Tyson Wash
Water Quality Assurance Revolving Fund
Registry Site

RECORD OF DECISION

Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

ADEQ
Arizona Department
of Environmental Quality

June 29, 2009

Tyson Wash PCE WQARF Site
Record of Decision
APPROVAL PAGE

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1.0 INTRODUCTION

The investigation at the Tyson Wash WQARF site was initiated by the Arizona Department of Environmental Quality (ADEQ) after a Leaking Underground Storage Tank (LUST) investigation of Don's Café in 1993 indicated tetrachloroethylene (PCE) concentrations of 39 micrograms per liter (µg/L), above the Aquifer Water Quality Standard (AWQS) of 5 µg/L, in the Braswell well B-2. Well B-2 is located on the southwest corner of the Braswell property. The depth to water in this shallow well was approximately 45 feet below ground surface (bgs). Trichloroethene (TCE) was also detected in the same well at a concentration of 0.7 µg/L, below the AWQS of 5µg/L. Don's Café is about 500 feet southeast of the Welcome RV Park.

In May, 1998 ADEQ identified the Welcome RV Park as a potential hazardous waste site. In December 1998, pursuant to Arizona Revised Statutes (ARS) §287.01(D), the Tyson Wash WQARF Site was placed on the WQARF Registry List with an eligibility and evaluation (E&E) score of 46 out of a possible 120, due to the presence PCE and TCE in groundwater. In June 2003, ADEQ completed the Remedial Investigation (RI) report for the Tyson Wash WQARF Site. The RI focused on three properties: the Welcome RV Park; the former Hi-Ali Motel; and the Braswell (currently Cast) property. In June 2007 ADEQ completed the Feasibility Study (FS) and completed the Proposed Remedial Action Plan (PRAP) for the Site in June 2008.

The PCE investigation first centered around the Braswell Laundromat on State Route 95 and Cowell Street, immediately east of Welcome RV Park. The investigation was expanded to the west with the highest groundwater concentrations found on the Welcome RV Park property. As part of an emergency response action (ERA), a groundwater pump and treat system consisting of five extraction wells and two 55-gallon carbon canisters were placed on the Welcome RV Park property in a chain link compound. The pump and treat system was designed to control the migration of the contaminants of concern to additional domestic wells. The pump and treat system was turned on in April 2003 and continues to operate.

According to A.R.S. §49-287.03, ADEQ completed the RI report and the FS report. The RI report established the nature and extent of the contamination and potential source areas; identified current and potential impacts to public health, welfare, and the environment; identified current and

reasonably foreseeable uses of land and waters of the state; and obtained and evaluated any information necessary for identification and comparison of alternative remedial actions. The FS report used the information collected as part of the RI to identify a reference remedy and alternative remedies that appear to be capable of achieving remedial and to evaluate them based on the comparison criteria to select a remedy that complies with A.R.S. §49-282.06.

ADEQ used the evaluation of remedial alternatives evaluated in the FS report to choose a remedial method. According to §49-287.04, ADEQ then prepared a proposed remedial action plan (PRAP) that included a description of the chosen remedy, how the remedy will achieve each of the remedial objectives identified in the RI report, how accomplishment of the remedial objects is to be measured, and a description of the use of the remediated water as defined in §49-283.01.

The PRAP was published for public comment. ADEQ did not receive any comments during the 30 day comment period regarding the proposed remedial plan and has prepared this record of decision (ROD). This ROD includes a description of the remedy, a demonstration that the remedy will achieve the remedial objectives, a demonstration that the remedy will achieve the remedial objectives, a demonstration that the remedy meets the requirements of A.R.S. §49-282.06, a time period for commencing and completing the remedy, a total estimated cost, and a time-frame for review of the remedy to ensure that the remedy is effective in achieving the remedial objectives.

2.0 SITE BACKGROUND

2.1 SITE DESCRIPTION

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 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 site boundary includes several properties that contain both private residences and commercial businesses. The Site is bounded approximately by the groundwater plume which extends approximately 500 feet to the north of Cowell Lane to the north, 350 feet east of Washington Boulevard to the east, 20 feet south of Cowell Lane to the south, and 200 feet east of Oregon Avenue to the west. The locations of properties, private wells, and monitoring wells within the Site are shown on Figures 1 and 2. The Site is characterized by the presence of PCE and, to a much less degree TCE, in the groundwater.

2.2 TYSON WASH WQARF REGISTRY SITE

Investigation of the groundwater volatile organic compound (VOC) plume at the Tyson Wash WQARF Site was initiated by the ADEQ in August 1993 with the finding of PCE in a monitoring well sampled for a LUST investigation. In a Preliminary Assessment/Site Inspection Unit (PASI) report in March 1997, it was concluded that there were elevated levels of PCE in groundwater and that three facilities were investigated. These facilities included Braswell Laundromat, Hi-Ali Motel/Laundromat, and the Welcome RV Park. The greatest PCE concentration in groundwater was detected at 200 µg/l in the domestic well at the Welcome RV Park in 1995.

The VOC plume contains PCE and TCE at concentrations above the ADEQ AWQS of 5 µg/L. There are no indications of the existence of non-aqueous phase liquids in soils or groundwater at the Site. The VOC plume has affected the upper aquifer, located approximately 40-70 feet below ground surface (bgs). VOC concentrations exceeding ADEQ Soil Remediation Levels (SRL) 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. ADEQ provided

bottled water and filtering devices to the residents of affected wells from June 1999 to March 2002. In September 2001, the Town of Quartzsite completed the installation of piping from residents homes to its municipal water supply. The Town of Quartzsite water supply wells are completed in the lower aquifer that starts at 300 feet bgs. These wells are drilled as deep as 1,250 feet bgs. This connection by the Town of Quartzsite provides residents of the area with an alternate source of drinking water.

2.3 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.

Soils consist of silty clay to clay below a depth of 60 to 70 feet, with the estimated clay percentage ranging from 50% to nearly 100%. Above the clay layer the groundwater flow in the upper aquifer is primarily horizontal through the coarser grained soils.

The shallow aquifer is believed to be perched and is estimated to extend at least 5 miles north of the Town of Quartzsite. Depth to groundwater at the Site is approximately 41 to 55 feet below ground surface (bgs). A thick, extensive clay/limestone layer separates the shallow aquifer from a deeper confined aquifer at approximately 150 feet bgs. The deep aquifer consists of semi-consolidated sand, gravel, and clay that are typically encountered below 300 feet bgs. To date, there is no indication that the deep aquifer has been impacted with VOCs. There are over 540 wells within a ½ mile radius of the Site. In order to determine if the wells in the surrounding area would not cause a cross contamination issue between the aquifers, the construction for each well would have had to be evaluated. Due to the unknown construction on wells in the area, there is a concern for cross-contamination.

Groundwater flow across the Site was generally toward the east-northeast between May 2000 and September 2001. During that time period, the groundwater flow was strongly influenced by the pumping of domestic wells in the area.

There was a correlation between the seasonal changes in groundwater elevations and seasonal use of domestic wells in the area. Based on quarterly sampling, between May and September 2000 the groundwater table elevation, 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 Quartzsite's increased winter city 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 Braswell (Currently Cast) property.

2.4 RESPONSIBLE PARTY INVESTIGATION AND SOURCE AREA DEFINITION

A Remedial Investigation (RI) was conducted at the Site. The results of the RI indicate that PCE had been released and impacted the groundwater.

Pursuant to Arizona Revised Statutes 49-283, a potential responsible party (PRP) search was conducted and an investigation report prepared. The Attorney General's Office has determined that initiating cost recovery on work conducted by ADEQ from PRPs is not appropriate at this site. Very little information is known about the date(s) or amount(s) of any release on any property. No information was discovered concerning who was responsible for releasing the PCE that impacted the groundwater.

A viable responsible party must be discovered in order to cost recover funds. As ADEQ's duty to investigate is conditioned upon a determination that cost recovery may be appropriate, it follows that conducting a "best effort" search would be inappropriate unless at least one person is found from whom to recovery costs.

Based upon the limited financial assessment for each PRP, it does not appear that cost recovery is appropriate.

2.5 SOURCE AREA DEFINITION

The source area for the Site is defined as that area where concentrations of PCE in the groundwater are greater than 50 µg/L. Historically the peak groundwater PCE concentration was seen in the Welcome RV Park domestic well at 200 µg/L. The source area for treatment is considered to be centered around the three Welcome RV Park wells; domestic well, QMW-3, and QMW-4.

2.6 CHRONOLOGY OF SITE ACTIVITIES

To assist in reviewing the various investigation activities, this chronology was compiled of major investigation activities at the Site. The following outlines many of the events and investigative milestones for the project:

Date	Event
November 1993	ADEQ retains Groundwater Technologies, Inc. (GTI) to perform soil and groundwater investigations at Don's Café, which was located approximately 500 feet southeast of the Braswell (currently Cast) property. Groundwater samples are collected from Braswell well B-2. PCE and TCE are detected at concentrations of 39 µg/L and 0.7 µg/L in Cast well B-2.
June 1994	GTI, for ADEQ, re-samples Braswell well B-2. PCE concentrations exceed AWQS of 5.0 µg/L.
February 1995	Former Hi-Ali Motel/Laundromat property and Braswell Property are identified by ADEQ as potential hazardous waste sites.
July and August 1995	ADEQ initiates a Preliminary Investigation/Site Assessment (PA/SI) at the Hi-Ali property and collects groundwater samples from two former wells known as HA-1 and HA-2. PCE is detected in these wells above AWQS of 5.0 µg/L.
August 1995 through October 1997	ADEQ initiates a Preliminary Investigation/Site Assessment (PA/SI) at the Braswell property in August 1995. The PA/SI concludes in October 1997. ADEQ collects groundwater samples from Braswell wells B-1, B-2, B-3, and B-4. Well B-2 is the only well detected with PCE above AWQS of 5.0 µg/L. PCE is detected below AWQS

