

Communicating Groundwater Science

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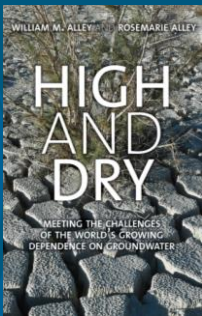
2017 NGWA Ground Water Summit
Nashville, TN

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Outline

- Writing for the Public
- Class Exercise
- Ten GW Communication Challenges



"Imagine a book about groundwater that reads like a novel, and is overflowing with interesting and essential knowledge about a much-neglected topic. This is the book."

Bruce Babbitt, former US Secretary of the Interior



How Not To Do It!

Statement on suitability of a site for a nuclear power plant (circa 1973):

"Even given the most careful execution of the exploration program ... there would remain certain areas of inadequate coverage and certain residual indeterminacies which would preclude final examination of the site with the degree of conservative assurance normally required for such application."



Questions

- Who is the target audience?
- What is the main idea?
- Who cares?
- What are the strengths and weaknesses?



USGS
Tracing and Dating Young Ground Water

Since the implementation of environmental laws, such as the Safe Drinking Water Act (SDWA) in 1974, and other drinking water-related legislation, ground water has become a more visible part of our lives. Ground water is a critical component of our nation's water supply, and its quality and quantity are essential for public health and the environment. This report provides information on the methods and techniques used to trace and date young ground water, which is water that has been in the ground for less than 50 years. The report is intended for scientists, engineers, and other professionals who are involved in the study and management of ground water resources.

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Summary of Estimated Water Use in the United States in 2010

Water use in the United States in 2010 was 143 billion gallons per day (BGD), or 51.7 billion gallons per day (BGD) from public supply systems and 91.9 BGD from other sources. Public supply systems provide water to homes, businesses, and industry. Other sources include agriculture, industry, and municipal and industrial (M&I) use.

Water Use by Category

- Public supply systems: 51.7 BGD
- Agriculture: 37.5 BGD
- Industry: 10.5 BGD
- Municipal and industrial (M&I): 2.0 BGD

Water Withdrawal by Category

- Public supply systems: 51.7 BGD
- Agriculture: 37.5 BGD
- Industry: 10.5 BGD
- Municipal and industrial (M&I): 2.0 BGD

Water Use in Florida, 2005 and Trends 1950-2005

Water use in Florida in 2005 was 1.8 billion gallons per day (BGD). Trends from 1950 to 2005 show a significant increase in water use, particularly in the agricultural and industrial sectors.

Water Withdrawal by Category

Water withdrawal by category shows that public supply systems are the largest category, followed by agriculture and industry.

Managed Aquifer Recharge: A Water Supply Management Tool

Introduction: Managed aquifer recharge (MAR) is a critical component of the water supply management toolbox. Approximately 1% percent of managed aquifer recharge is used for water supply. MAR is a water supply management tool that involves the intentional replenishment of aquifers with surface water, treated effluent, or other water sources.

Of all freshwater on Earth:

- 68.2% is surface and glaciers
- 30.2% is groundwater
- 0.3% is surface water
- 0.3% is water

NGWA

Growing Up... with Managed Aquifer Recharge

Michael R. Cooper

The Florida Water Resources Institute (FWRI) has been instrumental in the development of managed aquifer recharge (MAR) in Florida. MAR is a water supply management tool that involves the intentional replenishment of aquifers with surface water, treated effluent, or other water sources.

Water Withdrawal by Category

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The Health of the Nation's Streams

Nutrients in the Nation's Streams and Groundwater: National Findings and Implications

A multi-agency national study of the distribution and trends of nutrients (nitrogen and phosphorus) in streams and groundwater in the United States. The study found that nutrient levels are generally higher in agricultural and urban areas.

Streamflow and Distribution of Nutrients in Streams and Groundwater

Streamflow and distribution of nutrients in streams and groundwater are closely linked. Higher streamflow generally leads to higher nutrient concentrations.

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U.S. Geological Survey Groundwater Modeling Software: Making Sense of a Complex Natural Resource

Groundwater modeling is a complex task that involves simulating the flow of groundwater in a subsurface system. The U.S. Geological Survey (USGS) has developed several software packages to assist in this task.

