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Mapping Water Availability and Cost in the Western U.S.

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Sandia National Laboratories

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U.S. DEPARTMENT OF ENERGY | NNSA

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- University of Texas
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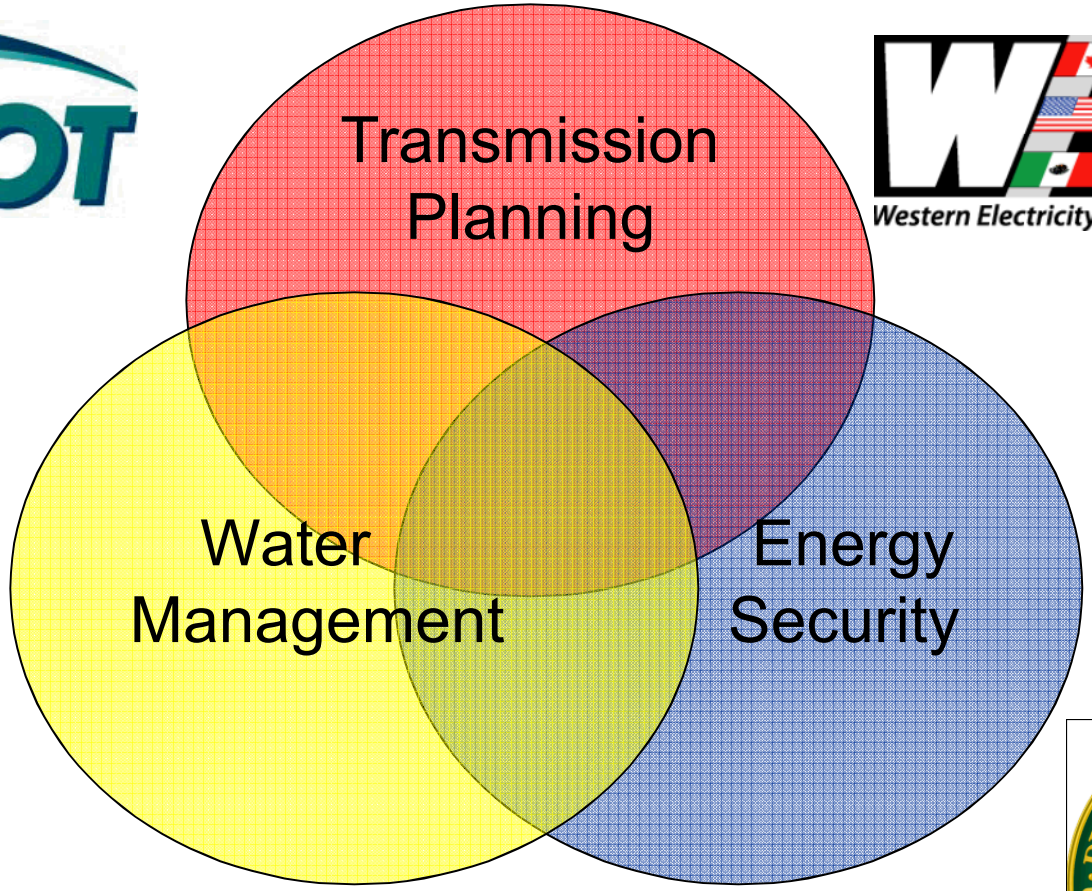
  - Carey King

Integrated Planning



ERCOT

WECC
Western Electricity Coordinating Council

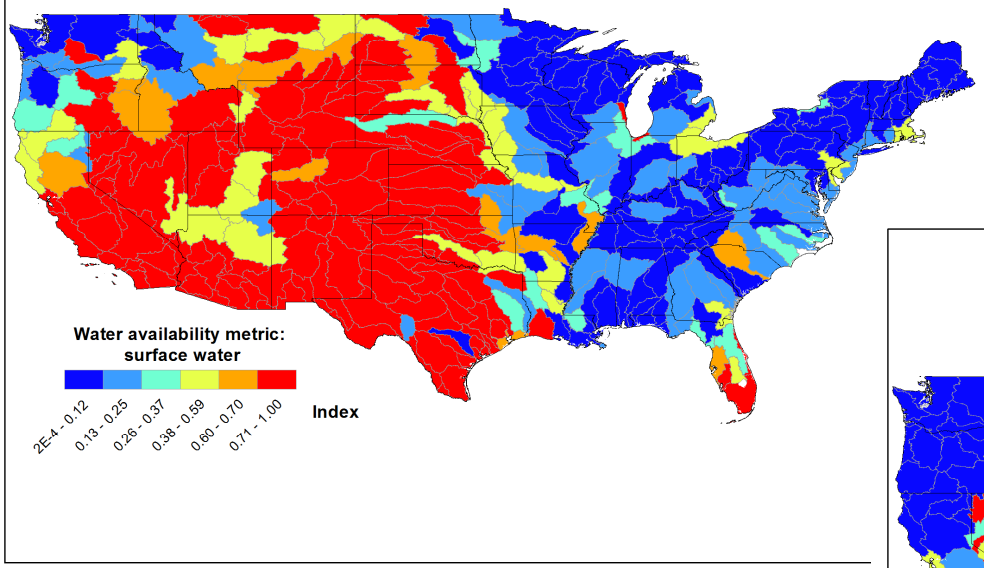
Western Governors' Association
Serving the Governors of 19 States and 3 US-Flag Pacific Islands

WSWC
Western States Water Council

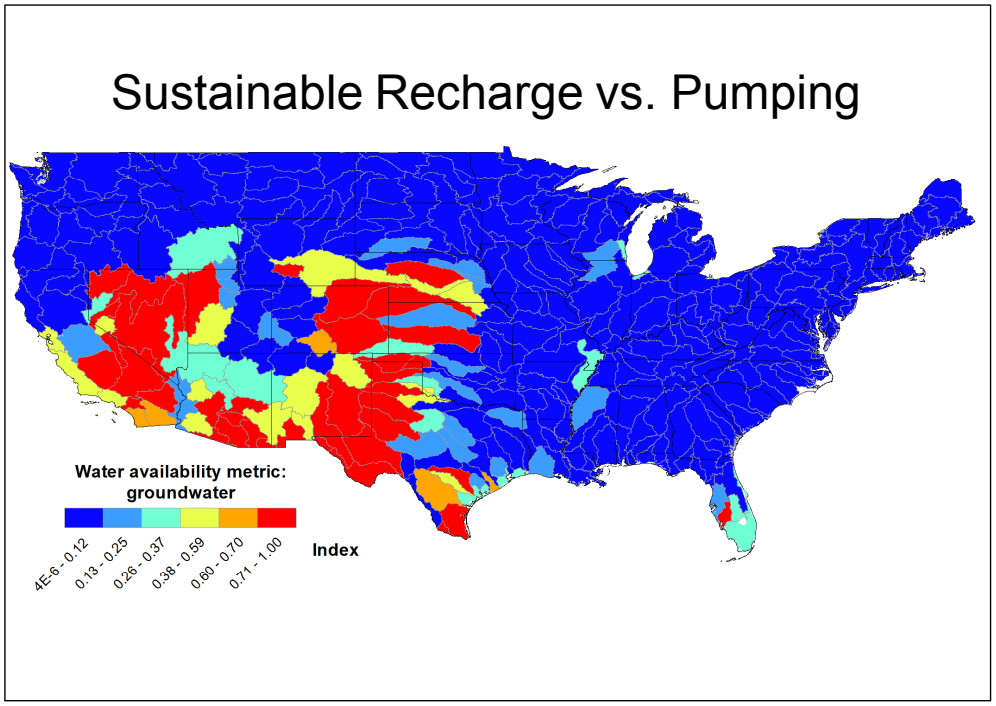
Department of Energy · United States of America

