URS

PROPOSED REMEDIAL ACTION PLAN (PRAP) SHALLOW GROUNDWATER SYSTEM WEST OSBORN COMPLEX REGISTRY WQARF SITE PHOENIX, ARIZONA

Prepared by
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LIST OF ACRONYMS	
1,1-DCE	1,1-dichloroethene
A.A.C	Arizona Administrative Code
AEC	Applied Environmental Consultants
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
ADWR	Arizona Department of Water Resources
A.R.S	Arizona Revised Statute
AWQS	Aquifer Water Quality Standards
BCC	Brown and Caldwell Consultants
BHHRA	baseline human health risk assessment
CAB	Community Advisory Board
CIP	Community Involvement Plan
COC	contaminants of concern
COP	City of Phoenix
COPC	Chemicals of Potential Concern
CTE	central tendency exposure
EPA	Environmental Protection Agency
ERA	Early Response Action
EW	Extraction well
FS	Feasibility Study
ft/ft	feet per foot
GPL	Groundwater Protection Level
gpm	gallons per minute
HI	Hazard Index
IW	injection well
LAU	Lower Alluvial Unit
LGAC	liquid-phase granular activated carbon
LSGS	Lower Sand and Gravel Subunit
MAU	Middle Alluvial Unit
MCL	Maximum Contaminant Level
MFGU	Middle Fine-Grained Unit
MNA	monitored natural attenuation
mg/kg	milligrams per kilogram
NCP	North Canal Plume
NPV	net present value
P&T	pump and treatment
PCE	tetrachloroethene
ROs	Remedial Objectives
PRAP	Proposed Remedial Action Plan
RI	Remedial Investigation
RME	reasonable maximum exposure
SGWS	Shallow Groundwater System
SRL	Soil Remediation Level
SRP	Salt River Project

LIST OF ACRONYMS	
SRV	Salt River Valley
SVE	soil vapor extraction
TCA	1,1,1-trichloroethane
TCE	trichloroethene
UAU	Upper Alluvial Unit
UIC	United Industrial Corporation
VOC	volatile organic compound
WCC	Woodward-Clyde Consultants
WCP	West Central Phoenix
WOC	West Osborn Complex
WQARF	Water Quality Assurance Revolving Fund
µg/L	micrograms per liter

1.0 INTRODUCTION

1.1 PURPOSE OF DOCUMENT

URS has been retained by the Arizona Department of Environmental Quality (ADEQ), to prepare this Proposed Remedial Action Plan (PRAP) for the West Osborn Complex (WOC) Water Quality Assurance Revolving Fund (WQARF) Site (WOC Site), located in Phoenix, Arizona. There are two plumes associated with the WOC Site; the Shallow Groundwater System (SGWS) plume and the Lower Sand and Gravel Subunit (LSGS) plume. ADEQ is required under Arizona Revised Statute (A.R.S.) §49-287.04 to issue a PRAP for the proposed remedy of the SGWS plume to the public for review and comment. This PRAP was prepared in accordance with Arizona Administrative Code (A.A.C.) R18-16-408 and summarizes information contained in the following documents:

- Remedial Investigation (RI) Report (GeoTrans, 2004b); and
- Final Feasibility Study (FS) Report for the Shallow Groundwater System (Geotrans, 2012a).

The information contained in the PRAP is drawn from and, in many cases, quotes directly from the above-referenced RI and FS Reports without attribution other than that noted here.

The purpose of the PRAP is to inform the public on the proposed remedy selected from the alternatives evaluation in the FS to address the SGWS plume and satisfy the cleanup goals that include site specific Remedial Objectives (ROs) (ADEQ, 2005). The PRAP is part of the final remedy selection process under WQARF where public input is solicited on all alternatives and on the rationale for proposing the preferred remedy. New information that ADEQ receives during the public comment period could result in the selection of a final remedy that differs from the Proposed Remedy. Therefore, the public is encouraged to review and comment on all the alternatives presented in this PRAP. Information on public participation activities associated with this PRAP is provided in Section 10.

1.2 SITE NAME AND LOCATION

The WOC Site is located in Phoenix, Arizona, and consists of the WOC Facility and two groundwater plumes originating from it; the SGWS plume and the LSGS plume. The WOC Site was originally designated as the West Central Phoenix (WCP) WQARF Site. However, in 1998, the WCP WQARF Site was divided into five WQARF Registry Sites, one of which is the current WOC Site.

The WOC Facility consists of three adjoining properties, located at 3536 (East Parcel), 3600 (Middle Parcel), and 3640 (West Parcel), West Osborn Road, in Phoenix, Arizona (see

Figure 1). The WOC Facility is bounded by the Grand Canal on the north, Osborn Road on the south, 35th Avenue on the east, and the extension of 37th Avenue on the west.

West Parcel – The West Parcel totals approximately 8 acres and is comprised of six individual parcels containing seven buildings and asphalt parking lots. Two of the seven buildings are industrial buildings, and five are multi-tenant office buildings. Until 2000, the majority of the West Parcel, with exception to the northeastern-most parcel, was owned by Mr. Charles May and occupied by May Industries, Inc. (May Industries). The May Industries' portion of the property included one industrial building that housed a precision machine shop and 2.6 acres of land in the northwest portion of the parcel. The other building, located at the northeastern corner of the parcel, was occupied by Metal Joining, an affiliate of May Industries, Inc. The parcels transferred ownership to Elm Properties, LLC in February 2000. The northeastern parcel of the West Parcel was owned by Ms. Gloria Chestnut until April 2000, when it was sold to Elm Properties, LLC.

Middle Parcel – The Middle Parcel is approximately 3.9 acres in size, partially enclosed with a chain-link fence and includes a large main building and a small storage shed located north of the main building. There are three, relatively small, unpaved dirt areas located along the western and eastern boundaries of the Middle Parcel. The remaining exterior areas are paved, primarily with asphalt. The Middle Parcel is currently owned by Delaney Family Trust. Mr. Charles Delaney purchased the property in December 1992 from Lenore U. Pincus Family Trust. A mattress and furniture liquidation and used furniture auctioning and sales company have been the tenants at the Middle Parcel since approximately December 1992.

East Parcel – The East Parcel is approximately 3.2 acres in size, completely enclosed by a chain-link fence, and contains a multi-tenant commercial/industrial building with asphalt paved driveways and parking areas. Until September 2002, the property was owned by Eugene and Laura Perri, and the main tenant was Western Dynex, Inc. Since September 2002, the East Parcel has been owned by The Seven Angels, LLC and is currently occupied by Industrial Chassis, Inc.

The WOC Site SGWS Plume is bounded approximately by the Grand Canal to the north, 31st Avenue to the east, McDowell Road to the south and 51st Avenue to the west (see Figure 2).

2.0 SITE BACKGROUND

2.1 CONTAMINATED MEDIA

The contaminated media associated with this PRAP is groundwater, specifically the SGWS. The contaminants of concern (COCs) associated with the SGWS plume are trichloroethene (TCE), tetrachloroethene (PCE), and 1,1-dichloroethene (1,1-DCE). These contaminants are also collectively referred to as volatile organic compounds (VOCs) within this PRAP. Early response actions (ERAs) completed at the WOC Site have addressed contamination in other media (i.e., soils).

2.2 HISTORY OF WASTE GENERATION AND DISPOSAL

The complete history of development at the WOC Site was summarized in the RI (GeoTrans, 2004b) and the FS (GeoTrans, 2012a) Reports. The following provides a brief history of chemical usage, waste generation or disposal activities conducted at the WOC Site.

Topp Industries, Inc. purchased the property in July 1959 and merged with United Industrial Corporation (UIC) the same month, with UIC as successor in the merger. In May 1962, the property was acquired by Nucor Corporation, which sold the property to Components, Inc. in October 1965. Components, Inc. sold the property in June 1971 to Corning Glass Works who maintained Components, Inc. as a new subsidiary of Corning Glass Works. Each of these owners manufactured electronic components, where solvents, including TCE and/or 1,1,1-trichloroethane (TCA), were used in the processes. Between 1976 and 1978, Components, Inc., subdivided the WOC Facility into three separate properties (the East, Middle, and West Parcels).

The **East Parcel** was purchased by Eugene and Laura Perri in November 1976. Western Dynex, Inc. was one of the main tenants that assembled computer disk drives at the East Parcel from November 1976 through September 2002. The **Middle Parcel** was purchased by Marbar Corporation (controlled by the Pincus family) in October 1976. Lansdale Transistor & Electronics, Inc. followed by Lansdale Semiconductor, Inc. produced transistors and semiconductors on the Middle Parcel from November 1976 to December 1992. The **West Parcel** was sold to Mr. Charles May in June 1978 and operated as a multiple-tenant office and industrial park with many businesses that included: May Industries, Inc., Metal Joining, Arizona Textile, and Aztec Chemical. In the operations conducted at all three parcels TCE and/or TCA were used.

When the WOC Facility was first developed in 1957 on-site systems consisting of five septic tanks and 17 seepage pits were used for wastewater disposal. Although the time period over which contamination occurred is unknown, it is believed that TCE was introduced to the ground via drainage from seepage pits between 1957 and 1965. Additionally, TCE contamination is believed to have impacted the LSGS aquifer via the WOC irrigation well (Pincus Well), a

581-foot deep well located at the northern end of the Middle Parcel of the WOC Facility. TCE use at the WOC Facility was discontinued in 1980.

The detailed history of site investigations and ERAs completed at the WOC Site was summarized in the RI (GeoTrans, 2004b) and the FS (GeoTrans, 2012a) Reports. The following provides brief summaries of the main events and investigative/ERA milestones for the WOC Site:

- **1982:** The City of Phoenix (COP) detected TCE in four municipal public supply wells; COP wells #70, #71, #151, and #152. Since the TCE concentrations exceeded the U.S. Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 5 micrograms per liter (µg/L) in COP wells #70 and #71, located downgradient of the WOC Facility, they were immediately shut down.
- **1983 – 1989:** The Arizona Department of Health Services (ADHS), Salt River Project (SRP), and the COP confirmed the presence of volatile organic compounds (VOCs) in the groundwater with sampling in 1983, 1985, and 1986. COP wells #151 and #152 were taken off-line on March 7, 1989. ADHS also identified dissolved-phase VOCs in the on-site WOC Irrigation Well (Pincus Well).
- **1987:** Woodward-Clyde Consultants (WCC) under a contract with Lansdale assessed shallow soils on the Middle Parcel for VOCs (WCC, 1987).
- **1989:** Earth Technology Corporation (Earth Tech) began regional groundwater investigations for ADEQ (Earth Tech, 1989; 1994; 1996). ADEQ also completed a preliminary assessment and recommended further investigations based on evidence of historic TCE usage at the WOC Facility. This was followed by site inspections of all three WOC Facility parcels (ADEQ, 1989a,b,c), as well as completion of a soil-gas survey on all three parcels in conjunction with drilling operations as part of the site investigations.
- **1991:** Applied Environmental Consultants (AEC) completed a Phase I RI/FS on the West Parcel of the WOC Facility on behalf of May Industries to identify any soil contamination (AEC, 1991).
- **July 1991 – 1992:** Brown and Caldwell Consultants (BCC) on behalf of Components, Inc. began a preliminary site characterization of the WOC Facility that included a geophysical survey and a subsurface soil investigation. In addition, BCC installed five groundwater monitoring wells (MW-1S thru MW-5S) into the SGWS at the WOC Facility, which were sampled twice along with the Pincus Well (BCC, 1992).
- **February 1996:** Earth Tech sampled the five groundwater monitoring wells at the WOC Facility for ADEQ (Earth Tech, 1996).
- **1996 - 1997:** UIC completed the RI Phase I and Phase II Soil Investigations, which included: excavation and sampling of test trenches and pits to locate waste disposal features (septic tanks, tile lines, and seepage pits); drilling of soil borings in potential source areas to determine the horizontal and vertical extent of the VOC contamination;

and evaluation of potential releases from piping. During this time, the contents of all five septic tanks (ST-1 thru ST-5) were removed. Additionally, four of these tanks (ST-1, ST-2, ST-3 and ST-5) and the associated piping connected to seepage pits were also completely removed (GeoTrans, 2004b).

