

APPENDIX I

GROUNDWATER OPERABLE UNIT REMEDIAL

INVESTIGATION REPORT—WRITTEN PUBLIC COMMENTS

AND RESPONSIVENESS SUMMARY

REMEDIAl INVESTIGATION REPORT

GROUNDWATER OPERABLE UNIT

Arizona Department of Environmental Quality

Broadway-Pantano Water Quality Assurance Revolving Fund Site

June 1, 2012

RESPONSIVENESS SUMMARY

**FINAL REMEDIAL INVESTIGATION REPORT--
GROUNDWATER OPERABLE UNIT
BROADWAY-PANTANO
WATER QUALITY ASSURANCE REVOLVING FUND SITE
TUCSON, ARIZONA**



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[NOTE—Appendix A contains copies of the written public comments.]

The Arizona Department of Environmental Quality (ADEQ) is presenting this Responsiveness Summary (RS) to comments received from various parties on the ADEQ *Draft Remedial Investigation Report—Groundwater Operable Unit and Other Potential Source Areas—April 2, 2007, Broadway-Pantano Water Quality Assurance Revolving Fund Site, Tucson, Arizona* (Draft GOU RI Report). The Draft GOU RI Report was made available for public review and comment between April 4, 2007 and May 29, 2007. ADEQ received written comments from the following: (1) the Broadway-Pantano WQARF Site Community Advisory Board (CAB), (2) Pima County, County Attorney, and its contractor, Brown and Caldwell (3) the City of Tucson—Water Department (a.k.a. Tucson Water [TW]), and (4) the City of Tucson—Environmental Services (COT-ES). ADEQ has prepared this RS for all comments received regarding the Draft GOU RI Report. No other comments were received in the period allotted. [Note that the comments from these parties, provided below in italicized print, are word-for-word as they were provided to ADEQ.]

The title of the final report is “Final Groundwater Operable Unit Remedial Investigation—Broadway-Pantano Water Quality Assurance Revolving Fund Site” (Final GOU RI Report). This title was changed to reflect that, even though data and information regarding contaminant sources are included in the Final GOU RI report, the focus of the Final GOU RI report is the impact to groundwater. ADEQ is still in the process of collecting the data needed to produce the Landfill Operable Unit (LOU) RI Report. The LOU includes the closed 100+ acre Broadway North Landfill (BNL), the northern part of the closed 50+ acre Broadway South Landfill (BSL), and the vadose zone directly beneath, and in close proximity to, the BNL and BSL boundaries. The GOU plume is the volume of the saturated zone containing volatile organic compound concentrations (VOCs) exceeding the State of Arizona Aquifer Water Quality Standards (AWQSS).

COMMENTS FROM THE BROADWAY-PANTANO WQARF SITE COMMUNITY ADVISORY BOARD

Comments regarding the Draft GOU RI Report were received in a letter from Broadway-Pantano WQARF Site (Site) CAB Co-Chairs James Garrett, Jr. and Judy Burns to ADEQ, dated May 23, 2007. The following section includes the text of comments along with a response to address each comment.

GENERAL COMMENTS

The Community Advisory Board for the Broadway-Pantano WQARF Site appreciates the extensive field investigations and the detailed draft Remedial Investigation (RI) Report that identifies the contaminants, their mode of transport, the extent of the contaminated groundwater, and potential public health risks. We are pleased that the Broadway South Landfill was added to the site.

However, we do think more vertical assessment of the groundwater plume needs to be done. But even more important, work needs to be done regarding soil gases. Looking at historical data, we are aware of the migration of soil gases within and also off of this site in some areas. Since gases that have been extracted from this site contain many VOCs that are a threat to human health and

safety, there is an urgent need for the EPA to establish and release guidelines for measurement of acceptable limits for these types of volatile organic compounds inside structures.

Finally, it is imperative that this report leads to a final plan for remediation for this site. Because this site is located in the City of Tucson's central well field, there is the real potential for serious public health risks. In times of drought, contaminants can be pulled and may eventually contaminate city drinking wells. There are nearby wells designated as "last on/first off" that have been turned on in times of water shortages. It is unconscionable that the sustainability and the health of the population of a major city in this state be subject to such risks.

Response to Specific Comments within General Comments:

- **Vertical Plume Delineation:** With the data from the WR-352A and WR-353A wells located in the western and eastern parts of the GOU, and the data from the BP-24A/B/C well cluster installed in 2007, ADEQ believes that the vertical extent of the GOU contamination has been sufficiently defined (approximately 100' below water table [BWT]) to proceed with the GOU Feasibility Study. The reader is referred to the Final GOU RI Subsection 3.5.3 and Section 4.2.3.
- **Soil Vapor Risk Assessment:** ADEQ agrees that there is a need for the United States Environmental Protection Agency (USEPA) to establish federal residential indoor air standards. ADEQ gathered shallow soil gas data along the southwest perimeter of the BNL, performed a risk assessment with these data, and published the results in the *Human Health Risk Assessment—Broadway North Landfill—Broadway-Pantano Water Quality Assurance Revolving Fund Site*, dated July 6, 2010. The results of this risk assessment indicated that the cumulative reasonable maximum exposure indoor health risk results are less than the USEPA's trigger levels for remediation (i.e., an excess cancer risk of 1.0×10^{-4} and a segregated hazard index of one), and below or at the *de minimus* risk of 1.0×10^{-6} , indicating no unacceptable health effects to current adjacent residents. ADEQ will be performing a similar risk assessment for the BSL as part of the LOU RI.
- **Site Progress:** ADEQ agrees that continued progress toward a final GOU remedy is important. In 2010, ADEQ produced a fate-and-transport groundwater model for this Site and ran preliminary future simulations of numerous potential final remedies using the model. These simulations will also be used as part of the future GOU Feasibility Study. Also, ADEQ finalized the Western Containment System Effectiveness Evaluation report in 2009.

COMMENTS FROM PIMA COUNTY, COUNTY ATTORNEY

Comments regarding the Draft GOU RI Report were received in a letter from Charles Wesselhoff, Deputy County Attorney, Pima County, to ADEQ, dated May 29, 2007. The following section includes the text of comments along with a response to address each specific comment.

GENERAL COMMENTS

Pima County and its consultant, Brown & Caldwell, have reviewed the draft Remedial Investigation (“RI”), dated April 2, 2007, for the Broadway-Pantano Water Quality Assurance Revolving Fund (“WQARF”) site. While, from this review, it is apparent that a substantial amount of work has been done at this site, it is also apparent that the draft RI meets neither the statutory criteria nor the federal guidance for a proper RI.

At the public meeting on May 23rd, concerns were expressed about over-studying the site. However, that is not the case here. Statutory and regulatory standards are in place to ensure that the remedial investigation results in a feasibility study, record of decision, and ultimately, a site clean-up that is protective of human health and the environment while meeting the economic reasonableness and technical feasibility directives of the WQARF program. Due to the data gaps in the draft RI for this site, these goals are not achievable.

Attached hereto as Attachment A are Pima County’s technical comments prepared by Brown & Caldwell regarding the draft RI. These address the data gaps, the areas where the draft RI fails to meet the minimal RI preparation standards, and areas where there are differing interpretations of the existing data.

This Remedial Investigation fails to meet the requirements of ARS 49-287.03 in that it did not achieve the minimum requirements of R18-16-406. This regulation sets out the requirements of the remedial investigation. The review by Brown and Caldwell clearly demonstrates that the first requirement has not been met. There has not been the establishment “of the nature and extent of the contamination and the sources thereof.” The standard for Remedial Investigations is to follow the guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA 540-G-89-004, October 1988). This document provides that as a minimum the extent of the groundwater and soil contamination should be determined both horizontally and vertically. At the public hearing it was stated that this determination requires more data collection. This [sic] data should be collected before any conclusions can be made with regard to sources of contamination and completion of the RI. In order to move on to a Feasibility Study or drafting of a scope of work for a feasibility study, further work is required. The Remedial Investigation is not ready to be finalized.

A cursory review of the opening section of the RI shows there are misstatements of fact in Section 1.3: Site Background. These include:

1. *The report asserts that landfilling began at Broadway South in 1953. While there is a 1953 agreement between the County and the then-owner of a small parcel of property that allowed disposal, there is no evidence that disposal ever occurred on this property during the two-year agreement period and indeed no evidence that any disposal occurred at Broadway South until 1956 when Sanitary District #1 began operations.*
2. *The report seems to suggest that the PAG-estimated 200 ton per day disposal rate extended from 1953 through 1961 or 1962. As discussed above, there is no*

evidence that there was disposal anywhere on the site prior to 1956 when Sanitary District #1 opened a landfill on a portion of the property.

Other misstatements may exist but Pima County has had insufficient time to fully review all of the factual statements made.

In sum, the draft RI does not meet the statutory and regulatory minimums in that it: (1) fails to adequately identify and evaluate all potential sources of contamination; (2) does not adequately characterize the extent of the contamination; (3) suggests contaminant transport scenarios (i.e., commingling of plumes) that are not supported by the hydrology; and (4) does not provide sufficient information to effectively move toward the development of an economically reasonable feasibility study.

Response to Specific Comments within the General Comments:

- **Contaminant Sources:** As indicated on page 1 of the Draft and Final GOU RI Report, the focus of this RI is the GOU—not soil contamination or characterization of the BNL and BSL. It is also indicated on page 1 of the Draft and Final GOU RI Report that the major sources, the BNL and the BSL, which compose the LOU, will be the focus of the future LOU RI Report. (Note: The sand and gravel pits located within the boundaries of the BNL and BSL properties, wherein wildcat/illegal dumping of wastes was done prior to and during the operation of the municipal BNL and BSL, will also be covered in the LOU RI Report.)

Section 3.1 of the Final GOU RI Report includes information from the April 4, 2012 HydroGeoLogic letter report (prepared for ADEQ) that summarizes BNL and BSL property ownership, operational history, usage, and waste streams.

Section 3.1 also includes information from the March 24, 2001 SECOR (now Stantec) *Regulatory Agency and Historical Records Review* report (prepared for ADEQ) that presents the results of an extensive historical environmental and other records review of facilities within and near the GOU that may have used chlorinated solvents—particularly tetrachloroethene (PCE) and trichloroethene (TCE). The purpose of SECOR's records review was to determine usage (or non-usage) of PCE or TCE by facilities within and near the GOU. Stantec published a report on May 1, 2012 of its more recent review of environmental records of potential PCE- or TCE-using facilities. Based on ADEQ's review of the information in this report and the historical and recent groundwater data from monitor wells near the PCE- and TCE-using facilities, and given the significant depth to groundwater at the Site, field investigations of these facilities is not warranted. The reader is referred to *Potential Historical Users of Tetrachloroethene and/or Trichloroethene* May 1, 2012, prepared by Stantec for ADEQ.

- **Vertical Plume Delineation:** The reader is referred to ADEQ's “Vertical Plume Delineation” Response on page 2 of this RS.
- **Lateral Plume Delineation:** Through the ADEQ/COT work share agreement, ADEQ and the COT installed three groundwater monitor wells (WR-702A, WR-703A, WR-704A)

downgradient of the Western Containment System Capture zone in the winter of 2008/2009. With water data from these three new wells and the Catalina Village water supply well, ADEQ believes that the lateral extent of the plume has been sufficiently delineated to proceed with the GOU Feasibility Study. The reader is referred to Final GOU RI Report Figure 49.