Potential Limits to Development

Gauged Streamflow vs. Consumption



Sustainable Recharge vs. Pumping



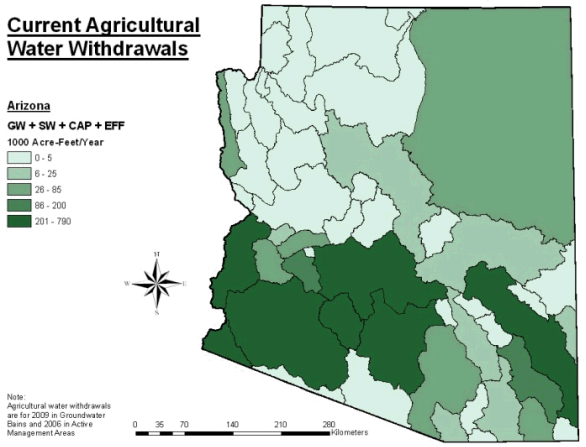
Key Water Sources

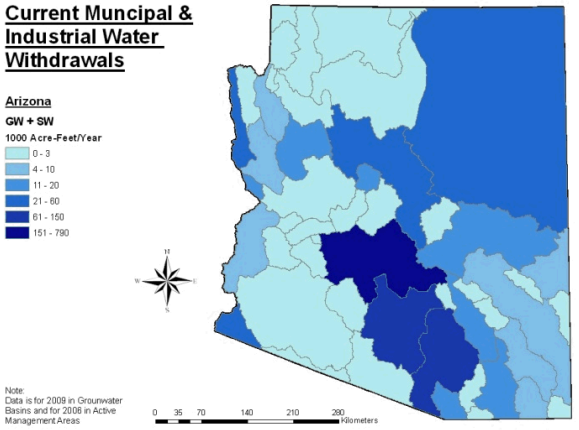
- **Potable Water**
  - **Unappropriated surface water**
  - **Appropriated surface water (rights transfers)**
  - **Groundwater**
- **Non-Potable Water**
  - **Municipal/Industrial wastewater**
  - **Shallow brackish water**

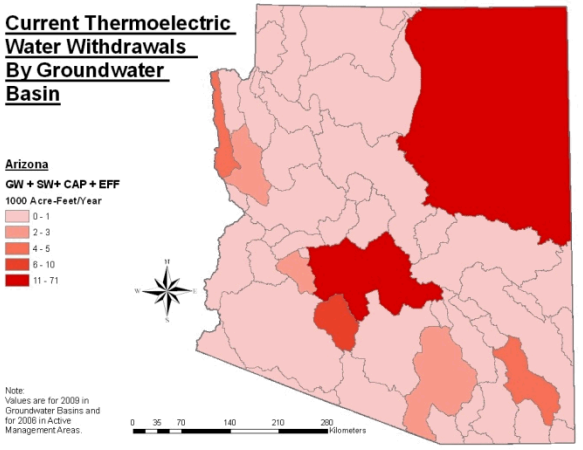
Relative Availability and Cost

Water Availability Indicators: Demand

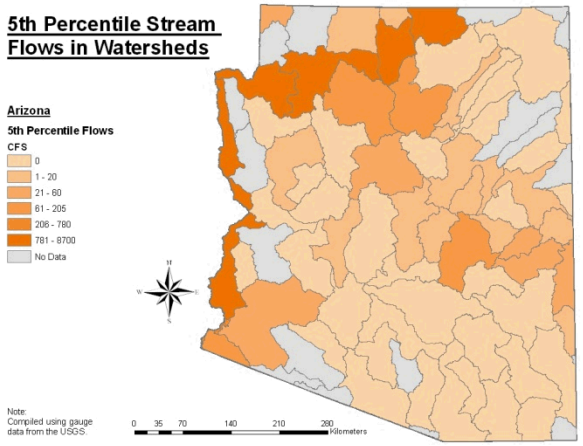
- ***Focus on withdrawals***
- ***Estimate consumption from withdrawals***
- ***Disaggregate by:***
  - ***8-digit watershed***
  - ***Sector***
    - ***M&I***
    - ***Agriculture***
    - ***Evaporative***
    - ***Instream***
  - ***Water source***



