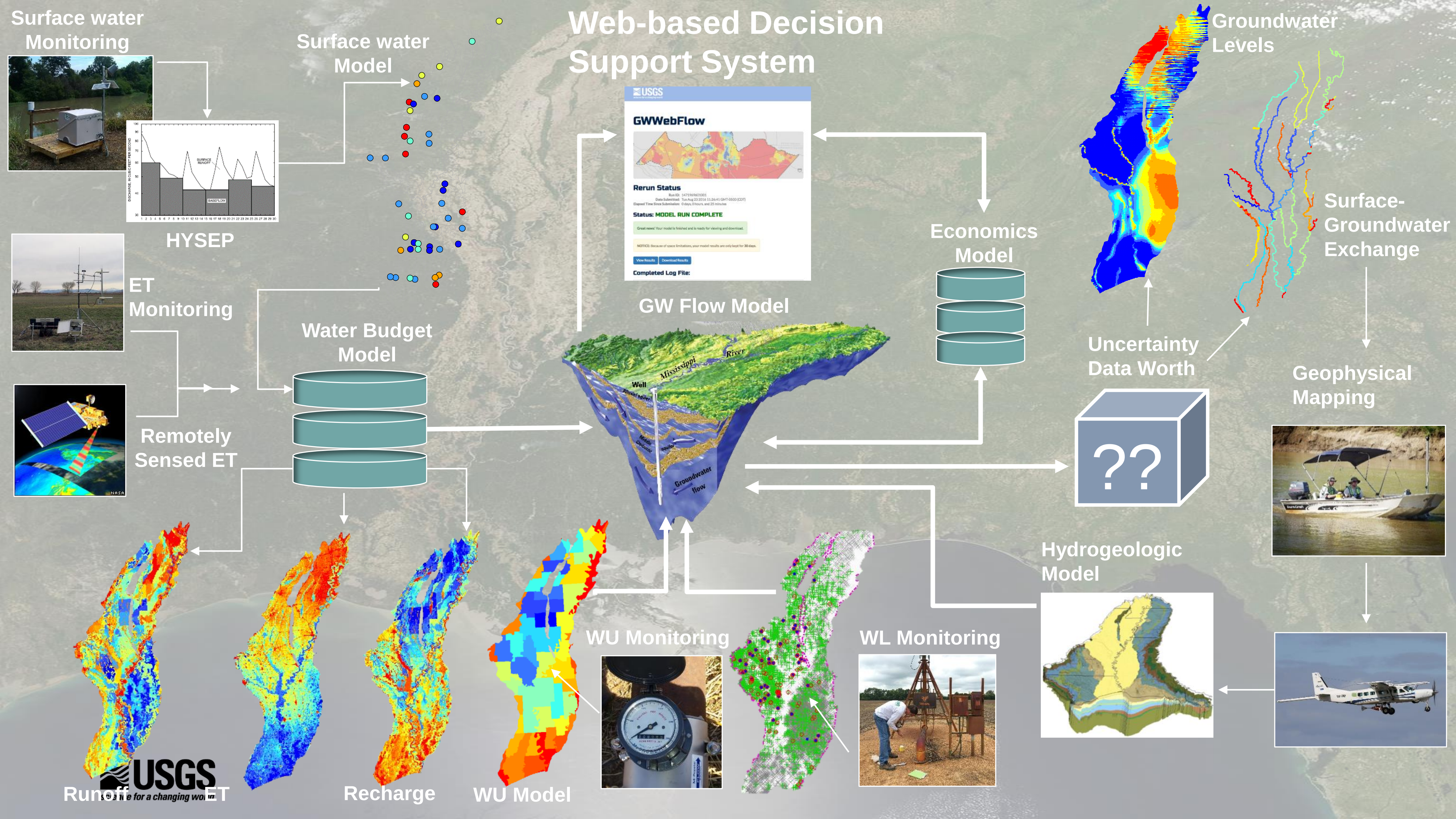
DELTA COUNCIL

MDEQ

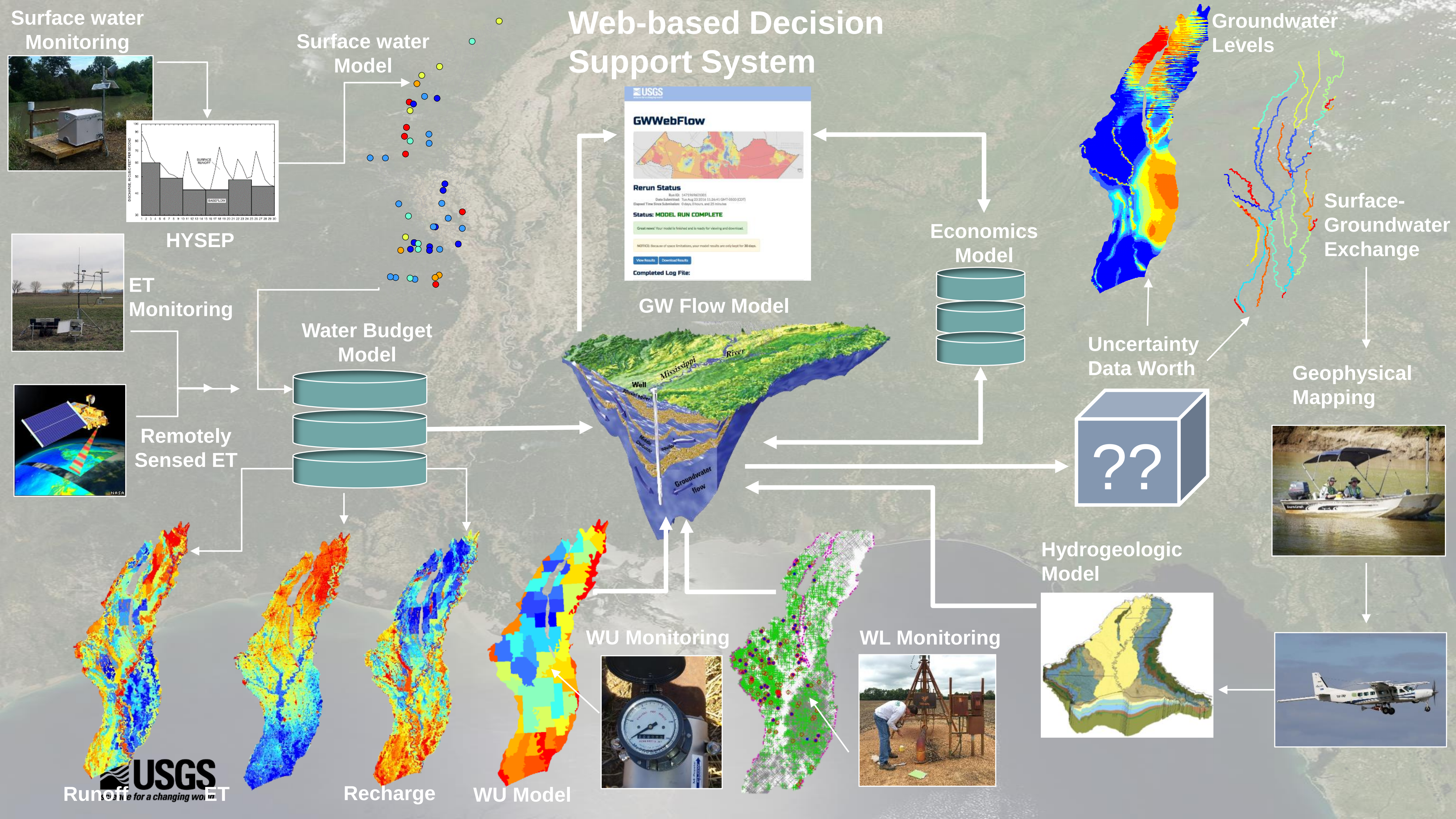
YMD

DELTA SUSTAINABLE WATER RESOURCES TASK FORCE

Delta Wildlife



Web-based Decision Support System
Surface water Monitoring
Surface water Model
HYSEP
SURFACE RUNOFF
BASEFLOW
ET Monitoring
Remotely Sensed ET
Water Budget Model
USGS
GWWebFlow
Rerun Status
Status: MODEL RUN COMPLETE
View Results
Download Results
Completed Log File:
GW Flow Model
Mississippi
