Securing Water for Southwest Missouri’s Future
The Story of Water is the Story of Us

H₂O
If every drop of water in the world was collected in a sphere, it would be just 869 miles in diameter. The illustration above shows a comparison of the volume of water and the size of Earth. The ball of water seems shockingly small, with a volume of only 338 million cubic miles (1.41 billion km$^3$). – www.theresilientearth.com
…the water cycle and the life cycle are one.  -Jacques-Yves Cousteau
World Water & Conflict Chronology

• The Water and Conflict Chronology traces the history of water as a tool of war and conflict going back 5,000 years.

http://www2.worldwater.org/chronology.html
Global factors - WORLD POPULATION GROWTH
American per capita daily use = 80-100 gal
World’s poorest nations subsist on 5.
http://water.usgs.gov/edu/qa-home-percapita.html

54%: Amount of groundwater wells surveyed in India where water levels declined over the past seven years.

16% of those wells decreased by more than 1 meter each year. Bloomberg

A billion people do not have access to safe drinking water.

In African ~1/3 of population lacks access to water.

These women in Kenya spend up to 5 hours a day carrying water.

46% of people on earth do not have water piped to their homes
About 2 1/2 billion people live without adequate sanitation.

At any given time, more than half of the developing world’s population is suffering from one or more of the main diseases associated with unsafe water and poor sanitation.

Every day, 6,000 children die of water-related diseases = 250 an hour = 4 a minute

More than four billion cases of diarrhea cause 2.2 million deaths annually—mostly of children under the age of five.

http://www.unicef.org/media/media_21423.html
CHINA

The South-North Water Transfer Project / December 2014 east and central

- Cost - $81 billion
- Water for energy and industry production
- Divert ~12 trillion gallons annually from the Yangtze River to the Yellow River
- Displaced hundreds of thousands of people.

http://www.internationalrivers.org/campaigns/south-north-water-transfer-project

Three Gorges Dam /2006 completed

- World’s largest hydropower project
- Dam Size – 1.4 miles / 607 feet
- Reservoir length - 410 miles
- Displaced - ~1.2 million
- Flooded -13 cities, 140 towns, 1,350 villages

http://www.internationalrivers.org
Estimates indicate that nearly 2 billion hectares of land worldwide – an area twice the size of China – are already seriously degraded, some irreversibly.

The San Joaquin Valley from 1925 to 1977
The Aral Sea, once the fourth largest lake in the world, has been shrinking steadily since the 1960s. The image on the left shows the sea in 2000, while the image on the right shows it in 2014.

“*Iran…is trying to reap as much economic gain from its water as possible, with little regard to the environmental outcomes.*”
More than 80% of sewage in developing countries is discharged untreated, polluting rivers, lakes and coastal areas.

“Dead Zones” - Globally, the most prevalent water quality problem is eutrophication, a result of high-nutrient loads (mainly phosphorus and nitrogen).

Many industries – some heavily polluting (such as leather and chemicals) – are moving from high-income countries to emerging market economies.

Projected population growth means increase in nutrient loads and wastewater.

IRELAND - As of Oct 1, 2014, Irish started to pay for water, ~$299 annually per household = $25 month. Riots ensued; one third of households refuse to pay.

AUSTRALIA - In the last decade Australia nearly ran out of water, and had to scramble to reinvent the country’s entire water system.

ATLANTA - In 2008, came within ninety days of running entirely out of clean water.

“…we’ve already left behind a century-long golden age when water was thoughtlessly abundant, free, and safe, and entered a new era of high-stakes water.”

Charles Fishman, *The Big Thirst*
The Challenges

Water is the ultimate commons.

- Barbara Kingslover, National Geographic, Water Issue, April 2010
The U.S. population is projected to increase from 314 million in 2012 to 420 million in 2060.

- US Census Bureau
DECAYING INFRASTRUCTURE

• EPA: $384B needed to upgrade 73,000 water systems in next 2 decades
• Most pipelines were laid during the 1940s-1960s
• American Water Works Association estimates the need for upgrades at closer to $1 trillion
Water is not priced to reflect its value

Average pool is ~20,000 Gallons
Pool full of **topsoil** (bags) cu ft $2.64 = $7,057
Pool full of **gasoline** at $2.50 = $50,000
Pool full of **milk** at $4 per gallon = $80,000
Pool full of **perfume** at 1 oz/$29 is 1 gal/$3,712 = $74,240,000
Pool full of **water** (in Cassville) at $3.70 (cost per 1000 gallons) X 20,000 gallons = $74.00 + $11.61 (base) = $85.61
Price of Water 2014: Up 6 Percent in 30 Major U.S. Cities; 33 Percent Rise Since 2010

WEDNESDAY, 07 MAY 2014 06:00 circleofblue.org  Key: Average Monthly Bill for Family of Four Using:

- Memphis $36.12
- Santa Fe $284.10
Excess

Sustainability
Change the Culture of Use

Develop Sustainable Sources

- Reuse & Recycle
- Rainwater Harvesting
- Storm water Harvesting
- Desalination
- Biomass
- Reverse Osmosis
Innovations in Technology

Portland installs turbines in their city water pipes, powers city by flushing toilets

The Central Arizona Project canal passes groundwater recharge ponds, north of Scottsdale. The 540-kilometer (336-mile) canal delivers Colorado River water to the interior of Arizona.

