Technical Memorandum

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Date 2-10-2011

Subject Review of Capture Evaluation for M52 OU2 2009 Effectiveness report

On behalf of Arizona Department of Environmental Quality (ADEQ), URS Corporation reviewed the groundwater capture zone evaluation presented by Conestoga-Rovers & Associates (CRA) in the *Effectiveness Report – 2009, 20th Street Groundwater Treatment Facility 52nd Street Superfund Site, Operable Unit 2 Area, Phoenix, Arizona, April 2010*. URS reviewed comments by ADEQ and the Environmental Protection Agency (EPA) on the 2009 Effectiveness Report. URS also reviewed the Environmental Protection Agency (EPA) Guidance Documents, *Methods for Monitoring Pump and Treat Performance, 1994,* and *A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems, 2008*, that form the basis of the capture evaluation. The results of the review conducted by URS are presented below in the context of the six-step systematic approach described by the EPA.

Step 1 – Review Data, site conceptual model, and remedy objectives.

CRA included a review of site data, the site conceptual model, and the remedy objectives. The remedial objective is stated as follows: "The OU2 Area GES (groundwater extraction system) is designed to fully contain the north-south width and depth of groundwater volatile organic compound (VOC) contamination observed in the area of Interstate 10".

Step 2 – Define site-specific Target Capture Zone.

The Target Capture Zone (TCZ) is described in the remedial objective in Step 1 above. Figures show the northern and southern boundaries of the plume as the concentration isocontour of 5 micrograms per liter (µg/l) for Trichloroethene (TCE), the Aquifer Water Quality Standard (AWQS). A specific TCZ is not labeled on figures and the upgradient and downgradient extent of the TCZ are not shown. The bounding lines of the TCZ should be shown and discussed, because areas with TCE concentrations substantially above the AWQS that are outside the southern limit of capture in Subunit B are shown in the area southeast of the OU2 GES. Based on Figure 3.7, groundwater contamination above the AWQS indicated in wells east and south from well PHXA04 is outside the limits of capture.

Step 3 – Interpret water levels.

Maps showing hand-drawn groundwater elevation contours and conceptual flow lines were used to demonstrate capture. Capture was estimated by approximating the location of a bounding flow line within which all flow lines converge towards extraction wells. However, there are a number of potential issues with the capture analysis based on water levels that potentially result in non-unique interpretations of the data and interpretations of capture.

Groundwater elevation contours are drawn somewhat arbitrarily in some areas around the extraction wells. The contours in an area of relatively flat gradient west of the extraction wells were constructed to show a stagnation point and water level divide at a distance of more than 1,000 feet west from the extraction wells. An example capture zone calculation should be provided for comparison to support the feasibility of this interpretation.

Flow paths are shown conceptually with arbitrary spacing and construction, and do not represent conventional flow net construction and analysis. The 1010 contour on the south side of the area appears to be arbitrarily shaped to support the construction of flow paths converging on EWS in Figures 3.7 and 3.8. The lines showing the limit of capture in Subunit D are shown differently on Figures 3.8 and 3.24 for Subunit D, and the limit of capture extends slightly further south in Subunit D than in Subunits A and B, which is unlikely and requires explanation. Capture in Subunit D is based on a limited amount of data and interpretations of capture have more uncertainty.

Step 4 – Calculations and modeling.

EPA guidance documents recommend conducting simple horizontal analyses to estimate the flow rate though the contaminated section of the aquifer and the pumping rate required to achieve capture. One or more of the simplifying assumptions required for the calculations is typically violated at a site. CRA states that for the OU2 GES, most of the simplifying assumptions are violated due to the complex hydrogeology at the site, and calculations were not conducted. Analytical calculations are needed to at least provide conceptual bounds and support the distance of the stagnation zone downgradient from the GES and the width of the capture zone upgradient from the GES.

CRA states that a site-specific numerical groundwater flow model developed for the design of the system has not been updated or approved for additional uses at the site. CRA further states that because models require simplification of site conditions and represent interpretation, interpretations of field data are preferable to demonstrate capture. Therefore, potential lines of evidence using calculations and modeling were not used to support interpretations of the capture zone for the OU2 GES.

Step 5 – Evaluate Concentration Trends.

CRA evaluated concentration trends for TCE to assess effectiveness of the OU2 GES in capturing contamination. Data from September 2009 were compared to historical water quality data for 2006 and Baseline data for 2001. Comparison of changes in isocontours for TCE concentration over time shows a narrowing of the plume and indicates that contaminant mass has been substantially reduced in areas upgradient and downgradient of the OU2 GES. Reduction of aerial extent of contaminant isocontours is a supporting line of evidence for capture by the OU2 GES; however, this data alone does not indicate complete capture or containment.

CRA presents statistical analysis that indicates most wells show significant downward trends in VOC concentrations. Because concentration is also decreasing in upgradient wells, decreasing trends in wells downgradient from the OU2 GES support evidence for capture by the OU2 GES; however, this data alone does not indicate complete capture or containment.

Step 6 - Interpret Actual Capture, Compare to Target Capture Zone, Assess Uncertainty

CRA elected not to use calculations or numerical modeling as a supporting line of evidence for their evaluation due to the simplifying assumptions required and the complexity of the hydrogeologic environment. These are potentially useful tools that could be used to further support the evaluation of capture. The results from the model used to design the system should be shown to compare predicted groundwater levels with observed. At a minimum, some calculation of the distance to the stagnation point should be used to support the bounding flow paths showing the limits of capture downgradient from the OU2 GES.

The upgradient extent of the TCZ should be shown graphically and more clearly defined because some areas along the southeast boundary of the plume in Subunit B are above the AWQS and outside the indicated capture zone and have the potential to migrate past the OU2 GES in the future. Without a graphical definition of the TCZ, the interpreted capture cannot be compared to the TCZ. It is unclear if upgradient concentrations above the AWQS southeast of the OU2 GES are part of the TCZ.

Uncertainty and data gaps are not specifically addressed and the report concludes that the lines of evidence are sufficient to show plume containment. However, only two lines of evidence are presented. The capture evaluation provided by CRA relies mainly on interpretation of groundwater level data and capture zones defined by flow paths. There is substantial uncertainty in the construction of the groundwater contours and a more rigorous approach to the construction of flow paths is required to refine the bounding flow lines defining the limits of capture.

Summary

The CRA capture zone evaluation indicates adequate capture is likely occurring for VOCs above the AWQS in the area of Interstate 10 in Subunits A and B; however, future evaluations should be supported with a more rigorous approach to defining groundwater contours, flow paths, the limit of capture, and the TCZ. Interpretations based on groundwater levels should be supported with calculations and comparison between predicted and observed results for calculations and numerical models. Analytical calculations should be provided to support estimates for the downgradient stagnation point, the extraction rate required to provide adequate capture, and the width of the capture zone. Interpretations of adequate capture in subunit D include more uncertainty and are more difficult to evaluate. Groundwater currently in the stated TCZ for Subunit D with the potential to escape capture is only slightly above the AWQS.

Longer-term issues with capture are indicated for areas southeast from the OU2 GES that exceed the AWQS and are outside the limit of capture. If contaminant concentrations migrate westward as indicated, the TCZ as currently stated will expand and include areas outside the current limits of capture.