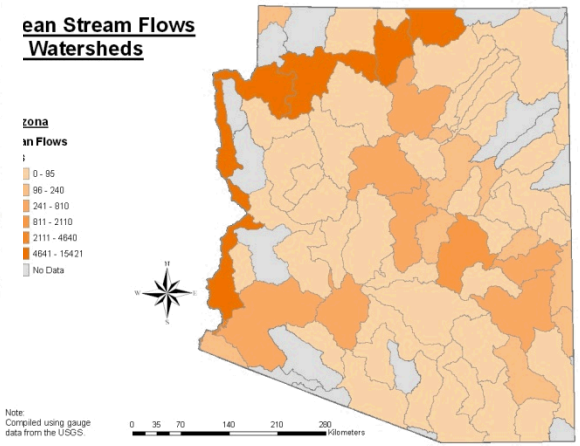




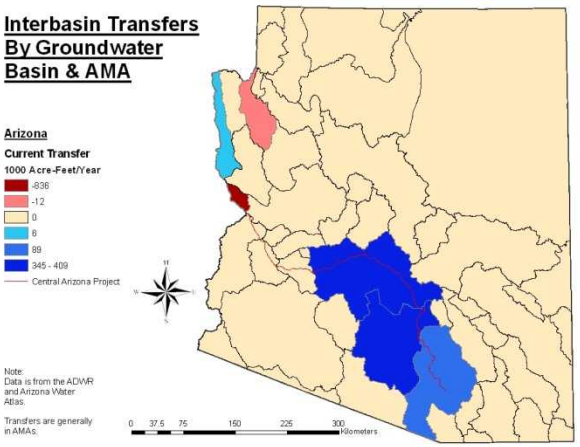
Water Availability Indicators: Supply



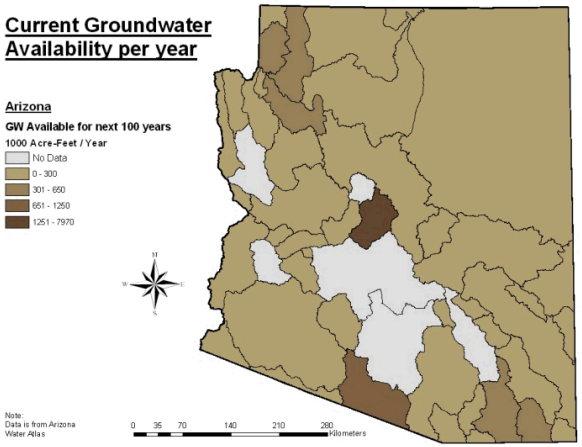
Mean Gauged Streamflow



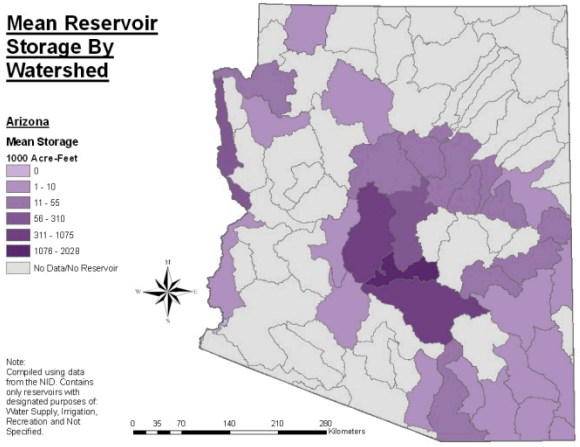
Annual Low Flow



Interbasin Transfers

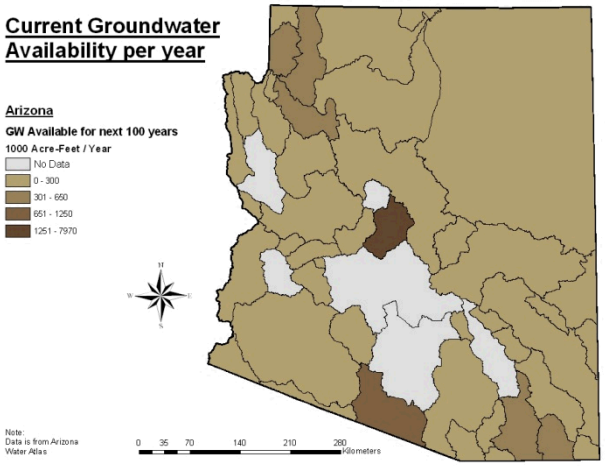


Groundwater Depletion

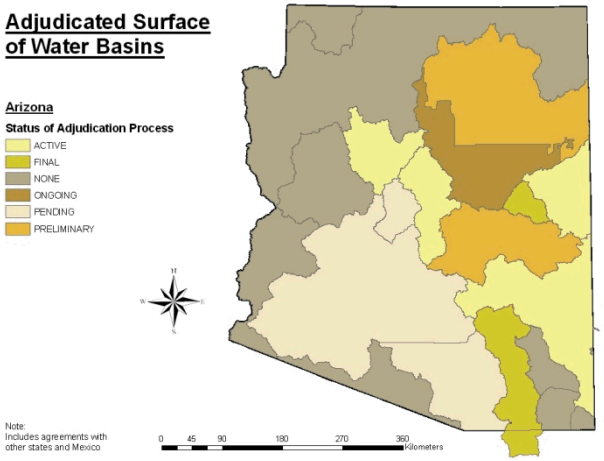


Reservoir Storage

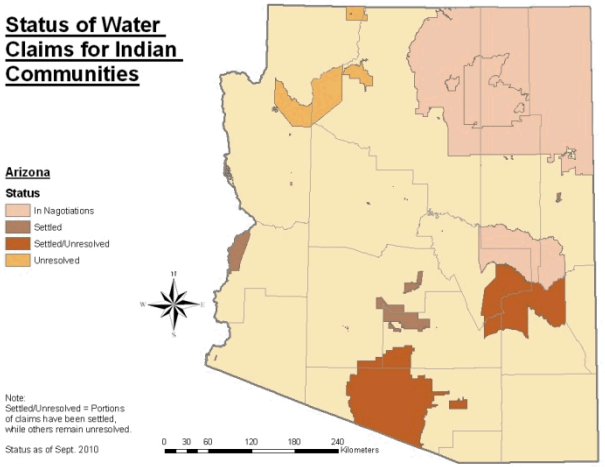
Water Availability Indicators: Institutional Factors



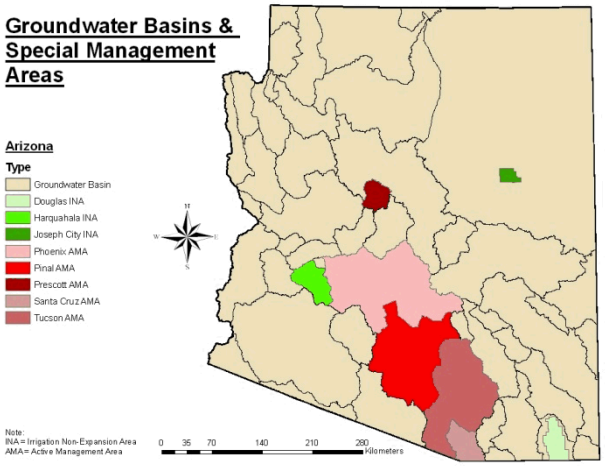
Unappropriated Water



Adjudication Status



Indian Water



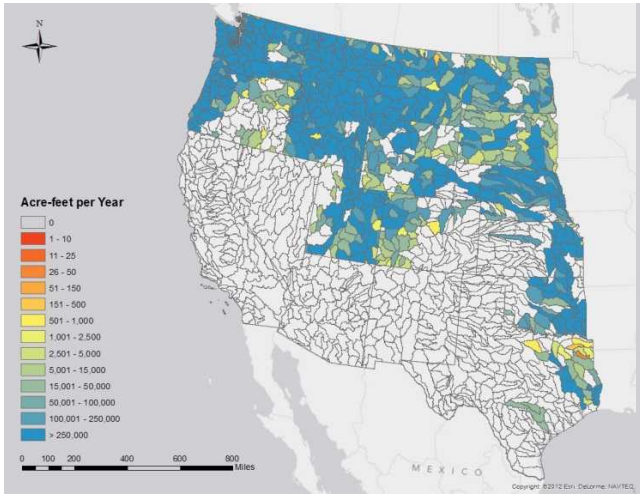
Administrative Control Areas

Metric Development

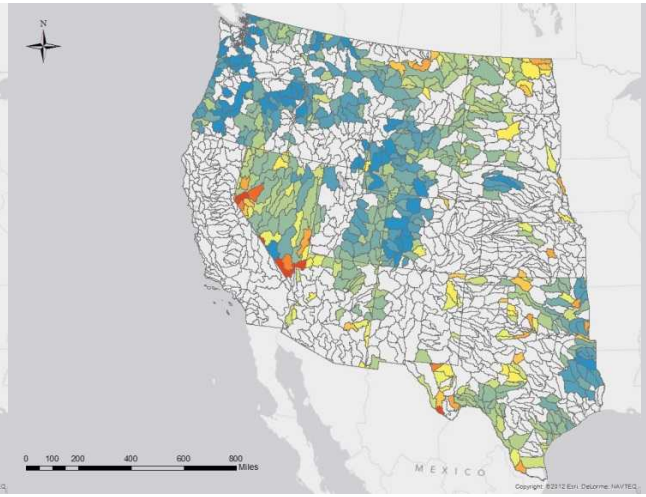
- **Data on "available water" are rare**
- **As such, metrics were estimated from available information**
- **Assisted by volunteer team from WSWC**
  - **Bret Bruce (USGS)**
  - **Dan Hardin (TX)**
  - **Sara Larsen (WSWC)**
  - **Dave Mitamura (TX)**
  - **Andy Moore (CO)**
  - **Ken Stahr (OR)**
  - **Todd Stonely (UT)**
  - **Steve Wolff (WY)**
  - **Dwane Young (WSWC)**

