

## SUMMARY OF PROCEEDINGS OF THE DROUGHT RESILIENCE AND GROUNDWATER WORKSHOP

PART 1: *IDENTIFYING RESEARCH NEEDS*, AT THE US EPA ROBERT S. KERR ENVIRONMENTAL RESEARCH CENTER IN ADA, OKLAHOMA HELD ON AUGUST 4, 2016

### Executive Summary:

As the first of two planned workshops to identify the needs and potential priorities for groundwater quality and associated drought resilience research, a workshop was held on 4 August 2016 at the Robert S. Kerr Environmental Research Center hosted by the Ground Water and Ecosystems Restoration Division of EPA's Office of Research and Development (ORD). The workshop included presentations from national, state, and university experts in groundwater and drought resilience with an afternoon field trip to local examples of water resources associated with groundwater (Appendix 1). The field trip included a visit to Byrds Mill Spring, the primary drinking water source for Ada, OK; the Blue River, a groundwater-fed cold-water river known for scenic beauty, recreation, and habitat; and a tour of the Arbuckle-Simpson Aquifer area that provides the source water for those systems. The workshop followed the Robert S. Kerr Environmental Research Center 50<sup>th</sup> Anniversary Event and Technical Symposium on August 3, 2016 (Appendix 2), celebrating more than half a century of research and accomplishment.



Dr. Richard Lowrance, RSKERC Director (far right) welcomes local, state and federal dignitaries to the RSKERC 50<sup>th</sup> Anniversary Celebration, August 3, 2016.

From the diverse group of presenters and panelists at the workshop several recurrent research needs were identified as potential areas of focus that will be used to set the agenda for Drought Resilience and Groundwater Workshop Part 2:

1. *Water capture and reuse.* Enhanced aquifer recharge, floodwater capture, aquifer storage and recovery, and green infrastructure runoff infiltration are all means of putting additional surface water into aquifers. Application of these technologies and practices will affect groundwater quality in unknown ways.
2. *Pollutant dynamics.* The effects of natural and human induced water table changes on water quality including arsenic, nitrate, and other co-pollutants. The water quality responses to recharge and drawdown of source water aquifers are largely unknown and will affect the ability to sustain aquifers as drinking water supplies during droughts.
3. *Groundwater – surface water interactions.* Groundwater quality and surface water quality and quantity effects of interactions between groundwater and surface water caused by recharge and drawdown in groundwater and surface waters. These relationships are drivers of saltwater intrusion, nutrient pollution enrichment, and shifts in dominant water quality pollutants depending on the stressors in connected groundwater – surface water systems.

These three priority research focus areas will guide the next workshop agenda and provide a framework to begin to identify how current research can contribute to problem solutions and how future research needs can be met by commitment and collaboration among EPA ORD and partners.

## Research needs presented within the workshop:

### *EPA's Safe and Sustainable Water Research National Program*

The EPA's Safe and Sustainable Water Research Program, presented by Suzanne van Drunick, provided multiple perspectives on groundwater quality and drought resilience research needs. This was a wide ranging list, but identified several critical areas for future efforts to include:

- 1) Determining the geochemical impacts of drought and extreme wet events on water quality is a pressing need.
- 2) Evaluation of both drinking water and water availability to support watershed integrity, particularly those areas of groundwater-surface water interactions that can alter the water quality for use.
- 3) The application of technology to enhance groundwater and aquifer recharge and removal were stated as a critical area of emphasis. This includes the effects and methods applied in enhanced aquifer storage and recovery for water re-use, groundwater recharge through the use of green infrastructure, and the effects of nutrient loading to and discharge of nutrients from sensitive aquifer systems.
- 4) Industrial and municipal impacts on groundwater were identified as critical areas of interest that, for example, include water transfers across watersheds of differing geochemical composition, water extraction and the effects on saltwater intrusion, aquifer exemptions due to mineral extraction, and the use of non-traditional water sources through treatment.