River
Well
Groundwater flow
Economics Model
Groundwater Levels
Surface-Groundwater Exchange
Uncertainty Data Worth
??
Geophysical Mapping
Hydrogeologic Model
WU Monitoring
WL Monitoring
Runoff
ET
Recharge
WU Model
USGS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WU Model
USGS
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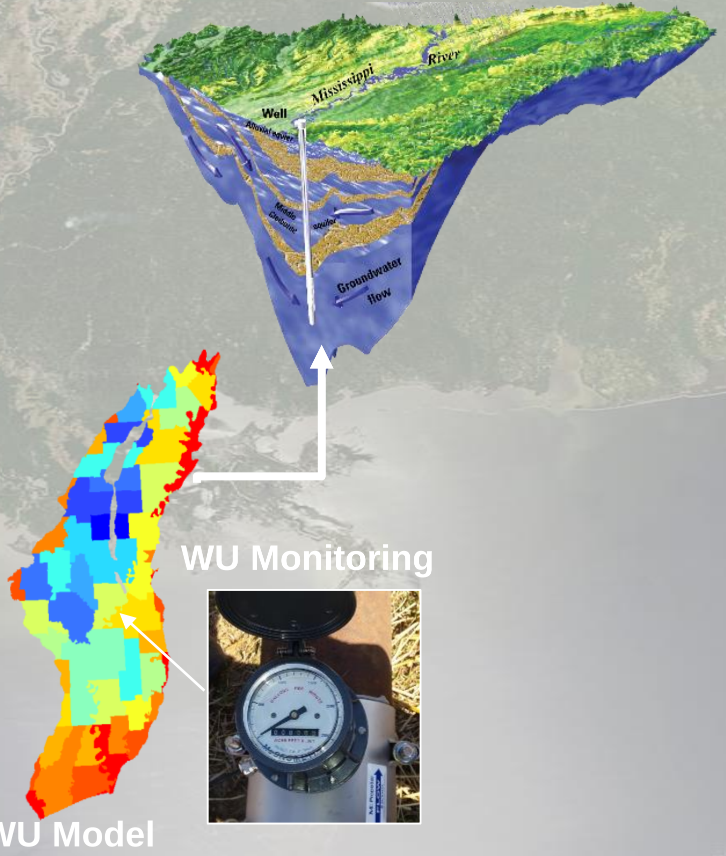
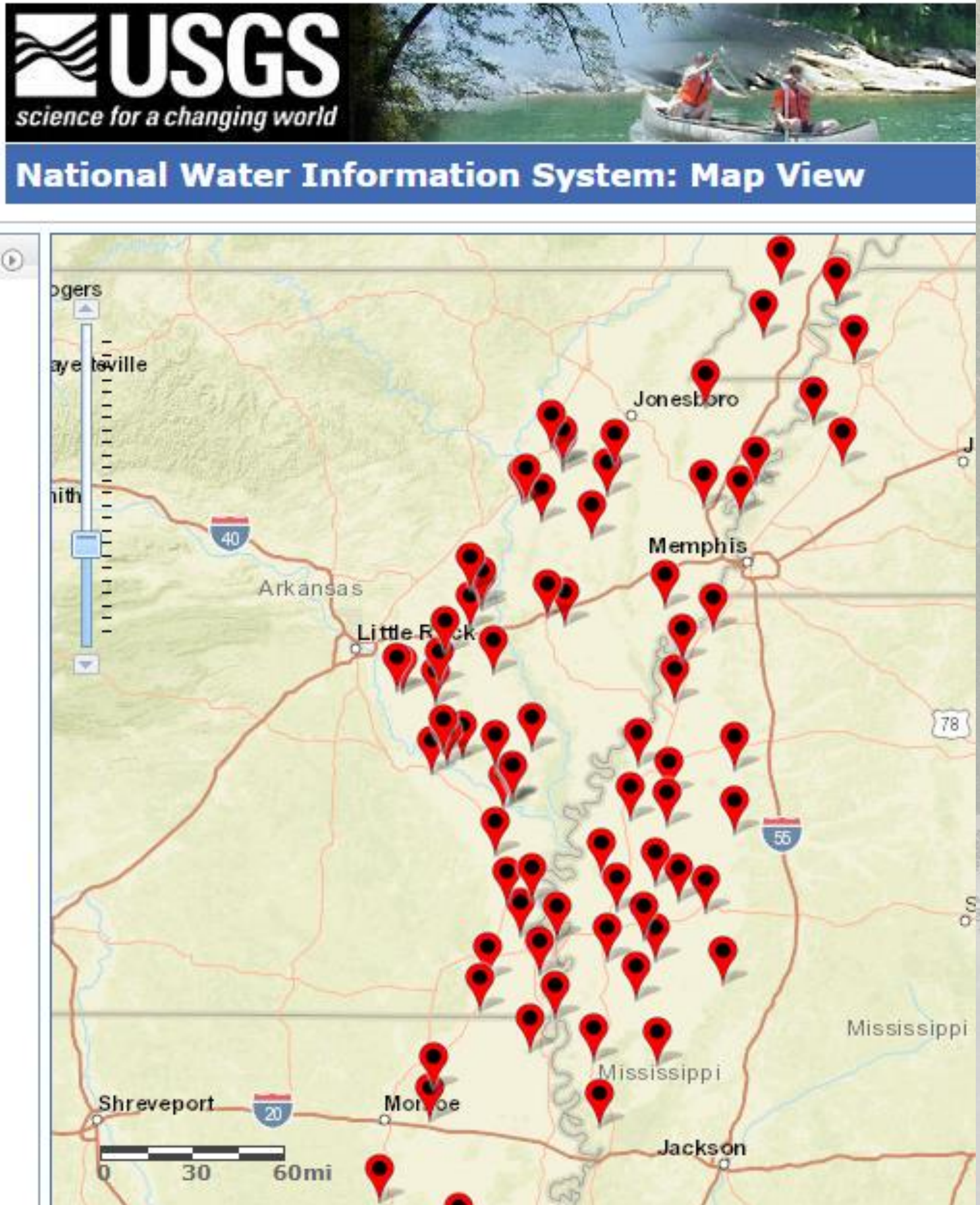
Water Use Monitoring and Mapping Efforts

