AP - 111

AGWMR

2015

Michelle Lujan Grisham
Governor

Howie C. Morales
Lt. Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6313
Phone (505) 476-6000 Fax (505) 476-6030
www.env.nm.gov

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

James C. Kenney
Cabinet Secretary

Jennifer J. Pruett
Deputy Secretary

January 15, 2020

John Moore
Environmental Superintendent
Western Refining, Southwest Inc., Gallup Refinery
92 Giant Crossing Road
Gallup, New Mexico 87301

RE: APPROVAL
WORK PLAN 2015 ANNUAL GROUNDWATER REPORT COMMENTS
WESTERN REFINING SOUTHWEST INC., GALLUP REFINERY
EPA ID # NMD000333211
HWB-WRG-18-012

Dear Mr. Moore:

The New Mexico Environment Department (NMED) has reviewed the *Response to Approval with Modifications Work Plan 2015 Annual Groundwater Report Comments* (Response), dated December 9, 2019, submitted on behalf of Marathon Petroleum Company dba Western Refining Southwest Inc., Gallup Refinery (the Permittee). NMED hereby issues this Approval.

The Permittee sufficiently addressed NMED's comments provided in the response letters dated December 9, November 15, August 23, and January 28, 2019. Accordingly, the Permittee may commence the investigation in accordance with the approved Work Plan. The Permittee must notify the NMED at least 15 days prior to any permit or corrective action-related field activity according to Permit Section IV.H.5.a.iv.

This approval is based on the information presented in the document as it relates to the objectives of the work identified by NMED at the time of review. Approval of this document does not constitute agreement with all information or every statement presented in the document.

If you have questions regarding this letter, please contact Michiya Suzuki of my staff at 505-476-6059.

Sincerely,

Kevin Pierard
Chief
Hazardous Waste Bureau

cc: D. Cobrain, NMED HWB
M. Suzuki, NMED HWB
C. Chavez, OCD
L. King, EPA Region 6 (6LCRRC)
B. Moore, WRG

File: Reading File and WRG 2020 File
HWB-WRG-18-012

Marathon Petroleum Company LP

December 9, 2019

Mr. Dave Cobrain, Program Manager
Hazardous Waste Bureau
New Mexico Environmental Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505-6303

RE: Response to Approval with Modifications
Work Plan 2015 Annual Groundwater Report Comments
Marathon Petroleum Company LP, Gallup Refinery
(dba Western Refining Southwest, Inc.)
EPA ID# NMD000333211
HWB-WRG-18-012

Dear Mr. Cobrain:

Marathon Petroleum Company LP (dba Western Refining Southwest, Inc.) Gallup Refinery is submitting the enclosed responses to your comments dated November 15, 2019 on the referenced Work Plan. If there are any questions, please call Brian Moore at 505-726-9745.

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,
Marathon Petroleum Company LP, Gallup Refinery

Robert S. Hanks

Robert S. Hanks
Refinery General Manager

Enclosure

cc K. Van Horn NMED
C. Chavez NMOCD
B. Moore Marathon Gallup Refinery

92 Giant Crossing Road
Jamestown, NM 87347

RESPONSE TO APPROVAL WITH MODIFICATIONS
November 15, 2019 Response to Second Disapproval Work Plan 2015
Annual Groundwater Report Comments
(June 2019)

NMED Comment 1:

The Permittee's response to NMED's *Disapproval* Comment 6 states, "[t]he comment is acknowledged and MPC understands the current focus is on delineation." Comment 1 in NMED's *Disapproval Annual Groundwater Monitoring Report: Gallup Refinery- 2017,* dated March 21, 2019 states, "[p]ropose to submit a work plan to investigate the extent of the contaminant migration in the Sonsela west of well OW-1 [by installing three sets of nested wells 1,500 feet, 2,000 feet and 2,500 feet west of pond EP-9] in a response letter." As a reminder, the response letter was due on **November 8, 2019.** Section 4.2 (New Sonsela Wells) states, "[t]o delineate the down-gradient extent of the plume detected at OW-1, a new Sonsela well will be installed approximately five hundred feet down-gradient to the west of OW-1. The proposed location is shown on Figure 3." Figure 3 (Proposed Monitoring Well Locations) does not depict the proposed well. Figure 4 (MKTF Well Locations) may be the pertinent figure. Provide a clarification in a response letter. In addition, the proposed location and number of wells to be installed west of OW-1 is not consistent with the NMED's direction provided by Comment 1 of the March 21, 2019 *Disapproval.* Revise the Work Plan to be consistent with the direction or provide a justification for the proposed location and the reduced number of well installations in the response letter.