### *EPA Office of Groundwater and Drinking Water and EPA groundwater research needs*

Roger Gorke from EPA Office of Water and Joseph Tiago from EPA Office of Ground Water and Drinking Water gave separate presentations and several examples of current and future research needs related to drought, climate, and stressors to groundwater quality. Points of interest included:

- 1) The effects of infrastructure on water quality
  - a. Aging or failed wells including wells for underground injection disposal

- b. Leaking sewer and distribution infrastructure
  - c. Green infrastructure effects on water quality

- 2) The influence of emerging industrial practices and drought or demand induced practices on aquifers
  - a. Brackish water risk management
    - i. Waste management of brine in groundwater and surface water
    - ii. Saltwater intrusion in coastal areas due to water drawdown and possible hydrologic or engineering solutions
  - b. Green infrastructure, aquifer storage and recovery, water re-use, water loss and leak detection
  - c. Determination and assessment of geochemical impacts of drought and drought related practices like river recharge
- 3) Availability of EPA Office of Research and Development staff as intellectual capital for consulting and leading research. Finding better ways to connect the smart technical leaders and consultants with demands from the EPA offices.
- 4) Impacts of drought and climate change on drinking water and environmental water, including nutrient pollution and emerging contaminants
- 5) Groundwater and surface water interactions that affect water quality changes related to floodplain recharge, hydrologic dynamics in surface and groundwater, as well as changes to water distribution
- 6) Groundwater protection and susceptibility to contamination related to:
  - a. Private wells
  - b. Municipal wells
  - c. Exemptions for groundwater protection
  - d. Non-traditional water use
- 7) Low concentrations of contaminant mixtures and their fate and dynamics

### *EPA's Groundwater and Ecosystems Restoration Division*

Richard Lowrance, director of EPA's Groundwater and Ecosystems Restoration Division emphasized areas of interest to his group's work, including enhanced aquifer recharge effects on water quality, particularly the influence of stormwater

contaminants entering through green infrastructure and the water quality effects of flood recharge in connected and disconnected floodplains. In outline format these areas of research emphasis include:

- 1) Enhanced aquifer recharge
  - a. Water quality effects of stormwater GI
  - b. Water quality effects of flood recharge in floodplains
  - c. Water quality effects of other enhanced aquifer recharge techniques
- 2) Identification of links and interactions between water quality and quantity in groundwater.
  - a. Drawdown effects on stream water quality
  - b. Drawdown and recharge effects on aquatic ecosystem function
  - c. Competitive use of private and municipal drinking water wells and irrigation wells and the implications to water quality
- 3) Aquifer storage and recovery
- 4) Policy implications and water quality concerns of source water protection and surface water interaction with groundwater.

***EPA's Regional science interests provided by the regional representatives including Regional Science Liaisons (RSLs)***

The RSLs and other EPA regional staff identified the following high priority research needs and opportunities for partnerships to address them:

- 1) Evaluate how unused or underused aquifers might be affected by drought, and establishing baselines for water quality, water quantity and determine how economical it might be to utilize those aquifers.
- 2) Develop greater recognition and education about the connectivity of surface and groundwater, and greater data collection and understanding of shallow groundwater systems around surface water features that might be used for water supply purposes.
- 3) Identify appropriate treatment and reuse potential for groundwater produced during liquid mineral extraction.
- 4) Study the effects of past and ongoing oil & gas extraction on groundwater quantity and quality,

including the geochemical interactions of injected waters and formation fluids/matrices as part of aquifer storage and recovery (ASR) projects.

- 5) Research, design, build criteria for, and complete a nationwide drought and water scarcity groundwater vulnerability assessment.

