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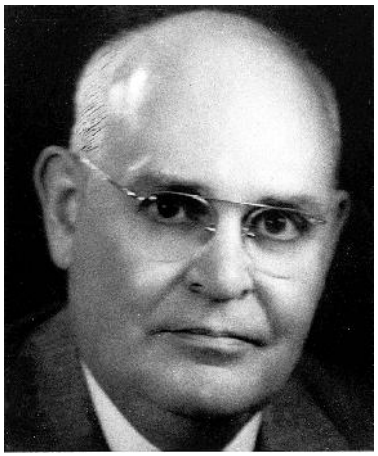
William A. McEllhiney Distinguished Lecture Series in Water Well Technology



National Ground Water Research and Educational Foundation's McEllhiney Lecture Series is supported by a grant from Franklin Electric.

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To foster professional excellence in water well technology, the National Ground Water Research and Educational Foundation, established the William A. McEllhiney Distinguished Lecture Series in Water Well Technology in 2000.

The lecture series honors William A. McEllhiney, a groundwater contractor and civil engineer from Brookfield, Illinois, who served as the founding president of the National Ground Water Association in 1948.

Michael J. Schnieders, PG, PH-GW

2017 McEllhiney Lecture:

Redefining Life Expectations of New Wells Through an Analysis of Past Failures

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Why the Concern with Well Failure?

- Significant Source of Supply
- Need for water: health, agriculture, energy
- Prolonged drought in the West
- Population density shifts
- Cost and availability of replacement wells
- Cost and ability to treat and distribute water

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Failure (noun) \'fāl-yer\ 1. the state of inability to perform a normal function; 2. an abrupt cessation of normal functioning.

per Merriam-Webster

Well Failure

Stoppage? Sanding? Poor quality?

Cost? Efficiency? Sustainability?

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Historical View of Groundwater:

- *Water located below the earth's surface, existing primarily in aquifers*
- *Usage and design, commonly defined by land ownership and political boundaries, not by aquifer*
- *Ground Water and Surface Water are separate entities with no communication, ever*

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Historical Well Design Goals & Objectives:

- *Achieve a desired Yield*
- *Relative Protection from Contamination*
- *Reasonable Sand Free Production*
- *Design Life of 25 Years*
- *Ease of Operation & Maintenance*
- *Minimal up-front cost*

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Areas of Concern and Failure

- Aquifer Evaluation
- Corrosion
- Development
- Operation and Monitoring
- Maintenance
- Regulations
- Work Environment

Aquifer Monitoring

- Focus on Water levels
- Specific contaminant levels
- Reactive in nature
- Disconnected data
- Typical separated from new well design

Corrosion

- Misunderstood and Misapplied
- When evaluated, focus is on the screen
- Fail to incorporate the entire well system

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Photo courtesy of Chris Johnson, Aegis Groundwater

Photo courtesy of Ned Marks, Terrane Resources

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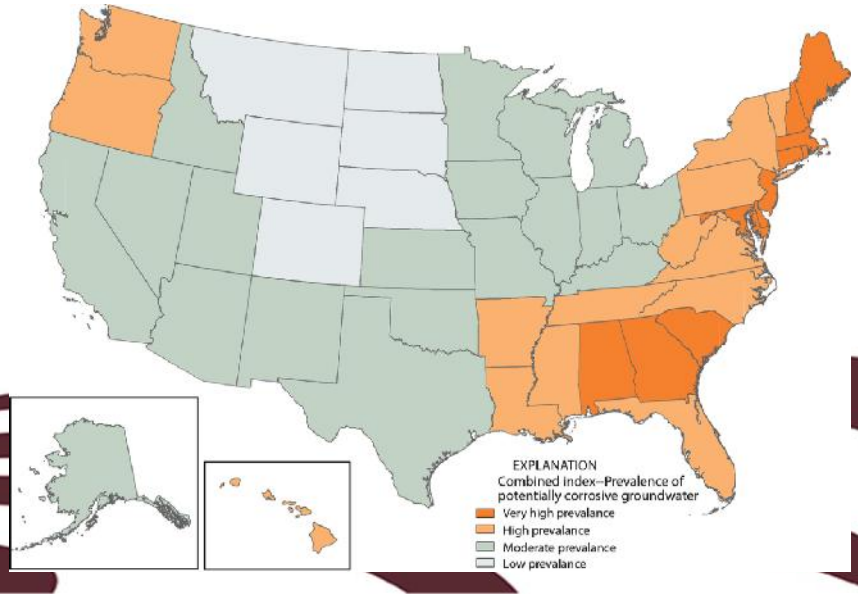
Long-term Corrosion Impacts