Water Availability

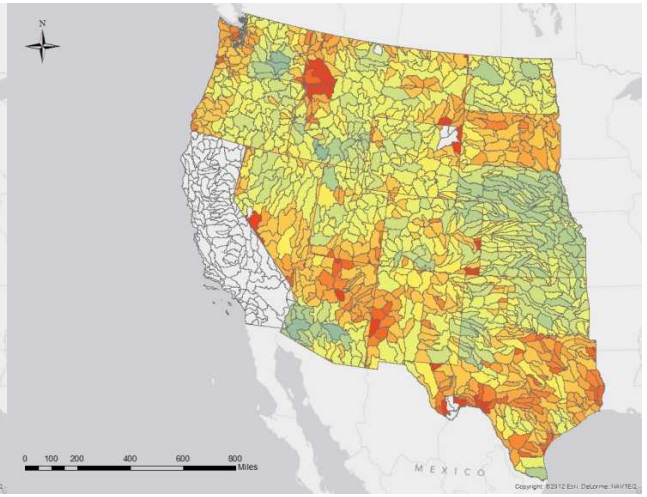
Unappropriated Surface Water



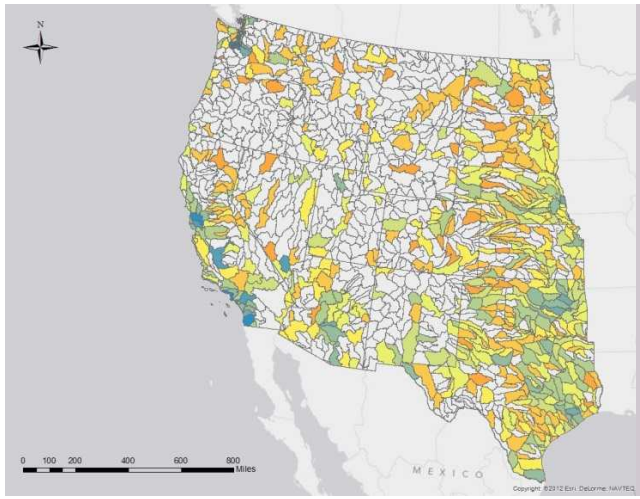
Unappropriated Groundwater



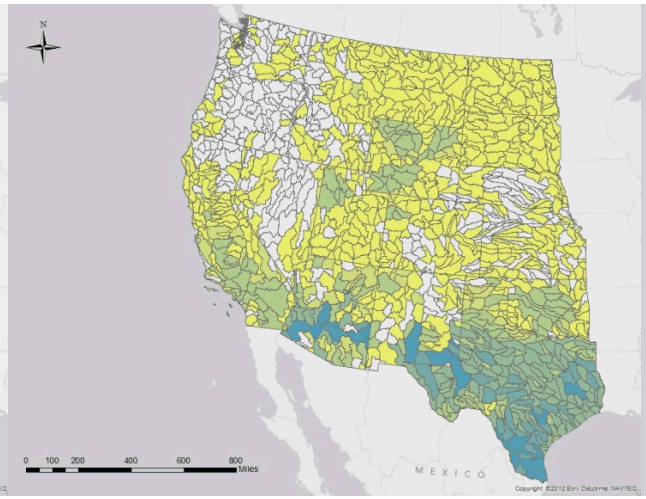
Appropriated Water



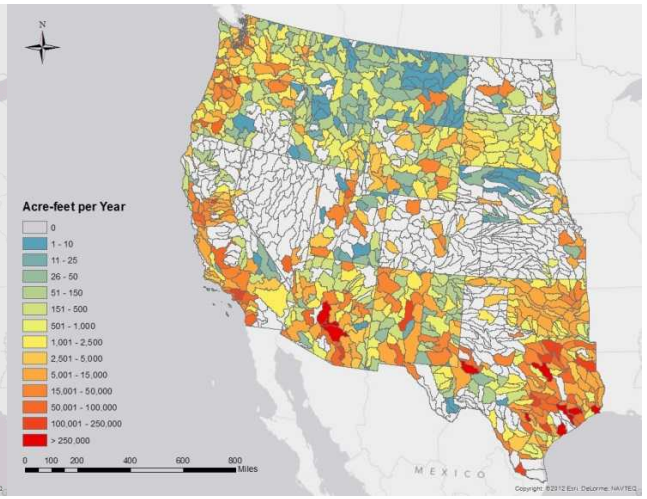
Municipal Wastewater



Brackish Groundwater

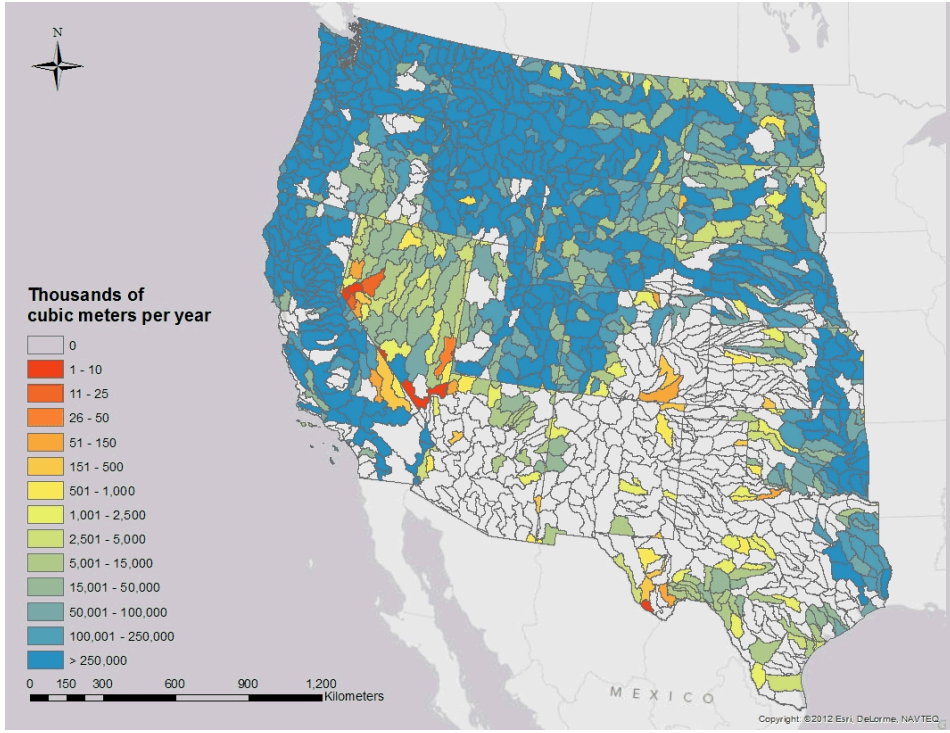


Consumptive Demand 2010-2030

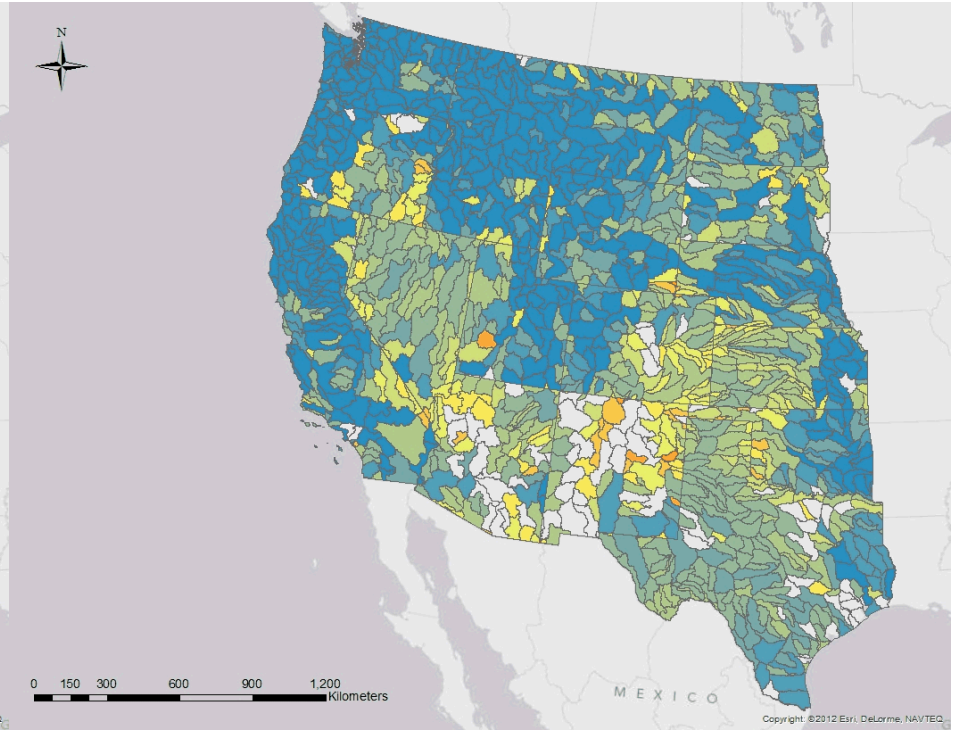


Water for Development

Unappropriated Sources – New Demand

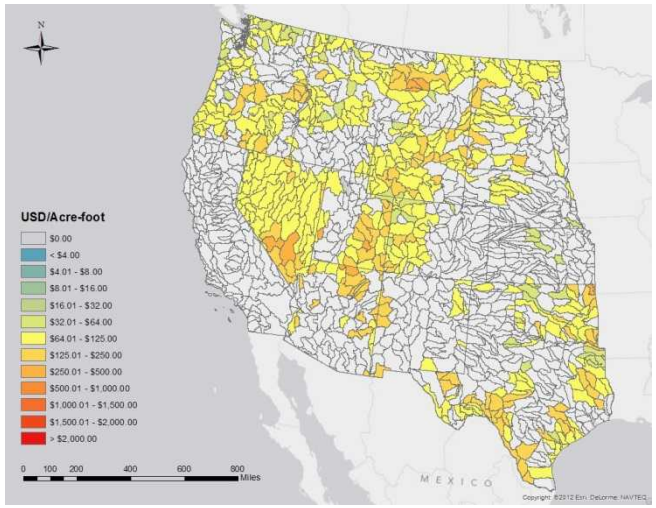


All Sources – New Demand

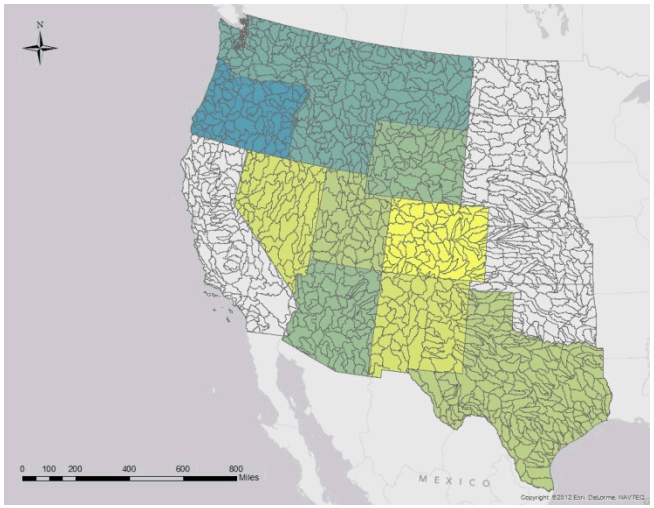


Relative Cost of Water