***State and local research needs presented by various state and local entities (Appendix 1)***

The research needs identified by various state and local entities presented in the workshop included both water quality and water quantity. Although the examples and topics of interest were presented as individual case examples the general research areas are summarized in outline form below:

- 1) Water treatment and reuse, particularly how treated wastewater and other waters could be reused by municipalities or industry
- 2) Aquifer storage and recovery of waters for later use. The approaches, hazards, and benefits of aquifer storage and recovery are areas that require further research
  - a. Evaluation of the activity of aquifer storage and recovery along with the risks posed by those activities
  - b. Evaluation of the water quality concerns related to recharge with treated or surface water into drinking and environmental source waters
- 3) Hydrogeochemistry of low quality waters, particularly in scenarios where aquifers and surface water storage are depleted or recharged, evaluation of the water quality consequences of dynamic storage, and the consequences and requirements of utilizing alternative lower quality waters in existing systems
- 4) Determination of the impact and consequences of improperly constructed wells used for source water, underground injection, and resource extraction, including the wide range of well types and the susceptibility of contamination of drinking and source waters to improper, failed, or misused wells.
- 5) Water pollution in small systems, with emphasis on nitrates in small drinking water and environmental systems
- 6) Evaluation of water incentives and education on water use, quantity, and quality of water

## Recommendations for Workshop 2

The presentations and panels provided a broad suite of issues and potential research areas from economic impacts of drought in agricultural communities, state water projects, and national water quality needs. Based on the proceedings of this first workshop, a focus on primarily groundwater and surface water quality with respect to the drivers of changes in recharge, industrial, municipal, climate, and demand factors are the recommended topics for the second workshop. The goal will be build working relationships for the development of future and existing research efforts to support water quality research in a dynamic human and climatic altered system.

The following are our topic and interest suggestions for consideration as the themes for the follow up workshop:

- 1) Background levels and interactions of contaminants
  - Arsenic, nitrate and/or co-pollutant dynamics
  - Aquifer drawdown effects on water quality
  - Water quality dynamics in extreme recharge events
  - Methods and approaches to determine background vs. contaminant levels
- 2) Groundwater–surface water interactions with respect to
  - Water quality during minimal surface water baseflows
  - Surface water capture for enhanced aquifer recharge
  - Indirect discharges of treated water to floodplains
- 3) Aquifer Storage and Recovery
- 4) Green infrastructure water quality effects
- 5) Incentives for sustainable groundwater management
- 6) Enhanced aquifer recharge

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**Appendix 1. Drought Resilience and Groundwater Workshop Part 1: Workshop Agenda  
from the 4 August 2016 event**

**Drought Resilience and Groundwater Workshop Part 1:  
Identifying Research Needs  
EPA Robert S. Kerr Environmental Research Center  
August 4, 2016 | Ada, Oklahoma**

This is the first of two planned workshops to identify the most essential research priorities for groundwater quality. This workshop is designed to gather regional and national experts in an educational and fact-finding forum to start formulating questions related to groundwater quality with emphasis on drought resilience. The specific questions to be addressed are: What work is currently being done or is planned? Where are the data gaps? What are the highest priority research needs? Are there opportunities for partnerships to address these needs? The goal of this meeting is to identify groundwater quality research areas that should be addressed in more detail at a follow-up workshop.

8:00 AM	<b>Introductions and Workshop Objectives</b> Richard Lowrance, Director, Ground Water and Ecosystems Restoration Division, NRMRL/ORD/EPA
8:10 AM	<b>ORD National Research Program Perspectives on Groundwater Quality and Drought Resilience Research Needs</b> Suzanne van Drunick, National Program Director for Safe and Sustainable Water Research, EPA ORD
8:20 AM	<b>National Drought Resilience Partnership</b> Roger Gorke, Senior Policy Advisor, EPA Office of Water/Region 9 Southern California Field Office ( <i>via video</i> )
8:35 AM	<b>National Overview of Drought Resilience and Groundwater</b> William Cunningham, Chief, Office of Groundwater, U.S. Geological Survey
9:00 AM	<b>Expert Panel on Drought and Groundwater Issues and Research Needs: Perspectives from States</b> <ul style="list-style-type: none"><li>• Josue Medellin-Azuara, University of California-Davis (Davis, CA)</li><li>• Mike Langston, Deputy Director, South Central Climate Science Center (Norman, OK)</li><li>• James Butler, Senior Scientist, Kansas Geological Survey, University of Kansas (Lawrence, KS)</li><li>• Robert Mace, Texas Water Development Board (Austin, TX)</li></ul> <i>Moderated by: David Jewett, NRMRL/ORD/EPA</i>