- **July 1996:** Ten groundwater monitoring wells (MW-6S, MW-7S, MW-2M, MW-3M, MW-4M, MW-6M, MW-7M, MW-4L, MW-6L and MW-7L) were installed in the SGWS (S-series wells), LSGS (M-series wells), and Middle Alluvial Unit (MAU; L-series wells) at locations designated in the 1996 Consent Decree. Monitoring and sampling of the newly installed and existing groundwater monitoring wells began.
- **1997:** Nine groundwater monitoring wells (MW-100S, MW-101S, MW-102S, MW-103S, MW-104S, MW-102M, MW-105M, MW-106M, and MW-13M) were installed in the SGWS and LSGS pursuant to ADEQ approvals. Monitoring and sampling of these wells began, in conjunction with the monitoring and sampling of the existing 15 wells.
- **December 1997 – 2007:** Five additional monitoring wells (MW-201S, MW-107M, MW-108M, and MW-110M) were installed over the next 10 years to define the lateral extent of the TCE impacts to the SGWS and LSGS. All installed wells were added to the groundwater monitoring network upon their completion.
- **January 1998**: The SRP constructed the lining of the Grand Canal located adjacent to the north boundary of the WOC Facility. Prior to 1998, the unlined Grand Canal in the vicinity of the WOC Facility served as a source of groundwater recharge. When the canal was lined, groundwater levels immediately began to decline and wells MW-3S, MW-4S, MW-5S, and MW-102S went dry.
- **June 1999 – October 2002**: A soil vapor extraction (SVE) system was installed as part of an ERA to remove VOCs in the vadose zone at the Middle Parcel of the WOC Facility. The primary objective of this ERA was to reduce the mass of contaminants in the vadose zone to prevent further leaching to, and contamination of, groundwater. The SVE system was operated from August 1999 to October 2002 and approximately 449 pounds of VOCs were removed from the vadose zone. Confirmation soil borings and soil sampling were completed to evaluate the progress of the SVE remediation. Based on these results, ADEQ approved permanent shutdown of the SVE system (GeoTrans, 2004a).
- **2000:** In February 2000, Roy F. Weston (currently Weston Solutions) prepared a baseline human health risk assessment (BHHRA) for the Site to evaluate potential COCs in soil and groundwater (Weston, 2000). The results of the BHHRA are summarized in Section 5.0.
- **July 2004:** GeoTrans, on behalf of UIC, issued an RI Report for the WOC Site (GeoTrans 2004b). ADEQ also issued the Land and Water Use Report for the Site (ADEQ, 2004a). In addition, the Pincus Well, which was believed to have been the conduit to the deeper contamination found at the Site, was abandoned following Arizona Department of Water Resources (ADWR) regulations.

- **May 2005:** ADEQ prepared the Final Remedial Objectives (RO) Report that incorporates the information contained in the Land and Water Use Report (ADEQ, 2005). The ROs are presented in Section 6.0.
- **June 2005 - 2006:** GeoTrans on behalf of UIC submitted an FS Work Plan for the WOC Site to ADEQ for review and approval. The FS Work Plan was approved at the end of June 2005 (GeoTrans, 2005). FS activities were implemented to evaluate specific remedial alternatives and strategies required to meet the ROs. In June 2006, as part of the FS, GeoTrans installed additional monitor wells to further define the extent of shallow groundwater contamination emanating from the WOC Facility.
- **2005 – 2010:** Groundwater sampling of the SGWS monitoring wells was conducted (at least annually) from June 2005 to September 2010. Groundwater sampling of LSGS wells was also conducted (at least annually) from July 2005 to September 2010. The groundwater sampling program was performed concurrently with additional downgradient characterization of contamination in the SGWS and LSGS, including the installation and sampling of wells MW-203S through MW-209S, and MW-203M (Geotrans, 2012a).
- **October 2007:** Dry wells MW-3S and MW-102S were replaced with wells MW-3SR and MW-102SR, drilled in the immediate vicinity of respective original wells and screened deeper in the shallow aquifer.
- **2007:** ADEQ in conjunction with UIC agreed that the SGWS and the LSGS would be further characterized and remediated separately.
- **October 2008:** As part of the FS, GeoTrans performed soil gas sampling in 7 select wells at the WOC Middle Parcel to evaluate remedial options and the potential justification for an additional source property remediation system.
- **2009:** GeoTrans (2009) on behalf of UIC prepared a draft FS Report for the SGWS plume at the WOC Site.
- **2011:** ADEQ provided comments on the draft FS Report and provided the decision to accept the remedial alternatives evaluations and the proposed remedy.
- **January 2012:** GeoTrans on behalf of UIC submitted to ADEQ, a final FS Report for the SGWS plume at the WOC Site.
- **May 2012:** GeoTrans on behalf of UIC submitted to ADEQ, a final FS Report for the LSGS plume at the WOC Site.

A map depicting SGWS groundwater monitoring well locations is included as Figure 3.

2.3 HISTORY OF ENFORCEMENT ACTIVITIES

1987: The WCP site, which included the WOC site at that time, was designated by ADEQ as a WQARF Priority List site.

1996: UIC and ADEQ entered into a consent decree in Federal Court to conduct the RI and FS at the Site, and pay oversight costs. ADEQ also received $250,000 on past and future oversight costs.

1998: The WOC Site was placed on the WQARF Registry by ADEQ with a score of 47 out of a possible 120.

2.4 PREVIOUS PUBLIC PARTICIPATION

A WCP Community Advisory Board (CAB) was formed and met on a regular basis to discuss issues and status of investigation and cleanup activities conducted at the WOC Site. These meetings were open to the public and the last meeting was held on October 22, 2009. Details of the CAB meeting agendas and minutes can be viewed on the ADEQ Web site at http://www.azdeq.gov/environ/waste/sps/reg.html. A Community Involvement Plan (CIP) was also developed for the WCP Site that was last updated in 2009. The following provides specific public participation activities that have been completed for the WOC Site; future public participation activities associated with this PRAP are provided in Section 10.0:

- **August 2004:** The RI and the Land and Water Use Reports were issued for public comments to meet the requirements under A.R.S. § 49-287.03 and A.A.C. R18-16-406. No comments were received.
- **November 2004:** A WCP CAB meeting was conducted in November, pursuant to A.A.C., R18-16-406(I)(1), to discuss the RI Report, as well as to obtain input on ROs for the Site.
- **April 2005:** ADEQ issued the Proposed RO Report for public comment. Comments were received from the public and ADEQ issued the Final RO Report in May 2005.
- **July 2005:** A notice was issued to the public indicating the availability of the Final RI Report and the Final RO Report.

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3.0 SITE CHARACTERISTICS

3.1 GEOGRAPHIC AND HYDROGEOLOGIC SETTINGS

The WOC Site is located in the West Salt River Valley (SRV), a broad, level, alluvial valley in the Basin and Range physiographic province of Central Arizona. The valley is filled with a layered mixture of unconsolidated sand, gravel, silt, and clay, also referred to as basin-fill, that have been derived from erosion of surrounding bedrock uplands. The total depth of basin-fill at the site is unknown, but is estimated at more than 1,500 feet (Brown and Pool, 1989).

The ADWR defined three hydrogeological units that generally correlate to the hydrostratigraphic units defined by the United States Bureau of Reclamation in 1976 (Corkhill et al. 1993). These include: the Upper Alluvial Unit (UAU), the Middle Alluvial Unit (MAU), and the Lower Alluvial Unit (LAU). The wells that were drilled at the WOC Site were named or identified with the suffixes S, M, and L. The L-series wells were completed in the MAU, the M-series wells were completed in the deepest part of the UAU that is part of the LSGS, and the S-series wells were completed in the upper part of the UAU that is considered the SGWS.

At the WOC Site, the aquifer unit of concern is the UAU. The UAU, which is composed mainly of silt, sand, and gravel with relatively thin, clay layers, is the most prolific water producer. The UAU has been encountered in all of the previous wells that have been drilled in the WOC Site. Most of these wells have only penetrated the top approximately one-half of the UAU. However, for wells drilled through the entire thickness of the UAU, three or four subunits can be recognized. Of particular relevance is the SGWS, consisting of silts and sands, typically present at a depth of 70-130 feet below ground surface. Deeper units in the UAU consist of the Middle Fine-Grained Unit (MFGU), typically consisting of silt and clay present beneath the SGWS, and the LSGS, a sand and gravel layer present beneath the MFGU. The LSGS is the most significant water-bearing zone in the vicinity of the WOC Site.

Hydraulic communication between the SGWS and the LSGS is believed to be minimal. The hydrostratigraphic unit between the SGWS and LSGS consists of a thick sequence of silts and clays that act as an aquitard. Groundwater flow directions and potentiometric surface elevations are significantly different in the SGWS compared to the LSGS. As a result, the two aquifers may be treated as though they are essentially hydraulically isolated and independent of each other for the purposes of remedial system design (GeoTrans, 2004b).

Groundwater flow directions and gradients at the WOC Facility have varied based on aquifer characteristics. Prior to lining of the Grand Canal in January 1998, groundwater flowed radially away from the canal at a south-southeast direction within the underlying SGWS. Following lining of the canal, flow gradients in the SGWS decreased from 0.05 to 0.001 foot per foot (ft/ft). Although flow direction in the SGWS did not significantly change at the WOC Facility, it appears to have a more westerly component south of well MW-104S. The

elevation of the water table also declined at the WOC Facility area over time by approximately 40 feet from 1996 to 2011 (Geotrans, 2012a).

3.2 NATURE AND EXTENT OF CONTAMINATION

3.2.1 Source of Release

Based on information in the RI report (GeoTrans, 2004b), it is believed that TCE was introduced to the ground via drainage from septic tanks (more specifically, the tank identified as ST-3) and associated seepage pits between 1957 and 1965. Additionally, TCE contamination is believed to have impacted the LSGS aquifer via the WOC irrigation well (Pincus Well), a 581-foot deep well located at the northern end of the Middle Parcel of the WOC Facility. TCE use at the WOC Facility was discontinued in 1980. Previous removal actions have been completed to eliminate these potential sources; the contents of all five septic tanks (ST-1 thru ST-5) were removed. Four of these tanks (ST-1, ST-2, ST-3 and ST-5) and the associated piping connected to seepage pits were also completely removed. In addition, the Pincus Well, a potential conduit of COCs from the SGWS to the LSGS, was abandoned following ADWR regulations (GeoTrans, 2004b).

Extensive soil sampling and analysis identified low levels of primarily TCE and even lower concentrations of 1,1-DCE and PCE in the vadose zone at the WOC Facility (GeoTrans, 2004b). An area in the north-northwest portion of the Middle Parcel appeared to have the largest mass of VOCs in soil. An SVE system implemented in this area removed an estimated 449 pounds of VOCs from the vadose zone soils. Geotrans has inferred that decreasing groundwater elevation following the lining of the Grand Canal may have resulted in TCE, 1,1-DCE, and PCE (that were formerly in the shallow groundwater and in the capillary zone) becoming trapped in the lower portion of the vadose zone with the potential to affect groundwater quality (Geotrans, 2012a).

A total of 257 soil samples collected from soil borings at all three parcels were analyzed for total RCRA metals. These soil borings were collected to depths up to 90 feet below ground surface. With the exception of arsenic, all RCRA metals, were detected at concentrations well below their respective Non-Residential Soil Remediation Levels (NR-SRLs), Residential Soil Remediation Levels (R-SRLs) and minimum Groundwater Protection Levels (GPLs). Arsenic exceeded the R-SRL and NR SRL (each of which is 10 mg/kg) in a total of eight samples at concentrations ranging from 11 mg/kg to 13 mg/kg, with a single sample exhibiting a concentration of 120 mg/kg. The concentration of 120 mg/kg is considered to be anomalous. All these concentrations are, however, below the minimum GPL of 290 mg/kg.

