ADEQ Arizona Department of Environmental Quality

TECHNICAL SUPPORT DOCUMENT

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

LUST Case File #: 5389.02
Facility ID # 0-006496
Yuma County

Circle K Store No. 2708475
2505 West 8th Street
Yuma, Arizona 85364

Background:
The facility currently operates as a Circle K convenience store with retail petroleum. The Site has operated as a convenience store and fuel sales since 1987. One 10,000-gallon capacity unleaded gasoline tank (northwestern), one 10,000-gallon capacity premium unleaded gasoline tank (southeastern), and one 10,000-gallon capacity unleaded gasoline tank (center) were installed in 1987 at the Site. In addition, there are two fuel dispensers on two islands located northeast of the UST basin. The UST owner/operator is Circle K Stores, Inc.

On March 10, 2004, Blaes Environmental Management, Inc. (Blaes) conducted a site assessment which included drilling and sampling six soil borings around the (UST) system. Soil samples collected during the assessment indicated detectable concentrations of petroleum hydrocarbons. As a result, ADEQ assigned leaking UST (LUST) File No. 5389.01 to the Site. ATC Associates Inc. (ATC) conducted initial site characterization investigations for LUST 5389.01 to define the lateral and vertical extent of the release. Analytical data from groundwater compliance samples reported benzene, toluene, ethylbenzene and xylenes below the laboratory reporting limits, so ADEQ granted closure of Leaking UST No. 5389.01 in a letter dated April 17, 2007.

UST #1 (northwestern unleaded gasoline tank) failed a tank tightness test on April 5, 2016, so ADEQ assigned LUST release #5389.02. Soil borings SB-1 and SB-2 were drilled and sampled adjacent to the UST basin north of the failed UST in April 2016. Groundwater monitor wells MW-1 and MW-2 were installed in borings SB-1 and SB-2 during the same mobilization due to shallow groundwater encountered at approximately 12.5 feet below ground surface (bgs). Analytical reports for soil samples collected during the initial investigation indicated volatile organic compounds (VOCs) exceeding residential Soil Remediation Levels (rSRLs) in soil boring SB-1 at five and 10 feet bgs and in SB-2 at five feet bgs. The extent of impact to soil was vertically delineated to groundwater based on observed free product in groundwater monitor well MW-1 on May 19, 2016 and groundwater sample results from groundwater monitor well MW-2 with dissolved-phase VOCs detected above Aquifer Water Quality Standards (AWQS). Benzo(a)pyrene was also detected above AWQS in groundwater monitor wells MW-1 and MW-3. Lateral delineation in soil was determined by soil analytical results from borings SB-3, SB-4 and SB-5 where VOCs and PAHs were reported below the rSRLs. Groundwater monitoring and sampling was conducted between September 2017 and September 2021, including all groundwater monitor wells, MW-1 through MW-7. Dissolved VOCs were delineated with down-gradient wells MW-6 and MW-7, up-gradient groundwater monitor well MW-3 and cross-gradient groundwater monitor wells MW-4 and MW-5. Details of site characterization investigation results for LUST 5389.02 were included in the *Site Characterization Report*

submitted to the ADEQ on January 10, 2020 and approved by ADEQ in a letter dated August 18, 2020.

Removal or control of the source of contamination:
Free product was detected in groundwater monitor well MW-1 during initial compliance sampling conducted in May 2016. Based on subsurface soil types, depth to groundwater and free product thickness, Soil Vapor Extraction (SVE) and free product pumping were the remedial technologies utilized at the Site. Free product removal was initiated using disposable dedicated bailers and thereafter with a zero-water skimmer pump. SVE was performed using a 250-cubic foot per minute (cfm) thermal/catalytic oxidizer. The SVE system was connected to groundwater monitor well MW-1 to reduce free product and to control lateral plume migration. ENCORE operated the SVE system at the Site between November 15, 2016 to November 21, 2019. Soil vapor samples were collected bi-weekly for the first six week of system operation and a minimum of once per month thereafter. Soil vapor samples were collected from the SVE system influent and effluent vapor streams to meet the requirements of the ADEQ Air Quality Permit and to track VOC mass extraction rates and emission destruction efficiency.

During optimization of the SVE system, free product mounded in MW-1 to a thickness approximately 5.46 feet. This mounding in MW-1 assisted in controlling free product plume migration and allowed for increased simultaneous pumping of product with little to no groundwater commingling. Due to shallow groundwater, increasing the vacuum higher than 40 inches water column (iwc) caused free product and/or groundwater to enter the SVE lines due to shallow groundwater depth. As a result, the SVE system was optimized with a maximum influent flow rate of approximately 116 cfm at a maximum influent vacuum of approximately 40 iwc. Based on operational data collected during the three years of SVE remediation, an estimated 32,826 pounds of gasoline range organic (GRO) hydrocarbons were removed from the subsurface. Based on a fuel density of 6.5 pounds per gallon, the SVE system removed approximately 5,050 gallons of fuel. Pre-dilution vapor GRO concentrations decreased from a high of 53,900 parts per million by volume (ppmv) in November 2016 to a low of 470 ppmv in November 2019.