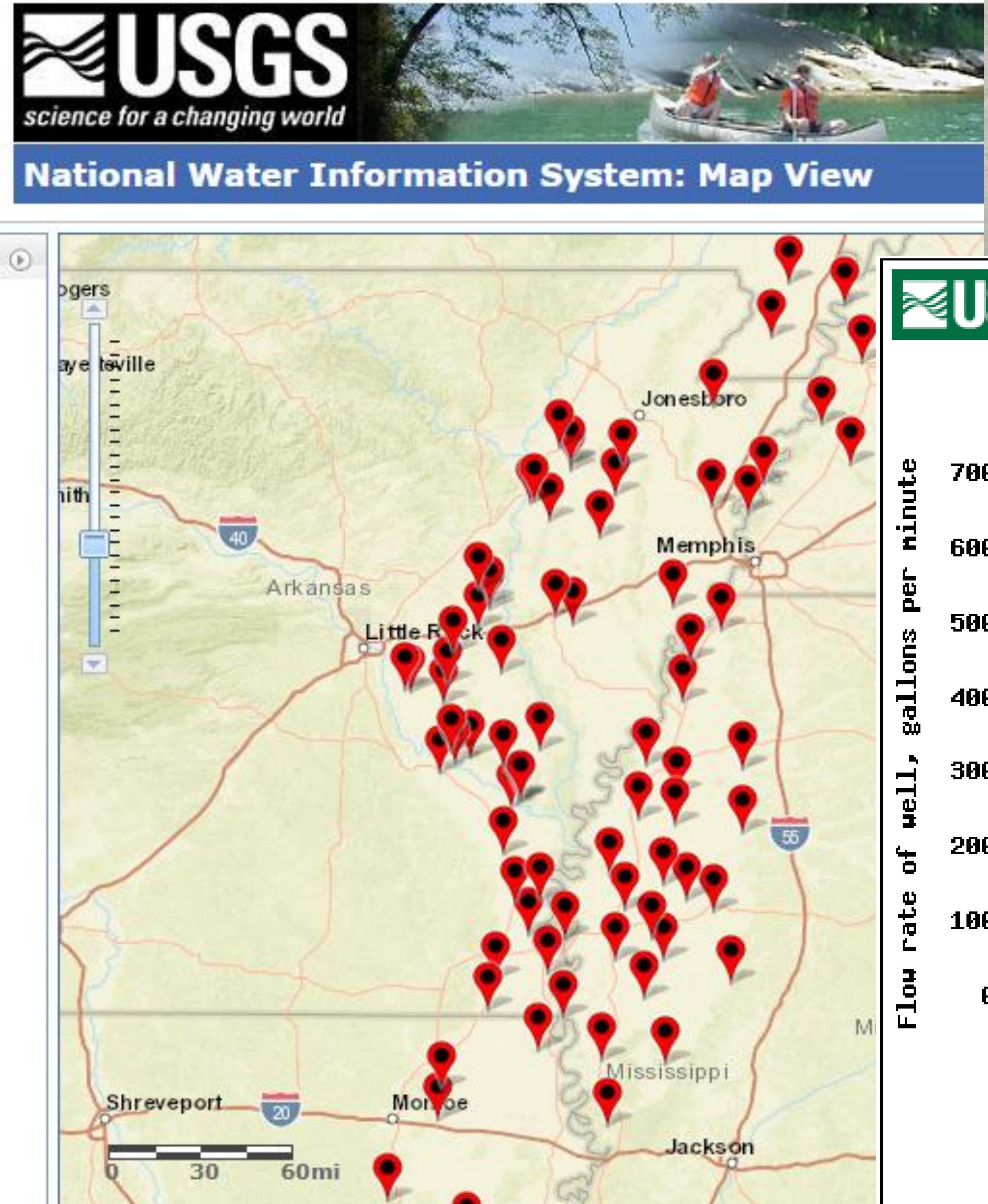


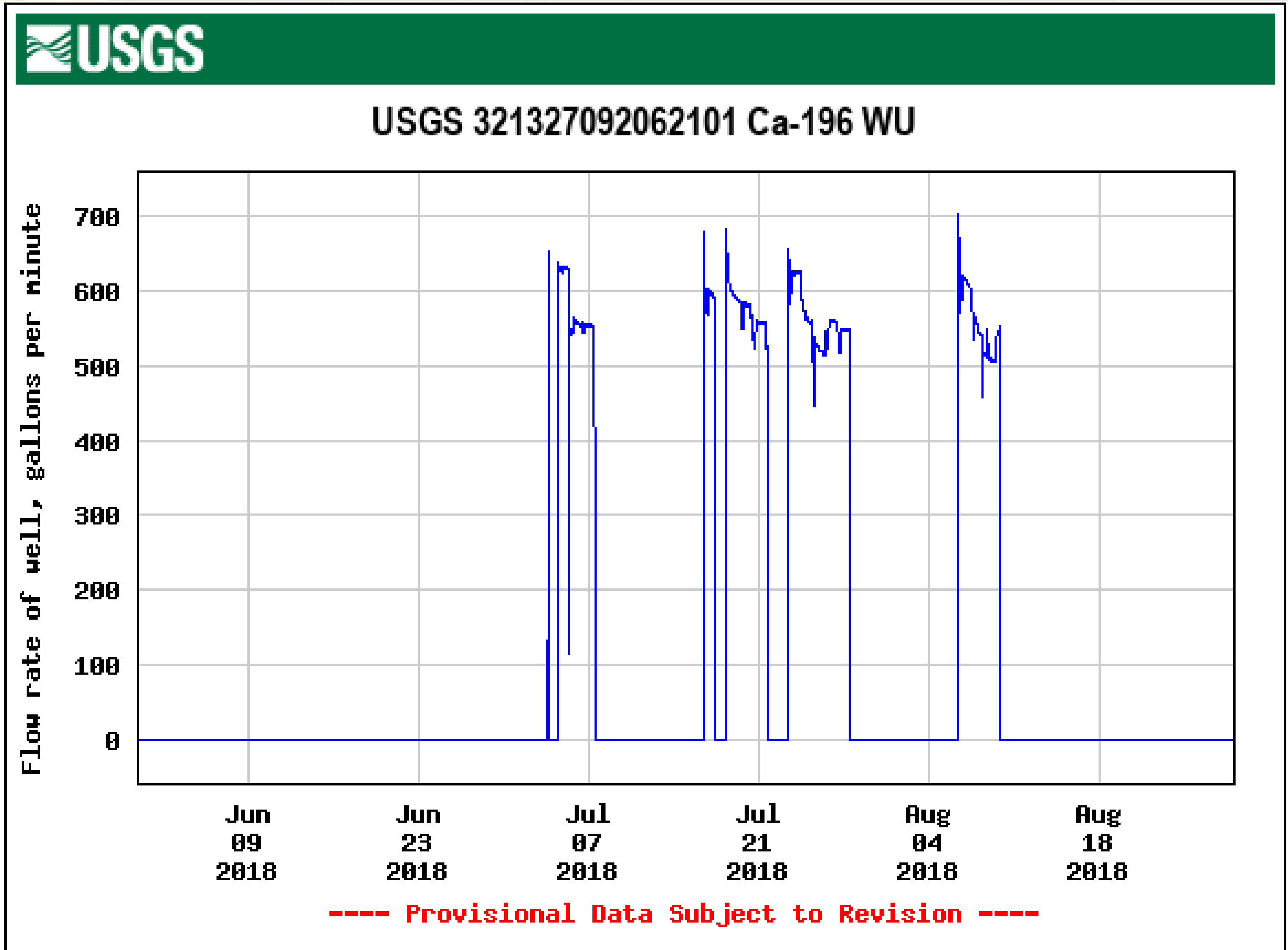


Real-time Water-Use Monitoring