- Treatment / rehabilitation failure
- Impacts water supply and treatment considerably (Flint, Mi)
- 2016 USGS study found 50% of the States have "*moderate to high prevalence of corrosive groundwater*"

AdEdge Iron and Manganese Removal

Data and Graphic courtesy of USGS



Development

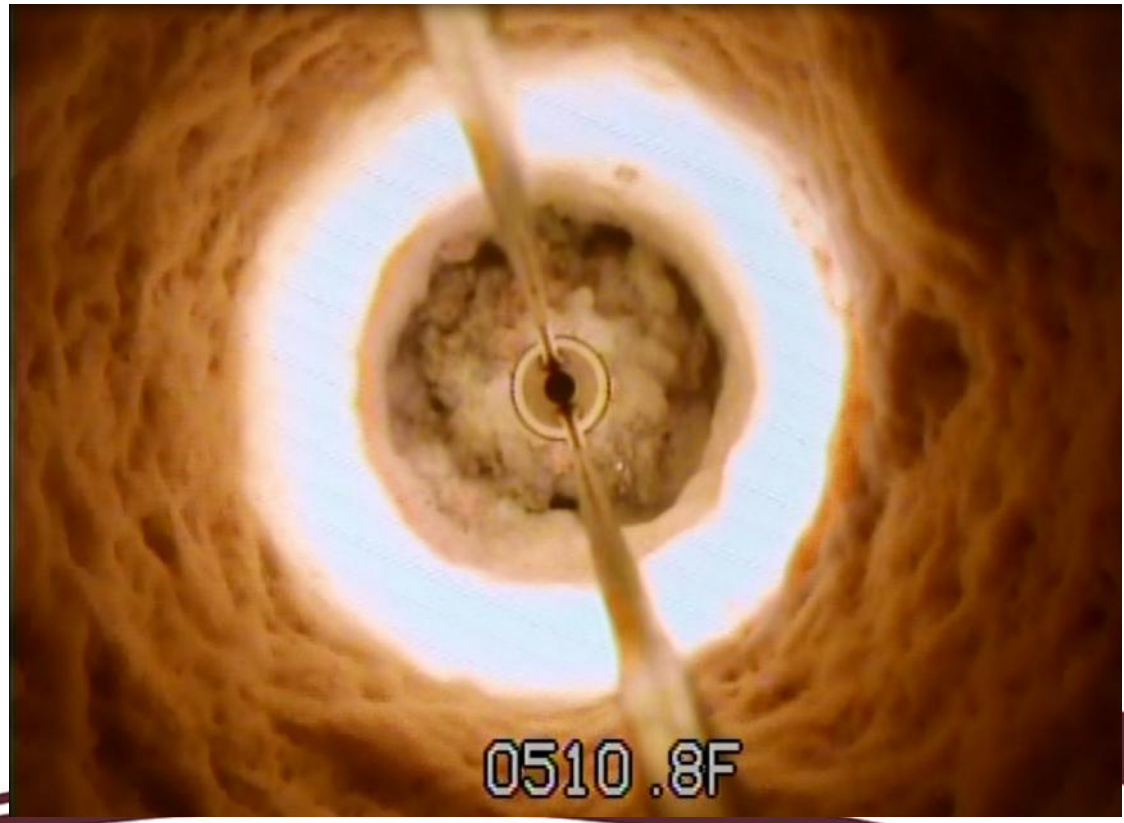
- Misunderstood
- Shortchanged process
- Resigned to a lump sum procedure
- Limited evaluation
- Typically, not tied to efficiency

Photo courtesy of Chris Johnson, Aegis Groundwater

Operation and Monitoring

- "Run to Failure" attitude
- Monitoring and testing goals are rarely tied to the well
- Testing is regulatory driven
- Operations follow a set schedule that rarely accounts for the well health or aquifer

Photo courtesy of Don Caillouet, Layne



Maintenance

- Reactive
- Methods and Focus vary widely
- Misunderstood and often misapplied
  - Sometimes the efforts cause more harm than good
- Few Practices Take Aquifer into Account
- Budgetary driven

Photo courtesy of Layne, Chandler, AZ

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Regulations, Permits, Designs, Licenses…..

