Appendix Q - Semi-Annual Groundwater Remediation Progress Report

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August 31, 2016

By Federal Express (Tracking Number: 777123771690)

Adrian Simmons
Land Protection Division
Oklahoma Department of Environmental Quality
707 N. Robinson
Oklahoma City, OK 73102

RE: Submission of the 2016 Semi-Annual Groundwater Remediation Progress Report
Consent Order Case No. 15-056
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Dear Mr. Simmons:

On behalf of Wynnewood Refining Company (WRC), please find enclosed the Semi-Annual Groundwater Remediation Progress Report detailing groundwater monitoring and recovery and investigation activities at the Wynnewood Refinery in Wynnewood, Oklahoma. The report format reflects the requirements of Section B of the Consent Order (Case No. 15-056).

Groundwater monitoring samples were collected from June 13 to 16, 2016. From February 23 to April 2, 2016, WRC conducted two direct-push sampling event to characterize site geology and delineate dissolved-phase and LNAPL plumes at the site. On July 13, 2016, WRC submitted the Interior Delineation Summary and Recommendation Report. WRC will continue to provide a monthly report of activities conducted as part of the Comprehensive Remediation Plan (Consent Order 15-056). The next groundwater sampling event is scheduled for December 2016 with a monitoring report submittal date of March 1, 2017.

If you have any questions, please do not hesitate to contact me at the number listed above.

Sincerely,

Sam A. McCormick
Project Manager

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Enclosure

cc/encl: Stephen Baldridge – ODEQ
Bob Morris – Wynnewood Refining Company, LLC
Evan Hilburn – Wynnewood Refining Company, LLC
Jerome McSorley – CVR Energy, Inc.
LeAnn Johnson Koch, Esq. – Perkins Coie LLP
Christine Warford – WSP | Parsons Brinckerhoff

SEMI-ANNUAL
GROUNDWATER REMEDIATION
PROGRESS REPORT
JANUARY 1 THROUGH JUNE 30, 2016

Consent Order Case No. 15-056

WYNNEWOOD REFINING COMPANY, LLC

WYNNEWOOD, OKLAHOMA

EPA ID No. OKD000396549

Prepared by

CVR Energy, Inc. and

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August 31, 2016

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SEMI-ANNUAL GROUNDWATER REMEDIATION PROGRESS REPORT

JANUARY 1 THROUGH JUNE 30, 2016
CONSENT ORDER CASE NO. 15-056

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Prepared for
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August 31, 2016

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Acronyms

ASTM	American Society for Testing and Materials
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
DRO	diesel range organics
EPA	Environmental Protection Agency
ft-bgs	feet below ground surface
ft/ft	foot per foot
ft/mile	feet per mile
gpm	gallons per minute
GRO	gasoline range organics
ISCO	in-situ chemical oxidation
LNAPL	light non-aqueous phase liquid
MOC	Management of Change
O&M	operation and maintenance
ODEQ	Oklahoma Department of Environmental Quality
OPDES	Oklahoma Pollutant Discharge Elimination System
OWRB	Oklahoma Water Resources Board
OWS	oil/water separator
PLF	product loading facility
POTW	publicly owned treatment works
PVC	polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
SVOC	semi-volatile organic compounds
µg/l	micrograms per liter
VOCs	volatile organic compounds
WRC	Wynnewood Refining Company, LLC
WWTP	waste water treatment plant

1 Introduction

1.1 PURPOSE

In accordance with Paragraph 27 of Oklahoma Department of Environmental Quality (ODEQ) Consent Order Case No. 15-056, this Semi-Annual Groundwater Remediation Progress Report (Progress Report) is being submitted on behalf of Wynnewood Refining Company, LLC (WRC) for its refinery at Wynnewood, Oklahoma (the Refinery, Figure 1).

The Refinery covers approximately 560 acres located south and southwest of Wynnewood, Oklahoma. The Refinery is owned and operated by WRC, a wholly owned subsidiary of CVR Energy, Inc. WRC purchased the Refinery from the Gary-Williams Energy Company on December 15, 2011. The Refinery was originally built in 1923 by the Texas Pacific Coal and Oil Company. Subsequent owners included the Kerr-McGee Corporation, which sold the Refinery to Gary-Williams in 1995.

The Refinery operates in accordance with a Resource Conservation Recovery Act (RCRA) Permit (Permit No. 000396549) for the closed Storm Water Retention Pond and an operating hazardous waste storage tank (Tank 2007). On June 30, 2015, ODEQ and WRC entered into a Consent Order to resolve certain RCRA allegations. The Consent Order, among other things, requires WRC to address certain Legacy Environmental Issues involving soil and groundwater contamination.

This Progress Report details activities undertaken to comply with the Consent Order during the reporting period, including:

- Groundwater monitoring results
- Potentiometric water levels and light non-aqueous phase liquid (LNAPL) thickness measurements
- Preparation of the Comprehensive Remediation Plan
- Groundwater recovery summary
- Existing system enhancements
- Interior delineation
- Additional remediation
- Performance Monitoring Plan

1.2 REPORTING PERIOD

The Refinery began hydrocarbon recovery operations in 1986. Semi-annual progress reports have been submitted to the State of Oklahoma beginning in August 1990. This report covers activity during the period from January 1 to June 30, 2016. This progress report is being submitted under the Consent Order, which became effective June 30, 2015. The submittal deadline for this Progress Report is September 1, 2016.

1.3 PROJECT PERSONNEL

Daily operations and routine field work including groundwater sampling and groundwater and LNAPL recovery were supervised by Evan Hilburn and Jerome McSorley, Professional Geologist, of WRC. Sam A. McCormick, Professional Geologist, is the WRC project manager. Assistance with LNAPL recovery operations and maintenance (O&M) for WRC is provided by StanTech. WRC has contracted with WSP to provide environmental consulting and drafting services on this project. The WSP project manager is Christine Warford (OKPE 25621). Christine Warford and Judy Andrews of WSP assisted Mr. McCormick and Mr. McSorley in the preparation of this report.

1.4 REGULATORY CONTACT AND REQUESTS

In a letter dated April 27, 2016, ODEQ requested that the Refinery formalize communication with neighboring landowners that currently have and use private wells downgradient from the Refinery. The Refinery delivered letters and well use questionnaires to the owners of the South Martin Well and McLaughlin wells along with the analytical results for their respective wells from the September 2016 comprehensive sampling event. Both landowners signed the form indicating they did not use water from the well for human consumption. Copies of the signed land owner acknowledgment forms were sent to ODEQ in monthly email correspondence and are included in Appendix 1.4.

2 Status of Investigation Activities Completed During the Reporting Period

2.1 GROUNDWATER MONITORING

Since groundwater monitoring began in 1980, a total of 167 groundwater monitoring and/or recovery wells (including piezometers) have been installed at the Refinery (Figure 2, Table 1). There are currently 113 monitoring and recovery wells within the groundwater monitoring and remediation network. Fluid levels, including depth to groundwater and depth to LNAPL, are collected from each monitoring and recovery well on a quarterly basis in March, June, September, and December of each year. Groundwater monitoring is conducted in accordance with the Comprehensive Remediation Plan submitted to ODEQ on August 13, 2015, and formally approved by ODEQ on February 1, 2016. The results of the groundwater monitoring events conducted in March and June 2016 are included in Section 2.2 and Section 2.3 of this Progress Report.

2.2 GROUNDWATER OBSERVATIONS AND LNAPL DISTRIBUTION

Groundwater elevation and LNAPL thickness measurements were collected in March and June 2016. The observations are summarized on Tables 2A and 2B and included in Appendix 2.2. The extent of LNAPL plumes shown in Figures 3A and 3B incorporate the results of the Interior Delineation investigation with fluid level measurements collected in monitoring wells and recovery wells during the quarterly monitoring events. The footprints of the LNAPL plumes were extended or modified based on the presence or absence of LNAPL at temporary boring locations installed during the direct-push investigation conducted in February, March, and April 2016 as part of the Interior Delineation investigation. The distribution of LNAPL based on the findings of the direct-push investigation were generally consistent with the historic LNAPL plumes mapped at the Site. No new plumes were encountered during the direct-push investigation. Activities associated with the Interior Delineation are discussed in more detail in Section 6.

2.2.1 Groundwater Observations

Groundwater elevations across the Refinery were relatively stable throughout the reporting period. Groundwater elevations decreased by 0.17 foot on average between December 2015 and March 2016 and increased an average of 0.15 foot from March 2016 to June 2016. On average, groundwater elevation measurements in June 2016 were 0.57 foot lower than measurements collected in June 2015.

All wells exhibited a large increase in groundwater elevation in the spring of 2015 due to high amount of rain in the months preceding the gauging event that year. For most wells, the observed June 2015 groundwater elevations were the highest elevations ever recorded. The high groundwater elevations continue to persist, with measurements approximately 5 feet higher than the average across the Refinery. A hydrograph showing the groundwater fluctuations at the Site is included in Appendix 2.2.1.

Groundwater flow across the Refinery is generally toward the southwest, with some localized variations. The groundwater flow direction at the Product Loading Facility (PLF) is toward the west. The slight difference in flow direction in this area is attributed to the continuous pumping at the hydrocarbon recovery system. The groundwater flow direction at the southern boundary is to the south.

The average horizontal groundwater gradient across the northern part of the Refinery was calculated from monitoring well UMW-1 to UMW-3 (a distance of 2,530 feet) as 0.014 foot per foot (ft/ft) (76 feet per mile [ft/mile]) in March 2016 and 0.015 ft/ft (77 ft/mile) in June 2016. The average horizontal gradient across the southern part of the Refinery was calculated from monitoring well SMW-18 to BMW-19 (a distance of 3,700 feet) as 0.0028 ft/ft (14.8 ft/mile) in March 2016 and 0.0029 ft/ft (15.3 ft/mile) in June 2016. Consistent with the previous reporting periods, the gradient is steepest on the east side of the Refinery (east of U.S. Highway 77) and relatively low in the open vegetated areas west of the railroad tracks (including the PLF area).

2.2.2 LNAPL Distribution

As shown on Figures 3A and 3B, there are five general areas where LNAPL was identified at the Refinery during the reporting period. The LNAPL plumes shown on Figures 3A and 3B are generally consistent with the LNAPL plumes observed in previous reporting periods, although the footprints of the LNAPL plumes were extended or modified based on the presence or absence of LNAPL encountered in temporary wells during the direct-push investigation, discussed in Section 6.

A generally increasing trend in LNAPL thickness has been observed in the North Process Area and South Process Area during the last two reporting periods, likely resulting from hydrodynamic changes associated with the concurrent rise in the water table. LNAPL thickness at PLF monitoring wells has remained generally stable to decreasing.

In the northern part of the process area, an LNAPL plume has historically extended from NMW-12 in the north to NMW-4 in the south. The direct-push investigation confirmed that the LNAPL accumulations in the vicinity of NMW-6 and NMW-12 are now separate, smaller plumes, distinct from the LNAPL accumulation in the North Process Area. Measurable LNAPL was present in recovery wells NRW-4 and NRW-6 in March and June 2016. LNAPL was also present in several monitoring wells in the vicinity of the recovery wells. LNAPL thicknesses at wells in the North Process Area ranged from 0.01 foot (NMW-18 and NMW-19 in March 2016) to 3.94 feet (NMW-10, March 2016). The LNAPL in the North Process Area to the east of the highway resembles gasoline, while the LNAPL west of the highway, in the vicinity of NRW-6 and NRW-7, resembles diesel.

An LNAPL plume is present in the South Process Area, centered near monitoring wells OMW-3 and OMW-4 and extending southward to LMW-11. The plume in this area has historically contained the largest sustained LNAPL thicknesses at the Refinery, with observations frequently exceeding 5 feet in multiple wells. LNAPL during this reporting period was observed in wells in this area at thicknesses ranging from 0.13 foot (LMW-1, March and June 2016) to 11.70 feet (OMW-4, March 2016). The LNAPL plume footprint in this area during the reporting period was similar to the one observed during the previous reporting period. The LNAPL in this area resembles diesel.

The footprint of the LNAPL plume in the PLF Area was historically localized around BMW-5, with no LNAPL observed in any other wells in that area between 2006 and 2011. Beginning in June 2011 and continuing to the present, LNAPL has been observed in as many as 14 different wells. LNAPL was observed in wells at the PLF at thicknesses ranging from 0.09 foot (BMW-26, March and June 2016) to 2.86 feet (BMW-5, June 2016). The footprint of the LNAPL plume in the PLF Area is relatively stable. The LNAPL in the PLF Area resembles gasoline.

A small LNAPL plume is intermittently observed near monitoring well LMW-5-0. LNAPL was observed in this well at a thickness of 0.02 foot in June 2016.

2.3 GROUNDWATER SAMPLING

In accordance with the Comprehensive Remediation Plan submitted to ODEQ on August 12, 2015 (WRC, 2015), samples were collected from a total of 21 monitoring wells, two water supply wells (S Martin Well and McLaughlin Well), and Martin Pond. Groundwater sampling locations are shown on Figure 2.

2.3.1 Sampling Procedure

The groundwater sampling for this reporting period was conducted from June 13 to 16, 2016. Monitoring wells were sampled using dedicated pumps and low-flow sampling methods. The samples from the offsite water wells were collected as grab samples from a hose connected to the well. The sample from Martin Pond was collected as a grab sample via bailer inserted near the pond center.

Samples were analyzed for the following parameters:

- gasoline range organics (GRO) by Oklahoma method GRO (8015D modified)
- diesel range organics (DRO) by Oklahoma method DRO (8015D modified)
- volatile organic compounds (VOCs) by U.S. Environmental Protection Agency (EPA) Method 8260

Groundwater samples were collected, labeled, shipped, and analyzed in general conformance with the groundwater sampling procedures specified in the Quality Assurance Project Plan (QAPP) submitted to ODEQ as Appendix A of the Comprehensive Remediation Plan (WRC, 2015).

2.3.2 Analytical Results

Groundwater samples were submitted to Pace Analytical Services, Inc. of Salina, Kansas (Oklahoma State Lab ID No. 8815). The groundwater sampling results for this reporting period are summarized in Table 3, and shown on Figure 4. Complete laboratory analytical reports including chain-of-custody forms are included in Appendix 2.3.A, and a copy of the field sampling logs is included in Appendix 2.3.B.

In accordance with the data quality objectives outlined in the QAPP submitted with the Comprehensive Remediation Plan (WRC, 2015), two duplicate samples, one equipment rinsate blank, one matrix spike and matrix spike duplicate, and one trip blank were collected for quality assurance/quality control (QA/QC) purposes during the June 2016 sampling event. According to the laboratory sample receipt form, one or more sample vials for samples collected from UMW-6 and SMW-24 contained air bubbles larger than 6 millimeters. There were no other QA/QC issues related to field activities or sample shipping noted by the laboratory. Additional data qualifiers were reported by the laboratory in the Quality Control Report and are included with the sample results in Table 3. Details of laboratory QA/QC are included in the laboratory reports in Appendix 2.3.A. The results of the duplicate samples were consistent with the concentrations measured in the primary samples.

2.3.2.1 Gasoline Range Organics

GRO were detected in 11 of the 24 samples collected from the monitoring wells, private supply wells, and Martin Pond in June 2016. The concentration of GRO exceeded the ODEQ Cleanup Level of 1,000 micrograms per liter (μg/l [ODEQ, 2004]) in samples collected from monitoring wells BMW-25, BMW-26, NMW-6, NMW-12, UMW-4, UMW-5, and UMW-6. The highest concentration of GRO was observed in monitoring well NMW-12 (37,000 μg/l), located at the northeastern portion of the refinery, in the north side of the Light Oils Tank Farm.

The concentration of GRO in samples collected from BMW-26 and UMW-5 exhibit a generally decreasing trend since 2011, while the concentration of GRO in UMW-6 shows a slight increasing trend. GRO concentrations do not exhibit an increasing or decreasing trend elsewhere at the Site.

2.3.2.2 Diesel Range Organics

DRO were detected in 16 of the 24 samples collected from the monitoring wells, private supply wells, and Martin Pond in June 2016. The concentration of DRO exceeded the ODEQ Cleanup Level of 1,000 µg/l (ODEQ, 2004) in samples collected from monitoring wells BMW-25, BMW-26, NMW6, NMW-12, UMW-1, UMW-4, and UMW-6. The highest concentration of DRO was observed in monitoring well NMW-6 (190,000 µg/l), located in the northeast portion of the Refinery in the Light Oils Tank Farm. Monitoring well NMW-6 contained 0.20 foot of LNAPL when it was sampled.

The trend in DRO concentrations across the Refinery are generally stable or decreasing. The concentration of DRO in June 2016 in monitoring well UMW-4 (1,600 µg/l), however, was the highest concentration detected since the well was installed in 2012. The detection of DRO in UMW-1 is the first time DRO have been detected in this well.

2.3.2.3 Benzene

Benzene was detected above the laboratory reporting limit and above the laboratory reporting limit in 8 of the 24 samples collected from the monitoring wells, private supply wells, and Martin Pond in June 2016. The concentration of benzene exceeded the EPA Drinking Water Standard (5 µg/l) at samples collected from monitoring wells BMW-25, BMW-26, NMW-6, NMW-12, UMW-4, UMW-5, UMW-6, and Martin Pond. The highest concentration of benzene was observed in monitoring well NMW-12 (8,540 µg/l), located at the northeastern portion of the refinery, in the north side of the Light Oils Tank Farm.

The trend in benzene concentrations across the Refinery are generally stable or decreasing. The concentration of benzene in monitoring well UMW-4 (903 µg/l) during this reporting period, however, was the highest concentration detected since the well was installed in 2012.

3 Comprehensive Remediation Plan

As part of a Consent Order signed on June 30, 2015 (Case No. 15-056), a Comprehensive Remediation Plan was submitted to ODEQ for review and approval on August 12, 2015. The Plan describes the activities proposed to be undertaken to comply with the requirements of Section B of the Order, specifies preliminary remediation goals and final cleanup goals, and includes timelines for completion of the proposed work scope.

ODEQ issued a Notice of Deficiencies Letter regarding the Plan on November 24, 2015. WRC responded to the Notice on December 23, 2015 and modified select sections of the text and figures to correct the deficiencies identified by ODEQ in their letter. The Plan was approved by ODEQ on February 1, 2016.

Figure 6.1 of the Comprehensive Remediation Plan has been updated to show the work that has been completed by the end of the reporting period and is included in Appendix 3. Additionally, WRC has been providing informal monthly progress updates to the ODEQ project coordinator.

4 Groundwater Recovery Summary

The Refinery has historically operated six hydrocarbon recovery systems. WRC currently operates three recovery systems: the PLF System, North Process Area System, and South Process Area System (Figure 5).

The first part of this section describes the historical recovery systems and summarizes their cumulative production. The second part of this section describes the current recovery system configuration, operations and maintenance, and recovery results for the reporting period.

4.1 HISTORICAL HYDROCARBON RECOVERY SYSTEMS

4.1.1 Tank 150 Area

The Tank 150 Area is located west of U.S. Highway 77, northeast of the main processing area of the Refinery. In 1985, LNAPL was observed in monitoring well NMW-7. The LNAPL was similar in characteristic to gasoline and was assumed to have originated from the nearby gasoline blending area. LNAPL recovery operations began in 1987.

The Tank 150 Area recovery system consisted of a sump, an 8-foot length of 30-inch diameter steel culvert installed at the water table (as it existed in 1987, apparently a relatively high period for groundwater), and an ORS Scavenger recovery pump. The pump was connected through a 1-inch diameter flexible hose to an adjacent 1,000-gallon (25-barrel) aboveground storage tank located inside the Tank 150 dike area. In the past, the tank was emptied as needed by transfer to a vacuum truck for reprocessing in the Refinery.

The ORS Scavenger pump was operated intermittently when high water table conditions permitted recovery from the sump. The system was last operated in the second half of 2008.

The Tank 150 Area system recovered 14,225 gallons (339 barrels) of LNAPL between 1990 and 2008. Additional LNAPL was recovered in the period 1987 to1989, but the volume was not recorded.

In accordance with the Comprehensive Remediation Plan, the Tank 150 Sump was plugged on August 19, 2015. WRC obtained a variance from the Oklahoma Water Resources Board to plug the sump. The variance was necessary since the prescribed method of plugging a well in Oklahoma (overdrilling and pulling the casing) was impractical for this sump.

Recovery operations for this area have now been incorporated into those associated with the North Process Area (Section 4.2.2).

4.1.2 Light Oils Terminal Area

The Light Oils Terminal recovery system is located in the northwest corner of the Refinery, east of U.S. Highway 77 and east of the main Refinery office. The area is hydraulically upgradient from the main process areas of the Refinery. The Light Oils Terminal area consists of about a dozen large aboveground storage tanks and an associated product loading rack for truck transports.

Petroleum LNAPL was discovered in this area in 1987 during a soil boring program associated with the Refinery's RCRA Facility Investigation. The LNAPL is presumably gasoline.

The Light Oils Terminal Area recovery system initially consisted of pneumatic ejector pumps installed in two monitoring wells (NMW-9 and NMW-10). Discharge lines from the wells were routed to an adjacent tank truck that served as a recovery tank. When full, the recovered LNAPL in the tank truck was removed via vacuum truck and reprocessed at the Refinery. Groundwater was drained to a process sewer for treatment under the Refinery's Oklahoma Pollutant Discharge Elimination System (OPDES) permit.

LNAPL recovery began in December 1989. Initially, only the volume of recovered LNAPL was recorded. In January 1990, a flow meter was added to the discharge line to the tank truck, and recovered groundwater volumes were recorded thereafter. A new pneumatic pump was installed in NMW-9 in April 2005. At that time the ejector pumps were removed from NMW-9 and NMW-10.

After April 2005, the Light Oils Terminal Area recovery system consisted of one pneumatic pump in monitoring well NMW-9. The pump discharged though a ½-inch diameter flexible hose that is routed across the ground to a nearby process sewer connection. There was a flow meter on the discharge line; however, the volume of LNAPL produced along with the groundwater was not measured.

The Light Oils Terminal Area recovery system has not operated since June 2009. It appears that much of the LNAPL in this area has now migrated downgradient to the Process Area recovery system. The Light Oils Terminal Area recovery system has a cumulative recovery of 158,705 gallons (3,779 barrels) of LNAPL and 461,026 gallons of groundwater.

Recovery operations for this area have now been incorporated into those for the North Process Area (Section 4.2.2).

4.1.3 Product Loading Facility Area

The PLF is located on the western boundary of the Refinery, and the recovery system is located north of the PLF. During an expansion project for the PLF in 1986, the Refinery discovered LNAPL on groundwater. The source was a leaking underground pipe. A sample of the LNAPL was tested for American Society for Testing and Materials (ASTM) physical properties (specific gravity and boiling point distribution) and chromatographic analysis by the Refinery laboratory. The sample analysis indicated that the LNAPL is similar in characteristics to premium unleaded gasoline.

Initially, three metal culvert sumps and skimmer pumps were installed to recover LNAPL. These were operated until they were no longer effective. In June 1990, the PLF Area recovery system was installed, consisting of five recovery wells (BRW-1 through BRW-5) positioned to capture total fluids at the downgradient edge of the previously defined LNAPL plume.

The system initially included an oil/water separator (OWS), with a working capacity of 1,000 gallons, downstream from the recovery wells. However, due to maintenance concerns with the tank, the discharge line from the system was routed directly to the process sewer. In 1991, the Refinery installed two additional monitoring wells (BMW-25 and BMW-26) downgradient from the recovery system. These wells are sampled on a semi-annual basis for benzene, toluene, ethylbenzene, and total xylenes (BTEX) to track the long-term effectiveness of the recovery system.

On July 6, 2001, improvements to the PLF recovery system were put in service. The improvements included: installing three new recovery wells (BRW-6, BRW-7, and BRW-8) along the west side of the area between monitoring wells BMW-25 and BMW-26; replacing the pumps with new electrical submersible pumps in five recovery wells (BRW-1 through BRW-5); and installing an air sparging system using seven existing monitoring wells. In December 2010, the air sparging wells were taken out of service as part of system enhancements and are now used as monitoring wells.

Current PLF recovery system operations are summarized in Section 4.2.1.

4.1.4 Laboratory and Control Building Area

The Laboratory and Control Building Area recovery system is located west of U.S. Highway 77, north of the gate into the Refinery Process Area. In 1989, LNAPL (presumably a hydrotreated heavy naphtha similar to kerosene, known by the trade name 100W) was observed in monitoring well NMW-8 (located 75 feet north of the laboratory building). The source of the release was not determined, but 100W is used at the laboratory as a solvent and is stored in aboveground storage tanks outside the laboratory.

In 1990, a process control building was constructed adjacent to the south side of the laboratory building. The lower floor of the process control building is approximately 5 feet below ground surface (bgs), and an air conditioning duct bank lies underneath the floor. During a period of high water table levels in 1990, groundwater and LNAPL entered the air conditioning duct bank, and the resulting vapors forced the evacuation of the process control building.

An emergency dewatering system was installed on the east side of the process control building. The system consisted of three dewatering wells (DRW-1, DRW-2, and DRW-3). The wells were installed at a depth of 20 ft-bgs and completed with 15 feet of 4-inch diameter polyvinyl chloride (PVC) screen. The wells were outfitted with Grundfos electric submersible pumps and operated on float-activated switches. The effluent from the three dewatering wells was piped directly to a process sewer. At the same time, the sub-floor air conditioning duct work was abandoned.

Four additional recovery wells (KRW-1 through KRW-4) were installed in 1990 along the outer walls of the laboratory building (two on the north side and two on the east side). The wells at the laboratory building were 4-inch diameter with 5 feet of slotted screen. The four wells were outfitted with ejector pumps. The intake level of the ejector pumps was designed to operate at a depth of 3 to 4 feet below the top of the static water table to maximize drawdown. The pumps were periodically raised or lowered in response to water table variations. Effluent from the ejector pumps was directed to an OWS. The LNAPL was recovered for reprocessing at the Refinery, and the groundwater was discharged to the Refinery's process sewer.

The four recovery wells at the laboratory building last operated continuously in December 2008. The four recovery wells were plugged on January 5, 2012, to make room to retrofit the laboratory with reinforced outer walls. Recovery operations for the laboratory and control building area are no longer productive, but the dewatering wells at the control building are presumably capable of being put back into service should the need arise. However, at the present time there is no need to do so.

The Laboratory and Control Building Area recovery system recovered 394,917 gallons of groundwater and 21,067 gallons (502 barrels) of LNAPL. The volume of groundwater removed by the three dewatering pumps was apparently not recorded.

4.1.5 South Alky Unit Area

The South Alky Unit Area recovery system was located west of the railroad tracks and west and south of the main processing units at the Refinery. The recovery system consisted of two 30-inch sumps installed to a depth of 20 ft-bgs. A skimmer and pump system (ORS Scavenger pump) was used for recovery at each sump. The two sumps were located 265 feet apart between the railroad tracks and the Refinery service road that runs parallel to the tracks. The LNAPL was pumped to a 100-barrel aboveground storage tank. As needed, the tank was emptied via vacuum truck, and the LNAPL was reprocessed at the Refinery. Due to a conflict with Refinery expansion plans, the sumps were plugged in accordance with Oklahoma Water Resource Board (OWRB) guidance. A variance was granted from OWRB in May 2013 (VR 2013-08) to plug the sumps by grouting in place. The storage tank has been emptied and removed from the area.

The South Alky Unit Area recovery system was installed as an adjunct to the Process Area recovery system and was operational from the second half of 1992 to 2012. Based on the physical appearance of LNAPL in nearby monitoring wells, the LNAPL in the vicinity of the south sump is likely a heavy naphtha, and the LNAPL in the vicinity of the north sump is likely a gas-oil. The cumulative amount of recovered LNAPL is 33,169 gallons (790 barrels).

Recovery operations for this area have now been incorporated into those for the South Process Area (Section 4.2.3).

4.1.6 Process Area

The Process Area recovery system is located along U.S. Highway 77 (from near the northern boundary of Refinery property), past the WRC main office building, across the highway, down through the main process areas of the Refinery, and across the railroad tracks that form the western boundary of the main process area. LNAPL was discovered in a monitoring well (LMW-13) installed on the west side of the railroad tracks in 1981. The LNAPL resembled a mixture of crude oil and distillate.

Initially, the Process Area recovery system consisted of three wells (ORW-1, ORW-2, and ORW-3). These 4-inch diameter PVC recovery wells were installed in 1986 east of the railroad tracks in what was then considered to be the center of the LNAPL plume. The wells were outfitted with ejector pumps. The recovery system produced a small volume (840 gallons) of LNAPL and a considerable (but unrecorded) volume of water. In January 1990, the ejector pumps were replaced with smaller pumps to limit the production of groundwater. Between January 1 and March 31, 1990, the system produced 1,769 gallons of LNAPL and 5,697 gallons of groundwater. Between March 31 and June 6, 1990, the system operated sporadically due to rapidly fluctuating groundwater elevations, and the system was shut off in June 1990.

In 1992, the Process Area recovery system was expanded to include 10 new recovery wells (NRW-1 through NRW-7, LRW-3 and LRW-4, and ORW-4). The new recovery wells were outfitted with electric submersible pumps. The original three wells were abandoned as recovery wells. In addition to the distillate products being recovered in the southern part of this area, the northern recovery wells (NRW-1 through NRW-7) are recovering LNAPL resembling gasoline—apparently part of the LNAPL plume that has migrated downgradient from the Light Oils Terminal area.

The Process Area recovery system last operated consistently in September 2010. Since that time a few wells have operated sporadically, but the system suffered from a lack of long-term maintenance on the pumps and effluent piping. The system cumulatively recovered a volume of 78,091,001 gallons of groundwater and an estimated 36,120 gallons (860 barrels) of LNAPL. Beginning in July 2003, the volume of LNAPL recovered was estimated, based on laboratory analysis, as being a small percentage (0.25 percent) of the recovered groundwater volume.

For reporting purposes, the Process Area recovery system has been terminated as of December 31, 2011. It has been replaced by a North Process Area recovery system (Section 4.2.2) and a South Process Area recovery system (Section 4.2.3).

4.2 EXISTING RECOVERY SYSTEM OPERATIONS

There are currently three existing recovery systems operating at the Refinery, the PLF system, North Process Area System, and South Process Area System. Monthly O&M is conducted on each recovery system by StanTech. Appendix 4.2.A contains the O&M field data sheets for the reporting period.

Semi-annual product recovery rate tests were conducted on June 15 and 16, 2016 at recovery wells of each recovery system. The product recovery rate is used to determine the amount of LNAPL recovered from the recovery systems. Recovery rates are determined by isolating the recovery wells and filling graduated buckets with flow from each recovery well. The recovered LNAPL and water were allowed to settle for a period of approximately five minutes before the volumes of LNAPL and water were recorded. The product recovery rate calculations are discussed in further detail in the sections below. Appendix 4.2.B contains the product recovery rate calculation. Table 4 includes a summary of LNAPL and groundwater recovery for the recovery systems.

4.2.1 Product Loading Facility Recovery System

The PLF recovery system currently consists of eight recovery wells, BRW-1 through BRW-8. At this time, five of the eight wells (BRW-3 and BRW-5 through BRW-8) are outfitted with electric submersible pumps (Figures 6A and 6B). Recovery wells BRW-3 and BRW-5 are 4-inch diameter wells, and BRW-6 through BRW-8 are 6-inch diameter wells. Each well is operated on a float switch, and the pump cycles on and off. Effluent from these five recovery wells is combined and discharged directly to the Refinery's process sewer for treatment in the Refinery's wastewater treatment plant. A target flow rate of 10 gallons per minute (gpm) was established, based on a 2011 evaluation, to provide sufficient drawdown (WRC, 2011).

Routine O&M activities conducted by StanTech during the reporting period for the PLF recovery system included cleaning the flow meters and meter screen and restarting the system. Copies of the O&M field log sheets are included in Appendix 4.2.A. On November 13, 2015, the air sparge piping that had historically connected monitoring wells BMW-2, BMW-6, BMW-8, BMW-11, BMW-18, BMW-25, BMW-26 to an air sparge system that is no longer operable was removed from the wells.

Groundwater flow is recorded on an effluent meter, and the meter is read monthly. During the reporting period, the PLF recovery system produced 1,156,107 gallons of groundwater. The continuous average system flow rate for this reporting period was approximately 4.7 gpm, which is approximately 1 gpm lower than the flow rate during the last reporting period. Since 1992, the PLF recovery system has produced a cumulative volume of 48,909,393 gallons of groundwater.

The January 2016 recovery rate test results, indicating approximately 0.0023 percent of the metered effluent is LNAPL, was used in January and February 2016. The June 2016 recovery rate test results, indicating approximately 0.0089 percent of the metered effluent is LNAPL was applied beginning in March 2016 through the end of the reporting period. This recovery factor of 0.0089 percent is consistent with the June 2015 recovery rate, and slightly higher than the recovery rate calculated in the previous reporting period (0.0023 percent). An estimated 78 gallons of LNAPL were entrained in the groundwater during the reporting period, and an estimated 13,866 gallons (330 barrels) of LNAPL have been recovered from the system since 1992 (Table 4). The recovery rate calculation is shown in Appendix 4.2.B. Copies of the field log sheets are included in Appendix 4.2.A. The recovery estimates shown in Table 4 have been calculated using the applicable recovery estimates for each reporting period.

There was an increase in LNAPL thickness at monitoring wells BMW-2, BMW-5, and BMW-24 from the previous reporting period, which is partially attributed to accumulation of LNAPL that entered and became entrapped in the wellbore during previous periods of decreased water table elevation and may not reflect the actual thickness of LNAPL in the subsurface.

Appendix 4.2.C contains total BTEX concentrations plotted over time for BMW-25 and BMW-26. The BTEX concentrations at the end of this reporting period (June 2016) decreased at both BMW-25 and BMW-26. BTEX concentrations at BMW-25 reduced by 72 percent from the previous reporting period (September 2015). BTEX concentrations at BMW-26 reduced by 24 percent from the previous reporting period, and has consistently decreased in the last three reporting periods (December 2014, June 2015, and September 2015). BTEX concentrations are the lowest concentrations since the June 2012 reporting period. The trends for BMW-25 and BMW-26, in conjunction with the LNAPL recovery factors, indicate that the PLF system is controlling the migration of contaminant plumes and capturing the free-phase and dissolved-phase contaminant plumes in this area. Upgrades for the PLF system are being reviewed through the Refinery's Management of Change (MOC) process. Planned enhancements to the PLF remediation system are discussed in Section 5.1.

4.2.2 North Process Area Recovery System

The North Process Area recovery system currently includes seven recovery wells (Figures 7A and 7B). The recovery wells (NRW-1 through NRW-7) are located along a roughly north-south axis on either side of U.S. Highway 77 on the western (downgradient) side of a LNAPL plume. Each recovery well is a 6-inch diameter well outfitted with an electric submersible pump.

The four wells east of U.S. Highway 77 (NRW-1 through NRW-4) are tied together at a common meter box located near the WRC main office. The effluent line from each well is 1½-inch diameter PVC pipe. Each well runs through individual piping to a common flow meter and then flows to a 4-inch diameter PVC discharge line. The discharge line crosses under U.S. Highway 77 and connects to the western wells and ultimately the Refinery's process sewer.

The three wells on the west side of U.S. Highway 77 (NRW-5 through NRW-7) are tied together at a common meter box on the highway fence line southeast of NRW-5. Before April 10, 2014, the 1½-inch diameter PVC effluent line from each of these three wells ran through individual flow meters before connecting to a 4-inch diameter PVC discharge line, and the process sewer. On April 10, 2014, a new meter box and flow meter were installed for the three recovery wells located west of U.S. Highway 77 (NRW-5 through NRW-7).

Routine O&M activities conducted during the reporting period for the North Process Area included cleaning the flow meter screens. Copies of the O&M field log sheets are included in Appendix 4.2.A.

During the reporting period, the North Process Area produced 3,181,435 gallons of groundwater. The continuous average system flow rate for this reporting period was 11.9 gpm, which is approximately 2 gpm higher than the flow rate reported during the last reporting period.

The June 2016 recovery rate test results indicated that approximately 0.49 percent of the metered effluent is LNAPL, slightly higher than the previous recovery rate of 0.12 percent calculated in January 2016. The January 2016 recovery rate test result was used in January and February 2016 and the June 2016 recovery factor of 0.49 percent was applied from March 2016 through the end of reporting period. An estimated 11,798 gallons of LNAPL were entrained in the groundwater recovered during the reporting period, and an estimated 60,204 gallons (1,433 barrels) of LNAPL have been recovered from the system since 2012 (Table 4). Copies of the field log sheets are included in Appendix 4.2.A. The recovery rate calculation is shown in Appendix 4.2.B.

WRC plans to upgrade the North Process Area recovery system based on a review of the existing infrastructure, boring logs, and hydrogeologic data. The focus of the initial improvements will be modifications to recovery wells NRW-1 through NRW-7. The proposed modifications for system enhancements were submitted to the Refinery as part of the MOC process. Planned enhancements to the North Process Area remediation system are discussed in Section 5.2.

4.2.3 South Process Area Recovery System

The South Process Area recovery system currently includes recovery well LRW-3, a 6-inch diameter well outfitted with an electric submersible pump (Figures 8A and 8B).

Recovery well LRW-3 previously discharged into a 6-inch diameter process sewer line that serves various storm water and process sumps on the west side of the railroad tracks. The 6-inch diameter sewer line crossed under the railroad tracks north of LRW-3 and joined the main Refinery process sewer at a sewer box near Tank 103, on the east side of the railroad tracks. Due to Refinery expansion projects in the area, the discharge line for LRW-3 was relocated to a new crossing under the railroad tracks. The recovery system was shut down in August 2013 and was restarted on June 30, 2014.

Routine O&M activities conducted during the reporting period for the South Process Area included cleaning and installation of a new strainer screen. The flow meter strainer screen was often clogged during the first half of the reporting period, causing the meter to not function properly. Copies of the O&M field log sheets are included in Appendix 4.2.B.

During the reporting period, the South Process Area is estimated to have produced 712,417 gallons of groundwater. Due to inaccurate meter readings when the flow meter screen was clogged, the recovered groundwater volume was estimated using the corresponding recovery rate test flow rates ranging from 1.7 gpm to 3.7 gpm, and the run time of the pump during the reporting period. The continuous average system flow rate for this reporting period was estimated to be 2.8 gpm.

The June 2016 recovery rate test results indicated that approximately 0.0089 percent of the metered effluent is LNAPL, an increase from the previous reporting period when no LNAPL recovery was indicated in January 2016. The January 2016 recovery rate test results was used in January and February 2016 and the June 2016 recovery factor of 0.0089 percent was applied from March 2016 through the end of reporting period. An estimated 46 gallons of LNAPL were entrained in the groundwater recovered during the reporting period, and an estimated 975 gallons (23 barrels) of LNAPL has been recovered from the system since 2012 (Table 4). Copies of the field log sheets are included in Appendix 4.2.A. The recovery rate calculation is shown in Appendix 4.2.B.

5 Existing Recovery System Enhancements

5.1 PRODUCT LOADING FACILITY SYSTEM ENHANCEMENTS

As discussed in Section 4.1.3, the existing system was installed in response to a release discovered in 1986. The system currently operates with five recovery wells outfitted with electric submersible pumps plumbed to a common header. In the Comprehensive Remediation Plan, the Refinery proposed enhancements to the PLF system in order to improve containment and capture of the dissolved-phase and LNAPL plumes by installing properly sized electric submersible pumps to maximize yield from individual recovery wells and lateral lines from individual recovery wells to a common header of sufficient size.

The focus of the initial improvements will be modifications to recovery wells BRW-6, BRW-7, and BRW-8, which are located along the western fence line. In February 2015, the Refinery conducted a thorough cleaning of biological deposits from the well screens and redeveloped recovery well BRW-8. After the well cleaning, a drawdown test (step-rate test) was conducted to determine the effective yield of the aquifer at the PLF for planning additional enhancements to the recovery system. The results of the drawdown test indicated there was good communication through the aquifer. However, recovery well BRW-8 was capable of pumping at a flow rate greater than the total flow rate of the current PLF remediation system, which indicates the remediation system piping is likely limiting the flow and needs to be replaced.

The enhancements to the system will use existing recovery wells BRW-6, BRW-7, and BRW-8. BRW-6 and BRW-7 will be redeveloped in a manner identical to how BRW-8 was developed prior to the pump test. The wells will be equipped with electric submersible pumps sized based on results from the pump test. Recovered fluids will be transferred underground via piping to an OWS that will be housed within a treatment equipment enclosure. Transfer piping will be installed within a carrier pipe. Whenever possible, transfer piping and electric lines will be installed in a common trench to limit the impact to underground utilities.

The OWS will be sized to manage total-fluids flow from the existing recovery wells and additional recovery wells that may be incorporated in the future. The purpose of the OWS is to separate the LNAPL from the groundwater. Recovered LNAPL will be transferred to a storage tank located within the treatment equipment enclosure. LNAPL will be reclaimed as necessary and blended back into the refining process. The recovered groundwater will be transferred from the OWS to an equalization tank.

Each wellhead will be reconstructed and housed in a 4-foot square subsurface steel vault. The base of the well vaults will be set in concrete with a concrete pad surrounding the well vault.

Recovery wells BRW-1 through BRW-5 will be shut off and will not be incorporated into the initial enhancements for the PLF system because the projected radius of influence of the enhancements to BRW-6 through BRW-8 should be sufficient to hydraulically control the LNAPL plume at the PLF. However, if information from the interior delineation or operational data indicates that the initial enhancements to the PLF are insufficient to hydraulically contain the dissolved-phase plume at the property boundary and/or recover the LNAPL plume, future enhancements of the PLF system may include redevelopment and use of BRW-1 through BRW-5.

The goals of the enhancement will be to hydraulically contain the dissolved-phase hydrocarbons at the Refinery boundary, recover LNAPL, and treat the recovered groundwater. The initial design concept for the enhancements assumed that the effluent water could be sent to the Refinery's wastewater plant for treatment. An initial MOC meeting was held on August 7, 2015. During the MOC meeting, the Refinery determined that other processing options should be considered for the effluent water, a separate treatment train will be designed for the PLF effluent water. Based on the Refinery's MOC process, the design may also need to be modified with respect to the location of the auxiliary equipment and specifications of the electrical components to meet the appropriate codes.

The Refinery decided to pursue a separate OPDES permit to discharge the water. The OPDES permit application was submitted to the Water Quality Division of ODEQ on June 15, 2016. The Refinery is working with the City of Wynnewood to discharge the treated recovered water from the PLF through the City's publicly owned treatment works (POTW) discharge pipe, downstream of the POTW compliance sampling point. The Refinery has met with the City of Wynnewood to procure an agreement to discharge water through their pipe, but an agreement has not been finalized at this time.

On May 6, 2016 ODEQ requested an engineering evaluation of the PLF groundwater recovery treatment system discharge pipe options. The purpose of the evaluation was to determine whether the existing City POTW discharge pipe is capable of accepting the Refinery PLF treatment water and that the Refinery's wastewater treatment plant (WWTP) piping does not have sufficient capacity to handle additional flow from the PLF treatment system.

The evaluation determined, that the City POTW flow rates are lower than the manufacturer allowed flow for the discharge, indicating that the discharge pipe is capable of handling all flow ranges observed in the recent history and beyond the extreme flow range. Additionally, operation of the PLF treatment system, discharging through the City POTW discharge pipe, will not be impacted by storm events except for highly irregular storm events on the order of a 10-year, 24-hour storm event.

The Refinery WWTP data indicates that the discharge pipe currently handles flow volumes outside of the recommended operational range from the Refinery WWTP. The addition of water from the PLF treatment system would tax the pipe further. Given the age of the pipe, the operational practices of the Refinery WWTP, and the unknowns associated with the existing pipe flow path and profile, WSP recommended not adding the additional 100 gpm of flow from the PLF treatment system into the 8-inch Refinery WWTP pipe due to risks of breakage.

WRC presented a connection agreement to the Wynnewood City Council on August 8, 2016. The city council tabled a motion to accept the agreement, postponing any further action until their September 2016 meeting.

On August 10, 2016, ODEQ approved the evaluation, contingent on the City of Wynnewood allowing the effluent from the PLF remediation system to be discharged via the City's POTW effluent pipe. The ODEQ requested the Refinery submit a copy of the official agreement between the City and the Refinery when it is approved.

5.2 NORTHERN PROCESS AREA SYSTEM ENHANCEMENTS

The focus of the initial enhancements for the Northern Process Area will be on recovery wells NRW-1 through NRW-4, which are located on the east side of the U.S. Highway 77. In February 2015, the Refinery conducted a thorough cleaning of biological deposits from the well screens and redeveloped recovery well NRW-3. NRW-1, NRW-2, and NRW-4 will be redeveloped in a manner identical to how NRW-3 was developed prior to the yield test conducted in February 2015.

As described in the Comprehensive Remediation Plan, existing recovery wells NRW-1 through NRW-4 will be equipped with pneumatic pumps that will be sized based on results from testing conducted in February 2015. The pneumatic pumps will be operated by an air compressor housed in the treatment equipment enclosure. Recovered fluids will be transferred underground via piping to an OWS that will be housed within a treatment equipment enclosure. New transfer piping will be installed within a carrier pipe to the treatment equipment enclosure. Whenever possible, transfer piping and air lines will be installed in a common trench to limit the impact to underground utilities. Effluent water from the treatment equipment enclosure will be connected to an existing effluent line crossing under U.S. Highway 77 and discharge into an existing connection to the Refinery process sewer for treatment at the Refinery WWTP.

The OWS will be sized to manage total-fluids flow from the existing recovery wells and additional recovery wells that may be incorporated in the future. The purpose of the OWS is to separate the LNAPL from the groundwater. Recovered LNAPL will be transferred to a storage tank located within the treatment equipment enclosure. LNAPL will be reclaimed as necessary and blended back into the refining process. The recovered groundwater will be transferred from the OWS to an equalization tank and then transferred to the Refinery process sewer. Each wellhead will be reconstructed and housed in a 4-foot square subsurface steel vault. The base of the well vaults will be set in concrete with a concrete pad surrounding the well vault.

Recovery wells NRW-5 through NRW-7 on the west side of U.S. Highway 77 will remain in the North Process Area as-is.

The conceptual design for the North Process Area was submitted to the Refinery for review and approval as part of the MOC process. An initial meeting was held on January 13, 2016. Based on the MOC meeting, the design was modified slightly to move the location of the auxiliary equipment building to a more secure location, and specifications of the electrical components were modified to meet the appropriate codes. The MOC was approved for installation on June 1, 2016. The Refinery will proceed with the implementation of the North Process Area remediation system enhancements during the next reporting period.

The goals of the additional North Process system enhancements will be the containment and control of the LNAPL plume. Based on the results of the interior delineation activities, an additional two recovery wells were recommended for this area of the Refinery. The recommendations were included in the *Interior Delineation Summary and Recommendation Report* submitted to ODEQ on July 13, 2016 and are also briefly discussed in Section 7.3

6 Interior Delineation

Data gaps existed in the conceptual site model pertaining to geologic characterization and the extent and magnitude of both the LNAPL and dissolved-phase hydrocarbon plume at the Refinery. A work plan for Interior Delineation was included in the Comprehensive Remediation Plan. The work plan described tasks to complete to address data gaps through installation of additional monitoring wells, groundwater sampling, and direct-push soil and groundwater investigation. The information obtained from these tasks will be used to inform decision-making processes for recovery systems and the monitoring well network.

The following Interior Delineation activities were completed during the reporting period:

- A total of 83 temporary borings were installed as part of the direct-push delineation to characterize the geology of the North Process Area to fill data gaps left by incomplete boring log data; delineate the LNAPL plume in the South Process Area, North Process Area, and PLF; and delineate the dissolved-phase plumes in areas where insufficient data existed.
- In order to assess the extent of LNAPL at the site, borings were installed to determine whether additional monitoring or recovery wells are needed.
- Groundwater samples were collected from a total of 51 temporary wells for analysis of GRO, DRO, and BTEX by Pace Analytical Services of Salina, Kansas.
- From May 4 through May 7, 2016, LNAPL recovery tests were performed at five monitoring wells. At monitoring wells NMW-2, NMW-6, NMW-10, and OMW-4, manual skimming of LNAPL was used to recover LNAPL. A baildown test was performed at monitoring well OMW-3 because LNAPL recharge to OMW-3 was too slow to perform the manual skimming test.

The *Interior Delineation Summary and Recommendation Report* was submitted to ODEQ on July 13, 2016. WRC proposes to install eighteen additional monitoring wells at property boundary and interior locations to monitor LNAPL and dissolved-phase trends. The report also included recommendations for additional groundwater remediation activities in the North Process Area, PLF, South Process Area, and a manual LNAPL recovery program based on the findings of the interior delineation and transmissivity testing. A complete electronic copy of the *Interior Delineation Summary and Recommendation Report*, including boring logs, laboratory analytical report, and LNAPL recovery tests previously submitted to ODEQ, is included as Appendix 6.

The following interior delineation activities are scheduled to occur during the upcoming reporting period:

- Install recommended additional monitoring and recovery wells, if approved by ODEQ.
- Sample all newly installed monitoring wells that do not exhibit LNAPL for GRO by Oklahoma method GRO (8015D modified), DRO by Oklahoma method DRO (8015D modified), VOCs by EPA Method 8260, semi-volatile organic compounds (SVOCs) by EPA Method 8270, and RCRA metals by SW 846 methods, within 60 days of completion, or during the next semi-annual sampling event, whichever comes first.

7 Additional Remediation

7.1 NORTH BOUNDARY INVESTIGATION

On May 4 through 6, 2016 the tracer test was conducted, in accordance with the ODEQ Title 252, Chapter 652 regarding underground injection control, near existing monitoring well UMW-6 to evaluate variability in subsurface characteristics, with baseline and post-test groundwater monitoring to confirm tracer distribution and to determine if remedial amendment delivery (e.g., for in-situ chemical oxidation is feasible). A Class V Injection Well Permit application was submitted to ODEQ on March 4, 2016, with a copy of the Tracer Test Work Plan. ODEQ approved the permit application on March 24, 2016.

The tracer test was conducted in two locations adjacent to UMW-6 to evaluate variability in subsurface characteristics with baseline and post-test groundwater monitoring to confirm tracer distribution. To monitor baseline and post-injection conditions, temporary monitoring wells were installed around the injection points to a depth of approximately 28 ft-bgs, the depth of UMW-6.

The tracer test at injection point I-1 was conducted in accordance with the work plan, with two injection horizons and two step-rate injections. However based on the results of the first injection test, modifications were made to the second injection test at injection point I-2. The temporary well locations were modified to address the observed local groundwater flow direction, which differed from the direction assumed by the workplan, and only one injection step (10 gpm) and one injection horizon (25 ft-bgs) was used for injection point (I-2).

Prior to the tracer test, bench-scale soil and groundwater samples were collected near UMW-6. The samples were analyzed to ensure appropriate design and implementation of in-situ chemical oxidation (ISCO). Samples were collected from boreholes installed using direct-push technology by DeTech of Lawrence, Kansas. Groundwater and saturated soil were collected, packaged, and submitted for analysis to Terra Systems, Inc. of Wilmington, Delaware. A copy of the bench-scale test results, which includes the analytical results is included as Appendix 7.1.

A soil sample was collected from within the saturated zone and submitted to Geotechnics of East Pittsburgh, Pennsylvania for analysis of grain size distribution by ASTM method D 422-63 (2007). The laboratory report is included in Appendix 7.1. The soil was given the Unified Soil Classification System classification of SP-SM, for a poorly graded sand with silt, with the sand content primarily in the range of fine- to medium-grained. Insufficient fines were present for hydrometer analysis; therefore, the silt designation is an assumed one, not a quantitative one. The results correlate well with field observations during installation of monitoring well UMW-6. The results of the tracer test and bench-scale testing were favorable and the Refinery is moving forward with plans to conduct an ISCO pilot test in the area adjacent to monitoring well UMW-6. The results will be discussed in detail in the Tracer Test Results Report, which will be submitted in the upcoming reporting period.

A minimum of two temporary monitoring wells and four injection locations will be installed in the area adjacent to existing monitoring well UMW-6. Based on the results of the bench-scale test, the ISCO pilot test will be conducted with a sodium persulfate (Peroxychem Klozur®) activated with sodium hydroxide (Peroxychem Klozur® Caustic), applied using a direct-push drill rig and direct-push rods equipped with a pressure-activated injection point or similar device. The combination of the two chemicals will provide two treatment pathways. The first pathway is direct chemical oxidation of plume constituents by the persulfate radicle and the second pathway is anaerobic biodegradation stimulated by native microbes respiring the reduction product of the persulfate radical, sulfate. Groundwater chemistry and water level monitoring will continue after the completion of the pilot test. Groundwater samples will be collected at select intervals after the injection to determine the treatment efficiency of the pilot test.

7.2 SOUTH BOUNDARY REMEDIATION SYSTEM

Recovery well SBR-1 was installed in the southwest corner of the WWTP surface impoundments on November 19, 2015. The well was installed to a total depth of approximately 28 ft-bgs. The well was constructed using a 4-inch diameter, flush-threaded schedule 40 PVC casing connected to 20 feet of 0.010-inch slot size PVC screen and included a three-foot sump constructed of 4-inch diameter PVC riser at the bottom of the boring. The screened interval is from 5 to 25 ft-bgs. A filter pack of #10-20 washed silica sand was placed within the annular space to approximately 1.5 feet above the top of the screened interval. The filter pack was overlain by 3.5 feet of hydrated bentonite pellets. The well was developed by surging and then by purging using a vacuum pump until discharged water was clear and free of sediment.

A step-drawdown pumping test was conducted at SBR-1 on December 16, 2015, and a constant rate pumping test was conducted from December 17 to December 18, 2015. The results of the pumping test were submitted to ODEQ in a letter report to the ODEQ on April 8, 2016. The letter report included a conceptual design for the full South Boundary remediation system and an assessment of technologies evaluated based on the results of the yield testing, the interior delineation results, and the ability to meet the cleanup goals.

Based on the results of the pumping test, the extent of the DRO plume, and the analytical results from the discharge sample, groundwater recovery from SBR-1 will likely be sufficient to achieve the objective of preventing migration of DRO-affected groundwater away from the Refinery property. SBR-1 will be equipped with an electric submersible pump that is capable of extracting groundwater and conveying it to the WWTP at the design flow rate of 2 gpm. Groundwater will be conveyed from SBR-1 to the eastern settling pond at the Refinery WWTP. The preferred point of discharge is the southeast corner of this lagoon.

Groundwater will be processed through the WWTP and discharged under WRC's existing Oklahoma discharge permit. Based on the analysis conducted during the pumping test, no additional treatment will be necessary before discharging the recovered groundwater to WWTP settling pond.

The conceptual design for the South Boundary Remediation System was submitted to the Refinery for review and approval as part of the MOC process. An initial meeting was held on April 15, 2016. Based on the MOC meeting, the specifications of the electrical components were modified to meet the appropriate codes. The MOC was approved for installation on July 15, 2016. The Refinery will proceed with the implementation of the South Boundary Remediation System during the next reporting period.

7.3 NORTH PROCESS AREA SYSTEM

Interior delineation activities were conducted in the North Process Area during the reporting period. The interior delineation activities in the North Process Area included direct-push sampling event for LNAPL delineation and dissolved-phase plume delineation as well as LNAPL transmissivity. The results were discussed in the *Interior Delineation Summary and Recommendation Report*, submitted to ODEQ on July 13, 2016.

As discussed in the Comprehensive Remediation Plan, additional remediation in the vicinity of the North Process Area may be installed to address the dissolved-phase plume to provide hydraulic control based on the results of the North Boundary Injection Test, or incorporate additional recovery wells. Based on the LNAPL transmissivity results and the interior delineation activities in the North Process Area, an additional two recovery wells, NRW-8 and NRW-9, were recommended for the North Process Area. If approved by ODEQ, the recovery wells will be included in the North Process Area Enhancement, which is in the process of being formally approved by the Refinery MOC process.

7.4 PRODUCT LOADING FACILITY SYSTEM

Interior delineation activities were conducted in the PLF during the reporting period. The interior delineation activities in the PLF included direct-push sampling event for LNAPL delineation and dissolved-phase plume delineation as well as LNAPL transmissivity. The results were discussed in the *Interior Delineation Summary and Recommendation Report*, submitted to ODEQ on July 13, 2016.

As discussed in the Comprehensive Remediation Plan, additional remediation in the vicinity of the PLF may be installed to address the need for additional containment and treatment of the dissolved-phase plume. The goal of the additional system modifications would be to improve hydraulic control and LNAPL recovery at the property boundary. The results from the interior delineation show there are no additional areas of LNAPL encountered in the PLF area, therefore no additional expansion of the PLF Remediation System is recommended at this time.

A total of four monitoring wells were recommended in the *Interior Delineation Summary and Recommendation Report* to address gaps in LNAPL and dissolved-phase monitoring at the site. Monitoring wells BMW-29 and BMW-30 were proposed to be installed to monitor for and delineate any previously unidentified LNAPL plumes resulting from historic releases in the tank farm north of the PLF. Monitoring well LMW-17 was proposed to be installed upgradient of the PLF tank farm to monitor dissolved-phase plume and LNAPL between the PLF and the South Process Area dissolved-phase plume. Monitoring well LMW-16 was proposed to be installed along the western property boundary to monitor downgradient of direct-push delineation point SW-DP-112.

7.5 SOUTH PROCESS AREA SYSTEM

Interior delineation activities were conducted in the South Process Area during the reporting period. The interior delineation activities in the South Process Area included direct-push sampling event for LNAPL delineation and dissolved-phase plume delineation as well as LNAPL transmissivity. The results were discussed in the *Interior Delineation Summary and Recommendation Report*, submitted to ODEQ on July 13, 2016.

As discussed in the Comprehensive Remediation Plan, additional remediation in the vicinity of the South Process Area may be installed to address the need for additional groundwater withdrawal for containment and treatment of the LNAPL and dissolved-phase plumes in the area. Based on the low LNAPL transmissivity results and the observed stability of both the LNAPL and dissolved-phase plumes in this area, no additional expansion of the South Process Area is recommended at this time. LNAPL thicknesses will be monitored quarterly and periodic manual LNAPL recovery may be conducted, as discussed in the *Interior Delineation Summary and Recommendation Report*. A total of four new monitoring wells, OMW-7 through OMW-10, were recommended for installation for LNAPL monitoring in the South Process Area.

8 Performance Monitoring Plan

ODEQ approved the Comprehensive Remediation Plan on February 1, 2016. WRC will submit a long-term Performance Monitoring Plan by February 1, 2017. The Performance Monitoring Plan will include details regarding the following elements, at a minimum:

- identification of the wells to be included in the semi-annual and 5-year comprehensive groundwater sampling networks
- semi-annual monitoring of the monitoring well network for GRO, DRO, and BTEX
- monthly operation and maintenance of the remediation systems
- quarterly fluid level measurements
- comprehensive sampling event of the monitoring well network once every 5 years for GRO, DRO, SVOCs, VOCs, and RCRA Metals

9 Summary and Conclusions

9.1 GROUNDWATER RECOVERY

The Refinery operates three hydrocarbon recovery systems: the PLF System, the North Process Area System, and the South Process Area System. During this reporting period, approximately 5,049,959 gallons of groundwater and an estimated 11,992 gallons of entrained LNAPL were recovered and treated in the wastewater treatment plant of the Refinery.

The Refinery is in the process of approving and implementing MOC documentation for the PLF remediation system enhancements, the South Boundary remediation system installation, and the North Process Area remediation system enhancements. An OPDES permit application for the PLF treated groundwater effluent has been submitted to ODEQ and negotiations continue with the City of Wynnewood on the management of the treated effluent.

The Refinery has completed the tracer test and bench-scale testing of an ISCO regime as part of the North Boundary Investigation. The underground injection control application for the ISCO pilot test has been approved by ODEQ. The pilot test will be completed during the next reporting period.

10 References

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CVR Energy, Inc. and WSP, 2015a. Semi-Annual Groundwater Remediation Report July 1 through December 31, 2014. February 27.

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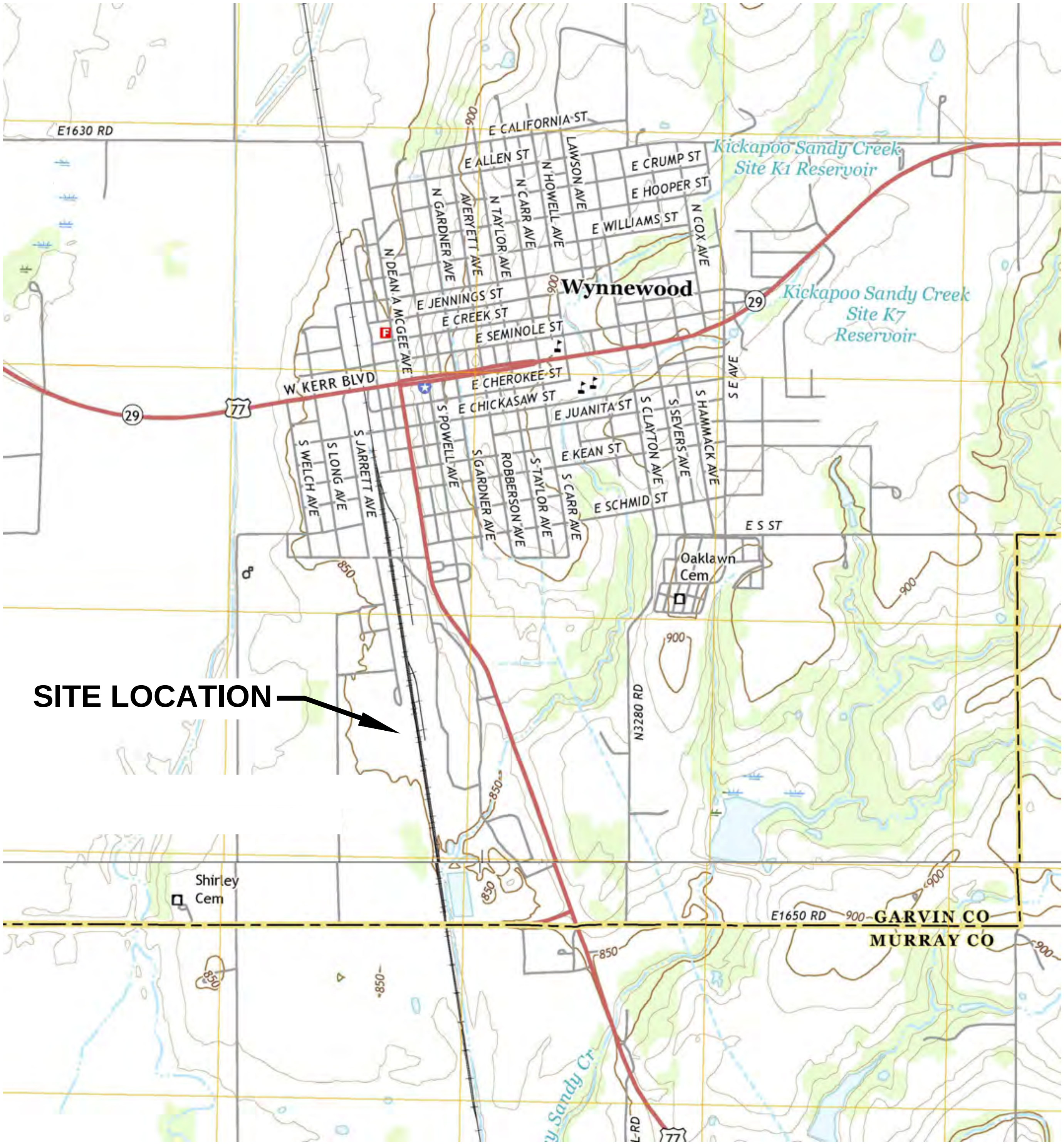
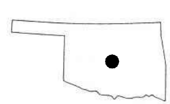
Figures



REFERENCE
7.5 MINUTE SERIES TOPOGRAPHIC QUADRANGLE
PAULS VALLEY, OKLAHOMA
2016
JOY OKLAHOMA
2016



Quadrangle Location

N

0 2,000 4,000
SCALE IN FEET

DWG Name: 314M00030-001
Checked:
Approved:
Drawn By: LS 2/10/2016

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Minneapolis, Minnesota 55401
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Figure 1

SITE LOCATION

WYNNEWOOD REFINING COMPANY
WYNNEWOOD, OKLAHOMA
PREPARED FOR
WYNNEWOOD REFINING COMPANY
WYNNEWOOD, OKLAHOMA

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND

- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PRIVATE SUPPLY WELL LOCATION
- PROPERTY BOUNDARY

N

0 650 1,300
SCALE IN FEET

WSP | PARSONS BRINCKERHOFF
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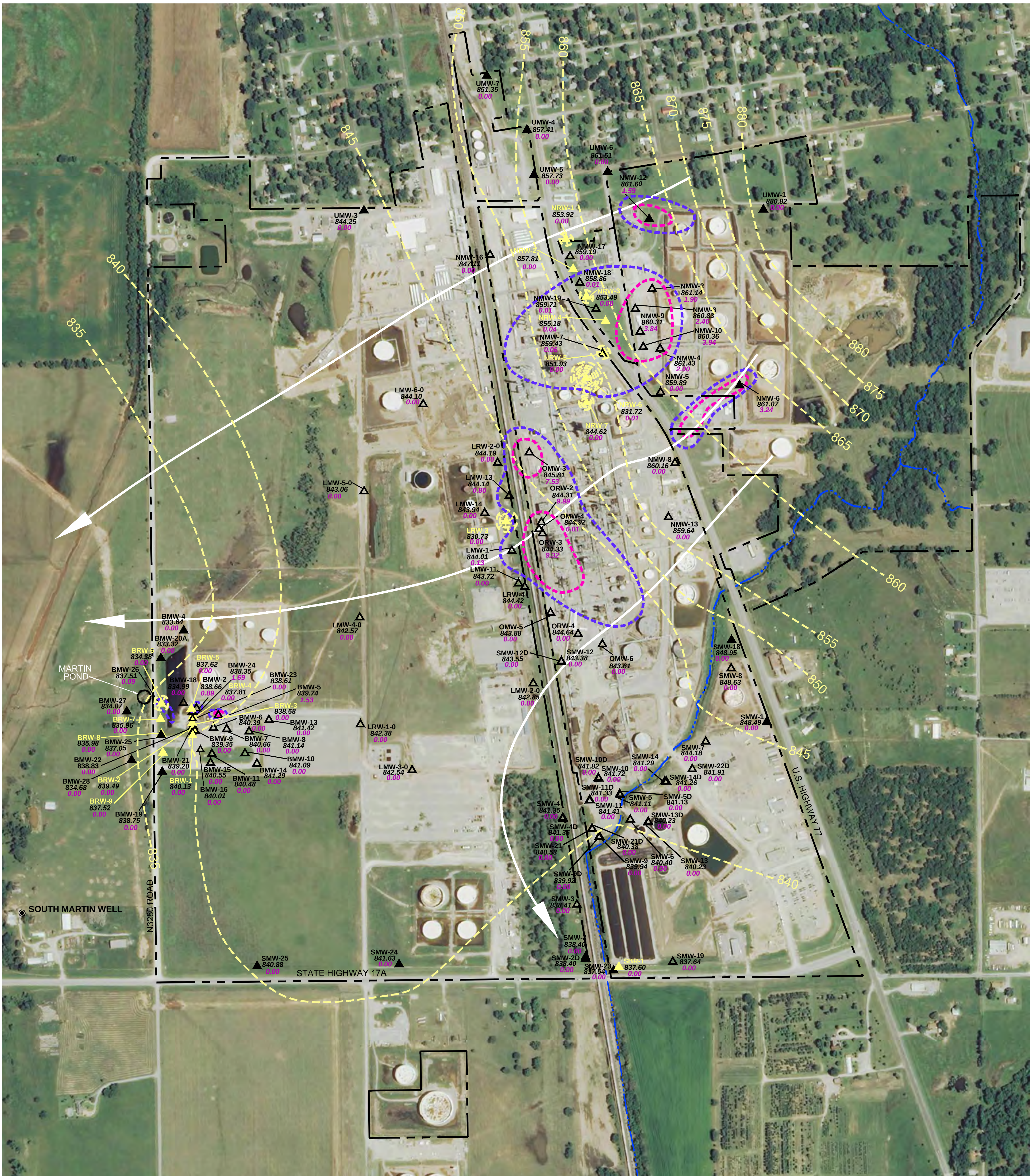
Figure 2

SITE MAP

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By:	LS 4/4/2016
Checked:	
Approved:	
DWG Name:	314M00030-002



REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND

▲ (yellow)	RECOVERY WELL LOCATION
△	MONITORING WELL LOCATION
▲	WRC PROPERTY BOUNDARY MONITORING WELL
◉	PRIVATE SUPPLY WELL LOCATION
— · —	PROPERTY BOUNDARY
- - - (yellow)	GROUNDWATER ELEVATION CONTOUR
838.66	GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
0.88	LNAPL THICKNESS (FEET)
	GROUNDWATER FLOW DIRECTION
- - - (blue)	LNAPL THICKNESS (FEET) (0.01–1.00)
- - - (magenta)	LNAPL THICKNESS (FEET) (>1.00)
←	GROUNDWATER FLOW DIRECTION

NOTES:
1. GROUNDWATER ELEVATIONS IN INTERMEDIATE AND DEEP WELLS NOT USED IN GENERATION OF CONTOURS.
2. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT 510R–96–001.
3. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELLS ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
4. LNAPL THICKNESS CONTOURS ARE BASED ON MARCH 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

N

0 650 1,300
SCALE IN FEET

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Figure 3A

WATER TABLE ELEVATION
AND LNAPL THICKNESS MAP
MARCH 2016

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS 5/1/2016
Checked:
Approved:
DWG Name: 314M00030–034

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LEGEND

- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PRIVATE SUPPLY WELL LOCATION
- PROPERTY BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- 863.32 GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- 1.48 LNAPL THICKNESS (FEET)
- LNAPL THICKNESS (FEET) (0.01–1.00)
- LNAPL THICKNESS (FEET) (>1.00)
- GROUNDWATER FLOW DIRECTION

NOTES:
1. GROUNDWATER ELEVATIONS IN DEEP WELLS NOT USED IN GENERATION OF CONTOURS.
2. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT 510R–96–001.
3. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELLS ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
4. LNAPL THICKNESS CONTOURS ARE BASED ON JUNE 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

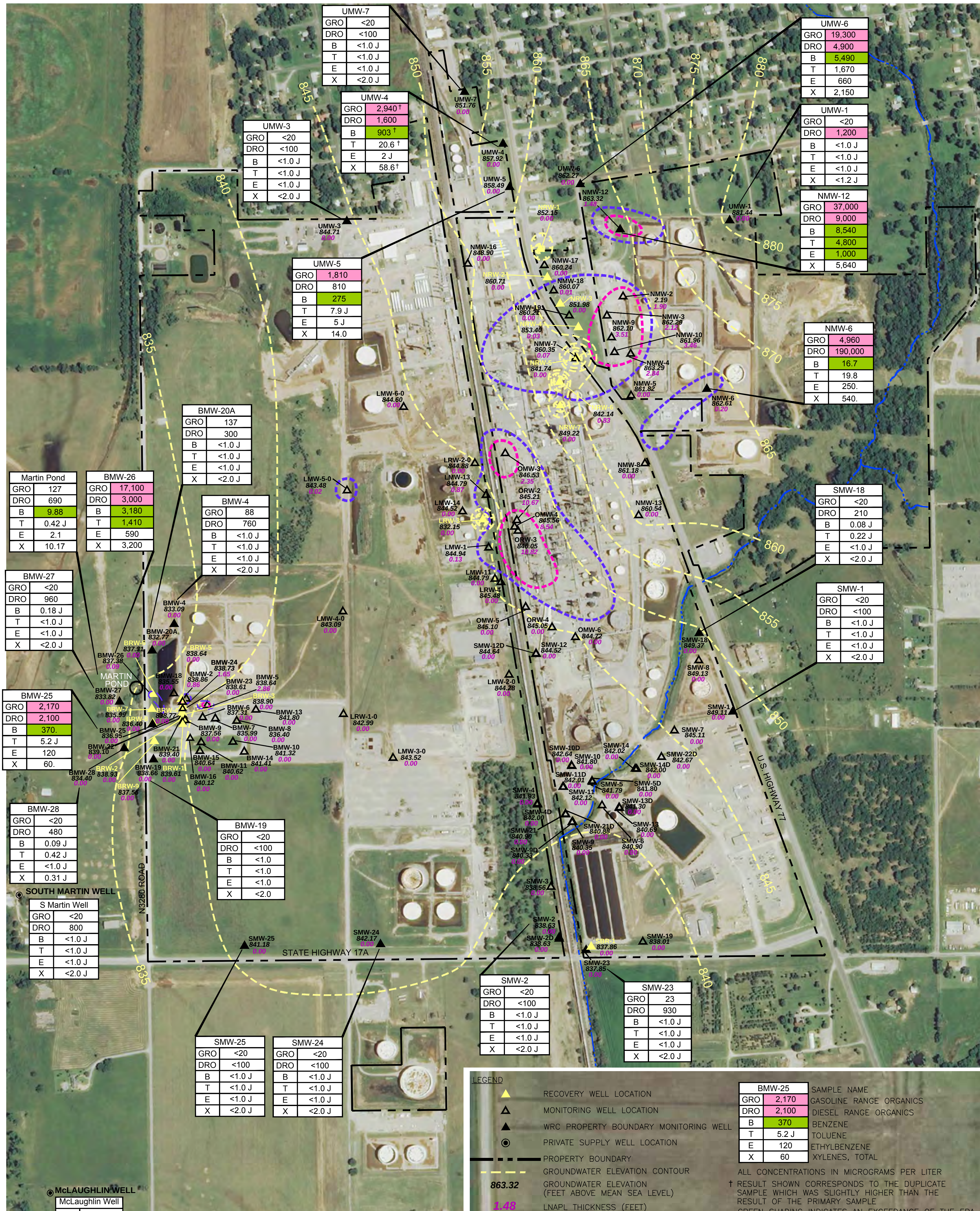
N

0 650 1,300

SCALE IN FEET

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

WSP PARSONS BRINCKERHOFF WSP USA Corp. 123 North Third Street, Suite 507 Minneapolis, Minnesota 55401 (612) 343-0510 www.wspgroup.com/usa	Figure 3B WATER TABLE ELEVATION AND LNAPL THICKNESS MAP JUNE 2016	WYNNEWOOD REFINING COMPANY, LLC WYNNEWOOD, OKLAHOMA PREPARED FOR WYNNEWOOD REFINING COMPANY, LLC WYNNEWOOD, OKLAHOMA	Drawn By: LS 8/15/2016 Checked: Approved: DWG Name: 314M00030–055



LEGEND

Symbol	Description
▲ (yellow)	RECOVERY WELL LOCATION
△	MONITORING WELL LOCATION
▲	WRC PROPERTY BOUNDARY MONITORING WELL
◉	PRIVATE SUPPLY WELL LOCATION
— · —	PROPERTY BOUNDARY
- - - (yellow)	GROUNDWATER ELEVATION CONTOUR
863.32	GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
1.48	LNAPL THICKNESS (FEET)
- - - (blue)	LNAPL THICKNESS (FEET) (0.01–1.00)
- - - (pink)	LNAPL THICKNESS (FEET) (>1.00)

BMW-25		
GRO	2,170	GASOLINE RANGE ORGANICS
DRO	2,100	DIESEL RANGE ORGANICS
B	370	BENZENE
T	5.2 J	TOLUENE
E	120	ETHYLBENZENE
X	60	XYLENES, TOTAL

SAMPLE NAME

ALL CONCENTRATIONS IN MICROGRAMS PER LITER

† RESULT SHOWN CORRESPONDS TO THE DUPLICATE SAMPLE WHICH WAS SLIGHTLY HIGHER THAN THE RESULT OF THE PRIMARY SAMPLE

GREEN SHADING INDICATES AN EXCEEDANCE OF THE EPA DRINKING WATER STANDARD FOR THAT COMPOUND

PINK SHADING INDICATES AN EXCEEDANCE OF THE ODEQ CLEANUP LEVEL FOR THAT COMPOUND

N

0 650 1,300

SCALE IN FEET

NOTES:
1. GROUNDWATER ELEVATIONS IN DEEP WELLS NOT USED IN GENERATION OF CONTOURS.
2. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT 510R–96–001.
3. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELLS ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
4. LNAPL THICKNESS CONTOURS ARE BASED ON JUNE 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

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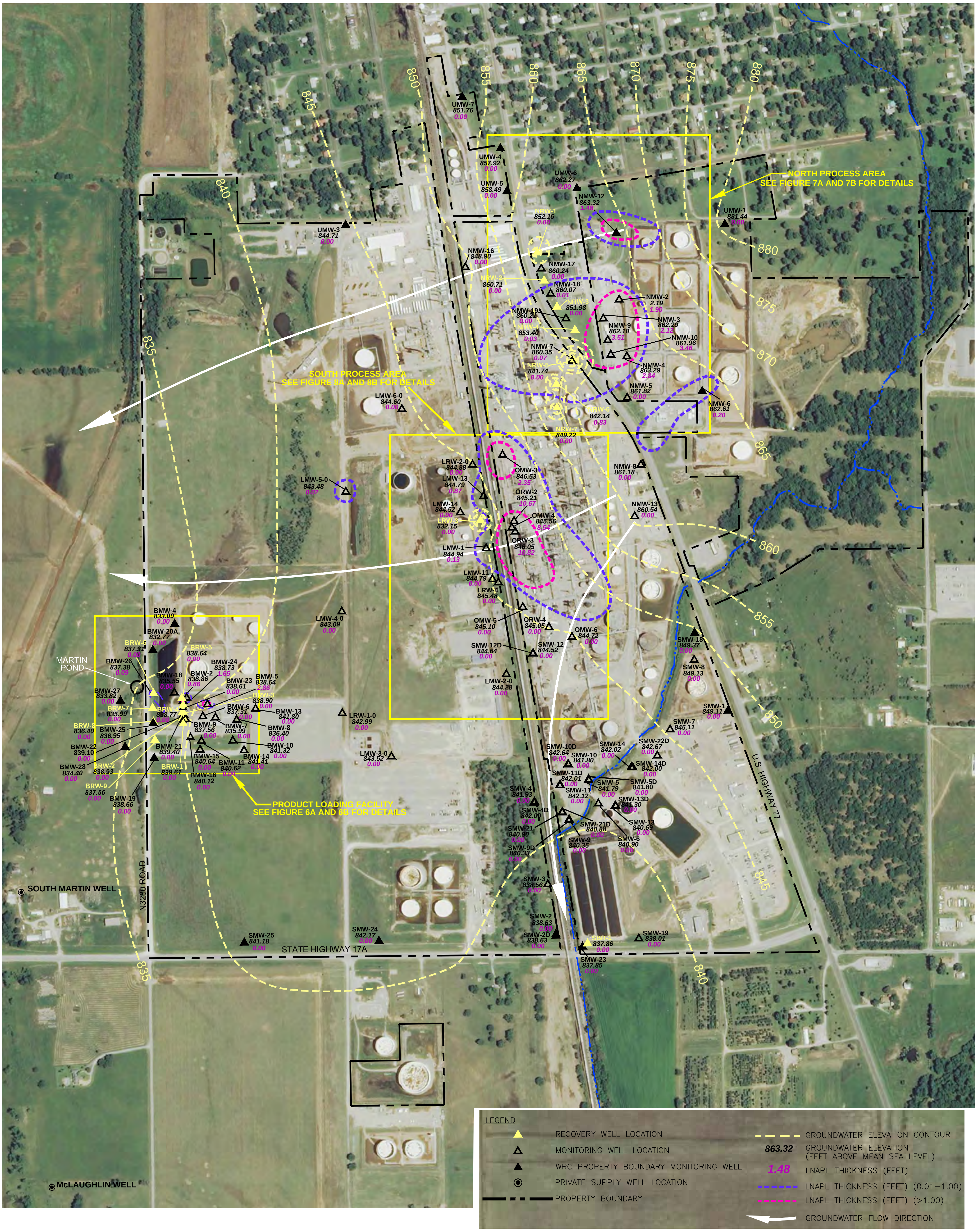
Figure 4

PERIMETER MONITORING ANALYTICAL (JUNE 2016)

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS 8/25/2016
Checked:
Approved:
DWG Name: 314M00030-056



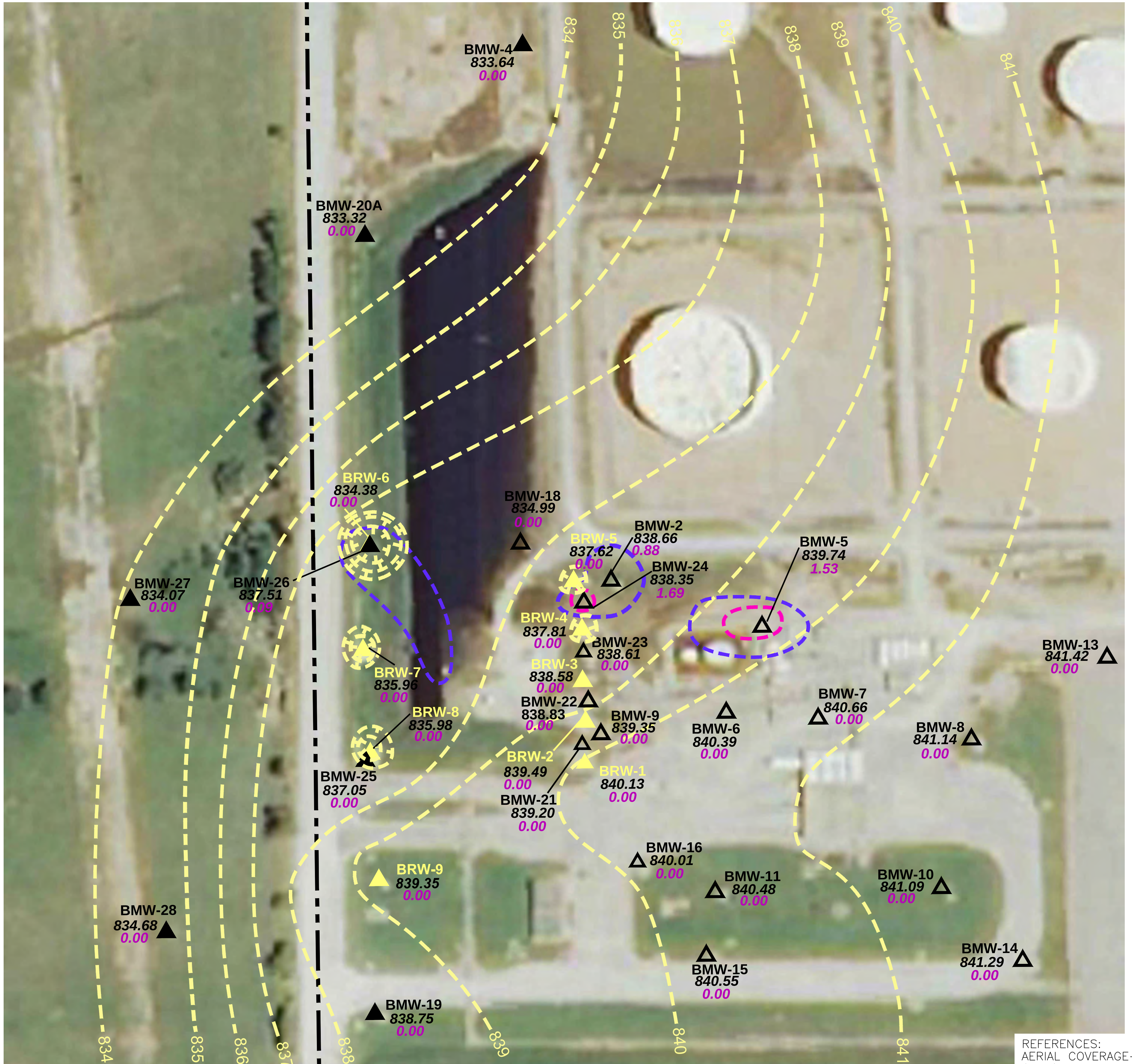
NOTES:
1. GROUNDWATER ELEVATIONS IN DEEP WELLS NOT USED IN GENERATION OF CONTOURS.
2. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT 510R–96–001.
3. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELLS ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
4. LNAPL THICKNESS CONTOURS ARE BASED ON JUNE 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

N

0 650 1,300
SCALE IN FEET

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

WSP PARSONS BRINCKERHOFF WSP USA Corp. 123 North Third Street, Suite 507 Minneapolis, Minnesota 55401 (612) 343-0510 www.wspgroup.com/usa	Figure 5 GROUNDWATER RECOVERY AREAS JUNE 2016	WYNNEWOOD REFINING COMPANY, LLC WYNNEWOOD, OKLAHOMA PREPARED FOR WYNNEWOOD REFINING COMPANY, LLC WYNNEWOOD, OKLAHOMA	Drawn By: LS 8/16/2016 Checked: Approved: DWG Name: 314M00030-058



LEGEND

- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PROPERTY BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- 839.74 GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- 1.53 LNAPL THICKNESS (FEET)
- LNAPL THICKNESS (FEET) (0.01–1.00)
- LNAPL THICKNESS (FEET) (>1.00)

NOTES:

1. GROUNDWATER ELEVATION IN DEEP WELL BMW–18 NOT USED IN GENERATING CONTOURS.
2. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT: 510R–96–001.
3. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELLS ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
4. LNAPL THICKNESS CONTOURS ARE BASED ON MARCH 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

N

0 100 200

SCALE IN FEET

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

Drawn By: LS 5/1/2016
Checked:
Approved:
DWG Name: 314M00030–035

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Figure 6A

PRODUCT LOADING FACILITY
MARCH 2016

WSP | PARSONS BRINCKERHOFF

WSP USA Corp.
123 North Third Street, Suite 507
Minneapolis, Minnesota 55401
(612) 343-0510
www.wspgroup.com/usa

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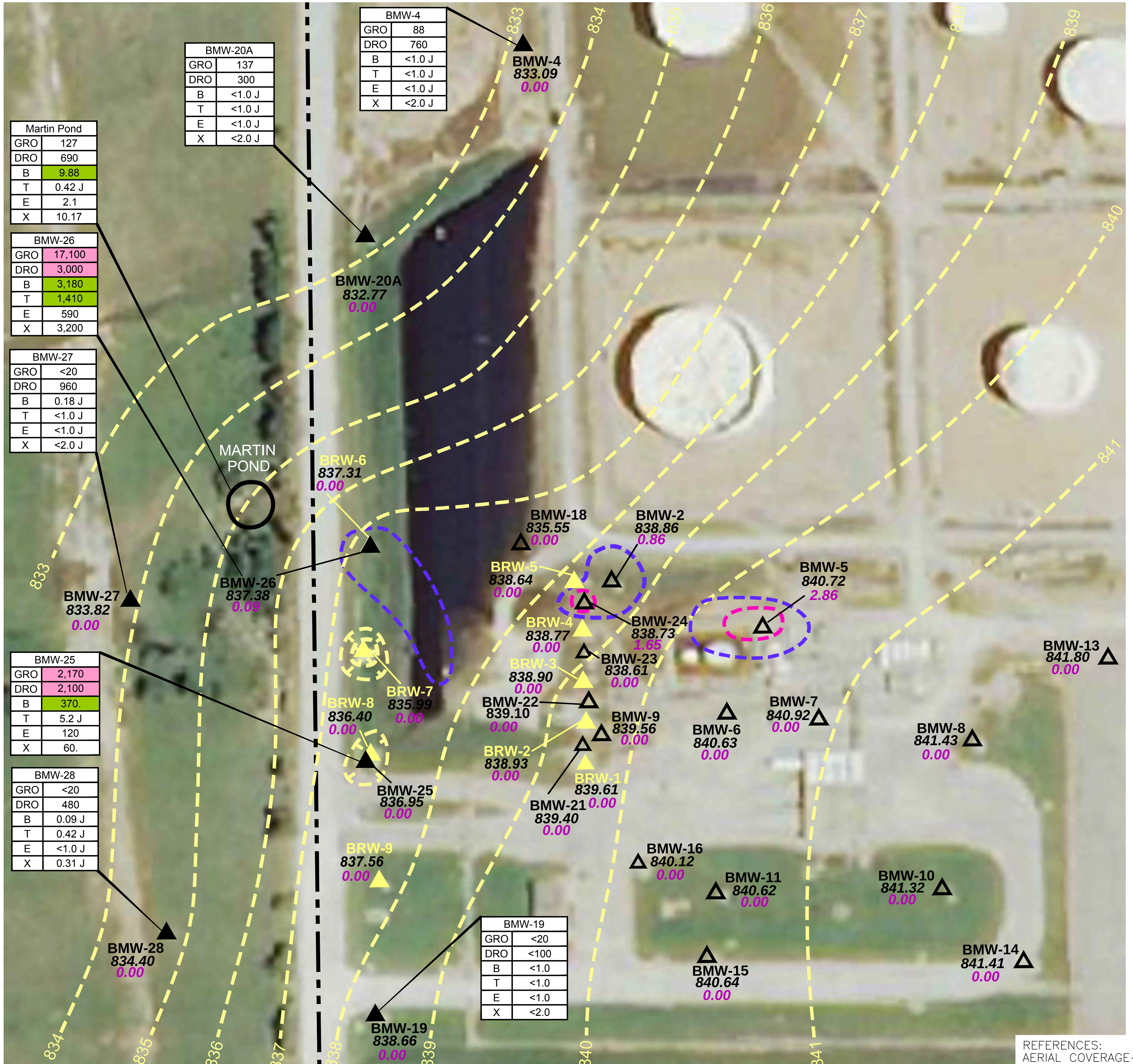

LEGEND

- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PROPERTY BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- 838.73 GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- 1.65 LNAPL THICKNESS (FEET)
- LNAPL THICKNESS (FEET) (0.01–1.00)
- LNAPL THICKNESS (FEET) (>1.00)

BMW-26		SAMPLE NAME
GRO	17,100	GASOLINE RANGE ORGANICS
DRO	3,000	DIESEL RANGE ORGANICS
B	3,180	BENZENE
T	1,410	TOLUENE
E	590	ETHYLBENZENE
X	3,200	XYLENES, TOTAL

ALL CONCENTRATIONS IN MICROGRAMS PER LITER

GREEN SHADING INDICATES AN EXCEEDANCE OF THE EPA DRINKING WATER STANDARD FOR THAT COMPOUND

PINK SHADING INDICATES AN EXCEEDANCE OF THE ODEQ CLEANUP LEVEL FOR THAT COMPOUND

NOTES:
1. GROUNDWATER ELEVATION IN DEEP WELL BMW–18 NOT USED IN GENERATING CONTOURS.
2. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT: 510R–96–001.
3. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELLS ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
4. LNAPL THICKNESS CONTOURS ARE BASED ON JUNE 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

N

0 100 200
SCALE IN FEET

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

Drawn By: LS 8/25/2016
Checked:
Approved:
DWG Name: 314M00030–057

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA
PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Figure 6B

PRODUCT LOADING FACILITY
JUNE 2016

PARSONS BRINCKERHOFF
WSP
WSP USA Corp.
123 North Third Street, Suite 507
Minneapolis, Minnesota 55401
(612) 343-0510
www.wspgroup.com/usa

NOTES:
1. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT: 510R–96–001, SEPTEMBER 1996.
2. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELLS ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
3. LNAPL THICKNESS CONTOURS ARE BASED ON MARCH 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

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WSP USA Corp.
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(612) 343-0510
www.wspgroup.com/usa

Figure 7A

NORTH PROCESS AREA
MARCH 2016

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS 5/1/2016
Checked:
Approved:
DWG Name: 314M00030–036

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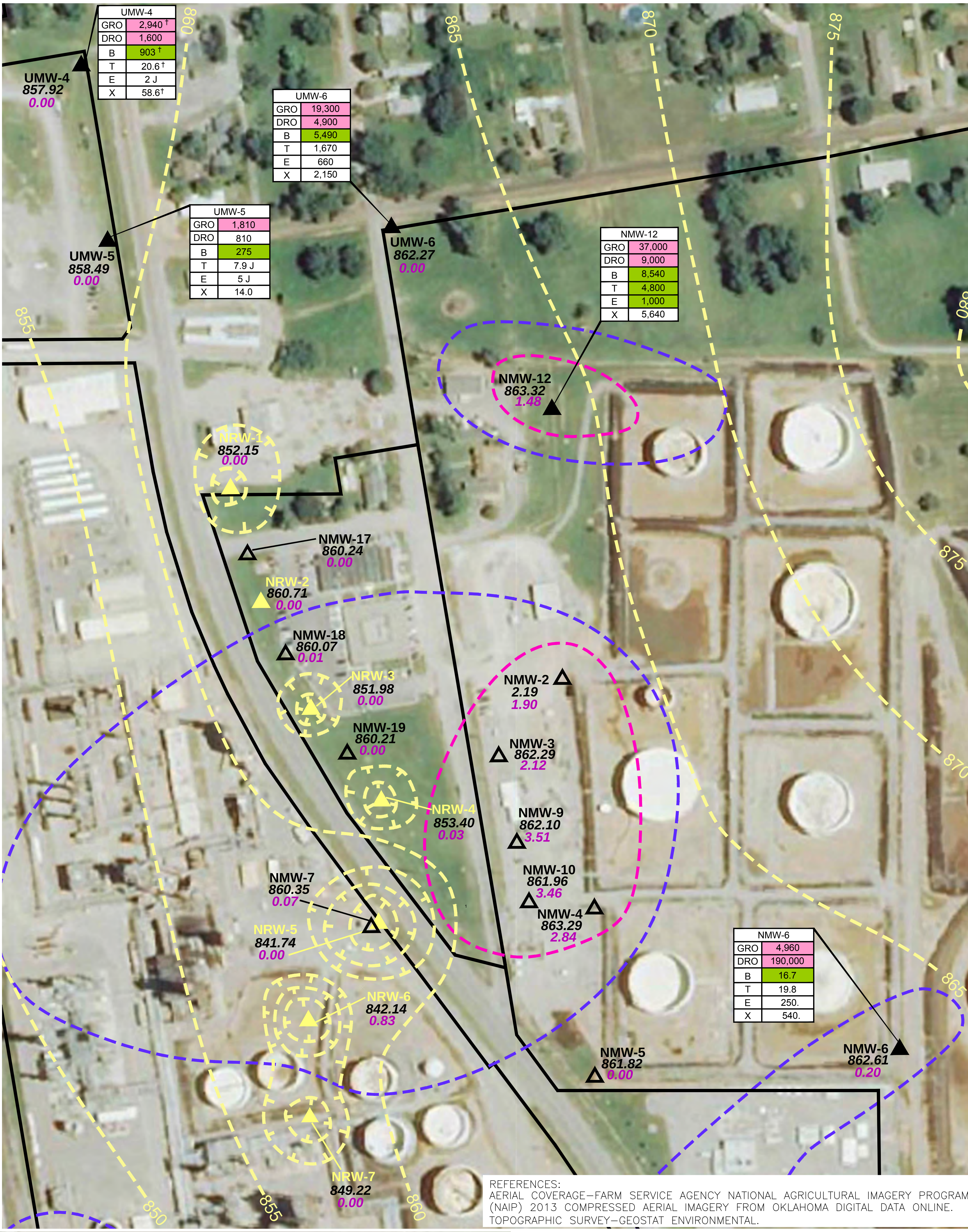

REFERENCES:
AERIAL COVERAGE—FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY—GEOSTAT ENVIRONMENTAL.

