ADEQ Arizona Department of Environmental Quality

TECHNICAL SUPPORT DOCUMENT

PROPOSED LEAKING UST (LUST) CASE CLOSURE- R18-12-263.04

LUST Case File # 5603.01 **Dockside Mini Mart**
Facility ID # 0-004141 **416 Hancock Road**
Mohave County **Bullhead City, Arizona 86442**

Background:
The Dockside Mini Market (DMM) is a convenience store located at the southeastern corner of the intersection of Hancock Road and Forest Drive, in a predominantly residential area of Bullhead City, Arizona. The DMM property consists of two parcels of land with an area of approximately 0.2 acres, and contains a 1,700-square foot store building. The rest of the property contains asphalt-paved parking and driveway areas.

The DMM fuel service station contained two fiberglass 10,000-gallon underground storage tanks (USTs) and associated dispensers, which were installed in 1986 according to the LUST file. Inventory reconciliation and tank tightness testing indicated that a release of approximately 1,200 to 1,400 gallons of unleaded gasoline may have occurred from Tank #2, this release was reported to the ADEQ on February 12, 2013. Both tanks were temporarily closed by emptying them of fuel on February 22, 2013. In May 2013, in order to evaluate whether a fuel release had occurred, SCS Engineers (SCS) drilled three soil borings (B-1, B-2, and B-3) near the northern and eastern edges of Tank #2. The soil borings were drilled into groundwater, encountered at a depth of approximately 30 feet below ground surface (bgs), and SCS collected soil and grab (Hydropunch™) groundwater samples from each boring. The analytical results indicated that benzene was detected in soil samples collected from each boring at depths of 28 feet bgs, with concentrations above the Arizona minimum groundwater protection level (GPL) of 0.44 milligrams per kilogram (mg/kg).

Benzene was also detected at concentrations exceeding the Aquifer Water Quality Standard (AWQS) of 5.0 micrograms per liter (µg/L) in the groundwater samples collected from B-1, located north of the central portion of Tank #2, and from B-3, located east of Tank #2. The findings of this investigation confirming the fuel release from Tank #2 were documented in a report by SCS dated July 11, 2013, titled *Initial Soil Boring Report*. On July 22, 2013, ADEQ assigned LUST File #5603.01 to the confirmed release from Tank #2.

On August 15, 2013, SCS observed the excavation and removal of the two USTs from the site. During the removal, Tank #2 was observed to have cracks along the bottom-center and near the eastern end of the tank. Tank #1 was observed to be intact. SCS collected soil samples from beneath the ends of both tanks and directed the backfilling of the excavation.

On November 25, 2013, ADEQ approved the *Initial Site Characterization Report* and requested that DMM complete and submit a *Corrective Action Plan* (CAP) by March 25, 2014. In January and February 2014, SCS performed additional soil and groundwater investigations to determine the lateral and vertical extent of soil and groundwater contamination beneath the site. SCS drilled and sampled four soil borings (B-4, B-5, B-6, and B-7) near the location of the former USTs, and installed and sampled three groundwater monitoring wells (MW-1, MW-2, and MW-3). Based on the analytical results of the soil samples collected, soil contamination was present in the area beneath the former USTs and south of the excavation, likely extending beneath the existing store building. Similarly, the analytical results of the groundwater samples indicated that the concentrations of benzene, toluene, ethylbenzene, and total xylenes (BTEX) exceeded their respective AWQS in well MW-1. The groundwater samples collected from wells MW-2 and MW-3 also contained BTEX, but only benzene exceeded the AWQS in these two wells. The direction of groundwater flow was estimated to be towards the southeast, although the migration of the dissolved benzene plume seems to extend towards the southwest. The monitoring wells were all installed to a depth of 50 feet bgs, and screened between 20 and 50 feet bgs. An additional three monitoring wells were installed, and the groundwater flow direction is to the southeast. The results of the additional soil and groundwater investigation were presented in the CAP submitted to ADEQ on May 8, 2014. The CAP recommended the installation of a soil vapor extraction (SVE) and air sparging (AS) system to remediate the soil and groundwater contamination beneath the site. Following the required public notice period, ADEQ approved the CAP on July 30, 2014.