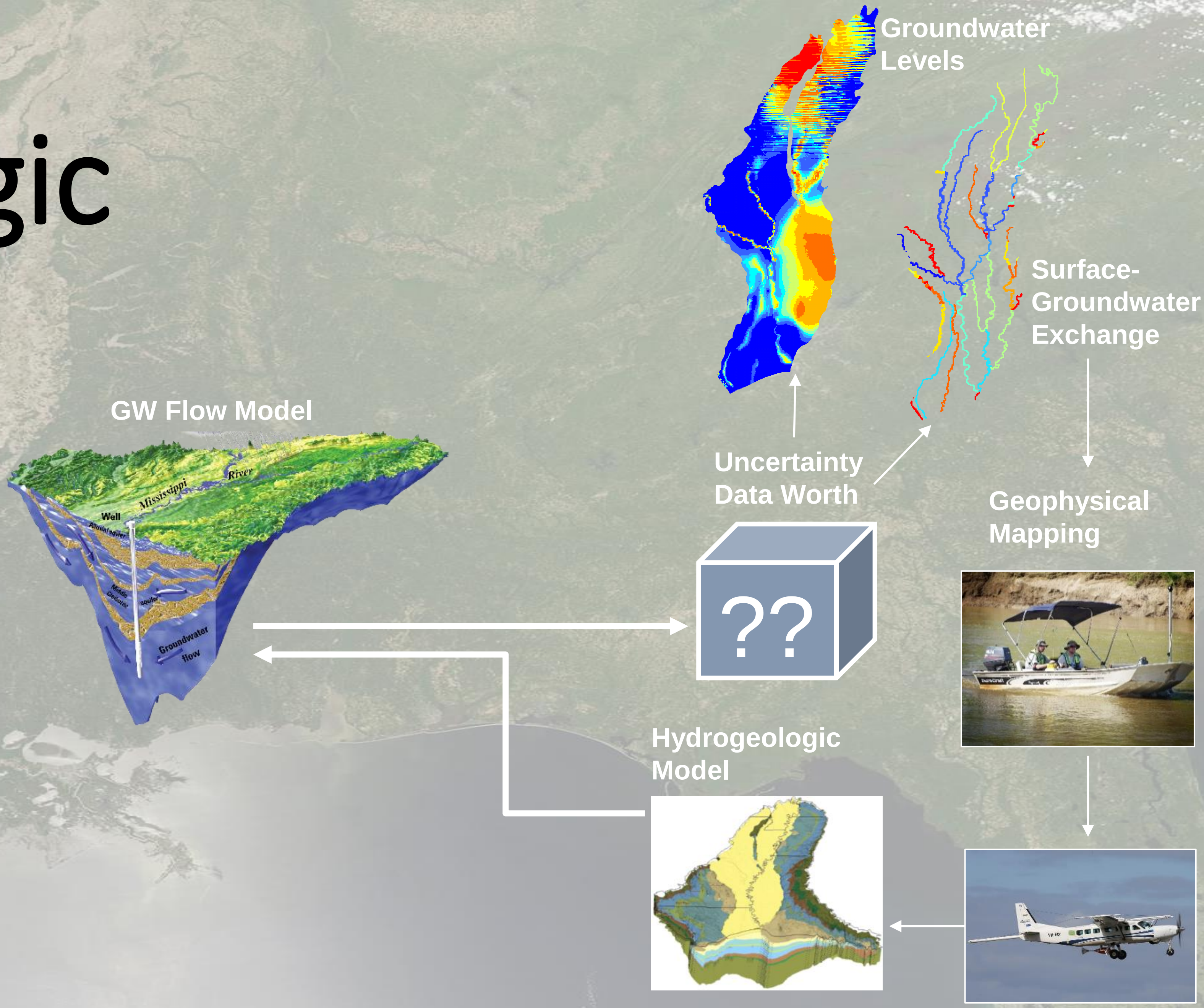
5 Sites in Louisiana in operation since May of 2018

