ADEQ Arizona Department of Environmental Quality

TECHNICAL SUPPORT DOCUMENT

PROPOSED UNDERGROUND STORAGE TANK (UST) RELEASE CASE CLOSURE EVALUATION SUMMARY

LUST Case File #0154.02
Facility ID #0-004929
Maricopa County

Texaco #60-349-1032 (Former Shell Station # 121361)
5201 North Central Avenue
Phoenix, AZ 85012

***Background*:**

The site is located at 5201 North Central Avenue in Phoenix and was a former Texaco Station #60-349-1032, which was also known as Former Shell Station #121361. The UST owner/operator was Shell Oil Products. The site operated as a service station between 1975 and approximately 2004. The site is located on the northeast corner of North Central Avenue and East Colter Street and is currently a vacant property that is used as a parking lot. The site is bordered to the north by commercial properties, to the east by residential properties, to the west by North Central Avenue, and to the south by East Colter Street.

The original tank pit system consisted of six (6) 10,000-gallon USTs containing diesel, unleaded gasoline, seven (7) dispensers, and associated piping. These tanks were installed in 1975 and removed on June 23, 1998. EnecoTech Southwest (ESI) oversaw the removal of the UST system and took soil samples. Twelve (12) soil samples were collected from each end of each UST and stockpiled soil samples were also collected and submitted for laboratory screening prior to disposal. The subsequent UST system was installed July 1998, consisted of four (4) USTs and was put into the same tank pit. This UST system was removed in 2004.

According to the ADEQ, Leaking UST case 0154.01, assigned to the gasoline product piping, was opened December 16, 1985 and closed October 20, 1992.

On June 7, 1993, a release was reported at the fill and pump ends of the former USTs during the installation of Phase II Vapor Recovery Equipment. ADEQ assigned Leaking UST # 0154.02 to this release in September 1997.

Site investigations began as early as 1993 to characterize the release. A revised Site Characterization Plan and work plan was submitted to ADEQ on November 17, 1997. The Site Characterization Plan was ultimately approved by ADEQ in September 2010. A Soil Vapor Extraction/ Air Sparge (SVE/ AS) system was installed at the site to remediate the elevated soil and groundwater concentrations, along with using Oxygen Releasing Compounds® (ORC®) socks and in-situ chemical oxidation (ISCO) techniques. Finally, a mobile SVE remediation system was used for a short period of time.

Removal or Control of the Source of Contamination

As mentioned previously leaking UST # 0154.01 was opened on December 16, 1985 and assigned to gasoline product piping. This leaking UST release was closed on October 20, 1992. The original tank pit system consisted of six 12,000-gallon USTs containing diesel and unleaded gasoline and seven dispensers, which were installed in 1975 and removed in June 1998.

In February 1997, an AS/ vapor extraction (VE) test was conducted for 120 minutes using AS-1 and VE-1 with MW-2, MW-3 and MW-5 used as observation wells. This pilot test concluded that air sparging would be an appropriate technology for the site.

The original UST system consisting of six USTs was removed in July 1998 and replaced with four USTs in the same tank pit.

ORC® socks were installed in wells MW-1 and MW-3 through MW-5 in November 1999.

No free product had been detected at the site prior to 2004, however, on March 12, 2004, free product was detected in monitoring well MW-3, which led to the installation of a Soakease™ absorbent sock in MW-3 and MW-4, as a passive free product recovery method. During subsequent groundwater monitoring, free product was bailed by hand to remove it from the groundwater table. Free product was last observed in monitoring well MW-4 on August 20, 2019.

The former (most recent configuration) UST system was completely removed from the Site in May 2004. Laboratory results of UST compliance soil samples indicated reportable concentrations of petroleum fuel hydrocarbons as gasoline near the center of the former UST pit, beneath the center two gasoline USTs (#2 and #3). Following UST system removal, the former station was completely demolished resulting in the removal of all former structures and concrete ground cover, except for a small area at the extreme northeast corner of the site.

On June 1, 2005, an SVE system was started at the site, using wells MW-1, MW-3, MW-4, MW-6, SVE-1 and SVE-2 as extraction wells. The system was shut down soon after, awaiting results of initial air-quality sampling. After ADEQ's approval, the system was re-started for full time operation on June 20, 2005. Because of several electrical problems and issues with the blower motor, the system operated inconsistently till April 2006, and operated consistently till June 2006. In June 2006, the system was shut down to evaluate the need for continued operation at the site. In April 2007, the SVE unit was returned to operational status through June 30, 2007.

In July 2007, an Air Sparging Pilot Test was conducted. The test concluded that air sparging appeared to be a viable remedial option for the site. In addition, the SVE unit was turned off to be converted from a thermal to a catalytic oxidizer (CATOX) in May 2007. The catalytic element had to be shipped on three separate occasions due to the element being damaged during shipment. This caused delays with restarting the system.

The SVE system was restarted in March 2008, however, neighbors complained about the noise associated with the system and therefore it was turned off in May 2008. After two City of Phoenix Planning and Zoning meetings, the Conditional Use Permit was renewed in June 2008, with stipulations. Because of the stipulations, the gas operated system was removed from the site and replaced with an electrically operated system on June 19, 2008. On May 18, 2010, the electric CATOX unit was replaced, and the SVE system was restarted on May 28, 2010.

The SVE system and electric CATOX operated intermittently during the first and second quarter of 2013. On May 24, 2013, the SVE system was shut down in preparation to be removed from the site. The system operated for a total of 27,516 hours and removed approximately 85,462 pounds of total volatile fuels hydrocarbons. Assuming a density of 6.5 pounds per gallon for the released fuel, this represents approximately 13,148 gallons removed from the subsurface.

In January 2014, the SVE and AS wells were abandoned, as part of resurfacing activities requested by the property owner.

In-situ injection applications using PersulfOx™ were completed using onsite wells in May and November 2019. Groundwater monitoring results following the ISCO indicated that it was successful in reducing dissolved concentrations of Contaminants of Concern (CoC). Subsequent ISCO was halted due to the lack of suitable wells for injection as not to foul the new wells remaining with representative groundwater.

On January 14, January 27, March 10 and March 24, 2021, 6-hour mobile SVE events were conducted at the site, on dry monitoring wells that had previously exhibited dissolved concentrations in excess of Arizona Aquifer Water Quality Standards (AWQS). The SVE events were conducted before influent concentrations were low enough to warrant discontinuing SVE. The low influent concentrations at MW-4, where free product was previously observed and the declining influent concentrations at MW-3, suggested that there was little mass remaining in the subsurface at these locations.

Characterization of the Groundwater Plume

The site lies within West Salt River Valley sub-basin of the Phoenix Active Management Area (AMA), in the Basin and Range physiographic province of Arizona. The province is characterized by elongated, northwest-southeast trending, mountain ranges that are separated by broad, sediment-filled desert valleys. The West Salt River is underlain by over 1,000 feet (ft) of Quaternary-age, unconsolidated to semi-consolidated alluvial sediments consisting of cobbles, gravel, sand and silt. Bedrock present below the alluvial deposits commonly consists of Precambrian-age granite, gneiss and schist. General subsurface lithology beneath the facility, based on boring logs, consist of inter-bedded sands, silty clay and clayey sand with gravel/sand stringers to approximately 85 ft in depth.

The regional groundwater flow direction is reported to be northeast. However, flow variations can occur locally due to groundwater pumping conditions. The nearest surface water is Salt River Project's Grand Canal, which is located approximately one mile south of the site. The site lies just outside the north boundary of the Central and Camelback Water Quality Assurance Revolving Fund (WQARF) site by

being north of East Orange Drive. The groundwater contamination at the WQARF site involves chlorinated solvents, most notably tetrachloroethylene. The WQARF well CC-15, which is approximately 450 ft east and cross gradient of the Texaco site, along Colter Street, has not been sampled since April 2017, based on historical non-detect results between 2014 and 2017.

In November 1993, borings B-1, B-2 and B-3 were installed to the north, south and east of the former UST area respectively as part of a subsurface site assessment. Benzene contamination was discovered starting at 30 ft, to groundwater at 58 ft. Benzene concentrations exceeded the ADEQ Suggested Soil Cleanup Level (SSCL) in soil borings B-1 and B-2 at 60 and 50 ft below grade, respectively (samples collected within the capillary fringe and below the water table). In October 1994, monitoring wells MW-1 through MW-3 were installed to 75 ft below ground surface (ft-bgs), and screened from 45 to 75 ft. Ten soil samples collected from these three wells were analyzed by Environmental Protection Agency (EPA) Method 8020 for benzene, toluene, ethylbenzene and xylenes (BTEX) constituents, and for Total Petroleum Hydrocarbons (TPH) by Arizona Method BLS-181 (similar to modified EPA method 418.1). Only the sample submitted from 50-ft at MW-3 (within the capillary fringe) contained reportable benzene (0.099 milligrams per kilogram (mg/kg)) and Toluene (0.097 mg/kg), which were below their respective SSCLs. Groundwater samples were collected from MW-1 through MW-3 by GTI and analyzed for volatile organic compounds (VOCs) by EPA Methods 524.1 and for TPH by Method 418.1, which were ADEQ preferred methods at the time. Benzene exceeded the AWQS, (equivalent to the Federal Primary Drinking Water maximum contaminant limit (MCLs), at all three wells at 2,200 micrograms per liter (µg/L), 25 ug/L and 890 µg /L respectively. The concentration of 1,2-Dichloroethane (1,2-DCA) exceeded the AWQS at MW-1, and the reported toluene concentrations at MW-3 also exceeded the corresponding AWQS. However, GTI noted that that the detected halogenated volatile organic compounds (HVOCs) in groundwater are not associated with the retail fuel operations of the former Texaco service station at the Site, as these are normally associated with industrial and dry-cleaning facilities.

Monitoring wells MW-4 (downgradient), MW-5 (upgradient), vapor extraction well VW-1 and air sparge well AS-1 (tank pit) were installed at the site from January 14 through 17, 1997. AS-1 and VW-1 were installed at approximate 30-degree angles beneath the north and south ends of the former UST area.