Threatened or impacted drinking water wells:
The source of potable water at the site is provided by EPCOR, the municipal water utility company. It is very unlikely that a well would be drilled and installed at the site as a future source of potable water. The shallow aquifer beneath the site is unconfined, and it is continuously recharged by the Colorado River, located approximately 800 feet west of the Site. The groundwater flow direction beneath the source area is generally to the southeast with a relatively flat gradient of 0.008 feet/foot. The nearest domestic well is located approximately 375 feet west and cross-gradient of the site. In response to active remediation and natural attenuation of contamination, concentrations of BTEX constituents (most notably benzene) have substantially decreased at the site. Only benzene remains above an AWQS in one well (MW-1) at the site. Data indicates that the zone with benzene is relatively small and localized around MW-1. Due to this and the cross-gradient direction of the domestic well from the MW-1 source zone, it is considered very unlikely that the domestic well could be adversely impacted by the benzene. The nearest municipal use water supply well (55-603415) is located approximately 1,270 feet southeast and down gradient of the source area in the northern portions of the site. Limited records on the Arizona Department of Water Resources (ADWR) website database indicate that it is 200 feet deep, and the well screened interval not documented in the database record. Although the screen interval information is missing, it is reasonable to assume that it extends nearly or fully to the 200 ft bgs well depth. EPCOR Water Arizona, Inc. has owned the water supply wells since July 2013. According to the ADEQ Safe Drinking Water database, there have been no detections of VOCs in the groundwater. EPCOR was sent a water provider questionnaire, but did not respond. The lateral extent of the dissolved benzene plume has significantly shrunk and is currently restricted to the immediate vicinity of well MW-1. The results of the natural attenuation evaluation (see below) including BIOSCREEN model

predictions indicate that conditions are favorable for continued attenuation of benzene; breakdown of benzene below the AWQS of 5 µg/L is predicted to occur within only 50 feet of the source. Additionally, benzene has not been detected in down gradient well MW-4 since December 2015. Any new or replacement well located at or near this site would need to meet the placement criteria of ADWR.

Other exposure pathways:
On June 6, 2018, SCS drilled confirmation soil boring SB-1 approximately 2 feet east of groundwater monitoring well MW-1, within the release source area. The boring was drilled to a depth of 30 feet bgs and soil samples were collected at depth intervals of 15, 20, 25, and 30 feet bgs. The soil samples were submitted to ESC Lab Sciences, Inc. (ESC), an Arizona-licensed analytical laboratory, for analyses of volatile organic compounds (VOCs) using EPA Method 8260B, and for tetraethyl lead (TEL) using MAI Organic Lead Method. None of the samples contained detectable TEL. Most of the soil samples had no VOC detections, and all soil samples had no VOC concentrations that exceeded the residential soil remediation levels (rSRLs) and/or the minimum GPLs. None of the samples contained detectable TEL. These analytical results confirm that the soil within the source area has been successfully remediated.

On June 6, 2018, SCS directed the installation and sampling of five temporary soil vapor monitoring probes (VP-1 through VP-5). VP-1 was located along the east side of the store building, VP-2 and VP-4 were located near the north side of the store building, VP-3 was located within the source area near source well MW-1, and VP-5 was located near the west side of the store building.

SCS used the three-phase partitioning equation presented in Section 6.1 of ADEQ's *Soil Vapor Sampling Guidance*, revised April 21, 2017 to compare the vapor concentrations to the rSRLs. SCS used the default values for the soil matrix properties and the chemical properties. None of the calculated total soil concentrations exceed their respective residential SRLs. SCS completed a Johnson-Ettinger (J&E) model simulation of the vapor intrusion risk using the vapor sampling data presented in the *Periodic Site Status Report* (PSSR) from June 2018. The carcinogenic risk and hazard quotient for all compounds detected above 10% of the Vapor Intrusion Screening Level (VISL) are acceptable.

There are no sensitive receptors such as schools, day care facilities, hospitals, or nursing homes located within a 0.25-mile radius from the property. The site is currently used as a mini market/convenience store. Therefore, the only onsite receptors that could be reasonably exposed to any remaining soil contamination beneath the site would be workers at the store. The nearest residential home is located approximately 75 feet south of the soil contamination area within the former UST basin. The subsurface soil contamination is limited to on-site, and the acceptable vapor risk assessment supports that offsite residents would not be exposed to the soil contamination and/or soil vapor derived from the soil contamination beneath the site.