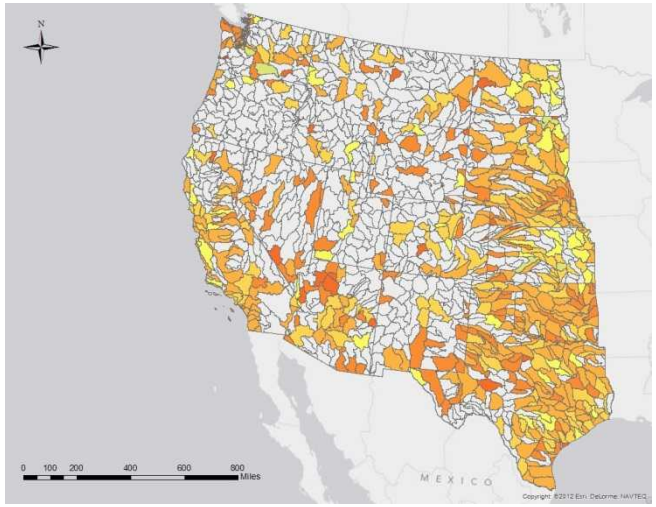
Unappropriated Groundwater



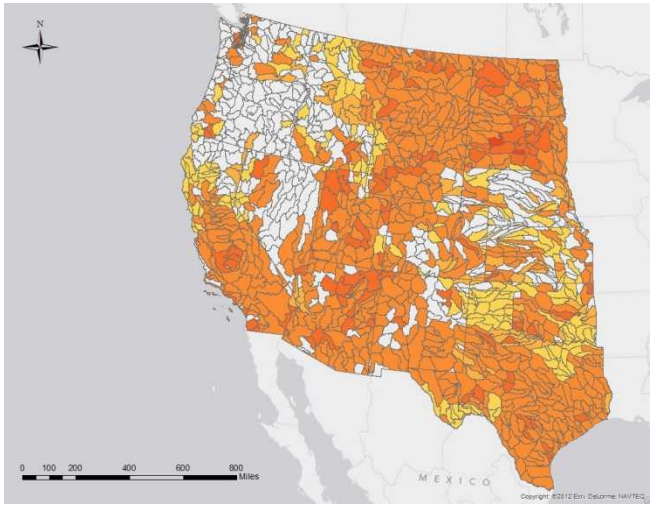
Appropriated Water



Municipal Wastewater



Brackish Groundwater



Environmental Risk Metric

Risk Calculation Methodology

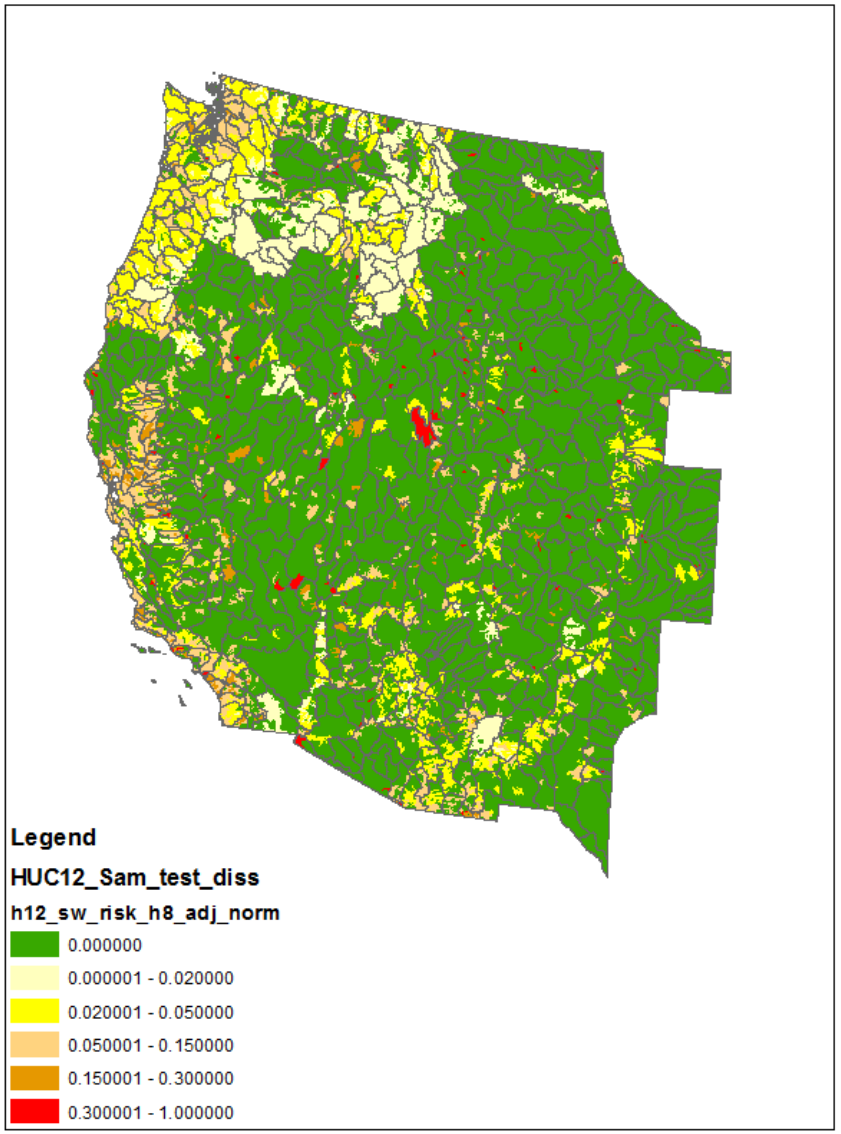
- Only species utilizing aquatic and riparian habitats are considered
- **Overall Risk** to a region from Water Extraction **(OR) = IR + AR** Eq1
- **Individual Risk (IR)** to a region is product of 4 Species Vulnerability Categories (**sij**'s) and 3 Habitat Vulnerability Categories (**hik**'s)
- **IR = ∑[(sij1 + sij2 + sij3 + sij4 + CF) * (hik1 + hik2 + hik3sw/gw) * EE]** Eq2