LEGEND

- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PRIVATE SUPPLY WELL LOCATION
- PROPERTY BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- 842.14 GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- 0.83 LNAPL THICKNESS (FEET)
- LNAPL THICKNESS (FEET) (0.01–1.00)
- LNAPL THICKNESS (FEET) (>1.00)

NMW-6		
		SAMPLE NAME
GRO	4,960	GASOLINE RANGE ORGANICS
DRO	190,000	DIESEL RANGE ORGANICS
B	16.7	BENZENE
T	19.8	TOLUENE
E	250	ETHYLBENZENE
X	540	XYLENES, TOTAL

ALL CONCENTRATIONS IN MICROGRAMS PER LITER
† RESULT SHOWN CORRESPONDS TO THE DUPLICATE SAMPLE WHICH WAS SLIGHTLY HIGHER THAN THE RESULT OF THE PRIMARY SAMPLE
GREEN SHADING INDICATES AN EXCEEDANCE OF THE EPA DRINKING WATER STANDARD FOR THAT COMPOUND
PINK SHADING INDICATES AN EXCEEDANCE OF THE ODEQ CLEANUP LEVEL FOR THAT COMPOUND

N

0 160 320
SCALE IN FEET

WSP | PARSONS BRINCKERHOFF
WSP USA Corp.
123 North Third Street, Suite 507
Minneapolis, Minnesota 55401
(612) 343-0510
www.wspgroup.com/usa

Figure 7B

NORTH PROCESS AREA
JUNE 2016

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS 8/25/2016
Checked:
Approved:
DWG Name: 314M00030–059

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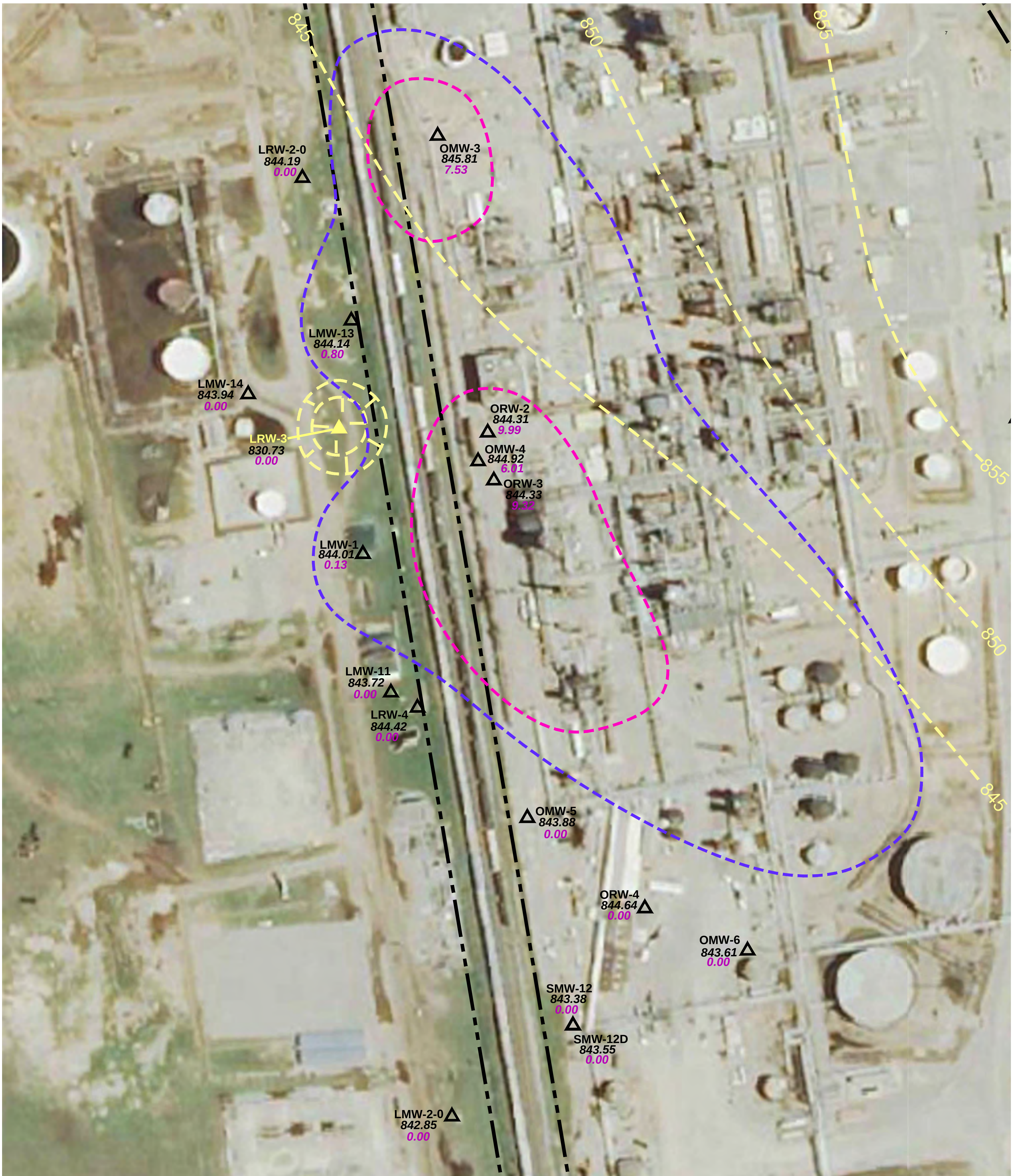


REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND

▲	RECOVERY WELL LOCATION
△	MONITORING WELL LOCATION
▲	WRC PROPERTY BOUNDARY MONITORING WELL
— · —	PROPERTY BOUNDARY
- - -	GROUNDWATER ELEVATION CONTOUR
844.01	GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
0.13	LNAPL THICKNESS (FEET)
- - -	LNAPL THICKNESS (FEET) (0.01–1.00)
- - -	LNAPL THICKNESS (FEET) (>1.00)

NOTES:
1. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT 510R–96–001.
2. GROUNDWATER ELEVATIONS IN DEEP WELLS NOT USED IN GENERATION OF CONTOURS.
3. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELL ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
4. LNAPL THICKNESS CONTOURS ARE BASED ON MARCH 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

N

0 150 300
SCALE IN FEET

WSP | PARSONS BRINCKERHOFF

WSP USA Corp.
123 North Third Street, Suite 507
Minneapolis, Minnesota 55401
(612) 343-0510
www.wspgroup.com/usa

Figure 8A

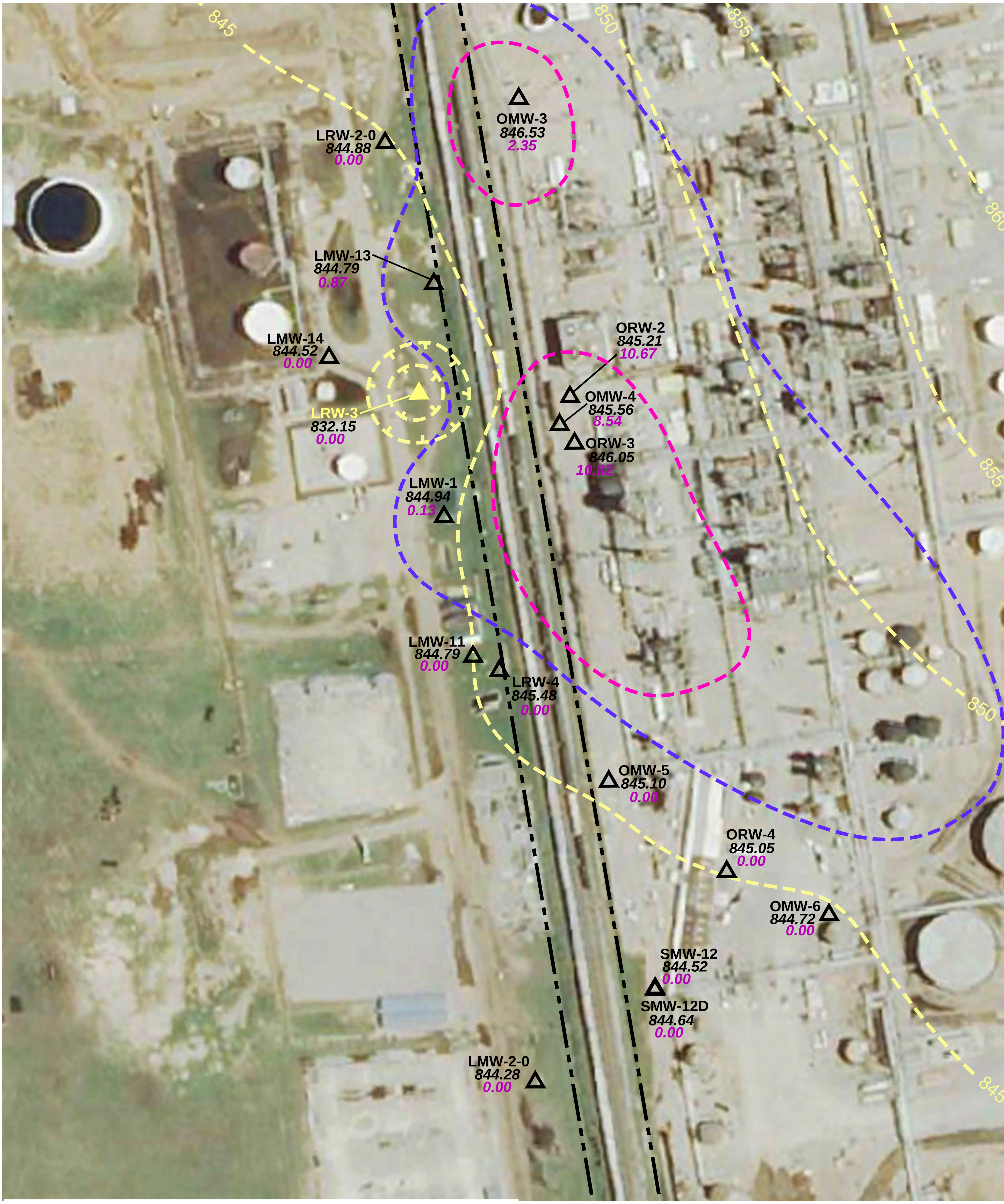
SOUTH PROCESS AREA
MARCH 2016

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By:	LS 5/1/2016
Checked:	
Approved:	
DWG Name:	314M00030–037

R:\Acad\CADD_314\31400030-WYNNEWOOD\CADD\314M00030-061.DWG 8/16/2016 10:37 AM USLS01166



REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND

- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PRIVATE SUPPLY WELL LOCATION
- PROPERTY BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- 863.32 GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- 1.48 LNAPL THICKNESS (FEET)
- LNAPL THICKNESS (FEET) (0.01–1.00)
- LNAPL THICKNESS (FEET) (>1.00)

N

0 150 300
SCALE IN FEET

WSP | PARSONS BRINCKERHOFF

WSP USA Corp.
123 North Third Street, Suite 507
Minneapolis, Minnesota 55401
(612) 343-0510
www.wspgroup.com/usa

Figure 8B

SOUTH PROCESS AREA
JUNE 2016

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS	8/16/2016
Checked:	
Approved:	
DWG Name: 314M00030–061	

Tables

Table 1

Monitoring and Recovery Well Data
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well ID	Well Function	Drilling Method	Date Installed	Total Drill Depth (ft-TOC)	Completed Well Depth (ft-TOC)	TOC Elevation (ft-AMSL) (b)	Stick-up Height (feet)	Ground Surface Elevation (ft-AMSL)	Screened Interval (ft-TOC)	Filter Pack Interval (ft-TOC)	Borehole Diameter (inches)	Casing Diameter and Type	Screen Slot Size and Type (inches)	Comments
BMW-1	PLF Monitoring Well	HSA	07/27/87	17.0	17.0	844.77	2.00	842.77	7.0 - 17.0	6.5 - 17.0		2" PVC	0.010 Slot PVC	
BMW-2	PLF Monitoring Well	HSA	07/27/87	18.9	18.9	842.98	2.67	840.31	8.9 - 18.9	7.9 - 18.9		2" PVC	0.010 Slot PVC	Formerly TA1-2
BMW-3	PLF Monitoring Well	HSA	07/27/87	22.9	21.4	842.00	2.86	839.14	11.4 - 21.4	10.9 - 22.9		2" PVC	0.010 Slot PVC	Formerly TA1-3. Abandoned 08/21/15.
BMW-4	PLF Monitoring Well	HSA	07/27/87	17.0	17.0	838.65	1.97	836.68	7.0 - 17.0	6.5 - 17.0		2" PVC	0.010 Slot PVC	Formerly TA1-4
BMW-5	PLF Monitoring Well	HSA	07/27/87	15.9	13.9	847.03	3.30	843.73	3.9 - 13.9	3.9 - 13.9		2" PVC	0.010 Slot PVC	Formerly W5
BMW-6	PLF Monitoring Well	HSA	07/27/87	18.0	18.0	844.97	1.91	843.06	8.0 - 18.0	8.0 - 18.0		2" PVC	0.010 Slot PVC	Formerly W6
BMW-7	PLF Monitoring Well	HSA	10/24/88	19.9	17.9	847.31	2.89	844.41	7.9 - 17.9	6.9 - 19.9		2" PVC	0.020 Slot PVC	Formerly MW11
BMW-8	PLF Monitoring Well	HSA	10/24/88	19.0	19.0	846.92	3.07	843.85	9.0 - 19.0	7.0 - 19.0	4	2" PVC	0.020 Slot PVC	Formerly MW7
BMW-9	PLF Monitoring Well	HSA	10/24/88	16.1	16.1	845.03	3.10	841.93	6.1 - 16.1	5.0 - 16.1	4	2" PVC	0.020 Slot PVC	Formerly MW9
BMW-10	PLF Monitoring Well	HSA	10/21/88	19.8	19.8	848.20	2.99	845.21	9.8 - 19.8	7.0 - 19.8	4	2" PVC	0.020 Slot PVC	Formerly MW6
BMW-11	PLF Monitoring Well	HSA	10/21/88	20.4	18.4	847.13	2.96	844.17	8.4 - 18.4	7.4 - 20.4	4	2" PVC	0.020 Slot PVC	Formerly MW3
BMW-12	PLF Monitoring Well	HSA	07/28/87	18.1	16.1	842.87	3.13	839.75	6.1 - 16.1	6.1 - 16.1		2" PVC	0.010 Slot PVC	Formerly W3. Abandoned 08/21/15.
BMW-13	PLF Monitoring Well	HSA	03/15/90	36.5	22.3	846.63	2.48	844.15	7.3 - 21.3	6.5 - 22.3	12	2" PVC	0.020 Slot PVC	
BMW-14	PLF Monitoring Well	HSA	03/13/90	20.7	20.7	848.85	2.41	846.44	5.7 - 19.7	4.9 - 20.7	12	2" PVC	0.010 Slot PVC	
BMW-15	PLF Monitoring Well	HSA	03/15/90	22.4	22.4	847.17	2.59	844.58	7.4 - 21.4	6.5 - 22.4	12	2" PVC	0.010 Slot PVC	
BMW-16	PLF Monitoring Well	HSA	03/14/90	21.1	21.1	846.95	2.75	844.20	6.1 - 20.1	5.3 - 21.1	12	2" PVC	0.010 Slot PVC	
BMW-17	PLF Monitoring Well	HSA	04/09/90	17.9	17.9	842.66	2.89	839.77	3.9 - 17.9	3.6 - 17.9	8	2" PVC	0.010 Slot PVC	Abandoned 08/21/15.
BMW-18	PLF Monitoring Well (Bedrock Well)	Mud Rotary	04/18/90	78.1	78.1	841.74	1.91	839.83	57.6 - 76.6	51.0 - 78.1	5.25	2" PVC	0.010 Slot PVC	
BMW-19	PLF Monitoring Well	HSA	05/23/90	21.4	18.9	844.34	1.85	842.49	4.4 - 18.9	3.9 - 18.9	7.5	2" PVC	0.010 Slot PVC	
BMW-20	PLF Monitoring Well	HSA	05/23/90	17.0	17.0	836.73	2.48	834.25	3.5 - 17	3.3 - 17	7.5	2" PVC	0.010 Slot PVC	Abandoned 09/06/11
BMW-20A	PLF Monitoring Well	HSA	09/07/12	18.7	18.7	838.51	2.65	835.86	8.7 - 18.7	6.7 - 18.7	8.25	2" PVC	0.010 Slot PVC	
BMW-21	PLF Monitoring Well	HSA	09/26/90	20.6	19.6	843.99	2.12	841.87	4.6 - 19.6	4.1 - 19.6	10.25	2" PVC	0.010 Slot PVC	
BMW-22	PLF Monitoring Well	HSA	09/26/90	20.4	19.4	843.06	1.91	841.14	4.4 - 19.4	3.9 - 19.4	10.25	2" PVC	0.010 Slot PVC	
BMW-23	PLF Monitoring Well	HSA	09/26/90	20.5	19.5	842.58	1.97	840.61	4.5 - 19.5	4.0 - 19.5	10.25	2" PVC	0.010 Slot PVC	
BMW-24	PLF Monitoring Well	HSA	09/25/90	20.0	19.5	841.63	1.96	839.67	4.5 - 19.5	4.0 - 19.5	10.25	2" PVC	0.010 Slot PVC	
BMW-25	PLF Monitoring Well	HSA	11/11/91	19.1	19.1	842.33	2.61	839.72	8.8 - 18.8	7.1 - 19.1	6.25	2" PVC	0.010 Slot PVC	
BMW-26	PLF Monitoring Well	HSA	11/11/91	19.2	19.2	840.29	2.85	837.44	8.9 - 18.9	7.2 - 19.2	6.25	2" PVC	0.010 Slot PVC	
BMW-27	PLF Monitoring Well	HSA	06/10/13	18.6	18.6	837.10	3.14	833.96	8.6 - 18.6	7.1 - 18.6	8.25	2" PVC	0.010 Slot PVC	
BMW-28	PLF Monitoring Well	HSA	06/10/13	18.6	18.6	842.07	3.10	838.97	8.6 - 18.6	7.1 - 18.6	8.25	2" PVC	0.010 Slot PVC	
BRW-1	PLF Recovery Well	HSA	05/16/90	28.2	27.7	842.39	0.20	842.20	2.7 - 16.7	2.2 - 27.7	12	4" PVC	0.010 Slot PVC	Not in service
BRW-2	PLF Recovery Well	HSA	05/15/90	28.2	27.7	841.50	0.16	841.34	2.7 - 16.7	2.2 - 27.7	12	4" PVC	0.010 Slot PVC	Not in service
BRW-3	PLF Recovery Well	HSA	05/15/90	28.3	27.8	841.08	0.28	840.80	2.8 - 16.8	2.3 - 27.8	12	4" PVC	0.010 Slot PVC	
BRW-4	PLF Recovery Well	HSA/Rotary	09/25/90	34.3	32.8	840.44	0.31	840.13	2.8 - 22.8	2.3 - 32.8	12	4" PVC	0.010 Slot PVC	Not in service
BRW-5	PLF Recovery Well	HSA/Rotary	09/24/90	34.5	32.5	840.53	0.05	840.49	2.5 - 22.5	2.0 - 33.0	12	4" PVC	0.010 Slot PVC	
BRW-6	PLF Recovery Well	HSA/Rotary	12/19/00	17.7	17.4	837.31	-0.55	837.86	2.4 - 16.9	1.4 - 17.7	12.875	6" PVC	0.010 Slot PVC	
BRW-7	PLF Recovery Well	HSA/Rotary	12/20/00	17.9	17.4	838.40	-0.61	839.01	2.4 - 16.9	1.4 - 17.9	12.875	6" PVC	0.010 Slot PVC	
BRW-8	PLF Recovery Well	HSA/Rotary	12/20/00	17.5	17.5	839.33	-0.50	839.83	2.5 - 17.0	1.5 - 17.5	12.875	6" PVC	0.010 Slot PVC	
BRW-9	PLF Recovery Well	HSA/Rotary	12/19/00	17.4	17.4	840.80	-0.60	841.40	2.4 - 16.9	1.4 - 17.4	12.875	6" PVC	0.010 Slot PVC	Not in service
LMW-1	Landfarm Monitoring Well	HSA	12/15/80	34.1	34.2	854.46	3.08	851.38	14.2 - 34.2	14.1 - 34.2	8.75	4" PVC	0.020 Slot PVC	
LMW-2	Landfarm Monitoring Well	HSA	12/15/80	34.1	33.1	852.98	3.13	849.85	13.1 - 33.1	13.1 - 33.1	8.75	4" PVC	0.020 Slot PVC	Abandoned 08/22/15.
LMW-2-0	Offset to LMW-2	HSA	05/07/86	14.8	14.8	851.67	1.77	849.90	7.3 - 14.8	6.3 - 14.8	8.5	4" PVC	0.010 Slot PVC	
LMW-3	Landfarm Monitoring Well	HSA	12/15/80	32.5	32.5	851.91	3.62	848.29	12.5 - 32.5	12.5 - 32.5	8.75	4" PVC	0.020 Slot PVC	Abandoned 08/20/15.
LMW-3-0	Offset to LMW-3	HSA	05/07/86	14.8	14.8	849.87	1.78	848.09	7.3 - 14.8	6.3 - 14.8	8.5	4" PVC	0.010 Slot PVC	
LMW-4	Landfarm Monitoring Well	HSA	12/15/80	33.3	33.3	851.50	3.34	848.16	13.3 - 33.3	13.3 - 33.3	8.75	4" PVC	0.010 Slot PVC	Abandoned 08/21/15.
LMW-4-0	Offset to LMW-4	HSA	05/08/86	15.3	15.3	850.51	1.79	848.72	7.3 - 15.3	5.8 - 15.3	8.5	4" PVC	0.010 Slot PVC	
LMW-5	Landfarm Monitoring Well	HSA	12/15/80	33.3	33.2	852.61	3.24	849.38	13.2 - 33.2	13.2 - 33.2	8.75	4" PVC	0.020 Slot PVC	Abandoned 08/21/15.
LMW-5-0	Offset to LMW-5	HSA	05/08/86	15.8	15.8	850.37	1.75	848.61	6.8 - 15.8	5.8 - 15.8	8.5	4" PVC	0.010 Slot PVC	

Table 1

Monitoring and Recovery Well Data
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well ID	Well Function	Drilling Method	Date Installed	Total Drill Depth (ft-TOC)	Completed Well Depth (ft-TOC)	TOC Elevation (ft-AMSL) (b)	Stick-up Height (feet)	Ground Surface Elevation (ft-AMSL)	Screened Interval (ft-TOC)	Filter Pack Interval (ft-TOC)	Borehole Diameter (inches)	Casing Diameter and Type	Screen Slot Size and Type (inches)	Comments
LMW-6	Landfarm Monitoring Well	HSA	09/17/84	36.9	36.9	851.46	1.88	849.58	11.9 - 36.9	5.9 -36.9	8.75	4" PVC	0.010 Slot PVC	Abandoned 08/24/15.
LMW-6-0	Offset to LMW-6	HSA	05/08/86	18.9	18.9	853.55	2.88	850.67	10.9 - 18.9	7.9 - 18.9	8.5	4" PVC	0.010 Slot PVC	
LMW-7	Landfarm Monitoring Well	HSA	09/24/84	30.1	16.3	851.71	1.56	850.15	7.1 - 16.6	5.6 - 16.6	6.25	4" PVC	0.010 Slot PVC	Formerly TB2. Abandoned in 1996
LMW-8	Landfarm Monitoring Well	HSA	09/19/84	39.6	17.5	851.41	2.55	848.86	8.1 - 17.6	6.6 - 16.6	6.25	4" PVC	0.010 Slot PVC	Formerly TB3. Abandoned in 1996
LMW-9	Slop Oil Monitoring Well	HSA	03/15/85	15.0	12.6	852.16	2.47	849.69	5.0 - 15.0	5.0 - 15.0	6	2" PVC	0.010 Slot PVC	Formerly R1. Abandoned in 1996
LMW-10	Slop Oil Monitoring Well	HSA	03/14/85	18.9	18.2	852.20	2.44	849.76	3.9 - 18.9	3.9 - 18.9	6	2" PVC	0.010 Slot PVC	Formerly R2. Abandoned in 1996
LMW-11	Slop Oil Monitoring Well	HSA	03/15/85	18.6	18.8	852.90	1.84	851.06	7.8 - 18.8	7.8 - 18.8	6	2" PVC	0.010 Slot PVC	Formerly R3
LMW-12	Slop Oil Monitoring Well	HSA	03/13/85	20.9	18.5	851.16	1.85	849.31	9.9 - 19.9	9.9 - 19.9	6	2" PVC	0.010 Slot PVC	Formerly R4. Abandoned 05/08/13.
LMW-13	Slop Oil Monitoring Well	HSA	03/14/85	25.1	24.1	854.19	1.57	852.62	9.1 - 24.1	9.1 - 24.1	6	2" PVC	0.010 Slot PVC	Formerly R5
LMW-14	Slop Oil Monitoring Well	HSA	04/04/90	22.1	22.1	853.66	2.04	851.62	7.1 - 21.1	6.0 - 22.1	8	2" PVC	0.010 Slot PVC	
LMW-15	Slop Oil Monitoring Well	HSA	05/24/90	20.1	19.1	847.99	2.11	845.88	4.6 - 19.1	4.1 - 19.1	7.5	2" PVC	0.010 Slot PVC	Abandoned 09/06/11
LPZ-1	Piezometer	HSA	02/14/91	34.9	34.9	854.89	2.93	851.96	34.9	32.9 - 34.9	7.75	1" PVC	20-mesh SS screen	Abandoned 12/12/13
LPZ-2	Piezometer	HSA	02/18/91	37.0	37.0	854.33	3.02	851.31	37.0	35.0 - 37.0	7.75	1" PVC	20-mesh SS screen	Abandoned 12/12/13
LPZ-3	Piezometer	HSA	02/18/91	36.8	36.8	854.38	2.81	851.57	36.8	34.8 - 36.8	7.75	1" PVC	20-mesh SS screen	Abandoned 12/12/13
LPZ-4	Piezometer	HSA	03/07/91	34.1	34.1	853.94	2.56	851.38	34.1	32.1 - 34.1	7.75	1" PVC	20-mesh SS screen	Abandoned 08/20/15
LPZ-5	Piezometer	HSA	02/14/91	34.9	34.9	853.95	2.93	851.02	34.9	32.9 - 34.9	7.75	1" PVC	20-mesh SS screen	Abandoned 08/22/15
LPZ-6	Piezometer	HSA	02/14/91	34.9	34.9	853.45	2.92	850.53	34.9	32.9 - 34.9	7.75	1" PVC	20-mesh SS screen	Abandoned 08/22/15
LPZ-7	Piezometer	HSA	02/14/91	34.9	34.9	853.42	2.91	850.51	34.9	32.9 - 34.9	7.75	1" PVC	20-mesh SS screen	Abandoned 08/22/15
LPZ-8	Piezometer	HSA	02/14/91	35.0	35.0	853.57	3.05	850.52	35.0	33.0 - 35.0	7.75	1" PVC	20-mesh SS screen	Abandoned 08/22/15
LRW-1	Landfarm Recording Monitoring Well	HSA	03/13/85	35.4	33.9	849.87	1.86	848.00	11.9 - 33.9	11.9 - 33.9	8.875	4" PVC	0.010 Slot PVC	Abandoned 08/21/15.
LRW-1-0	Offset to LRW-1	HSA	05/05/86	18.8	16.8	849.60	1.77	847.83	8.8 - 16.8	6.8 - 18.8	8.5	4" PVC	0.010 Slot PVC	
LRW-2	Landfarm Recording Monitoring Well	HSA	03/13/85	26.3	26.3	853.88	2.31	851.57	11.3 - 26.3	11.3 - 26.3	8.875	4" PVC	0.010 Slot PVC	Abandoned 08/21/15.
LRW-2-0	Offset to LRW-2	HSA	05/05/86	16.8	16.8	853.44	1.81	851.63	8.8 - 16.8	7.8 - 16.8	8.5	4" PVC	0.010 Slot PVC	
LRW-3	Recovery Well	Rotary Wash	01/30/91	43.9	40.4	855.05	2.94	852.11	9.2 - 35.0	5.4 - 40.4	10	6"#304 SS	0.020 Slot #304 SS	
LRW-4	Monitoring Well	Rotary Wash	02/05/91	44.9	40.4	853.70	2.94	850.76	9.1 - 40.4	7.1 - 40.4	10	6"#304 SS	0.020 Slot #304 SS	
NMW-1	NE Tank Area Monitoring Well	HSA	07/30/87			882.96	2.76	880.20				2" PVC	0.010 Slot PVC	Formerly LDW168. Abandoned 08/20/15.
NMW-2	NE Tank Area Monitoring Well	HSA	07/30/87	22.3	22.3	879.98	2.78	877.20	12.1 - 22.3	12.1 - 22.3		2" PVC	0.010 Slot PVC	Formerly LDW157
NMW-3	NE Tank Area Monitoring Well	HSA	10/31/88	34.9	34.9	877.28	1.87	875.41	16.9 - 34.9	5.9 - 34.9		2" PVC	0.010 Slot PVC	Formerly SBW4
NMW-4	NE Tank Area Monitoring Well	HSA	07/30/87	27.8	21.3	878.72	2.79	875.93	11.3 - 21.3	11.3 - 21.3		2" PVC	0.010 Slot PVC	Formerly LDW146
NMW-5	NE Tank Area Monitoring Well	HSA	07/30/87	22.8	21.3	878.42	2.82	875.59	11.3 - 21.3	11.3 - 21.3		2" PVC	0.010 Slot PVC	Formerly LDW142
NMW-6	NE Tank Area Monitoring Well	HSA	07/30/87			881.72	2.87	878.85				2" PVC	0.010 Slot PVC	Formerly LDW144
NMW-7	NE Tank Area Monitoring Well	HSA	11/07/85	31.5	21.5	873.20	1.51	871.68	11.5 - 21.5	7.5 - 21.5	6	2" PVC	0.020 Saw-slot PVC	Formerly WR1
NMW-8	NE Plume Monitoring Well	Rotary Wash	10/28/88	64.5	36.5	876.45	1.49	874.96	6.5 - 36.5	5.5 - 36.5		2" PVC	0.010 Slot PVC	Formerly SBW2
NMW-9	NE Tank Area Monitoring Well	HSA	10/29/88	36.6	36.6	877.07	1.63	875.44	6.6 - 36.6	5.6 - 36.6		2" PVC	0.010 Slot PVC	Formerly SBW5
NMW-10	NE Tank Area Monitoring Well	HSA	11/01/88	39.8	37.3	877.59	2.34	875.25	7.3 - 37.7	6.3 - 39.8		2" PVC	0.010 Slot PVC	Formerly SBW6
NMW-11	NE Tank Area Monitoring Well	HSA	03/30/90	32.3	32.0	878.75	2.34	876.41	12.3 - 31.3	10.6 - 32.3	8	2" PVC	0.010 Slot PVC	Abandoned 10/01/08
NMW-12	NE Tank Area Monitoring Well	HSA	04/03/90	32.1	32.1	882.64	1.96	880.68	12.1 -31.1	10.5 - 32.1	8	2" PVC	0.010 Slot PVC	
NMW-13	NE Plume Monitoring Well	HSA	04/06/90	27.5	27.5	869.23	2.02	867.21	8.5 - 27.5	6.1 - 27.5	8	2" PVC	0.010 Slot PVC	
NMW-14	NE Plume Monitoring Well	HSA	04/09/90	22.1	22.2	872.10	2.14	869.96	7.1 - 21.1	6.1 - 22.1	8	2" PVC	0.010 Slot PVC	Abandoned 01/05/12
NMW-15	NE Plume Monitoring Well	HSA	03/21/90	27.7	27.7	860.29	2.18	858.11	7.7 - 27.7	5.9 - 27.7	8	2" PVC	0.010 Slot PVC	Abandoned May 2010
NMW-16	NE Plume Monitoring Well	HSA	04/03/90	22.2	22.2	859.40	2.06	857.33	7.2 - 21.2	5.8 - 22.2	8	2" PVC	0.010 Slot PVC	
NMW-17	Monitoring Well	HSA	03/07/91	29.3	29.3	872.70	-0.19	872.89	9.3 - 28.8	4.8 - 29.3	7.75	2" PVC	0.010 Slot PVC	
NMW-18	Monitoring Well	HSA	03/07/91	29.8	29.3	870.62	-0.18	870.80	8.8 - 28.8	2.8 - 29.3	7.75	2" PVC	0.010 Slot PVC	
NMW-19	Monitoring Well	HSA	03/07/91	29.8	29.3	871.96	-0.18	872.14	8.8 - 28.8	2.8 - 29.3	7.75	2" PVC	0.010 Slot PVC	

Table 1

Monitoring and Recovery Well Data
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well ID	Well Function	Drilling Method	Date Installed	Total Drill Depth (ft-TOC)	Completed Well Depth (ft-TOC)	TOC Elevation (ft-AMSL) (b)	Stick-up Height (feet)	Ground Surface Elevation (ft-AMSL)	Screened Interval (ft-TOC)	Filter Pack Interval (ft-TOC)	Borehole Diameter (inches)	Casing Diameter and Type	Screen Slot Size and Type (inches)	Comments
NPZ-1	Recovery System Piezometer	HSA	01/21/91	27.8	27.8	870.29	-0.24	870.53	27.8	26.8 - 27.8	7.75	1" PVC	24-mesh SS Screen	Unable to locate. Assumed abandoned.
NPZ-2	Recovery System Piezometer	HSA	01/21/91	27.8	27.8	869.92	-0.16	870.08	27.8	26.8 - 27.8	7.75	1" PVC	24-mesh SS Screen	Unable to locate. Assumed abandoned.
NPZ-3	Recovery System Piezometer	HSA	01/21/91	27.8	27.8	869.88	-0.17	870.05	27.8	26.8 - 27.8	7.75	1" PVC	24-mesh SS Screen	Unable to locate. Assumed abandoned.
NPZ-4	Recovery System Piezometer	HSA	01/21/91	17.3	17.3	859.44	-0.22	859.66	17.3	16.3 - 17.3	7.75	1" PVC	24-mesh SS Screen	Abandoned 08/21/15
NPZ-5	Recovery System Piezometer	HSA	01/21/91	17.3	17.3	859.09	-0.21	859.30	17.3	16.3 - 17.3	7.75	1" PVC	24-mesh SS Screen	Abandoned 08/20/15
NPZ-6	Recovery System Piezometer	HSA	01/21/91	17.3	17.3	858.98	-0.22	859.20	17.3	16.3 - 17.3	7.75	1" PVC	24-mesh SS Screen	Abandoned 08/20/15
NPZ-7	Recovery System Piezometer	HSA	01/21/91	17.2	17.2	858.90	-0.26	859.16	17.2	16.2 - 17.2	7.75	1" PVC	24-mesh SS Screen	Abandoned 08/20/15
NRW-1	Recovery Well	Rotary Wash	03/01/91	39.5	36.0	875.10	2.77	872.33	10.1-30.5	8.0 - 36.0	10	6"#304 SS	0.020 Slot #304 SS	
NRW-2	Recovery Well	Rotary Wash	03/05/91	42.8	39.8	874.26	2.85	871.41	13.9 - 34.3	11.9 - 39.8	10	6"#304 SS	0.020 Slot #304 SS	
NRW-3	Recovery Well	Rotary Wash	03/06/91	42.3	38.3	873.60	2.78	870.82	12.4 - 32.8	7.8 - 38.3	10	6"#304 SS	0.020 Slot #304 SS	
NRW-4	Recovery Well	Rotary Wash	03/19/91	43.9	39.4	875.69	2.88	872.81	13.5 - 33.9	9.4 - 38.4	10	6"#304 SS	0.020 Slot #304 SS	
NRW-5	Recovery Well	Rotary Wash	03/25/91	39.4	36.4	873.51	2.38	871.12	10.1 - 30.9	8.9 - 36.4	10	6"#304 SS	0.020 Slot #304 SS	
NRW-6	Recovery Well	Rotary Wash	01/29/91	29.8	25.3	862.20	2.31	859.89	4.4 - 19.8	3.9 - 25.3	10	6"#304 SS	0.020 Slot #304 SS	
NRW-7	Recovery Well	Rotary Wash	02/27/91	28.5	25.5	861.25	2.51	858.75	4.6 - 20.0	3.5 - 25.5	10	6"#304 SS	0.020 Slot #304 SS	
OMW-1	Slop Oil Monitoring Well	HSA	11/07/85	24.8	22.2	855.51	2.31	853.20	12.3 - 22.3	12.3 - 22.3	6	2" PVC	0.020 Saw-slot PVC	Formerly WR4. Abandoned 10/01/08
OMW-2	Slop Oil Monitoring Well	HSA	11/08/85	24.9	24.8	855.34	2.44	852.90	14.9 - 24.9	14.9 - 24.9	6	2" PVC	0.020 Saw-slot PVC	Formerly WR3. Abandoned 08/26/05
OMW-3	Slop Oil Monitoring Well	HSA	11/08/85	25.2	22.7	857.83	2.75	855.08	12.7 - 22.7	12.7 - 22.7	6	2" PVC	0.020 Saw-slot PVC	Formerly WR2
OMW-4	Slop Oil Monitoring Well	HSA	11/08/85	28.1	23.1	857.47	3.11	854.36	13.1 - 23.1	13.1 - 23.1	6	2" PVC	0.020 Saw-slot PVC	Formerly WR5
OMW-5	Slop Oil Monitoring Well	HSA	04/06/90	27.6	27.6	855.96	2.09	853.87	7.6 - 26.6	6.4 - 27.6	8	2" PVC	0.010 Slot PVC	
OMW-6	Slop Oil Monitoring Well	HSA	04/09/90	27.1	27.1	857.70	2.07	855.63	7.1 - 26.1	6.1 - 27.1	8	2" PVC	0.010 Slot PVC	
ORW-1	Recovery Well	HSA	12/02/86	27.2	26.2	855.58	1.18	854.40	11.7 - 24.2	10.7 - 26.2		4" PVC		Abandoned 08/26/05
ORW-2	Recovery Well	HSA	12/03/86	26.3	26.3	855.42	1.34	854.08	8.8 - 21.3	7.8 - 26.3		4" PVC		
ORW-3	Recovery Well	HSA	12/04/86	26.2	26.2	856.06	1.70	854.36	8.7 - 21.2	7.7 - 26.2		4" PVC		
ORW-4	Monitoring Well	Rotary Wash	02/25/91	45.8	42.3	856.74	1.80	854.95	6.0 - 36.8	4.8 - 42.3	10	6"#304 SS	0.020 Slot #304 SS	
UMW-1	Facility Upgradient Well	Rotary Wash	10/28/88	62.2	42.2	905.97	2.22	903.74	7.2 - 42.2	6.2 - 42.2		2" PVC	0.010 Slot PVC	Formerly SBW01
UMW-2	North Background Well	Rotary Wash	10/28/88	87.3	26.3	858.01	1.25	856.76	6.3 - 26.3	6.3 - 26.3		2" PVC	0.010 Slot PVC	Formerly SBW03. Abandoned 09/06/11
UMW-3	Water Level Well	HSA	05/24/90	26.0	22.0	853.00	1.97	851.03	7.5 - 22.0	6.0 - 22.0	7.5	2" PVC	0.010 Slot PVC	
UMW-4	Water Level Well	HSA	09/09/12	25.3	24.8	868.78	2.82	865.96	14.8 - 24.8	12.8 - 25.3	8.25	2" PVC	0.010 Slot PVC	
UMW-5	Water Level Well	HSA	09/09/12	24.8	24.8	868.40	2.82	865.58	14.8 - 24.8	12.8 - 24.8	8.25	2" PVC	0.010 Slot PVC	
UMW-6	Water Level Well	HSA	09/08/12	33.7	33.7	882.79	2.72	880.07	23.7 - 33.7	21.7 - 33.7	8.25	2" PVC	0.010 Slot PVC	
UMW-7	Water Level Well	HSA	08/17/15	22.8	21.9	861.65	2.81	858.84	11.9 - 21.9	8.8 - 22.8	8.25	2" PVC	0.010 Slot PVC	
SMW-1	RFI Monitoring Well	HSA	06/26/89	21.9	21.9	863.15	1.86	861.30	11.6 - 21.6	10.2 - 21.9	8.875	2" PVC	0.010 Slot PVC	
SMW-2	RFI Monitoring Well	HSA	06/28/89	22.8	22.8	849.17	2.51	846.66	12.5 - 22.5	12.1 - 22.8	8.875	2" PVC	0.010 Slot PVC	
SMW-2D	RFI Monitoring Well	HSA	01/10/94	32.5	32.5	849.34	2.63	846.71	22.2 -31.9	21.2 - 32.4	8.75	2" PVC	0.010 Slot PVC	
SMW-3	RFI Monitoring Well	HSA	06/29/89	22.4	21.8	849.42	2.39	847.03	11.5 - 21.5	10.0 - 21.8	8.875	2" PVC	0.010 Slot PVC	
SMW-4	RFI Monitoring Well	HSA	06/29/89	18.6	18.6	851.70	2.30	849.39	8.3 - 18.3	7.3 - 18.6	8.875	2" PVC	0.010 Slot PVC	
SMW-4D	RFI Monitoring Well	HSA	01/10/94	31.2	31.2	851.11	1.65	849.46	19.7 - 29.4	17.7 - 31.2	8.75	2" PVC	0.010 Slot PVC	
SMW-5	SWRP Monitoring Well	HSA	06/27/89	26.0	22.2	854.69	2.04	852.64	11.9 - 21.9	10.5 - 22.2	8.875	2" PVC	0.010 Slot PVC	
SMW-5D	SWRP Monitoring Well	HSA	01/10/94	37.8	37.8	854.61	1.80	852.81	20.8 - 35.4	19.8 - 37.8	8.75	2" PVC	0.010 Slot PVC	
SMW-6	RFI Monitoring Well	HSA	05/25/90	26.1	22.1	854.48	2.08	852.39	7.1 - 22.1	6.1 - 22.1	7.5	2" PVC	0.010 Slot PVC	
SMW-7	Water Level Well	HSA	05/25/90	26.5	26.0	857.78	1.97	855.81	11.5 - 26.0	8.7 - 26.0	7.5	2" PVC	0.010 Slot PVC	
SMW-8	RFI Monitoring Well	HSA	07/18/91	24.5	24.5	858.70	2.34	856.36	7.4-22.5	5.35 - 24.5	12	2" PVC	0.010 Slot PVC	
SMW-9	SWRP Monitoring Well	HSA	11/23/92	22.3	19.3	853.27	2.34	850.93	9.0 - 19.0	7.3 - 19.3	8.5	2" PVC	0.010 Slot PVC	
SMW-9D	SWRP Monitoring Well	HSA	01/10/94	34.6	34.6	853.47	2.60	850.88	19.1 - 33.4	17.9 - 34.6	8.75	2" PVC	0.010 Slot PVC	
SMW-10	RFI Monitoring Well	HSA	01/19/94	20.6	20.6	853.71	1.47	852.24	8.0 - 20.1	7.0 - 20.6	8.75	2" PVC	0.010 Slot PVC	
SMW-10D	RFI Monitoring Well	HSA	01/19/94	36.4	35.2	853.72	1.42	852.29	20.4 - 34.8	19.0 - 36.4	8.75	2" PVC	0.010 Slot PVC	

Table 1

Monitoring and Recovery Well Data
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well ID	Well Function	Drilling Method	Date Installed	Total Drill Depth (ft-TOC)	Completed Well Depth (ft-TOC)	TOC Elevation (ft-AMSL) (b)	Stick-up Height (feet)	Ground Surface Elevation (ft-AMSL)	Screened Interval (ft-TOC)	Filter Pack Interval (ft-TOC)	Borehole Diameter (inches)	Casing Diameter and Type	Screen Slot Size and Type (inches)	Comments
SMW-11	SWRP Monitoring Well	HSA	01/18/94	21.1	21.1	853.13	1.47	851.66	8.5 - 20.6	7.5 - 21.2	8.75	2" PVC	0.010 Slot PVC	
SMW-11D	SWRP Monitoring Well	HSA	01/18/94	34.4	33.5	852.92	1.36	851.56	20.9 - 33.0	19.9 - 34.4	8.75	2" PVC	0.010 Slot PVC	
SMW-12	RFI Monitoring Well	HSA	01/20/94	20.5	20.5	855.02	1.38	853.64	7.9 - 20.0	6.9 - 20.5	8.75	2" PVC	0.010 Slot PVC	
SMW-12D	RFI Monitoring Well	HSA	01/20/94	35.9	35.4	855.04	1.40	853.64	20.4 - 34.9	19.4 - 35.9	8.75	2" PVC	0.010 Slot PVC	
SMW-13	RFI Monitoring Well	HSA	01/17/94	22.5	22.5	854.05	1.38	852.67	9.9 - 22.0	8.9 - 22.5	8.75	2" PVC	0.010 Slot PVC	
SMW-13D	RFI Monitoring Well	HSA	01/17/94	39.1	37.6	854.29	1.63	852.66	22.6 - 37.1	21.6 - 39.1	8.75	2" PVC	0.010 Slot PVC	
SMW-14	RFI Monitoring Well	HSA	01/17/94	22.2	22.1	854.70	1.61	853.09	7.1 - 21.6	6.1 - 22.2	8.75	2" PVC	0.010 Slot PVC	
SMW-14D	RFI Monitoring Well	HSA	01/14/94	36.7	34.8	854.71	1.66	853.06	22.2 - 34.3	21.2 - 36.7	8.75	2" PVC	0.010 Slot PVC	
SMW-15	RFI Monitoring Well	HSA	01/14/94	25.6	25.4	852.75	2.68	850.07	7.7 - 24.8	6.7 - 25.6	8.75	2" PVC	0.010 Slot PVC	Abandoned May 2010
SMW-16	RFI Monitoring Well	HSA	01/12/94	26.1	24.7	854.83	2.99	851.84	10.5 - 24.9	9.5 - 26.1	8.75	2" PVC	0.010 Slot PVC	Abandoned May 2010
SMW-17	RFI Monitoring Well	HSA	01/11/94	29.8	28.9	859.01	2.69	856.32	8.7 - 28.0	7.7 - 29.8	8.75	2" PVC	0.010 Slot PVC	Abandoned May 2010
SMW-18	RFI Monitoring Well	HSA	01/11/94	28.6	27.3	863.63	2.18	861.44	7.2 - 26.9	6.2 - 28.6	8.75	2" PVC	0.010 Slot PVC	
SMW-19	RFI Monitoring Well	HSA	01/13/94	27.4	27.5	847.91	1.37	846.53	7.4 - 26.8	6.4 - 27.4	8.75	2" PVC	0.010 Slot PVC	
SMW-20	RFI Monitoring Well	HSA	01/13/94	21.0	20.8	847.31	3.00	844.31	8.0 - 20.1	7.0 - 21.0	8.75	2" PVC	0.010 Slot PVC	Abandoned 10/23/12
SMW-20D	RFI Monitoring Well	HSA	01/13/94	31.5	30.6	847.02	2.47	844.55	18.0 - 29.9	17 - 31.5	8.75	2" PVC	0.010 Slot PVC	Abandoned 10/23/12
SMW-21	SWRP Monitoring Well	HSA	01/10/94	21.2	20.9	851.99	1.18	850.81	8.2 - 20.5	7.2 - 21.2	8.75	2" PVC	0.010 Slot PVC	
SMW-21D	SWRP Monitoring Well	HSA	01/10/94	34.2	33.4	852.09	1.23	850.86	20.7 - 33.0	19.6 - 34.2	8.75	2" PVC	0.010 Slot PVC	
SMW-22	RFI Monitoring Well	HSA	03/19/96	17.6	15.7	853.92	1.89	852.03	7.4 - 16.9	5.4 - 17.6	8.75	2" PVC	0.010 Slot PVC	Abandoned May 2010
SMW-22D	RFI Monitoring Well	HSA	03/19/96	34.0	34.0	855.07	1.85	853.23	18.8 - 33.3	16.8 - 33.9	8.75	2" PVC	0.010 Slot PVC	
SMW-23	RFI Monitoring Well	HSA	10/23/12	20.0	20.0	844.61	3.01	841.61	10.0 - 20.0	8.0 - 20.0	8.25	2" PVC	0.010 Slot PVC	
SMW-24	Water Level Well	HSA	08/18/15	19.8	18.6	850.11	2.82	847.29	8.6 - 18.6	7.8 - 19.8	8.25	2" PVC	0.010 Slot PVC	
SMW-25	Water Level Well	HSA	08/18/15	19.8	19.6	848.63	2.78	845.85	9.6 - 19.6	7.8 - 19.8	8.25	2" PVC	0.010 Slot PVC	
SBR-1	Water Level Well	HSA	01/19/15	30.9	30.9	847.35	2.85	844.50	7.9 - 27.9	6.4 - 30.9	10.25	4" PVC	0.010 Slot PVC	
SPZ-1	Piezometer	HSA	06/26/89	23.0	22.6		3				6.625	1" PVC	Open Bottom	Abandoned (date unknown)
SPZ-2	Piezometer	HSA	06/27/89	23.0	22.0		3				6.625	1" PVC	Open Bottom	Abandoned (date unknown)
SPZ-3	Piezometer	HSA	06/28/89	22.0	22.0		3				6.625	1" PVC	Open Bottom	Abandoned (date unknown)
KRW-1	Laboratory Recovery Well			30.0										Abandoned 01/05/12
KRW-2	Laboratory Recovery Well			30.0										Abandoned 01/05/12
KRW-3	Laboratory Recovery Well			30.0										Abandoned 01/05/12
KRW-4	Laboratory Recovery Well			30.0										Abandoned 01/05/12

a\ ft-TOC = feet below top of casing.
ft-AMSL = feet above mean sea level.
PLF = Product Loading Facility.
HSA = hollow stem auger.
PVC = polyvinyl chloride.
SS = stainless steel.
RFI = Resource Conservation and Recovery Act Feasibility Investigation.
SWRP = Storm Water Retention Pond.
DPT = Direct-push technology.
b\ Elevations and stick-up height have been updated with most recent survey data collected in April 2014.
Shading descriptors:
Groundwater Sampling Well for Perimeter Monitoring.
Groundwater Sampling Well for SWRP.

Table 2A

Groundwater Elevations and LNAPL Thickness Measurements
March 2016
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well Number	Measurement Date	TOC Elevation (ft-AMSL)	Depth to Water (ft-TOC)	Depth to LNAPL (ft-TOC)	LNAPL Thickness (ft)	Water Table Elevation (ft-AMSL)	API Gravity	Corrected Water Table Elevation (ft-AMSL) (b)
BMW-2	03/15/16	842.98	4.98	4.10	0.88	838.00	59.8 (c)	838.66
BMW-4	03/15/16	838.65	5.01	NP	0.00	833.64		833.64
BMW-5	03/15/16	847.03	8.43	6.90	1.53	838.60	58.5	839.74
BMW-6	03/15/16	844.97	4.58	NP	0.00	840.39	58.5 (c)	840.39
BMW-7	03/15/16	847.31	6.65	NP	0.00	840.66		840.66
BMW-8	03/15/16	846.92	5.78	NP	0.00	841.14		841.14
BMW-9	03/15/16	845.03	5.68	NP	0.00	839.35		839.35
BMW-10	03/15/16	848.20	7.11	NP	0.00	841.09		841.09
BMW-11	03/15/16	847.13	6.65	NP	0.00	840.48		840.48
BMW-13	03/15/16	846.63	5.21	NP	0.00	841.42		841.42
BMW-14	03/15/16	848.85	7.56	NP	0.00	841.29		841.29
BMW-15	03/15/16	847.17	6.62	NP	0.00	840.55	58.5 (c)	840.55
BMW-16	03/15/16	846.95	6.94	NP	0.00	840.01		840.01
BMW-18	03/15/16	841.74	6.75	NP	0.00	834.99		834.99
BMW-19	03/15/16	844.34	5.59	NP	0.00	838.75		838.75
BMW-20A	03/15/16	838.51	5.19	NP	0.00	833.32		833.32
BMW-21	03/15/16	843.99	4.79	NP	0.00	839.20		839.20
BMW-22	03/15/16	843.06	4.23	NP	0.00	838.83		838.83
BMW-23	03/15/16	842.58	3.97	NP	0.00	838.61		838.61
BMW-24	03/15/16	841.63	4.55	2.86	1.69	837.08	56.8	838.35
BMW-25	03/15/16	842.33	5.28	NP	0.00	837.05	54.9 (c)	837.05
BMW-26	03/15/16	840.29	2.85	2.76	0.09	837.44	54.9	837.51
BMW-27	03/15/16	837.10	3.03	NP	0.00	834.07		834.07
BMW-28	03/15/16	842.07	7.39	NP	0.00	834.68		834.68
BRW-1	03/15/16	842.39	2.26	NP	0.00	840.13		840.13
BRW-2	03/15/16	841.50	2.01	NP	0.00	839.49		839.49
BRW-3	03/15/16	841.08	2.50	NP	0.00	838.58		838.58
BRW-4	03/15/16	840.44	2.63	NP	0.00	837.81		837.81
BRW-5	03/15/16	840.53	2.91	NP	0.00	837.62		837.62
BRW-6	03/15/16	837.31	2.93	NP	0.00	834.38	54.9 (c)	834.38
BRW-7	03/15/16	838.40	2.44	NP	0.00	835.96	54.9 (c)	835.96
BRW-8	03/15/16	839.33	3.35	NP	0.00	835.98	54.9 (c)	835.98
BRW-9	03/15/16	840.80	3.28	NP	0.00	837.52		837.52
SMW-1	03/14/16	863.15	14.66	NP	0.00	848.49		848.49
SMW-2	03/15/16	849.17	10.77	NP	0.00	838.40		838.40
SMW-2D	03/15/16	849.34	10.94	NP	0.00	838.40		838.40
SMW-3	03/15/16	849.42	11.01	NP	0.00	838.41		838.41
SMW-4	03/15/16	851.70	10.35	NP	0.00	841.35		841.35
SMW-4D	03/15/16	851.11	9.76	NP	0.00	841.35		841.35
SMW-5	03/14/16	854.69	13.58	NP	0.00	841.11		841.11
SMW-5D	03/14/16	854.61	13.48	NP	0.00	841.13		841.13
SMW-6	03/14/16	854.48	14.08	NP	0.00	840.40		840.40
SMW-7	03/14/16	857.78	13.60	NP	0.00	844.18		844.18
SMW-8	03/14/16	858.70	10.07	NP	0.00	848.63		848.63
SMW-9	03/14/16	853.27	13.33	NP	0.00	839.94		839.94
SMW-9D	03/14/16	853.47	13.55	NP	0.00	839.92		839.92
SMW-10	03/14/16	853.71	11.99	NP	0.00	841.72		841.72
SMW-10D	03/14/16	853.72	11.90	NP	0.00	841.82		841.82
SMW-11	03/14/16	853.13	11.72	NP	0.00	841.41		841.41
SMW-11D	03/14/16	852.92	11.59	NP	0.00	841.33		841.33
SMW-12	03/14/16	855.02	11.64	NP	0.00	843.38		843.38
SMW-12D	03/14/16	855.04	11.49	NP	0.00	843.55		843.55
SMW-13	03/15/16	854.05	13.82	NP	0.00	840.23		840.23
SMW-13D	03/15/16	854.29	14.06	NP	0.00	840.23		840.23

Table 2A

Groundwater Elevations and LNAPL Thickness Measurements
March 2016
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well Number	Measurement Date	TOC Elevation (ft-AMSL)	Depth to Water (ft-TOC)	Depth to LNAPL (ft-TOC)	LNAPL Thickness (ft)	Water Table Elevation (ft-AMSL)	API Gravity	Corrected Water Table Elevation (ft-AMSL) (b)
SMW-14	03/14/16	854.70	13.41	NP	0.00	841.29		841.29
SMW-14D	03/14/16	854.71	13.45	NP	0.00	841.26		841.26
SMW-18	03/14/16	863.63	14.68	NP	0.00	848.95		848.95
SMW-19	03/14/16	847.91	10.27	NP	0.00	837.64		837.64
SMW-21	03/14/16	852.09	11.56	NP	0.00	840.53		840.53
SMW-21D	03/14/16	851.99	11.61	NP	0.00	840.38		840.38
SMW-22D	03/14/16	855.07	13.16	NP	0.00	841.91		841.91
SMW-23	03/15/16	844.61	7.07	NP	0.00	837.54		837.54
SMW-24	03/15/16	850.11	8.48	NP	0.00	841.63		841.63
SMW-25	03/15/16	848.63	7.75	NP	0.00	840.88		840.88
SBR-1	03/14/16	847.35	9.75	NP	0.00	837.60		837.60
LMW-1	03/15/16	854.46	10.56	10.43	0.13	843.90	34.2 (c)	844.01
LMW-2-0	03/15/16	851.67	8.82	NP	0.00	842.85		842.85
LMW-3-0	03/15/16	849.87	7.33	NP	0.00	842.54		842.54
LMW-4-0	03/15/16	850.51	7.94	NP	0.00	842.57		842.57
LMW-5-0	03/15/16	850.37	7.31	NP	0.00	843.06	40.8 (c)	843.06
LMW-6-0	03/14/16	853.55	9.45	NP	0.00	844.10		844.10
LMW-11	03/15/16	852.90	9.18	NP	0.00	843.72	34.2 (c)	843.72
LMW-13	03/15/16	854.19	10.72	9.92	0.80	843.47	37.4	844.14
LMW-14	03/14/16	853.66	9.72	NP	0.00	843.94		843.94
LRW-1-0	03/15/16	849.60	7.22	NP	0.00	842.38		842.38
LRW-2-0	03/14/16	853.44	9.25	NP	0.00	844.19		844.19
LRW-3	03/15/16	855.05	24.32	NP	0.00	830.73		830.73
LRW-4	03/15/16	853.70	9.28	NP	0.00	844.42	34.2 (c)	844.42
UMW-1	03/10/16	905.97	25.15	NP	0.00	880.82		880.82
UMW-3	03/15/16	853.00	8.75	NP	0.00	844.25		844.25
UMW-4	03/15/16	868.78	11.37	NP	0.00	857.41		857.41
UMW-5	03/15/16	868.40	10.67	NP	0.00	857.73		857.73
UMW-6	03/15/16	882.79	21.28	NP	0.00	861.51		861.51
UMW-7	03/15/16	861.65	10.30	NP	0.00	851.35		851.35
OMW-3	03/14/16	857.83	18.21	10.68	7.53	839.62	40.8	845.81
OMW-4	03/14/16	857.47	17.71	11.70	6.01	839.76	33.1	844.92
OMW-5	03/14/16	855.96	12.08	NP	0.00	843.88		843.88
OMW-6	03/14/16	857.70	14.09	NP	0.00	843.61		843.61
ORW-2	03/14/16	855.42	19.64	9.65	9.99	835.78	34.2	844.31
ORW-3	03/14/16	856.06	19.63	10.31	9.32	836.43	35.5	844.33
ORW-4	03/14/16	856.74	12.10	NP	0.00	844.64		844.64
NRW-1	03/15/16	875.10	21.18	NP	0.00	853.92		853.92
NRW-2	03/15/16	874.26	16.45	NP	0.00	857.81		857.81
NRW-3	03/15/16	873.60	20.11	NP	0.00	853.49	49.5 (c)	853.49
NRW-4	03/15/16	875.69	20.54	20.50	0.04	855.15	49.5 (c)	855.18
NRW-5	03/15/16	873.51	21.58	NP	0.00	851.93		851.93
NRW-6	03/15/16	862.20	30.49	30.48	0.01	831.71	32.1	831.72
NRW-7	03/15/16	861.25	16.63	NP	0.00	844.62	32.1	844.62
NMW-2	03/10/16	879.98	20.34	18.44	1.90	859.64	48.2	861.14
NMW-3	03/10/16	877.28	18.44	15.98	2.46	858.84	43.5	860.83
NMW-4	03/10/16	878.72	19.44	17.44	2.00	859.28		861.43
NMW-5	03/10/16	878.42	18.53	NP	0.00	859.89		859.89
NMW-6	03/10/16	881.72	23.46	20.22	3.24	858.26	40.3	861.07
NMW-7	03/14/16	873.20	13.82	13.76	0.06	859.38	32.1 (c)	859.43
NMW-8	03/14/16	876.45	16.29	NP	0.00	860.16		860.16
NMW-9	03/10/16	877.07	19.54	15.70	3.84	857.53	64.3	860.31
NMW-10	03/10/16	877.59	19.99	16.05	3.94	857.60	70.9	860.36
NMW-12	03/10/16	882.64	22.23	20.64	1.59	860.41	57.0	861.60

Table 2A

Groundwater Elevations and LNAPL Thickness Measurements
March 2016
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well Number	Measurement Date	TOC Elevation (ft-AMSL)	Depth to Water (ft-TOC)	Depth to LNAPL (ft-TOC)	LNAPL Thickness (ft)	Water Table Elevation (ft-AMSL)	API Gravity	Corrected Water Table Elevation (ft-AMSL) (b)
NMW-13	03/14/16	869.23	9.59	NP	0.00	859.64		859.64
NMW-16	03/14/16	859.40	12.29	NP	0.00	847.11		847.11
NMW-17	03/15/16	872.70	13.51	NP	0.00	859.19		859.19
NMW-18	03/15/16	870.62	11.77	11.76	0.01	858.85	49.5 (c)	858.86
NMW-19	03/15/16	871.96	12.25	12.24	0.01	859.71	49.5	859.71

a\ LNAPL = light non-aqueous phase liquid.
TOC = top of casing.
ft-AMSL = feet above mean sea level.
ft-TOC = feet from top of casing.
ft = feet.
API = American Petroleum Institute.
NP = No LNAPL detected.
b\ Groundwater Elevation is corrected for the presence of LNAPL according to EPA Publication 510-R-96-001, 1996.
c\ API Gravity interpolated from nearby wells.

Table 2B

Groundwater Elevations and LNAPL Thickness Measurements
June 2016
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well Number	Measurement Date	TOC Elevation (ft-AMSL)	Depth to Water (ft-TOC)	Depth to LNAPL (ft-TOC)	LNAPL Thickness (ft)	Water Table Elevation (ft-AMSL)	API Gravity	Corrected Water Table Elevation (ft-AMSL) (b)
BMW-2	06/08/16	842.98	4.77	3.91	0.86	838.21	59.8 (c)	838.86
BMW-4	06/08/16	838.65	5.56	NP	0.00	833.09		833.09
BMW-5	06/08/16	847.03	8.44	5.58	2.86	838.59	58.5	840.72
BMW-6	06/08/16	844.97	4.34	NP	0.00	840.63	58.5 (c)	840.63
BMW-7	06/08/16	847.31	6.39	NP	0.00	840.92		840.92
BMW-8	06/08/16	846.92	5.49	NP	0.00	841.43		841.43
BMW-9	06/08/16	845.03	5.47	NP	0.00	839.56		839.56
BMW-10	06/08/16	848.20	6.88	NP	0.00	841.32		841.32
BMW-11	06/08/16	847.13	6.51	NP	0.00	840.62		840.62
BMW-13	06/08/16	846.63	4.83	NP	0.00	841.80		841.80
BMW-14	06/08/16	848.85	7.44	NP	0.00	841.41		841.41
BMW-15	06/08/16	847.17	6.53	NP	0.00	840.64	58.5 (c)	840.64
BMW-16	06/08/16	846.95	6.83	NP	0.00	840.12		840.12
BMW-18	06/08/16	841.74	6.19	NP	0.00	835.55		835.55
BMW-19	06/08/16	844.34	5.68	NP	0.00	838.66		838.66
BMW-20A	06/08/16	838.51	5.74	NP	0.00	832.77		832.77
BMW-21	06/08/16	843.99	4.59	NP	0.00	839.40		839.40
BMW-22	06/08/16	843.06	3.96	NP	0.00	839.10		839.10
BMW-23	06/08/16	842.58	2.64	NP	0.00	839.94		839.94
BMW-24	06/08/16	841.63	4.14	2.49	1.65	837.49	56.8	838.73
BMW-25	06/08/16	842.33	5.38	NP	0.00	836.95	54.9 (c)	836.95
BMW-26	06/08/16	840.29	2.98	2.89	0.09	837.31	54.9	837.38
BMW-27	06/08/16	837.10	3.28	NP	0.00	833.82		833.82
BMW-28	06/08/16	842.07	7.67	NP	0.00	834.40		834.40
BRW-1	06/08/16	842.39	2.78	NP	0.00	839.61		839.61
BRW-2	06/08/16	841.50	2.57	NP	0.00	838.93		838.93
BRW-3	06/08/16	841.08	2.18	NP	0.00	838.90		838.90
BRW-4	06/08/16	840.44	1.67	NP	0.00	838.77		838.77
BRW-5	06/08/16	840.53	1.89	NP	0.00	838.64		838.64
BRW-6	06/08/16	837.31	0.00	NP	0.00	837.31	54.9 (c)	837.31
BRW-7	06/08/16	838.40	2.41	NP	0.00	835.99	54.9 (c)	835.99
BRW-8	06/08/16	839.33	2.93	NP	0.00	836.40	54.9 (c)	836.40
BRW-9	06/08/16	840.80	3.24	NP	0.00	837.56		837.56
SMW-1	06/08/16	863.15	14.04	NP	0.00	849.11		849.11
SMW-2	06/08/16	849.17	10.54	NP	0.00	838.63		838.63
SMW-2D	06/08/16	849.34	10.71	NP	0.00	838.63		838.63
SMW-3	06/08/16	849.42	10.86	NP	0.00	838.56		838.56
SMW-4	06/08/16	851.70	9.77	NP	0.00	841.93		841.93
SMW-4D	06/08/16	851.11	9.11	NP	0.00	842.00		842.00
SMW-5	06/06/16	854.69	12.90	NP	0.00	841.79		841.79
SMW-5D	06/06/16	854.61	12.81	NP	0.00	841.80		841.80
SMW-6	06/06/16	854.48	13.58	NP	0.00	840.90		840.90
SMW-7	06/06/16	857.78	12.67	NP	0.00	845.11		845.11
SMW-8	06/08/16	858.70	9.57	NP	0.00	849.13		849.13
SMW-9	06/06/16	853.27	12.92	NP	0.00	840.35		840.35
SMW-9D	06/06/16	853.47	13.14	NP	0.00	840.33		840.33
SMW-10	06/06/16	853.71	11.91	NP	0.00	841.80		841.80
SMW-10D	06/06/16	853.72	11.08	NP	0.00	842.64		842.64
SMW-11	06/06/16	853.13	11.01	NP	0.00	842.12		842.12
SMW-11D	06/06/16	852.92	10.91	NP	0.00	842.01		842.01
SMW-12	06/07/16	855.02	10.50	NP	0.00	844.52		844.52
SMW-12D	06/07/16	855.04	10.40	NP	0.00	844.64		844.64
SMW-13	06/06/16	854.05	13.36	NP	0.00	840.69		840.69
SMW-13D	06/06/16	854.29	12.99	NP	0.00	841.30		841.30

Table 2B

Groundwater Elevations and LNAPL Thickness Measurements
June 2016
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well Number	Measurement Date	TOC Elevation (ft-AMSL)	Depth to Water (ft-TOC)	Depth to LNAPL (ft-TOC)	LNAPL Thickness (ft)	Water Table Elevation (ft-AMSL)	API Gravity	Corrected Water Table Elevation (ft-AMSL) (b)
SMW-14	06/06/16	854.70	12.68	NP	0.00	842.02		842.02
SMW-14D	06/06/16	854.71	12.71	NP	0.00	842.00		842.00
SMW-18	06/07/16	863.63	14.26	NP	0.00	849.37		849.37
SMW-19	06/06/16	847.91	9.90	NP	0.00	838.01		838.01
SMW-21	06/06/16	852.09	11.19	NP	0.00	840.90		840.90
SMW-21D	06/06/16	851.99	11.11	NP	0.00	840.88		840.88
SMW-22D	06/06/16	855.07	12.40	NP	0.00	842.67		842.67
SMW-23	06/07/16	844.61	6.76	NP	0.00	837.85		837.85
SMW-24	06/07/16	850.11	7.94	NP	0.00	842.17		842.17
SMW-25	06/07/16	848.63	7.45	NP	0.00	841.18		841.18
SBR-1	06/07/16	847.35	9.49	NP	0.00	837.86		837.86
LMW-1	06/07/16	854.46	9.63	9.50	0.13	844.83	34.2 (c)	844.94
LMW-2-0	06/07/16	851.67	7.39	NP	0.00	844.28		844.28
LMW-3-0	06/07/16	849.87	6.35	NP	0.00	843.52		843.52
LMW-4-0	06/07/16	850.51	7.42	NP	0.00	843.09		843.09
LMW-5-0	06/07/16	850.37	6.90	6.88	0.02	843.47	40.8 (c)	843.48
LMW-6-0	06/07/16	853.55	8.95	NP	0.00	844.60		844.60
LMW-11	06/07/16	852.90	8.11	NP	0.00	844.79	34.2 (c)	844.79
LMW-13	06/07/16	854.19	10.13	9.26	0.87	844.06	37.4	844.79
LMW-14	06/07/16	853.66	9.14	NP	0.00	844.52		844.52
LRW-1-0	06/07/16	849.60	6.61	NP	0.00	842.99		842.99
LRW-2-0	06/07/16	853.44	8.56	NP	0.00	844.88		844.88
LRW-3	06/07/16	855.05	22.90	NP	0.00	832.15		832.15
LRW-4	06/07/16	853.70	8.22	NP	0.00	845.48	34.2 (c)	845.48
UMW-1	06/06/16	905.97	24.53	NP	0.00	881.44		881.44
UMW-3	06/07/16	853.00	8.29	NP	0.00	844.71		844.71
UMW-4	06/07/16	868.78	10.86	NP	0.00	857.92		857.92
UMW-5	06/07/16	868.40	9.91	NP	0.00	858.49		858.49
UMW-6	06/07/16	882.79	20.52	NP	0.00	862.27		862.27
UMW-7	06/07/16	861.65	9.89	NP	0.00	851.76		851.76
OMW-3	06/07/16	857.83	13.23	10.88	2.35	844.60	40.8	846.53
OMW-4	06/07/16	857.47	19.25	10.71	8.54	838.22	33.1	845.56
OMW-5	06/07/16	855.96	10.86	NP	0.00	845.10		845.10
OMW-6	06/07/16	857.70	12.98	NP	0.00	844.72		844.72
ORW-2	06/07/16	855.42	19.32	8.65	10.67	836.10	34.2	845.21
ORW-3	06/07/16	856.06	19.18	8.36	10.82	836.88	35.5	846.05
ORW-4	06/07/16	856.74	11.69	NP	0.00	845.05		845.05
NRW-1	06/07/16	875.10	22.95	NP	0.00	852.15		852.15
NRW-2	06/07/16	874.26	13.55	NP	0.00	860.71		860.71
NRW-3	06/07/16	873.60	21.62	NP	0.00	851.98	49.5 (c)	851.98
NRW-4	06/08/16	875.69	22.31	22.28	0.03	853.38	49.5 (c)	853.40
NRW-5	06/06/16	873.51	31.77	NP	0.00	841.74		841.74
NRW-6	06/06/16	862.20	20.78	19.95	0.83	841.42	32.1	842.14
NRW-7	06/07/16	861.25	12.03	NP	0.00	849.22	32.1	849.22
NMW-2	06/06/16	879.98	18.92	16.73	2.19	861.06	48.2	862.78
NMW-3	06/06/16	877.28	16.70	14.58	2.12	860.58	43.5	862.29
NMW-4	06/06/16	878.72	18.49	15.65	2.84	860.23		863.29
NMW-5	06/06/16	878.42	16.60	NP	0.00	861.82		861.82
NMW-6	06/06/16	881.72	19.29	19.09	0.20	862.43	40.3	862.61
NMW-7	06/06/16	873.20	12.91	12.84	0.07	860.29	32.1 (c)	860.35
NMW-8	06/06/16	876.45	15.27	NP	0.00	861.18		861.18
NMW-9	06/06/16	877.07	17.51	14.00	3.51	859.56	64.3	862.10
NMW-10	06/06/16	877.59	18.05	14.59	3.46	859.54	70.9	861.96
NMW-12	06/06/16	882.64	20.43	18.95	1.48	862.21	57.0	863.32

Table 2B

Groundwater Elevations and LNAPL Thickness Measurements
June 2016
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma (a)

Well Number	Measurement Date	TOC Elevation (ft-AMSL)	Depth to Water (ft-TOC)	Depth to LNAPL (ft-TOC)	LNAPL Thickness (ft)	Water Table Elevation (ft-AMSL)	API Gravity	Corrected Water Table Elevation (ft-AMSL) (b)
NMW-13	06/06/16	869.23	8.69	NP	0.00	860.54		860.54
NMW-16	06/06/16	859.40	10.50	NP	0.00	848.90		848.90
NMW-17	06/08/16	872.70	12.46	NP	0.00	860.24		860.24
NMW-18	06/08/16	870.62	10.55	NP	0.00	860.07	49.5 (c)	860.07
NMW-19	06/08/16	871.96	11.75	NP	0.00	860.21	49.5	860.21

a\ LNAPL = light non-aqueous phase liquid.
TOC = top of casing.
ft-AMSL = feet above mean sea level.
ft-TOC = feet from top of casing.
ft = feet.
API = American Petroleum Institute.
NP = No LNAPL detected.
NM = Not measured
b\ Groundwater Elevation is corrected for the presence of LNAPL according to EPA Publication 510-R-96-001, 1996.
c\ API Gravity interpolated from nearby wells.

Table 3

Summary of Groundwater Analytical Results
June 2016
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

					Total Petroleum Hydrocarbons (Oklahoma Methods 8020/8015 and 8000/8100)		**BTEX (EPA Method 8260B)**					
	Monitoring Well	**Field Sample ID**	**Laboratory Sample ID**	**Sample Date**	**Gasoline Range Organics** (µg/l)	**Diesel Range Organics** (µg/l)	**Benzene** (µg/l)	**Toluene** (µg/l)	**Ethylbenzene** (µg/l)	**m+p-Xylene** (µg/l)	**o-Xylene** (µg/l)	**Xylenes (Total) (a)** (µg/l)
Hydrocarbon Recovery Groundwater Samples	BMW-4	WRCBMW-4	16061471	06/15/16	**88 G**	**760 QC**	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	BMW-4	WRCDUP2	16061472	06/15/16	**72 G**	**750**	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	BMW-19	WRCBMW-19	16061469	06/15/16	<20	<100 QC	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	BMW-20A	WRCBMW-20A	16061474	06/16/16	**137 G**	**300**	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	BMW-25	WRCBMW-25	16061473	06/15/16	**2,170**	**2,100**	**370.**	5.2 J	**120 QC**	**50.0 QC**	**10 J QC**	**60. QC**
	BMW-26	WRCBMW-26	16061475	06/16/16	**17,100**	**3,000**	**3,180**	**1,410**	**590**	**2,420**	**780**	**3,200**
	BMW-27	WRCBMW-27	16061479	06/16/16	<20	**960**	0.18 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	BMW-28	WRCBMW-28	16061478	06/16/16	<20	**480**	0.09 J	0.42 J	<1.0 J	0.21 J	0.1 J	0.31 J
	NMW-6	WRCNMW-6	16061463	06/14/16	**4,960**	**190,000 QC**	**16.7**	**19.8**	**250.**	**406**	**134**	**540**
	NMW-12	WRCNMW-12	16061464	06/14/16	**37,000**	**9,000 QC**	**8,540**	**4,800**	**1,000**	**4,140**	**1,500**	**5,640**
	SMW-1	WRCSMW-1	16061459	06/13/16	<20	<100	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	SMW-2	WRCSMW-2	16061458	06/13/16	<20	<100	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	SMW-18	WRCSMW-18	16061477	06/16/16	<20	**210**	0.08 J	0.22 J	<1.0 J	0.13 J	<1.0 J	<2.0 J
	SMW-23	WRCSMW-23	16061470	06/15/16	23	**930 QC**	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	SMW-24	WRCSMW-24	16061476	06/16/16	<20	<100	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	SMW-25	WRCSMW-25	16061468	06/15/16	<20	<100 QC	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	UMW-1	WRCUMW-1	16061462	06/14/16	<20	**1,200**	<1.0 J	<1.0 J	<1.0 J	<1.0 J	0.2 J	<1.2 J
	UMW-3	WRCUMW-3	16061461	06/13/16	<20	<100	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	UMW-4	WRCUMW-4	16061455	06/13/16	**2,860**	**1,600**	**812**	**18.4**	2 J	**42.7**	**10.**	**52.7**
	UMW-4	WRCDUP1	16061454	06/13/16	**2,940**	**1,600 QC**	**903**	**20.6**	2 J	**47.6**	**11**	**58.6**
	UMW-5	WRCUMW-5	16061456	06/13/16	**1,810**	**810**	**275**	7.9 J	5 J	**12.0**	2 J	**14.0**
	UMW-6	WRCUMW-6	16061457	06/13/16	**19,300**	**4,900**	**5,490**	**1,670**	**660**	**1,600**	**550**	**2,150**
	UMW-7	WRCUMW-7	16061453	06/13/16	<20	<100	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	McLaughlin Well	WRC McLaughlin Well	16061467	06/14/16	<20	<100 QC	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
	Martin Pond	WRC-Martin Pond	16061465	06/14/16	**127**	**690 QC**	**9.88**	**0.42 J**	**2.1**	**7.87**	**2.3**	**10.17**
	S Martin Well	WRC-S Martin Well	16061466	06/14/16	<20	**800 QC**	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
QC Samples	Equipment Blank	WRCEB	16061460	06/13/16	<20	**150**	<1.0 J	0.38 J	<1.0 J	0.06 J	<1.0 J	<2.0 J
	Trip Blank	Trip Blank	16061452	06/13/16	<20	<100	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<1.0 J	<2.0 J
Screening Criteria	**EPA Primary Drinking Water Regulations**				NE	NE	5	1,000	700	NE	NE	10,000
	EPA Regional Screening Levels (Tap Water)				NE	NE	0.46	110	1.5	19	19	19
	ODEQ Cleanup Levels				1,000	1,000	NE	NE	NE	NE	NE	NE

Bold values indicate a detection above the reporting limit.
Shading descriptors:
Detected concentration exceeds the EPA Primary Drinking Water Regulations Maximum Contaminant Level, updated May 2009.
Detected concentration exceeds the EPA Regional Screening Level for Tap Water, updated November 2015.
Detected concentration exceeds ODEQ cleanup levels (2004).
BTEX = benzene, toluene, ethylbenzene, and xylenes.
EPA = United States Environmental Protection Agency.
µg/l = micrograms per liter.
NE = not established.
ODEQ = Oklahoma Department of Environmental Quality.
a\ The value of total xylenes is calculated as the sum of m+p-xylene and o-xylene.
b\ Lab data qualifiers:
G = The reported concentration includes a significant amount of individual compound(s) at concentrations not typically found in petroleum hydrocarbon patterns.
QC = Quality control data qualifiers were noted. See the laboratory quality control report.
J = The concentration or not detected value is below the limit of quantification and is considered an estimate.

Table 4

LNAPL and Groundwater Recovery Summary
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

RECOVERY SYSTEM												
	Historical Hydrocarbon Recovery Systems				Current Recovery Systems (a)							
	Light Oils, Tank 150 Area, Laboratory and Control Building, South Alky Unit		Process Area		Product Loading Facility		South Process Area		North Process Area		Total LNAPL Recovery	
	Groundwater (gallons)	LNAPL (gallons)	Groundwater (gallons)	LNAPL (gallons) (d)	Groundwater (gallons)	LNAPL (b,c) (gallons)	Groundwater (gallons)	LNAPL (gallons) (d)	Groundwater (gallons)	LNAPL (gallons) (e)	Groundwater (gallons)	LNAPL (barrels)
Total for Reporting Period	**0**	**0**	**0**	**0**	**1,156,107**	**78**	**712,417**	**46**	**3,181,435**	**11,798**	**11,922**	**284**
Cumulative Total	**856,068**	**227,166**	**78,091,001**	**36,120**	**48,909,393**	**13,866**	**1,816,567**	**975**	**17,116,232**	**60,204**	**326,409**	**7,772**
Jun-16					151,595	13.5	111,394	9.9	561,717	2,744	2,767	65.9
May-16					193,994	17.3	113,297	10.1	549,338	2,684	2,711	64.5
Apr-16					205,884	18.4	141,077	12.6	533,060	2,604	2,635	62.7
Mar-16					218,804	19.5	147,348	13.2	521,528	2,548	2,580	61.4
Feb-16					206,264	4.7	110,235	0.00	475,770	571	576	13.7
Jan-16					179,566	4.1	89,066	0.00	540,023	648	652	15.5
Dec-15					167,116	3.8	89,668	0.00	496,423	596	600	14.3
Nov-15					242,341	5.5	87,902	0.00	386,795	464	470	11.2
Oct-15					260,643	6.0	91,925	0.00	270,912	325	331	7.9
Sep-15					254,980	22.7	90,986	0.00	225,364	1,262	1,285	30.6
Aug-15					265,669	23.6	102,142	0.00	631,617	3,537	3,561	84.8
Jul-15					263,891	23.5	117,148	0.00	662,112	3,708	3,731	88.8
Jun-15					241,790	21.5	95,695	0.00	588,625	3,296	3,318	79.0
May-15					266,234	23.7	64,114	0.00	517,817	2,900	2,923	69.6
Apr-15					285,129	998.0	35,689	89.22	409,675	2,294	3,381	80.5
Mar-15					297,472	1,041.2	217	0.54	413,812	2,317	3,359	80.0
Feb-15					307,192	1,075.2	11,346	28.36	357,591	2,003	3,106	74.0
Jan-15					419,354	1,467.7	7,444	18.61	935,502	5,239	6,725	160.1
Dec-14					512,214	1,792.7	4	0.01	549,960	1,375	3,168	75.4
Nov-14					437,052	1,529.7	0	0.00	905,329	2,263	3,793	90.3
Oct-14					342,855	1,200.0	0	0.00	379,605	949	2,149	51.2
Sep-14					241,480	845.2	0	0.00	350,873	877	1,722	41.0
Aug-14					28,769	100.7	4	0.01	402,757	1,007	1,108	26.4
Jul-14					548,637	1,920.2	611	1.53	467,358	1,168	3,090	73.6
Jun-14					500,069	300.0	0	0	342,549	856	1,156	27.5
May-14					475,552	285.3	0	0	179,537	449	734	17.5
Apr-14					327,813	196.7	0	0	464,135	1,160	1,357	32.3
Mar-14					491,086	294.7	0	0	262,958	657	952	22.7
Feb-14					406,846	244.1	0	0	90,701	227	471	11.2
Jan-14					341,086	204.7	0	0	117,903	295	499	11.9

Table 4

LNAPL and Groundwater Recovery Summary
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

	RECOVERY SYSTEM											
	Historical Hydrocarbon Recovery Systems				Current Recovery Systems (a)						Total LNAPL Recovery	
	Light Oils, Tank 150 Area, Laboratory and Control Building, South Alky Unit		Process Area		Product Loading Facility		South Process Area		North Process Area			
	Groundwater (gallons)	LNAPL (gallons)	Groundwater (gallons)	LNAPL (gallons) (d)	Groundwater (gallons)	LNAPL (b,c) (gallons)	Groundwater (gallons)	LNAPL (gallons) (d)	Groundwater (gallons)	LNAPL (gallons) (e)	Groundwater (gallons)	LNAPL (barrels)
Dec-13					571,308	1.4	0	0.00	256,970	642.42	644	15.3
Nov-13					233,904	0.6	0	0.00	292,356	730.89	731	17.4
Oct-13					469,472	1.2	0	0.00	167,349	418.37	420	10.0
Sep-13					216,082	0.5	0	0.00	146,715	366.79	367	8.7
Aug-13					100,091	0.3	143	0.36	41,740	104.35	105	2.5
Jul-13					549,277	1.4	1,519	3.80	368,847	922.12	927	22.1
Jun-13					369,742	0.9	2,009	5	163,921	410	416	9.9
May-13					365,400	0.9	2,900	25	145,492	364	390	9.3
Apr-13					510,037	1.3	3,015	8	165,518	414	423	10.1
Mar-13					513,349	1.3	3,275	8	196,979	492	502	12.0
Feb-13					439,347	1.1	0	0	11,538	29	30	0.7
Jan-13					369,060	0.9	0	0	18,936	47	48	1.1
Dec-12					454,800	1.1	46,080	115	24,567	61	178	4.2
Nov-12					281,191	0.7	50,400	126	443,915	1,110	1,236	29.4
Oct-12					144,000	0.4	0	0	188,008	470	470	11.2
Sep-12					99,020	0.2	0	0	171,968	430	430	10.2
Aug-12					280,792	0.7	0	0	66,868	167	168	4.0
Jul-12					372,723	0.9	12,162	30	188,045	470	501	11.9
Jun-12					550,117	1.4	20,127	50	88,018	220	272	6.5
May-12					550,117	1.4	20,127	50	88,018	220	272	6.5
Apr-12					567,172	1.4	110,124	275	158,343	671.2	948	22.6
Mar-12					507,079	1.3	26,999	67	88,696	289.2	358	8.5
Feb-12					587,344	1.5	10,378	26	42,079	131.1	159	3.8
Jan-12					410,131	1.0	0	0	0	0	1	0.0
Dec-11	0	0	0	0	680,108	1.7					2	0.0
Nov-11	75	0	0	0	519,765	1.3					1	0.0
Oct-11	50	0	2	0.0	458,692	1.1					1	0.0
Sep-11	0	0	94	0.2	542,969	1.4					2	0.0
Aug-11	0	0	0	0.0	417,039	1.0					1	0.0
Jul-11	0	0	7	0.0	442,000	1.1					1	0.0
Jun-11	0	0	12	0.0	598,999	1.5					2	0.0
May-11	0	0	3,126	7.8	605,998	1.5					9	0.2
Apr-11	0	0	4	0.0	476,999	1.2					1	0.0
Mar-11	0	0	0	0.0	675,998	1.7					2	0.0
Feb-11	0	0	80	0.2	608,998	1.5					2	0.0
Jan-11	0	162	0	0.0	485,999	1.2					163	3.9

Table 4

LNAPL and Groundwater Recovery Summary
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

	RECOVERY SYSTEM											
	Historical Hydrocarbon Recovery Systems				Current Recovery Systems (a)						Total LNAPL Recovery	
	Light Oils, Tank 150 Area, Laboratory and Control Building, South Alky Unit		Process Area		Product Loading Facility		South Process Area		North Process Area			
	Groundwater (gallons)	LNAPL (gallons)	Groundwater (gallons)	LNAPL (gallons) (d)	Groundwater (gallons)	LNAPL (b,c) (gallons)	Groundwater (gallons)	LNAPL (gallons) (d)	Groundwater (gallons)	LNAPL (gallons) (e)	Groundwater (gallons)	LNAPL (barrels)
Dec-10	0	0		0.0	30,000	0.1					0	0.0
Nov-10	0	0		0.0	42,000	0.1					0	0.0
Oct-10	0	0		0.0	127,000	0.3					0	0.0
Sep-10	0	0	49,621	124.1	91,000	0.2					124	3.0
Aug-10	0	0	2,722	6.8	105,000	0.3					7	0.2
Jul-10	0	0		0.0	91,000	0.2					0	0.0
Jun-10	0	0	37,219	93.0	17,000	0.0					93	2.2
May-10	0	0	17,850	44.6	0	0.0					45	1.1
Apr-10	0	0	21,427	53.6	84,000	0.2					54	1.3
Mar-10	0	138	46,988	117.5	77,000	0.2					256	6.1
Feb-10	0	552	138,783	347.0	16,500	0.0					899	21.4
Jan-10	0	162	72,029	180.1	0	0.0					342	8.1
Dec-09	0	116	37,712	94.3	65,000	0.2					210	5.0
Nov-09	0	0	81,167	202.9	65,000	0.2					203	4.8
Oct-09	0	0	43,658	109.1	65,000	0.2					109	2.6
Sep-09	0	64	36,471	91.2	65,000	0.2					155	3.7
Aug-09	0	70	53,446	133.6	1,000	0.0					204	4.8
Jul-09	0	120	65,252	163.1	12,000	0.0					283	6.7
Jun-09	838	290	332,871	832	1,000	0.1					1,122	26.7
May-09	630	584	54,831	137	0	0.0					721	17.2
Apr-09	1,193	0	30,790	77	0	0.0					77	1.8
Mar-09	39	0	771	2	0	0.0					2	0.0
Feb-09	0	0	17	0	1,000	0.0					0	0.0
Jan-09	0	0	37,718	94	1,000	0.0					94	2.2
Dec-08	215	445	293,440	735	300,000	1.0					1,181	28.1
Jun-08	490	345	713,348	1784	300,000	1.0					2,130	50.7
Dec-07	1,198	832	690,337	1726	104,160	0.0					2,558	60.9
Jun-07	3,823	61	657,428	1644	300,400	1.0					1,706	40.6
Dec-06	5,099	51	423,989	1060	343,480	1.0					1,112	26.5
Jun-06	17,926	100	220,403	551	525,760	1.0					652	15.5
Dec-05	9,214	129	389,400	974	540,120	1.0					1,104	26.3
Jun-05	22,141	547	1,058,428	2646	663,200	2.0					3,195	76.1
Dec-04	110	160	440,039	1100	495,879	1.0					1,261	30.0
Jun-04	250	45	414,991	1038	735,440	2.0					1,085	25.8
Dec-03	30,900	147	656,287	1641	970,880	2.0					1,790	42.6
Jun-03	32,475	367	578,917	4	760,640	2.0					373	8.9
Dec-02	33,175	375	671,558	2	809,599	2.0					379	9.0
Jun-02	36,420	875	611,622	2	389,160	1.0					878	20.9
Dec-01	8,850	267	718,024	3	677,120	2.0					272	6.5
Jun-01	18,172	400	1,069,106	286	137,080	0.0					686	16.3
Dec-00	0	150	830,817	53	280,600	1.0					204	4.9
Jun-00	1,165	85	2,361,684	8	398,360	1.0					94	2.2

Table 4

LNAPL and Groundwater Recovery Summary
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

RECOVERY SYSTEM												
	Historical Hydrocarbon Recovery Systems				Current Recovery Systems (a)							
	Light Oils, Tank 150 Area, Laboratory and Control Building, South Alky Unit		Process Area		Product Loading Facility		South Process Area		North Process Area		Total LNAPL Recovery	
	Groundwater (gallons)	LNAPL (gallons)	Groundwater (gallons)	LNAPL (gallons) (d)	Groundwater (gallons)	LNAPL (b,c) (gallons)	Groundwater (gallons)	LNAPL (gallons) (d)	Groundwater (gallons)	LNAPL (gallons) (e)	Groundwater (gallons)	LNAPL (barrels)
Dec-99	35,130	369	3,944,994	267	774,638	8.0					644	15.3
Jun-99	17,880	1,347	4,012,484	527	745,198	2.0					1,876	44.7
Dec-98	20,245	212	2,980,852	165	420,440	1.0					378	9.0
Jun-98	29,127	4,117	4,662,673	2343	833,516	3.0					6,463	153.9
Dec-97	125,966	2,872	10,507,289	1582	1,102,157	3.0					4,457	106.1
Jun-97	52,980	729	0	0	374,439	7.3					736	17.5
Dec-96	7,285	3,150	5,077,897	445	95,680	0.1					3,595	85.6
Jun-96	20,172	1,139	3,760,060	49	340,390	10.2					1,198	28.5
Dec-95	38,041	4,107	4,950,467	2939	645,840	1.7					7,048	167.8
Jun-95	22,675	8,661	3,864,183	755	1,086,520	2.6					9,419	224.3
Dec-94	11,175	5,974	4,481,990	3632	897,920	4.9					9,611	228.8
Jun-94	35,319	9,465	4,577,841	3001	1,089,280	13.7					12,480	297.1
Dec-93	14,012	23,212	4,429,642	1006	685,400	6.4					24,224	576.8
Jun-93	25,965	7,717	5,988,809	1165	1,382,757	15.1					8,897	211.8
Dec-92	175,648	146,456	887,335	76	3,640,347	18.0					146,550	3489.3
TOTAL	856,068	227,166	78,091,001	36,120	48,909,393	13,866	1,816,567	975	17,116,232	60,204	326,409	7,772

a\ Beginning January 2013, monthly recovery system data was interpolated from field measurements collected during the reporting period.
b\ LNAPL = Light non-aqueous phase liquid.
c\ From January 2000 to December 2013, hydrocarbon recovery for the product loading facility (PLF) was estimated using a factor of 0.00025% LNAPL per gallon of water recovered. Beginning in January 2014, WRC has estimated a recovery factor based on concurrent field testing using standard methodology. The estimated recovery factors and relevant time periods are as follows:
January 2014-July 2014: 0.06% LNAPL per gallon of water recovered.
July 2014 - April 2015: 0.35% LNAPL per gallon of water recovered.
May 2015 - September 2015: 0.0089% LNAPL per gallon of water recovered.
October 2015 - February 2016: 0.00229% LNAPL per gallon of water recovered.
March 2016 - June 2016: 0.00893% LNAPL per gallon of water recovered.
d\ Beginning in July 2003, hydrocarbon recovery for the south process area (SPA) was estimated using a factor of 0.25% LNAPL per gallon of water recovered. Beginning in January 2014, WRC has estimated a recovery factor based on concurrent field testing using standard methodology. The estimated recovery factors and relevant time periods are as follows:
January 2014 - April 2015: 0.25% LNAPL per gallon of water recovered.
May 2015 - February 2016: no recovery based on field testing.
March 2016 - June 2016: 0.0089% LNAPL per gallon of water recovered.
e\ Beginning in July 2003, hydrocarbon recovery for the north process area (NPA) was estimated using a factor of 0.25% LNAPL per gallon of water recovered. Beginning in January 2014, WRC has estimated a recovery factor based on concurrent field testing using standard methodology. The estimated recovery factors and relevant time periods are as follows:
January 2014 - December 2014: 0.25% LNAPL per gallon of water recovered.
January 2015 - September 2015 : 0.56% LNAPL per gallon of water recovered.
October 2015 - February 2016: 0.12% LNAPL per gallon of water recovered.
March 2016 - June 2016: 0.4885% LNAPL per gallon of water recovered.

Appendix 1.4 – Landowner Well Usage Forms

Private Water Supply Well Questionnaire

The Oklahoma Department of Environmental Quality (ODEQ) has requested Wynnewood Refining Company, LLC conduct a survey of private water supply wells. The purpose of this survey is to determine whether or not the well is used for human consumption. We would greatly appreciate if you would take a minute to provide the answers to the following questions.

Name of well owner:

LeRoy W. McLaughlin

Address of property where the well is located:

7641 Froman Lane, Wynnewood, OK. 73098

This well is NOT used for human consumption: **Yes** ✓ **No** unknown

Wavie McLaughlin
Name

6/22/16
Date

Private Water Supply Well Questionnaire

The Oklahoma Department of Environmental Quality (ODEQ) has requested Wynnewood Refining Company, LLC conduct a survey of private water supply wells. The purpose of this survey is to determine whether or not the well is used for human consumption. We would greatly appreciate if you would take a minute to provide the answers to the following questions.