Groundwater plume stability:
Since February 2014 the dissolved benzene plume is stable and has significantly shrunk in size. Benzene has not been detected in down gradient well MW-2 since June 2014, in down gradient well MW-3 since September 2015, and in down gradient well MW-4 since December 2015.

Benzene has never been detected in up gradient and cross gradient wells MW-5 and MW-6, respectively. Benzene has not been detected in down gradient well MW-2 since June 2014, in down gradient well MW-3 since September 2015, or in down gradient well MW-4 since December 2015. Benzene has never been detected in up gradient and cross gradient wells MW-5 and MW-6, respectively. A Mann-Kendall assessment of the benzene trend at MW-1 was completed for two periods. First is the entire analytical record from 2014 through 2018. The trend is downward with a confidence of over 99%. For the second plot, the data from 2016 through 2018 was used to remove the influence of the initial drop in concentration from over 5000 ug/L. This more recent trend is also downward.

Characterization of the groundwater plume:
Benzene was detected at concentrations exceeding the AWQS of 5.0 micrograms per liter (µg/L) in the groundwater samples collected from B-1, located north of the central portion of Tank #2, and from B-3, located east of Tank #2. In January and February 2014, SCS performed additional soil and groundwater investigations to determine the lateral and vertical extent of soil and groundwater contamination beneath the site. SCS installed and sampled three groundwater monitoring wells (MW-1, MW-2, and MW-3). An approximately 1-inch thick free product layer was detected in the source well MW-1. No free product was detected in the other two monitoring wells. During the period of June through August 2014, SCS installed, developed and sampled three additional groundwater monitoring wells (MW-4, MW-5, and MW-6). These monitoring wells were constructed like MW-1-MW-3.

Groundwater contamination was remediated using in-situ chemical oxidation (ISCO) in October 2016 with Persulfox® (see Source Removal section below). On November 17, 2016 SCS collected a grab groundwater sample from well MW-1 using a disposable bailer. On January 4, 2107, SCS collected a second grab groundwater sample from well MW-1 to confirm previous results. The groundwater samples were analyzed for VOCs using USEPA Test Method 8260B full list. The analytical results indicated that a significant decrease in the concentration of VOCs had occurred at the source well. However, the concentration of benzene and toluene detected in well MW-1 continued to exceed their respective AWQS. Several other VOCs were detected in the sample collected from well MW-1, but the concentrations did not exceed their respective AWQS. In April 2017, a second ISCO event occurred by directly injecting Persulfox® into MW-1, AS-4 and AS-5.

On May 25, 2017, SCS collected compliance groundwater samples from all six monitoring wells at the site, MW-1 through MW-6. The analytical results indicated that a significant decrease (over 95% reduction) in the concentration of VOCs has occurred at the source well. The concentration of benzene was reduced from 516 μg/L in January 2017 to only 16.7 μg/L in June 2017. No VOCs were detected above the laboratory method reporting limits (MRLs) in any of the groundwater samples collected from the other five monitoring wells.

On August 29, 2017, SCS collected compliance groundwater samples from all six monitoring wells at the site, MW-1 through MW-6. The analytical results indicated that the concentration of several VOCs had increased at source well MW-1. More specifically, the concentration of benzene increased to 86.8 μg/L and the concentration of toluene increased to 2,050 μg/L in well MW-1. These concentrations of benzene and toluene are above the AWQS of 5.0 μg/L and 1,000

μg/L, respectively. However, none of the other five wells contained concentrations of VOCs above their respective AWQS, and no TEL was detected above the laboratory's MRLs in any of the groundwater samples collected from the six monitoring wells.

On December 27, 2017, SCS collected compliance groundwater samples from all six monitoring wells at the site, MW-1 through MW-6. The analytical results indicated that the concentration of several VOCs had decreased at the source well. The concentration of benzene decreased to 74.3 μg/L and the concentration of toluene decreased to 847 μg/L, below its AWQS of 1,000 μg/L. Similar to previous events, none of the other five wells contained concentrations of VOCs above the laboratory MRLs.

On March 27, 2018, SCS collected compliance groundwater samples from all six monitoring wells at the site, MW-1 through MW-6. The analytical results indicated that although several VOCs were detected in source well, MW-1, only the concentration of benzene was above its AWQS. The concentration of benzene continued to decrease at the source well and was detected at 65.0 μg/L. Similar to previous events, none of the other five wells contained concentrations of VOCs above the laboratory MRLs.