Real-time Water-Use Monitoring





Hydrogeologic Framework Mapping Efforts



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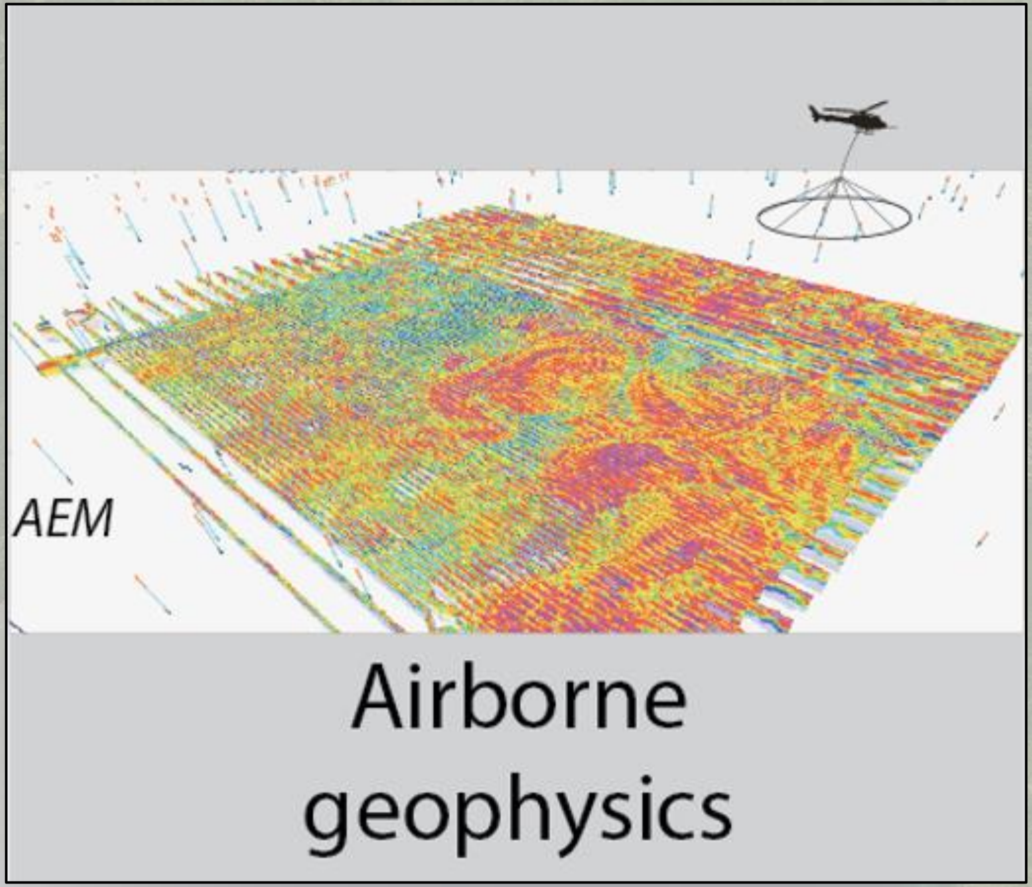
Geophysical Imaging



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Preliminary information-Subject to revision.
Not for citation or distribution.

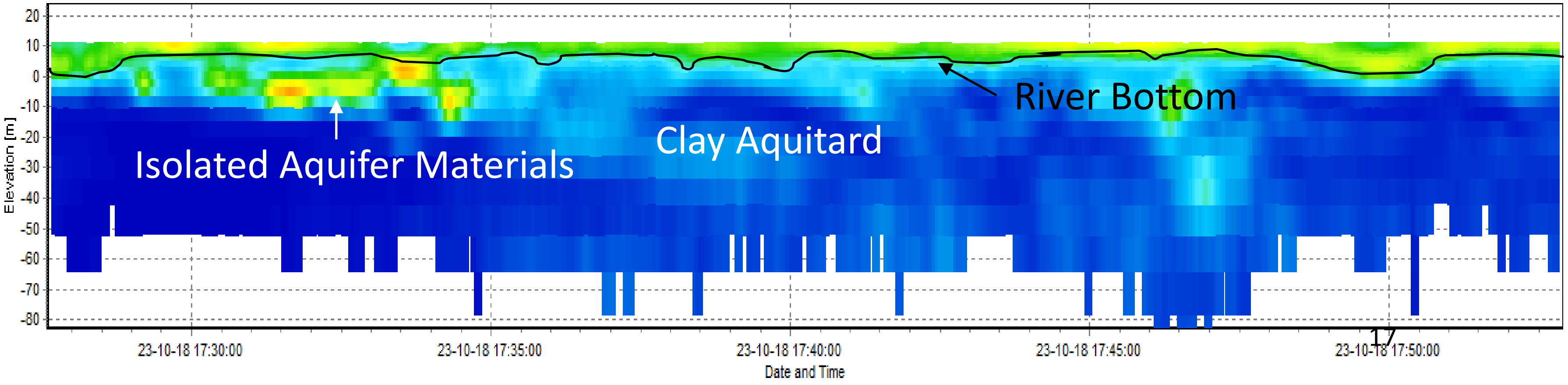

IRIS Resistivity Meter, Batteries, & Operator
Diff. GPS Antenna
WB Resistivity Cable (65m)
Echosounder
Water Quality Probe
Yazoo River at Egypt Plantation

Waterborne Geophysics on the Ouachita River

- In October of 2018, USGS and Aarhus University staff surveyed 130 miles of the Ouachita River from Monroe to Jonesville
- As part of the USGS Mississippi Alluvial Plain (MAP) project, this survey investigated groundwater-surface water interaction along this reach of the Ouachita
- This technique identifies geologic properties of different sediment units based on their electrical properties down to a depth of 250 feet