MPC Response 1:

The proposed well location is shown on Figure 4, not Figure 3 as originally referenced.

The justification was previously provided, but as essentially the same comments are being provided on both the 2015 and 2017 Annual Ground Water Monitoring Reports, most likely the justification provided in comments received on the 2017 Report were not yet reviewed when NMED drafted this Approval with Modifications letter. The response below is from the MPC's letter of November 12, 2019 with reference "Response to Approval with Modifications 2017 Annual Groundwater Report, OW-61 Through OW-65 Well Installation Report, Marathon Petroleum Company LP, Gallup Refinery (dba Western Refining Southwest, Inc.), EPA ID# NMD000333211, HWB-WRG-18-014."

> **NMED Comment 1:**
>
> The Permittee's response to NMED's Disapproval Comment 1 states, "MPC does not concur with MED's recommendation that three sets of nested wells should be installed in locations 1,500 feet, 2,000 feet and 2,500 feet west of pond EP-9 ... " To clarify, the Permittee is responsible for delineating the extent of groundwater contamination even if constituent concentrations do not exceed applicable standards, if constituents are detected above detection limits. The contaminant concentrations have been detected below the applicable standards in groundwater samples collected from well OW-1. Since there are no groundwater monitoring wells west of well OW-1, the extent of the plumes is not currently delineated and must be investigated. The Permittee must evaluate whether the plume is expanding further west and potentially off-site. Propose to submit a work plan to investigate the extent of the contaminant migration in the Sonsela west of well OW-1 in a response letter. Also, refer to Comment 6 in NMED's *Approval with Modifications Response to Disapproval Work Plan 2015 Annual Groundwater Report Comments.*
>
> **MPC Response 1:**
>
> The request for additional wells west of OW-10 was also included in NMED's comments on the Work Plan that was prepared to address comments received on the 2015 Annual Groundwater Monitoring Report. This was most recently addressed in the response to Comment 9c, which

responded to NMED's letter of August 23, 2019 *Second Disapproval Work Plan 2015Annual Groundwater Monitoring Report* (HWB -WRG-18-012). See the October 2019 revision to *Work Plan 2015 Annual Groundwater Report Comments*, which includes additional wells west of OW-1.

We note that as explained in the referenced response, the new well locations are approximately 500 feet down-gradient of OW-1 and not 1,500, 2,000, and 2,500 feet west of OW-1. MPC recently received comments from NMED on the investigation in the area of the North Drainage Ditch wherein NMED stated that it did not make sense to install additional down-gradient wells as proposed along the abandoned runway, as apparently the locations were too far down-gradient. Those locations ranged from approximately 170 feet down-gradient of NDD-16 and OW-52, up to approximately 850 feet down-gradient of NDD-4 and NDD-6. If those proposed locations were too far down-gradient in NMED's opinion, then we are uncertain why it would make sense to step out 1,500 feet, 2,000, and 2,500 feet down-gradient of OW-1. Therefore, we proposed locations approximately 500 feet down-gradient of OW-1 as a compromise between the minimum of 1,500 feet as directed in this letter and the maximum spacing of 200 feet as NMED required at the North Drainage Ditch area.

NMED Comment 2:

The Permittee's response to NMED's *Disapproval* Comment 10, states, "[t]he well screen and overlying sand pack in MKTF-17 extends from the 12 feet to 25 feet bgl, providing hydraulic connection to the saturated interval from 20 to 23 feet bgl, but not to the saturation encountered in the overlying fill materials." According to the MKTF-17 boring log, the observation of "saturated" and "damp" was likely caused by the difference in the grain size of soils. There is a clay-bearing layer that slows groundwater flow but does not prevent it; it does not appear that confining conditions exit. In order to ensure that the proposed wells adjacent to the MKTF wells produce water, the Permittee must propose to install temporary wells at the locations adjacent to the MKTF wells with screen depths to ten feet bgs as proposed. If the temporary wells produce water, they may be converted to permanent wells. If the temporary wells do not produce water, the Permittee must propose to install the wells with comparable depths to the original wells, but with longer well screens that intersect the water table. Propose the temporary wells in the response letter.

MPC Response 2:

The two proposed wells near MKTF-17 and MKTF-18 will be completed to the originally proposed depths of 10 feet as temporary wells. The wells will be checked to determine if they produce water. Upon this determination, NMED will be contacted to discussed if the wells are completed as permanent wells or if they are drilled deeper with longer well screens.