Name of well owner:

Loreata Martin   Stephen R Martin

Address of property where the well is located:

37885 Hwy 17A Wynnewood OK 73098

This well is NOT used for human consumption: **Yes** X **No**___

Stephen R Martin
Name

5-24-16
Date

Appendix 2.2 – Well Gauging Logs (March and June 2016)

Well Gauging - March 2016

Well Number	Measurement Date	TOC Elevation (ft-AMSL) (a)	Depth to Water (ft-TOC)	Depth to Free Product (ft-TOC)	Total Depth (ft-TOC)	Notes
BMW-2	3-15	844.23	4.98	4.10		
[illegible]		842.00				
BMW-4	3-15	838.65	5.01			
BMW-5	3-15	844.28	8.43	6.9		
BMW-6	3-15	846.05	4.58			
BMW-7	3-15	847.31	6.65			
BMW-8	3-15	848.21	5.78			
BMW-9	3-15	844.02	5.68			
BMW-10	3-15	848.20	7.11			
BMW-11	3-15	848.59	6.65			
BMW-12		842.87				
BMW-13	3-15	846.63	5.21			
BMW-14	3-15	848.85	7.56			
BMW-15	3-15	847.17	6.62			
BMW-16	3-15	846.95	6.94			
[illegible]		842.66				
BMW-18	3-15	842.97	6.75			
BMW-19	3-15	844.34	5.59			
BMW-20A	3-15	838.51	5.19			
BMW-21	3-15	843.99	4.79			
BMW-22	3-15	843.06	4.23			
BMW-23	3-15	842.58	3.97			
BMW-24	3-15	841.63	4.55	2.86		
BMW-25	3-15	843.75	5.28			
BMW-26	3-15	841.63	2.85	2.76		
BMW-27	3-15	837.10	3.03			
BMW-28	3-15	842.07	1.39			
BRW-1	3-15	842.39	2.26			
BRW-2	3-15	841.50	2.01			
BRW-3	3-15	841.08	2.50			
BRW-4	3-15	840.44	2.63			
BRW-5	3-15	840.53	2.91			
BRW-6	3-15	837.31	2.93			
BRW-7	3-15	838.40	2.44			
BRW-8	3-15	839.33	[illegible] 3.35			
BRW-9	3-15	840.80	3.28			
SMW-1	3-14	863.15	14.66			
SMW-2	3-15	849.17	10.77			
SMW-2D	3-15	849.34	10.94			
SMW-3	3-15	849.42	11.01			
SMW-4	3-15	851.70	10.35			
SMW-4D	3-15	851.11	9.76			
SMW-5	3-14	854.69	[illegible] 13.58			
SMW-5D	3-14	854.61	13.48			
SMW-6	2-14	854.48	14.08			
SMW-7	3-14	857.78	13.6			
SMW-8	3-14	858.70	10.07			
SMW-9	3-14	853.27	13.33			
SMW-9D	3-14	853.47	13.55			
SMW-10	3-14	853.71	11.99			
SMW-10D	3-14	853.72	11.90			
SMW-11	3-14	853.13	11.72			
SMW-11D	3-14	852.92	11.59			
SMW-12	3-14	855.02	11.64			
SMW-12D	3-14	855.04	11.49			
SMW-13	3-15	854.05	13.82			
SMW-13D	3-15	854.29	14.06			
SMW-14	3-14	854.70	13.41			
SMW-14D	3-14	854.71	13.45			
SMW-18	3-14	863.63	14.68			
SMW-19	3-14	847.91	10.27			
SMW-21	3-14	852.09	11.56			

SMW-21D	3-14	851.99	11.61			
SMW-22D	3-14	855.07	13.16			
SMW-23	3-15	844.61	7.07			
LMW-1	3-15	854.46	10.56	10.43		
[illegible]		852.98				
LMW-2-0	3-15	851.67	8.82			
[illegible]		851.91				
LMW-3-0	3-15	849.87	7.33			
[illegible]		851.50				
LMW-4-0	3-15	850.51	7.94			
[illegible]		852.61				
LMW-5-0	3-15	850.37	7.31			
[illegible]		851.46				
LMW-6-0	3-14	851.48	9.45			
LMW-11	3-15	852.90	9.18			
LMW-13	3-15	854.19	10.72	9.92		
LMW-14	3-14	853.66	9.72			
[illegible]		849.87				
LRW-1-0	3-15	849.60	7.22			
[illegible]		853.88				
LRW-2-0	3-14	853.44	9.25			
LRW-3	3-15	855.05	24.32			
LRW-4	3-15	853.70	9.28			
UMW-1	3-10	905.97	25.15			
UMW-3	3-15	853.00	8.75			
UMW-4	3-15	868.78	11.37			
UMW-5	3-15	868.40	10.67			
UMW-6	3-15	882.79	21.28			
OMW-3	3-14	857.83	18.21	10.68		
OMW-4	3-14	857.47	17.71	11.70		
OMW-5	3-14	855.96	12.08			
OMW-6	3-14	857.70	14.09			
ORW-2	3-14	855.42	19.64	9.65		
ORW-3	3-14	856.06	19.63	16.31		
ORW-4	3-14	856.74	12.10			
NRW-1	3-15	875.10	21.18			
NRW-2	3-15	874.26	16.45			
NRW-3	3-15	873.60	20.11			
NRW-4	3-15	875.69	20.54	20.50		
NRW-5	3-15	873.51	21.58			Product likely
NRW-6	3-15	862.20	30.49			
NRW-7	3-15	861.25	16.63			
[illegible]		882.96				
NMW-2	3-10	879.98	20.34	18.44		
NMW-3	3-10	877.28	18.44	15.98		
NMW-4	3-10	878.72	19.44	17.44		
NMW-5	3-10	878.42	18.53			
NMW-6	3-10	881.72	23.46	20.22		
NMW-7	3-14	873.20	13.82	13.76		
NMW-8	3-14	876.45	16.29			
NMW-9	3-10	877.07	19.54	15.70		
NMW-10	3-10	877.59	19.99	16.05		
NMW-12	3-10	882.64	22.23	20.64		
NMW-13	3-14	869.23	9.59			
NMW-16	3-14	859.40	12.29			
NMW-17	3-15	872.70	13.51			
NMW-18	3-15	870.62	11.77	11.76		
NMW-19	3-15	871.96	12.25	12.24		
[illegible]		853.94				
[illegible]		853.95				
[illegible]		853.45				
[illegible]		853.42				
[illegible]		853.57				

SMW 24 – 3-15 – 8.48 H_2O
SMW 25 – 3-15 – 7.75 H_2O
SBR1 – 3-14 – 9.75 H_2O

Table 2

Groundwater Elevations and LNAPL Thickness Measurements

Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Well Number	Measurement Date	TOC Elevation (ft-AMSL) (a)	Depth to Water (ft-TOC)	Depth to Free Product (ft-TOC)	Product Thickness (ft)	Notes
BMW-2	6-8-16	842.98	4.77	3.91		
BMW-4	6-8-16	838.65	5.56			
BMW-5	6-8-16	847.03	8.44	5.58		
BMW-6	6-8-16	844.97	4.34			
BMW-7	6-8-16	847.31	6.39			
BMW-8	6-8	846.92	5.49			
BMW-9	6-8	845.03	5.47			
BMW-10	6-8	848.20	6.88			
BMW-11	6-8	847.13	6.51			
BMW-13	6-8	846.63	4.83			
BMW-14	6-8	848.85	7.44			
BMW-15	6-8	847.17	6.53			
BMW-16	6-8	846.95	6.83			
BMW-18	6-8	841.74	6.19			
BMW-19	6-8	844.34	5.68			
BMW-20A	6-8	838.51	5.74			
BMW-21	6-8	843.99	4.59			
BMW-22	6-8	843.06	3.96			
BMW-23	6-8	842.58	2.64			
BMW-24	6-8	841.63	4.14	2.49		
BMW-25	6-8	842.33	5.38			
BMW-26	6-8	840.29	2.98	2.89		
BMW-27	6-8	837.10	3.28			
BMW-28	6-8	842.07	7.67			
BRW-1	6-8	842.39	2.78			
BRW-2	6-8	841.50	2.57			
BRW-3	6-8	841.08	2.18			
BRW-4	6-8	840.44	1.67			
BRW-5	6-8	840.53	1.89			
BRW-6	6-8	837.31	Surface			
BRW-7	6-8	838.40	2.41			
BRW-8	6-8	839.33	2.93			
BRW-9	6-8	840.80	3.24			
SMW-1	6-8	863.15	14.04			
SMW-2	6-8	849.17	10.54			
SMW-2D	6-8	849.34	10.71			
SMW-3	6-8	849.42	10.86			
SMW-4	6-8	851.70	9.77			
SMW-4D	6-8	851.11	9.11			
SMW-5	6-6-16	854.69	12.90			
SMW-5D	6-6-16	854.61	12.81			
SMW-6	6-6-16	854.48	13.58			
SMW-7	6-6-16	857.78	12.67			
SMW-8	6-8-16	858.70	9.57			
SMW-9	6-6-16	853.27	12.92			
SMW-9D	6-6-16	853.47	13.14			
SMW-10	6-6-16	853.71	11.91			

Table 2

Groundwater Elevations and LNAPL Thickness Measurements

Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Well Number	Measurement Date	TOC Elevation (ft-AMSL) (a)	Depth to Water (ft-TOC)	Depth to Free Product (ft-TOC)	Product Thickness (ft)	Notes
SMW-10D	6-6-16	853.72	11.08			
SMW-11	6-6-16	853.13	11.01			
SMW-11D	6-6-16	852.92	10.91			
SMW-12	6-7	855.02	10.5			
SMW-12D	6-7	855.04	10.4			
SMW-13	6-6-16	854.05	13.36			
SMW-13D	6-6-16	854.29	12.99			
SMW-14	6-6-16	854.70	12.68			
SMW-14D	6-6-16	854.71	12.71			
SMW-18	6-7	863.63	14.26			
SMW-19	6-6-16	847.91	9.90			
SMW-21	6-6-16	852.09	11.19			
SMW-21D	6-6-16	851.99	11.11			
SMW-22D	6-6-16	855.07	12.40			
SMW-23	6-7	844.61	6.76			
SMW-24	6-7	850.11	7.94			
SMW-25	6-7	848.63	7.45			
SBR-1	6-7	847.35	9.49			
LMW-1	6-7	854.46	9.63	9.50		
LMW-2-0	6-7	851.67	7.89			
LMW-3-0	6-7	849.87	6.55			
LMW-4-0	6-7	850.51	7.42			
LMW-5-0	6-7	850.37	6.90	6.88		
LMW-6-0	6-7	853.55	8.95			
LMW-11	6-7	852.90	8.11			
LMW-13	6-7	854.19	10.13	9.26		
LMW-14	6-7	853.66	9.14			
LRW-1-0	6-7	849.60	6.61			
LRW-2-0	6-7	853.44	8.56			
LRW-3	6-7	855.05	22.90			
LRW-4	6-7	853.70	8.22			
UMW-1	6-6-16	905.97	24.53			
UMW-3	6-7	853.00	8.29			
UMW-4	6-7	868.78	10.86			
UMW-5	6-7	868.40	9.91			
UMW-6	6-7	882.79	20.52			
UMW-7	6-7	861.65	~~[illegible]~~ 9.89	~~[illegible]~~		
OMW-3	6-7	857.83	13.23	10.88		
OMW-4	6-7	857.47	19.25	10.71		
OMW-5	6-7	855.96	10.86			
OMW-6	6-7	857.70	12.98			
ORW-2	6-7	855.42	19.32	8.65		
ORW-3	6-7	856.06	19.18	8.36		
ORW-4	6-7	856.74	11.69			
NRW-1	6-7	875.10	22.95			
NRW-2	6-7	874.26	13.55			
NRW-3	6-7	873.60	21.62			

Table 2

Groundwater Elevations and LNAPL Thickness Measurements

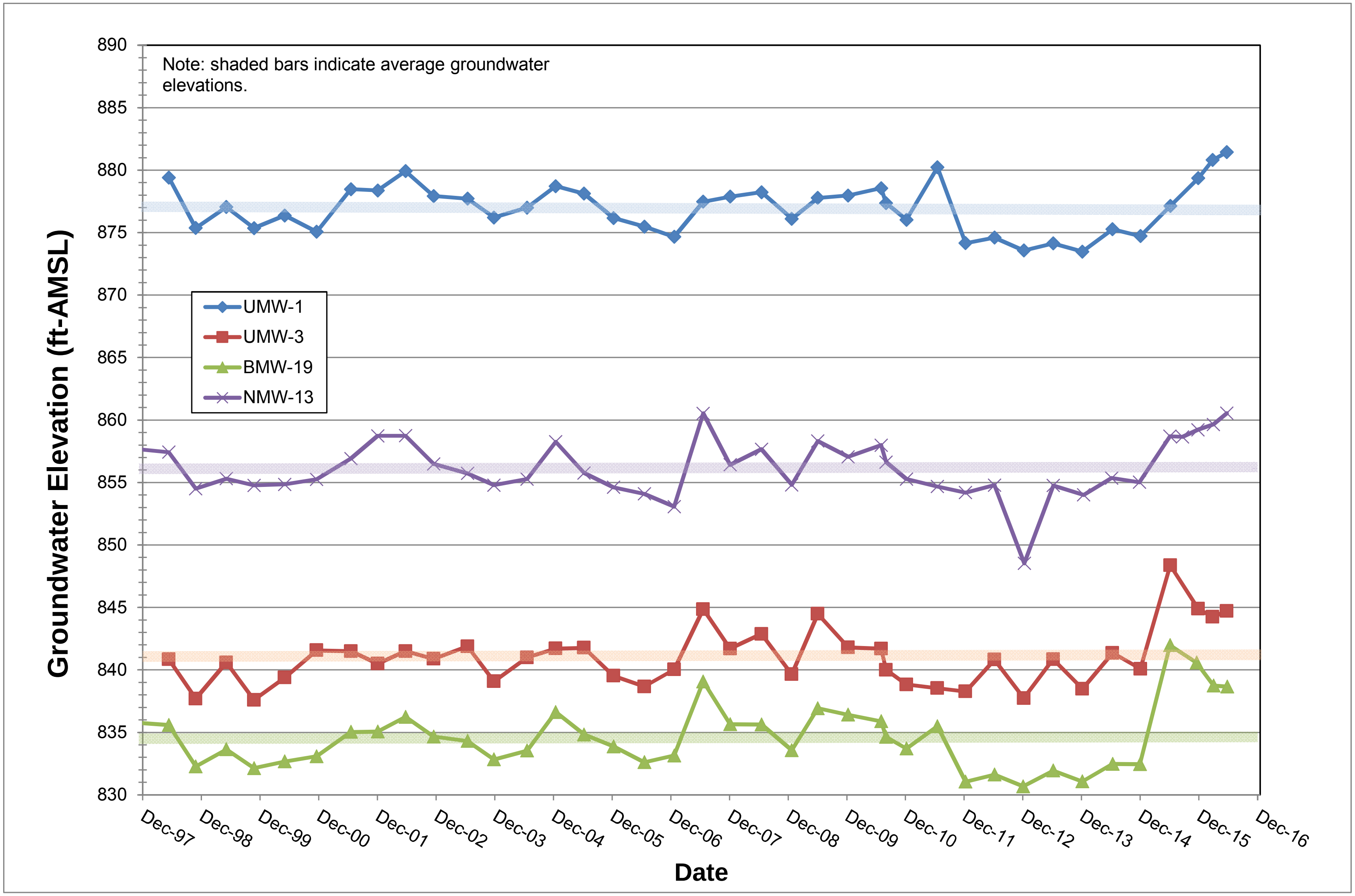
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Well Number	Measurement Date	TOC Elevation (ft-AMSL) (a)	Depth to Water (ft-TOC)	Depth to Free Product (ft-TOC)	Product Thickness (ft)	Notes
NRW-4	6-8	875.69	22.31	22.28		
NRW-5	6-6-16	873.51	31.77			
NRW-6	6-6-16	862.20	19.95			Has product
NRW-7	6-7	861.25	12.03			
NMW-2	6-6-16	879.98	18.92	16.73		
NMW-3	6-6-16	877.28	16.70	14.58		
NMW-4	6-6-16	878.72	18.49	15.65		
NMW-5	6-6-16	878.42	16.60			
NMW-6	6-6-16	881.72	19.29	19.09		
NMW-7	6-6-16	873.20	12.91	12.84		
NMW-8	6-6-16	876.45	15.21			
NMW-9	6-6-16	877.07	17.57	14.0		
NMW-10	6-6-16	877.59	18.05	14.59		
NMW-12	6-6-16	882.64	20.43	18.95		
NMW-13	6-6-16	869.23	8.69			
NMW-16	6-6-16	859.40	10.50			
NMW-17	6-8	872.70	~~[illegible]~~	~~[illegible]~~	12.46	
NMW-18	6-8	870.62	10.85			
NMW-19	6-8	871.96	11.25			

Appendix 2.2.1 – Hydrograph of Monitoring Wells

Appendix 2.2.1

Monitoring Well Hydrographs
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma



K:\Coffeyville Resources\WRC\Project Data\Tables\Semi-Annual Report Tables\Table 2 - WRC Fluid Levels Table.xlsx

Revised: August 22, 2016

Appendix 2.3.A – Groundwater Analytical Reports

Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date and Time Received: 06/17/2016 1750
Pace File No.: 8462
Pace Order No.: 133938
Project ID: WRC Wynnewood

Dear Mr. McCormick:

This laboratory report, containing the samples indicated below, includes 33 pages for the analytical report, 3 page(s) for the chain of custody and/or analysis request, and 6 page(s) for the sample receipt form.

PACE LAB ID #	SAMPLE DESCRIPTION	SAMPLE TYPE	DATE SAMPLED
16061452	Trip Blank	Liquid	6/13/2016
16061453	WRCUMW-7(061316)	Liquid	6/13/2016
16061454	WRCDUP1	Liquid	6/13/2016
16061455	WRCUMW-4(061316)	Liquid	6/13/2016
16061456	WRCUMW-5(061316)	Liquid	6/13/2016
16061457	WRCUMW-6(061316)	Liquid	6/13/2016
16061458	WRCSMW-18(061316)	Liquid	6/13/2016
16061459	WRCSMW-1(061316)	Liquid	6/13/2016
16061460	WRCEB(061316)	Liquid	6/13/2016
16061461	WRCUMW-3(061316)	Liquid	6/13/2016
16061462	WRCUMW-1(061416)	Liquid	6/14/2016
16061463	WRCNMW-6(061416)	Liquid	6/14/2016
16061464	WRCNMW-12(061416)	Liquid	6/14/2016
16061465	WRC-Martin Pond	Liquid	6/14/2016
16061466	WRC-S Martin Well	Liquid	6/14/2016
16061467	WRC-McLaughlin Well	Liquid	6/14/2016
16061468	WRCSMW-25(061516)	Liquid	6/15/2016
16061469	WRCBMW-19(061516)	Liquid	6/15/2016
16061470	WRCSMW-23(061516)	Liquid	6/15/2016
16061471	WRCBMW-4(061516)	Liquid	6/15/2016
16061472	WRCDUP2	Liquid	6/15/2016
16061473	WRCBMW-25(061516)	Liquid	6/15/2016
16061474	WRCBMW-20A(061616)	Liquid	6/16/2016
16061475	WRCBMW-26(061616)	Liquid	6/16/2016
16061476	WRCSMW-24(061616)	Liquid	6/16/2016
16061477	WRCSMW-2(061616)	Liquid	6/16/2016
16061478	WRCBMW-28(061616)	Liquid	6/16/2016
16061479	WRCBMW-27(061616)	Liquid	6/16/2016

The Appendix and Quality Control sections are integral parts of this laboratory report and may contain important data qualifiers.

All results are reported on a wet weight basis unless otherwise stated.

Samples will be retained for thirty days unless Pace is otherwise notified. Pace is accredited by the State of Kansas through the National Environmental Laboratory Accreditation Program (NELAP). The results contained in this report were obtained using Pace's Standard Operating Procedures. These procedures are in substantial compliance with the approved methods referenced and the standards published by NELAP unless otherwise noted in the Appendix and Quality Control sections of this report.

This report may not be reproduced, except in full, without written approval from Pace Analytical Services, Inc.

Thank you for choosing Pace for this project.

Gregory J. Groene
Project Manager
Gregory.Groene@pacelabs.com

Sample Results

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 07/01/2016 Date Received: 06/17/2016 Pace File No: 8462 Pace Order No: 133938

Lab Number: 16061452
Sample Description: Trip Blank

Date Sampled: 06/13/2016
Time Sampled: 0830

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/21/16 1406	1GC2173	1GC2173	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/26/16 2039	160620-4	2EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 2241	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061452

Lab Number: 16061453
Sample Description: WRCUMW-7(061316)

Date Sampled: 06/13/2016
Time Sampled: 0915

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources	Date Reported:	07/01/2016
	Attn: Sam McCormick	Date Received:	06/17/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	133938

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/21/16 1744	1GC2173	1GC2173	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/26/16 2107	160620-4	2EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 2306	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061453

Lab Number: 16061454
Sample Description: WRCDUP1

Date Sampled: 06/13/2016
Time Sampled: 1005

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	2940	µg/L	10	200	200
Oklahoma DRO	1600 QC	µg/L	4.0	400	400
BTEX					
Benzene	903	µg/L	10	0.4	10
Toluene	20.6	µg/L	10	0.6	10
Ethylbenzene	2 J	µg/L	10	1	10
m+p-Xylene	47.6	µg/L	10	0.6	10
o-Xylene	11	µg/L	10	1	10

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1553	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/28/16 0218	160620-5	5EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 2217	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061454

Client:	Coffeyville Resources	Date Reported:	07/01/2016
	Attn: Sam McCormick	Date Received:	06/17/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	133938

Lab Number: 16061455
Sample Description: WRCUMW-4(061316)

Date Sampled: 06/13/2016
Time Sampled: 1005

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	2860	µg/L	10	200	200
Oklahoma DRO	1600	µg/L	4.0	400	400
BTEX					
Benzene	812	µg/L	10	0.4	10
Toluene	18.4	µg/L	10	0.6	10
Ethylbenzene	2 J	µg/L	10	1	10
m+p-Xylene	42.7	µg/L	10	0.6	10
o-Xylene	10.	µg/L	10	1	10

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/21/16 1713	1GC2173	1GC2173	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/27/16 2229	160620-4	5EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 1833	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061455

Lab Number: 16061456
Sample Description: WRCUMW-5(061316)

Date Sampled: 06/13/2016
Time Sampled: 1044

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	1810	µg/L	4.0	80	80
Oklahoma DRO	810	µg/L	1.0	100	100
BTEX					
Benzene	275	µg/L	10	0.4	10
Toluene	7.9 J	µg/L	10	0.6	10
Ethylbenzene	5 J	µg/L	10	1	10
m+p-Xylene	12.0	µg/L	10	0.6	10
o-Xylene	2 J	µg/L	10	1	10

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103	Date Reported: 07/01/2016 Date Received: 06/17/2016 Pace File No: 8462 Pace Order No: 133938

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1521	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/26/16 2302	160620-4	2EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1415	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061456

Lab Number: 16061457
Sample Description: WRCUMW-6(061316)

Date Sampled: 06/13/2016
Time Sampled: 1132

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	19300	µg/L	50	1000	1000
Oklahoma DRO	4900	µg/L	10	1000	1000
BTEX					
Benzene	5490	µg/L	200	8	200
Toluene	1670	µg/L	200	10	200
Ethylbenzene	660	µg/L	200	20	200
m+p-Xylene	1600	µg/L	200	10	200
o-Xylene	550	µg/L	200	20	200

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1449	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/27/16 2258	160620-4	5EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 1923	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061457

Client:	Coffeyville Resources	Date Reported:	07/01/2016
	Attn: Sam McCormick	Date Received:	06/17/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	133938

Lab Number: 16061458
Sample Description: WRCSMW-18(061316)

Date Sampled: 06/13/2016
Time Sampled: 1327

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/21/16 1611	1GC2173	1GC2173	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/27/16 0028	160620-4	2EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 1948	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061458

Lab Number: 16061459
Sample Description: WRCSMW-1(061316)

Date Sampled: 06/13/2016
Time Sampled: 1400

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources
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10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/21/16 1539	1GC2173	1GC2173	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/27/16 0057	160620-4	2EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 2012	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061459

Lab Number: 16061460
Sample Description: WRCEB(061316)

Date Sampled: 06/13/2016
Time Sampled: 1445

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	150	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	0.38 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.06 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/21/16 1335	1GC2173	1GC2173	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/27/16 0125	160620-4	2EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 2037	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061460

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Lab Number: 16061461
Sample Description: WRCUMW-3(061316)

Date Sampled: 06/13/2016
Time Sampled: 1449

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/21/16 1508	1GC2173	1GC2173	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/27/16 0154	160620-4	2EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 2102	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061461

Lab Number: 16061462
Sample Description: WRCUMW-1(061416)

Date Sampled: 06/14/2016
Time Sampled: 0815

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	1200	µg/L	2.0	200	200
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	0.2 J	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

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Sample Results

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Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1315	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1320	06/27/16 2326	160620-4	5EX4178	SPA	OK DRO
BTEX	N/A	06/20/16 2127	1MS9172	1MS9172	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061462

Lab Number: 16061463
Sample Description: WRCNMW-6(061416)

Date Sampled: 06/14/2016
Time Sampled: 0853

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	4960	µg/L	20	400	400
Oklahoma DRO	190000 QC	µg/L	400	40000	40000
BTEX					
Benzene	16.7	µg/L	10	0.4	10
Toluene	19.8	µg/L	10	0.6	10
Ethylbenzene	250.	µg/L	10	1	10
m+p-Xylene	406	µg/L	10	0.6	10
o-Xylene	134	µg/L	10	1	10

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1243	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/28/16 0149	160620-5	5EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1451	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061463

Client:	Coffeyville Resources	Date Reported:	07/01/2016
	Attn: Sam McCormick	Date Received:	06/17/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	133938

Lab Number: 16061464
Sample Description: WRCNMW-12(061416)

Date Sampled: 06/14/2016
Time Sampled: 0936

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	37000	µg/L	100	2000	2000
Oklahoma DRO	9000 QC	µg/L	10	1000	1000
BTEX					
Benzene	8540	µg/L	500	20	500
Toluene	4800	µg/L	500	30	500
Ethylbenzene	1000	µg/L	500	50	500
m+p-Xylene	4140	µg/L	500	30	500
o-Xylene	1500	µg/L	500	50	500

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1212	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/28/16 0316	160620-5	5EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1526	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061464

Lab Number: 16061465
Sample Description: WRC-Martin Pond

Date Sampled: 06/14/2016
Time Sampled: 1030

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	127	µg/L	1.0	20	20
Oklahoma DRO	690 QC	µg/L	1.0	100	100
BTEX					
Benzene	9.88	µg/L	1.0	0.04	1.0
Toluene	0.42 J	µg/L	1.0	0.06	1.0
Ethylbenzene	2.1	µg/L	1.0	0.1	1.0
m+p-Xylene	7.87	µg/L	1.0	0.06	1.0
o-Xylene	2.3	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 07/01/2016 Date Received: 06/17/2016 Pace File No: 8462 Pace Order No: 133938

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1140	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/28/16 0344	160620-5	5EX4178	SPA	OK DRO
BTEX	N/A	06/22/16 1509	1MS8174	1MS8174	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061465

Lab Number: 16061466
Sample Description: WRC-S Martin Well

Date Sampled: 06/14/2016
Time Sampled: 1100

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	800 QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1108	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/27/16 1742	160620-5	4EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1638	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061466

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Lab Number: 16061467
Sample Description: WRC-McLaughlin Well

Date Sampled: 06/14/2016
Time Sampled: 1130

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1037	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/27/16 1908	160620-5	4EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1714	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061467

Lab Number: 16061468
Sample Description: WRCSMW-25(061516)

Date Sampled: 06/15/2016
Time Sampled: 1028

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources
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Date Reported: 07/01/2016
Date Received: 06/17/2016
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Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/22/16 1006	1GC2174	1GC2174	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/27/16 1937	160620-5	4EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1750	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061468

Lab Number: 16061469
Sample Description: WRCBMW-19(061516)

Date Sampled: 06/15/2016
Time Sampled: 1115

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/27/16 1716	1GC2179	1GC2179	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/27/16 2006	160620-5	4EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1825	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061469

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 07/01/2016 Date Received: 06/17/2016 Pace File No: 8462 Pace Order No: 133938

Lab Number: 16061470
Sample Description: WRCSMW-23(061516)

Date Sampled: 06/15/2016
Time Sampled: 1358

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	23	µg/L	1.0	20	20
Oklahoma DRO	930 QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1748	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/27/16 1811	160620-5	4EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 2347	1MS8173	2MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061470

Lab Number: 16061471
Sample Description: WRCBMW-4(061516)

Date Sampled: 06/15/2016
Time Sampled: 1504

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	88 G	µg/L	1.0	20	20
Oklahoma DRO	760 QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources	Date Reported:	07/01/2016
	Attn: Sam McCormick	Date Received:	06/17/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	133938

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1614	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/20/16 1500	06/27/16 1840	160620-5	4EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1901	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061471

Lab Number: 16061472
Sample Description: WRCDUP2

Date Sampled: 06/15/2016
Time Sampled: 1504

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	72 G	µg/L	1.0	20	20
Oklahoma DRO	750	µg/L	2.0	200	200
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1543	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/22/16 0900	06/27/16 2355	160622-1	5EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 1937	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061472

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 07/01/2016 Date Received: 06/17/2016 Pace File No: 8462 Pace Order No: 133938

Lab Number: 16061473
Sample Description: WRCBMW-25(061516)

Date Sampled: 06/15/2016
Time Sampled: 1558

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	2170	µg/L	10	200	200
Oklahoma DRO	2100	µg/L	4.0	400	400
BTEX					
Benzene	370.	µg/L	40	2	40
Toluene	5.2 J	µg/L	40	2	40
Ethylbenzene	120 QC	µg/L	40	4	40
m+p-Xylene	50.0 QC	µg/L	40	2	40
o-Xylene	10 J QC	µg/L	40	4	40

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1512	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/22/16 0900	06/28/16 0052	160622-1	5EX4178	SPA	OK DRO
BTEX	N/A	06/21/16 2012	1MS8173	1MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061473

Lab Number: 16061474
Sample Description: WRCBMW-20A(061616)

Date Sampled: 06/16/2016
Time Sampled: 0853

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	137 G	µg/L	1.0	20	20
Oklahoma DRO	300	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1441	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/22/16 0900	06/27/16 0807	160622-1	3EX4178	SPA	OK DRO
BTEX	N/A	06/22/16 0023	1MS8173	2MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061474

Lab Number: 16061475
Sample Description: WRCBMW-26(061616)

Date Sampled: 06/16/2016
Time Sampled: 0930

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	17100	µg/L	50	1000	1000
Oklahoma DRO	3000	µg/L	4.0	400	400
BTEX					
Benzene	3180	µg/L	200	8	200
Toluene	1410	µg/L	200	10	200
Ethylbenzene	590	µg/L	200	20	200
m+p-Xylene	2420	µg/L	200	10	200
o-Xylene	780	µg/L	200	20	200

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/28/16 1555	2GC2180	2GC2180	SPA	OK GRO
Oklahoma DRO	06/22/16 0900	06/28/16 0121	160622-1	5EX4178	SPA	OK DRO
BTEX	N/A	06/22/16 0059	1MS8173	2MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061475

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Client:	Coffeyville Resources		Date Reported: 07/01/2016
	Attn: Sam McCormick		Date Received: 06/17/2016
	10 E. Cambridge Circle Dr.		Pace File No: 8462
	Kansas City, KS 66103		Pace Order No: 133938

Lab Number: 16061476 — Date Sampled: 06/16/2016
Sample Description: WRCSMW-24(061616) — Time Sampled: 1041

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1338	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/22/16 0900	06/27/16 0934	160622-1	3EX4178	SPA	OK DRO
BTEX	N/A	06/22/16 0134	1MS8173	2MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061476

Lab Number: 16061477 — Date Sampled: 06/16/2016
Sample Description: WRCSMW-2(061616) — Time Sampled: 1123

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	210	µg/L	1.0	100	100
BTEX					
Benzene	0.08 J	µg/L	1.0	0.04	1.0
Toluene	0.22 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.13 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 07/01/2016 Date Received: 06/17/2016 Pace File No: 8462 Pace Order No: 133938

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1306	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/22/16 0900	06/27/16 1002	160622-1	3EX4178	SPA	OK DRO
BTEX	N/A	06/22/16 0210	1MS8173	2MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061477

Lab Number: 16061478
Sample Description: WRCBMW-28(061616)

Date Sampled: 06/16/2016
Time Sampled: 1404

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	480	µg/L	1.0	100	100
BTEX					
Benzene	0.09 J	µg/L	1.0	0.04	1.0
Toluene	0.42 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.21 J	µg/L	1.0	0.06	1.0
o-Xylene	0.1 J	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1234	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/22/16 0900	06/27/16 1031	160622-1	3EX4178	SPA	OK DRO
BTEX	N/A	06/22/16 0246	1MS8173	2MS8173	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061478

Client:	Coffeyville Resources	Date Reported:	07/01/2016
	Attn: Sam McCormick	Date Received:	06/17/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	133938

Lab Number: 16061479
Sample Description: WRCBMW-27(061616)

Date Sampled: 06/16/2016
Time Sampled: 1440

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	960	µg/L	1.0	100	100
BTEX					
Benzene	0.18 J	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	06/23/16 1202	1GC2175	1GC2175	SPA	OK GRO
Oklahoma DRO	06/22/16 0900	06/27/16 1100	160622-1	3EX4178	SPA	OK DRO
BTEX	N/A	06/22/16 1545	1MS8174	1MS8174	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16061479

Client:	Coffeyville Resources	Date Reported:	07/01/2016
	Attn: Sam McCormick	Date Received:	06/17/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	133938

ND indicates not detected with the Limit of Detection (LOD) in parentheses. The Method Detection Limit (MDL) is a calculated value representing the lowest concentration, that based on a statistical calculation represents the lowest concentration that theoretically, can be detected. The MDL is equivalent to the LOD. The Limit of Quantitation (LOQ) is the lowest concentration of the analytical standard that was used for calibrating the instrument. If an analytical standard is analyzed at the LOQ, an error of as much as +/- 50% can be expected. The MDL and LOQ values have been adjusted for the dilution factor and percent solids, as applicable. Due to rounding differences these values may vary slightly from the reported concentration. N/A, if present, indicates Not Applicable.

All samples which require cooling were received at a temperature of less than 6 degrees Celsius.

No analysis with a holding time of seventy-two hours or less was performed in this Pace order.

J - The concentration or not detected (ND) value is below the Limit of Quantitation (LOQ) and is considered an estimated value.

G - The reported concentration includes a significant amount of individual compound(s) at concentrations not typically found in petroleum hydrocarbon patterns.

QC - QC data qualifiers were noted. See the Quality Control Report.

Accreditation Summary

Client: Coffeyville Resources
Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

NELAP accreditation is issued under each EPA regulatory program for a given matrix/analyte/method combination. Pace is NELAP accredited for each matrix/analyte/method and EPA program cited in this Laboratory Report, except for those listed in the table below and for analyses performed in the field. For most of the analyses listed in the table, NELAP accreditation is not offered under the listed EPA program and Pace is NELAP accredited for the analysis, using the same analytical technology, but under a different EPA program. Pace's full NELAP accreditation status may be viewed at www.kdheks.gov/envlab. Note that unless qualified otherwise in the Laboratory Report, Pace performs all analyses, including each analysis listed in the table below, utilizing NELAP protocol.

Test	Analysis	Matrix-Regulatory Program	Method	Pace NELAP Accredited in Other Reg. Program
Pace is accredited for all analytes.				

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Quality Control Report
Batch Summary

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Test Code	Testname	QC Batch	Method Blank Date/Time Analyzed	LCS Date/Time Analyzed	MS Lab No. Date/Time Analyzed
CL108	Oklahoma GRO	1GC2173	BLK1GC2173 06/21/16 0848	LCS1GC2173 06/21/16 0817	16061453MS 06/21/16 1815
Lab numbers associated with this batch: 16061452 16061453 16061455 16061458 16061459 16061460 16061461					
CL108	Oklahoma GRO	1GC2174	BLK1GC2174 06/22/16 0934	LCS1GC2174 06/22/16 0903	16061462MS 06/22/16 1346
Lab numbers associated with this batch: 16061454 16061456 16061457 16061462 16061463 16061464 16061465 16061466 16061467 16061468					
CL108	Oklahoma GRO	1GC2175	BLK1GC2175 06/23/16 1130	LCS1GC2175 06/23/16 1059	16061471MS 06/23/16 1645
Lab numbers associated with this batch: 16061470 16061471 16061472 16061473 16061474 16061476 16061477 16061478 16061479					
CL108	Oklahoma GRO	1GC2179	BLK1GC2179 06/27/16 1645	LCS1GC2179 06/27/16 1613	16061469MS 06/27/16 1747
Lab numbers associated with this batch: 16061469					
CL108	Oklahoma GRO	2GC2180	BLK2GC2180 06/28/16 1524	LCS2GC2180 06/28/16 1452	16061475MS 06/28/16 1627
Lab numbers associated with this batch: 16061475					
CL122	Oklahoma DRO	160620-4	160620BLK4 06/26/16 1912	160620LCS4 06/26/16 1941	16061453MS 06/26/16 2136
Lab numbers associated with this batch: 16061452 16061453 16061455 16061456 16061457 16061458 16061459 16061460 16061461 16061462					
CL122	Oklahoma DRO	160620-5	160620BLK5 06/27/16 1323	160620LCS5 06/27/16 1352	16061454MS 06/28/16 0247
Lab numbers associated with this batch: 16061454 16061463 16061464 16061465 16061466 16061467 16061468 16061469 16061470 16061471					
CL122	Oklahoma DRO	160622-1	160622BLK1 06/27/16 0446	160622LCS1 06/27/16 0515	16061472MS 06/28/16 0024
Lab numbers associated with this batch: 16061472 16061473 16061474 16061475 16061476 16061477 16061478 16061479					
MS295	BTEX	1MS9172	BLK1MS9172 06/20/16 1450	LCS1MS9172 06/20/16 1401	16061453MS 06/20/16 2331
Lab numbers associated with this batch: 16061452 16061453 16061454 16061455 16061457 16061458 16061459 16061460 16061461 16061462					
MS295	BTEX	1MS8173	BLK1MS8173 06/21/16 1339	LCS1MS8173 06/21/16 1228	16061473MS 06/21/16 2048
Lab numbers associated with this batch: 16061456 16061463 16061464 16061466 16061467 16061468 16061469 16061470 16061471 16061472 16061473 16061474 16061475 16061476 16061477 16061478					

Quality Control Report
Batch Summary

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Test Code	Testname	QC Batch	Method Blank Date/Time Analyzed	LCS Date/Time Analyzed	MS Lab No. Date/Time Analyzed
MS295	BTEX	1MS8174	BLK1MS8174 06/22/16 1434	LCS1MS8174 06/22/16 1322	16061599MS 06/22/16 2255

Lab numbers associated with this batch:
16061465 16061479

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Analysis	Blank Data	Control Sample (% Recovery) LCS	LCSD	Spike Level	Limits	Control Precision RPD	Limit	Spiked Sample (% Recovery) MS	MSD	Spike Level	Limits	Spiked Sample Precision Data RPD	Limit	Units
QC Batch: 160620-4	**For samples prepared on: 06/20/2016 1320**						**Spiked sample: 16061453**							
Oklahoma DRO	ND(100)	88.3	93.3	500	80.0-120	5.5	#	93.9	80.9	500	80.0-120	14.9	20.0	µg/L
QC Batch: 160620-5	**For samples prepared on: 06/20/2016 1500**						**Spiked sample: 16061454**							
Oklahoma DRO	ND(100)	90.9	79.2 LL	500	80.0-120	13.8	#	84.9	F	500	80.0-120	**	20.0	µg/L
QC Batch: 160622-1	**For samples prepared on: 06/22/2016 0900**						**Spiked sample: 16061472**							
Oklahoma DRO	ND(100)	90.2	87.6	500	80.0-120	2.9	#	103	F	500	80.0-120	**	20.0	µg/L
QC Batch: 1GC2173	**For sample analyzed on: 06/21/2016**						**Spiked sample: 16061453**							
Oklahoma GRO	ND(20)	102	109	200	80.0-120	6.6	#	102	103	200	80.0-120	1.00	20.0	µg/L
Surrogate Data:														
4-BFB (8015D)	88.7	89.3	93.5	20.0	84.0-121			90.5	90.8	20.0	84.0-121			µg/L
FLUOROBENZENE (8015D)	97.5	96.7	95.4	20.0	71.7-132			94.9	95.7	20.0	71.7-132			µg/L
QC Batch: 1GC2174	**For sample analyzed on: 06/22/2016**						**Spiked sample: 16061462**							
Oklahoma GRO	ND(20)	100.	104	200	80.0-120	3.9	#	91.2	95.8	200	80.0-120	4.90	20.0	µg/L
Surrogate Data:														
4-BFB (8015D)	92.5	93.7	94.1	20.0	84.0-121			90.7	93.0	20.0	84.0-121			µg/L
FLUOROBENZENE (8015D)	102	101	99.4	20.0	71.7-132			101	97.7	20.0	71.7-132			µg/L
QC Batch: 1GC2175	**For sample analyzed on: 06/23/2016**						**Spiked sample: 16061471**							
Oklahoma GRO	ND(20)	102	94.6	200	80.0-120	7.5	#	94.5	98.1	200	80.0-120	3.70	20.0	µg/L
Surrogate Data:														
4-BFB (8015D)	90.8	92.8	91.1	20.0	84.0-121			92.8	93.6	20.0	84.0-121			µg/L
FLUOROBENZENE (8015D)	100.	98.6	98.1	20.0	71.7-132			101	101	20.0	71.7-132			µg/L
QC Batch: 1GC2179	**For sample analyzed on: 06/27/2016**						**Spiked sample: 16061469**							
Oklahoma GRO	ND(20)	101	95.5	200	80.0-120	5.6	#	88.6	96.0	200	80.0-120	8.00	20.0	µg/L
Surrogate Data:														
4-BFB (8015D)	89.9	92.9	92.7	20.0	84.0-121			92.6	92.1	20.0	84.0-121			µg/L
FLUOROBENZENE (8015D)	98.7	99.6	99.3	20.0	71.7-132			98.6	98.1	20.0	71.7-132			µg/L
QC Batch: 1MS8173	**For sample analyzed on: 06/21/2016**						**Spiked sample: 16061473**							
BTEX														
Benzene	ND(0.04)	102		10.0	80.0-120		#	112	109	400	79.6-118	2.70	9.8	µg/L
Toluene	ND(0.06)	110.		10.0	80.0-120		#	110.	108	400	89.7-116	1.80	8.0	µg/L
Ethylbenzene	ND(0.1)	114		10.0	80.0-120		#	117 MH	115 MH	400	89.1-114	1.70	6.5	µg/L
m+p-Xylene	ND(0.06)	116		20.0	80.0-120		#	119 MH	117 MH	800	88.6-116	1.70	6.7	µg/L
o-Xylene	ND(0.1)	111		10.0	80.0-120		#	116 MH	112	400	88.3-115	3.50	8.1	µg/L
Surrogate Data:														
1,2-DICHLOROETHANE-d4	98.0	90.6		10.0	74.3-123			106	105	400	74.3-123			µg/L
TOLUENE-d8	104	110.		10.0	80.0-120			110.	110.	400	80.0-120			µg/L
QC Batch: 1MS8174	**For sample analyzed on: 06/22/2016**						**Spiked sample: 16061599**							
BTEX								MN	MN			**		
Benzene	ND(0.04)	110.		10.0	80.0-120		#			1000	79.6-118	**	9.8	µg/L
Toluene	ND(0.06)	108		10.0	80.0-120		#			1000	89.7-116	**	8.0	µg/L
Ethylbenzene	ND(0.1)	113		10.0	80.0-120		#			1000	89.1-114	**	6.5	µg/L
m+p-Xylene	ND(0.06)	117		20.0	80.0-120		#			2000	88.6-116	**	6.7	µg/L
o-Xylene	ND(0.1)	111		10.0	80.0-120		#			1000	88.3-115	**	8.1	µg/L
Surrogate Data:														
1,2-DICHLOROETHANE-d4	109	101		10.0	74.3-123			MN	MN	1000	74.3-123	**		µg/L

Quality Control Report
Method Blank, LCS, MS/MSD Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

		Control Sample (% Recovery)				Control Precision		Spiked Sample (% Recovery)				Spiked Sample Precision Data		
Analysis	Blank Data	LCS	LCSD	Spike Level	Limits	RPD	Limit	MS	MSD	Spike Level	Limits	RPD	Limit	Units
QC Batch: 1MS8174	**For sample analyzed on: 06/22/2016**						**Spiked sample: 16061599**							
Surrogate Data:														
TOLUENE-d8	102	107		10.0	80.0-120			MN	MN	1000	80.0-120	**		µg/L
QC Batch: 1MS9172	**For sample analyzed on: 06/20/2016**						**Spiked sample: 16061453**							
BTEX														
Benzene	ND(0.04)	107		10.0	80.0-120		#	111	110.	10.0	79.6-118	0.90	9.8	µg/L
Toluene	ND(0.06)	112		10.0	80.0-120		#	113	111	10.0	89.7-116	1.80	8.0	µg/L
Ethylbenzene	ND(0.1)	112		10.0	80.0-120		#	110.	112	10.0	89.1-114	1.80	6.5	µg/L
m+p-Xylene	ND(0.06)	111		20.0	80.0-120		#	112	114	20.0	88.6-116	1.80	6.7	µg/L
o-Xylene	ND(0.1)	109		10.0	80.0-120		#	111	114	10.0	88.3-115	2.70	8.1	µg/L
Surrogate Data:														
1,2-DICHLOROETHANE-d4	94.6	95.5		10.0	74.3-123			96.3	99.1	10.0	74.3-123			µg/L
TOLUENE-d8	106	111		10.0	80.0-120			112	108	10.0	80.0-120			µg/L
QC Batch: 2GC2180	**For sample analyzed on: 06/28/2016**						**Spiked sample: 16061475**							
Oklahoma GRO	ND(20)	98.0	98.3	200	80.0-120	0.3	#	93.4	90.1	10000	80.0-120	3.60	20.0	µg/L
Surrogate Data:														
4-BFB (8015D)	91.6	94.2	94.8	20.0	84.0-121			91.7	93.2	1000	84.0-121			µg/L
FLUOROBENZENE (8015D)	98.6	98.0	101	20.0	71.7-132			97.9	99.7	1000	71.7-132			µg/L

Data Qualifiers:

LL - The Laboratory Control Sample (LCS) recovery for this analyte was below the method or laboratory quality control limit. The reported sample concentration may be biased low.

F - MS and/or MSD sample data are not available due to insufficient sample volume.

MH - The matrix spike and/or matrix spike duplicate recovery for this analyte was above the method or laboratory control limit. See LCS data for the basis for acceptance of this sample. The reported sample concentration is estimated.

MN - The MS/MSD sample analyses were not performed on a sample from this Pace order number.

** - RPD calculation not applicable/not available for this analysis.

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16061452		**Sample Description: Trip Blank**				
GC/FID Volatile						
4-BFB (8015D)		06/21/2016	20	µg/L	86.0	84.0-121
FLUOROBENZENE (8015D)		06/21/2016	20	µg/L	93.7	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	10	µg/L	104	74.3-123
TOLUENE-d8		06/20/2016	10	µg/L	107	80.0-120
Lab Number: 16061453		**Sample Description: WRCUMW-7(061316)**				
GC/FID Volatile						
4-BFB (8015D)		06/21/2016	20	µg/L	89.7	84.0-121
FLUOROBENZENE (8015D)		06/21/2016	20	µg/L	96.7	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	10	µg/L	100.	74.3-123
TOLUENE-d8		06/20/2016	10	µg/L	107	80.0-120
Lab Number: 16061454		**Sample Description: WRCDUP1**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	200	µg/L	92.4	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	200	µg/L	104	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	100	µg/L	105	74.3-123
TOLUENE-d8		06/20/2016	100	µg/L	105	80.0-120
Lab Number: 16061455		**Sample Description: WRCUMW-4(061316)**				
GC/FID Volatile						
4-BFB (8015D)		06/21/2016	200	µg/L	90.0	84.0-121
FLUOROBENZENE (8015D)		06/21/2016	200	µg/L	99.5	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	100	µg/L	101	74.3-123
TOLUENE-d8		06/20/2016	100	µg/L	106	80.0-120
Lab Number: 16061456		**Sample Description: WRCUMW-5(061316)**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	80	µg/L	95.8	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	80	µg/L	105	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	100	µg/L	98.7	74.3-123
TOLUENE-d8		06/21/2016	100	µg/L	109	80.0-120
Lab Number: 16061457		**Sample Description: WRCUMW-6(061316)**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	1000	µg/L	95.0	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	1000	µg/L	105	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	2000	µg/L	88.7	74.3-123
TOLUENE-d8		06/20/2016	2000	µg/L	106	80.0-120
Lab Number: 16061458		**Sample Description: WRCSMW-18(061316)**				
GC/FID Volatile						
4-BFB (8015D)		06/21/2016	20	µg/L	89.2	84.0-121
FLUOROBENZENE (8015D)		06/21/2016	20	µg/L	96.3	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	10	µg/L	102	74.3-123

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16061458		**Sample Description: WRCSMW-18(061316)**				
BTEX						
TOLUENE-d8		06/20/2016	10	µg/L	107	80.0-120
Lab Number: 16061459		**Sample Description: WRCSMW-1(061316)**				
GC/FID Volatile						
4-BFB (8015D)		06/21/2016	20	µg/L	89.3	84.0-121
FLUOROBENZENE (8015D)		06/21/2016	20	µg/L	97.1	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	10	µg/L	103	74.3-123
TOLUENE-d8		06/20/2016	10	µg/L	106	80.0-120
Lab Number: 16061460		**Sample Description: WRCEB(061316)**				
GC/FID Volatile						
4-BFB (8015D)		06/21/2016	20	µg/L	89.4	84.0-121
FLUOROBENZENE (8015D)		06/21/2016	20	µg/L	96.8	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	10	µg/L	100.	74.3-123
TOLUENE-d8		06/20/2016	10	µg/L	105	80.0-120
Lab Number: 16061461		**Sample Description: WRCUMW-3(061316)**				
GC/FID Volatile						
4-BFB (8015D)		06/21/2016	20	µg/L	88.4	84.0-121
FLUOROBENZENE (8015D)		06/21/2016	20	µg/L	96.0	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	10	µg/L	105	74.3-123
TOLUENE-d8		06/20/2016	10	µg/L	110.	80.0-120
Lab Number: 16061462		**Sample Description: WRCUMW-1(061416)**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	20	µg/L	93.1	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	20	µg/L	98.8	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/20/2016	10	µg/L	105	74.3-123
TOLUENE-d8		06/20/2016	10	µg/L	108	80.0-120
Lab Number: 16061463		**Sample Description: WRCNMW-6(061416)**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	400	µg/L	98.5	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	400	µg/L	100.	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	100	µg/L	104	74.3-123
TOLUENE-d8		06/21/2016	100	µg/L	109	80.0-120
Lab Number: 16061464		**Sample Description: WRCNMW-12(061416)**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	2000	µg/L	96.4	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	2000	µg/L	106	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	5000	µg/L	96.1	74.3-123
TOLUENE-d8		06/21/2016	5000	µg/L	110.	80.0-120
Lab Number: 16061465		**Sample Description: WRC-Martin Pond**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	20	µg/L	92.9	84.0-121

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16061465		**Sample Description: WRC-Martin Pond**				
GC/FID Volatile						
FLUOROBENZENE (8015D)		06/22/2016	20	µg/L	99.0	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/22/2016	10	µg/L	105	74.3-123
TOLUENE-d8		06/22/2016	10	µg/L	107	80.0-120
Lab Number: 16061466		**Sample Description: WRC-S Martin Well**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	20	µg/L	91.6	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	20	µg/L	99.2	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	10	µg/L	97.8	74.3-123
TOLUENE-d8		06/21/2016	10	µg/L	104	80.0-120
Lab Number: 16061467		**Sample Description: WRC-McLaughlin Well**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	20	µg/L	94.0	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	20	µg/L	102	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	10	µg/L	100.	74.3-123
TOLUENE-d8		06/21/2016	10	µg/L	105	80.0-120
Lab Number: 16061468		**Sample Description: WRCSMW-25(061516)**				
GC/FID Volatile						
4-BFB (8015D)		06/22/2016	20	µg/L	92.1	84.0-121
FLUOROBENZENE (8015D)		06/22/2016	20	µg/L	100.	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	10	µg/L	97.9	74.3-123
TOLUENE-d8		06/21/2016	10	µg/L	103	80.0-120
Lab Number: 16061469		**Sample Description: WRCBMW-19(061516)**				
GC/FID Volatile						
4-BFB (8015D)		06/27/2016	20	µg/L	92.2	84.0-121
FLUOROBENZENE (8015D)		06/27/2016	20	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	10	µg/L	98.5	74.3-123
TOLUENE-d8		06/21/2016	10	µg/L	103	80.0-120
Lab Number: 16061470		**Sample Description: WRCSMW-23(061516)**				
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	20	µg/L	92.9	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	20	µg/L	102	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	10	µg/L	106	74.3-123
TOLUENE-d8		06/21/2016	10	µg/L	102	80.0-120
Lab Number: 16061471		**Sample Description: WRCBMW-4(061516)**				
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	20	µg/L	90.4	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	20	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	10	µg/L	98.8	74.3-123
TOLUENE-d8		06/21/2016	10	µg/L	106	80.0-120

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16061472		**Sample Description: WRCDUP2**				
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	20	µg/L	84.0	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	20	µg/L	97.6	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	10	µg/L	102	74.3-123
TOLUENE-d8		06/21/2016	10	µg/L	103	80.0-120
Lab Number: 16061473		**Sample Description: WRCBMW-25(061516)**				
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	200	µg/L	92.0	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	200	µg/L	102	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/21/2016	400	µg/L	108	74.3-123
TOLUENE-d8		06/21/2016	400	µg/L	102	80.0-120
Lab Number: 16061474		**Sample Description: WRCBMW-20A(061616)**				
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	20	µg/L	90.1	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	20	µg/L	98.2	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/22/2016	10	µg/L	112	74.3-123
TOLUENE-d8		06/22/2016	10	µg/L	102	80.0-120
Lab Number: 16061475		**Sample Description: WRCBMW-26(061616)**				
GC/FID Volatile						
4-BFB (8015D)		06/28/2016	1000	µg/L	96.0	84.0-121
FLUOROBENZENE (8015D)		06/28/2016	1000	µg/L	103	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/22/2016	2000	µg/L	112	74.3-123
TOLUENE-d8		06/22/2016	2000	µg/L	103	80.0-120
Lab Number: 16061476		**Sample Description: WRCSMW-24(061616)**				
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	20	µg/L	92.3	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	20	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/22/2016	10	µg/L	112	74.3-123
TOLUENE-d8		06/22/2016	10	µg/L	101	80.0-120
Lab Number: 16061477		**Sample Description: WRCSMW-2(061616)**				
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	20	µg/L	92.7	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	20	µg/L	100.	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/22/2016	10	µg/L	113	74.3-123
TOLUENE-d8		06/22/2016	10	µg/L	102	80.0-120
Lab Number: 16061478		**Sample Description: WRCBMW-28(061616)**				
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	20	µg/L	92.7	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	20	µg/L	102	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/22/2016	10	µg/L	110.	74.3-123

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16061478	**Sample Description: WRCBMW-28(061616)**					
BTEX						
TOLUENE-d8		06/22/2016	10	µg/L	104	80.0-120
Lab Number: 16061479	**Sample Description: WRCBMW-27(061616)**					
GC/FID Volatile						
4-BFB (8015D)		06/23/2016	20	µg/L	93.6	84.0-121
FLUOROBENZENE (8015D)		06/23/2016	20	µg/L	102	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		06/22/2016	10	µg/L	104	74.3-123
TOLUENE-d8		06/22/2016	10	µg/L	105	80.0-120

Quality Control Report
Continuing Calibration Report

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 07/01/2016
Date Received: 06/17/2016
Pace File No: 8462
Pace Order No: 133938

Analysis	Date of Analysis	Instrument Batch ID	Amount in Standard	Amount Detected	Units	Percent Recovery
Oklahoma GRO	06/21/2016	1GC2173	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/21/2016	2GC2173	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/22/2016	1GC2174	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/22/2016	2GC2174	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/23/2016	1GC2175	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/23/2016	2GC2175	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/27/2016	1GC2179	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/27/2016	2GC2179	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/28/2016	2GC2180	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	06/28/2016	3GC2180	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	06/26/2016	2EX4178	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	06/27/2016	3EX4178	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	06/27/2016	4EX4178	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	06/27/2016	5EX4178	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	06/28/2016	6EX4178	CCV recovery acceptable for this Instrument Batch.			
BTEX	06/21/2016	1MS8173	CCV recovery acceptable for this Instrument Batch.			
BTEX	06/21/2016	2MS8173	CCV recovery acceptable for this Instrument Batch.			
BTEX	06/22/2016	3MS8173	CCV recovery acceptable for this Instrument Batch.			
BTEX	06/22/2016	1MS8174	CCV recovery acceptable for this Instrument Batch.			
BTEX	06/23/2016	2MS8174	CCV recovery acceptable for this Instrument Batch.			
BTEX	06/20/2016	1MS9172	CCV recovery acceptable for this Instrument Batch.			
BTEX	06/21/2016	2MS9172	CCV recovery acceptable for this Instrument Batch.			

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 133938

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:
Sampler's Name / Company:(Printed) Jerome McSorley CVR Energy; Sampler's Name (Signature)	Purchase Order Number:
Project Name: WRC Perimeter Wells; Facility Name / Address: WRC Wynnewood, OK	

PARAMETERS/CONTAINER TYPE (preservative): BTEX (8020/8015) - 3x glass 40 ml vials (HCL); Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL); Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER	BTEX	Oklahoma GRO	Oklahoma DRO	COMMENTS
TRIP BLANK	O	O	Jun 13, 2016	8:30	G	9	9						X	X	X	Provided by lab
WRCUMW-7 MS/MSD	GW	O	Jun 13, 2016	9:15	G	9	9						X	X	X	
WRCUMW-7(061316)	GW	O	Jun 13, 2016	9:15	G	8	8						X	X	X	
WRCDUP1	GW	O	Jun 13, 2016	10:05	G	8	8						X	X	X	Duplicate
WRCUMW-4(061316)	GW	O	Jun 13, 2016	10:05	G	8	8						X	X	X	
WRCUMW-5(061316)	GW	O	Jun 13, 2016	10:44	G	8	8						X	X	X	
WRCUMW-6(061316)	GW	O	Jun 13, 2016	11:32	G	8	8						X	X	X	
WRCSMW-18(061316)	GW	O	Jun 13, 2016	13:27	G	8	8						X	X	X	
WRCSMW-1(061316)	GW	O	Jun 13, 2016	14:00	G	8	8						X	X	X	
WRCEB(061316)	O	O	Jun 13, 2016	14:45	G	8	8						X	X	X	WRC Lab DI Water
WRCUMW-3(061316)	GW	O	Jun 13, 2016	14:49	G	8	8						X	X	X	

Discrepancies See C/S RF

6-20-16

Matrix (Sample Type): DW=Drinking Water, GW=Ground Water, WW=Waste Water, W=Wipe, S=Solid/Soil, SL=Sludge, A=Air, OL=Oil/Organic Liquid, O=Other,

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other, nR=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

RELINQUISHED BY:	DATE: 6-17-16	TIME: 1255	RECEIVED BY:	DATE: 6/21/16	TIME: 1255
RELINQUISHED BY:	DATE: 6/17/16	TIME: 1750	RECEIVED BY:	DATE:	TIME:
RECEIVED AT LAB BY:	DATE: 6/17/16	TIME: 1750	SHIPPED VIA:	SEAL #:	
			AIRBILL:	SEAL DATE:	

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 133938

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:

Sampler's Name / Company:(Printed): Jerome McSorley CVR Energy
Sampler's Name:(Signature):
Purchase Order Number:
Project Name: WRC Perimeter Wells
Facility Name / Address: WRC Wynnewood, OK

Parameters/Container Type (preservative): (1) BTEX (8020/8015) - 3x glass 40 ml vials (HCL); (2) Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL); (3) Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER	BTEX (8020/8015)	Oklahoma GRO (8020/8015)	Oklahoma DRO (8000/8100)								COMMENTS
WRCUMW-1(061416)	GW	O	Jun 14, 2016	8:15	G	8	8						X	X	X								
WRCNMW-6(061416)	GW	O	Jun 14, 2016	8:53	G	8	8						X	X	X								
WRCNMW-12(061416)	GW	O	Jun 14, 2016	9:36	G	8	8						X	X	X								Deionized Water
WRC-Martin Pond	O	O	Jun 14, 2016	10:30	G	8	8						X	X	X								Surface Water
WRC-S Martin Well	GW	O	Jun 14, 2016	11:00	G	8	8						X	X	X								
WRC-McLaughlin Well	GW	O	Jun 14, 2016	11:30	G	8	8						X	X	X								
WRCSMW-25(061516)	GW	O	Jun 15, 2016	10:28	G	8	8						X	X	X								
WRCBMW-19(061516)	GW	O	Jun 15, 2016	11:15	G	8	8						X	X	X								
WRCSMW-23(061516)	GW	O	Jun 15, 2016	13:58	G	8	8						X	X	X								
WRCBMW-4(061516)	GW	O	Jun 15, 2016	15:04	G	8	8						X	X	X								
WRCDUP2	GW	O	Jun 15, 2016	15:04	G	8	8						X	X	X								

Matrix (Sample Type): DW=Drinking Water, GW=Ground Water, WW=Waste Water, W=Wipe, S=Solid/Soil, SL=Sludge, A=Air, OL=Oil/Organic Liquid, O=Other,

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other, nR=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge) Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

	DATE:	TIME:		DATE:	TIME:
RELINQUISHED BY:	6-17-16	12:55	RECEIVED BY:	6/17/16	1255
RELINQUISHED BY:	6/17/16	1750	RECEIVED BY:		
RECEIVED AT LAB BY:	6-17-16	1750	SHIPPED VIA: / AIRBILL:	SEAL #: / SEAL DATE:	

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PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 133938

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:

Sampler's Name / Company (Printed): JEROME MCSORLEY CVR Energy
Sampler's Name (Signature):
Purchase Order Number:
Project Name: WRC Perimeter Wells
Facility Name / Address: WRC Wynnewood, OK

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER	BTEX (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)	COMMENTS
WRCBMW-25(061516)	GW	O	Jun 15, 2016	15:58	G	8	8						X	X	X	
WRCBMW-20A(061616)	GW	O	Jun 16, 2016	8:53	G	8	8						X	X	X	
WRCBMW-26(061616)	GW	O	Jun 16, 2016	9:30	G	8	8						X	X	X	
WRCSMW-24(061616)	GW	O	Jun 16, 2016	10:41	G	8	8						X	X	X	
WRCSMW-2(061616)	GW	O	Jun 16, 2016	11:23	G	8	8						X	X	X	
WRCBMW-28(061616)	GW	O	Jun 16, 2016	14:04	G	8	8						X	X	X	
WRCBMW-27(061616)	GW	O	Jun 16, 2016	14:40	G	8	8						X	X	X	

Matrix (Sample Type): DW=Drinking Water, GW=Ground Water, WW=Waste Water, W=Wipe, S=Solid/Soil, SL=Sludge, A=Air, OL= Oil/Organic Liquid, O=Other,

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other, nR=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

	DATE:	TIME:		DATE:	TIME:
RELINQUISHED BY:	6-17-16	12:55	RECEIVED BY:	6/17/16	1255
RELINQUISHED BY:	6/17/16	1750	RECEIVED BY:		
RECEIVED AT LAB BY:	6-17-16	1750	SHIPPED VIA:	SEAL #:	
			AIRBILL:	SEAL DATE:	

H:\COC\COC June 2016_Perimeter 0r WRC_Perimeter_PG 3 6.16.2016

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Continental Analytical Services, Inc.
Cooler/Sample Receipt Form (C/S RF)

CAS Order No.: 133938

Client Name: Coffeyville Resources

CAS File No.: 8462

Sample ID's in cooler:

3-LTA Trip Blanks
2-LTA WRCUMW-4
2-LTA WRCUMW-7
3 LTA WRCUMW-7 MS-MSD

Cooler 1 of 6 for this CAS Order No.

Cooler Identification: CAS Cooler #: 3930 / Client's Cooler / Box / Letter / Hand-delivered
Other: ______

Date/Time Cooler Received: 6/17/16 17:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other: ______

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —
Seal Name: — Seal Date: —
Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other: ______

Cooler Temperature (°C): Original Reading (°C) 1.8 Corrected Reading (°C) 1.7

SKR 6-17-16

Temperature. By: Temperature Blank / Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.1

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, CAS will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from: Cover Letter ☐ Container ☐ PO ☐ CAS Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies: ______

Detail to discrepancies/comments:

Completed by: SKR Date Completed: 6-17-16

Continental Analytical Services, Inc.
Cooler/Sample Receipt Form (C/S RF)

CAS Order No.: 133938

Client Name: Coffeyville Resources

CAS File No.: 8462

Sample ID's in cooler:

WRCBMW-26 (2LA) WRCBMW-27 (2LA)
WRCBMW-20A (2LA) WRCSMW-2 (2LA)
WRCSMW-24 (2LA)
WRCBMW-28 (2LA)

Cooler 2 **of** 6 **for this CAS Order No.**

Cooler Identification: CAS Cooler #: 4150 / Client's Cooler / Box / Letter / Hand-delivered
Other: ______

Date/Time Cooler Received: 6/17/16 17:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other: ______

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: ——
Seal Name: —— Seal Date: ——
Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other: ______

Cooler Temperature (°C): Original Reading (°C) 2.9 Corrected Reading (°C) 2.8

SKR
6-17-16

Temperature. By: Temperature Blank · Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.1

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, CAS will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ CAS Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies: ______

Detail to discrepancies/comments:

Completed by: SKR **Date Completed:** 6-17-16

Continental Analytical Services, Inc.
Cooler/Sample Receipt Form (C/S RF)

CAS Order No.: 133938

Client Name: Cottonwood Resources

CAS File No.: 8462

Sample ID's in cooler: VOCS

WRCEB → 2LA

Cooler 3 of 6 for this CAS Order No.

Cooler Identification: CAS Cooler #: 4199 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 6/17/16 17:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —

Seal Name: — Seal Date: —

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 3.0 Corrected Reading (°C) 2.9

SKR 6-17-16

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.1

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☒ No ~~☐ Yes~~ SK 6-17-16 (See below for discrepancies.)

Note: If discrepancies are present, CAS will proceed with analyses until/unless directed otherwise by the client.

☐ Chain of Custody not present - information taken from:
Cover Letter ☐ Container ☐
PO ☐ CAS Proj. Mgr. ☐

☐ Container label absent

☐ Chain of Custody incomplete [see detail below]

☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)

☐ Date or Time sampled obtained from container label

☐ Chain of Custody missing sampler's name

☐ Chain of Custody missing matrix (sample type)

☐ Missing relinquished information: signature date time

☐ Sample excluded from Chain of Custody

☐ Sample listed on Chain of Custody, not received

☐ Sample identification on container and Chain of Custody do not agree

☒ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]

☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
[Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]

☐ Broken or leaking containers (detail actions below)

☐ Sample container type or labeled chemical preservation inappropriate

☐ Other discrepancies:

Detail to discrepancies/comments:

2-VOC WRCMW-6

1-VOC WRCSMW-24

Completed by: SKR Date Completed: 6-17-16

Continental Analytical Services, Inc.
Cooler/Sample Receipt Form (C/S RF)

CAS Order No.: 133938

Client Name: Coffeyville Resources

CAS File No.: 8467

Sample ID's in cooler:

2-LTA WRCBMW-19 2-LTA WRCBMW-4
2-LTA-WRCBMW-25 2-LTA WRCSMW-23
2-LTA WRCSMW-25
2-LTA WRCMW2

Cooler 4 **of** 6 **for this CAS Order No.**

Cooler Identification: CAS Cooler #: 3189 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 6/17/16 17:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No:
Seal Name: Seal Date:
Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 1.5 Corrected Reading (°C) 1.4

SKR 6-17-16

Temperature By: Temperature Blank Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.1

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, CAS will proceed with analyses until/unless directed otherwise by the client.

☐ Chain of Custody not present - information taken from:
Cover Letter ☐ Container ☐
PO ☐ CAS Proj. Mgr. ☐
☐ Container label absent
☐ Chain of Custody incomplete [see detail below]
☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
☐ Date or Time sampled obtained from container label
☐ Chain of Custody missing sampler's name
☐ Chain of Custody missing matrix (sample type)
☐ Missing relinquished information: signature date time

☐ Sample excluded from Chain of Custody
☐ Sample listed on Chain of Custody, not received
☐ Sample identification on container and Chain of Custody do not agree
☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
[Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
☐ Broken or leaking containers (detail actions below)
☐ Sample container type or labeled chemical preservation inappropriate
☐ Other discrepancies:

Detail to discrepancies/comments:

Completed by: SKR Date Completed: 6-17-16

Continental Analytical Services, Inc.
Cooler/Sample Receipt Form (C/S RF)

CAS Order No.: 133938

Client Name: Coffeyville Resources **CAS File No.:** 8467

Sample ID's in cooler:

WRCDUP1 →(2LA) WRCSMW-18→(2LA)
WRCUMW-5→(2LA) WRCSMW-1→(2LA)
WRCUMW-3 →(3?LA)
WRCUMW-6 →(2LA)

Cooler 5 **of** 6 **for this CAS Order No.**

Cooler Identification: CAS Cooler #: 4111 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 6/17/16 17:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present; Intact / Broken Absent: ✓ Seal No:
Seal Name: Seal Date:
Seal matches Chain of Custody: Yes / No / NA

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 3.1 Corrected Reading (°C) 3.0

SKR 6-17-16

Temperature. By: Temperature Blank · Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.1

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, CAS will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ CAS Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments:

Completed by: SKR Date Completed: 6-17-16

Continental Analytical Services, Inc.
Cooler/Sample Receipt Form (C/S RF)

CAS Order No.: 133938

Client Name: Coffeyville Resources

CAS File No.: 8462

Sample ID's in cooler:

2-LTA. WRCNMW-6 , 2-LTA - WRC-Martin Pond, 2-LTA. WRC McLaughlin Well 2-LTA. WRCUM-1
2-LTA. WRC-S Martin Well, 2-LTA ~~WRC~~ WRCNMW-12

Cooler 6 of 6 for this CAS Order No.

Cooler Identification: CAS Cooler #: 3887 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 6/17/16 17:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —

Seal Name: — Seal Date: —

Seal matches Chain of Custody: Yes / No / NA

Type of Packing Material: Blue Ice / Ice / Melted Ice / ~~Bubble~~ / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 2.7 Corrected Reading (°C) 2.6

SKR 6-17-16

Temperature. By: Temperature Blank · Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.1

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ~~☒ No~~ ~~☐ Yes~~ **(See below for discrepancies.)** S 6-20-16 ✓ 9 6-20-16

Note: If discrepancies are present, CAS will proceed with analyses until/unless directed otherwise by the client.

☐ Chain of Custody not present - information taken from:
Cover Letter ☐ Container ☐
PO ☐ CAS Proj. Mgr. ☐
☐ Container label absent
☐ Chain of Custody incomplete [see detail below]
☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
☐ Date or Time sampled obtained from container label
☐ Chain of Custody missing sampler's name
☐ Chain of Custody missing matrix (sample type)
☐ Missing relinquished information: signature date time

☐ Sample excluded from Chain of Custody
☐ Sample listed on Chain of Custody, not received
☐ Sample identification on container and Chain of Custody do not agree
☒ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
☐ Broken or leaking containers (detail actions below)
☐ Sample container type or labeled chemical preservation inappropriate
☐ Other discrepancies:

Detail to discrepancies/comments:

~~2-VOC WRCUMW-6 Air Bubbles~~ S 6-20-16

Completed by: SKR Date Completed: 6-17-16

Appendix 2.3.B – Groundwater Sampling Field Logs for January 1 through June 30, 2016 Events

DAILY LOG FORM

WYNNEWOOD REFINING
A CVR Energy, Inc. Company

Well(s) PERIMETER Project/No. Semi-Annual Sampling

Site Location WRC - Wynnewood, OK

Prepared By Jerome McSorley, ~~Evan Hillburn~~ AARON GILBERT (KPS)

Date/Time	Description of Activities
6-13-16 0750	CVR ONSITE TO LOCATE AND ORGANIZE LAB COOLERS
	AND BOTTLES.
0800	YSI CALIBRATED - DO OUT OF RANGE SO
	MEMBRAIN REPLACED.
*0830	TRIP BLANK ADDED TO COOLERS
	* PACE SUPPLIED PRE-FILLED BOTTLES (9 TOTAL)
0840	BEGIN PERIMETER WELL SAMPLING.
0850	BEGIN PURGE AT UMW-7
*0915	SAMPLE: WRCUMW-7 (061316)
*	*MS/MSD COLLECTED (9 BOTTLES)
0940	BEGIN PURGE AT UMW-4
*1005	SAMPLE: WRCUMW-4 (061316)
*1005	SAMPLE: WRCDUP1
	DUPLICATE OF UMW-4
1025	BEGIN PURGE AT UMW-5
*1044	SAMPLE: WRCUMW-5 (061316)
1100	BEGIN PURGE AT UMW-6
*1132	SAMPLE: WRC UMW-6 (061316)
11:45-1230	LUNCH
1230	MOB TO OBTAIN PERMIT AT ASPHALT BLENDER
1305	BEGIN PURGE AT SMW-18
*1327	SAMPLE: ~~[illegible]~~ WRCSMW-18 (061316)
1340	BEGIN PURGE AT SMW-1

DAILY LOG FORM

WYNNEWOOD REFINING A CVR Energy, Inc. Company

Well(s) PERIMETER Project/No. Semi-Annual Sampling Page 2 of 4

Site Location WRC - Wynnewood, OK

Prepared By Jerome McSorley, ~~Evan Hillburn~~ AARON GILBERT (KPS)

Date/Time	Description of Activities
6-13-16 1400	SAMPLE: WRCSMW-1 (061316)
1410	SIGN OUT AT ASPHALT BLENDER
1430	BEGIN PURGE AT UMW-3
1445	EQUIPMENT BLANK COLLECTED FROM INTERFACE
	PROBE USING WRC LAB DI WATER.
*	ID: WRCEB (061316)
1449	SAMPLE: WRCUMW-3 (061316)
1510	MOB TO V-DITCH WASH PAD FOR PURGE WATER
	DISPOSAL.
1530	MOB TO WRC LAB FOR ICE
1540	COOLERS PACKED AND STORED OVERNIGHT
1600	CVR/KPS OFFSITE.
6-14-16 0720	CVR ONSITE TO CONTINUE SAMPLING. MEET KPS
	AND LOAD COOLERS AND EQUIPMENT.
0745	PERMIT OBTAINED AT LIGHT OILS
0755	BEGIN PURGE AT UMW-1
0815	SAMPLE: WRCUMW-1 (061416)
0830	BEGIN PURGE AT NMW-6 - VERY LOW FLOW DUE TO
	FREE PRODUCT ABOVE PUMP - (1 GAL PREPURGE)
0853	SAMPLE: WRCNMW-6 (061416)
0910	BEGIN PURGE AT NMW-12 - VERY LOW FLOW DUE TO
	FREE PRODUCT ABOVE PUMP - (1 GAL PREPURGE)
0936	SAMPLE: WRCNMW-12 (061416)

DAILY LOG FORM

WYNNEWOOD REFINING
A CVR Energy, Inc. Company

Well(s) PERIMETER Project/No. Semi-Annual Sampling Page 3 of 4

Site Location WRC - Wynnewood, OK

Prepared By Jerome McSorley, ~~Evan Hillburn~~ ANNA GILBERT (KPS)

Date/Time	Description of Activities
6-14-16 0940	- 1020 RAIN/LIGHTNING DELAY
1030	SAMPLE: WRC-MARTIN POND
1100	SAMPLE: WRC-S MARTIN WELL
1130	SAMPLE: WRC-MCLAUGHLIN WELL
1140	MOB TO DISPOSE OF PURGE WATER AT V-DITCH PAD.
1150	KPS OFFSITE.
1200	ICE ADDED TO COOLERS - STORED AT WRC OFFICES
1230	CVR OFFSITE
6-15-16 0720	Pre-use Calibration of YSI Machine
0955	Began purge at SMW-25
1028	Collected Sample at SMW-25
1050	started purge at BMW19
1115	Collected Sample at BMW-19
1215	Went to lunch
1330	Started purge at SMW-23
1358	SAMPLE: WRC SMW-23 (061516)
1400	MOB TO OBTAIN PERMIT FOR PLF
1440	BEGIN PURGE AT BMW-4
1504	SAMPLE: WRC BMW-4 (061516)
1504	SAMPLE: WRCDUP2 - DUPLICATE OF BMW-4
1525	BEGIN PURGE AT BMW-25
1558	SAMPLE: WRCBMW-25 (061516)
1610	MOB TO PACK COOLER ON ICE

1630 CVR/KPS OFFSITE.

DAILY LOG FORM

WYNNEWOOD REFINING
A CVR Energy, Inc. Company

Well(s) PERIMETER Project/No. Semi-Annual Sampling Page 4 of 4

Site Location WRC - Wynnewood, OK

Prepared By Jerome McSorley, ~~Evan Hillburn~~ AARON GILBERT (KPS)

Date/Time	Description of Activities
6-16-16 0720	CVR ONSITE. KPS IS OBTAINING AN ATV FOR
	SAMPLING IN HARD TO REACH AREAS. ATV WILL
	BE RENTED FROM KPS. ($5/HR).
0800	MOB TO PLF FOR PERMIT
0820	BEGIN PURGE AT BMW-20A
0853	SAMPLE: WRCBMW-20A (061616)
0910	BEGIN PURGE AT BMW-26 - VERY LOW FLOW (~200mL/min)
	DUE TO FREE PRODUCT IN WELL
0930	SAMPLE: WRCBMW-26 (061616)
0945	~~BM~~ SIGN OUT AT PLF - OBTAIN PERMIT FOR SMW-24
1005	BEGIN PURGE AT SMW-24
1041	SAMPLE: WRC~~B~~MW-24 (061616)
1050	SIGN OUT AT TEXOMA-NORTH (SMW-24)
1100	BEGIN PURGE AT SMW-2
1123	SAMPLE: WRCSMW-2 (061616)
1200-1300	LUNCH
1340	BEGIN PURGE AT BMW-28
1404	SAMPLE: WRC~~B~~MW-28 (061616)
1415	BEGIN PURGE AT BMW-27
1440	SAMPLE: WRCBMW-27 (061616)
1510	MOB TO DISPOSE OF PURGE WATER.
1530	MOB TO GET ICE AND PACK COOLERS
1600	CVR / KPS OFFSITE.

GROUNDWATER SAMPLING DATA SHEET

WYNNEWOOD REFINING
A CVR Energy, Inc. Company

Sampler Name(s): Aaron Gilbert / Jerome McSorley   Date: 6-13-16   Page 1 of 6

Weather Conditions: Days since last precip. 0   Air Temp. 72   Wind 5 mph

Well ID	UMW-7	UMW-4	UMW-5	UMW-6
Well Inspection (verify condition of each of the following:)				
-Lock	✓	✓	✓	✓
-Well Pad	✓	✓	✓	✓
-Protective Casing	✓	✓	✓	✓
-Well Cap	✓	✓	✓	✓
-Measurement Mark	✓	✓	✓	✓
-Well Identification	✓	✓	✓	✓
Water Level Date/Time	6-7-16	6-7-16	6-7-16	6-7-16
Water Level	9.89	10.86	9.91	20.32
Purge Start Date/Time	0850 / 6-13-16	0940 / 6-13-16	1025 / 6-13-16	1100 / 6-13-16
Temperature (time/reading) °C +/- 0.6	18.42 18.32 18.29 18.28 18.29 18.25 18.24 18.25	19.71 19.64 19.63 19.64 19.61 19.61 19.63 19.66	19.70 19.54 19.48 19.48 19.47 19.45	19.39 18.99 19.01 19.01 19.00 18.99 18.98 18.99 19.01 19.03
Specific Conductance ms/cm3 (time/reading) 3%	1.027 1.002 0.986 0.978 0.971 0.964 0.959 0.956	1.232 1.244 1.234 1.233 1.232 1.232 1.231 1.231	1.762 1.798 1.804 1.809 1.811 1.812	1.420 1.223 1.215 1.214 1.214 1.214 1.215 1.215 1.215 1.215
Dissolved Oxygen (time/reading) 10%	49.1 38.9 33.3 30.5 28.3 25.7 24.3 23.3	26.4 22.0 18.8 17.5 15.7 15.1 14.5 14.0	24.1 19.2 17.3 16.3 16.5 16.1	9.5 8.8 9.1 9.3 9.4 9.7 9.9 10.0 10.3 10.5
pH (time/reading) +/- 0.2	7.17 7.19 7.22 7.23 7.22 7.22 7.22 7.22	7.43 7.83 8.01 8.08 8.12 8.16 8.17 8.17	8.39 8.44 8.49 8.52 8.54 8.54	8.60 8.72 10.30 10.66 10.95 10.83 10.58 10.46 10.40 10.41
Purge Volume	4 Gal	4 Gal	2 1/2 Gal	
Sample Date/Time	6-13-16 / 0915	6-13-16 / 1005	6-13-16 / 1044	6-13-16 / 1132
Comments	Purge Rate: 400 mL MSMSD Collected	Purge Rate: 400 mL Duplicate Collected	Purge Rate: 400 mL	Purge Rate: 400 mL
Deviations from plan (e.g., well bailed)				

This form presumes use of dedicated purge/sample pumps and in-line flow cell for data retrieval. Please fully describe any variation from the written sampling plan.

GROUNDWATER SAMPLING DATA SHEET

WYNNEWOOD REFINING

Sampler Name(s) Aaron Gilbert / Jerome McSorley   Date: 6-13-16   Page 2 of 6

Weather Conditions   Days since last precip. 0   Air Temp. 72°   Wind 5 mph

Well ID	SMW-18	SMW-1	UMW-3	UMW-1
Well Inspection (verify condition of each of the following:)				
-Lock	✓	✓	✓	✓
-Well Pad	✓	✓	✓	✓
-Protective Casing	✓	✓	✓	✓
-Well Cap	✓	✓	✓	✓
-Measurement Mark	✓	✓	✓	✓
-Well Identification	✓	✓	✓	✓
Water Level Date/Time	6-7-16	6-7-16	6-7-16	6-6-16
Water Level	14.26	14.04	8.29	21.53
Purge Start Date/Time	6-13-16/1305	6-13-16/1340	6-13-16/1430	6-14-16/0755
Temperature (time/reading) °C +/- 0.6	18.54 18.37 18.33 18.40 18.39 18.39 18.40	19.30 19.21 19.19 19.21 19.19 19.22	20.31 19.48 19.74 19.87 19.95 19.98	19.92 18.89 18.36 18.84 18.83 18.84
Specific Conductance ms/cm3 (time/reading) 3%	1.083 1.073 1.073 1.072 1.073 1.073 1.073	1.222 1.269 1.272 1.271 1.271 1.270	1.237 0.938 0.671 0.640 0.644 0.654	1.197 1.380 1.419 1.431 1.434 1.435
Dissolved Oxygen (time/reading) 10%	14.1 11.1 9.9 9.4 9.0 8.9 8.5	8.8 12.4 14.3 14.9 15.4 15.8	1.89 17.1 16.9 17.2 17.2 17.3	55.9 50.2 49.7 49.4 49.7 49.7
pH (time/reading) +/- 0.2	8.25 7.96 7.92 7.91 7.88 7.87 7.85	7.86 7.81 7.79 7.78 7.78 7.76	7.70 7.49 7.51 7.49 7.46 7.52	5.41 5.84 5.99 6.04 6.09 6.11
Purge Volume	4 Gal	2 1/2 Gal	2 1/2 Gal	1 1/2 Gal
Sample Date/Time	6-13-16/1327	6-13-16/1400	6-13-16/1449	6-14-16/0815
Comments	Purge Rate: 400 mL	Purge Rate: 400 mL	Purge Rate: 400 mL	Purge Rate: ~~400~~ 250 mL
Deviations from plan (e.g., well bailed)				

This form presumes use of dedicated purge/sample pumps and in-line flow cell for data retrieval. Please fully describe any variation from the written sampling plan.

GROUNDWATER SAMPLING DATA SHEET

Sampler Name(s): Aaron Gilbert / Jerome McSorley   Date: 6-14-16   Page 3 of 6

Weather Conditions: Days since last precip. 0   Air Temp. 69°   Wind 5 MPH

Well ID	NMW-12	NMW-6	MARTIN POND	S MARTIN WELL
Well Inspection (verify condition of each of the following:)				
-Lock	✓	✓		
-Well Pad	✓	✓		
-Protective Casing	✓	✓		
-Well Cap	✓	✓		
-Measurement Mark	✓	✓		
-Well Identification	✓	✓		
Water Level Date/Time	6-6-16	6-6-16		
Water Level	20.43	19.29		
Purge Start Date/Time	6-14-16 / 0910	6-14-16 / 0830		
Temperature (time/reading) °C +/- 0.6	19.93 19.28 19.14 19.09 19.06	19.53 19.76 20.48 20.46 20.41 20.37 20.37		
Specific Conductance ms/cm3 (time/reading) 3%	1.675 1.475 1.420 1.410 1.402	1.487 1.436 1.639 1.659 1.677 1.691 1.698		
Dissolved Oxygen (time/reading) 10%	38.4 32.9 31.1 31.5 32.2	52.7 34.9 37.6 35.0 32.4 33.2 34.3		
pH (time/reading) +/- 0.2	7.80 8.03 8.21 8.28 8.27	6.31 6.45 7.30 7.31 7.34 7.46 7.49		
Purge Volume	2 Gal	2 Gal		
Sample Date/Time	6-14-16 / 0936	6-14-16 / 0853	6-14-16 / 1030	6-14-16 / 1100
Comments	Purge Rate: 200 mL	Purge Rate: 200 mL	VIA BAILER	HOUSE WELL HOSE CONNECTION
Deviations from plan (e.g., well bailed)				

This form presumes use of dedicated purge/sample pumps and in-line flow cell for data retrieval. Please fully describe any variation from the written sampling plan.

GROUNDWATER SAMPLING DATA SHEET

WYNNEWOOD REFINING

Sampler Name(s) Aaron Colbert / Jerome McSorley Date: 6-14-16 Page 4 of 6

Weather Conditions Days since last precip. Ø Air Temp. 75° Wind 5 mph

Well ID	McLAUGHLIN well	SMW-25	SMW-19	SMW-23
Well Inspection (verify condition of each of the following:)				
-Lock		✓	✓	✓
-Well Pad		✓	✓	X
-Protective Casing		✓	✓	✓
-Well Cap		✓	✓	✓
-Measurement Mark		✓	✓	✓
-Well Identification		✓	✓	✓
Water Level Date/Time		6-7-16	6-8-16	6-8-16
Water Level		7.45	6.59	6.76
Purge Start Date/Time		0955 / 6-15-16	1050 / 6-15-16	6-15-16 / 1330
Temperature (time/reading) °C +/- 0.6		18.97, 18.80, 18.81, 18.81, 18.84, 18.80, 18.79, 18.82, 18.81	19.12, 19.18, 19.20, 19.20, 19.15, 19.33	20.44, 20.15, 20.13, 20.18, 20.19, 20.18
Specific Conductance ms/cm3 (time/reading) 3%		0.243, 0.229, 0.227, 0.225, 0.227, 0.228, 0.231, 0.235, 0.237	0.886, 0.905, 0.907, 0.905, 0.904, 0.903	2.698, 2.653, 2.624, 2.608, 2.596, 2.591
Dissolved Oxygen (time/reading) 10%		47.9, 39.1, 41.4, 40.4, 37.5, 37.3, 40.1, 37.9, 38.3	52.9, 46.2, 43.9, 42.6, 41.1, 39.7	32.3, 25.6, 23.5, 22.2, 21.2, 21.0
pH (time/reading) +/- 0.2		8.43, 7.90, 7.60, 7.52, 7.34, 7.21, 7.07, 6.98, 6.96	6.95, 6.93, 7.01, 7.00, 7.05, 7.16	7.87, 8.16, 8.30, 8.37, 8.40, 8.44
Purge Volume		4 1/2 Gal	3 Gal	3 1/2 Gal
Sample Date/Time	6-14-16 / 1130	6-15-16 / 1028	6-15-16 / 1115	6-15-16 / 1358
Comments	HOUSE WELL - FAUCET	Purge Rate: 400 mL	Purge Rate: 300 mL	Purge Rate: 300 mL
Deviations from plan (e.g., well bailed)				

This form presumes use of dedicated purge/sample pumps and in-line flow cell for data retrieval. Please fully describe any variation from the written sampling plan.

GROUNDWATER SAMPLING DATA SHEET

WYNNEWOOD REFINING

Sampler Name(s) Aaron Gilbert / Jerome McSorley Date: 6-15-16 Page 5 of 6

Weather Conditions Days since last precip. 1 Air Temp. 90° Wind 5 MPH

Well ID	BMW-4	BMW-25	BMW-26	BMW-20A
Well Inspection (verify condition of each of the following:)				
-Lock	✓	✓	✓	✓
-Well Pad	✓	✓	✓	✓
-Protective Casing	✓	✓	✓	✓
-Well Cap	✓	✓	✓	✓
-Measurement Mark	✓	✓	✓	✓
-Well Identification	✓	✓	✓	✓
Water Level Date/Time	6-8-16	6-8-16	6-8-16	6-8-16
Water Level	5.56	5.28	2.98	5.74
Purge Start Date/Time	6-15-16 / 1440	6-15-16 / 1525	6-16-16 / 0910	6-16-16 / 0820
Temperature (time/reading)	20.49 20.23 20.18 19.98 19.99 20.06	21.62 21.45 21.54 21.43 21.43 21.45 21.47 21.34	20.41 20.49 20.47 20.42 20.40	21.72 17.62 17.75 17.60 17.65 17.60 17.62 17.60 17.60 17.62 17.61
Specific Conductance (time/reading) 3%	2.806 2.039 1.795 1.779 1.675 1.707	1.160 1.244 1.171 1.205 1.224 1.246 1.246 1.248	0.962 1.183 1.259 1.263 1.265	1.175 0.975 1.039 0.975 1.013 0.973 0.992 0.974 0.998 0.981 0.978
Dissolved Oxygen (time/reading) ± 10%	18.6 17.3 18.0 18.9 18.7 19.0	14.0 23.9 16.8 18.2 20.9 22.8 23.9 23.4	95.2 9.4 7.3 7.4 7.7	145.3 21.1 70.5 18.3 49.2 16.9 39.3 16.9 34.7 29.3 25.0
pH (time/reading) 0.2	8.15 7.67 7.53 7.49 7.50 7.46	7.13 7.53 7.0 7.65 7.06 7.22 7.44 7.45	7.19 8.76 9.04 9.16 9.19	7.06 6.94 6.97 6.94 7.06 6.94 6.39 6.94 6.86 6.92 6.94
Purge Volume	3½ Gal	4 Gal	2½ Gal	4½ Gal
Sample Date/Time	6-15-16 / 1504	6-15-16 / 1558	6-16-16 / 0930	6-16-16 / 0853
Comments	Purge Rate: 400 ML Duplicate 2 Collected	Purge Rate: 400 ML	Purge Rate: 200 mL Pre Purge 1 Gal	Purge Rate: ~~300 mL~~ 400
Deviations from plan (e.g., well bailed)				

This form presumes use of dedicated purge/sample pumps and in-line flow cell for data retrieval. Please fully describe any variation from the written sampling plan.

GROUNDWATER SAMPLING DATA SHEET

WYNNEWOOD REFINING

Sampler Name(s) Aaron Gilbert / Jerome McSorley Date: 6-16-16 Page 6 of 6

Weather Conditions Days since last precip. 2 Air Temp. 85 Wind 5 MPH

Well ID	SMW-24	SMW-2	BMW-27	BMW-28
Well Inspection (verify condition of each of the following:)				
-Lock	✓	✓	✓	✓
-Well Pad	✓	✓	✓	✓
-Protective Casing	✓	✓	✓	✓
-Well Cap	✓	✓	✓	✓
-Measurement Mark	✓	✓	✓	✓
-Well Identification	✓	✓	✓	✓
Water Level Date/Time	6-7-16	6-7-16	6-8-16	6-8-16
Water Level	7.94	10.54	3.28	7.67
Purge Start Date/Time	1005 / 6-16-16	6-16-16 / 1100	6-16-16 / 1415	6-16-16 / 1340
Temperature (time/reading)	22.44 19.32 19.23 19.30 19.28 19.27 19.21 19.26 19.17 19.29 19.16 19.32	22.94 18.69 18.60 18.59 18.58 18.58	[illegible] 19.19 21.48 19.19 19.36 19.03 19.10 19.15 19.72	32.76 19.18 18.92 18.91 18.95 18.89 18.90
Specific Conductance (time/reading)	0.187 0.235 0.269 0.233 0.257 0.232 0.249 0.230 0.244 0.231 0.240 0.239	0.426 2.070 2.161 2.142 2.180 2.214	[illegible] 1.701 1.340 1.700 1.467 1.710 1.716 1.708 1.705	2.099 1.320 1.322 1.335 1.339 1.338 1.337
Dissolved Oxygen (time/reading)	78.2 50.5 39.9 51.8 41.8 51.9 42.4 50.9 45.8 52.3 45.7 47.5	60.9 19.9 18.1 16.8 17.2 16.9	[illegible] 64.9 97.8 63.3 92.2 81.8 75.6 69.7 68.8	59.4 54.0 83 136.8 82.0 80.3 78.3
pH (time/reading)	13.64 7.71 10.07 7.52 9.10 7.38 8.37 7.26 8.11 7.22 7.91 7.80 [illegible]	6.33 6.93 6.98 6.96 6.95 6.92	[illegible] 8.96 7.33 8.93 7.57 8.27 8.53 8.84 8.89	6.89 5.46 5.99 5.93 6.27 6.20 6.21
Purge Volume	4 1/2 Gal	3 Gal	3 Gal	2 1/2 Gal
Sample Date/Time	6-16-16 / 1041	6-16-16 / 1123	6-16-16 / 1440	6-16-16 / 1404
Comments	Purge Rate: 400 mL	Purge Rate: 400 mL	Purge Rate 300 mL	Purge Rate: 400 mL 300
Deviations from plan (e.g., well bailed)				

This form presumes use of dedicated purge/sample pumps and in-line flow cell for data retrieval. Please fully describe any variation from the written sampling plan.

CALIBRATION FORM
YSI 556

WYNNEWOOD REFINING
A CVR Energy, Inc. Company

Pre-Use Calibration

Date: 6-10-16 Time: 0730 am/pm

Instrument Serial Number:

Barometric Pressure (source?) 29.98 - correction (inHg) 737.41

Get correction: http://www.csgnetwork.com/barcorrecthcalc.html 0.9483 at WRC office

Convert: mmHg = inHg x 25.4

Dissolved Oxygen Reading in saturated air	97	26.25°
ConductivityRange one calibration, e.g. (717 µS) (clear)	1.409	23.62°
pH low point calibration, (e.g., 4.0 (pink))	4.0	23.59°
pH mid point calibration, (e.g., 7.0 (yellow))	6.94	23.41°
pH high point calibration, (e.g.,10.0 (blue))	9.63	23.24°
Temperature is factory calibrated:		

Post-Use Calibration

Date: 6-10-16 Time: 1000 am/pm

Dissolved Oxygen Reading in saturated air	97	22.60°
ConductivityRange one calibration, e.g. (717 µS) (clear)	1.409	21.69°
pH low point calibration, (e.g., 4.0 (pink))	4.0	22.54°
pH mid point calibration, (e.g., 7.0 (yellow))	6.97	22.01°
pH high point calibration, (e.g.,10.0 (blue))	9.58	22.36°

Comments and/or description of work activities performed with instrument:

Groundwater Sampling

Calibrated by: Aaron Gilbert

CALIBRATION FORM
YSI 556

WYNNEWOOD REFINING
A CVR Energy, Inc. Company

Pre-Use Calibration

Date: 6-13-16 Time: 0800 am/pm

Instrument Serial Number:

Barometric Pressure (source?) 30.01 - correction (inHg) 738.17

Get correction: http://www.csgnetwork.com/barcorrecthcalc.html 0.9483 at WRC office

Convert: mmHg = inHg x 25.4

Dissolved Oxygen Reading in saturated air	97.1	21.73°
ConductivityRange one calibration, e.g. (717 µS) (clear)	1.408	21.60°
pH low point calibration, (e.g., 4.0 (pink))	4.0	21.78°
pH mid point calibration, (e.g., 7.0 (yellow))	7.0	21.64°
pH high point calibration, (e.g.,10.0 (blue))	9.79	21.78°
Temperature is factory calibrated:		

Post-Use Calibration

Date: 6-13-16 Time: 1810 am/pm

Dissolved Oxygen Reading in saturated air	97.1	19.40°
ConductivityRange one calibration, e.g. (717 µS) (clear)	1.408	21.54°
pH low point calibration, (e.g., 4.0 (pink))	4.01	21.68°
pH mid point calibration, (e.g., 7.0 (yellow))	7.0	21.91°
pH high point calibration, (e.g.,10.0 (blue))	10.01	21.75°

Comments and/or description of work activities performed with instrument:

Changed the membrane on the DO probe.

Groundwater Sampling

Calibrated by: [signature]

CALIBRATION FORM
YSI 556

WYNNEWOOD REFINING
A CVR Energy, Inc. Company

Pre-Use Calibration

Date: 6-14-16 Time: 0730 am/pm

Instrument Serial Number:

Barometric Pressure (source?) 30.01 - correction (inHg) 738.17

Get correction: http://www.csgnetwork.com/barcorrectthcalc.html 0.9483 at WRC office

Convert: mmHg = inHg x 25.4

Dissolved Oxygen Reading in saturated air	97.1	21.73°
ConductivityRange one calibration, e.g. (717 µS) (clear)	1.408	21.60°
pH low point calibration, (e.g., 4.0 (pink))	4.0	21.78°
pH mid point calibration, (e.g., 7.0 (yellow))	7.0	21.64°
pH high point calibration, (e.g.,10.0 (blue))	9.79	21.78°
Temperature is factory calibrated:		

Post-Use Calibration

Date: 6-14-16 Time: 1300 am/pm

Dissolved Oxygen Reading in saturated air	96.5	21.86°
ConductivityRange one calibration, e.g. (717 µS) (clear)	1.417	22.57°
pH low point calibration, (e.g., 4.0 (pink))	4.01	22.37°
pH mid point calibration, (e.g., 7.0 (yellow))	7.0	22.37°
pH high point calibration, (e.g.,10.0 (blue))	9.78	22.46°

Comments and/or description of work activities performed with instrument:

DO and High point PH were both out of range

Calibrated by: [signature]

CALIBRATION FORM
YSI 556

WYNNEWOOD REFINING
A CVR Energy, Inc. Company

Pre-Use Calibration

Date: 6-15-16 Time: 0720 am/pm

Instrument Serial Number:

Barometric Pressure (source?) 29.83 - correction (inHg) 733.60

Get correction: http://www.csgnetwork.com/barcorrecthcalc.html 0.9483 at WRC office

Convert: mmHg = inHg x 25.4

Dissolved Oxygen Reading in saturated air	96.5	21.86°
ConductivityRange one calibration, e.g. (717 µS) (clear)	1.417	22.57°
pH low point calibration, (e.g., 4.0 (pink))	4.01	22.37°
pH mid point calibration, (e.g., 7.0 (yellow))	7.0	22.37°
pH high point calibration, (e.g.,10.0 (blue))	9.78	22.46°
Temperature is factory calibrated:		

Post-Use Calibration

Date: ______________ Time: ____________am/pm

Dissolved Oxygen Reading in saturated air ____________

ConductivityRange one calibration, e.g. (717 µS) (clear) ____________

pH low point calibration, (e.g., 4.0 (pink)) ____________

pH mid point calibration, (e.g., 7.0 (yellow)) ____________

pH high point calibration, (e.g.,10.0 (blue)) ____________

Comments and/or description of work activities performed with instrument:

Calibrated by: ______________________________

Appendix 3 – Comprehensive Remediation Plan Work Progress Diagram

Comprehensive Remediation Plan
August 12, 2015 (Revised – August 30, 2016)

In Anticipation of ODEQ Approval

August 2015
1. Install 3 Monitoring Wells
2. Abandon Wells/Sump
3. Rehabilitate Wells
4. PLF/NPA Enhancements
   1. MOC Approvals
   2. RFP Bid Documents

September 2015
1. Quarterly GW Measurements
2. Install Dedicated Sampling Pumps
3. Comprehensive GW Sampling Event
4. LNAPL API Gravity Sampling Event
5. PLF/NPA Enhancements
   1. Bid Selection
   2. Begin Construction

↓

Complete PLF/NFA Enhancements
(Est. 6 months)

After Formal ODEQ Approval

Interior Delineation

↓

Direct-Push Sampling Event
Spring 2016
1. Dissolved-Plume Delineation
2. LNAPL Plume Delineation

↓

Transmit analytical report to ODEQ

↓

LNAPL Transmissivity Testing
Spring 2016
1. South Process Area
2. North Process Area

↓

Letter Report and Recommendations
Spring 2016
1. Additional Monitoring Wells
2. PLF/NPA/SPA Remediation System Upgrade Designs

↓

Install New Wells, pending ODEQ Approval- *Fall 2016*
1. Monitoring Wells
2. Recovery Wells

↓

Sample New Monitoring Wells
Fall 2016

↓

Build-out PLF/NPA/SPA System Upgrades
Est. 6 months (Spring/Summer 2017)

North Boundary Injection Project

↓

Tracer Test
Spring 2016

↓

Bench-Scale Testing
Spring 2016, if favorable

↓

Letter Report
Summer 2016

↓

Pilot Test
Fall/Winter 2016

↓

Letter Report and Recommendations
Fall/Winter 2016
1. Full Scale Injection Program

↓

Full Scale Injection Program
Spring 2017

South Boundary Remediation System

↓

Install Test Well
November 2015

↓

Conduct Yield Test
December 2015

↓

Letter Report and Recommendations
Spring 2016
1. South Boundary System Design

↓

Build-out South Boundary Remediation System
Fall 2016

Appendix 4.2.A – Recovery System Operation and Maintenance Field Logs

Date: 1-26-16

Project #: 3192GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refining Co. Wynnewood, OK

Client:

	AM	NOON	PM
TEMP.	30's Mostly Cloudy	45°F Mostly Cloudy	50's Mostly Cloudy
WEATHER	N Winds 10-15mph	N Winds 10-15mph	N Winds 15-20mph

Time	Activity
0715	Enroute to site. Refueled vehicle
0845	At Refinery; Met with Evan Hilburn; discussed SOW; obtained permit For PLF area
0915	Break (2.50 hrs)
1145	Lunch Meeting (-1.25) hrs.
1300	At NRW-1-4; Met with Safety; obtained permit to access vault. System readings & O&M; Performed Recovery Rate test on NRW-1, 2, 3 & 4
~1430	Jerome McSorley offsite; continued O&M activities
1450	Signed out of light oils & signed off on permit to access vault; Enroute to obtain new vehicle access permits
1530	Received approval from Jerry Merrell to enter plant. We can pick up new permits around lunch-time tomorrow; Enroute to LRW-3
1540	At LRW-3: O&M & System readings; Performed Recovery Rate Test
1630	Enroute to dispose of water
	Disposed of water; stored equipment in Env office
1715	Enroute to OKC
1845	Secured vehicle & equipment; End-Time

SIGNATURE:

NOTE: Please use ink. Record general progress of project. Detail problems and actions taken, injuries, equipment breakdown, unusual conditions or situations, out of scope work, inspections, hiring/firing of personnel and any other occurrences which may affect this project. This log may be utilized as a legal document.

Date: 1-26-16

Project #: 3192 VRU

StanTech

Page: 1 of 1

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refining Co. Wynnewood, OK

Client:

	AM	NOON	PM
TEMP.	30's Mostly Cloudy		
WEATHER	N Winds 10-15mph		

Time	Activity
0915	At Light Oils; Met with operator regarding SOW; obtained permit; Began O&M on VRU.
	System off: High Level Alarm triggered. Reset Alarm - System started up; observed moisture pulling into Moisture Separator Tank; shut off system for O&M.
≈ 1000	Jerome McSorley at VRU
	Removed clean out cap from discharge pipe: no sediment or water resting in ~~area~~ clean out line.
	Cleaned out Moisture Seperator Tank; thin layer of sediment resting in the bottom of MST. Flushed ≈40 gallons of clean water through MST & discharge line. Observed water draining out of discharge line into sewer cup. Secured end cap on clean out line. Re-assembled VRU; obtained system data.
	System Readings: North: -20.1" H_2O; East: ~~-31~~" -11.5" H_2O; West: -7.1" H_2O; Stack: 23.6 PPM; Vacuum Meter: 2.6" Hg
1145	Completed O&M on VRU; signed out of Light Oils area

SIGNATURE:

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Date: 1-27-16

Project #: 3192 GENERAL

StanTech

Page: 1 of 1

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refining Co. Wynnewood, OK

Client:

	AM	NOON	PM
TEMP.	34°F Sunny	50°F Sunny	50s Sunny
WEATHER	WSW Winds 5-10mph	SW Winds 1-5mph	SW Winds 1-5mph

Time	Activity
0730	Enroute to site
0845	Onsite; obtained equipment from Env. office, Met with Light Oils operater reg SOW at NRW-5,6,&7. Signed into Light Oils area
0930	At ~~tight~~ control box for NRW-5,6,&7; O&M on system, Recovery Rate Tests on pumps
1150	Obtained new vehicle access permits
1200	Obtained Permit to access PLF area
1210	Signed out of Light Oils
1230	Signed into PLF area; Began O&M on system; Restored power to BRW-6,7,&8; Continued O&M and Recovery Tests
1630	Signed out of PLF; Enroute to dispose of water at U-Ditch
1655	Stored tote under stairs of equipment trailer near the SE Gate; Enroute to store equipment in Env. Office
1715	Enroute to OKC
1845	Secured vehicle & equipment; End-Time

SIGNATURE: [signature]

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Date: 1-26-16 & 1-27-16

Sampler: Gerald Fields, Kyle Fishburn

Recovery Rate Test Procedures

1. Fill graduated bucket to a selected volume (64 oz or 112 oz). Record time it takes to fill bucket to that line on bucket.
2. Set bucket aside for a minimum of 5 minutes to allow product and water to separate.
3. Note if there is a sheen or if measureable product is present in bucket.