10:40 AM **Perspectives on Drought and Groundwater from a City Water Utility**  
Ken Komiske, Director of Utilities, City of Norman, OK

11:00 AM **Break**

**Panel and Roundtable Discussion: Research and Technology Needs Related to Drought Resilience and Groundwater, Areas of Focus for Follow-Up Workshop**

- 11:20 PM
- Chuck Job, Regulatory Affairs Manager, National Groundwater Association
  - Gary O'Neill, Oklahoma State Conservationist, U.S. Department of Agriculture-Natural Resources Conservation Service
  - William Andrews, Director, Oklahoma Water Science Center, U.S. Geological Survey
  - Wayne Kellogg, Environmental Engineer, Chickasaw Nation

*Moderated by: Joe Williams, Deputy National Program Director, Safe and Sustainable Water Research Program*

*Report-Out Leads: Ken Forshay and Hale Thurston, NRMRL/ORD/EPA*

12:30 PM **Wrap-Up and Next Steps for Follow-Up Meeting**  
Suzanne van Drunick, National Program Director for Safe and Sustainable Water Research, EPA ORD

12:45 PM **Lunch** (on your own)

2:15 – 5:00 PM **Field Trip to Byrds Mill Spring, Blue River, and Arbuckle-Simpson Aquifer**  
*Led by: Randall Ross, EPA ORD; Guy Sewell, East Central University; and Todd Halihan, Oklahoma State University. (Meet in Lobby).*

The Arbuckle-Simpson Aquifer (ASA) was designated a sole source aquifer by the U.S. EPA in 1990, and serves as the primary water source for approximately 150,000 people in southern Oklahoma, including much of the Chickasaw Nation. The ASA is recharged solely by precipitation and is susceptible to climatic changes. The Blue River is the largest groundwater discharge feature, receiving approximately half of the total discharge of the aquifer. The Blue River is the source of drinking water for the City of Durant and much of the Choctaw Nation. Byrds Mill Spring is the largest spring in Oklahoma and serves as the source of water for the City of Ada and most residents of Pontotoc County. Discharge from Byrds Mill correlates directly with groundwater elevations in the ASA. During extended droughts, the City of Ada relies on groundwater wells developed in the ASA to supplement their water supply and maintain flow to the spring run of Byrds Mill Creek in order to meet the riparian water rights of downstream users. The field trip will visit Byrd's Mill Spring, the Blue River, and other locations within the aquifer discharge area to show the complex problems caused by competing uses for the aquifer as a water source.

**Appendix 2. Agenda from the Robert S. Kerr Environmental Research Center 50<sup>th</sup> anniversary symposium on 3 August 2016**



**EPA Robert S. Kerr Environmental Research Center 50<sup>th</sup> Anniversary Event and Technical Symposium  
August 3, 2016 | Ada, Oklahoma**