Date	Event
	of 5.0 µg/L in Braswell wells B-1 and B-4.
November 1995	ADEQ collects a groundwater sample from the Welcome RV Park well. PCE is detected at a concentration of 200 µg/L.
March 1996	ADEQ installs two temporary wells on the Welcome RV Park property identified as HAP-9 and HAP-10. PCE was detected at a concentration of 76 µg/L in HAP-9 and at a concentration of 48 µg/L in HAP-10.
March 1996	ADEQ installs nine temporary wells on the Hi-Ali property identified as HAP-1 through HAP-8, and HAP-11. PCE concentrations range from laboratory non-detect to 34 µg/L.
May 1996	ADEQ drilled and sampled three soil borings at the Welcome RV Park property identified as SB-1, SB-3, and SB-4. Analytical results did not indicate VOC concentrations exceeding laboratory detection limits. At this time, ADEQ was also conducting investigations at the adjacent Braswell property (see below). As part of this investigation boring JB1 was drilled on the Welcome RV Park property. A soil vapor sample collected from this boring was not detected with VOCs.
May 1996	Soil and soil vapor samples are collected from seven locations on the Braswell Property. VOCs were not detected above laboratory reporting limits in the samples.
May 1996	ADEQ conducts additional soil, soil vapor, and groundwater sampling at the Hi-Ali property. Wells HA-1 and HA-2 are detected with 25 µg/L and 7.0 µg/L of PCE, respectively. Seventeen soil vapor samples are collected from borings HA1 through HA12, and HA18. Fourteen soil samples were also collected. VOCs were not detected above laboratory reporting limits in the soil and soil vapor samples.
April 1997 and March 1998	ADEQ supervises the installation of monitoring wells QMW-1, QMW-2, and QMW-3 in April 1997. ADEQ supervises the installation of monitoring wells QMW-4 and QMW-5 in March 1998. These wells are sampled by ADEQ between July 1997 and May 1999.
March 1998	ADEQ performs an ESI at Welcome RV Park. Eight soil vapor samples were collected from seven locations next to two on-site septic tanks. A total of five temporary wells (TYTI1 through TYTI5) were also installed and sampled and sludge samples were collected from the septic tanks. Soil vapor PCE concentrations ranged from 21 parts per billion vapor volume (ppbv) to 980 ppbv. PCE concentrations in the temporary wells ranged from 2 µg/L to 92 µg/L. PCE was detected in the sludge samples at

Date	Event
	concentrations of 24 µg/L and 15 µg/L of PCE.
March 1998	ADEQ performs an ESI at the Braswell property. Soil and soil vapor samples were collected from three borings identified as TY19SV, TY20SV, and TY21SV. VOCs were not detected above laboratory reporting limits in the soil samples. PCE concentrations in the soil vapor samples ranged from 1.3 ppbv to 5.2 ppbv. ADEQ concluded the PCE in the soil vapor originated from the contaminated groundwater.
March 1998	ADEQ performs an Expanded Site inspection (ESI) at the Hi-Ali property. Soil vapor samples were collected from nine borings identified as TY9SV through TY12SV and TY14SV through TY18SV. A soil sample was collected from a boring identified as TYT6 and two sludge samples were collected from two septic tanks. PCE soil vapor concentrations ranged from 2.9 ppbv to 77 ppbv. PCE was detected at a concentration of 75 µg/L in the sludge sample collected from the southeast septic tank. VOCs were not detected in the other sludge sample or soil samples.
May 1998	The Welcome RV Park is identified by ADEQ as a potential hazardous waste site.
July 1995 – May 1999	ADEQ conducts groundwater sampling of 23 other production wells in the area that are not located on the properties discussed above.
December 1998	The Tyson Wash WQARF site is placed on the WQARF Registry List
September 1999	MACTEC is retained by ADEQ to perform the RI/FS/PRAP for the Site.
November 1999	MACTEC begins the RI by conducting a groundwater sampling event.
March and April 2000	Wells QMW-6, QMW-7, QMW-8, and QMW-9 are installed. Wells OB-1 through OB-3 are installed as observation wells for an aquifer test performed on QMW-7 and wells OB-4 and OB-5 are installed as observation wells for an aquifer test performed on QMW-6. Well QMW-10 is also installed in April 2000.
July 2000	A surface geophysical survey is performed by MACTEC to identify septic tanks, drain lines, and leach fields at Welcome RV Park and the Hi-Ali property.
August and October 2000	MACTEC collects soil and soil vapor samples from 18 borings identified as SV1 – SV18 on August 7-9, 2000. On October 26, 2000, an additional soil vapor boring identified as SV19 is drilled and sampled. A total of 36 soil vapor samples were collected. PCE soil vapor concentrations ranged from non-detect to 151 ppbv.

Date	Event
April 2001	MACTEC drills and samples temporary wells ESE-TY1 and ESE-TY2. PCE is detected at concentrations of 9.7 µg/L and 3.0 µg/L, respectively in TY1 and TY2.
October 2001	Draft Land and Water Use Study and the Draft RI are published for public comment.
May 2000 to April 2002	MACTEC conducts quarterly groundwater sampling of monitoring and production wells.
August 2002	ADEQ implements an ERA to provide source control and remediate groundwater below the Site.
October 2002	MACTEC submits Draft RI Report and Draft Land and Water Use Study Report to ADEQ.
February 2003	MACTEC implements the ERA at the Site. A pilot test groundwater pump-treat-and re-injection system is installed consisting of extraction wells EW-1 and EW-2 and injection well INJ-1. The remediation system consisting of granular activated carbon (GAC) treatment is installed at the location shown in Figures 2 and 3. A pre-pilot test (baseline) groundwater sampling event is performed and soil and groundwater samples for an in-situ bioremediation bench-scale treatability study are collected.
April 2003	The pilot groundwater pump-and-treat system is started.
May 2003	ADEQ prepares the Remedial Objectives (RO) Report.
June 2003	MACTEC submits Final RI Report and Final Land and Water Use Study Report to ADEQ.
May 2003 – September 2005	MACTEC performs quarterly groundwater sampling to evaluate the performance of the pilot groundwater pump-and-treat system.
October 2003	The In-situ Bioremediation Treatability Study Report is submitted to ADEQ.
September 2005	The groundwater pump and treat system is expanded to full-scale by adding extraction wells EW-3, EW-4, and EW-5 and injection well INJ-2. Baseline groundwater monitoring for the expanded system is performed.
October 2005	The full-scale groundwater pump-and-treat system is started.
December 2005 – present	MACTEC performs quarterly groundwater sampling to evaluate the performance of the groundwater pump-and-treat system.
June 2007	MACTEC submits the Final Feasibility Study Report to ADEQ.
June 2007	Notice of availability for the Final Feasibility Study
June 2008	MACTEC submits the Draft PRAP to ADEQ

Date	Event
June 2008	Public comments are solicited for the PRAP
June 2009	Record of Decision (ROD) is issued

3.0 SELECTED REMEDY

3.1 SELECTED REMEDY

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 contamination identified at the Site appears to have only affected the upper aquifer. The extent of the plume, based on the November 2008 groundwater sampling event, is shown on Figure 3.

The Site includes nineteen privately owned wells, of which, only one well (B-3) is constructed in the deep aquifer. 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. Seven of the nineteen wells have historically had PCE concentrations above the AWQS of 5 µg/L. 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. Groundwater pumped from the deeper aquifer currently provides a supply of water for the Town of Quartzsite.

When determining a remedy at the site, uses of land and water by stakeholder must be taken into consideration. ADEQ conducted a water use survey regarding the Site. A questionnaire was given to thirty-five residents within the community involvement area (CIA) which is ½ mile radius beyond the site boundaries. 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 issued by the Town of Quartzsite on September 14, 1999, outlined several management strategies for the Wellhead Protection Area (WPA). The WPP is enforced by the Town of Quartzsite and not by the State of Arizona. 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 required 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.

The following factors were taken into consideration when developing the Remedial Objectives (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 shallow 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. However, cost analysis indicates that 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 WPP is enforced by the Town of Quartzsite and not by the State of Arizona.
- The WPA available at the time the RO Report was written does not include the Site. However, additional WPAs to the south of the Site may be established, as well as the

potential for 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 public water connection status of 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 existing 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.

3.1.1 Remedial Strategy

The remedial strategy for the Selected Remedy will be controlled migration through groundwater pump and treat technology to achieve the ROs. The Selected Remedy may also have the benefit of providing source control and ultimately plume remediation of contaminants of concern (COCs) to AWQSs over the long term. The COCs at the Site are identified as PCE and TCE.

3.1.2 Remedial Measures

In March 2003 a pump and treat system was installed consisting of two extraction wells and one injection well. The existing full scale groundwater pump-and-treat and inject system, which is the selected remedy, was installed as an ERA in September 2005 and has been in operation since October 2005. The remedial measures for the Selected Remedy will be as follows: 1) to pump groundwater from existing extraction wells (EWs) EW-1, EW-2, EW-3, EW-4, and EW-5; 2) treatment of the COCs by granulated activated carbon (GAC); and, 3) re-injection of the treated water back into the aquifer at existing injection (INJ) wells INJ-1 and INJ-2. Remediated water is injected back to the aquifer per the Environmental Protection Agency (EPA) Underground Injection Control (UIC) permit and in accordance with R18-16-408 (B4). The combined pumping and injection of the system controls downgradient migration of the plume by directing COC impacted water toward the extraction wells and flushing COCs from the saturated zone with the treated water. Historical data from groundwater monitoring and groundwater modeling indicates the selected remedy will meet the ROs through the long term benefit of source control and plume

remediation. The locations of the remediation wells and remediation system enclosure are shown on Figure 2. Construction schematics of the selected remedy are attached in Appendix A.

In the future, the pump-and-treat system may be shut-down and natural attenuation be employed to meet the RO's. This will be based on groundwater monitoring results. The discussion on the application of natural attenuation is presented in Section 3.1.5.