We Do Not Inherit the Earth from Our Ancestors; We Borrow It from Our Children
MISSOURI
WHERE DOES MISSOURI WATER COME FROM?

• Surface (Rivers, lakes) – 62%
  • 44% from Missouri River
    o 8 of 10 biggest cities

• Ground (aquifers) – 38%
  • High quality water
  • Abundant but not endless
    o Cones of depression
    o Well interference
    o Cost of pumping
    o Saltwater intrusion
    o Contamination
    o Subsidence
    o Dependent on re-charge
Missouri Population Growth

1990-2000

Average Growth 22%
Springfield 27%
Southwest 17%

Source: Missouri Economic Research and Information Center, Missouri Department of Economic Development
Average 16% Growth

- Christian 43%
- Taney 30%
- Webster 17%
- Polk 15%
- Greene 14%
- Jasper 12%
- Stone 12%
- Lawrence 10%
- Newton 10%
- McDonald 6%
- Barry 5%
Population densities stress water supplies

- Cones of depression
- Well interference
- Cost of pumping
- Saltwater intrusion
- Contamination
- Subsidence
- Dependent on re-charge
GROUNDWATER LEVEL DECLINE FROM PREDEVELOPMENT TO 2006-2007

Source: Mo DNR, Water Resources Center
Average Annual Municipal Water Use 1996 – 2008
(million gallons per year)

(Towns with populations of less than 500 excluded)
Annual Average Precipitation
(1895-2010)

Long-term average: 40.57 in.

2007-09 total: 159.59” (+37.88”)

Missouri Climate Center/MRCC

20 out of the past 29 years above normal (69%)
Drought Year 2012

U.S. Drought Monitor
Missouri

July 31, 2012
Valid 7 a.m. EST

Drought Conditions (Percent Area):

- Normal
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Exceptional
- D4 Drought - Extreme

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu

U.S. Drought Portal
www.drought.gov
FLOOD YEAR 2014

- “...the largest floods in over a century in the James River basin have occurred over the last 22 years.”
  - At upper James Gage on Kinser Rd bridge (far east Battlefield Rd), the four highest maximum annual flood peaks have been since 1956.
  - At the lower James Gage at Galena, three or four peaks over past 22 years since 1922.
  - The most recent flood of June 19, 2015, ranked #1 highest at upper James, #2 at Boaz west of Nixa, and #5-6 at Galena.

- “Climate change scenarios for the Ozarks predict more extreme flows including more droughts and larger floods. Global warming and regional increases in temperature have been most noticeable since 1980 and environmental responses are expected to follow that trend.”
  - Regional increases in temperature in Missouri have also occurred over the past three decades such as indicated by growing season and plant hardiness maps.

- Dr. Robert T. Pavlowsky, Director, Ozarks Environmental and Water Resources Institute, Missouri State University

June 19, 2015

New record flood peak for the upper James River watershed! (disclaimer: if gage is operating correctly...)

“In addition to the record for the gage, the USGS used paleo-discharge estimation techniques to mark a flood at 62,000 cfs and 22 ft stage at the same site in 1909.

However, the upper James River stage at 1:00 pm today was 22.18 ft or about 2.2 inches above the 1909 stage.”
State Level Planning Through Regional Water Supply Coalitions

Missouri Regional Water Supply Study and Project Areas

Legend
- Clarence Cannon Wholesale Water Commission
- Little Otter Creek, Caldwell Co.
- Cameron Pipeline Project
- Atchison Co. Wholesale Water Commission
- Howard Co. Regional Water Commission
- Northwest MO Study Area
- North Central MO Study Area
- Southwest MO Study Area

MISSOURI DEPARTMENT OF NATURAL RESOURCES


    Uh oh, we could run out!

2003 – Tri-State Water was born.

