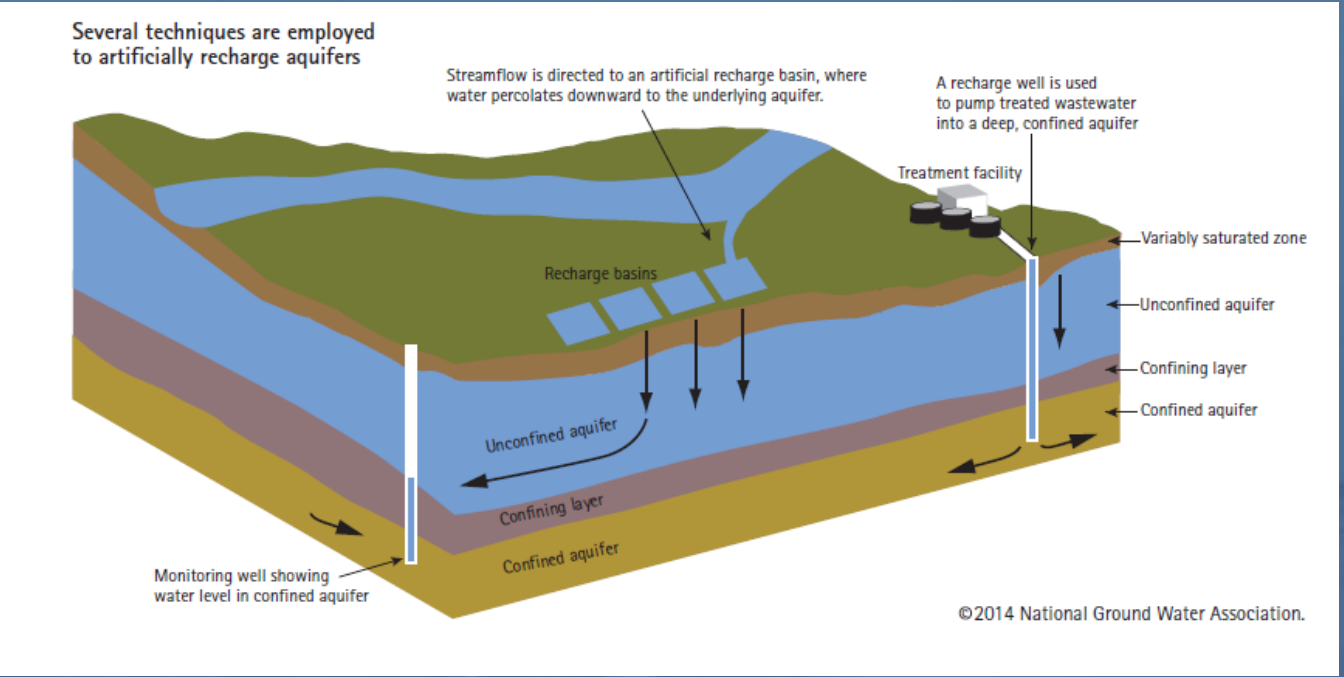
NGWA Informational Resources: Defining Managed Aquifer Recharge and Best Suggested Practices for Aquifer Storage and Recovery



William M. Alley and Steven P. Musick

2014 GWPC Annual Forum

national ground water association®

What is a “BSP?”

- “…those practices that have been shown to produce superior results; selected by a systematic process; and judged as exemplary, good, or successfully demonstrated.” – *The American Productivity and Quality Center*

national ground water association®

What is a “BSP?”

- Consensus-driven document
- Good idea, good practice, or recognized best practice
  - NOT a standard, guideline, handbook, or position paper
  - NOT a technical specification
- General scope:
  - Audience any industry segment
  - If document is for contractors, usually used for private residential water wells
  - Nationally applied
- Helps protect limited resources
- Sets industry benchmarks

national ground water association®

Who uses BSPs?