Well ID	Volume (oz)	Time (sec)	Sheen Present (Y/N)	Measureable Product (Y/N)	Estimated Product (oz)
PLF (all wells)	160	5	N	N	—
BRW-6	175	5	Y	N	—
BRW-7	133	6	N	N	—
BRW-8	128	6	N	N	—
NRW-1	120	29	Y	N	—
NRW-2	124	65	Y	N	—
NRW-3	128	23	Y	N	—
NRW-4	128	31	Y	N	—
NRW-5	125	8	Y	N	—
NRW-6	120	11	Y	Y	1
NRW-7	128	18	Y	N	—
LRW-3	128	12	N	N	—

Date: 2-29-16

Project #: 3192 GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	50°F Sunny	65°F Sunny	70°F Sunny
WEATHER	S Winds 10-15 mph	S Winds 10-15 mph	S Winds 10-15 mph

Time	Activity
0700	Enroute to site
	Break (-1.25 hrs)
0930	In Wynnewood; donned PPE. met with Evan Hillburn; obtained permit & equipment. Water storage tote is with drillers; will try to locate
	Unable to locate tote
1005	At PLF; signed into unit; O&M on Remd system; system running OK. BRW-6 working properly
1035	Signed out of PLF; Enroute to LRW-3; LRW-3 working properly
	Met with Jerome McSorley; discussed options to keep strainer & Totalizer from getting plugged up.
1145	Signed out of Refinery; Lunch (-1.25 hrs)
1300	At Refinery; continued O&M on Remd. system
1320	Signed into Light Oils; Called safety to access NRW-4; continued O&M on Remd. systems
1335	obtained permit from safety; continued O&M; Totalizer shut off while flushing strainer; cleaned battery contacts - Meter working properly. Totalizer changed from 665915 to 777940 once batteries were re-installed; continued O&M activities
	O&M activities at NRW-5, 6, & 7
1615	Signed out of Light Oils Area; signed off on safety permit for NRW-1, 2, 3, & 4; stored equipment at Env. Office
	At LRW-3; measured plumbing; discussed options for installing larger strainer
1700	Signed out of refinery; Enroute to OKC; Refueled vehicle
1845	Secured vehicle & equipment. End-Time

SIGNATURE: [signature]

Date: 2-26-16

StanTech

Page: 1 of

Project #: 3192GENERAL

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	40F Sunny	52°F Sunny	59°F Sunny
WEATHER	SSW Winds 10-15mph	SSW Winds 10-15mph	SSW Winds 13-19mph

Time	Activity
0645	Enroute to Pumps of Oklahoma
0715	At Pumps of Oklahoma: picked up BRW-6 Pump & LRW-3 screen for Y-strainer (extra screen)
~~0740~~ 0745	Enroute to Wynnewood
0915	At Refinery: Met with Evan Hilburn; discussed SOW; Electrician probably will not make it out to PLF today. Per EH, re-install pump in BRW-6 & try to start it & leave it running.
0945	At Light Oils Area;
1054	Jerome McSorley & Evan Hilburn called with an electrician's contact information, Todd Phillips 337-802-8838 can provide us with assistance @ the PLF area (BRW-6). I will call TP and set up a time to meet him @ the PLF and let JM/EH know when it gets scheduled.
1100	Spoke with Todd Phillips and he will meet us at the PLF's Operators Bldg. @ 1230 today.
	Break 0945-1230 (-2.75 hrs)
1230	At PLF: Met with electricians & operator; signed into PLF Area
1255	Obtained permit; began troubleshooting BRW-6
1435	Started BRW-6
	BRW-6 appears to be working properly after troubleshooting. Will check pump status next monday (2-29-16); obtained readings; closed up BRW-6
1450	Electrician offsite
1455	Phone call with JM reg. BRW-6 update; moved scaffolding to storage shed
1600	BRW-6 running at 4.62 A; Flowrate: 5.8 GPM; Totalizer: 963109 gal.
1605	Signed out of PLF area; checked LRW-3: Flowrate: 3.8 gallons per Minute
1630	At VRU (-0.50 hrs)
1700	Stored equipment in Env. Office; packed vehicle
1715	Enroute to OKC; Refueled vehicle
1900	Secured vehicle & equipment; End-Time

SIGNATURE: [signature]

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Date: 2-26-16

Project #: 3192 VRU

StanTech

Page: 1 of 1

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.			
WEATHER			

Time	Activity
0945	At Light Oils area; signed into unit; No operator present; Project Documentation; prepped for SOW
1030	Operator here; obtained permit; O&M on Remed. system
1054	Jerome McSorley & Evan Hilburn called with an electrician contractors information. Todd Phillips 337-802-8838 can provide us assistance at the PLF area (BRW-6). Call and set up a time to meet and let JM or EH know when it will happen.
1100	Spoke with Todd Phillips and he will meet us at the PLF's Operators Bldg @ 1230 today.
	Flushed out discharge line; cleaned out Moisture separator Tank; reassembled VRU; started system; running @ -3.0 in Hg
1145	Signed out of Light Oils Area
1630	Signed into Light Oils Area; System O&M; system running ok
	VRU stack: 112 ppm Vacuum Gauge: -2.6 in Hg N. Plug: -22" H_2O W. Plug: -8.3" H_2O E. Plug: -12.5" H_2O
1700	Signed out of Light Oils Area

SIGNATURE:

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Date: 2-25-16

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Page: 1 of 1

Project #: 3192GENERAL

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	30s-40s Sunny	48°F Sunny	50s Sunny
WEATHER	N Winds 10-15mph	N Winds 10-15mph	N Winds 10-15mph

Time	Activity
0645	Enroute to Pumps of Oklahoma
0715	At Pumps of Oklahoma; dropped off pump from BRW-6 in order to test pump. They will look into a new screen for the Y-strainer at LRW-3
0735	Enroute to site; purchased supplies; Refueled vehicle (~0.25 hrs)
1007	Phone call with Pumps of Oklahoma; pump appears to be working properly; Tested & ran pump for over an hour without any apparent issues. Normal wear & tear on internal parts of pump. They are continuing to look for solution for LRW-3 Y-strainer screen
1030	At Refinery; donned PPE; attempted contact with Evan Hilburn. left message reg. status of BRW-6 & discussed having electrician come out to check BRW-6
1044	Phone call with EH; he will check into having an electrician come out to BRW-6
1050	At PLF; obtained permit; O&M on Remd. system; closed valve to BRW-6
1115	Turned on pumps in BRW-3, BRW-5, BRW-7 & BRW-8.
1245	Signed out of PLF area; project documentation
1330	At LRW-3. O&M on Remd. system; cleaned strainer, disassembled plumbing; cleaned & flushed impeller on Totalizer (95% covered with biological growth); Re-assembled plumbing; flushed ≈ 17 gallons through Y-strainer
	Disposed of purged water; disposed of trash; loaded vehicle
1715	Offsite; Enroute to OKC
1845	Secured vehicle & equipment; End Time

SIGNATURE:

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Date: 2-24-16

Project #: 3192GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	40s Sunny	52°F Sunny	57°F Sunny
WEATHER	NW Winds 10-15mph	NW winds 10-15mph	WNW winds 12-18mph

Time	Activity
0715	Enroute to site
0830	Onsite: Donned PPE; Met with Jerome McSorley; discussed SOW; Exchanged equipment
0900	At Env. office; Met with Evan Hilburn; obtained permit for PLF; picked up equipment;
0920	At trailers in the SE corner of refinery. Sampling Tote used to store purged water no where to be found; Met with trailer contractors, Excel, & Arron Gilbert reg. tote location.
0956	Phone call with Excel: They located tote
1000	Picked up tote; Enroute to PLF
1015	At PLF: signed into PLF area - O&M on Remd system
1100	shut off BRW-3, BRW-5, BRW-6, BRW-7, & BRW-8
1155	Signed out of PLF
	Lunch Break (~0.75 hrs)
1300	Signed into PLF area: continued O&M on Remd. systems
≈1315	Sam McCormick & Jerome McSorley at PLF area; trouble shooting BRW-6. Per SM & JM pull & clean pump (BRW-6). Take pump to Pumps of Okkhoma for further testing/inspections.
≈1345	SM/JM signed out of PLF
	Completed cleaning pump; completed disposing of decon water;
1600	signed out of PLF area; Enroute to LRW-3
	LRW-3: 1" piping around totalizer, the rest of the plumbing is 3/4" Removed strainer screen out of LRW-4 Y-strainer. Will see what size screen we could exchange LRW-3 with
	Signed off on PLF permit; loaded vehicle; left message w/ JM reg update
1700	Enroute to OKC
1830	Secured vehicle & equipment; End-Time

SIGNATURE:

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Date: 2-18-16

Project #: 3192 GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	60s Sunny	70s Sunny	70s Sunny
WEATHER	SW Winds 15-25mph	SW Winds 15-25mph	SW Winds 15-25mph

Time	Activity
0730	Enroute to site
0845	Onsite; Met with safety orientation trainer; Began safety training
1030	Completed safety training; donned PPE; Obtained equipment from Env. office; left voicemail with Evan Hilburn reg SOW
1100	At PLF; signed into unit; obtained permit from operator; Began O&M on BRW-6
1116	PLF Totalizer 811619; GPM: 3.8 to 3.9 BRW-6 is drawing 0.09A; DTW in BRW-6: 0.57' Reset BRW-6 (3) times. The first & second times BRW-6 would draw 3.48 A & then the pump would turn off and only draw 0.34A after ≈10 seconds. Verified GPM remained at 3.9 GPM & DTW remained the same
1138	Reset BRW-6 for the third time. pump was drawing 3.48A. Pump remained on for 5 minutes. Flowrate: 5.2GPM DTW: 3.27'
1143	Pump shut off; Witnessed DTW rise back to 0.57'
	Phone call with Project Manager/Remd. Manager BRW-3 running at 0.57A; BRW-5 running at 1.13A; BRW-6 at 0.34 A Flowrate: 3.9 GPM shut off BRW-3 & BRW-5: GPM = Ø
	Phone call with Pumps of Oklahoma. Most probable cause is obstruction in pump (impellers) or obstruction in line. Power shouldn't be the issue since BRW-7 & 8 are working properly Phone call with Remd Manager/Project Manager
	Phone call with Jerome McGorley; Per JM Turn all pumps back on & come back next week to pull pump & diagnose issues
1335	All pumps online (BRW-6 still not running)
1341	Totalizer: 812129 Flowrate: 4.7GPM
1350	Signed out of PLF Area; Enroute to VRU
	*** CONTINUED ON PAGE 2 ***

SIGNATURE:

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Date: 2-18-16

Project #: 3192 GENERAL

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Page: 2 of 2

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.			
WEATHER			

Time	Activity
	*** CONTINUED FROM PAGE 1 ***
	Checked VRU; Running OK
	Turned equipment in to Environmental office
1415	Enroute to OKC, Refueled vehicle
1545	Secured vehicle/equipment; End-Time

SIGNATURE:

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Date: 2-10-16

Project #: 3192GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery Wynnewood, OK

Client:

	AM	NOON	PM
TEMP.		70s S. winds 15-20mph	
WEATHER		Sunny	

Time	Activity
1200	At office, loaded vehicle; enroute to site
1330	Onsite, met with Evan Hilburn; obtained PLF permit
1415	At PLF; BRW-6 is drawing 0.09A; BRW-7: 2.78A; BRW-8: 2.02A
1425	Unplugged BRWs 6-8. Reset breakers (3) times; plugged in BRW-6 and it now reads 3.48A
1440	Checked PLF flowrate: 5.6 GPM; 761655 GAL (BRW-3, BRW-5, & BRW-6 ONLY)
1445	BRW-6: ~~[illegible]~~ 3.4 GPM; fluid level in BRW-6 remains at TOC
	Removed pump in BRW-6; cleaned intake area of pump; recirculated fluids back into BRW-6 for ~ 15 mins; pump seems to be pumping at max GPM
1600	BRW-6 DTW: 3.33' after ~15 mins of operation; BRWs 7 & 8 remain offline; called EH with an update on BRW-6.
1625	BRW-6: 4.8 GPM; 762086 GAL
1630	Called Jerome McSorley and discussed O&M on BRW-6. Per JM leave BRW-7 & 8 pumps offline.
1640	BRW-6: 5.3 GPM
1645	Checked out of the PLF area; returned supplies to EH's office
1700	Offsite
1815	End time; vehicle and equipment secured.

SIGNATURE: Gerald A. Fields

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Date: 3-22-16

Project #: 3192 GENERAL

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Page 1 of 1

DAILY PROJECT LOG

Project Name: CUR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	50s-60s Sunny	67°F Sunny	72°F Sunny
WEATHER	S Winds 10-15mph	S Winds 15-20 mph	S Winds 15-25mph

Time	Activity
0700	At office; Reviewed SOW; loaded vehicle. Enroute to site; picked up rental equipment; purchased supplies.
0915	Updated Jerome McSorley with our ETA; Enroute to site from Norman, OK; Refueled vehicle.
1015	At Refinery: Met Environmental staff; obtained equipment from Env. office; H&S Meeting.
1045	At LRW-3; obtained readings & measurements; picked up supplies from warehouse, cut superstrut to fit LRW-3 box.
	(-1.00 hrs) Meal
1245	At Refinery; continued O&M on LRW-3.
	Completed installing 2" Y-strainer & re-directed plumbing for LRW-3. Discharge line has a very strong back-pressure on the line, we will test pump tomorrow when back-pressure resides; secured area.
1900	Enroute to OKC.
2030	Secured vehicle & equipment; End-Time.

SIGNATURE:

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Date: 3-23-16

Project #: 3192 GENERAL

StanTech

Page 1 of 1

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	60°F Partly Cloudy	72°F Partly Cloudy	80°F Partly Cloudy
WEATHER	SSW Winds 15-20mph	SSW Winds 15-20mph	SSW Winds 15-25mph

Time	Activity
0715	Enroute to equipment rental store.
0730	Checked in rental equipment.
0745	Enroute to site.
0900	At Refinery; Met with Jerry Merrell; obtained badge; H&S Meeting. Checked status of LRW-3: discharge line still has strong backpressure. ≈ 20-30 gpm of back pressure; swing check valve preventing back pressure from reaching flow-meter. Turned on LRW-3 pump: No Flow - unable to push through check valve. Left pump running to see if totalizer changes. Totalizer at: 533270
	Disposed of accumulated water from discharge line.
1015	At VRU. (~3.50 hrs)
1345	At NRW-1,2,3,&4; Met with Safety & obtained permit; Flowmeter showing 0.0 GPM. Totalizer has changed from 777940 to 778247 since 2-29-16. The "8" on the totalizer number was very faded. obtained data from pumps & flushed strainer.
	Disassembled plumbing & cleaned out Totalizer (90% blocked with biological growth on impellers).
	Re-assembled plumbing & tested system: Running OK at 9.6 GPM; We will Replace batteries in Totalizer; Researched batteries - Found supplier in OKC.
1535	Completed work at NRW-1,2,3,4; signed off on safety permit at Light Oils; Met with Env. staff reg SOW.
1600	Enroute to OKC - spoke with Jerome McGorley reg site update; Per JM we will purchase 4 new batteries.
	Purchased batteries.
1745	Secured vehicle & equipment; End-Time.

SIGNATURE:

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Date: 3-23-16

Project #: 3192 VRU

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.			
WEATHER			

Time	Activity
1015	At VRU; signed into Light Oils & obtained permit.
	High Level Alarm triggered; drained Moisture Separator Tank; cleaned out sand from MS Tank; Modified float to trigger the pump to come on sooner.
	Flushed out M.S. Tank & tested float switch for pump: working properly.
1215	Lunch (-1.00 hrs)
1315	At VRU; obtained readings; checked system.
	System Readings: North: $-20.4''H_2O$ East: $-11.5''H_2O$ West: $-7.4''H_2O$ Stack: 36 ppm Vacuum Meter: -2.5 in Hg
1345	Signed out of Light oils.

SIGNATURE: [signature]

Date: 3-24-16

Project #: 3192 GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	40s Cloudy	50s Partly Cloudy	60s Sunny
WEATHER	NW winds 10-20mph	NW winds 10-15mph	NW Winds 10-15mph

Time	Activity
0715	Enroute to site.
0840	At Refinery. Met with Environmental staff. obtained permit for PLF area; discussed SOW; H&S Meeting.
0915	At NRW-1,2,3,&4: Met with safety, obtained permit. Replaced batteries in Flowmeter; Met with Evan Hillburn.
	At LRW-3; Met with EH, Aaron Gilbert & Jerome McGorley: discussed LRW-3 back pressure; continued O&M on Remd. systems. Discussed NRW-1,2,3,4: 1½" pvc lines from wells to vault. 4" discharge line from vault to NRW-5,6,7 then to process sewer; EH checking on carrier line
	Lunch (-0.75hrs)
1245	At PLF area; signed into unit; O&M on Remd. system Flowmeter's face-plate is peeling off & Reset button starting to detach from front cover. Checked Warehouse & hardware store for epoxy to bond clear cover back onto front lid. Called manufacturer of Flowmeter. They recommended purchasing new clear cover to apply to lid from Pumps of Oklahoma. Part # 10970_01 for Flowmeter (FM0208).
	Sealed front cover with duct tape to prevent moisture from getting in before new clear cover can be installed.
1555 ~~1600~~	Signed out of PLF. Met with EH reg. flowmeter, left message with JM. EH recommended getting a water proof/sun proof bag to place over flowmeter.
1620	Enroute to OKC
1745	Secured vehicle & equipment, End-Time.

SIGNATURE: [signature]

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Date: 4-27-16

Project #: 3192 GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	63°F Cloudy	71°F Sunny	70s Sunny
WEATHER	SW winds @ 6mph	WNW winds @ 10 mph	NW winds @ 5-10mph

Time	Activity
0715	Enroute to site; refueled vehicle
0900	At refinery; met with Evan Hilburn; obtained permit for PLF; discussed planned scope of work; Health and Safety meeting
0950	At PLF area; met with PLF operator; checked PLF flowmeter - OK
1030	Jerome McSorley called; @ Env office; will met us at the PLF area or at lunch meeting.
1110	Met w/ JM, EH, Aaron Gilbert, & David @ PLF area
1140	Checked out of PLF area
	Break (~1.25 hr)
	Purchased field supplies for PLF area.
1342	Checked into PLF area; cleaned PLF flowmeter box and installed a new flowmeter faceplate and weatherproof bag (to help protect from sunlight and inclement weather conditions).
1530	Checked out of PLF area; enroute to LRW-3
1700	Disposed of decon water at the "V" ditch
1715	Offsite
1845	Vehicle, equipment, and supplies secured; end time.

SIGNATURE: Gerald A. Fields

...cord general progress of project. Detail problems and actions taken, injuries, equipment breakdown, unusual conditions or situations, out of scope work, ...onnel and any other occurrences which may affect this project. This log may be utilized as a legal document.

Date: 4-28-16

Project #: 3192GENERAL

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Page: 1 of 1

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	62°F Sunny	71°F Sunny	78°F Sunny
WEATHER	ENE winds @ 11mph	ENE winds @ 7mph	E winds @ 9mph

Time	Activity
0715	Enroute to site
0830	Onsite ; Health & Safety meeting ; discussed planned scope of work
0842	Phone call from Jerome McSorley – discussed completed and planned scope of
	work ; will meet us later on today prior to noon.
0900	At Light Oils for O&M on the VRU.
1100	Checked out of Light Oils area.
1225	Signed into Light Oils to complete scope of work on the VRU.
1320	Obtained permit to access NRWs 1-4.
1600	Checked LRW-3's flowmeter : OK
	Disposed of water @ "V" Ditch
1630	Signed out of Light Oils ; stored equipment in Env. office ; secured vehicle
	content
1700	Offsite ; sent text messages to JM regarding the flowmeter data for all
	areas ; refueled vehicle.
1845	Vehicle and equipment secured ; end time.

SIGNATURE: Gerald A. Fields

NOTE: Please use ink. Record general progress of project. Detail problems and actions taken, injuries, equipment breakdown, unusual conditions or situations, out of scope work, inspections, hiring/firing of personnel and any other occurrences which may affect this project. This log may be utilized as a legal document.

Date: 4-28-16

Project #: 3192VRU

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	62°F Sunny	71°F Sunny	
WEATHER	ENE winds @ 11mph	ENE winds @ 7mph	

Time	Activity
0900	At Light Oils for O&M on the VRU; obtained permit; signed into unit
0910	VRU cycle: ON; obtained data from VRU
	System Readings: North: −22.1 "H_2O VRU Stack: 46 PPM
	East: −11.5 "H_2O K.O. Tank Vacuum Meter: 2.5 inHg
	West: −9.0 "H_2O
	The screen that holds the check ball in the moisture seperator tank has deteriorated to a point that allowed the cup at the bottom of the screen to fall off. This allowed the check ball to float/move out of the screened area and rest inside of the K.O. tank.
	We will remove the screen and invert it and reassemble the check ball and cup and place back inside the K.O. tank.
0945	JM onsite - disscused VRU O&M
1050	Will need to purchase new screws and washers to hold the plastic cup (check ball rests in the cup) to the screen. The screen has been cleaned and inverted; screen is now attached to the K.O. tank's lid.
1100	Checked out of Light Oils area. (−0.75 hr)
1145	At hardware store to purchase field supplies
1225	Checked into Light Oils; cont. O&M on VRU; installed (3) screws on cup; removed ~2" of sediment from K.O. Tank; reassembled and tested VRU.
1315	Completed O&M on VRU; end time.

SIGNATURE: Gerald A. Fields

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Date: 5-25-16

Project #: 3192GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	79°F Cloudy	82°F Cloudy	84°F Cloudy
WEATHER	S Winds 10-15mph	SSE Winds 10-15mph	SSE Winds 10-15mph

Time	Activity
0715	Enroute to site, Refueled vehicle
0845	Onsite; Met Evan Hilburn reg. SOW; obtained permit for PLF area
	Checked VRU; running OK
0927	Phone call with Jerome McSorley reg. site update. Discussed LRW-3 & VRU status; continued O&M activities
0951	Checked LRW-3; running OK, continued O&M activities
1414	Phone call with EH regarding 2½" x 1¼" bushing needed at strainer at the PLF. Met with Aaron Gilbert at warehouse to pick up needed bushing. Part not found at warehouse. We will pick one up from vendor & install next month; continued O&M activities. Strainer is a 2" Keckley style B 250 LBS.
	Completed O&M on select Remed. systems; Met with EH reg. completed SOW & the needed bushing at the PLF. Stored equipment in Env. office
1615	Enroute to OKC
1745	Secured vehicle & equipment; End-Time

SIGNATURE: [signature]

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Date: 5-24-16

Project #: 3192 GENERAL

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	70s Sunny	81°F Partly Cloudy	70s Cloudy
WEATHER	S Winds 5-10 mph	S Winds 15 mph	S Winds 15-20 mph

Time	Activity
0730	Enroute to site
0845	At Refinery; Met with Env. staff reg. planned SOW; picked up equipment
	Phone call with Evan Hilburn reg SOW
0915	At VRU
1330	Signed out of VRU area; continued O&M activities on other Remd. systems
	Completed O&M activities on select Remd. systems; disposed of generated water in V-Ditch; secured equipment
1700	Enroute to OKC
1830	Secured vehicle & equipment; End-Time

SIGNATURE:

NOTE: Please use ink. Record general progress of project. Detail problems and actions taken, injuries, equipment breakdown, unusual conditions or situations, out of scope work, inspections, hiring/firing of personnel and any other occurrences which may affect this project. This log may be utilized as a legal document.

Date: 5-24-16

Project #: 3192 VRU

StanTech

Page: 1 of 1

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.		91°F Partly Cloudy	
WEATHER		S Winds 15 mph	

Time	Activity
0915	At VRU; System off due to High Vacuum Alarm; signed into Light Oils & obtained permit
	Disassembled Moisture Seperator Tank: Thin layer of sand in the bottom of the MST. Cleaned out MST. Re-assembled MST & tested system. System Running at higher vacuum (≈3.5 in.Hg). No vacuum reading at P&T plugs.
	Opened plugs at East & West VRU lateral lines to vent from atmosphere & remove vacuum. Primed VRU lines by increasing and decreasing vacuum at MST. Pulled water from lines into MST & observed discharge pump kick on successfully.
	Removed large wasp nest from end of discharge line. Discharging OK
	System running ok; continuing to pull in water
	System readings: North: -21.8" H_2O / East: -13.7" H_2O / West: -9.7" H_2O / VRU stack: 128 PPM / MST Vacuum Meter: -2.5 in Hg
	System running OK
1330	Signed out of unit

SIGNATURE:

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Date: 6-16-16

StanTech

Project #: 3192 GENERAL

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	80s Partly Cloudy	90°F Partly Cloudy Heat Index 102	90s Partly Cloudy Heat Index =100s
WEATHER	S Winds 5-10mph	SSW winds 10mph	SSW Winds 5-10mph

Time	Activity
0615	Enroute to OKC
0730	At Refinery; H&S Meeting; Met with Jerome McSorely reg. remaining SOW
0750	Met with Evan Hilburn, obtained permit to access PLF area
0900	Signed into Light Oils area; obtained permit from operator to access NRW-6 near Tank # 254
	At NRW-6 to obtain free product thickness w/ bailer. Dedicated bailer stuck (wrapped up in pump wire); shut off pump & pulled pump to dislodge bailer. Obtained free product thickness with bailer. Re-deployed NRW-6 pump into well. Turned on pump: No leaks, pump running properly
0940	Signed out of light oils area & signed off on light oils permit; continued O&M activities
	Signed into PLF area
	Performed Recovery rate tests on BRW-6, 7, & 8. BRW-6 pump was off. Removed pump wire splices out of flooded well box & allowed to dry off. Restarted pump - pump OK & drawing down
1200	Break (-1.00hrs)
1300	Continued O&M activities at PLF
	Replaced bushing on Y-strainer; All pumps on - system running OK
1510	Signed out of PLF area
	Performed O&M activities & ~~Br~~ Recovery Rate test at LRW-3
	Disposed of water at V-Ditch, Disposed of trash
	Dropped off equipment at Env. office; Correspondence with client
	Loaded vehicle
1700	Enroute to OKC; (-0.25 hrs) traffic delays
1845	Secured vehicle & equipment; End-Time

SIGNATURE: [signature]

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Date: 6-15-16

StanTech

Page: 1 of 1

Project #: 3192 GENERAL

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	80s Sunny	90°F Sunny	93°F (heat index: 108) Sunny
WEATHER	S Winds 5-10mph	S Winds 5-10mph	SSE Winds 5-10mph

Time	Activity
0600	Loaded vehicle
0615	Enroute to site; Refueled vehicle
0745	At Refinery; H&S Meeting; discussed SOW; obtained permit to access PLF area; loaded equipment from Env. office
0815	At Light Oils area for VRU O&M (-1.25 hrs)
0930	Completed VRU O&M; signed out of Light Oils; Enroute to pick up supplies from PLF storage shed
	Purchased ice
1040	Signed into Light Oils; Met with Safety
1050	Obtained permit to enter NRW-1,2,3,4 vault; continued O&M on Remed. system
	Correspondence with Evan Hillman & Jerome McSorley reg. getting PLF area mowed & obtaining proofer test sheets; continued O&M activities
	Break (-1.00 hrs)
	Continued O&M activities
	Completed O&M activities & Recovery Rate Tests at NRW-1,2,3,&4 & NRW-5,6,&7
1615	Phone call with JM reg. completed O&M activities & SOW for tomorrow
	Disposed of generated water at V-Ditch
1650	Checked out of Light Oils area
1700	Enroute to OKC; Purchased supplies; Construction on I-35 in multiple areas (≈0.25hrs) delay
1915	Secured vehicle & equipment; End-Time

SIGNATURE: [signature]

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Date: 6-15-16

Project #: 3192 VRU

StanTech

DAILY PROJECT LOG

Project Name: CVR Wynnewood Refinery

Client:

	AM	NOON	PM
TEMP.	40s Sunny		
WEATHER	S Winds 5 mph		

Time	Activity
0815	At Light Oils Area; System running; checked into unit & obtained permit for VRU O&M
	Obtained system readings North P&T plug: -23.0 "H_2O VRU Stack: 55.9 PPM East P&T plug: -14.4 "H_2O MST Vacuum Meter: -2.5 inHg West P&T plug: -11.9 "H_2O
	Shut off system; checked filter: Dry; Disassembled Moisture Seperator Tank (MST): ≈ ½" of fine grain sand in bottom of MST. Tested pump switches & high level alarm sensors: OK; cleaned out MST; modified float on pump switch is intact & working properly
	Reassembled MST; Turned on system; checked discharge line down to sewer cup: OK
	System running OK
0930	Signed out of Light Oils & signed off on permit

SIGNATURE: [signature]

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Recovery Rate Test Data Sheet

Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Date: 6-15-16 & 6-16-16 Sampler: Gerald Fields / Kyle Fishburn

Recovery Rate Test Procedures

1. Fill graduated bucket to a selected volume (64 oz or 112 oz). Record time it takes to fill bucket to that line on bucket.
2. Set bucket aside for a minimum of 5 minutes to allow product and water to separate.
3. Note if there is a sheen or if measureable product is present in bucket.

	Well ID	Volume (oz)	Time (sec)	Sheen Present (Y/N)	Measureable Product (Y/N)	Estimated Recovered Product (oz)	Estimated Product (oz)	Recovery Rate
	North Process Area							
6-15-16	NRW-1	112	21.61	Y	N	Ø	0	#DIV/0!
	NRW-2	40	25.13	Y	N	Ø	0	
	NRW-3	64	11.00	Y	N	Ø	0	
	NRW-4	64	7.81	Y	N	Ø	0	
	NRW-5	64	3.85	Y	Y	1.5 oz	0	
	NRW-6	64	4.17	Y	Y	0.5 oz	0	
	NRW-7	112	12.43	Y	Y	0.5 oz.	0	
	Product Loading Facility							
6-16-15	BRW-6	112	3.69	Y	N	Ø	0	#DIV/0!
	BRW-7	112	4.29	Y	N	Ø	0	
	BRW-8	112	4.45	Y	N	Ø	0	
	South Process Area							
	LRW-3	112	3.92	Y	N	Ø	0	#DIV/0!

Meter Readings

Wynnewood Groundwater System

NRW-1,2,3 4
METER
METER READINGS
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

DATE	TIME	NRW-1 Flow (GPM)	NRW-2 Flow (GPM)	NRW-3 Flow (GPM)	NRW-4 Flow (GPM)	Combined Flow (GPM)	Totalizer (Gallons)	Calculated Avg-GPM	Comments
3-26-15	1252	—	—	—	—	4.86	427490		7.8 GPM after cleaning Strainer
4-29-15	1252	—	—	—	—	3.80	616590		Cleaned strainer - max flowrate 8.9 GPM
5-27-15	1011	—	—	—	—	4.80	785242		Cleaned Strainer
~~KF~~						~~11.00~~	~~254249~~		~~ROLLOVER~~
6-23-15	1015	—	—	—	—	6.0	990592		
7-27-15	1050	—	—	—	—	5.5	256489		ROLLOVER; cleaned strainer; 11.5 GPM after cleaning
8-25-15	1041	—	—	—	—	6.3	534027		cleaned Strainer
9-22-15	1100	—	—	—	—	4.8	749693		cleaned strainer
10-28-15	1107	—	—	—	—	0.0	750015		cleaned strainer; 7.8 GPM after cleaning
11-24-15	1310	—	—	—	—	6.8	19099		Cleaned strainer; meter has rolled over; 8.8 GPM after Cleaning
12-15-15	1440	—	—	—	—	7.7	166662		cleaned strainer; 10.3 GPM after cleaning
1-26-16	1320	—	—	—	—	7.6	401649		Cleaned strainer; 9.6 GPM after cleaning
2-29-16	1330	—	—	—	—	6.8	665915		Cleaned battery contacts; New totalizer # after cleaning: 777940 Cleaned strainer; 8.2 GPM after cleaning;
3-23-16	1405	—	—	—	—	0.0	778247		The #8 on the display was faded. Will check batteries. cleaned strainer & cleaned out flowmeter - 9.6 GPM after
3-24-16	0920	—	—	—	—	5.9	778322		Replaced batteries; Reset Totalizer to 0.0 gal. Remained at 5.9 GPM

NRW-1,2,3 4

METER
METER READINGS
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

DATE	TIME	NRW-1 Flow (GPM)	NRW-2 Flow (GPM)	NRW-3 Flow (GPM)	NRW-4 Flow (GPM)	Combined Flow (GPM)	Totalizer (Gallons)	Calculated Avg-GPM	Comments
4-28-16	1328	—	—	—	—	Ø	15706		Rollover; cleaned strainer; Max flowrate: 10.7 GPM
5-24-16	1352	—	—	—	—	4.9	200525		cleaned strainer; Max Flowrate 10.5 GPM
6-15-16	1047	—	—	—	—	5.2	353548		cleaned strainer; Max Flowrate: 9.4 GPM Performed recovery rate tests on NRW-1,2,3,&4

NRW-5,6 7
METER
METER READINGS
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

DATE	TIME	NRW-5 Flow (GPM)	NRW-6 Flow (GPM)	NRW-7 Flow (GPM)	Combined Flow (GPM)	Totalizer (Gallons)	Calculated Avg GPM	Comments
6-23-15	0941	—	—	—	9.1	551836		Cleaned Strainer
7-27-15	1435	—	—	—	10.5	17224		Rollover; Cleaned strainer
8-25-15	1317	—	—	—	8.5	404260		Cleaned strainer - max flowrate 17.5 GPM
9-22-15	1258	—	—	—	9.3	735477		Cleared strainer - max flowrate : 10.3 GPM
10-28-15	—	—	—	—	—	—		No access due to construction in area
11-24-15	1409	—	—	—	7.1	386729		Meter rolled over; cleaned strainer; 9.4-12.5 GPM after cleaning
12-16-15	1028	—	—	—	7.5	605467		cleaned strainer; 9.5-15.5 GPM after cleaning
1-27-16	1008	—	—	—	7.6	86740		cleaned strainer; 15.5 GPM after cleaning; Rollover
2-29-16	1503	—	—	—	8.3	449918		cleaned strainer; 13.2 GPM after cleaning
3-24-16	1052	—	—	—	7.2	702853		cleaned strainer; 15.6 GPM after cleaning
4-28-16	1445	—	—	—	7.9	63899		Cleaned strainer; 16.0 GPM after cleaning
5-25-16	1031	—	—	—	8.0	366585		Cleaned strainer; 16.0 GPM after cleaning
6-15-16	1140	—	—	—	7.8	602309		cleaned strainer; 16.4 GPM after cleaning Performed Recovery Rate Tests on NRW-5, 6, & 7

METER NRW-5,6,7

METER PLF

METER READINGS
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

DATE	TIME	Flow (GPM)	Totalizer One (Gallons)	Totalizer Two (Gallons)	Comments
3-19-15	1041	7.2	153773	153773	
3-26-15	1530	8.2	156,502	—	
4-29-15	1031	7.4	525,977	—	Strainer was half full of soft solids; cleaned strainer - max flowrate after cleaning 7.4 GPM.
5-29-15	1011	6.0	808,542	—	strainer was ½ full of soft solids; cleaned strainer; Flowrate remained at 6.0 gpm
6-23-15	1332	2.7	997, 596	—	BRWS 6-8 are off (power issues) Power restored on 6-23-15 @ ≈ 1615
6-25-15	1414	6.1	13864	Rollover	cleaned strainer
7-27-15	1642	6.6	276264	—	cleaned strainer; strainer was ½ full of soft solids; Flowrate after cleaning strainer: 6.8 GPM
8-25-15	1452	6.3	534907	—	cleaned strainer; strainer was 1/4 full of soft solids Flowrate after cleaning strainer: 6.4 GPM
9-22-15	1538	6.0	776242	—	Cleaned Strainer
10-28-15	1510	5.9	80736	—	cleaned strainer; Flowrate after cleaning strainer: 5.9 GPM
11-24-15	1600	5.9	305277	—	Cleaned Strainer; Flowrate after cleaning the Strainer: rollover
12-16-15	1440	5.3	467330	—	cleaned strainer; Flowrate after cleaning the strainer: 5.4 GPM
1-27-16	1320	5.4	656125	—	Restored power to all PLF pumps. Cleaned strainer; flowrate after cleaning strainer: 5.4 GPM

METER PLF

METER PLF

METER READINGS
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

DATE	TIME	Flow (GPM)	Totalizer One (Gallons)	Totalizer Two (Gallons)	Comments
2-18-16	1116	3.9	811619	———	BRW-3, BRW-5, and BRW-6 only ; BRW-7 & BRW-8 are offline
2-18-16	1341	4.7	812129	———	BRW-3, BRW-5, BRW-6 (not running during this reading), BRW-7, and BRW-8 are online
2-24-16	1027	4.9	854100	———	
2-25-16	1132	4.7	854390	———	BRW-3, BRW-5, BRW-7, & BRW-8 running. started up pumps @ 1115
2-26-16	1600	5.8	863109	———	All pumps online. started BRW-6 at 1435
3-24-16	1300	5.4	70773	———	* ROLLOVER ; cleaned strainer ; Flowrate after cleaning: 5.6 GPM
4-27-16	1015	4.5	316559	———	Cleaned strainer; Flowrate after cleaning: 4.5 GPM; Removed and Cleaned faceplate on flowmeter; replaced faceplate & placed weatherproof bag on meter.
5-25-16	1300	4.1	489717	———	cleaned strainer; Flowrate after cleaning: 4.5 GPM. 2½" x 1¼" bushing needs replaced on 2" Keckley style B 250 lbs strainer
6-16-16	1033	3.5	613477	———	Performed recovery rate tests. BRW-6 unable to keep up with water recharging. Able to draw down with BRW 7 & 8 off. Replaced bushing on strainer. Cleaned strainer. Max Flowrate : 3.6 GPM

METER LRW-3
METER READINGS
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

DATE	TIME	Flow (GPM)	Totalizer One (Gallons)	Totalizer Two (Gallons)	Comments
6-16-16	1524	2.1	713091	—	Performed ~~[illegible]~~ recovery rate test Cleaned strainer; Max Flow: 4.4 GPM

METER LRW-3

METER LRW-3

METER READINGS

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

DATE	TIME	Flow (GPM)	Totalizer One (Gallons)	Totalizer Two (Gallons)	Comments
7-27-15	1545	3.2	326132	—	cleaned strainer
8-25-15	1637	2.0	451039	—	Cleaned Strainer; max flowrate: 4.1 GPM
9-22-15	1445	Ø	451077	—	Cleaned strainer;
10-28-15	1412	Ø	451077	—	cleaned strainer; Flowrate ranged from 0.0 to 4.6 GPM after cleaning
11-24-15	1510	Ø	451092	—	cleaned strainer; flowrate ranged from 3.5 to 5.8 GPM after cleaning
12-15-15	1550	Ø	451112	—	Cleaned strainer; Max Flowrate: 7.1 GPM after cleaning
1-26-16	1545	Ø	451134	—	cleaned Strainer; Max flowrate: 7.4 GPM after cleaning
2-25-16	1350	Ø	451157	—	cleaned strainer; disassembled plumbing, cleaned impeller (95% covered) Flushed ≈ 17 gallons through Y-strainer. Max Flowrate: 6.2 GPM Totalizer: 451176 @ 1645
2-29-16	1045	3.7	466572	—	
3-22-16	1048	Ø	533270	—	Installed new 2" Y-strainer & redirected plumbing into top valve that used to house LRW-4; strong back pressure
3-24-16	1030	Ø	533287	—	strong back pressure on discharge line preventing pump from pushing through check valve
4-27-16	1600	Ø	533287	—	Back pressure on discharge line and Bio-growth in strainer; pump is operating normally; cleaned Strainer; Max Flowrate: 9.4 GPM; 533,313 @ 1638
4-28-16	1600	3.1	537632	—	—
5-24-16	1508	1.7	644644	—	cleaned strainer; Max Flowrate: 4.4 GPM
5-25-16	0951	1.7	645838	—	—

METER LRW-3

Pump Information / Electrical Settings

Wynnewood Groundwater System

PUMP NRW-1

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
6-23-15	1020	OPEN	5000	100	87	5000	120	1642	10852	20265	0.75 A
7-27-15	1057	OPEN	5000	100	86	5000	120	1736	11670	20269	0.75A
8-25-15	1050	OPEN	5000	100	89	5000	110	1812	12366	20272	0.75A
9-22-15	1109	OPEN	5000	100	87	5000	110	1884	13038	20277	0.75A
10-28-15	1119	OPEN	5000	100	94	5000	110	1976	13904	20284	0.74A
11-24-15	1325	OPEN	5000	100	94	5000	110	2044	14554	20288	0.72 A
12-15-15	1446	OPEN	5000	100	95	5000	110	2098	15060	20292	0.72 A
1-26-16	1327	OPEN	5000	100	94	5000	110	2208	16068	20296	0.75 A
2-29-16	1341	OPEN	5000	100	94	5000	110	2294	16884	20306	0.69A
3-23-16	1410	OPEN	5000	100	93	5000	100	2352	17436	20311	0.68 A
4-28-16	1338	OPEN	5000	100	94	5000	100	2438	18300	20314	0.70 A
5-24-16	1402	OPEN	5000	100	93	5000	100	2498	18924	20319	0.70A
6-15-16	1110	OPEN	5000	100	92	5000	100	2554	19450	20322	0.70A

PUMP NRW-1

PUMP NRW-2

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
6-23-15	1026	OPEN	5000	100	77	5000	110	1812	11544	18655	0.74 A
7-27-15	1100	OPEN	5000	100	78	5000	110	1892	12360	18660	0.73 A
8-25-15	1053	OPEN	5000	100	81	5000	110	1966	13056	18664	0.74 A
9-22-15	1111	OPEN	5000	100	81	5000	100	2038	13728	18668	0.72 A
10-28-15	1123	OPEN	5000	100	81	5000	110	2130	14592	18671	0.73 A
11-24-15	1328	OPEN	5000	100	84	5000	100	2200	15242	18675	0.72 A
12-15-15	1449	OPEN	5000	100	84	5000	100	2250	15748	18678	0.72A
1-26-16	1328	OPEN	5000	100	84	5000	100	2350	16756	18681	0.74A
2-29-16	1343	OPEN	5000	100	85	5000	100	2430	17572	18691	0.69A
3-23-16	1413	OPEN	5000	100	84	5000	90	2482	18122	18696	0.67 A
4-28-16	1340	OPEN	5000	100	77	5000	80	2542	18740	19204	0.66 A
5-24-16	1406	OPEN	5000	100	77	5000	80	2542?	18752	20454	0.67 A
6-15-16	1114	OPEN	5000	100	77	5000	80	2544	18762	21506	0.65A

PUMP NRW-2

PUMP NRW-3

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
6-23-15	1029	OPEN	5000	100	78	45 5000	100	1040	7214	31413	0.69 A
7-27-15	1102	OPEN	5000	100	80	5000	110	1118	8032	31420	0.68 A
8-25-15	1055	OPEN	5000	100	81	5000	100	1186	8728	31423	0.69 A
9-22-15	1113	OPEN	5000	100	82	5000	100	1250	9400	31428	0.70 A
10-28-15	1127	OPEN	5000	100	82	5000	100	1332	10266	31431	0.70A
11-24-15	1330	OPEN	5000	100	85	5000	110	1396	10916	31434	0.73 A
12-15-15	1451	OPEN	5000	100	86	5000	100	1444	11422	31438	0.72A
1-26-16	1330	OPEN	5000	100	85	5000	110	1540	12430	31442	0.75A
2-29-16	1346	OPEN	5000	100	86	5000	110	1618	13246	31453	0.73A
3-23-16	1415	OPEN	5000	100	84	5000	100	1672	13798	31458	0.67 A
4-28-16	1342	OPEN	5000	100	85	5000	110	1754	14662	31461	0.72A
5-24-16	1410	OPEN	5000	100	82	5000	100	1814	15286	31466	0.69A
6-15-16	1118	OPEN	5000	100	80	5000	100	1864	15812	31470	0.68 A

PUMP NRW-3

PUMP NRW-4

PUMP INFORMATION
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
6-23-15	1032	OPEN	5000	100	77	5000	110	1456	11084	14930	0.74 A
7-27-15	1104	OPEN	5000	100	78	5000	100	1536	11902	14934	0.72 A
8-25-15	1057	OPEN	5000	100	80	5000	100	1606	12600	14937	0.72 A
9-22-15	1118	OPEN	5000	100	84	5000	110	1670	13272	14942	0.70 A
10-28-15	1130	OPEN	5000	100	80	5000	100	1752	14138	14945	0.71 A
11-24-15	1332	OPEN	5000	100	82	5000	110	1816	14790	14949	0.73 A
12-15-15	1454	OPEN	5000	100	82	5000	110	1868	15296	14952	0.77 A
1-26-16	1333	OPEN	5000	100	81	5000	110	1974	16304	14955	0.76 A
2-29-16	1348	OPEN	5000	100	81	5000	120	2056	17122	14965	0.76A
3-23-16	1417	OPEN	5000	100	80	5000	110	2108	17674	14971	0.71 A
4-28-16	1344	OPEN	5000	100	80	5000	110	2192	18538	14975	0.74A
5-24-16	1415	OPEN	5000	100	77	5000	110	2252	19164	14981	0.75A
6-15-16	1125	OPEN	5000	100	77	5000	100	2302	19690	14985	0.73A

PUMP NRW-5

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
4-29-15	1412	OPEN	7500	100	77	7400	300	142	394	37287	1.42 A
5-27-15	1238	OPEN	7500	100	83	7400	300	158	446	38627	1.43 A
6-23-15	0943	OPEN	7500	100	80	7400	280	172	488	39916	1.41 A
7-27-15	1440	OPEN	7500	100	84	7500	290	192	552	41558	1.30 A
8-25-15	1323	OPEN	7500	100	84	7400	280	204	592	42949	1.34 A
9-22-15	1323	OPEN	7500	100	80	7400	280	210	614	44305	1.34 A
10-28-15	– No Access	due to	construction	in area							
11-24-15	1414	OPEN	7500	100	82	7400	280	222	652	47329	1.32 A
12-16-15	1033	OPEN	7500	100	82	7500	310	226	666	48377	1.32 A
1-27-16	1012	OPEN	7500	100	80	7400	290	236	698	50391	1.62 A
2-29-16	1508	OPEN	7500	100	81	7400	280	242	716	51987	1.60 A
3-24-16	1055	OPEN	7500	100	81	7400	290	246	732	53130	1.59 A
4-28-16	1457	OPEN	7500	100	78	7400	280	256	760	54823	1.54 A
5-25-16	1042	OPEN	7500	100	82	7500	300	264	788	56111	1.53 A
6-15-16	1146	OPEN	7500	100	80	7500	300	270	810	57121	1.53 A

PUMP NRW-5

PUMP NRW-6

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
4-29-15	1417	OPEN	7500	100	82	7500	360	2910	6818	28711	1.57 A
5-27-15	1242	OPEN	7500	100	86	7400	340	3150	7488	28714	1.59A
6-23-15	0945	OPEN	7500	100	86	7500	340	3370	8134	28719	1.54 A
7-27-15	1443	OPEN	7500	100	86	7500	320	3656	8956	28722	1.40A
8-25-15	1328	OPEN	7500	100	86	7400	310	3882	9650	28727	1.43 A
9-22-15	1330	OPEN	7500	100	88	7400	310	4104	10322	28733	1.42 A
10-28-15	No Access due to construction in area										
11-24-15	1417	OPEN	7500	100	93	7500	340	4590	11832	28740	1.53 A
12-16-15	1038	OPEN	7500	100	91	7500	320	4774	12356	28749	1.51A
1-27-16	1015	OPEN	7500	100	85	7500	330	5132	13362	28756	1.66 A
2-29-16	1512	OPEN	7500	100	84	7500	350	5404	14160	28761	1.64 A
3-24-16	1059	OPEN	7500	100	86	7500	330	5606	14730	28766	1.69A
4-28-16	1455	OPEN	7500	100	89	7500	320	5894	15552	28912	1.63 A
5-25-16	1037	OPEN	7500	100	91	7500	346	6120	16196	28918	1.71 A
6-15-16	1142	OPEN	7500	100	91	7400	360	6302	16702	28923	1.72 A

PUMP NRW-6

PUMP NRW-7

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
4-29-15	1420	OPEN	7700	100	81	7700	360	2738	5672	32242	1.63 A
5-27-15	1245	OPEN	7700	100	85	7700	360	2828	5928	33515	1.63 A ~~1.55 A~~ KF
6-23-15	0948	OPEN	7700	100	93	7700	330	3030	6532	33729	1.51 A
7-27-15	1446	OPEN	7700	100	93	7700	340	3316	7354	33734	1.48 A
8-25-15	1331	OPEN	7700	100	88	7700	340	3560	8050	33739	1.54 ~~1.45~~ A
9.22.15	1333	OPEN	7700	100	91	7700	320	3782	8720	33773	1.42 A
10-28-15	No Access due to construction in area										
11-24-15	1421	OPEN	7700	100	92	7700	310	4274	10226	33809	1.43 A
12-16-15	1041	OPEN	7700	100	89	7700	300	4416	10680	34265	1.45 A
1-27-16	1017	OPEN	7700	100	85	7700	300	4738	11686	34306	1.61 A
2-29-16	1515	OPEN	7700	100	85	7700	310	4980	12460	34540	1.60 A
3-24-16	1102	OPEN	7700	100	86	7700	300	5162	13026	34603	1.60 A
4-28-16	1450	OPEN	7700	100	86	7700	300	5426	13854	34753	1.58 A
5-25-16	1050	OPEN	7700	100	86	7700	340	5642	14498	34758	1.70 A
6-15-16	1150	OPEN	7700	100	86	7700	340	5814	15004	34762	1.70 A

PUMP NRW-7

PUMP BRW-3

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
9-22-15	1453	OPEN	10700	100	81	10700	120	3606	7136	48482	0.59A
10-28-15	1528	OPEN	10700	100	75	10700	120	3628	7230	57895	0.58A
11-24-15	1617	OPEN	10700	100	80	10700	120	3644	7302	64972	0.58A
12-16-15	1539	OPEN	10700	100	77	10700	120	3658	7360	5439?	0.59A
1-27-16	1337	OPEN	10700	100	73	10700	120	3674	7428	12288	0.60 A
2-25-16	1135	OPEN	10700	100	72	10700	120	3694	7500	19307	0.60 A
3-24-16	1341	OPEN	10700	100	71	10700	120	3710	7574	26641	0.59A
4-27-16	1045	OPEN	10700	100	74	10700	120	3732	7662	35498	0.60A
5-25-16	1335	OPEN	10700	100	75	10700	120	3748	7736	42809	0.57A
6-16-16	1351	OPEN	10700	100	76	10700	120	3764	7794	48548	0.55A

PUMP BRW-3

PUMP BRW-5

PUMP INFORMATION
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
7-27-15	1709	OPEN	8000	100	95	8000	250	1042	4796	17326	1.17A
8-25-15	1512	OPEN	8000	100	97	8000	270	1186	5488	17349	1.19 A
9-22-15	1556	OPEN	8000	100	101	8000	270	1328	6160	17352	1.20 A
10.28-15	1534	OPEN	8000	100	112	8000	250	1510	7024	17356	1.20 A
11-24-15	1619	OPEN	8000	100	100	8000	260	1650	7674	17361	1.23 A
12-16-15	1543	OPEN	8000	100	99	8000	270	1770	8202	17364	1.25A
1-27-16	1351	OPEN	8000	100	89	8000	260	1908	8830	17369	1.28 A
2-25-16	1139	OPEN	8000	100	96	8000	210	2060	9498	17383	1.10 A
3-24-16	1349	OPEN	8000	100	95	8000	320	2206	10170	17385	1.44A
4-27-16	1050	OPEN	8000	100	99	8000	300	2386	10984	17388	1.45 A
5-25-16	1341	OPEN	8000	100	100	8000	300	2546	11654	17393	1.43A
6-16-16	1355	OPEN	8000	100	105	8000	300	2672	12180	17395	1.39A

PUMP BRW-5

PUMP BRW-6

PUMP INFORMATION
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

0.09A, restarted to obtain Amps. 3.53A for ≤10 sec. Then reduced to 0.35A (standby)

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
1-27-16	1329	OPEN	10700	100	86	10700	800	12396	13328	15311	3.57 A
2-10-16	1425	OPEN	10700	100	88	10700	800	12416	13352	15985	3.50A
2-10-16	1607	OPEN	10700	100	99	10700	860	12418	13354	15992	3.76A
2-18-16	1125	OPEN	10700	100	83	10700	790	12508	13458	16221	3.48A
2-24-16	1055	OPEN	10700	100	77	10700	780	12510	13462	16511	3.53A
2-26-16	1525	OPEN	10700	100	100	10700	1000	12512	13464	16525	4.60A
2-29-16	1022	OPEN	10700	100	98	10700	940	12578	13532	16527	4.15A
3-24-16	1316	OPEN	10700	100	96	10700	1200	13122	14110	16530	4.62 A
4-27-16	1035	OPEN	10700	100	95	10700	1100	13888	14924	16534	4.54A
5-25-16	1320	OPEN	10700	100	148	10700	1100 ~~440~~ KF	14580	15596	16541	4.70 A
6-16-16	1340	OPEN	10700	100	115	10700	940	15102	16124	16544	4.08A

PUMP BRW-6

PUMP BRW-7

PUMP INFORMATION
WEST SYSTEM
WYNNEWOOD REFINING COMPANY
WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
6-25-15	0942	OPEN	10700	100	72	10700	620	7266	10354	52443	2.73A
7-27-15	1656	OPEN	10700	100	73	10700	680	7682	11036	52774	2.84A
8-25-15	1502	OPEN	10700	100	85	10700	660	8120	11756	52815	2.84 A
9-22-15	1547	OPEN	10700	100	77	10700	650	8530	12438	53155	2.79 A
10-28-15	1520	OPEN	10700	100	80	10700	660	9070	13332	53279	2.86 A
11-24-15	1606	OPEN	10700	100	78	10700	660	9476	14006	53334	2.86 A
12-16-15	1457	OPEN	10700	100	76	10700	670	9818	14552	53346	2.86A
1-27-16	1332	OPEN	10700	100	65	10700	710	10238	15204	53368	3.07 A
2-25-16	1144	OPEN	10700	100	85	10700	670	10568	15700	53377	2.93A
3-24-16	1320	OPEN	10700	100	74	10700	700	11024	16398	53383	2.97A
4-27-16	1038	OPEN	10700	100	72	10700	690	11566	17244	53386	2.95A
5-25-16	1326	OPEN	10700	100	76	10700	700	12034	17940	53389	2.98A
6-16-16	1344	OPEN	10700	100	87	10700	650	12394	18486	53396	2.77A

PUMP BRW-7

PUMP BRW-8

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
6-25-15	0946	OPEN	10700	100	119	10700	500	11918	20192	3546	2.18A
7-27-15	1658	OPEN	10700	100	116	10700	520	12256	20968	3551	2.24A
8-25-15	1504	OPEN	10700	100	121	10700	520	12554	21662	3555	2.25 A
9-22-15	1549	OPEN	10700	100	131	10700	530	12846	22334	3558	2.27 A
10-28-15	1523	OPEN	10700	100	133	10700	520	13220	23198	3563	2.26A
11-24-15	1608	OPEN	10700	100	131	10700	510	13498	23848	3567	2.21 A
12-16-15	1530	OPEN	10700	100	130	10700	480	13754	24376	3570	2.21 A
1-27-16	1335	OPEN	10700	100	82	10700	540	14066	25004	3576	2.31A
2-25-16	1148	OPEN	10700	100	100	10700	520	14302	25480	3586	2.29A
3-24-16	1323	OPEN	10700	100	118	10700	510	14584	26154	3590	2.18A
4-27-16	1040	OPEN	10700	100	123	10700	480	14920	26966	3610	2.10A
5-25-16	1331	OPEN	10700	100	86	10700	490	15226	27634	3661	2.14A
6-16-16	1347	OPEN	10700	100	99	10700	470	15474	28160	3666	2.03A

PUMP BRW-8

PUMP LRW-3

PUMP INFORMATION

WEST SYSTEM

WYNNEWOOD REFINING COMPANY

WYNNEWOOD OKLAHOMA

Date	Time	Valve Position	Actual Setpoint (min-1)	External Setpoint:(%)	Temperature (Deg F)	Speed (min-1)	Power Input (watts)	Power Consuption (KWH)	Operating Hours	Number of Starts	
6-23-15	1348	OPEN	7500	100	84	7500	190	1134	3166	34732	1.03A
7-27-15	1555	OPEN	7500	100	86	7500	210	1306	3984	34737	1.02A
8-25-15	1640	OPEN	7500	100	91	7400	220	1460	4682	34744	1.08 A
9-22-15	1504	OPEN	7500	100	89	7500	220	1604	5354	34750	1.10 A
10-28-15	1422	OPEN	7500	100	91	7500	200	1744	6218	34754	1.02A
11-24-15	1516	OPEN	7500	100	97	7500	190	1922	6870	34759	1.03 A
12-15-15	1556	OPEN	7500	100	111	7400	200	2028	7376	34766	1.03A
1-26-16	1552	OPEN	7500	100	94	7500	230	2260	8384	34770	1.14 A
2-25-16	1400	OPEN	7500	100	98	7500	200	2416	9104	34774	1.05A
2-29-16	1053	OPEN	7500	100	104	7400	250	2434	9194	34786	1.22A
3-22-16	1056	OPEN	7500	100	99	7500	220	2554	9722	34789	1.14A
4-27-16	1607	OPEN	7500	100	98	7500	240	2750	10570	34799	1.17A
5-24-16	1529	OPEN	7500	100	89	7400	210	2902	11220	34805	1.07A
6-16-16	1544	OPEN	7500	100	92	7400	230	3034	11772	34809	1.12A

PUMP LRW-3

Appendix 4.2.B – Recovery Rate Calculation

Recovery Rate Test Data Sheet

Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

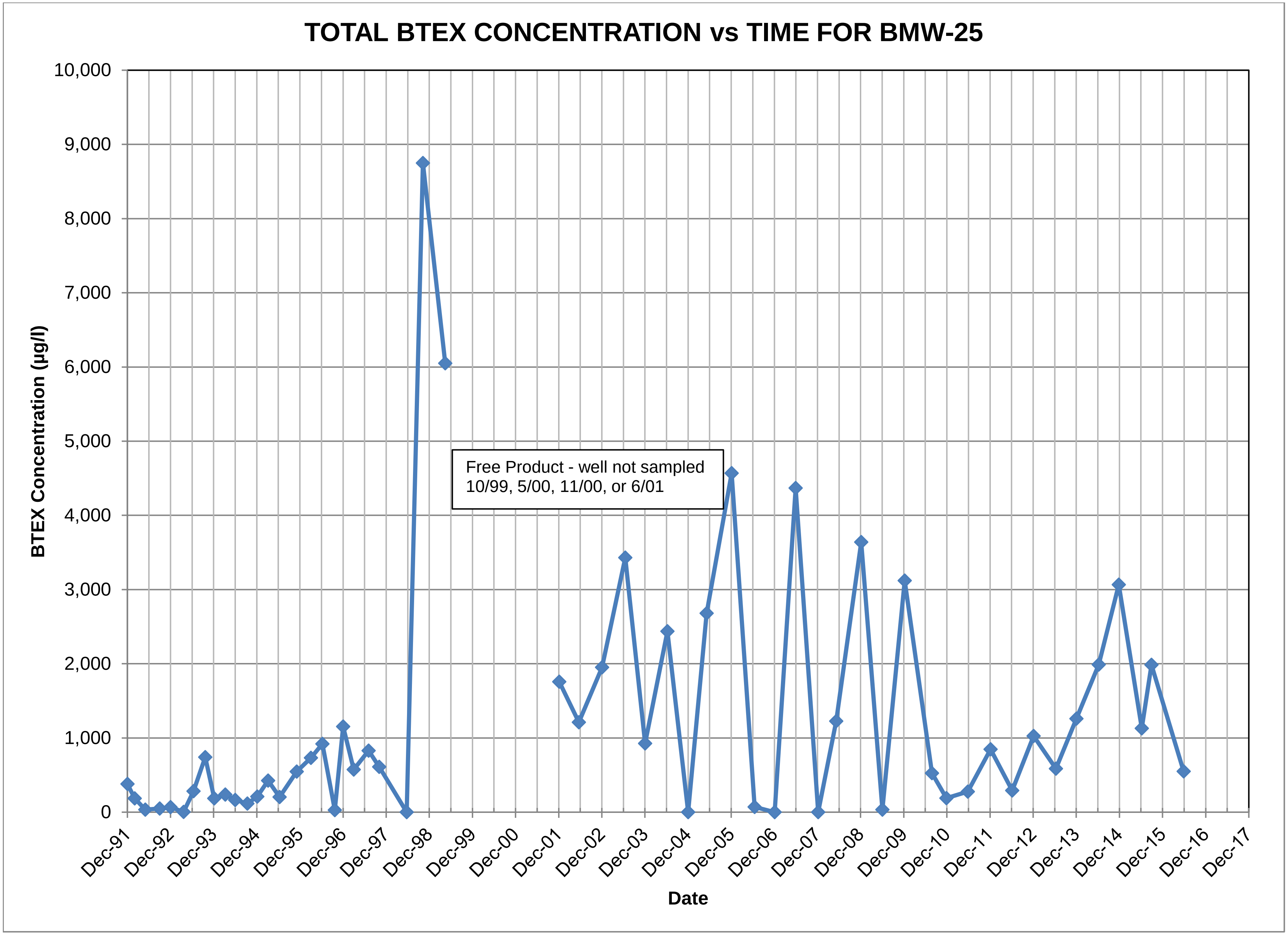
Date: 6/15/16 and 6/16/16 Sampler: Kyle Fishburn and Gerald Fields (StanTech)

Recovery Rate Test Procedures

1. Fill graduated bucket to a selected volume (64 oz or 112 oz). Record time it takes to fill bucket to that line on bucket.
2. Set bucket aside for a minimum of 5 minutes to allow product and water to separate.
3. Note if there is a sheen or if measureable product is present in bucket.

Well ID	Volume (oz)	Time (sec)	Sheen Present (Y/N)	Measureable Product (Y/N)	Estimated Recovered Product (oz)	Estimated Product (oz)	Recovery Rate
North Process Area							
NRW-1	112	21.61	Y	N	0	0.01	0.004885
NRW-2	40	25.13	Y	N	0	0.01	
NRW-3	64	11	Y	N	0	0.01	
NRW-4	64	7.81	Y	N	0	0.01	
NRW-5	64	3.85	Y	Y	1.5	1.5	
NRW-6	64	4.17	Y	Y	0.5	0.5	
NRW-7	112	12.43	Y	Y	0.5	0.5	
Product Loading Facility							
BRW-6	112	3.69	Y	N	0	0.01	8.93E-05
BRW-7	112	4.29	Y	N	0	0.01	
BRW-8	112	4.45	Y	N	0	0.01	
South Process Area							
LRW-3	112	3.92	Y	N	0	0.01	8.93E-05

Appendix 4.2.C – BTEX Trends for BMW-25 and BMW-26


TOTAL BTEX CONCENTRATION vs TIME FOR BMW-25
BTEX Concentration (µg/l)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Free Product - well not sampled
10/99, 5/00, 11/00, or 6/01
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Dec-01
Dec-02
Dec-03
Dec-04
Dec-05
Dec-06
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Dec-10
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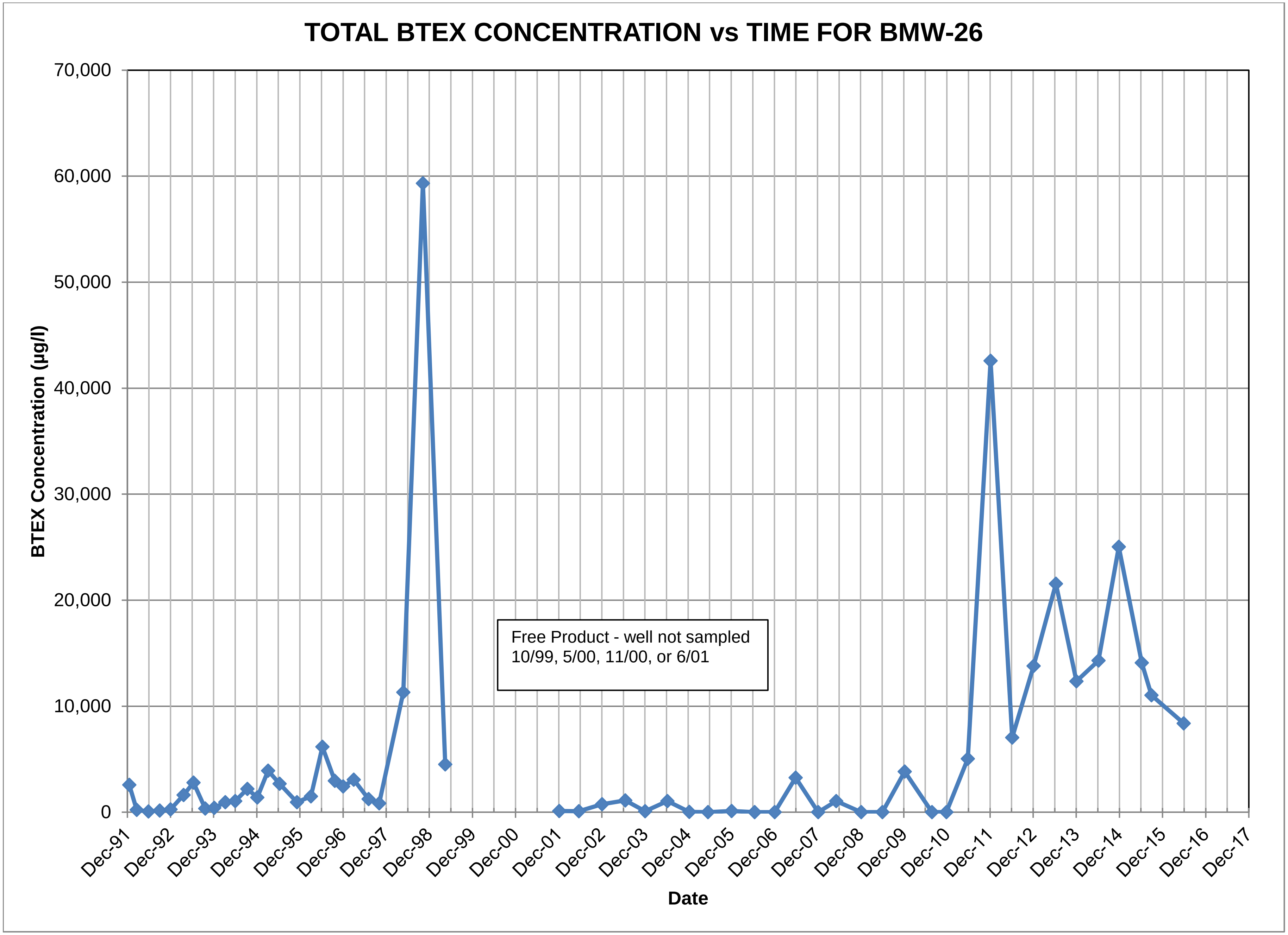
Dec-12
Dec-13
Dec-14
Dec-15
Dec-16
Dec-17
Date



TOTAL BTEX CONCENTRATION vs TIME FOR BMW-26
BTEX Concentration (µg/l)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Free Product - well not sampled
10/99, 5/00, 11/00, or 6/01
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
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Dec-17
Date

Appendix 6 – Interior Delineation Summary and Recommendation Report (on CD)

INTERIOR DELINEATION SUMMARY AND RECOMMENDATION REPORT

Consent Order Case No. 15-056

WYNNEWOOD REFINING COMPANY, LLC

WYNNEWOOD, OKLAHOMA

EPA ID No. OKD000396549

Prepared by

CVR Energy, Inc. and

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July 13, 2016

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INTERIOR DELINEATION SUMMARY AND RECOMMENDATION REPORT

CONSENT ORDER CASE NO. 15-056

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Prepared for
Wynnewood Refining Company, LLC
P.O. Box 305, 906 South Powell, Wynnewood, Oklahoma 73098

EPA ID No.: OKD000396549

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Acronyms

API	American Petroleum Institute
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
DRO	diesel range organics
EPA	Environmental Protection Agency
GRO	gasoline range organics
LNAPL	light non-aqueous phase liquid
MOC	Management of Change
O&M	operation and maintenance
ODEQ	Oklahoma Department of Environmental Quality
PID	photoionization detector
PLF	product loading facility
PMP	performance monitoring plan
ppm	parts per million
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RSL	Regional Screening Level
UV	ultraviolet
WRC	Wynnewood Refining Company, LLC

1 INTRODUCTION

1.1 PURPOSE

In accordance with the approved Comprehensive Remediation Plan required by Paragraph 13 of Oklahoma Department of Environmental Quality (ODEQ) Consent Order Case No. 15-056, this Interior Delineation Summary and Recommendation Report (Report) is being submitted on behalf of Wynnewood Refining Company, LLC (WRC) for its refinery at Wynnewood, Oklahoma (the Refinery, Figure 1).

The Refinery covers approximately 560 acres located south and southwest of Wynnewood, Oklahoma. The Refinery is owned and operated by WRC, a wholly owned subsidiary of CVR Energy, Inc. WRC purchased the Refinery from the Gary-Williams Energy Company on December 15, 2011. The Refinery was originally built in 1923 by the Texas Pacific Coal and Oil Company. Subsequent owners included the Kerr-McGee Corporation, which sold the Refinery to Gary-Williams in 1995.

The Refinery operates in accordance with a Resource Conservation Recovery Act (RCRA) Permit (Permit No. 000396549) for the closed Storm Water Retention Pond and an operating hazardous waste storage tank (Tank 2007). On June 30, 2015, ODEQ and WRC entered into a Consent Order to resolve certain RCRA allegations. The Consent Order, among other things, requires WRC to address certain Legacy Environmental Issues involving soil and groundwater contamination.

This report describes the activities conducted in accordance with the Consent Order, executed on June 30, 2015, and the Comprehensive Remediation Plan approved by ODEQ on February 1, 2016. Tasks associated with the Interior Delineation included additional groundwater sampling, a soil and groundwater profiling investigation, and light non-aqueous phase liquid (LNAPL) transmissivity testing. This report describes field activities, presents results, and provides recommendations for additional monitoring and recovery wells to be added to the site monitoring network.

1.2 PROJECT PERSONNEL

Sam A. McCormick, Professional Geologist, is the WRC project manager. Jerome McSorley, Professional Geologist, is the WRC site geologist and manages groundwater sampling events. Routine field work, including fluid level gauging and recovery system repairs, is managed by Evan Hilburn of WRC. Drilling services for this project were provide by DeTech, Inc. an Oklahoma licensed water well contractor. WRC has contracted with WSP USA Corp (WSP) to provide qualified field personnel, environmental consulting and drafting services on this project. The WSP project manager is Christine Warford, Professional Engineer. Christine Warford and Judy Andrews of WSP assisted Mr. McCormick and Mr. McSorley in the preparation of this Report.

2 INTERIOR DELINEATION FIELD ACTIVITIES

The purpose of the interior delineation was to address data gaps that existed in the conceptual site model pertaining to geologic characterization and the extent and magnitude of both the LNAPL and dissolved-phase hydrocarbon plumes at the Refinery. This section describes tasks performed to address data gaps through installation of additional monitoring wells, groundwater sampling, and a direct-push soil and groundwater investigation.

2.1 EXISTING MONITORING WELL NETWORK

Activities discussed in this section were conducted in 2015. The results were previously discussed in the *Semi-Annual Groundwater Remediation Progress Report*, submitted February 29, 2016; therefore, only a brief summary of field activities conducted are included in this report.

2.1.1 MONITORING WELL INSTALLATION AND PLUGGING

Monitoring wells UMW-7, SMW-24, and SMW-25 were installed along the northern and southern Refinery boundaries as part of the perimeter monitoring network (Figure 2) in August 2015. In addition, a total of 17 redundant or damaged monitoring wells, piezometers, and sumps were plugged in August 2015. The location of the wells installed and plugged in 2015 are shown on Figure 2. Boring logs for these wells are included in Appendix A.

2.1.2 MONITORING WELL REHABILITATION AND REPAIR

During site monitoring activities in 2015, it was noted that six monitoring wells had total depth measurements that were reduced by at least 1.5 feet from the depth stated on well construction tables or completion logs. In August 2015, these wells were redeveloped to remove sediment that had accumulated and the surface completions of monitoring wells LMW-6-0, BMW-5, and BMW-9 were upgraded.

2.1.3 SITE-WIDE COMPREHENSIVE GROUNDWATER SAMPLING EVENT

A site-wide groundwater delineation sampling event, which included sampling 69 monitoring wells and two private supply wells, was conducted in September 2015 to obtain better constraints on the location, extent, and magnitude of the dissolved-phase hydrocarbon plume throughout the Refinery. Groundwater samples from monitoring wells were collected using low-flow sampling methods. The samples from the offsite water wells were collected as grab samples from a hose connected to the well. Samples were analyzed for gasoline range organics (GRO), diesel range organics (DRO), volatile organic compounds, semi-volatile organic compounds, and RCRA metals. Groundwater samples were submitted to Pace Analytical Services, Inc. of Salina, Kansas (Oklahoma State Lab ID No. 8815). Appendix B includes the summary of the groundwater analytical results associated with the site-wide comprehensive groundwater sampling event.

2.1.4 API GRAVITY TESTING

Samples of LNAPL from 15 wells and from the combined discharge line of recovery wells NRW-6 and NRW-7 were collected in September 2015. All samples were analyzed at the Refinery laboratory for American Petroleum Institute (API) Gravity. The API Gravity value for LNAPL collected from BMW-6 was anomalously low compared to LNAPL collected from surrounding wells at the Product Loading Facility (PLF), so a second LNAPL sample was collected on the following day and analyzed. The second sample was also very low in comparison to the other wells; therefore, are considered suspect and are not used in correcting groundwater elevations. LNAPL has not been observed in BMW-6 since September 2015. As there is no apparent qualitative difference between the LNAPL present in BMW-6 and the other wells at the PLF, WRC assumes the LNAPL sampled from BMW-6 was an emulsion of petroleum product and water which has the effect of lowering the API gravity. An interpretive discussion of the API Gravity testing is included in Section 3.1.2.

2.2 DIRECT-PUSH SAMPLING EVENT

From February 23 to March 4, 2016 and from March 28 to April 2, 2016, the Refinery conducted a focused direct-push sampling event to meet the objectives outlined in Item 22.b of the Consent Order, which included:

- characterize the geology of the North Process Area to fill data gaps left by incomplete boring log data
- delineate the LNAPL plume in the South Process Area, North Process Area, and Product Loading Facility (PLF)
- delineate the dissolved-phase plumes in areas where insufficient data exists

2.2.1 SITE GEOLOGY AND HYDROGEOLOGY INVESTIGATION

In order to better characterize the geology and hydrogeology of the Refinery, WRC planned to install 78 temporary borings; however an additional five temporary borings were added during the course of field work to meet the objectives set by the Order and to address field findings. Figure 2 depicts the locations of the 83 temporary borings, a summary of boring details is provided in Table 1, and boring logs are provided in Appendix A.

Direct-push drilling technology was used to install 73 of the temporary borings and the remaining ten temporary borings were installed using a decontaminated stainless steel hand auger. At the direction of Refinery management, boring locations in Refinery process units and secondary containment areas were cleared for utilities by hydro-excavating three holes surrounding the boring to a depth of approximately 10 feet below ground surface (bgs) in a triangular patter surrounding the proposed temporary boring location. Hydro-excavation was stopped if the water table was encountered. This process preserved the soil at the temporary boring location for geologic characterization. The temporary borings and utility clearance probes were backfilled using clean fill material. All temporary borings were advanced to the water table for soil characterization, and advanced below the water table if a groundwater sample was to be collected. Core samples from the direct-push borings and cuttings from the auger borings were examined in the field by a qualified geologist to determine the lithology and other geological characteristics along with the presence or absence of groundwater. Lithologic boring logs for each temporary boring are provided in Appendix A.

Waste materials generated during the investigation were incorporated with other Refinery wastes in covered roll-off containers. Contents of the containers were sampled for waste characterization and managed for offsite disposal by the Refinery’s environmental department in accordance with the Refinery’s waste management protocol.

The results of the site geology and hydrogeology investigation are discussed in Section 3.2.1.

2.2.2 LNAPL PLUME DELINEATION

All soil borings were characterized by a geologist for soil characteristics as well as visual or olfactory evidence of impact. In accordance with procedures outlined in the Comprehensive Remediation Plan, soils were screened for organic vapors using a photoionization detector (PID). In soils where the organic vapor reading exceeded 100 parts per million (ppm), an ultraviolet light test was conducted, which consisted of placing the soil under a long-wave ultraviolet light, also known as a black light, to test for fluorescence. If the sample fluoresced, it was considered to contain LNAPL, the boring was advanced to the water table, and a temporary monitoring well was installed. Temporary monitoring wells were constructed using 1-inch diameter polyvinyl chloride (PVC) with a 5-foot PVC screen. The temporary well was kept in place for at least 24 hours, after which the well was gauged for the presence of LNAPL. If LNAPL was encountered in temporary boring locations identified in the Comprehensive Remediation Plan as potential groundwater sampling locations, no groundwater sample was collected.

The results of the LNAPL plume delineation are discussed in Section 3.2.2.

2.2.3 DISSOLVED-PHASE PLUME DELINEATION

In order to delineate the dissolved-phase plume, groundwater samples were collected from select boring locations, as stipulated in the Comprehensive Remediation Plan. Groundwater samples were collected using a peristaltic pump with dedicated tubing either from a stainless steel Geoprobe sampler or from a temporary monitoring well, constructed of 1-inch diameter PVC with a 5-foot PVC screen. Groundwater samples were analyzed for GRO, DRO, and benzene, toluene, ethylbenzene, xylenes (BTEX). Prior to collecting a sample, the well was gauged for the presence of LNAPL and water level. If LNAPL was encountered in a temporary well, no groundwater sample was collected. Probe locations NE-DP-43, NE-DP-44, and SE-DP-59, originally designated as groundwater profiling locations, were not sampled due to the presence of measurable LNAPL in the temporary well.

The results of the dissolved-phase plume delineation are discussed in Section 3.2.3.

2.3 LNAPL TRANSMISSIVITY

In order to assess potential locations of additional recovery wells, field activities were conducted to estimate transmissivity of LNAPL and determine the mobility of free-phase hydrocarbons in subsurface materials at the Refinery. Field activities were conducted in accordance with accepted methods outlined in ASTM Method E2856-13, Standard Guide for Estimation of LNAPL Transmissivity (ASTM 2013).

Based on the LNAPL thicknesses observed at the Refinery, LNAPL skimming tests were performed on select monitoring wells to evaluate LNAPL transmissivity. The criteria for well selection for the LNAPL skimming tests included location and consistent presence of LNAPL over time. The location criterion excluded monitoring wells that are adjacent to existing operating recovery wells and included monitoring wells outside the current areas of influence of operating recovery wells. The LNAPL criterion required wells to consistently contain measurable LNAPL. Based on historic fluid level measurements, six wells were selected for LNAPL skimming tests; three monitoring wells in the vicinity of the existing North Process Area (NMW-2, NMW-6, and NMW-10) and three monitoring wells in the vicinity of the existing South Process Area (OMW-3, OMW-4, and LMW-13).

Approximately three weeks prior to the LNAPL skimming tests, LNAPL in all six monitoring wells was evacuated by bailer to remove LNAPL stored in the wellbore and filter pack and fluid levels were allowed to recharge prior to the skimming test. The removal of LNAPL from the well prior to testing ensured that the LNAPL in the monitoring well during the LNAPL test was in communication with the formation and ensured that the initial fluid levels were representative of equilibrium formation conditions. The removal of LNAPL prior to testing was also used to determine how readily LNAPL thicknesses in the wells stabilized after removal. LNAPL thickness in all selected monitoring wells except LMW-13 appeared to stabilize within one week. Because LNAPL thickness in LMW-13 did not rebound or stabilize, this well was excluded from further testing. Field notes of the pre-test bailing of LNAPL, conducted by Refinery personnel, are included in Appendix C and the results of LNAPL transmissivity testing are discussed in Section 3.3.

3 INTERIOR DELINEATION RESULTS

The purpose of this section is to present the results of the comprehensive site-wide groundwater sampling event, direct-push investigation, and LNAPL transmissivity testing. Table 2 summarizes the direct-push analytical results. Analytical laboratory reports for groundwater collected during the direct-push investigation are included in Appendix D. A table summarizing the analytical results for groundwater samples collected from monitoring wells in September 2015 is provided in Appendix B. Hydrogeologic cross sections showing the geology at the Refinery, location of the water table, and presence of residual free product are provided on Figure 3. Cross sections illustrating site geology, hydrogeology, and extent of LNAPL in soil and groundwater are provided on Figure 4. The combined results of the comprehensive groundwater sampling event and the groundwater samples collected during the direct-push investigation are illustrated on Figures 5A, 5B, and 5C.

3.1 EXISTING MONITORING WELL NETWORK SAMPLING EVENT

3.1.1 SITE-WIDE DELINEATION GROUNDWATER SAMPLING EVENT

A total of 69 monitoring well were sampled as part of the site-wide comprehensive groundwater sampling event. The results of the comprehensive groundwater sampling event were reported in the *Semi-Annual Groundwater Remediation Progress Report*, submitted February 29, 2016.

GRO were detected in 30 of the 71 samples collected from the monitoring wells and private supply wells in September 2015. The concentration of GRO exceeded the ODEQ Cleanup Level of 1,000 µg/l (ODEQ, 2004) in 17 samples.

DRO were detected in 64 of the 71 samples collected from the monitoring wells and private supply wells in September 2015. The concentration of DRO exceeded the ODEQ Cleanup Level of 1,000 µg/l (ODEQ, 2004) in 31 samples.

Benzene was detected in 23 of the 71 samples collected from the monitoring well and private supply wells in September 2015. The concentration of benzene exceeded the Environmental Protection Agency (EPA) Regional Screening Level (RSL) of 0.46 µg/l (EPA, 2014) in all 23 samples and exceeded the EPA Primary Drinking Water criterion of 5 µg/l in 20 samples.

Site wide sampling highlighted four primary areas of high dissolved-phase concentrations. These include the Light Oils tank farm in the northeast portion of the refinery, the North Process Area in the north central portion of the Refinery, the South Process Area in the central portion of the Refinery, and the Product Loading Facility in the west central portion of the Refinery. The dissolved phase plumes from the Light Oils tank farm, North Process Area, and South Process Area have partially commingled and there is one primary dissolved phase plume extending from the northeast portion of the refinery to the southwest, terminating downgradient of the South Process Area. Results from the site-wide groundwater sampling event show that the dissolved-phase plumes are for the most part roughly coincident with, but more extensive than, the mapped LNAPL plumes and historic LNAPL data. One DRO plum in the southern portion of the Refinery property is not apparently associated with any LNAPL plume.

The results from the expanded analyte list used during the site-wide comprehensive sampling event showed that the existing list of analytes (GRO, DRO, benzene, toluene, ethylbenzene, and total xylenes) used in semi-annual sampling events is sufficient to capture the general distribution of the dissolved-phase plumes at the Refinery.

3.1.2 API GRAVITY TESTING

The results of the API Gravity testing conducted in September 2015 (Appendix E) show that historic releases at the Refinery have primarily been refined petroleum products. Additionally, the wide variety of API Gravity results (32.1 degrees [°] to 70.9°) indicates there has been little biodegradation of the LNAPL plumes, which would have had the effect of homogenizing the mixtures of diesel and gasoline.

Based on the results of the API Gravity testing, it appears that the LNAPL captured by the North Process Area system is a mixture of gasoline, kerosene, and jet fuel (API Gravity values ranging from 40.3° to 70.9°), with a diesel component predominating in the vicinity of NRW-6 and NRW-7, which had an API Gravity of 32.1°. Based on the shape of the plume and API Gravity distribution, it is likely that historically a separate diesel plume existed to the west of the highway and a plume of light oils was present east of the highway and that the two plumes have since merged. The LNAPL captured by the South Process Area is primarily diesel; API Gravity values range from 33.1° to 40.8°. At the PLF, LNAPL appears to be slightly degraded gasoline, with API Gravities ranging from 54.9° to 58.5°.

3.2 DIRECT-PUSH SAMPLING EVENT

A total of 83 temporary boring logs were installed as part of the direct-push delineation to characterize the geology of the North Process Area to fill data gaps left by incomplete boring log data; delineate the LNAPL plume in the South Process Area, North Process Area, and PLF; and delineate the dissolved-phase plumes in areas where insufficient data exists.

The original plan called for 78 temporary boring logs. The following five additional temporary wells were added to address field findings and to meet the objectives outlined in the Order:

- NE-DP-110 was installed upgradient of NE-DP-44 to delineate the extent of the LNAPL plume; however NE-DP-110 could not be advanced to groundwater at a depth below 15 feet due to a subsurface obstruction.
- NE-DP-111, was installed just west of NE-DP-110 for delineation of the LNAPL plume after NE-DP-110 failed to reach groundwater.
- SW-DP-109 was added upgradient of SW-DP-76 to delineate the extent of the LNAPL plume.
- SW-DP-112 was installed downgradient of SW-DP-70 to delineate the dissolved phase plume.
- SW-SP-113 was installed downgradient of SW-DP-81 to delineate the extent of the dissolved-phase plume.

Soil boring logs are provided in Appendix A. Hydrogeologic cross-sections are shown on Figure 3.

3.2.1 SITE GEOLOGY AND HYDROGEOLOGY

The Refinery is located in the Central Lowlands section of the Great Plains Physiographic Province. Most of this area is a low-lying plain, developed upon sedimentary formations of Paleozoic and Mesozoic age. The portion of the Central Lowlands in which the Refinery is located is referred to as the Central Redbed Plains. The Refinery was built on Washita River flood plain and relic terrace deposits. The Washita River Valley is incised into the Oscar Group, which outcrops east of the Refinery. The Pennsylvanian-age Oscar Group is an interbedded shale, sandstone, and limestone conglomerate, which is approximately 300 to 400 feet thick.

Native soils near the refinery are primarily classified as members of the Teller Loam series (USDA 2016). These are deep, well drained and moderately permeable soils. These soils formed in material from weathered loamy alluvial sediments. Teller Loam series soils typically exhibit hues ranging from red (10R) to reddish yellow (7.5YR). Upper intervals from 0 to 1.5 feet bgs are typically a brown loam and lower intervals are a fine sandy loam that grades from yellowish red to reddish yellow with depth (USDA 1985).

Groundwater is encountered in the alluvial deposits beneath the Refinery at depths ranging from near surface to approximately 25 feet bgs. There is a large seasonal variability in the water table at the Refinery that fluctuates in response to the rainfall pattern. Groundwater enters this alluvial aquifer from the east, and flows in a general west-southwest direction toward the Washita River. A localized variation in groundwater flow direction is observed along the southern boundary of the Refinery near the wastewater lagoons, where the groundwater flow direction is to the south.

In general, the stratigraphic profile for borings at the Refinery consists of silt or clay underlain by a silty very fine to fine-grained sand that coarsens downward in many locations, consistent with the Teller Loam series reported for this area. The upper silt and clay layer may act as a confining or semi-confining unit within the central portion of the refinery, particularly in the vicinity of the South Process Area. A hard, dry clay, likely derived from weathering of the underlying shale bedrock, was encountered in several borings in the Light Oils Tank Farm in the northeastern portion of the Refinery. This dry clay appears to indicate a lower limit for groundwater saturation, which creates reduced saturated thickness in that area when compared to the rest of the Refinery.

Fill is present in the first few feet of soil in many areas of the Refinery and consists primarily of gravel underlain by 1 to 4 feet of silt or clay. Fill near the crude oil processing area of the Refinery contained black fine-grained material resembling fly ash or coke from 2 feet bgs to 2.4 feet bgs in boring NE-DP-33. In boring NE-DP-35, a thin layer (approximately 1-inch thick) of black tar-like oil was observed at approximately 4 feet bgs. Weathered concrete was encountered in boring SE-DP-57, located in the South Process Area, from 1 feet bgs to 1.5 feet bgs.

The uppermost native soil is primarily silt and/or clay. The silt and clay layers are generally thickest on the eastern portion of the Refinery, with thickness of nearly 22 feet encountered in NE-DP-37 and NE-DP-53 (Figure 4, C-C′). The silt and clay thins westward and was thin or absent in borings, for example at NW-DP-100 and NW-DP-101 (Figure 4, C-C′). The silt and clay may act as a semi-confining layer in some locations, particularly in the central portion of the Refinery (e.g., NE-DP-35, NE-DP-37, NE-DP-40, SE-DP-57and SE-DP-64), which had water level measurements at least 6 feet higher than the saturated soil interval observed during drilling. At SE-DP-64, the groundwater level in the temporary well rose 15.5 feet above than the apparent saturated interval (Table 1).

The upper silt and clay layer is underlain by silty very fine to fine sand or very fine to fine sand with silt, with sand grain size typically coarsening downward to very fine to medium-grained sand. At multiple locations, fine to coarse or very coarse sand was encountered at the base of the boring, such as at NE-DP-44 NE-DP-46, and NE-DP-111 located in the northeastern portion of the Light Oils tank farm and in SW-DP-81 and SW-DP-84, west of the Refinery (Appendix A).

In the Light Oils tank farm, a hard, dry clay was encountered in borings NE-DP-48 at 27.8 feet bgs and NE-DP-30 at 20 feet bgs (Figure 4; A-A′ and B-B′). At boring NE-DP-48, there was no saturated layer apparent during drilling; a temporary well installed in this boring required several hours to accumulate enough water to collect a groundwater sample. These observations are consistent with nearby well logs.

A hard, dry clay layer was noted in monitoring wells installed in this area during previous investigations. The log for monitoring well NMW-2 notes “clay stone” was encountered at 19 feet bgs and refusal was noted at 19.5 feet bgs. The log for monitoring well NMW-9 states that a gray, hard clay was encountered at 31 feet bgs. Additionally, monitoring wells NMW-6 and NMW-2 frequently go dry when groundwater elevations are low.

In boring SE-DP-58, north of Savage Creek to the east of the South Process Area, a hard, dry clay was described near the base of the boring from 20-21 feet bgs; the log indicated drilling rod refusal at 21 feet bgs. As illustrated at the south end of cross-section A-A′ on Figure 4, weathered shale has been encountered in previous investigations at depths ranging from 24 feet bgs (SMW-18, south of SE-DP-58) to 36 feet bgs (SMW-13D; see also SMW-10D, SMW-12D, and SMW-21D). Weathered shale was also noted in the boring log for BMW-18 (Figure 4, D-D′). The weathered shale has been identified as the Oscar Formation in previous reports.

3.2.2 LNAPL DELINEATION

In order to assess the extent of LNAPL at the site, borings were installed to determine whether additional monitoring or recovery wells are needed. The results of field screening are summarized on Table 1 and included in the boring logs included as Appendix A. The extent of residual petroleum product in soil and LNAPL in groundwater is illustrated on the cross sections provided in Figure 3. Results of the direct-push sampling event were incorporated into the extent of LNAPL shown on Figure 4.

3.2.2.1 LNAPL IN SOILS

Soil collected from 31 borings contained a PID headspace reading greater than 100 ppm. All soil intervals with a headspace reading greater than 100 ppm were scanned using an ultraviolet (UV) light in a darkened setting to determine if the soil fluoresced under the UV light. Of the 31 borings with a PID headspace reading greater than 100 ppm, eighteen borings contained one or more sample intervals that fluoresced under the UV light. A positive fluorescence response is considered a positive test result for petroleum product.

Petroleum product was visible on soils in five borings where the UV light test indicated that product was present:

- NE-DP-33 (Cross-section A-A′): a yellow-colored product was visible from 12.9 feet bgs to 13 feet bgs; this interval had a headspace reading of 859.2 ppm. The product drained from the soil at this interval and collected in the sample liner. Dark gray silt from 8 feet bgs to 15.5 feet bgs was oily in appearance. NE-DP-33 was located in the North Process Area, adjacent to the railroad tracks.
- NE-DP-40 (Cross-section A-A′): a dark-colored product was visible from 12 feet bgs to the base of the boring at 20 feet bgs. The UV test was positive for petroleum product from 2 feet bgs to 4 feet bgs and from 8 feet bgs to 20 feet bgs. Headspace measurements exceeded 1,000 ppm from 10 feet bgs to 18 feet bgs. This boring was located in the crude oil processing unit, roughly in the center of the active process areas.
- NE-DP-43 (Cross-section A-A′): a dark reddish brown and oily product was observed on soils from 7 feet bgs to 19 feet bgs. The UV test was positive for petroleum product from 4 feet bgs to the base of the boring at 20 feet bgs. Headspace measurements exceeded 1,000 ppm from 6 feet bgs to 20 feet bgs. This boring was located in the crude oil processing unit, in the southern portion of the active process areas.

- SE-DP-57 (Cross-section A-A′): a dark reddish brown and oily product was observed on soils from 8 feet bgs to 9 feet bgs and from 12 feet bgs to the base of the boring at 20 feet bgs. The UV test was positive for petroleum product from 2 feet bgs to 20 feet bgs. Headspace measurements exceeded 1,000 ppm from 8 feet bgs to 20 feet bgs. This boring was located in the crude oil processing unit, in the southern portion of the active process areas.
- SW-DP-76 (located west of the Refinery and near perimeter monitoring well BMW-20A): a dark reddish brown product was visible on the soil from 4.5 feet bgs to 5 feet bgs. The UV test was positive for petroleum product from 2 feet bgs to the base of the boring at 8 feet bgs. The maximum headspace measurement was 1,111 ppm for the interval from 4 feet bgs to 6 feet bgs.

3.2.2.2 LNAPL IN GROUNDWATER

Borings that exhibited a positive ultraviolet light test result were converted to temporary monitoring wells to determine if LNAPL was present in groundwater at those locations. The temporary wells were allowed to remain in place for approximately 24 hours to allow LNAPL, if present, to collect in the well. Measurable LNAPL was present in four temporary monitoring wells (NE-DP-43, NE-DP-54, SE-DP-57, and SE-DP-59) at thicknesses ranging from 0.01 foot (NE-DP-43) to 1.8 feet (NE-DP-54).

Evidence of LNAPL was noted in five temporary wells in which no measurable LNAPL was found. LNAPL was present on the outside of the PVC casing when the PVC well casing was removed from the boring at NE-DP-33, NE-DP-40, and SW-DP-76. At soil profile location NE-DP-34, LNAPL was observed on the oil-water interface probe after the well was gauged, although measurable LNAPL was not detected by the probe. Because LNAPL was expected to be present at this location based on field observations during installation of the boring, a bailer was deployed to visually inspect for LNAPL. Fluid removed from the well was a mixture of water and emulsified LNAPL. Groundwater collected from NE-DP-39 for laboratory analysis exhibited a sheen. The visual observation of LNAPL at these locations indicates that LNAPL would likely be observed in these areas if an appropriately installed and developed permanent monitoring well were present.

3.2.3 DISSOLVED-PHASE PLUME DELINEATION

As part of the direct-push groundwater investigation, groundwater samples were collected from a total of 51 temporary wells for analysis of GRO, DRO, and BTEX by Pace Analytical Services of Salina, Kansas. Due to the presence of measurable LNAPL in the groundwater profile locations, NE-DP-43, NE-DP-44, and SE-DP-59 were not sampled.

Groundwater was collected using a peristaltic pump with dedicated tubing for each location. In an effort to reduce the amount of sediment in the groundwater sample, a small volume of groundwater, generally less than one gallon, was purged from the temporary wells prior to sampling. Quality control sampling consisted of three duplicate samples, three matrix spike/matrix spike duplicate samples, one equipment rinsate blank, and three trip blanks.

All sample coolers were received by the laboratory with temperatures below 6 degrees Celsius, no quality assurance or quality control issues related to field activities or sample shipping were noted by the laboratory. Additional data qualifiers were reported by the laboratory in the Quality Control Report and are included with the sample results in Table 2. Details of laboratory Quality Assurance/Quality Control are included in the laboratory reports in Appendix D. The results of the duplicate samples were consistent with the concentrations measured in the primary samples.

Isoconcentration contours were developed, using analytical data from samples collected from the Site-Wide Comprehensive Sampling event and the Interior Delineation, for select compounds to demonstrate the distribution of constituents of concern at the Refinery. Figures 5A, 5B, and 5C depict the isoconcentration contours for GRO, DRO, and benzene.

3.2.3.1 GASOLINE RANGE ORGANICS

GRO were detected in groundwater collected from 16 of the 48 temporary wells during the interior delineation sampling event. The concentration of GRO exceeded the ODEQ Cleanup Level of 1,000 µg/l (ODEQ, 2004) in groundwater samples collected from 7 locations at concentrations ranging from 1,630 µg/l (NE-DP-33) to 59,400 µg/l (NE-DP-39).

As shown on Figure 5A, GRO exceeded the regulatory criterion in three areas: in the vicinity of the PLF, in the northeast portion of the Refinery extending from approximately UMW-5 in the north and southward to NMW-13 located on the southern end of the North Process Area, and in the South Process Area in an area centered roughly around LRW-3. The distribution of GRO in the vicinity of the northern boundary outside of the current monitoring well network and investigation area was determined using groundwater data from the 2012 (WRC, 2012) and 2013 (CVR and WSP, 2013) north boundary groundwater investigations.

3.2.3.2 DIESEL RANGE ORGANICS

DRO were detected in groundwater collected from all 48 temporary wells during the interior delineation sampling event. The concentration of DRO exceeded the ODEQ Cleanup Level of 1,000 µg/l (ODEQ, 2004) in 16 of the 48 samples at concentrations ranging from 1,100 µg/l (NE-DP-105) to 24,000 µg/l (NE-DP-33).

As shown on Figure 5B, the distribution of DRO in groundwater generally mimics the distribution of GRO, with plumes exceeding the ODEQ Cleanup criterion in the vicinity of the PLF and from the north boundary southward including the South Process Area. DRO also exceeds the cleanup criterion in the southern portion of the Refinery, near the v-ditch, along Savage Creek, and around the wastewater lagoons. The distribution of DRO in the vicinity of the northern boundary outside of the current monitoring well network and investigation area was determined using groundwater data from the 2012 (WRC, 2012) and 2013 (CVR and WSP, 2013) north boundary groundwater investigations.

3.2.3.3 BENZENE

One or more BTEX compounds were detected above the method detection limit in groundwater collected from 26 of the 48 temporary wells during the interior delineation sampling event; of these 26 samples, only 9 contained detections above the laboratory reporting limit. Benzene was detected at concentrations exceeding the EPA RSL of 0.46 µg/l in groundwater collected from 11 locations and exceeded the EPA Primary Drinking Water criterion of 5 µg/l in groundwater collected from 8 locations. The maximum benzene concentration of 11,000 µg/l was detected in groundwater collected from NE-DP-39.