3.2.2 Soil

The ERA soil remediation conducted at the WOC facility through the use of a SVE system meets soil remediation standards established in A.R.S. §49-152 and A.A.C. R18-7-2. The confirmation soil analytical results indicated no detections of TCE (GeoTrans, 2004a). Therefore, it is noted in

the RO Report that the R-SRL and the minimum GPL of TCE at 27 milligrams per kilogram (mg/kg) and 0.61 mg/kg, respectively, had been satisfied (ADEQ, 2005). It should also be noted that TCE concentrations in soil following the ERA are also less than the 2007 R-SRL of 3.0 mg/kg and less than the January 2015 EPA Regional Screening Level (RSL) of 0.94 mg/kg. The January 2015 RSL incorporates the most current toxicity/risk data for TCE and is based on an excess cancer risk of one per million population (1E-06) and a total hazard quotient of one (1).

3.2.3 Groundwater

There are five groundwater plume sites in the WCP area consisting of: the East Grand Avenue Site, North Canal Plume (NCP) Site, North Plume Site, West Grand Avenue Site, and the WOC Site. The investigation and cleanup of the other four sites are being conducted under separate WQARF Registries. The COCs associated with the SGWS plume are TCE, PCE, and 1,1-DCE. The following summarizes the extent of SGWS groundwater contamination at the WOC Site:

- TCE at concentrations greater than the Aquifer Water Quality Standard (AWQS) of 5 µg/L extends beyond the following monitor wells: MW-3SR to the north, MW-202S to the east, MW-206S to the south, and MW-208S to the southwest (Figure 4);
- 1,1-DCE at concentrations greater than the AWQS of 7 µg/L extends beyond MW-3SR to the north and WCP-207 to the south. A detached 1,1-DCE plume also exists in the central area of the Site plume, extending from north of MW-203S to beyond MW-206S to the south-southwest (Figure 4);
- PCE at concentrations greater than the AWQS of 5 µg/L extends beyond MW-3SR to the north and WCP-207 to the south. Although PCE was reported to not be used in manufacturing processes at the WOC Facility, it was detected in soils underlying the site and in septic tanks at the site. PCE in groundwater is assumed to have also migrated into the WOC Site from different sources (GeoTrans, 2004b) (Figure 4); and
- Within the WOC Facility VOCs in the SGWS appear to have co-mingled with the NCP.

A map depicting the NCP and WOC SGWS plume boundaries is included as Figure 4. The COP is not currently operating any wells within a one-mile radius of the WOC Site plume. Two municipal wells (COP wells 70 and 71) were removed from service in 1982 due to TCE groundwater contamination at the WOC site. According to COP, loss of these wells has reduced Phoenix's overall well system capacity and ability to meet service area water demands, especially during droughts or temporary water system outages. The COP has determined that the WOC Site SGWS plume area may be considered for future well development for drought protection (ADEQ, 2005). COP well #68 is also located downgradient within the WOC Site plume. However, this well has been inactive since 1986 due to high TDS and nitrates.

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4.0 SCOPE AND ROLE OF REMEDIAL ACTION

4.1 OVERALL CLEANUP GOAL

The overall cleanup goal is to address the two groundwater plumes; one in the SWGS and the other in LSGS, associated with the WOC Site to:

- Satisfy ROs; and
- In accordance with A.R.S. §49-282.06A:
  - Assure protection of public health and welfare and the environment;
  - Provide for, as practicable, the control, management or cleanup of the hazardous substances in order to allow the maximum beneficial use of the water of the state; and
  - Be reasonable, necessary, cost-effective and technically feasible.

4.2 SCOPE OF SGWS PLUME REMEDIAL ACTION

The overall remedial strategy is to establish source control at the WOC Facility and then assess reduction of VOC concentrations in the larger, downgradient portion of the plume over time (Geotrans, 2012a). The proposed remedy for the SGWS plume (Section 9.0) will be the final action for the WOC site to reduce the toxicity, mobility, and/or volume of TCE, PCE, and 1,1-DCE found in the upper part of the UAU that will satisfy the cleanup goals presented in Section 4.1. The proposed remedy incorporates one or more remediation technology or methodology as provided in A.A.C. Rl8-16-407(F).

The remaining sections of this PRAP describes the risks associated with the COCs in groundwater, the ROs specific to the SGWS plume, and the remedial alternatives evaluation process that lead to the selection of the proposed remedy. Section 10 provides the procedures in which this PRAP will be issued for public comments. A separate PRAP will be issued to address the cleanup of the COCs in the LSGS plume.

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5.0 SUMMARY OF SITE RISKS

5.1 RESULTS OF HUMAN HEALTH RISK ASSESSMENT

As part of the RI/FS, in February 2000, Roy F. Weston (currently Weston Solutions) prepared a BHHRA for the WOC Site (Weston, 2000). The BHHRA estimated the likelihood of health problems occurring if no cleanup action were taken at the Site to address potential COCs in soil at the WOC Facility, and in groundwater at and downgradient of the WOC Facility. The BHHRA was divided into the following exposure areas and evaluated separately: surface soils, subsurface soils at four areas and groundwater at five areas. The potential COCs for soils consisted of arsenic and TCE, and the potential COCs for groundwater consisted of TCE, PCE, 1,1-DCE, bromodichloromethane, and chloroform. The risk assessment calculations for arsenic in soils are based upon soil samples which included the anomalously high concentration of 120 mg/kg (see Section 3.2.1). This resulted in a conservative estimate (i.e., overestimation) of risk from arsenic in soils; therefore, no need to remediate on-site soils was identified. The risk assessment was based on soil concentrations for samples collected prior to the SVE ERA. Following the ERA, no VOCs were detected in any of the collected soil samples. The following exposure pathways were evaluated:

- Exposure to surface soils at the WOC Facility by current on-site industrial/commercial workers and trespassers;
- Exposure to groundwater through groundwater use by current residents of downgradient neighborhoods living above contaminated groundwater; and
- Exposure to subsurface soils at the WOC Facility by current on-site construction workers, future residents, and future industrial/commercial workers.

Intakes and risks were calculated under reasonable maximum exposure (RME) and central tendency exposure (CTE) using single numbers (point estimates) for each input value. RME refers to people who are at the high end of the exposure distribution (approximately the 95th percentile). The RME scenario is intended to assess exposures that are higher than average, but are still within a realistic range of exposure. CTE refers to individuals who have average or typical intake of environmental media. The following is a summary of the RME/CTE results:

- **Current On-site Trespassers:** The total Carcinogenic Risk was 1.7E-06. This estimate of excess cancer risk is within the lower end of the acceptable risk range set by EPA and the State of Arizona of lE-06 to lE-04 (arsenic accounted for approximately 99% of the total cancer risk). The total Hazard Index (HI) was <1, below the benchmark of concern for non-carcinogens.
- **Current On-Site Industrial/Commercial Workers:** The total Carcinogenic Risk was 8.9E-06. This value is within the lower end of the acceptable risk range (arsenic

accounted for approximately 99 percent % of the total cancer risk). The total HI was <1, below the benchmark of concern for non-carcinogens.

- **Current/Future Off-Site Child and Adult Residents (Groundwater):** The total Carcinogenic Risk was 1.8E-4. This is above the acceptable risk range, where 51% of the risk was due to inhalation of VOCs during non-ingestion groundwater use, and 47% was due to groundwater ingestion (1,1-DCE accounted for about 80% of the total cancer risk). The total HI was 4.1 for child and 2.8 for adult, both above the benchmark of concern for non-carcinogens (TCE and chloroform accounted for approximately 94% of the total HI).
- **Future On-Site Child and Adult Residents (On-site Soils):** The total Carcinogenic Risk was from 1.4E-07 to 1.8E-05, depending on the location (based on arsenic and/or TCE). The total HI was <1, below the benchmark of concern for non-carcinogens.
- **Future On-Site Child and Adult Residents (Groundwater):** The total Carcinogenic Risk was 3.5E-04. This is above the acceptable risk range, where 51% of the risk was due to inhalation of VOCs during non-ingestion groundwater use, and 47% was due to groundwater ingestion (1,1-DCE accounted for about 75% of the risk). The total HI was 7.2 for child and 4.8 for adult, both above the benchmark of concern for non-carcinogens (TCE accounted for about 94% of the Total HI).
- **Future On-Site Industrial/Commercial Worker (On-Site Soil):** The total Carcinogenic Risk was greater than lE-06 but lower than lE-05 (arsenic accounted for most of the risk). The total HI was <1, below the benchmark of concern for non-carcinogens.
- **Future On-Site Industrial/Commercial Worker (Groundwater):** Total Carcinogenic Risk was 4E-05. This is within the risk range. Approximately 88% of the carcinogenic risk was due to groundwater ingestion (1,1-DCE accounted for approximately 76% of the risk). The total HI was <1, below the benchmark of concern for non-carcinogens.
- **Future On-Site Construction Worker:** The total Carcinogenic Risk was < lE-06, which is less than the lower end of the acceptable regulatory risk range. The total HI was <1, below the benchmark of concern for non-carcinogens.

The BHHRA point estimate calculations indicated TCE, 1,1-DCE, PCE, and arsenic were the primary chemicals of potential concern (COPC). The BHHRA results provided in the Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site, Phoenix, Arizona (GeoTrans, 2012a) concluded the following:

- Receptors for whom the total carcinogenic risks are less than or about equal to the lower limit of the regulatory risks range of 1E-06 to 1E-04 and for whom the non-cancer risk (i.e., HI) is below 1 are as follows:
    - On-Site trespassers.
    - Future on-Site construction workers.

- Receptors that are exposed to total carcinogenic risks within the regulatory range of 1E-06 to 1E-04 and to total HI below 1 are as follows:
  - On-Site Soil: Future on-Site child and adult residents.
  - On-Site Soil and Groundwater: Future on-Site industrial/commercial workers.
- Receptors that are exposed to total carcinogenic risks above the regulatory range of 1E-06 to 1E-04 and to total HI above 1 are as follows:
  - Groundwater: Future on-Site child and adult residents.
  - On-Site Soil and Groundwater: Future on-Site industrial/commercial workers.

The FS concludes that (Geotrans, 2012a) because no direct domestic or municipal use of groundwater is currently occurring, and no future use is planned without treatment, the groundwater exposure pathway is not complete for on- or off-site receptors. For this reason, the risks identified in the BHHRA were believed to be over-estimated for groundwater exposure at the Site. The FS further concludes that risk assessment calculations for exposure to arsenic in soils at the WOC Facility are based upon soil samples which include one anomalously high concentration of 120 mg/kg. This resulted in an overestimated risk from arsenic in soils at the WOC Facility. In addition, as discussed in Section 3.2.2, the concentrations of TCE in soil following the SVE ERA, are less than the November 2012 RSL of 0.91 mg/kg, which corresponds to a cancer risk of 1E-06. Therefore, the cancer risk corresponding to TCE in soil following the SVE ERA is less than 1E-06. Consequently, there is no need for remediation of on-site soils.

Based on the BHHRA findings and the known history of manufacturing operations at the WOC Facility (including information obtained from employee interviews conducted by the ADEQ), it was concluded that TCE, PCE, and 1,1-DCE are the only COCs for the Site (Geotrans, 2012a).

5.2 ECOLOGICAL RISK ASSESSMENT SUMMARY

Since the WOC Site is situated in fully developed areas, no ecological risk assessment was necessary and was, therefore, not conducted.