Monitoring wells MW-6 (northeast most corner of site), MW-7 and MW-8 (offsite downgradient wells), and one nested well (AS-2/ VEW-2/ VEW-3) were installed on or near the site from June 2004 through June 2005. Monitoring wells MW-6 through MW-8 were installed to depths of 91 ft and were screened from 60 to 90 ft-bgs. The remediation well was installed between former USTs #2 and #3.

MW-4 and MW-5 were cleaned and redeveloped during the week of July 26, 2004, to remove accumulated sediment and apparent bio-fouling (MW-4). Sediment accumulation in the well had restricted the ability to accurately monitor groundwater levels in these wells and obtain representative samples from these wells. While bailing groundwater and sediment, the presence of free product in MW-4 was noted.

Confirmation soil sampling was conducted through SB-1 on March 31, 2017, in the source area. Results indicated that the CoCs had attenuated since last sampled in 2013. Soil samples collected from the confirmation soil boring SB-1, suggested a significant reduction in soil impacts in the source area due to the extensive active remediation conducted at the site. Concentrations of naphthalene, 1,2,4-trimethylbenzene (TMB) and 1,3,5-TMB exceeded the Soil Remediation Levels (SRLs).

Groundwater monitoring has been performed at the site since 1994. The most recent sampling event was conducted on September 16, 2021. It should be noted that due to the lowered water table, the current groundwater level intersects the screened interval of the air sparge wells. No screens were submerged during the third quarter monitoring event. Depth to water measurements ranged from 74.23 ft bgs to 76.81 ft bgs in MW-7. Groundwater flow direction was consistent with historical measurements, to the northeast. Groundwater elevations declined approximately 18 ft from 1994 through 2021. Consequently, monitoring wells MW-1, MW-3 and MW-4 have gone dry since June 2019. Monitoring wells MW-5, MW-6, MW-7 and MW-8 have benzene detections below AWQS for several quarters.

Arizona Department of Water Resource (ADWR) registered wells 55-579467 through 579472 are a cluster of groundwater extraction wells located approximately ½ mile south-southwest (upgradient) from the site. The extraction wells (EW-1 through EW-5) are owned by ADEQ and the extraction permit is associated with the Central and Camelback WQARF site remediation system. These activities might indirectly influence the groundwater elevations at the Texaco site.

Groundwater Plume Stability

BTEX concentration data from August 2008 to September 2021 was entered into the GroundWater Spatiotemporal Data Analysis Tool (GWSDAT), an excel plugin. This is a software application for the visualization and interpretation of groundwater monitoring data. Based on the GWSDAT output, it appears that the bulk of the contaminant mass continues to straddle the north boundary of the site. The output depicts an overall shrinking plume of BTEX since 2008.

A trend analysis of benzene concentrations in MW-5, MW-6, AS-4, AS-5 and AS-7 was conducted using the GSI Mann-Kendall Toolkit. Results of the analysis indicate that benzene concentrations exhibit a 'decreasing' trend in MW-5, MW-6, AS-5 and AS-7. The 'no trend' exhibited in AS-4 is likely due to inconsistent benzene levels over the last decade. It should be noted that the logarithmic nature of the Mann-Kendall analysis requires all inputs to be at or above a unit equal to or greater than one to achieve an accurate trend. Monitoring wells that have gone dry were not included in the analysis.

Natural Attenuation

The transport mechanism for the CoCs consist of advection and dispersion in groundwater. CoCs dissolved in groundwater will be transported in the direction of groundwater flow with spreading of the solute plume under the influence of horizontal and vertical variation in permeability within the formation. Some retardation of contaminant migration rates will also occur due to the sorption of contaminants onto the aquifer matrix. Volatile petroleum hydrocarbons and related contaminants in bedrock and groundwater near the source area potentially could volatilize from groundwater into the vadose zone and be transported by vapor-phase diffusion to the surface or into overlying structures.

Natural attenuation of petroleum hydrocarbons and other organic contaminants is driven by naturally occurring biodegradation. When the rate of biodegradation in groundwater downgradient from the source equals or exceeds the rate of contaminant dissolution and transport away from the source, the

solute plume will stabilize or recede. The natural biodegradation of hydrocarbons by indigenous microbes is universal and occurs to varying extents in all subsurface environments.

BIOSCREEN is another analytical model-based software tool that simulates solute transport assuming relatively homogenous conditions in a porous media aquifer. Biodegradation is represented using either the instantaneous reaction model or as a first-order decay process. The instantaneous reaction model uses the change in redox constituents (dissolved oxygen (DO), nitrate, ferrous iron, sulfate and methane) along the length of the plume to calculate a degradation rate from the depletion of electron acceptors and generation of reduced species within the plume.

Monitored natural attenuation parameters were collected during a sampling event on December 11, 2017 (nitrate, sulfate, manganese, and ferrous iron). Aerobic biodegradation is demonstrated by the virtual depletion of dissolved oxygen in the source well MW-3, however, upgradient DO concentrations were non-existent. Anaerobic nitrate, sulfate, and manganese reducing bacteria are evidenced by the decrease in concentrations from MW-3 to MW-8. The nitrate concentrations remained depleted in MW-8 downgradient from the source, whereas the sulfate concentrations were further decreased. The manganese concentration showed a decrease down gradient of the source well. Based on these geochemical parameters, secondary lines of evidence for natural attenuation are also supported.

Benzene's rate of biodegradation varies greatly, depending on the environment it is in. However, under aerobic conditions, which appear to exist based on the groundwater sample parameters collected from the site, a conservative estimate is a half-life of 238 days which was used in the model. Results of these assessments indicate that the majority of the dissolved impacts observed in the vicinity of MW-6 are degrading at a rate that prevents impacts above an AWQS from extending beyond the most down gradient well MW-7. The results are generally backed up by field data.

Other Exposure Pathways

The depth to impacted groundwater is approximately 74 ft-bgs, and is limited to AS-4 and AS-5. Based on recent and historical groundwater monitoring events, and the absence of supply wells installed near the impacted groundwater plume, exposure by direct dermal contact and/or ingestion of groundwater is considered an incomplete exposure pathway.

Based on the confirmation soil boring (SB-1) installed on March 31, 2017, 1,2,4-TMBs and 1,3,5-TMBs exceeded SRLs at depths greater than 25 ft-bgs, and for naphthalene at 20 ft-bgs. However, this contamination was vertically characterized by the deeper samples having concentrations below SRLs. All other contamination was below SRLs. Based on the above characterization, exposure by direct dermal contact or ingestion of contaminated soil is an incomplete pathway.

A ½ mile Sensitive Receptor Survey was conducted for the subject site by GES on April 19, 2022. GES identified a high school within one half mile of the site, approximately 2,600 ft southwest of the former UST area. Given this school is upgradient from the site, and groundwater impacts do not extend off-site, the school can be ruled out as a sensitive receptor.

URS and Johnson Environmental Technologies (JET) mobilized to the site on January 31, 2014 to conduct a soil vapor survey. URS collected soil vapor sampled from sixteen temporary vapor probe points SG-40 through SG-55. The soil vapor sampling points were collected in the vicinity of previous soil borings or monitoring well locations that had CoC concentrations above applicable SRLs.

GES evaluated the soil vapor data from 2014 utilizing the Johnson & Ettinger (J&E) model. The results of the online J&E model revealed that none of the petroleum CoCs compound risk factors for human and known carcinogenic effects exceeded the standards for residential indoor inhalation. The results for the chlorinated compound risk factors for humans revealed that none of the chlorinated CoC compound risk factors for human and known carcinogenic effects exceeded the standards for residential indoor inhalation. The cancer risk for the petroleum compounds was 7.19E-08 while the cancer risk for the non-petroleum compounds chloroform, methylene chloride and tetrachloroethene was 6.12E-07. The non-cancer hazard quotient for petroleum and non-petroleum compounds was 1.65E-03 and 0.00E+00 respectively.

Threatened or Impacted Drinking Water Wells

A database of registered wells maintained by the ADWR currently identifies a total of 176 wells that are registered within one-half mile of the site. Records indicate that 130 of these wells are monitoring wells, 3 "exempt" wells, 21 "non-exempt" wells and 22 wells listed as "other". The ADWR database of registered wells lists four wells that may provide water for human consumption. Well #55-803882 is a domestic well located at 5509 North Central Avenue, approximately 1,800 feet north and downgradient from the site. This well was installed in 1922, with the principal use being for domestic and yard irrigation. The well is installed in a neighborhood that has access to water from the City of Phoenix. Based on the modelling and results from the downgradient wells MW-7 and MW-8, the well is not expected to be impacted with CoCs from the site. Well #55-608425 is a Salt River Project (SRP) irrigation well, that came up in the ADWR search, but it actually greater than ½ mile from the site. The approximate location of the well is approximately one-mile north northeast of the site (downgradient).

No CoCs have been detected in the most down gradient wells offsite, therefore impacts do not extend beyond the sites monitoring well network.

According to the City of Phoenix 2020 Water Quality Report, the sources of Phoenix's drinking water include rivers, lakes, streams, springs and wells. In 2020, about 97-99% of Phoenix's water came from surface water that mostly started as snow pack. Phoenix's primary sources of untreated surface water are the Salt, Verde and Colorado rivers. Some water from the Aqua Fria River is mixed with water from the Colorado River when stored in Lake Pleasant. The water is then delivered to one of the city's five water treatment plans. The remaining two percent of drinking water was supplied by about 20 groundwater wells currently operated by the city. These wells are sampled annually. The most recent sampling event was carried out in 2020, but analysis of Volatile Organic Compounds was not required.

Any new or replacement well located at or near this site, would need to meet the criteria of ADWR's R-12-15-1302 (B)(3).

***Requirements of A.R.S. §49-1005(D) and (E)**:*

The results of the groundwater data from the site assure protection of public health, welfare and the environment, to the extent practicable, and allow for the maximum beneficial use of the site, while being reasonable, necessary and cost effective.