Currently, only the concentration of benzene in well MW-1 exceeds the AWQS. In November 2018, SCS conducted a round of compliance sampling at MW-1, MW-4 and MW-5 to collect data needed to support the closure request. The benzene concentration in MW-1 was 52.0 µg/L. Benzene was not detected in either MW-4 or MW-5.

Natural Attenuation:
Natural attenuation processes include diffusion, dispersion, sorption, volatilization, and biodegradation. A decreasing trend in chemical concentrations in groundwater has been established, which supports evidence that natural attenuation is occurring. Hydrologic and geochemical data can be used to indirectly demonstrate the type(s) of natural attenuation processes. The extent of the dissolved benzene plume is restricted to the immediate vicinity of source well MW-1.

Monitored natural attenuation (MNA) parameter sampling was conducted in November 2018. Nitrate was not collected due to holding time limitations at this remote site. The primary line of evidence for MNA are the decreasing trends in the plume size and concentration. The MNA parameters provide additional support that the geochemical conditions are supportive of MNA. Dissolved oxygen (DO) is present above a 1.0 milligrams per liter (mg/L) in all three wells. This generally indicates aerobic conditions suitable for degradation, but DO is difficult to measure and not dispositive in itself. Dissolved iron, Fe (II), is present at MW-1 at several times the concentration of the other two wells. This suggests some degradation is occurring resulting in reduction of the Fe (III) to Fe (II). Sulfate is lower in the source area with degradation, however, no sulfide was detected. Methane is present in the source area and not at the background wells. Oxidation-reduction potential (ORP) is negative at MW-1 and positive at MW-4 and MW-5. These indicators all suggest aerobic degradation is occurring with residual DO available at MW-1.

Following the second ISCO injection event performed in February 2017, benzene concentrations significantly declinedd from 516 µg/L in January 2017 to 16.7 µg/L in May 2017. A small rebound of benzene concentration was observed in the August 2017 sampling event, but benzene concentrations have since continued to decrease from 74.3 µg/L in December 2017 to 65.0 µg /L in March 2018, and 52.0 µg/L in November 2018. The rate of concentration decline over this period was approximately 2 µg/L per month. This natural attenuation of benzene concentrations is likely due to dilution and diffusion, since the two rounds of ISCO injections likely killed many of the bacteria responsible for biodegradation processes. At the current rate of benzene attenuation, which is approximately 2 µg /L per month, it would take approximately 24 months for the benzene concentration to be below the 5.0 µg /L AWQS.

SCS conducted plume evaluations for natural attenuation using BIOSCREEN™ (Version 4.1) with four simulations. Geochemical parameter data obtained from groundwater sampling was included as input as well as two groundwater velocities (8.6 and 86 feet/year). A starting mass of 10 kg of benzene was assumed. Instantaneous reaction parameters were estimated from the MNA data. Delta oxygen was set at approximately ½ the measured amount in MW-1, since MW-1 was the highest DO reading. Delta sulfate was set at zero since the sulfate at MW-1 was the lowest reading. Nitrate was also set at zero. This eliminates any degradation from sulfate and nitrate electron acceptors and makes the estimate conservative. To get a worst and best case result for first-order decay, the half-life for benzene was set at 0.15 years for the 8.6 feet per year run (best case) and 0.3 years for the 86 feet per year run (worst case). A ten year time frame was used to get a significant migration for the no-degradation comparison. To look more closely at the instantaneous reaction, a 1 year time frame was run for each groundwater velocity. The results show complete breakdown within 50 feet of the source.
In both cases the BIOSCREEN™ model shows degradation to the AWQS within approximately 50 feet of the source under first order decay and similar disappearance of benzene under the instantaneous reaction simulation.

Removal or control of the source of contamination:
On August 15, 2013, SCS observed the excavation and removal of the two USTs from the site. During the removal, Tank #2 was observed to have cracks along the bottom-center and near the eastern end of the tank. A SVE remediation system was started on January 28, 2015, and the AS system, combined with the SVE started on April 15, 2015. SCS performed routine monitoring of the operation of the SVE system and collected influent and effluent air samples in accordance with the air permit. The SVE and AS systems operated continuously, except for intentional shutdown periods prior to performing groundwater sampling events and during occasional electrical power outages.
On April 28, 2016, based on the very low concentrations of VOCs being removed, the SVE and AS systems were shut down. The total mass of hydrocarbons removed since startup of the SVE unit through April 28, 2016, is estimated to be approximately 1,418 Kg (3,126 pounds).