NMED Comment 3:

The Permittee's response to NMED's *Disapproval* Comment 10, states, "[w]e do not think it is advisable to install wells as instructed by NMED that will breach the existing clay aquitard to allow a direct conduit for impacts in the fill materials to migrate directly into the lower interval." If borings and wells are installed properly, there is very little chance that the wells will create a conduit. No response required.

MPC Response 3:

The comment is acknowledged.

NMED Comment 4:
Section 4.3 is titled as "New Shallow Wells near EP-9 and West of OW-1". Section 4.3 discusses details for how the proposed shallow monitoring well south of pond EP-9 is installed; however, the section does not include a discussion of the proposed well west of OW-1. Include the discussion and provide a replacement page.

MPC Response 4:
Section 4.3 (page 4-2) is revised to discuss the proposed wells west of OW-1. Replacement pages are enclosed and the changes are made in the electronic copy (pdf) of the Work Plan.

NMED Comment 5:
Figure 4 (MKTF Well Locations) depicts a new well location west of well OW-1. According to the legend in Figure 3 (Proposed Monitoring Well Locations), the new well is a proposed Alluvium/Chinle well rather than Sonsela well. However, the new well is proposed to be installed across the Sonsela. Use the same legend included in Figure 3 and revise Figure 4. Provide a replacement figure in the Work Plan.

MPC Response 5:
The legend for Figure 3 is not necessarily applicable to other figures. The legend and title for Figure 4 are revised and replacement copies are provided along with revisions to the enclosed electronic copy of the Work Plan.

Table of Contents

List of Figures

Appendices

A review of the potentiometric surfaces measured in OW-12 (completed in Sonsela aquifer), OW-13 (completed in Sonsela aquifer) and OW-14 (completed in Chinle-Alluvial Interface Zone) indicates that the potentiometric surface measured in OW-13 tracks more closely with the potentiometric surface in OW-14 than the potentiometric surface in OW-12 (Appendix C). In fluid levels measured from June 2005 through November 2018, all three wells indicate rising water levels. From the lowest potentiometric surfaces recorded in December 2007 to the highest (April 2018 in OW-13 and OW-14 and August 2018 in OW-12), the increases are 2.78 feet, 4.14 feet, and 5.66 feet in OW-12, OW-13 and OW-14, respectively. While the increase at OW-13 is not as great as that measured at OW-14, it is significantly greater than the increase measured at OW-12, the other nearby well completed in the Sonsela aquifer.

The examination of the aquitard thickness and potentiometric surfaces indicates that well OW-13 is a possible migration pathway for contaminations to move vertically downward to the Sonsela aquifer. To address this concern a new well will be installed in the same area as OW-13 (Figure 3). OW-13 will be retained at this time to allow for further evaluation. The new well will be screened within the Sonsela aquifer, with a separate isolation casing set from the land surface to the top of the Chinle Formation.

To evaluate the potential migration of MTBE within the Sonsela aquifer, an additional well will be located approximately halfway between OW-12 and OW-13. The proposed location is shown on Figure 3. To delineate the down-gradient extent of the plume detected at OW-1, a new Sonsela well will be installed approximately five hundred feet down-gradient to the west of OW-1. The proposed location is shown on Figure 3.

4.3 New Wells near EP-9 and west of OW-1

A new shallow monitoring well will be installed adjacent to EP-9 on the south side of the pond for the purpose of leak detection. In addition, a new Sonsela well will be installed west of OW-1. If saturation is encountered in the alluvium deposits above the Chinle Group during the drilling of the new Sonsela well west of OW-1, then up to two “shallow” wells will be completed adjacent to the new Sonsela well consistent with those recently installed at locations BW-4A, BW-4B, BW-5A, and BW-5B. (Figure 4).

4.4 MKTF-01, MKTF-02 and MKTF-04 Replacement Wells

Monitoring wells MKTF-01, MKTF-02 and MKTF-04 will be plugged and abandoned. Replacement wells (MKTF-01R, MKTF-02R and MKTF-04R) will be drilled adjacent to the original well locations. The well screen in MKTF-01 was placed from 4 to 14 feet below ground level (bgl). MKTF-01R will be drilled to a depth of approximately 13 feet with the well screen set from 2 to 12 feet bgl. The well completion will include 1 foot of sand above the well screen and 1 foot of grout extending to the land surface.

The well screen in MKTF-02 was placed from 7 to 17 feet below ground level (bgl). MKTF-02R will be drilled to a depth of approximately 17 feet with the well screen set from 2.5 to 15.5 feet bgl. The well completion will include 1 foot of sand above the well screen and 1.5 feet of grout extending to the land surface.