Other information that is pertinent to the LUST case closure approval:

The facility and LUST files were reviewed for information regarding prior cleanup activities, prior site uses and operational history of the UST system.

Groundwater data tables:

AWQS	Arizona Water Quality Standard
ft.	Feet
µg/L	micrograms/ liter
DTW	Depth to Water

MW-2, MW-7, MW-8, AS-7 and AS-8 have historically had concentrations below detections, or below AWQS.

Well Identification	DATE	DTW (ft.)	Benzene
AWQS (µg/L)			**5**
MW-1 Crossgradient Screen (45-75 ft)	10/14/94	56.19	**2,200**
	05/24/95	54.85	**210**
	05/17/96	54.01	3.9
	05/02/97	52.96	**20**
	08/31/99	51.35	**28**
	06/16/00	53.85	**440**
	06/15/01	54.50	1.6
	09/23/02	57.93	**13**
	07/11/03	63.48	**4.0**
	03/12/04	65.20	**14**
	06/02/05	68.46	**48**
	03/03/06	66.94	1.3
	06/06/07	71.10	**10**
	09/04/07	69.09	<1.0
	Concentrations below AWQS since September 2007		
	DRY since 05/26/21		

Well Identification	DATE	DTW (ft.)	Benzene	Toluene	Ethylbenzene
AWQS (µg/L)			**5**	**1000**	**700**
MW-3 Downgradient Screen (45-75 ft)	10/14/94	56.94	**870**	**2,600**	0
	11/28/95	53.75	**3,400**	730	380
	05/17/96	54.86	**3,700**	**2,000**	43
	12/16/96	52.72	**3,100**	**1,100**	260
	05/02/97	53.61	**1,100**	380	52
	08/31/99	52.23	**17,000**	**23,000**	**2,700**
	06/16/00	54.75	**240**	59	12
	06/15/01	55.50	**190**	10	7.2
	09/23/02	58.93	**2,200**	160	150
	07/11/03	64.45	**32**	95	44
	03/12/04	65.95	**1,500**	**1,600**	**1,200**
	03/02/05	69.25	**8,800**	**2,700**	**3,700**
	12/26/06	66.70	**2,600**	**1,500**	**2,600**
	12/03/07	69.14	**1,200**	780	**1,500**
	08/25/08	68.22	**1,200**	74	630
	08/28/09	67.50	**700**	67.6	559
	01/22/10	66.11	**47.8**	< 5.00	40.0
	08/08/11	65.98	**290**	13.9	195
	08/28/12	68.68	**499**	10	97.2
	06/11/13	68.26	**56.4**	3.7	63.5
	06/24/14	69.42	**75.8**	3.5	78.2
	11/18/15	69.66	**2,060**	141	641
	02/16/16	70.39	**3,790**	224	**1,040**
	12/11/17	72.49	**2,630**	40.5	647
	12/06/18	72.69	**7,280**	75.8	**1,170**
	03/29/19	74.20	**6,090**	66.4	**1,220**
	06/25/19	**DRY**			

Well Identification	DATE	DTW (ft.)	Benzene	Toluene	Ethylbenzene	Total Xylenes
AWQS (µg/L)			**5**	**1000**	**700**	**10,000**
MW-4 Downgradient Screen (45 - 75 ft)	02/26/97	53.34	**7,000**	**8,700**	**1,300**	7,000
	05/02/97	53.96	**9,700**	**16,000**	**3,200**	**16,000**
	12/27/00	54.25	**32,000**	**25,000**	**5,100**	**23,000**
	06/15/01	55.70	**42,000**	**26,000**	**3,600**	**16,000**
	09/23/02	59.13	**8,200**	**2,400**	**1,700**	3,920
	07/11/03	64.36	**3,200**	< 30	560	33
	03/12/04	66.02	**4,300**	820	**1,300**	2,400
	03/02/05	69.25	**9,700**	**22,000**	**2,500**	**19,200**
	12/26/06	67.00	**12,000**	**20,000**	**2,800**	**14,000**
	09/04/07	69.96	**11,000**	**18,000**	**2,700**	**13,000**
	08/25/08	68.52	**6,200**	**1,300**	**1,400**	4,670
	10/30/09	67.01	**2,500**	**3,010**	**1,320**	5,590
	04/09/10	67.38	**1,890**	**1,900**	**1,340**	4,080
	08/08/11	66.29	**1,930**	**1,180**	**1,710**	4,650
	05/11/12	66.93	**1,310**	543	**1,240**	2,190
	06/11/13	68.52	**1,110**	656	**2,640**	3,930
	10/08/14	68.70	**576**	446	**2,960**	2,650
	05/14/15	70.98	**478**	502	**2,230**	2,690
	02/16/16	70.71	**402**	556	**2,250**	2,540
	12/11/17	72.83	**51.8**	27.2	228	23
	06/07/18	74.49	**69.0**	< 1.0	**1,570**	< 1.0
	03/28/19	74.81	**48.2**	108	**2,960**	6,270
	06/25/19	**DRY**				

Well Identification	DATE	DTW (ft.)	Benzene
AWQS (µg/L)			5
MW-5 Upgradient Screen (45 - 75 ft)	02/26/97	52.27	**34**
	05/02/97	52.84	**220**
	08/31/99	51.43	**840**
	12/27/00	53.03	**210**
	03/14/01	54.05	**270**
	09/23/02	58.21	<1.0
	07/11/03	63.32	< 0.50
	12/08/04	68.30	**150**
	03/02/05	68.45	**200**
	12/26/06	66.90	<1.0
	06/06/07	70.88	**19**
	02/25/08	68.60	< 1.0
	02/09/09	68.22	< 5.0
	01/22/10	65.52	< 5.00
	03/16/11	65.28	< 1.0
	02/23/12	65.25	2.4
	03/26/13	67.56	< 1.0
	06/24/14	68.10	< 1.0
	05/14/15	69.23	**27.2**
	02/16/16	68.98	**78.8**
	08/22/17	70.92	**998**
	06/07/18	72.69	< 1.0
	06/25/19	73.78	< 1.0
	06/22/20	73.24	< 1.00
	05/26/21	74.26	< 1.00
	09/16/21	74.23	< 1.00

Well Identification	DATE	DTW (ft.)	Benzene
AWQS (µg/L)			5
AS-2 Screen (60 - 90 ft)	07/23/10	67.08	4.0
	12/02/11	65.35	**10.2**
	02/23/12	65.94	**11.0**
	06/11/13	68.43	**66.1**
	10/08/14	67.87	**34.1**
	11/18/15	69.09	**30**
	12/30/19	73.52	< 1.00
	09/03/20	73.85	< 1.00
	03/24/21	74.25	NS
	05/26/21	**DRY**	

Well Identification	DATE	DTW (ft.)	Benzene
AWQS (µg/L)			**5**
AS-3 Screen (60 - 90)'	12/02/11	65.35	**336**
	05/11/12	67.03	**822**
	06/11/13	68.51	**1,710**
	06/24/14	69.64	**1,580**
	08/18/15	70.78	**1,890**
	05/24/17	72.89	**3,230**
	04/26/18	74.45	**4,210**
	08/20/19	73.98	**4,280**
	12/30/19	74.31	**39.5**
	03/18/20	75.01	**186**
	06/22/20	**DRY**	

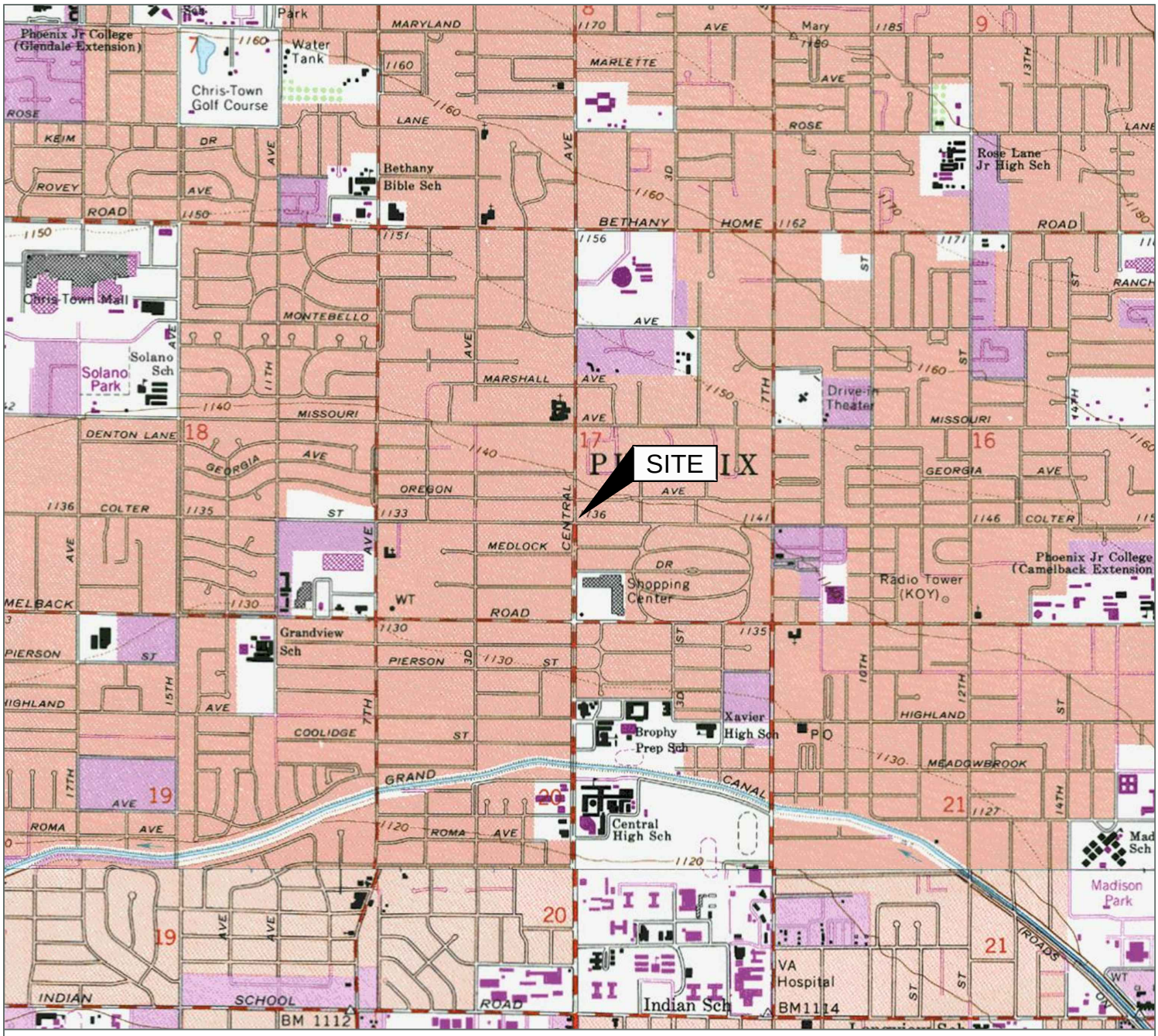
Well Identification	DATE	DTW (ft.)	Benzene
AWQS (µg/L)			**5**
AS-4 Downgradient Screen (60-90)'	03/16/11	66.46	3.8
	02/24/12	66.15	**17.3**
	06/11/13	68.57	**53.5**
	06/24/14	70.07	4.8
	11/18/15	69.94	**15.4**
	04/26/18	74.91	**46.5**
	06/25/19	74.78	**158**
	06/22/20	75.27	**87.7**
	09/03/20	75.06	**145**
	12/03/20	74.68	**185**
	03/24/21	75.12	3.65
	05/26/21	76.40	0.787
	09/16/21	76.02	**63.7**