- Industry professionals
  - Drilling and water systems contractors
  - Scientists and engineers
  - Manufacturers and suppliers
- Regulatory agencies
  - Federal
  - State
  - Local

Available NGWA BSPs

Managing a Flowing Water Well	Reducing Problematic Concentrations of Nitrates in Residential Water Well Systems
Reducing Problematic Concentrations of Hydrogen Sulfide in Residential Water Well Systems	Reducing Problematic Concentrations of Radon in Residential Water Well Systems
Reducing Problematic Concentrations of Arsenic in Residential Well Systems	Reducing Problematic Concentrations of Strontium in Residential Water Well Systems
Reducing Problematic Concentrations of Boron in Residential Water Well Systems	Reducing Problematic Concentrations of Uranium in Residential Water Well Systems
Reducing Problematic Concentrations of Fluoride in Residential Water Well Systems	Residential Well Cleaning
Reducing Problematic Concentrations of Iron and Manganese in Residential Water Well Systems	Water Well Systems for Fire Protection Services for Stand-Alone Housing Units of Four or Fewer
Reducing Problematic Concentrations of Microorganisms in Residential Water Well Systems	Water Well Systems Inspection
Emergency Residential Water Well Disinfection Following a Flooding Event	Reducing Problematic Concentrations of Perchlorate in Residential Water Well Systems
Reduce and Mitigate Problematic Concentrations of Methane in Residential Water Well Systems	