- Landfilling of BSL prior to 1956:

Pima County's assertion that there is no evidence that landfilling occurred at the property during Pima County's lease is contradicted by the following:

(1) The *Arizona Daily Star*, March 25, 1953 article, “Land Is Leased To Serve Pima As Garbage Site,” which states, “*Land on Broadway, west of Pantano wash [sic], has been leased by the county as a garbage disposal site to serve the northeast section of the community, Lambert Kautenberger, chairman of the board of supervisors, announced yesterday. The pit will be put in operation as soon as equipment can be purchased.*”

(2) The *Arizona Daily Star*, October 5, 1956 article which shows a picture of the “*sanitary fill at Broadway and Pantano Wash where the Sanitary District’s bulldozers are busily smoothing the 300-acre tract into parade ground smartness. The tract was formerly operated by the county and has now been turned over to the Sanitary District which has put some new equipment to work cleaning it up.*” The article states, “*The new equipment, two tractors, bulldozers and a pickup trailer recently purchased by Pima County Sanitary District, was put to the test this week in cleaning up the former county sanitary fill at Broadway and Pantano Wash. The 300-acre tract, which has been used for some years, as a dump and sanitary fill by the county was turned over to the district for operation and garbage disposal....Kenneth Sharman, district clerk, said yesterday it is hoped the district also can clean up the private dumping ground at E. 22nd Street and Pantano Wash, which has been used for a long time by the public and is not under control. This dump is on the north side of the street and extends over the desert in unsightly piles. People have confused this dump with the county dump to the south of Broadway, where they should have taken their waste, and in spite of warning signs have continued to use it.*”

(3) The BSL section of the February 1997 draft “LESP IV Preliminary Assessment of Fourteen County-Operated Landfills, Pima County, Arizona,” prepared for the Pima County Solid Waste Management by the Pima Association of Governments (PAG), indicates that PAG analysis of aerial photographs for the years 1953, 1955, 1958, 1960-1962, etc., indicated the landfill was opened by 1953. [NOTE: “LESP” stands for “Landfill Environmental Studies Program.]

- Commingling of BSL and BNL Groundwater Plumes: Pima County indicates commingling of the plumes is not supported by the hydrology. Given that the BNL is situated close to and directly north of the BSL, and that for the past ten years the ambient groundwater flow directions from the BNL and the BSL have been westward and northwestward, respectively, ADEQ does not understand the rationale behind Pima County's statement that the hydrology does not support that commingling of the plumes would be likely. In fact, the ambient

groundwater flow directions in the area of the BNL and BSL indicate that commingling should be expected.

- Sufficiency of Site Information: Pima County indicates that this draft RI “does not provide sufficient information to effectively move toward the development of an economically reasonable feasibility study.” As indicated in ADEQ’s preceding responses in this RS, it is ADEQ’s opinion that the extent of GOU contamination is characterized sufficiently to proceed with the GOU feasibility study.

Comments from Brown and Caldwell for Pima County, County Attorney

Comments regarding the Draft GOU RI Report were received from Brown and Caldwell, under contract to the Pima County Attorney, which were attached to the letter from Charles Wesselhoft, Deputy County Attorney, Pima County, to Gretchen Wagenseller, the ADEQ Project Manager, dated May 29, 2007. The following section includes the text of comments along with a response to address each specific comment.

GENERAL COMMENTS

Pima County retained Brown and Caldwell to perform a technical review of the Draft Remedial Investigation Report for the Groundwater Operable Unit and Other Potential Source Areas for the Broadway-Pantano Water Quality Assurance Revolving Fund Registry Site, Tucson, Arizona. The Draft Remedial Investigation (RI) Report dated April 27, 2007 was prepared by Secor International Incorporated (Secor) on behalf of the Arizona Department of Environmental Quality (ADEQ). Based on our review of the data included in the document and in other reports associated with the Broadway North Landfill (BNL), Broadway South Landfill (BSL) and Prudence Landfill (PL), Brown and Caldwell has developed a series of comments presented under a general categorization scheme below.

Overall, it is obvious that a large amount of work has gone into the various phases of remedial investigation activities associated with this report. In particular, a heavy emphasis has been placed on delineating the down-gradient extent of the PCE-impacted groundwater located west of the BNL in support of the design and operation of the Western Containment System (WCS). A second large effort was conducted at BNL regarding soil vapors as the mechanism for groundwater being impacted by chlorinated volatile organic compounds (CVOCs) and the subsequent design and operation of a landfill soil vapor extraction system. This latter work is not discussed in detail within the Draft RI report because (1) it was conducted by the City of Tucson, not ADEQ’s contractor, and (2) the vadose one [sic] is being addressed under a separate document associated with the landfill operable unit (LOU). However a presentation of BNL soil gas investigation results from 13 separate investigations over more than a 20-year time period are presented in Appendix C of the Draft RI.

A similar level of information was not discussed for the BSL. Based on the information presented in the Draft RI, the inclusion of the BSL into the Broadway-Pantano WQARF site is based largely if not entirely on the presence of PCE and TCE in monitor wells within and to the

northwest of the BSL. Although such data warrants further investigation, the inclusion of the BSL into the Broadway-Pantano WQARF site in 2005 appears to be premature and contrary to what information was collected on the BSL site prior to 2005 (e.g., minimal to no CVOCs in soil gas) and groundwater sampling results from wells to the west and northwest of the BSL. In Section 3.1.4 Broadway South Landfill of the Draft RI data [sic] it was stated that “ADEQ conducted a focused investigation, from July 2001 through March 2002, to evaluate the need for an ERA...”. That investigation was focused on the potential need for an ERA associated with the City of Tucson (COT) production wells C-025B and D-018A located west of BSL and not on whether BSL was a present source of groundwater contamination. A conclusion reached during that study was that based on the absence of PCE contamination in monitor well BP-8 and BP-15, no connection between potential CVOCs originating from the BSL and the PCE groundwater plume recognized to have originated from the BNL could be made. Based on this information and additional data collected since March 2002, the work completed to-date at the BSL and presented in the Draft RI does not meet Arizona Revised Statute (ARS) 49-287.03E where it is stated “The remedial investigation shall collect the data necessary to adequately characterize the site or the portion of the site for the purpose of developing and evaluating effective remediation alternatives pursuant to the feasibility study requirements prescribed by subsection F of this section”. Nor does the information presented address “The extent, general characteristics, and degree of the source of the release” as required under R18-16-406 Remedial Investigation.

SPECIFIC COMMENTS

Section 1—Commingling of PCE Plumes

In Section 1.3, page 2 of the Draft RI, Secor states that “The GOU currently (as of April 2006) consists of two PCE plumes (Figure 3)... One plume with two lobes extends westerly from the BNL and northwesterly from the BSL, respectively. The lobes conjoin further to the west.”

Brown and Caldwell believes that there are numerous inconsistencies with both groundwater analytical data and groundwater elevation data that do not provide technical justification for the conjoining of the “two lobes” of impacted groundwater based on the information available. A number of these inconsistencies are detailed below:

Comment 1: *Based on the groundwater flow direction from the BSL, as presented in the maps presented as Figures 22 through 26 in the draft RI, the PCE concentrations measured in monitor wells downgradient of BSL in April 2006 do not support a commingling of the PCE plumes as presented in Figure 34 of the draft RI. In particular, the absence of PCE concentrations in wells WR-177A, WR-179A, and D039A, combined with the low levels of PCE measured in BP-10 and BP-16 do not support the tenuous connection between the plumes as presented on Figure 34 of the draft RI. To connect the PCE concentration at WR-367A to BP-8, a distance of 3,200 feet as shown on Figure 3 of the Draft RI, would require groundwater flow to maintain a consistent flow direction for an approximately 8 year period (based on the 1 foot per day advective flow velocity referenced in the Draft RI) with virtually no lateral dispersion. This is highly unlikely.*

Response 1: COT-ES has previously submitted groundwater monitoring potentiometric maps to ADEQ from 1997 through 2000, and these maps generally have shown the groundwater flow directions at the BSL to be toward the northwest. Also, in 2001 and 2002, ADEQ installed groundwater monitoring wells to the northwest and west of the BSL to better define groundwater flow direction in this area, and the groundwater flow from the BSL has been shown to be consistently toward the northwest during every ADEQ monitoring event since ADEQ began monitoring in 2001. Likewise, the previously-referenced COT-ES potentiometric maps and the 2001-2011 ADEQ potentiometric maps have shown the groundwater flow direction at the BNL to be toward the west-northwest—not the southwest. Thus, it is more reasonable to project a PCE groundwater plume migrating to the northwest, with relatively little lateral dispersion, from the northern portion of the BSL than to hypothesize that the contaminant plume from the BNL shifted to the southwest toward well BP-8. Final GOU RI Report Figures 5 and 24 through 31 show that groundwater flow from the BNL from November 2001 through September 2011 consistently was to the west or west/northwest, not the southwest. The BNL groundwater plume should migrate by advection in the dominant groundwater flow direction.

It should be noted that with WR-177A (which has had low level detections of PCE in 2001 and 2005), one would more likely expect the dispersion impact to be from the BNL plume than the BSL plume, given that WR-177A is on the periphery of the BNL itself. The decision to add the BSL groundwater plume to the Site in 2005 was based on the water quality and well water elevation data that indicated the BSL groundwater plume was commingling with the BNL groundwater plume.

Likewise, it should be noted that the BP-10 well has contained up 50 micrograms/liter ($\mu\text{g/l}$) of PCE (at first sampling after installation in 2001) and WR-367A has contained up to 41 $\mu\text{g/l}$ of PCE.

Also, it should be noted that while the PCE soil gas concentrations found during ADEQ's October 2006 sampling of its soil gas probes at 50', 100', 150', 200', 250', 300', and 350' below ground surface (bgs) at four locations were low, only two of these samples were non-detect for PCE and these results do indicate that PCE was released from the BSL. The BSL soil gas investigation is still in progress.

To summarize, in 2005, water quality data indicated that the BSL plume was commingling with the BNL plume. Given that the data indicate that the groundwater beneath the BSL has been contaminated at least since 2000 when the first groundwater monitor well was installed, and that the groundwater flow direction from the BSL has been to the northwest, ADEQ's decision to add the BSL and the BSL groundwater plume to the Site in 2005 was not premature.

Comment 2: *It was stated in Section 5.4.3.2 Saturated Zone Fate and Transport Processes of the draft RI that “URS (2002a)¹ postulated that the plume originated at the closed BNL in approximately 1970 (approximately 10 years after the landfill began accepting refuse).” This was apparently estimated based on the date of*

known impacts at COT supply wells west of BNL and an estimate of advective groundwater flow velocity of approximately 1 foot per day. Based on the presence of concentrations of PCE in excess of 5 µg/L as early as 1988 in COT well C-021A located more than 5,000 feet downgradient of BNL, this is likely a reasonable estimate. Current conceptual models are that the VOCs impacted the groundwater largely if not entirely via the downward movement of landfill gas (LFG) impacted with PCE and its degradation daughter products.

Based on reports that BSL received wastes from the early 1950s to the early 1960s, and assuming that a similar mechanism for vertical transport would be responsible, it is not unreasonable to assume that groundwater beneath BSL could have been impacted by sometime in the 1970s. However, based on water quality results from numerous wells located to the west and northwest of BSL (the feasible downgradient groundwater flow directions) no groundwater impacts were observed in a feasible down-gradient location from BSL until the mid 1990s. Due to the limited data available, this discrepancy in mechanisms and timing for impacts to groundwater should be discussed prior to connecting VOCs possibly emanating from BSL to those documented to have emanated from BNL.

Response 2: The data collected during the RI to date clearly demonstrate that VOCs in groundwater are emanating from BSL and migrating toward the northwest from the BSL, and have commingled with the BNL plume in the past. The reader is referred to Response 1 on page 8 of this RS. Please note that D-021A, which is downgradient of the BSL and BNL (and much closer to both the BSL and BNL than the C-021A well) was first found to be impacted in 1988—not the mid 1990s.

Comment 3: *An analysis of time-series data presented for wells located to the southwest of BNL suggest [sic] that impacts to these wells is [sic] more likely the result of southwesterly movement of impacted groundwater from BNL than northwesterly movement of impacted groundwater from BSL. Along with information previously presented above, the southwesterly movement of impacted groundwater from BNL is supported by the shape of the GOU as presented in 2000 by URS as shown on Figure 4 of the Draft RI. Additionally, the absence of any detectable VOCs in well WR-179A until 1995 accompanied by increasing concentrations up till 2001 followed by a gradual decrease can be explained by the turning off of COT wells to the west of BNL in the late 1980s while COT wells to the southwest (C-025B and D-018A) of BNL were pumped to make-up [sic] the shortfall. This change in pumping pattern resulted in a southwesterly shift in groundwater flow direction, which was also documented in a memorandum (Clear Creek Associates, 2000²) completed on behalf of the City of Tucson and submitted to ADEQ on August 4, 2000.*

Response 3: ADEQ concurs that impacted groundwater from BNL, which naturally flows in a westward direction, could have shifted toward the southwest under the influence of heavy pumping of Tucson Water's production wells C-025B and D-018A. However, the potentiometric maps in COT-ES' groundwater sampling reporting from this time period (COT-ES started mapping its well water elevation data in its

reports in 1997) generally show western and northwestern groundwater flow directions for the BNL and BSL, respectively.