MW-6 is downgradient of AS-4

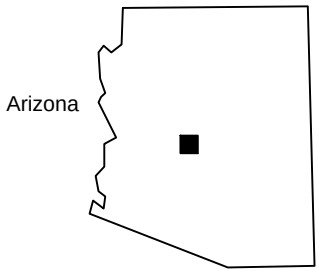
Well Identification	DATE	DTW (ft.)	Benzene
AWQS (µg/L)			**5**
AS-5 Downgradient Screen (60-90)'	12/02/11	65.63	**913**
	05/11/12	67.28	**490**
	06/11/13	68.75	**608**
	10/08/14	68.74	**1,100**
	05/14/15	71.11	**296**
	08/20/19	74.20	**511**
	12/03/20	74.90	**68.4**
	03/24/21	75.37	**129**
	05/26/21	76.21	**102**
	09/16/21	75.93	**140**

MW-6 is downgradient of AS-5

Well Identification	DATE	DTW (ft.)	Benzene
AWQS (µg/L)			**5**
MW-6 Downgradient of remedial wells AS-4 and AS-5 Screen (60 to 90 ft)	12/08/04	67.00	**1,900**
	12/14/05	67.88	**4,600**
	07/10/06	67.8	**9,100**
	06/06/07	72.43	**19,000**
	08/25/08	69.18	**6,800**
	08/28/09	68.43	**573**
	01/22/10	66.40	**575**
	03/16/11	65.98	**63.0**
	08/08/11	66.42	**40.7**
	05/11/12	67.13	**163**
	06/11/13	68.55	2.6
	01/21/14	67.62	**8.9**
	05/14/15	71.53	**5.3**
	05/17/16	72.82	**92.7**
	08/22/17	73.19	**306**
	06/07/18	75.00	**907**
	03/29/19	75.14	**1,040**
	06/25/19	75.14	3.59
	06/22/20	75.87	0.775
	09/03/20	75.36	**< 10.0**
	03/24/21	76.09	< 1.00
	05/26/21	76.70	0.259
	09/16/21	76.60	2.20



Source:
USGS 7.5 Minute Series
Topographic Quadrangle, 1982
Sunyslope, Arizona
Contour Interval = 20'



Quadrangle Location

Site Location Map

Shell Oil Products US
Shell Station #121361
5201 North Central Avenue
Phoenix, Arizona

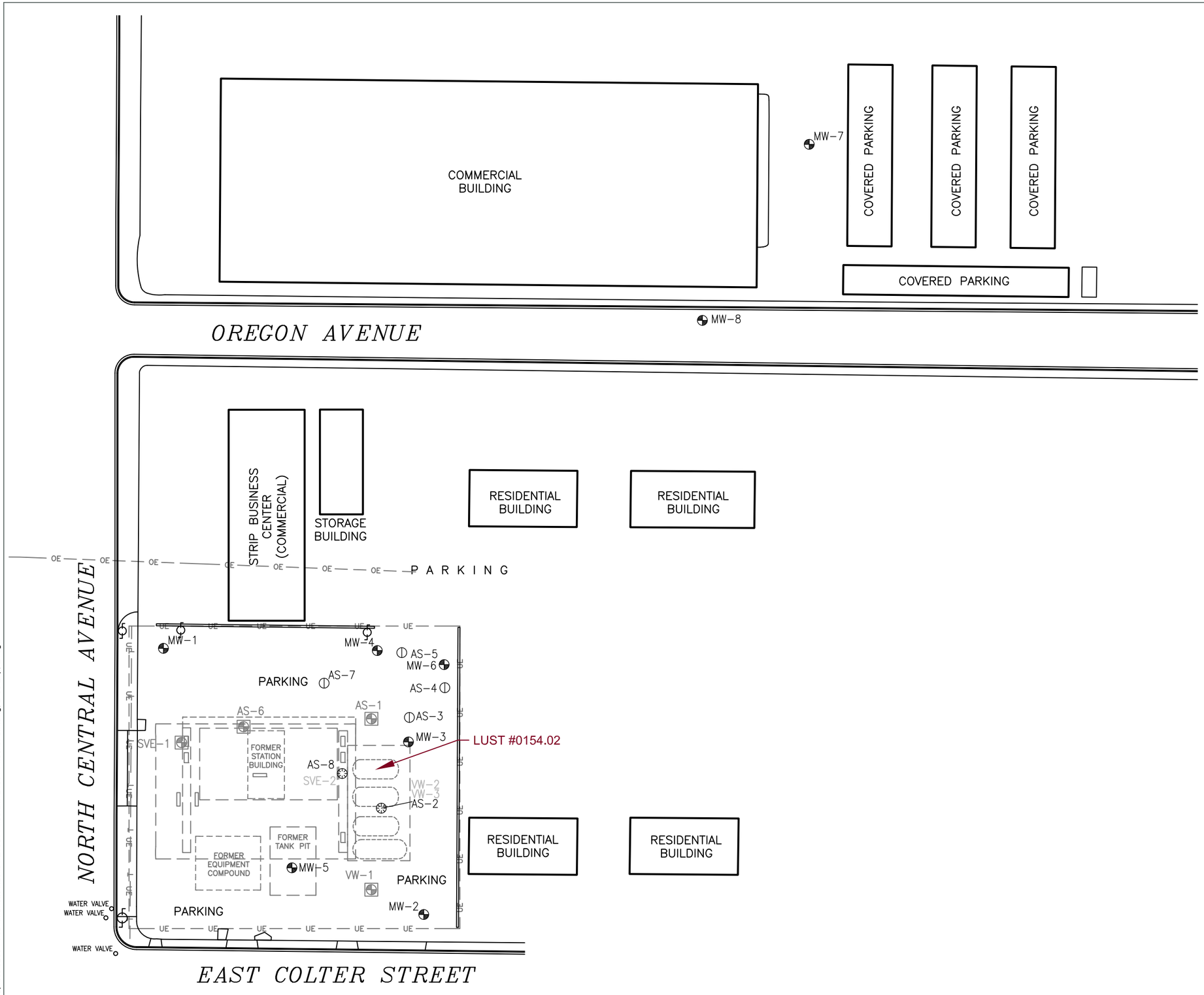
Drawn
W.G.S.
Designed
M.K.
Approved
B.B.

Date
5/3/18
Figure
1

Scale In Feet
0 2000

Groundwater & Environmental Services, Inc.

M:\Graphics\3200-Phoenix\Shell\Arizona\121361 Phoenix\121361 Phoenix SLM.dwg, Template SLM, WShea



LEGEND

- CATCH BASIN
- UTILITY POLE
- UTILITY MANHOLE
- LIGHT POLE
- AIR SPARGE WELL
- MONITORING WELL
- DESTROYED/ABANDONED WELL
- SOIL VAPOR EXTRACTION/SPARGE WELL CLUSTER
- T — UNDERGROUND TELEPHONE LINE
- UE — UNDERGROUND ELECTRIC LINE
- OE — OVERHEAD ELECTRIC LINE

Expanded Site Map

Shell Oil Products US
Shell Station #121361
5201 North Central Avenue
Phoenix, Arizona

