Scottsdale is a medium-sized Arizona city, having a current population of just over 220,000. The city serves water to customers through 10 points of entry (POE) originating from three sources. Two of these sources are surface water, which makes up 65 percent of the water supply; the balance is derived from groundwater. Chlorine is the source of disinfection for the treatment plants and the distribution system; there are 18 pressure zones. The primary surface water source is Colorado River water delivered via the Central Arizona Project. It serves 65 percent of the residents of Scottsdale, has a finished water total organic carbon (TOC) concentration averaging 2.5 parts per million (ppm), with water temperatures in the distribution system often exceeding 28 degrees Celsius, and in some locations a water age exceeding 14 days. All of these combined factors have presented challenges for the city in controlling disinfection byproducts (DBPs).

Scottsdale recognized that compliance with DBP2 would be impossible without implementation of system changes, including additional treatment of surface water sources.

Preparing for Stage 2
With the knowledge that EPA was to promulgate a DBP Stage 2 (DBP2) rule with much stricter criteria, Scottsdale began a multi-phased approach to addressing the problem areas. Initial phases included addressing water storage in the distribution system, developing an extensive monitoring program, creating a water quality model, and identifying capital improvements.

- **Water storage**: With the volume of water being stored (65.1 million gallons in 31 potable storage tanks with capacities of 100,000 gallons or greater), the city worked on optimizing the operation of the tanks to decrease water age. Each tank was studied for set points that would require the tank to empty and turn over faster, but still maintain fire protection.

- **Monitoring program**: Approximately 50 sample stations throughout the distribution system are being monitored monthly to establish a database for numerous parameters, including DBPs.

- **Water quality model**: The city contracted the development of this model, which is being used in combination with the monitoring program to determine water age.

- **Capital improvements**: Multiple projects were identified to address the DBP issue, including installation of granular activated carbon (GAC) at the CAP water treatment plant and improvements to existing reservoirs. GAC was also incorporated into the design of the recently constructed Chaparral Water Treatment Plant.

**Distribution Site Selection and Evaluation**
The DBP2 rule finalized in January 2006 requires systems to use a locational running annual average (LRAA) to determine compliance beginning in 2012. Another major requirement of DBP2 is the development of an
Initial Distribution System Evaluation (IDSE) monitoring plan by Oct. 1, 2006. The rule outlines four options for fulfilling the IDSE requirements:

- qualify for a very small system waiver;
- meet 40/30 certification requirements (no individual THM4 samples exceed 0.040 milligrams per liter [mg/L] and no individual HAA5 samples exceed 0.030 mg/L);
- conduct a system-specific study using existing monitoring results or a hydraulic model; or
- conduct standard monitoring.

The City of Scottsdale was eligible for only the last option, use of a standard monitoring plan (SMP).

Although an extensive amount of DBP data have been collected over the years, significant changes to the water system have taken place in the past year and will continue through 2006. These changes include the implementation of four satellite groundwater arsenic treatment facilities, commissioning of a 30 million gallon-per-day surface water treatment plant, installation of new reservoirs and booster stations, and disconnection of four groundwater wells. Taking all of these system changes into account, the city determined it would have to follow the SMP requirements of the IDSE. Based on its population, Scottsdale is required by the SMP to monitor 16 additional DBP locations bimonthly for twelve months. These locations must include:

- three near-entry points,
- four sites with average residence times,
- five sites with high THM4, and
- four sites with high HAA5.

City staff have completed selection of the 16 proposed IDSE monitoring locations. Site selection was based on information obtained from the water quality model, a review of historical data, location of the existing Stage 1 sites, and knowledge of the system configuration. The near-entry points were selected as the POEs of the two surface water plants and a POE representing the groundwater wells. The water quality model was run using the current configuration and the assumed future system configuration. A projection of water age was generated (see figure below) and this information was used to select the average residence times for each of the three water sources. Selecting the high THM4 and HAA5 sites was more challenging because many of the potential locations were already Stage 1 sites. The city relied upon extensive historical data collected from a baseline distribution monitoring program and data from the water quality model to determine these locations.

**Lessons Learned Through Compliance**

Through the extensive monitoring for compliance with the DBP1, the City of Scottsdale recognized that compliance with DBP2 would be impossible without implementation of system changes, including additional treatment of surface water sources. Water age, temperature, and TOC concentrations are factors that will prevent multiple sample locations from meeting the LRAA requirement of DBP2. The monitoring that will be performed with the IDSE should provide additional data to further validate this conclusion.

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Scottsdale made the significant and costly decision to add GAC as a treatment in both surface water treatment plants. The GAC will lower the TOC concentration, thereby reducing the precursors to DBP formation. Because the Chaparral Water Treatment Plant was being designed at the time of this decision, the additional treatment could be added before construction began. The GAC treatment in this facility is now operational and the benefits should be apparent in future monitoring. Addition of GAC to the CAP treatment plant required a capital project that is still under construction. Completion of this GAC facility is expected in 2007.

The largest complication with performing the IDSE during the required timeframe is the city’s continuing modifications to water treatment and the distribution system. These changes will not be completed before monitoring begins. This may mean that the some of the data will be obsolete and require additional study. We will work closely with the regulatory agencies over the next few years to understand what impact these continuing changes will have on the process to ensure compliance with DBP2 by 2012.

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*Model-predicted water age in the Scottsdale system ranges from less than 24 hours (blue) to more than 168 hours (red) old.*