

# **SUMMARIES OF TECHNICAL EXPERT DISCUSSIONS**

## **US EPA UIC Program Aquifer Storage and Recovery (ASR) Expert Meeting May 5 and 6, 2009 – Chicago, IL**

### **Introduction**

The U.S. Environmental Protection Agency (EPA) sponsored a meeting to gain stakeholder input on current issues associated with the use of aquifer storage and recovery wells (ASR) to manage drinking water supplies. ASR is becoming an increasingly important water resource management tool with applications in almost every region of the country. It provides a means to sustain potable water supplies; however, in some applications, water quality concerns have arisen. EPA and States with primary enforcement responsibility for underground injection control practices are mandated to protect underground sources of drinking water (USDWs) – the aquifers into which water is injected through ASR practices.

The ASR Expert Meeting was designed to bring together diverse parties with experience and interest in ASR, including Federal and State regulatory officials, private industry, environmental organizations, academics, and local water suppliers. The goal was to generate innovative ideas and individual input from participants on how to advance the use of ASR while protecting water quality within USDWs.

The ASR Expert Meeting began with plenary presentations designed to provide the participants with a common knowledge base and terminology to encourage effective and productive discussions. The plenary topics addressed multiple challenges related to ASR:

- Session #1: Scientific and technical considerations for ASR;
- Session #2: Current ASR practices; and,
- Session #3: Policy considerations for ASR.

Following these presentations, the participants were divided into three groups for breakout discussions on the topics listed above. This document provides an overview of these breakout discussions, organized by plenary topic, followed by discussion topics within each session.

### **Summaries of Breakout Group Discussions**

#### ***Scientific and Technical Considerations for ASR***

Technical experts provided individual input to EPA using the following two questions as structure. Ideas generated during the session conversations are summarized after each question. Summarized ideas do not reflect any type of consensus or concurrence.

## **When characterizing a potential ASR site, what level of technical detail is needed to determine the likelihood of adverse injection impacts to the aquifer?**

### **Summarized input:**

- Site characterization
  - Projects should start small and grow on an iterative or cyclical basis to allow for education and adaptation to on-site water quality challenges
  - Project should have a phased approach with site characterization and bench tests leading to a pilot-scale test at the site
  - Bench tests give a good first look at a potential ASR site and can back up modeling predictions, and help plan additional, larger scale tests. Bench-scale desorption dissolution test is an example
  - Monitor reactions that take place within the aquifer during pilot tests
  - Use data from first ASR cycle at a site and assess for potential to harm
  - Conduct hydrologic characterization such as conducting a geologic literature survey, geologic logging of wells, determining the storage capacity of aquifer and potential boundaries, evaluating water chemistry of aquifer and injectate, and examining adjacent, less productive geologic layers is important because water may enter these areas
  - Characterize aquifer hydraulics such as hydrochemistry, flow paths, transmissivity, and hydraulic conductivity (K) values, fractured areas and heterogeneous lithology
  - Collect borehole geophysics data, and perform aquifer performance tests (step drawdown)
  - Perform continuous core testing and batch testing. If no impact to neighboring wells, these tests should not be necessary
- Begin discussions with regulators at an early stage in the planning
- Use Class V experimental classification for pilot tests
- Determine acceptable level of change for aquifer water quality
- Monitor injected water quality and in-situ aquifer quality frequently

## **What successful operational practices and siting requirements should be considered for the establishment of Best Management Practices?**

### **Summarized input:**

- Pre-injection treatment
  - Remove oxygen out of injectate prior to injection to reduce redox reactions
  - Remove chlorine
  - Treat injectate to National Primary Drinking Water Standards
  - Match water quality of injectate to that of receiving aquifer to reduce reactivity
- In-situ treatments
  - Keep contamination within the property boundary of facility and manage on-site
  - Do not recover water from the buffer zone to eliminate the water quality influence of the buffer zone on recovered water and allow contamination to remain in zone
  - Assess in situ arsenic concentrations of aquifer and cease pumping before arsenic concentrations reach 10 ppb