As shown on Figure 5C, the distribution of benzene in groundwater generally mimics the distribution of GRO, with plumes in the vicinity of the PLF and from the north boundary southward including the South Process Area. The distribution of benzene in the vicinity of the northern boundary outside of the current monitoring well network was determined using groundwater data from the 2012 (WRC, 2012) and 2013 (CVR and WSP, 2013) north boundary groundwater investigations.

3.3 LNAPL TRANSMISSIVITY

From May 4 through May 7, 2016, LNAPL recovery tests were performed at five monitoring wells. At monitoring wells NMW-2, NMW-6, NMW-10, and OMW-4, manual skimming of LNAPL was used to recover LNAPL. A baildown test was performed at monitoring well OMW-3 because LNAPL recharge to OMW-3 was too slow to perform the manual skimming test.

3.3.1 FIELD PROCEDURES

The tests were performed according to ASTM document E2586-13. LNAPL manual skimming tests are performed by repeatedly removing LNAPL from the well without allowing more than approximately 25 percent of recharge to occur between product removal events. Skimming is repeated until the volume of LNAPL removed per unit of time stabilizes within 25 percent over three successive discharge events. The depth to LNAPL and depth to water at the monitoring well is periodically monitored to ensure LNAPL thickness remains below 25 percent of the original thickness until the test is complete.

LNAPL baildown tests involve removing all LNAPL from the well and closely monitoring changes in LNAPL thickness to determine the rate of recharge of LNAPL from the formation into the well.

For the manual skimming tests, LNAPL recharge only stabilized in monitoring well NMW-2. LNAPL recharge did not stabilize in NMW-6, NMW-10, or OMW-4., The LNAPL recovery rate in these three monitoring wells was so low that it was determined that the LNAPL transmissivity would be too low to warrant installing a recovery well for LNAPL extraction at these locations. The manual skimming test was discontinued and considered complete for these wells. Details of the manual skimming and baildown tests are provided in Appendix C.

3.3.2 CALCULATING LNAPL TRANSMISSIVITY

Analysis of data was be completed using the API LNAPL worksheet and in accordance with ASTM E2856-13 and the API user guide for the LNAPL worksheet (API, 2012).

The purpose of calculating the transmissivity of LNAPL is to evaluate the potential for, and practicability of, LNAPL recovery at a specific well. The LNAPL transmissivity value represents the volume of LNAPL through a unit width of aquifer per unit time per unit drawdown and changes as LNAPL volume and hydrogeologic conditions in the aquifer change. LNAPL transmissivity is directly proportional to LNAPL recoverability, whereas other metrics, such as apparent LNAPL thickness, do not exhibit a consistent relationship to recoverability (ASTM 2013).

LNAPL transmissivity from manual skimming tests is calculated using the following equation

$$T_n = \frac{Q_n \times \ln\left(\frac{R_{oi}}{r_w}\right)}{2\pi s_n}$$

where T_n is the LNAPL transmissivity, Q_n is the stabilized LNAPL recharge rate, R_{oi} is the radius of influence, r_w is the well radius, and s_n is the LNAPL drawdown in the well, calculated as the geometric mean of the starting and ending LNAPL drawdown values for a recharge cycle. An assumed value of 4.6 was used for $\ln(R_{oi}/R_w)$, from ASTM E2856-13.

Research indicates that hydraulic pumping recovery systems can practically reduce LNAPL transmissivity to values between 0.1 and 0.8 feet squared per day (ft^2/day) (ITRC, 2009). For the purposes of this investigation, monitoring wells with LNAPL transmissivity values less than 0.8 ft^2/day will not be targeted for mechanical LNAPL recovery efforts.

For the LNAPL baildown tests, transmissivity calculations were completed utilizing the API LNAPL Transmissivity Workbook: A Tool for Baildown Test Analysis (API, 2012). The workbook is a Microsoft Excel ™ spreadsheet that analyzes the data and calculates LNAPL transmissivity using three different methods: Bouwer & Rice (1976), Cooper & Jacob (1946), and Cooper, Bredehoeft, & Papadopulos (1967) methods.

Results of the LNAPL skimming and baildown tests are summarized in Table 3. Calculated LNAPL transmissivity for monitoring well for OMW-4 is ≤0.12 ft^2/day and for monitoring wells NMW-6, NMW-10, and OMW-3 are all below 0.1 ft^2/day, indicating that hydraulic LNAPL recovery in these areas is not an efficient recovery technique at this time. As mentioned above, the recharge rate at monitoring wells NMW-6, NMW-10, and OMW-4 did not stabilize and were still decreasing when the manual skimming test at these wells was terminated. Therefore, the calculated LNAPL transmissivity at these wells is a maximum estimate.

The LNAPL transmissivity at NMW-2 was the highest of all wells, with a value of 1.2 ft^2/day, indicating the LNAPL in this area of the Light Oils tank farm is recoverable using hydraulic recovery methods.

4 SUMMARY

4.1 PLUME DELINEATION

4.1.1 EXTENT OF LNAPL PLUME

The distribution of LNAPL based on the findings of the direct-push investigation are generally consistent with the historic LNAPL plumes mapped at the Site. No new plumes were encountered during the direct-push investigation. However, the footprints of the LNAPL plumes were extended or modified based on the presence or absence of LNAPL at temporary boring locations installed during the direct-push investigation. The extent of the LNAPL plumes has been effectively delineated based on the results of the interior delineation direct-push investigation and the Refinery monitoring well network.

There appear to be three separate LNAPL plumes at the Light Oils tank farm. The northernmost plume centered at NMW-12 and NE-DP-44 appears to be degraded refined product, based on the dark color of the LNAPL. The second isolated LNAPL plume is observed at NMW-6, NE-DP-54, and occasionally at NMW-8. The third LNAPL plume is larger and extends from the west central portion of the tank farm, westward to the North Process Area, where the LNAPL gasoline and kerosene plume from the Light Oils Tank Farm appears to have commingled with the diesel plum plume from the North Process Area. The results of the direct-push soil investigation indicate this plume extends downgradient to the railroad tracks, further west than has been shown in previous reports due to a lack of well control.

Similarly due to a lack of well control, the LNAPL diesel plume at the South Process Area was found to extend further east and south than previously illustrated. Free product was observed in soil cores in both the unsaturated zones in the vicinity of the crude oil unit (NE-DP-40, NE-DP-43, and SE-DP-57) suggesting historic releases in this area are a significant source of LNAPL to groundwater. No LNAPL was encountered in the borings to the west of the South Process Area, confirming that the LNAPL plume in that area is adequately delineated.

No additional LNAPL was encountered in temporary borings located in the vicinity of the PLF. The LNAPL that remains at the PLF is likely residual product from historic releases, the LNAPL in this area is adequately delineated, and expansion of the remediation system in this area for purposes of LNAPL recovery is not warranted.

No evidence of free product was encountered at any of the four borings surrounding LMW-5-0, which occasionally exhibits very small thicknesses of LNAPL. The lack of evidence for a source area for LNAPL at LMW-5-0 and the lack of free product in the vicinity of this monitoring well indicates that the LNAPL here is residual and not part of a larger, previously uncharacterized LNAPL plume.

LNAPL was observed in the soil core at SW-DP-76, west of Refinery property and downgradient of the Blue Knight Pipeline. LNAPL was also observed on the temporary well casing when it was removed from this boring. An additional boring, SW-DP-109, was installed upgradient of SW-DP-76 and the Blue Knight Pipeline and down gradient of the PLF. Because no indication of LNAPL was present during field screening at boring SW-DP-109 and because groundwater collected from SW-DP-109 did not include any detection of GRO or BTEX compounds, the LNAPL at SW-DP-76 is likely the result of historic releases from the third-party pipelines that are, or have been, located in the Blue Knight pipeline corridor.

4.1.2 EXTENT OF DISSOLVED-PHASE PLUME

Isoconcentration contours for GRO (Figure 5A), DRO (Figure 5B), and benzene (Figure 5C) show that the distribution in groundwater is somewhat similar for these compounds with the distribution of GRO and benzene being somewhat less extensive than the distribution of DRO. The dissolved-phase compounds are generally coincident with LNAPL plumes within the North Process Area, South Process Area, and PLF. However, a dissolved-phase DRO plume in the southern portion of the Refinery appears to be unassociated with any LNAPL plume. Samples collected from temporary wells in the northeastern portion of the Refinery contained the most detections and the highest concentrations of all compounds. The groundwater sample collected from NE-DP-39, located on the west side of U.S. Highway 77 directly downgradient of the Light Oils Tank Farm, contained the highest detections of GRO, benzene, toluene, ethylbenzene, and xylenes.

Based on the direct-push groundwater sampling result, the dissolved-phase plume in the vicinity of the PLF appears to be an amalgamation of three separate releases: one from the known historical release from the PLF; one from the WRC tank farm north of the PLF; and one from the third-party pipeline corridor on the property west of the PLF.

The isoconcentration contours and results from the expanded analyte list from the site-wide comprehensive sampling and direct-push sampling events show that the abbreviated list of analytes used in past sampling events have been sufficient to capture the general distribution of the dissolved-phase plumes at the Refinery.

4.2 LNAPL TRANSMISSIVITY

Results of the LNAPL skimming and baildown tests, summarized in Table 3, show that the current LNAPL transmissivity for monitoring wells OMW-4, NMW-6, NMW-10, and OMW-3 are at or below 0.12 ft^2/day, indicating that hydraulic LNAPL recovery in these areas is not an efficient recovery technique at this time.

The LNAPL transmissivity at NMW-2 was 1.2 ft^2/day, indicating the LNAPL in this area of the Light Oils tank farm is recoverable using hydraulic recovery methods and is a favorable location for expansion of hydraulic LNAPL recovery systems.

5 RECOMMENDATIONS

The recommendations included in this section are based on the results of the interior delineation activities, including the site-wide comprehensive groundwater sampling event, direct-push sampling event, which included both LNAPL plume and dissolved-phase plume delineation, and the LNAPL transmissivity testing conducted at the Refinery as part of the Interior Delineation task outlined in the Order.

5.1 ADDITIONAL MONITORING WELLS

WRC proposes to install eighteen additional monitoring wells at property boundary and interior locations to monitor LNAPL and dissolved-phase trends. Figure 6 depicts the locations of the proposed monitoring wells.

Monitoring well locations may change slightly due to Refinery restrictions and to avoid underground and overhead utilities. The monitoring wells will be installed in accordance with the procedures described in the Quality Assurance Project Plan, submitted with the Comprehensive Remediation Plan. Monitoring well screens shall be of sufficient length to detect, monitor or otherwise describe the contaminant plume according to observed conditions and site stratigraphy. Where LNAPL is present, wells will be screened over the mobile interval of LNAPL.

5.1.1 PERIMETER MONITORING WELL LOCATIONS

The following wells are proposed to be installed to enhance perimeter monitoring:

- UMW-8 and UMW-9 will be installed to monitor conditions upgradient of the Light Oils tank farm.
- SMW-25 will be installed along the southern boundary to delineate the DRO plume downgradient of SE-DP-69.
- LMW-16 will be installed along the western property boundary to monitor downgradient of SW-DP-112.

5.1.2 INTERIOR MONITORING WELL LOCATIONS

The following wells are proposed to be installed to enhance dissolved-phase monitoring:

- NMW-20 will be installed between temporary borings NW-DP-89 and NW-DP-106 to monitor dissolved-phase plume downgradient of northern lobe of the North Process Area LNAPL.
- NMW-22 will be installed along the eastern property boundary to monitor the dissolved-phase plume downgradient of the Light Oils Tank Farm.
- NMW-23 will be installed on the downgradient edge of the North Process Area dissolved-phase plume, slightly north of NE-DP-33.
- NMW-24 will be installed slightly south of NE-DP-33 to monitor the downgradient edge of the North Process Area dissolved-phase plume.
- LMW-17 will be installed upgradient of the PLF tank farm to monitor dissolved-phase plume and LNAPL between the PLF and the South Process Area dissolved-phase plume.
- SMW-26 will be installed in the vicinity of SW-DP-85 and SW-DP-86 to monitor the dissolved-phase plume downgradient of the V-Ditch.

The following wells are proposed to be installed for LNAPL monitoring:

- NMW-21 will be installed in the vicinity of temporary boring NE-DP-54, where 1.8 feet of LNAPL was encountered.
- OMW-7 will be installed between existing monitoring wells ORW-2 and OMW-3, within an existing LNAPL plume and temporary wells NE-DP-37 and NE-DP-40, where petroleum product was visible on soils and LNAPL was observed on the temporary well casing when it was removed from the boring.
- OMW-8 will be installed in the vicinity of temporary boring NE-DP-40, where petroleum product was visible on soils and LNAPL was observed on the temporary well casing when it was removed from the boring.
- OMW-9 will be installed in the vicinity of temporary boring NE-DP-43 where petroleum product was visible on soils and 0.1 foot of LNAPL was measured in the temporary monitoring well.
- OMW-10 will be installed in the vicinity of temporary boring SE-DP-57 where petroleum product was visible on soils and 1.72 feet of LNAPL was measured in the temporary monitoring well.
- LMW-18 will be installed in the North Process Area to delineate and monitor the LNAPL plume downgradient of NE-DP-33, where LNAPL was visible on soil from 12.9 feet bgs to 13 feet bgs and LNAPL was visible on the temporary well casing when it was removed from the boring. Additionally this location will assist in delineating the separation between the north lobe of the North Process Area dissolved-phase plume from the South Process Area dissolved-phase plume.
- BMW-29 and BMW-30: Located in and downgradient, respectively, of the PLF tank farm, to monitor for and delineate any previously unidentified LNAPL plumes resulting from historic releases in the tank farm north of the PLF.

5.2 ADDITIONAL GROUNDWATER REMEDIATION

5.2.1 NORTH PROCESS AREA RECOVERY SYSTEM MODIFICATION

As discussed in the Comprehensive Remediation Plan, additional remediation in the vicinity of the North Process Area may be installed to address the dissolved-phase plume to provide hydraulic control based on the results of the North Boundary Injection Test, or incorporate additional recovery wells.

LNAPL transmissivity calculated for NMW-2 indicates LNAPL in this area is recoverable. Therefore, it is suggested that a recovery well, NRW-8, be installed adjacent to NMW-2 to facilitate removal of LNAPL in the North Process Area.

Based on the results of the investigation activities conducted to date, the North Process Area dissolved-phase plume extends north of existing monitoring well NMW-12, which has intermittent LNAPL. Analytical results for temporary well NE-DP-45 exceeded clean-up criteria for GRO, DRO, benzene, and toluene. It is recommended to install a recovery well, NRW-9, in the vicinity of NE-DP-45, south of NMW-12, in order to address the dissolved-phase plume and to potentially recover the intermittent LNAPL present in the area.

The recovery wells will be installed in accordance with the procedures and materials described in the Quality Assurance Project Plan, submitted with the Comprehensive Remediation Plan. Recovery wells shall be 4-inch diameter wells with screens of sufficient length to provide capture of groundwater and

LNAPL as prescribed for the well's purpose. Total depths and screen lengths will be determined by qualified field personnel based on apparent depth to saturated soil as determined in the field.

In lieu of preparing a conceptual design, the Refinery is requesting approval to incorporate recovery wells NRW-8 and NRW-9 into the North Process Area Enhancement, which is in the process of being formally approved by the Refinery Management of Change (MOC) process.

If approved, NRW-8 and NRW-9 will be equipped with pneumatic pumps that are capable of extracting groundwater and conveying it to the North Process Area recovery building at the design flow rate. Groundwater will be processed through an oil/water separator and discharged to the Refinery waste water treatment plant for additional treatment prior to being discharged under WRC's existing Oklahoma discharge permit.

5.2.2 PRODUCT LOADING FACILITY ADDITIONAL REMEDIATION

As discussed in the Comprehensive Remediation Plan, additional remediation in the vicinity of the PLF may be installed to address the need for additional containment and treatment of the dissolved-phase plume. The goal of the additional system modifications will be to improve hydraulic control and LNAPL recovery at the property boundary. The results from the interior delineation show there are no additional areas of LNAPL encountered in the PLF area, therefore no additional expansion of the PLF is recommended at this time.

5.2.3 SOUTH PROCESS AREA

As discussed in the Comprehensive Remediation Plan, additional remediation in the vicinity of the South Process Area may be installed to address the need for additional groundwater withdrawal for containment and treatment of the LNAPL and dissolved-phase plumes in the area. Based on the low LNAPL transmissivity results and the observed stability of both the LNAPL and dissolved-phase plumes in this area, no additional expansion of the South Process Area is recommended at this time. LNAPL thicknesses will be monitored quarterly and periodic manual LNAPL recovery may be conducted, as discussed below.

5.2.4 MANUAL LNAPL RECOVERY

Based on the LNAPL transmissivity testing conducted in May 2016, the transmissivity values calculated for NMW-6, NMW-10, OMW-3, and OMW-4 are too low to warrant expansion of recovery systems for LNAPL removal in these areas.

In an effort to recover LNAPL present in wells that either have transmissivity values that are not favorable for mechanical recovery or that have intermittent LNAPL present, the Refinery intends to include a manual LNAPL recovery plan in the long-term Performance Monitoring and Sampling Plan (PMP). Manual LNAPL recovery from a well will be conducted based on the LNAPL thickness in the well. The Manual LNAPL recovery action criteria are as follows:

- If LNAPL thickness is greater than 0.5 feet, then monitor and recover LNAPL from the well monthly until the thickness is less than 0.5 feet in the subsequent month.
- If LNAPL thickness is less than 0.5 feet for six consecutive months, then suspend monthly monitoring of the well.

If quarterly fluid level measurements indicate a measured LNAPL thickness greater than 0.5 feet in a well, in a well not previously included in the manual LNAPL recovery program, the well will be added to the program. The well will continue in the program until LNAPL thickness decreases to 0.5 feet or less for six consecutive months.

6 REFERENCES

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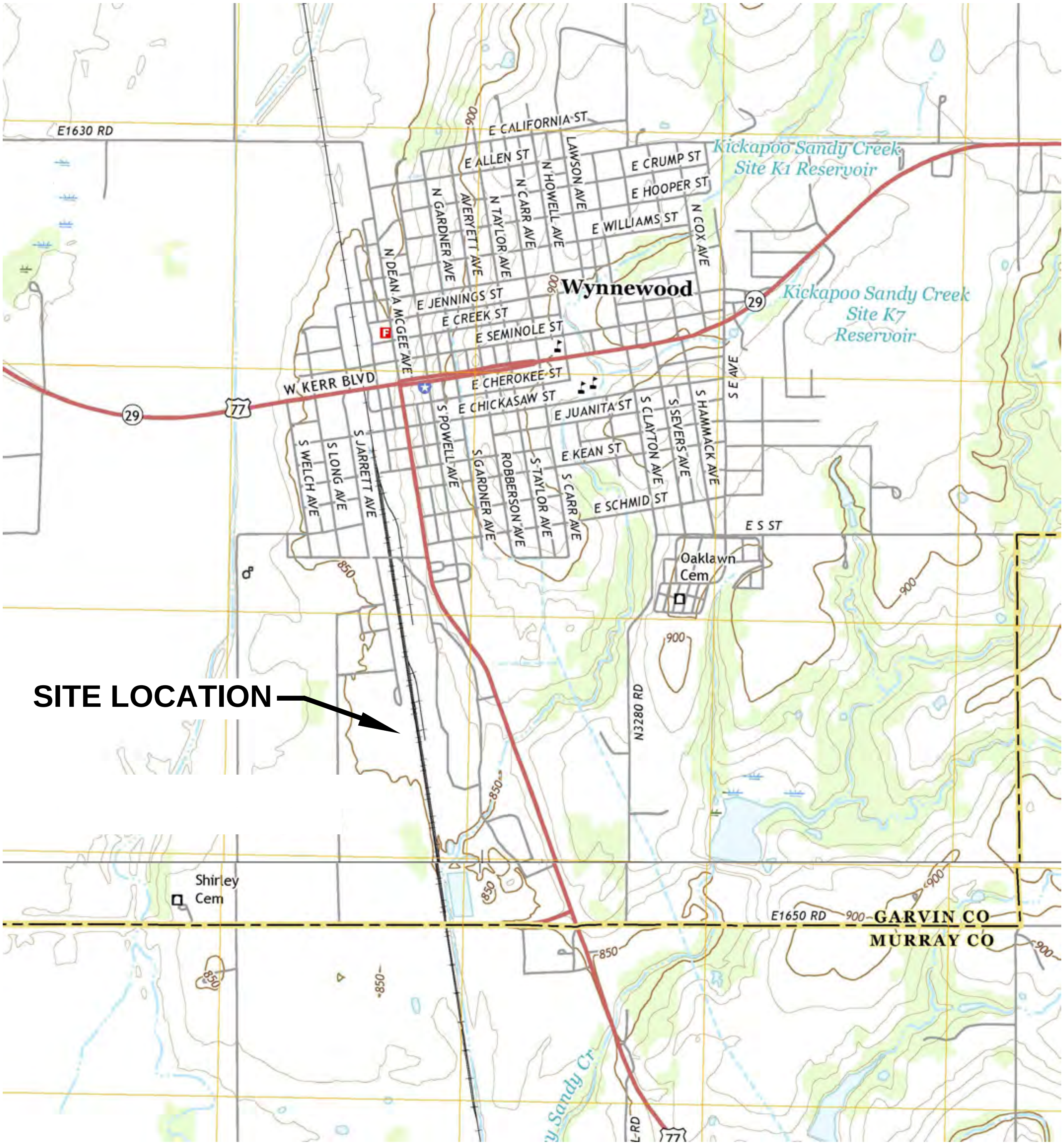
Figures



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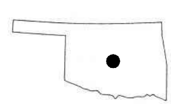
7.5 MINUTE SERIES TOPOGRAPHIC QUADRANGLE
PAULS VALLEY, OKLAHOMA
2016
JOY OKLAHOMA
2016



Quadrangle Location

N

0 2,000 4,000
SCALE IN FEET

DWG Name: 314M00030-001
Checked:
Approved:
Drawn By: LS 2/10/2016

WSP | PARSONS BRINCKERHOFF
WSP USA Corp.
123 North Third Street, Suite 507
Minneapolis, Minnesota 55401
(612) 343-0510
www.wspgroup.com/usa

Figure 1

SITE LOCATION

WYNNEWOOD REFINING COMPANY
WYNNEWOOD, OKLAHOMA
PREPARED FOR
WYNNEWOOD REFINING COMPANY
WYNNEWOOD, OKLAHOMA

R:\Acad\CADD_314\31400030-WYNNEWOOD\CADD\314M00030-049.DWG 7/8/2016 9:30 AM USLS01166

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

Drawing Number	FIGURE 2	WSP USA Corp.	SAMPLE LOCATIONS	DRAWN BY: LS 7/8/2016	SEAL	REVISIONS
314M00030–049		123 North Third Street, Suite 507 Minneapolis, Minnesota 55401 (612) 343-0510 www.wspgroup.com/usa	WYNNEWOOD REFINING COMPANY, LLC WYNNEWOOD, OKLAHOMA PREPARED FOR WYNNEWOOD REFINING COMPANY, LLC WYNNEWOOD, OKLAHOMA	CHECKED APPROVED	DATE	REV / DESCRIPTION Revised: Chkd: Appr.: Revised: Chkd: Appr.: Revised: Chkd: Appr.:

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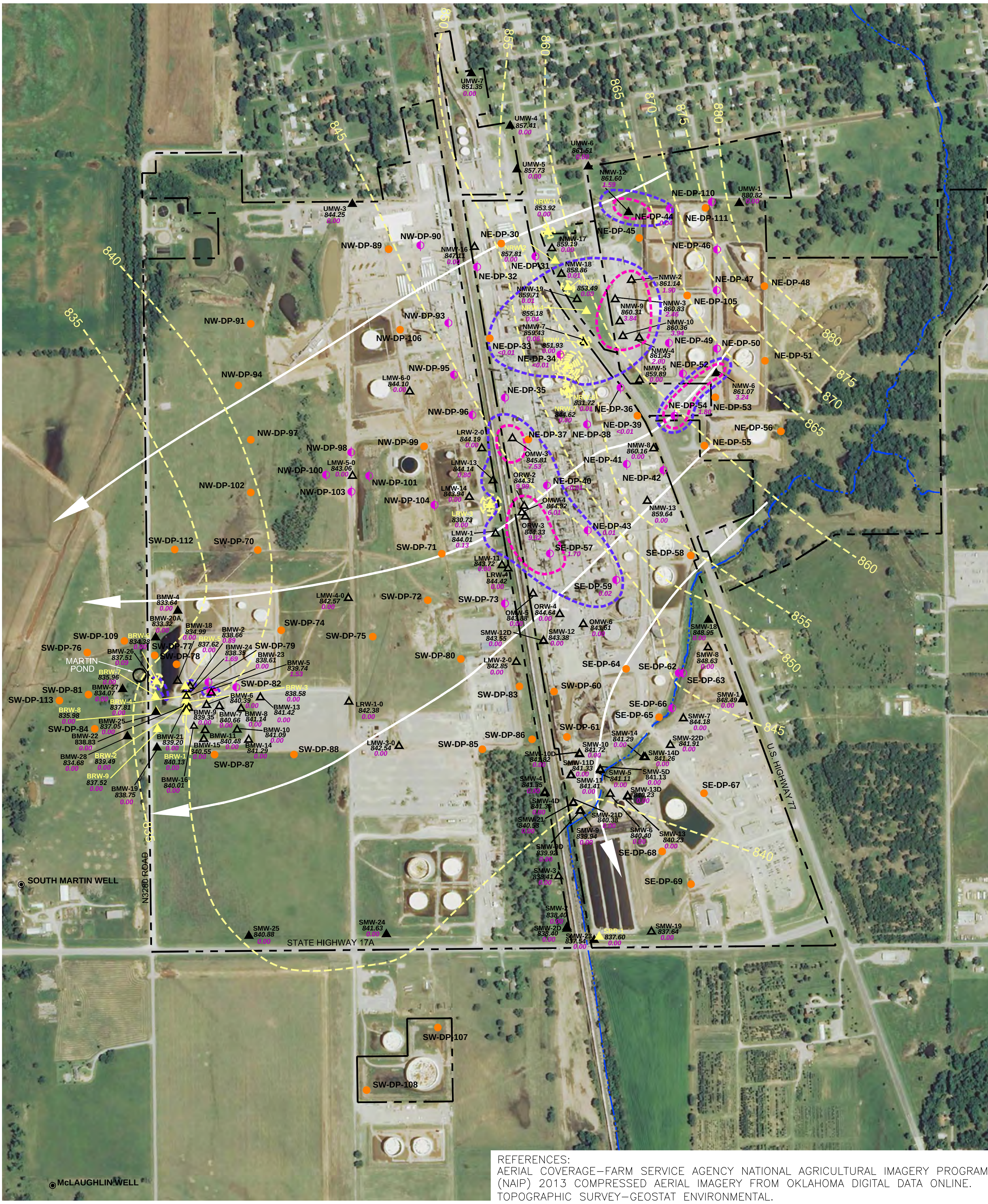

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND

- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PRIVATE SUPPLY WELL LOCATION
- GROUNDWATER PROFILE LOCATION
- SOIL PROFILE LOCATION
- PROPERTY BOUNDARY
- GROUNDWATER ELEVATION CONTOUR
- 838.66 GROUNDWATER ELEVATION (FEET ABOVE MEAN SEA LEVEL)
- 0.88 LNAPL THICKNESS (FEET)
- LNAPL THICKNESS (FEET) (0.01–1.00)
- LNAPL THICKNESS (FEET) (>1.00)
- GROUNDWATER FLOW DIRECTION

NOTES:
1. GROUNDWATER ELEVATIONS IN INTERMEDIATE AND DEEP WELLS NOT USED IN GENERATION OF CONTOURS.
2. GROUNDWATER ELEVATIONS ARE CORRECTED TO ACCOUNT FOR THE PRESENCE OF LNAPL IN ACCORDANCE WITH EPA GUIDANCE DOCUMENT 510R-96-001.
3. GROUNDWATER CONTOUR DEPRESSIONS SHOWN AROUND PUMPING RECOVERY WELLS ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY AND, DUE TO THE SCALE, DO NOT NECESSARILY DEPICT THE ACTUAL RADIUS OF INFLUENCE.
4. LNAPL THICKNESS CONTOURS ARE BASED ON MARCH 2016 WELL MEASUREMENTS AND FIELD OBSERVATIONS NOTED DURING THE 2016 INTERIOR DELINEATION INVESTIGATION.

N

0 650 1,300
SCALE IN FEET

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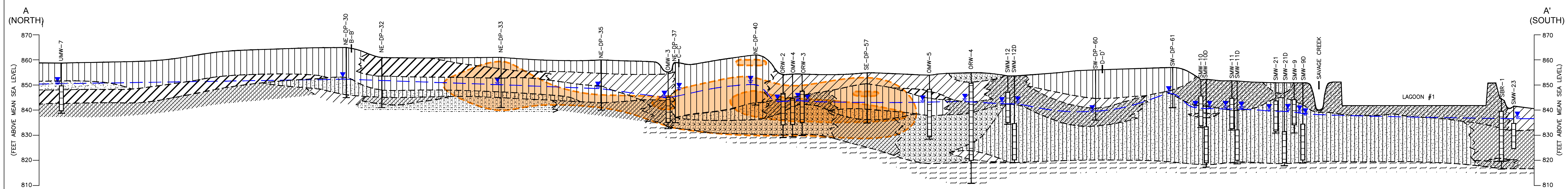
Figure 3

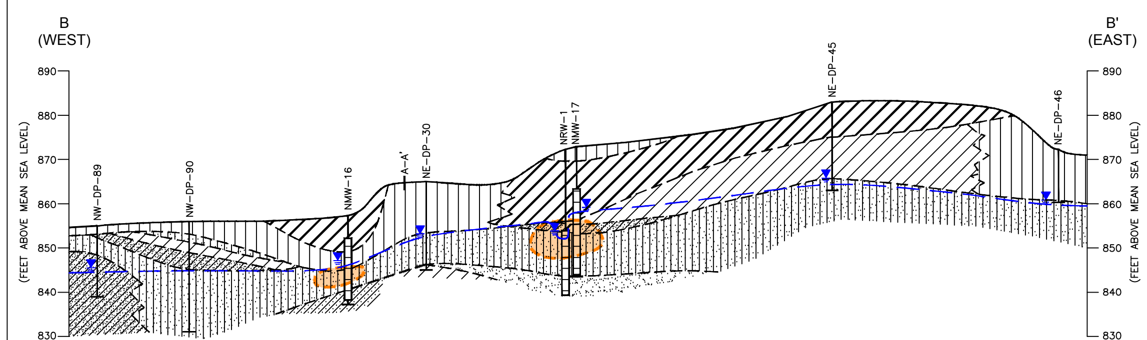
WATER TABLE ELEVATION AND LNAPL THICKNESS MAP MARCH 2016

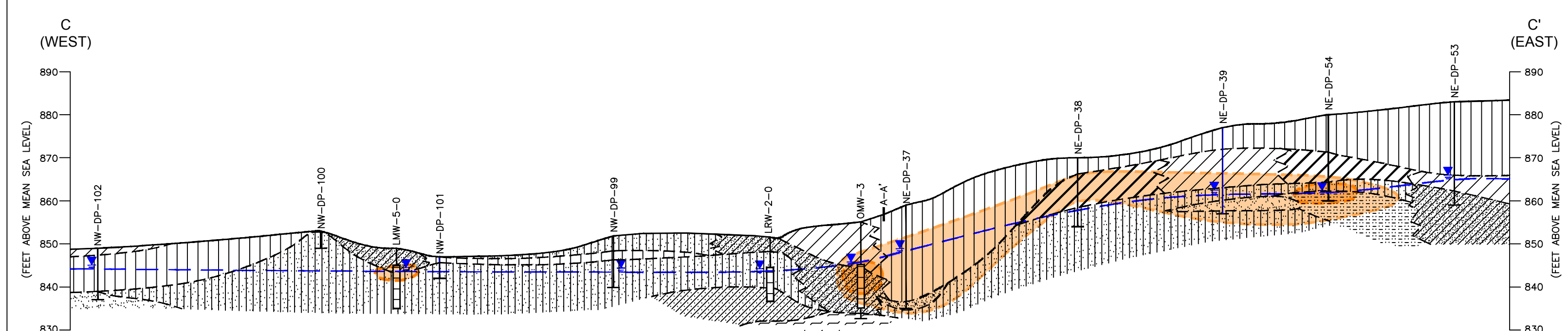
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

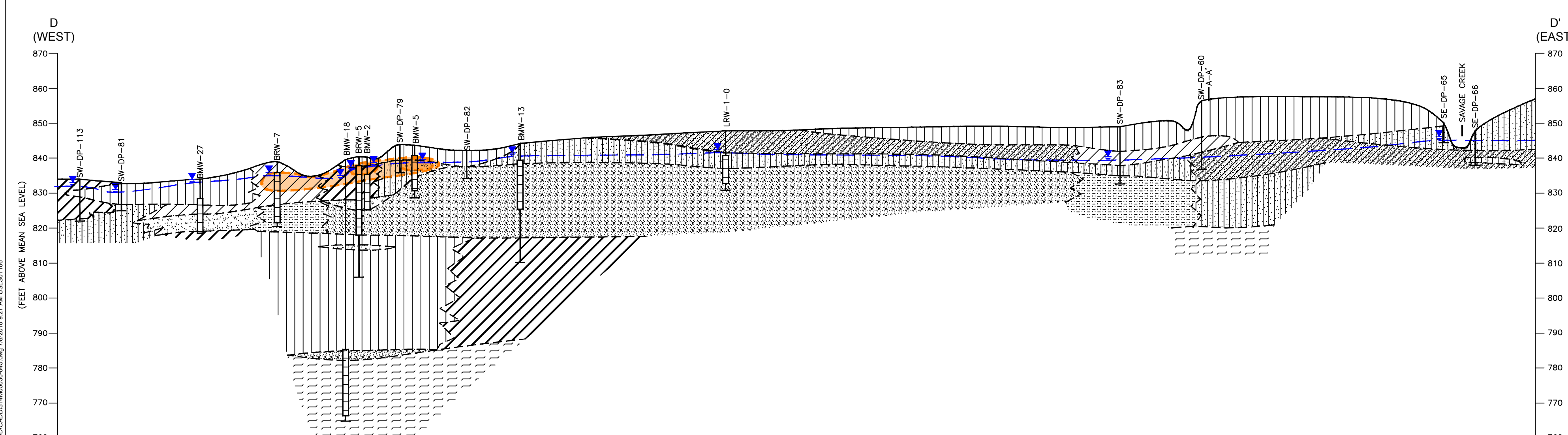
PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS	7/11/2016
Checked:	
Approved:	
DWG Name: 314M00030-047	

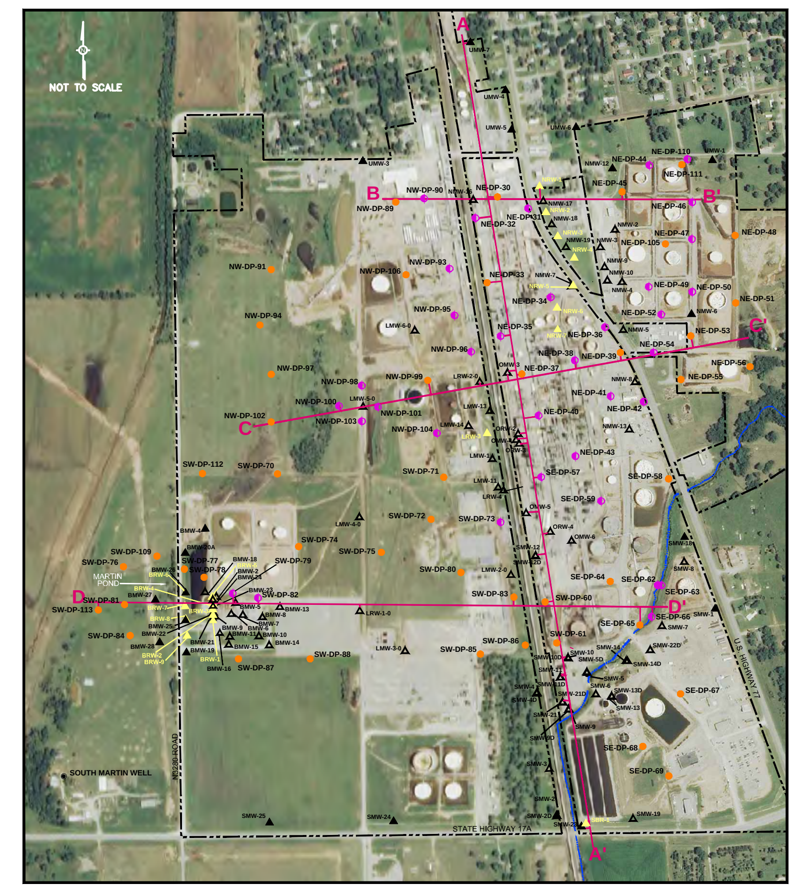








CROSS SECTION LOCATION MAP



LEGEND

- DIRECT-PUSH BORING LOCATION
- MONITORING WELL
- WATER TABLE ELEVATION, DASHED WHERE INFERRED (MARCH 2016)
- PLASTIC CLAY (CH)
- LEAN CLAY (CL)
- SILT (ML)
- SILTY SAND (SM)
- CLAYEY SAND (SC)
- WELL-GRADED SAND WITH SILT OR CLAY (SW-SM OR SW-SC)
- POORLY-GRADED SAND WITH SILT OR CLAY (SP-SM OR SP-SC)
- WELL-GRADED SAND (SW)
- POORLY-GRADED SAND (SP)
- HARD, DRY CLAY OR HEAVILY-WEATHERED SHALE
- POTENTIAL EXTENT OF FREE PRODUCT
- POTENTIAL EXTENT OF RESIDUAL FREE PRODUCT

0 200 400
HORIZONTAL SCALE IN FEET

0 20 40
VERTICAL SCALE IN FEET
10x VERTICAL EXAGGERATION

D

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REVISIONS

REV	DESCRIPTION		
1 Revised:		Chkd:	Apprv:
2 Revised:		Chkd:	Apprv:
3 Revised:		Chkd:	Apprv:

SEAL

DATE

DRAWN BY	LS	7/6/2016
CHECKED		
APPROVED		

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HYDROGEOLOGIC CROSS SECTIONS

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

WSP | PARSONS BRINCKERHOFF
WSP USA Corp.
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Minneapolis, Minnesota 55401
(612) 343-0510
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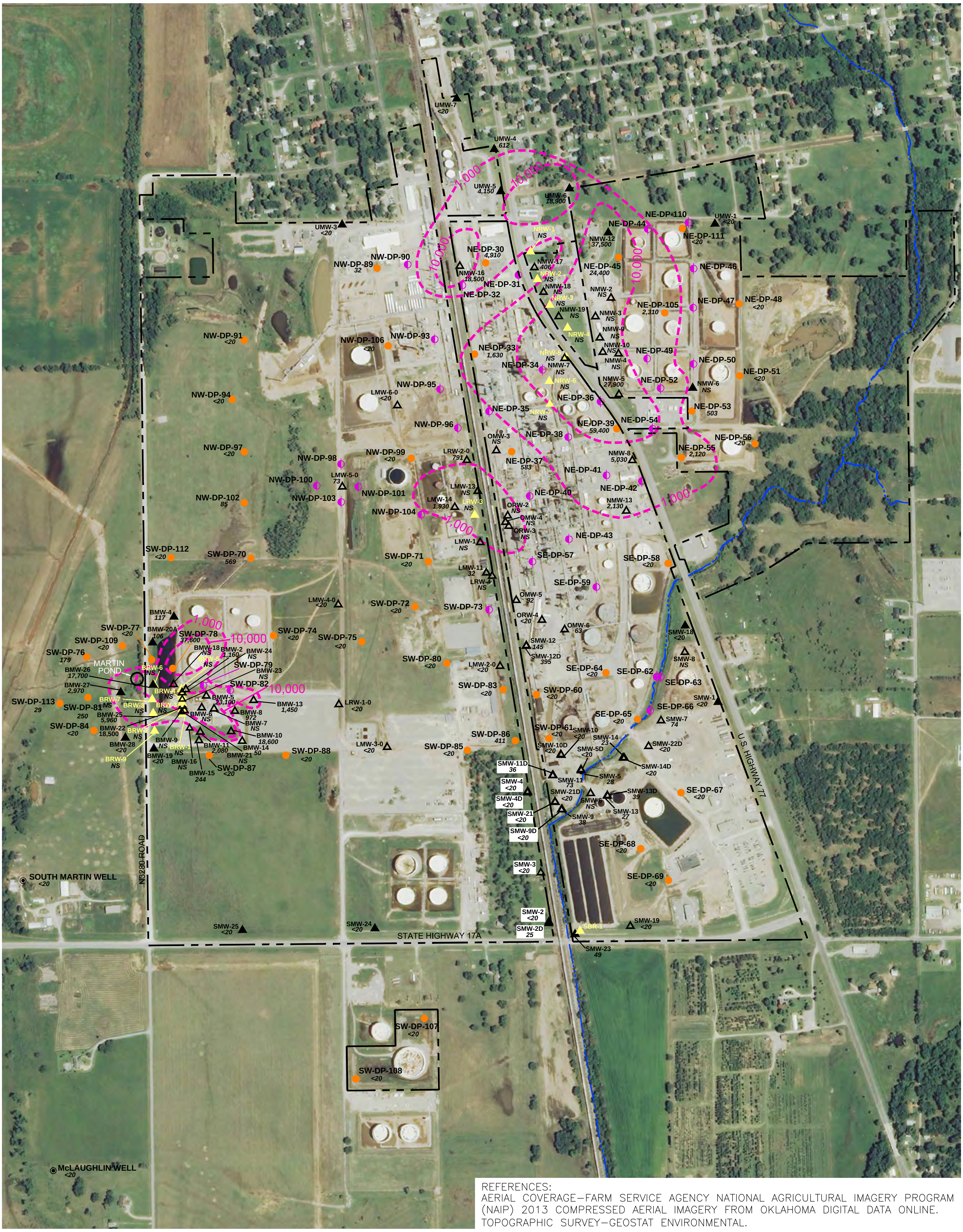
FIGURE 4

Drawing Number
314M00030-045



REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND

- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PRIVATE SUPPLY WELL LOCATION
- GROUNDWATER PROFILE LOCATION
- SOIL PROFILE LOCATION
- PROPERTY BOUNDARY
- 1,160 GASOLINE RANGE ORGANICS CONCENTRATION IN GROUNDWATER (MICROGRAMS PER LITER (µg/l))
- GASOLINE RANGE ORGANICS ISOCONCENTRATION CONTOUR(µg/l)
- NS NOT SAMPLED

NOTE:
ANALYTICAL DATA SHOWN HERE ARE FROM GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS IN SEPTEMBER 2015 AND FROM GROUNDWATER PROFILE LOCATIONS FROM FEBRUARY 2016 THROUGH APRIL 2016.

N

0 650 1,300
SCALE IN FEET

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Figure 5A

GASOLINE RANGE ORGANICS ISOCONCENTRATION MAP

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS 7/6/2016
Checked:
Approved:
DWG Name: 314M00030–042

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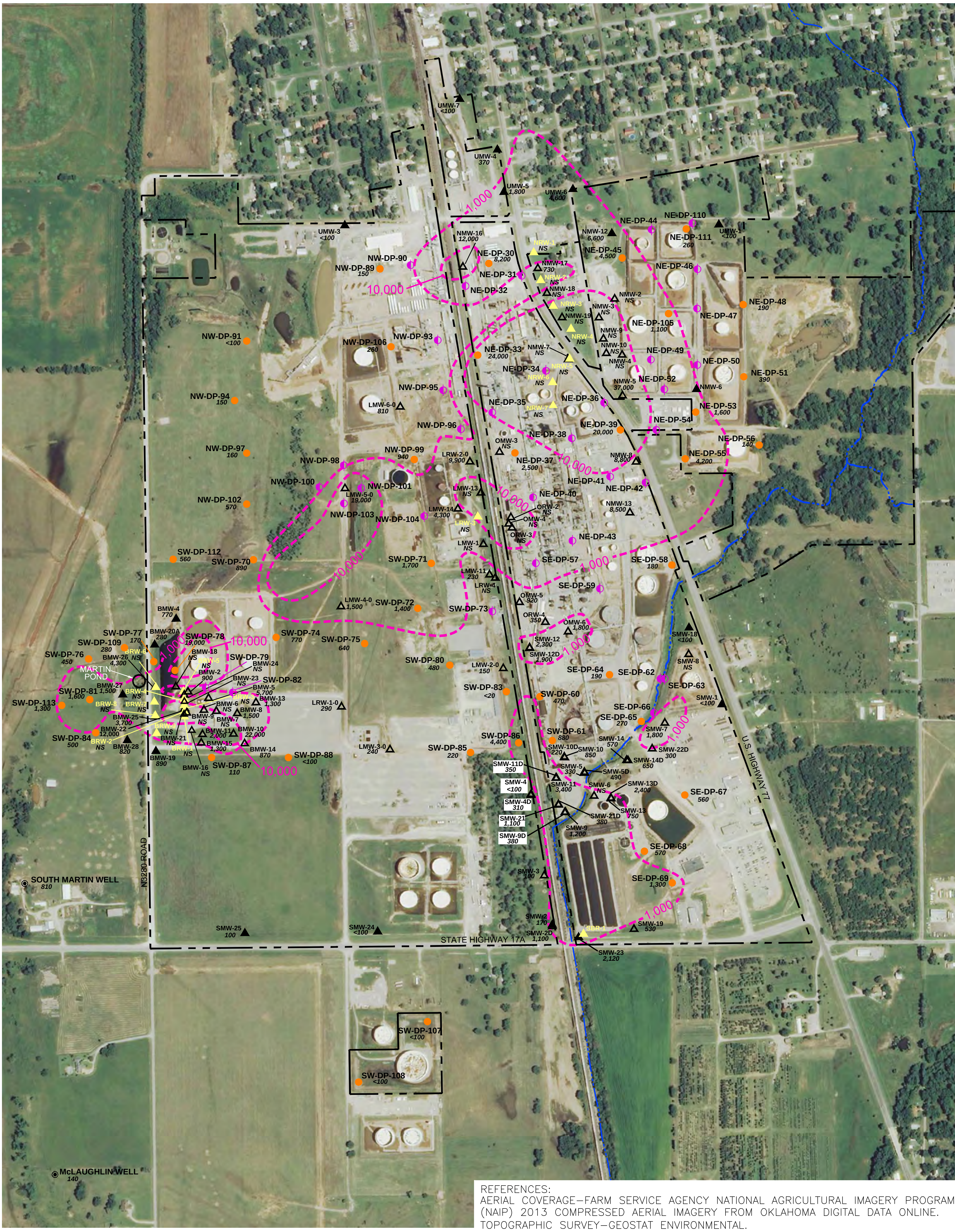

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND

▲ (yellow)	RECOVERY WELL LOCATION
△	MONITORING WELL LOCATION
▲	WRC PROPERTY BOUNDARY MONITORING WELL
◉	PRIVATE SUPPLY WELL LOCATION
● (orange)	GROUNDWATER PROFILE LOCATION
◐	SOIL PROFILE LOCATION
— · —	PROPERTY BOUNDARY
900	DIESEL RANGE ORGANICS CONCENTRATION IN GROUNDWATER (MICROGRAMS PER LITER (µg/l))
- - - (pink)	DIESEL RANGE ORGANICS ISOCONCENTRATION CONTOUR (µg/l)
NS	NOT SAMPLED

NOTE:
ANALYTICAL DATA SHOWN HERE ARE FROM GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS IN SEPTEMBER 2015 AND FROM GROUNDWATER PROFILE LOCATIONS FROM FEBRUARY 2016 THROUGH APRIL 2016.

N

0 650 1,300
SCALE IN FEET

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Figure 5B

DIESEL RANGE ORGANICS ISOCONCENTRATION MAP

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS 7/6/2016
Checked:
Approved:
DWG Name: 314M00030-043

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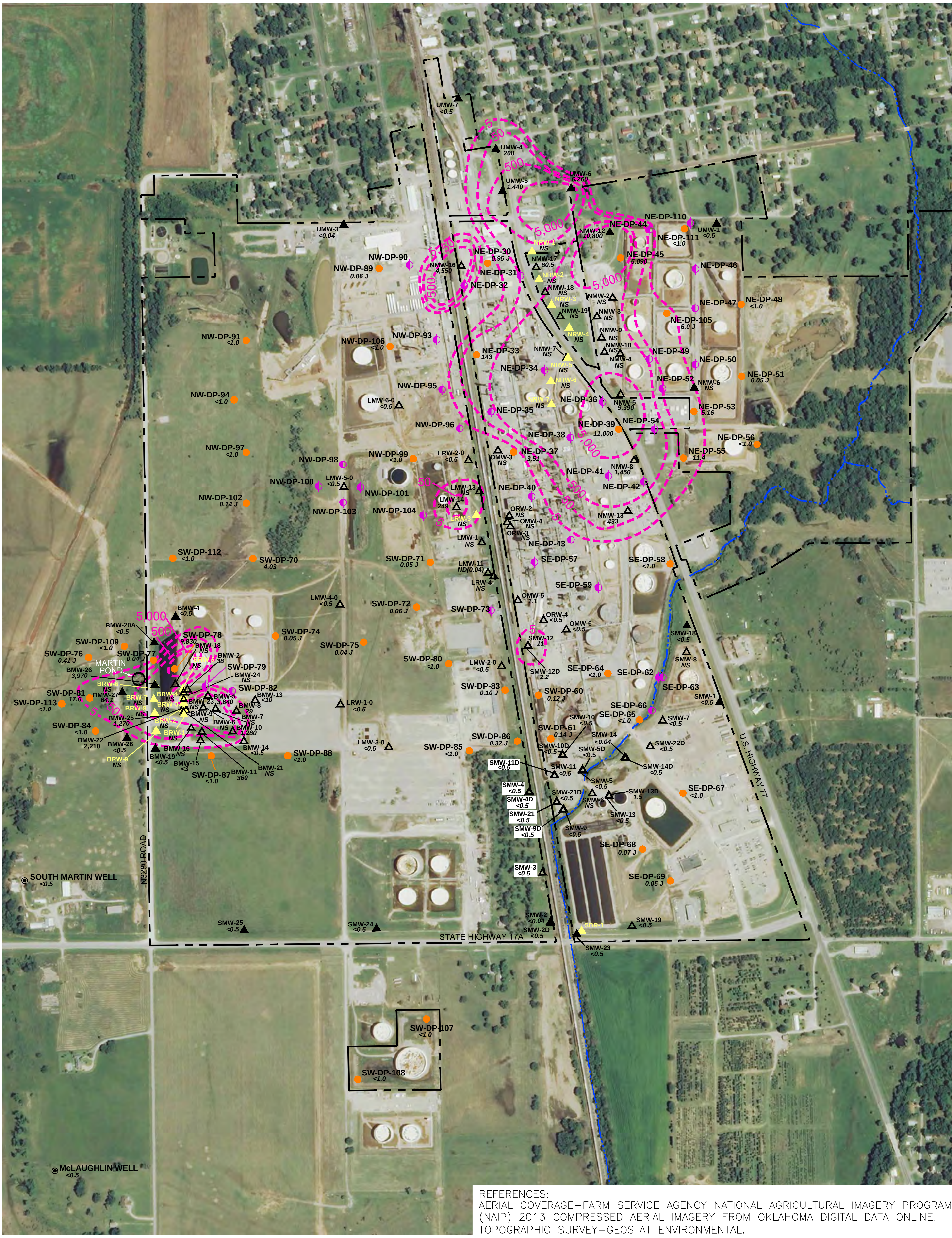

REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND

▲ (yellow)	RECOVERY WELL LOCATION
△	MONITORING WELL LOCATION
▲	WRC PROPERTY BOUNDARY MONITORING WELL
◉	PRIVATE SUPPLY WELL LOCATION
● (orange)	GROUNDWATER PROFILE LOCATION
◐	SOIL PROFILE LOCATION
— · —	PROPERTY BOUNDARY
1,280	BENZENE CONCENTRATION IN GROUNDWATER (MICROGRAMS PER LITER ($\mu g/l$))
- - -	BENZENE ISOCONCENTRATION CONTOUR ($\mu g/l$)
NS	NOT SAMPLED
J	THE CONCENTRATION IS BELOW THE LIMIT OF QUANTITATION AND IS CONSIDERED AN ESTIMATE VALUE

NOTE:
ANALYTICAL DATA SHOWN HERE ARE FROM GROUNDWATER SAMPLES COLLECTED FROM PERMANENT MONITORING WELLS IN SEPTEMBER 2015 AND FROM GROUNDWATER PROFILE LOCATIONS FROM FEBRUARY 2016 THROUGH APRIL 2016.

N

0 650 1,300
SCALE IN FEET

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Figure 5C

BENZENE ISOCONCENTRATION MAP

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By: LS 7/6/2016
Checked:
Approved:
DWG Name: 314M00030-044

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REFERENCES:
AERIAL COVERAGE–FARM SERVICE AGENCY NATIONAL AGRICULTURAL IMAGERY PROGRAM (NAIP) 2013 COMPRESSED AERIAL IMAGERY FROM OKLAHOMA DIGITAL DATA ONLINE.
TOPOGRAPHIC SURVEY–GEOSTAT ENVIRONMENTAL.

LEGEND
- RECOVERY WELL LOCATION
- MONITORING WELL LOCATION
- WRC PROPERTY BOUNDARY MONITORING WELL
- PRIVATE SUPPLY WELL LOCATION
- PROPOSED RECOVERY WELL LOCATION
- PROPOSED MONITORING WELL LOCATION
- PROPERTY BOUNDARY

N

0 650 1,300
SCALE IN FEET

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Figure 6

PROPOSED WELL LOCATIONS

WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

PREPARED FOR
WYNNEWOOD REFINING COMPANY, LLC
WYNNEWOOD, OKLAHOMA

Drawn By:	LS 7/6/2016
Checked:	
Approved:	
DWG Name:	314M00030-046

Tables

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
NE-DP-30	X	03/02/16	1,398 at 12-14	All negative	14	20	Yes	15-20	11.78	None
NE-DP-31		03/01/16	256.1 at 14-16	14-16/Negative	15	16	No	N/A		
NE-DP-32		03/02/16	36.2 at 4-6	None	10	20	No	N/A		
NE-DP-33	X	03/02/16	859.2 at 12-14	0-2/Negative 2-4/Negative 4-6/Positive (faint) 6-8/Positive 8-10/Positive 10-12/Positive 12-14/Positive 14-16/Positive 16-18/Positive 18-20/Positive	15.7	20	Yes	14-19	9.9	LNAPL visible on well casing when removed; no LNAPL measured
NE-DP-34		03/02/16	543.5 at 2-4	0-2/Positive 2-4/Positive	3	4	Yes	4-9	2.5	LNAPL visible on interface probe; no LNAPL measured
NE-DP-35		03/02/16	1,651 at 14-16	0-2/Negative 2-4 None 4-6/Negative 6-12 None 12-14/Negative 14-16/Positive 16-18/Positive 18-20/Negative	17.5	20	Yes	17-22	10.6	None

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
NE-DP-36		03/01/16	1,295 at 12-14	0-2/Negative 2-4/Positive (very faint) 4-6/Positive (faint) 6-8/Positive (faint) 8-10/Positive 10-12/Positive 12-14/Positive 14-16/Positive 16-18/Positive 18-20/Positive 20-22/Positive (very faint) 22-24/Positive (very faint)	20	24	Yes	18-23	15.6	None
NE-DP-37	X	03/01/16	1,816 at 12-14	0-2/Negative 2-4/Negative 4-6/Negative 6-8/Negative 8-10/Positive (faint) 10-12/Positive 12-14/Positive 14-16/Positive 16-18/Positive 18-20/Positive 20-22/Positive 22-24/Positive	20	24	Yes	21.5-26.5	10.12	None

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
NE-DP-38		03/01/16	1,438 at 4-6	0-2/Positive (very faint) 2-4/Negative 4-6/Positive (faint) 6-8/Positive 8-10/Positive 10-12 Negattive 12-14/Negative 14-16/Negative	12	16	Yes	11.5-16.5	4.3	None
NE-DP-39	X	03/01/16	2,304 at 8-10	8-10/Negative 10-12/Positive (faint) 12-14/Positive 14-16/Positive 16-18/Positive 18-20/Positive	14	20	Yes	14-19	14.5	Sheen visible on purged groundwater; no LNAPL measured
NE-DP-40		02/25/16	1,139 at 10-12	0-2/Negative 2-4/Positive (faint) 4-8/Negative 8-10/Positive (very faint) 10-12/Positive 12-14/Positive 14-16/Positive 16-18/Positive 18-20/Positive	19.5	20	Yes	15-20	10.3	LNAPL visible on well casing when removed; no LNAPL measured
NE-DP-41		03/01/16	1,311 at 12-14	All Negative	11.2	16	No	N/A		

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
NE-DP-42		03/31/16	2,572 at 12-14	10-12/Negative 12-14/Negative 14-16/Negative 16-18/Positive (faint) 18-20/Negative	14.2	20	Yes	14-19	14.8	None
NE-DP-43		02/26/16	1,444 at 16-18	0-2/Negative 2-4/Negative 4-6/Positive 6-8/Positive 8-10/Positive 10-12/Positive 12-14/Positive 14-16/Positive 16-18/Positive 18-20/Positive	19	20	Yes	11-16	9.98	
NE-DP-44		03/03/16	1,367 at 10-12	Negative	5.5	12	Yes	6-11	3.27	3.23
NE-DP-45	X	03/29/16	3,047 at 14-16	0-12 None 12-14/Negative 14-16/Negative 16-18/Negative 18-20/Negative	17	20	Yes	19-24	17.2	None
NE-DP-46		03/29/16	1.7 at 6-8	None	11.5	12	No			
NE-DP-47		03/29/16	2.2 at 4-10	None	19.5	20	No			
NE-DP-48	X	03/30/16	2.4 at 18-20	None		28	Yes	21-26	18.5	None

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
NE-DP-49		03/03/16	1,422 at 8-10	0-2/Negative 2-4/Negative 4-6/Negative 6-8/Negative 8-10/Positive (faint) 10-12/Positive (faint) 12-14/Positive (faint) 14-16/Positive (faint)	14.3	16	Yes	11-16	13.35	None
NE-DP-50		03/29/16	1.8 at 0-2	None	21.5	24	No			
NE-DP-51	X	03/30/16	2.2 at 22-25	None	23	25	Yes	20-25	19.3	None
NE-DP-52		03/03/16	1,514 at 17.5-19	All Negative	20	22	Yes	13-18	13.8	None
NE-DP-53	X	03/29/16	252.5 at 22-24	0-18 None 18-20/Negative 20-22/Negative 22-24/Negative	21	24	Yes	22-27	17.05	None
NE-DP-54		03/31/16	3,080 at 14-16	0-14: All/Negative 14-16:/Positive (Faint) 16-18:/Positive (Faint) 18-20:/Positive (Faint)	15.5	20	Yes	13.5-18.5	17.6	15.8
NE-DP-55	X	03/29/16	476.5 at 18-20	0-18 None 18-20/Negative	17	20	Yes	17-22	17.4	None
NE-DP-56	X	03/30/16	1.9 at 16-20	None	17.5	20	Yes	18.5-23.5	16.6	None
NE-DP-105	X	03/03/16	1,355 at 16-18	14-16/Negative 16-18/Positive (faint) 18-20/Positive (very faint) 20-22/Positive (very faint) 22-24/Positive (faint)	16	24	Yes	22-27	16.3	None

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
NE-DP-110		03/29/16	2.7 at 8-10	None	NE	15	No	N/A	N/A	None
NE-DP-111	X	03/30/16	1.4 at 10-12	None	9	12	Yes	9-14	8.15	None
NW-DP-89	X	04/02/16	1.3 at 10-12	None	4	12	Yes	9-14	9.45	None
NW-DP-90		04/02/16	0.6 at 0-2	None	4	12	No			
NW-DP-91	X	02/29/16	21.5 at 2-4	None	3	4	Yes	2.5-7.5	5.8	None
NW-DP-93		04/01/16	2.2 at 4-6	None	8	12	No			
NW-DP-94	X	02/29/16	22.6 at 2-4	None	6	8	Yes	13-18	6.9	None
NW-DP-95		04/01/16	117.6 at 12-14	8-10:/Negative 10-12:/Positive (Faint) 12-14:/Positive 14-16:/Positive	14	16	Yes	12.5-17.5	7.2	None
NW-DP-96		04/01/16	1.7 at 2-4 and 6-8	None	15	16	No			
NW-DP-97	X	02/29/16	28.5 at 4-6	None	10.5	12	Yes	9-14	4.9	None
NW-DP-98		02/25/16	28.9 at 4-6	None	4.5	6		N/A		
NW-DP-99	X	04/01/16	6.2 at 2-4	None	12	16	Yes	9.5-14.5	7.45	None
NW-DP-100		02/28/16	35.9 at 2-4	None	2.5	4	No	N/A		
NW-DP-101		02/25/16	20.2 at 0-2	None	4	5		N/A		
NW-DP-102	X	02/29/16	35.6 at 8-10	None	8	12	Yes	11-16	3.85	None
NW-DP-103		02/25/16	24.4 at 4-5	None	4	5		N/A		
NW-DP-104		04/01/16	0.6 at 10-12	None	7.5	12	Yes	9.5-14.5	7.8	None
NW-DP-106	X	04/01/16	6.6 at 0-2	None	10.5	12	Yes	8.5-13.5	5.6	None

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
SE-DP-57		02/26/16	1,395 at 10-12	0-2/Negative 2-4/Positive 4-6/Positive 6-8/Positive 8-10/Positive 10-12/Positive 12-14/Positive 14-16/Positive 16-18/Positive 18-20/Positive	18.5	20	Yes	14-19	12.4	10.7
SE-DP-58	X	03/02/16	20.8 at 4-6	None	2	21	Yes	16-21	4.83	None
SE-DP-59		02/26/16	1,717 at 8-10	0-8 No recovery 8-10/Negative 10-12/Negative 12-14/Negative 14-16/Positive	14.5	16	Yes	13-18	11.22	11.2
SE-DP-62		02/24/16	25.4 at 2-4	None	2	4		N/A		
SE-DP-63		02/24/16	22.3 at 10-12	None	10	12		N/A		
SE-DP-64	X	02/25/16	27.8 at 16-18	None	17.5	20		20-24	2	None
SE-DP-65	X	02/24/16	28.5 at 2-4	None	2.5	5.5	Yes			
SE-DP-66		02/24/16	37.0 at 2-4	None	9	10		N/A		
SE-DP-67	X	02/24/16	1,396 at 10-12	All negative	14	16		16-20	12	None
SE-DP-68	X	02/24/16	23.6 at 12-14	None	12	16	Yes	12-17	10.8	None
SE-DP-69	X	02/26/16	22.5 at 6-8	None	9	12		12-16	10	None
SW-DP-60	X	02/25/16	20.7 at 2-4	None	14	20		16-20		
SW-DP-61	X	02/24/16	36.2 at 4-6	None	10	16		15-19	9.2	
SW-DP-70	X	02/29/16	831.7 at 8-10	All negative	12.4	16	Yes	7.5-12.5	7.2	None

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
SW-DP-71	X	03/31/16	0.7 at 8-12	None	8	12	Yes	9-14	8.15	
SW-DP-72	X	03/31/16	1.2 at 10-12	None	8	12	Yes	9.5-14.5	8.1	
SW-DP-73		03/31/16	3.4 at 0-2	None	9	12	No			
SW-DP-74	X	02/28/16	24.0 at 4-6	None	4	8	Yes	3-8	2.7	None
SW-DP-75	X	02/28/16	24.3 at 0-2	None	3	4	Yes	3-8	4.95	None
SW-DP-76	X	02/27/16	1,111 at 4-6	0-2/Negative 2-4/Positive (very faint) 4-6/Positive 6-8/Positive (faint)	4.5	8	Yes	3-8	0.36	LNAPL visible on well casing when removed; no LNAPL measured
SW-DP-77	X	02/26/16	30.6 at 0-2	None	0	7	Yes	2-7	2.2	None
SW-DP-78	X	02/26/16	1,282 at 4-5	0-2/Negative 2-4/Negative 4-5/Positive (very faint)	3.3	5	Yes	0-5	0.73	None
SW-DP-79		02/27/16	1,234 at 6-8	All negative	5	8		N/A		
SW-DP-80	X	04/01/16	0.0 at 0-16	None	14	16	Yes	9-14	7.0	None
SW-DP-81	X	02/27/16	37.7 at 6-8	None	1.9	8	Yes	7-12	1.9	None
SW-DP-82		02/27/16	1,073 at 4.5-6	All negative	4.5	8		N/A		
SW-DP-83	X	03/31/16	1.1 at 4-8	None	11	16	Yes	9-14	8.6	None
SW-DP-84	X	02/27/16	29.4 at 2-4 and 10-12	None	2.8	12	Yes	7-12	2.75	None
SW-DP-85	X	03/31/16	0.0 at 0-8	None	6	8	Yes	6-11	6.5	None
SW-DP-86	X	03/31/16	2,879 at 8-10	6-8:/Positive (Faint) 8-10:/Positive 10-12:/Positive	8.5	12	Yes	8-13	7.3	None

Table 1

Direct-Push Boring Summary Sheet
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Profile ID	Groundwater Sample	Date	Highest PID (ppm) at Depth (feet bgs)	UV Test (Depth/Result)	Top of Saturated Soil (feet bgs)	Boring Depth (feet bgs)	Well Installed?	Screened Interval (feet bgs)	Depth to Water (feet bgs)	Depth to LNAPL (feet bgs)
SW-DP-87	X	02/29/16	33.1 at 6-8	None	9	12	Yes	9-14	5.35	None
SW-DP-88	X	02/29/16	29.2 at 4-6	None	6.5	8	Yes	8-13	6.2	None
SW-DP-107	X	04/02/16	0.4 at 2-4	None	3	8	Yes	7-12	4.85	None
SW-DP-108	X	04/02/16	1.0 at 2-4	None	4	8	Yes	7-12	6.0	None
SW-DP-109	X	02/27/16	46.8 at 2-4	None	0.5	8	Yes	4-9	0.5	None
SW-DP-112	X	04/02/16	0.6 at 0-4	None	5	8	Yes	4.5-9.5	5.7	None
SW-DP-113	X	04/02/16	0.6 at 2-6	None	8.5	12	Yes	10-15	1.0	None

PID = Photoionization detector.
ppm = parts per million.
bgs = below ground surface.
UV = Ultraviolet.
LNAPL = light non-aqueous phase liquid.

Table 2

Summary of Interior Delineation Groundwater Analytical Results (February - April 2016)
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Area	Boring ID	Field Sample ID	Laboratory Sample ID	Sample Date	Total Petroleum Hydrocarbons (Oklahoma Methods 8020/8015 and 8000/8100)		BTEX (a) (EPA Method 8260B)					
					Gasoline Range Organics (µg/l)	Diesel Range Organics (µg/l)	Benzene (µg/l)	Toluene (µg/l)	Ethylbenzene (µg/l)	m+p-Xylene (µg/l)	o-Xylene (µg/l)	Xylenes (Total) (b) (µg/l)
Northeastern Invesitation Area	NE-DP-30	WRCDP-30(030216)	16030532	03/02/16	4,910	8,200	0.95 J	2.9 J	84.9	37.8	2 J	39.8 J
	NE-DP-33	WRCDP-33(030316)	16030533	03/03/16	1,630	24,000	143	5.9 J	3 J	3.2 J	2 J	5.2 J
	NE-DP-37	WRCDP-37(030216)	16030529	03/02/16	583	2,500 LL	3.51	1.76	0.3 J	2.67	1.4	4.07
	NE-DP-39	WRCDP-39(030216)	16030531	03/02/16	59,400	20,000 LL	11,000	13,800	1,500	5,650	2,690	8,340
	NE-DP-45	WRCDP-45(033016)	16040145	03/30/16	23,200	4,500	4,820	3,880	600	1,960	990	2,950
	NE-DP-45	WRCDP-DUPE3	16040146	03/30/16	24,400	3,400	5,090	4,130	640	2,060	1,000	3,060
	NE-DP-48	WRCDP-48(033116)	16040152	03/31/16	<20	190	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	NE-DP-51	WRCDP-51(033016)	16040150	03/30/16	<20	390	0.05 J	<1.0	<1.0	<1.0	<1.0	<2.0
	NE-DP-53	WRCDP-53(033016)	16040147	03/30/16	503	1,600	5.16	0.30 J	2.7	15.6	6.2	21.8
	NE-DP-55	WRCDP-55(033016)	16040149	03/30/16	2,120	4,200	11.4	1.9 J	107	10.2	<5.0	<15.2
	NE-DP-56	WRCDP-56(033116)	16040151	03/31/16	<20	140	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	NE-DP-105	WRCDP-105(030416)	16030535	03/04/16	2,310	1,100	6.0 J	5.6 J	125	137	3 J	140 J
	NE-DP-111	WRCDP-111(033016)	16040148	03/30/16	<20	260	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
Northwestern Investigation Area	NW-DP-89	WRCDP-89(040216)	16040161	04/02/16	32	150	0.06 J	<1.0	<1.0	<1.0	<1.0	<2.0
	NW-DP-91	WRCDP-91(022916)	16030522	02/29/16	<20	<100 LL	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	NW-DP-94	WRCDP-94(022916)	16030526	02/29/16	<20	150 LL	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	NW-DP-97	WRCDP-97(022916)	16030523	02/29/16	<20	160 LL	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	NW-DP-99	WRCDP-99(040116)	16040159	04/01/16	<20	940	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	NW-DP-102	WRCDP-102(022916)	16030524	02/29/16	85 G	570 LL	0.14 J	0.11 J	<1.0	<1.0	<1.0	<2.0
	NW-DP-106	WRCDP-106(040116)	16040160	04/01/16	<20	260	<1.0	0.20 J	<1.0	0.16 J	<1.0	<1.16 J
Southeastern Investigation Area	SE-DP-58	WRCDP-58(030216)	16030530	03/02/16	<20	180 LL	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SE-DP-64	WRCDP-64(022516)	16022154	02/25/16	<20	190 B	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SE-DP-65	WRCDP-65(022416)	16022163	02/24/16	<20	270 B	<1.0	<1.0	<1.0	0.08 J	<1.0	<1.08 J
	SE-DP-67	WRCDP-67(022416)	16022151	02/24/16	<20	520 B, QC	<1.0	<1.0	<1.0	0.07 J	<1.0	<1.07 J
	SE-DP-67	WRCDP-DUPE-1(022416)	16022150	02/24/16	<20	560 B	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SE-DP-68	WRCDP-68(022416)	16022149	02/24/16	<20	570 B	0.07 J	0.08 J	<1.0	0.09 J	<1.0	<1.09 J
	SE-DP-69	WRCDP-69(022516)	16022155	02/25/16	<20	1,300	0.05 J	<1.0	<1.0	<1.0	<1.0	<2.0
Southwestern Investigation Area	SW-DP-60	WRCDP-60(022516)	16022153	02/25/16	<20	470 B	0.12 J	0.14 J	<1.0	0.15 J	<1.0	<1.15 J
	SW-DP-61	WRCDP-61(022416)	16022152	02/24/16	<20	880 B	0.14 J	0.19 J	<1.0	0.17 J	0.1 J	0.27 J
	SW-DP-70	WRCDP-70(022916)	16030525	02/29/16	569	9,200 LL	4.03	0.58 J	0.9 J	1.30	0.3 J	1.60 J
	SW-DP-71	WRCDP-71(040116)	16040156	04/01/16	<20	1,700	0.05 J	0.08 J	<1.0	<1.0	<1.0	<2.0
	SW-DP-72	WRCDP-72(040116)	16040155	04/01/16	<20	1,400	0.06 J	0.10 J	<1.0	0.17 J	<1.0	<1.17 J
	SW-DP-74	WRCDP-74(022816)	16022161	02/28/16	<20	770	0.05 J	<1.0	<1.0	0.13 J	<1.0	<1.13 J
	SW-DP-75	WRCDP-75(022816)	16022162	02/28/16	<20	640	0.04 J	<1.0	<1.0	0.08 J	<1.0	<1.08 J
	SW-DP-76	WRCDP-76(022816)	16022165	02/28/16	179	450 B	0.41 J	<1.0	1.3	0.23 J	0.2 J	0.43 J
	SW-DP-77	WRCDP-77(022616)	16022164	02/26/16	<20	170 B	0.04 J	0.08 J	<1.0	<1.0	<1.0	<2.0
	SW-DP-78	WRCDP-78(022716)	16022160	02/27/16	37,600	19,000	9,830	390 J	1,800	6,740 ML	770	7,510 ML
	SW-DP-80	WRCDP-80(040116)	16040157	04/01/16	<20	480	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
Screening Criteria	EPA Primary Drinking Water Regulations				NE	NE	5	1,000	700	NE	NE	10,000
	EPA Regional Screening Levels (Tap Water)				NE	NE	0.46	110	1.5	19	19	19
	ODEQ Cleanup Levels				1,000	1,000	NE	NE	NE	NE	NE	NE

Table 2

Summary of Interior Delineation Groundwater Analytical Results (February - April 2016)
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

	Boring ID	Field Sample ID	Laboratory Sample ID	Sample Date	Total Petroleum Hydrocarbons (Oklahoma Methods 8020/8015 and 8000/8100)		BTEX (a) (EPA Method 8260B)					
					Gasoline Range Organics (µg/l)	Diesel Range Organics (µg/l)	Benzene (µg/l)	Toluene (µg/l)	Ethylbenzene (µg/l)	m+p-Xylene (µg/l)	o-Xylene (µg/l)	Xylenes (Total) (b) (µg/l)
Southwestern Investigation Area	SW-DP-81	WRCDP-81(022716)	16022157	02/27/16	**250**	**1,500**	**17.6**	0.08 J	**7.6**	**5.79**	0.2 J	**5.99 J**
	SW-DP-81	WRCDP-DUPE-2(022716)	16022156	02/27/16	**248**	**1,600**	**17.0**	0.07 J	**7.5**	**6.08**	0.2 J	**6.28 J**
	SW-DP-83	WRCDP-83(033116)	16040154	03/31/16	<20	**890 QC**	0.10 J	0.15 J	<1.0	0.12 J	<1.0	<1.12 J
	SW-DP-84	WRCDP-84(022716)	16022158	02/27/16	<20	**500 B**	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SW-DP-85	WRCDP-85(033116)	16040153	03/31/16	<20	**220**	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SW-DP-86	WRCDP-86(040116)	16040158	04/01/16	**411 SR**	**4,400**	0.32 J	0.25 J	<1.0	0.52 J	0.3 J	0.82 J
	SW-DP-87	WRCDP-87(022916)	16030528	02/29/16	<20	**110 LL**	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SW-DP-88	WRCDP-88(022916)	16030527	02/29/16	<20	<100 LL	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SW-DP-107	WRCDP-107(040216)	16040162	04/02/16	<20	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SW-DP-108	WRCDP-108(040216)	16040163	04/02/16	<20	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SW-DP-109	WRCDP-109(022716)	16022159	02/27/16	<20	**280 B**	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SW-DP-112	WRCDP-112(040216)	16040164	04/02/16	<20	**560 QC**	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	SW-DP-113	WRCDP-113(040216)	16040165	04/02/16	**29**	**1,300**	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
Quality Control Samples	Equipment Blank	WRCEB(030416)	16030536	03/04/16	<20	<100	<1.0	0.14 J	<1.0	<1.0	<1.0	<2.0
	Trip Blank	Trip Blank (022916)	16022166	02/29/16	<20	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
	Trip Blank	Trip Blank(030416)	16030534	03/04/16	<20	<100	<1.0	<1.0	<1.0	0.11 J	<1.0	<1.11 J
	Trip Blank	Trip Blank	16040144	03/30/16	<20	<100	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0
Screening Criteria	**EPA Primary Drinking Water Regulations**				NE	NE	5	1,000	700	NE	NE	10,000
	EPA Regional Screening Levels (Tap Water)				NE	NE	0.46	110	1.5	19	19	19
	ODEQ Cleanup Levels				1,000	1,000	NE	NE	NE	NE	NE	NE

Bold values indicate a detection above the reporting limit.
Shading descriptors:
Detected concentration exceeds the EPA Primary Drinking Water Regulations Maximum Contaminant Level, updated May 2009.
Detected concentration exceeds the EPA Regional Screening Level for Tap Water, updated November 2015.
Detected concentration exceeds ODEQ cleanup levels (2004).
a\ BTEX = benzene, toluene, ethylbenzene, and xylenes.
EPA = United States Environmental Protection Agency.
µg/l = micrograms per liter.
NS = not sampled.
NE = not established.
ODEQ = Oklahoma Department of Environmental Quality.
b\ The value of total xylenes is calculated as the sum of m+p-xylene and o-xylene.
c\ Lab data qualifiers:
J = The concentration is below the limit of quantification and is considered an estimate.
LL = The Laboratory Control Sample recovery for this analyte was below the method or laboratory quality control limit. The reported sample concentration may be biased low.
B = Analyte is also present in the method blank or load blank at the concentration indicated in the Quality Control Report. The reported sample concentration has not been blank corrected.
QC = Quality control data qualifiers were noted. See the laboratory quality control report.
ML = The matrix spike and/or matrix spike duplicate recovery for this analyte was below the method or laboratory control limit. See LCS data for the basis for acceptance of this sample. The reported sample concentration is estimated.
SR = One or more surrogate recoveries for this analysis did not meet quality control limits. Please see the Quality Control Report for the sample surrogate data.

Table 3

LNAPL Transmissivity Summary
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Well ID	Manual LNAPL Skimming Results: Final LNAPL Discharge (gal/day)	Final LNAPL Discharge (ft^3/day)	LNAPL Drawdown, [s_n] (a) (feet)	LNAPL Transmissivity (ft^2/day)	Notes
NMW-2	8.7	1.2	0.71	1.2	
NMW-6	0.032	0.0043	0.57	≤ 0.0055	LNAPL discharge rate did not stabilize. Calculated value is a maximum estimate.
NMW-10	0.032	0.0043	0.59	≤ 0.0053	LNAPL discharge rate did not stabilize. Calculated value is a maximum estimate.
OMW-4	2.4	0.32	1.9	≤ 0.12	LNAPL discharge rate did not stabilize. Calculated value is a maximum estimate.

Well ID	LNAPL Baildown Transmissivity Results (ft^2/day): Bouwer & Rice Method	Cooper & Jacob Method	Cooper, Bredehoeft, & Papadopulos Method	LNAPL Transmissivity (b)	Notes
OMW-3	0.0035	0.0029	0.0045	0.0036	Volume of LNAPL removed was less than LNAPL volume in well casing and filter pack.

LNAPL = Light Non-Aqueous Phase Liquid.
gal/day = gallons per day.
ft^3/day = cubic foot per day.
ft^2/day = square-foot per day, or cubic foot per day per foot.
(a) LNAPL Drawdown shown here is the geometric mean of the LNAPL drawdowns at the beginning and end of the discharge cycle, as stipulated in ASTM Guidance Document E2856-13.
(b) LNAPL Transmissivity shown for the LNAPL Baildown Results is the arithmetic mean of the three methods.

Appendix A – Boring Logs

Boring Log: UMW-7

Project: Wynnewood Refining Company

Project No.: 31400030

Location: Wynnewood, Oklahoma

Completion Date: August 17, 2015

Surface Elevation (feet AMSL*): 858.84

TOC Elevation (feet AMSL*): 861.65

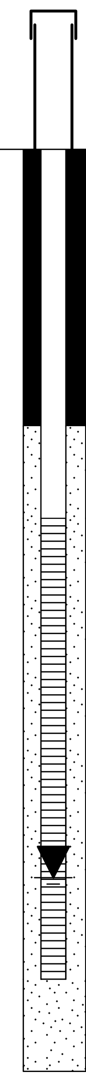
Total Depth (feet): 20

Borehole Diameter (inches): 8.25

*AMSL = Above mean sea level

Sample Data					Subsurface Profile	
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description
						Ground Surface
0–4	X	0.1		100		**Topsoil** Brown topsoil with grass; moist. **Silt with Sand (ML)** Dark reddish brown (5YR3/3) silt, little clay and sand; medium plasticity; stiff; moist. Clay content increases with depth; medium plasticity.
4–8 (5)	X	0.1		100		Gray mottling present from 4 - 8.5 feet bgs.
8–12 (10)	X	0.2		95		**Poorly-Graded Sand (SP)** Brown (10YR4/3) fine-grained sand; dense; moist. **Fat Clay (CH)** Grayish brown (10YR5/2) clay; plastic; stiff; moist.
12–16 (15)	X	0.2		100		Some sand present from 12 - 15 feet bgs. Sandy clay from 15 - 15.8 feet bgs.
16–20	X	0.2		25		**Poorly-Graded Sand with Silt (SP-SM)** Grayish brown (10YR5/2) fine-grained sand, little silt; dense becoming loose; wet.
20–25						Bottom of Boring at 20 feet below ground surface Total well depth = 18 feet below ground surface (bgs).

Well Details



Geologist(s): Jerome D. McSorley
Subcontractor: Detech
Driller/Operator: John McClure
Method: Hollow Stem Auger

CVR Energy, Inc.
10 E Cambridge Circle Dr. Suite 250
Kansas City, Kansas 66103
(913) 982-0457

Boring Log: SMW-24

Project: Wynnewood Refining Company
Project No.: 31400030
Location: Wynnewood, Oklahoma
Completion Date: August 18, 2015

Surface Elevation (feet AMSL*): 847.29
TOC Elevation (feet AMSL*): 850.11
Total Depth (feet): 17
Borehole Diameter (inches): 8.25
**AMSL = Above mean sea level*

Sample Data

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery
0–4	X	0.0		100
4–8	X	0.0		90
8–12	X	0.0		75
12–15	X	0.0		35

Subsurface Profile

Lithology / **Description** / **Well Details**

Ground Surface

Topsoil
Brown topsoil with grass; loose; dry.

Silt with Sand (ML)
Dark brown (10YR3/3) silt with clay, little sand; non-plastic; stiff; dry becoming moist at 2 feet bgs.

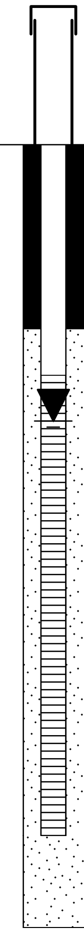
Silty Sand (SM)
Dark grayish brown (10YR4/2) fine-grained sand with silt and clay; dense; moist.

Poorly-Graded Sand with Silt (SP-SM)
Yellowish red (5YR5/6) fine-grained sand, little silt; dense; wet.

Poorly-Graded Sand with Silt (SP-SM)
Yellowish red (5YR4/6) very fine-grained sand, little silt and clay; dense; wet.

Brownish yellow banding present from 10 - 12 feet bgs.

Bottom of Boring at 17 feet below ground surface
Total well depth = 15 feet below ground surface (bgs).



Geologist(s): Jerome D. McSorley
Subcontractor: Detech
Driller/Operator: John McClure
Method: Hollow Stem Auger

CVR Energy, Inc.
10 E Cambridge Circle Dr. Suite 250
Kansas City, Kansas 66103
(913) 982-0457

Boring Log: SMW-25

Project: Wynnewood Refining Company

Project No.: 31400030

Location: Wynnewood, Oklahoma

Completion Date: August 18, 2015

Surface Elevation (feet AMSL*): 845.85

TOC Elevation (feet AMSL*): 848.63

Total Depth (feet): 17

Borehole Diameter (inches): 8.25

**AMSL = Above mean sea level*

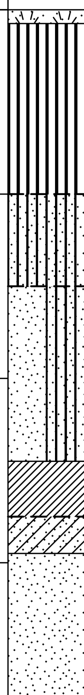
Sample Data

Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery
0–4		0.0		100
4–8		0.0		90
8–12		0.0		75
12–15		NM		0

Depth scale: 5, 10, 15, 20, 25

Subsurface Profile

Lithology



Description

Ground Surface

Topsoil
Brown (10YR5/3) topsoil with grass; dry.

Silt with Sand (ML)
Dark brown (10YR3/3) silt with clay, little sand; non-plastic; stiff; moist.

Silty Sand (SM)
Reddish brown (5YR4/4) fine-grained sand with silt and clay; dense; moist becoming wet at 5.8 feet bgs.

Poorly-Graded Sand with Silt (SP-SM)
Yellowish red (5YR4/6) fine-grained sand, little silt and clay; dense; wet.

Lean Clay (CL)
Yellowish red (5YR4/6) clay; non-plastic; stiff; wet.
Sandy from 10.7 - 11 feet bgs.

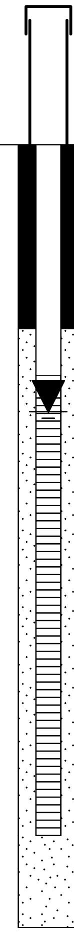
Clayey Sand (SC)
Yellowish red sand with silt and clay; dense; wet.

Poorly-Graded Sand (SP)
Strong brown (7.5YR4/6) fine-grained sand; loose; wet.

No recovery from 12 - 15 feet bgs due to loose sand.

Bottom of Boring at 17 feet below ground surface
Total well depth = 15 feet below ground surface (bgs).

Well Details



Geologist(s): Jerome D. McSorley
Subcontractor: Detech
Driller/Operator: John McClure
Method: Hollow Stem Auger

CVR Energy, Inc.
10 E Cambridge Circle Dr. Suite 250
Kansas City, Kansas 66103
(913) 982-0457

Boring Log: NE-DP-30

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 865
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		558.5	Negative	90		***Silt (ML)*** Dark brown (7.5YR 3/2) silt, few clay; cohesive; non-plastic; soft; moist.
2–4		58.1	None	90		Brown (7.5YR 4/3) and very stiff at 2.5 feet bgs.
4–6		57.9	None	75		Yellowish red (5YR 4/6) and medium stiff at 5 feet bgs.
6–8		59.3	None	75		
8–10		38.4	None	100		***Silt (ML)*** Brown (7.5YR 4/3) silt, little clay, few very fine sand; cohesive; non-plastic; medium stiff; moist.
10–12		176.4	Negative	100		
12–14		1,398	Negative	80		***Silty Sand (SM)*** Reddish brown (5YR 4/4) silty very fine to fine sand; dense; moist becoming wet at 14 feet (bgs); strong odor present.
14–16		1,294	Negative	80		
16–18		547.3	Negative	80		

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-30

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 865

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
20		122.7	Negative	80		**Lean Clay (CL)** Reddish brown (5YR 4/3) clay with purplish red mottling, some silt; very stiff; moist. Bottom of boring hard and dry.
22						Bottom of boring at 20 feet bgs. Temporary screen set at 15 - 20 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-30(030216)
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-31

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 874

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

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Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	31.3	None	90	Silt (ML)	***Silt (ML)*** Yellowish red (5YR 4/6) silt, few clay; cohesive; non-plastic; medium stiff; moist.
2–4	X	23.0	None	90	Silt (ML)	
4–6	X	28.1	None	75	Silt (ML)	Low plasticity at 4 feet bgs.
6–8	X	30.1	None	75	Silt (ML)	
8–10	X	22.5	None	88	Silt (ML)	
10–12	X	25.1	None	88	Silt (ML)	
12–14	X	29.6	None	80	Silt (ML) to 13; Silty Sand (SM) from 13	***Silty Sand (SM)*** Yellowish red silty very fine sand; dense; moist becoming wet at 15 feet bgs.
14–16	X	256.9	Negative	80	Silty Sand (SM)	
16–18						Bottom of boring at 16 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-32

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 861

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery
2		33.5	None	40
4		36.2	None	95
6		34.3	None	95
8		35.5	None	90
10		31.9	None	90
12		29.8	None	90
14		28.9	None	90
16		29.9	None	80
18				

Subsurface Profile

Lithology / Description

Ground Surface

Gravelly Fat Clay (CH)
Pale gray to brown clay with gravel (fill); wet.

Fat Clay (CH)
Dark brown (7.5YR 3/2) clay, few silt; cohesive; high plasticity; soft; moist.

Medium stiff at 4 feet bgs.

Brown (7.5YR 4/2) and stiff at 6.5 feet bgs.

Silt (ML)
Pinkish gray (7.5YR 6/2) silt, little clay, trace very fine sand; cohesive; medium plasticity; stiff; moist becoming wet at 10 feet bgs.

Moist at 12 feet bgs.

Sandy Silt (ML)
Pinkish gray (7.5YR 6/2) sandy silt; cohesive; medium plasticity; stiff; moist.

Silty Sand (SM)
Pinkish gray (7.5YR 6/2) silty very fine sand; dense; wet.

Poorly-Graded Sand with Silt (SP-SM)
Yellowish red (5YR 5/8) very fine to fine sand, few fines; dense; wet.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-32

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 861

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
– 20		29.5	None	80		Fine to coarse sand at 19.6 - 20 feet bgs.
20 – 36						Bottom of boring at 20 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-33

Project: Interior Delineation	**Surface Elevation (feet amsl*):** 861
Project No.: 31400030	**Total Depth (feet bgs*):** 20
Location: Wynnewood, OK	**Borehole Diameter (inches):** 2
Completion Date: March 2, 2016	**amsl = above mean sea level* *bgs = below ground surface*

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		34.0	Negative	75		***Silt (ML)*** Dark brown (7.5YR 3/3) silt, few clay; cohesive; non-plastic; stiff; moist.
2–4		385.0	Negative	75		***Silt (ML)*** Black silt; soft; dry (ash or coke?). ***Fat Clay (CH)*** Black clay; cohesive; high plasticity; soft; moist. ***Silt (ML)*** Brown (7.5YR 4/2) silt, few clay; cohesive; non-plastic; medium stiff; moist.
4–6		332.3	Positive (faint)	50		***Fat Clay (CH)*** Brown clay, few silt; cohesive; high plasticity; medium stiff; moist.
6–8		647.8	Positive	50		Dark brown staining from 4 - 4.5 feet bgs.
8–10		769.0	Positive	100		***Silt (ML)*** Dark gray (5Y 4/1) silt, little clay; cohesive; non-plastic; very stiff; moist; core is oily; mild odor present.
10–12		791.1	Positive	100		Stiff at 11 feet bgs.
12–14		859.2	Positive	100		Gray (5Y 6/1) at 12 feet bgs. Dark brown product visible from 12.9 - 13 feet bgs with yellow product pooled in liner.
14–16		315.8	Positive	100		
16–18		456.1	Positive	75		***Silty Sand (SM)*** Gray (5Y 6/1) silty very fine sand; dense; wet. Coarsens downward from 16 - 18 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log:* *NE-DP-33

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 861

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
	X	276.7	Positive	75		***Well-Graded Sand with Silt (SW-SM)*** Gray fine to coarse sand, few fines; dense; wet.
20						Bottom of boring at 20 feet bgs. Temporary screen set at 14 - 19 feet bgs. No LNAPL accumulated over 24-hour period. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-33(030316)
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-34

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 866

Total Depth (feet bgs*): 4

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
0						Ground Surface
0–1	X	390.0	Positive	50		***Fat Clay (CH)*** Dark brown (7.5YR 3/2) clay, few silt; cohesive; high plasticity; soft; moist.
1–4	X	494.4	Positive	50		***Silty Sand (SM)*** Yellowish red (5YR 4/6) silty very fine sand; loose; moist becoming wet at 3 feet bgs; strong gasoline-type odor.
4						Bottom of boring at 4 feet bgs. Temporary screen set at 4 - 9 feet bgs. No LNAPL accumulated over 24-hour period but visible on interface probe. Bailer deployed to inspect fluid contained visible free product.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-35

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 860

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
Ground Surface					
0–2	109.0	Negative	60	Silt (ML)	***Silt (ML)*** Dark brown (7.5YR 3/2) silt, few clay; non-cohesive; non-plastic; soft; dry.
2–4	59.6	None	60		Black tar-like thick oil at 3.9 - 4 feet bgs.
4–6	132.6	Negative	50		
6–8	44.9	None	50	Lean Clay (CL)	***Lean Clay (CL)*** Dark gray (7.5YR 4/1) clay, few silt; cohesive; medium plasticity; very stiff becoming hard; dry.
8–10	38.4	None	100		Hard at 8 feet bgs.
10–12	48.8	None	100		▼
12–14	376.2	Negative	95	Silt (ML)	***Silt (ML)*** Gray (10YR 5/1) silt, few clay, trace becoming few very fine sand; cohesive; non-plastic; medium stiff; moist.
14–16	165.1	Positive	95		
16–18	1,297	Positive	95		

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-35

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 860
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
20		123.5	Negative	95		***Poorly-Graded Sand with Silt (SP-SM)*** Gray (10YR 5/1) very fine to fine sand, few fines; dense; wet. Pink (7.5YR 7/4) at 18 feet bgs.
22						Bottom of boring at 20 feet bgs. Temporary screen set at 17 - 22 feet bgs. No LNAPL accumulated over 24-hour period.
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-36

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 879

Total Depth (feet bgs*): 24

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		111.2	Negative	50		**Silty Sand (SM)** Strong brown (7.5YR 5/6) silty very fine sand; loose; dry.
2–4		65.7	Positive (very faint)	50		**Silt (ML)** Dark brown (7.5YR 3/4) silt with 30% black mottling, little clay; cohesive; non-plastic; moist.
4–6		122.0	Positive (faint)	60		
6–8		101.7	Positive (faint)	60		**Silt (ML)** Brown (7.5YR 4/3) silt, few clay; non-cohesive; non-plastic; medium stiff; almost dry.
8–10		112.5	Positive	90		
10–12		914.4	Positive	90		**Silt (ML)** Brown (7.5YR 5/4) silt, little clay; cohesive; non-plastic; medium stiff; moist; petroleum-type odor.
12–14		1,295	Positive	95		**Silt (ML)** Gray (5Y 6/1) silt, little clay; cohesive; medium plasticity; medium stiff; moist; petroleum-type odor.
14–16		1,158	Positive	95		
16–18		909.6	Positive	100		

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-36

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 879

Total Depth (feet bgs*): 24

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18 - 20	X	988.7	Positive	100		Red (2.5YR 5/6) from 18.75 - 19.5 feet bgs. Sand seams at 19.6 - 19.7 feet bgs and 19.8 - 19.9 feet bgs.
20 - 22	X	382.5	Positive (faint)	90		***Poorly-Graded Sand (SP)*** Brown (7.5YR 5/4) very fine to fine sand, trace fines; dense; wet; no sheen on water.
22 - 24	X	236.6	Positive (faint)	90		
24						Bottom of boring at 24 feet bgs. Temporary screen set at 18 - 23 feet bgs. No LNAPL accumulated over 24-hour period.