Also, the observed timing of impacts at well BP-8 does not appear to have resulted from this potential southwestern shift. BP-8 was installed in 2001 and PCE wasn't detected in discrete-depth groundwater samples from well BP-8 at any depth until 2004, and PCE wasn't detected at all sample depths until 2005—seven years after Tucson Water's production wells C-025B and D-018A had been placed on severely-restricted-use standby status. [Use of C-025B and D-018A was ramped down from 1998 to 2000, and from 2001 through 2010 pumping from these wells was negligible.] ADEQ's potentiometric maps in the Final GOU RI Report covering 2001 through 2011 (Figures 5 and 24 through 31) show that the groundwater flow direction out of the southern part of the BNL was to the west/northwest—a direction not likely to impact BP-8. A more likely scenario is that the contamination detected in 2004 and 2005 in well BP-8 came from the BSL which is located directly upgradient and flowing towards BP-8 (Final GOU RI Report Figures 27 and 28).

Groundwater data collected from WR-367A was found to be contaminated during its first sampling in 2000 and all subsequent samplings. It is likely that this contamination extended farther downgradient even before WR-367A was installed. BP-10, located immediately downgradient of WR-367A, contained 50 µg/l when it was first sampled after installation in 2001. The detections of PCE in WR-179A during the late 1990s could easily have resulted from the migration of the BSL plume toward WR-179A in response to the pumping of D-018A/C-025B. Also, it should be noted that the GOU plume maps changed after 2000, not solely because of the gradual disappearance of PCE from WR-179A, but also because of the initial non-detect data from monitoring wells BP-7 (installed in 2002) and BP-8 (installed in 2001). It is likely that the plume shape in the URS Corporation 2000 GOU plume map was an artifact of not having any monitoring points between WR-179A and the BNL.

Comment 4: *In Section 3.1.4, page 23, Secor states “The results from the sampling events performed in 2002 through the middle of 2004 continued to indicate that the BSL plume was not commingled with the Broadway-Pantano Site plume. However, PCE was detected in well BP-8 (and BP-7) in November 2004 and most of the subsequent sampling events. ADEQ determined in 2005, on the basis of subsequent groundwater sampling, that the BSL plume was commingling with the BNL GOU groundwater plume; subsequently, the Broadway-Pantano Site boundary and RI were expanded to include the BSL groundwater plume.”*

The Draft RI does not provide an adequate discussion and evaluation of the groundwater sampling data to support the conclusion that the PCE detected in well BP-8 was derived from the BSL. The detection of PCE in well BP-8 could result from the migration of the BNL plume. The fact that PCE was initially detected in November 2004 in both wells BP-7 and BP-8 indicates that the source of the PCE should be located east and at an equidistant location from both wells.

In the Clear Creek Associates (2000) memo described above, it was concluded that groundwater flow direction and migration of the BNL plume shifted to a southwest direction in the early 1990s. The shift was in response to the shutdown of five groundwater production wells located immediately downgradient of the BNL and the continued groundwater extraction from wells C-025B and B-018A located southwest of the BNL plume. The southwest groundwater flow direction and BNL plume migration direction continued until 2001, when the two extraction wells were also shutdown [sic]. Similarly, in 2002 URS Corporation (URS), following the conduct of several groundwater investigations at the Broadway-Pantano Site, concluded that the groundwater plume emanates primarily from the southern portion of the BNL and flows toward the southwest for approximately one mile and then shifts to the northwest. In fact, the GOU, as described by URS in 2000 and shown on Figure 4 in the Draft RI already includes both BP-7 and BP-8 without any impact from BSL being shown. However, the absence of noticeable PCE in BP-7 and BP-8 until 2004 (per Table 5 of the Draft RI) indicates that the URS figure was also in error. Although it is very possible that the BNL plume that migrated to the southwest during the 1990s and then shifted to the west-northwest after 2001 is the source of the PCE detected in BP-7 and BP-8, the discrepancies in data highlight the difficulties in connecting plumes based on spatially and temporally limited data.

Response 4: ADEQ concurs that the source of the PCE detected in well BP-7 is the BNL groundwater plume. However, the source of the PCE detected in well BP-8 is much more likely to be the BSL groundwater plume than the BNL groundwater plume. The reader is referred to Response 3 on page 9 of this RS.

Comment 5: *The BNL and BSL are in a hydraulically complex portion of the Tucson basin due to their location within the historically heavily pumped central well field. This hydraulic complexity is compounded by the presence of an apparent low hydraulic conductivity northwest-southeast trending feature referred to as the Pantano Feature by numerous past researchers and specific to this Site, in Dames and Moore (2000)³. This feature trends roughly parallel with Pantano Wash but is offset approximately ½- to 1-mile to the east-northeast. An analysis of basin-wide groundwater flow maps prepared by Tucson Water during the 1980s through the present clearly show the “stacking up” of ground elevation contours along this feature. Although a detailed discussion of the feature is probably not needed for the RI due to its location upgradient of the landfills, its importance is reflected in the large effect it has on groundwater flow direction across both BNL and BSL. In particular, the combined effect of the Pantano Feature with groundwater pumping to the west of the BNL and BSL results in an abnormally sharp concave-west curve in the groundwater elevation contours. This is partially reflected in Figure 22 in the draft RI. An analysis of groundwater elevation maps prepared by Tucson Water for 1980 through the present identify [sic] that the direction of groundwater flow across BNL has varied from southwest to west, while across BSL it has varied from west to northwest. The convergence of groundwater flow directions across each landfill,*

i.e., southwest at BNL and northwest at BSL results in what is called a hydrogeologic singularity, or an area for which groundwater flow direction is mathematically undefined. At a minimum this reflects the variability over which groundwater flow directions have historically occurred in the area and the care that must be taken in drawing conclusions regarding groundwater flow paths over any length of time.

Response 5: The reader is referred to Responses 1-4 on pages 8-11 of this RS. ADEQ concurs that the direction of groundwater flow at the Site could have been impacted historically by the pumping of the Tucson Water last-on/first-off (LOFO) wells and may be impacted in the future by the pumping of these wells. Therefore, ADEQ has expanded its network of transducers within the groundwater monitoring well array to include more transducers in the immediate vicinities of the BSL and the D-018A and C-025B wells so that, if the two LOFO wells are pumped in the future, their impact on the Site groundwater flow can be determined conclusively. However, ADEQ is confident in drawing conclusions regarding the groundwater flow directions off of the BNL and BSL from 2001 through 2011 at the Site since the conclusions are based on its potentiometric maps generated from well water elevations collected from approximately 50 wells located at and near the Site during this period.

Comment 6: *Based on the above comments, there is insufficient information within the Draft RI to adequately address “The extent and general characteristics of the hazardous substances released, including physical state, concentration, toxicity, propensity to bioaccumulate, persistence and mobility” for neither BNL or BSL nor “The extent, general characteristics, and degree of the source of the release” as required under R18-16-406 Remedial Investigation.*

Response 6: The focus of the Final GOU RI Report is the groundwater contamination—not the source of this contamination. General characteristics regarding the hazardous substances released can be found in Tables 18 and 19 and Appendix G of the Final GOU RI Report. Also, these characteristics will be investigated further as needed in the LOU RI Report. Regarding determination of the extent of contamination, the reader is referred to the “Vertical Plume Delineation” Response on page 2 of this RS and the “Lateral Plume Delineation” Response on page 4 of this RS.

Section 2—PRP Search

Comment 1: *In Section 3.1.3, page 21 of the Draft RI, Secor states “The purpose of this review and site walk was to identify likely users (historical and current) of solvents and cleaning fluids containing VOCs (including drycleaners, lube shops, other automobile repair facilities, and other medical facilities).” It is not clear if Secor considered machine shops and/or metal fabrication facilities in their search of other likely users of solvents.*

Response 1: SECOR did include metal fabrication facilities in the search of other likely users of solvents and the Final GOU RI Report text as been revised accordingly.

Comment 2: *Section 3.1.3, page 22, Secor states “Based on the records review and site walk, SECOR (2001a) determined the following: Six current and former establishments were identified as possibly having on-site dry-cleaning operations...”. These six dry-cleaners seem to be the same six facilities located along Broadway Avenue identified by CDM in their Technical Memorandum Number 1 in 1996; however, Secor fails to identify the location of these potential sources on any figures of the draft RI. According to CDM, one of the dry-cleaning facilities is located adjacent to monitoring well BP-10, and two other dry-cleaning facilities are located immediately upgradient of well BP-8. These potential sources of PCE should have been investigated during the RI. A release from any of these facilities could have contributed to PCE concentrations detected in nearby groundwater monitoring wells BP-10 and/or BP-8.*

Response 2: Section 3.1 of the Final GOU RI Report includes information from the March 24, 2001 SECOR (now Stantec) *Regulatory Agency and Historical Records Review* report (prepared for ADEQ) that presents the results of an extensive historical environmental and other records review of facilities within and near the GOU that may have used chlorinated solvents—particularly PCE and TCE. The purpose of SECOR’s records review was to determine usage (or non-usage) of PCE or TCE by facilities within and near the GOU.

On May 1, 2012, Stantec issued a report for ADEQ of Stantec’s more recent review of environmental records of potential PCE- or TCE- using facilities. Based on ADEQ’s review of the information in this report and the historical and recent groundwater data from monitor wells near the PCE- and TCE-using facilities, and given the significant depth to groundwater at the Site, field investigations of these facilities is not warranted. The reader is referred to *Potential Historical Users of Tetrachloroethene and/or Trichloroethene* May 1, 2012, prepared by Stantec for ADEQ.

ADEQ considers it unlikely that any of the dry-cleaning facilities has impacted groundwater in the GOU that is over 300’ deep. The historical environmental records show only one dry cleaning facility had a release of PCE. Fersha Corporation at 7258 East Broadway Boulevard had a release of 15 gallons of still bottoms [spent solvent sludge] onto concrete in 1993. This release is not substantial enough to have been able to impact groundwater several hundred feet bgs. The closest well to the 7258 East Broadway Boulevard location is the cross-gradient BP-16. The highest PCE concentration in BP-16, which was installed in 2002, has been 3.0 µg/l. BP-16 is downgradient of the BSL and groundwater samples from BP-16 also have contained very low concentrations of dichlorodifluoromethane (DCDF)—indicative of contamination from landfill waste. Likewise, groundwater samples from BP-8, which is downgradient of 7258 East Broadway Boulevard and the BSL, have been found to contain DCDF and PCE, which is indicative of landfill contamination. DCDF has already been documented to have been part of the release from BSL, having been detected along with PCE in groundwater wells BP-23, WR-367A, BP-10, and BP-8, but DCDF is

not used for dry cleaning. Therefore, ADEQ concludes that the BNL, BSL, and sand and gravel pits (from illegal/wildcat dumping) are the only known sources of groundwater contamination in the Site GOU.

Comment 3: *The RI does not provide any reasoning for not considering the Prudence Landfill as a potential source of PCE groundwater contamination. It is disturbing that the RI does not mention or show on any figures well WR-434A, located west of well R-124A and immediately downgradient from the Prudence Landfill. This well was installed in 2002 and constructed with nested vapor monitoring probes at depths of 50, 150, 250 and 350 feet below surface. Analyses of vapor samples collected from each nested probe have consistently detected PCE, TCE and dichlorofluoromethane (DCFM) during each quarterly monitoring event. The concentrations of PCE, TCE and DCFM consistently increase with depth, and in June 2006, the 350-foot deep probe contained PCE concentrations of 29 µg/L, TCE of 3.5 µg/L and DCFM of 33 µg/L. Unfortunately, the RI fails to provide any groundwater analytical data from this well or from wells R-124A and R-125A located within the Prudence Landfill.*

Response 3: ADEQ has reviewed the groundwater data from Prudence Landfill and does not consider the Prudence Landfill to be a source of PCE groundwater contamination at the Site because PCE (and all other groundwater constituents of concern for the Site) has been either non-detect or below the AWQS in the R-124A and R-125A Prudence Landfill groundwater wells and in the WR-435A groundwater well located immediately downgradient of the Prudence Landfill. Text has been included in the Final GOU RI Report to show that Prudence Landfill data were reviewed to determine whether it was contributing to the Site groundwater contaminant plume.