- Allow natural attenuation processes to improve water quality with time and monitoring frequency can decrease over time
- Implement a monitoring program
- Other
  - Use aquifers, such as saline, that are not used regularly and where ASR practices may not endanger others
  - Employ long term monitoring of water quality and water quantity for ASR sites
  - Back-flush wells [purpose not-stated]
  - Develop targeted aquifer storage volumes
  - Account for time-of-travel for water and develop standards for distance between ASR system and other wells

### **Current ASR Practices**

The following questions were posed to focus discussion on current ASR practices. The breakout groups discussed a number of topics, including water quality, monitoring, successful practices, and impacts on USDWs. Ideas generated during the session conversations are summarized after each question. Summarized ideas do not reflect any type of consensus or concurrence.

**What are the current ASR practices and what has been their environmental impact on USDWs? What practices are both protecting USDWs and resulting in successful ASR operations? What practices are not working? How do practices differ around the country?**

*Arsenic was identified as a contaminant of concern with occurrence in the majority of regions represented, and formation of trihalomethanes was problematic for many systems that chlorinated water prior to injection.*

#### **Summarized input:**

- Successful practices with little to no impacts
  - Tertiary treated reclaimed water is injected with no degradation of USDW quality and no exceedances of an MCL
  - Potable surface water treated with chloramines is injected with 100% recovery that meets primary drinking water standards with the exception of arsenic
  - Inject water subjected to ozone if potable and UV disinfection if reclaimed water (<1000 mg/L total dissolved solids) with pre-treatment for geochemical compatibility between injectate and aquifer
  - Some areas cannot achieve permit compliance and have begun ASR operations that inject into non-USDWs (>10,000 mg/L total dissolved solids)
  - Permit requires residence time of 2.5 years for reclaimed waste water treated to reclaimed standards with concern for chloride concentrations. Operator has exemption for chloride concentration
  - Well installed near river bank (bank storage recovery well) diverts surface water above baseflow for recharge after filtration, sedimentation and treatment for Atrazine. Activated carbon is used as treatment, but may be replaced with full membrane treatment and hydrogen peroxide in the future
  - Chlorinated surface water is injected with 100% recovery. Contaminants of concern include metals, arsenic, and radium

- Injection depth is deep to avoid complication with other sources of water.
- Aquifer to aquifer storage has been successful in meeting drinking water standards and restoring/maintaining wildlife in the area
- ASR, used for plant optimization, injects treated surface water into a sandstone aquifer. Plant built pipeline to well site rather than using a location closer to the plant but not as well-suited for ASR
- Challenges to protecting the aquifer
  - Nitrates are problematic, especially with vadose zone wells and infiltration systems. Nitrate concentrations may increase quickly to high concentrations and decrease slowly over months or years
  - Water cannot be withdrawn from some aquifers without aquifer recharge due to pervasive salt water intrusion
  - If injectate is not chlorinated, biofilms grow on the well screen
  - “Stacking” – injection into two different aquifers – creates problems when the aquifers become connected through the same well
  - Temperature differential between injectate and native aquifer waters caused clogging of aquifer due to air entrainment
- Monitoring
  - Production, recovery, and private wells drawing from the same aquifer are assessed
  - Multiple depth monitoring is important
  - Cycle the ASR well until water quality stabilizes and then reduce monitoring
  - Daily to bi-weekly sampling frequency during injection and weekly to bi-weekly sampling for storage phase
  - Indicators are injected into the water to serve as tracers. Tracers could be used for monitoring instead of the full suite of parameters.
  - Place monitoring wells at the property boundary and beyond the boundary to ensure injected water remains on-site and shows continuous improvement
  - More monitoring is required if an exceedance of an MCL occurs although quantity and frequency vary among States
  - Monitoring for arsenic, coliform, and primary and secondary contaminants is conducted above injection zone in the confining layer or upper USDW
  - Some utilities are monitoring for emerging contaminants and developing simple, cost-effective methods to analyze redox conditions beyond using a probe
- Other comments
  - The alternative to ASR is to build reservoirs, which are more expensive and have a greater impact on the environment
  - Will water quality standards decrease to lower concentrations as technology improves?