On October 11 and 12, 2016, SCS contracted Regenesis to perform ISCO remediation of remaining hydrocarbons in soil and groundwater contamination beneath the former UST area. Regenesis recommended the injection of PersulfOx®, a sodium persulfate ISCO reagent product with a built-in activation catalyst. SCS directed Regenesis to inject the PersulfOx® solution into existing monitoring well MW-1 and into five additional injection points (IP-1 through IP-5). On

April 19, 2017, Regenesis mixed and injected a 10% PersulfOx® solution into existing monitoring well MW-1 from the depth of 50 to 30 feet bgs. At wells AS-4 and AS-5, Regenesis injected PersulfOx® solution. Following the conclusion of the injection events, well MW-1 was flushed with approximately 250 gallons of clean water, and wells AS-4 and AS-5 were flushed with 200 gallons each.

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, and remediation 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 data tables:

Groundwater data for MW-1 (source well)
Total Depth: 50 feet. Screened 20-50 feet.

Date	Benzene AWQS is 5 µg/L	Free Product Thickness (Feet)	Depth to water (Feet)
February 2014	**4,980**	0.1	30.68
June 2014	**Not sampled**	0.68	29.95
January 2015 SVE start up			
March 2015	**2,100**	0.02	30.32
April 2015 AS start up			
June 2015	**4,300**	Not present	30.4
September 2015	**5,550**	Not present	29.71
December 2015	**3,110**	0.11	30.61
March 2016	**2,180**	Not present	29.91
April 2016 SVE/AS system turned off		Not present	
June 2016	**1,550**	Not present	30.55
October 2016 ISCO event in MW-1			
November 2016 (grab sample)	**269**	Not present	Not measured
January 2017	**516**	Not present	Not measured
April 2017 ISCO event			
May 2017 compliance samples start here	**21.7**	Not present	30.65
August 2017	**86.8**	Not present	30.99

December 2017	**74.3**	Not present	31.6
March 2018	**65.0**	Not present	30.68
November 2018	**52.0**	Not present	30.26

Groundwater well MW-2 (down gradient of source to the southeast)
Total Depth: 50 feet. Screened 20-50 feet.

Date	**Benzene AWQS is 5 µg/L**	**Depth to water (Feet)**
February 2014	**28.1**	31.91
June 2014	**26**	30.7
January 2015 SVE start up		
March 2015	<1	31.04
April 2015 AS start up		
June 2015	<1	31.5
September 2015	<1	31.8
December 2015	<1	32.5
March 2016	<1	31.81
April 2016 SVE/AS system turned off		
June 2016	<1	31.66
May 2017 (compliance samples start here)	<1	31.65
August 2017	<1	31.48
December 2017	<1	32.61
March 2018	<1	32

Groundwater data for MW-3 (cross-gradient of MW-1 to the southwest)
Total Depth: 50 feet. Screened 20-50 feet.

Date	**Benzene AWQS is 5 µg/L**	**Depth to water (ft.)**
February 2014	**150**	29.29
June 2014	**64**	28.08
January 2015 SVE start up		
March 2015	1.2	28.75
April 2015 AS start up		
June 2015	3.8	29.17
September 2015	**5.23**	29.55
December 2015	<1	30.25
March 2016	<1	29.51
April 2016 SVE/AS system turned off		
June 2016	<1	29.45
May 2017 (compliance samples start here)	<1	29.25
August 2017	<1	29.11

December 2017	<1	30.32
March 2018	<1	29.65

Groundwater data for MW-4 (down-gradient of MW-1)
Total Depth: 50 feet. Screened 20-50 feet.

Date	**Benzene AWQS is 5 µg/L**	**Depth to water (ft.)**
February 2014	**1,600**	31.32
January 2015 SVE start up		
March 2015	<1	31.64
April 2015 AS start up		
June 2015	1.3	32.1
September 2015	1.54	32.38
December 2015	**5.5**	33.01
March 2016	<1	32.34
April 2016 SVE/AS system turned off		
June 2016	<1	32.2
May 2017 (compliance samples start here)	<1	32.25
August 2017	<1	31.89
December 2017	<1	33.12
March 2018	<1	31.89
November 2018	<1	31.94

Groundwater data for MW-5 (up gradient to cross gradient from MW-1)
Total Depth: 50 feet. Screened 20-50 feet.

