FEASIBILITY STUDY REPORT
TYSON WASH WQARF REGISTRY SITE
QUARTZSITE, ARIZONA
ADEQ TASK ASSIGNMENT 04-0048

Prepared for:

Arizona Department of Environmental Quality
Waste Programs Division
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MACTEC Project No. 4972-06-2100.5.4

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June 23, 2007

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June 23, 2007

Mr. Chris Gamache
Project Manager
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Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Subject: **Feasibility Study Report**
Tyson Wash WQARF Registry Site
ADEQ Task Assignment 04-0048
MACTEC Project No. 4972-06-2100.5.4

Dear Mr. Gamache:

MACTEC Engineering and Consulting, Inc. (MACTEC) is pleased to submit this *Feasibility Study Report* (FS Report) for the Tyson Wash WQARF Registry Site in Quartzsite, Arizona. This FS Report has been prepared in accordance with the FS Work Plan dated March 2006 and Arizona Administrative Code (A.A.C) R18-16-407(I) and is a compilation of the results of the Remedial Alternative Screening and Remedial Alternative Evaluation. This FS Report recommends the remedial alternative for the Site that will be carried over to the Proposed Remedial Action Plan (PRAP).

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

James N. Clarke, R.G
Principal Geologist

REGISTERED GEOLOGIST CERTIFICATE NO. 29374 JAMES N. CLARKE Date Signed 6/23/07 ARIZONA

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1.0 INTRODUCTION

This Feasibility Study (FS) Report recommends the remedial alternative for the Tyson Wash Water Quality Assurance Revolving Fund (WQARF) Registry Site (Site) that will be carried over to the Proposed Remedial Action Plan (PRAP). This recommendation is based on the results of the Remedial Alternatives Screening (RAS) and Remedial Alternatives Evaluation (RAE). This FS Report has been prepared in accordance with the following guidance documents:

- Paragraph B of Arizona Administrative Code (A.A.C) R18-16-407(B) (March 29, 2002).
- *Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA*, OSWER Directive 9355.3-01 dated October 1988.

1.1 PROJECT AUTHORIZATION

MACTEC Engineering and Consulting, Inc. (MACTEC) has been retained by the Arizona Department of Environmental Quality (ADEQ) to perform the following for the Site: a Remedial Investigation (RI); Human Health Risk Assessment (HHRA); Feasibility Study (FS); and, Early Response Action (ERA). This FS Report has been prepared in accordance with the scope of work and terms and conditions of the Arizona Superfund Response Action Contract (ASRAC) No. EV03-0073AO between MACTEC and ADEQ, and the ADEQ Task Assignment No. 04-0048.

1.2 OBJECTIVES

The FS was performed in accordance with A.A.C R18-16-407. The objectives of the FS are provided as follows:

- In coordination with ADEQ, evaluate a remedial strategy or combination of remedial strategies from the following: no action, monitoring, source control, controlled migration, physical containment, or plume remediation.
- Develop a reference remedy consisting of a combination of a remedial strategy (or strategies) and remedial measures.
- Develop alternative remedies consisting of a combination of a remedial strategy or strategies and remedial measures that will be compared to the reference remedy. According to R18-16-407 (E)(3), at least one of the alternative remedies must employ a remedial strategy or combination of strategies that is more aggressive than the reference

remedy, and at least one of the alternative remedies must employ a remedial strategy or combination of strategies that is less aggressive than the reference remedy.

- Conduct a detailed review and evaluation of remedial measures using the best available scientific information concerning available remedial methods and technologies and the comparison criteria identified in Arizona Revised Statutes (A.R.S) §49-282.06 (C).

- Ensure that the referenced remedy and the alternative remedies are capable of meeting the remedial objectives (ROs) developed during the remedial investigation (RI).

- Ensure that the proposed remedy is consistent with criteria set forth in A.R.S §49-282.06 (A) and A.R.S §49-282.06 (F).

In February 2003, a pilot-scale groundwater pump-and-treat system was installed as an Early Response Action (ERA) to evaluate pump-and-treat as a combination source control/controlled migration strategy. At the same time, a bench-scale treatability study was also performed to evaluate in-situ bioremediation to enhance source control/controlled migration over the conventional pump-and-treat approach. Monitoring of the pilot-scale system indicated the pilot-scale system was possibly performing some source control; however, the system was not effectively meeting the controlled migration objective. MACTEC subsequently modeled an expanded pump-and-treat system that involved different placements of additional extraction and injection wells. The modeling results indicated a combination of five extraction wells and a single injection well upgradient of the identified source area should be effective in meeting the controlled migration objective. Therefore, ADEQ authorized expansion of the system in July 2005. The expanded system was installed from September 26, 2005 through October 7, 2005 and was started on October 20, 2005. A groundwater model was run to evaluate system operation. An image of the resulting model is included as Appendix A. Additionally, as part of the ERA, a groundwater monitoring program was established.

2.0 BACKGROUND

This section provides the background of the Site and the basis for the FS.

2.1 SITE DESCRIPTION AND HISTORY

The Site is located northwest of the intersection of State Highway 95 and Business Route Interstate 10 in the Town of Quartzsite, La Paz County, Arizona. Quartzsite is located 125 miles west of Phoenix along U.S. Interstate 10, approximately 18 miles east of the Colorado River. The study area is located in the southeast quarter of Section 21, and the northeast quarter of Section 28, Township 4 North, Range 19 West, as shown on the Quartzsite, Arizona U.S. Geological Survey 7.5 minute Topographic Map (Figure 1). The WQARF study area includes several properties that contain both private residences and commercial businesses. The locations of properties, private wells, and monitoring wells within the Site are shown on Figures 1 and 3.

Investigation of the groundwater volatile organic compound (VOC) plume at the Tyson Wash WQARF Site was initiated by the Arizona Department of Environmental Quality (ADEQ) in August 1995. On June 30, 2003, MACTEC submitted the Final Remedial Investigation (RI) Report for the Tyson Wash WQARF Site. The RI focused on three properties shown on Figure 3: The Welcome RV Park; the former Hi-Ali Motel; and, the Cast (formerly Braswell) property. The greatest tetrachloroethene (PCE) concentration detected at the Site, which was 200 micrograms per liter (μg/l), was reported in the domestic well at the Welcome RV Park in 1995.

The VOC plume contains PCE and trichloroethene (TCE) at concentrations above the ADEQ Aquifer Water Quality Standard (AWQS) of 5 μg/L. The VOC plume has affected the upper aquifer, located approximately 40-70 feet below ground surface (bgs). There are no indications of the existence of non-aqueous phase liquids in soils or groundwater at the Site. VOC concentrations exceeding ADEQ Soil Remediation Levels have not been reported in any soil samples collected during the investigation. Historically, the shallow aquifer has been a source of drinking water for the area. In September 2001, the Town of Quartzsite completed the installation of its municipal water supply, thus providing residents of the area with an alternate source of drinking water.

MACTEC began quarterly groundwater monitoring in November 1999. Depth to groundwater measurements were collected from dedicated dataloggers installed in each of the monitoring wells from May 2000 through November 2002. Manual measurements have been collected from the wells since December 2002. Monitoring results through the 3rd Quarter 2001 indicated a relatively consistent groundwater flow direction to the northeast. During the 4th Quarter 2001, the groundwater flow direction began to change toward the north-northwest, a possible result of the shutting down of the three shallow domestic well in the area. Tables 1 and 2 provide well construction and groundwater elevation data through March 2007 and Tables 3 and 4 provide groundwater analytical data through March 2007. Figure 2 is a groundwater elevation hydrograph for the Site monitoring wells, Figure 3 shows the March 1, 2007 groundwater elevations, and Figure 4 shows the 1st Quarter 2007 PCE distribution.

In February 2003, MACTEC, under authorization of ADEQ, implemented an ERA at the site. The ERA initially consisted of two components as follows:

- Performance of a bench-scale treatability study to evaluate in-situ anaerobic (oxygen depleted) bioremediation, also referred to as in-situ reductive dechlorination; and,
- Performance of pump-and-treat pilot test to evaluate the effectiveness of a groundwater pump and injection system to 1) reduce PCE concentrations in the Welcome RV Park well; 2) control migration of the PCE plume to Town of Quartzsite production wells located approximately 0.5 miles downgradient of the Site; and, 3) assist in implementation of reductive dechlorination if selected as the remedy.

The results of the treatability study and pump-and-treat pilot test are discussed in Section 4. The ERA originally consisted of the installation of two groundwater extraction wells, identified as EW-1 and EW-2, and an injection well, identified as INJ-1 on the Welcome RV Park property. Groundwater extracted from EW-1 and EW-2 was pumped through a granular activated carbon (GAC) filter and re-injected to the aquifer at INJ-1. The system was operated on a cycle of three hours on and three hours off to avoid creation of a steep groundwater gradient. The system was started on April 7, 2003 and between April 7, 2003 and September 20, 2005, an estimated 2,909,487.3 gallons of groundwater had been pumped, treated in the GAC filter, and re-injected into the shallow aquifer through well INJ-1.

From February 2003 (baseline sampling event) to February 2005, the PCE concentrations in samples collected from the Welcome RV Park well decreased sharply from 160 μg/L to 30 μg/L, which indicated that the system was meeting the objective of decreased PCE concentrations in the Welcome RV Park well. However, PCE concentrations in QMW-1 and QMW-3 began steadily increasing. Based on the trends, it was concluded that the pilot-scale system had actually driven the PCE plume toward the south, toward QMW-1, and then northwest to QMW-3. Therefore, the objective of controlled migration was not being met. Based on this, MACTEC modeled an expanded system configuration consisting of three new extraction wells, identified as EW-3 through EW-5, and a new injection well, identified as INJ-2. The locations of theses wells are shown on Figure 4 and the modeling results are attached as Appendix A.

The expanded system was installed from September 26, 2005 through October 5, 2005 and testing and adjustments were performed on October 11-12, 2005 and on October 18-20, 2005. Testing indicated that INJ-2 could not accept more than approximately 7 gpm of water. Therefore, the system was set on October 20, 2005 at a total pumping rate of 8 gpm on a cycle of 1 hour on and two hours off with 7 gpm of treated water injected at INJ-2 and 1 gpm of treated water injected at INJ-1. Between April 7, 2003 and February 27, 2007, a total of 4,571,823 gallons of water had been pumped and treated and approximately 0.96 pounds of PCE have been removed.

2.2 GEOLOGY AND HYDROGEOLOGY

At the Site, subsurface soils consist of two main units. From the ground surface to a depth ranging from 60 to 70 feet bgs, soils consist of interbedded layers of well-cemented gravel, sand, silt, and clay. The upper 20 to 25 feet of this unit generally contain silty sand and silty gravel. A lens of caliche occurs at a depth ranging from 8 to 12 feet bgs. The remainder of the upper unit consists of interbedded layers of silty clay and silty sand.

Below a depth ranging from 60 to 70 feet across the Site, soils consist of silty clay to clay, with the estimated clay percentage ranging from 50 percent (%) to nearly 100%. This clay-rich unit appears to act as an aquitard, inhibiting the vertical flow of groundwater from the shallow aquifer to the deep aquifer. Groundwater flow in the upper aquifer is primarily horizontal through the coarser grained soils above the clay layer.

The shallow aquifer is believed to be perched and is estimated to extend at least 5 miles north of the Town of Quartzsite. A thick, extensive clay/limestone layer separates the shallow aquifer from a deeper confined aquifer. The deep aquifer consists of semi-consolidated sand, gravel, and clay that are typically encountered between 400 and 500 feet bgs. To date, there is no indication that the deep aquifer has been impacted with VOCs.

Depth to groundwater at the Site ranges from approximately 41 to 55 feet bgs. Groundwater flow across the Site was generally toward the east-northeast between May 2000 and September 2001. During that time period, the groundwater flow appeared to be strongly influenced by the pumping of domestic wells in the area.

The influence of the domestic wells also is indicated by the seasonal changes in the groundwater table elevation. Between May and September 2000 the groundwater table, as measured in monitoring wells QMW-1 through QMW-9 at the Site, generally increased or was relatively stable. Beginning in mid-October, and corresponding to the increased winter population, the groundwater table elevation decreased through March 2001, with the greatest change being noted in monitoring wells QMW-9 and QMW-2 on the Cast property. During April 2001, the water table decline ceased and elevations either stabilized or began to rise. This response corresponded to a decrease in water usage as the Town's population quickly declined near the end of March and early April. With the exception of the furthest up gradient wells (QMW-6 and QMW-7), the groundwater table elevation has increased steadily since the end of the Spring 2001 season, which coincides with the shutting down of a majority of the shallow domestic wells in the area. Depth-to-groundwater measurements collected since the 3rd Quarter 2001 also indicate a slight change in the groundwater flow direction toward to the north and northwest.

2.3 REMEDIAL OBJECTIVES SUMMARY

The Remedial Objectives Report dated May 14, 2003 and prepared by ADEQ presents the remedial objectives (ROs) for the Site (ADEQ 2003). The ROs established are used to develop the remedy for the site. The FS evaluates specific remedial measures and strategies and identifies a reference remedy and two alternative remedies capable of meeting the ROs. The FS also identifies the proposed remedy and describes how the proposed remedy will meet the ROs. This subsection summarizes the ROs for the Site.

The ROs are based on the current and reasonably foreseeable uses of land and the current and reasonably foreseeable beneficial uses of waters of the state identified in the Tyson Wash Use

Report, dated September 13, 2002. ROs were not established for every use identified in the Use Report. The determination as to whether a use was addressed was based on information gathered during the public involvement process, limitations of WQARF, and whether the use is reasonably foreseeable.

A public meeting was held on October 17, 2001 to discuss the Use Report and the proposed ROs. The Use Report was slightly modified as a result of the public meeting. As a result, ADEQ conducted another meeting on October 29, 2002 to discuss the proposed ROs. Comments on the Draft RO Report were accepted through November 29, 2002. After consideration by ADEQ, the final RO Report was prepared and dated May 14, 2003 (ADEQ, 2003).

2.3.1 Remedial Objectives for Land Use

The Site includes approximately 12 acres of low density residential and commercial properties. Land use within the Site includes residences, a mobile home park, a restaurant, and a former hotel. Future land use within the general Site area is expected to remain similar, but increase in density. The Quartzsite General Plan proposes a commercial development node at the intersection of Business Loop I-10 and Highway 95, just outside the southeast boundary of the Site.

RO's for land use are established for those properties known to be contaminated with a hazardous substance. However, laboratory analyses of soil samples and soil gas samples have not definitively identified areas of soil contamination within the Site. VOCs in the soil may have been present at one time, but now have appeared to have volatilized, degraded, or dispersed into the groundwater or environment after they were released.

Since there is no evidence of soil contamination present above soil remediation levels in the areas that have been investigated, an RO for land use is not warranted.

2.3.2 Remedial Objectives for Groundwater Use

The groundwater beneath the Site is present in an upper aquifer which exists from 40 to 70 feet bgs and a lower aquifer which begins at approximately 300 feet bgs. The PCE and TCE groundwater plume appears to have only affected the upper aquifer. The plume extends to approximately 300 feet to the north of Cowell Street, 400 feet east of Washington Boulevard, 300 feet south of Cowell Street, and 200 feet east of Oregon Avenue.

The Site includes nineteen privately owned wells of which only one well (B-3) is constructed in the deep aquifer (Figure 4). No municipal or large supply wells are located on or near the Site. According to Arizona Department of Water Resources (ADWR) records, there are approximately 544 registered private wells within approximately a one-half mile radius of the Site. Approximately 111 of the 544 registered wells are deep aquifer wells.

Ten of the nineteen wells have been impacted by PCE contamination (see Table 2). Seven of the nine wells have historically had PCE concentrations above the AWQS of 5 μg/L (see Table 2). Three of the nineteen wells have been impacted by TCE contamination, of which one well has had historical TCE contamination above the AWQS of 5 μg/L. The property zoning for each of the above wells is as follows:

Well Name[1]	Property Zoning	PCE > AWQS
Adams north	R	No
Adams south	R	No
Rhoades west	R	Yes
Rhoades east	R	inoperable
Parsons north	R	No
Parsons south	R	No
Kauffman	R/V	Yes
York	R	Yes
Welcome RV Park	SR/C	Yes *
La Casa west	SC	Yes
La Casa east	SC	No
Cast B-1	R/C	Yes
Cast B-2	R/C	Yes
Cast B-3	R/C	No
Cast B-4	R/C	No

Well Name[1]	Property Zoning	PCE > AWQS
Post Office	C	Yes
Eric's RV Repair	SC	No
Mark's Family Restaurant	C	No
La Mirage RV Park	C	No

1- All properties listed are currently connected to the Town of Quartzsite water and sewer system

R – Residential , SR - Seasonal residential, SC - Seasonal Commercial, V – Vacant,
C – Commercial, * Also contains TCE groundwater contamination > AWQS

ADEQ conducted a water use survey regarding the Site. A questionnaire was given to thirty-five residents within the community involvement area (CIA). As agreed in the questionnaire, ADEQ is keeping the names and addresses of the residents who responded anonymous. Eighteen persons responded to the survey and submitted a written questionnaire for evaluation.

The results of the survey suggest that most residents within the CIA indicated they would continue to use their private wells for non-potable use. Four of the respondents indicated they would also continue using their wells for drinking water purposes. One respondent did not answer the future use question. One respondent indicated they were not sure if they would continue using their well in the future. One respondent stated that they used their well for domestic purposes and indicated they would discontinue use if connected to the Town of Quartzsite water supply. One other respondent indicated they would continue to use their deep aquifer well for potable purposes.

All of the commercial and residential properties located within the Site are connected to both Town of Quartzsite water and sewer. The Wellhead Protection Plan (WPP), as installed by the Town of Quartzsite on September 14, 1999, outlined several management strategies for the Wellhead Protection Area (WPA). The WPP suggested that the Town require all property owners to disconnect shallow wells from drinking water connections once they have been connected to the Town's water system. The shallow wells could still be used for irrigation. The WPP also suggested a requirement that properties that desire to keep their privately owned wells install backflow prevention on their plumbing. The above two management strategies, if implemented, would deter private well owners from using their shallow wells as a drinking water source. In addition, A.A.C. R18-4-115 specifies that a public water system shall protect from contamination caused by backflow through unprotected cross-connections by requiring the installation and periodic testing of backflow-prevention assemblies. Therefore, in addition to the above mentioned management strategy, the State of Arizona also has rules to prevent contamination of a public drinking water system.

The following factors were taken into consideration when developing the ROs for the site:

- The Town of Quartzsite requires that all property owners within 200 feet of the water and sewer lines connect to the utilities provided.

- Some residents will continue to use their private wells for potable purposes due to taste issues resulting from high total dissolved solids (TDS) in the deep aquifer. However, residents who choose to use their private wells for potable purposes are required to isolate the private well water from the public supply distribution system.

- Elevated concentrations of TDS and nitrates occur in the shallow aquifer. Nitrate concentrations exceeding the Water Quality Standard of 10 milligrams per liter (mg/l) have been reported in groundwater samples collected from site monitoring wells. Nitrate concentrations range between 5 and 29 mg/l in groundwater beneath the site.

- As residents connect to the Town water system and discontinue use of their private wells, the plume geometry may change. Current groundwater analytical results indicate that the plume may be spreading toward Tyson Wash following the assumed natural direction of groundwater flow.

- All groundwater wells constructed within the deep aquifer may be possible conduits for cross-contamination between the two aquifers. Costs to evaluate deep wells as potential conduits are excessive and may exceed the cost required to cleanup the groundwater at the site.

- According to the WPP, installation of new wells in the shallow aquifer will be prohibited in the WPA.

- The WPA available at the time the RO Report was written does not include the Site. However, in the future additional areas just to the south of the Site may be established, as well as the entire community being declared a WPA.

- Shallow aquifer groundwater uses outside the boundaries of Site are assumed to be for potable use. This assumption is made because potential use of the shallow aquifer cannot be determined without extensive outreach to each and every individual with a shallow groundwater well.

- ADEQ has not confirmed the connection status of other residents outside of the plume boundaries. Therefore, it is assumed for the purposes of developing the ROs that residents outside of the plume boundaries are continuing to use their domestic wells for potable purposes.

- After residents are connected to the Town of Quartzsite public water supply, it is assumed that the private domestic wells will be unnecessary for potable purposes. The WPP indicates that the management strategies suggested would deter people from using their private wells for potable purposes. According to the WPP, backflow prevention equipment must be installed on any private wells that the property owner wishes to use after service connection. In addition, the water service from the house must be connected to the Town water source.

The Town of Quartzsite requires all property owners within 200 feet of the water and sewer service to connect to the utilities provided. In the future it is anticipated that all residents within the Town of Quartzsite will be connected to the public drinking water system.

PCE and TCE groundwater contamination from the shallow aquifer at the Site may continue to spread and impact the shallow aquifer outside of the current plume boundaries. According to the ADWR database, there are over 400 shallow aquifer wells within a one-half mile radius of the site.

The assumed current use of the shallow aquifer outside of the Site plume boundaries is for potable purposes for those residents not connected to the Town's water supply. After residents outside of the Site plume boundaries have connected to the Town's water supply, the future use of the shallow aquifer will be for non-potable purposes only. The proposed RO for potable and non-potable groundwater use of the shallow aquifer outside the plume boundaries is:

> To protect, restore, replace, or otherwise provide a water supply for potable use by private well owners outside the current plume boundaries of the Site if the current use is impaired or lost due to contamination from the Site. This RO is applicable until Town water service connections can be confirmed. After the Town water connections are confirmed, the RO is to protect, restore, replace, or otherwise provide a water supply for non-potable use by private well owners outside the current plume boundaries of the Site if the current use is impaired or lost due to contamination from the Site. This RO is needed for as long as the wells are used for non-potable purposes and their use is threatened, impaired, or lost as a result of contamination from the Site.

3.0 CURRENT SITE CONDITIONS

The current site conditions are discussed in detail in the following report that is included in ADEQ files:

> *First Quarter 2007 Groundwater Monitoring Report, Tyson Wash WQARF Site, Quartzsite, Arizona,* prepared by MACTEC and dated May 4, 2007

The March 1, 2007 groundwater elevations are shown on Figure 3. The March 1, 2007 groundwater elevations indicate groundwater flowed in a northwesterly direction across the southern two-thirds of the study area at a shallow gradient of approximately 0.01 feet/foot (ft/ft). The flow gradually turns to a more northerly direction in the northern third of the study area at a gradient of 0.04 ft/ft.

The 1st Quarter 2007 PCE distribution is shown on Figure 4. The following summarizes the analytical results for the 1st Quarter 2007 groundwater sampling event:

- PCE concentrations exceeded the ADEQ AWQS of 5.0 µg/L in the samples collected from monitoring wells QMW-1 (14 µg/L), QMW-3 (130/100(D) µg/L), QMW-4 (89 µg/L), QMW-5 (7.2 µg/L), QMW-8 (11 µg/L), QMW-10 (9.9 µg/L), and QMW-11 (9.3 µg/L). PCE was reported below the AWQS of 5.0 µg/L in the samples collected from monitoring wells QMW-7 (2.3 µg/L) and QMW-12 (1.6 µg/L). PCE was not detected in wells QMW-2 and QMW-9.

- PCE exceeded the AWQS of 5.0 µg/L in the samples collected from wells EW-3 (79/90(D) µg/L) and EW-4 (43 µg/L). PCE was reported below the AWQS of 5.0 µg/L in the samples collected from well EW-1 (1.2 µg/L) and EW-5 (1.0 µg/L). PCE was not detected above minimum LRLs in the samples collected from EW-2, INJ-1, and INJ-2.

- PCE exceeded the AWQS of 5.0 µg/L in the samples collected from the Rhoades West well (6.6/5.9(D) µg/L) and Welcome RV Park well (12 µg/L). PCE concentrations did not exceed the AWQS of 5.0 µg/L in the samples collected from the Adams South well (1.3 µg/L) and York well (3.4 µg/L). PCE was not detected in the samples collected from the Parsons well and Adams North well.

For the purposes of this FS, MACTEC has identified the source area as the area containing PCE groundwater concentrations in excess of 50 µg/L and the plume area as the area containing PCE groundwater concentrations in excess of the AWQS of 5.0 µg/L. Figure 4 shows the highest PCE concentrations are present in the area including wells QMW-1, QMW-3, QMW-4, QMW-5, EW-3, EW-4, and Welcome RV Park. This is essentially the source area. Between the 4th Quarter 2006 and 1st Quarter 2007 monitoring events, PCE concentrations in the sampled wells generally decreased, most significantly in the Welcome RV Park well (60 µg/L to 12 µg/L). As discussed in Section 2.1, the 1st Quarter 2007 PCE distribution pattern indicates the remediation system continues to apparently operate as predicted by groundwater modeling.

4.0 RESULTS OF PILOT TESTS AND TREATABILITY STUDIES

In February 2003, an ERA was implemented at the site. The ERA initially consisted of two components as follows:

- Performance of a bench-scale treatability study to evaluate in-situ anaerobic (oxygen depleted) bioremediation, also referred to as in-situ reductive dechlorination; and,
- Performance of pump-and-treat system pilot test.

The initial implementation of the ERA involved the installation of two groundwater extraction wells, identified as EW-1 and EW-2, and a treated groundwater injection well, identified as INJ-1. The locations of the wells are shown on Figure 3. The results of the pilot tests and treatability studies are summarized below.

4.1 IN-SITU BIOREMEDIATION TREATABILITY STUDY

The bench-scale in-situ bioremediation treatability study was performed to evaluate if the dissolved chlorinated solvents in the groundwater could be effectively bioremediated. Any naturally occurring bacteria will utilize hydrogen, from organic carbon, as an electron donor and energy source (oxidation) and will utilize electron acceptors for respiration (reduction). Oxygen, nitrate, ferric iron, sulfate, manganese, and carbon dioxide are the electron acceptors commonly used by bacteria for respiration. When sufficient biologically appealing organic carbon and hydrogen are available, bacteria will often deplete the supply of available electron acceptors. In this case, anaerobic, non-oxygen breathing, bacteria will utilize chlorinated solvents as electron acceptors, a process that is referred to as reductive dechlorination. Essentially, bacteria transfer hydrogen, the electron donor, to the chlorinated solvent, the electron acceptor, which releases a chlorine ion, thus the term reductive dechlorination. The conditions required for reductive dechlorination to occur are as follows:

- A sufficient supply of biologically appealing organic carbon must be available. Examples of biologically appealing organic carbon are petroleum hydrocarbons (benzene, toluene, ethylbenzene, xylene), sugars, alcohols (methanol, ethanol), lactate, and benzoate. Long-chain hydrocarbons are typically not biologically appealing.
- If the system is aerobic, there must be sufficient biologically appealing organic carbon available for aerobic bacteria to deplete the oxygen supply, thus creating an anaerobic

condition. If benzene is the source of the organic carbon, anaerobic conditions can occur at concentrations as low as 1.0 mg/L.

- At least one of the anaerobic electron acceptors, nitrate, ferric iron, manganese, sulfate or carbon dioxide must be present.

- The right anaerobic bacteria must be present. There have been several chlorinated solvent reducing bacteria identified. However, most of these bacteria only reductively dechlorinate to only one or two steps, such as PCE to TCE or PCE to c-1,2-DCE. The only bacterium identified that completely reductively dechlorinates PCE to ethene is *Dehalococcoides Ethenogenes* or DHE. If DHE is not present or has been out-competed by other bacteria, the process will "stall" and the daughter products will accumulate.

- The anaerobic bacteria must deplete the available electron acceptor supply before they deplete the organic carbon supply. For example, nitrate-reducing bacteria will not utilize chlorinated solvents as electron acceptors until all or most of the available nitrate is utilized and there must be adequate hydrogen for this to occur.

- The electron donor supply must be adequate to allow complete microbial reduction of the chlorinated solvent. Specifically, will the bacteria run out of chlorinated solvent before they run out of hydrogen?

As indicated above, it is rare to find sufficient naturally occurring organic carbon to promote reductive dechlorination. The organic carbon typically originates from a fuel release (i.e., leaking underground storage tank), leachate from a landfill, or added as part of a remedial action. Reductive dechlorination is evaluated through observation of VOC daughter products, trends in VOC distributions, and trends in natural attenuation parameters. Reductive dechlorination of PCE is indicated by the presence of reductive dechlorination daughter products as follows:

$$\text{PCE} \xrightarrow{H^{+}+e^{-}\text{-}Cl^{-}} \text{TCE} \xrightarrow{H^{+}+e^{-}\text{-}Cl^{-}} \text{c-1,2-DCE} \xrightarrow{H^{+}+e^{-}\text{-}Cl^{-}} \text{Vinyl Chloride} \xrightarrow{H^{+}+e^{-}\text{-}Cl^{-}} \text{Ethene}$$

The in-situ bioremediation treatability study was performed by Clemson University under contract to MACTEC. For a bench-scale in-situ bioremediation treatability study to best represent site conditions, actual aquifer material and groundwater from the site must be collected and used in the test. This is necessary to evaluate if there are mineralogical and physical components of the aquifer material that may interfere or hinder bioremediation. Therefore, a continuous core sampling system was used to collect samples of the aquifer material during drilling of EW-1 and EW-2. Additionally, approximately five gallons of groundwater was collected during initial sampling of EW-1 and EW-2.

There are two terms used to describe in-situ bioremediation. Biostimulation refers to activating or stimulating native bacteria by the addition of electron donors. Bioaugmentation refers to introducing non-native bacteria in the event biostimulation does not achieve the desired result. The overall objectives of the study were:

1) To evaluate biostimulation as a remediation technique, using lactate, hydrogen release compound (HRC), corn syrup, and ethanol as the electron donors. For comparative purposes, treatments with no electron donor were used;

2) To evaluate bioaugmentation as a remediation technique, using four cultures known to contain *Dehalococcoides ethenogenes* (DHE); and,

3) To determine the potential for aerobic bio-oxidation of vinyl chloride (VC).