5.3 NEED FOR REMEDIAL ACTION

Based on the results of the BHHRA, the FS concluded that there is no need for remediation of on-site soils (Geotrans, 2012a). This conclusion is further supported by completion of removal actions that eliminated potential VOC sources (i.e., removal of septic tank and abandonment of the Pincus Well), and completion of an SVE ERA implemented in the apparent high VOC source area. However, the results of the BHHRA showed that remedial action is necessary to prevent exposure of COCs in groundwater for a consumptive use of groundwater. Therefore, the Proposed Remedy identified in this PRAP, or one of the other alternatives, is necessary to protect public health and/or welfare and/or the environment.

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6.0 REMEDIAL OBJECTIVES

The ADEQ prepared an RO report for the WCP WOC WQARF Registry site to meet the requirements established under A.A.C. R18-16-406 (ADEQ, 2005). The RO report relied upon the Land and Water Use Report (Use Report) prepared by ADEQ for the site dated July 2004 and the comments received on the Proposed RO report dated March 2005.

ROs were established for the current and reasonably foreseeable uses of land and waters of the state that have been or are threatened to be affected by a release of a hazardous substance. The ROs chosen for the WOC Site were evaluated in the FS and a proposed remedy is being identified in this PRAP that satisfies the ROs.

6.1 REMEDIAL OBJECTIVES FOR LAND USE

The WOC Facility is fully developed (Section 1.2) and land uses for the WOC Facility property and within the WOC Site are expected to remain predominantly industrial (A-2) or light industrial (A-1). There are no foreseeable changes for land use in the future. In addition, based on the results of the BHHRA, the FS concluded that there is no need for remediation of on-site soils. Therefore, no ROs are needed for current and reasonably foreseeable land use.

6.2 REMEDIAL OBJECTIVES FOR GROUNDWATER USE

The following current and/or potential groundwater uses were identified within the WCP WOC site: 1) the current and future use of groundwater in the WCP WOC site for drinking water purposed by the COP; and 2) the current and future use of SRP irrigation wells. The ROs for each of these uses are as follows:

1. **Current COP Municipal Use** – To restore, replace, or otherwise provide for the COP groundwater supply that has currently been lost due to PCE and/or TCE contamination associated with the WCP WOC site. This action is needed as soon as possible. This action is needed for as long as the need for the water exists, the resource remains available, and TCE and/or PCE concentrations in the water prohibits or limits its use.
2. **Future COP Municipal Use** – To protect for the use of the COP municipal groundwater supply threatened by the TCE and/or PCE contamination emanating from the Site. According to the COP, this use may be needed by the year 2010. This action would be needed for as long as the level of contamination in the identified groundwater resource threatens or prohibits its use.
3. **SRP Current and Future Municipal and Irrigation Use of the Wells** – To protect for the use of the SRP groundwater supply threatened by the TCE and/or PCE contamination emanating from WCP WOC site. According to SRP, this use may be needed as soon as is technically feasible. This action would be needed for as long as the level of contamination in the identified groundwater resource threatens or prohibits its use.

6.3 BASIS FOR SELECTING CLEANUP LEVELS

This proposed remedy will reduce the excess cancer risk associated with exposure to contaminated groundwater to an acceptable risk range between lE-06 to lE-04 and will reduce the HI to <1 for non-cancer effects. This will be achieved by reducing the concentrations of the groundwater COCs to the following target levels:

TCE	5.0 µ/L
PCE	5.0 µ/L
1,1-DCE	7.0 µ/L

Targets were selected that would reduce the risk associated with exposure to groundwater COCs to an acceptable level that will satisfy the overall clean up goals (Section 4.1) and the above ROs for groundwater use. The target levels for the COCs are based on the Arizona AWQSs, which are equivalent to EPA's MCLs established under the Safe Drinking Water Act.

7.0 SUMMARY OF REMEDIAL ALTERNATIVES

The FS Report (Geotrans, 2012a) presents the evaluation process used in developing and selecting remedial technologies, remedial measures, prescribed remedial strategies, and discharge options. Based on this process, a Reference Remedy was developed along with two alternative remedies for comparison in the FS. The Reference Remedy and each alternative remedy consist of a remedial strategy and measures to achieve the cleanup goals specified in Section 4.1 that includes the ROs for the Site. As provided in A.A.C. Rl8-16-407(F), remedial strategies that were considered when developing the Reference Remedy and each alternative remedy included one or more of the following:

- Plume remediation to achieve water-quality standards for COCs in waters of the state throughout the Site;
- Physical containment to contain contaminants within definite boundaries;
- Controlled migration to control the direction or rate of migration, but not necessarily to contain migration of contaminants;
- Source control to eliminate or mitigate a continuing source of contamination;
- Monitoring to observe and evaluate the contamination at the Site through the collection of data; and
- No action as a strategy that consists of no action at a Site.

Containment of groundwater from the source area was considered as an element of the reference remedy and the more aggressive alternative remedy, but not for the less aggressive monitored natural attenuation (MNA) alternative. Remedial measures necessary for each alternative remedy were identified with consideration of the needs of the water providers (COP and SRP) and their customers. Remedial measures will remain in effect as long as required to ensure the continued achievement of ROs. The combination of the remedial strategy and remedial measures for each alternative remedy are designed to achieve the overall cleanup goals.

The Reference Remedy and each alternative remedy also include contingent remedial strategies or remedial measures to address reasonable uncertainties regarding the achievement of cleanup goals, or uncertain time frames in which cleanup goals will be achieved. The descriptions of the Reference Remedy and the alternative remedies considered for the SGWS as presented in the FS Report (Geotrans, 2012a) are reiterated below.

7.1 REFERENCE REMEDY

The Reference Remedy consists of the installation of an estimated 30 gallons per minute (gpm) groundwater pump and treatment (P&T) system for hydraulic containment and remediation of contaminated groundwater at the downgradient margin of the WOC Facility (i.e., the source). This will be combined with system performance and groundwater monitoring. In addition, after

two years of P&T operation, monitored natural attenuation (MNA) would also be performed to address the larger portion of the plume which has migrated downgradient (south) of the WOC Facility. Since the P&T remedy is designed to contain groundwater contamination emanating from the WOC Facility, as well as the NCP, in accordance with A.A.C. Rl8-16-407(F) it provides source control.

The P&T system for the Reference Remedy is comprised of three extraction wells (EWs) to prevent the migration of VOCs emanating from both the WOC Facility and the NCP (see Figure 5). Treatment of extracted groundwater consists of bag filtration for removal of fine sediment/particulates followed by liquid-phase granular activated carbon (LGAC) for VOC removal. Discharge of the treated groundwater would be to the Grand Canal that borders the north side of the WOC Facility. During operation of the P&T system monthly water levels and quarterly sampling of the existing 12 SGWS monitoring well network would be performed, along with quarterly reporting for system performance/groundwater monitoring. After the second year of P&T system operation, a routine MNA program would be implemented. MNA would consist of conducting semi-annual groundwater monitoring of the existing SGWS well network at the Site to evaluate the efficacy of natural attenuation over time (i.e., both physical and biodegradation attenuation processes). Groundwater samples would be collected and analyzed semi-annually for VOCs, and annually for pertinent MNA parameters, including nutrients and electron donors and acceptors. Shifts in VOC composition and declining concentrations indicative of natural attenuation processes would be monitored to assess the adequacy of this remedy. Reporting of MNA monitoring results would be completed on a semi-annual basis.

To assist with conceptual design of the Reference Remedy, simplistic modeling was performed to evaluate plume capture by EWs (see Figure 6). The EPA WhAEM code was used to model two-dimensional flow. Use of WhAEM requires situations where the aquifer can be modeled as having constant thickness and is horizontal. Although neither condition may be absolutely true in the SGWS, the assumptions should be acceptable for the purpose of assessing the location and capture zones of pumping wells. Aquifer hydraulic properties used as inputs for modeling were estimated based on: 1) historic aquifer tests performed on SGWS monitoring wells MW-6S and MW-7S at the Site; 2) an aquifer test performed in 2008 on well WCP-227 at the NCP Site; 3) a limited aquifer test performed in 2009 on well MW-206S at the Site; 4) data and other information presented in a draft model of 3-dimensional flow and TCE transport (HSI GeoTrans, 2000); and 5) available ADWR groundwater models. Results of the WhAEM simulations predict that capture of the estimated full width of the upgradient portion of the SGWS plume may be accomplished using three EWs with a continuous pumping rate of 10 gpm each. After the P&T system is operational, converging lines of evidence will be used to evaluate the effectiveness of plume capture. Such evidence would include: 1) interpreting water-level measurements; 2) performing flow-rate and capture-zone width calculations; 3) conducting and interpreting capture-zone modeling; and 4) evaluating VOC concentration trends. This information will be incorporated in the system performance and groundwater monitoring reports.

Multiple permits will be necessary to authorize installation and operation of the WOC Facility P&T system, as well as for use of existing or replacement groundwater monitoring wells for use with MNA. Permitting requirements, organized by regulatory agency, are described in the FS (Geotrans, 2012a).

The most cost-effective and practical option for discharge of the estimated 30-gpm discharge is to the adjacent Grand Canal. However, the P&T system cannot discharge to the Grand Canal during the SRP's annual dry-up period for canal maintenance (typically January/early February). To avoid system shut down, the treated discharge could potentially be diverted into the COP storm or sanitary sewer, or re-injected into LSGS during the annual dry-up period. Although the FS Report (GeoTrans, 2012a) recommended diversion of the treated water to the COP sanitary sewer during maintenance on the Grand Canal, temporary shutdown of the P&T system is considered in this PRAP as a reasonable alternative to the diversion of the treated water to a secondary discharge point. The period during which the canal is dry is generally of short duration (less than a month). The potential for dissolved VOCs to be transported downgradient from the WOC facility to a point beyond the capture zone of the P&T system during the shutdown period is considered to be very low. The shutdown period could also be used as an opportunity to perform scheduled maintenance on the P&T system.

There are some uncertainties and contingencies in implementing the Reference Remedy, as follows:

- The ability to obtain the access agreements is uncertain.
- The rate and degree to which water levels decline will be influenced by the remedy pumping rates and regional groundwater recharge rates. It is possible that EWs may gradually go dry, and therefore, altering pumping strategies and/or installing replacement EWs may be necessary. Similarly, existing monitoring wells at the Site could go dry, requiring installation of replacement wells.
- In the absence of performing aquifer tests on the proposed EWs, pumping yields and induced capture zones are uncertain, and locations of EWs may need to be adjusted based upon results of aquifer testing as successive EWs are installed.
- The efficacy of natural attenuation at the Site is uncertain (Geotrans, 2012a). VOC concentration declines were observed in the WOC Facility. However, these declines probably resulted primarily from declining water levels at the WOC Facility (i.e., physical attenuation processes), and contaminant mass removal by the interim SVE system. Based on review of the historical groundwater quality data for the SGWS, evidence of dechlorination via biodegradation is not apparent (Geotrans, 2012a). Implementation of P&T at the WOC Facility will be effective in controlling the source of VOC migration. Since the SGWS will not be used for drinking water, MNA may still be an effective and acceptable remedial alternative. If MNA results indicate that natural attenuation is inadequate and/or occurring too slowly to achieve ROs within a reasonable

timeframe, then active P&T for the downgradient portion of the plume as described for the More Aggressive Remedy will need to be implemented.

7.2 MORE AGGRESSIVE REMEDY

The More Aggressive Remedy consists of the same groundwater P&T system as the Reference Remedy but includes the installation of three additional EWs for partial hydraulic containment and remediation of the SGWS aquifer at the central portion of the plume that contains the highest VOC concentrations. The estimated pumping rate of the Central Area P&T System would be approximately 300 gpm (100 gpm per EW). Groundwater treatment would consist of bag filtration removal of fine sediment/particulate followed by LGAC for VOC removal. The treated groundwater would be discharged via IWs into the LSGS of the aquifer. This will be combined with system performance and groundwater monitoring that includes use of existing monitoring wells MW-206S and AVB130-01 to evaluate capture zones of the three central EWs. In addition, two supplemental monitoring wells/piezometers, located at strategic locations either between and/or in the vicinity of the EWs, would be installed to evaluate the capture zone and water quality associated with the central area remedy pumping. After two years of operations, MNA would also be performed to address the downgradient portions of the plume which would not be actively captured and remediated by the Central Area P&T system. The MNA program for this alternative will be similar to the Reference Remedy program. In addition, since the P&T remedy at the WOC Facility is identical to the Reference Remedy, in accordance with AAC Rl8-16-407(F) this remedy provides supplemental source control.