- Ambiguity of State/Provincial Licensing
- Well design and usage are typically tied to political boundaries and not aquifers
- Vast differences in Design and Construction Requirements

Work Environment

- Lack of Cooperative Environment:
  - Driller vs. Engineer vs. Regulator
- Changing Workforce:
  - Technology Application Increasing
  - "water industry" turnover

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How do we do improve?

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Changing View of Groundwater:

- *water found underground in soil, rock, and unconsolidated materials, to include aquifers as well as the areas of recharge*
- *extends beyond political boundaries*
- *use it or lose it attitude is counter to conservation efforts*

Image courtesy of USGS Fact Sheet 2011-3070

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Trending Well Design Goals & Objectives:

- Sustainable yield with minimal drawdown
- Targeted efficiency
- Protection from contaminants, aquifer interaction
- Sand production of <10 ppm
- Design Life of 75 years, minimum
- “manageable operating costs”

Image courtesy of Johnson Screens

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Aquifer Monitoring

- Move beyond water levels, tracking aquifer parameters and saturated thickness
- Integration of State/Provincial and Federal Efforts Incorporate data into all aspects of land-use and water resource planning/application
- Nat. GW Monitoring Network (NGWMN)
- Open Water Data Initiative

Monitoring Station, Ft. Leavenworth, KS. Image courtesy of USGS

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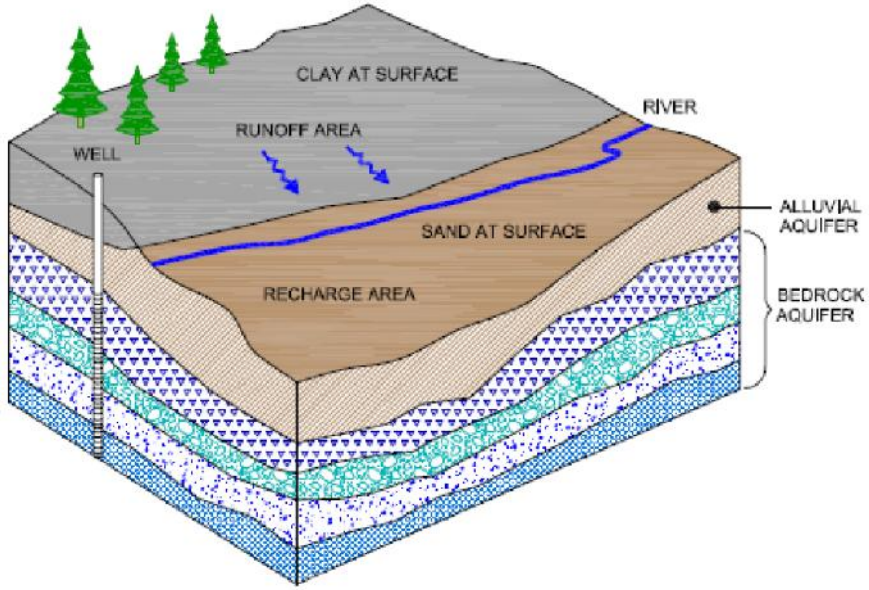
Delineate and Evaluate Contributing Watersheds



- Identify areas of recharge
- Develop protection zones
- Define potential impacts
- Mitigate natural influences
- Develop proactive responses plans
- Identify and monitor potential sources of anthropogenic impact
- Canadian GUDI Program

Aquifer Management

Photo Courtesy of Edd Schofield, Johnson Screens

- Regional Cooperation for permitting and usage
- Aquifer specific guidelines for well design and construction

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Putting Science into Materials Selection

- Targeted lifespan
- Role of Economics – beyond initial cost
- Incorporating water chemistry and regional/aquifer/site issues
- Develop process for evaluation of new methods and materials