Pumping to remove free product included the installation of a zero-water dedicated pump in MW-1 that operated simultaneously with the SVE system. Approximately 2,395 gallons of free product were removed through pumping at MW-1 between January 2017 and June 2018. Pumping was discontinued in MW-1 when the free product thickness decreased to a degree where pumping was no longer feasible.

Characterization of the groundwater plume:
Groundwater monitoring and sampling was conducted between May 2016 and March 2021. Depth to groundwater was measured between approximately 11 and 12 feet bgs during the monitoring period. Groundwater flow direction is predominantly to the southwest with an average gradient of 0.00042 feet/foot (ft/ft). Free product was initially observed at a thickness of 0.27 feet in May of 2016 and increased to approximately 0.71 feet by June of 2016 under static conditions. Based on soil boring characterization at the Site, saturated soils were observed to consist of poorly graded sands.

After free product was no longer detected in MW-1, groundwater sampling (low-flow purge) was conducted on September 7, 2017, and between August 27, 2018 and March 10, 2021.

Dissolved-phase VOC concentrations were reported above AWQS in monitor well MW-1 during all sampling events. Groundwater laboratory analytical results indicated dissolved benzene concentrations were reduced from 11,000 micrograms per liter (ug/L) in May 2016 to 113 ug/L in March 2021. Groundwater monitor well MW-2 located southwest of MW-1 indicated a decrease in dissolved benzene from 3,680 ug/L in May 2016 to 29.4 ug/L in March 2021. VOCs were not reported above the AWQS in groundwater monitor wells MW-3 through MW-7, located northwest, northeast, southwest and southeast of the UST basin between August 2018 and March 2021. Benzo(a)pyrene in groundwater monitor wells MW-1 and MW-3 also decreased to less than the AWQS.

Groundwater plume stability:

Benzene concentrations reported in groundwater monitor wells MW-1 (source well), MW-2 (down-gradient well) and MW-6 (down gradient well) throughout investigation of LUST 5389.02 were evaluated using the GSI Mann-Kendall Toolkit for constituent trend analysis to determine if the dissolved VOC plume is increasing, decreasing or stable. Results of the Mann-Kendall analysis indicated a "decreasing trend" for dissolved benzene in monitor wells MW-1 and MW-6 and a "probably decreasing" trend in MW-2.

Natural Attenuation:

Degradation of petroleum hydrocarbons in groundwater can proceed via aerobic or anaerobic microbial processes. Bacteria present in soil and groundwater obtain energy for cell production and maintenance by facilitating thermodynamically advantageous oxidation-reduction reactions involving transfer of electrons from electron donors to available electron acceptors. When sufficient dissolved oxygen (DO) is present in groundwater, biodegradation of hydrocarbons proceeds aerobically (with oxygen as the electron acceptor). As oxygen becomes less available, anaerobic microorganisms consume electron acceptors in the following order of preference: nitrate, manganese (IV), iron (III), sulfate, and carbon dioxide. Anaerobic biodegradation processes are thus associated with decreased concentrations of nitrate and sulfate, increased concentrations of dissolved manganese and ferrous iron, and production of methane within the plume (i.e., elevated when compared to background).

Groundwater was analyzed for natural attenuation parameters during four sampling events in June 2017, July 2018, November 2019, and December 2020. Methane was detected in all groundwater monitor wells, except for MW-4, between June 2017 and December 2020 indicating the presence of organic compound degradation which could contribute to the decrease in dissolved VOCs over time. Concentrations of DO were recorded to be above 0.5 mg/L during sampling events in wells MW-1 through MW-6 indicating aerobic biodegradation.

Threatened or impacted drinking water wells:

Review of Arizona Department of Water Resources (ADWR) records indicates that 46 registered wells, including seven associated with the Site, are located within one-quarter mile of the Site. Of the registered wells, twenty-two of them are documented as abandoned. Based on well location records, the ADWR registered wells not associated with the Site are located cross-gradient and up-gradient, suggesting that they are not threatened by LUST release 5389.02 at the Site. The nearest water production well (ADWR #55-610886) is located an estimated 300 to 400 feet northwest (cross-gradient) of the northern Project Site property boundary in the Wintergardens Co-Operative mobile home park and is listed as having irrigation use. ADWR well #55-610886 was drilled to in 1973 to depth of approximately 163 feet bgs, however the

screened interval was not listed on the driller report.

ADEQ expanded the well search to ½ mile. A total of 89 registered wells were found (75 monitor or other, five "non-exempt" and nine "exempt"). There are no registered "non-exempt" or "exempt" wells located down-gradient of the Site.

No production wells owned by the City Utilities Department or other local water providers were identified in this search. Potable water is supplied to the area by the City of Yuma Utilities Department. According to information available from the City of Yuma website, water is sourced from the Colorado River and groundwater production wells and treated at its Main Street Water Treatment Plan and Agua Viva Treatment Plant.