3.1.3 Proposed System Operation

On October 20, 2005, the full-scale pump, treat and inject system was started. The limiting factors for operation of the system were the pumping rate for an extraction well and the treated water injection rate to an injection well. The primary injection well was INJ-2. As shown in the construction schematics attached in Appendix B, the extracted groundwater was pumped through the GAC treatment and into an equalization tank. The treated water was then allowed to gravity feed to INJ-2 and INJ-1. Testing of the system indicated that at a total pumping rate of eight gpm from the five extraction wells, INJ-2 would fill to the top of the casing in less than one hour if 100 percent of the water is injected to INJ-2. The equalization tank would also fill to capacity in less than two hours. Further testing of the system indicated that by injecting 10 to 15 percent of the treated water to INJ-1, INJ-2 would fill to the top of the casing in approximately 75 minutes (1.25 hours) and approximately 120 minutes (two hours) were required for the well to drain to near static water levels. On March 30, 2006, MACTEC enhanced the system operation by installing a water level switch in the equalization tank and installing a secondary GAC treatment canister. In May 2006, MACTEC installed a remote monitoring and operation system known as an AlarmAgent. With the overfill protection systems installed, 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

The last two "OFF" cycles were increased by 15 minutes to allow for stabilization of cumulative effects. This operation schedule 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, would 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 for wells EW-1 and EW-2 have historically been set by controller at 1.0 gpm and 2.0 gpm, respectively. The pumps installed in EW-3 through EW-5 are equipped with internal rate controllers that respond to back pressure. The pumping rates for wells EW-3 and EW-4 are set to vary from 2.0 to 2.5 gpm and the pumping rate for EW-5 is set to vary from 1.0 to 1.5 gpm. The designed total pumping rate for the five extraction wells is 8.0 gpm. However, the actual measured total pumping rate has stabilized at approximately 8.5 gpm. As COC concentrations decrease at EW-1 and EW-2, these wells may be taken off-line or pumping rates reduced and the pumping rates for EW-3 and EW-4 increased to enhance source control. Due to low concentrations, EW-2 was turned off in April 2008. However, the total pumping rate for the system currently will not exceed 8.5 gpm.

3.1.4 Source Control

As shown on Figure 3, the boundaries of the plume have been established. There is currently no identified source area that contains vadose (unsaturated) zone soil contamination by COCs or non-aqueous phase COCs. The impact at the Site is apparently limited to dissolved and possibly sorbed COCs in the shallow saturated zone. A detailed discussion of the remediation area is provided in Section 3.3; however, the remediation area has been divided into two areas based on PCE concentrations. The "source" area is the area of groundwater containing concentrations of PCE that are greater than 50 µg/L. The "plume" area is the area of groundwater containing concentrations of PCE greater than the AWQS of 5.0 µg/L. Though source control is not the remedial strategy for the Selected Remedy, the Selected Remedy may have the long-term benefit of ultimately remediating the defined "source" area to concentrations of PCE below 50 µg/L.

3.1.5 Proposed Metrics

In accordance with A.A.C R18-16-408, Proposed Remedial Action Plan, the PRAP must discuss how the remedial action progress will be measured. To measure the progress of achievement of the

ROs, ADEQ will collect a combination of groundwater gradient measurements and groundwater sample analysis. Initially this will be conducted quarterly. The monitoring frequency may be reduced to a semi-annual basis after the "source" area concentrations of PCE are reduced.

3.1.5.1 Groundwater Levels

ADEQ has been measuring water levels at the Site since May 2000. However, the groundwater measurements collected since December 2005 are the most representative to the operation of the remediation system.

Water levels in 14 wells QMW-1, QMW-3, QMW-4, QMW-5, QMW-8, QMW-11, QMW-12, EW-1, EW-2, EW-3, EW-4, EW-5, INJ-1, and INJ-2 are measured while the system is "ON". These wells were selected due to their locations within the area of influence of the remediation system and the water levels could be measured within or slightly after a one hour "ON" period. System "ON" gradient tracking for these wells evaluates the aquifer under dynamic conditions. The system "ON" groundwater measurements since December 2005 indicate the system is controlling plume migration as modeled and designed. The system "ON" groundwater measurements will continue to be collected on a quarterly basis until the groundwater monitoring frequency is reduced to a semi-annual basis. The system "ON" groundwater measurements will then be collected on a semi-annual basis until system operation is terminated as indicated by groundwater quality sampling and authorized by ADEQ.

After the system "ON" water levels are measured and groundwater samples are collected from the extraction wells and treatment system, the system is turned "OFF" to allow for collection of groundwater samples from the 7 monitoring wells and measurement of water levels in 16 wells while the system is "OFF". System "OFF" water levels are measured no less than 24-hours after system shut-down to evaluate the groundwater gradient under near-static conditions. Groundwater level measurements collected since the 4th Quarter of 2001 have indicated a consistent westerly groundwater flow gradient in the southern portion of the Site and a consistent northerly groundwater flow gradient in the northern portion of the Site. Evaluation of the static groundwater gradient will become more important in the future if the remediation system is shut-down and monitored natural attenuation (MNA) is implemented. Therefore, the system "OFF" groundwater measurements will continue to be collected on a quarterly basis until the groundwater monitoring frequency is reduced to a semi-annual basis. The system "OFF" groundwater measurements will

then continue to be collected on a semi-annual basis until system operation is terminated as indicated by groundwater quality sampling and authorized by ADEQ.

3.1.5.2 Groundwater Quality Sampling

Groundwater quality sampling is likely the critical metric in evaluating the effectiveness of the system in meeting the ROs. The baseline groundwater sampling event for the operation of the current pump-and-treat system was performed in September and October 2005. Periodic groundwater sampling will indicate whether the plume is expanding or contracting spatially, and changes in contaminate concentrations with time. Groundwater sampling since the baseline event has shown that the pump and treat system is meeting the ROs and is operating as modeled and designed.

3.1.6 Uncertainties and Contingencies

Groundwater monitoring performed since September 2005 indicates that the pump-and-treat system is meeting the ROs and reducing COC concentrations. The single uncertainty identified at the Site is the continued rising groundwater levels. The lowest groundwater levels were measured at the Site during 2001. Since that time, groundwater levels have risen more than 8.5 feet and groundwater levels have been increasing annually between 0.5 feet and 1.0 foot. A 20 year operation and maintenance (O&M) program was established as part of the FS. If this trend continues, water levels may rise more than 10 feet over the 20 year program. Depth-specific groundwater samples are being collected from the well network. Therefore, the rising groundwater levels should not influence groundwater quality data. However, the rising groundwater levels may influence operation of the remediation system, particularly the re-injection of the treated groundwater back to the aquifer. As groundwater levels rise, less screened interval is exposed to allow injected water back to the aquifer, which may result in a reduction in the injection rate, in turn reducing the quantity of water that is pumped and treated. As a safeguard the system is equipped with protection mechanisms (high level water cut off switches) that prevent overfilling of the equalization tank in the event the water injection is slowed. However, if the overfill protection system is triggered, the amount of water pumped and treated is reduced. For this reason a quarterly monitoring program is proposed, at least over the short-term. As water levels fluctuate, adjustments are made to the system pumping rate and timing. As a contingency, as dissolved PCE concentrations decrease, extraction wells, particularly EW-1 and EW-2 (currently offline), may be

taken off-line and the pumping rates for wells EW-3 and EW-4 increased. This may allow continued effective operation of the system while the water table rises. If the effectiveness is significantly reduced, the injection rate to INJ-1 can be increased, existing injection wells may be replaced, or additional injection wells can be installed.

Another uncertainty is the effectiveness of the pump-and-treat system to reduce dissolved PCE concentrations within the defined "source" area to below 50 µg/L. Though source control is not necessarily included in the remedial strategy, groundwater quality sampling has indicated the remediation system may remediate the defined "source" area to dissolved PCE concentrations below 50 µg/L in the long-term. Though groundwater pump-and-treat is proven to be an effective migration control remedial approach by removing dissolved-phase mass, it does not effectively remove contaminant mass sorbed to the soil. But, the soil flushing action provided by the treated water re-injection is intended to enhance removal of the sorbed contaminant mass.

Another uncertainty is the influence of natural attenuation. Groundwater monitoring since September 2005 has indicated that the plume is relatively stabile. This is due to natural attenuation at the edge of the plume enhanced by the operation of the pump-and-treat system. Natural attenuation may continue to provide plume migration control in the event the remediation system is temporarily or permanently shut down before PCE concentrations within the plume area are remediated below 5.0 µg/L. Based on the pre-remediation system groundwater monitoring data, this is a likely possibility. Prior to startup of the pilot system in 2003 and the full system in October 2005, natural attenuation by the physical processes of dilution, diffusion, volatilization, and sorption was apparently controlling migration of the plume. Concentrations of PCE in the Adams wells, the York well, and QMW-8 and QMW-10 were below AWQS. However, natural attenuation by physical processes alone does not result in removal of contaminant mass. Concentrations of PCE above the AWQS standard were not detected in the York well and wells QMW-8 and QMW-10 until after the remediation system was started. The groundwater model predicted that as PCE was drawn from the Braswell wells B-1 and B-2 that the York well and wells QMW-8 and QMW -10 may have PCE detections.

3.2 ACHIEVEMENT OF REMEDIAL OBJECTIVES

The Remedial Objectives Report dated May 14, 2003 and prepared by ADEQ presents ROs for the Site (ADEQ 2003). The ROs established were used to develop the remedy for the Site. The FS

evaluated specific remedial measures and strategies and identified a reference remedy and two alternative remedies capable of meeting the ROs. The FS also identified the proposed remedy and describes how the proposed remedy will meet the ROs.

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 of the water was addressed was based on information gathered during the public involvement process, and whether the use is reasonably foreseeable. As defined in A.A.C R18-16-406 (I4): The Department shall prepare a report of the proposed remedial objectives for the site that shall list the current and reasonably foreseeable uses of land and the current and reasonably foreseeable beneficial uses of waters of the state. These uses shall be identified based upon information provided during the public meeting and any other information received. The report shall state the remedial objectives for each listed use in the following terms: a) Protecting against the loss or impairment of each listed use that is threatened to be lost or impaired as a result of a release of a hazardous substance; b) Restoring, replacing or otherwise providing for each listed use to the extent that it has been or will be lost or impaired as a result of a release of a hazardous substance; c) Time-frames when action is needed to protect against or provide for the impairment or loss of the use; and d) The projected duration of the action needed to protect or provide for the use.

Part of the public involvement process was the delivery of approximately 35 questionnaires to residents within the Community Involvement Area in April 2001. These questionnaires were regarding current and future water use. Of those returned, nineteen indicated they use their shallow wells for non-potable household uses, four use their shallow wells for potable water, and two obtain their potable water from deep wells on their property.

Other groundwater quality issues besides the VOC groundwater plume at the Site include the occurrence of nitrate and petroleum hydrocarbon contamination. Both of these are outside the ADEQ WQARF regulatory jurisdiction.