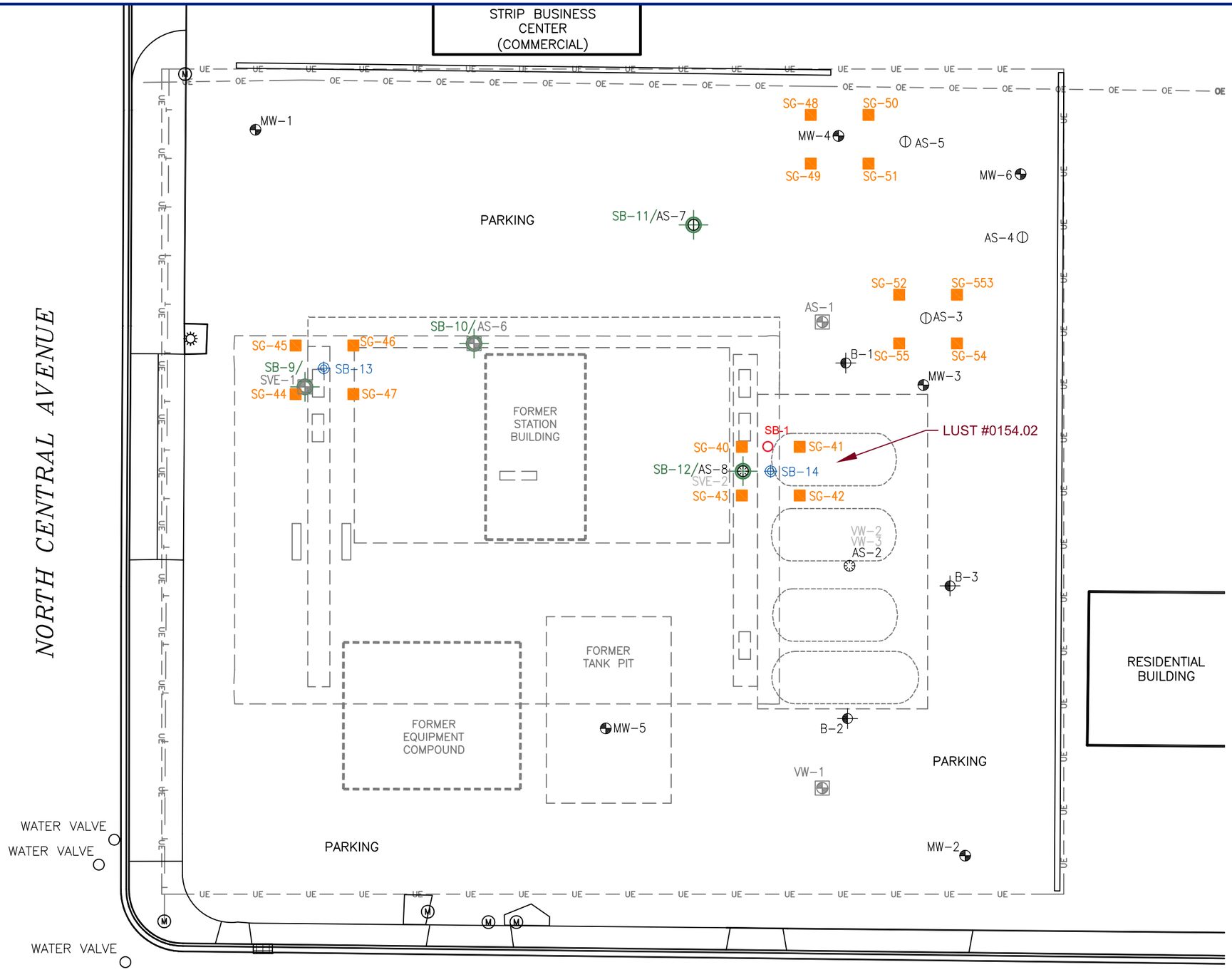
Drawn
E.V.
Designed
M.K.
Approved
B.B.

Date
07/02/18
Figure
2

Scale In Feet
0 50

Groundwater & Environmental Services, Inc.

M:\Graphics\3200-Phoenix\Shell\Arizona\121361 Phoenix\121361 Phoenix SM.dwg, B-50 Exp, EVega



LEGEND

- CATCH BASIN
- UTILITY POLE
- UTILITY MANHOLE
- LIGHT POLE
- AIR SPARGE WELL
- MONITORING WELL
- DESTROYED/ABANDONED WELL
- SOIL VAPOR EXTRACTION/SPARGE WELL CLUSTER
- SOIL BORING (NOVEMBER 1993)
- SOIL BORING (AUGUST 2010)
- CONFIRMATION SOIL BORING (AUGUST 2013)
- SOIL GAS SAMPLE (JANUARY 2014)
- CONFIRMATION SOIL BORING (MARCH 2017)
- UNDERGROUND TELEPHONE LINE
- UNDERGROUND ELECTRIC LINE
- OVERHEAD ELECTRIC LINE

Expanded Site Map

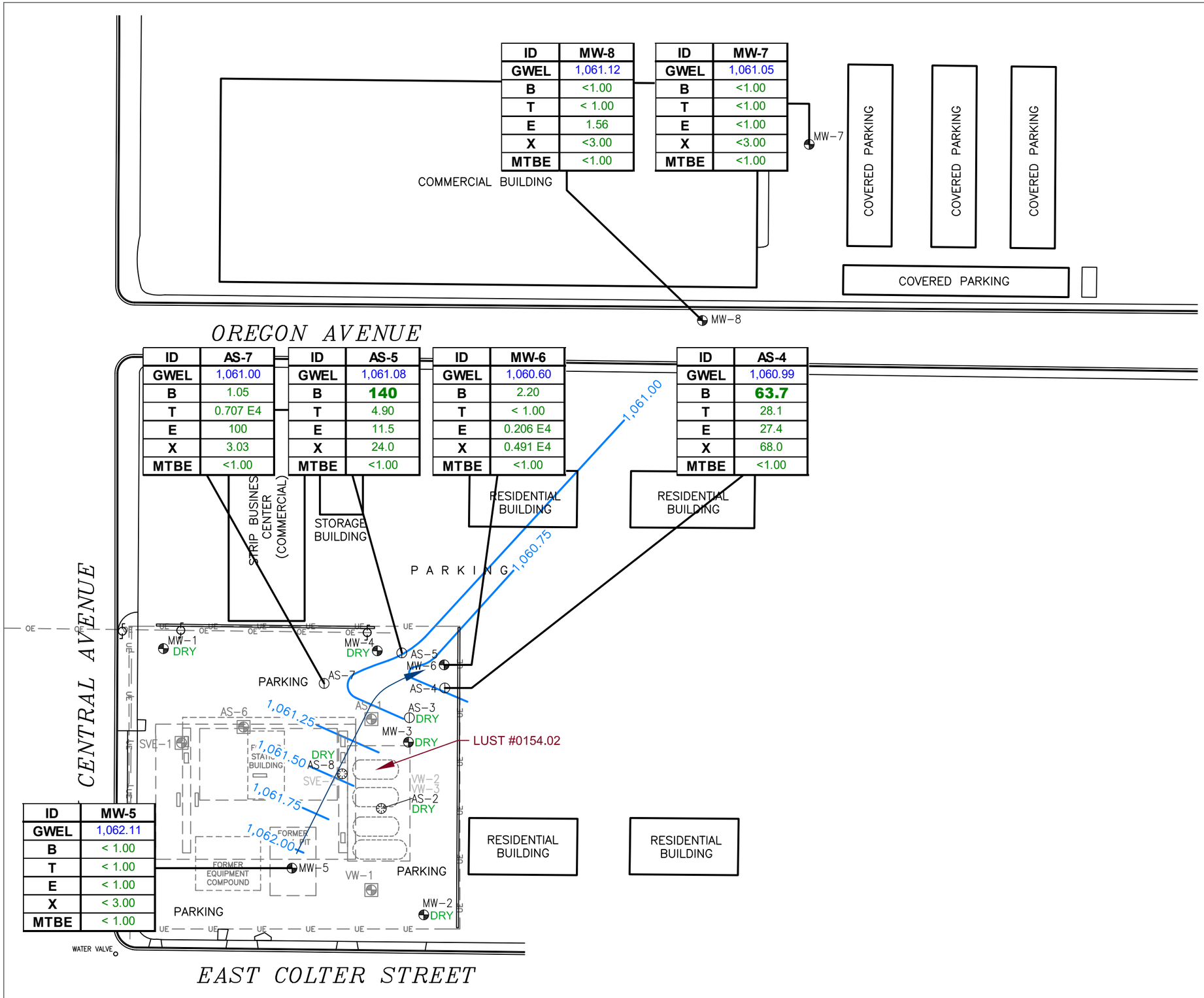
Shell Oil Products US
Shell Station #121361
5201 North Central Avenue
Phoenix, Arizona

Drawn E.V.
Designed M.K.
Approved B.B.

Date 07/02/18
Figure 3

Scale In Feet
0 50

Groundwater & Environmental Services, Inc.



LEGEND

	CATCH BASIN
	UTILITY POLE
M	UTILITY MANHOLE
	LIGHT POLE
	AIR SPARGE WELL
	MONITORING WELL
	DESTROYED/ABANDONED WELL
	SOIL VAPOR EXTRACTION/SPARGE WELL CLUSTER
T	UNDERGROUND TELEPHONE LINE
UE	UNDERGROUND ELECTRIC LINE
OE	OVERHEAD ELECTRIC LINE
	LINE OF EQUAL GROUNDWATER ELEVATION; (DASHED WHERE INFERRED)
	APPROXIMATE GROUNDWATER GRADIENT
GWEL	GROUNDWATER ELEVATION IN FEET (FEET ABOVE MEAN SEA LEVEL)
B	BENZENE CONCENTRATION (µg/L)
T	TOLUENE CONCENTRATION (µg/L)
E	ETHYLBENZENE CONCENTRATION (µg/L)
X	XYLENES CONCENTRATION (µg/L)
MTBE	METHYL *tert*–BUTYL ETHER CONCENTRATION (µg/L)
µg/L	MICROGRAMS PER LITER
<#	WHERE AN ANALYTE IS NOT DETECTED A METHOD REPORTING LIMIT IS GIVEN
BOLD	ANALYTE CONCENTRATION GREATER THAN LABORATORY REPORTING LIMIT, OR FREE PRODUCT WAS PRESENT
E4	ESTIMATED CONCENTRATION; ANALYTE WAS DETECTED BELOW LABORATORY MINIMUM REPORTING LEVEL (MRL) BUT ABOVE THE METHOD DETECTION LIMIT (MDL)

Groundwater Monitoring Map
September 16, 2021

Shell Oil Products US
Shell Station #121361
5201 North Central Avenue
Phoenix, Arizona