We have since grown to 16 counties in SW MO.
Membership Includes:
- Cities
- Counties
- Public and private water providers

Our mission is to ensure adequate, affordable long-term water supplies for southwest Missouri
Laying a Solid Research Foundation

Completed
• Joplin Hydro Study (Wittman)
• Water Supply Study (Black & Veatch)
• Reservoir Site Screening (Freese & Nichols)
• Supplemental Reservoir Study (Freese & Nichols)
• Report Summary (TSWRC)
• Missouri Water Resource Study – Phase I (CDM)
• Missouri Water Resource Study – Phase II (CDM)

Current
Missouri Water Resource Study – Phase III (CDM)
• Stockton Lake Reallocation Study (USACE)

www.tristatewater.org
Example of Storage Taken from Multi-Purpose Pool
Surface Elevation Does Not Change / Storage Allocated Differently

- With water supply storage
- Different apportionment of storage space within the lake
- Without water supply storage
Request Water from Stockton and Table Rock Lakes

2007 – Coalition made application to US Army Corps of Engineers for water from both Stockton and Table Rock Lakes

• Corps of Engineers replied that it could be 5 – 7 years before we would receive an answer (and the answer could be NO)
## Southwest Missouri Water Resource Study – Phase I: Forecast of Regional Water Demands 2010 – 2060 (CDM)

– September 2012 (Revised November 2012)

**Estimated S.W. Missouri Baseline and Projected Average Water Demands to 2060 (GPD)**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>HIGH GROWTH</th>
<th>MEDIUM GROWTH</th>
<th>LOW GROWTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010**</td>
<td>338,503,791</td>
<td>338,326,175</td>
<td>338,326,175</td>
</tr>
<tr>
<td>2030</td>
<td>414,026,845</td>
<td>382,615,101</td>
<td>358,502,024</td>
</tr>
<tr>
<td>2060</td>
<td>581,735,120</td>
<td>462,337,386</td>
<td>387,226,057</td>
</tr>
</tbody>
</table>

% INCREASE
- **71.9%**
- **36.7%**
- **14.5%**
What about Conservation?  
– A piece in the puzzle, not a total solution

Two scenarios - regional publically supplied municipal and industrial water demands.
• Metering (residential and commercial)
• Leak detection programs
• Educational programs on water savings
• Residential and commercial water audits

How did Conservation impact Forecast Results?
Under conservation scenario I (moderate)
• water demands are estimated to decrease by 1-3% annually

Under conservation scenario II (substantial)
• water demands are expected to be reduced by 4-7% annually

Difference of ~2,600,000 gallons a day from baseline
Reducing Demand with Conservation

Gap analysis: supply versus demand

Selecting Strategies to Decrease Demand & Increase Resource Capacity

Baseline Resource Capacity

Reducing demand meets needs through 2040

Future Capacity

Increasing capacity meets needs through 2050

Total Demand Projection (Broken line indicates total demand with conservation)
Southwest Missouri Water Resource Study – Phase II: Forecast of Regional Water Supply and Gap Analysis

The Phase II study evaluated water supply sources followed by a gap analysis to identify counties and areas that may experience either water supply shortages or unreliable sources of water in the future.

16 County total Supply Gap
Medium Growth / Drought

Surface Water Demand
Groundwater Demand
Total Water Supply
Current Studies –

**Southwest Missouri Water Resource Study – Phase III**
- Environmental impacts
- Storage reallocation questions
- Infrastructure evaluations

**Stockton Lake Reallocation Study**
- Water demand, supply and system evaluation review
- Water delivery system hydraulic analysis
- Water delivery systems cost analysis
- Hydropower Analysis Center/Portland: reallocation analysis
Leveraging partnerships

**Sponsor contributions toward water supply studies for S.W. MO**

as of 6/15/15

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missouri American Water Company</td>
<td>(2003 study) $150,000</td>
</tr>
<tr>
<td>U.S. Army Corps of Engineers, Little Rock District</td>
<td>(2006 study plus PAS studies) $475,000</td>
</tr>
<tr>
<td>U.S. Army Corps of Engineers, Kansas City District</td>
<td>(PAS studies plus Reallocation studies) $630,000</td>
</tr>
<tr>
<td>Missouri Department of Natural Resources</td>
<td>(2009 study plus PAS studies) $630,000</td>
</tr>
</tbody>
</table>

**TOTAL INVESTMENT as of 6/15/15** $2,057,600
Technical Studies
www.tristatewater.org

• Joplin Hydro Study (Wittman)
• Water Supply Study (Black & Veatch)
• Reservoir Site Screening (Freese & Nichols)
• Supplemental Reservoir Study (Freese & Nichols)
• Report Summary (TSWRC)
• Missouri Water Resource Study – Phase I (CDM)
• Missouri Water Resource Study – Phase II (CDM)

Under way
• Missouri Water Resource Study – Phase III (CDM)
• Stockton Lake & Pomme De Terre Lake Reallocation Studies (USACE)
Building Additional Regional Water Infrastructure

The Southwest Missouri Joint Municipal Water Utility Commission

**Tri State Water Resource Coalition**

**Joint Municipal Utility Commission (April, 2012)**

**JMUC Board—Will Consist of one director from each JMUC member**

**Tri State/JMUC Executive Director**

**Staff**

**Project A**

**Project B**

**Project C**
Proactive goals

**Two Big Hairy Audacious Goals**

1. Secure additional water source(s) for southwest Missouri.

2. Build infrastructure to deliver that additional water supply to regional communities

- Technical
- Financial
- Legal
- Education
- Advocacy
- Etc…
Securing Water for Southwest Missouri’s Future