A public meeting was held on October 17, 2001 to discuss the Tyson Wash Use Report and the proposed ROs. The Tyson Wash Use Report was slightly modified as a result of public comments received at the public meeting. 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).

3.2.1 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 identified areas of soil contamination above a regulatory level 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.

3.2.2 Remedial Objectives for Groundwater Use

The ROs for groundwater use at the Site are as follows:

1. **Remedial Objective for Potable use of the Shallow Aquifer outside the Tyson Wash WQARF site Plume Boundaries prior to Town Water Supply Connection and Non-potable use after Town Water Supply Connection**

   The Town of Quartzsite requires all property owners within 200 feet of 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. 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 of Quartzsite water supply. After residents outside of the Tyson Wash WQARF site plume boundaries have connected to the Town 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 Tyson Wash WQARF 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 Tyson Wash WQARF 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 Tyson Wash site.

2. **Non-potable use of the Shallow Aquifer within the Tyson Wash WQARF Plume Boundaries by Currently Impacted Private Well Owners**

Nine shallow privately-owned domestic wells located within the Tyson Wash site have been impacted by PCE groundwater contamination. All of the businesses and residences located within the Tyson Wash WQARF site are connected to the Town water supply. Of the wells that have been impacted, Welcome RV, Rhoades/Day, and Adams have indicated that they will continue to use their private wells for non-potable purposes.

The current and future use of the shallow aquifer within the Tyson Wash WQARF plume boundaries is for non-potable purposes. The current and future use is reasonably foreseeable. The proposed RO for non-potable shallow aquifer groundwater use by currently impacted private well owners is:

To protect, restore, replace, or otherwise provide a water supply for non-potable use by currently impacted private well owners within the Tyson Wash WQARF site if the current use is impaired or lost due to contamination from the site. Actions are 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 Tyson Wash site.

3. **Remedial Objective for Municipal use of the groundwater located in the deep aquifer**

According to the Land and Water Use Report (contained in the Final RI Report), there are 4 deep wells (i.e. wells greater than 500 feet deep) located within less than a 1/8 mile radius of the Tyson Wash site. All of these wells could be considered threatened for groundwater contamination within the deep aquifer. There is concern regarding possible conduits from the shallow aquifer to the deep aquifer created from improper installation of deep wells. In order to make a determination regarding whether the deep wells are conduits, extensive studies of each deep well would be required to assure that a pathway has not been created.

The current use of the deep aquifer is for potable purposes. Potable groundwater use of the deep aquifer is considered reasonably foreseeable. The proposed RO for this use is:

To protect, restore, replace, or otherwise provide a water supply for potable use of the deep aquifer. These actions will continue for as long as contamination from the Tyson Wash site threatens the deep aquifer.

The remedial strategy for the Site is to control the migration of the COCs from the current plume boundaries to wells outside the current plume boundaries. The groundwater model and groundwater monitoring performed since December 2005 have demonstrated that the current groundwater pump-and-treat and re-injection system is controlling migration of the COCs and thus achieving the ROs. The metric for evaluating the remedial action will be to monitor changes in PCE concentrations in the Adams wells, Rhoades west well, the York well, QMW-7, QMW-8, QMW-10, and EW-5, which are located along the downgradient boundary of the plume.

Plume remediation and source control are not exclusively discussed as part of the remedial strategy. However, the current remediation system may eventually reduce the "source" area PCE groundwater concentrations within a reasonable timeframe. Plume containment and reduction may also be achieved using the current remediation system. However, several years may be required and plume remediation may be considered unnecessary once the "source" area is remediated and natural attenuation is capable of meeting the ROs.

3.3 DEFINITION OF REMEDIATION AREAS

The remediation area is divided into two sub-areas. The "plume" area includes groundwater impacted with dissolved PCE above the AWQS of 5.0 µg/L. The "source" area is defined as groundwater impacted with dissolved PCE above 50 µg/L. However, an actual cause of contamination remains unknown. The boundaries of the "plume" area and "source" area based on the 2nd Quarter 2007 groundwater monitoring. Extraction wells EW-1 through EW-4 are located within or near the "source" area and serve the purpose of controlling migration and reducing PCE concentrations within the "source" area. Extraction well EW-5 is located along the downgradient boundary of the "plume" area and serves the purpose of controlling migration of PCE. The majority of the contaminant mass removal and migration control is being performed by EW-3 and EW-4, which contain the highest PCE concentrated groundwater concentrations of the extraction wells and are currently set at the highest pumping rates. Re-injection of treated water at INJ-1 and INJ-2 has the effect of directing PCE impacted groundwater toward EW-3 and EW-4 and "flushing" PCE from both the saturated soil and groundwater, thus providing groundwater remediation to the south of the extraction wells.

3.4 ACHIEVEMENT OF REMEDIAL ACTION CRITERIA PURSUANT TO ARS §49-282.06

The Reference Remedy from the 2007 Feasibility Study Report has been selected as the Final Remedy for the Site. Compared with the Less Aggressive and More Aggressive Remedies (MACTEC, 2007), the Reference Remedy appears to:

- Best assure the protection of public health and welfare and the environment;
- To the extent practicable, provide for the control, management and cleanup of the PCE contamination, maximizing beneficial use of the groundwater in the Town of Quartzsite; and,
- Is reasonable, necessary, cost-effective and technically feasible.

The groundwater pump-and-treat and injection system is currently operational, operating effectively, meeting the RO's of controlled migration, source control, monitoring and possibly plume remediation. The groundwater pump-and-treat and injection system was initially intended as an Early Response Action (ERA) that controlled contaminate migration in groundwater. However, as demonstrated by on-going groundwater monitoring, the combination of extraction and the flushing action provided by the re-injection system is also providing source area remediation. 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 boundaries of the source area has also been reduced. A review of operational data suggests that the system is efficient, is operating as designed, and that no significant changes are warranted. As the contaminant mass is removed and the sizes of the plume and source areas decrease, natural attenuation should play more of a role and may be implemented as a stand alone approach in the future with long-term monitoring of a stabilized plume and asymptotic results from the pump and treat system.

Because the remediation system is currently operational and data indicates that it is controlling migration of the plume and is reducing PCE concentrations in the groundwater, this remedy is clearly the best choice.

3.5 CONSISTENCY WITH TOWN OF QUARTZSITE WATER USE PLANS

The ROs were developed based on Town of Quartzsite water use plans. Therefore, the operation of the current remediation system is consistent with the Town of Quartzsite water use plans.

The Wellhead Protection Plan (WPP) 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 prohibits the installation of new wells in the shallow aquifer in the WPA. To provide drinking water, the Town of Quartzsite requires that all property owners within 200 feet of the water and sewer lines connect to the utilities provided. Shallow groundwater use outside the boundaries of the Site are assumed to be for potable use, and 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. Likewise, 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.

3.6 COMPLIANCE WITH ARIZONA ADMINISTRATIVE CODE (A.A.C)

In compliance with A.A.C. R-18-16-403, Scope of Work, Fact Sheet, Outline of the Community Involvement Plan, and Notification of Availability, ADEQ published a notice of availability indicating the new WQARF site and the start of the RI phase in the Quartzsite Times newspaper on October 14 and 21, 1998. The notice of availability informed community members and interested parties that the scope of work, fact sheet, and the outline of the community involvement plan was available for review and comment. An updated fact sheet was also distributed in December 1999 and October 2001 as warranted.

More than two environmental meetings were held. On September 25, 1996, ADEQ and La Paz County held an open house meeting at the Quartzsite Town Hall to inform the community of groundwater, drinking water, and wastewater issues. A second public meeting was held in Quartzsite on December 11, 1996 to discuss placing the site on the WQARF registry list.

The ERA as outlined in A.A.C. R-18-16-405 was conducted in order to address a current risk to public health, welfare and the environment; protect or provide a supply of water; address sources of contamination; or control or contain contamination where such actions were expected to reduce the scope or cost of the remedy needed at the site. The following outlines the ERA that was conducted at the site:

- In August 2002, ADEQ conducted an ERA to provide source control and remediate the groundwater beneath the site. Two extraction wells and one injection well were installed as part of the pump and treat remediation system. Startup of the system began in March 2003. In September 2005, three extraction wells and one injection well were installed at the site to expand the groundwater treatment system. In October 2005 the expanded system was turned on.

The final *Remedial Investigation Report – Tyson Wash WQARF Site* was published on June 30, 2003 (MACTEC, 2003). A notice of availability was published on November 29, 2002. In accordance with A.A.C. R18-16-406, the RI report established the nature and extent of the

contamination and the sources thereof; identified current and potential impacts to public health, welfare, and the environment; identified current and reasonably foreseeable uses of land and waters of the state; and obtained and evaluated any other information necessary for identification and comparison of alternative remedial actions. The RI report was released in draft form for public comment and a notice of opportunity to comment on the Draft RI appeared in the *Quartzsite Times* on October 3, 2001. After the RI public comment period, the proposed remedial objective report was released for public comment on October 30, 2002. The two reports were combined to form the final RI report as described above. The Feasibility Study work plan was written following A.A.C. R18-16-407B outlining specific elements to be included.

The *Feasibility Study Report – Tyson Wash WQAREF Registry Site* (FS Report) was published on June 23, 2007. The FS report, as required by A.A.C. R18-16-407, included a reference remedy that was evaluated and capable of meeting the remedial objectives, along with a more aggressive and a less aggressive remedy. The FS report evaluated each remedial alternative and detailed the ability for the remedial alternative to achieve the remedial objectives; evaluated the consistency with the water management plans of affected water providers and the general land use plans of local governments; a comparison of criteria such of practicability, feasibility, effectiveness, reliability, etc.; evaluated the risk associated with the alternative; evaluated the total cost; and evaluated the benefit, or value, of the remediation.

The *Proposed Remedial Action Plan – Tyson Wash WQARF Registry Site* (PRAP) was published on June 2, 2008 according to A.A.C. R18-16-408. The PRAP contained a description of the proposed remedy, the information required in A.R.S. §49-287.04(A), a description of how the proposed remedy will achieve the remedial objectives; and a description of all recharge, discharge, transportation, and use of remediated water as defined in A.R.S. §49-283.01. A notice was published in the Quartzsite Times/Palo Verde Valley Times on June 4, 2008 on the availability of the PRAP for public comment. The public meeting was held in conjunction with the CAB meeting on June 11, 2008. A call to the public for public comments on the PRAP was made in the meeting and no comments were received. Likewise, no comments were received during the 30 day comment period. A responsiveness summary was not necessary since no comments were received.