The results of the microcosm study indicated that the addition of an electron donor alone was not likely to initiate PCE dechlorination in the Tyson Wash aquifer. However, addition of an electron donor plus bioaugmentation with a commercially available DHE enrichment culture did appear to be technically feasible, at least in terms of compatibility with the geochemistry of the impacted soil and groundwater. The high background level of sulfate does not appear to be a problem. Indirect results suggest that there is a relatively high potential for iron(III) reduction, and the iron(II) formed is removing the sulfide as a precipitate. Attention would have to be given to ensuring that an adequate level of electron donor is supplied along with the DHE culture, since the demand for an electron donor is well in excess of that required for stoichiometric reduction of nitrate, sulfate and PCE. Iron(III) reduction may be the reason for this higher than anticipated electron donor demand.

VC reduction to ethene is the rate-limiting reaction for each of the three commercially available enrichment cultures tested. Based on a first order model, the cultures perform similarly in their rates of VC reduction. If bioaugmentation were selected for field-scale evaluation, below are several factors that should be considered:

1) Cost: This factor is critical to the overall success of the project, but it should not be the only factor. The total cost will include purchase and distribution of the enrichment culture, as well as purchase and distribution of the electron donor. When comparing costs of the enrichment culture, the evaluation should be based on the total inoculum required, not the unit cost of the culture.

2) Field Experience: While the treatability study demonstrated the potential for each of the cultures in a laboratory setting, field application requires experience at this

level of application, especially when it comes to issues such as how the culture should be handled to minimize inactivation by exposure to air. The supplier should have some success with other field-scale bioaugmentation applications in which a DHE enrichment culture was used.

3) Technical Support: DHE enrichment cultures are "sensitive," i.e., they have to be handled in a manner that ensures proper growth conditions. The company that supplies the enrichment culture should be able to provide technical support during the inoculation phase as well as the follow-up phase, to help troubleshoot potential problems (e.g., why is the in situ activity slowing down?).

Based on the results of the in-situ bioremediation treatability study, bioaugmentation combined with the addition of lactate as an electron donor was screened as a remedial alternative for both source control and plume remediation. The treatability study indicated bioaugmentation would likely achieve the ROs; however, due to the number of injection points required to deliver the DHE bacteria to the aquifer, bioaugmentation may not be cost effective or as easily implemented compared to other remedial alternatives. Bioaugmentation was not originally carried forward to the RAE, but at the request of ADEQ, the remedial alternative has been included in Section 5.0 as an additional remedial alternative that is more aggressive than the reference remedy.

4.2 GROUNDWATER PUMP-AND-TREAT PILOT TEST

The pilot-scale pump-and-treat system consisted of the installation of two groundwater extraction wells, identified as EW-1 and EW-2, and an injection well, identified as INJ-1 on the Welcome RV Park property. Groundwater modeling using the program MODFLOW was used to evaluate the locations of the pilot test wells. Groundwater extracted from EW-1 and EW-2 was pumped through a granular activated carbon (GAC) filter and re-injected to the aquifer at INJ-1. The system was operated on a cycle of three hours on and three hours off to avoid creation of a steep groundwater gradient. This pilot-scale system was intended to demonstrate the following:

1) That groundwater pump-and-treat could reduce PCE concentrations in the Welcome RV Park well;

2) Control migration of the PCE plume to Town of Quartzsite production wells located approximately 0.5 miles downgradient of the Site; and,

3) That the system could assist in implementation of in-situ bioremediation if selected as the preferred remedial alternative for the site.

The system was started on April 7, 2003 and was operated as a pilot system until September 2005. In February 2005, it was evaluated that the pilot system was not meeting the RO of controlling migration. Based on this, MACTEC modeled an expanded system configuration consisting of three new extraction wells, identified as EW-3 through EW-5, and a new injection well, identified as INJ-2. The locations of theses wells are shown on Figures 3 and 4 and the modeling results are attached as Appendix A.

On October 20, 2005, the full-scale system was started. On March 30, 2006, MACTEC enhanced the system operation by installing a water level switch in the equalization tank and a secondary GAC scrubber was also installed. Additionally, in May 2006, MACTEC installed a remote monitoring and operation system known as an AlarmAgent. With the overfill protection systems installed on the system, the optimized 24-hour operation schedule was set on March 30, 2006 as follows:

0900 – 1015	ON
1015 – 1215	OFF
1215 – 1330	ON
1330 – 1530	OFF
1530 – 1645	ON
1645 – 1845	OFF
1845 – 2000	ON
2000 – 2200	OFF
2200 – 2315	ON
2315 – 0115	OFF
0115 – 0230	ON
0230 – 0500	OFF
0500 – 0630	ON
0630 – 0900	OFF

This results in the system being 'ON" for a maximum of nine hours during a 24-hour period; however, maximum water level system shut-downs, if they occur, will decrease the daily pumping time. These system shut-downs will be recorded by the remote operating system and can also be identified by recording the monthly quantity of water pumped. The pumping rates are set by controllers to a total pump rate of 8.0 gallons per minute (gpm). However, the actual measured pumping rate has stabilized at approximately 7.5 to 8.5 gpm.

From April 7, 2003 through February 27, 2007, a total of 4,571,823 gallons of water had been pumped, treated, and re-injected at the site. Through February 27, 2007 an estimated 0.96 pounds of PCE had been removed.

5.0 INITIAL REMEDIAL ALTERNATIVES SCREENING

An ERA was implemented at the site. As part of the ERA evaluation, MACTEC worked with ADEQ to identify remedial strategies and remedial measures, including innovative treatment technologies, which appeared capable of achieving the ROs. MACTEC identified and screened remedial alternatives in the following categories:

1. Plume remediation;
2. Physical containment;
3. Controlled migration;
4. Source control;
5. Monitoring; and,
6. No action alternative.

The RO's established for the Site require that the selected remedy meet Items 3 through 5 above and possibly Item 1. Remedies providing physical containment (Item 2), which would include the use of slurry walls, would also meet the RO's. However, the cost and implementability for these types of remedial alternatives will be cost preventative compared to other remedial alternatives. Therefore, remedial alternatives providing physical containment were not screened or evaluated. During the ERA evaluation, MACTEC and ADEQ evaluated three potential remedial alternatives for the Site; groundwater pump-and-treat, in-situ bioremediation, and monitored natural attenuation (MNA). Therefore, these remedial alternatives and possibly additional remedial alternatives were screened for effectiveness, implementability, cost, and ability to meet the RO's.

The RAS Technical Memorandum, which is attached as Appendix B, was submitted to ADEQ on June 21, 2006. The RAS indicated that using a combination of remedial strategies and alternatives often has the effect of meeting the RO's in a shorter timeframe and sometimes at a lower cost. For example, a short-term source control technology combined with a controlled migration technology and monitoring may result in plume remediation at a lower cost than just applying a total plume remediation approach. Though in-situ bioremediation was proven effective by the treatability study, the cost to implement in-situ bioremediation as a source control technology was estimated to be higher than operating the pump-and-treat system for 10 years as a source control technology. However, the RAS indicated that in-situ chemical oxidation (ISCO), which uses chemical oxidants to degrade PCE to inert compounds, could possibly be effectively employed as a source control technology at a lower cost than operating the pump-and-treat system as a source control technology. Therefore, ISCO was selected for further evaluation and in-situ bioremediation was initially rejected for further evaluation. However, at the request of ADEQ, in-situ bioremediation has been added as a more aggressive remedial approach.

Based on the results of the RAS, the groundwater modeling, groundwater monitoring that was performed through March 2006, and the request by ADEQ, the reference and alternative remedies that were and are carried forward to the RAE are listed as follows:

Remedial Alternative	Remedial Technology
More Aggressive Alternative 1	ISCO as source control, pump-and-treat as controlled migration, and monitoring.
More Aggressive Alternative 2	In-situ bioremediation as source control, pump-and-treat as controlled migration, and monitoring.
Reference Remedy	Groundwater pump-and-treat as controlled migration
Less Aggressive	MNA

The groundwater pump-and-treat system had been installed and in operation at the time the RAS was completed. Therefore, groundwater pump-and-treat as a controlled migration technology was selected as the reference technology. ISCO or in-situ bioremediation employed for source control, combined with pump-and-treat for controlled migration, were considered as more aggressive alternatives than groundwater pump-and-treat due to the linking of technologies and potential shorter timeframe for remediation. Though MNA alone will not immediately meet the RO's, MNA may be employed in the future, either as a stand alone approach, or in combination with pump-and-treat. Therefore, MNA was evaluated as a less aggressive alternative than groundwater pump-and-treat.

6.0 DETAILED REMEDIAL ALTERANTIVES EVALUATION AND ANALYSIS

The approved RAS Technical Memorandum was submitted to ADEQ on June 21, 2006. The objective for completion of the RAE was to maximize protection of human health and groundwater resources while meeting the ROs. The evaluation was based on the seven criteria identified in ARS §49-282.06 (C) as summarized below:

- Population, environmental and welfare concerns at risk;
- Routes of exposure;
- Amount, concentration, hazardous properties, environmental fate, and form of substance present;
- Physical factors affecting human and environmental exposure and extent of previous expected migration;
- Beneficial use of water;
- Technical practicality and cost effectiveness; and,
- Availability of other appropriate remedial action and enforcement mechanisms.

In accordance with A.A.C R18-16-407 (H) (2), the remedial alternative was also evaluated using the following:

1. A demonstration that the remedial alternative will achieve the remedial objectives.
2. An evaluation of consistency with the water management plans of affected water providers and the general land use plans of local governments with land use jurisdiction.
3. An evaluation of comparison criteria, including:
    - Practicality of the alternative, including its feasibility, short and long term effectiveness, and reliability;
    - Risk, including fate and transport of contaminants, assessment of current land and resource use, exposure pathways and duration of exposure, protection of health and biota during implementation of remedial action, and residual risk in aquifer at end of remediation;
    - Cost of remedial alternative, including capital, operating, maintenance, life cycle, and transactional costs;

- Benefit of value of remediation, including lowered risk, reduction in concentration or volume, decreased liability, acceptance by public, aesthetics, enhancement of future uses, and improvement to local economics; and,

- Discussion of comparison criteria in relation to each other.

The proposed remedy must meet the requirements provided in A.R.S §49-282.06 (A) as listed below:

- Assure the protection of public health and welfare and the environment;

- To the extent practicable, provide for the control, management, or cleanup of the hazardous substances so as to allow for the maximum beneficial use of the waters of the state; and,

- Be reasonable, necessary, cost effective, and technically feasible.

Additionally, in accordance with A.A.C. R18-16-407 (G), ADEQ consulted with the Town of Quartzsite on water management plans; the WPA; and, the WPP in case these have been updated since the release of the RO Report in 2003. As of the date of this FS Report, there have been no changes.

MACTEC submitted the RAE Technical Memorandum to ADEQ on March 28, 2007, which is attached as Appendix C. As indicated in Section 5, in-situ bioremediation was not initially carried forward to the RAE as a more aggressive alternative. However, at the request of ADEQ, the FS also evaluates in-situ bioremediation, though it is not included in the RAE Technical Memorandum attached as Appendix C. The following summarizes the RAE of in-situ bioremediation combined with pump-and-treat and long-term monitoring as a source control technology:

- In-situ bioremediation would require injection of the DHE bacterium along with an electron donor to stimulate and culture the DHE bacterium. In-situ bioremediation is a proven technology that can remediate a source zone in a short timeframe. In-situ bioremediation is considered somewhat practical for the Site because the remedial alternative can make use of the existing pump-and-treat system to deliver the electron donor. However, an estimated 100 injection points are required to deliver the DHE bacterium to the aquifer. This reduces the implementability and practicality of in-situ bioremediation when compared to pump-and-treat and ISCO.

- The risks and benefits associated with in-situ bioremediation are the same as ISCO in that in-situ bioremediation may remediate the source zone in a shorter timeframe than pump-and-treat.

- The estimated cost to install, operate, and maintain an in-situ bioremediation system at the Site as a source control alternative is approximately $1,000,000, not including costs for long-term plume area containment and monitoring. This is approximately $700,000 more than implementation of ISCO for source control. Including the same long-term plume containment and monitoring costs that were included for ISCO, the total cost for the in-situ bioremediation system would exceed $1,500,000, which is more than the ISCO alternative.

When comparing the practicability, risk, cost, and benefit associated with each alternative, and the ability to meet the ROs, pump-and-treat, which was evaluated as the reference alternative, may be the preferred alternative.

MNA, which was evaluated as the less aggressive remedial alternative, was immediately ruled out because the RO's would not immediately be met using natural attenuation alone. However, MNA may have a role in the future after active remediation has been evaluated to be complete. ISCO, which was evaluated as the more aggressive alternative, may result in quicker remediation and a slightly lower cost than the reference alternative. However, the implementation of the more aggressive alternative may result in private property access concerns. Considering the reference remedial alternative has already been installed and is demonstrated to be operating effectively and meeting the RO's, the cost difference between the reference and more aggressive remedial alternatives was considered insignificant.

7.0 SUMMARY AND CONCLUSIONS

Based on the results of the RAE, the current groundwater pump-and-treat and injection system is recommended as the final remedy. The groundwater pump-and-treat system is primarily intended as a controlled migration remedial approach. However, as demonstrated by on-going groundwater monitoring, the combination of extraction and the flushing action provided by the re-injection system is apparently also providing source control. The full system has been in operation since October 2005 and groundwater monitoring has demonstrated that downgradient migration of the plume area has been controlled and the size of the plume area is decreasing. Recent groundwater monitoring has also shown that PCE concentrations within the source area are decreasing and the size of the source area has also decreased. Therefore, the current system is operating as designed and is meeting the RO's for the Site. The system should continue to meet the ROs in the future as contaminant mass is removed and the sizes of the plume and source areas decrease. As this occurs, natural attenuation should become more of a factor and may be implemented as a stand alone approach in the future after it is evaluated that the plume is stabile without the pump-and-treat system in operation.

6.0 REFERENCES

Arizona Administrative Code R18-16-406, R18-16-407 and R18-16-408

Arizona Department of Environmental Quality (ADEQ), 2003. *"Remedial Objectives Report, Tyson Wash WQARF Site, Quartzsite, Arizona"* dated May 14, 2003

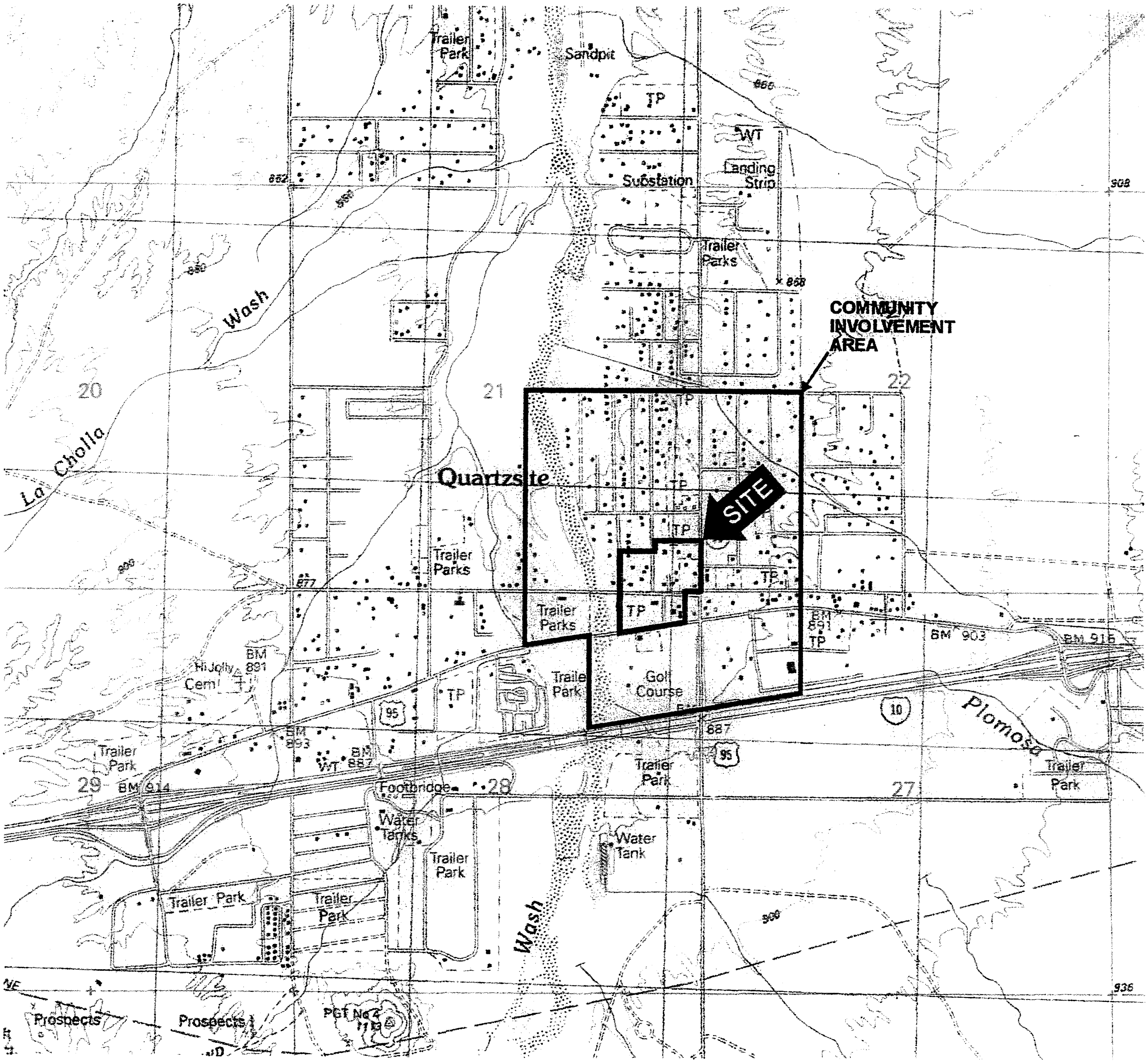
Arizona Revised Statutes §49-281 et. seq.

Environmental Protection Agency (EPA), 1988. *"Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final"* dated October 1988.

MACTEC, 2003. *"Remedial Investigation Report, Tyson Wash WQARF Site, Quartzsite, Arizona"* prepared by MACTEC for ADEQ and dated June 30, 2003

FIGURES

N:data/wpdocs/saw/wqarf/tyson/corel/sitelocation



N

0 500' 1000' 2000'

SCALE IN FEET

NOTE:

MAP TAKEN FROM QUARTZSITE, ARIZONA
U.S. GEOLOGICAL SURVEY 7.5 MINUTE
TOPOGRAPHIC MAP.

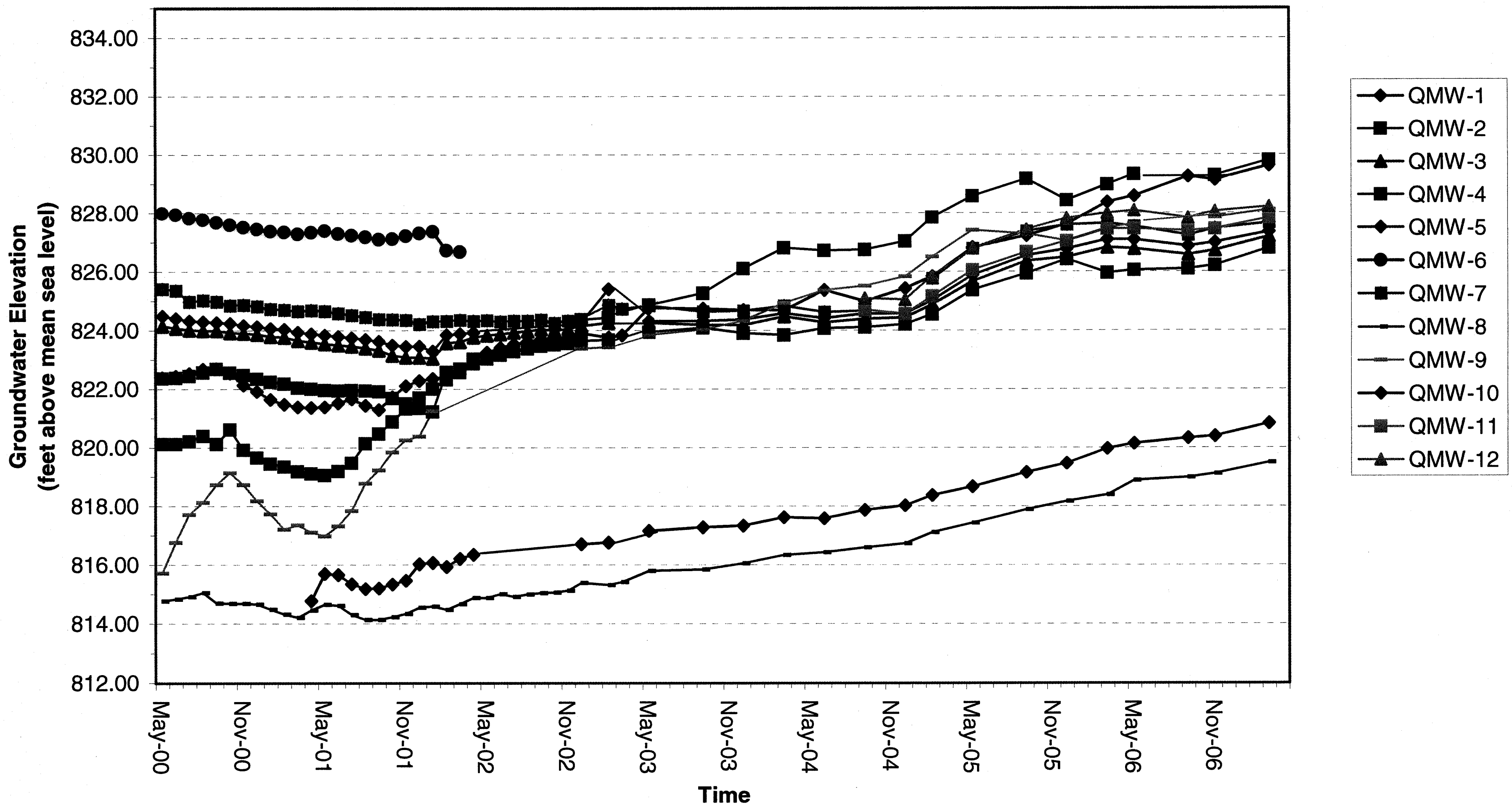
MACTEC

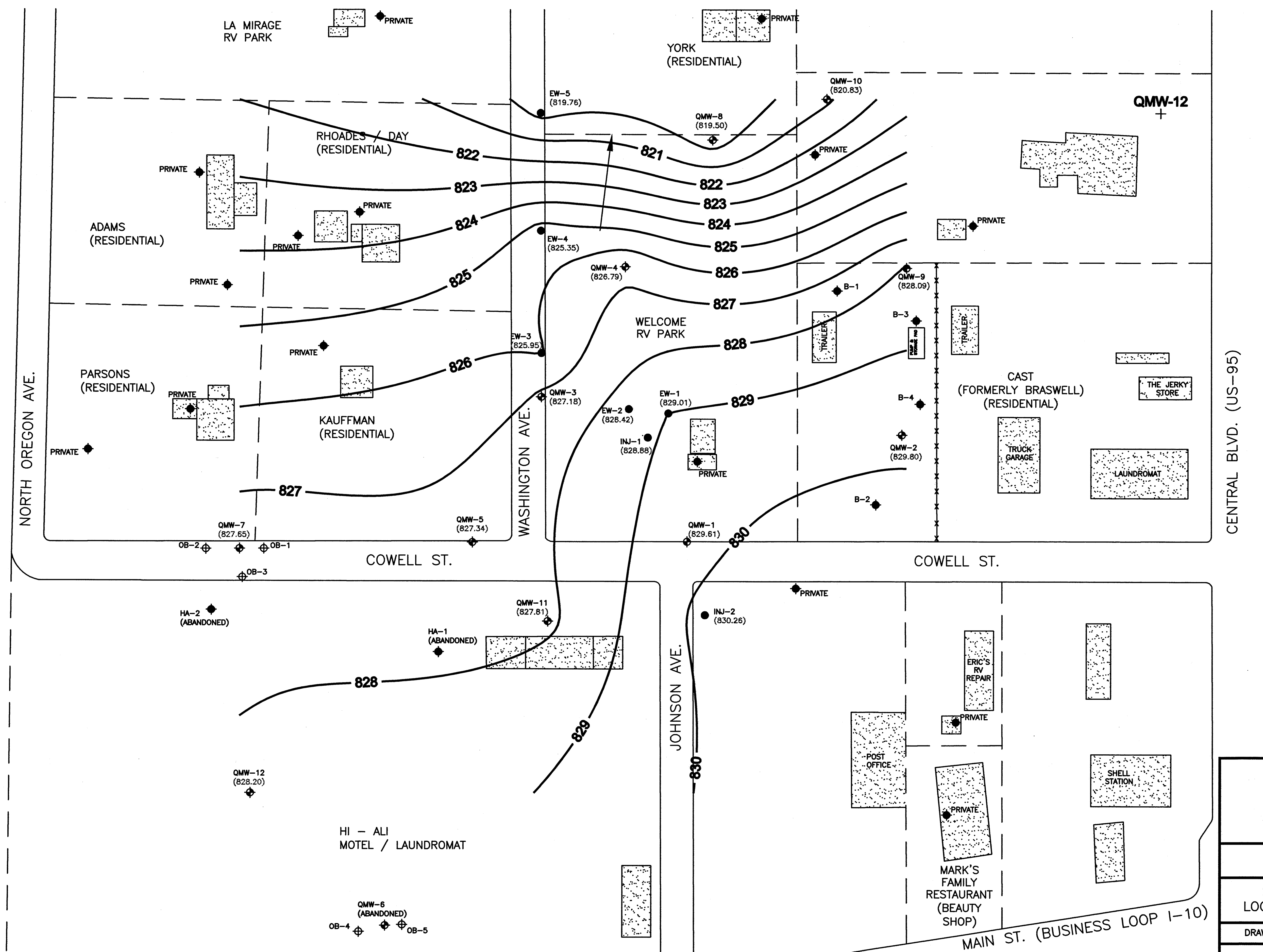
SITE LOCATION
ADEQ TYSON WASH WQARF SITE
QUARTZSITE, ARIZONA

FIGURE
1

DRAWN	PROJECT NUMBER	APPROVED	DATE
DANIEL L. KUDLICKI	661026	SAW	7/12/2001

Figure 2
Groundwater Elevation vs Time, May 2000 - March 2007
Tyson Wash WQARF Site





EXPLANATION

- QMW-2 MONITORING WELL
- QMW-2 OBSERVATION WELL
- B-4 DOMESTIC WELL
- GROUNDWATER CONTOUR LINE DASHED WHERE INFERRED
- GROUNDWATER FLOW DIRECTION
- EW-1 WATER TREATMENT EXTRACTION AND INJECTION WELLS

NOTE: LOCATION & NUMBER OF DOMESTIC WELLS ARE APPROXIMATE.