Drawn E.V.
Designed A.F.
Approved B.B.
Date 10/19/21
Figure 4

Scale In Feet (Approximate)
0 50

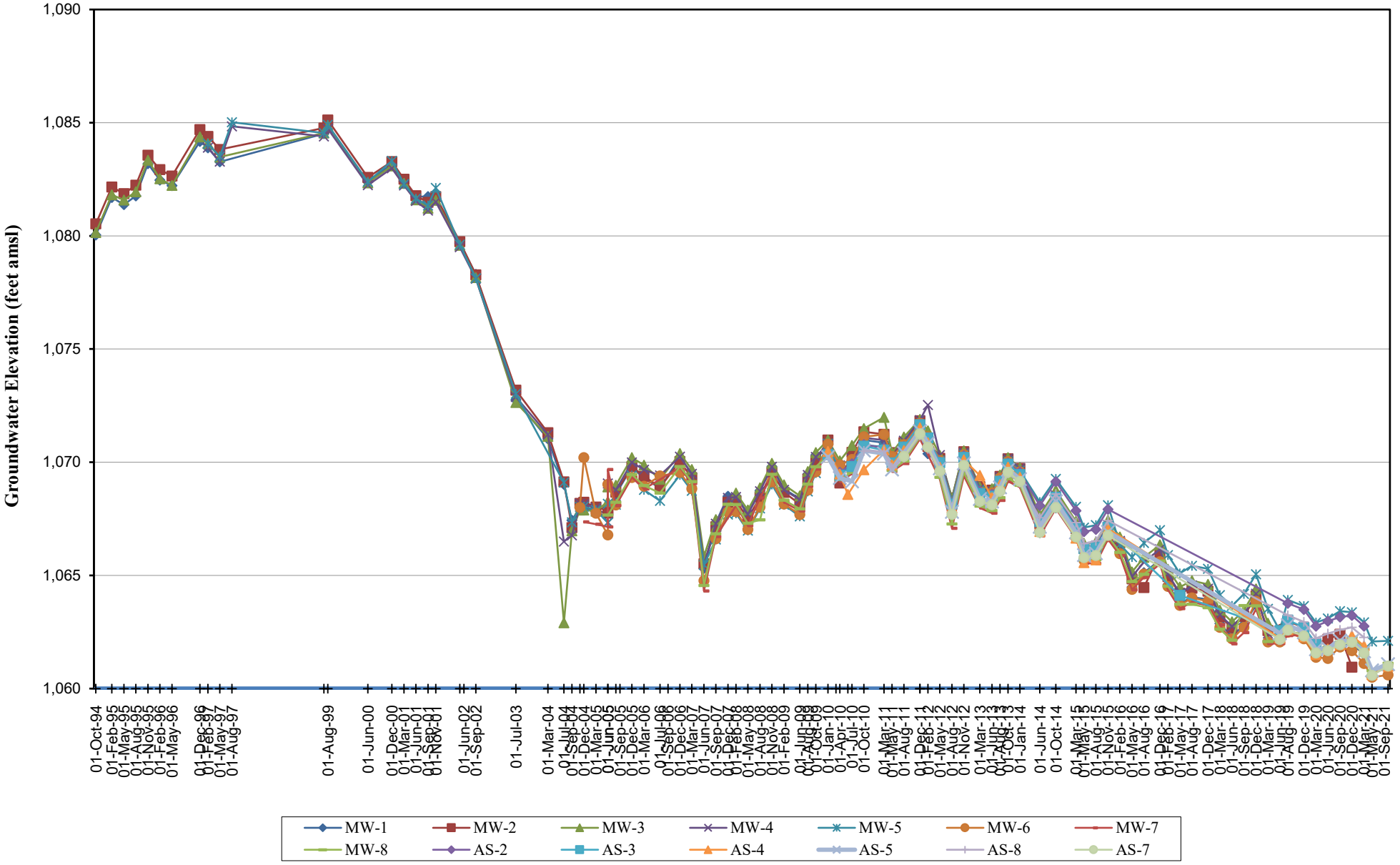
Groundwater & Environmental Services, Inc.

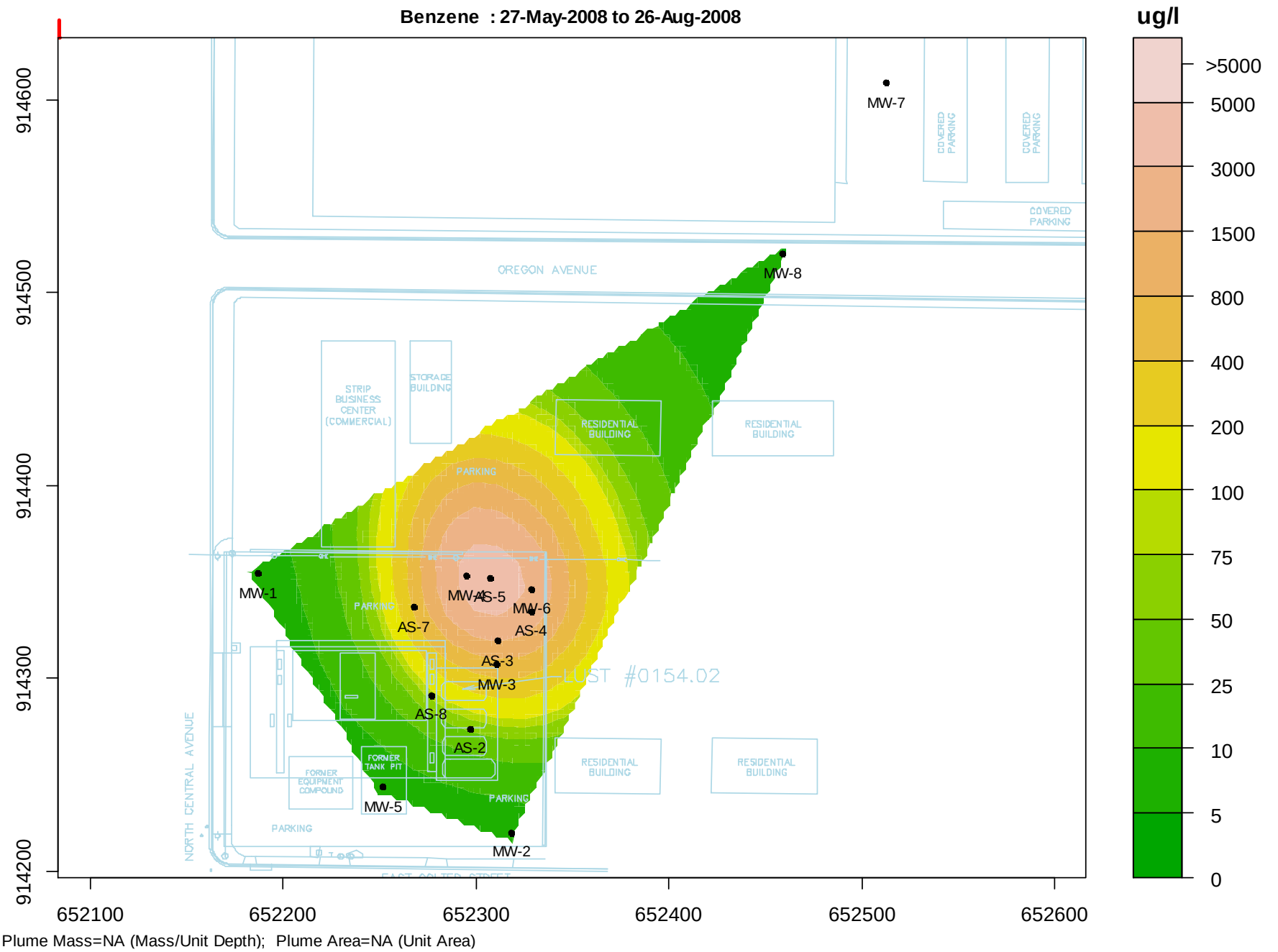
M:\Graphics\3200-Phoenix\Shell\Arizona\121361 Phoenix\121361 Phoenix SM.dwg, B-50, EVega