ADEQ took reasonable effort in researching responsible parties. According to §49-287.02(A), the department determined that cost recovery was not appropriate.

The *ROD* was published in June 2009 according to A.A.C. R18-16-410.

3.7 COMMUNITY INVOLVEMENT AND PUBLIC COMMENT REQUIREMENTS

ADEQ complied with A.A.C. R18-16-404 with respect to community involvement requirements and completed all community involvement and public comment requirements for the Tyson Wash WQARF Site. The activities and time periods for these requirements are outlined in the table below.

Table 3-1

Previous Community Involvement Activities

Community Involvement Activity	Regulatory Citation/ Rule	Date
Establish CIA	A.R.S. §289.02	Established December 1999
Notice of the site listing on the Registry	A.R.S. §287.01	Mailed to property owners on June 29, 1998; appeared in the *Quartzsite Times* on August 22 and September 2, 1998
Hazardous substance contamination notice	A.R.S. §289.02	Appeared in December 1999 fact sheet
Establish a CAB selection committee	A.R.S. §289.03	Selection committee established and disbanded January 2000
Establish CAB	A.R.S. §289.03	Selected January 2000; first meeting February 2000
Public notice of CAB meetings	A.R.S. §289.03	At least 24 hours in advance of meetings; meeting agendas are posted in all ADEQ offices, on the ADEQ web page, and mailed to the site mailing list
Issue notice of RI scope of work, fact sheet and outline of CIP	A.R.S. §287.03	Appeared October 14 and 21, 1998, in *Quartzsite Times*
Designate a spokesperson	A.R.S. §289.03	Designated December 1999
Fact sheets	A.R.S. §289.03	Distributed December 1999, October 2001; and June 2005
Interviews with community members	R18-16-404	Interviews conducted October 1999, September 2001, November/December 2002, and June 2006
Establish information repository	A.R.S. §289.03	Established June 1999 at ADEQ Records Center and Quartzsite Library
Notice of availability of draft Land and Water Use Study	R18-16-404	Appeared in *Quartzsite Times* October 2, 2001
Public meeting to discuss draft Land and Water Use Study	R18-16-404	October 17, 2001
Notice of opportunity to comment on draft RI report and public meetings to establish ROs	A.R.S. §289.03	Appeared in *Quartzsite Times* October 3, 2001; October 30, 2002 Meeting –
Notice of availability of proposed	R18-16-406	Appeared in *Quartzsite Times* October

RO report		30, 2002
Public meetings to discuss proposed RO report	R18-16-404	February 12, 2002; June 6, 2002
Public meeting to discuss revised RO report	R18-16-404	October 29, 2002
Notice of availability of final RO report and final RI report	R18-16-406	November 29, 2002
Notice of availability of FS work plan	R18-16-407	August 2007
Notice of opportunity to comment on PRAP and public meeting	R18-16-408	June 11, 2008
Notice and notification to interested parties of the availability of record of decision	R18-16-410	June 2009

4.0 RESPONSIVENESS SUMMARY

During the public comment period for the site PRAP, ADEQ did not receive any public comments.

5.0 LIFE-CYCLE COST ESTIMATE

The groundwater pump-and-treat system has been selected as the final remedy for the Tyson Wash WQARF Site based on the previously completed feasibility study report and the proposed remedial action plan. According to A.A.C. R18-16-410 (B) (7), a total estimated cost shall be compiled for the remaining time for the remedy to be completed.

A life-cycle cost estimate has been completed for the design, installation, operation, maintenance, and monitoring for the pump and treat system. The long term remedial strategy for the pump and treat system is controlled migration. However, the system may remediate the "source" area to PCE concentrations below 50 µg/L and possibly the "plume" area to concentrations below 5.0 µg/L within the operational life-cycle of the system. The "source" area wells are currently identified as QMW-3, QMW-4, EW-3, and EW-4. Well EW-4 is located on the apparent edge of the "source" area. PCE concentrations in EW-4 have not changed significantly since December 2005, ranging from 39 µg/L to 55 µg/L and having an operational average of approximately 48 µg/L. PCE concentrations in QMW-3 have decreased approximately 107 µg/L since December 2005, which is an average of approximately 18 µg/L per quarter. PCE concentrations in well EW-3 have decreased approximately 38 µg/L since December 2005, which is an average of 6.0 µg/L per quarter. Applying the currently observed trends, the PCE concentrations in wells QMW-3, QMW-4, and EW-3 may be reduced below 50 µg/L within two years. However, the rate of PCE concentration decrease is expected to slow. Therefore, reduction of the PCE concentrations in wells QMW-3, QMW-4, and EW-3 below 50 µg/L could require more than five years.

There is moderate uncertainty regarding the timeframe required to reduce the PCE concentrations in all monitoring, remediation, and production wells to concentrations below 5.0 µg/L without rebound. With the exception of the Welcome RV Park well, QMW-1, and QMW-5, PCE concentrations in wells within the "plume" area and outside the "source" area have not reduced significantly since startup of the remediation system in September 2005. The PCE concentration trends in the Welcome RV Park well, QMW-1, and QMW-5 indicate PCE concentrations in these wells may be below the AWQS of 5.0 µg/L within a few years. PCE concentrations are currently declining at rates of approximately 10 µg/L to 20 µg/L per year in the Welcome RV Park well, approximately 6.0 µg/L per year in QMW-1, and approximately 2.0 µg/L per year in QMW-5. However, these wells are located upgradient of the extraction wells and are influenced by the re-injection portion of the system. During operation of the remediation system, PCE concentrations in

wells QMW-8 and QMW-10 have been decreasing. However, it is anticipated the PCE concentrations in QMW-8 and QMW-10 should begin to decrease more appreciably after the "source" area is remediated below a PCE concentration of 50 µg/L.

In the FS, costs were evaluated for three potential system operation scenarios. For the purposes of providing a life-cycle cost estimate for the system selected, a 30 year lifetime was assumed. That 30 year lifetime includes a 19 year remediation system operation period (the system has been in operation for four years) followed by an 11 year monitoring period. The life-cycle cost estimate is also based on the following factors and assumptions:

- Groundwater extraction and re-injection rates will not change significantly over the operational lifespan of the remediation system;
- Additional injection wells are not required due to the rising water table. Specifically, should the re-injection rate to INJ-2 decrease due to the rising table, the re-injection rate to INJ-1 will be increased as appropriate to maintain the pumping rate. No additional remediation wells will be installed.
- System operation and maintenance (O&M) and groundwater monitoring will be performed as follows:
  - During the first five years of operation, which was from April 2003 to December 2008, the system O&M visits were performed once monthly and groundwater monitoring was conducted quarterly.
  - For the next three years of operation (January 2009 to June 2012), 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, from June 2012 to June 2014 (years 10 and 11), the system O&M and monitoring program will not be changed.
  - From June 2014 to June 2021 (years 12 through 19), O&M visits will be reduced to once quarterly and the groundwater monitoring program will be reduced to semi-annual events. The program assumes no change in the number of wells that are sampled. It is anticipated that 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.
  - At the end of year 19 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 monitoring 10 of the wells for five years. Groundwater monitoring of the 10 wells will be performed quarterly for year 20, and semi-annually for years 21 through 30.

- A single GAC unit will be replaced once annually during system operation. The capital equipment included with the remediation system are the groundwater pumps, controls, and the equalization tank. These items may require replacement. Pipes, hoses, and gauges may require periodic repair/replacement. These items are considered standard maintenance items and are included in the cost estimate.

- Post closure tasks include abandonment of the monitoring and remediation wells by removing well vaults and filling the wells with grout, leaving subsurface piping in-place, and removing the surface equipment. The post-closure work is estimated to be completed between June 2032 and December 2032.

- The O&M and sampling costs have been assumed to increase on an inflationary basis of 5% annually per annum for the duration of the remedial action.

The estimate of the implementation cost of the final remedy does not include costs for repairs to the Welcome RV Park well. The estimate of the total system implementation costs for the selected remedy includes:

- The cost for design and installation of the pilot test system from December 2002 through April 2003 was $110,000.00 for the five month period.

- The cost for system monitoring, O&M, and reporting from April 2003 through April 2004 was $80,000.00 for the 12 month period.

- The cost for design and installation of the full system from April 2004 through September 2005 was $112,339.00 for the six month period.

- The cost for system monitoring, O&M, and reporting from April 2004 through June 2007 (does not include 2nd Quarter 2007 groundwater monitoring) was $109,420.00 for the 26 month period.

Table 5-1

Summary of Life-Cycle Cost Analysis

Operational Years	Estimated Cost
December 2002 – June 2007	$411,759
June 2007 – June 2008	$82,000
June 2008 – June 2009	$74,558
June 2009 – June 2010	$78,278
June 2010 – June 2011	$82,191
June 2011 – June 2012	$86,301
June 2012 – June 2013	$90,616
June 2013 – June 2014	$95,147
June 2014 – June 2015	$61,000
June 2015 – June 2016	$64,050
June 2016 – June 2017	$67,253
June 2017 – June 2018	$70,615
June 2018 – June 2019	$74,146
June 2019 – June 2020	$77,853
June 2020 – June 2021	$81,746
June 2021 – June 2022	$79,934
June 2022 – June 2023	$43,000
June 2023 – June 2024	$45,150
June 2024 – June 2025	$47,408
June 2025 – June 2026	$49,778
June 2026 – June 2027	$52,267
June 2027 – June 2028	$54,880
June 2028 – June 2029	$57,624
June 2029 – June 2030	$60,505
June 2030 – June 2031	$63,531
June 2031 – June 2032	$66,707
June 2032 – December 2032	$80,000
Total Life-Cycle Cost	**$2,198,297.00**

Therefore, through June 2007, the total cost for design, installation, monitoring, and O&M of the system is $411,759.00. Based on an assumed inflation rate of 5%, the assumptions listed above, and the costs estimated in the table above, the selected remedy has an approximate total cost of $2,198,297. These costs include analytical testing, electrical power, equipment repair, GAC usage and other consumable supplies as part of O&M, and consulting and reporting.