Installation of EWs pumping at 100 gpm each at the central portion of the SGWS plume is expected to effectively contain and gradually remediate the most contaminated zone of the VOC plume (see Figure 7). Several conceptual locations of EWs have been selected based on the effectiveness of capture zone (see Figure 8). Review of vacant land area reveals that an east EW could potentially be located in an alley, between residential Parcels 108-22-045 and 108-22-047. A landscape area at the northeast corner of Parcel 103-210-001E could potentially be utilized for installation of a west EW. The LGAC treatment plant could potentially be installed in the large parking lot at the southwest end of Parcel 108-210-002R. The land development in this area is commercial and industrial, and the plant would be located near two busy roadways. LGAC treatment is not expected to pose a noise concern.

Multiple permits will be necessary to authorize installation and operation of the two P&T system, as well as for use of existing or replacement groundwater monitoring wells for use with MNA. Permitting requirements, organized by regulatory agency, are described in the FS (Geotrans, 2012a).

The recommended option for management of the Central P&T system treated water is re-injection into the LSGS utilizing two injection wells (IWs); one for typical full-flow operation, and another for use as a backup during periods of IW maintenance. There are multiple locations

with sufficient space for installation of the two IWs. However, to minimize costs, the IWs could potentially be installed on the same parcel as the Central P&T treatment plant. Alternatively, IWs could also be located in the public ROW, if necessary. In addition, the FS considered alternative management options of the treated water, such as discharge into the COP storm or sanitary sewer.

The same uncertainties and contingencies associated with the Reference Remedy apply to this More Aggressive Remedy. In addition, the uncertainties and contingencies in implementing the 2nd P&T system in central area of the VOC plume are as follows:

- The rate and degree to which water levels decline will be influenced by the remedy pumping rates and regional groundwater recharge rates. It is possible that EWs may gradually go dry, and therefore, altering pumping strategies and/or installing replacement EWs may be necessary. Similarly, existing monitoring wells at the Site could go dry. If the EWs and monitoring wells do go dry, or if sustained pumping rates are inadequate to achieve plume capture, it may be appropriate to select new locations for and/or install supplemental EWs and monitoring wells. Decisions to replace EWs would be based on actual observed pumping rates, VOC capture zones, and groundwater monitoring while the P&T system is operational.
- In the absence of performing aquifer tests on the proposed EWs, pumping yields and induced capture zones are uncertain, and locations of EWs may need to be adjusted based upon results of aquifer testing as successive EWs are installed.
- The ADEQ conducts periodic reviews of implemented groundwater remediation remedies at WQARF Sites. In this case, the effectiveness of the More Aggressive Remedy strategies and measures would be assessed at least every five years. For the P&T systems, it is recommended that converging lines of evidence be used to evaluate the effectiveness of plume capture. Such evidence would include: 1) interpreting water-level measurements; 2) performing flow-rate and capture-zone width calculations; 3) conducting and interpreting capture-zone modeling; and 4) evaluating VOC concentration trends. With this information, the ability to determine actual capture zones compared to the overall design/target capture can best be assessed.

7.3 LESS AGGRESSIVE REMEDY

The Less Aggressive Remedy involves solely MNA for SGWS groundwater that has been characterized with elevated VOCs at the WOC Site. This PRAP assumes that the entire network of 12 existing active SGWS wells would be included in the MNA program. Consistent with MNA described for the Reference Remedy, groundwater level measurements and samples would be collected on a semi-annual basis. Sample analysis for VOCs and MNA parameters would occur on a semi-annual and annual basis, respectively. Technical reporting to evaluate the direction and value of the hydraulic gradient, and to assess MNA

performance, would also occur on a semi-annual basis. Replacement wells could be necessary if declining water levels cause one or more of the existing wells to go dry, or if potential damage to a well(s) occurred preventing the ability to effectively monitor the well(s).

Minimal permits and authorizations will be necessary to implement this remedy. Permitting requirements, organized by regulatory agency, are described in the FS (Geotrans, 2012a).

The uncertainties and contingencies in implementing this MNA remedy are essentially the same as the uncertainties and contingencies of the MNA component of the Reference Remedy.

8.0 EVALUATION OF ALTERNATIVES

In accordance with the Remedy Selection Rule (A.A.C. R18-16-407), an FS was completed to identify a Reference Remedy and two alternative remedies that appear to be capable of achieving ROs. The comparison criteria used in the FS to evaluate each alternative and select a proposed remedy consisted of practicability, cost, risk, and benefit. The comparison of the three remedial alternatives to the evaluation criteria are summarized in the following table.

Alternative Remedies	Practicability	Total Cost	Risk	Benefit
Reference	This Remedy is considered practicable.	$ 4,099,500	Source control will minimize risk to potential future downgradient receptors. As source control is established, VOC reduction in the larger, downgradient portion of the plume will be monitored over time. This will provide a means to implement contingency measures, if potential future receptors are threatened by the contaminant plume.	Source control will prevent the continued migration of contaminant mass into the Site and beyond the WOC Facility boundary to reduce the time to complete remediation. The discharge from the P&T system will provide beneficial use of water for irrigation, if needed, by the SRP.
More Aggressive	Based upon the limited current and foreseeable funding available for the WQARF Program, this Remedy is considerably less practicable in terms of cost than the other two Remedies.	$ 10,415,724	Compared with the Reference Remedy, this Remedy reduces risk because of the supplemental active central area P&T system that would capture/remediate a large portion of the downgradient, central core of the plume.	In addition to the benefits described for the Reference Remedy, this Remedy conserves the groundwater resource via re-injection of the 300 GPM P&T flow from the central area. It also reduces risk when compared to the reference remedy.
Less Aggressive	Based upon the limited current and foreseeable funding available for the WQARF Program, this Remedy is considerably more practicable in terms of cost than the other two Remedies.	$ 2,690,000	This Remedy has an increased risk relative to the two other remedies, because no active remediation involving source control or containment of VOCs will be conducted. The absence of active remediation represents a greater risk to potential future downgradient receptors.	The benefit identified for this Remedy is significantly lower costs. Furthermore, all construction-related disruptions associated with installing extraction wells, conveyance pipelines, treatment plants, and/or injection wells are avoided.

Practicability – Each of the selected remedies is considered to be technically and operationally practicable.

Cost – The least costly alternative is the Less Aggressive Remedy, which relies solely on MNA with a net present value (NPV) of approximately $1.1M and total estimate of approximately $2.7M. The Reference Remedy has the median cost (NPV estimate approximately $2.1M; total estimate approximately $4.1M). The More Aggressive Remedy has the highest cost (NPV approximately $5.9M; total estimate approximately $10.4M).

Risk – The More Aggressive Remedy provides the least risk and the Less Aggressive Remedy represents the most potential risk associated with all three alternatives. The Reference Remedy is considered to provide a balance of risk between the two aforementioned remedies. It should be noted that currently, the risk posed by the existing SGWS groundwater contamination is low because of the absence of groundwater pumping for potable uses within the area. The risk posed by future use of groundwater by the COP is addressed through the operation of the P&T systems for both the SGWS and the LSGS at the Site, assuming either the Reference Remedy or More Aggressive Remedy which include active pumping are selected for the SGWS.

Benefit – The three remedies each benefit the environment through remediation of the SGWS groundwater plume over time. However, the Less Aggressive Remedy (although the most cost effective) does not contain/remediate groundwater at the source or downgradient areas, and provides less benefit that would presumably result in a longer time period to achieve cleanup goals. The Reference Remedy provides for source control P&T with downgradient MNA at costs considered practical between the Less and More Aggressive Remedies. The More Aggressive Remedy includes both source area containment/remediation, and P&T containment/remediation downgradient to addresses the central core of the plume. Contamination which is not captured by this P&T system would be addressed by MNA. Therefore, the More Aggressive Remedy provides the greatest benefit for completeness of remediation to achieve cleanup goals.

9.0 PROPOSED REMEDY

9.1 PROPOSED REMEDY AND RATIONALE FOR SELECTION

The Reference Remedy is recommended as the Proposed Remedy with a contingency (see Section 9.2.1) for implementation of the More Aggressive Remedy. The Proposed Remedy consists of a pump and treatment (P&T) system consisting of three groundwater extraction wells located at the south edge of the WOC Facility for source area control and containment, in conjunction with monitored natural attenuation of the downgradient portion of the SGWS dissolved plume. Extracted water will be filtered to remove sediment and treated with LGAC to remove VOCs. Treated water will normally be discharged to the adjacent Grand Canal. During maintenance periods for the Grand Canal (referred to as the dry-up period in the FS Report), the P&T system will be shut down. The recommendation to implement the Proposed Remedy is based on what is considered to be the best combination of remedial effectiveness, practicability, cost, and benefit for restoration and use of the SGWS resource. The Proposed Remedy will:

- Achieve the goals presented in Section 4.1, including achieving the RO's described in Section 6.0,
- Be consistent with water management plans, and
- Be consistent with general land use planning.

9.1.1 Achievement of Remedial Objectives

The SGWS Proposed Remedy and contingencies achieve the ROs for the Site when combined with the potential remedial measures to be implemented for the LSGS (Geotrans, 2012b), which are presented in a separate PRAP document. The combination of the Proposed Remedies for the SGWS and LSGS will be protective of the groundwater resource for use by the COP and SRP. The Proposed Remedy also satisfies the remedial action criteria pursuant to A.R.S. §49-282.06A.

9.1.2 Consistency with Water Management Plans

In the FS the COP's Water Resources Plan, 2005 Update (COP, 2006), was reviewed to determine if the proposed remedial actions are generally consistent with the COP's written plans. Although the COP currently uses groundwater for less than 3% of its total demands, wells are reportedly important for providing water supply and infrastructure redundancy. Many of the COP's groundwater wells have been removed from service due to age, reduced efficiency, and/or groundwater contamination. The disconnection and/or abandonment of the wells due to water-quality concerns and aging equipment has left the COP capable of only meeting 10 to 15% of its peak demand with groundwater. In addition to VOCs in groundwater that have impacted COP wells located within WQARF sites, nitrate, arsenic, heavy metals, and petroleum hydrocarbons have also affected wells located outside and within WQARF sites. It is understood that wellhead

treatment facilities for arsenic and nitrate removal have been installed and currently operate as part of the COP's network for municipal water sources.

The Water Resources Plan, 2005 Update (COP, 2006) and the 2011 Water Resource Plan (COP, 2011) indicate that the COP will work closely with ADEQ and EPA on cleanup strategies for the Central Phoenix contamination issues. In Chapter 5 of the 2005 Update, Strategic Concepts, the COP considered environmental benefits and costs in the analysis of water supply and demand management efforts. This section stated that "strategic location and operation of wells may also bring benefits with regard to plume containment and cleanup efforts. As potential well sites are evaluated, ongoing or planned plume remediation efforts would be considered to determine if the locations would support such efforts without compromising the quality of the water supply." URS reviewed the COP's Water Resources Plan, (COP, 2011) to determine if the proposed, remedial actions are generally consistent with the COP's most current written plan. The COP has identified a need to substantially rebuild its well capacity for drought redundancy, operating flexibility, and system emergencies. In correspondence and discussions with the ADEQ and EPA, the COP has emphasized that the Central Phoenix Aquifer is an important future water supply that the COP will need to be able to access.