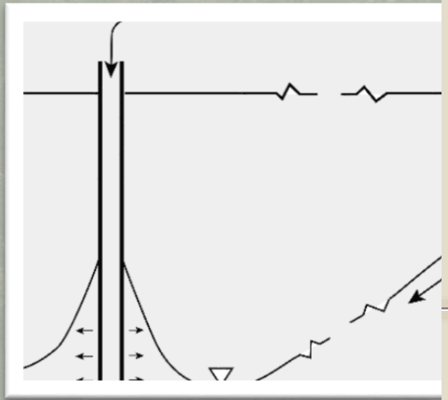
Resistivity (ohm*m)	Low	High

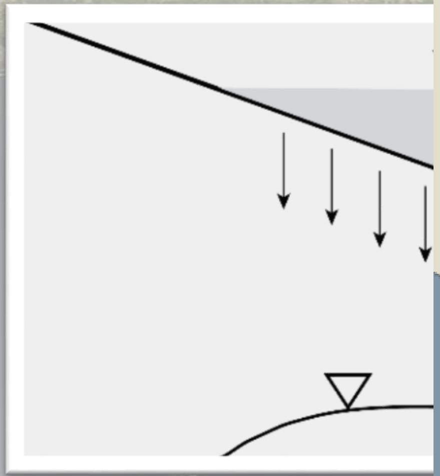
Sed. Size	Fine grained	Coarse grained
Sed. Type	Clay	Sand
SW/GW Exchange Potential	Lower Potential	Higher Potential



Geophysical Mapping

- Water resource management
  - Recharge
  - Groundwater/ Surface water exchange
  - Hydrogeologic framework
- Infrastructure projects
  - Groundwater transfer project
  - Enhanced recharge in rivers (weirs)
  - Mississippi River levee





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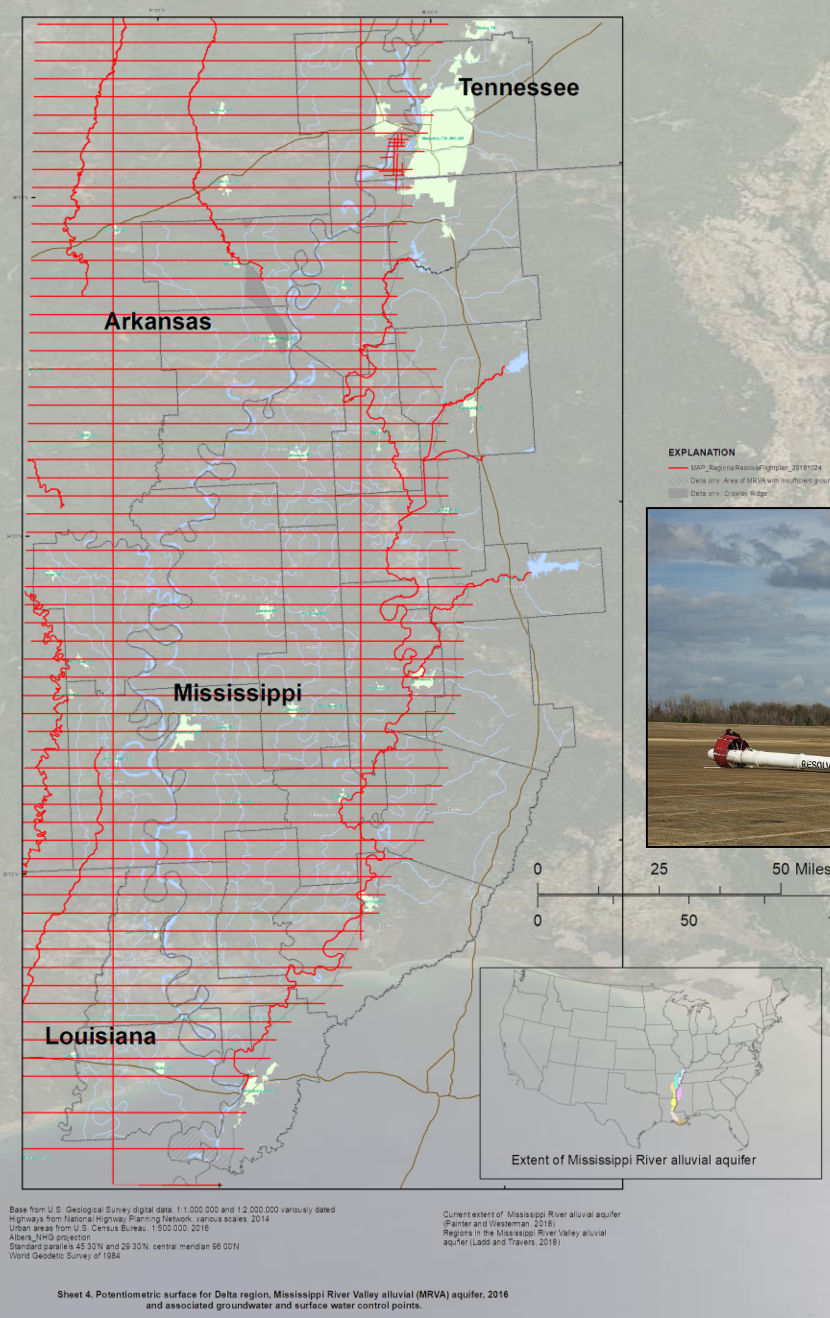
Hydrogeologic Framework: Airborne Survey

- Helicopter and Fixed-wing platforms
- Largest AEM survey for water resource mapping in the CONUS
  - Total planned +40,000 line-kms
    - Fall/Winter 2018: 19,000 line-km **(flying now)**
    - 12km line-spacing throughout entire region
    - 6km line-spacing for large continuous region in the middle
    - Summer 2019: 9,000 line-kms
    - More in 2020 and 2021
  - http://arcg.is/01nraa