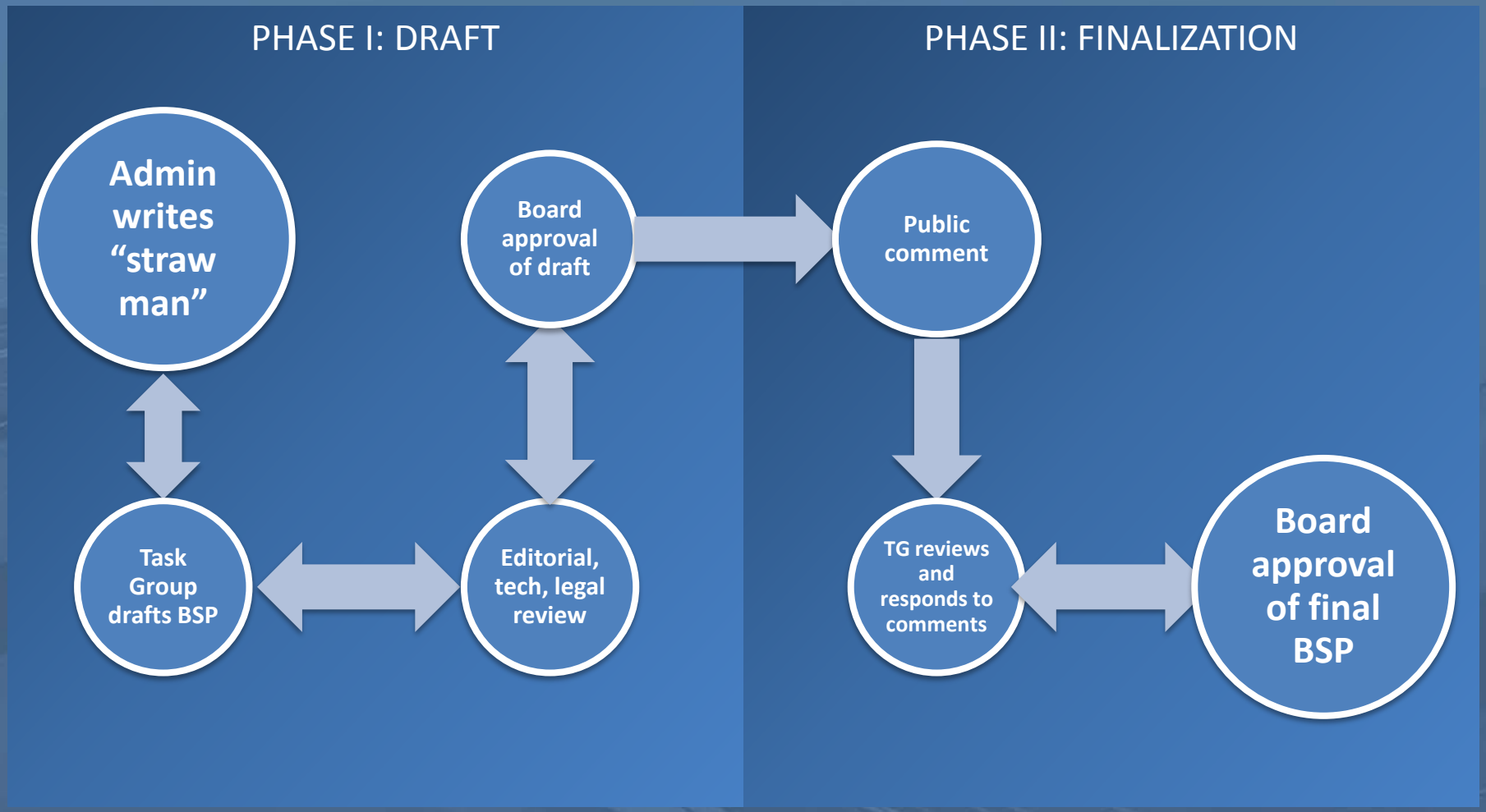
national ground water association®

BSPs in development

Relationship Between Wells with Elevated Iron Levels and Arsenic	Well Development
Groundwater Sampling	Groundwater Testing
Safe Handling of Radioactive Wastes from Water Treatment Devices	Water Well and Pump System Operation and Maintenance

national ground water association®

Development Process: Step by Step



What's in a Name?

- Artificial recharge
- Managed aquifer recharge (MAR)
- Aquifer Storage and Recovery (ASR)
- Aquifer Storage Transfer and Recovery (ASTR)
- Soil aquifer treatment (SAT)
- Managed underground storage (MUS) of recoverable water
- Recharge basin (pond), spreading basin, infiltration basin, surface spreading
- Recharge well
- Vadose zone (dry) well
- Bank filtration

national ground water association®

NGWA ASR BSP: Scope and Definitions

- ASR includes:
  - dual purpose well(s) for recharge and recovery, and
  - separate recharge and production wells
- Focus is on using potable source water

national ground water association®

What's contained within the BSP?

- ASR goals and challenges
- Planning and implementation
- System components
- Source water considerations
- Aquifer characteristics
- Drilling methods, well design and construction
- Monitoring
- System performance evaluation
- Regulatory and policy requirements
- Stakeholder involvement
- Case studies
- Information resources
- Disclaimer

national ground water association®

Goals

- **Operational Goals**

— *Recharge*

- Recharge goals are hydrologic in nature. An aquifer must be sufficiently permeable in order to accept water by pumping, without over-pressuring the aquifer or affecting existing users.

— *Storage*

- Storage goals are driven by a specific use, such as human consumption or crop irrigation, and often a particular time frame (seasonal, long term, or short term to meet municipal system or emergency demands), or to optimize availability of permitted water rights. Aquifer transmissivity and gradient should be such that the recharged water will remain near the point of recharge so that it can be recovered later through the ASR well.

— *Recovery*

- Recovery augments water supply for droughts, system outages, and meeting peak or seasonal demands. Recovered water must be of a quality suitable for its intended use and be in compliance with all permit criteria.

Goals Continued

- **Aquifer Restoration Goals**

— Aquifer restoration goals may aim to decrease or prevent declining water levels, reduce subsidence, and/or improve water quality (e.g., saltwater intrusion prevention or dilution).

- **Public Water Supply Goals**

— A primary goal of ASR is providing for public water supply needs, including drinking water.

— Urban ASR systems can provide a local emergency water source for fire control or loss of water supply during storms or earthquakes in areas where above-ground storage is not feasible.