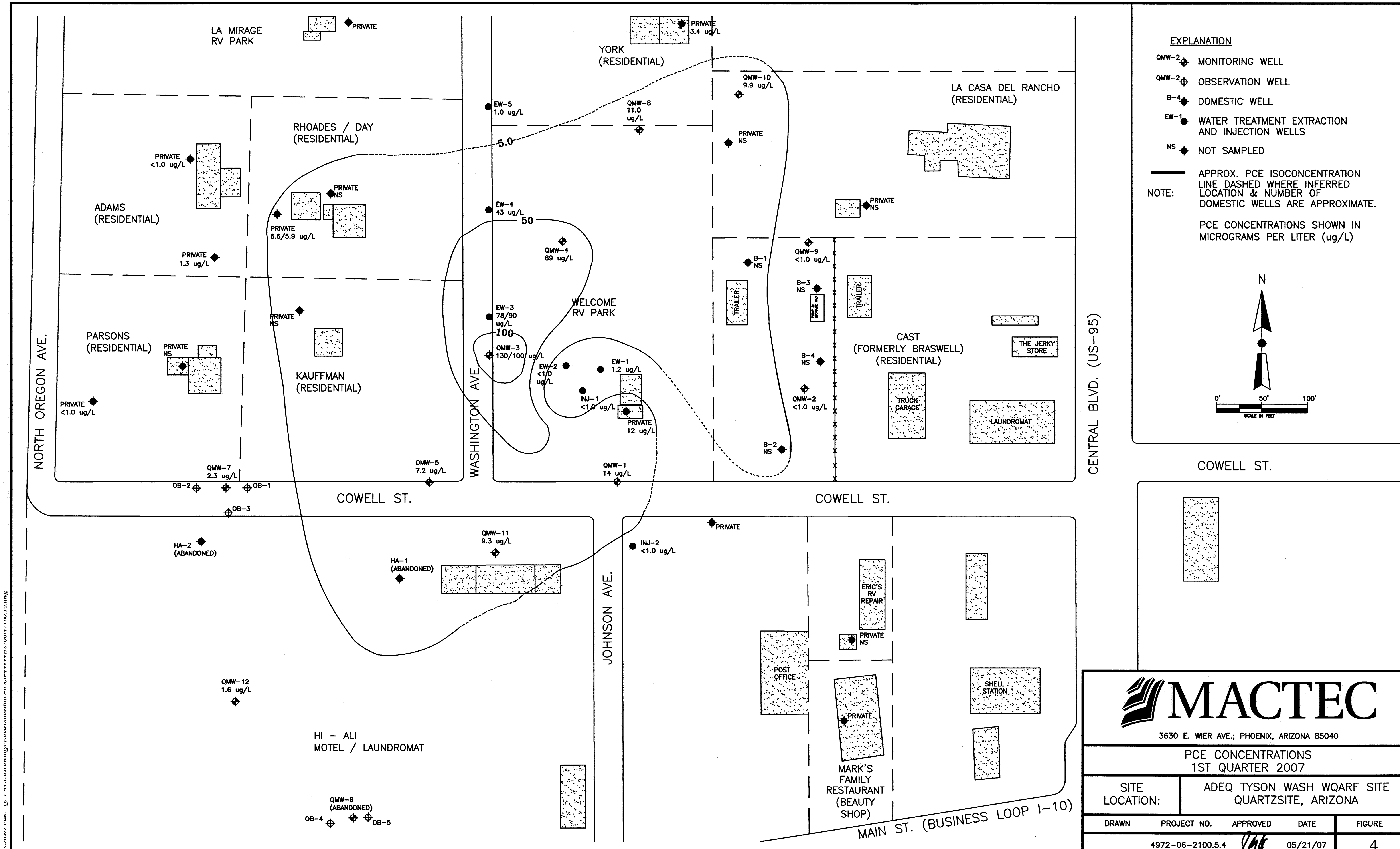
MACTEC

3630 E. WIER AVE.; PHOENIX, ARIZONA 85040

MARCH 1, 2007
STATIC GROUNDWATER ELEVATIONS

SITE LOCATION:	ADEQ TYSON WASH WQARF SITE QUARTZSITE, ARIZONA

DRAWN	PROJECT NO.	APPROVED	DATE	FIGURE
	4972-06-2100.5.4	JAT	05/21/07	3


EXPLANATION
MONITORING WELL
OBSERVATION WELL
DOMESTIC WELL
WATER TREATMENT EXTRACTION AND INJECTION WELLS
NOT SAMPLED
APPROX. PCE ISOCONCENTRATION LINE DASHED WHERE INFERRED
NOTE: LOCATION & NUMBER OF DOMESTIC WELLS ARE APPROXIMATE.
PCE CONCENTRATIONS SHOWN IN MICROGRAMS PER LITER (ug/L)
N
0' 50' 100'
SCALE IN FEET
LA MIRAGE RV PARK
YORK (RESIDENTIAL)
LA CASA DEL RANCHO (RESIDENTIAL)
RHOADES / DAY (RESIDENTIAL)
ADAMS (RESIDENTIAL)
PARSONS (RESIDENTIAL)
KAUFFMAN (RESIDENTIAL)
WELCOME RV PARK
CAST (FORMERLY BRASWELL) (RESIDENTIAL)
THE JERKY STORE
TRUCK GARAGE
LAUNDROMAT
TRAILER
HI – ALI MOTEL / LAUNDROMAT
ERIC'S RV REPAIR
POST OFFICE
MARK'S FAMILY RESTAURANT (BEAUTY SHOP)
SHELL STATION
NORTH OREGON AVE.
WASHINGTON AVE.
JOHNSON AVE.
CENTRAL BLVD. (US-95)
COWELL ST.
MAIN ST. (BUSINESS LOOP I-10)
PRIVATE 3.4 ug/L
QMW-10 9.9 ug/L
QMW-8 11.0 ug/L
EW-5 1.0 ug/L
EW-4 43 ug/L
EW-3 78/90 ug/L
QMW-3 130/100 ug/L
QMW-4 89 ug/L
EW-2 <1.0 ug/L
EW-1 1.2 ug/L
INJ-1 <1.0 ug/L
PRIVATE 12 ug/L
QMW-1 14 ug/L
QMW-5 7.2 ug/L
QMW-7 2.3 ug/L
OB-1
OB-2
OB-3
PRIVATE <1.0 ug/L
PRIVATE 6.6/5.9 ug/L
PRIVATE 1.3 ug/L
PRIVATE NS
QMW-9 <1.0 ug/L
QMW-2 <1.0 ug/L
B-1 NS
B-2 NS
B-3 NS
B-4 NS
HA-2 (ABANDONED)
HA-1 (ABANDONED)
QMW-11 9.3 ug/L
INJ-2 <1.0 ug/L
QMW-12 1.6 ug/L
QMW-6 (ABANDONED)
OB-4
OB-5
5.0
50
100
MACTEC
3630 E. WIER AVE.; PHOENIX, ARIZONA 85040
PCE CONCENTRATIONS 1ST QUARTER 2007
SITE LOCATION: ADEQ TYSON WASH WQARF SITE QUARTZSITE, ARIZONA
DRAWN
PROJECT NO. 4972-06-2100.5.4
APPROVED
DATE 05/21/07
FIGURE 4

TABLES

Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
QMW-1	05/11/00	30-80	45.79	868.28	822.49
(55-561847)	06/11/00	30-80	45.84	868.28	822.44
56370	07/11/00	30-80	45.74	868.28	822.54
	08/11/00	30-80	45.60	868.28	822.68
	09/11/00	30-80	45.58	868.28	822.70
	10/11/00	30-80	45.73	868.28	822.55
	11/11/00	30-80	46.14	868.28	822.14
	12/11/00	30-80	46.36	868.28	821.92
	01/11/01	30-80	46.63	868.28	821.65
	02/11/01	30-80	46.80	868.28	821.48
	03/11/01	30-80	46.89	868.28	821.39
	04/11/01	30-80	46.91	868.28	821.37
	05/11/01	30-80	46.89	868.28	821.39
	06/11/01	30-80	46.75	868.28	821.53
	07/11/01	30-80	46.62	868.28	821.66
	08/11/01	30-80	46.84	868.28	821.44
	09/11/01	30-80	46.97	868.28	821.31
	10/11/01	30-80	46.54	868.28	821.74
	11/11/01	30-80	46.17	868.28	822.11
	12/11/01	30-80	45.99	868.28	822.29
	01/11/02	30-80	45.92	868.28	822.36
	02/11/02	30-80	45.85	868.28	822.43
	03/11/02	30-80	45.63	868.28	822.65
	04/11/02	30-80	45.29	868.28	822.99
	05/11/02	30-80	45.03	868.28	823.25
	06/11/02	30-80	44.87	868.28	823.41
	07/11/02	30-80	44.75	868.28	823.53
	08/11/02	30-80	44.66	868.28	823.62
	09/11/02	30-80	44.58	868.28	823.70
	10/11/02	30-80	44.52	868.28	823.76
	11/11/02	30-80	44.53	868.28	823.75
	12/12/02[1]	30-80	44.38	868.28	823.90
	02/18/03[1]	30-80	44.52	868.28	823.76
	03/11/03	30-80	44.45	868.28	823.83
	05/14/03[1]	30-80	43.51	868.28	824.77
	09/04/03[1]	30-80	43.54	868.28	824.74
	12/03/03[1]	30-80	43.59	868.28	824.69
	03/03/04[1]	30-80	43.60	868.28	824.68
	06/08/04[3]	30-80	42.92	868.28	825.36
	09/23/04[3]	30-80	43.29	868.28	824.99
	12/07/04[3]	30-80	42.86	868.28	825.42
	02/16/05[3]	30-80	42.45	868.28	825.83
	05/25/05[3]	30-80	41.47	868.28	826.81
	09/20/05[3]	30-80	41.06	868.28	827.22
	12/6/05[3,5]	30-80	40.66	868.28	827.62
	12/7/05[3]	30-80	40.68	868.28	827.60
	2/28/06[3,5]	30-80	39.91	868.28	828.37
	3/1/06[3]	30-80	39.92	868.28	828.36
	5/22/06[3,5]	30-80	39.71	868.28	828.57
	5/23/06[3]	30-80	39.70	868.28	828.58
	9/12/06[3,5]	30-80	38.99	868.28	829.29
	9/14/06[3]	30-80	39.03	868.28	829.25
	11/28/06[3,5]	30-80	38.94	868.28	829.34
	11/29/06[3]	30-80	39.15	868.28	829.13
	2/27/07[3,5]	30-80	38.34	868.28	829.94
	2/27/07[3]	30-80	38.67	868.28	829.61
QMW-2	05/11/00	30-80	50.14	870.27	820.13
(55-561849)	06/11/00	30-80	50.14	870.27	820.13
56371	07/11/00	30-80	50.05	870.27	820.22
	08/11/00	30-80	49.86	870.27	820.41
	09/11/00	30-80	50.14	870.27	820.13
	10/11/00	30-80	49.64	870.27	820.63
	11/11/00	30-80	50.34	870.27	819.93
	12/11/00	30-80	50.61	870.27	819.66
	01/11/01	30-80	50.82	870.27	819.45
	02/11/01	30-80	50.92	870.27	819.35
	03/11/01	30-80	51.08	870.27	819.19
	04/11/01	30-80	51.16	870.27	819.11
	05/11/01	30-80	51.21	870.27	819.06
	06/11/01	30-80	51.07	870.27	819.20

See Page 10 for Notes

Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
	08/11/01	30-80	50.12	870.27	820.15
QMW-2	09/11/01	30-80	49.79	870.27	820.48
(55-561849)	10/11/01	30-80	49.38	870.27	820.89
56371	11/11/01	30-80	48.94	870.27	821.33
	12/11/01	30-80	48.56	870.27	821.71
	01/11/02	30-80	48.26	870.27	822.01
	02/11/02	30-80	47.94	870.27	822.33
	03/11/02	30-80	47.69	870.27	822.58
	04/11/02	30-80	47.24	870.27	823.03
	12/12/02[1]	30-80	45.90	870.27	824.37
	02/12/03[1]	30-80	45.83	870.27	824.44
	05/14/03[1]	30-80	45.40	870.27	824.87
	09/04/03[1]	30-80	45.01	870.27	825.26
	12/04/03[1]	30-80	44.17	870.27	826.10
	03/03/04[1]	30-80	43.47	870.27	826.80
	06/09/04[3]	30-80	43.56	870.27	826.71
	9/22/04[3]	30-80	43.53	870.27	826.74
	12/08/04[3]	30-80	43.25	870.27	827.02
	02/16/05[3]	30-80	42.43	870.27	827.84
	05/25/05[3]	30-80	41.69	870.27	828.58
	10/3/05[3]	30-80	41.11	870.27	829.16
	12/7/05[3]	30-80	41.84	870.27	828.43
	3/1/06[3]	30-80	41.30	870.27	828.97
	5/23/06[3]	30-80	40.95	870.27	829.32
	9/14/06[3]	30-80	Inaccessible	870.27	NM
	11/28/06[3]	30-80	41.00	870.27	829.27
	3/1/07[3]	30-80	40.47	870.27	829.80
QMW-3	05/11/00	30-80	43.54	867.69	824.15
(55-561848)	06/11/00	30-80	43.61	867.69	824.08
56372	07/11/00	30-80	43.68	867.69	824.01
	08/11/00	30-80	43.69	867.69	824.00
	09/11/00	30-80	43.69	867.69	824.00
	10/11/00	30-80	43.77	867.69	823.92
	11/11/00	30-80	43.79	867.69	823.90
	12/11/00	30-80	43.82	867.69	823.87
	01/11/01	30-80	43.90	867.69	823.79
	02/11/01	30-80	43.92	867.69	823.77
	03/11/01	30-80	44.03	867.69	823.66
	04/11/01	30-80	44.09	867.69	823.60
	05/11/01	30-80	44.14	867.69	823.55
	06/11/01	30-80	44.19	867.69	823.50
	07/11/01	30-80	44.23	867.69	823.46
	08/11/01	30-80	44.29	867.69	823.40
	09/11/01	30-80	44.36	867.69	823.33
	10/11/01	30-80	44.24	867.69	823.45
	11/11/01	30-80	44.18	867.69	823.51
	12/11/01	30-80	44.19	867.69	823.50
	01/11/02	30-80	44.14	867.69	823.55
	02/11/02	30-80	44.12	867.69	823.57
	03/11/02	30-80	44.08	867.69	823.61
	04/11/02	30-80	43.92	867.69	823.77
	05/11/02	30-80	43.86	867.69	823.83
	06/11/02	30-80	43.81	867.69	823.88
	07/11/02	30-80	43.76	867.69	823.93
	08/11/02	30-80	43.72	867.69	823.97
	09/11/02	30-80	43.65	867.69	824.04
	10/11/02	30-80	43.69	867.69	824.00
	11/11/02	30-80	43.64	867.69	824.05
	12/12/02	30-80	43.54	867.69	824.15
	02/18/03[1]	30-80	43.43	867.69	824.26
	05/14/03[1]	30-80	43.64	867.69	824.05
	09/04/03[1]	30-80	43.50	867.69	824.19
	12/03/03[1]	30-80	43.51	867.69	824.18
	03/03/04[1]	30-80	43.22	867.69	824.47
	06/08/04[3]	30-80	43.42	867.69	824.27

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Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
QMW-3	12/07/04[3]	30-80	43.25	867.69	824.44
(55-561848)	02/16/05[3]	30-80	42.81	867.69	824.88
56372	05/25/05[3]	30-80	42.03	867.69	825.66
	9/20/05[3]	30-80	41.34	867.69	826.35
	12/6/05[3,5]	30-80	41.49	867.69	826.20
	12/7/05[3]	30-80	41.21	867.69	826.48
	2/28/06[3,5]	30-80	41.04	867.69	826.65
	3/1/06[3]	30-80	40.88	867.69	826.81
	5/22/06[3,5]	30-80	41.28	867.69	826.41
	5/23/06[3]	30-80	40.92	867.69	826.77
	9/12/06[3,5]	30-80	41.61	867.69	826.08
	9/14/06[3]	30-80	41.12	867.69	826.57
	11/28/06[3,5]	30-80	41.34	867.69	826.35
	11/29/06[3]	30-80	40.98	867.69	826.71
	2/27/07[3,5]	30-80	40.83	867.69	826.86
	3/1/07[3]	30-80	40.51	867.69	827.18
QMW-4	05/11/00	30-60	45.73	867.59	821.86
(55-567650)	06/11/00	30-60	45.71	867.59	821.88
57292	07/11/00	30-60	45.65	867.59	821.94
	08/11/00	30-60	45.53	867.59	822.06
	09/11/00	30-60	44.90	867.59	822.69
	10/11/00	30-60	45.03	867.59	822.56
	11/11/00	30-60	45.62	867.59	821.97
	12/11/00	30-60	45.75	867.59	821.84
	01/11/01	30-60	45.85	867.59	821.74
	02/11/01	30-60	45.91	867.59	821.68
	03/11/01	30-60	46.05	867.59	821.54
	04/11/01	30-60	46.09	867.59	821.50
	05/11/01	30-60	46.13	867.59	821.46
	06/11/01	30-60	46.15	867.59	821.44
	07/11/01	30-60	46.15	867.59	821.44
	08/11/01	30-60	46.15	867.59	821.44
	09/11/01	30-60	46.18	867.59	821.41
	10/11/01	30-60	46.41	867.59	821.18
	11/11/01	30-60	46.59	867.59	821.00
	12/11/01	30-60	46.75	867.59	820.84
	01/11/02	30-60	46.87	867.59	820.72
	02/11/02	30-60	45.52	867.59	822.07
	03/11/02	30-60	45.41	867.59	822.18
	04/11/02	30-60	45.22	867.59	822.37
	05/11/02	30-60	45.06	867.59	822.53
	06/11/02	30-60	44.93	867.59	822.66
	07/11/02	30-60	44.81	867.59	822.78
	08/11/02	30-60	44.72	867.59	822.87
	09/11/02	30-60	44.63	867.59	822.96
	10/11/02	30-60	44.58	867.59	823.01
	11/11/02	30-60	44.54	867.59	823.05
	12/12/02[1]	30-60	44.45	867.59	823.14
	02/12/03[1]	30-60	44.43	867.59	823.16
	05/14/03[1]	30-60	44.16	867.59	823.43
	09/04/03[1]	30-60	44.01	867.59	823.58
	12/03/03[1]	30-60	44.20	867.59	823.39
	03/03/04[1]	30-60	43.75	867.59	823.84
	06/08/04[3]	30-60	43.52	867.59	824.07
	09/23/04[3]	30-60	43.48	867.59	824.11
	12/08/04[3]	30-60	43.38	867.59	824.21
	02/17/05[3]	30-60	43.04	867.59	824.55
	05/25/05[3]	30-60	42.23	867.59	825.36
	09/20/05[3]	30-60	41.67	867.59	825.92
	12/6/05[3,5]	30-60	42.14	867.59	825.45
	12/7/05[3]	30-60	41.18	867.59	826.41
	2/28/06[3,5]	30-60	41.67	867.59	825.92
	3/1/06[3]	30-60	41.65	867.59	825.94

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Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
QMW-4	5/23/06[3]	30-60	41.56	867.59	826.03
(55-567650)	9/12/06[3,5]	30-60	41.57	867.59	826.02
57292	9/14/06[3]	30-60	41.51	867.59	826.08
	11/28/06[3,5]	30-60	41.33	867.59	826.26
	11/29/06[3]	30-60	41.39	867.59	826.20
	2/27/07[3,5]	30-60	40.75	867.59	826.84
	3/1/07[3]	30-60	40.80	867.59	826.79
QMW-5	05/11/00	35-65	42.56	867.05	824.49
(55-567649)	06/11/00	35-65	42.64	867.05	824.41
57293	07/11/00	35-65	42.72	867.05	824.33
	08/11/00	35-65	42.75	867.05	824.30
	09/11/00	35-65	42.78	867.05	824.27
	10/11/00	35-65	42.81	867.05	824.24
	11/11/00	35-65	42.88	867.05	824.17
	12/11/00	35-65	42.92	867.05	824.13
	01/11/01	35-65	42.98	867.05	824.07
	02/11/01	35-65	43.01	867.05	824.04
	03/11/01	35-65	43.11	867.05	823.94
	04/11/01	35-65	43.16	867.05	823.89
	05/11/01	35-65	43.21	867.05	823.84
	06/11/01	35-65	43.26	867.05	823.79
	07/11/01	35-65	43.30	867.05	823.75
	08/11/01	35-65	43.36	867.05	823.69
	09/11/01	35-65	43.42	867.05	823.63
	10/11/01	35-65	43.35	867.05	823.70
	11/11/01	35-65	43.32	867.05	823.73
	12/11/01	35-65	43.31	867.05	823.74
	01/11/02	35-65	43.13	867.05	823.92
	02/11/02	35-65	43.20	867.05	823.85
	03/11/02	35-65	43.16	867.05	823.89
	04/11/02	35-65	43.12	867.05	823.93
	12/12/02[1]	35-65	42.77	867.05	824.28
	02/18/03[1]	35-65	41.65	867.05	825.40
	05/14/03[1]	35-65	42.73	867.05	824.32
	09/04/03[1]	35-65	42.72	867.05	824.33
	12/03/03[1]	35-65	42.68	867.05	824.37
	03/04/04[1]	35-65	42.47	867.05	824.58
	06/08/04[3]	35-65	42.63	867.05	824.42
	09/23/04[3]	35-65	42.48	867.05	824.57
	12/07/04[3]	35-65	42.48	867.05	824.57
	02/16/05[3]	35-65	42.04	867.05	825.01
	05/25/05[3]	35-65	41.18	867.05	825.87
	09/20/05[3]	35-65	40.51	867.05	826.54
	12/6/05[3,5]	35-65	40.30	867.05	826.75
	12/7/05[3]	35-65	40.29	867.05	826.76
	2/28/06[3,5]	35-65	39.98	867.05	827.07
	3/1/06[3]	35-65	39.97	867.05	827.08
	5/22/06[3,5]	35-65	40.03	867.05	827.02
	5/23/06[3]	35-65	39.98	867.05	827.07
	9/12/06[3,5]	35-65	40.28	867.05	826.77
	9/14/06[3]	35-65	40.20	867.05	826.85
	11/28/06[3,5]	35-65	40.05	867.05	827.00
	11/29/06[3]	35-65	40.07	867.05	826.98
	2/27/07[3,5]	35-65	39.67	867.05	827.38
	3/1/07[3]	35-65	39.71	867.05	827.34
QMW-6	05/11/00	35-70	42.29	870.28	827.99
(55-578364)	06/11/00	35-70	42.34	870.28	827.94
	07/11/00	35-70	42.46	870.28	827.82
	08/11/00	35-70	42.51	870.28	827.77
	09/11/00	35-70	42.60	870.28	827.68
	10/11/00	35-70	42.69	870.28	827.59
	11/11/00	35-70	42.77	870.28	827.51
	12/11/00	35-70	42.83	870.28	827.45
	01/11/01	35-70	42.91	870.28	827.37
	02/11/01	35-70	42.93	870.28	827.35

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Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
QMW-6	04/11/01	35-70	42.94	870.28	827.34
(55-578364)	05/11/01	35-70	42.89	870.28	827.39
	06/11/01	35-70	42.99	870.28	827.29
	07/11/01	35-70	43.04	870.28	827.24
	08/11/01	35-70	43.10	870.28	827.18
	09/11/01	35-70	43.18	870.28	827.10
	10/11/01	35-70	43.25	870.28	827.03
	11/11/01	35-70	43.37	870.28	826.91
	12/11/01	35-70	43.45	870.28	826.83
	01/11/02	35-70	43.50	870.28	826.78
	02/11/02	35-70	43.56	870.28	826.72
	03/11/02	35-70	43.60	870.28	826.68
QMW-7	05/11/00	35-70	41.34	866.75	825.41
(55-577300)	06/11/00	35-70	41.40	866.75	825.35
58691	07/11/00	35-70	41.77	866.75	824.98
	08/11/00	35-70	41.73	866.75	825.02
	09/11/00	35-70	41.77	866.75	824.98
	10/11/00	35-70	41.90	866.75	824.85
	11/11/00	35-70	41.88	866.75	824.87
	12/11/00	35-70	41.93	866.75	824.82
	01/11/01	35-70	42.02	866.75	824.73
	02/11/01	35-70	42.05	866.75	824.70
	03/11/01	35-70	42.09	866.75	824.66
	04/11/01	35-70	42.07	866.75	824.68
	05/11/01	35-70	42.09	866.75	824.66
	06/11/01	35-70	42.17	866.75	824.58
	07/11/01	35-70	42.23	866.75	824.52
	08/11/01	35-70	42.30	866.75	824.45
	09/11/01	35-70	42.37	866.75	824.38
	10/11/01	35-70	42.38	866.75	824.37
	11/11/01	35-70	42.40	866.75	824.35
	12/11/01	35-70	42.53	866.75	824.22
	01/11/02	35-70	42.44	866.75	824.31
	02/11/02	35-70	42.43	866.75	824.32
	03/11/02	35-70	42.40	866.75	824.35
	04/11/02	35-70	42.43	866.75	824.32
	05/11/02	35-70	42.41	866.75	824.34
	06/11/02	35-70	42.45	866.75	824.30
	07/11/02	35-70	42.42	866.75	824.33
	08/11/02	35-70	42.42	866.75	824.33
	09/11/02	35-70	42.39	866.75	824.36
	10/11/02	35-70	42.50	866.75	824.25
	11/11/02	35-70	42.42	866.75	824.33
	12/12/02	35-70	NM	866.75	--
	02/18/03[1]	35-70	41.89	866.75	824.86
	05/14/03[1]	35-70	41.91	866.75	824.84
	09/04/03[1]	35-70	42.11	866.75	824.64
	12/03/03[1]	35-70	42.08	866.75	824.67
	03/04/04[1]	35-70	41.92	866.75	824.83
	06/08/04[3]	35-70	42.13	866.75	824.62
	09/23/04[3]	35-70	42.08	866.75	824.67
	12/07/04[4]	35-70	NM	866.75	--
	02/16/05[3]	35-70	40.99	866.75	825.76
	05/25/05[3]	35-70	39.97	866.75	826.78
	9/20/05[3]	35-70	39.39	866.75	827.36
	12/7/05[3]	35-70	39.17	866.75	827.58
	3/1/06[3]	35-70	39.11	866.75	827.64
	5/23/06[3]	35-70	39.22	866.75	827.53
	9/14/06[3]	35-70	39.52	866.75	827.23
	11/29/06[3]	35-70	39.29	866.75	827.46
	3/1/07[3]	35-70	39.10	866.75	827.65
QMW-8	05/11/00	35-75	52.44	867.21	814.77
(55-577298)	06/11/00	35-75	52.37	867.21	814.84
58692	07/11/00	35-75	52.29	867.21	814.92

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Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
QMW-8	09/11/00	35-75	52.51	867.21	814.70
(55-577298)	10/11/00	35-75	52.52	867.21	814.69
58692	11/11/00	35-75	52.52	867.21	814.69
	12/11/00	35-75	52.55	867.21	814.66
	01/11/01	35-75	52.72	867.21	814.49
	02/11/01	35-75	52.89	867.21	814.32
	03/11/01	35-75	53.00	867.21	814.21
	04/11/01	35-75	52.75	867.21	814.46
	05/11/01	35-75	52.56	867.21	814.65
	06/11/01	35-75	52.59	867.21	814.62
	07/11/01	35-75	52.91	867.21	814.30
	08/11/01	35-75	53.07	867.21	814.14
	09/11/01	35-75	53.07	867.21	814.14
	10/11/01	35-75	52.98	867.21	814.23
	11/11/01	35-75	52.87	867.21	814.34
	12/11/01	35-75	52.66	867.21	814.55
	01/11/02	35-75	52.62	867.21	814.59
	02/11/02	35-75	52.73	867.21	814.48
	03/11/02	35-75	52.54	867.21	814.67
	04/11/02	35-75	52.33	867.21	814.88
	05/11/02	35-75	52.33	867.21	814.88
	06/11/02	35-75	52.20	867.21	815.01
	07/11/02	35-75	52.29	867.21	814.92
	08/11/02	35-75	52.21	867.21	815.00
	09/11/02	35-75	52.16	867.21	815.05
	10/11/02	35-75	52.14	867.21	815.07
	11/11/02	35-75	52.08	867.21	815.13
	12/12/02	35-75	51.97	867.21	815.24
	02/12/03	35-75	51.89	867.21	815.32
	05/14/03[1]	35-75	51.41	867.21	815.80
	09/04/03[1]	35-75	51.36	867.21	815.85
	12/03/03[1]	35-75	51.15	867.21	816.06
	03/03/04[1]	35-75	50.87	867.21	816.34
	06/08/04[3]	35-75	50.78	867.21	816.43
	09/23/04[3]	35-75	50.61	867.21	816.60
	12/08/04[3]	35-75	50.47	867.21	816.74
	02/17/05[3]	35-75	50.10	867.21	817.11
	05/25/05[3]	35-75	49.78	867.21	817.43
	09/20/05[3]	35-75	49.32	867.21	817.89
	12/6/05[3,5]	35-75	49.03	867.21	818.18
	12/7/05[3]	35-75	49.03	867.21	818.18
	2/28/06[3,5]	35-75	48.60	867.21	818.61
	3/1/06[3]	35-75	48.81	867.21	818.40
	5/22/06[3,5]	35-75	48.36	867.21	818.85
	5/23/06[3]	35-75	48.33	867.21	818.88
	9/12/06[3,5]	35-75	48.27	867.21	818.94
	9/14/06[3]	35-75	48.23	867.21	818.98
	11/28/06[3,5]	35-75	48.03	867.21	819.18
	11/29/06[3]	35-75	48.10	867.21	819.11
	2/27/07[3,5]	35-75	47.66	867.21	819.55
	3/1/07[3]	35-75	47.71	867.21	819.50
QMW-9	05/11/00	35-70	53.30	869.03	815.73
(55-577299)	06/11/00	35-70	52.26	869.03	816.77
58693	07/11/00	35-70	51.31	869.03	817.72
	08/11/00	35-70	50.90	869.03	818.13
	09/11/00	35-70	50.29	869.03	818.74
	10/11/00	35-70	49.89	869.03	819.14
	11/11/00	35-70	50.29	869.03	818.74
	12/11/00	35-70	50.84	869.03	818.19
	01/11/01	35-70	51.29	869.03	817.74
	02/11/01	35-70	51.82	869.03	817.21
	03/11/01	35-70	51.67	869.03	817.36
	04/11/01	35-70	51.92	869.03	817.11

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Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
QMW-9	06/11/01	35-70	51.71	869.03	817.32
(55-577299)	07/11/01	35-70	51.19	869.03	817.84
58693	08/11/01	35-70	50.25	869.03	818.78
	09/11/01	35-70	49.80	869.03	819.23
	10/11/01	35-70	49.18	869.03	819.85
	11/11/01	35-70	48.77	869.03	820.26
	12/11/01	35-70	48.64	869.03	820.39
	01/11/02	35-70	47.78	869.03	821.25
	12/12/02[1]	35-70	45.65	869.03	823.38
	02/12/03[1]	35-70	45.60	869.03	823.43
	05/14/03[1]	35-70	45.19	869.03	823.84
	09/04/03[1]	35-70	45.01	869.03	824.02
	12/04/03[1]	35-70	44.70	869.03	824.33
	03/03/04[1]	35-70	44.11	869.03	824.92
	06/09/04[3]	35-70	43.68	869.03	825.35
	09/22/04[3]	35-70	43.53	869.03	825.50
	12/08/04[3]	35-70	43.21	869.03	825.82
	02/16/05[3]	35-70	42.53	869.03	826.50
	05/25/05[3]	35-70	41.63	869.03	827.40
	10/03/05[3]	35-70	41.76	869.03	827.27
	12/7/05[3]	35-70	42.00	869.03	827.03
	3/1/06[3]	35-70	41.56	869.03	827.47
	5/23/06[3]	35-70	41.41	869.03	827.62
	9/14/06[3]	35-70	Inaccessible	869.03	NM
	11/28/06[3]	35-70	41.20	869.03	827.83
	3/1/07[3]	35-70	40.94	869.03	828.09
QMW-10	04/11/01	45-75	54.99	869.77	814.78
(55-583806)	05/11/01	45-75	54.06	869.77	815.71
59643	06/11/01	45-75	54.10	869.77	815.67
	07/11/01	45-75	54.41	869.77	815.36
	08/11/01	45-75	54.58	869.77	815.19
	09/11/01	45-75	54.56	869.77	815.21
	10/11/01	45-75	54.42	869.77	815.35
	11/11/01	45-75	54.29	869.77	815.48
	12/11/01	45-75	53.73	869.77	816.04
	01/11/02	45-75	53.69	869.77	816.08
	02/11/02	45-75	53.82	869.77	815.95
	03/11/02	45-75	53.55	869.77	816.22
	04/04/02	45-75	53.43	869.77	816.34
	12/12/02[1]	45-75	53.05	869.77	816.72
	02/12/03[1]	45-75	53.00	869.77	816.77
	05/14/03[1]	45-75	52.60	869.77	817.17
	09/04/03[1]	45-75	52.48	869.77	817.29
	12/04/03[1]	45-75	52.43	869.77	817.34
	03/03/04[1]	45-75	52.14	869.77	817.63
	06/09/04[3]	45-75	52.18	869.77	817.59
	09/22/04[3]	45-75	51.90	869.77	817.87
	12/08/04[3]	45-75	51.74	869.77	818.03
	02/17/05[3]	45-75	51.39	869.77	818.38
	05/25/05[3]	45-75	51.10	869.77	818.67
	09/20/05[3]	45-75	50.61	869.77	819.16
	12/7/05[3]	45-75	50.30	869.77	819.47
	3/1/06[3]	45-75	49.79	869.77	819.98
	5/23/06[3]	45-75	49.62	869.77	820.15
	9/14/06[3]	45-75	49.44	869.77	820.33
	11/29/06[3]	45-75	49.37	869.77	820.40
	3/1/07[3]	45-75	48.94	869.77	820.83
QMW-11	09/22/04[3]	35-70	44.07	868.76	824.69
(55-204757)	12/08/04[3]	35-70	44.20	868.76	824.56
64687	02/16/05[3]	35-70	43.61	868.76	825.15