RESOLVE
CGG
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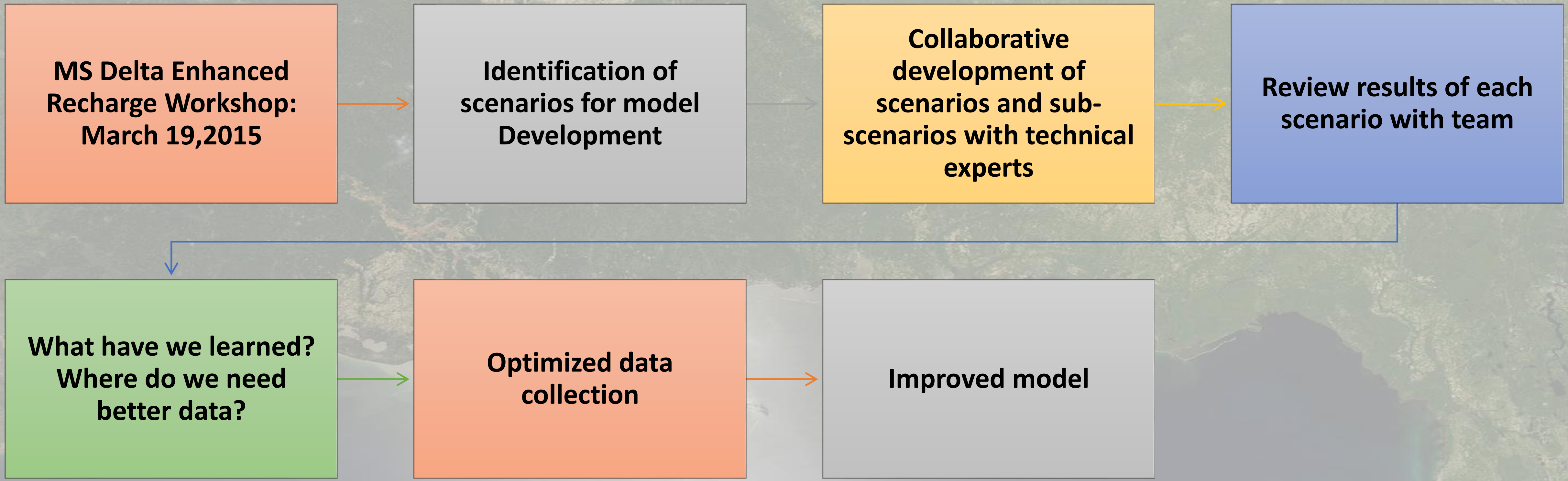
Alternative Water-Supply Scenarios

What can we model now? What information do we need for the future?



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Modeling Purpose

The purpose of the model simulations are to:

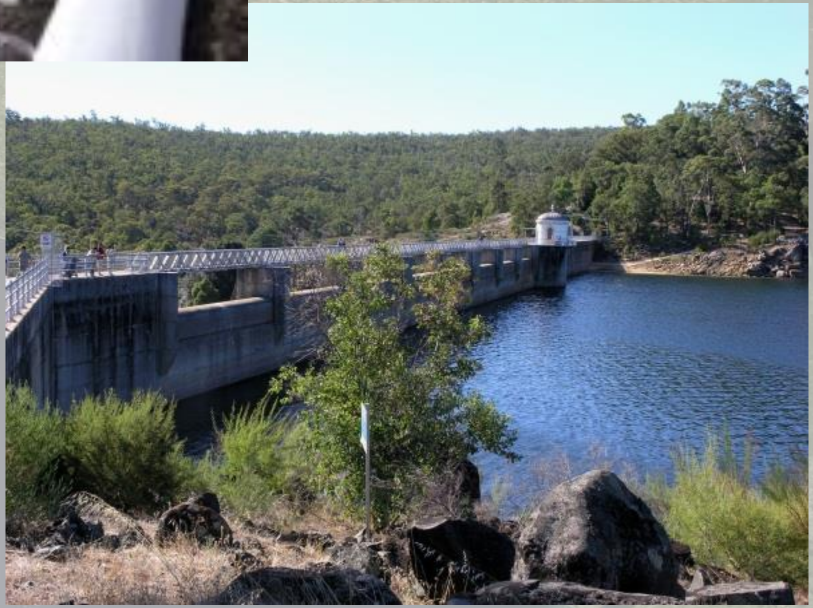
1. Collect all relevant information about each alternative and identify the assumptions needed for the model
2. Assess the change in water-level relative to the base scenario resulting from each scenario
3. **Provide information related to the amount of water not pumped or injected AND the resulting water level response for an economic analysis of each scenario (MSU, Dr. Falconer)**
4. Identify areas in need of further research and data collection

Alternative Water-Supply Scenarios

Decrease GW Withdrawals

- Irrigation efficiency
- Instream weirs to increase surface-water availability
- Tailwater recovery and onsite farm storage
- Inter/intra-basin transfer(s)

Irrigation efficiency in the Mississippi Delta; *photo credit: Jason Krutz, MSU-DREC*



Mundaring Water Treatment Plant, Australia; *photo credit: http://www.water-technology.net*

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Alternative Water-Supply Scenarios

Decrease GW Withdrawals

- Irrigation efficiency
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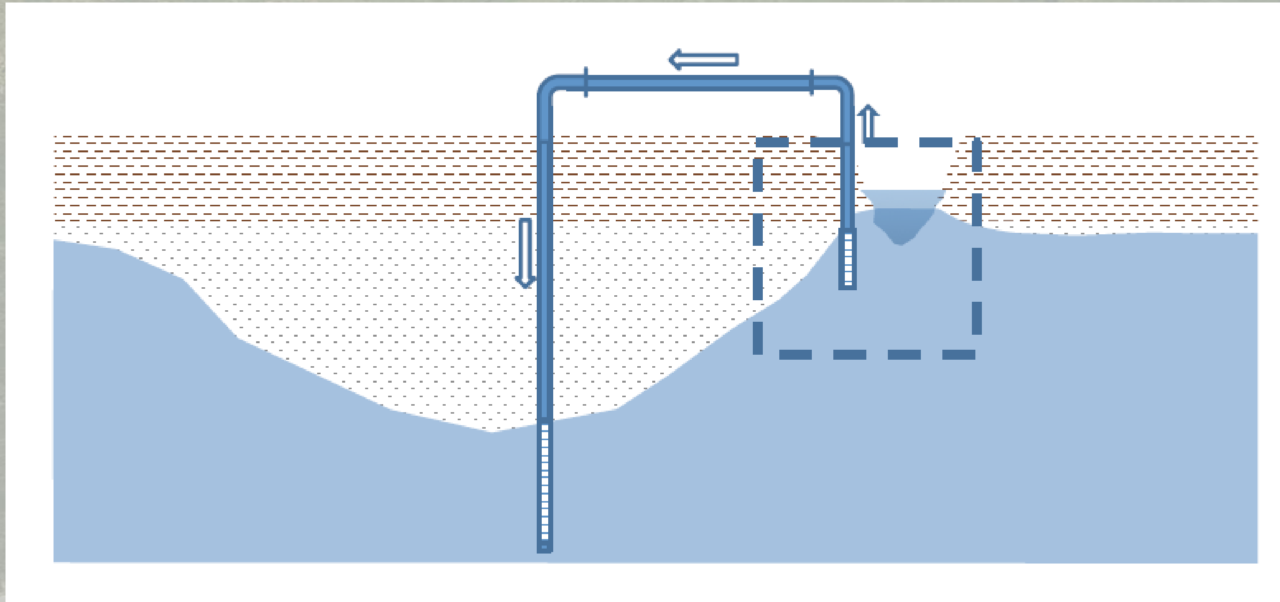
- Inter/intra-basin transfer(s)