Completion of the LOU RI will include field confirmation of the southern boundary of the BSL (extending through Gollob Park) proposed in the *Historical Summary Report—Prudence Landfill/Gollob Park Area*, dated March 5, 2004, prepared by URS for the City of Tucson Environmental Services. The WR-434A soil gas monitor well is within the proposed BSL boundary from the aforementioned report—not within the Prudence Landfill boundary.

Comment 4: *Based on the above comments, the Draft RI is insufficient to adequately “Establish the nature and extent of the contamination and the sources thereof,” as required under R-18-16-406.”*

Response 4: The reader is referred to the “Vertical Plume Delineation” Response on page 2 of this RS, the “Contaminant Sources” and “Lateral Plume Delineation” Responses on page 4 of this RS, and Responses 1-3 on page 12-14 of this RS.

Section 3—Vertical Mixing of Groundwater Quality

Comment 1: *A great deal of effort was expended in the Draft RI to support or dismiss the depth-specific groundwater quality results collected from the long-screened*

monitor wells using depth-specific samples. This appeared to be justified based on results, where several of the long (over 100 feet in length) screened wells showed similar PCE concentrations from top to bottom. This extent of vertical mixing of groundwater quality is generally considered highly unlikely in alluvial basins due to the large contrast in horizontal versus vertical hydraulic conductivity. With properly constructed depth-discrete monitor wells this is even difficult to attain under vertical gradients imposed by pumping. Most deep or vertically extensive groundwater quality problems in basin and range alluvial groundwater systems have been traced to improper well seals or vertical mixing within old production wells with long screen lengths. Brown and Caldwell generally agrees with Section 4.2.3 in the Draft RI where it is stated “The actual vertical extent of the groundwater plume in the GOU near the LOU needs to be determined by monitoring of a cluster of short screened length (either 15- or 20-foot long) wells installed at depths from 5 to 100 feet BWT.” Although this level of detail may not be required, a more accurate understanding of the vertical extent of contamination is required before a Final RI can be developed, before a Groundwater Feasibility Study can be completed, before a Reference Remedy proposed, and realistically should have been completed during or immediately after the Western Containment System (WCS) was installed and turned on. The continued impact of the WCS on the lateral and vertical spreading of VOC-impacted groundwater is a major gap in the completion of RI.

Based on the uncertain nature of the vertical sampling results, the Draft RI is presently incomplete per R-18-16-406 where it is stated “The remedial investigation for a site or portion of a site shall: 1. Establish the nature and extent of the contamination and the sources thereof.

Response 1: The reader is referred to the “Vertical Plume Delineation” Response on page 2 of this RS. Regarding the impact of the WCS, the reader is referred to Section 7.4 of the Final GOU RI Report and the *Western Containment System Effectiveness Evaluation* report dated January 5, 2009, prepared by Stantec for ADEQ. This report confirms that the WCS is preventing further westward migration of the plume beyond the WCS; however, the WCS obviously cannot address the contaminated groundwater which had already passed by the reach of the WCS in 2003—the year the WCS came on line.

Section 4—General Comments

Comment 1: *In Section 3.2, page 25, under COT 2001, and in Section 4.2.2, page 46, well WR-435A is located downgradient of the Prudence Landfill, not upgradient as stated in the Draft RI report.*

Response 1: The Final GOU RI Report text has been corrected to show that well WR-435A is located downgradient of the Prudence Landfill.

COMMENTS FROM CITY OF TUCSON, WATER DEPARTMENT

Comments regarding the Draft GOU RI Report were received in a letter from TW to ADEQ, dated May 29, 2007. The following section includes the text of comments along with a response to address each specific comment.

GENERAL COMMENT

Included as Attachment B a suggested revision of the “Present and Future Water Use” section based on recently updated information which has become available.

Response to General Comment:

- ADEQ has updated the GOU RI Report (and Water Use Study) as needed in accordance with Attachment B.

SPECIFIC COMMENTS

Comment 1: *Executive Summary, page E-1, last paragraph, “The purpose of the WCS was to prevent, to the extent feasible, further migration of the groundwater contamination [sic] within COT’s CWF.” Strike the qualifying phrase, “...to the extent feasible...” There was no question that this has always been, in the Water Department’s opinion, the “purpose” of the WCS.*

Response 1: Inclusion of the qualifier “to the extent feasible” is based on Arizona Revised Statute (A.R.S.) § 49-282.06(A)(2), which requires that remedial actions “to the extent feasible, provide for the control, management, or cleanup of hazardous substances in order to allow the maximum beneficial use of the waters of the state” and A.R.S. § 49-282.06(A)(3) which requires that remedial actions be “reasonable, necessary, cost-effective, and technically feasible.”

Comment 2: *Executive Summary, page E-4, last paragraph, 2nd line—The ADEQ RI has not identified the “lateral extent” of the contamination at the western toe of the plume, 5 ppb or otherwise.*

Response 2: The reader is referred to the “Lateral Plume Delineation” Response on page 4 of this RS.

Comment 3: *Page 15, last paragraph, third sentence—“Also, most if not all, of the wells in the CWF will be needed in both the short-term and long-term as backup sources of supply.” Change to: “All CWF wells including the Last On/First Off wells will be needed in both...” This is evidenced by the need for LOFO wells during November and December 06 when a 36” main broke in Avra Valley.*

Response 3: The text has been revised in accordance with the comment.

Comment 4: *Page 15, last paragraph, last sentence—Change to: “Therefore, COT believes that it is extremely important to maintain operational use of all CWF wells, including the Last On/First Off wells, as well as other available supply sources.*

Response 4: The text has been revised in accordance with the comment.

Comment 5: *Page 16, first paragraph, last sentence— Change to “Although TW has been able to temporarily reduce reliance on CWF wells in recent years, the AVRA Valley 26” main break in Nov 06 resulted in the need to turn on CWF wells and the Last On/First Off wells for two months, and emphasized the need to contain the western migration of the Broadway-Pantano plume.”*

Response 5: The text has been revised in accordance with the comment.

Comment 6: *Section 8, page 71, first bullet—Does [sic] sample frequency and understanding of flow dynamics allow this statement?*

Response 6: Below is the text referenced in Comment #6:

The groundwater plume appears to be being generated in sporadic pulses instead of continuously, based on analysis and interpretation of time series PCE plume maps and COC concentration trend graphs.

This text has been deleted from the Final GOU RI Report “Summary and Conclusions” section. However, at the end of Section 5.4.1 of the Final GOU RI Report, the text reads as follows: *The groundwater contaminant plume will continue to evolve until additional contaminants cease to enter the system or the biodegradation rate of the contaminants exceeds the flux of new contaminants into the aquifer. The discontinuity of the groundwater contaminant plume beyond about one-third mile from the LOU (Figure 5) suggests that source additions and/or biodegradation rates may be sporadic rather than continuous.*

Comment 7: *Section 8, page 71, third bullet—The first sentence is only true of [sic] 5 ppb concentration plume boundary is our limit of concern. We are not satisfied with said level.*

Response 7: Below is the Draft GOU RI Report text referenced in the Item #7 comment:

For purposes of this RI, the future feasibility study (FS), and the future remedial action plan (RAP), the horizontal extent of groundwater impacted by the identified COCs has been adequately characterized.

Comment is noted. The applicable regulatory standard for PCE is the AWQS of 5 µg/l. .

Comment 8: *Figure 15—On hole WR-275A, two zones designated “SC” are the wrong pattern.*

- Response 8: Figure 17 (formerly labeled “Figure 15”) has been revised to show the correct pattern for clayey sand at borehole WR-275A.
- Comment 9:** *Figure 20—Neither WR-458A nor WR-459A were installed for the 1992 RI Report. These wells were drilled much later.*
- Response 9: Figure 20 has been revised to remove wells WR-458A and WR-459A.
- Comment 10:** *Figure 21—This is the only Figure that shows BP-20 in its correct location. All other figures show the well incorrectly located northwest of BP-21 (see 34 and 37).*
- Response 10: The location of BP-20 has been corrected on all figures as needed.
- Comment 11:** *All Registered Wells should be included in the report and shown on all applicable figures.*
- Response 11: ADEQ does not see the relevance of showing registered wells that are either abandoned, unable to be located, or unlikely to be impacted by the Site.
- Comment 12:** *A figure should be included in the report that shows all monitoring points with detected PCE (i.e., SECOR quarterly progress reports include these figures).*
- Response 12: The reader is referred to Final GOU RI Report Figures 8 and 32 through 51 which show all PCE, TCE, or vinyl chloride results (depending on the figure) obtained during the particular sampling event being contoured.
- Comment 13:** *Section 4.4.2, Page 46, paragraph two—There are multiple references to “second” and “third” plumes in this and subsequent sections. The report should reflect a single detectable contaminant plume not two or three separate [sic] plumes.*
- Response 13: Comment is noted. The WQARF program focuses on releases exceeding regulatory standards; thus, ADEQ is mapping the groundwater contaminant concentrations at or exceeding the AWQS. ADEQ acknowledges that if the groundwater contaminant concentrations below the AWQS were also mapped, the plume[s] would show much more continuity; however, the reader should note that the plume figures do show the contaminant of concern concentrations at all sampling points—not just those within the plume—for the reader to see. Also, the effect of the WCS is containing all or most of the contamination to the east of the system has created a discontinuity—WR-178A has been non-detect since 2006—between the plume being captured by R-092A and the remnants, if any, of the plume being treated by C-026B.

Comment 14: *Section 5.4.3.4, third paragraph—The statement that the WCS “is effectively capturing groundwater flow containing COCs in the impacted portion of the Central Well Field”, is incorrect as evidenced by COCs detected at BP-021.*

Response 14: Regarding the impact of the WCS, the reader is referred to Section 7.4 of the updated Final GOU RI Report and the *Western Containment System Effectiveness Evaluation* report dated January 5, 2009, prepared by Stantec for ADEQ. This report confirms that the WCS is preventing further westward migration of the plume beyond the WCS; however, the WCS obviously cannot address the contaminated groundwater which had already passed by the reach of the WCS in 2003—the year the WCS came on line.

Based on the new data obtained with the installation of wells WR-702A, WR-703A, and WR-704A, which confirms that the PCE plume extends well beyond the WCS capture zone, the Draft GOU RI Report text quoted in the comment above has been changed to the following in the Final GOU RI Report: *However, the WCS, located downgradient of the BNL and BSL, appears to be capturing all of the Site groundwater COC contamination except for the contamination that had already passed by the downgradient extent of the WCS capture zone when the WCS came on line in 2003 (Figure 8).*

COMMENTS FROM CITY OF TUCSON, ENVIRONMENTAL SERVICES

Comments regarding the Draft GOU RI Report were received in a letter from Andrew H. Quigley, Director, COT-ES to ADEQ, dated May 29, 2007. The following section includes the text of comments along with a response to address each specific comment.

GENERAL COMMENTS

The City of Tucson Department of Environmental Services appreciates the opportunity to provide comments regarding the “Draft Remedial Investigation (RI) Report, Groundwater Operable Unity [sic] and other Potential Source Areas” for the Broadway-Pantano WQARF site prepared by Secor International Inc. Overall, we found the RI to be a comprehensive, well-written document that summarizes many years of investigation.

Our comments are listed on the attached document, referenced by page and paragraph number.

Thank you for considering these comments to the Draft RI for the Broadway-Pantano site. The City of Tucson Department of Environmental Services looks forward to working with ADEQ as remedial objectives (ROs) are finalized and the feasibility study begins so that a suitable remedy can be implemented.