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Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
QMW-11	09/20/05[3]	35-70	42.10	868.76	826.66
(55-204757)	12/7/05[3,5]	35-70	41.75	868.76	827.01
64687	12/7/05[3]	35-70	41.74	868.76	827.02
	2/28/06[3,5]	35-70	41.36	868.76	827.40
	3/1/06[3]	35-70	41.32	868.76	827.44
	5/22/06[3,5]	35-70	41.34	868.76	827.42
	5/23/06[3]	35-70	41.31	868.76	827.45
	9/12/06[3,5]	35-70	41.43	868.76	827.33
	9/14/06[3]	35-70	41.39	868.76	827.37
	11/28/06[3,5]	35-70	41.25	868.76	827.51
	11/29/06[3]	35-70	41.32	868.76	827.44
	2/27/07[3,5]	35-70	40.87	868.76	827.89
	3/1/07[3]	35-70	40.95	868.76	827.81
QMW-12	09/22/04[3]	35-70	44.48	869.57	825.09
(55-204757)	12/08/04[3]	35-70	44.53	869.57	825.04
64688	02/16/05[3]	35-70	43.73	869.57	825.84
	05/25/05[3]	35-70	42.78	869.57	826.79
	09/20/05[3]	35-70	42.15	869.57	827.42
	12/7/05[3]	35-70	41.77	869.57	827.80
	3/1/06[3]	35-70	41.59	869.57	827.98
	5/23/06[3]	35-70	41.50	869.57	828.07
	9/14/06[3]	35-70	41.76	869.57	827.81
	11/29/06[3]	35-70	41.53	869.57	828.04
	3/1/07[3]	35-70	41.37	869.57	828.20
EW-1	03/26/03[1]	35-70	45.38	869.08	823.70
(55-596439)	05/15/03[1,2]	35-70	44.28	869.08	824.80
60797	06/12/03[1,2]	35-70	44.15	869.08	824.93
	09/04/03[1,2]	35-70	44.39	869.08	824.69
	12/03/03[1,2]	35-70	44.53	869.08	824.55
	03/04/04[1,2]	35-70	44.48	869.08	824.60
	06/08/04[3]	35-70	43.83	869.08	825.25
	09/23/04[3]	35-70	44.13	869.08	824.95
	12/07/04[3]	35-70	43.87	869.08	825.21
	02/18/05[3]	35-70	43.36	869.08	825.72
	05/25/05[3]	35-70	42.43	869.08	826.65
	09/20/05[3]	35-70	41.96	869.08	827.12
	12/6/05[3,5]	35-70	42.81	869.08	826.27
	12/7/05[3]	35-70	41.92	869.08	827.16
	2/28/06[3,5]	35-70	43.75	869.08	825.33
	3/1/06[3]	35-70	41.41	869.08	827.67
	5/22/06[3,5]	35-70	42.11	869.08	826.97
	5/23/06[3]	35-70	41.29	869.08	827.79
	9/12/06[3,5]	35-70	41.37	869.08	827.71
	9/14/06[3]	35-70	40.81	869.08	828.27
	11/28/06[3,5]	35-70	40.83	869.08	828.25
	11/29/06[3]	35-70	40.69	869.08	828.39
	2/27/07[3,5]	35-70	40.10	869.08	828.98
	3/1/07[3]	35-70	40.07	869.08	829.01
EW-2	03/26/03[1]	35-70	44.63	868.25	823.62
(55-596441)	05/15/03[1,2]	35-70	44.14	868.25	824.11
60798	06/12/03[1,2]	35-70	44.13	868.25	824.12
	09/04/03[1,2]	35-70	43.83	868.25	824.42
	12/03/03[1,2]	35-70	43.84	868.25	824.41
	03/04/04[1,2]	35-70	43.76	868.25	824.49
	06/08/04[3]	35-70	43.48	868.25	824.77
	09/23/04[3]	35-70	43.70	868.25	824.55
	12/07/04[3]	35-70	43.36	868.25	824.89
	02/18/05[3]	35-70	42.86	868.25	825.39
	05/25/05[3]	35-70	42.06	868.25	826.19
	09/20/05[3]	35-70	41.46	868.25	826.79
	12/6/05[3,5]	35-70	43.27	868.25	824.98

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Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
	2/28/06[3,5]	35-70	42.55	868.25	825.70
	3/1/06[3]	35-70	40.91	868.25	827.34
	5/22/06[3,5]	35-70	42.84	868.25	825.41
	5/23/06[3]	35-70	40.82	868.25	827.43
	9/12/06[3,5]	35-70	42.84	868.25	825.41
	9/14/06[3]	35-70	40.82	868.25	827.43
	11/28/06[3,5]	35-70	41.38	868.25	826.87
	11/29/06[3]	35-70	40.40	868.25	827.85
	2/27/07[3,5]	35-70	41.13	868.25	827.12
	3/1/07[3]	35-70	39.83	868.25	828.42
EW-3	10/03/05[3]	35-70	40.64	866.08	825.44
(55-205419)	12/6/05[3,5]	35-70	42.11	866.08	823.97
62465	12/7/05[3]	35-70	40.76	866.08	825.32
	3/1/06[3]	35-70	40.41	866.08	825.67
	5/22/06[3,5]	35-70	42.70	866.08	823.38
	5/23/06[3]	35-70	40.51	866.08	825.57
	9/12/06[3,5]	35-70	44.44	866.08	821.64
	9/14/06[3]	35-70	40.73	866.08	825.35
	11/28/06[3,5]	35-70	44.07	866.08	822.01
	11/29/06[3]	35-70	40.54	866.08	825.54
	2/27/07[3,5]	35-70	43.15	866.08	822.93
	3/1/07[3]	35-70	40.13	866.08	825.95
EW-4	10/03/05[3]	35-70	40.84	866.29	825.45
(55-205422)	12/6/05[3,5]	35-70	44.87	866.29	821.42
62466	12/7/05[3]	35-70	42.01	866.29	824.28
	2/28/06[3,5]	35-70	43.18	866.29	823.11
	3/1/06[3]	35-70	41.35	866.29	824.94
	5/22/06[3,5]	35-70	43.60	866.29	822.69
	5/23/06[3]	35-70	41.47	866.29	824.82
	9/12/06[3,5]	35-70	43.60	866.29	822.69
	9/14/06[3]	35-70	41.47	866.29	824.82
	11/28/06[3,5]	35-70	43.25	866.29	823.04
	11/29/06[3]	35-70	41.38	866.29	824.91
	2/27/07[3,5]	35-70	42.60	866.29	823.69
	3/1/07[3]	35-70	40.94	866.29	825.35
EW-5	10/03/05[3]	35-70	45.62	865.67	820.05
(55-205420)	12/6/05[3,5]	35-70	48.75	865.67	816.92
65344	12/7/05[3]	35-70	46.68	865.67	818.99
	2/28/06[3,5]	35-70	47.00	865.67	818.67
	3/1/06[3]	35-70	46.51	865.67	819.16
	5/22/06[3,5]	35-70	46.28	865.67	819.39
	5/23/06[3]	35-70	46.11	865.67	819.56
	9/12/06[3,5]	35-70	48.21	865.67	817.46
	9/14/06[3]	35-70	46.69	865.67	818.98
	11/28/06[3,5]	35-70	47.38	865.67	818.29
	11/29/06[3]	35-70	46.28	865.67	819.39
	2/27/07[3,5]	35-70	46.96	865.67	818.71
	3/1/07[3]	35-70	45.91	865.67	819.76
INJ-1	03/26/03[1]	45-70	45.10	868.99	823.89
(55-596441)	05/15/03[1,2]	45-70	43.92	868.99	825.07
60800	06/12/03[1,2]	45-70	43.51	868.99	825.48
	09/04/03[1,2]	45-70	44.40	868.99	824.59
	12/03/03[1,2]	45-70	44.60	868.99	824.39
	03/04/04[1,2]	45-70	44.57	868.99	824.42
	06/08/04[3]	45-70	43.72	868.99	825.27
	09/23/04[3]	45-70	43.70	868.99	825.29
	12/07/04[3]	45-70	43.92	868.99	825.07
	02/18/05[3]	45-70	43.43	868.99	825.56
	05/25/05[3]	45-70	42.45	868.99	826.54
	09/20/05[3]	45-70	41.97	868.99	827.02
	12/6/05[3,5]	45-70	29.50	868.99	839.49
	12/7/05[3]	45-70	41.97	868.99	827.02
	2/28/06[3,5]	45-70	37.18	868.99	831.81
	3/1/06/05[3]	45-70	41.45	868.99	827.54

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Table 1. Results of Depth to Groundwater Measurements, May 2000 - March 2006
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID (ADWR Registration Number)	Date Measured	Well Screened Interval (ft)	Depth To Groundwater (ft below Measuring Pt)	Measuring Point Elevation (ft above MSL)	Groundwater Table Elevation (ft above MSL)
	5/23/06[3]	45-70	41.31	868.99	827.68
	9/12/06[3,5]	45-70	30.30	868.99	838.69
	9/14/06[3]	45-70	40.81	868.99	828.18
	11/28/06[3,5]	45-70	28.50	868.99	840.49
	11/29/06[3]	45-70	40.88	868.99	828.11
	2/27/07[3,5]	45-70	34.20	868.99	834.79
	3/1/07[3]	45-70	40.11	868.99	828.88
INJ-2	10/03/05[3]	35-70	39.87	867.52	827.65
(55-205421)	12/6/05[3,5]	35-70	0.00	867.52	867.52
65345	12/7/05[3]	35-70	37.73	867.52	829.79
	2/28/06[3,5]	35-70	17.20	867.52	850.32
	3/1/06[3]	35-70	37.31	867.52	830.21
	5/22/06[3,5]	35-70	0.00	867.52	867.52
	5/23/06[3]	35-70	37.26	867.52	830.26
	9/12/06[3,5]	35-70	0.00	867.52	867.52
	9/14/06[3]	35-70	36.71	867.52	830.81
	11/28/06[3,5]	35-70	0.00	867.52	867.52
	11/29/06[3]	35-70	36.80	867.52	830.72
	2/27/07[3,5]	35-70	0.00	867.52	867.52
	3/1/07[3]	35-70	37.26	867.52	830.26
Adams North	09/22/04[3]		42.32		
	12/08/04[3]		42.17		
	02/18/05[3]		41.18		
	05/24/05[3]		40.32		
	09/20/05[3]		39.81		
	12/7/05[3]		39.51		
	3/1/06[3]		39.48		
	5/22/06[3]		39.71		
	9/14/06[3]		40.03		
	11/29/06[3]		39.67		
	3/1/07[3]		39.41		
Rhoades East	09/22/04[3]		43.42		
	12/08/04[3]		43.36		
	02/18/05[3]		42.87		
	05/25/05[3]		42.05		
	9/20/05[3]		41.50		
	12/7/05[3]		41.41		
	3/1/06[3]		41.14		
	5/22/06[3]		41.29		
	9/14/06[3]		41.68		
	11/29/06[3]		41.41		
	3/1/07[3]		41.10		

Notes:

- Measuring points are located at the top north edge of the sanitary well seal at each well.
- Groundwater data collected by dedicated data loggers at approximately 12:00pm on the given date.
- Well QMW-6 has been inaccessible since March 2002 due to road construction activities.
- Groundwater data was not collected due to malfunctioning pressure transducers from wells QMW-2, QMW-5, and QMW-10 between 5/02 and 11/02; and from well QMW-9 between 2/02 and 11/02.

[1] - Groundwater data collected manually using a Heron H.01L Interface Probe.
[2] - Groundwater elevation not fully equilibrated following remedial system shut-down.
[3] - Groundwater data collected manually using a Solinst Water Level Probe
[4] - Depth to water in QMW-7 was read incorrectly on 12/07/04. Therefore, the groundwater elevation is omitted from the table.
[5] - Depth to water measured while remediation system operational.

MSL - Mean Sea Level
Checked by: JNC

Table 2. Results of Depth to Groundwater Measurements - Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID	Date Measured	Time	Pumping Rate (gpm)	Injection Rate (gpm)	Static Water Level (ft below MP)	System Operational Water Level (ft below MP)
EW-1	04/07/03	1221			44.98	
	04/07/03	1319	--			47.21
Well Screened Interval = 35'-70'						
	04/10/03	0905			45.00	
	04/10/03	1044	2.94	NA		46.83
	04/10/03	1250	3.15	NA		46.89
	04/14/03	1021	1.76	NA		45.66
	04/14/03	1332	3.01	NA		46.48
	04/24/03	1100			44.51	
	04/24/03	1244	3.14	NA		46.59
	05/01/03	1057			44.52	
	05/01/03	1322	2.91	NA		46.50
	05/15/03	0836	2.65	NA		46.10
	05/15/03	1025			44.28	
	06/12/03	0935			44.15	
	06/12/03	1105	2.96	NA		46.07
	07/16/03	0836	2.37	NA		45.93
	07/16/03	1013			44.21	
	09/04/03	1640			44.39	
	10/13/03	1819			44.43	
	10/14/03	0731			44.38	
	11/13/03				44.40	
	12/04/03				44.53	
		1037			44.54	
		1042	2.92	NA		46.32
		1047				46.47
		1052				46.37
		1107				46.21
	03/04/04	1432			44.48	
	06/08/04				43.83	
	09/23/04	1040			44.13	
	12/07/04	910			43.87	
	02/18/05	1255			43.36	
	05/25/05	1020			42.45	
	09/20/05	1150			41.96	
	12/06/05		1.00	NA		42.81
	12/07/05				41.92	
	02/28/06		1.00	NA		43.75
	03/01/06				41.41	
	05/22/06	1320	1.00	NA		42.11
	05/23/06	1020			41.29	
	09/12/06	1035	1.00	NA		41.37
	09/14/06				40.81	
	11/28/06	910	1.00	NA		40.83
	11/29/06	1010			40.69	

See Page 5 for Notes

Table 2. Results of Depth to Groundwater Measurements - Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID	Date Measured	Time	Pumping Rate	Injection Rate	Static Water Level	System Operational Water Level
EW-2	02/27/07	1248	1.00	NA		40.10
	03/01/07	1121			40.07	
	04/07/03	1226			44.14	
	04/07/03	1321	--			46.84
Well Screened Interval = 35'-70'	04/10/03	0928			44.16	
	04/10/03	1047	2.96	NA		46.30
	04/10/03	1251	3.09	NA		46.98
	04/14/03	1223	2.37	NA		46.93
	04/14/03	1333	3.09	NA		47.52
	04/24/03	1100			44.12	
	04/24/03	1245	2.95	NA		46.90
	05/01/03	1322			44.07	
	05/01/03	1323	1.44	NA		45.42
	05/15/03	0837	2.98	NA		47.01
	05/15/03	1026			44.14	
	06/12/03	0936			44.13	
	06/12/03	1106	2.97	NA		46.76
	07/16/03	0838	2.48	NA		46.23
	07/16/03	1014			43.95	
	09/04/03	1640			43.83	
	10/13/03	1821			43.82	
	10/14/03	0732			43.76	
	11/13/03				43.79	
	12/04/03				43.84	
		1037			43.85	
		1042	2.94	NA		45.79
		1047				46.06
		1052				46.18
		1107				46.28
	03/04/04	1434			43.76	
	06/08/04				43.48	
	09/23/04				43.70	
	12/07/04	920			43.36	
	02/18/05	1245			42.86	
	05/25/05	1025			42.06	
	09/20/05	1200			41.46	
	12/06/05		2.00	NA		43.27
	12/07/05				41.37	
	02/28/06		2.00	NA		42.55
	03/01/06				40.91	
	05/22/06	1325	2.00	NA		42.84
	05/23/06	1025			40.91	
	09/12/06	1038	2.00	NA		42.08
	09/14/06				40.50	

See Page 5 for Notes

Table 2. Results of Depth to Groundwater Measurements - Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID	Date Measured	Time	Pumping Rate	Injection Rate	Static Water Level	System Operational Water Level
EW-3	11/28/06	915	2.00	NA		41.38
	11/29/06				40.40	
	02/27/07	1255	2.00	NA		41.13
	03/01/07	1124			39.83	
	10/03/05	835			40.64	
	12/06/05		2.00	NA		42.11
Well Screened	12/07/05				40.76	
Interval = 35'-70'	02/28/06		2.00	NA		41.04
	03/01/06				40.41	
	05/22/06	1345	2.00	NA		42.70
	05/23/06	855			40.51	
	09/12/06	1012	2.00	NA		44.44
	09/14/06				40.73	
	11/28/06	930	2.00	NA		44.07
	11/29/06	910			40.54	
	02/27/07	1225	2.00	NA		43.15
	03/01/07	1050			40.13	
EW-4	10/03/05	840			40.84	
	12/06/05		2.00	NA		44.87
Well Screened	12/07/05				42.01	
Interval = 35'-70'	02/08/06		2.00	NA		43.18
	03/01/06				41.35	
	05/22/06	1350	2.00	NA		43.60
	05/23/06	900			41.47	
	09/12/06	1008	2.00	NA		44.17
	09/14/06				41.82	
	11/28/06	935	2.00	NA		43.25
	11/29/06				41.38	
	02/27/07	1230	2.00	NA		42.60
	03/01/07				40.94	
EW-5	10/03/05	845			45.62	
	12/06/05		1.00	NA		48.75
Well Screened	12/07/05				46.68	
Interval = 35'-70'	02/28/06		1.00	NA		47.00
	03/01/06				46.51	
	05/22/06	1400	1.00	NA		46.28
	05/23/06	905			46.11	
	09/12/06	1003	1.00	NA		48.21
	09/14/06				46.69	
	11/28/06	940	1.00	NA		47.38
	11/29/06				46.28	
	02/27/07	1235	1.00	NA		46.96
	03/01/07				45.91	

See Page 5 for Notes

Table 2. Results of Depth to Groundwater Measurements - Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID	Date Measured	Time	Pumping Rate	Injection Rate	Static Water Level	System Operational Water Level
INJ-1	04/07/03	1215			45.05	
Well Screened	04/07/03	1316	NA			45.32
Interval = 45'-70'	04/10/03	0902	NA	5.90	45.07	
	04/10/03	1033	NA	5.90		44.50
	04/10/03	1034	NA	5.90		44.52
	04/10/03	1037	NA	5.90		44.37
	04/10/03	1038	NA	5.90		44.50
	04/10/03	1041	NA	5.90		44.62
	04/10/03	1042	NA	5.90		44.68
	04/10/03	1248	NA	6.24		40.93
	04/14/03	1019	NA	4.13		41.49
	04/14/03	1336	NA	6.10		39.95
	04/24/03	1100			44.38	
	04/24/03	1243	NA	6.09		34.82
	05/01/03	1055			44.39	
	05/01/03	1320	NA	4.35		35.87
	05/15/03	0834	NA	5.63		28.11
	05/15/03	1024			43.92	
	06/12/03	0934			43.51	
	06/12/03	1104	NA	5.93		35.30
	07/16/03	0834	NA	4.85		26.68
	07/16/03	1015			43.98	
	09/04/03	1610			44.40	
	10/13/03	1818			44.49	
	10/14/03	0730			44.44	
	11/13/03				44.47	
	12/03/03	1101			44.60	
	12/04/04	1037			44.62	
	03/04/04	1430			44.57	
	06/08/04				43.72	
	09/23/04				43.84	
	12/07/04	905			43.92	
	02/18/05	1250			43.43	
	05/25/05	1030			42.45	
	09/20/05	1210			41.97	
	12/06/05		NA	1.00		29.50
	12/07/05				41.97	
	02/28/06		NA	1.00		37.18
	03/01/06				41.45	
	05/22/06	1315	NA	1.00		32.25
	05/23/06	1015			41.31	

See Page 5 for Notes

Table 2. Results of Depth to Groundwater Measurements - Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

WELL ID	Date Measured	Time	Pumping Rate	Injection Rate	Static Water Level	System Operational Water Level
	09/12/06	950	NA	1.00		30.30
	09/14/06				40.81	
	11/28/06	955	NA	1.00		28.50
	11/29/06	1020			40.83	
	02/27/07	1245	NA	1.00		34.20
	03/01/07	1127			40.11	
INJ-2	10/03/05	855			39.87	
	12/06/05		NA	7.00		0.00
Well Screened	12/07/05				37.73	
Interval = 35'-70'	02/28/06		NA	7.00		17.20
	03/01/06				37.31	
	05/22/06	1335	NA	7.00		0.00
	05/23/06	920			37.26	
	09/12/06	958	NA	7.00		0.00
	09/14/06				36.71	
	11/28/06	1000	NA	7.00		0.00
	11/29/06	805			36.80	
	02/27/07	1300	NA	7.00		0.00
	03/01/07	1107			37.26	

Notes:
gpm - Gallons Per Minute
MP - Measuring Point
Measuring points are located at the top north edge of the sanitary well seal at each well.
Groundwater data collected manually using a Heron H.01L Interface Probe or Solinst Probe.
NA - Not Applicable

Checked by: JNC______________

Table 3. Results of Groundwater Sample Analyses - Monitoring and Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR No.)	Date Sampled	Pump Intake Depth (ft)	Sample Flow Rate (gpm)	Volatile Organic Compound Concentrations (µg/l)			
				PCE	TCE	*cis* -1,2-DCE	1,1-DCE
QMW-1 (55-561847)	07/30/97	68	--	**97**	4	--	--
	10/29/97	68	--	**81**	3.1	--	--
	05/13/98	68	--	**73**	2.6	--	--
	08/12/98	68	--	**76**	<2.5	--	--
	11/16/98	68	--	**56**	1.8	--	--
	02/22/99	68	--	**34**	1.3	--	--
	05/27/99	68	--	**51**	2.3	--	--
	05/11/00	68	6.6	**49**	<2	<2	<5
	05/11/00 **D**	68	6.6	**66**	2.4	<2	<5
	08/09/00	68	6.6	**62**	2.8	<2	<5
	10/30/00	68	--	**41**	2.7	<1	<2
	02/12/01	68	6.2	**50**	2.5	<1	<2
	05/08/01	68	6.2	**54**	2.7	<1	<2
	08/14/01	68	--	NA	NA	NA	NA
	11/20/01	68	6.5	**34**	2.7	<1	<2
	03/27/02	68	4.5	**51**	2.5	<1	<2
	02/18/03	68	0.052	**38**	2.4	<2	<5
	05/15/03	60	0.031	**22**	2.3	<2	<5
	09/04/03	60	0.078	**28**	4.3	<2	<5
	12/03/03	60	0.039	**38**	**5.0**	<2	<5
	03/04/04	60	0.045	**44**	3.6	<2	<5
	06/08/04	60	0.044	**38**	4.9	<1	<2
	09/23/04	60	0.046	**34**	3.1	<1	<2
	12/07/04	60	0.045	**69.6**	4.4	<1	<1
	02/17/05	60	0.050	**83**	4.1	<1	<1
	05/25/05	60	0.050	**80**	4.6	<1	<2
	09/21/05	60	0.040	**98**	**5.6**	<1	<2
	12/07/05	60	0.044	**63**	3.0	<1	<2
	03/01/06	60	0.045	**39**	1.8	<1	<2
	05/27/06	60	0.046	**30**	1.5	<1	<2
	09/13/06	60	0.046	**22**	1.1	<1	<2
	11/29/06	60	0.046	**19**	1.1	<1	<2
	02/28/07	60	0.046	**14**	<1	<1	<2
QMW-2 (55-561849	07/30/97	68	--	<2	<2	--	--
	10/29/97	68	--	<0.5	<0.5	--	--
	11/16/97	68	--	<0.5	<0.5	--	--
	05/13/98	68	--	<0.5	<0.5	--	--
	08/12/98	68	--	<0.5	<0.5	--	--
	11/16/98	68	--	<0.5	<0.5	--	--
	02/22/99	68	--	<0.5	<0.5	--	--
	05/27/99	68	--	<2	<2	--	--
	11/04/99	68	--	<2	<2	<2	<2
	05/11/00	68	6.4	<2	<2	<2	<5
	08/09/00	68	6.5	<2	<2	<2	<5
	10/30/00	68	--	<1	<1	<1	<2
	02/12/01	68	5.1	<1	<1	<1	<2
	05/08/01	68	6.3	<1	<1	<1	<2
	08/14/01	68	6.3	<1	<1	<1	<2
	11/20/01	68	6.0	<1	<1	<1	<2
	03/27/02	68	3.5	<1	<1	<1	<2
	02/12/03	68	0.036	**9.1**	<2	<2	<5
	05/14/03	60	0.031	3.5	<2	<2	<5
	09/04/03	60	0.065	<2	<2	<2	<5
	12/04/03	60	0.039	**6.0**	<2	<2	<5
	03/03/04	60	0.042	2.2	2.3	<2	<5
	06/09/04	60	0.053	**8.0**	1.0	<1	<2
	09/22/04	60	0.044	<1	<1	<1	<2
	12/08/04	60	0.044	**8.2**	<1	<1	<1
	02/17/05	60	0.05	1.5	<1	<1	<1
	05/25/05	60	0.05	2.2	<1	<1	<2
	10/03/05	60	0.05	<1	<1	<1	<2
	12/08/05	60	0.05	1.2	<1	<1	<2
	03/01/06	60	0.052	<1	<1	<1	<2
	05/23/06	60	0.046	<1	<1	<1	<2
	09/14/06	Well was inaccessible and was not sampled					
	11/28/06	60	0.046	<1	<1	<1	<2
	02/27/07	60	0.046	<1	<1	<1	<2
QMW-3 (55-561848)	07/30/97	68	--	**160**	**10**	--	--
	07/30/97 **D**	68	--	**150**	**9.9**	--	--
	10/29/97	68	--	**160**	**9.1**	--	--
	10/29/97 **D**	68	--	**150**	**8.2**	--	--
	12/08/97	68	--	**67**	<5	--	--
	05/13/98	68	--	**110**	4.8	--	--
	05/13/98 **D**	68	--	**110**	4.9	--	--
ADEQ AWQS				5	5	70	7