Other exposure pathways:
The Project Site property is currently zoned Commercial per the Yuma County Assessor's Office and there is no zoning change pending as of the date of this summary document. Based on site reconnaissance, potential off-site receptors were identified within one-quarter mile of the Site. The nearest residential areas are located approximately 100 feet north-northwest and 135 feet southeast of the Project Site. A nearby school/daycare facility is located approximately 400 feet northeast (Bubbles Early Learning Center). Neighboring properties immediately adjacent to the Project Site include:

- 8th Street and Val's Liquor to the north;
- Avenue B and Desert Water store to the east;
- Vacant lot and driveway to the south, and
- Wal-Mart Store and parking lot to the west.

Two vapor intrusion evaluations were performed for LUST 5389.02 utilizing data from soil vapor sampling events conducted on February 9, 2017 and December 11, 2020. The February 2017 event was conducted following the initial SVE period between November 2016 and January 2017 to evaluate progress of the remediation system and potential risk to on-site commercial receptors. Vapor sample analytical results for select VOCs that exceeded 1/10th of the EPA Risk Based Screening Levels were modeled to estimate indoor inhalation risk using the EPA Johnson Ettinger (J-E) Simplified Forward Screening Model. Results of the model for samples collected in February 2017 indicated a cumulative excess lifetime cancer risk of 9.573E-03 and a hazard index of 3.836+02 for all VOCs modeled (petroleum and non-petroleum), and a cumulative excess lifetime cancer risk of 6.518E-03 and a hazard index of 7.588E+01 for petroleum-related VOCs included in the model. Please note, February 2017 data was conservatively modeled assuming a residential on-site receptor for a 30-year exposure period.

The second vapor survey sampling event was conducted following shut-down of the SVE system to evaluate the site for indoor air soil vapor intrusion to support closure of LUST release #5389.02. Results of the J-E model for samples collected in December 2020 indicated a cumulative excess lifetime cancer risk of 1.224E-04 and a hazard index of 2.472E+00 for all VOCs modeled (petroleum and non-petroleum), and a cumulative excess lifetime cancer risk of 1.074E-04 and a hazard index of 0.622 for petroleum-related VOCs included in the model. For the December 2020 data set, ENCORE included the maximum concentration of VOCs in the soil vapor evaluation, including the less than laboratory reporting limits.

ADEQ reviewed the soil vapor data and SV-2 had the highest detected concentrations of remaining VOCs. The modeled soil vapor data predicts a cumulative lifetime cancer risk of 2.92E-06, and a hazard index of 0.119 for petroleum-related VOCs. Results of the indoor

inhalation air models indicate the estimated cumulative excess lifetime cancer risk and hazard quotient for petroleum related chemicals of concern demonstrate acceptable risk for the indoor-air inhalation exposure, in accordance with Arizona Administrative Code R18-7-206(D).

Soil analytical results for samples collected from soil borings SB-1 (MW-1) and SB-2 (MW-2) in 2016 indicated VOCs reported above the ADEQ rSRL at approximately five and ten feet bgs. VOCs were not reported above the ADEQ rSRL in samples collected from soil borings SB-3 through SB-7 between five and 15 feet bgs. Due to the shallow depth to groundwater observed between 11 and 12 feet bgs, and the residual dissolved VOC impact in source area monitor wells MW-1 and MW-2, post-remedial soil confirmation samples were not collected. As residual dissolved groundwater impact is within the surficial horizon (0-15 feet bgs), post-remedial groundwater data will be utilized to support LUST case closure, according to ENCORE.

ADEQ evaluated the 2016 soil data from SB-1 (MW-1) and SB-2 (MW-2). Benzene was reported at 3.68 milligrams per kilogram (mg/Kg) in SB-1 at a depth of 10 feet bgs, and in SB-2 at 1.02 mg/Kg at a depth of 5 feet bgs. Given the volatility of benzene, there is no dermal contact screening level for carcinogenic target risk or non-cancer child hazard index listed on the November 2021 EPA Regional Screening Level Resident Soil Table.
The ingestion screening level for carcinogenic risk is 1.2E+02 mg/Kg, and the non-cancer child hazard index is 3.1E+02 mg/Kg. Therefore, the historic, pre-remedial contamination concentrations are below the applicable EPA screening levels.

Based on visual inspection of the site vicinity and review of USGS Topographical maps and aerial imagery, the nearest surface water is the Colorado River located approximately 1.4 miles north of the Project Site.

Requirements of A.R.S. §49-1005(D) and (E):
The results of the corrective action completed at the site assure protection of public health, welfare and the environment, to the extent practicable, the clean-up activities competed at this site 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 prior to removal.

Groundwater tables:

MW-1 (Source area)
Total Depth: 40 feet bgs Screened Interval: 7-37 feet bgs

Date	Benzene AWQS is 5 µg/L	Depth to Water (feet)
April 2016	**4,060**	12.51
May 2016	**11,000**	12.58
September 2017	**1,570**	12.80
SVE start November 2016	**---**	---
August 2018	**590**	12.93
February 2019	**214**	12.55
May 2019	**46.1**	12.51
August 2019	**133**	12.65
November 2019	**24.9**	12.45
SVE end November 2019	---	---
December 2020	**45.4**	12.30
March 2021	**113**	12.42