SPECIFIC COMMENTS

Comment 1: *Page E-3, paragraph 1—Please consider rewording the following sentence as ‘Additionally, ADEQ completed a focused investigation to evaluate the need for an Early Response action (ERA) to determine whether the two CWF production wells (C-025B and D-018A) could remain in service....’*

Response 1: Below is the text referenced in Comment 1 above:

Additionally, ADEQ completed a focused investigation to evaluate the need for an Early Response Action (ERA) to ensure that two CWF production wells 9C-025B and D-018A) could remain in service without drawing in part of the GOU plume.

The main purpose of the focused investigation [stated on page 1 of the “Focused Investigation Report, (TW production wells C-025B and D-018A),” dated November 18, 2002], was as follows:

This report summarizes the results of a focused investigation designed to evaluate the need for an Early Response Action (ERA) to protect or provide for the use of the water from two City of Tucson (COT) supply wells located to the south of the existing tetrachloroethene (PCE) groundwater plume at the Broadway-Pantano Water Quality Assurance Revolving fund (WQARF) Site located in Tucson, Arizona (Figure 1).

ADEQ has revised the RI text accordingly. However, determining whether the pumping of C-025B and/or D-018A would draw the plume toward one or both of these wells was an important part of the focused investigation work plan. As stated in Section 3.1.4 of the Final GOU RI Report, *TW did not pump either C-025B or D-018A during this investigation, so no determination could be made as to whether pumping of these wells would be likely to draw the BSL PCE plume towards these wells.*

Comment 2: *Page E-4, paragraph 1—Consider revising the sentence as ‘Other significant fate and transport processes that are affecting the groundwater plume in the GOU include hydrodynamic dispersion, dilution, sorption, and biodegradation.’*

Response 2: The text has been revised in accordance with the comment.

Comment 3: *Page E-4, paragraph 4—The six ‘Last on-first off’ wells were actually pumped to the potable water system in late 2006, not in October 2006, as stated in this paragraph. Please revise the sentence to reflect the actual dates of pumpage as provided by Tucson Water.*

Response 3: The text has been revised in accordance with the comment.

Comment 4: *Page 2, paragraph 4—Consider revising the sentence as ‘The depth of the groundwater table ranges from approximately 315 feet below ground surface (bgs) to 370 feet bgs (Table 1).’*

Response 4: The text has been corrected.

Comment 5: *Page 2, paragraph 4—Consider revising the sentence as ‘Neither plume contains any evidence of dense non-aqueous phase liquids (DNAPLs).’*

Response 5: The text has been revised in accordance with the comment.

Comment 6: *Page 4, paragraph 5—Consider revising as ‘4. ADEQ operates the SVE system at BNL, and’*

Response 6: The text has been revised in accordance with the comment.

Comment 7: *Page 6, paragraph 3—Consider revising as ‘A Hilton hotel has been constructed in the northeastern portion of the BSL and Broadway proper to the southeast.’*

Response 7: ADEQ has added “Broadway Proper Retirement Community is located to the southwest of the BSL.” [NOTE: Broadway Proper Retirement Community is located to the southwest (not southeast) of the BSL.]

Comment 8: *Page 6, Paragraph 4—Are only the young, old, and/or infirm considered sensitive receptors, or are all people who are possibly drinking groundwater sensitive receptors? The City contends that anyone drinking contaminated groundwater could be considered a sensitive receptor.*

Response 8: ADEQ is using the definition of sensitive receptor as this applies to human health risk assessments. All people who possibly drink or are otherwise exposed to contaminated groundwater are classified as human receptors.

Comment 9: *Page 10, Paragraph 3--It would be helpful to know the total depths of these wells.*

Response 9: The total depths of these wells has been added to the text.

Comment 10: *Page 13, Paragraph 1—This paragraph discusses the decline of the groundwater table with the last set of data from 1999. According to Tucson Water, the groundwater levels in the basin around the groundwater operable unit have actually gone up in recent years. Please resolve this discrepancy.*

Response 10: The text has been be revised accordingly.

Comment 11: *Page 13, paragraph 2—Proper spelling is “aerially.”*

Response 11: The adverb “areally” referring to area as an adverb is spelled correctly. “Aerial” means “of, for, or by aircraft,” as in “aerial” view. To avoid confusion, the word “areally” has been replaced with the word “laterally.”

Comment 12: *Page 14, paragraph 2—Use of the term “bedrock” to describe well lithified basin-fill sediments is confusing. Is this the accepted usage? Generally the term “bedrock” would be used to describe the crystalline basement rocks beneath the basin fill.*

Response 12: The phrase “consolidated bedrock” in the referenced text has been removed.

Comment 13: *Page 15, paragraph 1—See comment above for Page E-4, paragraph 4.*

Response 13: The phrase “consolidated bedrock” in the referenced text has been removed.

Comment 14: *Page 15, paragraph 4—Consider revising as ‘Therefore, COT believes that it is extremely important to maintain operational use of all CWF wells including LOFO wells, as well as other available supply sources.’*

Response 14: The text has been revised in accordance with the comment.

Comment 15: *Page 16, paragraph 1—Consider revising as ‘The reduced reliance on these wells (albeit temporarily)...and the restricted use status of these wells due to presence of PCE in the groundwater from the GOU (Marra, written communication, 2007).’*

Response 15: The text in Section 2.8 regarding Tucson Water present and future water needs was revised in accordance with text submitted by Tucson Water and this point is made in the text.

Comment 16: *Page 41, paragraph 4—If possible, please explain at what distance and how many short screened length wells would be necessary to address this data gap.*

Response 16: This data gap has been addressed. The reader is referred to ADEQ’s response “Vertical Plume Delineation” on page 2 of the RS.

Comment 17: *Page 50, paragraph 1—Please explain why lead is not a contaminant of concern at this time.*

Response 17: A full explanation as to why lead is not a contaminant of concern at this time can be found in the “lead” subsection of Section 4.2.2. of the Final GOU RI Report. In summary, lead has been detected above the AWQS at one sample depth in WR-177A and in WR-207A during one sampling event in 2001, and subsequent lead testing of these two wells did not show lead to be above the AWQS. Likewise, lead was detected above the AWQS at one sample depth in WR-353A during one sampling event in 2002 and subsequent lead testing of this well did not show lead to be above the AWQS.

Comment 18: *Page 56, Paragraph 2--Consider revising as: ‘The average hydraulic conductivity (K_H) of the regional aquifer...’ since the aquifer is not homogeneous.*

Response 18: The text has been revised in accordance with the comment.

Comment 19: *Page 58, Paragraph 6—It may be helpful to add that the downward vapor migration of VOCs to the groundwater is generally not conducive to the occurrence of non-aqueous phase liquids.*

Response 19: The paragraph deals with dissolution of dense non-aqueous phase liquids after they reach groundwater and not the transport mechanism through the vadose zone. The mechanism[s] by which VOCs actually are transported through the vadose zone to the saturated zone will be discussed in more detail in ADEQ’s LOU RI Report.

Comment 20: *Page 61, paragraph 4—We suggest alternate wording such as: the WCS “appears to be effectively capturing groundwater flow containing COCs”. Capture has not been conclusively proven.*

Response 20: The reader is referred to Response 14 on page 19 of this RS.

Comment 21: *Page 62, Paragraph 1—See comment above on Page 6, paragraph 4. Since drinking water standards apply to all people, not just the infirm, young, and elderly, all people should be considered to be “sensitive receptors”.*

Response 21: ADEQ concurs that drinking water standards apply to all people, not just the infirm, young, and elderly. The paragraph as written makes a distinction between “potential human receptors” and “potential human sensitive receptors.” The former term applies to all persons who come into contact with and ingest impacted groundwater or inhale vapor during bathing or washing. The latter term applies to the subcategory of human receptors which is most at risk of adverse health risks from such exposure to impacted groundwater. The term “sensitive receptors” as defined by the United States Environmental Protection Agency for human health risk assessments is applied specifically to the infirm, young, and elderly.

Comment 22: *Page 67, paragraph 1—Please continue first sentence with: ‘infrastructure to meet system demand and to meet supply demands in November – December 2006 when a water main in Avra Valley broke.’*

Response 22: The text has been revised in accordance with the comment.

Comment 23: *Page 71, bullet 4: The LOFO wells are active wells, which are on “standby”. They can be turned on at any time if demand requires it. Therefore, we suggest that instead of saying that these wells are “shut down”, that the words “on standby” be used.*

Response 23: The text has been revised in accordance with the comment.

APPENDIX A

Copy of Written Comments Submitted to ADEQ by the Public

CTS # 15852 |
(already filed)

The Broadway-Pantano Community Advisory Board
for the State of Arizona
Broadway-Pantano Water Quality Assurance Revolving Fund (WQARF) Site
Tucson, Arizona

May 23, 2007

Gretchen Wagenseller, Project Manager
Arizona Department of Environmental Quality (ADEQ)
400 W. Congress, Suite 433
Tucson, AZ 85701



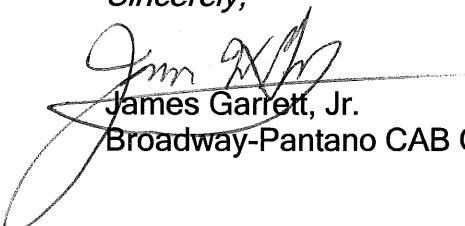
The following is a comment to the draft Groundwater Remedial Investigation (RI) Report and Remedial Objective comments for the Broadway-Pantano Water Quality Assurance Revolving Fund (WQARF) Site, Tucson, Arizona, from the Broadway-Pantano Community Advisory Board (CAB):

The Community Advisory Board for the Broadway-Pantano WQRF Site appreciates the extensive field investigations and the detailed draft Remedial Investigation (RI) Report that identifies the contaminants, their mode of transport, the extent of the contaminated groundwater, and potential public health risks. We are pleased that the Broadway South Landfill was added to the site.

However, we do think more vertical assessment of the groundwater plume needs to be done. But even more important, work needs to be done regarding soil gases. Looking at historical data, we are aware of the migration of soil gases within and also off of this site in some areas. Since gases that have been extracted from this site contain many VOCs that are a threat to human health and safety, there is an urgent need for the EPA to establish and release guidelines for measurement of acceptable limits for these types of volatile organic compounds inside structures.

Finally, it is imperative that this report leads to a final plan for remediation for this site. Because this site is located in the City of Tucson's central well field, there is the real potential for serious public health risks. In times of drought, contaminants can be pulled and may eventually contaminate city drinking wells. There are nearby wells designated as "last on/first off" that have been turned on in times of water shortages. It is unconscionable that the sustainability and the health of the population of a major city in this state be subject to such risks.

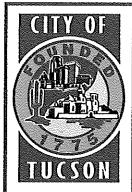
Sincerely,


James Garrett, Jr.
Broadway-Pantano CAB Co-Chair


Judy Burns
Broadway-Pantano CAB Co-Chair

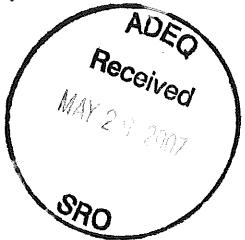
cc: Broadway-Pantano Community Advisory Board

CTS # 158524
(already filed)



May 29, 2007

Ms. Gretchen A Wagenseller
Arizona Department of Environmental Quality
CITY OF
TUCSON Southern Regional Office
400 W Congress; Suite 433
TUCSON WATER Tucson, AZ 85701
DEPARTMENT



SUBJECT: Transmittal of Tucson Water's Comments Regarding SECOR's Draft Remedial Investigation Report—Groundwater Operable Unit and Other Potential Source Areas

Dear Ms. Wagenseller:

Please find tabulated in Attachment A Tucson Water's comments to SECOR's Draft Remedial Investigation Report Groundwater Operable Unit and Other Potential Source Areas. Included as Attachment B a suggested revision of the "Present and Future Water Use" section based on recently updated information which has become available. An electronic copy of the latter can be made available to you at your request.

Tucson Water appreciates your attention to these comments. If you should have any further questions or inquiries, please give me a call at (520) 791-5080 x1412.

Sincerely,

A handwritten signature in black ink, appearing to read "Ralph P. Marra".