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-37

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 859
Total Depth (feet bgs*): 24
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	133.3	Negative	100		***Poorly-Graded Gravel (GP)*** Gray gravel (fill). ***Silt (ML)*** Red (2.5YR 5/8) silt, little clay; cohesive; non-plastic; medium stiff; moist. Color becomes brown (7.5YR 4/3) at 0.8 foot.
2–4	X	409.4	Negative	100		Black from 2.6 - 2.8 feet bgs and 3.6 - 6 feet bgs. Silty fine to coarse sand at 2.8 - 3 feet bgs.
4–6	X	885.4	Negative	100		Few clay and soft from 4 - 6 feet bgs.
6–8	X	760.0	Positive (faint)	100		***Silt (ML)*** Very dark gray (10YR 3/1) silt, few clay; cohesive; non-plastic; stiff; moist; strong petroleum-type odor.
8–10	X	1,775	Positive	100		Medium stiff from 8 - 12 feet bgs.
10–12	X	1,693	Positive	100		
12–14	X	1,816	Positive	100		***Silt (ML)*** Dark gray (5Y 4/1) silt, few clay; cohesive; non-plastic; soft; moist; petroleum-type odor.
14–16	X	1,768	Positive	100		Trace very fine sand from 15.7 - 21.8 feet bgs.
16–18	X	1,616	Positive	100		

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-37

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 859
Total Depth (feet bgs*): 24
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP
PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–20	X	1,333	Positive	100		Medium stiff from 18 - 20 feet bgs. Soft at 20 feet bgs becoming very soft and wet at 21.2 feet bgs.
20–22	X	1,648	Positive	80		
22–24	X	464.4	Positive (faint)	80		***Well-Graded Sand (SW)*** Gray (10YR 5/1) very fine to medium sand, trace fines; medium dense; wet.
24–36						Bottom of boring at 24 feet bgs. Temporary screen set at 21.5 - 26.5 feet bgs. No LNAPL accumulated over 24-hour period. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-37(030216)

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-38

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 870

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		2,050	Positive (very faint)	95		***Silt with Sand (ML)*** Brown (10YR 4/3) silt, little sand, trace gravel (fill); cohesive; non-plastic; moist.
2–4		1,253	Negative	95		***Silt (ML)*** Very dark grayish brown (10YR 3/2) to brown (10YR 4/3) silt with 25% dark gray mottling, few clay; cohesive; non-plastic; medium stiff; moist.
4–6		1,438	Positive (faint)	80		***Fat Clay (CH)*** Brown (10YR 5/3) clay with 10% reddish brown mottling, few silt; cohesive; high plasticity; medium stiff; moist.
6–8		1,338	Positive	80		Soft at 7 feet bgs.
8–10		426.2	Positive	100		Abrupt color change to reddish brown (5YR 4/4) at 10.8 feet bgs.
10–12		154.1	Negative	100		
12–14		100.6	Negative	50		***Silty Sand (SM)*** Brown (7.5YR 4/4) very fine sand, little silt and clay; dense; moist. Becoming reddish brown (5YR 4/4), loose, and wet at 12 feet bgs.
14–16		62.3	Negative	50		Clayey sand at 13 - 13.4 feet bgs and 15.8 - 16 feet bgs.
16–18						Bottom of boring at 16 feet bgs. Temporary screen set at 11.5 - 16.5 feet bgs. No LNAPL accumulated over 24-hour period.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log:* *NE-DP-39

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 877

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	PID/OVM (ppm)	UV Test	% Recovery	Description
				Ground Surface
0–2	50.6	None	75	***Silt (ML)*** Dark brown (7.5YR 3/4) silt, few clay; cohesive; non-plastic; moist. Strong brown (7.5YR 4/6) at 1 foot.
2–4	42.9	None	75	Little clay at 3.8 feet bgs.
4–6	44.6	None	75	***Lean Clay (CL)*** Strong brown (7.5YR 4/6) clay, few silt; cohesive; medium plasticity; stiff; moist.
6–8	64.0	None	75	
8–10	2,304	Negative	90	
10–12	2,102	Positive (faint)	90	***Lean Clay (CL)*** Brown (7.5YR 4/4) clay, few silt, trace very fine sand; cohesive; medium plasticity; stiff becoming medium stiff; moist; odor present.
12–14	2,262	Positive	90	Increasing sand content from 12 - 14 feet bgs.
14–16	1,620	Positive	90	***Silty Sand (SM)*** Yellowish red (5YR 4/6) very fine sand, some silt and clay; dense; wet; strong gasoline-type odor.
16–18	1,548	Positive	70	

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-39

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 877
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
19–20	X	1,025	Positive	70		***Poorly-Graded Sand (SP)*** Reddish brown (5YR 4/4) very fine to fine sand, trace fines; medium dense; wet; odor present.
20						***Silty Sand (SM)*** Dark brown (7.5YR 3/4) very fine to coarse sand, little silt and clay; medium dense; wet.
22						Bottom of boring at 20 feet bgs. Temporary screen set at 14 - 19 feet bgs. No LNAPL accumulated over 24-hour period. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-39(030216)
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-40

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 862
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0-2		156.5	Negative	88		***Silt with Gravel (ML)*** Dark brown (10YR 3/3) silt with coarse gravel (fill); cohesive; non-plastic; stiff; moist.
2-4		725.9	Positive (faint)	88		***Silt (ML)*** Dark gray (10YR 4/1) silt, few clay; cohesive; non-plastic; medium stiff; moist; faint odor.
4-6		772.1	Negative	38		Stiff from 4 - 10 feet bgs.
6-8		772.1	Negative	38		
8-10		590.0	Positive (very faint)	90		
10-12		1,139	Positive	90		***Silt (ML)*** Gray (10YR 6/1) silt, little becoming some clay; cohesive; medium plasticity; medium stiff; moist.
12-14		1,073	Positive	100		
14-16		1,081	Positive	100		***Silt (ML)*** Gray silt with light red mottling, some clay, trace sand; cohesive; medium plasticity; medium stiff; moist; strong odor and visible dark product present.
16-18		1,103	Positive	100		Few clay and few sand from 16 - 19.5 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-40

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 862
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
		967.4	Positive	100		
20						**Silty Sand (SM)** Gray very fine to medium sand, some silt and clay; dense; wet; visible product.
22						Bottom of boring at 20 feet bgs. Temporary screen set at 15 - 20 feet bgs. No LNAPL accumulated over 24-hour period. Free product was visible on screen when pulled from boring.
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-41

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 1, 2016

Surface Elevation (feet amsl*): 873

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0-1		119.2	Negative	100		***Silty Gravel (GM)*** Silty gravel (fill).
1-2						***Silt (ML)*** Dark brown (7.5YR 3/3) silt, little clay; cohesive; non-plastic; very stiff; moist.
2-4		129.4	Negative	100		Brown (7.5YR 4/4) at 1 foot bgs. Trace very fine sand from 3 - 4 feet bgs.
4-6		706.5	Negative	75		Soft from 4 - 6.8 feet bgs.
6-8		791.0	Negative	75		***Lean Clay (CL)*** (from 6.8 feet) Greenish gray (Gley1 6/10GY) clay with 1% reddish brown mottling, little silt; cohesive; medium plasticity; very stiff becoming hard; moist.
8-10		974.3	Negative	100		
10-12		1,534	Negative	100		***Silt (ML)*** Greenish gray (Gley1 6/10GY) silt with 1% reddish brown mottling, little clay; cohesive; low plasticity; medium stiff; moist; odor present.
12-14		1,311	Negative	60		***Poorly-Graded Sand (SP)*** Light brownish gray (10YR 6/2) very fine to fine sand, few silt and clay; dense; moist; odor present. Brown (7.5YR 4/4), loose, and wet at 12 feet bgs.
14-16		479.7	Negative	60		
16-18						Bottom of boring at 16 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-42

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 876
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		0.2	None	90		***Topsoil*** Grass and topsoil.
						Fat Clay (CH) Reddish brown (5YR 4/4) clay, little silt; cohesive; high plasticity; medium stiff; moist.
2–4		0.3	None	90		
4–6		0.6	None	100		3% dark gray and 3% light gray mottling starting at 4 feet bgs. Stiff from 4 - 10 feet bgs.
6–8		0.4	None	100		
8–10		7.9	None	100		Color transitions to brown (7.5YR 5/3) with 50% light gray mottling at 9 feet bgs.
10–12		725.1	Negative	100		Faint odor from 9 - 14.2 feet bgs.
12–14		2,572	Negative	100		Few very fine sand from 12 - 14.2 feet bgs.
14–16		2,419	Negative	100		***Silty Sand (SM)*** Yellowish red (5YR 5/6) silty very fine sand; dense; wet; odor present.
16–18		1,917	Positive (faint)	75		

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-42

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 876

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–20	X	1,975	Negative	75		**Well-Graded Sand (SW)** Light reddish brown (5YR 6/4) very fine to medium sand, trace fines; medium dense; wet; strong odor.
20						Bottom of boring at 20 feet bgs. Temporary screen set at 14 - 19 feet bgs. No LNAPL accumulated over 24-hour period.
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-43

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 26, 2016

Surface Elevation (feet amsl*): 862

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery
0–2		416.5	Negative	100
2–4		66.2	Negative	100
4–6		388.0	Positive	95
6–8		1,357	Positive	95
8–10		1,230	Positive	100
10–12		1,303	Positive	100
12–14		1,417	Positive	100
14–16		1,433	Positive	100
16–18		1,444	Positive	100

Subsurface Profile

Lithology | **Description**

Ground Surface

Well-Graded Gravel with Sand (GW)
Sandy gravel cover (fill), non uniform gravel; dry.

Silt (ML)
Brown (7.5YR 4/3) silt, few clay; cohesive; non-plastic; medium stiff; moist.

Silt (ML)
Grayish brown (10YR 5/2) silt, little clay; cohesive; non-plastic; stiff; moist.

Dark reddish brown oily product present from 7 - 19 feet bgs.

Trace very fine sand from 11.8 - 15 feet bgs.
Strong odor from 12 - 19 feet bgs.

Few very fine sand starting at 15 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-43

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 26, 2016

Surface Elevation (feet amsl*): 862

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
		1,134	Positive	100		Color becomes light brown (7.5YR 6/4) at 18.5 feet bgs.
20						***Poorly-Graded Sand (SP)*** Light brown (7.5YR 6/4) fine to very fine sand, trace silt; dense; wet.
22						Bottom of boring at 20 feet bgs. Temporary screen set at 11 - 16 feet bgs. 0.01 foot bgs of LNAPL accumulated over 24-hour period. Product visible on interface probe and casing.
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-44

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 3, 2016

Surface Elevation (feet amsl*): 888
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	24.0	None	60	ML	**Silt (ML)** Red (2.5YR 4/6) silt, little clay; cohesive; medium plasticity; soft; moist becoming wet at 5.5 feet bgs.
2–4	X	18.5	None	60	ML	
4–6	X	18.5	None	90	ML	Few clay and non-plastic at 4 feet bgs. Color transitions to brown (7.5YR 4/4) by 6.5 feet bgs.
6–8	X	18.0	None	90	ML	
8–10	X	65.9	None	60	ML	
10–12	X	1,367	Negative	60	SM / ML	**Silty Sand (SM)** Dark brown (7.5YR 3/4) fine to coarse sand, little silt and clay; loose; wet; odor present; no sheen on water. **Silt (ML)** Reddish brown (5YR 5/4) silt, little clay; cohesive; non-plastic; hard; moist becoming dry.
12–18						Bottom of boring at 12 feet bgs. Temporary screen set at 6 - 11 feet bgs. 0.04 foot of LNAPL accumulated over 24-hour period.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-45

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 883

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–1	X	0.5	None	75	Fat Clay (CH)	**Fat Clay (CH)** Reddish brown (5YR 4/4) clay, trace silt; cohesive; high plasticity; medium stiff; moist. Organics (roots) present from 0 - 4 feet bgs.
2	X	0.5	None	75		
4	X	1.1	None	80		
6	X	50.5	None	80		Color transitions to brown (7.5YR 4/4) at 6 feet bgs. Faint petroleum-type odor from 6 - 8 feet bgs.
8	X	43.1	None	100	Lean Clay (CL)	**Lean Clay (CL)** Strong brown (7.5YR 4/6) clay, few silt; cohesive; medium plasticity; medium stiff; moist becoming wet at 17 feet bgs.
10	X	93.7	None	100		
12	X	164.0	Negative	100		Petroleum-type odor present from 12 - 19.5 feet bgs.
14	X	3,047	Negative	100		
16	X	1,350	Negative	90		
18						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-45

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 883

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
		2,380	Negative	90		Transition to sandy clay at 19 feet bgs.
20						***Silty Sand (SM)*** Yellowish red (5YR 4/6) silty very fine to fine sand; dense; wet; odor present.
						Bottom of boring at 20 feet bgs. Temporary screen set at 19 - 24 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-45(033016) Duplicate groundwater sample collected. Duplicate ID = WRCDP-DUPE3(033016)
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-46

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 891

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	1.2	None	80	Silt (ML)	***Silt (ML)*** Dark brown (7.5YR 3/3) silt, few clay; non-cohesive; non-plastic; medium stiff; moist. Color transitions to yellowish red (5YR 4/6) at 1 foot bgs.
2–4	X	1.2	None	80	Silt (ML)	
4–6	X	1.4	None	75	Silt (ML)	Cohesive and stiff at 4 feet bgs.
6–8	X	1.7	None	75	Silt (ML)	
8–10	X	1.4	None	60	Silt (ML)	Becomes medium stiff at 8 feet bgs.
10–12	X	1.5	None	60	Silt (ML) to 10.5; Silty Sand (SM)	***Silty Sand (SM)*** Yellowish red (5YR 5/6) silty very fine sand; dense; wet.
						Silty Sand (SM) Yellowish red (5YR 5/6) fine to coarse sand, some silt and clay; dense; wet.
						Bottom of boring at 12 feet bgs.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-47

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 887

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description Ground Surface
0–2		1.5	None	75		***Silt (ML)*** Dark reddish brown (5YR 3/3) silt, few clay; cohesive; non-plastic; medium stiff to stiff; moist. Color transitions to yellowish red (5YR 4/6) with depth.
2–4		2.1	None	75		Color becomes red (2.5YR 4/6) at 4 feet bgs.
4–6		2.1	None	75		
6–8		2.2	None	75		
8–10		2.2	None	90		***Elastic Silt (MH)*** Red (2.5YR 4/6) silt, few clay; cohesive; high plasticity; stiff; moist.
10–12		2.0	None	90		Some clay from 10 - 12 feet bgs.
12–14		1.2	None	100		
14–16		1.8	None	100		***Fat Clay (CH)*** Reddish brown (5YR 4/4) clay, some silt; cohesive; high plasticity; stiff; moist becoming very moist at 17 feet bgs. Color transitions to brown (7.5YR 4/4) with 30% red (2.5YR 4/6) and 2% dark gray mottling at 16 feet bgs. Becomes few silt and soft at 16 feet bgs.
16–18		1.4	None	90		

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-47

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 887

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
		1.2	None	90		
20						**Silty Sand (SM)** Yellowish red (5YR 4/6) silty very fine sand; dense; wet.
						Bottom of boring at 20 feet bgs.
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-48

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 30, 2016

Surface Elevation (feet amsl*): 890

Total Depth (feet bgs*): 28

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0–1						***Silty Sand (SM)*** Yellowish red (5YR 4/6) silty very fine sand; loose; moist.
2		1.5	None	75		***Fat Clay (CH)*** Red (2.5YR 4/6) clay, little silt; cohesive; high plasticity; medium stiff; moist.
4						Color transitions to red (2.5YR 4/8) at 4 feet bgs. Stiff from 4 - 12 feet bgs.
6		2.1	None	90		
8						<1% tiny (approximately 1 millimeter) vesicles present from 8 - 20 feet bgs.
10		2.1	None	90		
12						
14		1.5	None	95		Becomes soft at 14.8 feet bgs.
16						50% light reddish brown (5YR 6/4) mottling and wet (?) at 16 feet bgs.
17		1.9	None	100		
18						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-48

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 30, 2016

Surface Elevation (feet amsl*): 890

Total Depth (feet bgs*): 28

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–20	X	2.4	None	100		
20–22	X	2.2	None	100		***Fat Clay (CH)*** Light brown (7.5YR 6/3) clay with 5% yellow (2.5Y 7/8) mottling, trace coarse sand, trace fine subangular gravel; cohesive; very high plasticity; soft; moist.
22–24	X	1.4	None	100		
24–26	X	0.4	None	100		***Fat Clay with Sand (CH)*** Light brown (7.5YR 6/3) clay with 50% reddish yellow (7.5YR 6/6) mottling, few to little very coarse angular sand, trace fine sub-angular gravel; cohesive; high plasticity; soft; moist. Soft transitions to stiff at 24.5 feet bgs then very stiff at 25 feet bgs. Bottom of boring hard and dry.
26–28	X	0.6	None	100		
28–36						Bottom of boring at 28 feet bgs. Temporary screen set at 21 - 26 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-48(033116)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-49

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 3, 2016

Surface Elevation (feet amsl*): 879

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	420.8	Negative	50	Silt	***Silt (ML)*** Brown (7.5YR 4/3) silt, few clay; cohesive; non-plastic; soft; dry.
2–4	X	508.2	Negative	50	Silt	Becoming medium stiff and moist at 2.5 feet bgs.
4–6	X	1,225	Negative	80	Silt	Stiff; odor present from 4 - 9.3 feet bgs.
6–8	X	897.9	Negative	80	Silt	
8–10	X	1,422	Positive (faint)	95	Silt / Fat Clay	***Fat Clay (CH)*** Light brown (7.5YR 6/3) clay with 1% reddish brown mottling, few silt; cohesive; high plasticity; medium stiff; moist; odor.
10–12	X	1,116	Positive (faint)	95	Fat Clay	
12–14	X	904.0	Positive (faint)	100	Fat Clay	Red (2.5YR 4/6) at 13 feet bgs. ▼
14–16	X	979.7	Positive (faint)	100	Silty Sand	***Silty Sand (SM)*** Light brownish gray (10YR 6/2) silty very fine sand; dense; wet; odor present.
16–18						Bottom of boring at 16 feet bgs. Temporary screen set at 11 - 16 feet bgs. No LNAPL accumulated over 24-hour period.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-50

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 882
Total Depth (feet bgs*): 24
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP
PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0–4		1.8	None	80	Silt	***Silt (ML)*** Dark reddish brown (2.5YR 3/4) silt, few clay; cohesive; non-plastic; medium stiff; moist.
4–8		1.4	None	75	Fat Clay	***Fat Clay (CH)*** Yellowish red (5YR 4/6) clay, few silt; cohesive; high plasticity; stiff; moist.
8–12		1.1	None	90		2% dark brown mottling starting at 8 feet bgs.
12–16		1.1	None	100		Becomes stiff at 12 feet bgs.
16–18						Becomes very stiff at 16 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-50

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 882

Total Depth (feet bgs*): 24

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–20	X	0.7	None	100		
20–22	X					Becomes soft at 21 feet bgs.
22–24	X	0.2	None	100		*Clayey Sand (SC)* Red (2.5YR 4/8) clayey very fine sand; dense; wet.
24						Bottom of boring at 24 feet bgs.
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-51

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 30, 2016

Surface Elevation (feet amsl*): 882
Total Depth (feet bgs*): 25
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		0.5	None	80		***Silt (ML)*** Dark reddish brown (5YR 3/3) silt, few clay; non-cohesive; non-plastic; soft; dry.
2–4		1.0	None	80		***Fat Clay (CH)*** Dark reddish brown (5YR 3/2) clay; cohesive; high plasticity; soft; moist. Color transitions to dark grayish brown (10YR 4/2) at 1.5 feet bgs. Becomes stiff at 2.5 feet bgs.
4–8		1.3	None	75		Becomes very stiff at 4 feet bgs hardening with depth. Color transitions to grayish brown (10YR 5/2) with 1% yellowish brown (10YR 5/8) mottling at 6.5 feet bgs.
8–12		1.3	None	100		Trace coarse sand starting at 8 feet bgs. Color transitions to light brownish gray (10YR 6/2) with 3% yellowish brown (10YR 5/8) and 3% very dark brown (10YR 2/2) mottling and becomes hard at 8 feet bgs. Becomes very stiff at 9.5 feet bgs.
12–16		2.0	None	100		Mottling increases with depth to 6% yellowish brown and 6% very dark brown by 12 feet bgs. Yellowish brown mottling replaced by yellowish red (5YR 5/6) mottling at 14.5 feet bgs.
16–18		1.5	None	100		Clay is swelling producing partial sampler flights starting at 16 feet bgs. Color transitions to red (2.5YR 5/6) with 1% very dark brown (10YR 2/2) mottling at 16.5 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-51

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 30, 2016

Surface Elevation (feet amsl*): 882

Total Depth (feet bgs*): 25

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

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Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18-19						Becomes stiff at 19 feet bgs.
19-22		2.1	None	100		3% pale grayish brown mottling from 19 - 23 feet bgs. Stiff transitions to soft then very soft from 22 - 23 feet bgs.
22-25		2.2	None	100		***Sandy Lean Clay (CL)*** Red (2.5YR 5/8) sandy clay; cohesive; non-plastic; very soft; wet. Becomes soft at 23.5 feet bgs. ***Clayey Sand (SC)*** Red (2.5YR 5/8) very fine sand, some clay; dense; wet.
25						Bottom of boring at 25 feet bgs. Temporary screen set at 20 - 25 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-51(033016)

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-52

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 3, 2016

Surface Elevation (feet amsl*): 878
Total Depth (feet bgs*): 22
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–1		56.0		95		***Silt (ML)*** Strong brown (7.5YR 4/6) silt, few to little clay; cohesive; non-plastic; medium stiff; moist.
2		146.9		95		***Fat Clay (CH)*** Dark gray (5YR 4/1) clay, trace silt; cohesive; high plasticity; medium stiff; moist. Black staining from 1.2 - 1.7 feet bgs.
4		85.1		90		Soft at 4 feet bgs becoming stiff at 5 feet bgs.
6		65.0		90		
8		131.1		100		
10		263.7		100		
12		864.6		100		***Lean Clay (CL)*** Greenish gray (Gley1 5/5GY) clay with 5% reddish brown mottling, trace silt; cohesive; low to medium plasticity (too stiff to roll); stiff to very stiff; moist.
14		1,337		100		Little very fine sand from 15.8 - 16 feet bgs.
16		1,453		100		Clay expanding in liner.
18						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-52

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 3, 2016

Surface Elevation (feet amsl*): 878
Total Depth (feet bgs*): 22
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–19	X	1,514		100	CL	**Sandy Lean Clay (CL)** Dark gray (7.5YR 4/1) sandy clay, very fine sand; medium stiff; very moist becoming wet at 20 feet bgs; odor present; clay expanding in liner. Color transitions to greenish gray (Gley1 5/5GY) at 18.7 feet bgs. Soft at 20.2 feet bgs.
19–20	X	855.4		100	CL	
20–22	X	273.7		100	SM	**Silty Sand (SM)** Dark gray (7.5YR 4/1) silty very fine sand; wet. Yellowish brown staining from 21.3 - 21.7 feet bgs. Reddish brown (5YR 5/4) at 21.7 feet bgs.
22						Bottom of boring at 22 feet bgs. Temporary screen set at 13 - 18 feet bgs. No LNAPL accumulated over 24-hour period.

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-53

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 883

Total Depth (feet bgs*): 24

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		2.2	None	50		***Silt (ML)*** Brown (7.5YR 4/4) silt, few clay; cohesive; non-plastic; soft; moist; roots present.
2–4		2.5	None	50		
4–6		2.2	None	75		***Silt (ML)*** Red (2.5YR 4/6) silt, few clay, trace very fine sand; cohesive; non-plastic; soft; moist.
6–8		2.3	None	75		
8–10		1.6	None	80		Transitions to yellowish red (5YR 4/6) and medium plastic at 8 feet bgs.
10–12		1.8	None	80		
12–14		2.1	None	100		***Silt (ML)*** Yellowish red (5YR 4/6) silt, few clay, few very fine to coarse sand; cohesive; low plasticity; medium stiff; moist.
14–16		1.9	None	100		
16–18		5.7	None	100		***Lean Clay (CL)*** Yellowish red (5YR 4/6) clay with 50% light grayish brown mottling, few silt; cohesive; medium plasticity; stiff; moist becoming wet at 21 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-53

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 883
Total Depth (feet bgs*): 24
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–20	X	128.6	Negative	100		Faint odor at 20 feet bgs.
20–22	X	193.9	Negative	100		
22–24	X	252.5	Negative	100		***Clayey Sand (SC)*** Red (2.5YR 4/6) clayey very fine sand; dense; wet.
24–36						Bottom of boring at 24 feet bgs. Temporary screen set at 22 - 27 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-53(033016)

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-54

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 880
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		136.7	Negative	80		***Silty Gravel (GM)*** Silty coarse gravel fill. ***Silt (ML)*** Brown (7.5YR 4/2) silt, few clay; cohesive; non-plastic; medium stiff; moist.
2–4		166.6	Negative	80		Color transitions to reddish brown (5YR 4/4) at 2.5 feet bgs.
4–6		109.6	Negative	50		60% dark grayish brown mottling at 4 feet bgs becoming 5% mottling at 7 feet bgs.
6–8		173.0	Negative	50		Loose fine to coarse sand with gravel lens from 7 - 7.5 feet bgs; odor present in lens.
8–10		1,101	Negative	75		Few coarse sand from 8 - 9 feet bgs. ***Fat Clay (CH)*** Yellowish red (5YR 5/6) clay, few silt; cohesive; high plasticity; medium stiff; moist; gasoline-type odor.
10–12		1,131	Negative	75		
12–14		1,175	Negative	100		Very strong gasoline-type odor from 12 - 15.5 feet bgs.
14–16		3,080	Positive (faint)	100		Almost 100% light gray mottling from 13 - 14 feet bgs decreasing to 50% mottling from 14 - 15.5 feet bgs.
16–18		NM	Positive (faint)	70		***Silty Sand (SM)*** Reddish brown (5YR 5/3) silty very fine sand; dense; wet; very strong odor; possible free product. Coarsening with depth.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-54

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 880
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

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PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–20	X	1,176	Positive (faint)	70		***Well-Graded Sand with Silt (SW-SM)*** Reddish brown (5YR 5/3) very fine to medium sand, few fines; medium dense; wet; very strong odor.
20						Bottom of boring at 20 feet bgs. Temporary screen set at 13.5 - 18.5 feet bgs. 1.8 feet bgs of LNAPL accumulated over 24-hour period.
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-55

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 879

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–1		1.7	None	80		**Well-Graded Gravel with Sand (GW)** Sandy coarse gravel fill.
1–2						**Silt (ML)** Very dark brown silt; very hard; dry.
2–4		1.5	None	80		**Silt (ML)** Red (2.5YR 4/6) silt, few clay; cohesive; low plasticity; medium stiff; moist. Becomes soft and non-plastic at 4 feet bgs.
4–6		1.1	None	50		
6–8		1.0	None	50		
8–10		1.8	None	100		Transitions to stiff by 8 feet bgs. 2% dark brown mottling from 8 - 13 feet bgs.
10–12		1.8	None	100		
12–14		1.8	None	100		**Fat Clay (CH)** (from 13 ft) Reddish brown (5YR 5/4) clay with 50% red (2.5YR 5/6) mottling; cohesive; high plasticity; stiff; moist.
14–16		1.9	None	100		Becomes soft at 14 feet bgs.
16–18		2.2	None	75		**Sandy Fat Clay (CH)**

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-55

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 879
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
		476.5	Negative	75		Reddish brown (5YR 5/4) sandy clay with 50% red (2.5YR 5/6) mottling; cohesive; high plasticity; soft; wet. ***Poorly-Graded Sand with Silt (SP-SM)*** Yellowish red (5YR 5/6) very fine to fine sand, few silt and clay; dense; wet; petroleum-type odor.
20						Bottom of boring at 20 feet bgs. Temporary screen set at 17 - 22 feet bgs. No LNAPL accumulated over 24-hour period. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-55(033016)
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-56

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 30, 2016

Surface Elevation (feet amsl*): 884
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Description
					Ground Surface
0–4		1.6	None	75	***Silt (ML)*** Dark reddish brown (5YR 3/2) silt, few clay; non-cohesive; non-plastic; soft; dry; tree roots present. ***Silt (ML)*** Red (2.5YR 4/6) silt, some clay; cohesive; low to medium plasticity; stiff; moist. Tree roots present from 1 - 4 feet bgs.
4–8		1.1	None	80	Becomes very stiff at 4 feet bgs. Trace coarse to very coarse sand from 4 - 12 feet bgs. Some coarse to very coarse sand (sandy clay) from 6 - 8 feet bgs.
8–12		1.5	None	50	Moist and very stiff becoming dry and hard with depth.
12–16		1.6	None	90	***Fat Clay (CH)*** Red (2.5YR 5/6) clay with 1% very dark brown mottling, few silt; cohesive; high plasticity; very stiff; moist. Becomes stiff at 14 feet bgs then medium stiff at 15 feet bgs.
16–18		1.9	None	100	Becomes soft at 17 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-56

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 30, 2016

Surface Elevation (feet amsl*): 884

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–20	X	1.9	None	100	SC	**Clayey Sand (SC)** Red (2.5YR 4/6) clayey very fine sand; dense; wet.
20						Bottom of boring at 20 feet bgs. Temporary screen set at 18.5 - 23.5 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-56(033116)

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-105

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 3, 2016

Surface Elevation (feet amsl*): 860

Total Depth (feet bgs*): 24

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2				0		***No Recovery***
2–4				0		
4–6		11.8	None	90		***Fat Clay (CH)*** Red (2.5YR 4/6) clay, little silt; cohesive; high plasticity; medium stiff; moist.
6–8		24.5	None	90		
8–10		19.5	None	95		
10–12		29.6	None	95		Wet from 10 - 13 feet (bgs). Brown (7.5YR 4/2) from 11.5 - 12 feet (bgs).
12–14		56.0	None	100		Brown (7.5YR 4/3) at 12 feet (bgs).
14–16		394.0	Negative	100		Faint odor at 15 - 23 feet (bgs).
16–18		1,355	Positive (faint)	100		Wet at 16 feet (bgs).

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-105

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 3, 2016

Surface Elevation (feet amsl*): 860
Total Depth (feet bgs*): 24
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

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Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
18–20	X	1,075	Positive (very faint)	100		Reddish brown (5YR 4/4) from 16.5 - 20 feet (bgs). Trace very fine sand at 19.5 feet (bgs). Yellowish red (5YR 4/6) at 20 feet (bgs).
20–22	X	1,293	Positive (very faint)	100		
22–24	X	1,137	Positive (faint)	100		***Silty Sand (SM)*** Reddish brown (5YR 4/4) very fine to fine sand, little silt and clay; dense; wet; odor.

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Bottom of boring at 24 feet bgs.
Temporary screen set at 22 - 27 feet bgs.
No LNAPL accumulated over 24-hour period.
Groundwater sample collected for analysis of BTEX, GRO, and DRO.
Sample ID = WRCDP-105(030416)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-110

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 29, 2016

Surface Elevation (feet amsl*): 863

Total Depth (feet bgs*): 15

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

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Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		2.6	None	60		**Silt (ML)** Red (2.5YR 4/6) silt, few clay; non-cohesive; non-plastic; soft; moist. Organics (roots) present from 0 - 4 feet bgs.
2–4		2.4	None	60		
4–6		0.4	None	60		
6–8		2.6	None	60		Few very fine sand from 6 - 15 feet (bgs).
8–10		2.7	None	75		Dry from 9 - 12 feet (bgs).
10–12		2.4	None	75		
12–13.5		2.2	None	100		
13.5–15		2.1	None	100		Rock chip or concrete in sampler causing refusal at 15 feet (bgs).
15–18						Bottom of boring at 15 feet bgs. Boring terminated at refusal.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NE-DP-111

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 30, 2016

Surface Elevation (feet amsl*): 860

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

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Depth (feet bgs)	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
					Ground Surface
0–4	0.3	None	60	Silt (ML)	**Silt (ML)** Red (2.5YR 5/8) silt, few clay, trace sand; non-cohesive; non-plastic; soft; moist.
4–8	0.4	None	75	Silt (ML)	Becomes cohesive with 2% very dark gray and 1% light gray mottling at 4 feet (bgs).
8–10	1.0	None	80	Silt (ML) to 9; Silty Sand (SM) 9–10	Sand content increasing with depth to few sand at 8 feet (bgs).
10–12	1.4	None	80	Silty Sand (SM)	**Silty Sand (SM)** Reddish brown (2.5YR 5/3) very fine to coarse sand with 5% very dark gray mottling, some silt and clay, trace fine sub-rounded and sub-angular quartz gravel; dense; wet.
12–18					Bottom of boring at 12 feet bgs. Temporary screen set at 9 - 14 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-111(033016)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-89

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: April 2, 2016

Surface Elevation (feet amsl*): 855

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
0						Ground Surface
0–2	X	0.6	None	90	ML	**Silt (ML)** Brown (7.5YR 4/4) silt, few clay; cohesive; non-plastic; hard; dry; organics (roots) present.
2–4	X	0.4	None	90	SM	**Silty Sand (SM)** Strong brown (7.5YR 4/6) very fine sand, little silt and clay; medium dense; moist becoming wet at 4 feet bgs.
4–6	X	0.8	None	70	SM	
6–8	X	1.0	None	70	SC	**Clayey Sand (SC)** Light brown (7.5YR 6/4) clayey very fine to fine sand; dense; wet; reddish yellow banding present.
8–10	X	0.9	None	60	SC	Medium dense at 8 feet bgs becoming loose with depth. ▼
10–12	X	1.3	None	60	SC	
12–18						Bottom of boring at 12 feet bgs. Temporary screen set at 9 - 14 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-89(040216)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-90

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: April 2, 2016

Surface Elevation (feet amsl*): 856

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0-2		0.6	None	90		***Silt (ML)*** Brown (7.5YR 4/3) silt, few clay; cohesive; non-plastic; medium stiff; moist.
2-4		0.5	None	90		***Silty Sand (SM)*** Brown (7.5YR 5/3) very fine sand, some silt and clay; dense; moist.
4-6		0.5	None	50		***Sandy Lean Clay (CL)*** Strong brown (7.5YR 4/6) sandy clay, very fine sand; soft; wet.
6-8		0.3	None	50		***Clayey Sand (SC)*** Strong brown (7.5YR 4/6) clayey very fine sand; medium dense; wet.
8-10		0.3	None	60		Reddish yellow banding from 8 - 11 feet bgs.
10-12		0.4	None	60		Color transitions to reddish yellow (5YR 6/6) at 10 feet bgs. ***Silty Sand (SM)*** Reddish yellow (5YR 6/6) very fine to fine sand, some silt and clay; medium dense; wet.
12-18						Bottom of boring at 12 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-91

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 29, 2016

Surface Elevation (feet amsl*): 852

Total Depth (feet bgs*): 4

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	20.4	None	70		**Silt (ML)** Dark brown (7.5YR 3/4) silt, little clay, organics (roots) present; cohesive; non-plastic; soft; moist.
2–4	X	21.5	None	70		**Silt (ML)** Strong brown (7.5YR 4/6) silt, few clay; cohesive; non-plastic; soft; moist.
						Sandy Silt (ML) Strong brown (7.5YR 4/6) sandy silt; cohesive; non-plastic; soft; moist.
						Silty Sand (SM) Strong brown (7.5YR 4/6) silty very fine sand; medium dense; wet.
						Bottom of boring at 4 feet bgs. Temporary screen set at 2.5 - 7.5 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-91(022916)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-93

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: April 1, 2016

Surface Elevation (feet amsl*): 853
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	PID/OVM (ppm)	UV Test	% Recovery	Description
0				Ground Surface
0–2	1.4	None	90	**Silt (ML)** Dark grayish brown (10YR 4/2) silt with 5% brownish red mottling, few clay; cohesive; non-plastic; medium stiff; dry.
2–4	1.4	None	90	
4–6	2.2	None	60	Becomes soft at 4 feet bgs.
5				**Poorly-Graded Sand with Silt (SP-SM)** Light brownish gray (10YR 6/2) very fine sand with 3% yellowish red mottling, few silt; loose; moist becoming wet at 8 feet bgs.
6–8	1.3	None	60	
8–10	1.6	None	70	
10–12	1.4	None	70	
12				Bottom of boring at 12 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-94

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 29, 2016

Surface Elevation (feet amsl*): 848
Total Depth (feet bgs*): 8
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	22.7	None	100		***Silt (ML)*** Dark brown (7.5YR 3/4) silt with roots, few clay; cohesive; non-plastic; medium stiff; moist. Strong brown (7.5YR 4/6) at 1 foot bgs.
2–4	X	22.6	None	100		
4–6	X	18.0	None	75		***Sandy Silt (ML)*** Dark brown (7.5YR 3/4) silt, some very fine sand, few clay; cohesive; non-plastic; medium stiff; moist. Sandy silt and wet at 6 feet bgs bgs.
6–8	X	18.6	None	75		***Silty Sand (SM)*** Brown (7.5YR 5/3) silty very fine to fine sand, few clay; dense; wet.
8–18						Bottom of boring at 8 feet bgs. Temporary screen set at 13 - 18 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-94(022916)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-95

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: April 1, 2016

Surface Elevation (feet amsl*): 854
Total Depth (feet bgs*): 16
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	2.1	None	75	Fat Clay (CH)	***Fat Clay (CH)*** Very dark grayish brown (10YR 3/2) clay, few silt, trace gravel; cohesive; high plasticity; medium stiff; moist; fill.
2–4	X	1.2	None	75	Fat Clay (CH) / Clayey Sand (SC)	***Clayey Sand (SC)*** Yellowish red (5YR 4/6) very fine sand, some clay; medium dense; moist.
4–6	X	1.0	None	50	Silt (ML)	***Silt (ML)*** Brown (7.5YR 5/2) silt, some clay, few very fine sand; cohesive; low plasticity; stiff; moist.
6–8	X	0.8	None	50	Silt (ML)	▼
8–10	X	10.1	Negative	100	Silt (ML)	Color transitions to gray (2.5Y 6/1) at 9 feet bgs.
10–12	X	111.8	Positive (faint)	100	Silt (ML)	Little sand at 10.5 feet bgs becoming some sand with depth.
12–14	X	117.6	Positive	75	Silt (ML) / Sandy Lean Clay (CL)	5% black mottling from 12 - 13 feet bgs. ***Sandy Lean Clay (CL)*** Gray (2.5Y 6/1) sandy clay; medium stiff; moist becoming wet at 14 feet bgs.
14–16	X	99.1	Positive	75	Sandy Lean Clay (CL) / Well-Graded Sand with Clay (SW-SC)	***Well-Graded Sand with Clay (SW-SC)*** Light gray (2.5Y 7/1) very fine to medium sand, few fines; medium dense; wet. Black staining at 14 feet bgs.
16–18						Bottom of boring at 16 feet bgs. Temporary screen set at 12.5 - 17.5 feet bgs. No LNAPL accumulated over 24-hour period.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-96

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: April 1, 2016

Surface Elevation (feet amsl*): 839

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		1.6	None	75		**Well-Graded Gravel (GW)** Gravel fill. **Silt (ML)** Very dark grayish brown (10YR 3/2) silt, few clay; non-cohesive; non-plastic; medium stiff; dry.
2–4		1.7	None	75		**Lean Clay (CL)** Very dark gray (7.5YR 3/1) clay, few silt; medium stiff; moist.
4–6		1.6	None	60		**Silt (ML)** Brown (7.5YR 5/2) silt with 1% yellowish red mottling, little clay, trace to few very fine sand; cohesive; medium plasticity; stiff; moist.
6–8		1.7	None	60		
8–10		1.4	None	100		Very stiff from 8 - 10 feet bgs.
10–12		0.6	None	100		Medium stiff from 11 - 12 feet bgs.
12–14		0.8	None	100		
14–16		1.0	None	100		**Silty Sand (SM)** Very pale brown (10YR 7/3) silty very fine sand; dense; wet.
16–18						Bottom of boring at 16 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-97

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 29, 2016

Surface Elevation (feet amsl*): 850

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0-2	X	14.4	None	90		***Silt (ML)*** Dark brown (7.5YR 3/4) silt with organics (roots), little clay; cohesive; non-plastic; soft; moist.
2-4	X	21.3	None	90		***Fat Clay (CH)*** Brown (7.5YR 4/4) clay, little silt; cohesive; high plasticity; stiff; moist. Few very fine sand from 4 - 4.5 feet bgs.
4-6	X	28.5	None	90		***Fat Clay with Sand (CH)*** Brown clay, little silt, little very fine sand; cohesive; high plasticity; stiff; moist.
6-8	X	27.4	None	90		Pinkish gray (7.5YR 6/2) with 1% reddish brown mottling from 6.5 - 10.5 feet bgs.
8-10	X	23.3	None	75		Sandy clay from 9.5 - 10.5 feet bgs.
10-12	X	20.1	None	75		***Poorly-Graded Sand (SP)*** Light brown (7.5YR 6/4) fine to medium sand, trace silt and clay; medium dense; wet.
12-18						Bottom of boring at 12 feet bgs. Temporary screen set at 9 - 14 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-97(022916)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-98

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 853

Total Depth (feet bgs*): 6

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP
PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		11.1	None	100		***Sandy Organic Soil (OL/OH)*** Reddish brown (5YR 4/4) organic rich silty fine sand; loose; moist.
2–4		12.8	None	100		***Lean Clay (CL)*** Dark reddish brown (5YR 3/3) silty clay, few fine sand; non-cohesive; non-plastic; medium stiff; moist. Little gravel from 0.5 - 0.75 feet bgs. Few organics and faint petroleum-type odor from 0.5 - 2 feet bgs. Dark brown (7.5YR 3/2) clayey silt from 3 - 3.5 feet bgs.
4–6		28.9	None	100		***Sandy Silt (ML)*** Strong brown (7.5YR 4/6) sandy silt; non-cohesive; non-plastic; medium stiff; moist.
						Silty Sand (SM) Strong brown (7.5YR 4/6) silty very fine to fine sand; medium dense; moist becoming wet at 4.5 feet bgs.
						Bottom of boring at 6 feet bgs.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: NW-DP-99

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: April 1, 2016

Surface Elevation (feet amsl*): 852
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description Ground Surface
0–2	X	0.2	None	80		**Silty Sand (SM)** Brown (7.5YR 4/4) very fine to fine sand, some silt and clay; medium dense; moist.
2–4	X	0.2	None	80		
4–6	X	0.5	None	60		**Silt (ML)** Brown (7.5YR 4/3) silt, little clay; cohesive; non-plastic; medium stiff; moist.
6–8	X	0.6	None	60		**Silty Sand (SM)** Light brown (7.5YR 6/4) very fine sand, little silt and clay; medium dense; moist becoming wet at 7 feet bgs. Yellowish red and reddish brown banding throughout.
8–10	X	0.3	None	80		Sand coarsens to very fine to fine sand at 8 feet bgs.
10–12	X	0.9	None	80		Color transitions to red (2.5YR 4/8) at 11 feet bgs.
12–18						Bottom of boring at 12 feet bgs. Temporary screen set at 9.5 - 14.5 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-99(040116)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-100

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 28, 2016

Surface Elevation (feet amsl*): 853

Total Depth (feet bgs*): 4

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0 - 2		24.4	None	100		**Poorly-Graded Sand with Silt (SP-SM)** Yellowish red (5YR 4/6) fine to very fine sand, few fines, trace organics; loose; moist. Little organics from 0 - 0.25 foot bgs.
2 - 4		35.9	None	100		**Silty Sand (SM)** Yellowish red (5YR 4/6) fine to very fine sand, little silt; loose; moist becoming wet at 2.5 feet bgs. Trace coarse sand from 3 - 4 feet bgs.
4						Bottom of boring at 4 feet bgs.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: NW-DP-101

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 847

Total Depth (feet bgs*): 5

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		20.2	None	100		***Silty Sand (SM)*** Dark reddish brown (5YR 3/3) silty sand; loose; moist. Little organics from 0 - 0.5 foot bgs.
2–4		19.2	None	100		***Silt with Sand (ML)*** Yellowish red (5YR 4/6) clayey silt, little sand; non-cohesive; non-plastic; medium stiff; moist. Some sand from 2 - 2.5 feet bgs.
4–5		18.1	None	100		***Silty Sand (SM)*** Yellowish red (5YR 4/6) silty fine to very fine sand; loose; moist becoming wet at 3.75 feet bgs.
						Bottom of boring at 5 feet bgs.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: NW-DP-102

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 29, 2016

Surface Elevation (feet amsl*): 849
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	27.2	None	90		**Lean Clay (CL)** Brown (7.5YR 4/3) clay with organics (roots), trace coarse sand; cohesive; medium plasticity; very soft; moist.
2–4	X	28.3	None	90		**Silt (ML)** Brown (10YR 5/3) silt with 5% yellowish brown mottling, little clay, roots present; cohesive; low plasticity; stiff; moist.
4–6	X	29.7	None	75		5% reddish brown and black mottling from 4 - 7 feet bgs.
6–8	X	33.3	None	75		
8–10	X	35.6	None	60		**Silt (ML)** Light gray (10YR 7/2) silt, little clay, trace medium-grained gravel; cohesive; low plasticity; soft; wet.
10–12	X	33.2	None	60		Sandy silt from 10.7 - 11 feet bgs. **Poorly-Graded Sand (SP)** Light brown (7.5YR 6/4) very fine to fine sand, trace or no fines; dense; wet.

Bottom of boring at 12 feet bgs.
Temporary screen set at 11 - 16 feet bgs.
Groundwater sample collected for analysis of BTEX, GRO, and DRO.
Sample ID = WRCDP-102(022916)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-103

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 833

Total Depth (feet bgs*): 5

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		18.9	None	100		**Silty Sand (SM)** Reddish brown (5YR 4/4) silty fine sand, trace organics; loose; wet becoming moist at 0.25 foot bgs. Dark reddish brown (5YR 3/4) with few gravel from 0.5 - 1.5 feet bgs. Petroleum-type odor from 1 - 1.5 feet bgs.
2–4		24.3	None	100		**Sandy Silt (ML)** Dark reddish brown clayey silt, little sand; non-cohesive; non-plastic; medium stiff; moist.
						Sandy Silt (ML) Strong brown (7.5YR 4/6) sandy silt; non-cohesive; non-plastic; medium stiff; moist.
4–5		24.4	None	100		**Silty Sand (SM)** Strong brown (7.5YR4/6) fine sand, little silt; loose; moist becoming wet at 4.25 feet bgs.
						Bottom of boring at 5 feet bgs.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: NW-DP-104

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: April 1, 2016

Surface Elevation (feet amsl*): 855
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0-2	X	0.1	None	90	ML	**Silt (ML)** Brown (7.5YR 4/4) silt, few clay; cohesive; non-plastic; stiff; moist.
2-4	X	0.4	None	90	ML	1% yellowish red and 1% very dark brown mottling from 3 - 4.5 feet bgs.
4-6	X	0.4	None	75	SM	**Silty Sand (SM)** Yellowish red (5YR 5/6) very fine sand, some silt; dense; moist becoming wet at 7.5 feet bgs.
6-8	X	0.4	None	75	SM	
8-10	X	0.4	None	90	SM	**Silty Sand (SM)** Red (2.5YR 4/6) silty very fine to fine sand; dense; wet.
10-12	X	0.6	None	90	SM	
12						Bottom of boring at 12 feet bgs. Temporary screen set at 9.5 - 14.5 feet bgs. No LNAPL accumulated over 24-hour period.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: NW-DP-106

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: April 1, 2016

Surface Elevation (feet amsl*): 898

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	6.6	None	75		**Silty Gravel with Sand (GM)** Sandy silty gravel fill; loose; dry.
2–4	X	53.0	None	75		**Fat Clay (CH)** Brown (7.5YR 4/4) clay with 20% very dark gray mottling, little silt; trace gravel; cohesive; high plasticity; stiff; moist.
						Silt (ML) Very dark gray (7.5YR 3/1) silt, few clay; non-cohesive; non-plastic; medium stiff becoming stiff; moist.
4–6	X	1.3	None	60		**Poorly-Graded Sand with Silt (SP-SM)** Grayish brown (10YR 5/2) very fine sand, few silt and clay; medium dense; moist becoming wet at 5 feet bgs.
6–8	X	1.5	None	60		
8–10	X	0.9	None	75		**Silt (ML)** Light brownish gray (10YR 6/2) silt, little clay; cohesive; non-plastic; stiff; moist.
10–12	X	0.4	None	75		**Poorly-Graded Sand with Silt (SP-SM)** Reddish yellow (7.5YR 6/6) very fine to fine sand, few silt and clay; medium dense; wet; red and yellowish red banding present.

Bottom of boring at 12 feet bgs.
Temporary screen set at 8.5 - 13.5 feet bgs.
Groundwater sample collected for analysis of BTEX, GRO, and DRO.
Sample ID = WRCDP-106(040116)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-57

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 26, 2016

Surface Elevation (feet amsl*): 855
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Description
0					Ground Surface
0–2		256.9	Negative	90	***Silt (ML)*** Dark brown (10YR 3/3) silt, few clay; non-cohesive; non-plastic; stiff; moist. ***Concrete*** Degraded concrete.
2–4		505.6	Positive	90	***Lean Clay (CL)*** Black (10YR 2/1) clay, few silt; cohesive; medium plasticity; medium stiff; moist.
4–6		884.2	Positive	88	***Silt (ML)*** Dark grayish brown (10YR 4/2) silt, few clay; cohesive; non-plastic; stiff; moist.
6–8		980.7	Positive	88	
8–10		1,273	Positive	100	Color transitions to grayish brown (10YR 5/2) at 8 feet bgs. Dark reddish brown product present from 8 - 9 feet bgs.
10–12		1,395	Positive	100	Color transitions to gray (10YR 5/1) at 10 feet bgs.
12–14		1,173	Positive	100	Trace very fine sand; strong odor and product visible from 12 - 15 feet bgs.
14–16		1,201	Positive	100	***Sandy Silt (ML)*** Gray (10YR 5/1) sandy silt, very fine sand; cohesive; non-plastic; stiff; moist; product visible and strong odor throughout.
16–18		1,135	Positive	100	

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-57

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 26, 2016

Surface Elevation (feet amsl*): 855

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
19–20	X	1,227	Positive	100		**Poorly-Graded Sand with Silt (SP-SM)** Grayish brown (10YR 5/2) fine to very fine sand, few silt and clay; dense; wet. Dark reddish brown product visible throughout and collecting in liner.
20						Bottom of boring at 20 feet bgs. Temporary screen set at 14 - 19 feet bgs. 1.72 feet bgs of LNAPL accumulated over 24-hour period.

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-58

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 854

Total Depth (feet bgs*): 21

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		11.2	None	75		***Silt (ML)*** Reddish brown (7.5YR 4/3) silt, few clay; non-cohesive; non-plastic; soft; barely moist.
2–4		19.8	None	75		***Silt (ML)*** Brown (7.5YR 4/2) silt, little clay; cohesive; low plasticity; soft; wet.
4–6		20.5	None	90		Medium plasticity at 4 feet bgs.
6–8		20.8	None	90		
8–10		17.6	None	100		***Silt (ML)*** Brown (7.5YR 4/2) silt with 30% yellowish brown to reddish brown and black mottling, little clay; cohesive; medium plasticity; stiff; moist.
10–12		14.8	None	100		
12–14		17.9	None	100		
14–16		19.7	None	100		***Fat Clay (CH)*** Gray (7.5YR 6/1) clay, few silt; cohesive; high plasticity; soft; wet.
16–18		17.4	None	75		***Lean Clay (CL)*** Brown (7.5YR 5/3) clay with 5% reddish brown mottling, few silt; cohesive; medium plasticity; very stiff; moist becoming dry.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-58

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 2, 2016

Surface Elevation (feet amsl*): 854

Total Depth (feet bgs*): 21

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
19		17.9	None	75		
20		15.5	None	100		Clay is brown (7.5YR 5/2) and dry from 20 - 21 feet bgs.
21						Bottom of boring at 21 feet bgs. Refusal at 21 feet bgs. Temporary screen set at 16 - 21 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-58(030216)
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-59

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 26, 2016

Surface Elevation (feet amsl*): 852

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
0						Ground Surface
0–4				0		**No Recovery** No recovery. Soil too soft, mud. Boring is located next to standing water in tank dike.
4–8				0		
8–10		1,717	Negative	88		**Silt (ML)** Dark grayish brown (10YR 4/2) silt, few clay; cohesive; low plasticity; stiff; moist becoming wet at 14.5 feet bgs.
10–12		1,698	Negative	88		
12–14		1,713	Negative	88		Medium stiff with trace very fine sand from 12 - 15 feet bgs.
14–16		1,704	Positive	88		**Silty Sand (SM)** (from 15 feet bgs) Dark grayish brown silty very fine sand; dense; wet.
16–18						Bottom of boring at 16 feet bgs. Temporary screen set at 13 - 18 feet bgs. 0.02 feet bgs of LNAPL accumulated over 24-hour period.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: ***SE-DP-62***

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 24, 2016

Surface Elevation (feet amsl*): 853

Total Depth (feet bgs*): 4

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		21.5	None	100		**Silty Sand (SM)** Brown (7.5YR 4/3) very fine sand, little silt, trace organics; loose; wet.
2–4		25.4	None	100		**Silty Sand (SM)** Brown fine to medium sand, little silt; loose; wet.
3						Plastic sheet/liner at 3 feet bgs.
						Clayey Sand (SC) Brown (7/5YR 4/2) clayey very fine sand; loose; wet.
4						Bottom of boring at 4 feet bgs.

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: SE-DP-63

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 24, 2016

Surface Elevation (feet amsl*): 853

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0–2		16.7	None	100		***Silty Sand (SM)*** Brown (7.5YR 4/4) silty very fine sand, trace organics, trace gravel; loose; moist.
2–4		15.7	None	100		***Sandy Silt (ML)*** Dark brown (7.5YR 3/3) sandy silt; cohesive; low plasticity; soft; moist. 30% yellowish red (5YR 4/6) mottling starting at 4 feet bgs.
4–6		20.0	None	100		Little clay from 5 - 6 feet bgs.
6–8		20.6	None	100		***Clayey Sand (SC)*** Strong brown (7.5YR 4/6) clayey very fine sand; medium dense; moist.
8–10		21.1	None	100		***Sandy Lean Clay (CL)*** Brown (7.5YR 4/4) sandy clay, sand lenses throughout; cohesive; low plasticity; soft; moist becoming wet at 10 feet bgs.
10–12		22.3	None	100		
12–18						Bottom of boring at 12 feet bgs.

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: SE-DP-64

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 852

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Description
					Ground Surface
0–2		6.0	None	75	***Lean Clay with Gravel (CL)*** Brown (10YR 4/2) silty clay with gravel (fill); medium stiff; dry. ***Silt (ML)*** Brown (7.5YR 4/3) silt, little clay; cohesive; low plasticity; soft; moist.
2–4		6.7	None	75	
4–6		8.7	None	70	Stiff at 5 feet bgs.
6–8		10.8	None	70	Grayish brown (10YR 5/2) with 5% strong brown (7.5YR 5/6) mottling from 7 - 8 feet bgs.
8–10		17.0	None	88	
10–12		18.6	None	88	***Silt (ML)*** Yellowish brown (10YR 5/4) silt with 5% black mottling, little clay, trace very fine sand; cohesive; medium plasticity; stiff; moist.
12–14		19.4	None	100	
14–16		25.7	None	100	
16–18		27.8	None	90	***Clayey Sand (SC)*** Light yellowish brown (10YR 6/4) clayey fine to very fine sand; dense; moist becoming wet at 17.5 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-64

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 852

Total Depth (feet bgs*): 20

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
		25.3	None	90		Light red and yellowish brown banding from 18.5 - 20 feet bgs.
20						Bottom of boring at 20 feet bgs. Stainless steel screen point sampler set at 20 - 24 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-64(022516)
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-65

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 24, 2016

Surface Elevation (feet amsl*): 850
Total Depth (feet bgs*): 5.5
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP
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Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		22.6	None	100		***Sandy Silt (ML)*** Brown (7.5YR 4/3) sandy silt, few organics; cohesive; low plasticity; soft; wet. ***Silty Sand (SM)*** Brown (7.5YR 4/3) very fine to fine sand, little silt; loose; wet. Trace organics from 0.5 - 1.5 feet bgs.
2–4		28.5	None	100		Color transitions to brown (7.5YR 4/4) at 2 feet bgs.
4–5.5		21.0	None	100		15% yellowish red mottling from 4 - 5.5 feet bgs.
						Bottom of boring at 5.5 feet bgs. Temporary screen set at 0 - 5 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-65(022416)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: SE-DP-66

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 24, 2016

Surface Elevation (feet amsl*): 848
Total Depth (feet bgs*): 10
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

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Sample Data

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery
0 - 2		18.0	None	100
2 - 4		37.0	None	100
4 - 6		21.8	None	100
6 - 8		26.8	None	100
8 - 10		26.6	None	100

Subsurface Profile

Lithology

Description

Ground Surface

Silty Sand (SM)
Brown (7.5YR 4/4) silty very fine sand, few organics; loose; moist.

Medium stiff at 1.5 feet bgs
Color transitions to dark brown (7.5YR 3/3) at 2 feet bgs.

Sandy Silt (ML)
Very dark brown (7.5YR 2.5/2) sandy silt; cohesive; low plasticity; soft; moist.

Silty Sand (SM)
Brown (7.5YR 4/4) silty fine sand; medium dense; wet.
Yellowish red (5YR 4/6) loose fine sand from 4.2 - 4.6 feet bgs.

Sandy Lean Clay (CL)
Grayish brown (10YR 5/2) sandy clay with 15% yellowish red (5YR 4/6) mottling, little silt; cohesive; medium plasticity; stiff; moist.
Brown (10YR 4/3) with yellowish red and dark grayish brown (7.5YR 4/2) mottling and medium stiff from 4.75 - 5 feet bgs.
Wet sand lens at 4.8 - 4.9 feet bgs.

Sandy Silt (ML)
Grayish brown (10YR 5/2) sandy silt with 15% yellowish red mottling; cohesive; low plasticity; medium stiff; moist.

Silty Sand (SM)
Grayish brown (10YR 5/2) silty sand with yellowish red mottling, little clay; medium dense; moist becoming wet at 8.75 feet bgs.

Clayey Sand (SC)
Grayish brown (10YR 5/2) clayey sand with 30% strong brown mottling; medium dense; wet.

Bottom of boring at 10 feet bgs.

Depth scale (feet bgs): 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: SE-DP-67

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 24, 2016

Surface Elevation (feet amsl*): 839

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	14.1	None	75		**Silt (ML)** Very dark grayish brown (10YR 3/2) silt with 1% very dark gray and 1% reddish brown mottling, few clay; cohesive; low plasticity; medium stiff; moist.
2–4	X	18.9	None	75		
4–6	X	8.6	None	70		**Silt (ML)** Dark grayish brown (10YR 4/2) silt with 20% reddish brown mottling, little clay; cohesive; medium plasticity; stiff; moist.
6–8	X	12.8	None	70		
8–10	X	23.3	None	100		**Silt (ML)** Grayish brown (10YR 5/2) silt with 10% black mottling, few clay; cohesive; non-plastic; stiff; moist to very moist. Color to dark gray (10YR 4/1) with faint petroleum-type odor at 10 feet bgs.
10–12	X	1,396	Negative	100		**Silt with Sand (ML)** Dark gray (10YR 4/1) silt with 10% black mottling, little fine to very fine sand, few clay; cohesive; non-plastic; moist to very moist; faint petroleum-type odor.
12–14	X	1,036	Negative	70		**Silty Sand (SM)** Dark gray (10YR 4/1) silty very fine sand; dense; moist to very moist; faint petroleum-type odor.
14–16	X	43.0	None	70		**Poorly-Graded Sand (SP)** Reddish yellow (5YR 6/6) very fine to fine sand, few silt; medium dense; wet.
16–18						Bottom of boring at 16 feet bgs. Stainless steel screen point sampler set at 16 - 20 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-67(022416) Duplicate groundwater sample collected. Duplicate ID = WRCDP-DUPE1(022416)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-68

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 24, 2016

Surface Elevation (feet amsl*): 852

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0-2		10.3	None	88	GW / ML	**Well-Graded Gravel (GW)** Gravel ground cover. **Silt (ML)** Strong brown (7.5YR 4/6) silt with 1% black mottling, few clay; cohesive; non-plastic; stiff; moist.
2-4		10.5	None	88	ML	
4-6		15.6	None	88	ML / CL	**Lean Clay (CL)** Dark grayish brown (10YR 4/2) clay with 5% reddish brown mottling, few silt; cohesive; medium plasticity; medium stiff; moist.
6-8		16.2	None	88	CL	
8-10		20.2	None	88	CL	
10-12		23.6	None	88	CL	Yellowish red (5YR 5/6) at 10 feet bgs.
12-14		20.3	None	75	SM	**Silty Sand (SM)** Yellowish red (5YR 4/6) silty fine to medium sand; dense; moist becoming wet at 12 feet bgs. Very fine to fine sand from 12 - 14 feet bgs.
14-16		19.6	None	75	SP-SM	**Poorly-Graded Sand with Silt (SP-SM)** Yellowish red (5YR 4/6) fine to medium sand with silt; dense; wet.
16-18						Bottom of boring at 16 feet bgs. Temporary screen set at 7 - 12 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-68(022416)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SE-DP-69

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 26, 2016

Surface Elevation (feet amsl*): 852
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0-2	X	17.4	None	90	Silt	***Silt (ML)*** Brown (7.5YR 4/2) silt, few clay; cohesive; non-plastic; stiff; moist.
2-4	X	20.2	None	90	Silt	
4-6	X	21.6	None	95	Silt	Very stiff with 5% grayish brown mottling from 4 - 8 feet bgs.
6-8	X	22.5	None	95	Silt	
8-10	X	19.7	None	50	Silty Sand	***Silty Sand (SM)*** Light brown (7.5YR 6/4) silty fine to very fine sand; loose; moist becoming wet at 9 feet bgs. ▼
10-12	X	22.3	None	50	Silty Sand	
12-18						Bottom of boring at 12 feet bgs. Stainless steel screen point sampler set at 12 - 16 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-69(022616)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-60

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 856
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	PID/OVM (ppm)	UV Test	% Recovery	Description
0–2	16.6	None	50	Ground Surface **Clayey Gravel (GC)** Coarse gravel with clay (fill). **Silt (ML)** Yellowish red (5YR 4/6) silt, trace clay; non-cohesive; non-plastic; soft; dry.
2–4	20.7	None	50	Color transitions to dark yellowish brown (10YR 4/4) at 4 feet bgs.
4–6	13.6	None	25	
6–8	13.6	None	25	
8–10	12.2	None	100	**Silt (ML)** Very dark grayish brown (10YR 3/2) silt, few clay; cohesive; low plasticity; medium stiff; moist.
10–12	14.4	None	100	**Lean Clay (CL)** Dark grayish brown (10YR 4/2) clay, few silt; cohesive; medium plasticity; soft; moist.
12–14	15.7	None	75	
14–16	15.4	None	75	**Clayey Sand (SC)** Very dark grayish brown (10YR 3/2) clayey very fine to fine sand; dense; wet.
16–18	19.5	None	90	

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-60

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 25, 2016

Surface Elevation (feet amsl*): 856
Total Depth (feet bgs*): 20
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
		18.9	None	90		
20						Bottom of boring at 20 feet bgs. Stainless steel screen point sampler set at 16 - 20 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-60(022516)
22						
24						
26						
28						
30						
32						
34						
36						

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-61

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 24, 2016

Surface Elevation (feet amsl*): 857

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Description
0					Ground Surface
0–2		34.3	None	100	***Clayey Gravel (GC)*** Dark gray clayey coarse gravel (fill). / ***Silt (ML)*** Brown (10YR 4/3) silt, few clay; non-cohesive; non-plastic; medium stiff; lightly moist.
2–4		30.3	None	100	
4–6		36.2	None	90	***Silt (ML)*** Strong brown (7.5YR 4/6) silt, little clay; non-cohesive; non-plastic; stiff; lightly moist.
6–8		18.3	None	90	
8–10		24.7	None	75	Trace to few very fine sand from 8 - 9.5 feet bgs.
10–12		25.8	None	75	***Silty Sand (SM)*** Strong brown very fine to fine sand, some silt and clay; medium dense; moist becoming wet at 10 feet bgs.
12–14		31.8	None	63	Color transitions to red (2.5YR 4/8) at 12 feet bgs.
14–16		32.0	None	63	
16–18					Bottom of boring at 16 feet bgs. Stainless steel screen point sampler set at 15 - 19 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-61(022416)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-70

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 29, 2016

Surface Elevation (feet amsl*): 850

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		32.8	None	50		***Fat Clay (CH)*** Brown (10YR 5/3) clay with roots, few silt; cohesive; high plasticity; very soft; moist. Wet from 1 - 1.5 feet bgs.
2–4		33.1	None	50		
4–6		32.6	None	75		***Lean Clay (CL)*** Gray (5Y 5/1) clay with 1% black and yellowish brown mottling, few silt; cohesive; medium plasticity; stiff; moist; petroleum-type odor. Silt content increasing with depth.
6–8		391.2	Negative	75		Very stiff at 6 feet bgs. Greenish gray (Gley1 5/5GY) at 8 feet bgs.
8–10		831.7	Negative	100		
10–12		110.8	Negative	100		Clay with some very fine sand from 11.8 - 12.4 feet bgs.
12–14		323.7	Negative	70		***Silty Sand (SM)*** Gray (10YR 5/1) silty very fine sand; dense; wet.
14–16		34.3	Negative	70		***Well-Graded Sand (SW)*** Pinkish gray (7.5YR 6/2) very fine to medium sand, trace fines; loose to medium dense; wet. Strong brown (7.5YR 5/6) at 13.8 feet bgs.
16–18						Bottom of boring at 16 feet bgs. Temporary screen set at 7.5 - 12.5 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-70(022916)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-71

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 832

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
Ground Surface						
0 - 2	X	0.4	None	90		***Silt (ML)*** Very dark grayish brown (10YR 3/2) silt, few clay; stiff becoming soft; almost dry. Color transitions to reddish brown (5YR 4/4) at 1 foot bgs. Few very fine sand from 2 - 3 feet bgs.
2 - 4	X	0.0	None	90		***Sandy Silt (ML)*** Yellowish red (5YR 4/6) sandy silt; non-cohesive; non-plastic; medium stiff; almost dry becoming moist at 4 feet bgs.
4 - 6	X	0.0	None	70		
6 - 8	X	0.0	None	70		Becomes wet at 8 feet bgs.
8 - 10	X	0.7	None	75		***Silty Sand (SM)*** Red (2.5YR 4/6) very fine to medium sand with 1% very dark brown mottling, little silt and clay; medium dense; wet.
10 - 12	X	0.7	None	75		
12 - 18						Bottom of boring at 12 feet bgs. Temporary screen set at 9 - 14 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-71(040116)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-72

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 838
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	PID/OVM (ppm)	UV Test	% Recovery	Description
				Ground Surface
0–2	0.2	None	80	***Silt (ML)*** Brown (7.5YR 4/3) silt, few clay; non-cohesive; non-plastic; medium stiff; dry.
2–4	0.6	None	80	Color transitions to yellowish red (5YR 4/6) at 2.5 feet bgs.
4–8	0.3	None	30	***Poorly-Graded Sand with Silt (SP-SM)*** Brown (10YR 5/3) very fine sand, few fines; loose; moist becoming wet at 8 feet bgs.
8–10	0.8	None	75	
10–12	1.2	None	75	***Silty Sand (SM)*** Red (2.5YR 4/6) very fine sand, little becoming some fines; medium dense; wet.

Bottom of boring at 12 feet bgs.
Temporary screen set at 9.5 - 14.5 feet bgs.
Groundwater sample collected for analysis of BTEX, GRO, and DRO.
Sample ID = WRCDP-72(040116)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-73

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 841
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

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Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	3.4	None	80		***Silt (ML)*** Very dark grayish brown (10YR 3/2) silt, few clay; cohesive; non-plastic; stiff; dry. ***Lean Clay (CL)*** Brown (7.5YR 4/3) clay, little silt; cohesive; medium plasticity; medium stiff; moist.
2–4	X	1.4	None	80		
4–6	X	0.6	None	75		Becomes very stiff and dry at 4 feet bgs becoming medium stiff and moist with depth. 25% dark brown, 25% reddish brown, and 1% black mottling from 4 - 8 feet bgs.
6–8	X	0.9	None	75		Few very fine sand from 7 - 8 feet bgs.
8–10	X	1.0	None	75		***Lean Clay with Sand (CL)*** Brown (7.5YR 4/3) clay with 25% reddish brown mottling, little very fine sand, little silt; cohesive; medium plasticity; moist becoming wet at 9 feet bgs.
10–12	X	1.1	None	75		***Well-Graded Sand with Silt (SW-SM)*** Strong brown (7.5YR 5/6) very fine to medium sand, few silt and clay; medium dense; wet.
12						Bottom of boring at 12 feet bgs.

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-74

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 28, 2016

Surface Elevation (feet amsl*): 844

Total Depth (feet bgs*): 8

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	23.0	None	40		**Silt (ML)** Reddish brown (5YR 4/4) silt, few clay, roots present; cohesive; non-plastic; stiff; moist.
2–4	X	23.1	None	40		
4–6	X	24.0	None	75		**Silty Sand (SM)** Reddish brown (5YR 4/4) silty very fine sand, few clay; low density; moist becoming wet at 4 feet bgs.
6–8	X	19.3	None	75		Sand coarsens downward becoming very fine to medium sand with little silt and clay at 7 feet bgs.
8						Bottom of boring at 8 feet bgs. Temporary screen set at 3 - 8 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-74(022816)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-75

Project: Interior Delineation	**Surface Elevation (feet amsl*):** 851
Project No.: 31400030	**Total Depth (feet bgs*):** 4
Location: Wynnewood, OK	**Borehole Diameter (inches):** 2
Completion Date: February 28, 2016	**amsl = above mean sea level* *bgs = below ground surface*

PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0–2	X	24.3	None	90		***Silt (ML)*** Dark brown (7.5YR 3/4) silt, few clay; cohesive; non-plastic; medium stiff; moist.
2–4	X	24.1	None	90		***Sandy Silt (ML)*** Dark brown sandy silt; cohesive; non-plastic; medium stiff; wet.
						Silty Sand (SM) Reddish brown (5YR 4/4) silty very fine to fine sand, little clay; dense; wet.
						Bottom of boring at 4 feet bgs. Temporary screen set at 3 - 8 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-75(022816)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews	**WSP | Parsons Brinckerhoff**
Subcontractor: Detech	123 N 3rd Street, Suite 507
Driller/Operator: John McClure	Minneapolis, MN 55401
Method: Direct Push	(612)343-0510

Boring Log: SW-DP-76

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 27, 2016

Surface Elevation (feet amsl*): 833
Total Depth (feet bgs*): 8
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP
PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0–2	X	20.5	Negative	75		***Silt (ML)*** Dark brown (7.5YR 3/2) silt, some clay, organics present; cohesive; medium plasticity; soft; moist.
2–4	X	28.6	Positive (very faint)	75		***Silt (ML)*** Very dark grayish brown (10YR 3/2) silt with 15% reddish brown mottling, few clay; cohesive; non-plastic; stiff; moist becoming wet at 4 feet bgs. Petroleum odor from 4 - 4.5 feet bgs. Color is dark gray (10YR 4/1) at 4 feet bgs.
4–6	X	1,111	Positive	75		***Well-Graded Sand (SW)*** Gray (10YR 5/1) very fine to medium sand, few silt and clay; dense; wet; petroleum-type odor. Dark reddish brown product visible from 4.5 - 5 feet bgs.
6–8	X	49.0	Positive (faint)	75		
8						Bottom of boring at 8 feet bgs. Temporary screen set at 3 - 8 feet bgs. No LNAPL accumulated over 24-hour period. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-76(022816)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-77

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 26, 2016

Surface Elevation (feet amsl*): 843

Total Depth (feet bgs*): 7

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		30.6	None	100		***Silty Sand (SM)*** Dark brown (7.5YR 4/3) silty very fine to fine sand, little clay; loose; wet. Trace gravel and trace organics from 0 - 0.5 foot bgs.
2–4		23.9	None	100		***Sandy Silt (ML)*** Dark brown sandy silt, little clay; cohesive; low plasticity; soft; wet. Color is very dark brown (10YR 2/2) at 3.5 feet bgs.
4–6		23.6	None	100		***Silty Sand (SM)*** Very dark grayish brown (10YR 3/2) silty very fine to fine sand; medium dense; wet. Color is brown (10YR 4/3) at 6 feet bgs.
6–7		21.7	None	100		
7–18						Bottom of boring at 7 feet bgs. Temporary screen set at 2 - 7 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-77(022616)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: SW-DP-78

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 26, 2016

Surface Elevation (feet amsl*): 852

Total Depth (feet bgs*): 5

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
0						Ground Surface
0 - 2		184.0	Negative	100		**Silty Sand (SM)** Dark brown (7.5YR 4/3) silty sand; loose; moist. Few organics from 0 - 0.5 foot bgs.
2 - 4		1,212	Positive (very faint)	100		**Silty Sand (SM)** Dark brown fine to very fine sand, little silt; loose; moist becoming wet at 3.25 feet bgs. Petroleum-type odor from 2 - 4 feet bgs. Few silt from 3.5 - 4 feet bgs.
4 - 5		1,282	Positive (faint)	100		**Silty Sand (SM)** Dark grayish brown (10YR 3/2) silty very fine to fine sand with 40% yellowish brown (10YR 4/6) mottling; medium dense; wet. Petroleum-type odor.

Bottom of boring at 5 feet bgs.
Temporary screen set at 0 - 5 feet bgs.
No LNAPL accumulated over 24-hour period.
Groundwater sample collected for analysis of BTEX, GRO, and DRO.
Sample ID = WRCDP-78(022716)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: N/A
Driller/Operator: Kevin P. Walter
Method: Hand Auger

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Boring Log: SW-DP-79

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 27, 2016

Surface Elevation (feet amsl*): 844

Total Depth (feet bgs*): 8

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	36.6	None	90		**Topsoil** Dark brown topsoil with organics.
2–4	X	62.6	None	90		**Silt (ML)** Brown (10YR 5/3) silt with 10% reddish brown mottling, few clay; cohesive; non-plastic; medium stiff; moist.
4–5	X	263.6	Negative	75		
5–6	X	518.4	Negative	75		**Silty Sand (SM)** Dark gray (10YR 4/1) silty very fine to fine sand; medium dense; wet; petroleum-type odor. Black staining from 5 - 5.5 feet bgs.
6–8	X	1,234	Negative	75		
8						Bottom of boring at 8 feet bgs.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-80

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: April 1, 2016

Surface Elevation (feet amsl*): 850

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0–2		0.0	None	75		***Silt (ML)*** Dark brown (7.5YR 3/3) silt, few clay; cohesive; non-plastic; soft; dry.
2–4		0.0	None	75		***Fat Clay (CH)*** Reddish brown (5YR 4/4) clay, few silt; cohesive; high plasticity; medium stiff; moist. Becomes stiff at 4 feet bgs.
4–8		0.0	None	30		***Sandy Lean Clay (CL)*** Brown (7.5YR 5/3) sandy clay, very fine sand; cohesive; medium plasticity; stiff; moist; sticky. Clay plugged up 4 - 8 foot sampler. 10% strong brown (7.5YR 5/8) mottling at 8 feet bgs.
8–12		0.0	None	40		
12–14		0.0	None	100		***Silty Sand (SM)*** Red (2.5YR 4/6) silty very fine sand; dense; moist becoming wet at 14 feet bgs.
14–16		0.0	None	100		***Silty Sand (SM)*** Yellowish red (5YR 5/6) very fine to medium sand, little silt and clay; medium dense; wet.
16–18						Bottom of boring at 16 feet bgs. Temporary screen set at 9 - 14 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-80(040116)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-81

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 27, 2016

Surface Elevation (feet amsl*): 833
Total Depth (feet bgs*): 8
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	26.3	None	60		***Fat Clay (CH)*** Black (10YR 2/1) clay, few silt and sand, organics (roots) present; cohesive; high plasticity; medium stiff; moist becoming wet at 4 feet bgs.
2–4	X	32.7	None	60		
4–6	X	34.0	None	50		Color becomes dark gray (10YR 4/1) at 5 feet bgs.
6–8	X	37.7	None	50		***Silty Sand (SM)*** Dark gray (10YR 4/1) very fine to coarse sand, little silt and clay; dense; wet; very faint petroleum-type odor.
8						Bottom of boring at 8 feet bgs. Temporary screen set at 7 - 12 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-81(022716) Duplicate groundwater sample collected. Duplicate ID = WRCDP-DUPE2(022716)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-82

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 27, 2016

Surface Elevation (feet amsl*): 842
Total Depth (feet bgs*): 8
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
0						Ground Surface
0 - 0.8	0 - 4	53.2	None	38		**Topsoil** Dark brown topsoil with organics; soft.
0.8 - 4.5						**Silt (ML)** Yellowish red (5YR 4/6) silt with 10% dark brown mottling, few clay, few very fine sand; non-cohesive; non-plastic; soft; moist.
4.5 - 8	4 - 6	1,073	Negative	75		**Well-Graded Sand with Silt (SW-SM)** Dark grayish brown (10YR 4/2) very fine to medium sand, few silt and clay; wet. Very dark gray (10YR 3/1) staining at 6 - 6.5 feet bgs and 7.5 - 8 feet bgs.
	6 - 8	1,036	Negative	75		
8						Bottom of boring at 8 feet bgs.

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-83

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 849

Total Depth (feet bgs*): 16

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		0.7	None	90		**Silt (ML)** Very dark grayish brown (10YR 3/2) silt, few becoming little clay; cohesive; non-plastic; moist. Color transitions to brown (7.5YR 4/3) at 1 foot bgs.
2–4		0.7	None	90		10% reddish brown mottling at 2 feet bgs.
4–6		1.1	None	90		**Silt (ML)** Brown (7.5YR 4/3) silt with 10% reddish brown mottling, little becoming some clay; cohesive; medium plasticity; stiff; moist.
6–8		1.1	None	90		**Sandy Lean Clay (CL)** Light brown (7.5YR 6/3) sandy clay with 5% brown mottling, very fine sand; moist.
8–10		1.0	None	75		Transitions to clayey sand starting at 10 feet bgs.
10–12		0.8	None	75		**Silty Sand (SM)** Brown (7.5YR 5/4) very fine to medium sand, little silt and clay; medium dense; moist becoming wet at 11 feet bgs.
12–14		0.6	None	70		Color transitions to red (2.5YR 4/6) at 11.8 feet bgs.
14–16		0.9	None	70		**Well-Graded Sand with Silt (SW-SM)** Red (2.5YR 4/6) fine to coarse sand, few fines; medium dense; wet.
16–18						Bottom of boring at 16 feet bgs. Temporary screen set at 9 - 14 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-83(033116)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-84

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 27, 2016

Surface Elevation (feet amsl*): 855

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0-2	X	28.8	None	95	Silt	***Silt (ML)*** Reddish brown (5YR 4/4) silt with clay, organics (roots) present; cohesive; medium plasticity; medium stiff; moist.
2-4	X	29.4	None	95	Silt	▼
4-6	X	28.4	None	100	Silt	Stiff with 1% dark brown mottling at 4 feet bgs.
6-8	X	29.0	None	100	Silt	
8-10	X	23.1	None	100	Sand	***Well-Graded Sand (SW)*** Reddish brown very fine to very coarse sand, trace fine gravel, trace silt and clay; dense; wet. Very fine to fine sand with some silt and clay from 7.8 - 8 feet bgs.
10-12	X	29.4	None	100	Sand	
12						Bottom of boring at 12 feet bgs. Temporary screen set at 7 - 12 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-84(022716)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

WSP | Parsons Brinckerhoff
123 N 3rd Street, Suite 507
Minneapolis, MN 55401
(612)343-0510

Boring Log: SW-DP-85

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 856

Total Depth (feet bgs*): 8

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

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Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Description
0					Ground Surface
0–2	X	0.0	None	75	***Silt (ML)*** Dark brown (7.5YR 3/2) silt, few clay; non-cohesive; non-plastic; soft; moist to dry.
2–4	X	0.0	None	75	***Lean Clay (CL)*** Brown (7.5YR 4/3) clay with 10% red (2.5YR 4/6) mottling, few silt; cohesive; low plasticity; soft; moist.
4–6	X	0.0	None	60	***Fat Clay with Sand (CH)*** Brown (7.5YR 4/3) clay with 10% red (2.5YR 4/6) mottling, few silt; cohesive; high plasticity; medium stiff; moist. Little very fine sand starting at 3.6 feet bgs.
6–8	X	0.0	None	60	***Poorly-Graded Sand with Silt (SP-SM)*** Brown (7.5YR 5/3) very fine to fine sand, few silt and clay; medium dense; wet.

Bottom of boring at 8 feet bgs.
Temporary screen set at 6 - 11 feet bgs.
Groundwater sample collected for analysis of BTEX, GRO, and DRO.
Sample ID = WRCDP-85(033116)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

WSP | Parsons Brinckerhoff
123 N 3rd Street, Suite 507
Minneapolis, MN 55401
(612)343-0510

Boring Log: SW-DP-86

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: March 31, 2016

Surface Elevation (feet amsl*): 844

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	1.0	None	75	Silt (ML)	***Silt (ML)*** Dark brown (7.5YR 3/3) silt, few clay; cohesive; non-plastic; medium stiff; moist. Color transitions to brown (7.5YR 5/4) at 1 foot bgs.
2–4	X	1.6	None	75	Silt (ML)	Clay increasing to some clay at 3.5 feet bgs.
4–6	X	2.0	None	100	Silt (ML)	10% reddish brown mottling at 4 feet bgs.
6–8	X	354.7	Positive (faint)	100	Silt (ML)	Few sand from 6.5 - 7.5 feet bgs. ▼
8–10	X	2,879	Positive	80	Fat Clay (CH) / Clayey Sand (SC)	***Fat Clay (CH)*** Dark gray (10YR 4/1) clay with 25% black mottling; cohesive; high plasticity; moist; faint odor. ***Clayey Sand (SC)*** Grayish brown (10YR 5/2) clayey very fine sand with 25% dark gray mottling; dense; wet; odor present.
10–12	X	2,037	Positive	80	Silt (ML) / Silty Sand (SM)	***Silt (ML)*** Grayish brown (10YR 5/2) silt with 25% reddish brown mottling, little clay; cohesive; non-plastic; stiff to very stiff; moist. ***Silty Sand (SM)*** Brown (7.5YR 4/4) silty very fine sand with 10% dark gray mottling; dense; moist to wet.
12–18						Bottom of boring at 12 feet bgs. Temporary screen set at 8 - 13 feet bgs. No LNAPL accumulated over 24-hour period. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-86(040116)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

WSP | Parsons Brinckerhoff
123 N 3rd Street, Suite 507
Minneapolis, MN 55401
(612)343-0510

Boring Log: SW-DP-87

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: February 29, 2016

Surface Elevation (feet amsl*): 854

Total Depth (feet bgs*): 12

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0 - 2		25.1	None	95		***Silt (ML)*** Dark brown (7.5YR 3/2) silt, few clay, trace becoming few fine sand, organics (roots); cohesive; non-plastic; medium stiff; moist.
2 - 4		29.7	None	95		Yellowish red (5YR 4/6) from 2.5 - 4.5 feet bgs. Little very fine sand from 4 - 4.5 feet bgs.
4 - 6		32.7	None	75		***Silty Sand (SM)*** Yellowish red (5YR 4/6) silty very fine to fine sand; medium dense becoming loose; wet.
6 - 8		33.1	None	75		***Sandy Lean Clay (CL)*** Grayish brown (10YR 5/2) sandy clay with 25% reddish brown mottling, very fine sand; cohesive; medium plasticity; stiff; moist.
8 - 10		29.5	None	70		***Silty Sand (SM)*** Yellowish red (5YR 5/6) fine to medium sand, little silt and clay; medium dense becoming dense; wet.
10 - 12		32.2	None	70		
12 - 18						Bottom of boring at 12 feet bgs. Temporary screen set at 9 - 14 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-87(022916)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Minneapolis, MN 55401
(612)343-0510

Boring Log: SW-DP-88

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 29, 2016

Surface Elevation (feet amsl*): 844
Total Depth (feet bgs*): 8
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0 - 2	X	25.2	None	95	SM	***Silty Sand (SM)*** Dark brown (7.5YR 3/4) very fine sand, some silt and clay; medium dense; dry becoming moist. Sandy silt from 2 - 2.5 feet bgs.
2 - 4	X	27.4	None	95	ML	***Silt (ML)*** Dark brown (7.5YR 3/4) silt, few fine sand; cohesive; non-plastic; medium stiff; moist.
4 - 6	X	29.2	None	90	ML	***Sandy Silt (ML)*** Dark brown sandy silt, very fine to fine sand; non-plastic; moist. ▼
6 - 8	X	16.7	None	90	SM	***Silty Sand (SM)*** Yellowish red (5YR 4/6) silty very fine sand; medium dense; wet. Sand is very fine- to medium-grained from 7 - 8 feet bgs.
8 - 18						Bottom of boring at 8 feet bgs. Temporary screen set at 8 - 13 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-88(022916)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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123 N 3rd Street, Suite 507
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(612)343-0510

Boring Log: SW-DP-107

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: April 2, 2016

Surface Elevation (feet amsl*): 853
Total Depth (feet bgs*): 8
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2		0.3	None	80		***Silt (ML)*** Dark brown (7.5YR 3/4) silt, few clay; cohesive; non-plastic; hard; dry.
2–4		0.4	None	80		***Silty Sand (SM)*** Red (2.5YR 4/6) very fine to fine sand, some silt and clay; medium dense; moist becoming wet at 3 feet bgs.
4–6		0.2	None	75		
6–8		0.2	None	75		Medium plasticity clay with silt lens from 6 - 7.3 feet bgs.
8						Bottom of boring at 8 feet bgs. Temporary screen set at 7 - 12 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-107(040216)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Minneapolis, MN 55401
(612)343-0510

Boring Log: SW-DP-108

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: April 2, 2016

Surface Elevation (feet amsl*): 845
Total Depth (feet bgs*): 8
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP | PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0–2	X	0.1	None	90		***Silt (ML)*** Reddish brown (5YR 4/4) silt, some clay; cohesive; medium plasticity; stiff; dry becoming moist at 2 feet bgs.
2–4	X	1.0	None	90		Becomes medium stiff at 2 feet bgs.
4–8	X	0.4	None	30		Becomes very soft and wet at 6 feet bgs.
						Silty Sand (SM) Yellowish red (5YR 4/6) very fine to fine sand, some silt and clay; medium dense; wet.
8						Bottom of boring at 8 feet bgs. Temporary screen set at 7 - 12 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-108(040216)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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Boring Log: SW-DP-109

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: February 27, 2016

Surface Elevation (feet amsl*): 855
Total Depth (feet bgs*): 8
Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP
PARSONS BRINCKERHOFF

Depth (feet bgs)	Sample/Interval	PID/OVM (ppm)	UV Test	% Recovery	Lithology	Description
						Ground Surface
0 - 2	X	40.0	None	100		**Silt (ML)** Brown (7.5YR 4/4) clayey silt, little organics; cohesive; low plasticity; soft; moist.
2 - 4	X	46.8	None	100		**Silt (ML)** Yellowish brown (10YR 5/4) silt, little clay; cohesive; low plasticity; soft; moist. Few organics to 2.5 feet bgs, then trace organics from 2.5 - 6 feet bgs. Medium stiff at 3 feet bgs. 30% strong brown (7.5YR 5/8) mottling from 3 - 6 feet bgs. Stiff at 4 feet bgs.
4 - 6	X	46.3	None	100		
6 - 8	X	46.3	None	100		**Silt (ML)** Light olive gray (5Y 6/2) silt, few clay, few sand; cohesive; low plasticity; stiff; moist. Sandy silt from 7 - 7.5 feet bgs.
8						**Poorly-Graded Sand (SP)** Brown (10YR 5/3) very fine to fine sand, few fines; loose; wet.
						Bottom of boring at 8 feet bgs. Temporary screen set at 4 - 9 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-109(022716)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Kevin P. Walter
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

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123 N 3rd Street, Suite 507
Minneapolis, MN 55401
(612)343-0510

Boring Log: SW-DP-112

Project: Interior Delineation

Project No.: 31400030

Location: Wynnewood, OK

Completion Date: April 2, 2016

Surface Elevation (feet amsl*): 840

Total Depth (feet bgs*): 8

Borehole Diameter (inches): 2

*amsl = above mean sea level
bgs = below ground surface

WSP
PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0–2	X	0.6	None	60		***Silt (ML)*** Reddish brown (5YR 4/4) silt, some clay; cohesive; medium plasticity; medium stiff; dry becoming moist; roots present.
2–4	X	0.6	None	60		
4–6	X	0.2	None	50		***Clayey Sand (SC)*** Yellowish red (5YR 4/6) clayey very fine sand with 1% very dark gray mottling; loose; wet.
6–8	X	0.3	None	50		
8						Bottom of boring at 8 feet bgs. Temporary screen set at 4.5 - 9.5 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-112(040216)

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

WSP | Parsons Brinckerhoff
123 N 3rd Street, Suite 507
Minneapolis, MN 55401
(612)343-0510

Boring Log: SW-DP-113

Project: Interior Delineation
Project No.: 31400030
Location: Wynnewood, OK
Completion Date: April 2, 2016

Surface Elevation (feet amsl*): 834
Total Depth (feet bgs*): 12
Borehole Diameter (inches): 2

**amsl = above mean sea level*
bgs = below ground surface

WSP PARSONS BRINCKERHOFF

Sample Data					Subsurface Profile	
Depth (feet bgs)	**Sample/Interval**	**PID/OVM (ppm)**	**UV Test**	**% Recovery**	**Lithology**	**Description**
						Ground Surface
0–2		0.5	None	75		***Fat Clay (CH)*** Black (5YR 2.5/1) clay; cohesive; high plasticity; soft; moist.
2–4		0.6	None	75		Color transitions to dark reddish brown (5YR 3/2) at 3 feet bgs.
4–6		0.6	None	100		***Silt (ML)*** Red (2.5YR 5/8) silt with 5% dark gray and 5% light gray mottling, some clay; cohesive; medium plasticity; medium stiff; moist.
6–8		0.5	None	100		***Sandy Fat Clay (CH)*** Reddish brown (5YR 4/4) sandy clay; cohesive; high plasticity; medium stiff; moist becoming wet at 8.5 feet bgs. 10% light gray mottling from 6.5 - 8 feet bgs.
8–10		0.2	None	70		Soft at 8.5 feet bgs.
10–12		0.1	None	70		Stiff at 11.3 feet bgs.
12						***Silty Sand (SM)*** Pink (7.5YR 7/3) fine to very coarse sand, some silt and clay; loose; wet.
						Bottom of boring at 12 feet bgs. Temporary screen set at 10 - 15 feet bgs. Groundwater sample collected for analysis of BTEX, GRO, and DRO. Sample ID = WRCDP-113(040216)

Geologist(s): Judy L. Andrews
Subcontractor: Detech
Driller/Operator: John McClure
Method: Direct Push

WSP | Parsons Brinckerhoff
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Minneapolis, MN 55401
(612)343-0510

Appendix B – Summary of Site-Wide Comprehensive Groundwater Sampling Event

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

		Regulatory Screening Criteria				Product Loading Facility and Western Boundary Monitoring Wells					
		EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Monitoring Well	BMW-2	BMW-4	BMW-5	BMW-8	BMW-10	BMW-11
					Sample ID	WRCBMW-2(091515)	WRCBMW-4(091615)	WRCBMW-5(091615)	WRCBMW-8(091515)	WRCBMW-10(091515)	WRCBMW-11(091515)
					Laboratory ID	15091248	15091249	15091253	15091247	15091280	15091279
Constituent					Sample Date	09/15/15	09/16/15	09/16/15	09/15/15	09/15/15	09/15/15
TPH (Oklahoma Methods)	**CAS Number**				**Units**						
Gasoline Range Organics		NE	NE	1,000	µg/l	**1,160**	**117**	**23,100**	**972**	**18,600**	**2,080**
Diesel Range Organics		NE	NE	1,000	µg/l	**900**	**770**	**5,700**	**1,500**	**22,000**	**2,000**
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<100	<10	<2,000	<100	<200	<200
Benzene	71-43-2	5	0.46	NE	µg/l	**38**	<0.5	**3,640**	**29**	**1,280**	**360**
2-Butanone	78-93-3	NE	560	NE	µg/l	<100	<10	<2,000	<100	<200	<200
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<8 M	<0.5	<100	<8 M	<90 M	<20 M
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<5	<0.5	<100	<5	<10	<10
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<5	<0.5	<100	<5	<10	<10
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<10	<1.0	<200	<10	<20	<20
Chloroform	67-66-3	80	0.22	NE	µg/l	<5	<0.5	<100	<5	<10	<10
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<50	<5.0	<1,000	<50	<260 M	<100
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5	<0.5	<100	<5	<10	<10
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	**27**	<0.5	**1,100**	**20**	**290**	**110**
Hexane	110-54-3	NE	32	NE	µg/l	**12**	<1.0	**210**	<10	**63**	<20
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<5	<0.5	<100	<5	**20**	<10
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<5	<0.5	<100	<5	<10	<10
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<50	<5.0	<1,000	<50	<100	<100
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	**94**	**164**	**4,730**	**215**	**546**	**412**
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	**8**	<0.5	**100**	**11**	**58**	**25**
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<5	<0.5	<100	<5	<10	<10
Toluene	108-88-3	1,000	110	NE	µg/l	**53**	<0.5	**1,700**	<5	**1,030**	**10**
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	**75**	<0.5	**760**	<5	**1,030**	**34**
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	**20**	<0.5	**200**	<5	**224**	<10
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	**217**	<1.0	**2,910**	<10	**2,380**	**84**
o-Xylene	95-47-6	NE	19	NE	µg/l	**90**	<0.5	**740**	<5	**947**	<10
Xylenes, calculated total (b)		10,000	19	NE	µg/l	**307**	<1.5	**3,650**	<15	**3,327**	<94
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 SR	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10 MP	**50**	<10	**610**	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0	**125**	<5.0	**152**	**15.4**
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	**32.9**	<5.0	**191**	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 SR	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	**38**	<5	**671**	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	**238**	**5.7**	**338**	**35.1**
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5	<5 SR	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	**22**	<5	**191**	**9**
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	<0.005	**0.024**	**0.007**	<0.005	**0.059**	**0.025**
Barium	7440-39-3	2	0.38	NE	mg/l	**0.201**	**0.108**	**0.183**	**0.696**	**0.326**	**0.963**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	**0.002**	<0.001	**0.013**	**0.015**	**0.254**	<0.001
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	<0.005	**0.006**	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

Constituent	CAS Number	EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Units	BMW-13	BMW-13	BMW-14	BMW-15	BMW-19	BMW-20A	BMW-22
		Regulatory Screening Criteria			Monitoring Well	Product Loading Facility and Western Boundary Monitoring Wells						
					Sample ID	WRCBMW-13(091515)	WRCDUP4	WRCBMW-14(091515)	WRCBMW-15(091515)	WRCBMW-19(091115)	WRCBMW-20A(091615)	WRCBMW-22(091515)
					Laboratory ID	15091276	15091277	15091246	15091245	15090843	15091250	15091256
					Sample Date	09/15/15	09/15/15	09/15/15	09/15/15	09/11/15	09/16/15	09/15/15
TPH (Oklahoma Methods)												
Gasoline Range Organics		NE	NE	1,000	µg/l	**1,450**	**1,390**	**50**	**244**	<20	**106**	**18,500**
Diesel Range Organics		NE	NE	1,000	µg/l	**1,300**	**1,100**	**870**	**1,300**	**890**	**280**	**12,000**
Volatile Organics (EPA Method 8260) (a)												
Acetone	67-64-1	NE	1,400	NE	µg/l	<200	<200	<10	<50	<10	<10	<1,000
Benzene	71-43-2	5	0.46	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	**2,210**
2-Butanone	78-93-3	NE	560	NE	µg/l	<200	<200	<10	<50	<10	<10	<1,000
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	<60 M
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	<50
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	<50
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<20	<20	<1.0	<5.0	<1.0	<1.0	<100
Chloroform	67-66-3	80	0.22	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	<50
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<100	<100	<5.0	<25	<5.0	<5.0	<500
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	<50
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	**210**
Hexane	110-54-3	NE	32	NE	µg/l	<20	<20	<1.0	<5.0	<1.0	<1.0	<100
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	<50
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	<50
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<100	<100	<5.0	<25	<5.0	<5.0	<500
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	**1,730**	**1,800**	**58.2**	**293**	**3.5**	**139**	**10,500**
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	**60**
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	<50
Toluene	108-88-3	1,000	110	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	**140**
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	**520**
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	**130**
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<20	<20	<1.0	<5.0	<1.0	<1.0	**1,560**
o-Xylene	95-47-6	NE	19	NE	µg/l	<10	<10	<0.5	<3	<0.5	<0.5	**400**
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<30	<30	<1.5	<8.0	<1.5	<1.5	**1,960**
Semi-Volatile Organics (EPA Method 8270C)												
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 QC	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10	<10	<10	<10 QC	<10	**260**
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 QC	<5.0	**92.5**
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 QC	<5.0	**60.6**
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 QC	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	<5	<5	<5 QC	<5	**57**
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 QC	<5.0	**150**
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5	<5 QC	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	<5	<5	<5 QC	<5	**25**
Metals (EPA Methods 6020A and 7470A)												
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	**0.011**	**0.014**	<0.005	<0.005	<0.005	<0.005	**0.042**
Barium	7440-39-3	2	0.38	NE	mg/l	**0.136**	**0.136**	**0.055**	**0.087**	**0.139**	**0.200**	**0.247**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.032**
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

Constituent	CAS Number	Regulatory Screening Criteria: EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Units	Product Loading Facility and Western Boundary Monitoring Wells: BMW-25	BMW-26	BMW-27	BMW-28	S Martin Well	McLaughlin Well
					Sample ID	WRCBMW-25(091615)	WRCBMW-26(091615)	WRCBMW-27(091715)	WRCBMW-28(091715)	WRC-S Martin Well	WRC-McLaughlin Well
					Laboratory ID	15091251	15091252	15091254	15091255	15090833	15090832
					Sample Date	09/16/15	09/16/15	09/17/15	09/17/15	09/09/15	09/09/15
TPH (Oklahoma Methods)											
Gasoline Range Organics		NE	NE	1,000	µg/l	**5,960**	**17,700**	**2,970**	<20	<20	<20
Diesel Range Organics		NE	NE	1,000	µg/l	**3,700**	**4,300**	**1,500**	**820**	**810**	**140**
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<500	<2,000	<70 M	<10	<10	<10
Benzene	71-43-2	5	0.46	NE	µg/l	**1,270**	**3,970**	**64.1**	<0.5	<0.5	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<500	<2,000	<20 M,QC	<10	<10	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<50 M	<100	<30 M,QC	<0.5	<0.5	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<30	<100	**3.3**	<0.5	<0.5	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<30	<100	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<50	<200	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<30	<100	<2 M	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	**250**	<1,000	**185**	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<30	<100	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	**440**	**840**	**87.4**	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<50	**210**	**11.4**	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<30	<100	**16.4**	<0.5	<0.5	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<30	<100	**1.5**	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<250	<1,000	**65.2**	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<65 M	**1,700**	<40 M,QC	**5.2**	**1.1**	<0.5
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	**62**	<100	**49**	<0.5	<0.5	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<30	<100	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<30	**2,700**	**2.9**	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	**180**	**640**	**166**	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	**40**	**200**	**71.3**	<0.5	<0.5	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	**200**	**2,570**	**27.7**	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	**77**	**960**	**15.6**	<0.5	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	**277**	**3,530**	**43.3**	<1.5	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	**10**	<10 MP	<10	<10	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	**17.2**	**84.7**	**37.0**	<5.0	<5.0	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	**11.7**	<5.0	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	**17.2**
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	**48**	<5	<5	<5	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	**77.5**	**147**	**54.9**	<5.0	<5.0	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	**14**	<5	<5	<5	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	**0.022**	**0.061**	**0.041**	<0.005	<0.005	<0.005
Barium	7440-39-3	2	0.38	NE	mg/l	**0.571**	**0.735**	**0.339**	**0.074**	**0.096**	**0.240**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	**0.002**	**0.013**	<0.001	<0.001	<0.001	**0.002**
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

		Regulatory Screening Criteria				Refinery Interior Monitoring Wells					
		EPA Primary Drinking Water Regulations	**EPA Regional Screening Levels (Tap Water)**	**ODEQ Cleanup Levels**	**Monitoring Well**	**LMW-2-0**	**LMW-3-0**	**LMW-4-0**	**LMW-5-0**	**LMW-6-0**	**LMW-11**
					Sample ID	WRCLMW-2-0(091515)	WRCLMW-3-0(091515)	WRCLMW-4-0(091615)	WRCLMW-5-0(091515)	WRCLMW-6-0(091615)	WRCLMW-11(091615)
					Laboratory ID	15091243	15091244	15091259	15091278	15091260	15091263
Constituent					**Sample Date**	09/15/15	09/15/15	09/16/15	09/15/15	09/16/15	09/16/15
TPH (Oklahoma Methods)	**CAS Number**				**Units**						
Gasoline Range Organics		NE	NE	1,000	µg/l	<20	<20	<20	**73**	<20	**32**
Diesel Range Organics		NE	NE	1,000	µg/l	**150**	**240**	**1,500**	**19,000**	**810**	**230**
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<10	<10	<10	<10	<10	<10
Benzene	71-43-2	5	0.46	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<10	<10	<10	<10	<10	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<0.5	<0.5	<0.5	<1.0 M	<0.5	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<0.5	<0.5	<0.5	**0.6**	<0.5	**5.3**
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<0.5	<0.5	<0.5	**0.7**	<0.5	**2.3**
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 SR	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10	<10	<10	<10 SR	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 SR	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 SR	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 SR	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	<5	<5	<5 SR	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0 SR	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5	<5 SR	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	<5	<5	<5 SR	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	<0.005	<0.005	<0.005	**0.012**	<0.005	**0.015**
Barium	7440-39-3	2	0.38	NE	mg/l	**0.089**	**0.275**	**0.186**	**0.383**	**0.200**	**0.191**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001	<0.001	<0.001	<0.001	**0.005**	<0.001
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	**0.008**	<0.005	<0.005	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