MW-2 (source area)
Total Depth: 40 feet bgs Screened Interval: 7-37 feet bgs

Date	Benzene AWQS is 5 µg/L	Depth to Water (feet)
May 2016	**3,680**	12.60
June 2016	**2,480**	12.70
September 2016	**169**	12.82
SVE start November 2016	**---**	---
February 2017	**289**	12.82
April 2017	**341**	12.58
June 2017	**6.61**	12.80
September 2017	<0.100	13.05
December 2017	<1.00	12.96
April 2018	<0.100	12.91
July 2018	<0.185	13.10
February 2019	**20.4**	12.79
May 2019	<0.331	12.63
August 2019	**7.21**	12.60
November 2019	<0.331	12.55
SVE end November 2019	---	---
December 2020	4.50	12.41
March 2021	**29.4**	12.53

MW-3 (up gradient)
Total Depth: 40 feet bgs Screened Interval: 7-37 feet bgs

Date	Benzene AWQS is 5 µg/L	Depth to Water (feet)
June 2016	**889**	12.55
September 2016	**203**	12.66
SVE start November 2016	---	---
February 2017	<0.500	12.65
April 2017	<0.100	12.41
June 2017	<0.100	12.65
September 2017	<0.100	12.87
December 2017	<0.100	12.80
April 2018	<0.100	12.64
July 2018	<0.185	12.94
February 2019	<1.00	12.63
May 2019	<0.331	12.48
August 2019	<1.00	12.45
November 2019	<0.331	12.40
SVE end November 2019	---	---
December 2020	<0.0941	12.26
March 2021	<0.0941	12.39

MW-4 (cross gradient)
Total Depth: 40 feet bgs Screened Interval: 7-37 feet bgs

Date	Benzene AWQS is 5 µg/L	Depth to Water (feet)
June 2016	<0.500	12.60
September 2016	<0.500	12.71
February 2017	<0.500	12.72
April 2017	<0.100	12.47
June 2017	<0.100	12.70
September 2017	<0.100	12.92
December 2017	<0.100	12.85
April 2018	<0.100	12.81
July 2018	<0.185	13.00
February 2019	<1.00	12.69
May 2019	<0.331	12.52
August 2019	<1.00	12.51
November 2019	<0.331	12.46
December 2020	<0.0941	12.31
March 2021	<0.0941	12.42

MW- 5(cross gradient)
Total Depth: 40 feet bgs Screened Interval: 7-37 feet bgs

Date	Benzene AWQS is 5 µg/L	Depth to Water (feet)
June 2016	<0.500	12.78
September 2016	<0.500	12.90
February 2017	<0.500	12.90
April 2017	<0.100	12.65
June 2017	<0.100	12.88
September 2017	<0.100	13.11
December 2017	<0.100	13.04
April 2018	<0.100	12.97
July 2018	<0.185	13.17
February 2019	<1.00	12.87
May 2019	<0.331	12.72
August 2019	<1.00	12.70
November 2019	<0.331	12.63
December 2020	<0.0941	12.5
March 2021	<0.0941	12.62

MW-6 (down gradient)
Total Depth: 40 feet bgs Screened Interval: 7-37 feet bgs

Date	Benzene AWQS is 5 µg/L	Depth to Water (feet)
May 2017	**26.2**	12.60
June 2017	**37.2**	12.97
September 2017	<0.100	13.18
December 2017	<0.500	13.11
April 2018	2.18	13.06
July 2018	<0.185	13.26
February 2019	<1.00	12.96
May 2019	<0.331	12.78
August 2019	<1.00	12.76
November 2019	<0.331	12.71
December 2020	<0.0941	12.57
March 2021	<0.0941	12.69

MW-7 (furthest down gradient)
Total Depth: 40 feet bgs Screened Interval: 7-37 feet bgs

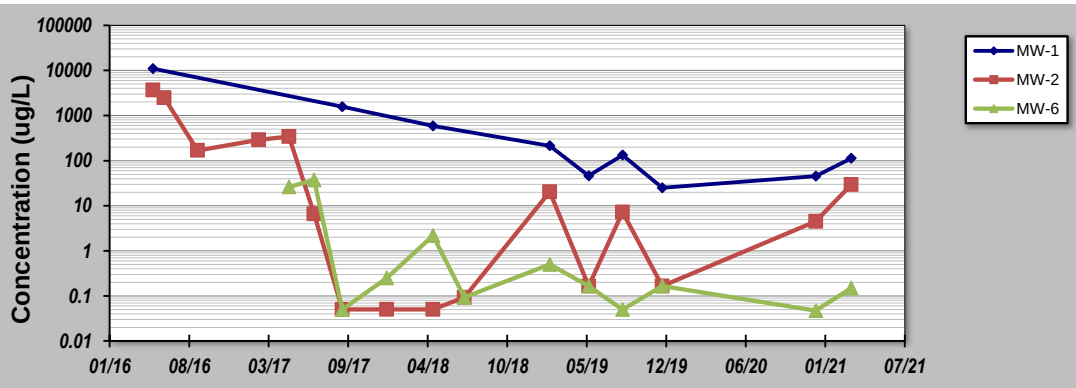
Date	Benzene AWQS is 5 µg/L	Depth to Water (feet)
April 2017	3.75	12.57
June 2017	<0.0700	12.81
September 2017	<0.100	13.01

