This presentation premiered at WaterSmart Innovations

watersmartinnovations.com
A SYSTEM DYNAMIC MODEL AND VISUALIZATION TOOL FOR WATER USE IN THE UNITED STATES

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THE US WATER USE TREND IN POPULATION AND FRESHWATER WITHDRAWALS BY SOURCE, 1950 - 2010

TOTAL WATER WITHDRAWALS BY CATEGORY OF USE, 2010

WATERSIM AMERICA MODEL

- Display an interactive computer simulation of the complexity of water supply and demand at a state level
- Within Smithsonian Institution’s water ways exhibition traveling to 30 states and 180 rural communities from 2016 to 2020

Source: https://sustainability.asu.edu/dcdc/watersim/
MODEL COMPONENTS

Sources of Water
- River
- Lake
- Groundwater
- Recycled

Consumers of Water
- Cities and Towns
- Agriculture
- Industry
- Power


Source: https://water.usgs.gov/edu/wups.html
CLIMATE CHANGE AND POLICY ACTION SCENARIOS

**Water Supply** – How much water is available, and where does it come from?

**Water Demand** – primarily influenced by policy and population growth

**Climate Change** – look at past patterns – decades with high flows, low flows or high variability from year to year

**Population Growth** - change in water demand

**Policy Decisions** – Who gets to use the water that is available?

https://www.nwcouncil.org/news/blog/drought-and-streamflow-research-may-2016/
DATA COMPILATION

GROUND WATER
- Global Land Data Assimilation system - NASA
- National Snow and Ice Data Center - University of Colorado Boulder

SURFACE WATER
- Public Water Systems – EPA
- National Hydrography Dataset - USGS

ECONOMY
- Freight Analysis Framework, FHWA USDOT
- Water Use, USGS
- Employment Population – US Census
- Agricultural Acreage – NASS USDA

AGRICULTURE EFFICIENCY
- Water Use and Power – USGS
- Net Farm Income – NASS USDA

ENVIRONMENT
- Wastewater Treatment Plants – EPA
- National Hydrography Dataset - USGS

URBAN RURAL EFFICIENCY
- Water Use – USGS
- Population – USGS

POWER EFFICIENCY
- Water Use – USGS
- Power Production - USGS
SUSTAINABILITY INDICATORS

Help users to understand the trade-offs between
- water conservation
- agriculture
- economic development
- environmental preservation
SUSTAINABILITY INDICATORS

• GROUNDWATER INDICATOR
  • Total groundwater withdrawal
• ECONOMY
  • Local water used for goods production as a % of total water use
• AGRICULTURE EFFICIENCY
  • Gallons per dollar of agriculture production per day
• URBAN EFFICIENCY
  • Gallons per capita per day
• ENVIRONMENT
  • Wastewater discharge as a % of total stream flow
• SURFACE WATER
  • Withdrawal by water treatment plants as a % of stream flow

ENVIRONMENT INDICATOR

Dilution factor = $\frac{\text{Wastewater} + \text{Streamflow}}{\text{Wastewater}}$

Legend: top and bottom of box = 75th and 25th percentiles respectively; top and bottom of whisker = max and min percentiles respectively; line across inside of box = median (50th percentile); black dot = average

SURFACE WATER INDICATOR (SWI)

\[
\text{SWI} = \frac{\text{ITS}}{\text{WA}} \times 100
\]

- ITS = intake surface water withdrawal by DWTP serving more than 10,000 people (gallons/day);
  - ITS = \text{SURPC} \times \text{Population served};
  - \text{SURPC} = \text{surface water withdrawal per capita (gallon per person per day)};
- WA = the surface water available (gallons/day);
  - WA = k \times \sum_{j=1}^{n} Q_{0001E_j} ;
  - Q_{0001E} = \text{mean annual stream flow (cubic feet per second)};
  - k = \text{conversion constant (from cfs to gallons per day)};
- SWI (in percentage or gallons per day/gallons per day)

<table>
<thead>
<tr>
<th>STATE</th>
<th>SWI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILLINOIS</td>
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<tr>
<td>MINNESOTA</td>
<td>0.01</td>
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<tr>
<td>IDAHO</td>
<td>0.31</td>
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<td>FLORIDA</td>
<td>1.54</td>
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<tr>
<td>WYOMING</td>
<td>3.43</td>
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</tbody>
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CONCLUSION

• WaterSim America model for the first five states in the United States (Florida, Idaho, Illinois, Minnesota and Wyoming)
• Directly engage small town audiences and bring new attention to underserved rural communities
• Explore how water sustainability is influenced by various scenarios
• General access among the public via a web browser interface and through ipad devices
• Enjoy the model as a game for entertainment but also as an educational tool to better understand water resource sustainability


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THANK YOU!

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