The Proposed Remedy for the SGWS, in combination with recommended remedial strategies and measures for the LSGS (GeoTrans, 2012b), are believed to be consistent with the COP's 2005 and 2011 updates to its published water management plan. In addition, discharging treated water from the WOC Facility P&T system into the adjacent Grand Canal, which is part of the SGWS Proposed Remedy, will augment the SRP's existing irrigation water supply.

9.1.3 Consistency with General Land Use Planning

As discussed in the RO Report (ADEQ, 2005) and FS Report (Geotrans, 2012a), the zoning pattern in the area of the Site has long been established, and there are no foreseeable changes for the future. The Proposed Remedy is considered to be consistent with Current and Future Land Use and provides for adequate protection of public health and welfare and the environment.

Installation of a P&T system (extraction wells, pipelines, treatment systems, and associated utilities) at the conceptual locations identified in the FS will require negotiations for land access with the private land owner or owners (WOC Facility property, see Figure 5). Although formal discussions regarding access have not been initiated, the current configuration and use of the properties suggests that the installation of a P&T system is feasible.

9.2 CONTINGENCIES

The Proposed Remedy includes monitoring existing SGWS groundwater wells to: a) evaluate plume capture for the P&T system; and b) evaluate the attenuation of the downgradient portion of the dissolved VOC plume. The FS Report proposed periodic monitoring on a quarterly basis

for 2 years followed by semi-annual (twice per year) periodic monitoring for subsequent years while the Proposed Remedy is in effect.

9.2.1 Contingency for Lack of Downgradient Attenuation

Between 2007 and 2014, TCE concentrations in MW-208S, the most downgradient of the wells within the SGWS at WOC, have shown a general downward trend (see Figure 9). The concentration trend in MW-208S will continue to be monitored on a regular basis (as described in Section 9.2) following implementation of the Reference Remedy to evaluate for attenuation. If, within the initial 2 years of implementation of the Reference Remedy, monitoring results indicate a lack of attenuation in the downgradient portion of the VOC plume, a contingency remedial action will be implemented.

The contingency remedial action will be the More Aggressive Remedy as described in Section 7.2 and will consist of the installation of three extraction wells (with extraction rates estimated at 100 gpm each) within the central portion of the SGWS plume. Extracted water will be filtered to remove sediment and treated with LGAC to remove VOCs. Treated water will be discharged to an injection well to be installed and screened within the LSGS. A second injection well to be installed and screened within the LSGS will provide a backup during IW maintenance.

9.2.2 Contingency for Inadequate Capture of the VOC plume across the WOC Facility

Should monitoring results indicate inadequate capture of the VOC plume across the WOC Facility, additional contingency actions may be implemented.

The FS Report indicated that possible contingency actions include:

- Increasing the pumping rate from one or more EWs to expand plume capture;
- Installing additional EWs and connecting them to the P&T systems to enhance plume capture; and
- Installing supplemental monitoring wells or piezometer wells, as necessary, for use with evaluating the adequacy of plume capture and attenuation of the downgradient portion of the plume.

Although modeling documented in the FS Reports indicates that a pumping rate of 10 gpm per well will achieve capture of the estimated full width of the plume, the system appurtenances will be designed to convey and treat flows exceeding these rates to allow for system expansion, if necessary.

9.2.3 Contingency for Decreasing Groundwater Elevation

If EWs go dry in response to lack of recharge in the Site vicinity, drought, and/or gradual SGWS dewatering from remedy pumping, strategies for periodic pumping could potentially be

employed to maintain plume capture and remediation. In addition, deeper replacement EWs could be installed to address significant water-level elevation declines at the Site.

9.3 LEAD AGENCY STATEMENT FOR SELECTING PROPOSED REMEDY

Based on information currently available, the ADEQ believes the Proposed Remedy and the contingency to implement the More Aggressive Remedy meet the threshold criteria and provide the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The ADEQ expects the Proposed Remedy to satisfy the remedial action criteria pursuant to A.R.S. §49-282.06 and the ROs as described in Section 6.0.

10.0 COMMUNITY PARTICIPATION

10.1 PUBLIC COMMENT PERIOD OF PRAP

The public comment period for this PRAP extended from August20, 2013 through October 21, 2013. Comments received will be incorporated into a responsiveness summary within the forthcoming Record of Decision.

10.2 ADMINISTRATIVE RECORD

Interested parties can review the PRAP and other Site documents at the Burton Barr Central Library (Arizona Room) located at 1221 N. Central Avenue in Phoenix (602) 262-4636.

The complete official Site file can also be reviewed at the ADEQ Main Office located at 1110 W. Washington Street, Phoenix. With 24-hour notice, an appointment to review related documentation is available Monday through Friday from 8:30 a.m. to 4:30 p.m., at the ADEQ Records Management Center. Please contact (602) 771-4380 or (800) 234-5677 to schedule an appointment to review these documents.

10.3 OTHER CONTACT INFORMATION

Name/Title/Address	Phone/Fax	E-mail
Kevin Snyder, ADEQ Project Manager	(602) 771-4186 (602) 771-4138 fax	kcs@azdeq.gov
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FIGURES

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Map courtesy of GeoTrans, Inc. "Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site," prepared for AAI Corporation, dated January 27, 2012 (GeoTrans, Inc. project number 2209.004).

SITE LOCATION MAP

Arizona Department of Environmental Quality
Proposed Remedial Action Plan
Shallow Groundwater System
West Osborn Complex Registry WQARF Site
Phoenix, Arizona

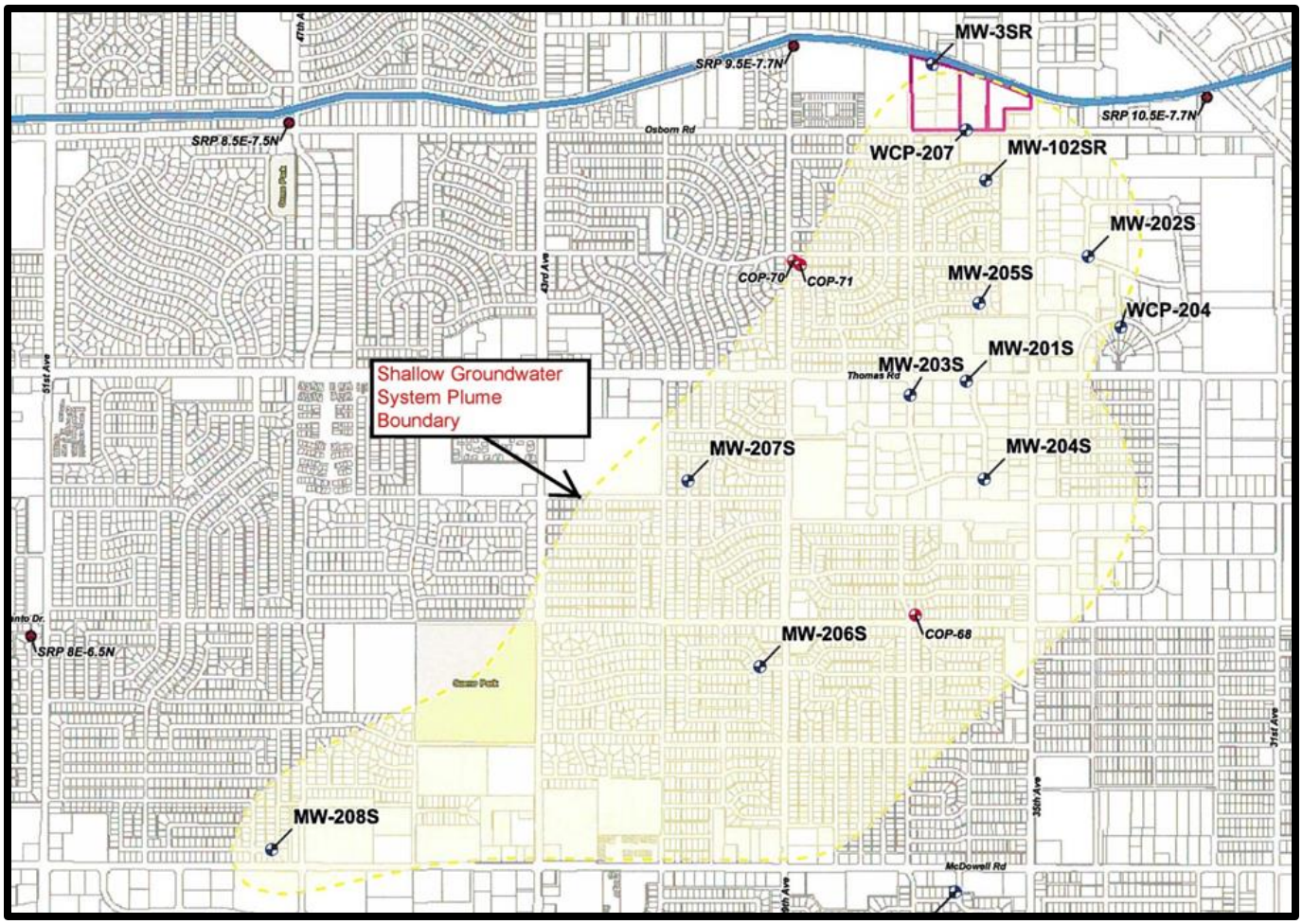
January 2015

URS

N

No Scale

FIGURE 1



Map courtesy of GeoTrans, Inc. "Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site," prepared for AAI Corporation, dated January 27, 2012 (GeoTrans, Inc. project number 2209.004).

SGWS PLUME BOUNDARY – DECEMBER 2006

Arizona Department of Environmental Quality
Proposed Remedial Action Plan
Shallow Groundwater System
West Osborn Complex Registry WQARF Site
Phoenix, Arizona

January 2015

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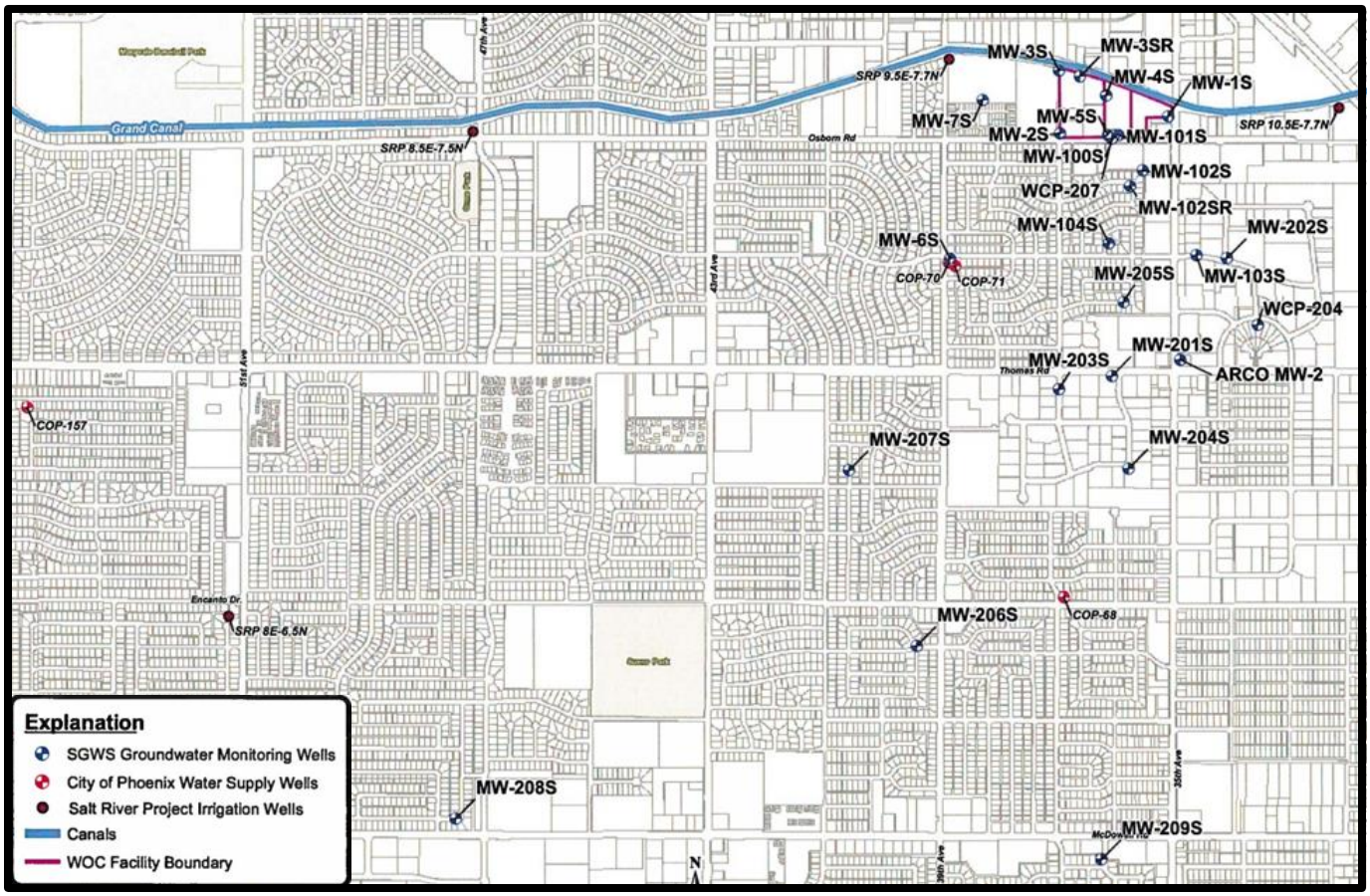
No Scale