December 2017	<0.500	12.95
April 2018	<0.100	12.90
July 2018	<0.185	13.10
February 2019	<1.00	12.79
May 2019	<0.331	12.63
August 2019	<1.00	12.60
November 2019	<0.331	12.52
December 2020	<0.0941	12.41
March 2021	<0.0941	12.53

GSI MANN-KENDALL TOOLKIT
for Constituent Trend Analysis

Evaluation Date:	22-Oct-21	Job ID:	CK8475
Facility Name:	Circle K Store No. 2708475	Constituent:	Benzene
Conducted By:	S. Wagner	Concentration Units:	ug/L

Sampling Point ID:	MW-1	MW-2	MW-6				
Sampling Event	Sampling Date	BENZENE CONCENTRATION (ug/L)						
1	19-May-16	11000	3680					
2	16-Jun-16		2480					
3	8-Sep-16		169					
4	9-Feb-17		289					
5	26-Apr-17		341	26.2				
6	28-Jun-17		6.61	37.2				
7	7-Sep-17	1570	0.05	0.05				
8	28-Dec-17		0.05	0.25				
9	23-Apr-18	590	0.05	2.18				
10	11-Jul-18		0.0925	0.0925				
11	11-Feb-19	214	20.4	0.5				
12	20-May-19	46.1	0.1655	0.1655				
13	13-Aug-19	133	7.21	0.05				
14	21-Nov-19	24.9	0.1655	0.1655				
15	11-Dec-20	45.4	4.5	0.04705				
16	10-Mar-21	113	29.4	0.149				
17								
18								
19								
20								
Coefficient of Variation:		2.35	2.41	2.23				
Mann-Kendall Statistic (S):		-26	-34	-30				
Confidence Factor:		99.7%	93.0%	97.8%				
Concentration Trend:		Decreasing	Prob. 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.

DISCLAIMER: *The GSI Mann-Kendall Toolkit is available "as is". Considerable care has been exercised in preparing this software product; however, no party, including without limitation GSI Environmental Inc., makes any representation or warranty regarding the accuracy, correctness, or completeness of the information contained herein, and no such party shall be liable for any direct, indirect, consequential, incidental or other damages resulting from the use of this product or the information contained herein. Information in this publication is subject to change without notice. GSI Environmental Inc., disclaims any responsibility or obligation to update the information contained herein.*