See Page 6 for Notes

Table 3. Results of Groundwater Sample Analyses - Monitoring and Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR No.)	Date Sampled	Pump Intake Depth (ft)	Sample Flow Rate (gpm)	Volatile Organic Compound Concentrations (µg/l)			
				PCE	TCE	*cis*-1,2-DCE	1,1-DCE
QMW-3 (55-561848)	08/12/98	68	--	**120**	<2.5	--	--
	11/16/98	68	--	**67**	<0.5	--	--
	02/22/99	68	--	**66**	3	--	--
	05/27/99	68	--	**73**	3.7	--	--
	05/27/99 **D**	68	--	**73**	3.4	--	--
	05/11/00	68	7.2	**130**	4.1	<2	<5
	09/08/00	68	6.8	**80**	4.3	1.4	<2
	09/08/00	68	6.8	**81**	4.7	1.6	<2
	10/30/00	68	--	**96**	4.7	1.5	<2
	10/30/00 **D**	68	--	**98**	**5.1**	1.5	<2
	02/12/01	68	5.8	**130**	4.5	1.2	<2
	05/08/01	68	6.0	**130**	4.7	1.3	<2
	08/15/01	68	7.1	**110**	**5.7**	1.7	<2
	11/20/01	68	7.1	**160**	**5.2**	1.5	<2
	03/27/02	68	4.5	**140**	**5.2**	1.6	<2
	02/18/03	68	0.047	**69**	4.5	<2	<5
	02/18/03 **D**	60	0.047	**75**	4.6	<2	<5
	05/15/03	60	--	**40**	3.3	<2	<5
	09/04/03	60	0.1	**46**	3.7	<2	<5
	12/03/03	60	0.039	**70**	**5.3**	<2	<5
	03/04/04	60	0.049	**83**	**5.1**	<2	<5
	3/04/04 **D**	60	0.049	**92**	**5.4**	<2	<5
	06/08/04	60	0.044	**60**	4.0	1.1	<2
	6/08/04**D**	60	0.044	**68**	**5.5**	1.4	<2
	09/23/04	60	0.053	**52**	3.8	<1	<2
	9/23/04**D**	60	0.053	**53**	4.0	<1	<2
	12/07/04	60	0.044	**84.2**	4.5	1.0	<1
	12/07/04**D**	60	0.044	**95.4**	4.6	<1	<1
	02/17/05	60	0.046	**100**	4.4	1.1	<1
	02/17/05**D**	60	0.046	**100**	4.3	1.1	<1
	05/25/05	60	0.046	**61**	4.5	<1	<2
	05/25/05**D**	60	0.046	**130**	4.8	1.2	<2
	09/21/05	60	0.045	**160**	**6.0**	1.1	<2
	9/21/05**D**	60	0.045	**150**	**5.6**	1.1	<2
	12/07/05	60	0.049	**200**	**6.2**	1.3	<2
	12/7/05**D**	60	0.049	**200**	**6.5**	1.3	<2
	03/01/06	60	0.044	**190**	**6.2**	1.2	<2
	3/01/06**D**	60	0.044	**200**	**6.5**	1.2	<2
	05/23/06	60	0.046	**140**	**5.2**	<1	<2
	5/23/06**D**	60	0.046	**140**	**5.1**	<1	<2
	09/13/06	60	0.046	**140**	4.7	<1	<2
	9/13/06**D**	60	0.046	**140**	**5.0**	<1	<2
	11/29/06	60	0.046	**130**	4.4	<1	<2
	11/29/06**D**	60	0.046	**110**	4.1	<1	<2
	02/28/07	60	0.046	**130**	4.0	<1	<2
	2/28/07**D**	60	0.046	**100**	4.0	<1	<2
QMW-4 (55-567650)	03/26/98	62	--	**29**	<1	--	--
	05/13/98	62	--	**33**	1	--	--
	08/12/98	62	--	**32**	0.59	--	--
	11/16/98	62	--	**39**	0.97	--	--
	02/22/99	62	--	**45**	1.4	--	--
	02/22/99 **D**	62	--	**38**	1.2	--	--
	05/27/99	62	--	**57**	<2	--	--
	05/11/00	62	6.4	**57**	<2	<2	<5
	09/08/00	62	--	**33**	1.6	<1	<2
	10/30/00	62	--	**40**	1.7	<1	<2
	02/12/01	62	5.5	**38**	1.2	<1	<2
	05/08/01	62	6.0	**43**	1.4	<1	<2
	05/08/01 **D**	62	6.0	**42**	1.3	<1	<2
	08/14/01	62	5.8	**44**	1.6	<1	<2
	11/20/01	62	7.0	**36**	1.4	<1	<2
	03/27/02	62	3.0	**52**	3.1	<1	<2
	02/12/03	62	0.052	**36**	2.9	<2	<5
	05/15/03	60	0.031	**14**	<2	<2	<5
	09/04/03	60	0.065	**26**	3.1	<2	<5
	09/04/03 **D**	60	0.065	**25**	3.1	<2	<5
	12/03/03	60	0.039	**26**	**5.0**	<2	<5
	03/03/04	60	0.038	**31**	3.6	<2	<5
	06/08/04	60	0.044	**19**	4.1	<1	<2
	09/23/04	60	0.053	**18**	2.6	<1	<2
	12/08/04	60	0.045	**55.9**	3.7	<1	<1
	02/18/05	60	0.046	**49**	2.9	<1	<1
	05/25/05	60	0.043	**18**	2.0	<1	<2
	09/21/05	60	0.044	**80**	4.5	<1	<2
	12/07/05	60	0.045	**96**	4.9	<1	<2
	03/01/06	60	0.049	**97**	**5.0**	<1	<2
	05/23/06	60	0.046	**76**	4.0	<1	<2
ADEQ AWQS				**5**	**5**	**70**	**7**

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Table 3. Results of Groundwater Sample Analyses - Monitoring and Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR No.)	Date Sampled	Pump Intake Depth (ft)	Sample Flow Rate (gpm)	Volatile Organic Compound Concentrations (µg/l)			
				PCE	TCE	*cis*-1,2-DCE	1,1-DCE
QMW-4 (55-567650)	09/12/06	60	0.046	**62**	3.2	<1	<2
	11/29/06	60	0.046	**76**	3.7	<1	<2
	02/28/07	60	0.046	**89**	3.9	<1	<2
QMW-5 (55-567649)	04/03/98	55	--	**130**	<5	--	--
	05/13/98	55	--	**130**	<5	--	--
	08/12/98	55	--	**160**	<5	--	--
	08/12/98 D	55	--	**180**	<2.5	--	--
	11/16/98	55	--	**86**	<10	--	--
	11/16/98 D	55	--	**69**	<10	--	--
	02/22/99	55	--	**37**	1.1	--	--
	05/27/99	55	--	**38**	<2	--	--
	05/11/00	55	6.6	**60**	<2	<2	<5
	09/08/00	55	--	**34**	1.3	<1	<2
	10/30/00	55	--	**34**	1.4	<1	<2
	02/12/01	55	4.9	**40**	1.1	<1	<2
	05/08/01	55	6.1	**46**	1.1	<1	<2
	08/14/01	55	7.0	**46**	1.3	<1	<2
	11/20/01	55	6.0	**38**	1.2	<1	<2
	11/20/01 **D**	55	6.0	**37**	1.2	<1	<2
	03/27/02	55	3.0	**30**	1.1	<1	<2
	03/27/02 **D**	55	3.0	**31**	1.1	<1	<2
	02/18/03	55	0.057	**8.7**	<2	<2	<5
	05/14/03	55	0.031	3.1	<2	<2	<5
	09/04/03	55	--	**6.6**	2.7	<2	<5
	12/03/03	55	0.039	**31**	3.2	<2	<5
	03/04/04	55	0.039	**11**	<2	<2	<5
	06/08/04	55	0.050	**12**	2.6	<1	<2
	09/23/04	50	0.046	4.7	1.5	<1	<2
	12/07/04	50	0.045	**10.5**	1.8	<1	<1
	02/17/05	50	0.044	**13**	1.7	<1	<1
	05/25/05	50	0.050	**6.0**	<1	<1	<2
	09/21/05	50	0.049	**20.0**	1.9	<1	<2
	12/08/05	50	0.050	**17**	2.0	<1	<2
	03/01/06	50	0.045	**16**	1.6	<1	<2
	05/23/06	50	0.046	**12**	1.5	<1	<2
	09/13/06	50	0.046	**8.0**	1.3	<1	<2
	11/29/06	50	0.046	**7.5**	1.3	<1	<2
	02/28/07	50	0.046	**7.2**	1.1	<1	<2
QMW-6 [1] (55-578364)	05/11/00	68	6.4	<2	<2	<2	<5
	09/08/00	68	--	<1	<1	<1	<2
	10/30/00	68	--	<1	<1	<1	<2
	02/12/01	68	8.5	<1	<1	<1	<2
	05/08/01	68	9.5	<1	<1	<1	<2
	08/14/01	68	--	<1	<1	<1	<2
	11/20/01	68	8.2	<1	<1	<1	<2
	03/27/02	68	3.5	<1	<1	<1	<2
QMW-7 (55-577300)	05/11/00	68	7.0	**7**	<2	<2	<5
	08/09/00	68	9.4	**11**	<2	<2	<5
	10/30/00	68	--	**12**	<1	<1	<2
	02/12/01	68	8.9	**9**	<1	<1	<2
	05/08/01	68	9.8	**10**	<1	<1	<2
	08/14/01	68	7.3	**11**	<1	<1	<2
	11/20/01	68	10.1	**10**	<1.0	<1	<2
	03/27/02	68	5.0	**11**	<1	<1	<2
	02/18/03	68	0.029	**6.7**	<2	<2	<5
	05/14/03	60	0.033	3.0	<2	<2	<5
	09/04/03	60	0.068	**6.3**	<2	<2	<5
	12/03/03	60	0.039	**21**	<2	<2	<5
	12/03/03 **D**	60	0.039	**20**	<2	<2	<5
	03/04/04	60	0.050	**13**	<2	<2	<5
	06/08/04	60	0.046	**9.7**	1.2	<1	<2
	09/23/04	60	0.053	1.9	<1	<1	<2
	12/07/04	60	0.044	**6.7**	<1	<1	<1
	02/17/05	60	0.046	3.9	<1	<1	<1
	05/26/05	60	0.046	**10.0**	<1	<1	<2
	09/21/05	60	0.045	4.2	<1	<1	<2
	12/08/05	60	0.045	4.5	<1	<1	<2
	03/01/06	60	0.049	3.9	<1	<1	<2
	05/23/06	60	0.046	2.4	<1	<1	<2
	09/13/06	60	0.046	3.0	<1	<1	<2
	11/29/06	60	0.046	3.4	<1	<1	<2
	02/28/07	60	0.046	2.3	<1	<1	<2
QMW-8 (55-577298)	05/11/00	68	5.0	2	<2	<2	<5
	08/09/00	68	6.2	4	<2	<2	<5
	10/30/00	68	--	4	<1	<1	<2
	02/12/01	68	4.9	5	<1	<1	<2
ADEQ AWQS				5	5	70	7

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Table 3. Results of Groundwater Sample Analyses - Monitoring and Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR No.)	Date Sampled	Pump Intake Depth (ft)	Sample Flow Rate (gpm)	Volatile Organic Compound Concentrations (µg/l)			
				PCE	TCE	*cis*-1,2-DCE	1,1-DCE
QMW-8 (55-577298)	02/12/01 **D**	68	4.9	4	<1	<1	<2
	05/08/01	68	5.8	4	<1	<1	<2
	08/14/01	68	4.2	**5.1**	<1	<1	<2
	11/20/01	68	5.8	3	<1	<1	<2
	03/27/02	68	4.0	4.6	<1	<1	<2
	02/12/03	68	0.031	**5.8**	<2	<2	<5
	05/15/03	60	0.031	3.8	<2	<2	<5
	09/04/03	60	0.068	**9.7**	<2	<2	<5
	12/03/03	60	0.039	**14**	2.4	<2	<5
	03/03/04	60	0.044	**5.2**	<2	<2	<5
	06/08/04	60	0.038	**9.6**	2.0	<1	<2
	09/23/04	60	0.044	**6.9**	<1	<1	<2
	12/08/04	60	0.045	**18.8**	<1	<1	<1
	02/18/05	60	0.046	**15**	<1	<1	<1
	05/25/05	60	0.043	<1	<1	<1	<2
	09/21/05	60	0.050	**15**	<1	<1	<2
	12/07/05	60	0.045	**11**	<1	<1	<2
	03/01/06	60	0.044	**14**	<1	<1	<2
	05/23/06	60	0.046	**11**	<1	<1	<2
	09/12/06	60	0.046	**8.7**	<1	<1	<2
	11/29/06	60	0.046	**11**	<1	<1	<2
	02/28/07	60	0.046	**11**	<1	<1	<2
QMW-9 (55-577299)	05/11/00	68	6.8	<2	<2		<5
	09/08/00	68	--	<1	<1	<1	<2
	10/30/00	68	--	<1	<1	<1	<2
	02/12/01	68	5.3	<1	<1	<1	<2
	05/08/01	68	6.0	<1	<1	<1	<2
	08/14/01	68	6.8	1.5	<1	<1	<2
	11/20/01	68	6.3	<1	<1	<1	<2
	03/27/02	68	3.5	<1	<1	<1	<2
	02/12/03	68	0.031	4.0	<2	<2	<5
	05/14/03	60	0.03	3.2	<2	<2	<5
	09/04/03	60	0.062	<2	2.5	<2	<5
	12/04/03	60	0.039	**7.4**	<2	<2	<5
	03/03/04	60	0.034	<2	<2	<2	<5
	06/09/04	60	0.045	**9.0**	1.4	<1	<2
	09/22/04	60	0.046	<1	<1	<1	<2
	12/08/04	60	0.045	**6.5**	<1	<1	<1
	02/17/05	60	0.045	1.3	<1	<1	<1
	05/25/05	60	0.043	4.8	<1	<1	<2
	10/03/05	60	0.049	<1	<1	<1	<2
	12/08/05	60	0.045	1.5	<1	<1	<2
	03/01/06	60	0.049	1.8	<1	<1	<2
	05/23/06	60	0.046	<1	<1	<1	<2
	09/13/06	Well was inaccessible and was not sampled					
	11/28/06	60	0.046	<1	<1	<1	<2
	02/27/07	60	0.046	<1	<1	<1	<2
QMW-10 (55-583806)	03/06/01	68	5.8	<1	<1	<1	<2
	05/08/01	68	5.7	<1	<1	<1	<2
	08/14/01	68	6.5	<1	<1	<1	<2
	11/20/01	68	6.3	2	<1	<1	<2
	03/27/02	68	5.0	<1	<1	<1	<2
	02/12/03	68	0.047	<2	<2	<2	<5
	05/14/03	60	0.031	3.7	<2	<2	<5
	09/04/03	60	0.039	<2	4	<2	<5
	12/04/03	60	0.039	**10**	<2	<2	<5
	03/03/04	60	0.045	2.1	<2	<2	<2
	06/09/04	60	0.050	**12**	1.5	<1	<2
	09/23/04	60	0.044	**10**	<1	<1	<2
	12/08/04	60	0.045	**7.7**	<1	<1	<1
	02/17/05	60	0.044	**5.1**	<1	<1	<1
	05/26/05	60	0.046	**6.6**	<1	<1	<2
	09/21/05	60	0.049	**13.0**	<1	<1	<2
	12/08/05	60	0.044	**11**	<1	<1	<2
	03/01/06	60	0.045	**14**	<1	<1	<2
	05/23/06	60	0.046	**9.2**	<1	<1	<2
	09/12/06	60	0.046	**8.4**	<1	<1	<2
	11/29/06	60	0.046	**9.2**	<1	<1	<2
	02/27/07	60	0.046	**9.9**	<1	<1	<2
QMW-11	09/22/04	60	0.046	2.5	<1	<1	<2
	12/08/04	60	0.044	**15.4**	<1	<1	<1
	02/17/05	60	0.046	**7.4**	<1	<1	<1
	05/26/05	60	0.043	**11.0**	<1	<1	<2
	09/21/05	60	0.044	**12.0**	<1	<1	<2
	12/08/05	60	0.045	**18**	<1	<1	<2
	03/01/06	60	0.045	**12**	<1	<1	<2
	05/23/06	60	0.046	**10**	<1	<1	<2
ADEQ AWQS				5	5	70	7

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Table 3. Results of Groundwater Sample Analyses - Monitoring and Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR No.)	Date Sampled	Pump Intake Depth (ft)	Sample Flow Rate (gpm)	Volatile Organic Compound Concentrations (µg/l)			
				PCE	TCE	*cis*-1,2-DCE	1,1-DCE
QMW-11	09/12/06	60	0.046	**8.4**	<1	<1	<2
	11/29/06	60	0.046	**9.5**	<1	<1	<2
	02/27/07	60	0.046	**9.3**	<1	<1	<2
QMW-12	09/22/04	60	0.046	1.6	<1	<1	<2
	12/07/04	60	0.045	**28.1**	<1	<1	<1
	02/17/05	60	0.044	2.4	<1	<1	<1
	05/26/05	60	0.050	3.1	<1	<1	<2
	09/21/05	60	0.045	2.3	<1	<1	<2
	12/08/05	60	0.044	3.8	<1	<1	<2
	03/01/06	60	0.045	2.0	<1	<1	<2
	05/23/06	60	0.046	1.9	<1	<1	<2
	09/12/06	60	0.046	2.2	<1	<1	<2
	11/29/06	60	0.046	1.8	<1	<1	<2
	02/27/07	60	0.046	1.6	<1	<1	<2
OB-2	08/09/00	68	--	**5.7**	<2	<2	<5
INFLUENT	04/07/03	--	--	**89**	4	**0.74**	4
EFFLUENT 1	04/07/03	--	--	--	--	<0.5	<0.5
EFFLUENT 2	04/07/03	--	--	--	--	<0.5	<0.5
EFF	06/08/04	--	--	1.1	<1	<1	<2
	02/18/05	--	--	**8.4**	<1	<1	<2
	05/25/05	--	--	<1	<1	<1	<2
	10/20/05	--	--	<1	<1	<1	<2
	12/06/05	--	--	1.5	<1	<1	<2
	03/02/06	--	--	**6.4**	<1	<1	<2
	05/24/06	--	--	<1	<1	<1	<2
	09/12/06	--	--	<1	<1	<1	<2
	11/28/06	--	--	<1	<1	<1	<2
	02/27/07	--	--	<1	<1	<1	<2
INT	05/24/06	--	--	<1	<1	<1	<2
	09/12/06	--	--	2.5	<1	<1	<2
	11/28/06	--	--	<1	<1	<1	<2
	02/27/07	--	--	<1	<1	<1	<2
EW-1 (55-596439)	03/26/03	55.5	0.033	**28**	2.2	<2	<5
	05/15/03	60	--	**24**	<2	<2	<5
	06/12/03	60	--	**15**	<2	<2	<5
	07/16/03	60	2.74	**12**	<2	<2	<5
	09/04/03	60	2.89	**9.7**	<2	<2	<5
	10/14/03	60	--	**6.4**	<2	<2	<5
	11/13/03	60	2.5	4.7	<2	<2	<5
	12/03/03	60	2.92	3.8	<2	<2	<5
	02/10/04	60		3.3	<2	<2	<5
	03/04/04	60		2.5	<2	<2	<5
	06/08/04	60		2.7	<1	<1	<2
	09/23/04	60		2.3	<1	<1	<2
	12/07/04	60		4.1	<1	<1	<1
	02/18/05	60		**7.8**	<1	<1	<1
	05/25/05	60		1.5	<1	<1	<2
	09/21/05	60		<1	<1	<1	<2
	12/06/05	60	1.00	<1	<1	<1	<2
	03/02/06	60	1.00	2.1	<1	<1	<2
	05/24/06	60	1.00	4.2	<1	<1	<2
	09/12/06	60	1.00	1.8	<1	<1	<2
	11/28/06	60	1.00	2.9	<1	<1	<2
	02/27/07	60	1.00	1.2	<1	<1	<2
EW-2 (55-596440)	03/26/03	55.5	0.068	**30**	2.1	<2	<5
	05/15/03	60	--	**56**	2.2	<2	<5
	06/12/03	60	--	**34**	<2	<2	<5
	07/16/03	60	3.05	**35**	<2	<2	<5
	09/04/03	60	2.96	**15**	<2	<2	<5
	10/14/03		--	4.4	<2	<2	<5
	11/13/03		2.7	4.1	<2	<2	<5
	12/04/03	60	2.94	2.4	<2	<2	<5
	02/10/04	60		2.5	<2	<2	<5
	03/04/04	60		2.7	<2	<2	<5
	06/08/04	60		**18**	<1	<1	<2
	09/23/04	60		**6.1**	<1	<1	<2
	12/07/04	60		**26.6**	1.2	<1	<1
	02/18/05	60		**13.0**	<1	<1	<1
	05/25/05	60		**22.0**	<1	<1	<2
	09/21/05	60		**9.2**	<1	<1	<2
	12/06/05	60	2.00	**16**	<1	<1	<2
	03/02/06	60	2.00	**23**	<1	<1	<2
	05/24/06	60	2.00	2.6	<1	<1	<2
	09/12/06	60	2.00	<1.0	<1	<1	<2
	11/28/06	60	2.00	<1.0	<1	<1	<2
	02/27/07	60	2.00	<1.0	<1	<1	<2
ADEQ AWQS				5	5	70	7

See Page 6 for Notes

Table 3. Results of Groundwater Sample Analyses - Monitoring and Remediation Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR No.)	Date Sampled	Pump Intake Depth (ft)	Sample Flow Rate (gpm)	Volatile Organic Compound Concentrations (µg/l)			
				PCE	TCE	*cis*-1,2-DCE	1,1-DCE
EW-3 (55-205419)	10/03/05	60	0.05	**27.0**	1.2	<1	<2
	12/06/05	60	2.00	**120**	4.4	1.1	<2
	12/06/05**D**	60	2.00	**120**	4.3	<1	<2
	03/02/06	60	2.00	**120**	3.9	<1	<2
	3/02/06**D**	60	2.00	**120**	4.0	<1	<2
	05/24/06	60	2.00	**95**	3.3	<1	<2
	5/24/06**D**	60	2.00	**97**	3.4	<1	<2
	09/12/06	60	2.00	**89**	3.1	<1	<2
	9/12/06**D**	60	2.00	**89**	2.9	<1	<2
	11/28/06	60	2.00	**110**	3.0	<1	<2
	11/28/06**D**	60	2.00	**100**	3.0	<1	<2
	02/27/07	60	2.00	**78**	2.5	<1	<2
	2/27/05**D**	60	2.00	**90**	2.6	<1	<2
EW-4 (55-205422)	10/03/05	60	0.045	**6.6**	<1	<1	<2
	12/06/05	60	2.00	**55**	3.4	<1	<2
	03/02/06	60	2.00	**54**	3.2	<1	<2
	05/24/06	60	2.00	**39**	2.5	<1	<2
	09/12/06	60	2.00	**40**	2.4	<1	<2
	11/28/06	60	2.00	**55**	2.7	<1	<2
	02/27/07	60	2.00	**43**	2.4	<1	<2
EW-5 (55-20520)	10/03/05	60	0.045	<1	<1	<1	<2
	12/06/05	60	1.00	2.0	<1	<1	<2
	03/02/06	60	1.00	**5.3**	<1	<1	<2
	05/24/06	60	1.00	**30**	1.3	<1	<2
	09/12/06	60	1.00	<1	<1	<1	<2
	11/28/06	60	1.00	<1	<1	<1	<2
	02/27/07	60	1.00	1.0	<1	<1	<2
INJ-1 (55-596441)	03/26/03	55.5	0.068	**52**	3.5	<2	<5
	05/15/03	60	--	**7.5**	<2	<2	<5
	06/12/03	60	0.031	3.2	<2	<2	<5
	07/16/03	60	0.039	3.4	<2	<2	<5
	09/04/03	60	0.034	4.5	<2	<2	<5
	10/14/03	60	0.039	<2	3.2	<2	<5
	11/13/03	60	0.039	<2	3.5	<2	<5
	12/03/03	60	0.039	<2	3.3	<2	<5
	02/10/04	60		<2	2.6	<2	<5
	03/04/04	60	0.049	**28**	<2	<2	<5
	06/08/04	60	0.046	**7.1**	1.8	<1	<2
	09/23/04	60	0.046	<1	<1	<1	<2
	12/07/04	60		**6.1**	<1	<1	<1
	02/18/05	60	0.05	**15**	<1	<1	<1
	05/25/05	60	0.05	<1	<1	<1	<2
	09/21/05	60	0.045	3	<1	<1	<2
	12/06/05	60	0.045	2.0	<1	<1	<2
	03/02/06	60	0.044	**5.9**	<1	<1	<2
	05/23/06	60	0.044	<1	<1	<1	<2
	09/12/06	60	0.046	1.4	<1	<1	<2
	11/29/06	60	0.046	<1	<1	<1	<2
	02/28/07	60	0.046	<1	<1	<1	<2
INJ-2 (55-205421)	10/03/05	60	0.044	**8.0**	<1	<1	<2
	12/06/05	60	0.044	1.7	<1	<1	<2
	03/02/06	60	0.050	**6.1**	<1	<1	<2
	05/23/06	60	0.046	<1	<1	<1	<2
	09/12/06	60	0.046	<1	<1	<1	<2
	11/29/06	60	0.046	<1	<1	<1	<2
	02/28/07	60	0.046	<1	<1	<1	<2
ADEQ AWQS				5	5	70	7

Notes:

µg/l - micrograms per liter
PCE - tetrachloroethene
TCE - trichloroethene
cis-1,2-DCE - *cis*-1,2-dichloroethene
1,1-DCE - 1,1-dichloroethene
-- - data unavailable

EPA - U.S. Environmental Protection Agency
ADEQ - Arizona Department of Environmental Quality
AWQS - Aquifer Water Quality Standards
NE - Not Established
NA - Not Analyzed
D - Duplicate Sample

[1] - Well QMW-6 has been inaccessible since March 2002 due to road construction activity. Abandoned 1/22/04.

Checked by:______________________

Table 4. Results of Groundwater Sample Analyses - Domestic Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR Number)	Date Sampled	EPA Method 8260B/524.2 [1] (µg/L)			
		PCE	TCE	cis-1,2-DCE	1,1-DCE
Cast					
B-1 [2]	08/08/95	1.4	<0.5	--	--
(55-540500)	11/04/99	**10**	0.58	<0.4	<0.4
	05/12/00	**11**	0.7	<0.5	<0.5
	08/10/00	**12**	0.84	<0.5	<0.5
	10/31/00	**11**	0.88	<0.5	<0.5
	02/13/01	**9**	0.82	<0.5	<0.5
	05/08/01	**8.2**	0.70	<0.5	<0.5
B-2 [2]	08/08/95	**20**	0.8	--	--
(55-531202)	08/08/95 **D**	**19**	0.8	--	--
	07/30/97	1.3	<0.5	--	--
	10/29/97	**4.1**	<0.5	--	--
	05/13/98	**22**	0.96	--	--
	08/12/98	**25**	<0.5	--	--
	11/16/98	**22**	0.54	--	--
	02/22/99	**37**	1.6	--	--
	05/27/99	**42**	2.1	--	--
B-3	02/07/00	<2	<2	<2	<1
(deep well)	05/12/00	<0.5	<0.5	<0.5	<0.5
(55-526878)	08/10/00	<0.5	<0.5	<0.5	<0.5
	10/31/00	<0.5	<0.5	<0.5	<0.5
	02/13/01	<0.5	<0.5	<0.5	<0.5
	05/08/01	<0.5	<0.5	<0.5	<0.5
	08/15/01	NA	NA	NA	NA
	11/21/01	<0.5	<0.5	<0.5	<0.5
	11/21/01 **D**	<0.5	<0.5	<0.5	<0.5
	03/28/02	<0.5	<0.5	<0.5	<0.5
	02/12/03	<2	<2	<2	<5
	05/14/03	NA	NA	NA	NA
	12/03/03	<2	<2	<2	<5
	03/03/04	<2	<2	<2	<5
	06/09/04	<1	<1	<1	<2
	09/22/04	<1	<1	<1	<2
	12/08/04	<1	<1	<1	<1
	02/17/05	<1	<1	<1	<1
	05/25/05	<1	<1	<1	<2
	10/03/05	sampling attempted, pump was inoperable			
	12/07/05	sampling attempted, pump was inoperable			
	03/02/06	sampling attempted, pump was inoperable			
	05/22/06	pump inoperable, well is removed from sampling program			
B-4 [2]	08/08/95	<0.5	<0.5	--	--
(55-530652)	08/30/95	0.8	<0.5	--	--
	11/04/99	<0.4	<0.4	<0.4	<0.4
Parsons	10/29/97	<0.5	<0.5	.--	--
(55-630831)	05/27/99	<0.4	<0.4	--	--
	05/12/00	<0.5	<0.5	<0.5	<0.5
	10/31/00	<0.5	<0.5	<0.5	<0.5
	02/13/01	<0.5	<0.5	<0.5	<0.5
	05/08/01	<0.5	<0.5	<0.5	<0.5
	08/15/01	NA	NA	<0.5	NA
	11/21/01	<0.5	<0.5	<0.5	<0.5
	03/28/02	<0.5	<0.5	<0.5	<0.5
	02/18/03	<2	<2	<2	<5
	05/14/03	<2	<2	<2	<5
	09/04/03	<2	<2	<2	<5
	12/04/03	<2	<2	<2	<5
	03/03/04	<2	<2	<2	<5
	06/09/04	<1	<1	<1	<2
	09/22/04	<1	<1	<1	<2
	12/07/04	<1	<1	<1	<1
	02/16/05	<1	<1	<1	<1
	05/24/05	<1	<1	<1	<2
	09/21/05	<1	<1	<1	<2
	12/07/05	<1	<1	<1	<2
	03/02/06	<1	<1	<1	<2
	05/22/06	<1	<1	<1	<2
	09/14/06	<1	<1	<1	<2
	11/28/06	<1	<1	<1	<2
	02/27/07	<1	<1	<1	<2
ADEQ AWQS		**5**	**5**	**70**	**7**