Ralph P Marra
Water Administrator

WW:RM P:\R\SRF\Correspondence\2007\URS_RI_Response_052307.doc

Attachments

cc: David Modeer, Marie Pearthree, Bruce Johnson, John Kmiec, Bruce Prior,
Joe Huerstel, and Dan Stanton of Tucson Water;
Alison Jones and Jeff Drumm of COT's Environmental Services Department



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ATTACHMENT A

Item	Reference	Review Comment
1	Exec Summary; pg E-1; last paragraph	"The purpose of the WCS was to prevent, to the extent feasible, further migration of the groundwater contamination within COT's CWF." Strike the qualifying phrase, "...to the extent feasible..." There is no question that this has always been, in the Water Department's opinion, the "purpose" of the WCS.
2	ES; pg E-4; last para.; 2nd line	The ADEQ RI has not identified the "lateral extent" of the contamination at the western toe of the plume, 5 ppb or otherwise.
3	Page 15; Last paragraph, third sentence	"Also, most, if not all, of the wells in the CWF will be needed in both the short-term and long-term as backup sources of supply." Change to: "All CWF wells including the Last On/First Off wells will be needed in both...." This is evidenced by the need for LOFO wells during Nov and Dec 06 when a 36" main broke in Avra Valley.
4	Page 15; Last paragraph, last sentence	Change to: "Therefore, COT believes that it is extremely important to maintain operational use of all CWF wells, including the Last On/First Off wells, as well as other available supply sources.
5	Page 16; First paragraph, last sentence	Change to: "Although TW has been able to temporarily reduce reliance on CWF wells in recent years, the Avra Valley 36" main break in Nov 06 resulted in the need to turn on CWF wells and the Last On/First Off wells for two months, and emphasized the need to contain the western migration of the Broadway-Pantano plume.
6	Section 8; pg. 71; first bullet	Does sample frequency and understanding of flow dynamics allow this statement?
7	Section 8; pg. 71; 3rd bullet	The first sentence is only true of 5ppb concentration plume boundary is our limit of concern. We are not satisfied with said level (TW)
8	Figure 15	On hole WRF-275A, two zones designated "SC" are the wrong pattern.
9	Figure 20	Neither WR-458A nor WRF-459A were installed for the 1992 RI Report. These wells were drilled much later.
10	Figure 21	This is the only Figure that shows BP-20 in its correct location. All other Figures show the well incorrectly located northwest of BP-21 (see 34 and 37).
11	General Comment	All Registered Wells should be included in the report and shown on all applicable figures.
12	General Comment	A figure should be included in the report that shows all monitoring points with detected PCE (i.e. SECOR quarterly progress reports include these figures).
13	Section 4.4.2; Page 46; paragraph two	There are multiple references to "second" and "third" plumes in this and subsequent sections. The report should reflect a single detectable contaminant plume not two or three separate plumes.
14	Section 5.4.3.4; third paragraph	The statement that the WCS "is effectively capturing groundwater flow containing COCs in the impacted portion of Central Well Field", is incorrect as evidenced by COCs detected at BP-021.

ATTACHMENT B

2.8 PRESENT AND FUTURE GROUNDWATER USES

TW, which is COT's water department, currently relies on water supply production from five well fields within the Tucson Basin and Avra Valley to meet current municipal demand (COT Water Department, 2004). The most significant renewable source of potable supply is the Central Avra Valley Storage and Recovery Project (CAVSARP) Well Field located in Avra Valley, while the CWF is TW's largest groundwater supply source (COT Water Department, 2004). The CWF is located in the Tucson Basin and encompasses much of the urbanized footprint of the COT. The GOU is situated near the center of the CWF.

TW has numerous water supply wells in the vicinity of the GOU (Figure 5). Four wells (C-021A, C-026B, D-021A, and D-022A) have been removed from operation since the late 1980s and early 1990s due to the presence of VOCs. A fifth well, C-022A, was contaminated after it was removed from service in October 1975. In addition, four active water supply wells currently have restricted use status ("last on/first off", or LOFO) because of their proximity to the GOU. LOFO wells are among the last wells to be brought into service and the first wells to be taken out of service when a period of increased water supply need arises. Since August 1999, COT voluntarily has placed two other wells (wells C-025B and D-018A; Figure 5), both situated immediately south of the GOU, on restricted use to limit the potential for the GIOU groundwater contamination to migrate toward these wells and to ensure the availability of these wells for supply when they are needed. All of these restricted use wells were pumped in the Summer of 2006 to assess the viability of the well infrastructure to meet system demand. In late 2006, four of the original LOFO wells were again put into service to provide potable supply due to a system outage in TW's groundwater supply infrastructure in Avra Valley. TW is continuing to maintain and sample these wells so that they will be available to meet system demand as may be required in future years. Table 4 provides a summary of annual production (in millions of gallons) of CWF water supply wells located within the vicinity of the GOU. The table presents full production data for 1957 through 2000, as well as partial data (for only the six restricted use wells) for 2001 through 2006.

COT currently has had a policy to take wells out of service that have VOC concentrations that exceed half of the potable drinking water standards for any regulated compound (i.e., EPA Maximum Contaminant Levels [MCLs] or ADEQ AWQSs). The six municipal wells in the immediate vicinity of the GOU are being monitored for VOCs at least semiannually, and at least monthly during those times when the wells are brought into service for more than seven days. This policy ensures the quality of potable water supplies drawn from this area (Marra, written communication, 2007).

According to TW, the CWF has historically been and will remain an essential component of COT's water supply infrastructure. Current TW plans include continuing the recharge and recovery of Central Arizona Project (CAP) water at CAVSARP, an operating storage

and recovery facility in the Avra Valley. Potable use of the recovered blend of CAP water and Avra Valley groundwater began in May 2001 and continues to the present. TW has expanded the recharge capacity of CAVSARP up to 80,000 acre-feet per year and is in the process of expanding its recovery capacity in the near term (Marra, written communication, 2007). TW is currently in the process of developing a project similar to CAVSARP several miles to the south; this facility is called the Southern Avra Valley Storage and Recovery Project (SAVSARP) and it will provide an additional source of renewable supply. The SAVSARP facility will be permitted to recharge up to 60,000 acre-feet per year and is expected to become operational in 2008; the recovery component of the project is expected to become operational in 2011. TW anticipates that use of both CAVSARP and SAVSARP facilities will further reduce its reliance on groundwater pumping in the CWF during most of each year. However, TW will continue to need its CWF, and in particular the six restricted use wells, in the near, mid, and long terms for the following reasons:

- To help meet peak water demand during the hottest months;
- To meet projected annual potable demand when it exceeds the COT's current annual CAP allocation—anticipated to occur within the next few years;
- To provide emergency backup supply should there be a disruption in CAP supply due to problems with the CAP infrastructure or due to supply disruptions caused by system outages on TW's own system;
- To provide potentially long-term backup potable supply should a shortage be declared on the Colorado River—the Secretary of Interior may make such a declaration within the next five years and it could be in place for an indeterminate period of time.

To summarize, as the use of blended groundwater/CAP water from these facilities in Avra Valley increases, and assuming normal operating conditions will prevail, the need for the LOFO wells in the CWF as potable water supply wells will likely be reduced in the near-term and mid-term except to meet peak potable demand. However, as TW achieves maximum renewable resource utilization, and as potable demand grows, the availability of these LOFO wells (and the aquifer from which they pump) will increase in importance as COT sources of supply. Also, most, if not all, of the wells in the CWF will be needed in both the short-term and long-term as backup sources of supply. For instance, the CWF will be a critical source of supply if there are disruptions to CAP supply due to infrastructure failure of CAP's delivery system or because of a declaration of shortage on the Colorado River, power outages, system outages associated with lengthy planned maintenance activities, or major potable system emergencies (Marra, written communication, 2007). Therefore, COT places a high priority on maintaining its operational use of the CWF, as well as other available supply sources (URS, 2002a)

According to TW pumpage data for the six restricted-use wells for 2006 (Table 4), the pumpage rates (in millions of gallons) ranged from 12.6 (for well D-018A) to 78.2 (for

well C-114A) and totaled 278.6 for all six wells. By contrast, during 1992, these same six wells were pumped at rates (in millions of gallons) ranging from 3.311 (for well C-025B) to 240.014 (for well C-020B), and the total pumpage was 1,165.649 (or approximately 1.17 billion gallons). The reduced reliance on these wells (albeit temporarily) in recent years is a function of TW's increasing utilization of renewable supplies to meet potable water demand (making them less necessary for year around use), the absence of any major potable system emergencies, and the restricted use status of these wells (Marra, written communication, 2007).

The vast majority of Tucson residences and businesses receive their water from TW, but there are some private water supply wells in the vicinity of the Site. The only private wells within the GOU groundwater plume are the previously shut-down TW production wells and the St. Joseph's Hospital well which is receiving wellhead treatment that removes the PCE (Section 1.4). There are two small municipal water providers – Far Horizons, which provides water to the mobile homes and travel trailers in its residential park; and Catalina Village, which provides water to its assisted living residents. Also, there are two non-exempt (more than 35 gpm capacity well pump) wells that are used solely for irrigation and a non-exempt well used by a commercial car wash. There are also six private exempt (less than 35 gpm well pump) commercial wells used for irrigation/potable supply. For more information on groundwater users at the Site, see the Water Use Study Report in Appendix A.



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May 29, 2007

CTS #158526
(already filed)

Barbara LaWall
PIMA COUNTY ATTORNEY

CTS✓



VIA HAND DELIVERY

Ms. Gretchen Wagenseller
Project Manager
Superfund Programs Unit
Southern Regional Office
ADEQ
400 W. Congress, Ste. 433
Tucson AZ 85701

Re: Broadway-Pantano WQARF Site
Comments Regarding Draft Remedial Investigation
Proposed Remedial Objectives

Dear Ms. Wagenseller:

Pima County and its consultant, Brown & Caldwell, have reviewed the draft Remedial Investigation (“RI”), dated April 2, 2007, for the Broadway-Pantano Water Quality Assurance Revolving Fund (“WQARF”) site. While, from this review, it is apparent that a substantial amount of work has been done at this site, it is also apparent that the draft RI meets neither the statutory criteria nor the federal guidance for a proper RI.

At the public meeting on May 23rd, concerns were expressed about over-studying the site. However, that is not the case here. Statutory and regulatory standards are in place to ensure that the remedial investigation results in a feasibility study, record of decision, and ultimately, a site clean-up that is protective of human health and the environment while meeting the economic reasonableness and technical feasibility directives of the WQARF program. Due to the data gaps in the draft RI for this site, these goals are not achievable.

Attached hereto as Attachment A are Pima County’s technical comments prepared by Brown & Caldwell regarding the draft RI. These address the data gaps, the areas where the draft RI fails to meet the minimal RI preparation standards, and areas where there are differing interpretations of the existing data.

Ms. Gretchen Wagenseller

May 29, 2007

Page 2 of 3

This Remedial Investigation fails to meet the requirements of ARS 49-287.03 in that it did not achieve the minimum requirements of R18-16-406. This regulation sets out the requirements of the remedial investigation. The review by Brown and Caldwell clearly demonstrates that the first requirement has not been met. There has not been the establishment "of the nature and extent of the contamination and the sources thereof."

The standard for Remedial Investigations is to follow the guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA 540-G-89-004, October 1988). This document provides that as a minimum the extent of the groundwater and soil contamination should be determined both horizontally and vertically. At the public hearing it was stated that this determination requires more data collection. This data should be collected before any conclusions can be made with regard to sources of contamination and completion of the RI. In order to move on to a Feasibility Study or drafting of a scope of work for a feasibility study, further work is required. The Remedial Investigation is not ready to be finalized.

A cursory review of the opening section of the RI shows there are misstatements of fact in Section 1.3: Site Background. These include:

1. The report asserts that landfilling began at Broadway South in 1953. While there is a 1953 agreement between the County and the then-owner of a small parcel of property that allowed disposal, there is no evidence that disposal ever occurred on this property during the two-year agreement period and, indeed no evidence that any disposal occurred at Broadway South until 1956 when Sanitary District #1 began operations.
2. The report seems to suggest that the PAG-estimated 200 ton per day disposal rate extended from 1953 through 1961 or 1962. As discussed above, there is no evidence that there was disposal anywhere on the site prior to 1956 when Sanitary District #1 opened a landfill on a portion of the property.