6.0 DISPOSITION OF TREATED WATER

From April 2003 to September 2005, the pump and treat effluent was re-injected at INJ-1 (see Figure 2). With startup of the full system in September 2005, the treated water was injected in both INJ-1 and INJ-2, with approximately 88% of the water injected at INJ-2. As described in Section 3.1.3, the system pumping rate may be adjusted in the future to optimize or increase the efficiency of the system. Adjustments and/or modifications to the system will be reported in periodic operation and monitoring reports.

One of the uncertainties associated with future operation of the system is the affect the rising water table will have on the injection rates, particularly at INJ-2. Should the injection rate at INJ-2 decrease significantly due to a rising water table, modifications may be made to INJ-2 to optimize the injection rate or the injection rate to INJ-1 may be increased as appropriate and necessary. This may also be appropriate as the PCE concentrations in the monitoring wells upgradient of the extraction wells decrease.

7.0 REMEDY REVIEW (CONCLUSIONS)

The five year review will ensure that the remedy is operating as designed and is progressing as expected. The review will also enable ADEQ to ensure that the remedial objectives specified in the PRAP remain protective of human health and the environment. ADEQ will continue to review the remedy every five years until the remedy is no longer feasible to continue operating at the site.

The groundwater pump-and-treat system is expected to take until 2032 to achieve groundwater aquifer water quality standards. According to A.A.C. R18-16-410 (B) (8), ADEQ will review the remedy every five (5) years from the issuance of the record of decision document.

The groundwater pump and treat system will continue pumping at a rate between 7.5 to 8.5 gpm per the pumping schedule presented in Section 3.1.3. The pumping rates have recently stabilized to between 8.0 and 8.5 gpm. The system pumping rate may be adjusted in the future to optimize or increase the efficiency of the system. Modifications may also be made to the injection wells to optimize injection rates. Adjustments and/or modifications to the system will be reported in periodic operation and monitoring reports. Groundwater monitoring data since December 2005 indicate that the current system is operating as modeled and designed and is meeting the remedial strategy and achieving the ROs for the Site. System modifications may be performed in the future as water levels rise and PCE concentrations in groundwater decrease. Modifications may include decreasing the injection rate at INJ-2 while increasing the injection rate and INJ-1. This may also involve the periodic shut down of the pump-and-treat system to evaluate the effectiveness of MNA in meeting the remedial strategy and achieving the ROs. Should MNA demonstrate effectiveness in meeting the ROs, the pump-and-treat system will be decommissioned; however, long-term groundwater monitoring will continue until the Site is removed from the registry.

8.0 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.

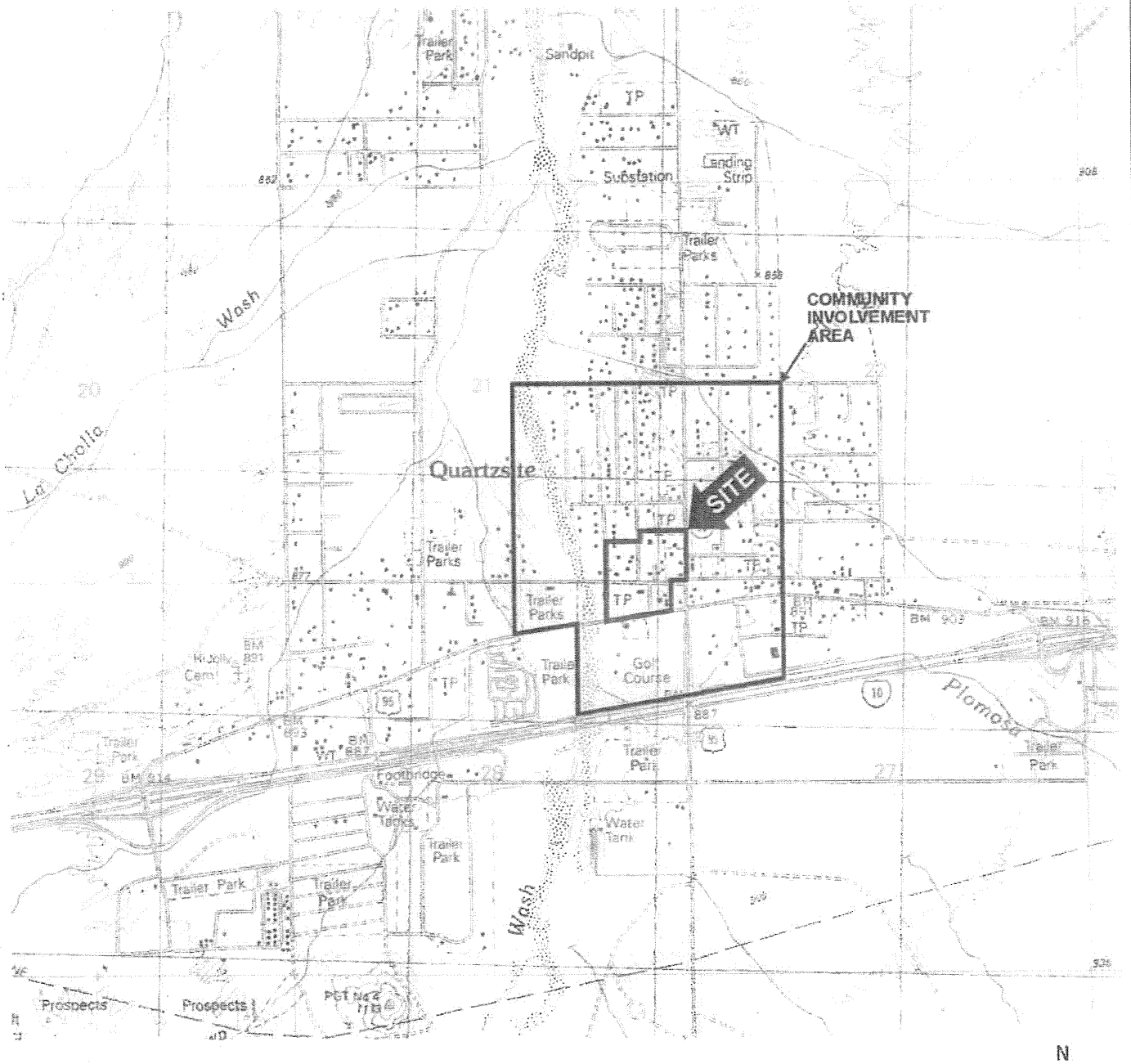
MACTEC, 2003. *"Remedial Investigation Report, Tyson Wash WQARF Site, Quartzsite, Arizona"* prepared by MACTEC for ADEQ and dated June 30, 2003

MACTEC, 2007. *"Feasibility Study Report, Tyson Wash WQARF Site, Quartzsite, Arizona"* prepared by MACTEC for ADEQ and dated June 23, 2007

MACTEC, 2008. *"Proposed Remedial Action Plan, Tyson Wash WQARF Site, Quartzsite, Arizona"* prepared by MACTEC for ADEQ and dated June 2, 2008

FIGURES

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



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

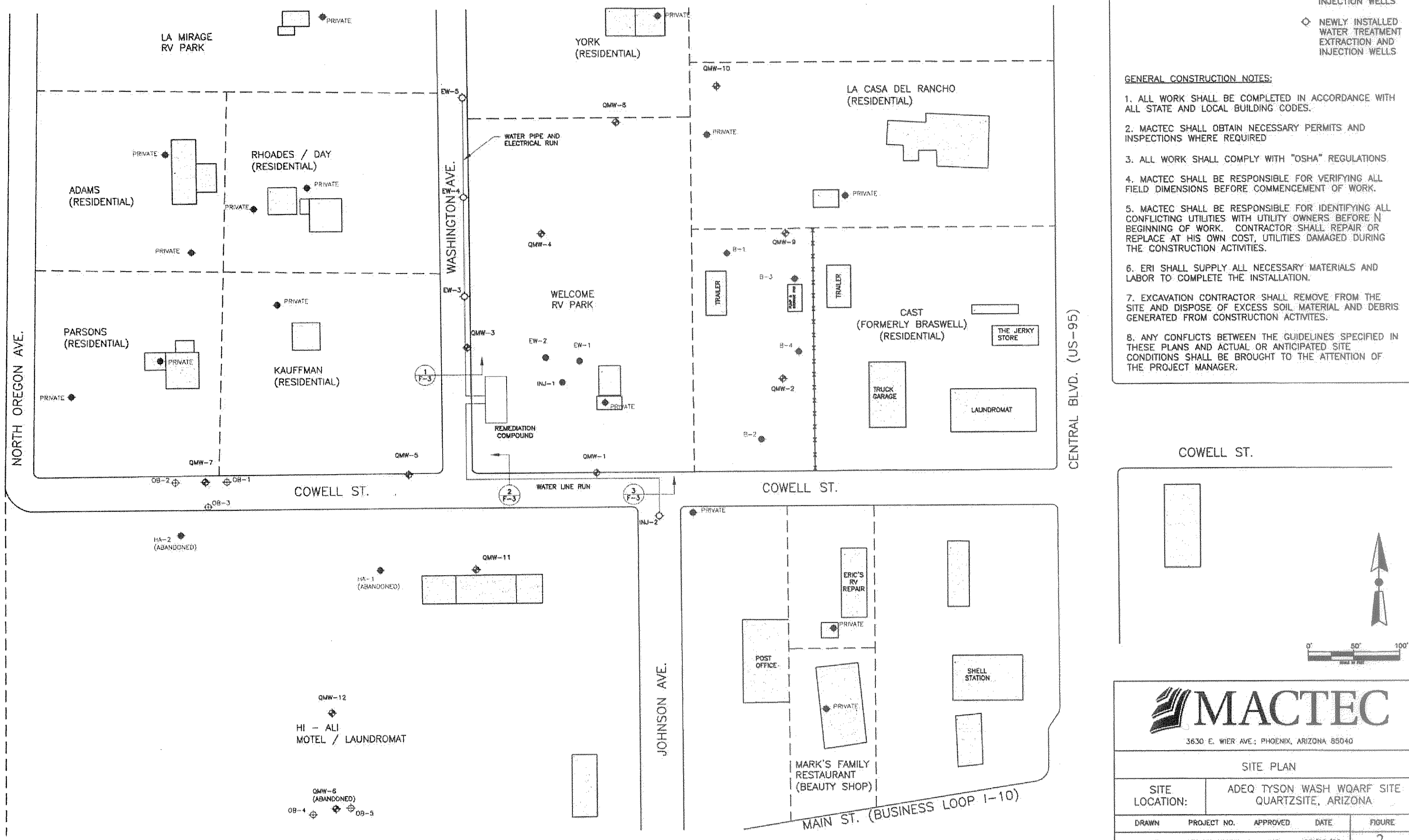
DRAWN	PROJECT NUMBER	APPROVED	DATE
DANIEL L. KUDLICKI	661026	SAW	7/12/2001

EXPLANATION

- QMW-2 ⊕ MONITORING WELL
- B-4 ◆ DOMESTIC WELL
- OB-4 ⊕ OBSERVATION WELL
- EW-1 ● WATER TREATMENT EXTRACTION AND INJECTION WELLS
- ◇ NEWLY INSTALLED WATER TREATMENT EXTRACTION AND INJECTION WELLS