Constituent	CAS Number	Regulatory Screening Criteria: EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Units	Refinery Interior Monitoring Wells: LMW-14	LRW-1-0	LRW-2-0	OMW-5	OMW-6	ORW-4
					Sample ID	WRCLMW-14(091615)	WRCLRW-1-0(091515)	WRCLRW-2-0(091615)	WRCOMW-5(092215)	WRCOMW-6(092115)	WRCORW-4(092115)
					Laboratory ID	15091262	15091257	15091261	15091441	15091435	15091434
					Sample Date	09/16/15	09/15/15	09/16/15	09/22/15	09/21/15	09/21/15
TPH (Oklahoma Methods)											
Gasoline Range Organics		NE	NE	1,000	µg/l	**1,930**	<20	**791**	**92**	**63**	<20
Diesel Range Organics		NE	NE	1,000	µg/l	**4,300**	**290**	**9,900**	**920**	**1,800**	**350**
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<200	<10	<40 M	<10	**10**	<10
Benzene	71-43-2	5	0.46	NE	µg/l	**249**	<0.5	<0.5	**1.1**	<0.5	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<200	<10	<10	<10	<10	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<20 M	<0.5	<30 M	<2 M	<1.0 M	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<10	<0.5	**15.7**	**0.6**	<0.5	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<10	<0.5	**2.8**	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<20	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<10	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<100	<5.0	**14.4 EC**	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<10	<0.5	<0.5	<0.5	<0.5	**0.6**
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<10	<0.5	<0.5	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<20	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	**10**	<0.5	**21.0**	**3.1**	<0.5	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<10	<0.5	<0.5	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<100	<5.0	**7.0**	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	**160**	<0.5	**27.5**	<0.5	**2.2**	**2.1**
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	**20**	<0.5	**7.1**	**2.8**	<0.5	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<10	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<10	<0.5	**0.6**	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<10	<0.5	**0.7**	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<10	<0.5	<0.5	<0.5	<0.5	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<20	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	<10	<0.5	**0.5**	<0.5	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<30	<1.5	<1.5	<1.5	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0 SR	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10	<10 SR	<10 QC	<10 QC	<10 QC
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	**26.6**	<5.0	**8.8**	<5.0	<5.0	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	<5.0 SR	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0 SR	<5.0	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	<5 SR	<5	<5	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	<5.0 SR	<5.0	<5.0	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5 SR	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	<5 SR	<5	<5	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	**0.024**	<0.005	**0.054**	**0.05**	**0.18**	**0.019**
Barium	7440-39-3	2	0.38	NE	mg/l	**0.431**	**0.130**	**0.376**	**0.295**	**0.457**	**0.318**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	**0.003**	<0.001	<0.001	**0.001**	**0.004**	<0.001
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	**0.006**	<0.005	<0.005	<0.005	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

		Regulatory Screening Criteria				North Boundary Monitoring Wells					
		EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Monitoring Well	UMW-1	UMW-3	UMW-4	UMW-5	UMW-6	UMW-7
					Sample ID	WRCUMW-1(091015)	WRCUMW-3(091015)	WRCUMW-4(091015)	WRCUMW-5(091015)	WRCUMW-6(091015)	WRCUMW-7(091015)
					Laboratory ID	15090839	15090837	15090835	15090836	15090838	15090834
Constituent					Sample Date	09/10/15	09/10/15	09/10/15	09/10/15	09/10/15	09/10/15
TPH (Oklahoma Methods)	**CAS Number**				**Units**						
Gasoline Range Organics		NE	NE	1,000	µg/l	<20	<20	**612**	**4,150**	**18,900**	<20
Diesel Range Organics		NE	NE	1,000	µg/l	<100	<100	**370**	**1,800**	**4,600**	<100
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<10	<10	<200	<1,000	<2,000	<10
Benzene	71-43-2	5	0.46	NE	µg/l	<0.5	<0.5	**208**	**1,440**	**6,260**	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<10	<10	<200	<1,000	<2,000	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<1.0	<1.0	<20	<100	<200	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<0.5	<0.5	<10	<50	<200 M	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<5.0	<5.0	<100	<500	<1,000	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<0.5	<0.5	<10	<50	**530**	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<1.0	<1.0	<20	<100	**310**	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<5.0	<5.0	<100	<500	<1,000	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<0.5	**0.8**	<10	<50	<100	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<0.5	<0.5	<10	<50	**1,200**	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<0.5	<0.5	<10	<50	**380**	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<0.5	<0.5	<10	<50	<100	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<1.0	<1.0	<20	<100	**1,400**	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	<0.5	<0.5	<10	<50	**430**	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<1.5	<1.5	<30	<150	**1,830**	<1.5
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0 QC	<5.0	<5.0	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10 QC	<10	<10	<10	<10	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0 QC	<5.0	<5.0	**7.8**	**86.5**	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0 QC	<5.0	<5.0	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0 QC	<5.0	<5.0	<5.0	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5 QC	<5	<5	<5	<5	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0 QC	<5.0	<5.0	**40**	**242**	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5 QC	<5	<5	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5 QC	<5	<5	<5	15	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	<0.005	<0.005	<0.005	**0.017 Y**	**0.025**	<0.005
Barium	7440-39-3	2	0.38	NE	mg/l	**0.194**	**0.133**	**1.03**	**0.480 Y**	**1.16**	**0.244**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001 Y	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001	<0.001	<0.001	<0.001 Y	<0.001	<0.001
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	**0.014**	<0.005	<0.005 Y	<0.005	**0.007**
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002 Y	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002 Y	<0.0002	<0.0002

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

Constituent	CAS Number	Regulatory Screening Criteria: EPA Primary Drinking Water Regulations	Regulatory Screening Criteria: EPA Regional Screening Levels (Tap Water)	Regulatory Screening Criteria: ODEQ Cleanup Levels	Units	North Process Area Monitoring Wells: NMW-5	NMW-8	NMW-12	NMW-13	NMW-16	NMW-17
Sample ID						WRCNMW-5(092115)	WRCNMW-8(092115)	WRCNMW-12(091015)	WRCNMW-13(092115)	WRCNMW-16(092115)	WRCNMW-17(092115)
Laboratory ID						15091433	15091431	15090840	15091432	15091430	15091429
Sample Date						09/21/15	09/21/15	09/10/15	09/21/15	09/21/15	09/21/15
TPH (Oklahoma Methods)											
Gasoline Range Organics		NE	NE	1,000	µg/l	27,900	5,030	37,500	2,130	18,500	406
Diesel Range Organics		NE	NE	1,000	µg/l	37,000	8,800	6,600	8,500	12,000	730
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<3,000	<200	<5,000	<200	<500	<30 M
Benzene	71-43-2	5	0.46	NE	µg/l	9,390	1,450	10,800	433	4,550	80.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<3,000	<200	<5,000	<200	<500 QC	<10 QC
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<100	<30 M	<300	<30 M	<160 M	<6 M
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<100	<10	<300	20	<30	1.6
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<100	<10	<300	<10	<30	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<250	<20	<500	<20	<50	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<100	<10	<300	<10	<30	<2 M
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<1,300	<100	<2,500	<100	<250	11.4
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<100	<10	<300	<10	<30	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	1,100	22	920	<10	1,810	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	700	<20	<500	<20	<50	1.7
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<100	10	<300	50	83	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<100	<10	<300	<10	<30	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<1,300	<100	<2,500	<100	<250	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<300 M	24	<300	227	240	72.8
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	100	25	<300	89	260	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<100	<10	<300	<10	<30	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<100	89	2,300	<10	160	1.8
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	1,500	<10	960	<10	739	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	300	<10	<300	<10	150	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	3,000	63	3,300	<20	1,780	2.2
o-Xylene	95-47-6	NE	19	NE	µg/l	<100	20	930	<10	63	1.2
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<3,100	83	4,230	<30	1,843	3.4
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0 SR	<5.0	<5.0 SR	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	150	<10 QC	42	<10 QC	<10 QC	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	307	63.9	117	12.5	202	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	13	<5.0	22.1	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0 SR	<5.0	<5.0 SR	<5.0	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	148	<5	29	57	6	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	464	29.9	346	9.1	583	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	7	<5	<5 SR	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	14	12	77 IM	<5	17	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	0.081	0.022	0.02	0.033	0.048 Y	0.054
Barium	7440-39-3	2	0.38	NE	mg/l	0.875	0.634	0.676	0.892	0.662 Y	0.797
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001 Y	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	0.094	0.003	0.001	0.009	<0.001 Y	<0.001
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005 Y	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002 Y	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002 Y	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

		Regulatory Screening Criteria				Closed Stormwater Retention Pond and South Boundary Monitoring Wells					
		EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Monitoring Well	SMW-1	SMW-2	SMW-2D	SMW-3	SMW-4	SMW-4D
					Sample ID	WRCSMW1(090915)	WRCSMW-2(091415)	WRCSMW-2D(091415)	WRCSMW-3(091415)	WRCSMW-4(091415)	WRCSMW-4D(091415)
					Laboratory ID	15090831	15091272	15091238	15091239	15091241	15091240
Constituent					Sample Date	09/09/15	09/14/15	09/14/15	09/14/15	09/14/15	09/14/15
TPH (Oklahoma Methods)	**CAS Number**				**Units**						
Gasoline Range Organics		NE	NE	1,000	µg/l	<20	<20	**25**	<20	<20	<20
Diesel Range Organics		NE	NE	1,000	µg/l	<100	**170**	**1,100**	**100**	<100	**310**
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<10	<10	<10	<10	<10	<10
Benzene	71-43-2	5	0.46	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<10	<10	<10	<10	<10	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<0.5	<0.5	**1.2**	<0.5	<0.5	**0.6**
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10	<10	<10	<10	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	<5	<5	<5	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	<5	<5	<5	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	<0.005	<0.005	**0.038**	<0.005	<0.005	**0.012**
Barium	7440-39-3	2	0.38	NE	mg/l	**0.135**	**0.105**	**0.162**	**0.186**	**0.094**	**0.212**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001	<0.001	**0.002**	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	<0.005	**0.011**	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

Constituent	CAS Number	EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Units	SMW-5	SMW-5D	SMW-7	SMW-9	SMW-9D	SMW-9D
		Regulatory Screening Criteria				Closed Stormwater Retention Pond and South Boundary Monitoring Wells					
					Sample ID	WRCSMW-5(090815)	WRCSMW-5D(090815)	WRCSMW-7(091715)	WRCSMW-9(090815)	WRCSMW-9D(090815)	WRCDUP1
					Laboratory ID	15090819	15090820	15091265	15090822	15090823	15090824
					Sample Date	09/08/15	09/08/15	09/17/15	09/08/15	09/08/15	09/08/15
TPH (Oklahoma Methods)											
Gasoline Range Organics		NE	NE	1,000	µg/l	**28**	<20	**74**	**38**	<20	<20
Diesel Range Organics		NE	NE	1,000	µg/l	**330**	**490**	**1,800**	**1,200**	**380**	**320**
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<50 M	<10	<10	<10	<10	<10
Benzene	71-43-2	5	0.46	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<50 M	<10	<10	<10	<10	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<0.5	<0.5	<0.5	**19**	**1.2**	**1.1**
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<0.5	<0.5	**0.6**	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<0.5	<0.5	**0.7**	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<1.0	<1.0	**1.7**	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	<0.5	<0.5	**2.8**	**1.4**	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<1.5	<1.5	**4.5**	<2.4	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10	<10	<10	<10	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	<5	<5	<5	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	<5	<5	<5	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	<0.005 Y	**0.011**	<0.005	**0.006**	**0.014**	**0.014**
Barium	7440-39-3	2	0.38	NE	mg/l	**0.142 Y**	**0.203**	**0.123**	**0.056**	**0.161**	**0.160**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001 Y	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001 Y	<0.001	0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005 Y	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002 Y	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002 Y	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

		Regulatory Screening Criteria				Closed Stormwater Retention Pond and South Boundary Monitoring Wells					
		EPA Primary Drinking Water Regulations	**EPA Regional Screening Levels (Tap Water)**	**ODEQ Cleanup Levels**	**Monitoring Well**	**SMW-10**	**SMW-10D**	**SMW-11**	**SMW-11D**	**SMW-12**	**SMW-12D**
					Sample ID	WRCSMW-10(091815)	WRCSMW-10D(091815)	WRCSMW-11(090915)	WRCSMW-11D(090915)	WRCSMW-12(091815)	WRCSMW-12D(091815)
					Laboratory ID	15091423	15091424	15090827	15090828	15091425	15091426
Constituent					**Sample Date**	09/18/15	09/18/15	09/09/15	09/09/15	09/18/15	09/18/15
TPH (Oklahoma Methods)	**CAS Number**				**Units**						
Gasoline Range Organics		NE	NE	1,000	µg/l	<20	<20	**73**	**36**	**145**	**395**
Diesel Range Organics		NE	NE	1,000	µg/l	**850**	**220**	**3,400**	**350**	**2,300**	**1,900**
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<10	<10	<10	<10	<10	<10
Benzene	71-43-2	5	0.46	NE	µg/l	<0.5	<0.5	<0.5	<0.5	**11.0**	**2.2**
2-Butanone	78-93-3	NE	560	NE	µg/l	<10 QC	<10 QC	<10	<10	<10	<10 QC
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<0.5	<0.5	<0.5	<1.0 M	<2 M	<6 M
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<0.5	<0.5	**1.4**	<0.5	<0.5	**0.8**
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<0.5	<0.5	**4.9**	<0.5	**1.0**	**0.8**
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<0.5	<0.5	**0.6**	**1.1**	**1.7**	**88.8**
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<0.5	<0.5	**2.1**	<0.5	**2.2**	**0.7**
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<0.5	<0.5	<0.5	<0.5	**0.6**	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0 SR	<5.0	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10 SR	<10	<10	<10	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0 SR	<5.0	<5.0	<5.0	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0 SR	<5.0	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0 SR	<5.0	<5.0	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5 SR	<5	<5	<5	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0 SR	<5.0	<5.0	<5.0	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5 SR	<5	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5 SR	<5	<5	<5	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	<0.005	**0.022**	**0.038**	**0.013**	**0.013**	**0.093**
Barium	7440-39-3	2	0.38	NE	mg/l	**0.193**	**0.303**	**0.400**	**0.114**	**0.600**	**0.658**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	**0.029**
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	<0.005	0.006	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

Constituent	CAS Number	Regulatory Screening Criteria: EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Units	Closed Stormwater Retention Pond and South Boundary Monitoring Wells					
					Monitoring Well	SMW-13	SMW-13D	SMW-14	SMW-14D	SMW18	SMW-19
					Sample ID	WRCSMW-13(091815)	WRCSMW-13D(091815)	WRCSMW-14(091715)	WRCSMW-14D(091715)	WRCSMW18(090915)	WRCSMW-19(091715)
					Laboratory ID	15091421	15091422	15091267	15091268	15090830	15091269
					Sample Date	09/18/15	09/18/15	09/17/15	09/17/15	09/09/15	09/17/15
TPH (Oklahoma Methods)	**CAS Number**				**Units**						
Gasoline Range Organics		NE	NE	1,000	µg/l	**27**	**39**	**23**	<20	<20	<20
Diesel Range Organics		NE	NE	1,000	µg/l	**750**	**2,400**	**570**	**650**	<100	**530**
Volatile Organics (EPA Method 8260) (a)											
Acetone	67-64-1	NE	1,400	NE	µg/l	<10	<10	<10	<10	<10	<10
Benzene	71-43-2	5	0.46	NE	µg/l	<0.5	**1.5**	<0.5	<0.5	<0.5	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<10	<10	<10	<10	<10	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<1.0	**1.1**	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<0.5	**1.7**	<0.5	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<0.5	**0.6**	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<0.5	**2.2**	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<0.5	**0.5**	<0.5	<0.5	<0.5	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<1.0	**2.8**	<1.0	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	**0.9**	**2.9**	**1.9**	**0.7**	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<1.9	**5.7**	<2.9	<1.7	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)											
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10 QC	<10	<10	<10	<10	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	<5	<5	<5	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	<5	<5	<5	<5
Metals (EPA Methods 6020A and 7470A)											
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	**0.03**	**0.011**	**0.013**	<0.005	<0.005	**0.022**
Barium	7440-39-3	2	0.38	NE	mg/l	**0.244**	**0.141**	**0.185**	**0.239**	**0.170**	**0.205**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001	**0.04**	<0.001	**0.003**	<0.001	**0.001**
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Appendix B

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

Constituent	CAS Number	Regulatory Screening Criteria: EPA Primary Drinking Water Regulations	Regulatory Screening Criteria: EPA Regional Screening Levels (Tap Water)	Regulatory Screening Criteria: ODEQ Cleanup Levels	Units	Closed Stormwater Retention Pond and South Boundary Monitoring Wells							
					Monitoring Well	**SMW-21**	**SMW-21D**	**SMW-22D**	**SMW-23**	**SMW-23**	**SMW-24**	**SMW-24**	**SMW-25**
					Sample ID	WRCSMW-21(090915)	WRCSMW-21D(090915)	WRCSMW-22D(091715)	WRCSMW-23(091115)	WRCDUP2	WRCSMW-24(091415)	WRCDUP3	WRCSMW-25(091415)
					Laboratory ID	15090825	15090826	15091266	15090841	15090842	15091273	15091274	15091275
					Sample Date	09/09/15	09/09/15	09/17/15	09/11/15	09/11/15	09/14/15	09/14/15	09/14/15
TPH (Oklahoma Methods)													
Gasoline Range Organics		NE	NE	1,000	µg/l	<20	<20	<20	**48**	**49**	<20	<20	<20
Diesel Range Organics		NE	NE	1,000	µg/l	**1,100**	**380**	**300**	**2,120**	**1,900**	<100	<100	**100**
Volatile Organics (EPA Method 8260) (a)													
Acetone	67-64-1	NE	1,400	NE	µg/l	<10	<10	<10	<10	<10	<10	<10	<10
Benzene	71-43-2	5	0.46	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<10	<10	<10	<10	<10	**20**	**20**	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	**2.0**	**0.8**	<0.5	**0.9**	**0.9**	<0.5	<0.5	0.5
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)													
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0 QC	<5.0 QC	<5.0	<5.0	<5.0
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10	<10	<10 QC	<10 QC	<10	<10	<10
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0 QC	<5.0 QC	<5.0	<5.0	<5.0
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	<5.0	<5.0 QC	<5.0 QC	<5.0	<5.0	<5.0
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0 QC	<5.0 QC	<5.0	<5.0	<5.0
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	<5	<5 QC	<5 QC	<5	<5	<5
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	<5.0	<5.0 QC	<5.0 QC	<5.0	<5.0	<5.0
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5 QC	<5 QC	<5	<5	<5
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	<5	<5 QC	<5 QC	<5	<5	<5
Metals (EPA Methods 6020A and 7470A)													
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	**0.021**	**0.015**	<0.005	**0.053**	**0.052**	<0.005	<0.005	<0.005
Barium	7440-39-3	2	0.38	NE	mg/l	**0.278**	**0.202**	**0.273**	**0.141**	**0.141**	**0.104**	**0.100**	**0.198**
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.003**
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	**0.005**	**0.005**	<0.005	<0.005	<0.005
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Summary of Groundwater Analytical Results
September 2015

Wynnewood Refining Company
Wynnewood, Oklahoma

		Regulatory Screening Criteria				Quality Assurance/Quality Control Samples											
					Monitoring Well	Equipment Blanks								Trip Blanks			
		EPA Primary Drinking Water Regulations	EPA Regional Screening Levels (Tap Water)	ODEQ Cleanup Levels	Sample ID	WRCEB(090815)	EB091415	EB091515	EB091615	EB091715	EB091815	EB092115	EB092215	Trip Blank	Trip Blank	Trip Blank	Trip Blank
					Laboratory ID	15090821	15091237	15091242	15091258	15091264	15091420	15091428	15091436	15090829	15091271	15091270	15091427
Constituent					Sample Date	09/08/15	09/14/15	09/15/15	09/16/15	09/17/15	09/18/15	09/21/15	09/22/15	09/09/15	09/14/15	09/17/15	09/21/15
TPH (Oklahoma Methods)	**CAS Number**				**Units**												
Gasoline Range Organics		NE	NE	1,000	µg/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Diesel Range Organics		NE	NE	1,000	µg/l	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Volatile Organics (EPA Method 8260) (a)																	
Acetone	67-64-1	NE	1,400	NE	µg/l	<10	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzene	71-43-2	5	0.46	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-Butanone	78-93-3	NE	560	NE	µg/l	<10	<10	<10	<10	<10	<10	<10 QC	<10	<10	<10	<10	<10
n-Butylbenzene	104-51-8	NE	100	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
sec-Butylbenzene	135-98-8	NE	200	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
tert-Butylbenzene	98-06-6	NE	69	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Carbon disulfide	75-15-0	NE	81	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	67-66-3	80	0.22	NE	µg/l	<0.5	<0.5	**3.5**	**2.9**	**0.8**	**1.0**	**1.1**	<0.5	<0.5	<0.5	<0.5	<0.5
Cyclohexane	110-82-7	NE	1,300	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	100-41-4	700	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Hexane	110-54-3	NE	32	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Isopropylbenzene (Cumene)	98-82-8	NE	45	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-Isopropyltoluene	99-87-6	NE	NE	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Methylcyclohexane	108-87-2	NE	NE	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Methyl tertiary butyl ether (MTBE)	1634-04-4	NE	14	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
n-Propylbenzene	103-65-1	NE	66	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tetrachloroethene	127-18-4	5	4.1	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	108-88-3	1,000	110	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,4-Trimethylbenzene	95-63-6	NE	1.5	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,3,5-Trimethylbenzene	108-67-8	NE	12	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
m+p-Xylene	108+106-38-3	NE	19	NE	µg/l	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	95-47-6	NE	19	NE	µg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes, calculated total (b)		10,000	19	NE	µg/l	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
Semi-Volatile Organics (EPA Method 8270C)																	
1,4-Dichlorobenzene	106-46-7	75	0.48	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
2,4- and 2,5-Dimethylphenol	105-67-9	NE	36 (c)	NE	µg/l	<10	<10	<10	<10	<10	<10	<10	<10 QC	NA	NA	NA	NA
2-Methylnaphthalene	91-57-6	NE	3.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
2-Methylphenol	95-48-7	NE	93	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	117-81-7	6	5.6	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
Methylphenol (3 & 4)	108-39-4/106-44-5	NE	93 (d)	NE	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	NA	NA	NA	NA
Naphthalene	91-20-3	NE	0.17	NE	µg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
Phenanthrene	85-01-8	NE	NE	NE	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	NA	NA	NA	NA
Phenol	108-95-2	NE	580	NE	µg/l	<5	<5	<5	<5	<5	<5	<5	<5	NA	NA	NA	NA
Metals (EPA Methods 6020A and 7470A)																	
Arsenic	7440-38-2	0.01	0.000052	NE	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	NA	NA	NA
Barium	7440-39-3	2	0.38	NE	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	NA	NA	NA
Cadmium	7440-43-9	0.005	0.00092	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA	NA	NA	NA
Lead	7439-92-1	0.015	0.015	NE	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA	NA	NA	NA
Selenium	7782-49-2	0.05	0.01	NE	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	NA	NA	NA	NA
Silver	7440-22-4	NE	0.0094	NE	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	NA	NA	NA	NA
Mercury	7439-97-6	0.002	0.000063	NE	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	NA	NA	NA	NA

Table 3 Footnotes:
Bold values indicate a detection above the reporting limit.
Shading descriptors:
Detected concentration exceeds the EPA Primary Drinking Water Regulations Maximum Contaminant Level, updated May 2009.
Detected concentration exceeds the EPA Regional Screening Level for Tap Water, updated November 2015.
Detected concentration exceeds ODEQ cleanup levels (2004).
EPA = United States Environmental Protection Agency.
ODEQ = Oklahoma Department of Environmental Quality.
TPH = Total Petroleum Hydrocarbons.
NE = not established.
µg/l = micrograms per liter.
mg/l = milligrams per liter.
NA= not analyzed.
a\ Only those organic compounds detected in one or more groundwater samples are shown in this summary table. Refer to laboratory analytical reports for full analyte list.
b\ The value of total xylenes is calculated as the sum of m+p-xylene and o-xylene.
c\ Regional Screening Level is for 2,4-dimethylphenol only.
d\ Regional Screening Level is for 3-methylphenol only.
Laboratory data qualifiers:
EC - This result is estimated due to insufficient chromatographic resolution from other compounds.
IM - Due to matrix interference this analyte did not meet qualitative criteria or was subject to chromatographic peak distortion.
M - The Limit of Quantitation (LOQ) is higher than normal due to matrix interferences.
MP - The MS/MSD recoveries for this analyte exceeded the method or laboratory precision control limit. The reported sample concentration is estimated.
QC - Quality control data qualifiers were noted. See the laboratory quality control report.
SR - One or more surrogate recoveries for this analysis did not meet quality control limits. Please see the Quality Control Report for the sample surrogate data.
Y - The recommended pH adjustment or chemical preservation procedure was not followed or was inadequate for this sample matrix.

Appendix C – LNAPL Transmissivity Data

Pre-Test Bailing Data
LNAPL Transmissivity Testing

Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Well ID	Date/Time	Depth to LNAPL (ft-btoc)	Depth to Water (ft-btoc)	LNAPL Thickness (feet)	Volume of LNAPL (gallons)	Volume LNAPL removed (gallons)	Total Depth (ft-btoc)
NMW-2	4/12/16 10:00	18.84	20.50	1.66	0.49	2	21.30
	4/12/16 10:20	20.90	NW	0.40	0.12		
	4/14/16 13:10	18.79	21.15	2.36	0.69		
	4/18/16 11:05	18.83	21.14	2.31	0.68		
NMW-6	4/12/16 11:00	20.59	23.75	3.16	0.93	2	23.88
	4/12/16 11:20	23.56	NW	0.32	0.09		
	4/14/16 13:20	20.83	22.97	2.14	0.63		
	4/18/16 11:21	20.21	22.76	2.55	0.75		
NMW-10	4/12/16 10:30	16.83	20.63	3.80	1.12	2.5	NM
	4/12/16 10:50	17.90	18.20	0.30	0.09		
	4/14/16 13:17	17.53	18.19	0.66	0.19		
	4/18/16 11:13	17.64	18.27	0.63	0.19		
OMW-3	4/12/16 12:58	12.01	19.57	7.56	2.22	2	20.10
	4/12/16 13:15	19.60	NW	0.50	0.15		
	4/14/16 13:45	13.82	15.48	1.66	0.49		
	4/18/16 13:44	13.17	14.57	1.40	0.41		
OMW-4	4/13/16 9:10	12.82	20.41	7.59	2.23	3	NM
	4/13/16 10:00	20.60	21.05	0.45	0.13		
	4/14/16 13:35	13.33	16.75	3.42	1.00		
	4/18/16 13:30	12.69	20.53	7.84	2.30		
LMW-13	4/12/16 13:34	10.81	NW	1.75	0.51	1.5	12.56
	4/12/16 13:50	12.20	NW	0.36	0.11		
	4/14/16 13:55	10.69	NW	1.87	0.55		
	4/18/16 13:52	9.69	9.92	0.23	0.07		

ft-btoc = feet below top of casing.
LNAPL = Light Non-Aqueous Phase Liquid.
NW = No water present.
NM = Not measured.

Manual LNAPL Skimming Test Field Form

Well ID *NMW-2*

Site ID *WRC (Wynnewood, OK)*

Start Date: 05/04/16

Casing Diameter (inches)	2	
Borehole Diameter (inches)	6	(inferred, unknown)
Top of Screen (ft-btoc)	12	
Bottom of Screen (ft-btoc)	22	
LNAPL API Gravity	48.2	
LNAPL Specific Gravity	0.79	

Pump Used	Peristaltic
Initial Depth to LNAPL (ft-btoc)	17.18
Initial Depth to Water (ft-btoc)	19.29
Initial LNAPL Thickness (feet)	2.11
Initial LNAPL Well Volume (gal)	0.6
Volume LNAPL Removed (gal)	3.6

Pump	Date	Time	Elapsed Time* (min)	LNAPL Volume Removed (gal)	Water Volume Removed (gal)	Depth to LNAPL (ft-btoc)	Depth to Water (ft-btoc)	LNAPL Thickness (feet)	LNAPL Drawdown (feet)	Corrected Depth to Water (ft-btoc)	Total Drawdown (feet)	Comments
On	05/04/16	10:25								17.63		
Off		11:16	0	2.5	1.2	18.76	18.78	0.02	1.58	18.76	1.14	
		11:19	3			18.59	18.66	0.07	1.41	18.60	0.98	
		11:22	6			18.50	18.64	0.14	1.32	18.53	0.90	
		11:25	9			18.39	18.59	0.20	1.21	18.43	0.80	
		11:29	13			18.27	18.56	0.29	1.09	18.33	0.70	
		11:33	17			18.19	18.53	0.34	1.01	18.26	0.63	
		11:40	24			18.07	18.50	0.43	0.89	18.16	0.53	
On		11:41	25									
Off		11:47	31	0.3	trace	18.25	18.28	0.03	1.07	18.26	0.63	
		11:51	4			18.12	18.34	0.22	0.94	18.17	0.54	
		11:53	6			18.08	18.34	0.26	0.90	18.14	0.51	
		11:58	11			18.01	18.33	0.32	0.83	18.08	0.45	
		12:05	18			17.96	18.31	0.35	0.78	18.03	0.41	
On		12:15	28			17.83	18.29	0.46	0.65	17.93	0.30	
Off		12:32	45	0.3	0.2	18.11	18.24	0.13	0.93	18.14	0.51	
		12:38	6			17.99	18.17	0.18	0.81	18.03	0.40	
		12:45	13			17.87	18.15	0.28	0.69	17.93	0.30	
On		13:04	32			17.75	18.15	0.40	0.57	17.84	0.21	
Off		13:09	37	0.25	0.15	18.22	18.23	0.01	1.04	18.22	0.59	
		13:29	20			17.83	18.04	0.21	0.65	17.87	0.25	
		13:36	27			17.78	18.02	0.24	0.60	17.83	0.20	
On		13:39	30									
Off		13:42	33	0.2	0.05	18.03	18.04	0.01	0.85	18.03	0.40	
		16:48	186			17.48	17.97	0.49	0.30	17.58	-0.04	
	05/06/16	18:00	1,698			17.21	18.99	1.78	0.03	17.59	-0.04	
	05/10/16	10:00	6,978			17.05	19.61	2.56	-0.13	17.59	-0.03	

** Elapsed time since the end of the previous discharge event.*

Manual LNAPL Skimming Test Field Form

Well ID ***NMW-6*** | **Site ID** ***WRC (Wynnewood, OK)*** | Start Date: 05/04/16

Casing Diameter (inches)	2	
Borehole Diameter (inches)	6	(inferred, unknown)
Top of Screen (ft-btoc)	14	(inferred, unknown)
Bottom of Screen (ft-btoc)	24	(inferred, unknown)
LNAPL API Gravity	40.3	
LNAPL Specific Gravity	0.82	

Pump Used	Peristaltic
Initial Depth to LNAPL (ft-btoc)	17.96
Initial Depth to Water (ft-btoc)	20.37
Initial LNAPL Thickness (feet)	2.41
Initial LNAPL Well Volume (gal)	0.7
Volume LNAPL Removed (gal)	1.5

Pump	Date	Time	Elapsed Time* (min)	LNAPL Volume Removed (gal)	Water Volume Removed (gal)	Depth to LNAPL (ft-btoc)	Depth to Water (ft-btoc)	LNAPL Thickness (feet)	LNAPL Drawdown (feet)	Corrected Depth to Water (ft-btoc)	Total Drawdown (feet)	Comments
On	05/04/16	14:19								18.39		
Off		14:50	0	1.15	0.25	20.17	20.43	0.26	2.21	20.22	1.83	
		14:55	5			19.72	19.86	0.14	1.76	19.74	1.36	
		15:58	68			19.02	19.31	0.29	1.06	19.07	0.69	
		16:05	75			18.97	19.29	0.32	1.01	19.03	0.64	
		16:12	82			18.93	19.24	0.31	0.97	18.98	0.60	
On		16:14	84									
Off		16:20	90	0.15	0.05	19.25	19.27	0.02	1.29	19.25	0.87	
		16:26	6			19.10	19.22	0.12	1.14	19.12	0.74	
		16:55	35			18.91	19.07	0.16	0.95	18.94	0.55	
		17:20	60			18.82	18.96	0.14	0.86	18.84	0.46	
	05/05/16	10:24	1,084			18.38	18.69	0.31	0.42	18.43	0.05	
On		10:50	1,110									
Off		10:58	1,118	0.13	0.2	18.33	18.35	0.02	0.37	18.33	-0.05	
		11:02	4			18.75	18.82	0.07	0.79	18.76	0.38	
	05/06/16	9:15	1,333			18.42	18.61	0.19	0.46	18.45	0.07	
On		9:25	1,343									
Off		9:28	1,346	0.03	trace	18.66	18.67	0.01	0.70	18.66	0.28	
		9:30	2			18.57	18.64	0.07	0.61	18.58	0.20	
		17:53	505			18.39	18.51	0.12	0.43	18.41	0.03	
	05/10/16	10:30	5,317			18.45	18.61	0.16	0.49	18.48	0.09	

** Elapsed time since the end of the previous discharge event.*

Manual LNAPL Skimming Test Field Form

Well ID ***NMW-10***

Site ID ***WRC (Wynnewood, OK)***

Start Date: 05/05/16

Casing Diameter (inches)	2	
Borehole Diameter (inches)	6	(inferred, unknown)
Top of Screen (ft-btoc)	7	
Bottom of Screen (ft-btoc)	37	
LNAPL API Gravity	70.9	
LNAPL Specific Gravity	0.70	

Pump Used	Peristaltic
Initial Depth to LNAPL (ft-btoc)	15.38
Initial Depth to Water (ft-btoc)	17.21
Initial LNAPL Thickness (feet)	1.83
Initial LNAPL Well Volume (gal)	0.5
Volume LNAPL Removed (gal)	0.9

Pump	Date	Time	Elapsed Time* (min)	LNAPL Volume Removed (gal)	Water Volume Removed (gal)	Depth to LNAPL (ft-btoc)	Depth to Water (ft-btoc)	LNAPL Thickness (feet)	LNAPL Drawdown (feet)	Corrected Depth to Water (ft-btoc)	Total Drawdown (feet)	Comments
On	05/04/16	15:18								15.93		
Off		15:42	0	0.7	0.4	15.98	16.03	0.05	0.60	16.00	0.06	
		15:47	5			15.88	16.05	0.17	0.50	15.93	0.00	
		16:31	49			15.81	16.07	0.26	0.43	15.89	-0.04	
		16:45	63			15.81	16.09	0.28	0.43	15.89	-0.04	
		17:53	131			15.81	16.10	0.29	0.43	15.90	-0.03	
On		17:38	116									
Off		17:50	128	0.03	0.2	15.92	15.93	0.01	0.54	15.92	-0.01	
		17:51	1			15.89	15.93	0.04	0.51	15.90	-0.03	
		17:56	6			15.87	15.96	0.09	0.49	15.90	-0.03	
	05/05/16	11:10	1,040			15.94	16.34	0.40	0.56	16.06	0.13	
On		11:12	1,042									
Off		11:33	1,063	0.1	0.4	16.17	16.19	0.02	0.79	16.18	0.25	During LNAPL skimming during last 5/5 and 5/6 removal events, very little LNAPL could be removed from well. The measured LNAPL thickness may not accurately represent LNAPL drawdown in monitoring well.
		11:38	5			16.07	16.11	0.04	0.69	16.08	0.15	
	05/06/16	9:40	1,327			15.93	16.41	0.48	0.55	16.07	0.14	
On		9:45	1,332									
Off		9:57	1,344	0.03	0.2	16.02	16.55	0.53	0.64	16.18	0.25	
		9:59	2			15.98	16.57	0.59	0.60	16.16	0.23	
		17:49	472			15.82	16.29	0.47	0.44	15.96	0.03	
	05/10/16	10:15	5,778			15.52	17.13	1.61	0.14	16.00	0.07	

** Elapsed time since the end of the previous discharge event.*

Manual LNAPL Skimming Test Field Form

Well ID ***OMW-3***

Site ID ***WRC (Wynnewood, OK)***

Start Date: 05/06/16

Casing Diameter (inches)	2
Borehole Diameter (inches)	6
Top of Screen (ft-btoc)	13
Bottom of Screen (ft-btoc)	23
LNAPL API Gravity	40.8
LNAPL Specific Gravity	0.82

Pump Used	Peristaltic
Initial Depth to LNAPL (ft-btoc)	11.09
Initial Depth to Water (ft-btoc)	14.19
Initial LNAPL Thickness (feet)	3.1
Initial LNAPL Well Volume (gal)	0.9
Volume LNAPL Removed (gal)	0.5

Pump	Date	Time	Elapsed Time* (min)	LNAPL Volume Removed (gal)	Water Volume Removed (gal)	Depth to LNAPL (ft-btoc)	Depth to Water (ft-btoc)	LNAPL Thickness (feet)	LNAPL Drawdown (feet)	Corrected Depth to Water (ft-btoc)	Total Drawdown (feet)	Comments
On	05/06/16	13:36								11.64		
Off		13:40	0	0.5	trace	13.67	13.68	0.01	2.58	13.67	2.03	
		13:41	1			13.65	13.66	0.01	2.56	13.65	2.01	
		13:42	2			13.63	13.64	0.01	2.54	13.63	1.99	
		13:43	3			13.62	13.64	0.02	2.53	13.62	1.98	
		13:44	4			13.59	13.62	0.03	2.50	13.60	1.95	
		13:45	5			13.56	13.59	0.03	2.47	13.57	1.92	
		13:50	10			13.48	13.54	0.06	2.39	13.49	1.85	
		13:55	15			13.45	13.55	0.10	2.36	13.47	1.82	
		14:00	20			13.43	13.53	0.10	2.34	13.45	1.80	
		14:05	25			13.42	13.50	0.08	2.33	13.43	1.79	
		14:15	35			13.38	13.47	0.09	2.29	13.40	1.75	
		14:25	45			13.35	13.45	0.10	2.26	13.37	1.72	
		14:45	65			13.29	13.43	0.14	2.20	13.32	1.67	
		15:00	80			13.32	13.45	0.13	2.23	13.34	1.70	
		15:15	95			13.28	13.42	0.14	2.19	13.31	1.66	
		15:30	110			13.31	13.46	0.15	2.22	13.34	1.69	
		16:20	160			13.25	13.42	0.17	2.16	13.28	1.64	
		17:30	230			13.15	13.33	0.18	2.06	13.18		
	05/07/16	9:00	1,160			12.34	13.06	0.72	1.25	12.47	0.82	
	05/10/16	9:30	4,070			None	11.44	0.00		11.44	-0.20	No measurable LNAPL

** Elapsed time since the end of the previous discharge event.*

Manual LNAPL Skimming Test Field Form

Well ID *OMW-4*

Site ID *WRC (Wynnewood, OK)*

Start Date: 05/05/16

Casing Diameter (inches)	2
Borehole Diameter (inches)	6
Top of Screen (ft-btoc)	13
Bottom of Screen (ft-btoc)	23
LNAPL API Gravity	33.1
LNAPL Specific Gravity	0.86

Pump Used	Peristaltic
Initial Depth to LNAPL (ft-btoc)	11.27
Initial Depth to Water (ft-btoc)	18.15
Initial LNAPL Thickness (feet)	6.88
Initial LNAPL Well Volume (gal)	2.0
Volume LNAPL Removed (gal)	4.5

Pump	Date	Time	Elapsed Time* (min)	LNAPL Volume Removed (gal)	Water Volume Removed (gal)	Depth to LNAPL (ft-btoc)	Depth to Water (ft-btoc)	LNAPL Thickness (feet)	LNAPL Drawdown (feet)	Corrected Depth to Water (ft-btoc)	Total Drawdown (feet)	Comments
On	05/05/16	13:45								12.24		
Off		14:17	0	2.7	trace	17.85	17.86	0.01	6.58	17.85	5.62	
		14:19	2			17.80	17.95	0.15	6.53	17.82	5.59	
		14:20	3			17.67	17.87	0.20	6.40	17.70	5.46	
		14:21	4			17.52	17.95	0.43	6.25	17.58	5.34	
		14:22	5			17.35	17.87	0.52	6.08	17.42	5.19	
		14:23	6			17.20	17.66	0.46	5.93	17.26	5.03	
		14:24	7			17.03	17.72	0.69	5.76	17.13	4.89	
		14:25	8			16.89	17.55	0.66	5.62	16.98	4.75	
		14:26	9			16.79	17.51	0.72	5.52	16.89	4.66	
		14:27	10			16.69	17.35	0.66	5.42	16.78	4.55	
		14:30	13			16.55	17.23	0.68	5.28	16.65	4.41	
		14:40	23			16.02	16.73	0.71	4.75	16.12	3.88	
		14:50	33			15.59	16.36	0.77	4.32	15.70	3.46	
		15:00	43			15.21	16.08	0.87	3.94	15.33	3.10	
		15:15	58			14.81	15.89	1.08	3.54	14.96	2.73	
		15:30	73			14.41	15.70	1.29	3.14	14.59	2.36	
		15:48	91			14.18	15.58	1.40	2.91	14.38	2.14	
On		15:49	92									
Off		15:58	101	0.38	trace	15.70	15.72	0.02	4.43	15.70	3.47	
		16:05	7			15.33	15.45	0.12	4.06	15.35	3.11	
		16:16	18			15.05	15.21	0.16	3.78	15.07	2.84	
		16:46	48			14.39	14.84	0.45	3.12	14.45	2.22	
		17:05	67			14.15	14.69	0.54	2.88	14.23	1.99	
On		17:06	68									
Off		17:14	76	0.38	0.10	15.28	15.30	0.02	4.01	15.28	3.05	
	05/06/16	10:23	1,029			12.31	13.82	1.51	1.04	12.52	0.29	

** Elapsed time since the end of the previous discharge event.*

Manual LNAPL Skimming Test Field Form

Well ID ***OMW-4*** **Site ID** ***WRC (Wynnewood, OK)*** Start Date: 05/05/16

Pump	Date	Time	Elapsed Time (min)	LNAPL Volume Removed (gal)	Water Volume Removed (gal)	Depth to LNAPL (ft-btoc)	Depth to Water (ft-btoc)	LNAPL Thickness (feet)	LNAPL Drawdown (feet)	Corrected Depth to Water (ft-btoc)	Total Drawdown (feet)	Comments
On	05/06/16	10:30										
Off		10:36	0	0.45	0.025	13.65	13.67	0.02	2.38	13.65	1.42	
		10:39	3			13.30	13.54	0.24	2.03	13.33	1.10	
		16:38	362			12.51	13.65	1.14	1.24	12.67	0.43	
On		16:42	366									
Off		17:09	393	0.66	0.063	14.24	14.26	0.02	2.97	14.24	2.01	
		17:15	6			13.95	14.16	0.21	2.68	13.98	1.74	
	05/07/16	9:09	1,404			12.26	13.65	1.39	0.99	12.46	0.22	
	05/10/16	9:45	4,320			11.74	14.75	3.01	0.47	12.16	-0.07	

Generalized Bouwer and Rice (1976)

Well Designation:	OMW-3
Date:	6-May-16

$$T_n = \frac{r_e^{\,2}\ln(R/r_e)\ln(s_n(t_1)/s_n(t))}{2(-J)(t-t_1)}$$

L_e/r_e
9.1
C
1.16
R/r_e
4.97

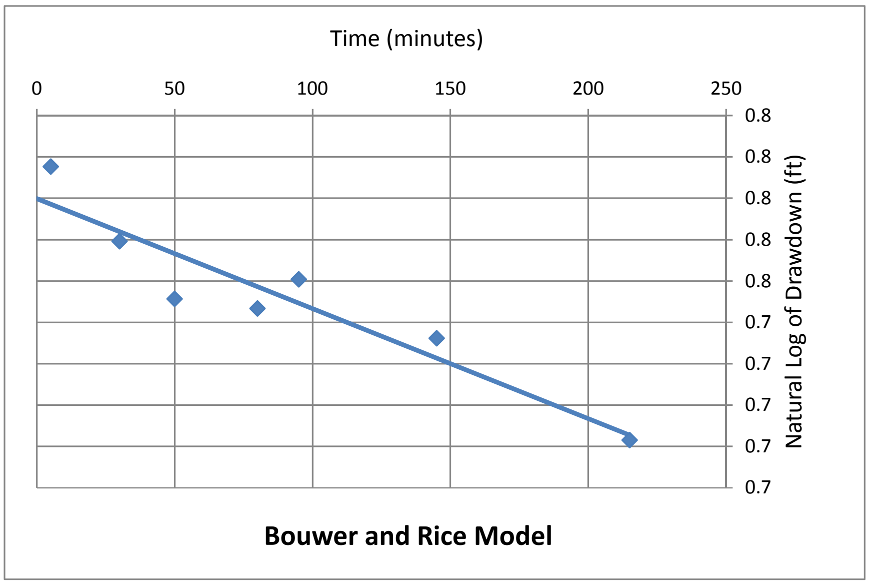
J-Ratio
-2.941

Enter early time cut-off for least-squares model fit

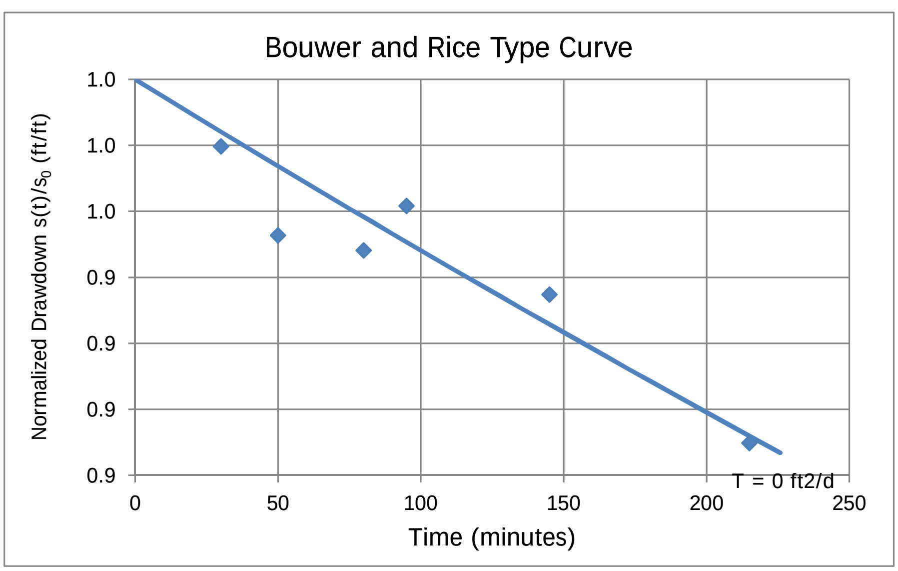
$Time_{cut}$	15	<- Enter or change value here

Model Results: T_n (ft^2/d) = 0.0035 +/- 0.00057 ft^2/d

Coef. Of Variation
0.16



C coefficient calculated from Eq. 6.5(c) of Butler, The Design, Performance, and Analysis of Slug Tests, CRC Press, 2000.



Cooper, Bredehoeft and Papadopulos (1967)

Well Designation:	OMW-3
Date:	6-May-16

Enter early time cut-off for least-squares model fit

$Time_{cut}$ (min):	15	<- Enter or change values here
Initial Drawdown s_n (ft):	2.48	

Trial S_n: 0.050 <-- Enter d for default

Root-Mean-Square Error: 0.091 <-- Minimize this using "Solver"

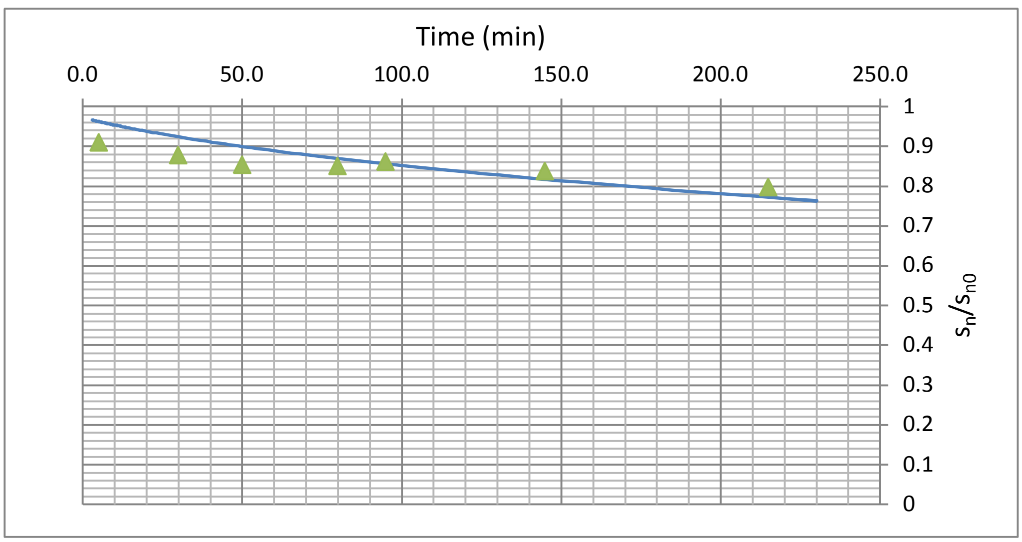
Trial T_n (ft^2/d): 0.004 <-- By changing T_n through "Solver"

0.050 <-- Working S_n

Add constraint Tn > 0.00001

Model Result: T_n (ft^2/d) = **0.0045**

T_{min}	3
T_{max}	230



J-Ratio
-2.941

Cooper and Jacob (1946)

Well Designation:	OMW-3
Date:	6-May-16

$$V_n(t_i) = \sum_j^i \frac{4\pi T_n s_j}{\ln\left(\frac{2.25 T_n t_j}{r_e^2 S_n}\right)} \Delta t_j$$

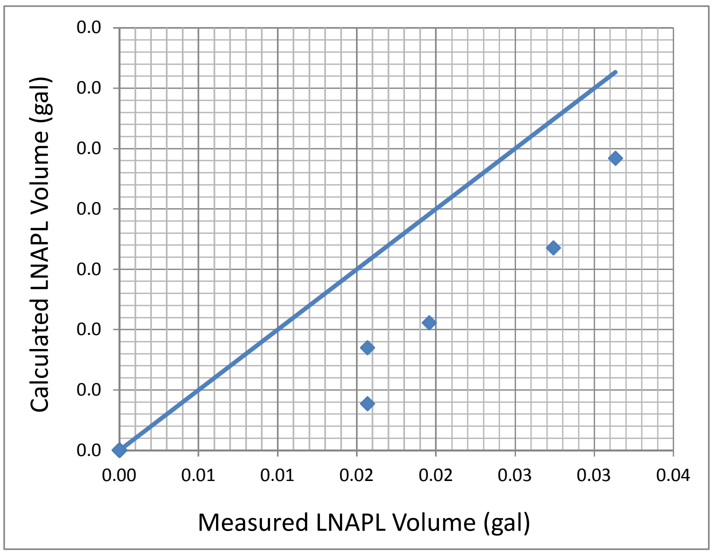
Enter early time cut-off for least-squares model fit

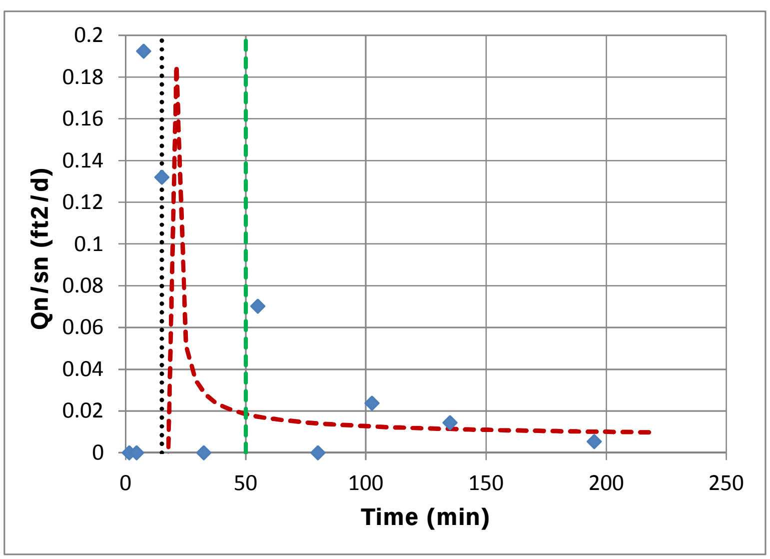
Time_{cut} (min):	50	<- Enter or change values here
Time Adjustment (min):	15	

Trial S_n:	d	<-- Enter d for default or enter S_n value
Root-Mean-Square Error:	0.021	<-- Minimize this using "Solver"
	0.001	<-- Working S_n
Trial T_n (ft^2/d):	0.003	<-- By changing T_n through "Solver"

Add constraint $T_n > 0.00001$

Model Result: T_n (ft^2/d) = **0.00286**





Height

15

Appendix D – Direct-Push Investigation Analytical Laboratory Reports

Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date and Time Received: 02/29/2016 1615
Pace File No.: 8462
Pace Order No.: 131715
Project ID: WRC Wynnewood

Dear Mr. McCormick:

This laboratory report, containing the samples indicated below, includes 22 pages for the analytical report, 2 page(s) for the chain of custody and/or analysis request, and 5 page(s) for the sample receipt form.

PACE LAB ID #	SAMPLE DESCRIPTION	SAMPLE TYPE	DATE SAMPLED
16022149	WRCDP-68(022416)	Liquid	2/24/2016
16022150	WRCDP-DUPE-1(022416)	Liquid	2/24/2016
16022151	WRCDP-67(022416)	Liquid	2/24/2016
16022152	WRCDP-61(022416)	Liquid	2/24/2016
16022153	WRCDP-60(022516)	Liquid	2/25/2016
16022154	WRCDP-64(022516)	Liquid	2/25/2016
16022155	WRCDP-69(022516)	Liquid	2/25/2016
16022156	WRCDP-DUPE-2(022716)	Liquid	2/27/2016
16022157	WRCDP-81(022716)	Liquid	2/27/2016
16022158	WRCDP-84(022716)	Liquid	2/27/2016
16022159	WRCDP-109(022716)	Liquid	2/27/2016
16022160	WRCDP-78(022716)	Liquid	2/27/2016
16022161	WRCDP-74(022816)	Liquid	2/28/2016
16022162	WRCDP-75(022816)	Liquid	2/28/2016
16022163	WRCDP-65(022416)	Liquid	2/24/2016
16022164	WRCDP-77(022616)	Liquid	2/26/2016
16022165	WRCDP-76(022816)	Liquid	2/28/2016
16022166	Trip Blank (022916)	Liquid	2/29/2016

The Appendix and Quality Control sections are integral parts of this laboratory report and may contain important data qualifiers.

All results are reported on a wet weight basis unless otherwise stated.

Samples will be retained for thirty days unless Pace is otherwise notified. Pace is accredited by the State of Kansas through the National Environmental Laboratory Accreditation Program (NELAP). The results contained in this report were obtained using Pace's Standard Operating Procedures. These procedures are in substantial compliance with the approved methods referenced and the standards published by NELAP unless otherwise noted in the Appendix and Quality Control sections of this report.

Thank you for choosing Pace for this project.

Gregory J. Groene
Project Manager
Gregory.Groene@pacelabs.com

Sample Results

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Lab Number: 16022149
Sample Description: WRCDP-68(022416)

Date Sampled: 02/24/2016
Time Sampled: 0950

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	570 B	µg/L	1.0	100	100
BTEX					
Benzene	0.07 J	µg/L	1.0	0.04	1.0
Toluene	0.08 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.09 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 1742	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/07/16 1203	160302-1	1EX4067	SPA	OK DRO
BTEX	N/A	03/01/16 2001	1MS8061	1MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022149

Lab Number: 16022150
Sample Description: WRCDP-DUPE-1(022416)

Date Sampled: 02/24/2016
Time Sampled: 1330

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	560 B	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources	Date Reported:	03/14/2016
	Attn: Sam McCormick	Date Received:	02/29/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	131715

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 1814	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/07/16 1232	160302-1	1EX4067	SPA	OK DRO
BTEX	N/A	03/01/16 2036	1MS8061	1MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022150

Lab Number: 16022151
Sample Description: WRCDP-67(022416)

Date Sampled: 02/24/2016
Time Sampled: 1500

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	520 B QC	µg/L	2.0	200	200
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.07 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 1845	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/08/16 0817	160302-1	3EX4067	SPA	OK DRO
BTEX	N/A	03/01/16 2335	1MS8061	1MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022151

Client:	Coffeyville Resources	Date Reported:	03/14/2016
	Attn: Sam McCormick	Date Received:	02/29/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	131715

Lab Number: 16022152
Sample Description: WRCDP-61(022416)

Date Sampled: 02/24/2016
Time Sampled: 1745

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	880 B	µg/L	1.0	100	100
BTEX					
Benzene	0.14 J	µg/L	1.0	0.04	1.0
Toluene	0.19 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.17 J	µg/L	1.0	0.06	1.0
o-Xylene	0.1 J	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 2019	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/07/16 1428	160302-1	1EX4067	SPA	OK DRO
BTEX	N/A	03/01/16 2112	1MS8061	1MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022152

Lab Number: 16022153
Sample Description: WRCDP-60(022516)

Date Sampled: 02/25/2016
Time Sampled: 1058

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	470 B	µg/L	1.0	100	100
BTEX					
Benzene	0.12 J	µg/L	1.0	0.04	1.0
Toluene	0.14 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.15 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources	Date Reported: 03/14/2016
	Attn: Sam McCormick	Date Received: 02/29/2016
	10 E. Cambridge Circle Dr.	Pace File No: 8462
	Kansas City, KS 66103	Pace Order No: 131715

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 2050	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/07/16 1457	160302-1	1EX4067	SPA	OK DRO
BTEX	N/A	03/01/16 2148	1MS8061	1MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022153

Lab Number: 16022154
Sample Description: WRCDP-64(022516)

Date Sampled: 02/25/2016
Time Sampled: 1440

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	190 B	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 2122	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/07/16 1134	160302-1	1EX4067	SPA	OK DRO
BTEX	N/A	03/01/16 2224	1MS8061	1MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022154

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 03/14/2016 Date Received: 02/29/2016 Pace File No: 8462 Pace Order No: 131715

Lab Number: 16022155
Sample Description: WRCDP-69(022516)

Date Sampled: 02/25/2016
Time Sampled: 1630

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	1300	µg/L	2.0	200	200
BTEX					
Benzene	0.05 J	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 2153	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/08/16 0524	160302-1	3EX4067	SPA	OK DRO
BTEX	N/A	03/01/16 2259	1MS8061	1MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022155

Lab Number: 16022156
Sample Description: WRCDP-DUPE-2(022716)

Date Sampled: 02/27/2016
Time Sampled: 1030

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	248	µg/L	1.0	20	20
Oklahoma DRO	1600	µg/L	2.0	200	200
BTEX					
Benzene	17.0	µg/L	1.0	0.04	1.0
Toluene	0.07 J	µg/L	1.0	0.06	1.0
Ethylbenzene	7.5	µg/L	1.0	0.1	1.0
m+p-Xylene	6.08	µg/L	1.0	0.06	1.0
o-Xylene	0.2 J	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 2224	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/07/16 1947	160302-2	2EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0310	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022156

Lab Number: 16022157
Sample Description: WRCDP-81(022716)

Date Sampled: 02/27/2016
Time Sampled: 1115

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	250.	µg/L	1.0	20	20
Oklahoma DRO	1500	µg/L	2.0	200	200
BTEX					
Benzene	17.6	µg/L	1.0	0.04	1.0
Toluene	0.08 J	µg/L	1.0	0.06	1.0
Ethylbenzene	7.6	µg/L	1.0	0.1	1.0
m+p-Xylene	5.79	µg/L	1.0	0.06	1.0
o-Xylene	0.2 J	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1008	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/08/16 0748	160302-2	3EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0345	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022157

Client:	Coffeyville Resources		Date Reported: 03/14/2016
	Attn: Sam McCormick		Date Received: 02/29/2016
	10 E. Cambridge Circle Dr.		Pace File No: 8462
	Kansas City, KS 66103		Pace Order No: 131715

Lab Number: 16022158
Sample Description: WRCDP-84(022716)

Date Sampled: 02/27/2016
Time Sampled: 1215

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	500 B	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1040	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/07/16 2113	160302-2	2EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0421	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022158

Lab Number: 16022159
Sample Description: WRCDP-109(022716)

Date Sampled: 02/27/2016
Time Sampled: 1320

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	280 B	µg/L	1.14	100	110
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103	Date Reported: 03/14/2016 Date Received: 02/29/2016 Pace File No: 8462 Pace Order No: 131715

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1111	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/07/16 2142	160302-2	2EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0457	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022159

Lab Number: 16022160
Sample Description: WRCDP-78(022716)

Date Sampled: 02/27/2016
Time Sampled: 1710

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	37600	µg/L	200	4000	4000
Oklahoma DRO	19000	µg/L	22.47	2000	2200
BTEX					
Benzene	9830	µg/L	500	20	500
Toluene	390 J	µg/L	500	30	500
Ethylbenzene	1800	µg/L	500	50	500
m+p-Xylene	6740 QC	µg/L	500	30	500
o-Xylene	770	µg/L	500	50	500

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1143	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/07/16 2211	160302-2	2EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 1637	1MS8062	1MS8062	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022160

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Lab Number: 16022161
Sample Description: WRCDP-74(022816)

Date Sampled: 02/28/2016
Time Sampled: 1045

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	770	µg/L	1.0	100	100
BTEX					
Benzene	0.05 J	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.13 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1214	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/07/16 2240	160302-2	2EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0609	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022161

Lab Number: 16022162
Sample Description: WRCDP-75(022816)

Date Sampled: 02/28/2016
Time Sampled: 1148

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	640	µg/L	1.0	100	100
BTEX					
Benzene	0.04 J	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.08 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 03/14/2016 Date Received: 02/29/2016 Pace File No: 8462 Pace Order No: 131715

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1348	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/07/16 2309	160302-2	2EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0644	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022162

Lab Number: 16022163
Sample Description: WRCDP-65(022416)

Date Sampled: 02/24/2016
Time Sampled: 1720

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	270 B	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.08 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 2256	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/07/16 1555	160302-1	1EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0720	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022163

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Lab Number: 16022164
Sample Description: WRCDP-77(022616)

Date Sampled: 02/26/2016
Time Sampled: 1540

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	170 B	µg/L	1.0	100	100
BTEX					
Benzene	0.04 J	µg/L	1.0	0.04	1.0
Toluene	0.08 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/08/16 2327	1GC2068	1GC2068	LPL	OK GRO
Oklahoma DRO	03/02/16 0930	03/07/16 1105	160302-1	1EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0756	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022164

Lab Number: 16022165
Sample Description: WRCDP-76(022816)

Date Sampled: 02/28/2016
Time Sampled: 1000

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	179	µg/L	1.0	20	20
Oklahoma DRO	450 B	µg/L	1.0	100	100
BTEX					
Benzene	0.41 J	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	1.3	µg/L	1.0	0.1	1.0
m+p-Xylene	0.23 J	µg/L	1.0	0.06	1.0
o-Xylene	0.2 J	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103	Date Reported: 03/14/2016 Date Received: 02/29/2016 Pace File No: 8462 Pace Order No: 131715

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1419	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/07/16 2337	160302-2	2EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0832	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022165

Lab Number: 16022166
Sample Description: Trip Blank (022916)

Date Sampled: 02/29/2016
Time Sampled: 1000

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1451	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/02/16 1130	03/08/16 0006	160302-2	2EX4067	SPA	OK DRO
BTEX	N/A	03/02/16 0907	1MS8061	2MS8061	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16022166

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

ND indicates not detected with the Limit of Detection (LOD) in parentheses. The Method Detection Limit (MDL) is a calculated value representing the lowest concentration, that based on a statistical calculation represents the lowest concentration that theoretically, can be detected. The MDL is equivalent to the LOD. The Limit of Quantitation (LOQ) is the lowest concentration of the analytical standard that was used for calibrating the instrument. If an analytical standard is analyzed at the LOQ, an error of as much as +/- 50% can be expected. The MDL and LOQ values have been adjusted for the dilution factor and percent solids, as applicable. Due to rounding differences these values may vary slightly from the reported concentration. N/A, if present, indicates Not Applicable.

All samples which require cooling were received at a temperature of less than 6 degrees Celsius.

No analysis with a holding time of seventy-two hours or less was performed in this Pace order.

B - Analyte is also present in the method blank or load blank at the concentration indicated either to the right of the letter B and/or in the Quality Control Report. The reported sample concentration has not been blank corrected.

J - The concentration or not detected (ND) value is below the Limit of Quantitation (LOQ) and is considered an estimated value.

QC - QC data qualifiers were noted. See the Quality Control Report.

Accreditation Summary

Client:	Coffeyville Resources Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 03/14/2016 Date Received: 02/29/2016 Pace File No: 8462 Pace Order No: 131715

NELAP accreditation is issued under each EPA regulatory program for a given matrix/analyte/method combination. Pace is NELAP accredited for each matrix/analyte/method and EPA program cited in this Laboratory Report, except for those listed in the table below and for analyses performed in the field. For most of the analyses listed in the table, NELAP accreditation is not offered under the listed EPA program and Pace is NELAP accredited for the analysis, using the same analytical technology, but under a different EPA program. Pace's full NELAP accreditation status may be viewed at www.kdheks.gov/envlab. Note that unless qualified otherwise in the Laboratory Report, Pace performs all analyses, including each analysis listed in the table below, utilizing NELAP protocol.

Test	Analysis	Matrix-Regulatory Program	Method	Pace NELAP Accredited in Other Reg. Program
Pace is accredited for all analytes.				

Quality Control Report
Batch Summary

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Test Code	Testname	QC Batch	Method Blank Date/Time Analyzed	LCS Date/Time Analyzed	MS Lab No. Date/Time Analyzed
CL108	Oklahoma GRO	1GC2068	BLK1GC2068 03/08/16 1639	LCS1GC2068 03/08/16 1608	16022151MS 03/08/16 1916
Lab numbers associated with this batch: 16022149 16022150 16022151 16022152 16022153 16022154 16022155 16022156 16022163 16022164					
CL108	Oklahoma GRO	1GC2069	BLK1GC2069 03/09/16 0937	LCS1GC2069 03/09/16 0905	16022161MS 03/09/16 1245
Lab numbers associated with this batch: 16022157 16022158 16022159 16022160 16022161 16022162 16022165 16022166					
CL122	Oklahoma DRO	160302-1	160302BLK1 03/07/16 0938	160302LCS1 03/07/16 1007	16022151MS 03/08/16 0846
Lab numbers associated with this batch: 16022149 16022150 16022151 16022152 16022153 16022154 16022155 16022163 16022164					
CL122	Oklahoma DRO	160302-2	160302BLK2 03/07/16 1820	160302LCS2 03/07/16 1849	16022156MS 03/07/16 2015
Lab numbers associated with this batch: 16022156 16022157 16022158 16022159 16022160 16022161 16022162 16022165 16022166					
MS295	BTEX	1MS8061	BLK1MS8061 03/01/16 1702	LCS1MS8061 03/01/16 1551	16022151MS 03/02/16 0011
Lab numbers associated with this batch: 16022149 16022150 16022151 16022152 16022153 16022154 16022155 16022156 16022157 16022158 16022159 16022161 16022162 16022163 16022164 16022165 16022166					
MS295	BTEX	1MS8062	BLK1MS8062 03/02/16 1304	LCS1MS8062 03/02/16 1151	16022160MS 03/02/16 1713
Lab numbers associated with this batch: 16022160					

Quality Control Report
Method Blank, LCS, MS/MSD Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Analysis	Method Blank	LCS % Rec	LCS Limits	LCS Spike Level	Units	Spiked Sample (% Recovery) MS	MSD	MS/MSD Limits	MS/MSD Spike Level	Units	Spiked Sample Precision Data RPD	Limit
QC Batch: 160302-1	**For samples prepared on: 03/02/2016 0930**					**Spiked sample: 16022151**						
Oklahoma DRO	110 BK	108	80.0-120	500	µg/L	88.4	120 MP	80.0-120	500	µg/L	30.3	20.0
QC Batch: 160302-2	**For samples prepared on: 03/02/2016 1130**					**Spiked sample: 16022156**						
Oklahoma DRO	59 J	109	80.0-120	500	µg/L	95.5	F	80.0-120	500	µg/L	**	20.0
QC Batch: 1GC2068	**For sample analyzed on: 03/08/2016**					**Spiked sample: 16022151**						
Oklahoma GRO	ND(20)	101	80.0-120	200	µg/L	107	107	80.0-120	200	µg/L	0.0	20.0
Surrogate Data:												
4-BFB (8015D)	99.7	102	84.0-121	20.0	µg/L	104	105	84.0-121	20.0	µg/L		
FLUOROBENZENE (8015D)	96.8	97.8	71.7-132	20.0	µg/L	100.	101	71.7-132	20.0	µg/L		
QC Batch: 1GC2069	**For sample analyzed on: 03/09/2016**					**Spiked sample: 16022161**						
Oklahoma GRO	ND(20)	99.7	80.0-120	200	µg/L	90.5	91.2	80.0-120	200	µg/L	0.80	20.0
Surrogate Data:												
4-BFB (8015D)	94.4	101	84.0-121	20.0	µg/L	100.	101	84.0-121	20.0	µg/L		
FLUOROBENZENE (8015D)	92.6	99.0	71.7-132	20.0	µg/L	95.0	96.4	71.7-132	20.0	µg/L		
QC Batch: 1MS8061	**For sample analyzed on: 03/01/2016**					**Spiked sample: 16022151**						
BTEX												
Benzene	ND(0.04)	103	80.0-120	10.0	µg/L	106	105	79.6-118	10.0	µg/L	0.90	9.8
Toluene	ND(0.06)	102	80.0-120	10.0	µg/L	101	100.	89.7-116	10.0	µg/L	1.00	8.0
Ethylbenzene	ND(0.1)	98.6	80.0-120	10.0	µg/L	98.4	96.3	89.1-114	10.0	µg/L	2.20	6.5
m+p-Xylene	ND(0.06)	96.1	80.0-120	20.0	µg/L	95.0	93.8	88.6-116	20.0	µg/L	1.30	6.7
o-Xylene	ND(0.1)	101	80.0-120	10.0	µg/L	98.7	97.2	88.3-115	10.0	µg/L	1.50	8.1
Surrogate Data:												
1,2-DICHLOROETHANE-d4	93.2	94.8	74.3-123	10.0	µg/L	95.6	96.6	74.3-123	10.0	µg/L		
TOLUENE-d8	95.4	97.4	80.0-120	10.0	µg/L	96.1	96.0	80.0-120	10.0	µg/L		
QC Batch: 1MS8062	**For sample analyzed on: 03/02/2016**					**Spiked sample: 16022160**						
BTEX												
Benzene	ND(1.0)	104	80.0-120	10.0	µg/L	101	100.	79.6-118	5000	µg/L	1.00	9.8
Toluene	ND(1.0)	101	80.0-120	10.0	µg/L	97.2	96.8	89.7-116	5000	µg/L	0.40	8.0
Ethylbenzene	ND(1.0)	97.4	80.0-120	10.0	µg/L	96.1	96.4	89.1-114	5000	µg/L	0.30	6.5
m+p-Xylene	ND(1.0)	96.3	80.0-120	20.0	µg/L	86.6 ML	85.6 ML	88.6-116	10000	µg/L	1.20	6.7
o-Xylene	ND(1.0)	98.4	80.0-120	10.0	µg/L	98.4	98.0	88.3-115	5000	µg/L	0.40	8.1
Surrogate Data:												
1,2-DICHLOROETHANE-d4	98.3	94.7	74.3-123	10.0	µg/L	90.7	96.4	74.3-123	5000	µg/L		
TOLUENE-d8	93.2	96.2	80.0-120	10.0	µg/L	95.5	96.3	80.0-120	5000	µg/L		

Data Qualifiers:

BK - The concentration of this analyte, if present in an associated sample, is considered an estimated value if the sample concentration is less than ten times the amount present in this method blank.

MP - The MS/MSD recoveries for this analyte exceeded the method or laboratory precision control limit. The reported sample concentration is estimated.

J - The concentration or not detected (ND) value is below the Limit of Quantitation (LOQ) and is considered an estimated value.

F - MS and/or MSD sample data are not available due to insufficient sample volume.

ML - The matrix spike and/or matrix spike duplicate recovery for this analyte was below the method or laboratory control limit. See LCS data for the basis for acceptance of this sample. The reported sample concentration is estimated.

** - RPD calculation not applicable/not available for this analysis.

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16022149	**Sample Description: WRCDP-68(022416)**					
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	99.0	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	95.7	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/01/2016	10	µg/L	92.7	74.3-123
TOLUENE-d8		03/01/2016	10	µg/L	94.4	80.0-120
Lab Number: 16022150	**Sample Description: WRCDP-DUPE-1(022416)**					
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	98.3	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	94.5	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/01/2016	10	µg/L	92.4	74.3-123
TOLUENE-d8		03/01/2016	10	µg/L	96.0	80.0-120
Lab Number: 16022151	**Sample Description: WRCDP-67(022416)**					
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	103	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	99.5	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/01/2016	10	µg/L	95.1	74.3-123
TOLUENE-d8		03/01/2016	10	µg/L	95.6	80.0-120
Lab Number: 16022152	**Sample Description: WRCDP-61(022416)**					
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	100.	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	97.8	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/01/2016	10	µg/L	96.1	74.3-123
TOLUENE-d8		03/01/2016	10	µg/L	96.6	80.0-120
Lab Number: 16022153	**Sample Description: WRCDP-60(022516)**					
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	100.	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	97.5	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/01/2016	10	µg/L	98.0	74.3-123
TOLUENE-d8		03/01/2016	10	µg/L	96.3	80.0-120
Lab Number: 16022154	**Sample Description: WRCDP-64(022516)**					
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	103	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	98.6	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/01/2016	10	µg/L	95.7	74.3-123
TOLUENE-d8		03/01/2016	10	µg/L	94.5	80.0-120
Lab Number: 16022155	**Sample Description: WRCDP-69(022516)**					
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	97.3	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	95.3	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/01/2016	10	µg/L	95.8	74.3-123

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16022155		**Sample Description: WRCDP-69(022516)**				
BTEX						
TOLUENE-d8		03/01/2016	10	µg/L	93.7	80.0-120
Lab Number: 16022156		**Sample Description: WRCDP-DUPE-2(022716)**				
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	102	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	100.	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	98.7	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	94.4	80.0-120
Lab Number: 16022157		**Sample Description: WRCDP-81(022716)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	103	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	100.	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	95.0	80.0-120
Lab Number: 16022158		**Sample Description: WRCDP-84(022716)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	101	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	98.0	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	98.8	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	95.7	80.0-120
Lab Number: 16022159		**Sample Description: WRCDP-109(022716)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	98.6	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	94.8	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	93.9	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	95.2	80.0-120
Lab Number: 16022160		**Sample Description: WRCDP-78(022716)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	4000	µg/L	102	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	4000	µg/L	99.2	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	5000	µg/L	89.9	74.3-123
TOLUENE-d8		03/02/2016	5000	µg/L	95.5	80.0-120
Lab Number: 16022161		**Sample Description: WRCDP-74(022816)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	101	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	97.9	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	98.7	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	94.0	80.0-120
Lab Number: 16022162		**Sample Description: WRCDP-75(022816)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	99.7	84.0-121

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16022162		**Sample Description: WRCDP-75(022816)**				
GC/FID Volatile						
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	99.4	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	98.5	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	94.4	80.0-120
Lab Number: 16022163		**Sample Description: WRCDP-65(022416)**				
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	99.9	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	99.3	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	102	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	90.6	80.0-120
Lab Number: 16022164		**Sample Description: WRCDP-77(022616)**				
GC/FID Volatile						
4-BFB (8015D)		03/08/2016	20	µg/L	96.8	84.0-121
FLUOROBENZENE (8015D)		03/08/2016	20	µg/L	96.9	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	97.6	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	96.9	80.0-120
Lab Number: 16022165		**Sample Description: WRCDP-76(022816)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	98.0	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	91.4	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	101	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	94.8	80.0-120
Lab Number: 16022166		**Sample Description: Trip Blank (022916)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	101	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	98.4	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/02/2016	10	µg/L	99.6	74.3-123
TOLUENE-d8		03/02/2016	10	µg/L	95.3	80.0-120

Quality Control Report
Continuing Calibration Report

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/14/2016
Date Received: 02/29/2016
Pace File No: 8462
Pace Order No: 131715

Analysis	Date of Analysis	Instrument Batch ID	Amount in Standard	Amount Detected	Units	Percent Recovery
Oklahoma GRO	03/08/2016	1GC2068	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/08/2016	2GC2068	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/09/2016	1GC2069	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/09/2016	2GC2069	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	03/07/2016	1EX4067	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	03/07/2016	2EX4067	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	03/08/2016	3EX4067	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	03/08/2016	4EX4067	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/01/2016	1MS8061	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/02/2016	2MS8061	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/02/2016	3MS8061	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/02/2016	1MS8062	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/02/2016	2MS8062	CCV recovery acceptable for this Instrument Batch.			

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 131215

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:

Sampler's Name / Company:(Printed): Judy Andrews, Kevin Walter WSP USA
Sampler's Name:(Signature):
Purchase Order Number:
Project Name: WRC Interior Delineation
Facility Name / Address: WRC Wynnewood, OK

PARAMETERS/CONTAINER TYPE (preservative): BTEX (8020/8015) - 3x glass 40 ml vials (HCL); Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL); Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER:	BTEX (8020/8015)	Oklahoma GRO (8020/8015)	Oklahoma DRO (8000/8100)	COMMENTS
WRCDP-68(022416)	GW	O	02/24/16	9:50	G	8	8						X	X	X	
WRCDP-DUPE-1(022416)	GW	O	02/24/16	13:30	G	8	8						X	X	X	Duplicate
WRCDP-67(022416)	GW	O	02/24/16	15:00	G	8	8						X	X	X	
WRCDP-67(022416) MS/MSD	GW	O	02/24/16	15:00	G	9	9						X	X	X	MS/MSD
WRCDP-61(022416)	GW	O	02/24/16	17:45	G	8	8						X	X	X	
WRCDP-60(022516)	GW	O	02/25/16	10:58	G	8	8						X	X	X	
WRCDP-64(022516)	GW	O	02/25/16	14:40	G	8	8						X	X	X	
WRCDP-69(022616)	GW	O	02/26/16	16:30	G	8	8						X	X	X	
WRCDP-DUPE-2(022716)	GW	O	02/27/16	10:30	G	8	8						X	X	X	Duplicate
WRCDP-81(022716)	GW	O	02/27/16	11:15	G	8	8						X	X	X	
WSCDP-84(022716)	GW	O	02/27/16	12:15	G	8	8						X	X	X	

Discrepancies See C/S RF 2-29-16

Matrix (Sample Type): **DW**=Drinking Water, **GW**=Ground Water, **WW**=Waste Water, **W**=Wipe, **S**=Solid/Soil, **SL**=Sludge, **A**=Air, **OL**=Oil/Organic Liquid, **O**=Other,

Regulatory Program: **N**=NPDES, **R**=RCRA, **D**=Drinking Water, **SL**=503 Sludge, **O**=Other, **nR**=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge) Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

	DATE:	TIME:		DATE:	TIME:
RELINQUISHED BY:	2-29-16	10:15	RECEIVED BY:	2-29-16	1015
RELINQUISHED BY:	2-29-16	1605	RECEIVED BY:		
RECEIVED AT LAB BY:	2-29-16	1615	SHIPPED VIA: AIRBILL:	SEAL #:	SEAL DATE:

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 13115

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:
Sampler's Name / Company:(Printed) Judy Andrews, Kevin Walter WSP USA; Sampler's Name:(Signature)	Purchase Order Number:
Project Name: WRC Interior Delineation; Facility Name / Address: WRC Wynnewood, OK	

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER:	BTEX (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)	COMMENTS
WRCDP-109(022716)	GW	O	02/27/16	13:20	G	8	8						X	X	X	
WRCDP-78(022716)	GW	O	02/27/16	17:10	G	8	8						X	X	X	
WRCDP-74(022816)	GW	O	02/28/16	10:45	G	8	8						X	X	X	
WRCDP-75(022816)	GW	O	02/28/16	11:48	G	8	8						X	X	X	
WRCDP-65(022416)	GW	O	02/28/16	17:20	G	8	8						X	X	X	
WRCDP-77(022616)	GW	O	02/26/16	15:40	G	8	8						X	X	X	
WRCDP-76(022816)	GW	O	02/28/16	10:00	G	8	8						X	X	X	
Trip Blank (022916)	GW	O	02/29/16	10:00	G	8	8						X	X	X	Provided by Lab

Matrix (Sample Type): **DW**=Drinking Water, **GW**=Ground Water, **WW**=Waste Water, **W**=Wipe, **S**=Solid/Soil, **SL**=Sludge, **A**=Air, **OL**= Oil/Organic Liquid, **O**=Other,

Regulatory Program: **N**=NPDES, **R**=RCRA, **D**=Drinking Water, **SL**=503 Sludge, **O**=Other, **nR**=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge) Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

RELINQUISHED BY:	DATE: 2-29-16	TIME: 10:15	RECEIVED BY:	DATE: 2-29-16	TIME: 1015
RELINQUISHED BY:	DATE: 2291c	TIME: 1615	RECEIVED BY:	DATE:	TIME:
RECEIVED AT LAB BY:	DATE: 22916	TIME: 1615	SHIPPED VIA: AIRBILL:	SEAL #:	SEAL DATE:

H:\COC\COC 2016 Delineation.xls\WRC_Delineation 2-29-2016

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Pace Analytical | **Pace Order No.:** 131715

Cooler/Sample Receipt Form (C/S RF)

Client Name: Coffeyville Res. | **Pace File No.:** 8462

Sample ID's in cooler:

Trip Blank-2LA

WRCDP-75, 74, 76, 109 2LA

Cooler 1 **of** 5 **for this Pace Order No.**

Cooler Identification: Pace Cooler #: 4200 / Client's Cooler / Box / Letter / Hand-delivered
Other: ______

Date/Time Cooler Received: 2 / 29 / 16 16 : 15

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other: ______

Custody Seal: Present: Intact / Broken Absent: X Seal No: ______

Seal Name: ______ Seal Date: ______

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other: ______

Cooler Temperature (°C): Original Reading (°C) 2.7 Corrected Reading (°C) 2.2

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☒ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies: ______

Detail to discrepancies/comments:

Completed by: MWS **Date Completed:** 2-29-16

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131718

Client Name: Coffeyville Res.

Pace File No.: 8462

Sample ID's in cooler:

WRCPF-81, 65, 77, Dupe 2 2LA

Cooler 2 of 5 for this Pace Order No.

Cooler Identification: Pace Cooler #: 4193 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 2 / 29 / 16 16 : 15

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: X Seal No:

Seal Name: Seal Date:

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 2.0 Corrected Reading (°C) 1.5

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☐ No ☒ Yes **(See below for discrepancies.)** MWS 2-29-16

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments: 65 date sampled on bottles reads 2-24-16

Completed by: MWS Date Completed: 2-29-16

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131715

Client Name: Coffeyville Res.

Pace File No.: 8462

Sample ID's in cooler:

VOC's

Cooler 3 **of** 5 **for this Pace Order No.**

Cooler Identification: Pace Cooler #: 2318 / Client's Cooler / Box / Letter / Hand-delivered

Other:

Date/Time Cooler Received: 2 / 29 / 16 16 : 15

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: X Seal No:

Seal Name: Seal Date:

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 2.0 Corrected Reading (°C) 1.5

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☒ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments:

Completed by: mws **Date Completed:** 2-29-16

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131715

Client Name: Coffeyville Res.

Pace File No.: 8462

Sample ID's in cooler:

WRCPP- 78, 69, 60, 84, 64

Cooler 4 **of** 5 **for this Pace Order No.**

Cooler Identification: Pace Cooler #: 4136 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 2 / 29 / 16 16 : 15

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: X Seal No:

Seal Name: Seal Date:

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 1.6 Corrected Reading (°C) 1.1

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☒ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
  [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments:

Completed by: MWS **Date Completed:** 2-29-16

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131715

Client Name: Coffeyville Res.

Pace File No.: 8462

Sample ID's in cooler:

WRCDB- Dypel, 68, 61, 67 2LA
67 MD 3LA

Cooler 5 **of** 5 **for this Pace Order No.**

Cooler Identification: Pace Cooler #: 4013 / Client's Cooler / Box / Letter / Hand-delivered
Other: ____

Date/Time Cooler Received: 2 / 29 / 16 16 : 15

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other: ____

Custody Seal: Present: Intact / Broken Absent: X Seal No: ____

Seal Name: ____ Seal Date: ____

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other: ____

Cooler Temperature (°C): Original Reading (°C) 1.6 Corrected Reading (°C) 1.1

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☒ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies: ____

Detail to discrepancies/comments:

Completed by: MWS **Date Completed:** 2-29-16

Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date and Time Received: 03/04/2016 1710
Pace File No.: 8462
Pace Order No.: 131848
Project ID: WRC Wynnewood

Dear Mr. McCormick:

This laboratory report, containing the samples indicated below, includes 21 pages for the analytical report, 2 page(s) for the chain of custody and/or analysis request, and 5 page(s) for the sample receipt form.

PACE LAB ID #	SAMPLE DESCRIPTION	SAMPLE TYPE	DATE SAMPLED
16030522	WRCDP-91(022916)	Liquid	2/29/2016
16030523	WRCDP-97(022916)	Liquid	2/29/2016
16030524	WRCDP-102(022916)	Liquid	2/29/2016
16030525	WRCDP-70(022916)	Liquid	2/29/2016
16030526	WRCDP-94(022916)	Liquid	2/29/2016
16030527	WRCDP-88(022916)	Liquid	2/29/2016
16030528	WRCDP-87(022916)	Liquid	2/29/2016
16030529	WRCDP-37(030216)	Liquid	3/2/2016
16030530	WRCDP-58(030216)	Liquid	3/2/2016
16030531	WRCDP-39(030216)	Liquid	3/2/2016
16030532	WRCDP-30(030216)	Liquid	3/2/2016
16030533	WRCDP-33(030316)	Liquid	3/3/2016
16030534	Trip Blank(030416)	Liquid	3/4/2016
16030535	WRCDP-105(030416)	Liquid	3/4/2016
16030536	WRCEB(030416)	Liquid	3/4/2016

The Appendix and Quality Control sections are integral parts of this laboratory report and may contain important data qualifiers.

All results are reported on a wet weight basis unless otherwise stated.

Samples will be retained for thirty days unless Pace is otherwise notified. Pace is accredited by the State of Kansas through the National Environmental Laboratory Accreditation Program (NELAP). The results contained in this report were obtained using Pace's Standard Operating Procedures. These procedures are in substantial compliance with the approved methods referenced and the standards published by NELAP unless otherwise noted in the Appendix and Quality Control sections of this report.

Thank you for choosing Pace for this project.

Gregory J. Groene

Gregory J. Groene
Project Manager
Gregory.Groene@pacelabs.com

Sample Results

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Lab Number: 16030522
Sample Description: WRCDP-91(022916)

Date Sampled: 02/29/2016
Time Sampled: 1000

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1522	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/14/16 2104	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1252	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030522

Lab Number: 16030523
Sample Description: WRCDP-97(022916)

Date Sampled: 02/29/2016
Time Sampled: 1115

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	160 QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources	Date Reported:	03/18/2016
	Attn: Sam McCormick	Date Received:	03/04/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	131848

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1553	1GC2069	1GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/14/16 2133	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1328	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030523

Lab Number: 16030524
Sample Description: WRCDP-102(022916)
Date Sampled: 02/29/2016
Time Sampled: 1400

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	85 G	µg/L	1.0	20	20
Oklahoma DRO	570 QC	µg/L	1.0	100	100
BTEX					
Benzene	0.14 J	µg/L	1.0	0.04	1.0
Toluene	0.11 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1727	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/14/16 2202	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1404	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030524

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Lab Number: 16030525
Sample Description: WRCDP-70(022916)

Date Sampled: 02/29/2016
Time Sampled: 1500

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	569	µg/L	1.0	20	20
Oklahoma DRO	9200 QC	µg/L	20	2000	2000
BTEX					
Benzene	4.03	µg/L	1.0	0.04	1.0
Toluene	0.58 J	µg/L	1.0	0.06	1.0
Ethylbenzene	0.9 J	µg/L	1.0	0.1	1.0
m+p-Xylene	1.30	µg/L	1.0	0.06	1.0
o-Xylene	0.3 J	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1758	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/14/16 2231	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1440	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030525

Lab Number: 16030526
Sample Description: WRCDP-94(022916)

Date Sampled: 02/29/2016
Time Sampled: 1555

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	150 QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Pace Analytical Services, Inc.
525 N. Eighth St. - Salina, KS 67401
785-827-1273 800-535-3076 Fax 785-823-7830

Sample Results

Client:	Coffeyville Resources		Date Reported: 03/18/2016
	Attn: Sam McCormick		Date Received: 03/04/2016
	10 E. Cambridge Circle Dr.		Pace File No: 8462
	Kansas City, KS 66103		Pace Order No: 131848

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1830	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/14/16 2259	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1516	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030526

Lab Number: 16030527
Sample Description: WRCDP-88(022916)

Date Sampled: 02/29/2016
Time Sampled: 1650

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1901	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/14/16 2328	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1552	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030527

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 03/18/2016 Date Received: 03/04/2016 Pace File No: 8462 Pace Order No: 131848

Lab Number: 16030528
Sample Description: WRCDP-87(022916)

Date Sampled: 02/29/2016
Time Sampled: 1730

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	110 QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 1933	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/14/16 2357	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1628	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030528

Lab Number: 16030529
Sample Description: WRCDP-37(030216)

Date Sampled: 03/02/2016
Time Sampled: 1305

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	583	µg/L	2.0	40	40
Oklahoma DRO	2500 QC	µg/L	4.0	400	400
BTEX					
Benzene	3.51	µg/L	1.0	0.04	1.0
Toluene	1.76	µg/L	1.0	0.06	1.0
Ethylbenzene	0.3 J	µg/L	1.0	0.1	1.0
m+p-Xylene	2.67	µg/L	1.0	0.06	1.0
o-Xylene	1.4	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources	Date Reported: 03/18/2016	
	Attn: Sam McCormick	Date Received: 03/04/2016	
	10 E. Cambridge Circle Dr.	Pace File No: 8462	
	Kansas City, KS 66103	Pace Order No: 131848	

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 2005	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/14/16 1937	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1851	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030529

Lab Number: 16030530
Sample Description: WRCDP-58(030216)

Date Sampled: 03/02/2016
Time Sampled: 1420

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	180 QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 2139	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/15/16 0026	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 1704	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030530

Client:	Coffeyville Resources	Date Reported: 03/18/2016	
	Attn: Sam McCormick	Date Received: 03/04/2016	
	10 E. Cambridge Circle Dr.	Pace File No: 8462	
	Kansas City, KS 66103	Pace Order No: 131848	

Lab Number: 16030531
Sample Description: WRCDP-39(030216)

Date Sampled: 03/02/2016
Time Sampled: 1515

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	59400	µg/L	500	10000	10000
Oklahoma DRO	20000 QC	µg/L	40	4000	4000
BTEX					
Benzene	11000	µg/L	200	8	200
Toluene	13800	µg/L	200	10	200
Ethylbenzene	1500	µg/L	200	20	200
m+p-Xylene	5650	µg/L	200	10	200
o-Xylene	2690	µg/L	200	20	200

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 2210	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/07/16 1230	03/15/16 0055	160307-5	1EX4074	SPA	OK DRO
BTEX	N/A	03/08/16 2259	1MS8068	2MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030531

Lab Number: 16030532
Sample Description: WRCDP-30(030216)

Date Sampled: 03/02/2016
Time Sampled: 1615

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	4910	µg/L	10	200	200
Oklahoma DRO	8200	µg/L	10	1000	1000
BTEX					
Benzene	0.95 J	µg/L	5.0	0.2	5
Toluene	2.9 J	µg/L	5.0	0.3	5
Ethylbenzene	84.9	µg/L	5.0	0.5	5
m+p-Xylene	37.8	µg/L	5.0	0.3	5
o-Xylene	2 J	µg/L	5.0	0.5	5

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources		Date Reported: 03/18/2016
	Attn: Sam McCormick		Date Received: 03/04/2016
	10 E. Cambridge Circle Dr.		Pace File No: 8462
	Kansas City, KS 66103		Pace Order No: 131848

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/09/16 2242	2GC2069	2GC2069	LPL	OK GRO
Oklahoma DRO	03/09/16 1015	03/15/16 1501	160309-3	1EX4075	SPA	OK DRO
BTEX	N/A	03/09/16 1538	1MS9069	1MS9069	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030532

Lab Number: 16030533
Sample Description: WRCDP-33(030316)

Date Sampled: 03/03/2016
Time Sampled: 1355

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	1630	µg/L	5.0	100	100
Oklahoma DRO	24000	µg/L	25	3000	2500
BTEX					
Benzene	143	µg/L	10	0.4	10
Toluene	5.9 J	µg/L	10	0.6	10
Ethylbenzene	3 J	µg/L	10	1	10
m+p-Xylene	3.2 J	µg/L	10	0.6	10
o-Xylene	2 J	µg/L	10	1	10

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/16/16 1810	1GC2076	1GC2076	LPL	OK GRO
Oklahoma DRO	03/09/16 1015	03/15/16 1305	160309-3	1EX4075	SPA	OK DRO
BTEX	N/A	03/09/16 1603	1MS9069	1MS9069	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030533

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Lab Number: 16030534
Sample Description: Trip Blank(030416)

Date Sampled: 03/04/2016
Time Sampled: 1200

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.11 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/17/16 1328	1GC2077	1GC2077	LPL	OK GRO
Oklahoma DRO	03/09/16 1015	03/15/16 1334	160309-3	1EX4075	SPA	OK DRO
BTEX	N/A	03/08/16 1815	1MS8068	1MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030534

Lab Number: 16030535
Sample Description: WRCDP-105(030416)

Date Sampled: 03/04/2016
Time Sampled: 0950

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	2310	µg/L	10	200	200
Oklahoma DRO	1100	µg/L	2.0	200	200
BTEX					
Benzene	6.0 J	µg/L	10	0.4	10
Toluene	5.6 J	µg/L	10	0.6	10
Ethylbenzene	125	µg/L	10	1	10
m+p-Xylene	137	µg/L	10	0.6	10
o-Xylene	3 J	µg/L	10	1	10

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 03/18/2016 Date Received: 03/04/2016 Pace File No: 8462 Pace Order No: 131848

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/17/16 1400	1GC2077	1GC2077	LPL	OK GRO
Oklahoma DRO	03/09/16 1015	03/15/16 1530	160309-3	1EX4075	SPA	OK DRO
BTEX	N/A	03/09/16 1629	1MS9069	1MS9069	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030535

Lab Number: 16030536
Sample Description: WRCEB(030416)

Date Sampled: 03/04/2016
Time Sampled: 1040

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	0.14 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	03/16/16 2047	1GC2076	1GC2076	LPL	OK GRO
Oklahoma DRO	03/09/16 1015	03/15/16 1432	160309-3	1EX4075	SPA	OK DRO
BTEX	N/A	03/08/16 2224	1MS8068	2MS8068	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16030536

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

ND indicates not detected with the Limit of Detection (LOD) in parentheses. The Method Detection Limit (MDL) is a calculated value representing the lowest concentration, that based on a statistical calculation represents the lowest concentration that theoretically, can be detected. The MDL is equivalent to the LOD. The Limit of Quantitation (LOQ) is the lowest concentration of the analytical standard that was used for calibrating the instrument. If an analytical standard is analyzed at the LOQ, an error of as much as +/- 50% can be expected. The MDL and LOQ values have been adjusted for the dilution factor and percent solids, as applicable. Due to rounding differences these values may vary slightly from the reported concentration. N/A, if present, indicates Not Applicable.

All samples which require cooling were received at a temperature of less than 6 degrees Celsius.

No analysis with a holding time of seventy-two hours or less was performed in this Pace order.

QC - QC data qualifiers were noted. See the Quality Control Report.

G - The reported concentration includes a significant amount of individual compound(s) at concentrations not typically found in petroleum hydrocarbon patterns.

J - The concentration or not detected (ND) value is below the Limit of Quantitation (LOQ) and is considered an estimated value.

Accreditation Summary

Client:	Coffeyville Resources	Date Reported:	03/18/2016
	Sam McCormick	Date Received:	03/04/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	131848

NELAP accreditation is issued under each EPA regulatory program for a given matrix/analyte/method combination. Pace is NELAP accredited for each matrix/analyte/method and EPA program cited in this Laboratory Report, except for those listed in the table below and for analyses performed in the field. For most of the analyses listed in the table, NELAP accreditation is not offered under the listed EPA program and Pace is NELAP accredited for the analysis, using the same analytical technology, but under a different EPA program. Pace's full NELAP accreditation status may be viewed at www.kdheks.gov/envlab. Note that unless qualified otherwise in the Laboratory Report, Pace performs all analyses, including each analysis listed in the table below, utilizing NELAP protocol.

Test	Analysis	Matrix-Regulatory Program	Method	Pace NELAP Accredited in Other Reg. Program
Pace is accredited for all analytes.				