Groundwater Flow and Transport Modeling Using the Paper to Support

The Paper to Support (PTS) is a software package that provides a user-friendly interface for groundwater modeling. It is designed to be used by non-technical users.

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Assessing the Vulnerability of Public Supply Wells to Contamination from Urban, Agricultural, and Natural Sources

Public supply wells are a critical source of drinking water. However, they are vulnerable to contamination from various sources, including urban areas, agriculture, and natural sources.

Assessing the Vulnerability of Public Supply Wells to Contamination from Urban, Agricultural, and Natural Sources

This study assesses the vulnerability of public supply wells to contamination from various sources. It found that urban areas are the most vulnerable, followed by agricultural areas.

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California Groundwater Ambient Monitoring and Assessment (GAMA) Program

Priority Basin Project: Shallow Aquifer Assessment

What is the GAMA Priority Basin Project (GAMA PBP)?
The GAMA PBP is a cooperative assessment of shallow aquifers in California. The program is a partnership between the USGS and the State of California. The program was established in 2004 and is currently in its third year. The program is a cooperative effort between the USGS and the State of California. The program is a partnership between the USGS and the State of California. The program was established in 2004 and is currently in its third year.

What Will Participants Gain from the GAMA PBP Shallow Aquifer Assessment?
The program will provide participants with information about groundwater quality, quantity, and trends. The program will also provide participants with information about the state of the shallow aquifer in their region.

- Establish baseline groundwater quality and quantity data for the shallow aquifer in their region.
- Identify emerging trends in groundwater quality and quantity.
- Improve understanding of the shallow aquifer in their region.
- Reduce groundwater quality and quantity monitoring costs.
- Provide and enhance groundwater quality and quantity monitoring data.
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Groundwater Quality in the Borrego Valley, Central Desert, and Low-Use Basins of the Mojave and Sonoran Deserts, California

Overview of Water Quality

The Borrego Valley, Central Desert, and Low-Use Basins of the Mojave and Sonoran Deserts Study Unit is a cooperative effort between the USGS and the State of California. The program is a partnership between the USGS and the State of California. The program was established in 2004 and is currently in its third year.

Ground Water and Surface Water A Single Resource

U.S. Geological Survey Circular 119

Estimated Withdrawals from Principal Aquifers in the United States, 2000

Circular 1279
U.S. Department of the Interior
U.S. Geological Survey

Do Created Wetlands Replace the Wetlands that are Destroyed?

By Robert J. Howarth

Why should we care about wetland loss?
Wetlands are important ecosystems that provide many benefits to society. They provide habitat for many species of plants and animals, and they also provide many other benefits to society. They provide habitat for many species of plants and animals, and they also provide many other benefits to society.

What are the wetland mitigation requirements?
Wetland mitigation requirements are designed to ensure that wetlands are not lost. They require that for every acre of wetland destroyed, a certain amount of wetland must be created or restored. They require that for every acre of wetland destroyed, a certain amount of wetland must be created or restored.

What is wetland mitigation?
Wetland mitigation is the process of creating or restoring wetlands to replace those that have been destroyed. It is the process of creating or restoring wetlands to replace those that have been destroyed.

The Value of Long-Term Monitoring in the Development of Ground-Water-Flow Models

By Robert J. Howarth, David J. Hill, and James J. VanDine

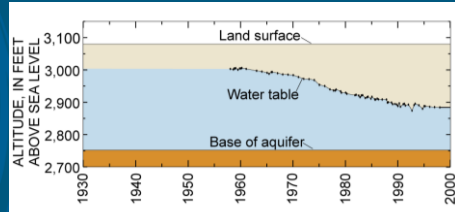
Model Construction and Calibration
Groundwater flow models are used to predict the behavior of groundwater systems. They are used to predict the behavior of groundwater systems. They are used to predict the behavior of groundwater systems.

Long-Term Monitoring
Long-term monitoring is essential for the development of groundwater flow models. It provides the data needed to calibrate and validate the models. It provides the data needed to calibrate and validate the models.