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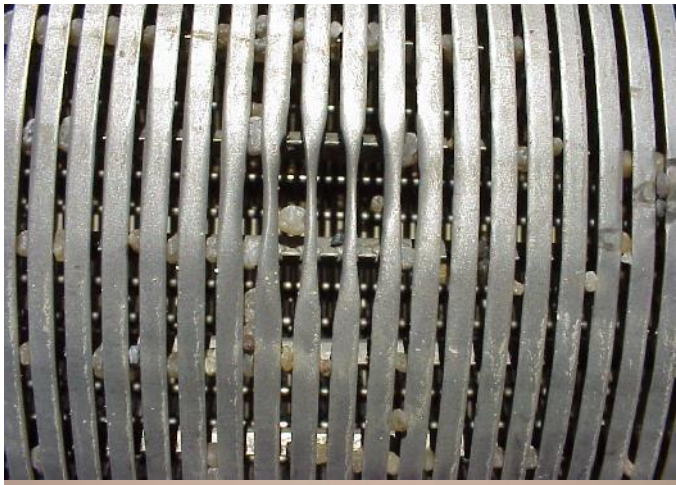
Filter Pack and Sediment Control

- Adequate and standardized evaluation of filter pack materials
- Set and enforce general quality standards
- Limit influence prior to usage



Development

- Education
- Improve Drilling Education
  - Aquifer variances
  - Limit influences at drill site
- Set Development Goals
  - Well specific:
    - Formation, method, design
- Improve solids control

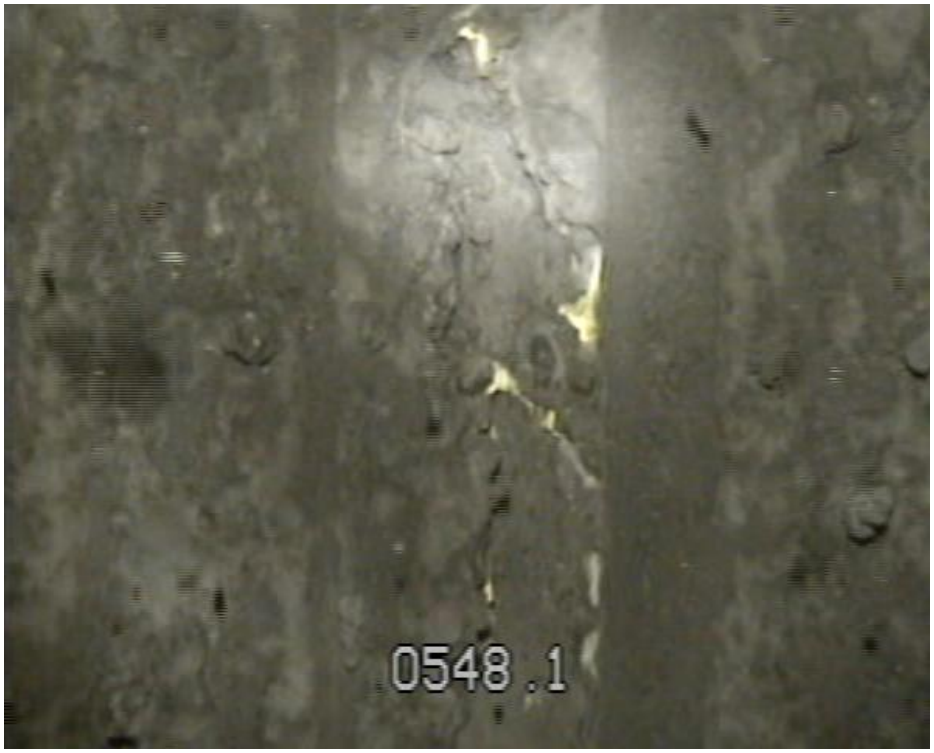


Photo courtesy of Jim Baird, Johnson Screens

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Evolve beyond Regulatory driven Testing & Monitoring

- Varied Sample Collection
- Hardness presence
- Biofouling potential
- Corrosion
- Sediment / formation influence
- Proactive mindset