### ***Policy Considerations for ASR***

Technical experts provided individual input to EPA using the following two questions as structure. Ideas generated during the session conversations are summarized after each question. Summarized ideas do not reflect a general consensus.

## What EPA role in ASR management do you think is important?

### Summarized input:

- EPA should develop firmer guidance on the definition of endangerment and opportunities for flexibility in determining endangerment
  - Use a site-based, risk-assessment approach to determine points of compliance that meet local needs, considers aquifer heterogeneity
  - Establish a zone of discharge where exceedances of an MCL is approved if fluid does not migrate beyond a specific boundary, or preventative limits at a percentage of MCL (<100%)
  - Differentiate between temporary, start-up requirements and long-term management requirements for ASR wells to address water quality improvements over time
  - Allow time to solve problems that may arise – temporary waiver of MCL exceedances
  - Allow contamination in the aquifer even if only for a short period of time if no impact on human health
  - Allow less frequent monitoring, e.g. monthly, to establish an annual average
  - Allow alternative yet comparable protection to current regulations for non-endangerment
  - Redefine USDW definition specific to ASR
  - Develop new well class for beneficial use including ASR
- Any new guidance or regulations EPA adopts should not impact sites where things are currently working well
- EPA should collect information on the following management/operating practices:
  - Managing disinfection byproducts
  - Modeling
  - Water volumes
  - Cycle testing
  - Land use (key to endangerment)
  - Bench-scale testing and transition to in-situ
  - Common terminology
- EPA should conduct research on evaluating the risk of leaving contamination within the injection zone, migration away from the well site, and in-situ microorganism survival to determine if disinfection is necessary
- EPA could play a role in raising awareness of ASR with the general public and elected officials as follows:
  - Publish data on the value and cost of water to help water suppliers obtain approval to invest in water system improvements and treatment technologies needed for ASR
  - Publish a cost-effect analysis of ASR compared to other water storage methods
  - Connect ASR as a management strategy for water scarcity issues and climate change
  - Collaborate with USGS for education and outreach
  - Develop scale-accurate visual aids and information from multiple sources (e.g. presentations and papers)

- EPA should remove ASR from the UIC program and place under the water supply program
- EPA should allow aquifer exemptions for ASR wells
- EPA should form a technical group to develop guidance and a decision matrix with site-specific information, possibly in connection with the National Drinking Water Advisory Committee
- EPA should coordinate with other Federal and State agencies to bridge gap among water rights, water supply programs and water quality regulators, especially in cases of transboundary aquifers, policy development, and non-UIC methods of aquifer recharge
- EPA should host a series of follow-up workshops with specific focus such as point of compliance, monitoring, site characterization, and other technical and policy issues
- EPA should compile baseline information on best management practices currently used and types of permits issued in different States to be referenced by permitting agencies when reviewing permit applications.

### **What are the top 5-7 most significant State requirements?**

#### **Summarized input:**

- Residence time for treated wastewater
- Point of compliance at the wellhead
- Allowance of exceedance of an MCL under a contingency order
- Allowing time allowances for exceedances of an MCL
- Issuing a limited license prior to aquifer stabilization and before permanent licenses are issued
- Changes to monitoring and reporting requirements

### **What change would you like to see in State regulations, or are there barriers you would like to see removed?**

#### **Summarized input:**

- Remove stigma of administrative / consent orders built into the permit
- Adopt a zone of discharge to allow for limited contamination
- Changes to definition of USDW to consider different standards for saline water
- Consider using Class III wells for arsenic solution mining as a means to get permit

### **Are there any State or other approaches that should be applied on a national scale?**

#### **Summarized input:**

- Pre-permitting coordination with other agencies to develop baseline understanding on what has been done, what permits have been issued, and BMPs used
- State agency issues guidance to let operators know when they need an administrative / consent order
- State agencies held public information meeting with permitting agents there for questions. Public could talk to different agencies and it made the permitting process easier.
- Demonstration permit, limited license should be considered for national scale

- More pilot projects or demonstration projects would be helpful to States that do not already have ASR operations and would like to see what practices are being used.