Ten GW Communication Challenges



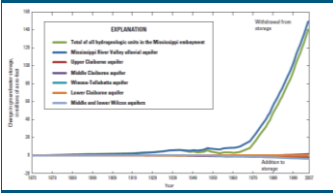
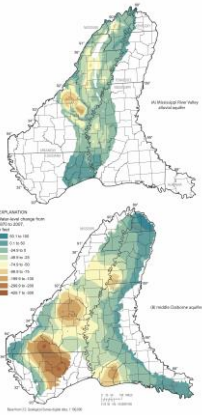
1. Not All Aquifers Are Created Equal



h. Hydrograph for well number 374406101221501 In Grant County, Kansas



2. Confined vs Unconfined Aquifers



USGS Professional Paper 1785



3. Scales of Impact

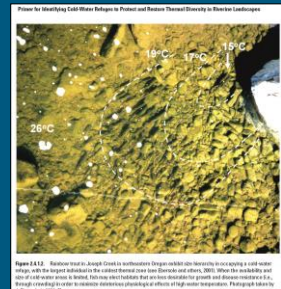


Figure 8.4.3. Evidence that a August Dred in southern Oregon might also be used to illustrate a cold water refuge. The temperature indicated in the colored thermal zone from Franke and others, 2001. When the availability and use of cold water areas is limited, fish may select habitats that are less desirable for growth and disease resistance (i.e., through avoidance) or they may experience physiological effects of high water temperature. Photograph courtesy of Franke et al. (2001).

Torgersen, C.E., Ebersole, J.L., Keenan, D.M., 2012. *Primer for Identifying Cold-Water Refuges to Protect and Restore Thermal Diversity in Riverine Landscapes*. EPA 910-C-12-001



4. Depletion of a small part of the total volume of groundwater can have large effects on surface water, water quality, or subsidence which become limiting factors to development



Houston, TX



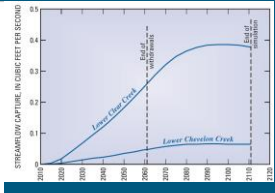
Republican River Basin, CO, KS, NE



Edwards Aquifer, TX



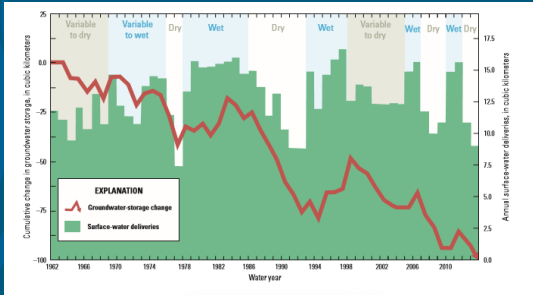
5. Streamflow Capture



Leake, Hoffmann, and Dickinson, 2005



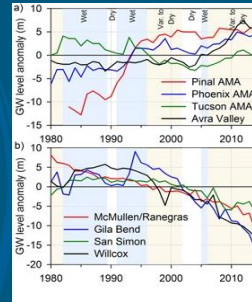
6. Resilience (or Not)



Source: USGS Fact Sheet 2015-3084



7. Managed Aquifer Recharge



Scanlon et al. (2016) Environ. Res. Lett.



8. Collaborative Modeling



San Pedro River, AZ

IDAHO Department of Water Resources

Collaborative Modeling

- Modeling committee
 - Technical advisory committee
 - All are welcome
 - Open exchange of ideas and data
 - Legal process is less painful

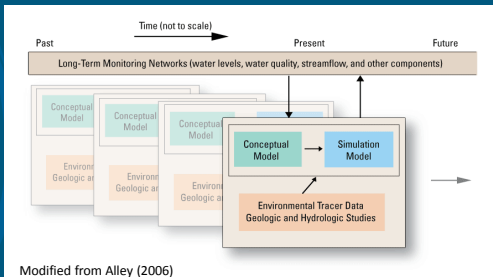
A. Wylie, 2017 GW Foundation National Meeting



9. Permit-Exempt Wells



10. Integrated Monitoring and Modeling



Modified from Alley (2006)



Questions?