Increase Recharge to the Alluvial Aquifer

- Enhanced aquifer recharge



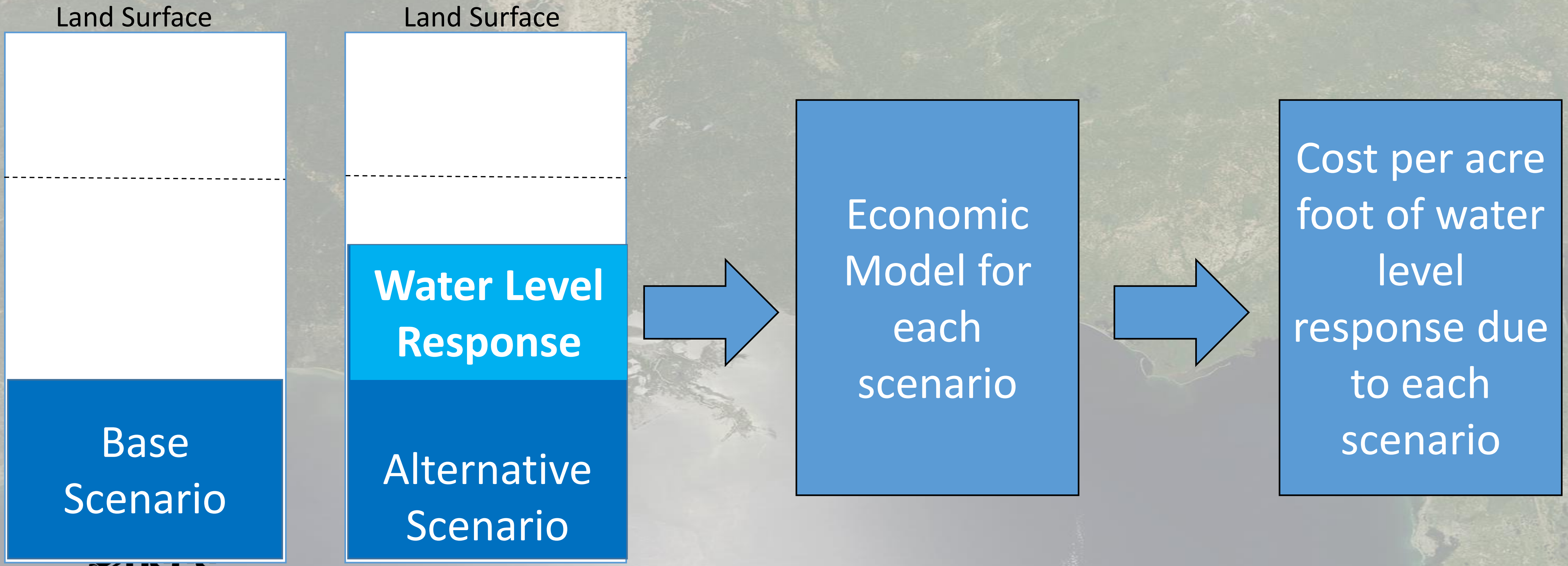
Groundwater transfer and injection schematic

Image from Dr. J.R. Rigby, USDA-ARS

How much will water levels decline within the area of the Delta with the highest rate of water-level declines?

How much will it cost?

Connect water and economic models to estimate anticipated cost for each scenario.



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Economic Analysis: Most Realistic Scenarios

Scenario	Estimated Total NPV Cost of Project	Average Water Level Increase at Year 50 in Feet	Cost of Change - Average Foot of Increase
Irrigation Efficiency			
Delta Wide	$354,913,325	15	$23,660,888
Central Delta	$9,295,469	10	$929,547
In Stream Weirs 1/2 Mile Service Area			
66% Adoption Rate	$6,724,753	8	$840,594
33% Adoption Rate	$11,560,932	4	$2,890,233
Tallahatchie- Quiver 1/2 Mile Service Area			
66% Adoption Rate	$51,427,291	4	$12,856,823
33% Adoption Rate	$49,113,657	2	$24,556,829
Enhanced Aquifer Recharge			
10 Abstraction Wells	$52,762,173	8	$6,595,272
20 Abstraction Wells	$105,524,338	17	$6,207,314
30 Abstraction Wells	$158,286,513	27	$5,862,463
40 Abstraction Wells	$211,048,680	35	$6,029,962

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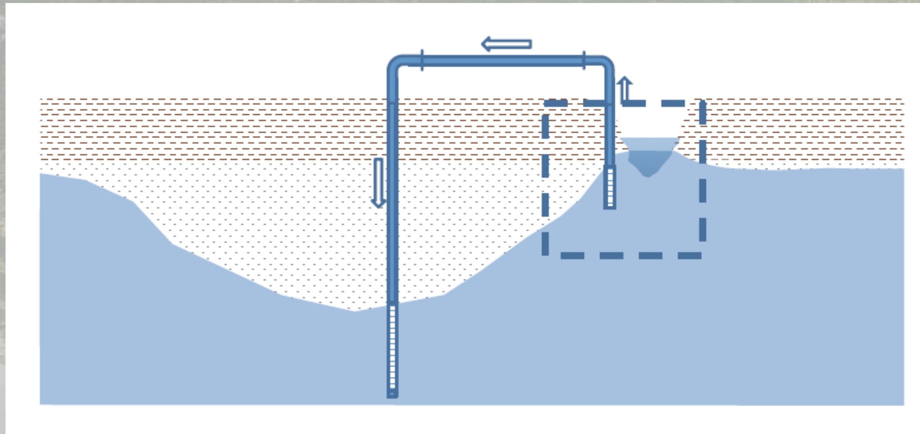
Future efforts will involve optimizing multiple solutions

Goal: Provide reliable scientific information to MDEQ and The Task Force in order to maximize the resource, minimize the costs



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Questions?

- Wade H. Kress
- wkress@usgs.gov