See Page 4 for Notes

Table 4. Results of Groundwater Sample Analyses - Domestic Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR Number)	Date Sampled	EPA Method 8260B/524.2 [1] (µg/L)			
		PCE	TCE	cis-1,2-DCE	1,1-DCE
Adams					
North (55-644019)	05/27/99	<0.4	<0.4	--	--
	05/12/00	<0.5	<0.5	<0.5	<0.5
	08/10/00	<0.5	<0.5	<0.5	<0.5
	10/31/00	<0.5	<0.5	<0.5	<0.5
	02/13/01	<0.5	<0.5	<0.5	<0.5
	05/08/01	<0.5	<0.5	<0.5	<0.5
	08/15/01	NA	NA	NA	NA
	11/21/01	<0.5	<0.5	<0.5	<0.5
	03/28/02	0.64	<0.5	<0.5	<0.5
	02/13/03	<2	<2	<2	<5
	05/14/03	<2	<2	<2	<5
	09/04/03	<2	<2	<2	<5
	12/04/03	<2	<2	<2	<5
	03/03/04	<2	<2	<2	<5
	06/09/04	1.2	<1	<1	<2
	09/22/04	1.1	<1	<1	<2
	12/08/04	1.4	<1	<1	<1
	02/18/05	1.3	<1	<1	<1
	05/24/05	1.0	<1	<1	<2
	09/21/05	1.1	<1	<1	<2
	12/07/05	1.1	<1	<1	<2
	03/02/06	1.0	<1	<1	<2
	05/22/06	<1.0	<1	<1	<2
	09/14/06	1.2	<1	<1	<2
	11/28/06	1.1	<1	<1	<2
	02/27/07	<1	<1	<1	<2
South (55-644020)	05/12/00	<0.5	<0.5	<0.5	<0.5
	08/10/00	<0.5	<0.5	<0.5	<0.5
	10/31/00	<0.5	<0.5	<0.5	<0.5
	02/13/01	<0.5	<0.5	<0.5	<0.5
	05/08/01	<0.5	<0.5	<0.5	<0.5
	08/15/01	NA	NA	<0.5	NA
	11/21/01	<0.5	<0.5	<0.5	<0.5
	03/28/02	0.61	<0.5	<0.5	<0.5
	02/13/03	<2	<2	<2	<5
	05/14/03	<2	<2	<2	<5
	09/04/03	<2	<2	<2	<5
	12/04/03	<2	<2	<2	<5
	03/03/04	<2	<2	<2	<5
	06/09/04	1.2	<1	<1	<2
	09/22/04	<1	<1	<1	<2
	12/08/04	1.2	<1	<1	<1
	02/18/05	1.4	<1	<1	<1
	05/24/05	<1	<1	<1	<2
	09/21/05	1.1	<1	<1	<2
	12/07/05	<1	<1	<1	<2
	03/02/06	<1	<1	<1	<2
	05/22/06	<1	<1	<1	<2
	09/14/06	1.3	<1	<1	<2
	11/28/06	<1	<1	<1	<2
	02/27/07	1.3	<1	<1	<2
Rhoades West (55-526314)	10/29/97	4.9	<0.5	--	--
	02/22/99	**5.1**	<0.5	--	--
	05/14/99	4.4	<0.4	--	--
	05/27/99	**5.1**	<0.4	--	--
	10/31/00	**9.4**	<0.5	<0.5	<0.5
	02/13/01	**8.0**	<0.5	<0.5	<0.5
	05/08/01	**8.1**	<0.5	<0.5	<0.5
	05/08/01 **D**	**7.9**	<0.5	<0.5	<0.5
	08/15/01	**10.0**	<0.5	<0.5	<0.5
	11/21/01	**8.3**	<0.5	<0.5	<0.5
	03/28/02	**5.5**	<0.5	<0.5	<0.5
	03/28/02 **D**	**5.9**	<0.5	<0.5	<0.5
	02/18/03	3.3	<2	<2	<5
	05/15/03	3.2	<2	<2	<5
	09/04/03	3.2	<2	<2	<5
	09/04/03 **D**	3.0	<2	<2	<5
	12/03/03	**5.4**	<2	<2	<5
	12/03/03 **D**	**5.0**	<2	<2	<5
ADEQ AWQS		5	5	70	7

See Page 4 for Notes

Table 4. Results of Groundwater Sample Analyses - Domestic Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR Number)	Date Sampled	EPA Method 8260B/524.2 [1] (µg/L)			
		PCE	TCE	cis-1,2-DCE	1,1-DCE
Rhoades West (55-526314)	03/03/04	4.3	<2	<2	<5
	03/03/04 **D**	4.5	<2	<2	<5
	06/09/04	**6.4**	<1	<1	<2
	6/9/04**D**	**6.6**	<1	<1	<2
	09/22/04	**5.2**	<1	<1	<2
	9/22/04**D**	**5.6**	<1	<1	<2
	12/07/04	**7.7**	<1	<1	<1
	12/07/04**D**	**7.8**	<1	<1	<1
	02/18/05	**5.5**	<1	<1	<1
	2/18/05**D**	4.8	<1	<1	<1
	05/24/05	4.3	<1	<1	<1
	5/24/2005**D**	4.3	<1	<1	<2
	09/21/05	**6.5**	<1	<1	<2
	9/21/05**D**	**6.1**	<1	<1	<2
	12/07/05	3.4	<1	<1	<2
	12/07/05**D**	3.1	<1	<1	<2
	03/02/06	3.0	<1	<1	<2
	03/02/06**D**	3.0	<1	<1	<2
	05/22/06	3.7	<1	<1	<2
	5/22/06**D**	3.8	<1	<1	<2
	09/14/06	4.7	<1	<1	<2
	9/14/06**D**	**5.0**	<1	<1	<2
	11/28/06	**6.1**	<1	<1	<2
	11/28/06**D**	**5.7**	<1	<1	<2
	03/01/07	**6.6**	<1	<1	<2
	3/01/07**D**	**5.9**	<1	<1	<2
Kauffman [2]	08/12/98	<1	<1	--	--
	05/27/99	**29**	<1	--	--
	05/08/01	**11**	<1	<0.5	<0.5
Welcome RV (55-541533)	11/09/95	**200**	**6.2**	**--**	--
	11/9/95 **D**	**180**	**7**	**--**	--
	11/04/99	**74**	<4	<4	<4
	11/04/99 **D**	**79**	<4	<4	<4
	04/03/00	**120**	**5.7**	<0.5	<0.5
	08/10/00	NA	NA	<0.5	NA
	11/16/00	**100**	4.7	<0.5	<0.5
	11/16/00 **D**	**110**	4.9	<0.5	<0.5
	02/13/01	**130**	**5.0**	<0.5	<0.5
	05/08/01	NA	NA	<0.5	NA
	08/15/01	NA	NA	<0.5	NA
	12/14/01	**120**	**5.5**	<0.5	<0.5
	03/28/02	NA	NA	<0.5	NA
	02/12/03	**160**	4.5	<2	<5
	02/12/03	**160**	4.6	<2	<5
	05/14/03	NA	NA	<0.5	NA
	11/18/03	**100**	3.8	<2	<5
	01/08/04	**92**	3.0	<2	<5
	02/10/04	**91**	3.0	<2	<5
	02/10/04 [3]	**79**	2.9	<0.5	<0.5
	03/03/04	**90**	2.9	<2	<5
	11/22/2004[4]	**7.8**	<1	<1	<2
	12/08/04	**27.3**	<1	<1	<1
	02/16/05	**30**	<1	<1	<1
	12/07/05	**12**	<1	<1	<2
	03/02/06	**20**	1.0	<1	<2
	11/28/06	**60**	2.9	<1	<2
	03/01/07	**12**	<1	<1	<2
York (55-600695)	04/03/98	<0.5	<0.5	--	--
	05/27/99	<0.4	<0.4	--	--
	11/04/99	<0.4	<0.4	<4	<0.4
	05/12/00	<0.5	<0.5	<4	<0.5
	08/10/00	<0.5	<0.5	<0.5	<0.5
	10/31/00	<0.5	<0.5	<0.5	<0.5
	02/13/01	<0.5	<0.5	<0.5	<0.5
	05/08/01	<0.5	<0.5	<0.5	<0.5
	05/08/01 **D**	<0.5	<0.5	<0.5	<0.5
	08/15/01	<0.5	<0.5	<0.5	<0.5
	11/21/01	<0.5	<0.5	<0.5	<0.5
	03/27/02	<0.5	<0.5	<0.5	<0.5
ADEQ AWQS		**5**	**5**	**70**	**7**

See Page 4 for Notes

Table 4. Results of Groundwater Sample Analyses - Domestic Wells
Tyson Wash WQARF Site, Quartzsite, Arizona

Well ID (ADWR Number)	Date Sampled	EPA Method 8260B/524.2 [1] (µg/L)			
		PCE	TCE	cis-1,2-DCE	1,1-DCE
York	02/13/03	<2	<2	<2	<5
(55-600695)	05/14/03	NA	NA	NA	NA
	09/04/03	<2	<2	<2	<5
	12/04/03	<2	<2	<2	<5
	01/08/04	<2	<2	<2	<5
	03/03/04	<2	<2	<2	<5
	06/09/04	3.7	<1	<1	<2
	09/22/04	1.4	<1	<1	<2
	12/08/04	2.5	<1	<1	<1
	02/18/05	1.6	<1	<1	<1
	05/24/05	4.3	<1	<1	<2
	09/21/05	4	<1	<1	<2
	12/07/05	4.2	<1	<1	<2
	03/02/06	3.8	<1	<1	<2
	05/22/06	**7.2**	<1	<1	<2
	09/14/06	3.1	<1	<1	<2
	11/28/06	4.1	<1	<1	<2
	03/01/07	3.4	<1	<1	<2
La Casa Del Rancho Restaurant					
East	11/04/99	1.5	<0.4	<0.4	<0.4
	05/12/00	NA	NA	<0.5	NA
	08/10/00	<0.5	<0.5	<0.5	<0.5
	10/31/00	<0.5	<0.5	<0.5	<0.5
	02/13/01	<0.5	<0.5	<0.5	<0.5
	05/08/01	<0.5	<0.5	<0.5	<0.5
	08/15/01	<0.5	<0.5	<0.5	<0.5
	11/21/01	<0.5	<0.5	<0.5	<0.5
	03/28/02	<0.5	<0.5	<0.5	<0.5
	02/12/03	NA	NA	NA	NA
	05/14/03	<2	<2	<2	<5
West	11/04/99	4	<0.4	<0.4	<0.4
	05/12/00	**5.1**	<0.5	<0.5	<0.5
	08/10/00	**5.9**	<0.5	<0.5	<0.5
	11/16/00	**7.6**	<0.5	<0.5	<0.5
	02/13/01	**9**	<0.5	<0.5	<0.5
	05/08/01	**8.6**	<0.5	<0.5	<0.5
	08/15/01	NA	NA	<0.5	NA
	11/21/01	**9.8**	<0.5	<0.5	<0.5
	03/28/02	<0.5	<0.5	<0.5	<0.5
	04/19/02	**10**	<0.5	<0.5	<0.5
	02/12/03	<2	<2	<2	<5
	05/14/03	**14**	<2	<2	<5
Joyce's Craft Supplies	01/08/04	<2	<2	<2	<5
Mark's Family Restaurant [2]	11/09/95	<0.5	<0.5	--	<0.5
(Formerly The Beauty Shop)	11/04/99	<0.4	<0.4	<0.4	<0.4
Post Office [2]	08/08/95	**8.5**	<0.5	--	<0.5
	11/04/99	**21**	<0.8	<0.8	<0.8
Eric's RV Repair [2]	02/07/00	0.5	<0.5	<0.5	3
(55-514430)	05/12/00	<0.5	<0.5	<0.5	<0.5
	08/10/00	<0.5	<0.5	<0.5	<0.5
	10/31/00	<0.5	<0.5	<0.5	<0.5
	02/13/01	<0.5	<0.5	<0.5	<0.5
	05/08/01	<0.5	<0.5	<0.5	<0.5
ADEQ AWQS		**5**	**5**	**70**	**7**

Notes:

[1] - Samples were analyzed by U.S. EPA Method 524.2 through March 2002, and by Method 8260B thereafter. Except where indicated, samples collected after 5/99 were analyzed by Del Mar Analytical.

[2] - Well is no longer in service

[3] - Split sample analyzed by Transwest Geochem, Inc.

[4] - Sample collected by ADEQ on 11/22/04

µg/l - micrograms per liter
PCE - tetrachloroethene
TCE - trichloroethene
1,1-DCE - 1,1-dichloroethene
MTBE - methyl-tert-butyl-ether
cis-1,2-DCE - *cis*-1,2-dichloroethene
NA - Not analyzed during this sampling event

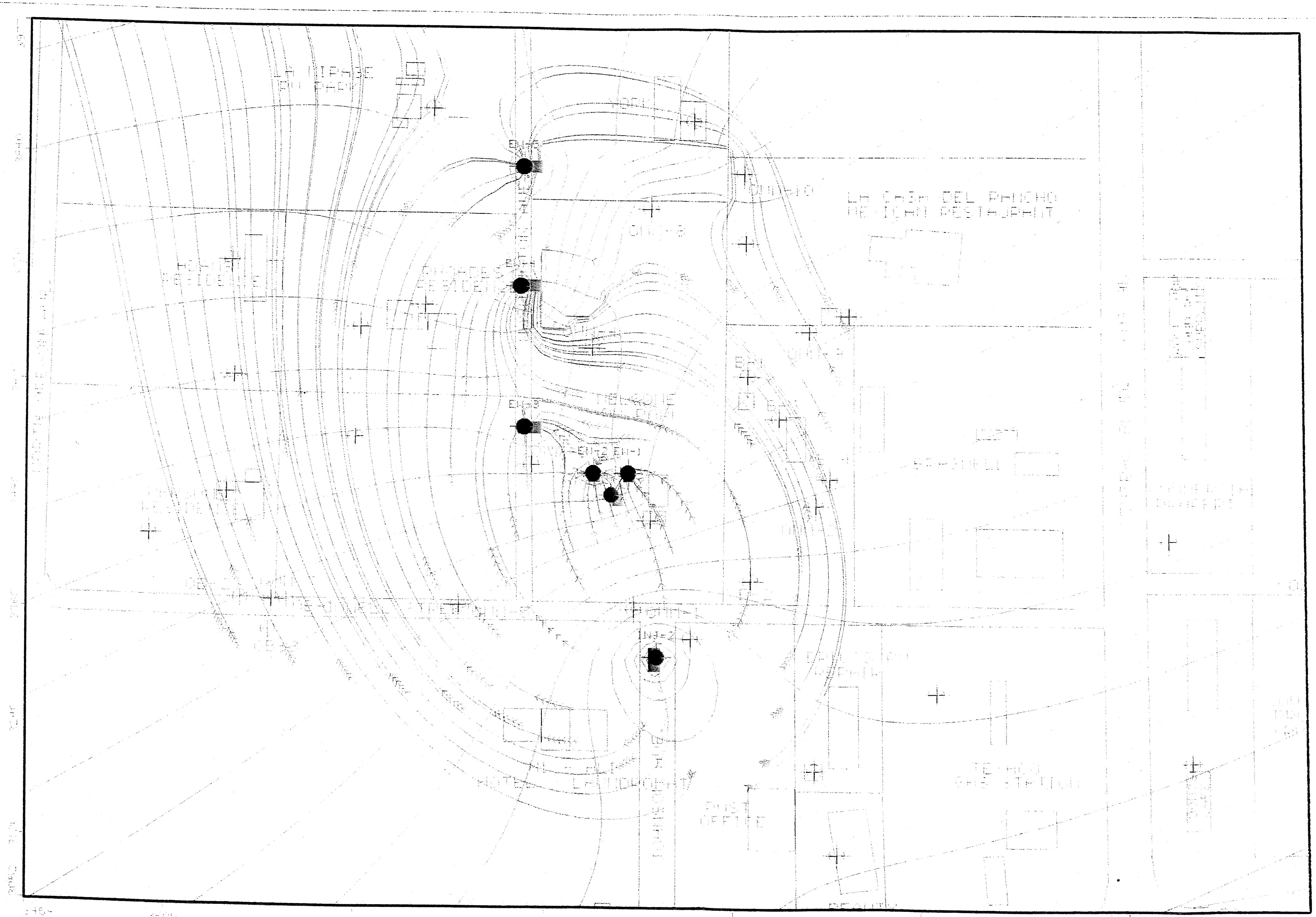
EPA - U.S. Environmental Protection Agency
ADEQ - Arizona Department of Environmental Quality
AWQS - Aquifer Water Quality Standards
NE - Not Established
NA - Not Analyzed
D - Duplicate Sample
-- - data unavailable

Checked by: JNC

APPENDICES

APPENDIX A

EXPANDED REMEDIATION SYSTEM MODELING RESULTS



MACTEC ENGINEERING AND CONSULTING
Project: Tyson Wash WQARF
Description: 2005_MODEL_C
Modeller: Paul Salcido
11 May 05

Visual MODFLOW v.2.8.2, (C) 1995–1999
Waterloo Hydrogeologic, Inc.
NC: 98 NR: 96 NL: 1
Current Layer: 1

APPENDIX B

REMEDIAL ALTERNATIVES SCREENING TECHNICAL MEMORANDUM

REMEDIAL ALTERNATIVES SCREENING
TECHNICAL MEMORANDUM
TYSON WASH WQARF REGISTRY SITE
QUARTZSITE, ARIZONA
ADEQ TASK ASSIGNMENT 04-0048

Prepared for:

Arizona Department of Environmental Quality
Waste Programs Division
1110 West Washington
Phoenix, Arizona 85007

Prepared by:

MACTEC Engineering and Consulting, Inc.
3630 East Wier Avenue
Phoenix, Arizona 85040

MACTEC

MACTEC Project No. 4972-04-2100.5.2

June 21, 2006

MACTEC

engineering and constructing a better tomorrow

June 21, 2006

Mr. Chris Gamache
Project Manager
Superfund Programs Section
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Subject: **Remedial Alternatives Screening Technical Memorandum**
Tyson Wash WQARF Registry Site
ADEQ Task Assignment 04-0048
MACTEC Project No. 4972-04-2100.5.2

Dear Mr. Gamache:

In accordance with Arizona Administrative Code (A.A.C) R18-16-407, Task Assignment 04-0048, and the Feasibility Study Work Plan dated March 30, 2006, MACTEC Engineering and Consulting, Inc. (MACTEC) has completed this Remedial Alternatives Screening (RAS) Technical Memorandum for the Tyson Wash WQARF Registry Site in Quartzsite, Arizona (Site).

The groundwater at the Site is impacted with chlorinated solvents. The compounds of concern (COCs) that are monitored are tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (c-1,2-DCE), and 1,1-DCE. TCE and c-1,2-DCE are degradation products of PCE. However, PCE and TCE are the only COCs that have exceeded the Arizona Aquifer Water Quality Standards (AWQSs). Based on the results of the remedial investigation (RI), the impact at the Site is apparently limited to COCs dissolved in the groundwater and no vadose zone (unsaturated) soil or non-aqueous phase liquid (NAPL) source area has been identified and is not considered to be present. Groundwater monitoring has been conducted since 1995 and through the March 2006 sampling event, the maximum PCE concentration detected in a production well or monitoring well has been 200 micrograms per liter (μg/L), which is above the AWQS for 5.0 μg/L for PCE, and the maximum TCE concentration detected in a well is 6.5 μg/L, which is above the AWQS of 5.0 μg/L for TCE. The results of the RI are presented in the *"Remedial Investigation Report, Tyson Wash WQARF Site, Quartzsite, Arizona"* prepared by MACTEC for ADEQ and dated June 30, 2003, and Groundwater Monitoring Reports (GMRs) providing historical and current groundwater monitoring results are available for review.

On May 14, 2003, the Arizona Department of Environmental Quality (ADEQ) issued the Final Remedial Objective (RO) Report for the Site. The RO for groundwater use at the Site is summarized below:

> To protect, restore, replace, or otherwise provide a water supply for potable use by private well owners outside the current plume boundaries of the Site if the current use is impaired or lost due to contamination from the Site. This RO is applicable until Town of Quartzsite (Town) water service connections can be confirmed. After the Town water connections are confirmed, the RO is to protect, restore, replace, or otherwise provide a water supply for non-potable use by private well owners outside the current plume boundaries of the Site if the current use is impaired or lost due to contamination from the Site. This RO is needed

MACTEC Engineering and Consulting, Inc.
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for as long as the wells are used for non-potable purposes and their use is threatened, impaired, or lost as a result of contamination from the Site.

Figure 1 provides the March 2006 PCE distribution at the Site, which provides the locations of wells at the Site and the basis for the RAS. For the purposes of the RAS, groundwater containing PCE concentrations greater than 50 μg/L is considered the "source area", and groundwater containing PCE concentrations greater than the AWQS of 5.0 μg/L is considered the "plume area". Prior to 2003, the source area was centered around the Welcome RV Park well, which was characterized with PCE concentrations ranging from 74 μg/L to 200 μg/L. The source area encompassed wells QMW-1 and QMW-3 and periodically wells QMW-4 and QMW-5, though by 2003 PCE concentrations in these wells had decreased below 50 μg/L. In February 2003, an Early Response Action (ERA) was implemented at the Site. The ERA consisted of the following:

- Installation of a pilot-scale groundwater pump-and-treat system consisting of two extraction wells (EW-1 and EW-2) and one injection well (INJ-1) in the vicinity of the Welcome RV Park well. Groundwater was treated using granulated activated carbon (GAC) and injected at INJ-1. Approximately 5 to 7 gallons per minute (gpm) of water were pumped and treated.

- Performance of a treatability study to evaluate in-situ bioremediation as a remedial alternative. The treatability study, which along with groundwater monitoring data was also used to evaluate natural attenuation, was completed in October 2003.

The treatability study and groundwater monitoring data indicated that natural biodegradation of the COCs was not readily occurring at the Site and that natural attenuation may not achieve the ROs. The treatability study demonstrated that the conditions required for biodegradation of the COCs were not present and that biodegradation would require introduction of both bacteria and organic carbon to achieve the ROs. Though in-situ bioremediation was demonstrated to be able to mitigate the groundwater impact in a short period of time and achieve the ROs, implementation may be less cost effective than other remedial alternatives.

The pilot-scale pump-and-treat system operated from April 2003 to September 2005. Groundwater monitoring data indicated that the pilot-scale system was effectively reducing PCE concentrations in the Welcome RV Park well, to as low as 27.3 μg/L in December 2004. However, as the system operated, PCE concentrations began increasing in wells QMW-1, QMW-3, QMW-4, and QMW-8, which indicated the pilot-scale system was not achieving the ROs. During 2005, using the program MODFLOW, MACTEC modeled several extraction and injection well configurations for the pump-and-treat system to meet the ROs. Taking into account access limitations, MACTEC proposed a configuration of three new extraction wells (EW-3, EW-4, and EW-5) along Washington Street, and a new injection well (INJ-2) at the intersection of Cowell Street and Johnson Boulevard (see Figure 1). This configuration was accepted by ADEQ and installed in September 2005. The full system has been in operation since October 2005 and the current results of system operation are shown on Figure 1. PCE concentrations have been reduced in well QMW-1 to below 50 μg/L and the source area has been shifted to the west and north of the Welcome RV Park well to encompass wells QMW-3, QMW-4, EW-3, and EW-4, which was predicted by the groundwater model. Groundwater monitoring data that has been collected since October 2005 indicates the full-scale system is operating as predicted by the groundwater model and is meeting the ROs.

In accordance with (A.A.C) R18-16-407, the RAS involved selection of a remedial strategy or combination of remedial strategies from the following (listed from most aggressive to least aggressive):

1. Plume remediation;

2. Physical containment;

3. Controlled migration;

4. Source control;

5. Monitoring; and,

6. No action alternative.

Physical containment of the groundwater plume will involve installation of a feature such as a slurry wall. This strategy will not be cost effective due to the depth and length required to install a slurry wall. Therefore, physical containment was not considered as a remedial strategy. The other possible remedial strategies will likely be employed at one or more times throughout the remedial timeframe or will be employed in combination.

Possible RAs are screened against the criteria of effectiveness, cost, implementability, and ability to meet the ROs. Groundwater pump-and-treat, in-situ bioremediation, and monitored natural attenuation (MNA) were evaluated during the ERA selection process. Therefore, these RAs have been included in the RAS. There are also other proven technologies available that are capable of meeting the ROs. These technologies include the following: air sparging/soil vapor extraction (AS/SVE), which involves injection of air into the groundwater and extraction of volatilized vapors; Accelerated Remedial Technology (ART), which is an in-well groundwater air stripping/aeration technology; and, in-situ chemical oxidation (ISCO), which involves introduction of oxidants such as hydrogen peroxide to chemically degrade chlorinated solvents to inert components. Therefore, MACTEC has also included these other technologies in the RAS. Though a technology may be able to meet the ROs, the technology may prove to be more difficult to implement and/or less cost effective when compared to other technologies that can also meet the ROs. Therefore, the RAS is used to select RAs that will be further evaluated by the FS process.

The results of the RAS are shown in Table 1. Using a combination of remedial strategies and alternatives often has the effect of meeting the RO's in a shorter timeframe and sometimes at a lower cost. For example, a short-term source control technology combined with a controlled migration technology and monitoring may result in plume remediation at a lower cost than just applying a total plume remediation approach. Though in-situ bioremediation was proven effective by the treatability study, the estimated cost to implement in-situ bioremediation as a source control technology is higher than operating the pump-and-treat system for 10 years as a source control technology ($750,000 versus $1,000,000). However, the RAS has indicated that ISCO can possibly be effectively employed as a source control technology at a lower cost than operating the pump-and-treat system as a source control technology ($280,000 versus $750,000).

Based on the results of the RAS (Table 1), the groundwater modeling, and groundwater monitoring that was performed in December 2005 and March 2006, the reference and alternative remedies to be carried forward to the Remedial Alternative Evaluation (RAE) are presented as follows:

Remedial Alternative	Remedial Technology
More Aggressive	ISCO as source control, pump-and-treat as controlled migration, and monitoring.
Reference Remedy	Groundwater pump-and-treat as controlled migration
Less Aggressive	MNA

A groundwater pump-and-treat has been installed. Therefore, groundwater pump-and-treat as a controlled migration technology is selected as the reference technology. ISCO employed for source control, combined with pump-and-treat for controlled migration, is considered a more aggressive alternative than groundwater pump-and-treat due to the linking of technologies and potential shorter timeframe for remediation. Though MNA alone will not immediately meet the RO's, MNA may be employed in the future, either as a stand alone approach, or in combination with pump-and-treat. Therefore, MNA will be evaluated as a less aggressive alternative than groundwater pump-and-treat.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

James N. Clarke, R.G
Principal Geologist

Phillip A. Schneider, P.E
Office Manager

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Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

Remedial Strategy	Treatment Technology	Selection Criteria Screening (effectiveness, implementability, and cost)	Ability to Meet Remedial Objectives: Protective of Public Health and the Environment	Ability to Meet Remedial Objectives: Protective of Groundwater Uses Outside Known Plume Boundaries
Plume Remediation[1]	Groundwater extraction and granular activated carbon (GAC) treatment	• Ultimately effective; however, due to slow mass removal duration of remediation may not be as expeditious as a more aggressive remedy. • Implemented in September 2005. • Total cost to install existing system was approximately $200,000. Water can effectively be treated using GAC unit with annual replacement required. Estimated annual cost for O&M, electricity, quarterly monitoring, and reporting is $60,000. Total cost may exceed $2,000,000.	Yes	Yes
	Groundwater extraction with other treatment (air stripping, UV, biotreat, oxidation)	• Same as above. • Will require larger compound than GAC treatment. Air stripping will require air permitting and off-gas treatment. • Higher O&M cost compared to GAC.	Yes	Yes

Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

Remedial Strategy	Treatment Technology	Selection Criteria Screening (effectiveness, implementability, and cost)	Ability to Meet Remedial Objectives: Protective of Public Health and the Environment	Ability to Meet Remedial Objectives: Protective of Groundwater Uses Outside Known Plume Boundaries
Plume Remediation cont.	In-situ bioremediation	• Treatability study performed in 2004 demonstrated in-situ bioremediation can possibly achieve RO's in less than 2 years. • Assuming the plume covers an area of approximately 300,000 square feet (sf) and an injection point spacing of 20 feet, approximately 750 injection points will be required, most of which will be on private property. Therefore, not readily implemented. • High installation cost. The estimated cost to treat a 10,000 sf area was approximately $200,000. Therefore, cost for plume remediation may exceed $6,000,000.	Yes	Yes
	In-situ chemical oxidation (ISCO)	• Proven technology capable of rapidly meeting cleanup goals. • Not readily implemented due to multiple injection points to treat entire plume. • Potentially high installation costs due to number of injection points.	Yes	Yes

Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

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Plume Remediation cont.	Air Sparging/Soil Vapor Extraction (AS/SVE)	• More effective as a source control technology than as a plume remediation technology. • Not readily implemented due to number of sparge points (200) required. • Installation and O&M costs will likely exceed long-term groundwater extraction costs.	Yes	Yes
	Accelerated Remediation Technology (ART) An in-well system that combines AS/SVE, air stripping, and groundwater aeration.	• Proven effective in treating fuel hydrocarbon plumes; however, has had recent successes in treating chlorinated solvent plumes. Technology is very effective in low permeability aquifers and results in larger radius of influence than a standard AS well. • Radius of influence (ROI) for a single well can be up to 45 feet. Plume remediation will require a minimum of 150 wells, several of which would be on private property, making implementation difficult. • Though plume remediation can be achieved in two years or less, costs for installation and O&M will exceed $2,000,000.	Yes	Yes

Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

Remedial Strategy	Treatment Technology	Selection Criteria Screening (effectiveness, implementability, and cost)	Ability to Meet Remedial Objectives: Protective of Public Health and the Environment	Ability to Meet Remedial Objectives: Protective of Groundwater Uses Outside Known Plume Boundaries
Physical Containment	Due to the depth to groundwater and size of the plume, remedial alternatives capable of achieving physical containment will not be considered.			
Controlled Migration	**Groundwater extraction and granular activated carbon (GAC) treatment**	• Widely used and proven very effective as a controlled migration/plume containment technology. Long-term operation required. • Implemented in September 2005. • Total cost to install existing system was approximately $200,000. Water can effectively be treated using GAC unit with annual replacement required. Estimated annual cost for O&M, electricity, quarterly monitoring, and reporting is $60,000. In order to maintain RO's, the system may require operation for an extended period of time at a total cost in excess of $2,000,000, assuming quarterly groundwater monitoring.	Yes	Yes
	Permeable reactive barrier (PRB)	• Effective controlled migration technology. • Due to length and depth of wall, not readily implemented. • Very high installation cost.	Yes	Yes

Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

Remedial Strategy	Treatment Technology	Selection Criteria Screening (effectiveness, implementability, and cost)	Ability to Meet Remedial Objectives: Protective of Public Health and the Environment	Ability to Meet Remedial Objectives: Protective of Groundwater Uses Outside Known Plume Boundaries
Controlled Migration cont.	AS/SVE	• Can be installed as a curtain or gallery across downgradient extent of plume. Combination of groundwater mounding and VOC stripping can result in controlled migration. • Assuming a 30-foot radius of influence, approximately 20 wells will be required. Additionally, each well will require an air line and vapor extraction line, thus requiring trenching. Installation on private properties will make implementation difficult. • Installation costs are very high. O&M costs are very high due to need for air sparge blowers, vapor extraction system, and vapor treatment systems.	Yes	Yes
Source Control	**Groundwater extraction and granular activated carbon (GAC) treatment**	• Ultimately effective; however, due to slow mass removal duration of remediation may not be as expeditious as a more aggressive remedy. • Implemented in September 2005. • Estimated O&M cost for 10 years is $750,000.	Yes	Yes

Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

Remedial Strategy	Treatment Technology	Selection Criteria Screening (effectiveness, implementability, and cost)	Ability to Meet Remedial Objectives: Protective of Public Health and the Environment	Ability to Meet Remedial Objectives: Protective of Groundwater Uses Outside Known Plume Boundaries
Source Control cont.	In-situ bioremediation	• Treatability study performed in 2004 demonstrated in-situ bioremediation can reduce source area concentrations in less than 2 years. • Not readily implemented due to number of injection points (100). Operation will utilize existing pump-and-treat system. • High installation cost. Estimated cost for source control is $1,000,000.	Yes	Yes
	In-situ chemical oxidation (ISCO)	• Proven technology capable of rapidly meeting cleanup goals. Estimated less than one year for source control. • Readily implemented. Source control will utilize existing monitoring wells and pump-and-treat system. • Mass reduction in source area can be rapidly achieved at lower cost than in-situ bioremediation and pump-and-treat. Estimated cost for source control is $280,000.	Yes	Yes

Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

Remedial Strategy	Treatment Technology	Selection Criteria Screening (effectiveness, implementability, and cost)	Ability to Meet Remedial Objectives: Protective of Public Health and the Environment	Ability to Meet Remedial Objectives: Protective of Groundwater Uses Outside Known Plume Boundaries
Source Control cont.	AS/SVE	• Proven source control technology. Pulsing can avoid formation of preferred pathways. Less effective in finer-grained materials due to smaller radius of influence. • Assuming a 30-foot radius of influence, approximately 45 wells will be required. Additionally, each well will require an air line and vapor extraction line, thus requiring trenching. Installation on private properties will make implementation difficult. • Installation costs are very high. O&M costs are higher than pump-and-treat due to need for air sparge blowers, vapor extraction system, and vapor treatment systems.	Yes	Yes
	Accelerated Remediation Technology (ART) – in well groundwater air stripping/aeration technology.	• Technology is very effective in low permeability aquifers and results in larger radius of influence than a standard AS well. • Source control will require up to 30 wells. • Installation and O&M costs are very high compared to other technologies.	Yes	Yes

Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

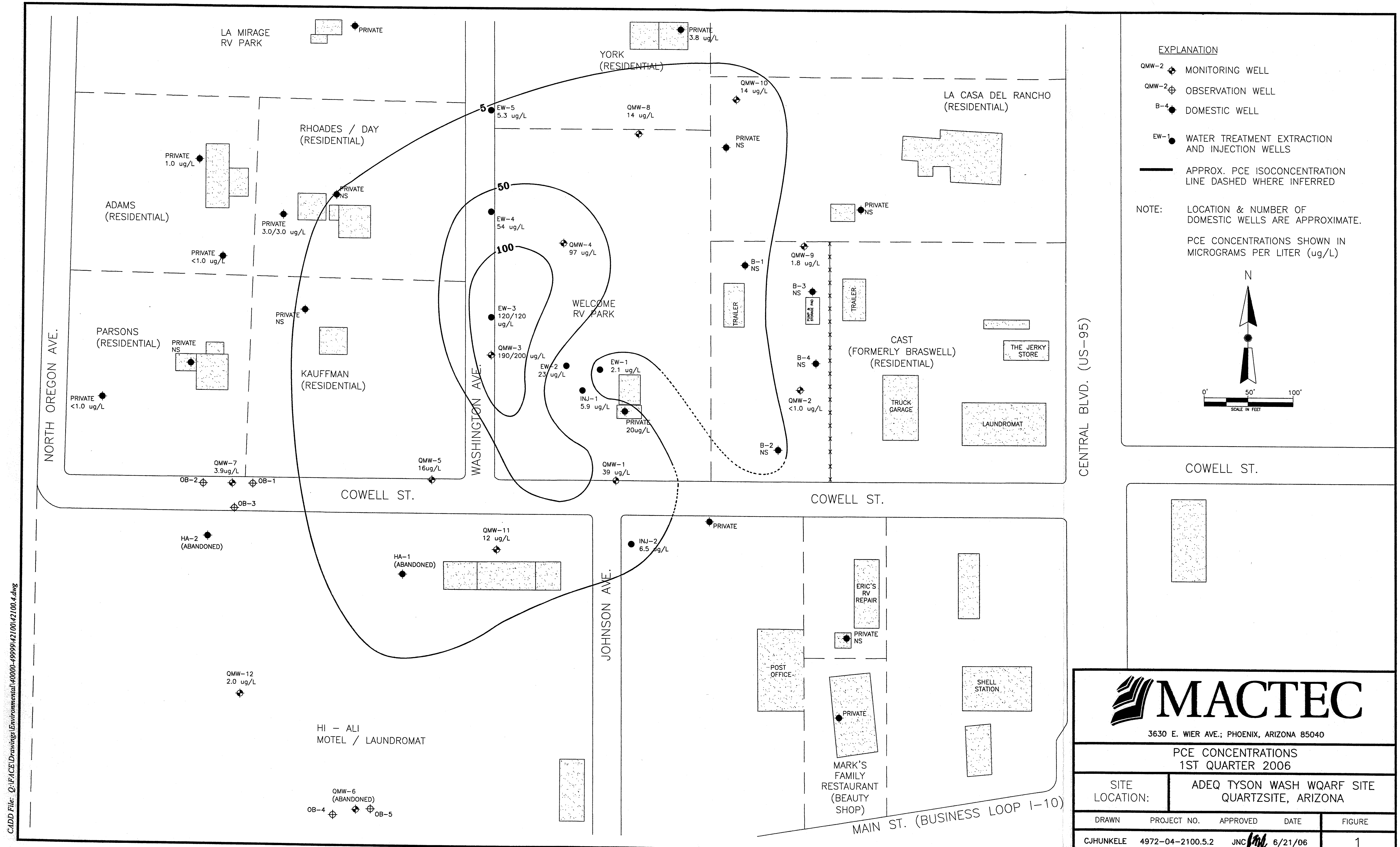
Remedial Strategy	Treatment Technology	Selection Criteria Screening (effectiveness, implementability, and cost)	Ability to Meet Remedial Objectives: Protective of Public Health and the Environment	Ability to Meet Remedial Objectives: Protective of Groundwater Uses Outside Known Plume Boundaries
Monitoring	Monitored natural attenuation (MNA)	• Bioremediation treatability study demonstrated that due to aerobic conditions, lack of available organic carbon, and lack of appropriate naturally occurring bacteria, natural biodegradation is not readily occurring. Physical processes of dilution, diffusion, and adsorption are the only processes available for plume stability and containment. Monitoring will not meet RO's without implementation of other technologies. However, monitoring may be applied in the future after source removal is completed. • Will utilize existing well network. • Cost depends on frequency of monitoring events and number of wells that are sampled. Estimated cost for each monitoring event is approximately $12,000.	Yes	Not immediately; possibly in the future.

Table 1. Remedial Alternatives Screening Process
Tyson Wash WQARF Registry Site

Remedial Strategy	Treatment Technology	Selection Criteria Screening (effectiveness, implementability, and cost)	Ability to Meet Remedial Objectives: Protective of Public Health and the Environment	Ability to Meet Remedial Objectives: Protective of Groundwater Uses Outside Known Plume Boundaries
No Action	No Action	• Other than physical natural attenuation processes of dilution, adsorption, and diffusion, there would be no reduction in COC concentrations. • Readily implemented. Declarations of Environmental Use Restriction (DEURs) may be required on some properties. • DEUR filing fees.	Yes	No

Notes:

1. Plume implies extent of tetrachloroethene (PCE) impact to Aquifer Water Quality Standard (AWQS) greater than 5.0 microgram per liter (µg/L).
2. Source implies extent of PCE impact greater than 50 µg/L.



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APPENDIX C

REMEDIAL ALTERNATIVES EVALUATION TECHNICAL MEMORANDUM

REMEDIAL ALTERNATIVES EVALUATION
TECHNICAL MEMORANDUM
TYSON WASH WQARF REGISTRY SITE
QUARTZSITE, ARIZONA
ADEQ TASK ASSIGNMENT 04-0048

Prepared for:

Arizona Department of Environmental Quality
Waste Programs Division
1110 West Washington
Phoenix, Arizona 85007

Prepared by:

MACTEC Engineering and Consulting, Inc.
3630 East Wier Avenue
Phoenix, Arizona 85040

MACTEC Project No. 4972-06-2100.5.3

MACTEC

March 28, 2007

MACTEC

engineering and constructing a better tomorrow

March 28, 2007

Mr. Chris Gamache
Project Manager
Superfund Programs Section
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Subject: **Remedial Alternatives Evaluation Technical Memorandum**
Tyson Wash WQARF Registry Site
ADEQ Task Assignment 04-0048
MACTEC Project No. 4972-06-2100.5.3

Dear Mr. Gamache:

In accordance with Arizona Administrative Code (A.A.C) R18-16-407, Task Assignment 04-0048, and the Feasibility Study Work Plan dated March 30, 2006, MACTEC Engineering and Consulting, Inc. (MACTEC) has completed this Remedial Alternatives Evaluation (RAE) Technical Memorandum for the Tyson Wash WQARF Registry Site in Quartzsite, Arizona (Site). This RAE Technical Memorandum is a component of the Feasibility Study process.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

James N. Clarke, R.G
Principal Geologist

Phillip A. Schneider, P.E
Office Manager

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1.0 INTRODUCTION AND BACKGROUND

The Tyson Wash Water Quality Assurance Revolving Fund (WQARF) Registry Site (Site) is located in Quartzsite, Arizona. The location of the Site is shown on Figure 1. The groundwater at the Site is impacted with chlorinated solvents. The compounds of concern (COCs) that are monitored are tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (c-1,2-DCE), and 1,1-DCE. TCE and c-1,2-DCE are degradation products of PCE. However, PCE, and TCE are the only COCs that have exceeded the Arizona Aquifer Water Quality Standards (AWQSs) of 5.0 micrograms per liter (µg/L). Based on the results of the remedial investigation (RI), the impact at the Site is apparently limited to COCs dissolved in the groundwater and no vadose zone (unsaturated) soil or non-aqueous phase liquid (NAPL) source area has been identified and is not considered to be present.

Groundwater monitoring has been conducted since 1995 and through the September 2006 sampling event, the maximum PCE and TCE concentrations detected in a production well or monitoring well have been 200 µg/L and 6.5 µg/L, respectively, which are above the AWQS for 5.0 µg/L for PCE and TCE. The results of the RI are presented in the *"Remedial Investigation Report, Tyson Wash WQARF Site, Quartzsite, Arizona"* prepared by MACTEC for ADEQ and dated June 30, 2003, and Groundwater Monitoring Reports (GMRs) providing historical and current groundwater monitoring results are available for review.

On May 14, 2003, the Arizona Department of Environmental Quality (ADEQ) issued the Final Remedial Objective (RO) Report for the Site. The RO for groundwater use at the Site is summarized below:

> To protect, restore, replace, or otherwise provide a water supply for potable use by private well owners outside the current plume boundaries of the Site if the current use is impaired or lost due to contamination from the Site. This RO is applicable until Town of Quartzsite (Town) water service connections can be confirmed. After the Town water connections are confirmed, the RO is to protect, restore, replace, or otherwise provide a water supply for non-potable use by private well owners outside the current plume boundaries of the Site if the current use is impaired or lost due to contamination from the Site. This RO is needed for as long as the wells are used for non-potable purposes and their use is threatened, impaired, or lost as a result of contamination from the Site.

Figure 2 provides the September 2006 PCE distribution at the Site, which provides the locations of wells at the Site and the basis for the Remedial Alternative Screening (RAS). The September 2006 PCE distribution presents the most recently collected groundwater analytical data for the Site. For the purposes of the RAE (Remedial Alternative Evaluation), groundwater containing PCE concentrations greater than 50 µg/L is considered the "source area", and groundwater containing PCE concentrations greater than the AWQS of 5.0 µg/L is considered the "plume area". Prior to 2003, the source area was centered on the Welcome RV Park well, which was characterized with PCE concentrations ranging from 74 µg/L to 200 µg/L. The source area encompassed wells QMW-1 and QMW-3 and periodically wells QMW-4 and QMW-5, though by 2003 PCE concentrations in these wells had decreased below 50 µg/L. In February 2003, an Early Response Action (ERA) was implemented at the Site. The ERA consisted of the following:

- Installation of a pilot-scale groundwater pump-and-treat system consisting of two extraction wells (EW-1 and EW-2) and one injection well (INJ-1) in the vicinity of the Welcome RV Park well. Groundwater was treated using granulated activated carbon (GAC) and injected at INJ-1. Approximately five to seven gallons per minute (gpm) of water were pumped and treated.

- Performance of a treatability study to evaluate in-situ bioremediation as a remedial alternative. The treatability study, which along with groundwater monitoring data was also used to evaluate natural attenuation, was completed in October 2003.

The treatability study and groundwater monitoring data indicated that natural biodegradation of the COCs was not readily occurring at the Site and that natural attenuation may not achieve the ROs. The treatability study demonstrated that the conditions required for biodegradation of the COCs were not present and that biodegradation would require introduction of both bacteria and organic carbon to achieve the ROs. Though in-situ bioremediation was demonstrated to be able to mitigate the groundwater impact in a short period of time and achieve the ROs, implementation may be less cost effective than other remedial alternatives.

The pilot-scale pump-and-treat system operated from April 2003 to September 2005. Groundwater monitoring data indicated that the pilot-scale system was effectively reducing PCE concentrations in the Welcome RV Park well, to as low as 27.3 µg/L in December 2004. However, as the system operated, PCE concentrations began increasing in wells QMW-1, QMW-3, QMW-4, and QMW-8, which indicated the pilot-scale system was not achieving the ROs. During 2005, using the program MODFLOW, MACTEC modeled several extraction and injection well configurations for the pump-and-treat system to meet the ROs. Taking into account access limitations, MACTEC proposed a configuration of three new extraction wells (EW-3, EW-4, and EW-5) along Washington Street, and a new injection well (INJ-2) at the intersection of Cowell Street and Johnson Boulevard (see Figure 2). This configuration was accepted by ADEQ and installed in September 2005. The full system has been in operation since October 2005 and the current results of system operation are shown on Figure 2. PCE concentrations have been reduced in well QMW-1 to below 50 μg/L and the source area has been shifted to the west and north of the Welcome RV Park well to encompass wells QMW-3, QMW-4, EW-3, and EW-4, which was predicted by the groundwater model. Groundwater monitoring data that has been collected since October 2005 indicates the full-scale system is operating as predicted by the groundwater model and is meeting the ROs.

2.0 OBJECTIVES

The objective for completion of the RAE is to maximize protection of human health and groundwater resources while meeting the Remedial Objectives (ROs) and minimizing overall cost of remediation. The evaluation will be based on the seven criteria identified in ARS §49-282.06 (C) as summarized below:

- Population, environmental and welfare concerns at risk;
- Routes of exposure;
- Amount, concentration, hazardous properties, environmental fate, and form of substance present;
- Physical factors affecting human and environmental exposure and extent of previous expected migration;
- Beneficial use of water;
- Technical practicality and cost effectiveness; and,
- Availability of other appropriate remedial action appropriate remedial action and enforcement mechanisms.

In accordance with A.A.C R18-16-407 (H), the remedial alternative will also be evaluated using the following:

1. A demonstration that the remedial alternative will achieve the remedial objectives.
2. An evaluation of consistency with the water management plans of affected water providers and the general land use plans of local governments with land use jurisdiction.
3. An evaluation of comparison criteria, including:
    - Practicality of the alternative, including its feasibility, short and long term effectiveness, and reliability;
    - Risk, including fate and transport of contaminants, assessment of current land and resource use, exposure pathways and duration of exposure, protection of health and biota during implementation of remedial action, and residual risk in aquifer at end of remediation;
    - Cost of remedial alternative, including capital, operating, maintenance, life cycle, and transactional costs;

- Benefit of value of remediation, including lowered risk, reduction in concentration or volume, decreased liability, acceptance by public, aesthetics, enhancement of future uses, and improvement to local economics; and,

- Discussion of comparison criteria in relation to each other.

On June 21, 2006, MACTEC submitted the Remedial Alternative Screening (RAS) Technical Memorandum to ADEQ. The RAS Technical Memorandum recommended the following three remedial alternatives be carried over to the RAE:

Remedial Alternative	**Remedial Technology**
More Aggressive	In-situ chemical oxidation (ISCO) as source control, pump-and-treat as controlled migration, and monitoring.
Reference Remedy	Groundwater pump-and-treat as controlled migration
Less Aggressive	Monitored Natural Attenuation (MNA)

A groundwater pump-and-treat has been installed. Therefore, groundwater pump-and-treat, as a controlled migration technology, was selected as the reference technology. ISCO employed for source control, combined with pump-and-treat for controlled migration, is considered a more aggressive alternative than groundwater pump-and-treat due to the linking of technologies and potential shorter timeframe for remediation. Though MNA alone will not immediately meet the RO's, MNA may be employed in the future, either as a stand alone approach, or in combination with pump-and-treat. Therefore, MNA will be evaluated as a less aggressive alternative than groundwater pump-and-treat.

3.0 DETAILED EVALUATION CRITERIA

The RI and continuing groundwater monitoring program have identified the following:

- Population, environmental, and welfare concerns at risk;
- Routes of exposure;
- Amount, concentration, hazardous properties, environmental fate, and form of substance present; and,
- Physical factors affecting human and environmental exposure and extent of previous expected migration.

In the RAS Technical Memorandum issued to ADEQ on June 21, 2006, it was shown that two of the three remedial alternatives selected for detailed evaluation would immediately meet the ROs. MNA, as a stand-alone remedial alternative, will not immediately meet the ROs. However, MNA may be employed as a stand-alone remedial approach in the future after source control has been completed. Therefore, the detailed analysis of remedial alternatives is focused on the assessment of each alternative's feasibility and overall effectiveness, based on the following remaining four criteria:

1. Practicability;
2. Risk;
3. Cost; and,
4. Benefit;

These four criteria are defined, as follows:

Practicability refers to the feasibility, short- and long-term effectiveness, and reliability of the remedial alternative. The practicability of a remedial alternative can be influenced by criteria such as site-specific conditions, the chemical properties and physical distribution of contaminants, the performance capabilities of available technologies, and institutional considerations.

The feasibility of the remedial alternative can be separated into the following criteria:

- Technical feasibility, e.g., the difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, and the ability to monitor the effectiveness of the remedy;
- Administrative feasibility includes activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions);
- Availability of services and materials includes the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies; and,
- Ease of undertaking additional remedial actions, if necessary.

The short-term effectiveness assesses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, and how treatment is used to address the principal threats posed by the site. Factors that may be considered include the following:

- The treatment or recycling processes the alternatives employ and materials they will treat;
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled;
- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents (EPA, 1990);
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures;
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and,
- Time until remedial action objectives are achieved (EPA, 1990).

The long-term effectiveness and permanence of alternatives are assessed considering the following:

- The degree of expected reduction in toxicity, mobility or volume of the waste due to treatment or recycling and the specification of which reduction(s) are occurring;

- The degree to which the treatment is irreversible; and,
- Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste (EPA, 1990).

Risk refers to the evaluation of the remedial alternatives to determine their overall protectiveness of public health and aquatic and terrestrial biota under reasonably foreseeable land use scenarios and end uses of groundwater. Issues to be considered in the risk evaluation include:

- Fate and transport of contaminants, and concentrations and toxicity over life of the remediation;
- Present and future land and resource use;
- Exposure pathways, duration of exposure, and changes in risk over the life of the remediation;
- Protection of human health and aquatic and terrestrial biota while implementing the remedial action; and,
- Residual risks in the aquifer at the end of remediation.

In the risk evaluation, alternatives are assessed to determine whether they can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals. The RI Report dated June 30, 2003 served as the basis in completing the risk evaluations in this memorandum.

Cost refers to the expense associated with a remedial alternative. The cost analysis considers:

- Capital costs;
- Operating and maintenance (O&M) costs; and,
- Life cycle costs.

In addition, the cost analysis may also consider any uncertainties, if appropriate, that may affect the cost of a remedial alternative. In addition, because the implementation of the remedy will be funded by ADEQ under the WQARF program, transactional costs were not considered.

The accuracy of each cost estimate developed during the detailed evaluation depends upon the assumptions made with respect to the design, implementation, and operation of an alternative. It also further depends on the cost information available. To assess the degree of certainty associated with the cost estimates for each alternative, and the impact of changes in underlying assumptions, a cost sensitivity analysis is performed. The sensitivity analysis assesses assumptions associated with individual cost components and the effects they can have on the estimated cost for an alternative.

The cost sensitivity analysis varies certain assumptions to determine potential effects on the cost of each alternative. The assumptions varied include factors that possess the ability to cause significant change to total alternative costs with only small changes in values, and factors with a high degree of uncertainty associated with them. These factors include items such as operation and maintenance costs, the volume of treated material, life of the remedial action, size of the treatment system, and the combination of remedial technologies. Low, medium, and high case scenarios are developed for each alternative. A 20-year present worth cost is then prepared for the low, medium, and high case scenarios of each alternative. Present-worth costs are presented assuming a 20-year operational period, as appropriate, a five percent interest rate, and a three percent inflation rate.

Benefit refers to the value of the remediation, and considers factors such as:

- Lowered risk to human and aquatic and terrestrial biota;
- Reduced concentration and/or volume of contaminated water;
- Decreased liability;
- Acceptance by the public;
- Aesthetics;
- Preservation of existing uses; and,
- Improvements to local economies.

4.0 DETAILED ANALYSIS OF ALTERNATIVES

The evaluations of the alternatives discussed below address the degree to which the alternative would meet the ROs. Table 1 provides a summary of the detailed analysis of the alternatives and the respective technologies.

For the purposes of this analysis, the source area includes PCE concentrations greater than 50 µg/L and covers and area of approximately one acre, and the plume area includes PCE concentrations greater than 5.0 µg/L and covers and area of approximately seven acres. Assuming a saturated thickness of approximately eight feet and an effective porosity of 0.30, the source area contains approximately 782,000 gallons of water. Assuming the average PCE concentration in the source area is 90 µg/L, the source area contains approximately 0.6 pounds of dissolved PCE.

4.1 MORE AGGRESSIVE

The more aggressive remedial alternative involves linking of the following multiple technologies:

1. ISCO for source control;
2. Pump-and-treat for controlled migration; and,
3. Monitoring.

Table 1 provides the detailed analysis of the alternative.

4.1.1 Description of Alternative

The detailed description of the three technologies incorporated in the more aggressive alternative is provided below:

4.1.1.1 ISCO

MACTEC has evaluated a variety of peroxide, persulfate, permanganate, ozone, and perozone oxidation processes and delivery platforms. Based on the site conditions and plume characteristics, MACTEC has evaluated the Tyson Wash plume to be suitable for several chemical oxidation peroxide and ozonation techniques that will completely destroy the contaminant chemical bonds resulting in innocuous end points such as oxygen and carbon dioxide. Because of the advantages inherent in applying liquid reagents to the Site via the existing wells, only the ENR_x proprietary peroxygens system was retained for evaluation and costing.

This technology can be readily implemented. ISCO will make use of the existing extraction, re-injection, and monitoring wells already installed through-out the source area. No additional piping or electrical installation will be required. Three additional two-inch diameter injection wells are recommended for coverage and better application sequencing. Treatment implementation will require little power and water, and the processes selected can be applied safely using relatively dilute amendments. Either oxidant properly applied is capable of achieving results below detection with time. The total treatment time may be largely dependent on the PCE mass and any smeared areas of residual sorbed PCE acting as secondary sources.

ENR_X reagent (formerly known as OXY-3™) is a combination of products used in the production of *in-situ* catalyzed peroxygen comprised of a buffered solid source of sustained release singlet oxygen (SSO) and a liquid organic activator (Synergist). The reagent contains no metals and is 100% soluble. The Synergist is consumed in the reaction, and forensic analysis of the post-treatment by-products finds significant and extended increase in dissolved oxygen (D.O.), carbon dioxide (CO_2), sodium chloride (NaCl), and water (H_2O). For bulk (greater than 10 mg/Kg) mass based removal of organic contaminants by chemical oxidation, approximately 30% or less strength hydrogen peroxide (H_2O_2) may be substituted more cost effectively for SSO.

A phased, multiple application will be required at the Site to complete remediation of the source area. In addition to source removal and treatment of residual source on-site PCE, treatment of dissolved plume PCE already migrating slightly down-gradient is needed to provide final remediation of the plume.

Due to the relatively low levels of residual PCE contaminants and the quarterly monitoring which clearly indicated the location of the residual mass, the primary challenge is to thoroughly permeate the contaminated zone with the stabile peroxygen based reagent and allow reaction time. This objective will be accomplished by using well injection techniques coupled with limited sequenced pumping recirculation of groundwater to enhance dispersion.

Combined pumping rates from the four-inch extraction wells will depend on reagent mounding, which are expected to be high in the silty soil. Temperatures should not exceed several degrees above ambient, pressures will be low below fracture pressures; pH may be slightly depressed in the treatment zone by less than two pH units, if at all. Reagent concentrations will not be higher than 10% in the aqueous blend fed to the injection wells. The amount of reagents required per pound of PCE to be destroyed is based on a 100 parts per million (ppm) dosing of the matrix (soil and groundwater mass). This evaluation assumes the necessary underground injection control (UIC) information required by UIC will be provided prior to use. This information includes chemical analysis (composition) of the fluid to be injected. The chemical information will be compared to applicable primary and secondary drinking water standards and will meet these standards.

There will be multiple injection events, numbering up to three unless monitoring indicates treatment goals have been achieved. The injection volume per well per injection event is based on a reagent dosing of 100 ppm of the contaminated matrix mass. Based on the cubic volume of soil and groundwater in the soil and distal plume area the calculated injection volume of reagent is 435 lbs in 4,350 gallons per injector, or 6,525 lbs in 65,250 gallons per event or less.

The scope of work includes the following.

- Provide oversight and field screening for monitoring of area well pumping.
- Install three 2-inch diameter injection wells in the vicinity of wells EW-3, QMW-1, and QMW-3.
- Install several portable polyethylene mixing tanks to mix ENR_x (SSO and Synergist) oxidant and associated pumps and hoses to pump into groundwater via the wells.
- Introduce reagent via the upgradient and deeper extraction wells and injectors and recirculate over a 21 day period per event.

Existing extraction wells EW-1 through EW-4 will be utilized to circulate the oxidants. During operation of the system, the discharge from wells EW-1 through EW-4 will be bypassed around the current granular activated carbon (GAC) treatment system and will be injected to INJ-1. This will avoid oxidant reactions with the GAC. Extraction well EW-5 will be operated as a controlled migration well, with the discharge treated by the GAC treatment system and injected to INJ-2. The anticipated schedule of injection events for reagents (i.e. the timing and frequency of injections over the life of the project) includes:

- Operate recirculation system for at least 12 hours per day, for a period of approximately 15-21 days. Duration of system operation will be based on field and laboratory testing to confirm oxidant has been evenly distributed throughout the smear zone.
- One primary injection and up to two localized polishing treatments are expected to be sufficient to remediate the source area. Polishing treatments, if required, will be based on post injection monitoring of on-site existing groundwater monitoring wells.

Besides the contaminants of concern at the site, the sampling plan analyses includes in situ parameters as necessary in the source area monitor wells to evaluate the zone of influence and verification of process chemistry in the subsurface versus time. Samples and operating parameter measurements for a chemical oxidation project will include, but are not necessarily limited to the following: sodium, pH, DO, ORP, Temperature, and Alkalinity.

4.1.1.2 Pump-and-Treat and Monitoring

These two components of the more aggressive alternative are essentially combined. The full-scale pump-and-treat system has been installed and has been in operation since October 2005. During operation of the ISCO system, wells EW-1 through EW-4 and INJ-1 will be used to re-circulate oxidant through the system. Well EW-5 will continue to be operated as a pump-and-treat well for containment of the downgradient boundary of the plume area, with GAC treated water injected to well INJ-2.

The ISCO system is anticipated to reduce PCE concentrations within the source area to less than the AWQS of 5.0 μg/L within one year. After completion of ISCO for source control, the pump-and-treat system will continue to be operated to maintain migration control of the remaining plume area and to remove remaining PCE from the saturated zone. At that time, extraction from wells EW-3 through EW-5 should be sufficient to meet the ROs. The total pumping rate will be eight gallons per minute. If groundwater monitoring data indicates PCE concentrations in wells QMW-1, QMW-5, and QMW-11 have been reduced below 5.0 μg/L, then a majority of the GAC treated water will be injected to INJ-1. Once the source area is mitigated, natural attenuation via physical factors will become a more active remedial component. For cost estimation purposes, MACTEC assumes the following:

- The pump-and-treat system will be operated for 10 years after ISCO or until monitoring indicates PCE concentrations have been reduced to below the AWQS of 5.0 μg/L in the wells currently included in the sampling program, whichever occurs first. System O&M

visits will continue on a monthly basis and groundwater monitoring will continue on a quarterly basis for the first year of operations. Assuming the PCE plume has stabilized, for the following years up to Year 10, system O&M visits will be performed quarterly and groundwater monitoring will be performed bi-annually. MACTEC assumes the current number of wells will be included in the groundwater monitoring program.

- If PCE concentrations are still above the AWQS of 5.0 µg/L in some of the wells at the end of Year 10 of operation, the pump-and-treat system will be shut down and a MNA program will be initiated. The current well network consists of 24 wells. The MNA program will involve only 10 of the wells and will be up to a 10 year program. Groundwater monitoring of the 10 wells will be performed quarterly for Year 1, bi-annually for Years 2-6, and annually for Years 7-10.