Date	**Benzene AWQS is 5 µg/L**	**Depth to water (ft.)**
February 2014	<1	25.98
January 2015 SVE start up		
March 2015	<1	26.31
April 2015 AS start up		
June 2015	<1	26.47
September 2015	<1	26.79
December 2015	<1	27.59
March 2016	<1	26.59
April 2016 SVE/AS system turned off		
June 2016	<1	26.62
May 2017 (compliance samples start here)	<1	26.49
August 2017	<1	27.05
December 2017	<1	27.62

March 2018	<1	26.66
November 2018	<1	26.98

Groundwater data for MW-6 (down gradient to cross-gradient from source)
Total Depth: 50 feet. Screened 20-50 feet.

Date	**Benzene AWQS is 5 µg/L**	**Depth to water (ft.)**
February 2014	<1	27.61
January 2015 SVE start up		
March 2015	<1	28.49
April 2015 AS start up		
June 2015	<1	27.97
September 2015	<1	28.29
December 2015	<1	29.02
March 2016	<1	28.2
April 2016 SVE/AS system turned off		
June 2016	<1	28.11
May 2017 (compliance samples start here)	<1	28.05
August 2017	<1	28.53
December 2017	<1	29.11
March 2018	<1	28.37

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Dockside Mini Market
416 Hancock Road
Bullhead City, Arizona

Figure 1
Site Vicinity Map

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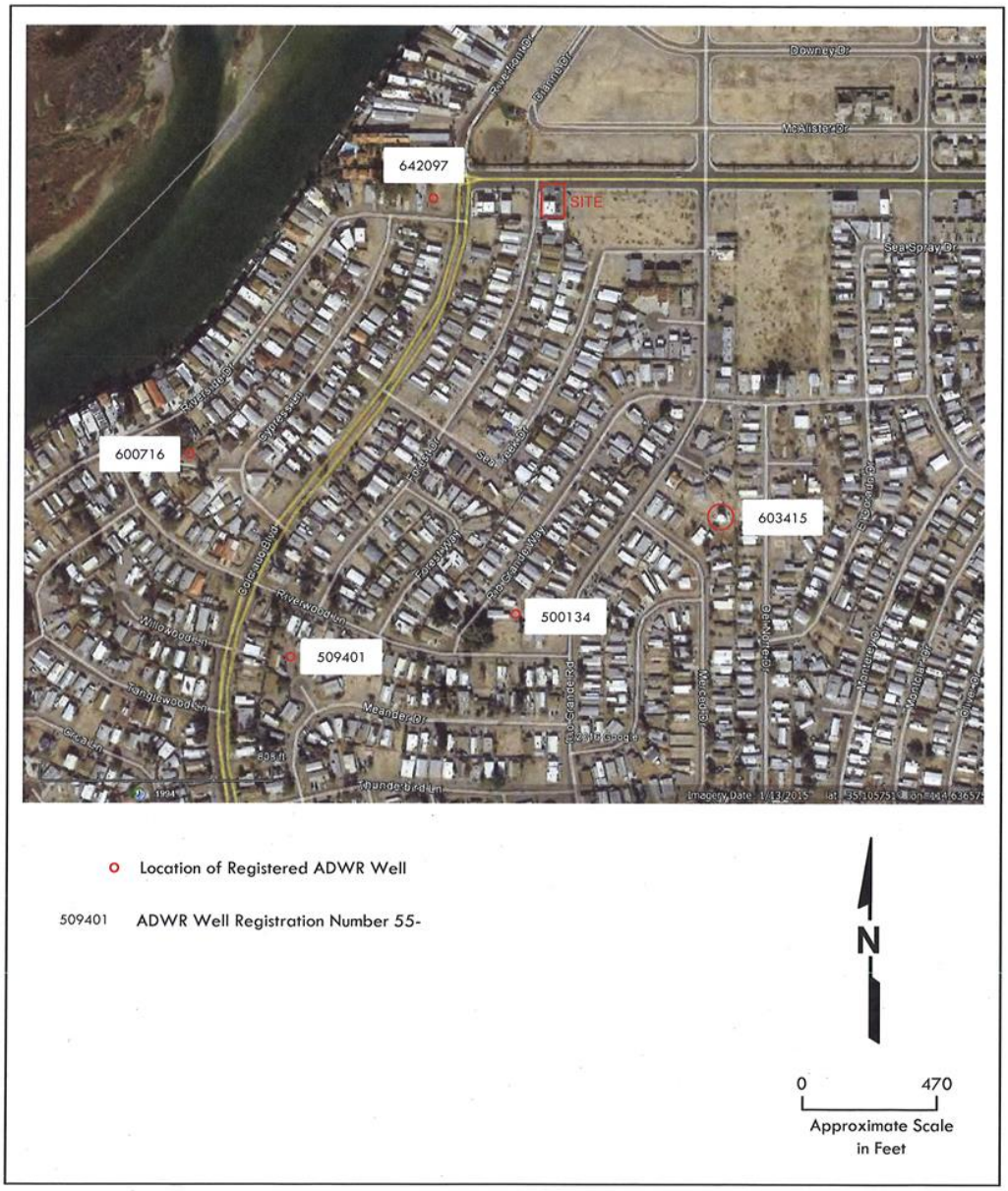