  sij1 = Diversity
  sij2 = Imperilment
  sij3 = Endemicity
  sij4 = Sensitivity

  hik1 = Area
  hik2 = Critical habitat
  hik3 = Habitat type
  hik3 risks are separate for surface- (sw) and groundwater (gw)

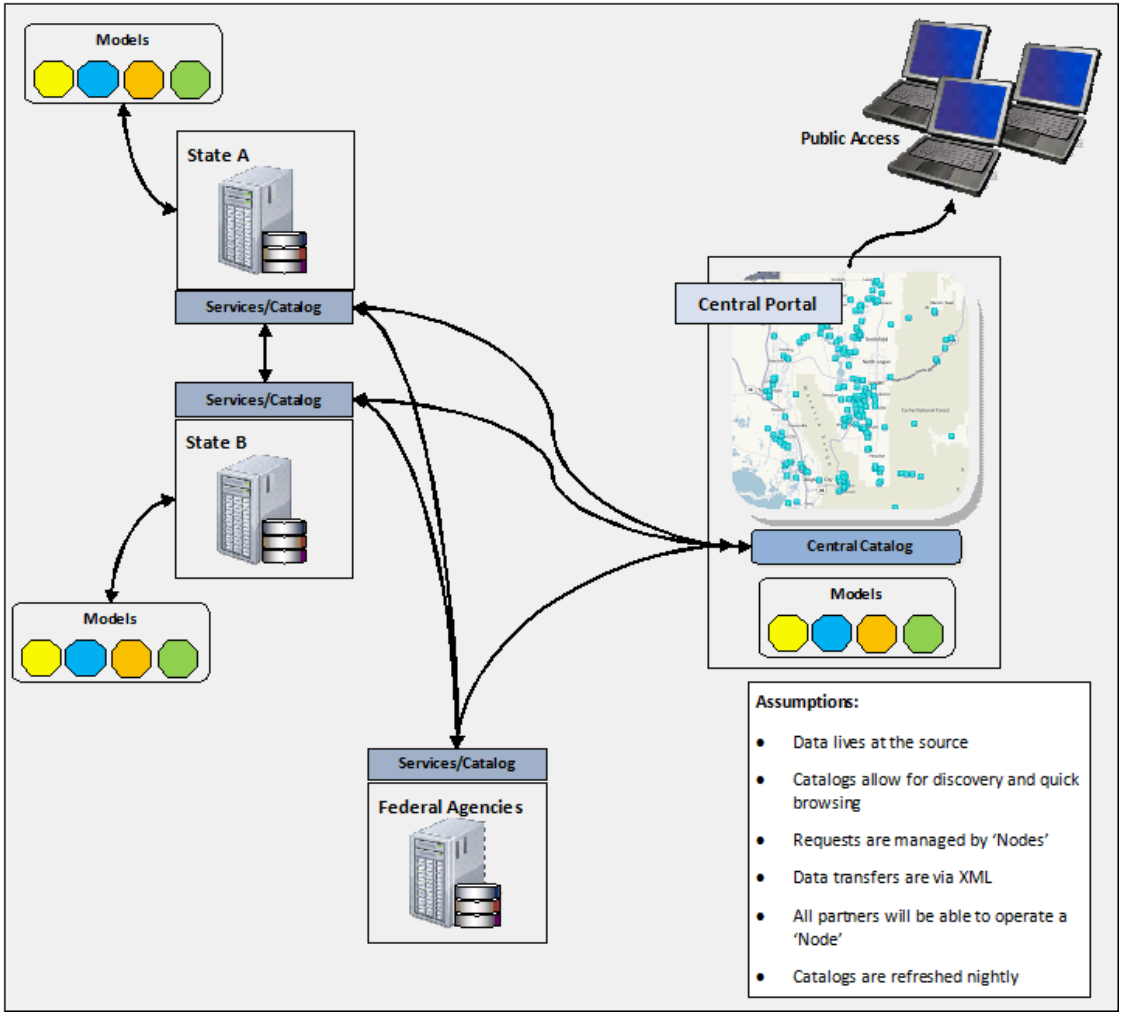
- Edge-effect filter **EE_8 factors (0.5, 1) and EE_{12} factors (1, 2)**
- **Association Risk (AR) = 0.5 * IR** of Immediate Downstream Polygon Eq3
- Correction Factor (CF - Binary), Edge-effect (EE) filter, and Association Risk (AR) – Not used for this analysis

HUC-12 Risk Map (From Surface Withdrawals)



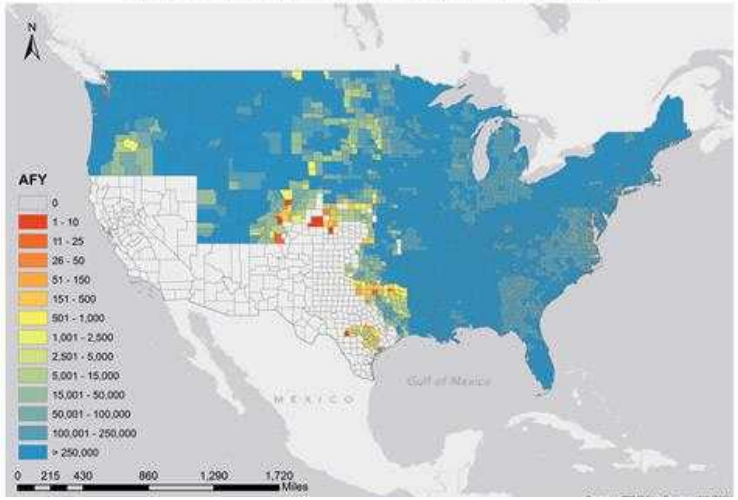
Water Use Data Exchange (WaDE)

- Use Web Services to transfer data
- Data Stay at the Source (i.e. the states)
- Provide transparent link between state data and integrated water metrics
  - Link to metadata
  - Changes in state data are automatically reflected in metrics