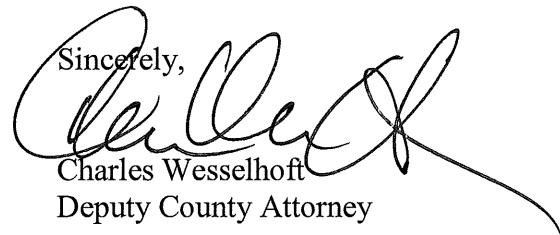
Other misstatements may exist but Pima County has had insufficient time to fully review all of the factual statements made.

In sum, the draft RI does not meet the statutory and regulatory minimums in that it: (1) fails to adequately identify and evaluate all potential sources of contamination; (2) does not adequately characterize the extent of the contamination; (3) suggests contaminant transport scenarios (*i.e.*, commingling of the plumes) that are not supported by the hydrology; and (4) does not provide sufficient information to effectively move toward the development of an economically reasonable feasibility study.

Pima County also wishes to take this opportunity to submit proposed Remedial Objectives for the site. These are attached hereto as Attachment B.

Ms. Gretchen Wagenseller
May 29, 2007
Page 3 of 3

If you have any questions regarding the above or wish to meet with the County to discuss these comments, please do not hesitate to contact either Dave Eaker or me.

Sincerely,

Charles Wesselhoft
Deputy County Attorney

cc: Ursula Kramer – PDEQ
Dave Eaker – PDEQ
Harlan Agnew – PCAO
John Bernal

MEMORANDUM REPORTB R O W N A N D
C A L D W E L L

TO: Charles Wesselhoft, Deputy County Attorney – Pima County

CC: Dave Eaker and Ursula Kramer,
Pima County Department of Environmental Quality

FROM: Steve Brooks, R.G.

PREPARED BY: Steve Brooks, R.G., Jeff Littell, and Randy Bauer, R.G

REVIEWED BY:

DATE: May 29, 2007

BC PROJECT NO.: 133032

SUBJECT: Review of the Draft Remedial Investigation Report – Groundwater Operable Unit and Other Potential Source Areas, Broadway-Pantano WQARF Site, Tucson, Arizona

Pima County retained Brown and Caldwell to perform a technical review of the *Draft Remedial Investigation Report for the Groundwater Operable Unit and Other Potential Source Areas for the Broadway-Pantano Water Quality Assurance Revolving Fund Registry Site, Tucson, Arizona*. The Draft Remedial Investigation (RI) Report dated April 27, 2007 was prepared by Secor International Incorporated (Secor) on behalf of the Arizona Department of Environmental Quality (ADEQ). Based on our review of the data included in the document and in other reports associated with the Broadway North Landfill (BNL), Broadway South Landfill (BSL) and Prudence Landfill (PL), Brown and Caldwell has developed a series of comments presented under a general categorization scheme below.

Overall, it is obvious that a large amount of work has gone into the various phases of remedial investigation activities associated with this report. In particular, a heavy emphasis has been placed on delineating the down-gradient extent of the PCE-impacted groundwater located west of the BNL in support of the design and operation of the Western Containment System (WCS). A second large effort was conducted at BNL regarding soil vapors as the mechanism for groundwater being impacted by chlorinated volatile organic compounds (CVOCs) and the subsequent design and operation of a landfill soil vapor extraction system. This latter work is not discussed in detail within the Draft RI report because (1) it was conducted by the City of Tucson, not ADEQ's contractor, and (2) the vadose one is being addressed under a separate document associated with the landfill operable unit (LOU). However, a presentation of BNL soil gas investigation results from 13 separate investigations over more than a 20-year time period are presented in Appendix C of the Draft RI.

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A similar level of information was not discussed for the BSL. Based on the information presented in the Draft RI, the inclusion of the BSL into the Broadway-Pantano WQARF site is based largely if not entirely on the presence of PCE and TCE in monitor wells within and to the northwest of the BSL. Although such data warrants further investigation, the inclusion of the BSL into the Broadway-Pantano WQARF site in 2005 appears to be premature and contrary to what information was collected on the BSL site prior to 2005 (e.g., minimal to no CVOCs in soil gas) and groundwater sampling results from wells to the west and northwest of the BSL. In Section 3.1.4 Broadway South Landfill of the Draft RI data it was stated that "*ADEQ conducted a focused investigation, from July 2001 through March 2002, to evaluate the need for an ERA...*". That investigation was focused on the potential need for an ERA associated with the City of Tucson (COT) production wells C-025B and D-018A located west of BSL and not on whether BSL was a present source of groundwater contamination. A conclusion reached during that study was that based on the absence of PCE contamination in monitor well BP-8 and BP-15, no connection between potential CVOCs originating from the BSL and the PCE groundwater plume recognized to have originated from the BNL could be made. Based on this information and additional data collected since March 2002, the work completed to-date at the BSL and presented in the Draft RI does not meet Arizona Revised Statute (ARS) 49-287.03.E where it is stated "*The remedial investigation shall collect the data necessary to adequately characterize the site or the portion of the site for the purpose of developing and evaluating effective remediation alternatives pursuant to the feasibility study requirements prescribed by subsection F of this section.*". Nor does the information presented address "*The extent, general characteristics, and degree of the source of the release*" as required under R18-16-406 Remedial Investigation.

Comment No. 1- Commingling of PCE Plumes

In Section 1.3, page 2 of the Draft RI, Secor states that "*The GOU currently (as of April 2006) consists of two PCE plumes (Figure 3) ... One plume with two lobes extends westerly from the BNL and northwesterly from the BSL, respectively. The lobes conjoin further to the west.*"

Brown and Caldwell believes that there are numerous inconsistencies with both groundwater analytical data and groundwater elevation data that do not provide technical justification for the conjoining of the "two lobes" of impacted groundwater based on the information available. A number of these inconsistencies are detailed below:

- Based on the groundwater flow direction from the BSL, as presented in the maps presented as Figures 22 through 26 in the draft RI, the PCE concentrations measured in monitor wells downgradient of BSL in April 2006 do not support a commingling of the PCE plumes as presented in Figure 34 of the draft RI. In particular, the absence of PCE concentrations in wells WR-177A, WR-179A and D-039A, combined with the low levels of PCE measured in BP-10 and BP-16 do not support the tenuous connection between the plumes as presented on Figure 34 of the draft RI. To connect the PCE concentration at WR-367A to BP-8, a distance of 3,200 feet as shown on Figure 3 of the Draft RI, would require groundwater flow to maintain a consistent flow direction for an approximately 8

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year period (based on the 1 foot per day advective flow velocity referenced in the Draft RI) with virtually no lateral dispersion. This is highly unlikely.

- It was stated in Section 5.4.3.2 Saturated Zone Fate and Transport Processes of the draft RI that “*URS (2002a)¹ postulated that the plume originated at the closed BNL in approximately 1970 (approximately 10 years after the landfill began accepting refuse).*” This was apparently estimated based on the date of known impacts at COT supply wells west of BNL and an estimate of advective groundwater flow velocity of approximately 1 foot per day. Based on the presence of concentrations of PCE in excess of 5 µg/L as early as 1988 in COT well C-021A located more than 5,000 feet downgradient of BNL, this is likely a reasonable estimate. Current conceptual models are that the VOCs impacted the groundwater largely if not entirely via the downward movement of landfill gas (LFG) impacted with PCE and its degradation daughter products.

Based on reports that BSL received wastes from the early 1950s to the early 1960s, and assuming that a similar mechanism for vertical transport would be responsible, it is not unreasonable to assume that groundwater beneath BSL could have been impacted by sometime in the 1970s. However, based on water quality results from numerous wells located to the west and northwest of BSL (the feasible downgradient groundwater flow directions) no groundwater impacts were observed in a feasible down-gradient location from BSL until the mid 1990s. Due to the limited data available, this discrepancy in mechanisms and timing for impacts to groundwater should be discussed prior to connecting VOCs possibly emanating from BSL to those documented to have emanated from BNL.

- An analysis of time-series data presented for wells located to the southwest of BNL suggest that impacts to these wells is more likely the result of southwesterly movement of impacted groundwater from BNL than northwesterly movement of impacted groundwater from BSL. Along with information previously presented above, the southwesterly movement of impacted groundwater from BNL is supported by the shape of the GOU as presented in 2000 by URS as shown on Figure 4 of the Draft RI. Additionally, the absence of any detectable VOCs in well WR-179A until 1995 accompanied by increasing concentrations up till 2001 followed by a gradual decrease can be explained by the turning off of COT wells to the west of BNL in the late 1980s while COT wells to the southwest (C-025B and D-018A) of BNL were pumped to make-up the shortfall. This change in pumping pattern resulted in a southwesterly shift in groundwater flow direction, which was also documented in a memorandum (Clear Creek Associates, 2000²) completed on behalf of the City of Tucson and submitted to ADEQ on August 4, 2000.

¹ URS Corporation, 2002a, Remedial Investigation Report – Broadway-Pantano WQARF Site, Groundwater Operable Unit for mid 1980’s through 2000. June 30.

² Southern Interim Containment System Evaluation, prepared by Clear Creek Associates and submitted to Nancy Petersen (City of Tucson – Office of Environmental Management), Ralph Marra (Tucson Water) and Chris Cawein (Pima County) dated July 28, 2000.

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- In Section 3.1.4, page 23, Secor states “*The results from the sampling events performed in 2002 through the middle of 2004 continued to indicate that the BSL plume was not commingled with the Broadway-Pantano Site plume. However, PCE was detected in well BP-8 (and BP-7) in November 2004 and most of the subsequent sampling events. ADEQ determined in 2005, on the basis of subsequent groundwater sampling, that the BSL plume was commingling with the BNL GOU groundwater plume; subsequently, the Broadway-Pantano Site boundary and RI were expanded to include the BSL groundwater plume.*”

The Draft RI does not provide an adequate discussion and evaluation of the groundwater sampling data to support the conclusion that the PCE detected in well BP-8 was derived from the BSL. The detection of PCE in well BP-8 could result from the migration of the BNL plume. The fact that PCE was initially detected in November 2004 in both wells BP-7 and BP-8 indicates that the source of the PCE should be located east and at an equidistant location from both wells. In the Clear Creek Associates (2000) memo described above, it was concluded that groundwater flow direction and migration of the BNL plume shifted to a southwest direction in the early 1990s. The shift was in response to the shutdown of five groundwater production wells located immediately downgradient of the BNL and the continued groundwater extraction from wells C-025B and D-018A located southwest of the BNL plume. The southwest groundwater flow direction and BNL plume migration direction continued until 2001, when the two extraction wells were also shutdown. Similarly, in 2002 URS Corporation (URS), following the conduct of several groundwater investigations at the Broadway-Pantano Site, concluded that the groundwater plume emanates primarily from the southern portion of the BNL and flows toward the southwest for approximately one mile and then shifts to the northwest. In fact, the GOU, as described by URS in 2000 and shown on Figure 4 in the Draft RI already includes both BP-7 and BP-8 without any impact from BSL being shown. However, the absence of noticeable PCE in BP-7 and BP-8 until 2004 (per Table 5 of the Draft RI) indicates that the URS figure was also in error. Although it is very possible that the BNL plume that migrated to the southwest during the 1990s and then shifted to the west-northwest after 2001 is the source of the PCE detected in BP-7 and BP-8, the discrepancies in data highlight the difficulties in connecting plumes based on spatially and temporally limited data.

- The BNL and BSL are in a hydraulically complex portion of the Tucson basin due to their location within the historically heavily pumped central well field. This hydraulic complexity is compounded by the presence of an apparent low hydraulic conductivity northwest-southeast trending feature referred to as the Pantano Feature by numerous past researchers and, specific to this Site, in Dames and Moore (2000)³. This feature trends roughly parallel with Pantano Wash but is offset approximately ½- to 1-mile to the east-northeast. An analysis of basin-wide groundwater flow maps prepared by Tucson

³ Groundwater Flow Model Report, Broadway-Pantano WQARF site, Groundwater Operable Unit. Prepared for City of Tucson and the Broadway-Pantano Joint Project Management Team, March 17, 2000.