MONITORING WELL HYDROGRAPHS

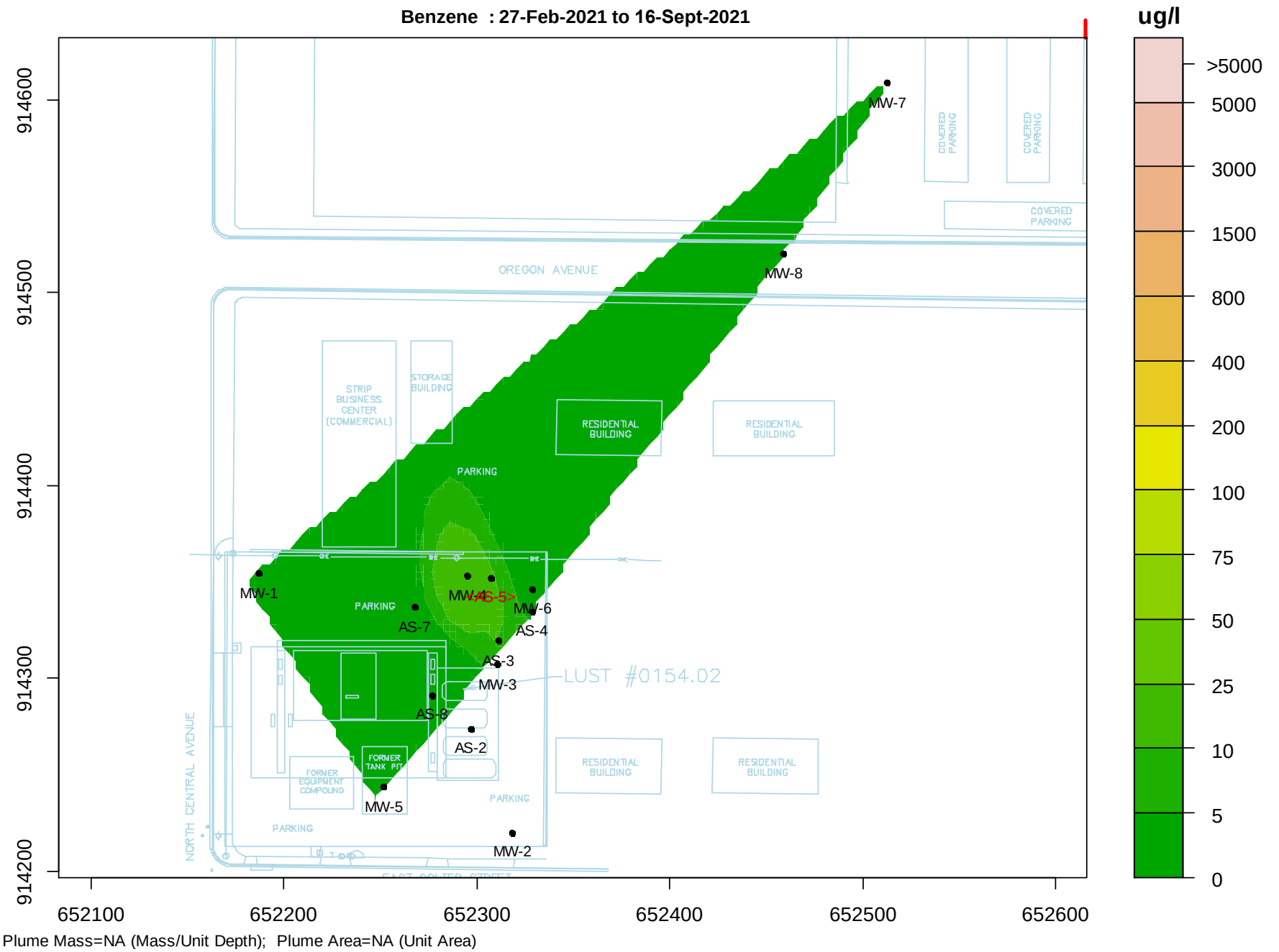
Texaco # 60-349-1032

5201 North Central Avenue, Phoenix, AZ





Plume Mass=NA (Mass/Unit Depth); Plume Area=NA (Unit Area)

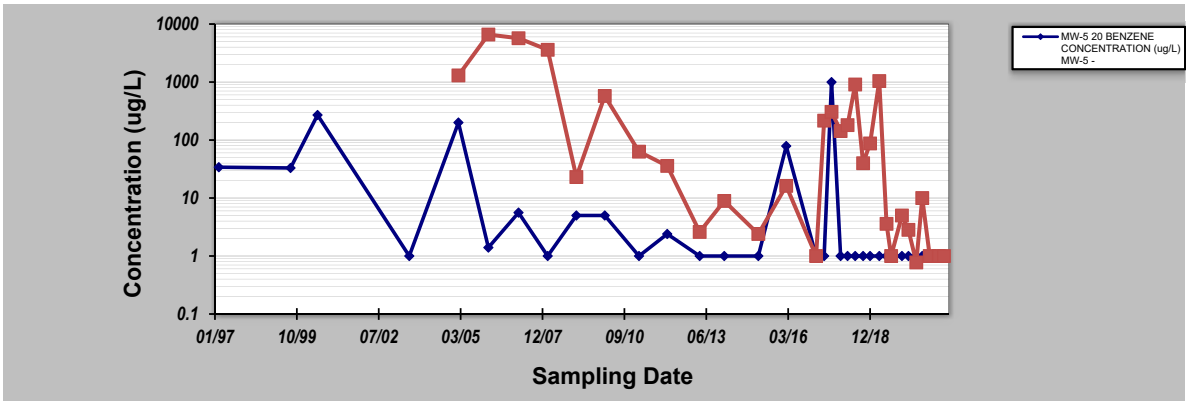


Plume Mass=NA (Mass/Unit Depth); Plume Area=NA (Unit Area)

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	20-Jul-21	Job ID:	3616003
Facility Name:	Shell Central #121361	Constituent:	Benzene
Conducted By:	Anthony Ferrell	Concentration Units:	ug/L

Sampling Point ID:	MW-5	MW-6					
Sampling Event	Sampling Date	BENZENE CONCENTRATION (ug/L)						
1	9-Feb-95	-	-					
2	16-Feb-96	-	-					
3	26-Feb-97	34	-					
4	22-Jul-99	33	-					
5	16-Jun-00	270	-					
6	11-Jul-03	1	-					
7	12-Mar-04	-	-					
8	2-Mar-05	200	1300					
9	3-Mar-06	1.4	6600					
10	6-Mar-07	5.6	5700					
11	25-Feb-08	1	3600					
12	9-Feb-09	5	23					
13	22-Jan-10	5	575					
14	16-Mar-11	1	63					
15	24-Feb-12	2.4	35.8					
16	26-Mar-13	1	2.6					
17	20-Jan-14	1	8.9					
18	12-Mar-15	1	2.4					
19	16-Feb-16	78.8	16.2					
20	15-Feb-17	1	1					
21	24-May-17	1	216					
22	22-Aug-17	998	306					
23	11-Dec-17	1	143					
24	6-Mar-18	1	181					
25	7-Jun-18	1	907					
26	12-Sep-18	1	39.8					
27	6-Dec-18	1	87.3					
28	28-Mar-19	1	1040					
29	25-Jun-19	1	3.59					
30	20-Aug-19	1	1					
31	30-Dec-19	1	5					
32	18-Mar-20	1	2.83					
33	22-Jun-20	1	0.775					
34	3-Sep-20	1	10					
35	3-Dec-20	1	1					
36	24-Mar-21	1	1					
37	26-May-21	1	1					
38								
39								
40								
Coefficient of Variation:		3.64	2.37					
Mann-Kendall Statistic (S):		-209	-199					
Confidence Factor:		99.9%	>99.9%					
Concentration Trend:		Decreasing	Decreasing					



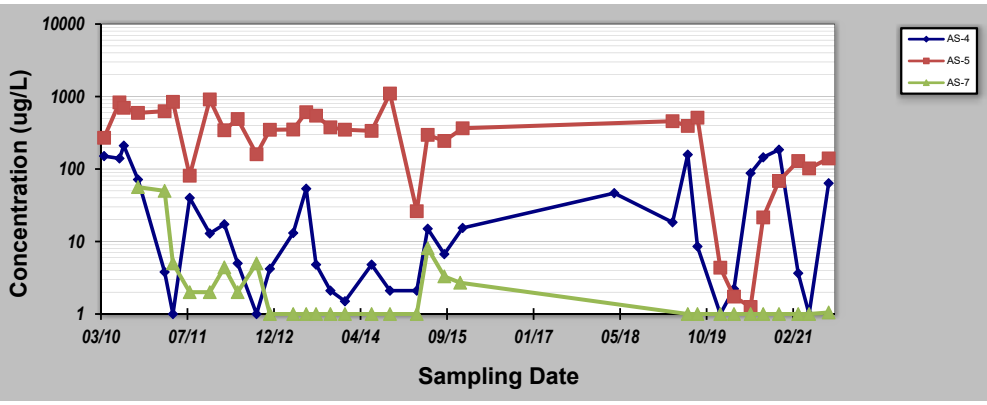
Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	20-Jul-21	Job ID:	3616003
Facility Name:	Shell Central #121361	Constituent:	Benzene
Conducted By:	Anthony Ferrell	Concentration Units:	ug/L

Sampling Point ID:	AS-4	AS-5	AS-7				
Sampling Event	Sampling Date	BENZENE CONCENTRATION (ug/L)						
1	31-Mar-10	151	270	-				
2	9-Apr-10	-	-	-				
3	28-Jun-10	140	830	-				
4	23-Jul-10	210	700	-				
5	13-Oct-10	71.6	595	56.3				
6	16-Mar-11	3.8	628	50				
7	3-May-11	1	846	5				
8	8-Aug-11	40	80.9	2				
9	2-Dec-11	12.9	913	2				
10	21-Dec-11	-	-	-				
11	24-Feb-12	17.3	343	4.4				
12	11-May-12	5	490	2				
13	28-Aug-12	1	160	5				
14	13-Nov-12	4.2	348	1				
15	28-Mar-13	13.1	351	1				
16	11-Jun-13	53.5	608	1				
17	7-Aug-13	4.8	545	1				
18	29-Oct-13	2.1	376	1				
19	21-Jan-14	1.5	349	1				
20	24-Jun-14	4.8	336	1				
21	8-Oct-14	2.1	1100	1				
22	12-Mar-15	2.1	26.2	1				
23	14-May-15	15	296	8.1				
24	18-Aug-15	6.7	244	3.3				
25	18-Nov-15	-	-	2.7				
26	2-Dec-15	15.4	365	-				
27	24-May-17	-	-	-				
28	26-Apr-18	46.5	-	-				
29	29-Mar-19	18.4	457	-				
30	25-Jun-19	158	393	1				
31	20-Aug-19	8.55	511	1				
32	30-Dec-19	1	4.36	1				
33	18-Mar-20	2.22	1.74	1				
34	22-Jun-20	87.7	1.25	1				
35	3-Sep-20	145	21.5	1				
36	3-Dec-20	185	68.4	1				
37	24-Mar-21	3.65	129	1				
38	26-May-21	1	102	1				
39	16-Sep-21	63.7	140	1.05				
40								
Coefficient of Variation:		1.43	0.77	2.46				
Mann-Kendall Statistic (S):		-21	-221	-152				
Confidence Factor:		61.1%	>99.9%	99.7%				
Concentration Trend:		No Trend	Decreasing	Decreasing				



Notes:

1. At least four independent sampling events per well are required for calculating the trend. *Methodology is valid for 4 to 40 samples.*
2. Confidence in Trend = Confidence (in percent) that constituent concentration is increasing (S>0) or decreasing (S<0): >95% = Increasing or Decreasing; ≥ 90% = Probably Increasing or Probably Decreasing; < 90% and S>0 = No Trend; < 90%, S≤0, and COV ≥ 1 = No Trend; < 90% and COV < 1 = Stable.
3. Methodology based on "MAROS: A Decision Support System for Optimizing Monitoring Plans", J.J. Aziz, M. Ling, H.S. Rifai, C.J. Newell, and J.R. Gonzales, *Ground Water*, 41(3):355-367, 2003.