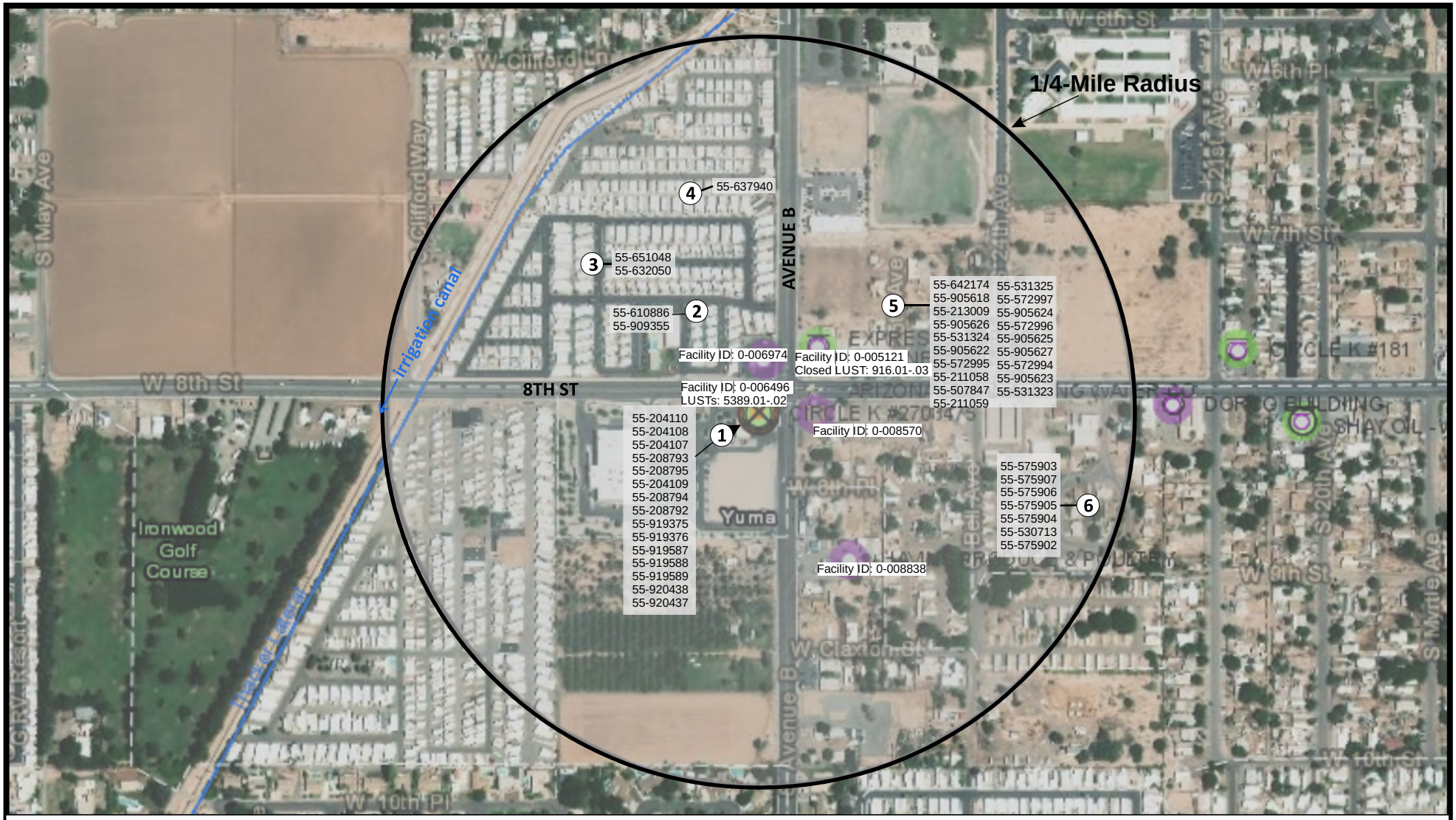


Image captured from Arizona Dept. of Environmental Quality GIS map: https://http://gisweb.azdeq.gov/arcgis/emaps/?topic=ust

Approx. location of above map

0 1000 2000 FEET

APPROX. SCALE: 1 INCH = 480 FEET

LEGEND

(1) Known Location (Arrow) of Arizona Dept. of Water Resources (ADWR) Registered Well(s)

(2) General location of nearby ADWR Registered Well(s)

ENCORE
Environmental Compliance & Remediation
950 W. Elliot Rd., Ste. 116
Tempe, Arizona 85284
480.258.1778