FIGURE 2



Map courtesy of GeoTrans, Inc. "Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site," prepared for AAI Corporation, dated January 27, 2012 (GeoTrans, Inc. project number 2209.004).

SGWS GROUNDWATER MONITORING WELL LOCATIONS

Arizona Department of Environmental Quality
Proposed Remedial Action Plan
Shallow Groundwater System
West Osborn Complex Registry WQARF Site
Phoenix, Arizona

January 2015

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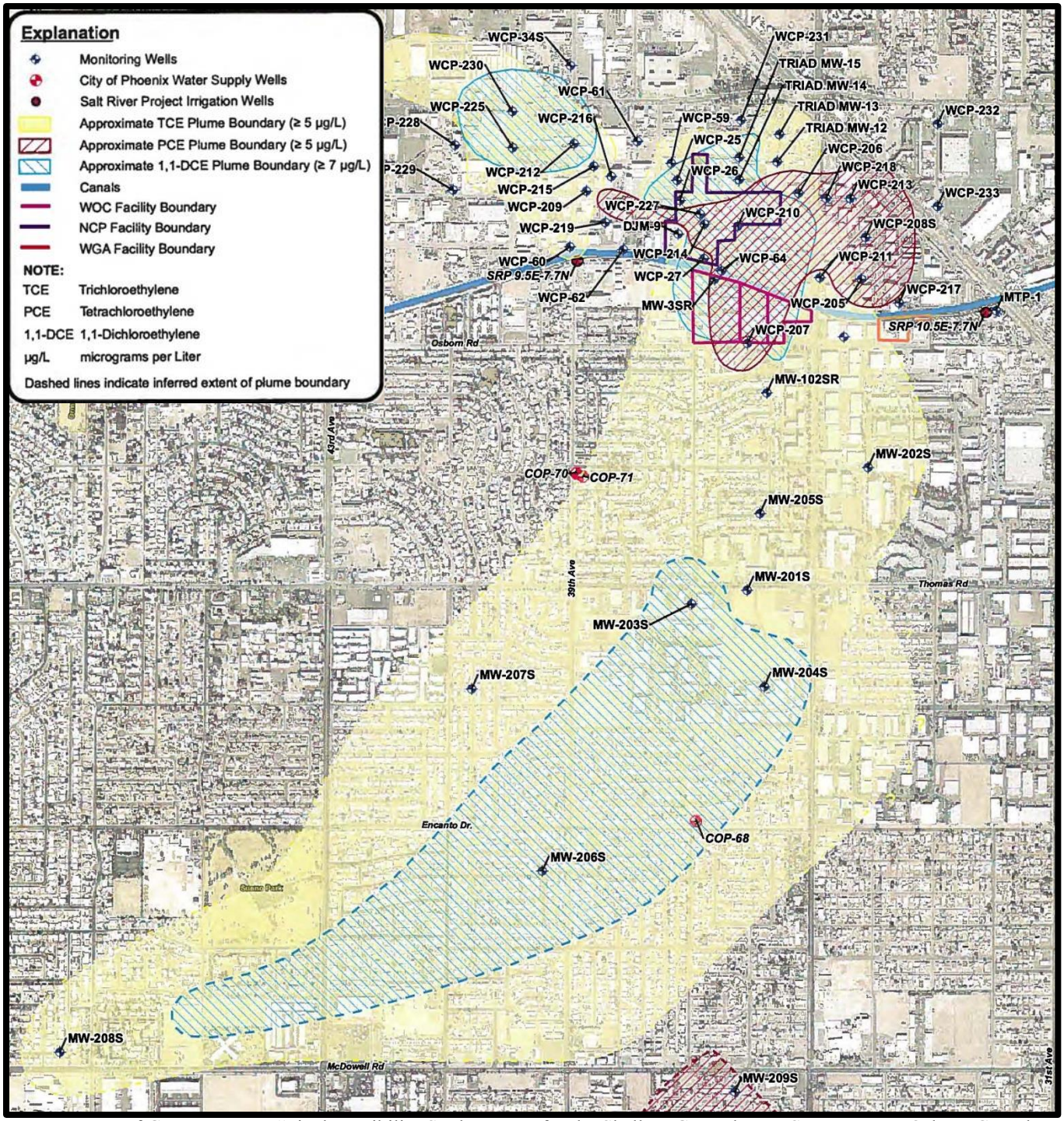
FIGURE 3



Map courtesy of GeoTrans, Inc. "Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site," prepared for AAI Corporation, dated January 27, 2012 (GeoTrans, Inc. project number 2209.004).

NCP AND WOC SGWS GROUNDWATER PLUME BOUNDARIES – SEPTEMBER 2008

Arizona Department of Environmental Quality
Proposed Remedial Action Plan
Shallow Groundwater System
West Osborn Complex Registry WQARF Site
Phoenix, Arizona

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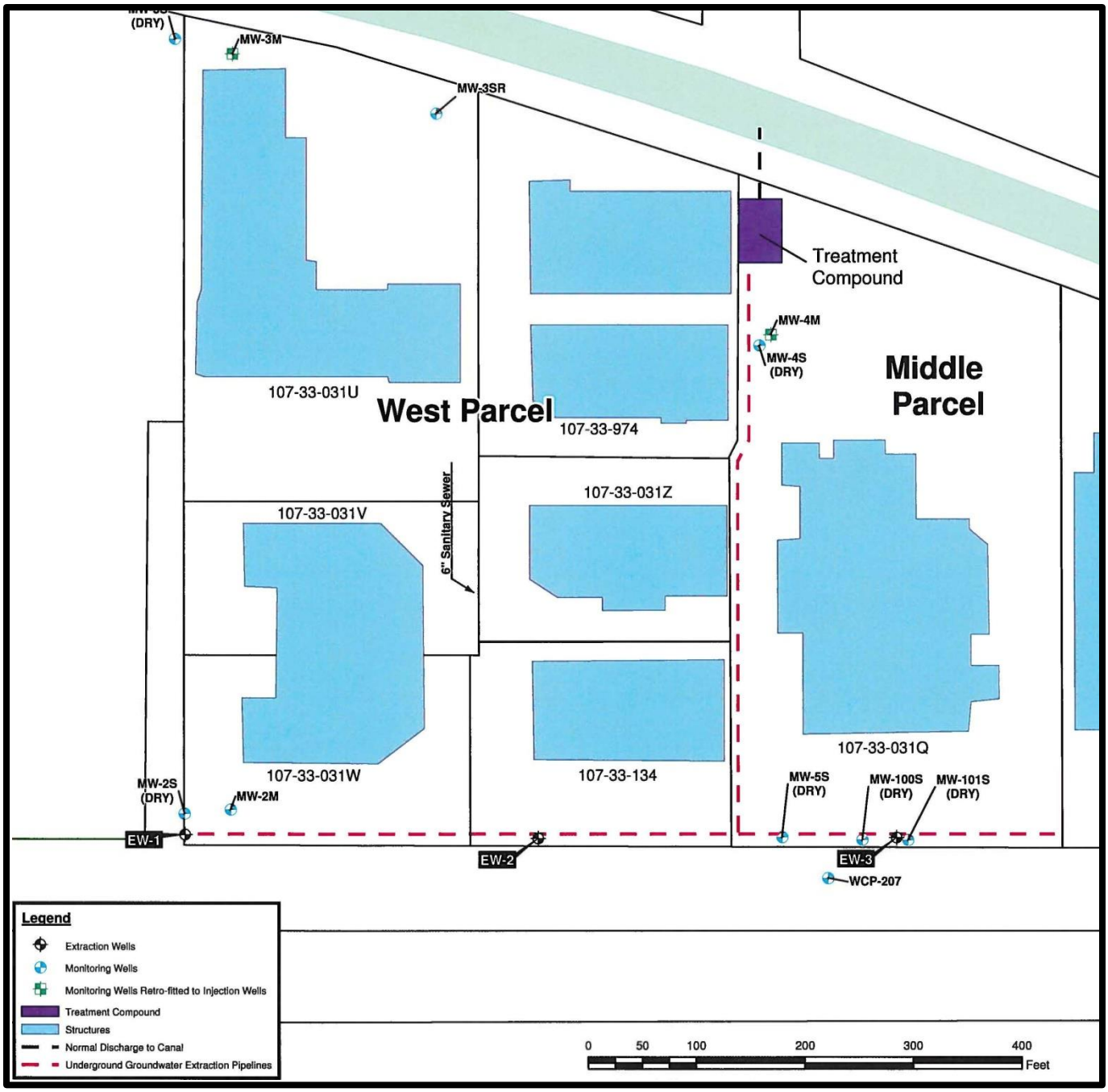
FIGURE 4



Map courtesy of GeoTrans, Inc. "Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site," prepared for AAI Corporation, dated January 27, 2012 (GeoTrans, Inc. project number 2209.004).