- **Environmental Benefit Goals**

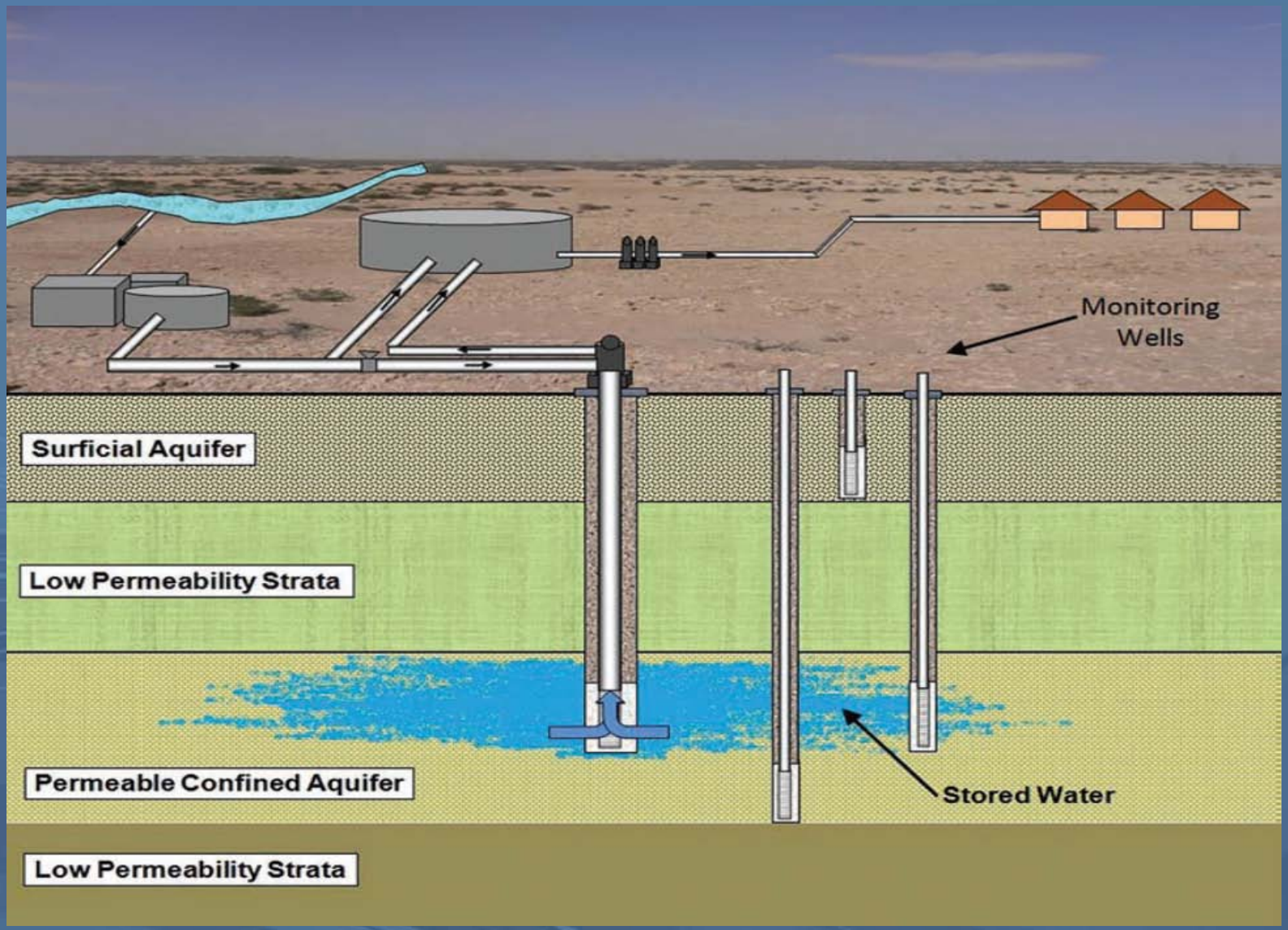
—Recovery and distribution of stored water for environmental benefits including maintenance of appropriate wetland hydration and surface-water flows.

national ground water association®

Issues & Challenges

- Regulatory complexity as an obstacle in many cases where there are overlapping federal and state jurisdictions
- Financial and scientific challenges can limit the use of ASR for smaller water utilities
- Perception of higher ASR project costs than some alternatives
- Perceived need for protection of recharge water from other pumpers
- Chemical reactions of recharged water with aquifer materials
- Technical issues include the need for improved design, construction, and development of ASR wells, and maintenance of well efficiency by minimizing well clogging and addressing source water quality variability
- Federal policy - current challenges to constructing and operating ASR facilities in some areas arise from the potential or actual endangerment of underground sources of drinking water by the operation of ASR