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Dockside Mini Market
416 Hancock Road
Bullhead City, Arizona

Figure 6
Location of ADWR Wells

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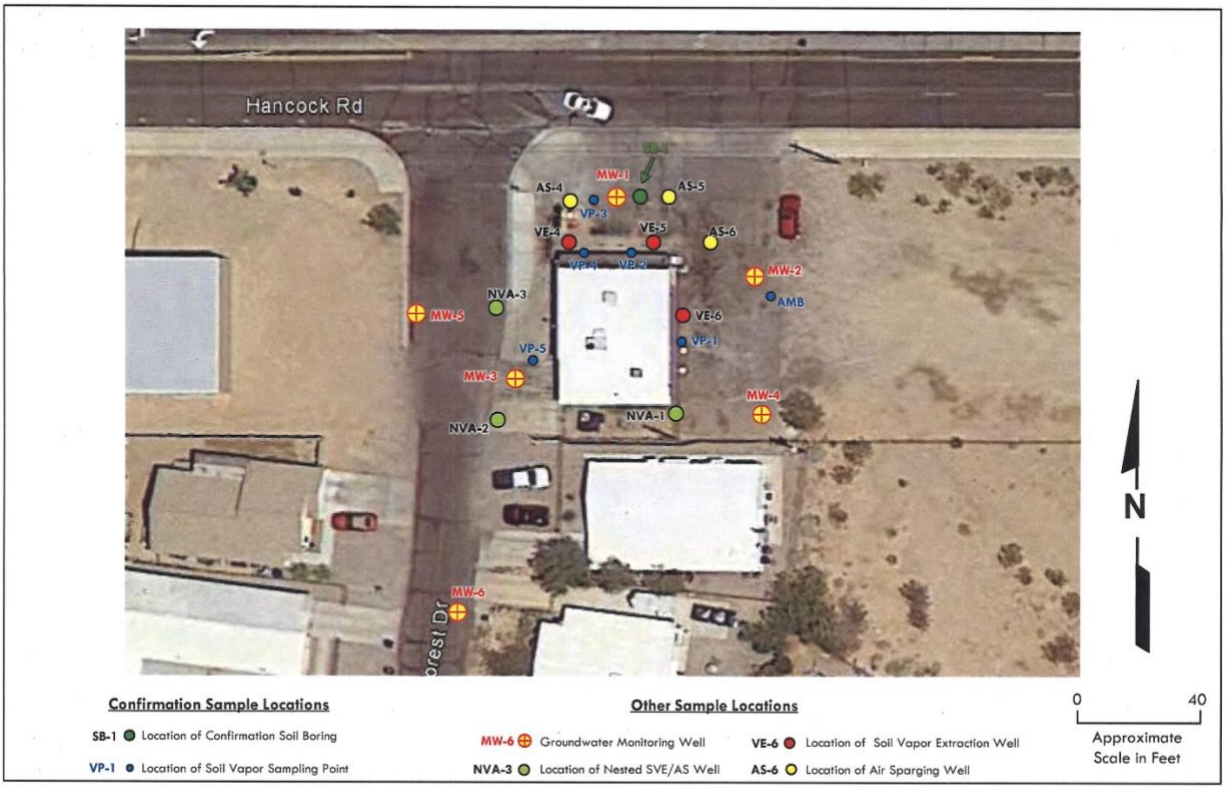

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Figure 5
Location of Confirmation Samples