Quality Control Report
Batch Summary

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Test Code	Testname	QC Batch	Method Blank Date/Time Analyzed	LCS Date/Time Analyzed	MS Lab No. Date/Time Analyzed
CL108	Oklahoma GRO	1GC2069	BLK1GC2069 03/09/16 0937	LCS1GC2069 03/09/16 0905	16022161MS 03/09/16 1245
Lab numbers associated with this batch: 16030522 16030523					
CL108	Oklahoma GRO	2GC2069	BLK2GC2069 03/09/16 1656	LCS2GC2069 03/09/16 1624	16030529MS 03/09/16 2036
Lab numbers associated with this batch: 16030524 16030525 16030526 16030527 16030528 16030529 16030530 16030531 16030532					
CL108	Oklahoma GRO	1GC2076	BLK1GC2076 03/16/16 1739	LCS1GC2076 03/16/16 1707	
Lab numbers associated with this batch: 16030533 16030536					
CL108	Oklahoma GRO	1GC2077	BLK1GC2077 03/17/16 1257	LCS1GC2077 03/17/16 1225	16030535MS 03/17/16 1431
Lab numbers associated with this batch: 16030534 16030535					
CL122	Oklahoma DRO	160307-5	160307BLK5 03/14/16 1810	160307LCS5 03/14/16 1839	16030529MS 03/14/16 2006
Lab numbers associated with this batch: 16030522 16030523 16030524 16030525 16030526 16030527 16030528 16030529 16030530 16030531					
CL122	Oklahoma DRO	160309-3	160309BLK3 03/15/16 1041	160309LCS3 03/15/16 1110	16030536MS 03/09/16
Lab numbers associated with this batch: 16030532 16030533 16030534 16030535 16030536					
MS295	BTEX	1MS8068	BLK1MS8068 03/08/16 1216	LCS1MS8068 03/08/16 1104	16030529MS 03/08/16 1927
Lab numbers associated with this batch: 16030522 16030523 16030524 16030525 16030526 16030527 16030528 16030529 16030530 16030531 16030534 16030536					
MS295	BTEX	1MS9069	BLK1MS9069 03/09/16 1512	LCS1MS9069 03/09/16 1421	
Lab numbers associated with this batch: 16030532 16030533 16030535					

Quality Control Report
Method Blank, LCS, MS/MSD Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Analysis	Method Blank	LCS % Rec	LCS Limits	LCS Spike Level	Units	Spiked Sample (% Recovery) MS	MSD	MS/MSD Limits	MS/MSD Spike Level	Units	Spiked Sample Precision Data RPD	Limit
QC Batch: 160307-5	**For samples prepared on: 03/07/2016 1230**					**Spiked sample: 16030529**						
Oklahoma DRO	ND(100)	74.0 LL	80.0-120	500	µg/L	I	I	80.0-120	500	µg/L	**	20.0
QC Batch: 160309-3	**For samples prepared on: 03/09/2016 1015**					**Spiked sample: 16030536**						
Oklahoma DRO	ND(100)	85.1	80.0-120	500	µg/L	F	F	80.0-120		µg/L	**	20.0
QC Batch: 1GC2069	**For sample analyzed on: 03/09/2016**					**Spiked sample: 16022161**						
Oklahoma GRO	ND(20)	99.7	80.0-120	200	µg/L	MN	MN	80.0-120	200	µg/L	**	20.0
Surrogate Data:												
4-BFB (8015D)	94.4	101	84.0-121	20.0	µg/L	MN	MN	84.0-121	20.0	µg/L	**	
FLUOROBENZENE (8015D)	92.6	99.0	71.7-132	20.0	µg/L	MN	MN	71.7-132	20.0	µg/L	**	
QC Batch: 1GC2076	**For sample analyzed on: 03/16/2016**					**Spiked sample:**						
Oklahoma GRO	22 BK	107	80.0-120	200	µg/L	MN	MN	80.0-120		µg/L	**	20.0
Surrogate Data:												
4-BFB (8015D)	99.5	103	84.0-121	20.0	µg/L	MN	MN	84.0-121		µg/L	**	
FLUOROBENZENE (8015D)	93.0	95.5	71.7-132	20.0	µg/L	MN	MN	71.7-132		µg/L	**	
QC Batch: 1GC2077	**For sample analyzed on: 03/17/2016**					**Spiked sample: 16030535**						
Oklahoma GRO	ND(20)	99.3	80.0-120	200	µg/L	103	99.1	80.0-120	2000	µg/L	3.90	20.0
Surrogate Data:												
4-BFB (8015D)	98.0	101	84.0-121	20.0	µg/L	104	101	84.0-121	200	µg/L		
FLUOROBENZENE (8015D)	94.8	95.3	71.7-132	20.0	µg/L	96.6	96.5	71.7-132	200	µg/L		
QC Batch: 1MS8068	**For sample analyzed on: 03/08/2016**					**Spiked sample: 16030529**						
BTEX												
Benzene	ND(0.04)	102	80.0-120	10.0	µg/L	104	105	79.6-118	10.0	µg/L	1.00	9.8
Toluene	ND(0.06)	98.5	80.0-120	10.0	µg/L	96.8	100.	89.7-116	10.0	µg/L	3.30	8.0
Ethylbenzene	ND(0.1)	95.1	80.0-120	10.0	µg/L	98.9	96.5	89.1-114	10.0	µg/L	2.50	6.5
m+p-Xylene	ND(0.06)	93.9	80.0-120	20.0	µg/L	94.6	92.8	88.6-116	20.0	µg/L	1.90	6.7
o-Xylene	ND(0.1)	97.4	80.0-120	10.0	µg/L	101	97.7	88.3-115	10.0	µg/L	3.30	8.1
Surrogate Data:												
1,2-DICHLOROETHANE-d4	100.	98.9	74.3-123	10.0	µg/L	110.	114	74.3-123	10.0	µg/L		
TOLUENE-d8	96.7	98.4	80.0-120	10.0	µg/L	100.	99.4	80.0-120	10.0	µg/L		
QC Batch: 1MS9069	**For sample analyzed on: 03/09/2016**					**Spiked sample:**						
BTEX						MN	MN					
Benzene	ND(0.04)	94.6	80.0-120	10.0	µg/L			79.6-118		µg/L	**	9.8
Toluene	ND(0.06)	103	80.0-120	10.0	µg/L			89.7-116		µg/L	**	8.0
Ethylbenzene	ND(0.1)	103	80.0-120	10.0	µg/L			89.1-114		µg/L	**	6.5
m+p-Xylene	ND(0.06)	102	80.0-120	20.0	µg/L			88.6-116		µg/L	**	6.7
o-Xylene	ND(0.1)	104	80.0-120	10.0	µg/L			88.3-115		µg/L	**	8.1
Surrogate Data:												
1,2-DICHLOROETHANE-d4	88.3	93.4	74.3-123	10.0	µg/L	MN	MN	74.3-123		µg/L	**	
TOLUENE-d8	109	109	80.0-120	10.0	µg/L	MN	MN	80.0-120		µg/L	**	
QC Batch: 2GC2069	**For sample analyzed on: 03/09/2016**					**Spiked sample: 16030529**						
Oklahoma GRO	ND(20)	97.8	80.0-120	200	µg/L	94.4	84.7	80.0-120	400	µg/L	10.8	20.0
Surrogate Data:												
4-BFB (8015D)	93.4	98.0	84.0-121	20.0	µg/L	107	105	84.0-121	40.0	µg/L		
FLUOROBENZENE (8015D)	89.5	94.4	71.7-132	20.0	µg/L	102	101	71.7-132	40.0	µg/L		

Data Qualifiers:

Quality Control Report
Method Blank, LCS, MS/MSD Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Analysis	Method Blank	LCS % Rec	LCS Limits	LCS Spike Level	Units	Spiked Sample (% Recovery) MS	MSD	MS/MSD Limits	MS/MSD Spike Level	Units	Spiked Sample Precision Data RPD	Limit

LL - The Laboratory Control Sample (LCS) recovery for this analyte was below the method or laboratory quality control limit. The reported sample concentration may be biased low.

I - Due to the concentration of analyte in the sample, the spike level is too low to allow accurate quantification of the spike recovery.

F - MS and/or MSD sample data are not available due to insufficient sample volume.

MN - The MS/MSD sample analyses were not performed on a sample from this Pace order number.

BK - The concentration of this analyte, if present in an associated sample, is considered an estimated value if the sample concentration is less than ten times the amount present in this method blank.

** - RPD calculation not applicable/not available for this analysis.

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16030522		**Sample Description: WRCDP-91(022916)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	101	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	95.9	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	106	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	96.6	80.0-120
Lab Number: 16030523		**Sample Description: WRCDP-97(022916)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	100.	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	97.5	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	104	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	95.8	80.0-120
Lab Number: 16030524		**Sample Description: WRCDP-102(022916)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	97.9	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	94.1	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	102	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	97.8	80.0-120
Lab Number: 16030525		**Sample Description: WRCDP-70(022916)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	106	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	103	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	107	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	98.0	80.0-120
Lab Number: 16030526		**Sample Description: WRCDP-94(022916)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	101	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	97.6	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	101	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	98.0	80.0-120
Lab Number: 16030527		**Sample Description: WRCDP-88(022916)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	100.	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	99.0	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	100.	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	97.6	80.0-120
Lab Number: 16030528		**Sample Description: WRCDP-87(022916)**				
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	102	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	98.6	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	103	74.3-123

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16030528	**Sample Description: WRCDP-87(022916)**					
BTEX						
TOLUENE-d8		03/08/2016	10	µg/L	96.1	80.0-120
Lab Number: 16030529	**Sample Description: WRCDP-37(030216)**					
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	40	µg/L	104	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	40	µg/L	100.	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	111	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	99.5	80.0-120
Lab Number: 16030530	**Sample Description: WRCDP-58(030216)**					
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	20	µg/L	97.4	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	20	µg/L	96.0	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	108	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	97.4	80.0-120
Lab Number: 16030531	**Sample Description: WRCDP-39(030216)**					
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	10000	µg/L	99.2	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	10000	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	2000	µg/L	102	74.3-123
TOLUENE-d8		03/08/2016	2000	µg/L	98.6	80.0-120
Lab Number: 16030532	**Sample Description: WRCDP-30(030216)**					
GC/FID Volatile						
4-BFB (8015D)		03/09/2016	200	µg/L	101	84.0-121
FLUOROBENZENE (8015D)		03/09/2016	200	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/09/2016	50	µg/L	82.2	74.3-123
TOLUENE-d8		03/09/2016	50	µg/L	110.	80.0-120
Lab Number: 16030533	**Sample Description: WRCDP-33(030316)**					
GC/FID Volatile						
4-BFB (8015D)		03/16/2016	100	µg/L	101	84.0-121
FLUOROBENZENE (8015D)		03/16/2016	100	µg/L	93.3	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/09/2016	100	µg/L	90.6	74.3-123
TOLUENE-d8		03/09/2016	100	µg/L	114	80.0-120
Lab Number: 16030534	**Sample Description: Trip Blank(030416)**					
GC/FID Volatile						
4-BFB (8015D)		03/17/2016	20	µg/L	97.9	84.0-121
FLUOROBENZENE (8015D)		03/17/2016	20	µg/L	93.4	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	102	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	98.0	80.0-120
Lab Number: 16030535	**Sample Description: WRCDP-105(030416)**					
GC/FID Volatile						
4-BFB (8015D)		03/17/2016	200	µg/L	101	84.0-121

Quality Control Report
Sample Surrogate Data

Client:	Coffeyville Resources		Date Reported: 03/18/2016
	Attn: Sam McCormick		Date Received: 03/04/2016
	10 E. Cambridge Circle Dr.		Pace File No: 8462
	Kansas City, KS 66103		Pace Order No: 131848

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16030535	**Sample Description:WRCDP-105(030416)**					
GC/FID Volatile						
FLUOROBENZENE (8015D)		03/17/2016	200	µg/L	94.8	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/09/2016	100	µg/L	84.6	74.3-123
TOLUENE-d8		03/09/2016	100	µg/L	109	80.0-120
Lab Number: 16030536	**Sample Description:WRCEB(030416)**					
GC/FID Volatile						
4-BFB (8015D)		03/16/2016	20	µg/L	96.4	84.0-121
FLUOROBENZENE (8015D)		03/16/2016	20	µg/L	90.2	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		03/08/2016	10	µg/L	103	74.3-123
TOLUENE-d8		03/08/2016	10	µg/L	96.9	80.0-120

Quality Control Report
Continuing Calibration Report

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 03/18/2016
Date Received: 03/04/2016
Pace File No: 8462
Pace Order No: 131848

Analysis	Date of Analysis	Instrument Batch ID	Amount in Standard	Amount Detected	Units	Percent Recovery
Oklahoma GRO	03/09/2016	1GC2069	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/09/2016	2GC2069	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/10/2016	3GC2069	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/16/2016	1GC2076	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/17/2016	2GC2076	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/17/2016	1GC2077	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	03/17/2016	2GC2077	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	03/14/2016	1EX4074	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	03/15/2016	2EX4074	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	03/15/2016	1EX4075	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	03/15/2016	2EX4075	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/08/2016	1MS8068	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/08/2016	2MS8068	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/09/2016	3MS8068	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/09/2016	1MS9069	CCV recovery acceptable for this Instrument Batch.			
BTEX	03/09/2016	2MS9069	CCV recovery acceptable for this Instrument Batch.			

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 131848

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:

Sampler's Name / Company:(Printed) Judy Andrews, Kevin Walter WSP USA

Sampler's Name:(Signature)

Purchase Order Number:

Project Name: WRC Interior Delineation

Facility Name / Address: WRC Wynnewood, OK

PARAMETERS/CONTAINER TYPE (preservative)

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER:	BTEX (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)						COMMENTS
WRCDP-91(022916)	GW	O	02/29/16	10:00	G	8	8						X	X	X						
WRCDP-97(022916)	GW	O	02/29/16	11:15	G	8	8						X	X	X						
WRCDP-102(022916)	GW	O	02/29/16	14:00	G	8	8						X	X	X						
WRCDP-70(022916)	GW	O	02/29/16	15:00	G	8	8						X	X	X						
WRCDP-94(022916)	GW	O	02/29/16	15:55	G	8	8						X	X	X						
WRCDP-88(022916)	GW	O	02/29/16	16:50	G	8	8						X	X	X						
WRCDP-87(022916)	GW	O	02/29/16	17:30	G	8	8						X	X	X						
WRCDP-37(030216)	GW	O	03/02/16	13:05	G	8	8						X	X	X						
WRCDP-37(030216) MS/MSD	GW	O	03/02/16	13:05	G	9	9						X	X	X						MS/MSD
WRCDP-58(030216)	GW	O	03/02/16	14:20	G	8	8						X	X	X						
WRCDP-39(030216)	GW	O	03/02/16	15:15	G	8	8						X	X	X						

Matrix (Sample Type): DW=Drinking Water, GW=Ground Water, WW=Waste Water, W=Wipe, S=Solid/Soil, SL=Sludge, A=Air, OL= Oil/Organic Liquid, O=Other,

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other, nR=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

RELINQUISHED BY:	DATE:	TIME:	RECEIVED BY:	DATE:	TIME:
	3-4-16	1220		3-4-16	1220
RELINQUISHED BY:	DATE: 3-4-16	TIME: 1710	RECEIVED BY:	DATE:	TIME:
RECEIVED AT LAB BY: Mclw [illegible]	DATE: 3-4-16	TIME: 17:10	SHIPPED VIA: AIRBILL:	SEAL #: SEAL DATE:	

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 131848

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:

Sampler's Name / Company:(Printed) Judy Andrews, Kevin Walter WSP USA
Sampler's Name:(Signature)
Purchase Order Number:
Project Name: WRC Interior Delineation
Facility Name / Address: WRC Wynnewood, OK

PARAMETERS/CONTAINER TYPE (preservative): BTEX (8020/8015) - 3x glass 40 ml vials (HCL); Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL); Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER:	BTEX (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)	COMMENTS
WRCDP-30(030216)	GW	O	03/02/16	16:15	G	8	8						X	X	X	
WRCDP-33(030316)	GW	O	03/03/16	13:55	G	8	8						X	X	X	
Trip Blank (030416)	GW	O	03/04/16	12:00	G	8	8						X	X	X	Provided by Lab
WRCDP-105(030416)	GW	O	3-4-16	9:50	G	8	8						X	X	X	
WRCEB(030416)	GW	O	3-4-16	10:40	G	8	8						X	X	X	Equipment Blank

Matrix (Sample Type): DW=Drinking Water, GW=Ground Water, WW=Waste Water, W=Wipe, S=Solid/Soil, SL=Sludge, A=Air, OL= Oil/Organic Liquid, O=Other,

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other, nR=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

	DATE:	TIME:		DATE:	TIME:
RELINQUISHED BY:	3-4-16	1220	RECEIVED BY:	3-4-16	1220
RELINQUISHED BY:	3-4-16	1716	RECEIVED BY:		
RECEIVED AT LAB BY: M W Sthrof	3-4-16	17:10	SHIPPED VIA: / AIRBILL:	SEAL #:	SEAL DATE:

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131848

Client Name: Coffeyville Resources LLC   Pace File No.: 8462

Sample ID's in cooler: See COC

Cooler 1 of 5 for this Pace Order No.

Cooler Identification: Pace Cooler #: 4117 / Client's Cooler / Box / Letter / Hand-delivered
Other: ____

Date/Time Cooler Received: 03/04/16 17:10

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other: ____

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: ____
Seal Name: ____ Seal Date: ____
Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other: ____

Cooler Temperature (°C): Original Reading (°C) 1.2 Corrected Reading (°C) 0.7
Temperature. By: Temperature Blank Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes (See below for discrepancies.)

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  Cover Letter ☐ Container ☐
  PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
  [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies: ____

Detail to discrepancies/comments:
5-LTA WRCDP-37
2-LTA WRCDP-87
2 LTA WRCDP-88

Completed by: SK Date Completed: 3-4-16

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131848

Client Name: Cottleyville Resources. **Pace File No.:** 8462

Sample ID's in cooler: See COC

Cooler 2 of 5 **for this Pace Order No.**

Cooler Identification: Pace Cooler #: 4202 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 03/04/16 17:10

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No:
Seal Name: Seal Date:
Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 2.5 Corrected Reading (°C) 2.0
Temperature. By: Temperature Blank Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

☐ Chain of Custody not present - information taken from:
Cover Letter ☐ Container ☐
PO ☐ Pace Proj. Mgr. ☐

☐ Container label absent

☐ Chain of Custody incomplete [see detail below]

☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)

☐ Date or Time sampled obtained from container label

☐ Chain of Custody missing sampler's name

☐ Chain of Custody missing matrix (sample type)

☐ Missing relinquished information: signature date time

☐ Sample excluded from Chain of Custody

☐ Sample listed on Chain of Custody, not received

☐ Sample identification on container and Chain of Custody do not agree

☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]

☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
[Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]

☐ Broken or leaking containers (detail actions below)

☐ Sample container type or labeled chemical preservation inappropriate

☐ Other discrepancies:

Detail to discrepancies/comments:
2-LTA WRCDP-30
2-LTA WRCDP-39
2-LTA WRCDP-58
2 LTA -Trip Blank.

Completed by: [signature] **Date Completed:** 3-4-16.

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131848

Client Name: Coffeyville Resources

Pace File No.: 8462

Sample ID's in cooler: See COC

Cooler 3 of 5 for this Pace Order No.

Cooler Identification: Pace Cooler #: 4116 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 03 04 16 17:10

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —

Seal Name: — Seal Date: —

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 2.1 Corrected Reading (°C) 1.6

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☒ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
  [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments:

VOC

Completed by: Date Completed:

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131 84 F

Client Name: Cottgwille Resources LLC Pace File No.: 8462

Sample ID's in cooler: See COC

Cooler 4 of 5 for this Pace Order No.

Cooler Identification: Pace Cooler #: 4108 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 03 04 16 17:10

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No:

Seal Name: Seal Date:

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 2.0 Corrected Reading (°C) 1.5

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments:

2-LTA WRCDP-105
2-LTA WRCEB
2-LTA WR CPP-33

Completed by: [signature] **Date Completed:**

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 131848

Client Name: Cotterville

Pace File No.: 8462

Sample ID's in cooler: See COC

Cooler 5 **of** 5 **for this Pace Order No.**

Cooler Identification: Pace Cooler #: 4112 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 03 04 16 17:10

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —
Seal Name: Seal Date: —
Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 1.2 Corrected Reading (°C) 0.7
Temperature. By: Temperature Blank Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☒ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments:

LTA 2- WRCDP-70 (2 LTA)
LTA 2- WRCDP-97
2-LTA WRCDP-94
2-LTA WRCDP-91
2-LTA WRCDP-102

Completed by: SH **Date Completed:** 3-4-16

Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date and Time Received: 04/04/2016 1550
Pace File No.: 8462
Pace Order No.: 132348
Project ID: WRC Wynnewood

Dear Mr. McCormick:

This laboratory report, containing the samples indicated below, includes 27 pages for the analytical report, 3 page(s) for the chain of custody and/or analysis request, and 6 page(s) for the sample receipt form.

PACE LAB ID #	SAMPLE DESCRIPTION	SAMPLE TYPE	DATE SAMPLED
16040144	Trip Blank	Liquid	3/30/2016
16040145	WRCDP-45(033016)	Liquid	3/30/2016
16040146	WRCDP-DUPE3	Liquid	3/30/2016
16040147	WRCDP-53(033016)	Liquid	3/30/2016
16040148	WRCDP-111(033016)	Liquid	3/30/2016
16040149	WRCDP-55(033016)	Liquid	3/30/2016
16040150	WRCDP-51(033016)	Liquid	3/30/2016
16040151	WRCDP-56(033116)	Liquid	3/31/2016
16040152	WRCDP-48(033116)	Liquid	3/31/2016
16040153	WRCDP-85(033116)	Liquid	3/31/2016
16040154	WRCDP-83(033116)	Liquid	3/31/2016
16040155	WRCDP-72(040116)	Liquid	4/1/2016
16040156	WRCDP-71(040116)	Liquid	4/1/2016
16040157	WRCDP-80(040116)	Liquid	4/1/2016
16040158	WRCDP-86(040116)	Liquid	4/1/2016
16040159	WRCDP-99(040116)	Liquid	4/1/2016
16040160	WRCDP-106(040116)	Liquid	4/1/2016
16040161	WRCDP-89(040216)	Liquid	4/2/2016
16040162	WRCDP-107(040216)	Liquid	4/2/2016
16040163	WRCDP-108(040216)	Liquid	4/2/2016
16040164	WRCDP-112(040216)	Liquid	4/2/2016
16040165	WRCDP-113(040216)	Liquid	4/2/2016

The Appendix and Quality Control sections are integral parts of this laboratory report and may contain important data qualifiers.

All results are reported on a wet weight basis unless otherwise stated.

Samples will be retained for thirty days unless Pace is otherwise notified. Pace is accredited by the State of Kansas through the National Environmental Laboratory Accreditation Program (NELAP). The results contained in this report were obtained using Pace's Standard Operating Procedures. These procedures are in substantial compliance with the approved methods referenced and the standards published by NELAP unless otherwise noted in the Appendix and Quality Control sections of this report.

Thank you for choosing Pace for this project.

Gregory J. Groene
Project Manager
Gregory.Groene@pacelabs.com

Sample Results

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Lab Number: 16040144
Sample Description: Trip Blank

Date Sampled: 03/30/2016
Time Sampled: 0800

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 0954	1GC2097	1GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/05/16 1428	160405-1	1EX4096	SPA	OK DRO
BTEX	N/A	04/05/16 1713	1MS8096	1MS8096	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040144

Lab Number: 16040145
Sample Description: WRCDP-45(033016)

Date Sampled: 03/30/2016
Time Sampled: 0845

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	23200	µg/L	50	1000	1000
Oklahoma DRO	4500	µg/L	10	1000	1000
BTEX					
Benzene	4820	µg/L	200	8	200
Toluene	3880	µg/L	200	10	200
Ethylbenzene	600	µg/L	200	20	200
m+p-Xylene	1960	µg/L	200	10	200
o-Xylene	990	µg/L	200	20	200

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 04/18/2016 Date Received: 04/04/2016 Pace File No: 8462 Pace Order No: 132348

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1026	1GC2097	1GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/05/16 2240	160405-1	2EX4096	SPA	OK DRO
BTEX	N/A	04/07/16 1648	1MS8098	1MS8098	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040145

Lab Number: 16040146
Sample Description: WRCDP-DUPE3

Date Sampled: 03/30/2016
Time Sampled: 0845

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	24400	µg/L	50	1000	1000
Oklahoma DRO	3400	µg/L	10	1000	1000
BTEX					
Benzene	5090	µg/L	200	8	200
Toluene	4130	µg/L	200	10	200
Ethylbenzene	640	µg/L	200	20	200
m+p-Xylene	2060	µg/L	200	10	200
o-Xylene	1000	µg/L	200	20	200

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1539	1GC2097	1GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/05/16 2308	160405-1	2EX4096	SPA	OK DRO
BTEX	N/A	04/07/16 1723	1MS8098	1MS8098	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040146

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 04/18/2016 Date Received: 04/04/2016 Pace File No: 8462 Pace Order No: 132348

Lab Number: 16040147
Sample Description: WRCDP-53(033016)

Date Sampled: 03/30/2016
Time Sampled: 1000

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	503	µg/L	2.0	40	40
Oklahoma DRO	1600	µg/L	2.0	200	200
BTEX					
Benzene	5.16	µg/L	1.0	0.04	1.0
Toluene	0.30 J	µg/L	1.0	0.06	1.0
Ethylbenzene	2.7	µg/L	1.0	0.1	1.0
m+p-Xylene	15.6	µg/L	1.0	0.06	1.0
o-Xylene	6.2	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1819	2GC2097	2GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/06/16 1120	160405-1	1EX4097	SPA	OK DRO
BTEX	N/A	04/07/16 1759	1MS8098	1MS8098	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040147

Lab Number: 16040148
Sample Description: WRCDP-111(033016)

Date Sampled: 03/30/2016
Time Sampled: 1040

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	260	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103	Date Reported: 04/18/2016 Date Received: 04/04/2016 Pace File No: 8462 Pace Order No: 132348

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1129	1GC2097	1GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/05/16 1624	160405-1	1EX4096	SPA	OK DRO
BTEX	N/A	04/05/16 1749	1MS8096	1MS8096	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040148

Lab Number: 16040149
Sample Description: WRCDP-55(033016)

Date Sampled: 03/30/2016
Time Sampled: 1400

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	2120	µg/L	4.0	80	80
Oklahoma DRO	4200	µg/L	10	1000	1000
BTEX					
Benzene	11.4	µg/L	5.0	0.2	5
Toluene	1.9 J	µg/L	5.0	0.3	5
Ethylbenzene	107	µg/L	5.0	0.5	5
m+p-Xylene	10.2	µg/L	5.0	0.3	5
o-Xylene	ND	µg/L	5.0	0.5	5

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/07/16 1445	1GC2098	1GC2098	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/05/16 2337	160405-1	2EX4096	SPA	OK DRO
BTEX	N/A	04/06/16 1637	1MS8097	1MS8097	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040149

Client:	Coffeyville Resources		Date Reported: 04/18/2016
	Attn: Sam McCormick		Date Received: 04/04/2016
	10 E. Cambridge Circle Dr.		Pace File No: 8462
	Kansas City, KS 66103		Pace Order No: 132348

Lab Number: 16040150 — Date Sampled: 03/30/2016
Sample Description: WRCDP-51(033016) — Time Sampled: 1450

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	390	µg/L	1.0	100	100
BTEX					
Benzene	0.05 J	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1748	2GC2097	2GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/06/16 0006	160405-1	2EX4096	SPA	OK DRO
BTEX	N/A	04/05/16 1825	1MS8096	1MS8096	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040150

Lab Number: 16040151 — Date Sampled: 03/31/2016
Sample Description: WRCDP-56(033116) — Time Sampled: 0920

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	140	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client:	Coffeyville Resources	Date Reported:	04/18/2016
	Attn: Sam McCormick	Date Received:	04/04/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	132348

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1302	1GC2097	1GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/05/16 1751	160405-1	1EX4096	SPA	OK DRO
BTEX	N/A	04/06/16 1449	1MS8097	1MS8097	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040151

Lab Number: 16040152
Sample Description: WRCDP-48(033116)

Date Sampled: 03/31/2016
Time Sampled: 1040

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	190	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1436	1GC2097	1GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/06/16 1051	160405-1	1EX4097	SPA	OK DRO
BTEX	N/A	04/05/16 1900	1MS8096	1MS8096	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040152

Client:	Coffeyville Resources Attn: Sam McCormick 10 E. Cambridge Circle Dr. Kansas City, KS 66103		Date Reported: 04/18/2016 Date Received: 04/04/2016 Pace File No: 8462 Pace Order No: 132348

Lab Number: 16040153
Sample Description: WRCDP-85(033116)

Date Sampled: 03/31/2016
Time Sampled: 1410

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	220	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1508	1GC2097	1GC2097	SPA	OK GRO
Oklahoma DRO	04/05/16 0715	04/05/16 1947	160405-1	1EX4096	SPA	OK DRO
BTEX	N/A	04/05/16 1936	1MS8096	1MS8096	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040153

Lab Number: 16040154
Sample Description: WRCDP-83(033116)

Date Sampled: 03/31/2016
Time Sampled: 1545

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	890 QC	µg/L	1.0	100	100
BTEX					
Benzene	0.10 J	µg/L	1.0	0.04	1.0
Toluene	0.15 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.12 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/07/16 1033	1GC2098	1GC2098	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/07/16 2047	160406-2	1EX4098	SPA	OK DRO
BTEX	N/A	04/05/16 2012	1MS8096	1MS8096	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040154

Lab Number: 16040155
Sample Description: WRCDP-72(040116)

Date Sampled: 04/01/2016
Time Sampled: 0910

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	1400	µg/L	2.0	200	200
BTEX					
Benzene	0.06 J	µg/L	1.0	0.04	1.0
Toluene	0.10 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.17 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 1954	2GC2097	2GC2097	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/08/16 1129	160406-2	1EX4099	SPA	OK DRO
BTEX	N/A	04/05/16 2048	1MS8096	1MS8096	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040155

Client:	Coffeyville Resources		Date Reported: 04/18/2016
	Attn: Sam McCormick		Date Received: 04/04/2016
	10 E. Cambridge Circle Dr.		Pace File No: 8462
	Kansas City, KS 66103		Pace Order No: 132348

Lab Number: 16040156 | Date Sampled: 04/01/2016
Sample Description: WRCDP-71(040116) | Time Sampled: 0945

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	1700	µg/L	4.0	400	400
BTEX					
Benzene	0.05 J	µg/L	1.0	0.04	1.0
Toluene	0.08 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 2026	2GC2097	2GC2097	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/08/16 1158	160406-2	1EX4099	SPA	OK DRO
BTEX	N/A	04/05/16 1530	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040156

Lab Number: 16040157 | Date Sampled: 04/01/2016
Sample Description: WRCDP-80(040116) | Time Sampled: 1250

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	480	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

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Sample Results

Client:	Coffeyville Resources	Date Reported: 04/18/2016	
	Attn: Sam McCormick	Date Received: 04/04/2016	
	10 E. Cambridge Circle Dr.	Pace File No: 8462	
	Kansas City, KS 66103	Pace Order No: 132348	

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 2201	2GC2097	2GC2097	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/08/16 1353	160406-2	1EX4099	SPA	OK DRO
BTEX	N/A	04/05/16 1555	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040157

Lab Number: 16040158
Sample Description: WRCDP-86(040116)

Date Sampled: 04/01/2016
Time Sampled: 1320

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	Reporting Limit LOQ
Oklahoma GRO	411 SR	µg/L	1.0	20	20
Oklahoma DRO	4400	µg/L	10	1000	1000
BTEX					
Benzene	0.32 J	µg/L	1.0	0.04	1.0
Toluene	0.25 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.52 J	µg/L	1.0	0.06	1.0
o-Xylene	0.3 J	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/07/16 1517	1GC2098	1GC2098	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/08/16 1227	160406-2	1EX4099	SPA	OK DRO
BTEX	N/A	04/06/16 1412	1MS8097	1MS8097	GMA	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040158

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Lab Number: 16040159
Sample Description: WRCDP-99(040116)

Date Sampled: 04/01/2016
Time Sampled: 1425

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	940	µg/L	2.0	200	200
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 2304	2GC2097	2GC2097	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/08/16 1800	160406-2	2EX4099	SPA	OK DRO
BTEX	N/A	04/05/16 1620	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040159

Lab Number: 16040160
Sample Description: WRCDP-106(040116)

Date Sampled: 04/01/2016
Time Sampled: 1510

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	260	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	0.20 J	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	0.16 J	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/06/16 2335	2GC2097	2GC2097	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/08/16 1003	160406-2	1EX4099	SPA	OK DRO
BTEX	N/A	04/05/16 1645	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040160

Lab Number: 16040161
Sample Description: WRCDP-89(040216)

Date Sampled: 04/02/2016
Time Sampled: 0940

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	32	µg/L	1.0	20	20
Oklahoma DRO	150	µg/L	1.0	100	100
BTEX					
Benzene	0.06 J	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/07/16 1105	1GC2098	1GC2098	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/07/16 1921	160406-2	1EX4098	SPA	OK DRO
BTEX	N/A	04/05/16 1710	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040161

Client:	Coffeyville Resources		Date Reported: 04/18/2016
	Attn: Sam McCormick		Date Received: 04/04/2016
	10 E. Cambridge Circle Dr.		Pace File No: 8462
	Kansas City, KS 66103		Pace Order No: 132348

Lab Number: 16040162 Date Sampled: 04/02/2016
Sample Description: WRCDP-107(040216) Time Sampled: 1115

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/07/16 1136	1GC2098	1GC2098	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/07/16 1950	160406-2	1EX4098	SPA	OK DRO
BTEX	N/A	04/05/16 1734	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040162

Lab Number: 16040163 Date Sampled: 04/02/2016
Sample Description: WRCDP-108(040216) Time Sampled: 1320

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	ND	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)

-Continued-

Sample Results

Client: Coffeyville Resources	Date Reported: 04/18/2016
Attn: Sam McCormick	Date Received: 04/04/2016
10 E. Cambridge Circle Dr.	Pace File No: 8462
Kansas City, KS 66103	Pace Order No: 132348

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/07/16 1207	1GC2098	1GC2098	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/07/16 2018	160406-2	1EX4098	SPA	OK DRO
BTEX	N/A	04/05/16 1759	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040163

Lab Number: 16040164
Sample Description: WRCDP-112(040216)

Date Sampled: 04/02/2016
Time Sampled: 1440

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	ND	µg/L	1.0	20	20
Oklahoma DRO	560 QC	µg/L	1.0	100	100
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/07/16 1239	1GC2098	1GC2098	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/08/16 0134	160406-3	2EX4098	SPA	OK DRO
BTEX	N/A	04/05/16 1824	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040164

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Lab Number: 16040165
Sample Description: WRCDP-113(040216)

Date Sampled: 04/02/2016
Time Sampled: 1610

Analysis	Concentration	Units	Dilution Factor	Reporting Limit LOD	LOQ
Oklahoma GRO	29	µg/L	1.0	20	20
Oklahoma DRO	1300	µg/L	2.0	200	200
BTEX					
Benzene	ND	µg/L	1.0	0.04	1.0
Toluene	ND	µg/L	1.0	0.06	1.0
Ethylbenzene	ND	µg/L	1.0	0.1	1.0
m+p-Xylene	ND	µg/L	1.0	0.06	1.0
o-Xylene	ND	µg/L	1.0	0.1	1.0

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Oklahoma GRO	N/A	04/07/16 1414	1GC2098	1GC2098	SPA	OK GRO
Oklahoma DRO	04/06/16 1300	04/08/16 1256	160406-3	1EX4099	SPA	OK DRO
BTEX	N/A	04/05/16 1849	1MS9096	1MS9096	RKR	8260B
Volatile Analysis Preparation Method						5030B
GC/FID Volatile Preparation Method						5030B
OK DRO Preparation Method						OK DRO

Conclusion of Lab Number: 16040165

Appendix

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

ND indicates not detected with the Limit of Detection (LOD) in parentheses. The Method Detection Limit (MDL) is a calculated value representing the lowest concentration, that based on a statistical calculation represents the lowest concentration that theoretically, can be detected. The MDL is equivalent to the LOD. The Limit of Quantitation (LOQ) is the lowest concentration of the analytical standard that was used for calibrating the instrument. If an analytical standard is analyzed at the LOQ, an error of as much as +/- 50% can be expected. The MDL and LOQ values have been adjusted for the dilution factor and percent solids, as applicable. Due to rounding differences these values may vary slightly from the reported concentration. N/A, if present, indicates Not Applicable.

All samples which require cooling were received at a temperature of less than 6 degrees Celsius.

No analysis with a holding time of seventy-two hours or less was performed in this Pace order.

J - The concentration or not detected (ND) value is below the Limit of Quantitation (LOQ) and is considered an estimated value.

QC - QC data qualifiers were noted. See the Quality Control Report.

SR - One or more surrogate recoveries for this analysis did not meet quality control limits. Please see the Quality Control Report for the sample surrogate data.

Accreditation Summary

Client:	Coffeyville Resources	Date Reported:	04/18/2016
	Sam McCormick	Date Received:	04/04/2016
	10 E. Cambridge Circle Dr.	Pace File No:	8462
	Kansas City, KS 66103	Pace Order No:	132348

NELAP accreditation is issued under each EPA regulatory program for a given matrix/analyte/method combination. Pace is NELAP accredited for each matrix/analyte/method and EPA program cited in this Laboratory Report, except for those listed in the table below and for analyses performed in the field. For most of the analyses listed in the table, NELAP accreditation is not offered under the listed EPA program and Pace is NELAP accredited for the analysis, using the same analytical technology, but under a different EPA program. Pace's full NELAP accreditation status may be viewed at www.kdheks.gov/envlab. Note that unless qualified otherwise in the Laboratory Report, Pace performs all analyses, including each analysis listed in the table below, utilizing NELAP protocol.

Test	Analysis	Matrix-Regulatory Program	Method	Pace NELAP Accredited in Other Reg. Program
Pace is accredited for all analytes.				

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Quality Control Report
Batch Summary

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Test Code	Testname	QC Batch	Method Blank Date/Time Analyzed	LCS Date/Time Analyzed	MS Lab No. Date/Time Analyzed
CL108	Oklahoma GRO	1GC2097	BLK1GC2097 04/06/16 0923	LCS1GC2097 04/06/16 0852	16040151MS 04/06/16 1333
Lab numbers associated with this batch: 16040144 16040145 16040146 16040148 16040151 16040152 16040153					
CL108	Oklahoma GRO	2GC2097	BLK2GC2097 04/06/16 1717	LCS2GC2097 04/06/16 1646	16040156MS 04/06/16 2058
Lab numbers associated with this batch: 16040147 16040150 16040155 16040156 16040157 16040159 16040160					
CL108	Oklahoma GRO	1GC2098	BLK1GC2098 04/07/16 1002	LCS1GC2098 04/07/16 0930	16040164MS 04/07/16 1311
Lab numbers associated with this batch: 16040149 16040154 16040158 16040161 16040162 16040163 16040164 16040165					
CL122	Oklahoma DRO	160405-1	160405BLK1 04/05/16 1301	160405LCS1 04/05/16 1330	16040151MS 04/05/16 1820
Lab numbers associated with this batch: 16040144 16040145 16040146 16040147 16040148 16040149 16040150 16040151 16040152 16040153					
CL122	Oklahoma DRO	160406-2	160406BLK2 04/07/16 1432	160406LCS2 04/07/16 1501	16040154MS 04/07/16 2116
Lab numbers associated with this batch: 16040154 16040155 16040156 16040157 16040158 16040159 16040160 16040161 16040162 16040163					
CL122	Oklahoma DRO	160406-3	160406BLK3 04/07/16 2311	160406LCS3 04/07/16 2339	16040164MS 04/08/16 0203
Lab numbers associated with this batch: 16040164 16040165					
MS295	BTEX	1MS8096	BLK1MS8096 04/05/16 1621	LCS1MS8096 04/05/16 1510	
Lab numbers associated with this batch: 16040144 16040148 16040150 16040152 16040153 16040154 16040155					
MS295	BTEX	1MS9096	BLK1MS9096 04/05/16 1505	LCS1MS9096 04/05/16 1416	
Lab numbers associated with this batch: 16040156 16040157 16040159 16040160 16040161 16040162 16040163 16040164 16040165					
MS295	BTEX	1MS8097	BLK1MS8097 04/06/16 1036	LCS1MS8097 04/06/16 0924	16040151MS 04/06/16 1524
Lab numbers associated with this batch: 16040149 16040151 16040158					
MS295	BTEX	1MS8098	BLK1MS8098 04/07/16 1612	LCS1MS8098 04/07/16 1500	16040275MS 04/07/16 2058
Lab numbers associated with this batch: 16040145 16040146 16040147					

Quality Control Report
Method Blank, LCS, MS/MSD Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Analysis	Method Blank	LCS % Rec	LCS Limits	LCS Spike Level	Units	Spiked Sample (% Recovery) MS	MSD	MS/MSD Limits	MS/MSD Spike Level	Units	Spiked Sample Precision Data RPD	Limit
QC Batch: 160405-1	**For samples prepared on: 04/05/2016 0715**					**Spiked sample: 16040151**						
Oklahoma DRO	ND(100)	93.6	80.0-120	500	µg/L	86.0	81.3	80.0-120	500	µg/L	5.60	20.0
QC Batch: 160406-2	**For samples prepared on: 04/06/2016 1300**					**Spiked sample: 16040154**						
Oklahoma DRO	ND(100)	110	80.0-120	500	µg/L	37.3 ML	F	80.0-120	559	µg/L	**	20.0
QC Batch: 160406-3	**For samples prepared on: 04/06/2016 1300**					**Spiked sample: 16040164**						
Oklahoma DRO	ND(100)	99.0	80.0-120	500	µg/L	43.5 ML	F	80.0-120	500	µg/L	**	20.0
QC Batch: 1GC2097	**For sample analyzed on: 04/06/2016**					**Spiked sample: 16040151**						
Oklahoma GRO	ND(20)	99.3	80.0-120	200	µg/L	98.5	102	80.0-120	200	µg/L	3.50	20.0
Surrogate Data:												
4-BFB (8015D)	92.4	93.4	84.0-121	20.0	µg/L	93.3	94.6	84.0-121	20.0	µg/L		
FLUOROBENZENE (8015D)	101	101	71.7-132	20.0	µg/L	101	99.0	71.7-132	20.0	µg/L		
QC Batch: 1GC2098	**For sample analyzed on: 04/07/2016**					**Spiked sample: 16040164**						
Oklahoma GRO	ND(20)	100.	80.0-120	200	µg/L	102	100.	80.0-120	200	µg/L	2.00	20.0
Surrogate Data:												
4-BFB (8015D)	90.5	94.2	84.0-121	20.0	µg/L	95.5	92.5	84.0-121	20.0	µg/L		
FLUOROBENZENE (8015D)	97.9	99.6	71.7-132	20.0	µg/L	99.4	97.8	71.7-132	20.0	µg/L		
QC Batch: 1MS8096	**For sample analyzed on: 04/05/2016**					**Spiked sample:**						
BTEX						MN	MN					
Benzene	ND(0.04)	103	80.0-120	10.0	µg/L			79.6-118		µg/L	**	9.8
Toluene	ND(0.06)	99.7	80.0-120	10.0	µg/L			89.7-116		µg/L	**	8.0
Ethylbenzene	ND(0.1)	96.4	80.0-120	10.0	µg/L			89.1-114		µg/L	**	6.5
m+p-Xylene	ND(0.06)	95.7	80.0-120	20.0	µg/L			88.6-116		µg/L	**	6.7
o-Xylene	ND(0.1)	97.5	80.0-120	10.0	µg/L			88.3-115		µg/L	**	8.1
Surrogate Data:												
1,2-DICHLOROETHANE-d4	97.9	96.1	74.3-123	10.0	µg/L	MN	MN	74.3-123		µg/L	**	
TOLUENE-d8	97.0	100.	80.0-120	10.0	µg/L	MN	MN	80.0-120		µg/L	**	
QC Batch: 1MS8097	**For sample analyzed on: 04/06/2016**					**Spiked sample: 16040151**						
BTEX												
Benzene	ND(0.04)	108	80.0-120	10.0	µg/L	107	109	79.6-118	10.0	µg/L	1.90	9.8
Toluene	ND(0.06)	99.3	80.0-120	10.0	µg/L	98.8	98.3	89.7-116	10.0	µg/L	0.50	8.0
Ethylbenzene	ND(0.1)	96.0	80.0-120	10.0	µg/L	92.7	92.4	89.1-114	10.0	µg/L	0.30	6.5
m+p-Xylene	ND(0.06)	95.1	80.0-120	20.0	µg/L	91.1	90.3	88.6-116	20.0	µg/L	0.90	6.7
o-Xylene	ND(0.1)	97.0	80.0-120	10.0	µg/L	94.2	96.1	88.3-115	10.0	µg/L	2.00	8.1
Surrogate Data:												
1,2-DICHLOROETHANE-d4	100.	97.1	74.3-123	10.0	µg/L	106	108	74.3-123	10.0	µg/L		
TOLUENE-d8	94.7	96.7	80.0-120	10.0	µg/L	98.3	99.2	80.0-120	10.0	µg/L		
QC Batch: 1MS8098	**For sample analyzed on: 04/07/2016**					**Spiked sample: 16040275**						
BTEX						MN	MN					
Benzene	ND(0.04)	90.9	80.0-120	10.0	µg/L			79.6-118	10.0	µg/L	**	9.8
Toluene	ND(0.06)	86.1	80.0-120	10.0	µg/L			89.7-116	10.0	µg/L	**	8.0
Ethylbenzene	ND(0.1)	82.3	80.0-120	10.0	µg/L			89.1-114	10.0	µg/L	**	6.5
m+p-Xylene	ND(0.06)	81.2	80.0-120	20.0	µg/L			88.6-116	20.0	µg/L	**	6.7
o-Xylene	ND(0.1)	84.5	80.0-120	10.0	µg/L			88.3-115	10.0	µg/L	**	8.1
Surrogate Data:												
1,2-DICHLOROETHANE-d4	98.9	95.4	74.3-123	10.0	µg/L	MN	MN	74.3-123	10.0	µg/L	**	
TOLUENE-d8	95.5	97.3	80.0-120	10.0	µg/L	MN	MN	80.0-120	10.0	µg/L	**	

Quality Control Report
Method Blank, LCS, MS/MSD Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Analysis	Method Blank	LCS % Rec	LCS Limits	LCS Spike Level	Units	Spiked Sample (% Recovery) MS	MSD	MS/MSD Limits	MS/MSD Spike Level	Units	Spiked Sample Precision Data RPD	Limit
QC Batch: 1MS9096	**For sample analyzed on: 04/05/2016**					**Spiked sample:**						
BTEX						MN	MN					
Benzene	ND(0.04)	98.6	80.0-120	10.0	µg/L			79.6-118		µg/L	**	9.8
Toluene	ND(0.06)	107	80.0-120	10.0	µg/L			89.7-116		µg/L	**	8.0
Ethylbenzene	ND(0.1)	104	80.0-120	10.0	µg/L			89.1-114		µg/L	**	6.5
m+p-Xylene	ND(0.06)	106	80.0-120	20.0	µg/L			88.6-116		µg/L	**	6.7
o-Xylene	ND(0.1)	105	80.0-120	10.0	µg/L			88.3-115		µg/L	**	8.1
Surrogate Data:												
1,2-DICHLOROETHANE-d4	99.3	96.0	74.3-123	10.0	µg/L	MN	MN	74.3-123		µg/L	**	
TOLUENE-d8	107	112	80.0-120	10.0	µg/L	MN	MN	80.0-120		µg/L	**	
QC Batch: 2GC2097	**For sample analyzed on: 04/06/2016**					**Spiked sample: 16040156**						
Oklahoma GRO	ND(20)	102	80.0-120	200	µg/L	105	104	80.0-120	200	µg/L	1.00	20.0
Surrogate Data:												
4-BFB (8015D)	92.7	96.8	84.0-121	20.0	µg/L	97.2	95.3	84.0-121	20.0	µg/L		
FLUOROBENZENE (8015D)	102	102	71.7-132	20.0	µg/L	101	102	71.7-132	20.0	µg/L		

Data Qualifiers:

ML - The matrix spike and/or matrix spike duplicate recovery for this analyte was below the method or laboratory control limit. See LCS data for the basis for acceptance of this sample. The reported sample concentration is estimated.

F - MS and/or MSD sample data are not available due to insufficient sample volume.

MN - The MS/MSD sample analyses were not performed on a sample from this Pace order number.

** - RPD calculation not applicable/not available for this analysis.

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16040144	**Sample Description: Trip Blank**					
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	93.6	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	94.3	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	95.9	80.0-120
Lab Number: 16040145	**Sample Description: WRCDP-45(033016)**					
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	1000	µg/L	96.5	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	1000	µg/L	106	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/07/2016	2000	µg/L	100.	74.3-123
TOLUENE-d8		04/07/2016	2000	µg/L	96.0	80.0-120
Lab Number: 16040146	**Sample Description: WRCDP-DUPE3**					
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	1000	µg/L	93.6	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	1000	µg/L	106	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/07/2016	2000	µg/L	98.5	74.3-123
TOLUENE-d8		04/07/2016	2000	µg/L	95.3	80.0-120
Lab Number: 16040147	**Sample Description: WRCDP-53(033016)**					
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	40	µg/L	96.5	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	40	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/07/2016	10	µg/L	100.	74.3-123
TOLUENE-d8		04/07/2016	10	µg/L	97.6	80.0-120
Lab Number: 16040148	**Sample Description: WRCDP-111(033016)**					
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	94.7	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	102	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	98.3	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	95.8	80.0-120
Lab Number: 16040149	**Sample Description: WRCDP-55(033016)**					
GC/FID Volatile						
4-BFB (8015D)		04/07/2016	80	µg/L	98.5	84.0-121
FLUOROBENZENE (8015D)		04/07/2016	80	µg/L	98.9	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/06/2016	50	µg/L	104	74.3-123
TOLUENE-d8		04/06/2016	50	µg/L	98.1	80.0-120
Lab Number: 16040150	**Sample Description: WRCDP-51(033016)**					
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	92.7	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	100.	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	97.1	74.3-123

Quality Control Report
Sample Surrogate Data

Client:	Coffeyville Resources	Date Reported: 04/18/2016
	Attn: Sam McCormick	Date Received: 04/04/2016
	10 E. Cambridge Circle Dr.	Pace File No: 8462
	Kansas City, KS 66103	Pace Order No: 132348

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16040150		**Sample Description: WRCDP-51(033016)**				
BTEX						
TOLUENE-d8		04/05/2016	10	µg/L	96.1	80.0-120
Lab Number: 16040151		**Sample Description: WRCDP-56(033116)**				
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	94.1	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	102	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/06/2016	10	µg/L	104	74.3-123
TOLUENE-d8		04/06/2016	10	µg/L	96.9	80.0-120
Lab Number: 16040152		**Sample Description: WRCDP-48(033116)**				
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	91.7	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	99.9	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	95.9	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	95.5	80.0-120
Lab Number: 16040153		**Sample Description: WRCDP-85(033116)**				
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	89.3	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	95.7	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	96.3	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	97.2	80.0-120
Lab Number: 16040154		**Sample Description: WRCDP-83(033116)**				
GC/FID Volatile						
4-BFB (8015D)		04/07/2016	20	µg/L	93.2	84.0-121
FLUOROBENZENE (8015D)		04/07/2016	20	µg/L	99.4	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	98.3	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	95.5	80.0-120
Lab Number: 16040155		**Sample Description: WRCDP-72(040116)**				
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	93.1	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	99.6	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	95.8	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	97.4	80.0-120
Lab Number: 16040156		**Sample Description: WRCDP-71(040116)**				
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	92.7	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	100.	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	96.8	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	106	80.0-120
Lab Number: 16040157		**Sample Description: WRCDP-80(040116)**				
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	89.1	84.0-121

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16040157		**Sample Description: WRCDP-80(040116)**				
GC/FID Volatile						
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	100.	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	98.7	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	107	80.0-120
Lab Number: 16040158		**Sample Description: WRCDP-86(040116)**				
GC/FID Volatile						
4-BFB (8015D)		04/07/2016	20	µg/L	122 SI	84.0-121
FLUOROBENZENE (8015D)		04/07/2016	20	µg/L	98.8	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/06/2016	10	µg/L	104	74.3-123
TOLUENE-d8		04/06/2016	10	µg/L	97.3	80.0-120
Lab Number: 16040159		**Sample Description: WRCDP-99(040116)**				
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	89.6	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	99.2	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	100.	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	106	80.0-120
Lab Number: 16040160		**Sample Description: WRCDP-106(040116)**				
GC/FID Volatile						
4-BFB (8015D)		04/06/2016	20	µg/L	88.0	84.0-121
FLUOROBENZENE (8015D)		04/06/2016	20	µg/L	96.4	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	96.7	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	106	80.0-120
Lab Number: 16040161		**Sample Description: WRCDP-89(040216)**				
GC/FID Volatile						
4-BFB (8015D)		04/07/2016	20	µg/L	94.6	84.0-121
FLUOROBENZENE (8015D)		04/07/2016	20	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	105	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	108	80.0-120
Lab Number: 16040162		**Sample Description: WRCDP-107(040216)**				
GC/FID Volatile						
4-BFB (8015D)		04/07/2016	20	µg/L	93.4	84.0-121
FLUOROBENZENE (8015D)		04/07/2016	20	µg/L	99.8	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	100.	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	107	80.0-120
Lab Number: 16040163		**Sample Description: WRCDP-108(040216)**				
GC/FID Volatile						
4-BFB (8015D)		04/07/2016	20	µg/L	91.9	84.0-121
FLUOROBENZENE (8015D)		04/07/2016	20	µg/L	99.3	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	97.3	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	107	80.0-120

Quality Control Report
Sample Surrogate Data

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 16040164	**Sample Description: WRCDP-112(040216)**					
GC/FID Volatile						
4-BFB (8015D)		04/07/2016	20	µg/L	93.0	84.0-121
FLUOROBENZENE (8015D)		04/07/2016	20	µg/L	99.4	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	96.8	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	105	80.0-120
Lab Number: 16040165	**Sample Description: WRCDP-113(040216)**					
GC/FID Volatile						
4-BFB (8015D)		04/07/2016	20	µg/L	91.2	84.0-121
FLUOROBENZENE (8015D)		04/07/2016	20	µg/L	101	71.7-132
BTEX						
1,2-DICHLOROETHANE-d4		04/05/2016	10	µg/L	99.3	74.3-123
TOLUENE-d8		04/05/2016	10	µg/L	106	80.0-120

Data Qualifiers:
SI - One or more surrogate recoveries for this analysis were not within the laboratory or method control limits. The sample result(s) or reporting limit(s) for this analysis are estimated due to sample matrix interferences.

Client: Coffeyville Resources
Attn: Sam McCormick
10 E. Cambridge Circle Dr.
Kansas City, KS 66103

Date Reported: 04/18/2016
Date Received: 04/04/2016
Pace File No: 8462
Pace Order No: 132348

Analysis	Date of Analysis	Instrument Batch ID	Amount in Standard	Amount Detected	Units	Percent Recovery
Oklahoma GRO	04/06/2016	1GC2097	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	04/06/2016	2GC2097	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	04/07/2016	3GC2097	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	04/07/2016	1GC2098	CCV recovery acceptable for this Instrument Batch.			
Oklahoma GRO	04/07/2016	2GC2098	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/05/2016	1EX4096	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/05/2016	2EX4096	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/06/2016	3EX4096	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/06/2016	1EX4097	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/06/2016	2EX4097	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/07/2016	1EX4098	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/07/2016	2EX4098	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/08/2016	3EX4098	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/08/2016	1EX4099	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/08/2016	2EX4099	CCV recovery acceptable for this Instrument Batch.			
Oklahoma DRO	04/08/2016	3EX4099	CCV recovery acceptable for this Instrument Batch.			
BTEX	04/05/2016	1MS8096	CCV recovery acceptable for this Instrument Batch.			
BTEX	04/06/2016	1MS8097	CCV recovery acceptable for this Instrument Batch.			
BTEX	04/06/2016	2MS8097	CCV recovery acceptable for this Instrument Batch.			
BTEX	04/07/2016	1MS8098	CCV recovery acceptable for this Instrument Batch.			
BTEX	04/08/2016	2MS8098	CCV recovery acceptable for this Instrument Batch.			
BTEX	04/05/2016	1MS9096	CCV recovery acceptable for this Instrument Batch.			
BTEX	04/05/2016	2MS9096	CCV recovery acceptable for this Instrument Batch.			

Pace Analytical Services, Inc.
525 N. Eighth St. - Salina, KS 67401
785-827-1273 800-535-3076 Fax 785-823-7830

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 132348

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:

Sampler's Name / Company:(Printed): Jerome McSorley
Sampler's Name:(Signature):
Purchase Order Number:
Project Name: WRC Interior Delineation
Facility Name / Address: WRC Wynnewood, OK

PARAMETERS/CONTAINER TYPE (preservative)

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER	BTEX (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)						COMMENTS
Trip Blank	O	O	03/30/16	8:00	G	8	8						X	X	X						Provided by Lab
WRCDP-45(033016)	GW	O	03/30/16	8:45	G	8	8						X	X	X						
WRCDP-DUPE3	GW	O	03/30/16	8:45	G	8	8						X	X	X						Duplicate
WRCDP-53(033016)	GW	O	03/30/16	10:00	G	8	8						X	X	X						
WRCDP-111(033016)	GW	O	03/30/16	10:40	G	8	8						X	X	X						
WRCDP-55(033016)	GW	O	03/30/16	14:00	G	8	8						X	X	X						
WRCDP-51(033016)	GW	O	03/30/16	14:50	G	8	8						X	X	X						
WRCDP-56(033116)	GW	O	03/31/16	9:20	G	8	8						X	X	X						
WRCDP-56 MS/MSD	GW	O	03/31/16	9:20	G	9	9						X	X	X						MS/MSD
WRCDP-48(033116)	GW	O	03/31/16	10:40	G	8	8						X	X	X						
WRCDP-85(033116)	GW	O	03/31/16	14:10	G	8	8						X	X	X						

Matrix (Sample Type): DW=Drinking Water, GW=Ground Water, WW=Waste Water, W=Wipe, S=Solid/Soil, SL=Sludge, A=Air, OL= Oil/Organic Liquid, O=Other,

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other, nR=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

	DATE	TIME		DATE	TIME
RELINQUISHED BY:	4-4-16	1100	RECEIVED BY:	4-4-16	1100
RELINQUISHED BY:	4-4-16	1550	RECEIVED BY:		
RECEIVED AT LAB BY:	4-4-16	1550	SHIPPED VIA: / AIRBILL:	SEAL #: / SEAL DATE:	

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Continental Analytical Services, Inc.
525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: 132348

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:
Sampler's Name / Company:(Printed) Jerome McSorley; Sampler's Name (Signature)	Purchase Order Number:
Project Name: WRC Interior Delineation; Facility Name / Address: WRC Wynnewood, OK	

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER	BTEX (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)							COMMENTS
WRCDP-83(033116)	GW	O	03/31/16	15:45	G	8	8						X	X	X							
WRCDP-72(040116)	GW	O	04/01/16	9:10	G	8	8						X	X	X							
WRCDP-71(040116)	GW	O	04/01/16	9:45	G	8	8						X	X	X							
WRCDP-80(040116)	GW	O	04/01/16	12:50	G	8	8						X	X	X							
WRCDP-86(040116)	GW	O	04/01/16	13:20	G	8	8						X	X	X							
WRCDP-99(040116)	GW	O	04/01/16	14:25	G	8	8						X	X	X							
WRCDP-106(040116)	GW	O	04/01/16	15:10	G	8	8						X	X	X							
WRCDP-89(040216)	GW	O	04/02/16	9:40	G	8	8						X	X	X							
WRCDP-107(040216)	GW	O	04/02/16	11:15	G	8	8						X	X	X							
WRCDP-108(040216)	GW	O	04/02/16	13:20	G	8	8						X	X	X							
WRCDP-112(040216)	GW	O	04/02/16	14:40	G	8	8						X	X	X							

Matrix (Sample Type): **DW**=Drinking Water, **GW**=Ground Water, **WW**=Waste Water, **W**=Wipe, **S**=Solid/Soil, **SL**=Sludge, **A**=Air, **OL**= Oil/Organic Liquid, **O**=Other,

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other, nR=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

RELINQUISHED BY:	DATE: 4-4-16	TIME: 1100	RECEIVED BY:	DATE: 4-4-16	TIME: 1100
RELINQUISHED BY:	DATE: 4-4-16	TIME: 1550	RECEIVED BY:	DATE:	TIME:
RECEIVED AT LAB BY:	DATE: 4-4-16	TIME: 1550	SHIPPED VIA: AIRBILL:	SEAL #: SEAL DATE:	

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Continental Analytical Services, Inc.

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CHAIN OF CUSTODY RECORD

Continental Order Number: 132348

Client/Reporting Information	Invoice Information
Company Name: Coffeyville Resources, LLC	Company Name: Coffeyville Resources, LLC
Address: 10 East Cambridge Circle Dr. / Suite 250	Address: 10 East Cambridge Circle Dr. / Suite 250
City: Kansas City State: Kansas Zip: 66103	City: Kansas City State: Kansas Zip: 66103
Contact: Sam McCormick / Jerome McSorley	Contact: Sam McCormick
E-mail: samccormick@cvrenergy.com / jdmcsorley@cvrenergy.com	E-mail:
Phone Number: 913-982-0457 Fax Number:	Phone Number: 913-982-0457 Fax Number:
Sampler's Name / Company:(Printed) Jerome McSorley	Sampler's Name:(Signature) [signature]
Project Name: WRC Interior Delineation	Facility Name / Address: WRC Wynnewood, OK
Purchase Order Number:	

PARAMETERS/CONTAINER TYPE (preservative)

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	HCl	NaOH	HNO3	H2SO4	NONE	OTHER:	BTEX (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma GRO (8020/8015) - 3x glass 40 ml vials (HCL)	Oklahoma DRO (8000/8100) - 2x amber 1L (HCL)							COMMENTS
WRCDP-113(040216)	GW	O	04/02/16	16:10	G	8	8						X	X	X							

Number of Preserved Bottles: HCl, NaOH, HNO3, H2SO4, NONE

Matrix (Sample Type): **DW**=Drinking Water, **GW**=Ground Water, **WW**=Waste Water, **W**=Wipe, **S**=Solid/Soil, **SL**=Sludge, **A**=Air, **OL**= Oil/Organic Liquid, **O**=Other,

Regulatory Program: **N**=NPDES, **R**=RCRA, **D**=Drinking Water, **SL**=503 Sludge, **O**=Other, **nR**=Non RCRA IMW

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (3 working days)

	DATE:	TIME:		DATE:	TIME:
RELINQUISHED BY: [signature]	4-4-16	1100	RECEIVED BY: [signature]	4-4-16	1100
RELINQUISHED BY: [signature]	4-4-16	1550	RECEIVED BY:	DATE:	TIME:
RECEIVED AT LAB BY: [signature]	4-4-16	1550	SHIPPED VIA: / AIRBILL:	SEAL #:	SEAL DATE:

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 132348

Client Name: Coffeyville

Pace File No.: 8462

Sample ID's in cooler: 1-LTA WRCDP-86, 2-LTA WRCDP-89, 2LTA WRCDP-99
2-LTA WRCDP-106, 2LTA WRCDP-107, 2LTA WRCDP-108
1-LTA WRCDP-112

Cooler 1 **of** 5 **for this Pace Order No.**

Cooler Identification: Pace Cooler #: 4120 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 4/4/16 15:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —
Seal Name: Seal Date: —
Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 2.4 Corrected Reading (°C) 1.9
Temperature. By: Temperature Blank Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
  [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments:

Completed by: SKR **Date Completed:** 4-4-16

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 132348

Client Name: Cottleville

Pace File No.: 8462

Sample ID's in cooler: 2-LTA WRCDP-48, 2-LTA WRCDP-51, 2-LTA WRCDP-55
5~~2~~-LTA WRCDP-56
SR 4-4-16

Cooler 2 of 5 for this Pace Order No.

Cooler Identification: Pace Cooler #: 4192 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 4/4/16 15:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —

Seal Name: — Seal Date: —

Seal matches Chain of Custody: Yes / No / NA

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 3.0 Corrected Reading (°C) 2.5

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

☐ Chain of Custody not present - information taken from:
  Cover Letter ☐ Container ☐
  PO ☐ Pace Proj. Mgr. ☐

☐ Container label absent

☐ Chain of Custody incomplete [see detail below]

☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)

☐ Date or Time sampled obtained from container label

☐ Chain of Custody missing sampler's name

☐ Chain of Custody missing matrix (sample type)

☐ Missing relinquished information: signature date time

☐ Sample excluded from Chain of Custody

☐ Sample listed on Chain of Custody, not received

☐ Sample identification on container and Chain of Custody do not agree

☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]

☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
[Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]

☐ Broken or leaking containers (detail actions below)

☐ Sample container type or labeled chemical preservation inappropriate

☐ Other discrepancies:

Detail to discrepancies/comments:

Completed by: SKR Date Completed: 4-4-16

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 132348

Client Name: Cotleywille.

Pace File No.: 8462

Sample ID's in cooler:

2-LTA WRCDP-Dup 3, 2LTA WRCDP-45, 2LTA WRCDP-53
2-LTA WRCDP-111 1-LTA WRCDP-112
2 LTA - TRIP Blanks.

Cooler 3 **of** 5 **for this Pace Order No.**

Cooler Identification: Pace Cooler #: 3920 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 4/4/16 15:50

Delivered By: UPS / FedX / AB Express / ~~Field Svcs~~ / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —

Seal Name: — Seal Date: —

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 1.0 Corrected Reading (°C) 0.5

Temperature. By: Temperature Blank · Surface Temperature
Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies:

Detail to discrepancies/comments:

Completed by: SL **Date Completed:** 4-4-16.

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 1323YF

Client Name: Cotteywille

Pace File No.: 8462

Sample ID's in cooler:

S-447 WRCP WRCAP-71-2LTA, 2LTA WRCAP-72, 2LTA WRCAP80
2-LTA WRCAP-83, 2LA WRCPP-85, 1LTA-WRCAP-86
1-LTA WRCAP-112

Cooler 4 of 5 for this Pace Order No.

Cooler Identification: Pace Cooler #: 4109 / Client's Cooler / Box / Letter / Hand-delivered
Other: ______

Date/Time Cooler Received: 4/4/16 15:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other: ______

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —

Seal Name: — Seal Date: —

Seal matches Chain of Custody: Yes / No / N/A

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other: ______

Cooler Temperature (°C): Original Reading (°C) 2.4 Corrected Reading (°C) 1.9

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☑ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ Pace Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☐ Missing relinquished information: signature date time
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample identification on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies: ______

Detail to discrepancies/comments:

Completed by: SKP Date Completed: 4-4-16

Pace Analytical
Cooler/Sample Receipt Form (C/S RF)

Pace Order No.: 13234 8

Client Name: Cottleville   Pace File No.: 8462

Sample ID's in cooler:

VOC'S
WRCDF- 113 2LA

Cooler 6 of 6 for this Pace Order No.

Cooler Identification: Pace Cooler #: 4149 / Client's Cooler / Box / Letter / Hand-delivered
Other:

Date/Time Cooler Received: 4/4/16 15:50

Delivered By: UPS / FedX / AB Express / Field Svcs / Mail / Walk-In / Other:

Custody Seal: Present: Intact / Broken Absent: ✓ Seal No: —

Seal Name: — Seal Date: —

Seal matches Chain of Custody: Yes / No / NA

Type of Packing Material: Blue Ice / Ice / Melted Ice / Bubble / Foam / Paper / Peanuts / Vermiculite / None / Other:

Cooler Temperature (°C): Original Reading (°C) 1.9 Corrected Reading (°C) 1.4

Temperature. By: Temperature Blank Surface Temperature

Thermo. ID No.: 585 Thermo. Correction Factor (°C): -0.5

☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☒ No ☐ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, Pace will proceed with analyses until/unless directed otherwise by the client.

☐ Chain of Custody not present - information taken from:
Cover Letter ☐ Container ☐
PO ☐ Pace Proj. Mgr. ☐
☐ Container label absent
☐ Chain of Custody incomplete [see detail below]
☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
☐ Date or Time sampled obtained from container label
☐ Chain of Custody missing sampler's name
☐ Chain of Custody missing matrix (sample type)
☐ Missing relinquished information: signature date time

☐ Sample excluded from Chain of Custody
☐ Sample listed on Chain of Custody, not received
☐ Sample identification on container and Chain of Custody do not agree
☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement
[Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
☐ Broken or leaking containers (detail actions below)
☐ Sample container type or labeled chemical preservation inappropriate
☐ Other discrepancies:

Detail to discrepancies/comments:

Completed by: SKR Date Completed: 4-4-16

Appendix E – Summary of API Gravity Results

Appendix E

Summary of API Gravity Results
Wynnewood Refining Company, LLC
Wynnewood, Oklahoma

Well ID	Date	API Gravity
BMW-5	09/21/15	58.5
BMW-6	09/21/15	24.8 (a)
BMW-6	09/22/15	9.4 (a)
BMW-24	09/21/15	56.8
BMW-26	09/21/15	54.9
LMW-13	09/21/15	37.4
NMW-2	09/21/15	48.2
NMW-3	09/21/15	43.5
NMW-6	09/21/15	40.3
NMW-9	09/21/15	64.3
NMW-10	09/21/15	70.9
NMW-12	09/21/15	57.0
NMW-19	09/21/15	49.5
NRW-6	09/22/15	32.1
NRW-7	09/22/15	32.1
OMW-3	09/21/15	40.8
OMW-4	09/21/15	33.1
ORW-2	09/21/15	34.2
ORW-3	09/21/15	35.5

Samples of Light Non-Aqueous Phase Liquid were analyzed at the WRC laboratory according to ASTM-D287 method.
All results presented in degrees (°).
(a) API Gravity values are anomolously low at BMW-6. Results are considered suspect and are not used in groundwater elevation corrections.

Appendix 7.1 – Grain-size Distribution and Bench-scale Results

May 26, 2016

Project No. 2015-213-001

Judy Andrews
WSP Environment & Energy
123 North Third St, Suite 507
Minneapolis, MN 55401

Transmittal
Laboratory Test Results
WRC Tracer Test 31400030-05

Please find attached the laboratory test results for the above referenced project. The tests were outlined on the Project Verification Form that was transmitted to your firm prior to the testing. The testing was performed in general accordance with the methods listed on the enclosed data sheets. The test results are believed to be representative of the samples that were submitted for testing and are indicative only of the specimens that were evaluated. We have no direct knowledge of the origin of the samples and imply no position with regard to the nature of the test results, i.e. pass/fail and no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization by our Client. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please contact our office.

Respectively submitted,
***Geotechnics, Inc*.**

David R. Backstrom
Laboratory Director

We understand that you have a choice in your laboratory services and we thank you for choosing Geotechnics.

DCN: Data Transmittal Letter Date: 1/28/05 Rev.: 1

SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	WSP Group	Boring No.:	WRC-NBA
Client Reference:	WRC Tracer Test 31400030-05	Depth (ft):	NA
Project No.:	2016-213-001	Sample No.:	Soil (050316)
Lab ID:	2016-213-001-001	Soil Color:	Reddish Brown

USCS Symbol:

sp-sm, ASSUMED

D60 = 0.22 CC = 0.88

USCS Classification:

D30 = 0.14 CU = 2.18

POORLY GRADED SAND WITH SILT

(UNABLE TO RUN HYDRO)(INSUFFICIENT FINES)

D10 = 0.10

Tested By SG Date 5/16/16 Checked By CLK Date 5/25/16

 DCN: CT-S3C DATE 3/20/13 REVISION: 3

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WASH SIEVE ANALYSIS

ASTM D 422-63 (2007)

Client:	WSP Group	Boring No.:	WRC-NBA
Client Reference:	WRC Tracer Test 31400030-05	Depth (ft):	NA
Project No.:	2016-213-001	Sample No.:	Soil (050316)
Lab ID:	2016-213-001-001	Soil Color:	Reddish Brown

Moisture Content of Passing 3/4" Sample		Water Content of Retained 3/4" Sample	
Tare No.:	12	Tare No.:	NA
Wt. of Tare & Wet Sample (g):	1258.40	Weight of Tare & Wet Sample (g):	NA
Wt. of Tare & Dry Sample (g):	1100.33	Weight of Tare & Dry Sample (g):	NA
Weight of Tare (g):	202.66	Weight of Tare (g):	NA
Weight of Water (g):	158.07	Weight of Water (g):	NA
Weight of Dry Sample (g):	897.67	Weight of Dry Sample (g):	NA
Moisture Content (%):	**17.6**	**Moisture Content (%):**	**NA**

Wet Weight of -3/4" Sample (g):	NA	Weight of the Dry Sample (g):	897.67
Dry Weight of - 3/4" Sample (g):	847.8	Weight of - #200 Material (g):	49.88
Wet Weight of +3/4" Sample (g):	NA	Weight of + #200 Material (g):	847.79
Dry Weight of + 3/4" Sample (g):	0.00		
Total Dry Weight of Sample (g):	NA		

Sieve Size	Sieve Opening (mm)	Weight of Soil Retained (g)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	Accumulated Percent Finer (%)
12"	300	0.00	0.00	0.00	100.00	**100.00**
6"	150	0.00	0.00	0.00	100.00	**100.00**
3"	75	0.00	0.00	0.00	100.00	**100.00**
2"	50	0.00	0.00	0.00	100.00	**100.00**
1 1/2"	37.5	0.00	0.00	0.00	100.00	**100.00**
1"	25.0	0.00	0.00	0.00	100.00	**100.00**
3/4"	19.0	0.00	0.00	0.00	100.00	**100.00**
1/2"	12.50	0.00	0.00	0.00	100.00	**100.00**
3/8"	9.50	0.00	0.00	0.00	100.00	**100.00**
#4	4.75	0.00	0.00	0.00	100.00	**100.00**
#10	2.00	0.83	0.09	0.09	99.91	**99.91**
#20	0.850	4.64	0.52	0.61	99.39	**99.39**
#40	0.425	38.77	4.32	4.93	95.07	**95.07**
#60	0.250	251.23	27.99	32.92	67.08	**67.08**
#140	0.106	508.80	56.68	89.60	10.40	**10.40**
#200	0.075	43.52	4.85	94.44	5.56	**5.56**
Pan	-	49.88	5.56	100.00	-	**-**

Tested By SG Date 5/16/16 Checked By CLK Date 5/25/16

DCN: CT-S3C DATE 3/20/13 REVISION: 3

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July 5, 2016

Paul D. Lindquist, EIT
Project Consultant
Environmental
WSP | PARSONS BRINCKERHOFF
123 North Third Street, Suite 507, Minneapolis, MN 55401

RE: Draft Report for In Situ Chemical Oxidation Treatability Study for Wynnwood, OK Version 1

Dear Paul:

Terra Systems, Inc. (TSI) has conducted treatability studies at over 100 sites in support of in situ chemical oxidation (ISCO) using potassium and sodium permanganate, activated persulfate, catalyzed hydrogen peroxide, or ozone, or in situ chemical reduction of volatile organics, semivolatiles organics, and metals. TSI does not perform ISCO or in situ reduction field projects, but works with a number of environmental engineering consultants including ERM, AMEC, TRC, Moraine Environmental, URS, GZA, WSP, and others to evaluate chemical oxidant demand and effectiveness in the laboratory before the consultants go to pilot or full-scale implementation. The treatability work was directed by Michael D. Lee, Ph.D. He has over 25 years of experience in conducting treatability studies and in situ bioremediation of chlorinated solvents and hydrocarbons. He has published over 100 papers. Erich Hauptmann prepared the treatability studies and did the sampling. He is a graduate of the University of Delaware with seven years of experience in the treatability lab.

I have prepared this draft report for the ISCO treatability study for the Wynnwood, OK site contaminated with hydrocarbons including benzene, toluene, ethylbenzene, and xylenes (BTEX), gasoline range organics (GRO), and diesel range organics (DRO). The soil was analyzed for the following parameters by Pace Laboratory of Salina, KS: BTEX, OK GRO, and OK DRO. The groundwater was analyzed for the following parameters by Pace Laboratory: BTEX, OK GRO, OK DRO, oxyanions (selenium, chromium, vanadium, molybdenum, and uranium), and chemical oxygen demand (COD). TSI measured the soil density, soil moisture, soil field holding capacity, and pH of the soil and groundwater and determined the quantities of 25% sodium hydroxide needed to raise and maintain the pH to 10.5 of 136 g soil and 15 mL groundwater for the following treatments: control, Peroxychem product Klozur 10 g/L sodium persulfate, 20 g/L Klozur persulfate, and 40 g/L Klozur persulfate.

A contaminant destruction evaluation was conducted with three dosages of Klozur sodium persulfate activated with sodium hydroxide and a control. Two replicates of each treatment were prepared in 1,000 mL bottles with 1,372 g soil (density of 1.98 g/cm^3) and 300 mL groundwater or approximately 70% by volume soil and 30% volume groundwater. The volume of sodium hydroxide required to maintain the pH above 10.5 determined in the initial characterization step were added to the two replicates. The pH, redox potential, and persulfate of one bottle from each treatment were recorded over time.

1.0 SUPPLY OF SAMPLES

WSP personnel sent representative soil and groundwater samples on ice and under standard Chain-of-Custody procedures directly to TSI at the following shipping address:

Michael D. Lee, Ph.D.
Terra Systems, Inc.
130 Hickman Road, Suite 1
Claymont DE 19703
Phone: 302-798-9553
Fax: 302-798-9554
E-mail: mlee@terrasystems.net.

The following samples were supplied for the treatability studies:

- Six quarts (about 6 L or 10.3 kg including glass jars) of groundwater from a contaminated well
- 59 kg of contaminated soil. The soil was collected in 28 quart jars. The soil samples were collected from within the treatment zone.

The samples were collected with as little headspace as possible and shipped on ice. The samples were collected and shipped on May 5, 2016 and received at TSI on May 6, 2016. .

2.0 SCOPE OF WORK

A comprehensive workplan for the completion of the proposed work was drafted. The experimental design for the bench-scale treatability study consisted of three phases of work:

1. Initial compositing and characterization of the site soil and groundwater;
2. Treatment effectiveness for three loading of sodium hydroxide activated Klozur sodium persulfate, and an unamend control
3. Report.

Each phase of work is described in detail in the sections that follow.

2.1 Initial Characterization of Site Soils and Groundwater

Prior to beginning the actual treatability experiments, the soil and groundwater samples were composited. The soil was analyzed for the following parameters by Pace Laboratory of Salina, KS: BTEX (4 tared VOC vials with methanol), OK BTEX/GRO Low (2-ounce jar with septa), OK GRO High (4 tared VOC vials with methanol), and OK DRO (4-ounce jar). Pace Laboratories was paid directly by WSP. The groundwater was analyzed for the following parameters by Pace Laboratory: BTEX (three 40 mL VOA vials preserved with HCl), OK GRO (three 40 mL VOA vials preserved with HCl), OK DRO (1 L preserved with HCl), chemical oxygen demand or COD (120 mL plastic preserved with H_2SO_4), and oxyanions including selenium, chromium, vanadium, and molybdenum (250 mL plastic preserved with HNO_3), and uranium (250 mL plastic preserved with HNO_3). The Pace Laboratory does not have Oklahoma certification for uranium and subcontracted this analysis to Eurofins Lancaster Laboratories, Lancaster, PA. TSI measured the soil density and pH of the soil and groundwater and determined the quantities of 25% sodium hydroxide needed to raise and maintain the pH to 10.5 of 136 g soil and 30 mL groundwater for the following treatments: control, Klozur 10 g/L sodium persulfate, 20 g/L Klozur persulfate, and 40 g/L Klozur persulfate. The pH was monitored over a four-day incubation period. When the pH drifted below 10.5, additional 25% sodium hydroxide was added.

2.2 Initial Characterization Results

Table 1 presents the initial characterization results for the groundwater and soil. The groundwater contained 27.8 mg/L OK- GRO, 13 mg/L OK-DRO, 2.73 mg/L benzene, 4.77 mg/L toluene, 0.79 mg/L ethylbenzene, 2.62 mg/L m,p-xylenes, and 1.39 mg/L o-xylene. Oxyanions included 0.061 mg/L chromium, 0.00629 mg/L molybdenum, 0.0035 mg/L selenium, 0.057 mg/L vanadium, and 0.0101 mg/L uranium. There was 103 mg/L of COD.

Two soil samples were analyzed. The soil contained 170 to 180 mg/kg OK-GRO, 44 to 56 mg/kg OK-DRO, 0.108 to 0.122 mg/kg benzene, 1.5 to 1.72 mg/kg toluene, 1.22 to 1.34 mg/kg ethylbenzene, 4.11 to 4.5 mg/kg m,p-xylenes, and 1.92 to 2.12 mg/kg o-xylene. The soil moisture ranged from 82.5 to 84.2%. The soil density was 1.96 g/mL.

Table 2 contains the 25% sodium hydroxide titrations for the control, 10 g/L, 20 g/L, and 50 g/L persulfate solutions with 136 g soil and 30 mL groundwater. The initial pH of the control soil and groundwater was 7.2. In the persulfate-amended treatments, the initial pH ranged from 7.4 to 7.6. The pH was measured on 5/16/16 before and after 25% sodium hydroxide additions and on 5/19/16 and again on 5/20/16. Aliquots of 25% sodium hydroxide were added to raise the pH above 10.5. For the soil and groundwater without persulfate, 0.5 mL of the 25% sodium hydroxide was required or the equivalent of 0.92 g sodium hydroxide per kg of soil. The hydroxide demands increased as the persulfate dosages increased from 1.29 g/kg of the 10 g/L persulfate treatment, 1.47 g/kg for the 20 g/L persulfate treatment, and 1.65 g/kg for the 40 g/L persulfate treatment. These loadings of sodium hydroxide were used in the efficiency studies.

Table 1. Initial Characterization Results

Sample	OK GRO	OK DRO	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylenes	Solids
Units	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	
Groundwater	27.8	13	2.73	4.77	0.79	2.62	1.39	
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%
Soil A	170	44	0.122	1.72	1.34	4.5	2.12	82.5
Soil B	180	56	0.108	1.5	1.22	4.11	1.92	84.2
Avg Soil	175	50	0.115	1.61	1.28	4.305	2.02	83.4
Sample	**Chromium**	**Molybdenum**	**Selenium**	**Vanadium**	**Uranium**	**COD**		
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		
Groundwater	0.061	0.00629	0.0035	0.057	0.0101	103		
Soil Density	1.96 g/mL							

Table 2. Soil, Groundwater, and Persulfate Titrations

Sample	**Control 136 g soil + 30 mL GW**				**Sample**	**10 g/L PS 136 g soil + 30 mL GW + 0.6 g/L PS**		
Date	Time	Vol 25% NaOH	pH		Date	Time	Vol 25% NaOH	pH
		mL	SU				mL	SU
5/16/2016	15:00	0	7.2		5/16/2016	15:00	0	7.6
		0.3	10.6				0.4	10.7
5/19/2016	8:15		9.8		5/19/2016	8:15		9.1
		0.4	12.0				0.6	10.4
5/20/2016	11:45		10.3				0.7	11.4
		0.5	11.0		5/20/2016	11:45		10.6
NaOH Demand g/kg Soil			0.92					1.29
Sample	**20 g/L PS 136 g soil + 30 mL GW + 0.6 g PS**				**Sample**	**40 g/L PS 136 g soil + 30 mL GW + 1.2 g PS**		
Date	Time	Vol 25% NaOH	pH		Date	Time	Vol 25% NaOH	pH
		mL	SU				mL	SU
5/16/2016	15:00	0	7.4		5/16/2016	15:00	0	7.5
		0.5	12.3				0.6	11.5
5/19/2016	8:15		9.5		5/19/2016	8:15		9.4
		0.6	10.3				0.8	11.6
		0.7	11.2		5/20/2016	11:45		10.2
5/20/2016	11:45		10.3				0.9	11.8
NaOH Demand g/kg Soil			1.47					1.65

2.3 Site Soil Persulfate Demand and Contaminant Destruction Efficiency Testing

Three loadings of Klozur sodium persulfate were added to separate 1,000 mL vessels containing an estimated 1,372 g site soil and 300 mL groundwater (ratio of 70% soil and 30% groundwater by volume). Table 3 presents the treatments and volumes of soil and groundwater used in the treatability studies. Sodium azide (1 g/L) was added to all treatments to minimize biodegradation losses. The Klozur sodium persulfate loadings resulted in oxidant concentrations of 10, 20, and 40 g/L groundwater. The groundwater with persulfate, sodium hydroxide, and sodium azide were added to the soil to thoroughly distribute the reagents. The bottles with soil, groundwater, and persulfate were closed and inverted several times to mix. Periodic measurements of pH, ORP, and oxidant concentrations in the groundwater phase were made from one replicate of the treatment and control vessels after 1-2, 246, 100, 150, and 173 hours. The oxidant concentrations were measured using a back titration method wherein 0.4 M ferrous ammonium sulfate solution was added to consume the persulfate to a portion of the groundwater with 10 mL 25% sulfuric acid and titrated with potassium permanganate. The concentration of residual persulfate in the groundwater is related to the volume of permanganate solution consumed versus a blank. After 7 days, the groundwater from the opened and unopened replicates were analyzed for pH, ORP, and oxidant concentrations. Groundwater samples from the unopened replicate were separated from soil by centrifugation. The groundwater was diluted 1 part GW to 1 parts distilled water and submitted to Pace Laboratories for analysis of BTEX (three 40 mL VOA vials preserved with HCl) and OK GRO (three 40 mL VOA vials preserved with HCl). The groundwater samples analyzed for OK DRO (were diluted 100 mL groundwater to 900 mL distilled water) and preserved with HCl). The 1:10 diluted groundwater from the 20 g/L persulfate treatment was analyzed for oxyanions including selenium, chromium, vanadium, and molybdenum (250 mL plastic preserved with HNO_3), and uranium (250 mL plastic preserved with HNO_3). After 7 days, soil samples from the unopened replicate were submitted to Pace Laboratories for analysis of BTEX (4 tared VOC vials with methanol), OK BTEX/GRO Low (2-ounce jar with septa), OK GRO High (4 tared VOC vials with methanol), and OK DRO (4-ounce jar).

Table 3. Volumes of Soil and Groundwater

Phase	Bottles	Soil g	GW mL	Persulfate g	Sodium Azide g	Sodium Hydroxide g
Initial Characterization						
BTEX		20	130			
GRO		60	130			
DRO		120	1000			
COD			120			
Oxyanions			250			
Uranium			250			
pH Control		136	30		0.03	
pH 10 g/L Persulfate		136	30	0.3	0.03	?
pH 20 g/L Persulfate		136	30	0.6	0.03	?
pH 40 g/L Persulfate		136	30	1.2	0.03	?
Oxidant Demands						
Unamended Control	2	1372	300		0.3	
10,000 mg/kg Klozur + NaOH	2	1372	300	3	0.3	1.8
20,000 mg/kg Klozur + NaOH	2	1372	300	6	0.3	2.0
40,000 mg/kg Klozur + NaOH	2	1372	300	12	0.3	2.3
Total		**11720**	**4400**	**44.1**	**2.52**	

2.4 Site Soil Persulfate Demand Results

Table 4 presents the field parameters for the efficiency study. Sodium hydroxide was not added to the control treatment. The pH of the control ranged from 6.7 to 7.4 and the ORP from 262 to 339 mV.

In the treatment with 10 g/L persulfate (equivalent to 7.2 pounds per cubic yard of aquifer) and 1.8 g sodium hydroxide (equivalent to 4.3 pounds of sodium hydroxide per cubic yard), the pH ranged 12.9 after 2 hours to a low of 12.1; the loading of sodium hydroxide was sufficient to maintain the alkaline conditions necessary for activation of the persulfate. The redox potential was lower in this treatment (-30 to 48 mV); the high pH affected the ORP readings. The persulfate concentration was 6,287 mg/L after two hours due to the initial reaction with the soil. The persulfate concentration dropped to 3,478 mg/L in both the opened and unopened replicate after 172 hours. The soil oxidant demand was 1,426 mg/kg of soil. Based upon the soil density of 1.96 g/cm^3 or 3,306 pounds per cubic yard of aquifer, the soil oxidant demand would be equivalent to 4.7 pounds sodium persulfate per cubic yard.

In the treatment with 20 g/L persulfate (equivalent to 14.5 pounds per cubic yard of aquifer) and 2.0 g sodium hydroxide (equivalent to 4.8 pounds per cubic yard of aquifer), the pH ranged 13.2 after 1.5 hours to a low of 12.3; the loading of sodium hydroxide was sufficient to maintain the alkaline conditions necessary for activation of the persulfate. The redox potential ranged from 11 to 152 mV. The persulfate concentration was 12,462 mg/L after two hours. The persulfate concentration dropped to 6,846 mg/L in the opened and 8,530 mg/L in the unopened replicate after 172 hours. The soil oxidant demand was 2,876 mg/kg of soil in the opened container and 2,508 mg/kg in the unopened container. The soil oxidant demand would be equivalent to 8.3 to 9.5 pounds sodium persulfate.

In the treatment with 40 g/L persulfate (equivalent to 28.9 pounds per cubic yard of aquifer) and 2.3 g sodium hydroxide (equivalent to 5.5 pounds per cubic yard of aquifer), the pH ranged 13.2 after 1 hours to a low of 12.3; the loading of sodium hydroxide was sufficient to maintain the alkaline conditions necessary for activation of the persulfate. The redox potential ranged from 98 to 227 mV. The persulfate concentration was 27,058 mg/L after two hours due to the initial reaction with the soil. The persulfate concentration dropped to 18,635 mg/L in the opened and 20,319 mg/L in the unopened replicate. The soil oxidant demand was 4,672 mg/kg of soil in the opened container and 4,303 mg/kg in the unopened container. Based upon the soil density, the soil oxidant demand would be equivalent to 14.2 to 15.4 pounds sodium persulfate.

Table 4. Field Parameters for Efficiency Tests

Control	Date	Time	pH	ORP		
		Hours	SU	mV		
	6/2/2016	3	6.7	269		
Start 9:00	6/3/2016	26	7.4	294		
	6/6/2016	100	6.8	318		
	6/8/2016	150	7.4	296		
Open	6/9/2016	173	7.3	262		
Unopened	6/9/2016	173	7.0	339		
10 g/L PS	**Date**	**Time**	**pH**	**ORP**	**Persulfate**	**SOD Demand mg/kg**
1.8 g NaOH		**Hours**	**SU**	**mV**	**mg/L**	
	6/2/2016	2	12.9	48	6,287	
Start 10:00	6/3/2015	25	12.1	-30	6,287	
	6/6/2016	99	12.6	29	4,041	
	6/8/2016	149	12.3	-21	5,164	
Open	6/9/2016	172	12.5	33	3,478	1,426
Unopened	6/9/2016	172	12.6	10	3,478	1,426
20 g/L PS	**Date**	**Time**	**pH**	**ORP**	**Persulfate**	**SOD Demand mg/kg**
2.0 g NaOH		**Hours**	**SU**	**mV**	**mg/L**	
	6/2/2016	1.5	13.2	124	12,462	
Start 10:30	6/3/2016	24.5	12.3	39	13,023	
	6/6/2016	98.5	12.6	42	10,778	
	6/8/2016	148.5	12.3	11	96,55	
Open	6/9/2016	171.5	12.6	152	68,46	2,876
Unopened	6/9/2016	171.5	12.6	121	8,530	2,508
40 g/L PS	**Date**	**Time**	**pH**	**ORP**	**Persulfate**	**SOD Demand mg/kg**
2.3 g NaOH		**Hours**	**SU**	**mV**	**mg/L**	
	6/2/2016	1	13.2	193	27,058	
Start 11:00	6/3/2016	24	12.7	123	28,742	
	6/6/2016	98	12.6	98	23,689	
	6/8/2016	148	12.3	108	23,126	
Open	6/9/2016	171	12.6	227	18,635	4,672
Unopened	6/9/2016	171	13.2	219	20,319	4,303

2.5 Contaminant Destruction Efficiency Testing Results

Table 5 presents the OK GRO, OK DRO, BTEX and anion concentrations in the initial characterization aqueous samples and in the Control, 10 g/L persulfate and 1.8 g sodium hydroxide, 20 g/L persulfate and 2.0 g sodium hydroxide, and the 40 g/L persulfate and 2.5 g sodium hydroxide treatments. Table 6 shows the percent reduction from the aqueous phase Initial Characterization to the Day 7 treatments. The OK GRO in the aqueous phase decreased from 27.8 mg/L in the Initial Characterization samples to 16.2 mg/L in the Control at Day 7 presumably due to volatilization as biodegradation was inhibited by the sodium azide. Aqueous OK GRO concentrations decreased as the persulfate loading increased to as low as 4.18 mg/L (85% reduction from the initial control). The aqueous OK DRO concentrations increased from the Initial Characterization samples in all treatments, but the change was greatest in the Control treatment. Aqueous benzene concentrations fell from 2.73 mg/L in the initial characterization samples to 1.26 mg/L in the control and to a low of 0.326 mg/L at the 40 g/L persulfate treatment (88.1% reduction from Initial Characterization). Aqueous concentrations of Toluene, Ethylbenzene, m,p-Xylenes, and o-Xylenes followed a similar pattern with limited decreases from the Initial Characterization to Day 7 Control (30.2 to 47.0%), 66.8 to 80.3% in the 10 g/L persulfate treatment, 63.8 to 84.0% in the 20 g/L persulfate treatment, and 88.4 to 95.2% in the 40 g/L persulfate treatment. Anions (chromium, molybdenum, selenium, vanadium, and uranium) also increased from the initial characterization samples to the Day 7 20 g/L persulfate treatment potentially due to the alkaline conditions extracting the metals from the soil.

Table 7 presents the OK GRO, OK DRO, BTEX and anion concentrations in the initial characterization soil samples and in the Control, 10 g/L persulfate and 1.8 g sodium hydroxide, 20 g/L persulfate and 2.0 g sodium hydroxide, and the 40 g/L persulfate and 2.3 g sodium hydroxide treatments. Table 8 shows the percent reduction from the soil phase Initial Characterization to the Day 7 treatments. The OK GRO in the soil phase decreased from an average of 175 mg/kg in the Initial Characterization samples to 130 mg/kg in the Control at Day 7 presumably due to volatilization as biodegradation was inhibited by the sodium azide. Soil OK GRO concentrations decreased as the persulfate loading increased to as low as 110 mg/kg (37.1% reduction from the initial control). The soil OK DRO concentrations increased from the average Initial Characterization samples in all treatments, but the change was greatest in the Control and 10 g/L persulfate treatments. Soil benzene concentrations increased from an average of 0.115 mg/kg in the initial characterization samples to 0.317 mg/kg in the control, 0.262 mg/kg in the 20 g/L persulfate treatment, and were reduced to a low of 0.0.0941 mg/kg at the 40 g/L persulfate treatment (18.2% reduction from Initial Characterization). Soil concentrations of Toluene, Ethylbenzene, m,p-Xylenes, and o-Xylenes followed a similar pattern with limited decreases from the Initial Characterization to Day 7 Control (25.5 to 44.1%), 11.0 to 20.3% in the 10 g/L persulfate treatment, 25.4 to 49.2% in the 20 g/L persulfate treatment, and 50.1 to 75.4% in the 40 g/L persulfate treatment.

Table 5. Aqueous Phase Efficiency Results

Sample	OK GRO	OK DRO	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylenes	Chromium	Molybdenum	Selenium	Vanadium	Uranium
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Groundwater	27.8	13	2.73	4.77	0.79	2.62	1.39	0.061	0.00629	0.0035	0.057	0.0101
Day 7												
Control	16.2	63.6	1.26	2.53	0.48	1.83	0.91					
10 g/L PS	6.16	15	0.83	1.132	0.262	0.516	0.33					
20 g/L PS	5.56	29	0.556	0.764	0.286	0.434	0.304	1.25	0.0791	0.02	1.24	0.063
40 g/L PS	4.18	24	0.326	0.246	0.092	0.1256	0.078					

0.02 Compound detected below method calibration limit and also found in laboratory blank.

Table 6. Percent Reductions in Aqueous Concentrations from Initial Characterization to Day 7

Sample	OK GRO	OK DRO	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylenes	Chromium	Molybdenum	Selenium	Vanadium	Uranium
Control	41.7	-389.2	53.8	47.0	39.2	30.2	34.5					
10 g/L PS	77.8	-15.4	69.6	76.3	66.8	80.3	76.3					
20 g/L PS	80.0	-123.1	79.6	84.0	63.8	83.4	78.1	-1949.2	-1157.6	-471.4	-2075.4	-523.8
40 g/L PS	85.0	-84.6	88.1	94.8	88.4	95.2	94.4					

Table 7. Soil Phase Efficiency Results

	OK GRO	OK DRO	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylenes	Solids
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%
Soil A	170	44	0.122	1.72	1.34	4.5	2.12	82.5
Soil B	180	56	0.108	1.5	1.22	4.11	1.92	84.2
Avg Soil	175	50	0.115	1.61	1.28	4.305	2.02	83.4
Day 7								
Control	130	65	0.317	1.2	0.715	2.57	1.15	84.8
10 g/L PS	120	65	0.262	1.17	1.02	3.83	1.73	81.1
20 g/L PS	110	62	0.169	0.818	0.822	3.21	1.44	81.2
40 g/L PS	110	60	0.0941	0.392	0.51	2.15	0.888	82.0

Table 8. Percent Reductions in Soil Concentrations from Initial Characterization to Day 7

	OK GRO	OK DRO	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylenes
Control	25.7	-30.0	-175.7	25.5	44.1	40.3	43.1
10 g/L PS	31.4	-30.0	-127.8	27.3	20.3	11.0	14.4
20 g/L PS	37.1	-24.0	-47.0	49.2	35.8	25.4	28.7
40 g/L PS	37.1	-20.0	18.2	75.7	60.2	50.1	56.0

Table 9 shows the mass balance of the soil and groundwater for the OK DRO, OK GRO, and benzene, toluene, ethylbenzene, m,p-xylenes, and o-xylene. The OK GRO in the aqueous and soil phases decreased from an average of 248.4 mg in the Initial Characterization samples to 183.2 mg in the Control at Day 7 presumably due to volatilization as biodegradation was inhibited by the sodium azide. The mass balance on OK DRO concentrations increased in all treatments. The total benzene concentrations decreased from an average of 1.0 mg in the initial characterization samples to 0.81 mg in the control, 0.61 mg in the 10 g/L persulfate treatment, 0.40 mg in the 20 g/L persulfate treatment, and 0.23 mg in the 40 g/L persulfate treatment (76.8% reduction from Initial Characterization). Mass balance concentrations of Toluene, Ethylbenzene, m,p-Xylenes, and o-Xylenes followed a similar pattern with limited decreases from the Initial Characterization to Day 7 Control (33.9 to 43.6%), 19.2 to 46.6% in the 10 g/L persulfate treatment, 32.2 to 62.9% in the 20 g/L persulfate treatment, and 55.4 to 83.2% in the 40 g/L persulfate treatment.

3.0 CONCLUSIONS

The following conclusions can be reached from this treatability study:

- Between 49 and 66% of the persulfate was consumed in the 7-day incubation period with soil oxidant demands between 1,426 and 4,672 mg/kg (4.7 to 15.4 pounds per cubic yard).
- Sodium hydroxide loadings of 1.3 to 1.7 g/kg of soil (4.3 to 5.5 pounds per cubic yard) were sufficient to activate the persulfate at loadings of 2.2 to 8.7 g/kg (7.2 to 28.9 pounds per cubic yard).
- There were losses of GRO and BTEX in the aqueous and soil phases for the control likely due to volatilization.
- As the dosage of persulfate increased, greater removals of GRO and BTEX were noted in the aqueous and soil phases and on a mass balance basis.
- DRO increased in all treatments in the groundwater and soil phases; the alkaline conditions may have made the DRO more soluble.
- The aqueous oxyanion concentrations increased significantly in 20 g/L persulfate treatment. The alkaline treatment may have released the oxyanions from the soil.
- Repeated applications of persulfate or a longer treatment period would likely be required to reduce the GRO and BTEX to below the groundwater treatment standards.,
- A pilot is recommended to evaluate oxidant delivery and distribution and to confirm the treatment efficiency.

Should you have any questions about the draft report or need additional information, please feel free to contact me.

Sincerely,
TERRA SYSTEMS, INC.

Michael D Lee, PhD.

Michael D. Lee, Ph.D.
Vice-President Research and Development

Table 9. Mass Balance on Soil and Aqueous Phases (mg)

	OK GRO	OK DRO	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylenes
Units	**mg**	**mg**	**mg**	**mg**	**mg**	**mg**	**mg**
Avg Soil	248.4	72.5	1.0	3.6	2.0	6.7	3.2
Day 7							
Control	183.2	108.3	0.81	2.4	1.1	4.1	1.9
10 g/L PS	166.5	93.7	0.61	1.9	1.5	5.4	2.5
20 g/L PS	152.6	93.8	0.40	1.4	1.2	4.5	2.1
40 g/L PS	152.2	89.5	0.23	0.61	0.73	3.0	1.2

Table 10. Percent Reduction on Mass Balance on Soil and Aqueous Phases

	OK GRO	OK DRO	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylenes
Control	26.3	-49.3	16.8	33.9	43.6	39.1	42.0
10 g/L PS	33.0	-29.2	37.7	46.6	25.8	19.2	22.5
20 g/L PS	38.6	-29.3	59.2	62.9	39.1	32.2	35.2
40 g/L PS	38.7	-23.5	76.8	83.2	63.5	55.4	61.1