CONCEPTUAL DESIGN OF P&T SYSTEM AT WOC FACILITY

Arizona Department of Environmental Quality
Proposed Remedial Action Plan
Shallow Groundwater System
West Osborn Complex Registry WQARF Site
January 2015 Phoenix, Arizona

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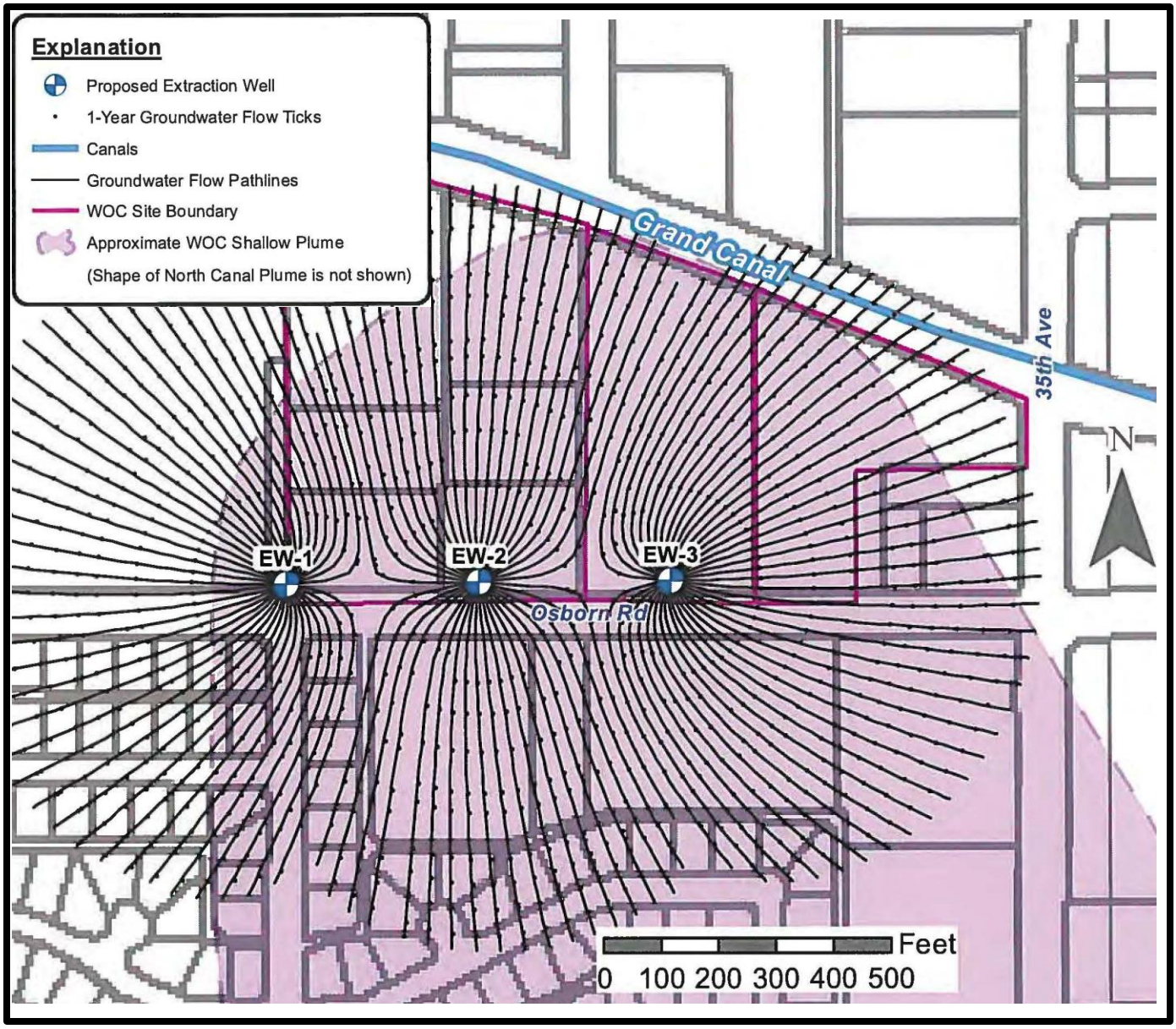
FIGURE 5



Map courtesy of GeoTrans, Inc. "Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site," prepared for AAI Corporation, dated January 27, 2012 (GeoTrans, Inc. project number 2209.004).

MODELED CAPTURE ZONES, 3 EXTRACTION WELLS, WOC FACILITY

Arizona Department of Environmental Quality
Proposed Remedial Action Plan
Shallow Groundwater System
West Osborn Complex Registry WQARF Site
Phoenix, Arizona

January 2015

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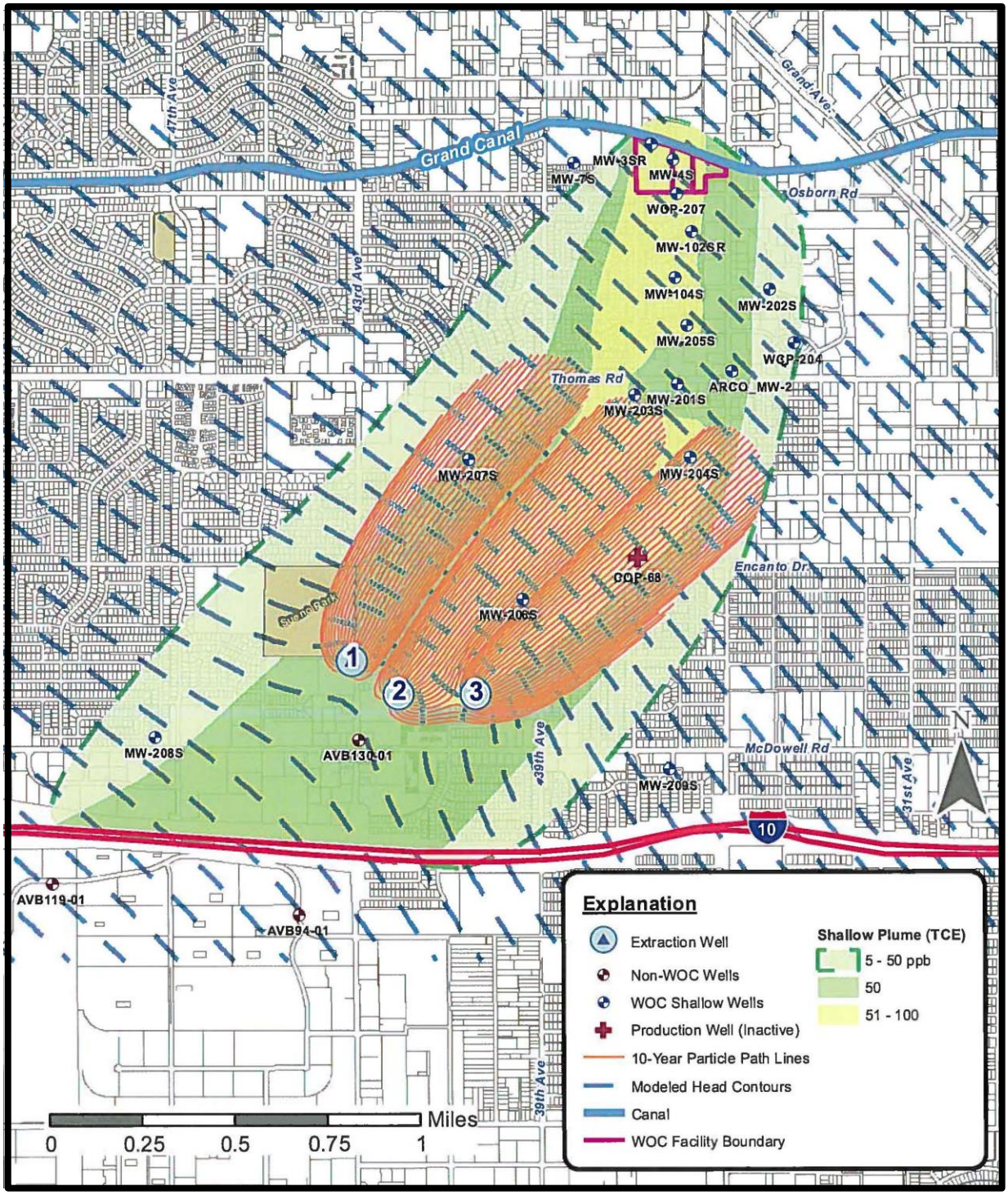
FIGURE 6



Map courtesy of GeoTrans, Inc. "Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site," prepared for AAI Corporation, dated January 27, 2012 (GeoTrans, Inc. project number 2209.004).

MODELED CAPTURE ZONES, CENTRAL AREA P&T WITH 3 EXTRACTION WELLS

Arizona Department of Environmental Quality
Proposed Remedial Action Plan
Shallow Groundwater System
West Osborn Complex Registry WQARF Site
Phoenix, Arizona

January 2015

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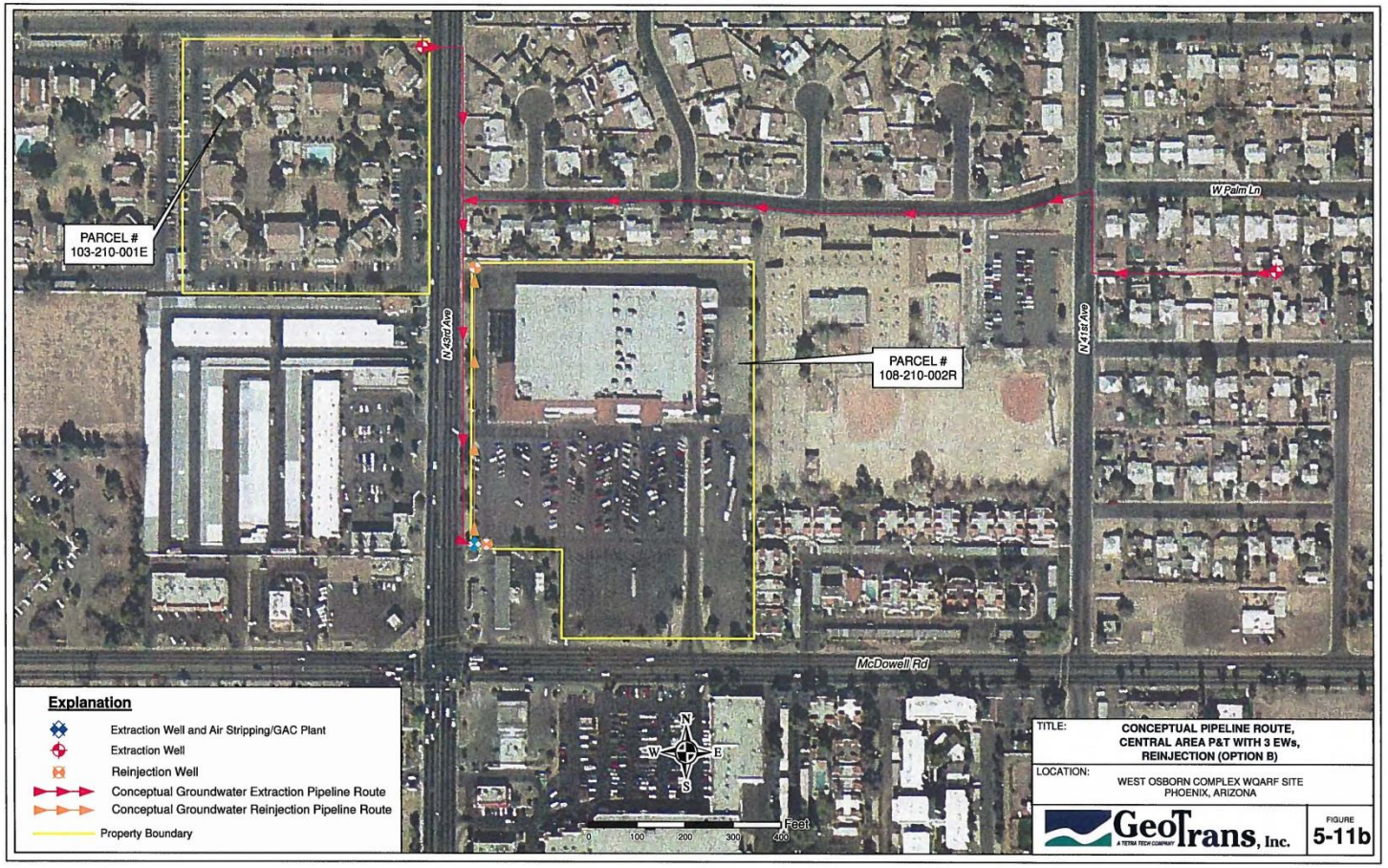
FIGURE 7



Map courtesy of GeoTrans, Inc. "Final Feasibility Study Report for the Shallow Groundwater System, West Osborn Complex WQARF Site," prepared for AAI Corporation, dated January 27, 2012 (GeoTrans, Inc. project number 2209.004).

CONTINGENCY EXTRACTION/INJECTION WELL PROPOSED LOCATIONS

Arizona Department of Environmental Quality
Proposed Remedial Action Plan
Shallow Groundwater System
West Osborn Complex Registry WQARF Site
Phoenix, Arizona

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FIGURE 8

Figure 9. MW-208S TCE Time Series Graph
Shallow Groundwater System
West Osborn Complex WQARF Site