national ground water association®



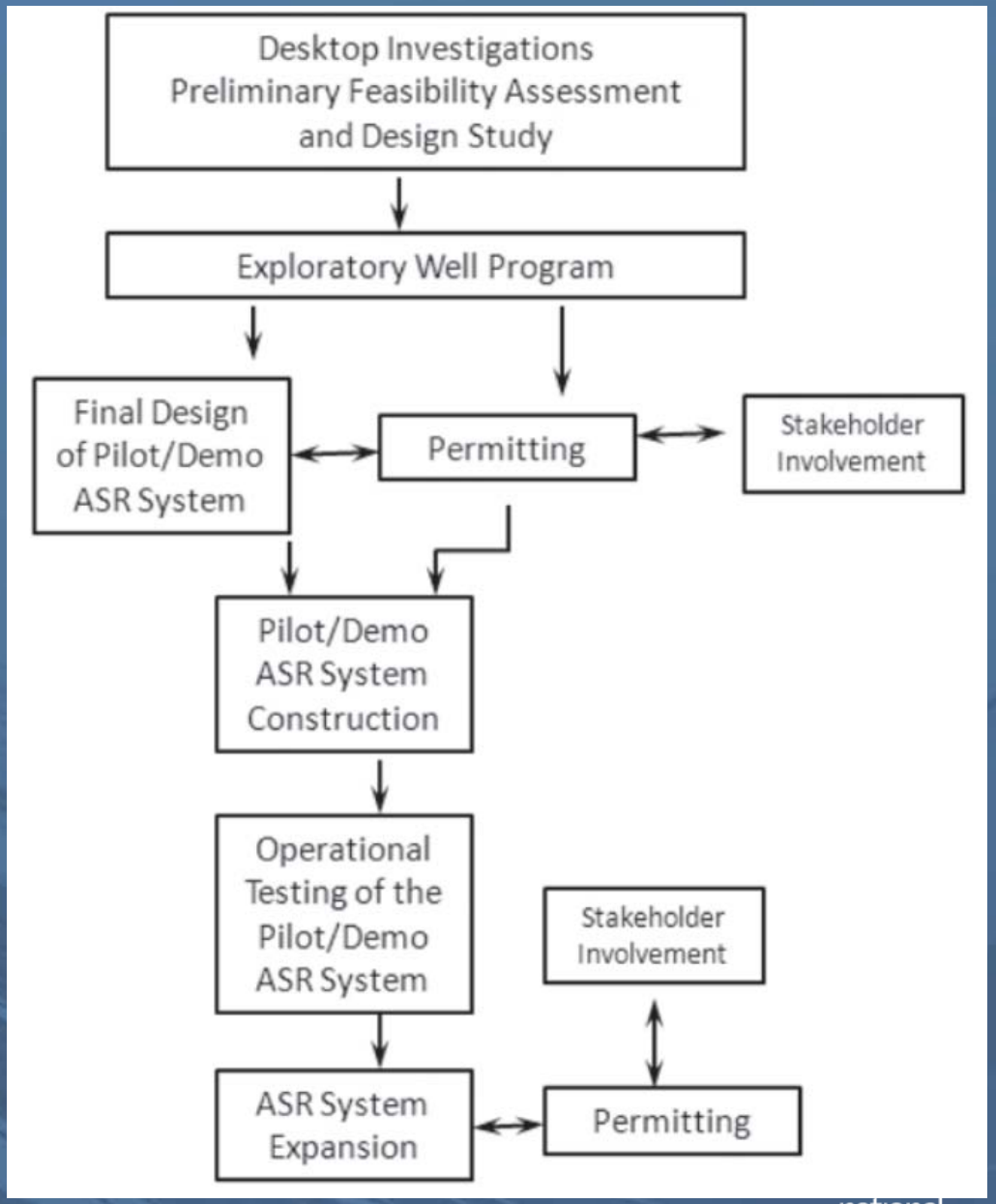
Components of a ASR System

(Intentionally simplified for reference)

national ground water association®

Phases of ASR system development

Adapted from Maliva and Missimer (2010).



national ground water association®

ASR Evaluation

- Planning and implementation of ASR projects
- Source water considerations
- Aquifer characterization
- Drilling methods, well design, and construction
- Monitoring of ASR systems

Other Considerations

- Guidance on evaluating ASR system performance
- Regulatory and policy requirements
- Considerations for stakeholder involvement
- Reference for case study information
- Further resources for federal and state agency information

Who contributed?

- Michael Alferi, PG
- Allan Biddlecomb
- Kevin Frederick, PG
- Marvin Glotfelty, PG
- Yemia Hashimoto, CHG
- Robert Maliva, Ph.D.
- Jessica Rhoads, NGWA Coordinator
- Kenneth Minn, PE
- June Mirecki
- Steve Musick, PG
- Tim Parker, PG, CEG, CHG
- Marcus Trotta
- Sam Upchurch

national ground water association®