N

Circle K Stores Inc.
Store No. 2708475
2505 W. 8th Street
Yuma, Arizona 85364

SITE LOCATION MAP

FIGURE 1

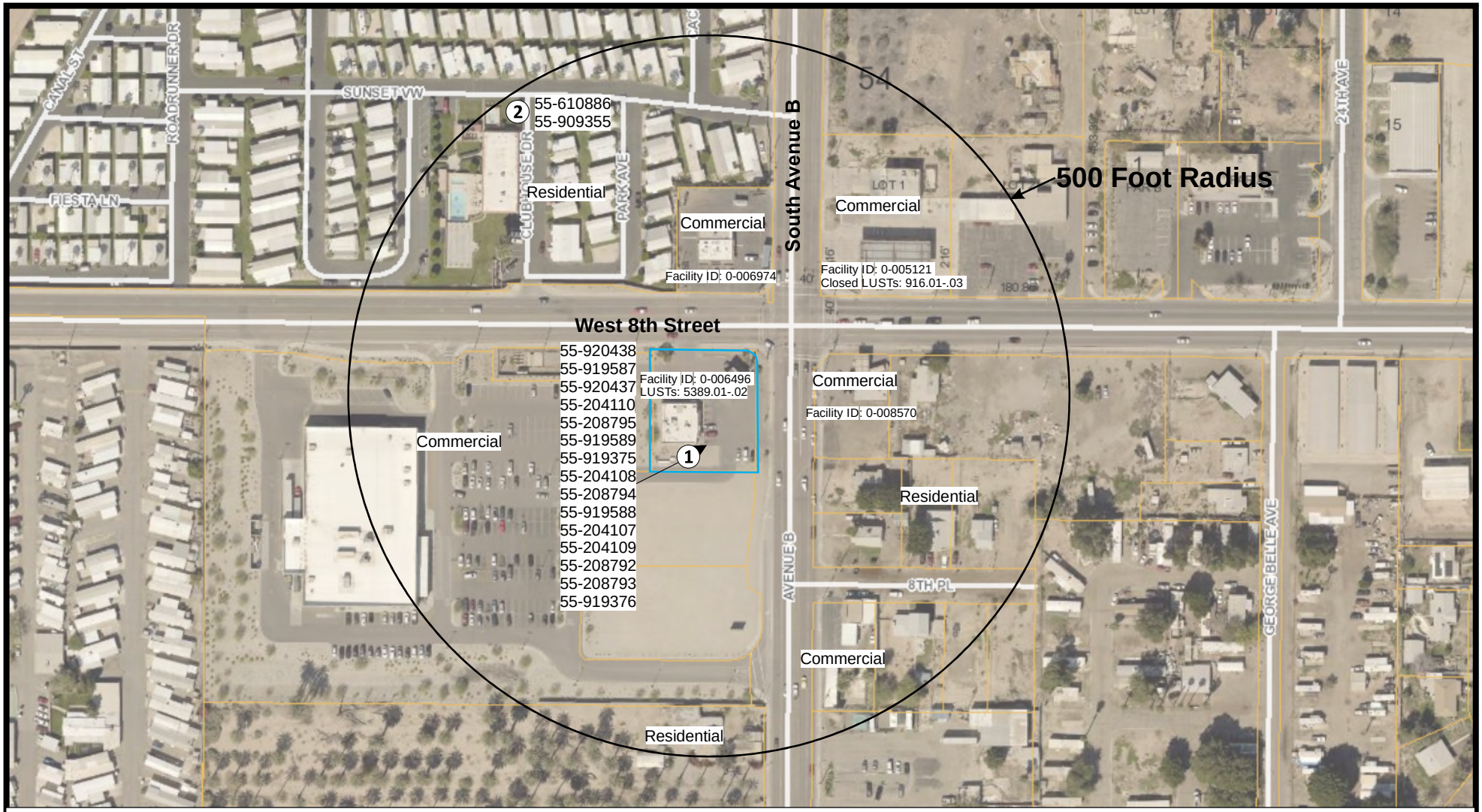


Image captured from Yuma County Assessor 2021

Approx. location of above map

0 200 400 FEET

APPROX. SCALE: 1 INCH = 200 FEET

LEGEND

(1) Known Location (Arrow) of Arizona Dept. of Water Resources (ADWR) Registered Well(s)

(2) General location of nearby ADWR Registered Well(s)

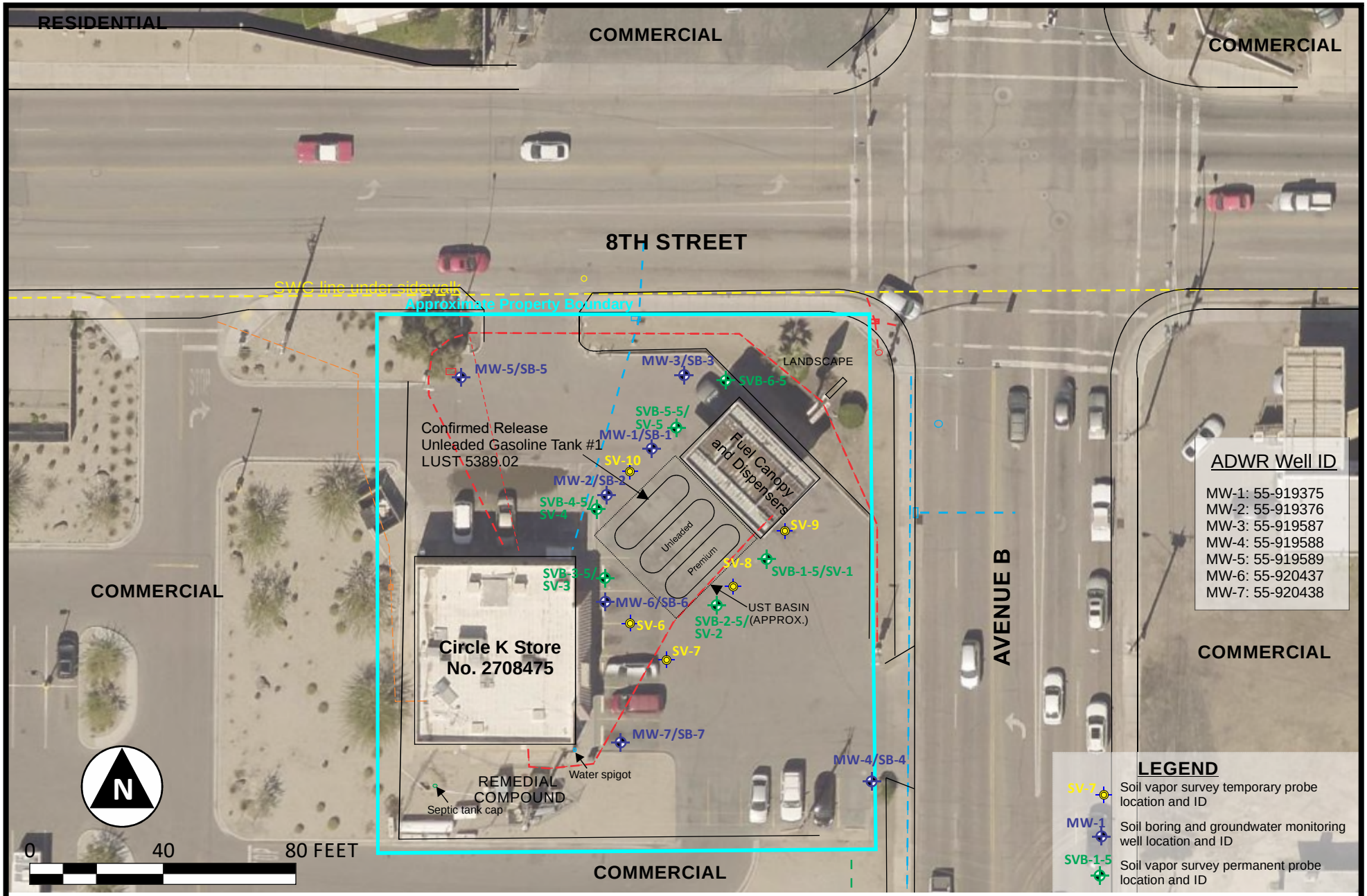
ENCORE
Environmental Compliance & Remediation
950 W. Elliot Rd., Ste. 116
Tempe, Arizona 85284
480.258.1778