Pump Testing and Well Efficiency

- Education
- Expand abilities
- Coordination with data storage and use

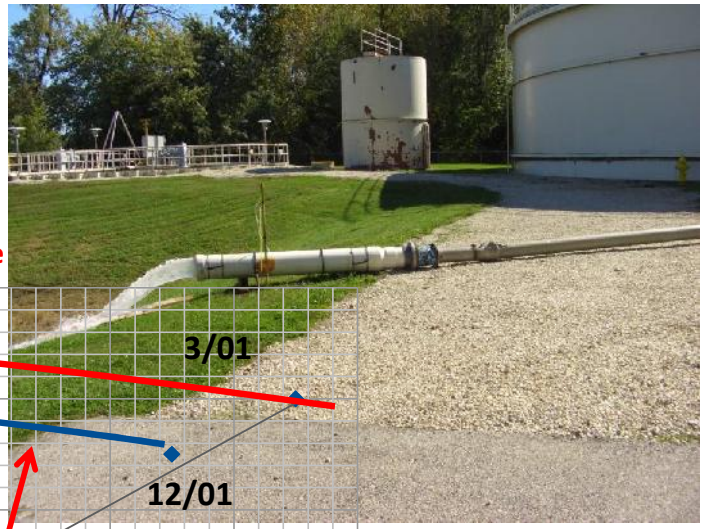
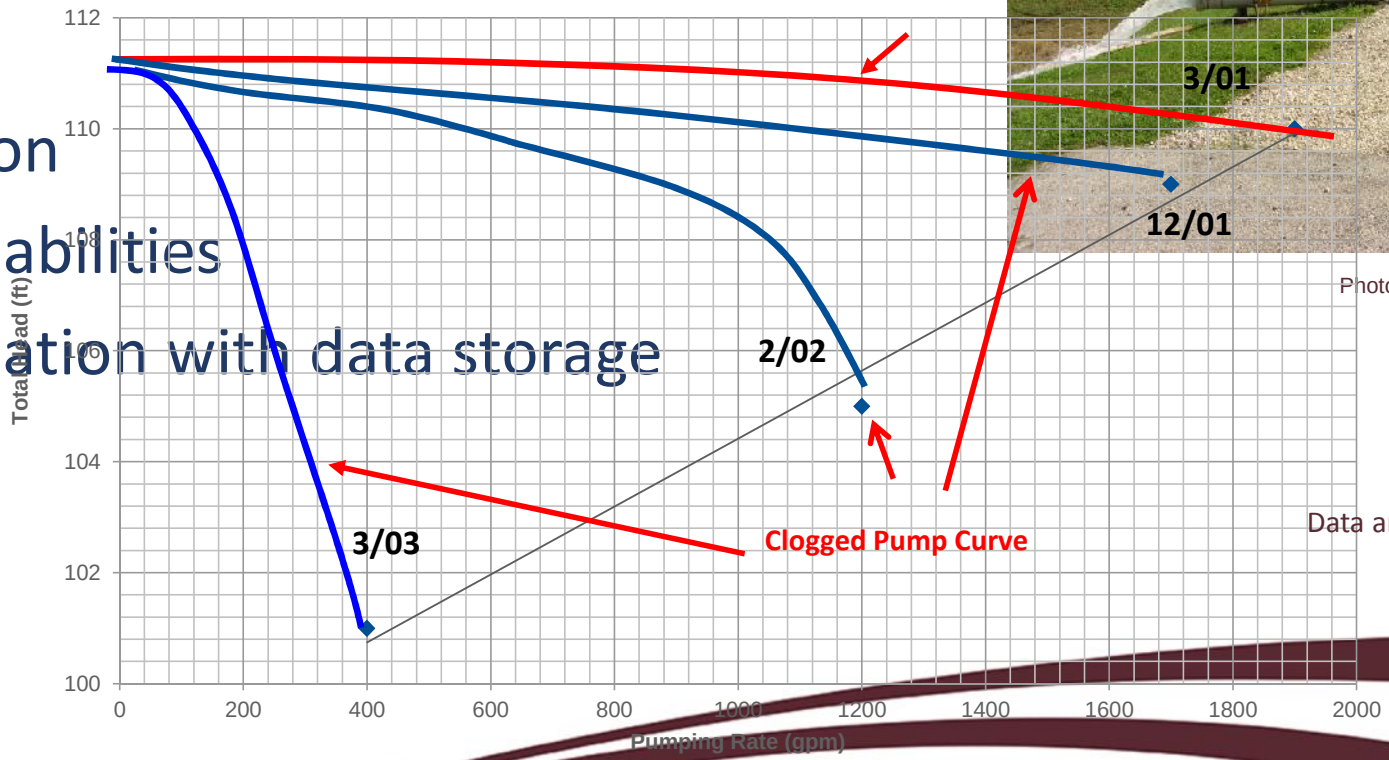


Photo courtesy of Layne, Aurora, IL



Data and Graphic courtesy of Bob Pritchard, Serv-Tech, Inc.