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

Shell Central - Benz
MW-6 to MW-7
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ or
0.02 → 2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* → Data used directly in model.
20 → Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	*Vs*	3.0	*(ft/yr)*
or		↑ or	
Hydraulic Conductivity	*K*	8.0E-05	*(cm/sec)*
Hydraulic Gradient	*i*	0.011	*(ft/ft)*
Porosity	*n*	0.3	*(-)*

2. DISPERSION

Longitudinal Dispersivity*	*alpha x*	1.5	*(ft)*
Transverse Dispersivity*	*alpha y*	0.2	*(ft)*
Vertical Dispersivity*	*alpha z*	0.0	*(ft)*
or		↑ or	
Estimated Plume Length	*Lp*	20	*(ft)*

3. ADSORPTION

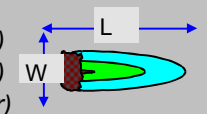
Retardation Factor*	*R*	1.0	*(-)*
or		↑ or	
Soil Bulk Density	*rho*	1.7	*(kg/l)*
Partition Coefficient	*Koc*	38	*(L/kg)*
FractionOrganicCarbon	*foc*	5.7E-5	*(-)*

4. BIODEGRADATION

1st Order Decay Coeff*	*lambda*	1.3E+0	*(per yr)*
or		↑ or	
Solute Half-Life	*t-half*	0.55	*(year)*
or Instantaneous Reaction Model			
Delta Oxygen*	*DO*	1.65	*(mg/L)*
Delta Nitrate*	*NO3*	0.7	*(mg/L)*
Observed Ferrous Iron*	*Fe2+*	16.6	*(mg/L)*
Delta Sulfate*	*SO4*	22.4	*(mg/L)*
Observed Methane*	*CH4*	6.6	*(mg/L)*

5. GENERAL

Modeled Area Length*	325	*(ft)*
Modeled Area Width*	45	*(ft)*
Simulation Time*	5	*(yr)*



6. SOURCE DATA

Source Thickness in Sat.Zone* 10 *(ft)*

Source Zones:

Zone	Width* (ft)	Conc. (mg/L)*
1	10	0
2	7.5	0
3	5	0.0022
4	7.5	0
5	10	0

Source Halflife (see Help):

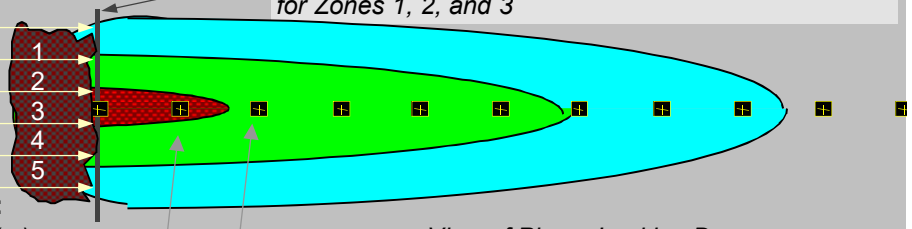
90 | >1000 *(yr)*

Inst. React. ↑ ↑ 1st Order

Soluble Mass 20 *(Kg)*

In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	.002							.001			.001
Dist. from Source (ft)	0	25	58	90	123	155	188	220	253	285	318

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — **View Output**

RUN ARRAY — **View Output**

Help | Recalculate

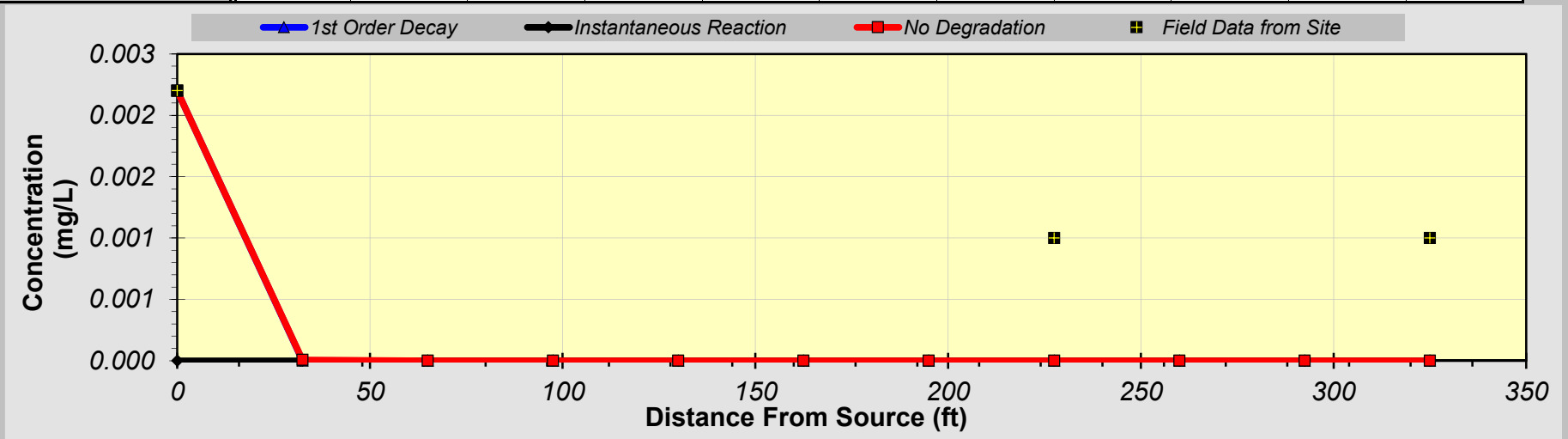
Paste Example Dataset

Restore Formulas for Vs,

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	33	65	98	130	163	195	228	260	293	325
No Degradation	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1st Order Decay	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	0.002							0.001			0.001



Replay Animation

Next Timestep

Prev Timestep

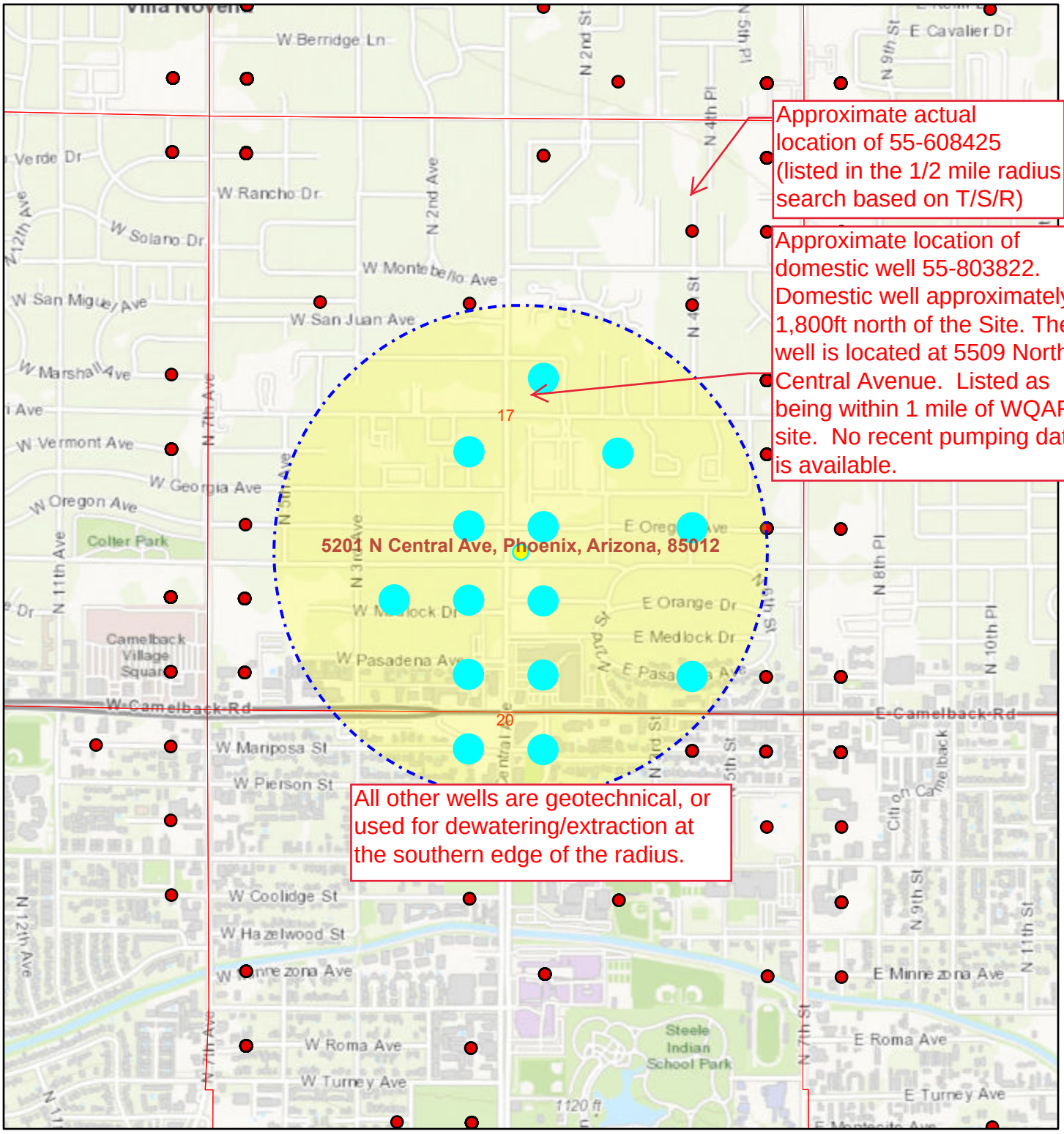
Time:

5 Years

Return to

Recalculate This

Former Texaco Station #60-349-1032 - 0.5 mile radius



April 19, 2022

1:18,056

0 0.13 0.25 0.5 mi

0 0.2 0.4 0.8 km

Well_Registry

Section

Township

County

PHX GIS, City of Phoenix, Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA

Arizona Department of Water Resources