GENERAL CONSTRUCTION NOTES:

1. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH ALL STATE AND LOCAL BUILDING CODES.
2. MACTEC SHALL OBTAIN NECESSARY PERMITS AND INSPECTIONS WHERE REQUIRED
3. ALL WORK SHALL COMPLY WITH "OSHA" REGULATIONS
4. MACTEC SHALL BE RESPONSIBLE FOR VERIFYING ALL FIELD DIMENSIONS BEFORE COMMENCEMENT OF WORK.
5. MACTEC SHALL BE RESPONSIBLE FOR IDENTIFYING ALL CONFLICTING UTILITIES WITH UTILITY OWNERS BEFORE N BEGINNING OF WORK. CONTRACTOR SHALL REPAIR OR REPLACE AT HIS OWN COST, UTILITIES DAMAGED DURING THE CONSTRUCTION ACTIVITIES.
6. ERI SHALL SUPPLY ALL NECESSARY MATERIALS AND LABOR TO COMPLETE THE INSTALLATION.
7. EXCAVATION CONTRACTOR SHALL REMOVE FROM THE SITE AND DISPOSE OF EXCESS SOIL MATERIAL AND DEBRIS GENERATED FROM CONSTRUCTION ACTIVITES.
8. ANY CONFLICTS BETWEEN THE GUIDELINES SPECIFIED IN THESE PLANS AND ACTUAL OR ANTICIPATED SITE CONDITIONS SHALL BE BROUGHT TO THE ATTENTION OF THE PROJECT MANAGER.



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SITE PLAN

SITE LOCATION:	ADEQ TYSON WASH WQARF SITE QUARTZSITE, ARIZONA

DRAWN	PROJECT NO.	APPROVED	DATE	FIGURE
MDF	4972-04-2100.4.2	JNC	09/02/05	2

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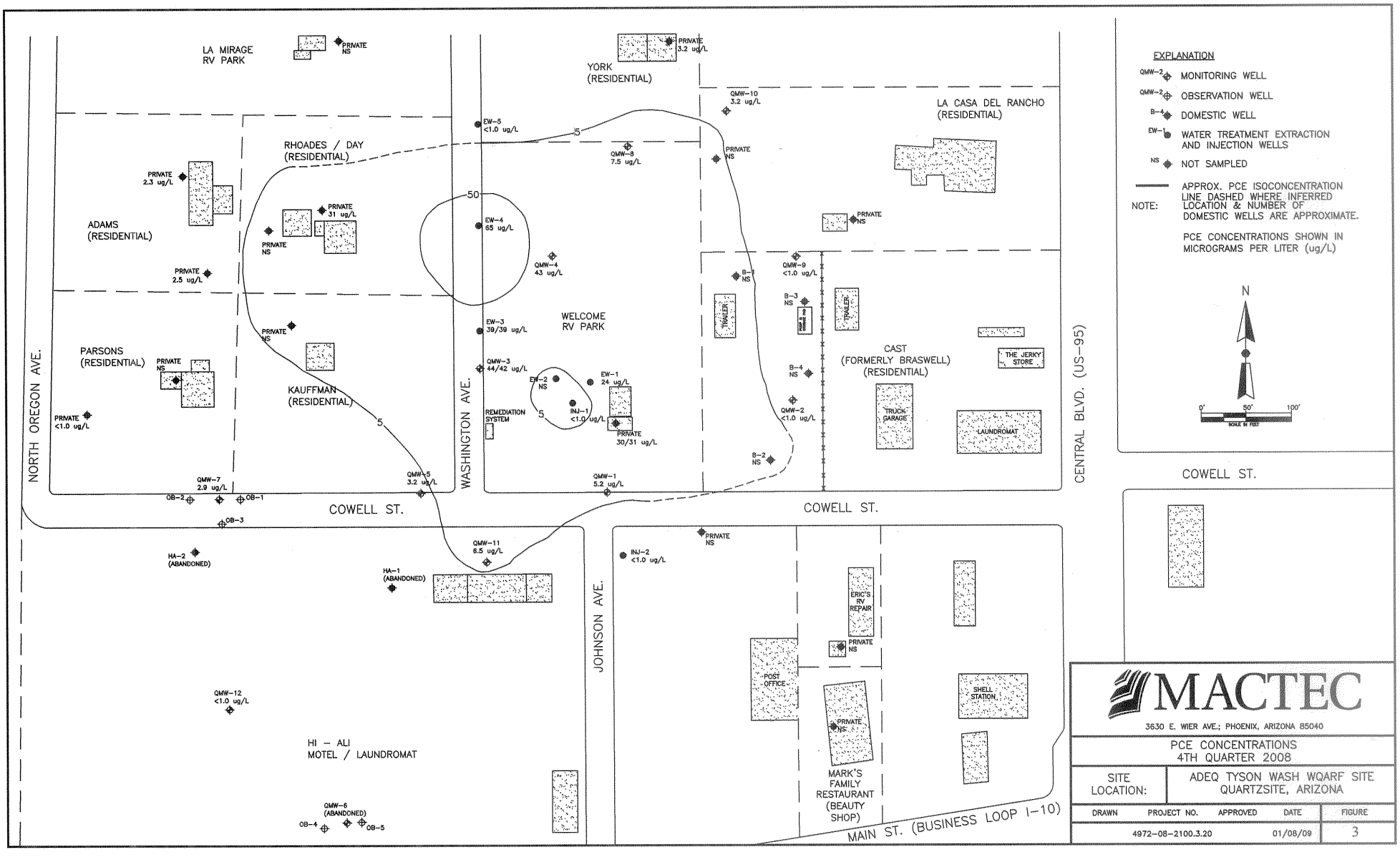

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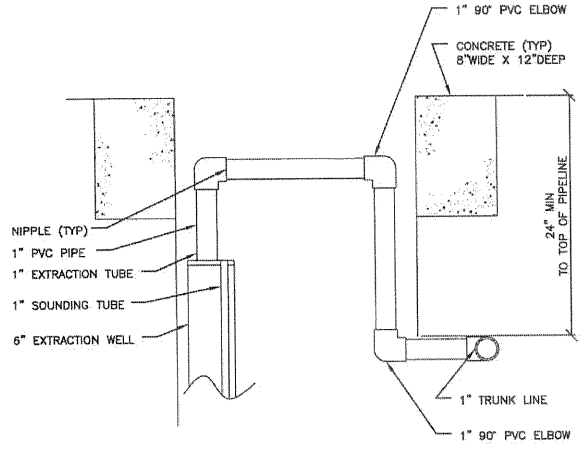
PCE CONCENTRATIONS
4TH QUARTER 2008

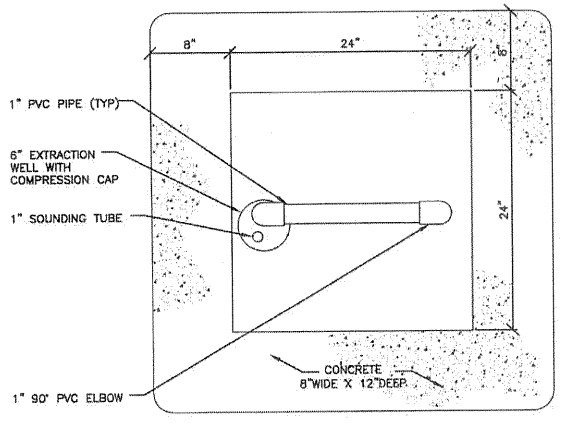
SITE LOCATION:	ADEQ TYSON WASH WQARF SITE QUARTZSITE, ARIZONA			
DRAWN	PROJECT NO.	APPROVED	DATE	FIGURE
	4972-08-2100.3.20		01/08/09	3

APPENDICES

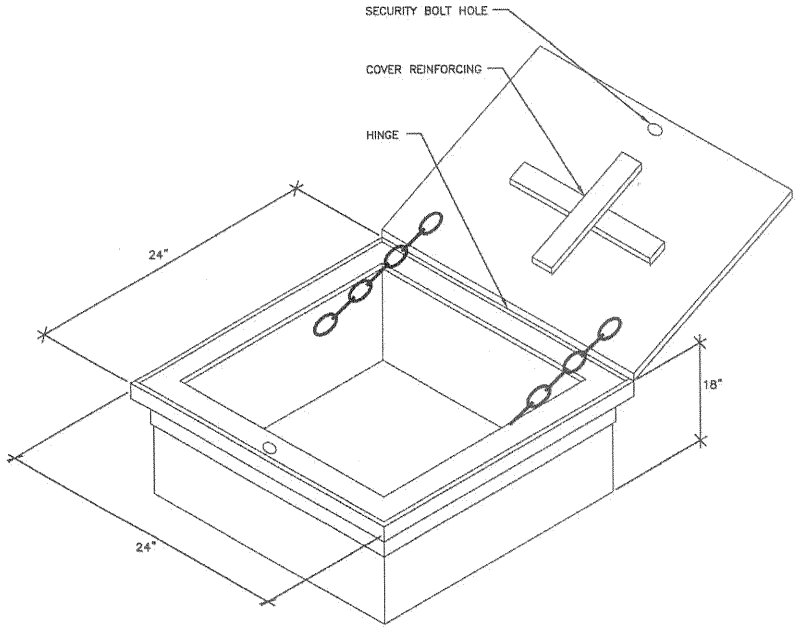
APPENDIX A

REMEDIATION SYSTEM CONSTRUCTION SCHEMATICS





EXTRACTION WELL VAULT
SCALE: 1" = 1'-0"