**AGENDA**

9:00 AM	<b>Event Registration, Posters, and Networking</b>
	<b>Welcome and Opening Remarks</b>
9:30 AM	Richard Lowrance, Director, Ground Water and Ecosystems Restoration Division, EPA Office of Research and Development (ORD) Cynthia Sonich-Mullin, Director, National Risk Management Research Laboratory, EPA ORD
9:45 AM	<b>EPA Robert S. Kerr Environmental Research Center—Pioneers in Groundwater Research: Past, Present, and Future</b> Ron Curry, Regional Administrator, EPA Region 6 Lek Kadeli, Principal Deputy Assistant Administrator for Management, EPA ORD
	<b>Remarks by Elected and Local Officials</b> Governor Mary Fallin, State of Oklahoma U.S. Congressman Tom Cole - 4 <sup>th</sup> District of Oklahoma Secretary Jim Reese, Oklahoma Department of Agriculture, Food and Forestry Senator Susan G. Paddock - District 13 of Oklahoma State Representative Todd Thomsen - District 25 of Oklahoma
10:15 AM	<b>The Oka' Institute at East Central University: Collaborating to Create Water Solutions for Sustainable Ecological Management and Economic Development</b> John Hargrave, President, East Central University (Ada, OK) Guy Sewell, Director of Research, Oka' Institute
11:40 AM	<b>50<sup>th</sup> Anniversary Recognition</b> Presentation of plaque commemorating anniversary of the center by Lek Kadeli, Principal Deputy Assistant Administrator for Management, EPA ORD <i>RSKERC Time Capsule 1966 – 2016</i>
12:00 Noon	<b>Lunch (on your own)</b>

1:30 PM	<b>Signing Ceremony for Memorandum of Understanding on Cooperation and Coordination between the U.S. EPA and the Chickasaw Nation</b> Remarks by Lek Kadeli, Principal Deputy Assistant Administrator for Management, EPA ORD, and Bill Anoatubby, Governor of the Chickasaw Nation <i>Memorandum Signing Ceremony</i>
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### Technical Research Symposium on Groundwater, Watersheds, and Ecosystem Restoration

2:00 PM	<b>Challenges for Improved Groundwater Management</b> Jerad Bales, Chief Scientist for Water, U.S. Geological Survey
2:30 PM	<b>Resilience of 21<sup>st</sup> Century Agriculture: Adapting to Climate and Water Challenges</b> Jean Steiner, Laboratory Director, U.S. Department of Agriculture-Agricultural Research Service (El Reno, OK); Past-President, American Society of Agronomy
3:00 PM	<b>Groundwater Quality and Remediation: A Personal Journey and the Ada Lab</b> David Sabatini, David Ross Boyd Professor and Sun Oil Company Endowed Chair, University of Oklahoma; Director, Water Technologies for Emerging Regions (WaTER) Center
3:30 PM	<b>Break</b> - Posters will be on display in lobby and corridor areas
3:45 PM	<b>EPA Office of Ground Water and Drinking Water: Current and Future Needs on Drought Resilience and Groundwater</b> Joseph Tiago, Physical Scientist, Drinking Water Protection Division, EPA Office of Ground Water and Drinking Water (OGWDW); OGWDW Designated Federal Officer, National Environmental Justice Advisory Council
4:00 PM	<b>Overview of EPA Regional Office Perspectives on Drought Resilience and Groundwater</b> <ul style="list-style-type: none"> <li>• <i>Moderated by:</i> Patti Tyler, EPA ORD Regional Science Liaison to Region 8 (Denver, CO)</li> <li>• Carole Braverman, EPA ORD Regional Science Liaison to Region 5 (Chicago, IL)</li> <li>• Michael Overbay, Regional Ground Water Center Coordinator, EPA Region 6 (Dallas, TX)</li> <li>• Brenda Groskinsky, EPA ORD Regional Science Liaison to Region 7 (Kansas City, KS)</li> <li>• Treasure Bailley, EPA Region 8 (Denver, CO)</li> </ul>
4:30 PM	<b>EPA ORD's Research Program for Drought Resilience and Extreme Events</b> Rick Greene, Associate National Program Director, Safe and Sustainable Water Research Program, EPA ORD
4:50 PM	<b>Closing Remarks</b> Richard Lowrance, Director, Ground Water and Ecosystems Restoration Division, EPA Office of Research and Development (ORD)
5:00-6:00 PM	<b>Poster and Networking Session</b> EPA scientists will be available to discuss the details of their research. Refreshments will be served.

**Thank you for honoring us with your presence at this milestone event celebrating  
50 years of excellence in environmental research at RSKERC!**