N

Circle K Stores Inc.
Store No. 2708475
2505 W. 8th Street
Yuma, Arizona 85364

SITE VICINITY MAP

FIGURE 2



APPROX. SCALE: 1 INCH = 40 FEET

Map based on 2017 aerial imagery from http://geo-viewer.yumacountyaz.gov/Html5Viewer/index.html?viewer=YumaCountyPublicApplication

ENCORE
Environmental Compliance & Remediation
950 W. Elliot Rd., Ste. 116
Tempe, Arizona 85284
480.258.1778

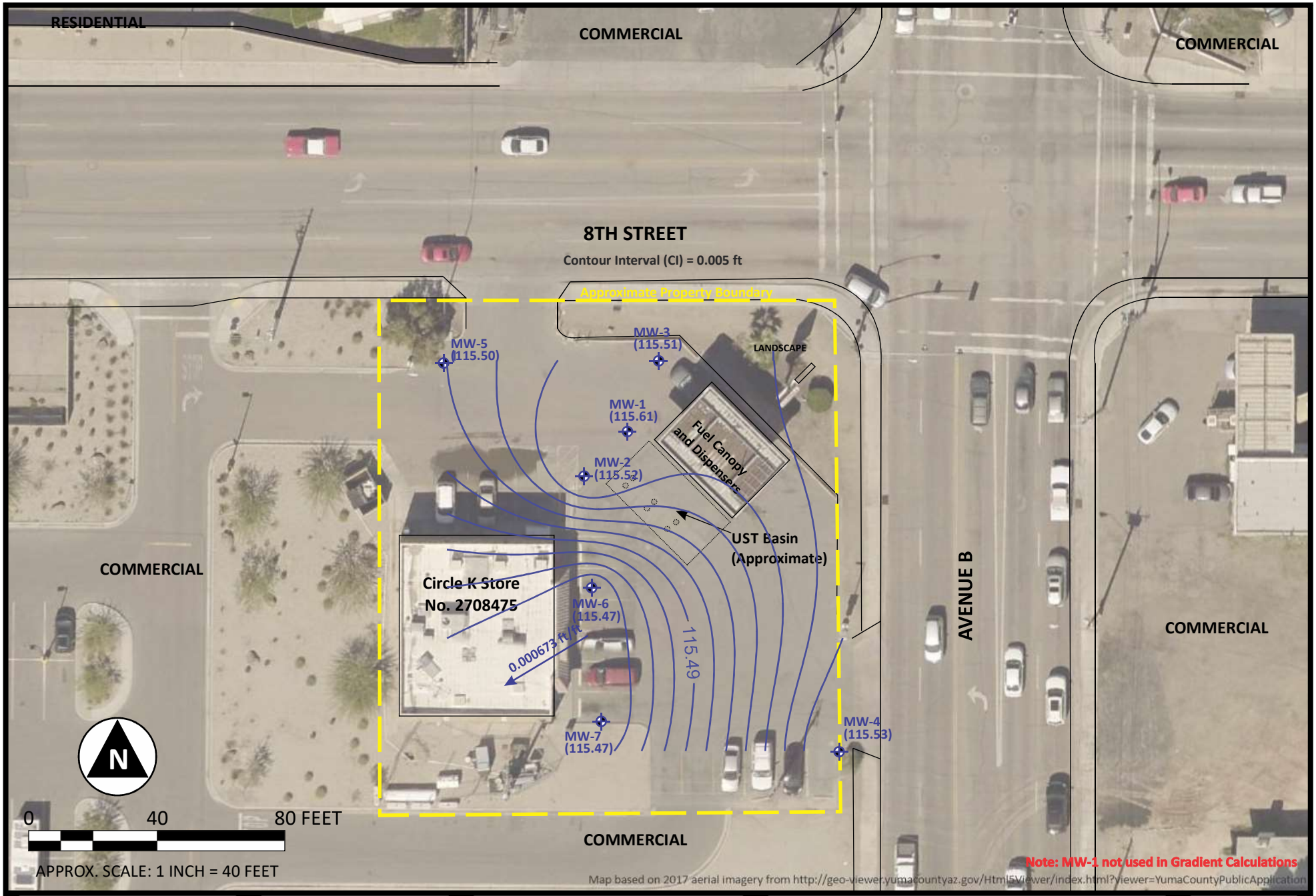
File: .../CK8475_SITE PLAN.cdr
Drawing Date: 12/29/2020
Approx. Scale: 1" = 40', Lndscp8x11
Layer: Yuma County GIS
Prepared By: SLW

Circle K Stores Inc.
Store No. 2708475
2505 W. 8th St.
Yuma, Arizona 85364

SITE PLAN

FIGURE 3

Facility ID: 0-006496



ENCORE
Environmental Compliance & Remediation
950 W. Elliot Rd., Ste. 116
Tempe, Arizona 85284
480.258.1778

File: .../CK8475_GWGM.cdr
Drawing Date: 04/07/2021
Approx. Scale: 1" = 40', Lndscp8x11
Layer: Yuma County GIS
Prepared By: JAI

Circle K Stores Inc.
Store No. 2708475
2505 W. 8th St.
Yuma, Arizona 85364

GROUNDWATER CONTOURS 03/09/2021

FIGURE 18