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Water during the 1980s through the present clearly show the “stacking up” of ground elevation contours along this feature. Although a detailed discussion of the feature is probably not needed for the RI due to its location upgradient of the landfills, its importance is reflected in the large effect it has on groundwater flow direction across both BNL and BSL. In particular, the combined effect of the Pantano Feature with groundwater pumping to the west of the BNL and BSL results in an abnormally sharp concave-west curve in the groundwater elevation contours. This is partially reflected in Figure 22 in the draft RI. An analysis of groundwater elevation maps prepared by Tucson Water for 1980 through the present identify that the direction of groundwater flow across BNL has varied from southwest to west, while across BSL it has varied from west to northwest. The convergence of groundwater flow directions across each landfill, i.e., southwest at BNL and northwest at BSL results in what is called a hydrogeologic singularity, or an area for which groundwater flow direction is mathematically undefined. At a minimum this reflects the variability over which groundwater flow directions have historically occurred in the area and the care that must be taken in drawing conclusions regarding groundwater flow paths over any length of time.

Based on the above comments, there is insufficient information within the Draft RI to adequately address “*The extent and general characteristics of the hazardous substances released, including physical state, concentration, toxicity, propensity to bioaccumulate, persistence and mobility*” for neither BNL or BSL nor “*The extent, general characteristics, and degree of the source of the release*” as required under R18-16-406 Remedial Investigation.

Comment No. 2 – PRP Search

- In Section 3.1.3, page 21 of the Draft RI, Secor states “The purpose of this review and site walk was to identify likely users (historical and current) of solvents or cleaning fluids containing VOCs (including drycleaners, lube shops, other automobile repair facilities, and other medical facilities).” It is not clear if Secor considered machine shops and/or metal fabrication facilities in their search of other likely users of solvents.
- Section 3.1.3, page 22, Secor states “*Based on the records review and site walk, SECOR (2001a) determined the following:*

Six current and former establishments were identified as possibly having on-site dry-cleaning operations...

These six dry-cleaners seem to be the same six facilities located along Broadway Avenue identified by CDM in their Technical Memorandum Number 1 in 1996; however, Secor fails to identify the location of these potential sources on any figures of the draft RI. According to CDM, one of the dry-cleaning facilities is located adjacent to monitoring well BP-10, and two other dry-cleaning facilities are located immediately upgradient of well BP-8. These potential sources of PCE should have been investigated during the RI.

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A release from any of these facilities could have contributed to PCE concentrations detected in nearby groundwater monitoring wells BP-10 and/or BP-8.

- The RI does not provide any reasoning for not considering the Prudence Landfill as a potential source of PCE groundwater contamination. It is disturbing that the RI does not mention or show on any figures well WR-434A, located west of well R-124A and immediately downgradient from the Prudence Landfill. This well was installed in 2002 and constructed with nested vapor monitoring probes at depths of 50, 150, 250 and 350 feet below surface. Analyses of vapor samples collected from each nested probe have consistently detected PCE, TCE and dichlorofluoromethane (DCFM) during each quarterly monitoring event. The concentrations of PCE, TCE and DCFM consistently increase with depth, and in June 2006, the 350-foot deep probe contained PCE concentrations of 29 µg/L, TCE of 3.5 µg/L and DCFM of 33 µg/L. Unfortunately, the RI fails to provide any groundwater analytical data from this well or from wells R-124A and R-125A located within the Prudence Landfill.

Based on the above comments, the Draft RI is insufficient to adequately “*Establish the nature and extent of the contamination and the sources thereof,*” as required under R-18-16-406.

Comment No. 3 – Vertical Mixing of Groundwater Quality

A great deal of effort was expended in the Draft RI to support or dismiss the depth-specific groundwater quality results collected from the long-screened monitor wells using depth-specific samples. This appeared to be justified based on results, where several of the long (over 100 feet in length) screened wells showed similar PCE concentrations from top to bottom. This extent of vertical mixing of groundwater is generally considered highly unlikely in alluvial basins due to the large contrast in horizontal versus vertical hydraulic conductivity. With properly constructed depth-discrete monitor wells this is even difficult to attain under vertical gradients imposed by pumping. Most deep or vertically extensive groundwater quality problems in basin and range alluvial groundwater systems have been traced to improper well seals or vertical mixing within old production wells with long screen lengths. Brown and Caldwell generally agrees with Section 4.2.3 in the Draft RI where it is stated “*The actual vertical extent of the groundwater plume in the GOU near the LOU needs to be determined by monitoring of a cluster of short screened length (either 15- or 20-foot long) wells installed at depths from 5 to 100 feet BWT.*” Although this level of detail may not be required, a more accurate understanding of the vertical extent of contamination is required before a Final RI can be developed, before a Groundwater Feasibility Study can be completed, before a Reference Remedy proposed, and realistically should have been completed during or immediately after the Western Containment System (WCS) was installed and turned on. The continued impact of the WCS on the lateral and vertical spreading of VOC-impacted groundwater is a major gap in the completion of RI.

Based on the uncertain nature of the vertical sampling results, the Draft RI is presently incomplete per R-18-16-406 where it is stated “*The remedial investigation for a site or portion of a site shall:*

TECHNICAL MEMORANDUM

B-P Draft RI

Page 7

1. *Establish the nature and extent of the contamination and the sources thereof,"*

Comment No. 4 – General Comments

In Section 3.2, page 25, under COT 2001, and in Section 4.2.2, page 46, well WR-435A is located downgradient of the Prudence Landfill, not upgradient as stated in the Draft RI report.

**BROADWAY PANTANO
WQARF SITE**

**REMEDIAL OBJECTIVES
PROPOSED BY PIMA COUNTY
MAY 29, 2007**

1. Prevent exposure to contaminated groundwater above acceptable risk levels.
2. Prevent further migration of contaminated groundwater.
3. Reduce the mass and concentration of CVOCs near suspected sources.
4. Beneficially use treated groundwater.

CTS # 158525
(already filed)



CITY OF
TUCSON
ENVIRONMENTAL
SERVICES

Ms. Gretchen Wagenseller, Project Manager
Arizona Department of Environmental Quality
400 W. Congress
Suite 433
Tucson, AZ 85701

May 29, 2007



Re: Draft Remedial Investigation Report
Broadway Pantano Water Quality Assurance Revolving Fund (WQARF)
Site

Dear Ms. Wagenseller:

The City of Tucson Department of Environmental Services appreciates the opportunity to provide comments regarding the "Draft Remedial Investigation (RI) Report, Groundwater Operable Unity and other Potential Source Areas" for the Broadway-Pantano WQARF site prepared by Secor International Inc. Overall, we found the RI to be a comprehensive, well-written document that summarizes many years of investigation.

Our comments are listed on the attached document, referenced by page and paragraph number.

Thank you for considering these comments to the Draft RI for the Broadway-Pantano site. The City of Tucson Department of Environmental Services looks forward to working with ADEQ as remedial objectives (ROs) are finalized and the feasibility study begins so that a suitable remedy can be implemented. Please call Alison Jones at 837-3712 if you have any questions.

Very truly yours,

A handwritten signature in black ink, appearing to read "Quigley".

Andrew H. Quigley
Director

AHQ/AJ/dl

Cc: Karen Masbruch, City of Tucson, Manager's Office
David Modeer, City of Tucson, Tucson Water
Ralph Marra, City of Tucson, Tucson Water
Nancy Petersen, City of Tucson, Environmental Services
Alison Jones, City of Tucson, Environmental Services
Broadway-Pantano file



City of Tucson Department of Environmental Services
Comments on Draft Remedial Investigation Report
Broadway Pantano WQARF Site

Each comment is referenced in order by page and paragraph.

Page E-3, paragraph 1: Please consider rewording following sentence as ‘Additionally, ADEQ completed a focused investigation to evaluate the need for an Early Response Action (ERA) to determine whether the two CWF production wells (C-025B and D-018A) could remain in service....’

Page E-4, paragraph 1: Consider revising the sentence as ‘Other significant fate and transport processes that are affecting the groundwater plume in the GOU include hydrodynamic dispersion, dilution, sorption, and biodegradation.’

Page E-4, paragraph 4: The six ‘Last on-first off’ wells were actually pumped to the potable water system in late 2006, not in October 2000, as stated in this paragraph. Please revise the sentence to reflect the actual dates of pumpage as provided by Tucson Water.

Page 2, paragraph 4: Consider revising the sentence as ‘The depth of the groundwater table ranges from approximately 315 feet below ground surface (bgs) to 370 feet bgs (Table 1).’

Page 2, paragraph 4: Consider revising the sentence as ‘Neither plume contains any evidence of dense non-aqueous phase liquids (DNAPLs).’

Page 4, paragraph 5: Consider revising as ‘4. ADEQ operates the SVE system at BNL, and’

Page 6, paragraph 3: Consider revising as ‘A Hilton hotel has been constructed in the northeastern portion of the BSL and Broadway proper to the southeast.’

Page 6, paragraph 4: Are only the young, old, and/or infirm considered sensitive receptors, or are all people who are possibly drinking groundwater sensitive receptors? The City contends that anyone drinking contaminated groundwater could be considered a sensitive receptor.

Page 10, paragraph 3: It would be helpful to know the total depths of these wells.

Page 13, paragraph 1: This paragraph discusses the decline of the groundwater table with the last set of data from 1999. According to Tucson Water, the groundwater levels in the basin around the groundwater operable unit have actually gone up in recent years. Please resolve this discrepancy.

Page 13, paragraph 2: Proper spelling is “aerially”.

Page 14, paragraph 2: Use of the term “bedrock” to describe well-lithified basin-fill sediments is confusing. Is this the accepted usage? Generally the term “bedrock” would be used to describe the crystalline basement rocks beneath the basin fill.

Page 15, paragraph 1: See comment above for Page E-4, paragraph 4.

Page 15, paragraph 4: Consider revising as ‘Therefore, COT believes that it is extremely important to maintain operational use of all CWF wells including LOFO wells, as well as other available supply sources.’

Page 16, paragraph 1: Consider revising as ‘The reduced reliance on these wells (albeit temporarily)...and the restricted use status of these wells due to presence of PCE in the groundwater from the GOU (Marra, written communication, 2007).’

Page 41, paragraph 4: If possible, please explain at what distance and how many short screened length wells would be necessary to address this data gap.

Page 50, paragraph 1: Please explain why lead is not a contaminant of concern at this time.

Page 56, paragraph 2: Consider revising as: ‘The average hydraulic conductivity (K_H) of the regional unconfined aquifer...’ since the aquifer is not homogeneous.

Page 58, paragraph 6: It may be helpful to add that the downward vapor migration of VOCs to the groundwater is generally not conducive to the occurrence of non-aqueous phase liquids.

Page 61, paragraph 4:, We suggest alternate wording such as: the WCS “appears to be effectively capturing groundwater flow containing COCs”. Capture has not been conclusively proven.

Page 62, paragraph 1: See comment above on Page 6, paragraph 4. Since drinking water standards apply to all people, not just the infirm, young, and elderly, all people should be considered to be “sensitive receptors”.

Page 67, paragraph 1: Please continue first sentence with: ‘infrastructure to meet system demand and to meet supply demands in November – December 2006 when a water main in Avra Valley broke.’

Page 71, bullet 4: The LOFO wells are active wells, which are on “standby”. They can be turned on at any time if demand requires it. Therefore, we suggest that instead of saying that these wells are “shut down”, that the words “on standby” be used.

Gretchen A. Wagenseller

From: Alison Jones [Alison.Jones@tucsonaz.gov]
Sent: Tuesday, May 29, 2007 4:43 PM
To: Gretchen A. Wagenseller
Subject: Broadway RI comments

Attachments: Comments to ADEQ on GOU RI.doc



Comments to ADEQ
on GOU RI.doc...

G-

ASV

here are our comments. A final, signed (by our Director) copy is being sent by snail mail and will be postmarked as required to meet the deadline.

Thanks,

Alison H. Jones, RG
Environmental Manager
City of Tucson
520.837.3712 NEW Number
520.791.5417 fax
520.237.0067 cell