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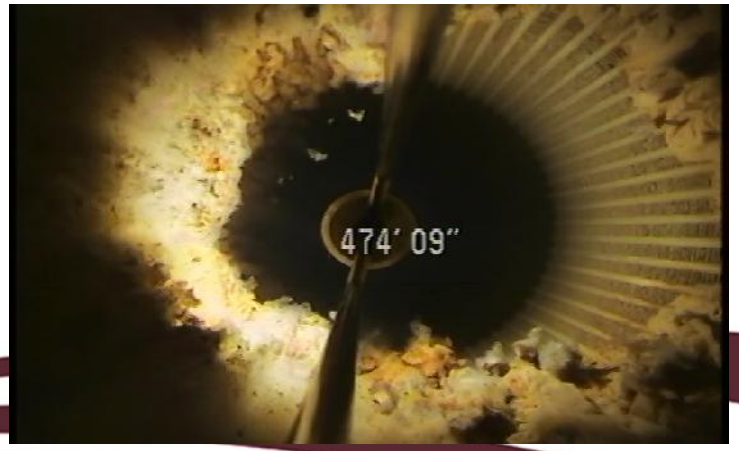
Develop Site Specific Monitoring and Maintenance

- Proactive vs Reactive
- Treatment Practices that are well specific
- Reduce damage to the well structure and potential harm to the aquifer
- Develop less invasive methods to target wells experiencing loss earlier to reduce the need for more costly efforts



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Site Specific Maintenance

- Identification of problems earlier
- Mechanical and Chemical Method tailored to the well and problems
- More effective treatment
  - 300% more effective disinfection
  - 62% greater reduction in iron fouling
- Longer run-times for wells, treatment plants, filter systems

Photo courtesy of Layne, Kansas City, KS

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Cooperative Environment

Photo courtesy of Twentieth Century Fox “Unfinished Business”

- True Groundwater Professionals
- Create interested “stakeholders” of all parties
- Reduce animosity

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Summary

- Aquifer Evaluation
- Corrosion
- Development
- Operation and Monitoring
- Maintenance
- Regulations
- Work Environment

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Smart Choices

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So, let's ask ourselves a few questions...

- Do we provide a new well design/spec to City X that is right for the aquifer or a design that will win the bid?
- In completing a new well, we meet production goals despite just starting development – do we stop? Or do we complete development, likely increasing production and efficiency?
- City Y's main well has had a Coliform hit, we super chlorinated it and it failed testing, are we going to repeat the process and pray, or take the time to investigate the well and identify the real problem, even though it's a holiday weekend?

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Summary: Well Management is a *Process*

- Each well is designed, constructed, and operated differently.
- Early identification of problems saves time and money, while extending the operational life of the well
- Resolution (maintenance) should be well and problem specific
- Follow-up is vital

Thank you!

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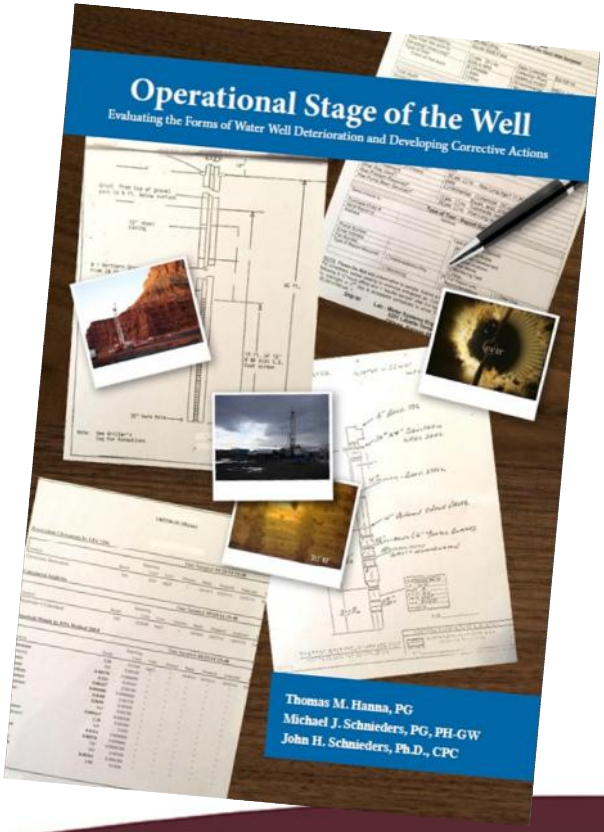
Operational Stage of the Well

Thom Hanna, PG
Michael Schnieders, PG, PH-GW
John H. Schnieders, PhD., CPC

NGWA Press 2017



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