In the event PCE concentrations in the wells are reduced below the AWQS of 5.0 µg/L during the 10 year operation period, the pump-and-treat system will be shut down and a quarterly groundwater monitoring program of the wells currently included in the monitoring program will be implemented. If the monitoring program does not indicate a rebound in PCE concentrations, the remediation system will be decommissioned and closure via "No Further Action" will be recommended.

4.1.2 Detailed Evaluation of More Aggressive Alternative

4.1.2.1 Practicality

4.1.2.1.1 Feasibility

The pump and treat system is currently in-place and no additional piping will be required. Three additional injection wells are recommended, which will be installed in Quartzsite street right-of-way. Oxidant will be injected into wells on the Welcome RV Park property. Therefore, oxidant injections should be performed during spring months when the Welcome RV Park in not in use. Other than potential access issues with the Welcome RV Park, the system, including long-term monitoring, is fully feasible.

4.1.2.1.2 Short-Term Effectiveness

Operation of the ISCO system is expected to remediate the source area to PCE concentrations less than the AWQS of 5.0 µg/L in less than one year. The objective of the ISCO system operation is to remediate the source area, which will in turn decrease the amount of time and cost required to operate the pump-and-treat system to contain the remainder of the plume area and possibly lead to complete aquifer remediation. Therefore, the system will achieve the RO's in the short-term.

4.1.2.1.3 Long-Term Effectiveness and Reliability

The pump-and-treat system has been in operation since October 2005 and the most recent monitoring data indicates that the system is operating effectively and reliably. A remote web-based monitoring system and automatic shut-off switches have been installed to improve the reliability of the system. Extraction pumps may require periodic replacement and GAC treatment canisters must be replaced at least once annually. Therefore, the system should be effective and reliable in meeting the RO's in the long-term.

4.1.2.1.4 Risk Evaluation

There are no associated environmental or toxicological concerns associated with operation of the ISCO system. This is because the ISCO system will not will not result in the formation of intermediate degradation products of the reagents, or intermediate by-products by the interaction of those reagents with the contaminants of concern at the site. Therefore, no other monitoring is currently proposed.

This site is located in a residential area. A non-chlorinated water source is located at the injection area on-site. Safety considerations regarding neighbors and passersby are minimal. The site will be enclosed with caution tape and posted. All visitors will be required to sign in and be escorted at all times. The "Hot Zone" will be identified as within the application zone and beyond for 50-ft. This distance is at least twice the typical injector well radius of influence.

Safety items applicable to fire, explosion, toxicological and safe handling of chemicals may include, but are not necessarily limited to on-site fire extinguishers, water supplies, and cell phone communications with first responders. Material safety data sheets, toxicity, or other information pertinent to the chemicals and catalysts involved will be provided. Field application will include provisions for safe handling of chemicals: avoidance of mixing, premature mixing, or improper storage of incompatible Chemicals. The oxidant and activator will be separately containerized and stored in a locked structure.

Lower Explosive Level (LEL) considerations were evaluated. Based on the composition of the amendments and the low groundwater concentration, production of off-gas is unlikely and would not exceed LELs, even under enhanced groundwater dissolved oxygen levels.

The potential for vapor migration, either passively or by convection, or driven by air or other gases used, or generated by the heat of exothermic, chemical reactions, or the vaporization of free product by heat was evaluated and is extremely unlikely. There is no free product at the site, and the chemical amendment does not generate typically measurable vapors. A high eV lamp PID vapor analyzer will be used during injection to verify the lack of vapors in the breathing zone. The ENRx process has been documented to cause almost no measurable temperature increases.

Personnel handling chemical oxidation reagents will wear appropriate chemical-resistant and use spark-resistant materials of construction for equipment items. These will include coated Tyvek or better clothing, use of disposable and nitrile gloves, eye protection and face shields, and use of rubber boots.

Personal protection of workers will include a site specific HASP with information on the handling of all chemicals and equipment.

As previously stated, the pump-and-treat system is equipped with level switches that minimize the potential for overfilling of the equalization tank. The system is also equipped with primary and secondary GAC treatment units and the effluent from each unit is sampled and analyzed on a quarterly basis. A single primary GAC unit will breakthrough after approximately nine months of operation. This system was installed to prevent injection of water containing PCE back into the aquifer. The system is also equipped with a cell phone alarm system and web-based monitoring system. The system can be remotely shut down or turned on in response to an alarm or phone call from area residents.

Based on the above, there are minimal risks associated with operation of the system.

4.1.2.2 Cost Evaluation of More Aggressive Alternative

The estimated cost to design, install, and implement the ISCO system is $265,000. The estimated annual cost for remediation system monitoring, operation, maintenance, and reporting is $60,000 per year. Therefore, the total estimated cost for the ISCO system, assuming one year of operation, is $325,000.

Three cost-case scenarios for pump-and-treat/monitoring are provided as follows: system operation for five years following ISCO, plus one year of post shut-down quarterly monitoring; system operation for 10 years following ISCO, plus one year of post shut-down monitoring; and, system operation for 10 years following ISCO, plus a 10 year MNA program. Monitoring will be performed as described in Section 4.1.1.2. The present worth estimated costs for the three scenarios are presented below:

Low:	$250,000 (allows for pump replacement)
Medium:	$460,000 (allows for pump replacement)
High:	$575,000 (allows for pump replacement)

Therefore, the estimated cost for the more aggressive alternative will range from $575,000 to $900,000.

4.1.2.3 Benefit Evaluation of More Aggressive Alternative

The more aggressive alternative is capable of achieving the ROs. The primary benefit is that the result of operation may be restoration of the aquifer in a shorter period of time, or implementation of MNA in a shorter period of time.

4.2 REFERENCE REMEDIAL ALTERNATIVE

The reference remedial alternative involves the following technologies:

1. Pump-and-treat for controlled migration; and,
2. Monitoring.

Table 1 provides the detailed analysis of the alternative.

4.3.2 Description of Alternative

The two technologies of pump-and-treat and monitoring are essentially combined. The pump-and-treat system has been installed and has been in operation since October 2005. The pump-and-treat system is currently being operated approximately nine hours per day. Groundwater is currently being extracted as follows: EW-1 – 1.0 gallons per minute (gpm); EW-2 – 2.0 gpm; EW-3 – 2.0 gpm; EW-4 – 2.0 gpm; and EW-5 – 1.0 gpm. A total of eight gpm of water is being pumped, treated by the GAC units, and injected at INJ-1 and INJ-2, which are located upgradient of the extraction wells. This approach, as compared to pump-and-treat with off-site water management, provides an aquifer flushing action, thus increasing the effectiveness of the system. As indicated by monitoring results, the system operation can be optimized by adjusting pump rates for wells. However, a single injection well can accept no more than approximately 7.0 gpm of water.

Recent groundwater monitoring data has indicated that not only is the system effective in containing plume migration, the system may also be effective as a moderate-term source control alternative. Unlike ISCO, the pump-and-treat system will not remediate the source area to PCE concentrations below AWQS of 5.0 µg/L. However, the pump-and-treat system may reduce PCE concentrations within the source area to less than 50 µg/L within a reasonable and cost effective time frame. Based on the most recent monitoring data, MACTEC anticipates this may occur within five years of system startup. This assumes that EW-1 and EW-2 are taken off-line and pumping rates from EW-3 and EW-4 are increased to 3.5 gpm each. The pumping rate from EW-5 will remain at 1.0 gpm. For cost comparison purposes, the system will be operated for a period of 15 years, after which time a MNA program may be implemented. Based on this assumption, the following provides the O&M, monitoring, and reporting program for the system:

- During the first five years of system operation (Year 1 has been completed), system O&M visits will continue to be performed once monthly, and groundwater monitoring will be conducted quarterly.
- Assuming the source area has been remediated to PCE concentrations less than 50 µg/L, during Years 6 and 7 the system O&M and monitoring program will not be changed.
- During Years 8 through 15, O&M visits will be reduced to once quarterly and the groundwater monitoring program will be reduced to bi-annual events. The program

assumes no change in the number of wells that are sampled. The pump-and-treat system will be operated for this period or until monitoring indicates PCE concentrations have been reduced to below the AWQS of 5.0 µg/L in the wells currently included in the sampling program, whichever occurs first.

- If PCE concentrations are still above the AWQS of 5.0 µg/L in some of the wells at the end of Year 15 of operation, the pump-and-treat system will be shut down and a MNA program will be initiated. The current well network consists of 24 wells. The MNA program will involve only 10 of the wells and will be up to a five year program. Groundwater monitoring of the 10 wells will be performed quarterly for Year 1, and bi-annually for years 2-5.

In the event PCE concentrations in the wells are reduced below the AWQS of 5.0 µg/L during operation period, the pump-and-treat system will be shut down and a quarterly groundwater monitoring program of the wells currently included in the monitoring program will be implemented. If the monitoring program does not indicate a rebound in PCE concentrations, the remediation system will be decommissioned and closure via "No Further Action" will be recommended.

4.3.2 Detailed Evaluation of Reference Remedial Alternative

4.2.2.1 Practicality

4.2.2.1.1 Feasibility

The pump and treat system is currently in-place and has been in operation since October 2005. Monitoring data indicates the system is currently meeting the RO's and is also providing source control. Therefore, the pump-and-treat system, including long-term monitoring, is fully feasible.

4.2.2.1.2 Short-Term Effectiveness

As indicated above, monitoring data indicates the system is currently meeting the RO's.

4.2.2.1.3 Long-Term Effectiveness and Reliability

The pump-and-treat system has been in operation since October 2005 and the most recent monitoring data indicates that the system is operating effectively and reliably. A remote web-based monitoring system and automatic shut-off switches have been installed to improve the reliability of the system.

Extraction pumps may require periodic replacement and GAC treatment canisters must be replaced at least once annually. Therefore, the system should be effective and reliable in meeting the RO's in the long-term.

4.2.2.1.4 Risk Evaluation

The pump-and-treat system is equipped with level switches that minimize the potential for overfilling of the equalization tank. The system is also equipped with primary and secondary GAC treatment units and the effluent from each unit is sampled and analyzed on a quarterly basis. A single primary GAC unit will breakthrough after approximately nine months of operation. This system was installed to prevent injection of water containing PCE back into the aquifer. The system is also equipped with a cell phone alarm system and web-based monitoring system. The system can be remotely shut down or turned on in response to an alarm or phone call from area residents. Based on this, there are minimal risks associated with operation of the system.

4.2.2.2 Cost Evaluation of Reference Remedial Alternative

The pump-and-treat system has been installed. Therefore, installation costs are not included in the cost evaluation. Assuming all wells within the network are sampled on a quarterly basis, the estimated annual cost for remediation system monitoring, operation, maintenance, and reporting is $60,000 per year.

Three cost-case scenarios for pump-and-treat/monitoring are provided as follows: system operation for 10 years, plus one year of post shut-down quarterly monitoring; system operation for 15 years, plus one year of post shut-down monitoring; and, system operation for 15 years, plus a 5 year MNA program. Monitoring will be performed as described in Section 4.2.1. The present worth estimated costs for the three scenarios are presented below:

Low:	$650,000 (allows for pump replacement)
Medium:	$910,000 (allows for pump replacement)
High:	$975,000 (allows for pump replacement)

Therefore, the estimated cost for the reference remedial alternative will range from $650,000 to $975,000.

4.2.2.3 Benefit Evaluation of Reference Remedial Alternative

Monitoring performed since the system was started in October 2005 indicates the reference alternative is capable of achieving the ROs. The primary benefit is that the system has been installed and is operating and no additional equipment is required.

4.3 LESS AGGRESSIVE REMEDIAL ALTERNATIVE

The less aggressive remedial alternative involves only monitoring. Table 1 provides the detailed analysis of the alternative.

4.3.2 Description of Alternative

This alternative is also known as natural attenuation. Under this alternative, natural processes provide plume containment and degradation. Under favorable conditions, PCE will naturally biodegrade by a process known as reductive dechlorination. Under this process, the chlorinated solvents take on a hydrogen atom and an electron and release a chlorine atom. Hence, PCE will degrade as follows:

$$\text{PCE} \xrightarrow{H^{+}+e^{-}-Cl^{-}} \text{TCE} \xrightarrow{H^{+}+e^{-}-Cl^{-}} \text{c-1,2-DCE} \xrightarrow{H^{+}+e^{-}-Cl^{-}} \text{Vinyl Chloride} \xrightarrow{H^{+}+e^{-}-Cl^{-}} \text{Ethene}$$

The conditions required for natural reductive dechlorination are listed below:

- The presence of organic carbon. Arizona soils typically do not contain a sufficient amount of naturally occurring organic carbon to promote biodegradation. Therefore, the organic carbon must be anthropogenic or introduced. The anthropogenic organic carbon can originate from a fuel hydrocarbon release or from septic systems.

- The groundwater must contain less than 2.0 parts per million (ppm) of dissolved oxygen, which is referred to as an anaerobic condition. Most groundwater in Arizona is aerobic and will not become anaerobic unless organic carbon is present.

- The transfer of an electron from one compound to another is known as reduction. The compound that accepts the electron is being reduced and the compound that gives up the electron is being oxidized. Though the chlorinated solvent may eventually act as the electron acceptor, there must be an initial supply of an electron acceptor in the groundwater. The common electron acceptors are nitrate, sulfate, ferrous iron, manganese, and carbon dioxide.

- Reducing bacteria must be naturally present in the soil and groundwater. These bacteria are relatively common; however, if the previously discussed conditions are not present, these bacteria may not be present. There are several bacteria capable of degrading PCE; however, the only known bacterium that will completely degrade PCE to ethene is *Dehalococcoides Ethenogenes* or DHE. This bacterium is typically active in a sulfate reducing environment. If sulfate is not present, DHE will not become active. In the event there is so much organic carbon that methane is being generated, known as methanogenic, the reductive dechlorination process often stops at TCE or c-1,2-DCE.

In 2003, MACTEC performed a treatability study to evaluate the possible use of in-situ reductive dechlorination at the Site. As part of the study, MACTEC evaluated natural conditions along with the addition of electron donors and different strains of the DHE bacterium. The study indicated that conditions at the Site were not favorable for wide-scale reductive dechlorination, though the presence of TCE and c-1,2-DCE in some wells indicates reductive dechlorination to these compounds is locally occurring. Therefore, plume containment via natural attenuation can only be achieved by the physical processes of sorption, dilution, dispersion, and volatilization. These processes will not remove contaminant mass and if source loading overcomes the physical processes, the plume will not stabilize until the plume attains a size where these physical processes provide containment.

4.3.2 Detailed Evaluation of Less Aggressive Remedial Alternative

4.3.2.1 Practicality

4.3.2.1.1 Feasibility

Based on the current conditions, natural attenuation alone will not be capable of meeting the RO's. Monitoring is a component of the more aggressive and reference remedial alternatives. After it has been evaluated that the source area has been remediated and the plume is apparently stabile, a MNA program will be initiated.

4.3.2.1.2 Short-Term Effectiveness

As indicated above, current data shows that at this time natural attenuation may not be effective in meeting the RO's in the short-term.

4.3.2.1.3 Long-Term Effectiveness and Reliability

Natural attenuation may be effective in the long-term after contaminant mass has been removed from the source area.

4.3.2.1.4 Risk Evaluation

MNA via biologic reductive dechlorination can result in the formation of vinyl chloride (VC), which is a known carcinogen and is highly mobile in groundwater. The VC can then be degraded further by the DHE bacterium under anaerobic conditions or as an electron donor in an aerobic environment. As discussed previously, the formation and degradation of VC requires favorable conditions that are not present at the Site. Though there is limited reductive dechlorination of PCE to TCE, the data indicates that there is no further biologic degradation of TCE occurring at the Site. Therefore, there is no apparent risk associated with MNA via biologic reductive dechlorination. MNA via physical processes does not result in the formation of potentially more toxic byproducts. However, as indicated above, MNA alone may not result in removal of contaminant mass and may allow migration of PCE beyond the current plume boundaries. This results in increased risk to wells located downgradient of the current plume boundaries. As the contaminant mass is decreased within the source area using active remedial approaches, MNA via the physical processes of dispersion, dilution, sorption, and volatilization may become a more important component in controlling plume migration, thus reducing the risk to downgradient wells.

4.3.2.2 Cost Evaluation of Less Aggressive Remedial Alternative

MNA costs have been included in the cost scenarios for the more aggressive and reference remedial alternatives. However, a cost analysis for stand alone MNA over a twenty year period has been performed. The cost analysis assumes that all wells, not including the five existing remediation wells, are sampled under the following scenarios: quarterly for 20 years; quarterly for 10 years and bi-annually for 10 years; and, quarterly for five years, bi-annually for 10 years, and annually for five years. The present worth estimated costs for the three scenarios are presented below:

Low:	$838,098
Medium:	$958,443
High:	$1,387,716

5.0 COMPARISON OF REMEDIAL ALTERNATIVES

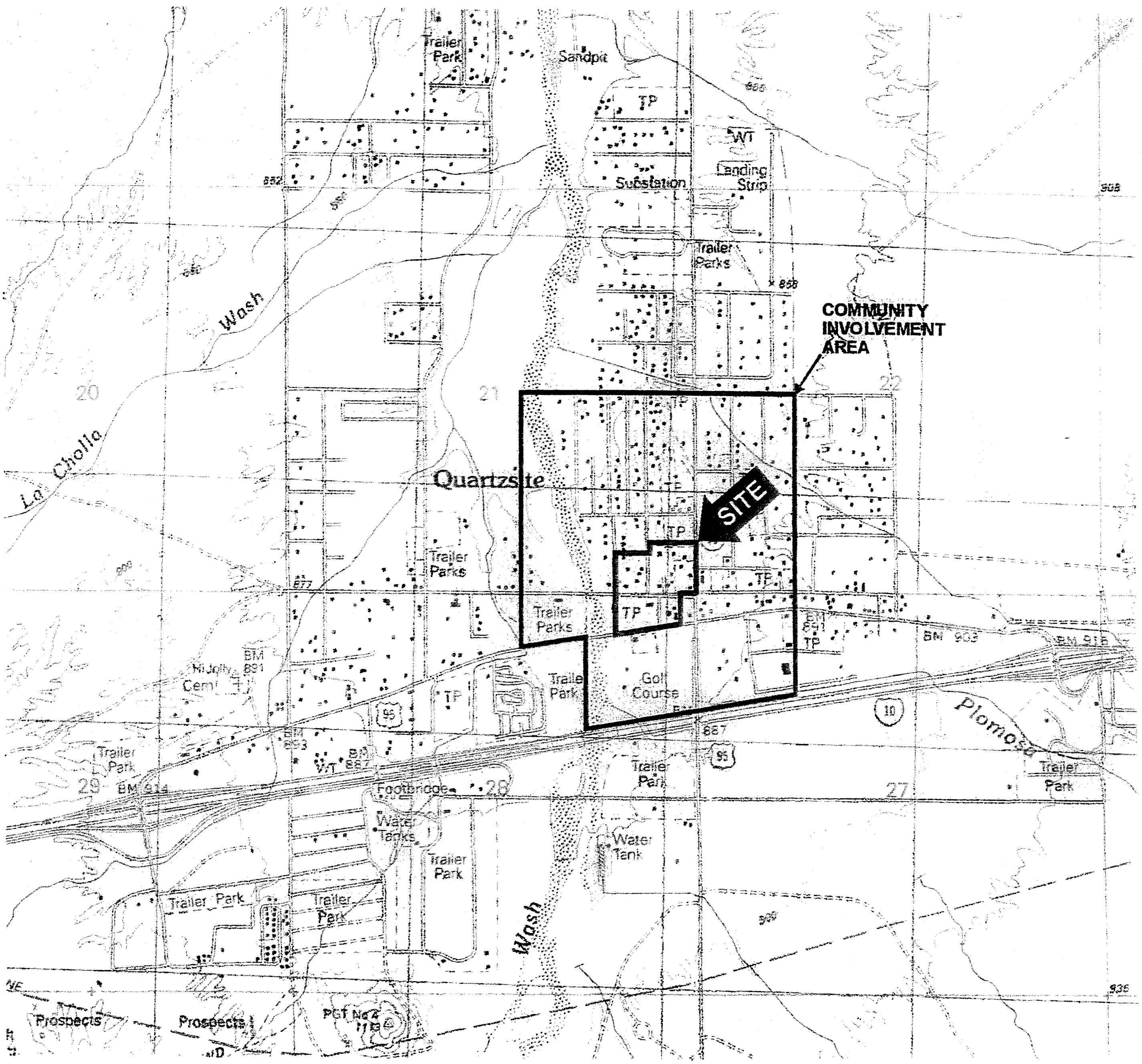
A comparative summary of the three remedial alternatives, based on the detailed evaluation, is provided in Table 1. When comparing the practicability, risk, cost, and benefit associated with each alternative, and the ability to meet the ROs, the reference alternative remains the preferred alternative.

The less aggressive remedial alternative was immediately ruled out because the RO's would not immediately be met using natural attenuation alone. However, MNA may have a role in the future after active remediation has been evaluated to be complete. The more aggressive alternative may result in quicker remediation and a slightly lower cost than the reference alternative. However, the implementation of the more aggressive alternative may result in private property access concerns. Considering the reference remedial alternative has already been installed and is demonstrated to be operating effectively and meeting the RO's, the cost difference between the reference and more aggressive remedial alternatives is considered insignificant.

4.3.2.3 Benefit Evaluation of Less Aggressive Remedial Alternative

The only benefit provided by the less aggressive alternative is the possible early shut-down of the pump-and-treat system and the cost savings associated with the O&M and full well network monitoring program.

N:data/wpdocs/saw/wqarf/tyson/corel/sitelocation



NOTE:

MAP TAKEN FROM QUARTZSITE, ARIZONA
U.S. GEOLOGICAL SURVEY 7.5 MINUTE
TOPOGRAPHIC MAP.

N

0 500' 1000' 2000'
SCALE IN FEET

MACTEC

SITE LOCATION
ADEQ TYSON WASH WQARF SITE
QUARTZSITE, ARIZONA

FIGURE
1

DRAWN	PROJECT NUMBER	APPROVED	DATE
DANIEL L. KUDLICKI	661026	SAW	7/12/2001

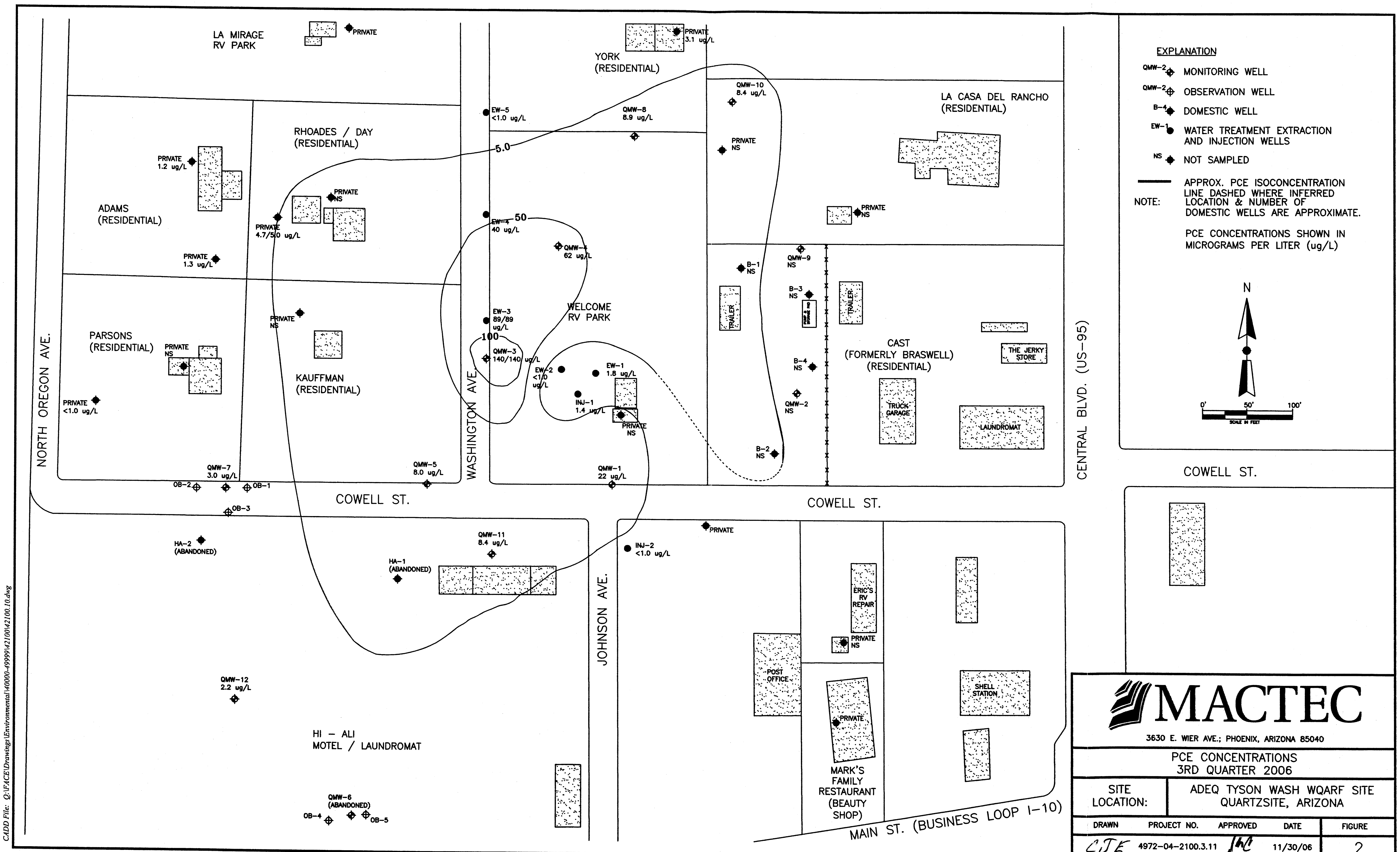


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TABLE 1. SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES
Tyson Wash Site
Quartzsite, Arizona

Assessment Factor	More Aggressive Alternative (ISCO combined with pump-and-treat and monitoring)	Reference Alternative (pump-and-treat combined with monitoring)	Less Aggressive Alternative (natural attenuation)
Major Components	• In-situ chemical oxidation for source control • Pump-and-treat for controlled migration • Monitoring to evaluate system effectiveness and in the future natural attenuation	• Pump-and-treat for source control and controlled migration • Long-term monitoring to monitor effectiveness of system and in the future natural attenuation.	• Natural attenuation of groundwater plume • Long term groundwater monitoring would be used to evaluate effectiveness of natural attenuation
Practicability: • Feasibility • Short-term effectiveness • Long-term effectiveness • Reliability	• Will make use of existing pump-and-treat system. Up to 3 additional injection wells may be required. Access to private property for oxidant injection equipment may be an issue. • Proven technologies for source control and controlled migration. • ISCO is a proven short-term alternative for source control. • Pump-and-treat is a proven long-term alternative for controlled migration. • Remedial objectives would be achieved in the short-term and long-term..	• Pump-and-treat system has already been installed and has been operating since October 2005. • Recent monitoring data indicates the system is operating effectively as a moderate-term source control alternative. • Proven technology for long-term controlled migration. • System will require long-term maintenance • ROs will be achieved in the short-term and long-term..	• Readily implemented, will utilize existing well network • Will not be effective in the short-term in meeting RO's without implementation of active remediation. May be effective in the long-term after active remediation has been completed. • Will not reduce PCE mass in groundwater. May eventually reduce PCE concentrations to AWQS; however, several years will be required. • No long-term maintenance required • Natural attenuation may become a stand alone component after active remediation has been completed.
Risk: • Overall protection of human health and environment	• Will successfully reduce PCE concentrations in the source area more rapidly than the reference alternative. • Will reduce the amount of time required for pump-and-treat system operation. • Will meet RO's. • Long-term monitoring will be necessary to confirm that concentrations of PCE are declining	• Will meet ROs by controlling downgradient migration of PCE. • May be effective in source control. • Long-term monitoring will be necessary to confirm that concentrations of PCE are declining and that plume migration is controlled.	• May not meet RO's in the short-term. • Long-term monitoring is necessary to confirm that levels of PCE are declining
Cost: • Capital costs • O&M • Life cycle costs	• Design, installation, and O&M cost of $325,000 is higher than one year of pump-and-treat system O&M cost of $60,000. • Design, installation, and O&M cost of $325,000 is approximately the same as five years of pump-and-treat system operation for source control. • Total cost of a 20 year remediation program that includes ISCO, pump-and-treat, and long-term monitoring is approximately $75,000 less than a 20 year pump-and-treat and monitoring program.	• Relatively low annual O&M cost of $60,000. • Monitoring program can be adjusted as necessary to minimize costs. • Long-term O&M and monitoring costs can escalate. The estimated cost for a 20 year program is $975,000.	• Alternative may not meet RO's in short-term and costs have been included in the more aggressive and reference remedial alternatives. Depending on frequency of monitoring, costs may range from a maximum of $1,387,716 for 20 years of quarterly monitoring to a low of $838,098 for less frequent monitoring.
Benefit: • Lowered risk to human health and environment • Reduction in COC concentration and/or volume Decreased liability • Public acceptance • Aesthetics • Preservation of existing uses • Enhancement of future uses • Improvement to local economy	• Will successfully lower risk to human health and environment by remediating impacted groundwater. • Will meet RO's. • Will remediate source area quicker than pump-and-treat. • May reduce time and total cost for remediation.	• Will successfully lower risk to human health and environment by remediating impacted groundwater. However, several years may be required before PCE concentrations are reduced to below AWQS. • Will meet ROs in short-term and long-term.	• If indicated by monitoring, natural attenuation may become a more active component in the future. This may result in early shut down of the active remediation system, thus saving O&M costs.