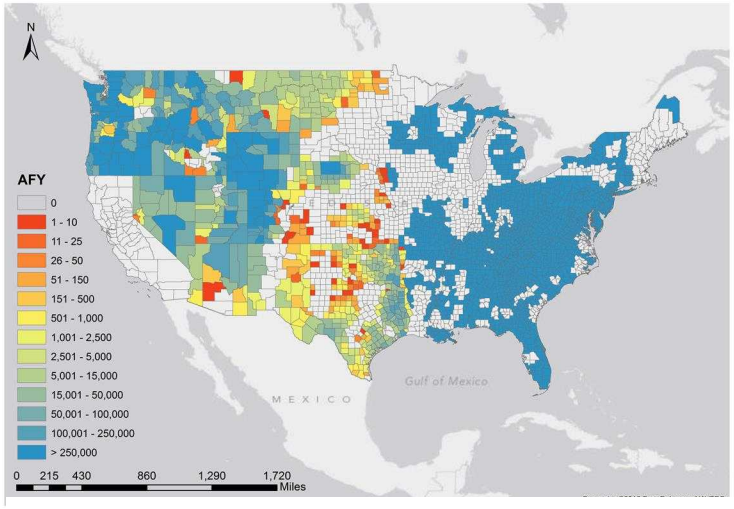


Water Availability

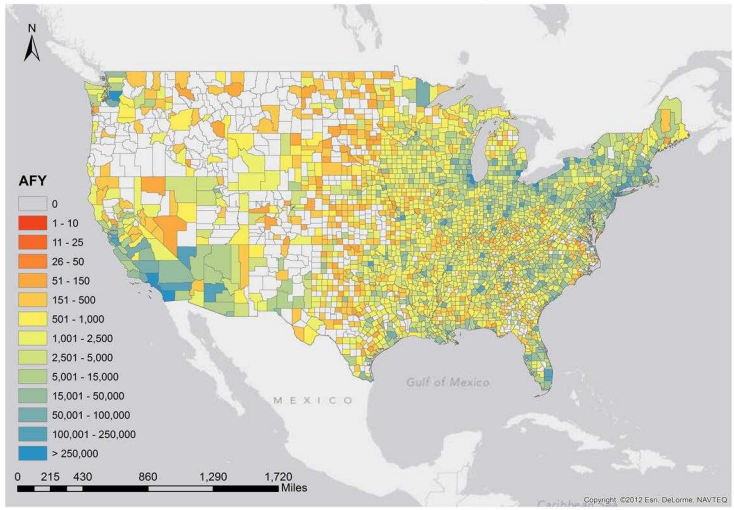
Unappropriated Surface Water Availability