WELLHEAD & VAULT COVER
SCALE: 3/8" = 1'-0"

MACTEC
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WELLHEAD DETAILS & ENTRANCE

SITE LOCATION:	ADEQ TYSON WASH WQARF SITE QUARTZSITE, ARIZONA			
DRAWN	PROJECT NO.	APPROVED	DATE	FIGURE
MDF	4972-04-2100.4.2	JNC	09/02/05	1

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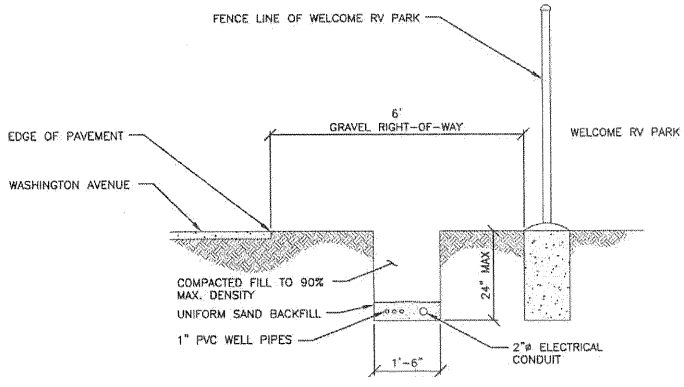
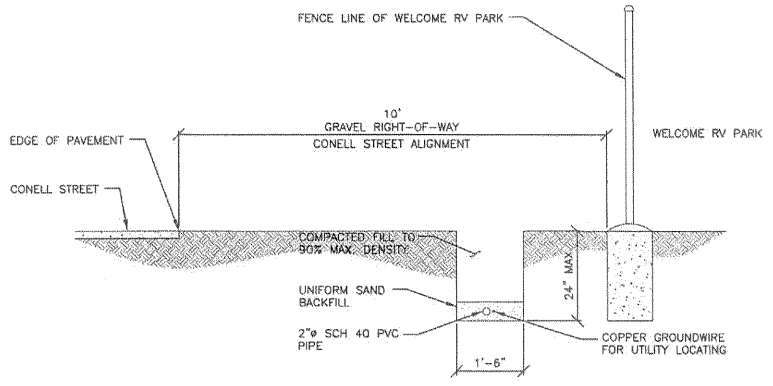
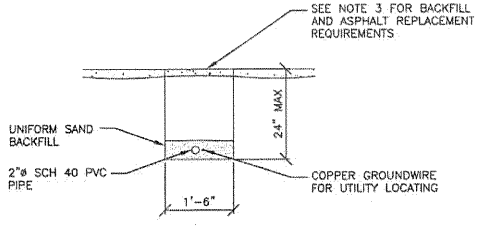


1 – EXTRACTION PIPE TRENCH DETAIL
SCALE: 3/8" = 1'-0"



2 – INJECTION PIPE TRENCH DETAIL
SCALE: 3/8" = 1'-0"



3 – COWELL STREET CROSSING
SCALE: 3/8" = 1'-0"

NOTES:
1. TRENCH LOCATION ON RIGHT-OF-WAY CAN BE ADJUSTED LATERALLY TO AVOID CONFLICT WITH EXISTING UTILITIES

2. PIPE MUST BE GENTLY SLOPED DOWNWARD FROM SYSTEM COMPOUND TO WELLHEAD

3. FOR SOIL BACKFILL AND RECONSTRUCTION OF THE ASPHALT CONCRETE PAVEMENT SECTIONS THE MATERIALS, CONSTRUCTION PROCEDURES, AND OPERATIONS SHALL CONFORM TO THE FOLLOWING SECTIONS OF THE MARICOPA ASSOCIATION OF GOVERNMENTS UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION: SECTION 206 FOR EXCAVATION AND BACKFILL, SECTION 301 FOR SUBGRADE PREPARATION, SECTION 310 FOR AGGREGATE BASE COURSE, AND SECTION 321 FOR ASPHALT CONCRETE PAVEMENT.

THE THICKNESS OF THE REPLACEMENT AGGREGATE BASE COURSE AND ASPHALT CONCRETE PAVEMENT SECTIONS SHALL MATCH THE EXISTING PAVEMENT SECTIONS WITHIN THE ROADWAY IMPROVEMENT AREA.

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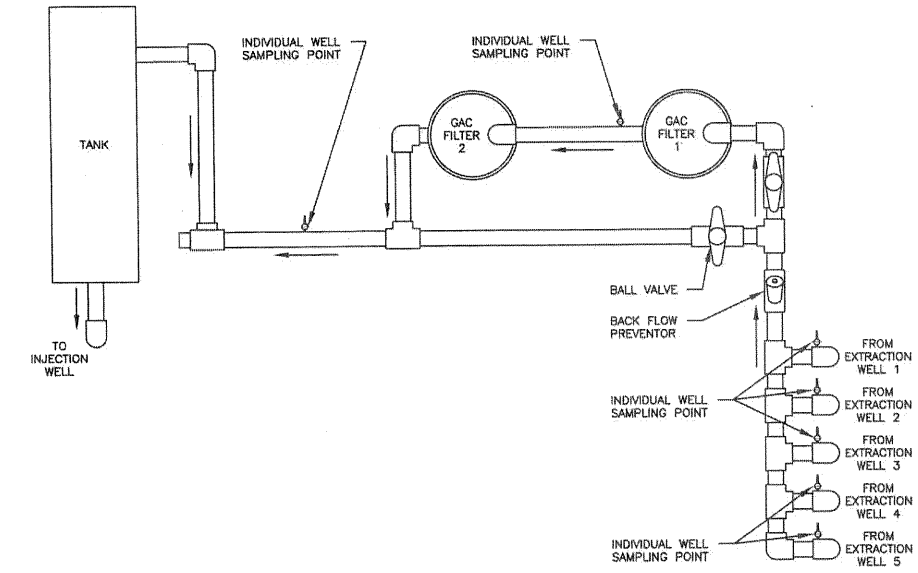
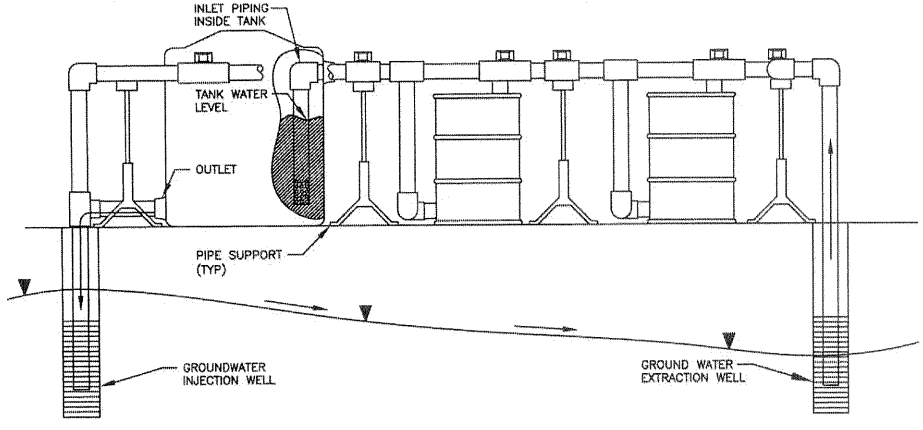
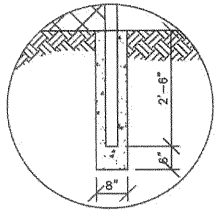
TRENCH DETAILS

SITE LOCATION:	ADEQ TYSON WASH WQARF SITE QUARTZSITE, ARIZONA			
DRAWN	PROJECT NO.	APPROVED	DATE	FIGURE
MDF	4972-04-2100.4.2	JNC	09/02/05	2

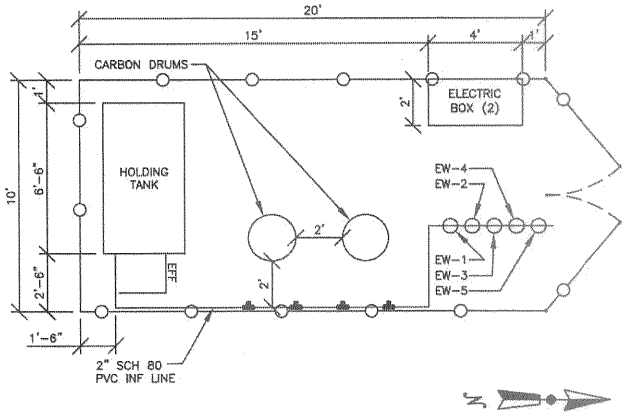


ABOVE GROUND TANK & MANIFOLD CONFIGURATION
SCALE: 3/16" = 1'-0"

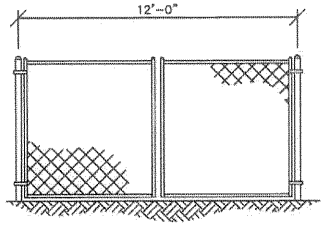




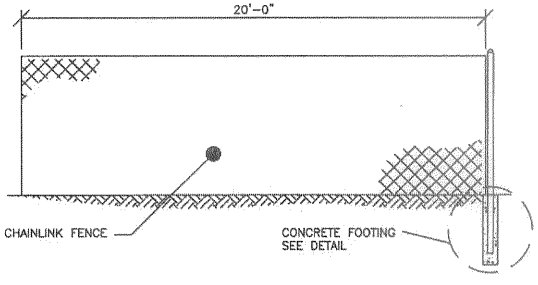
FOOTING DETAIL (TYP)
SCALE: 3/8" = 1'-0"



WATER TREATMENT COMPOUND
SCALE: 3/16" = 1'-0"



FRONT ELEVATION



SIDE ELEVATION

REMEDIATION FENCE
SCALE: 3/16" = 1'-0"

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ENCLOSURE DIAGRAM

SITE LOCATION:	ADEQ TYSON WASH WQARF SITE QUARTZSITE, ARIZONA			
DRAWN	PROJECT NO.	APPROVED	DATE	FIGURE
CJE	4972-07-2100.8.0		07/19/07	3

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