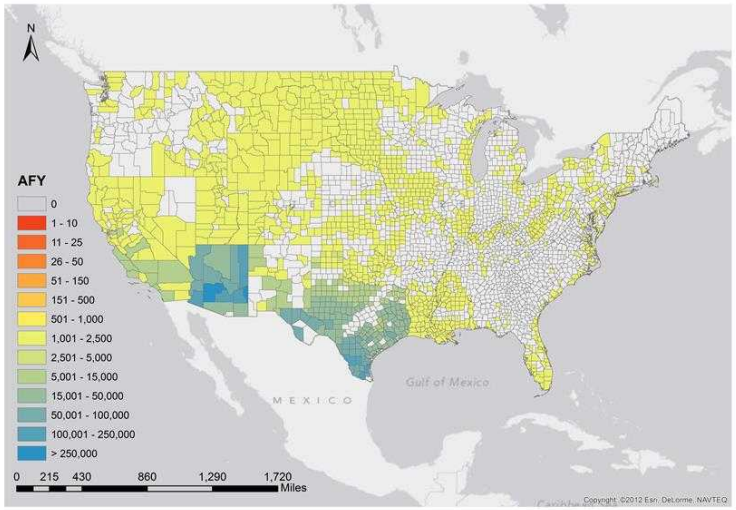
Potable Groundwater Availability



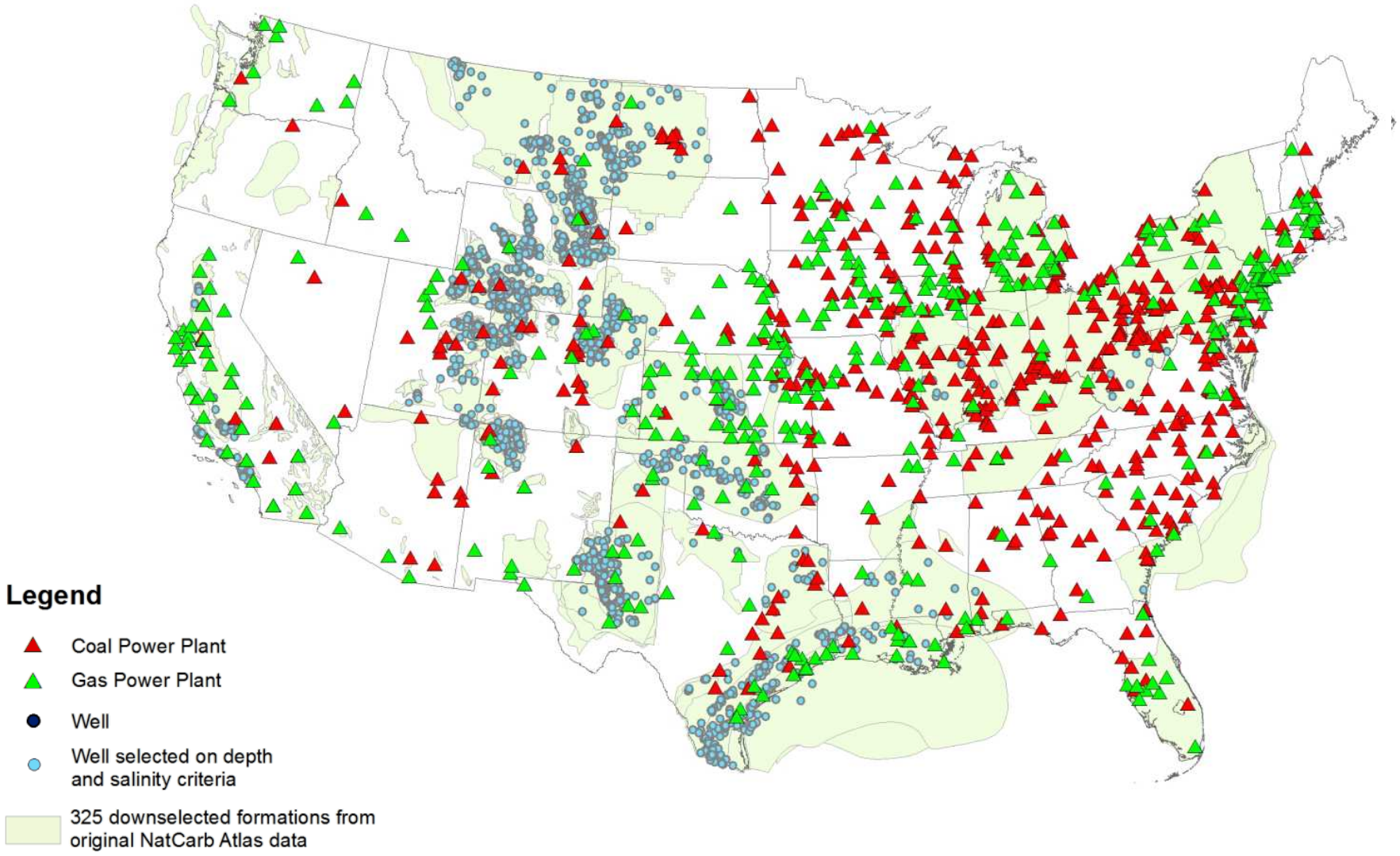
Wastewater Availability



Brackish Groundwater Availability



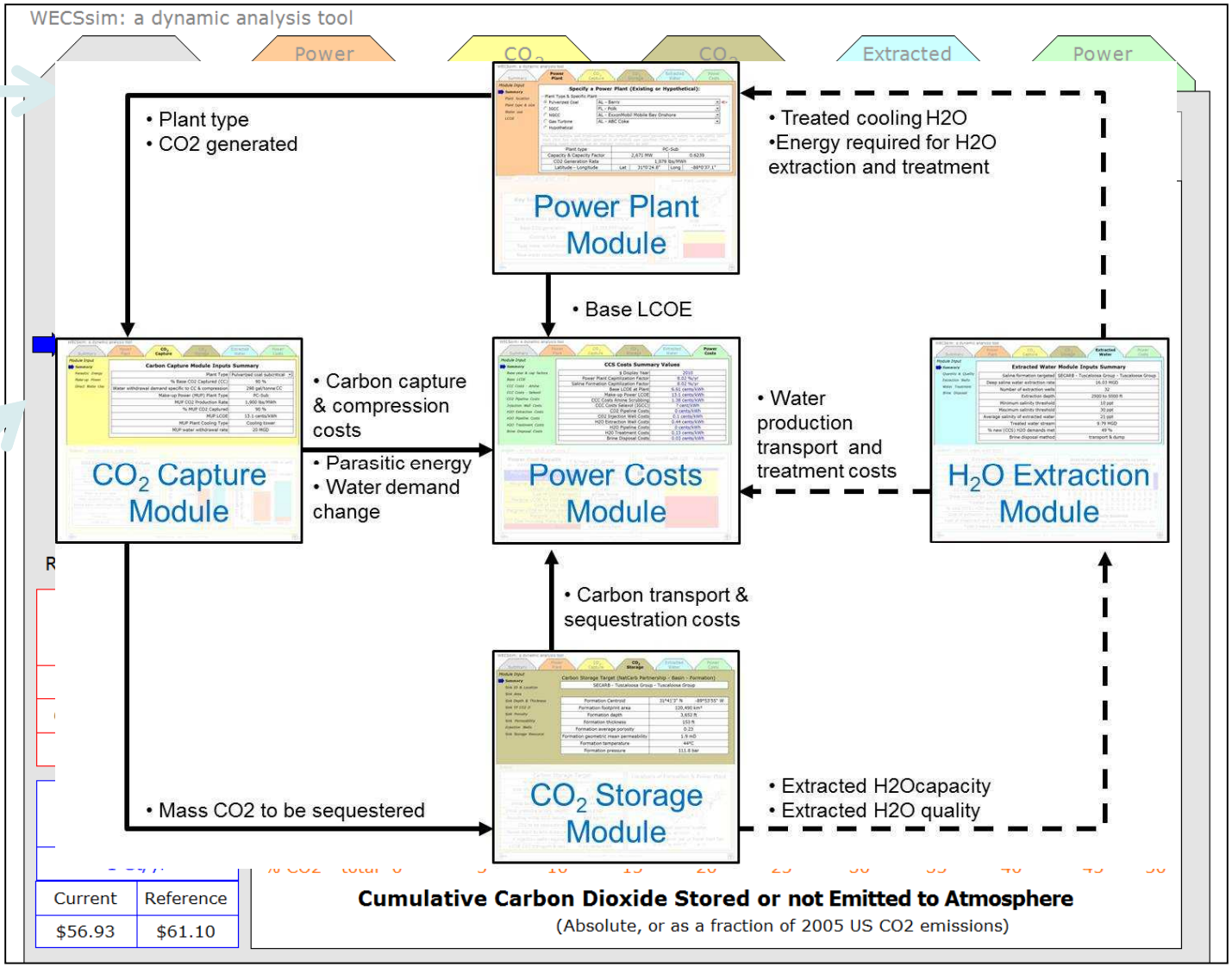
U.S. CO_2 Saline Formation Sinks

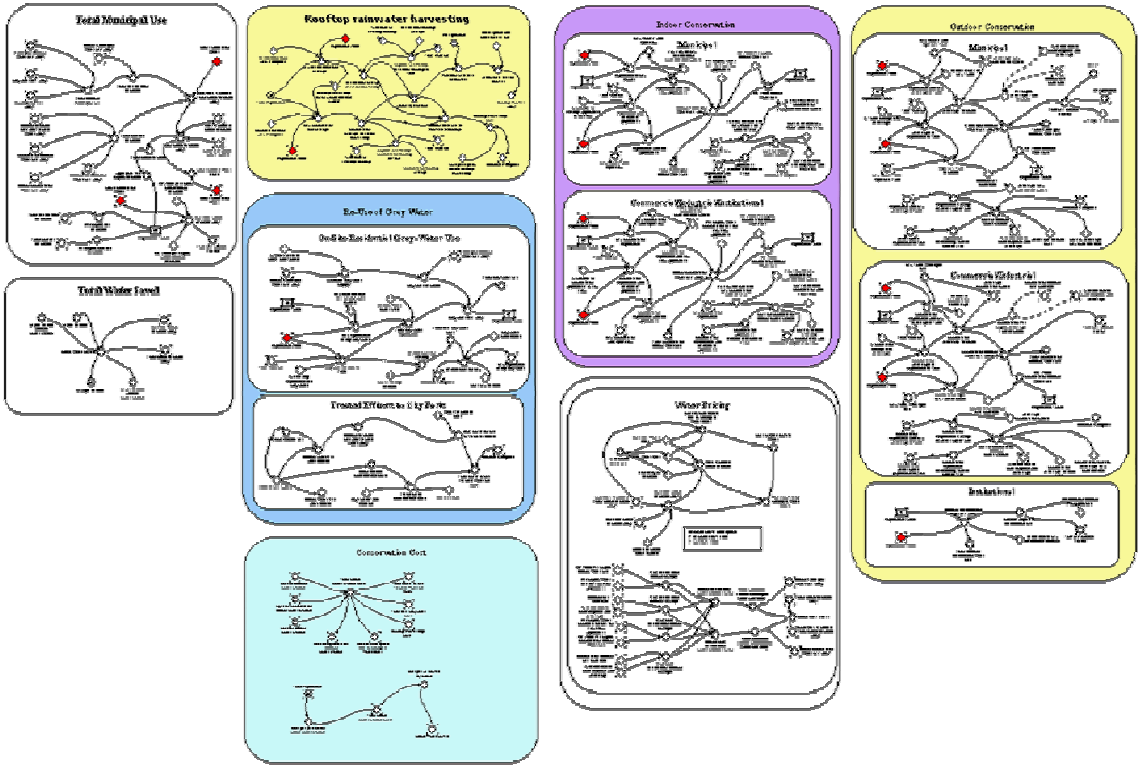


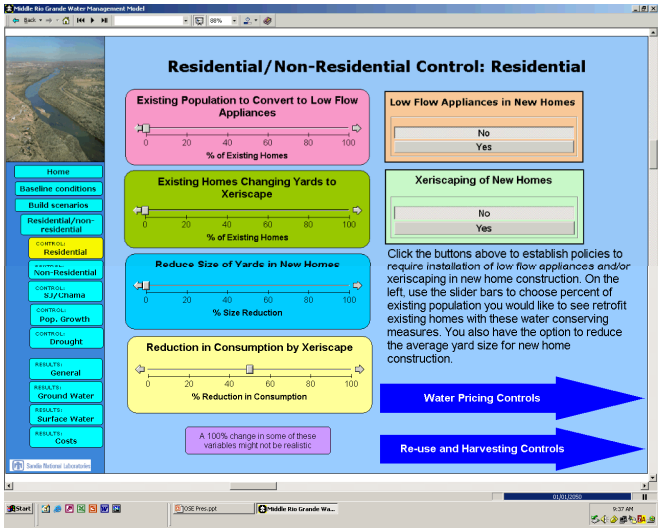
Modeling Deep Saline CO_2 Storage

Module Input Tabs

Module Output Screens







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