The well screen in MKTF-04 was placed from 12 to 22 feet bgl. MKTF-04R will be drilled to a depth of approximately 19 feet with the well screen set from 4 to 19 feet bgl. The well completion will include 2 foot of sand above the well screen and 2 feet of grout extending to the land surface.

4.5 Soil Sample Field Screening and Logging

Samples obtained from the soil borings will be screened in the field on 2.0-foot intervals for evidence of contaminants. Field screening results will be recorded on the exploratory boring logs. Field screening results will be used to aid in the possible selection of soil samples for laboratory analysis. The primary screening methods include: (1) visual examination, (2) olfactory examination, and (3) headspace vapor screening for volatile organic compounds.

Visual screening includes examination of soil samples for evidence of staining caused by petroleum-related compounds or other substances that may cause staining of natural soils such as elemental sulfur or cyanide compounds. Headspace vapor screening targets volatile organic compounds and involves placing a soil sample in a plastic sample bag or a foil sealed container allowing space for ambient air. The container will be sealed and then shaken gently to expose the soil to the air trapped in the container. The sealed container will be allowed to rest for a minimum of 5 minutes while vapors equilibrate. Vapors present within the sample bag's headspace will then be measured by inserting the probe of the instrument in a small opening in the bag or through the foil. The maximum value and the ambient air temperature will be recorded on the field boring or test pit log for each sample.

The monitoring instruments will be calibrated each day to the manufacturer's standard for instrument operation. A photoionization detector (PID) equipped with a 10.6 or higher electron volt (eV) lamp or a combustible gas indicator may be used for VOC field screening. Field screening results may be site- and boring-specific and the results may vary with instrument type, the media screened, weather conditions, moisture content, soil type, and type of contaminant, therefore, all conditions capable of influencing the results of field screening will be recorded on the field logs.

Soil samples will be collected for laboratory analysis from zones for which screening indicates the potential for site impacts. In addition, soil samples will be collected at the groundwater interface and termination depths of all soil borings. The physical characteristics of the samples (such as mineralogy, ASTM soil classification, moisture content, texture, color, presence of stains or odors, and/or field screening results), depth where each sample was obtained, method of sample collection, and other observations will be recorded in the field log by a qualified geologist or engineer. Detailed logs of each boring will be completed in the field by a qualified engineer or geologist. Additional information, such as the presence of water-bearing zones and any unusual or noticeable conditions encountered during drilling, will be recorded on the logs.

Quality Assurance/Quality Control (QA/QC) samples will be collected to monitor the validity of the soil sample collection procedures as follows:

- Field duplicates will be collected at a rate of 10 percent; and
- Equipment blanks will be collected from all sampling apparatus at a frequency of one per day.

4.5.1 Drilling Activities

Soil borings will be drilled using hollow-stem augers and it may be necessary to switch to air rotary for the deep well drilled into the Sonsela Aquifer. The drilling equipment will be properly decontaminated before drilling each boring. The NMED will be notified as early as practicable if conditions arise or are encountered that do not allow the advancement of borings to the specified depths or at planned sampling locations. Appropriate actions (e.g., installation of protective surface casing or relocation of borings to a less threatening location) will be taken to minimize any negative impacts from investigative borings. Slotted (0.01 inch) PVC well screen will be placed at the bottom of the borings and 10/20 sand filter pack will be installed to two feet over the top of the well screen. Some locations may have wells screen placed near the land surface and in these locations the sand filter pack may be reduced to 1 foot. Where possible, aboveground surface completions will be used; with in-ground vaults only used in areas where an aboveground completion is not practicable.

4.6 Groundwater Sample Collection

Groundwater samples shall initially be obtained from newly installed monitoring wells between ten and 30 days after completion of well development. Well development and purging prior to sample collection will be in accordance with procedures described in Appendix D. Prior to collection of groundwater samples for laboratory analyses, the fluid levels and the total depths of each well will be measured.

Groundwater samples will be collected from the new monitoring wells within 24 hours of the completion of well purging using disposal bailers. Alternatively, well sampling may also be conducted in accordance with the NMED's Position Paper *Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring* (October 30, 2001, as updated). Sample collection methods will be documented in the field monitoring reports. The samples will be transferred to the appropriate, clean, laboratory-prepared containers provided by the analytical laboratory. Sample handling and chain-of-custody procedures will be in accordance with the procedures presented below in Section 4.4.1.

Groundwater samples intended for metals analysis will be submitted to the laboratory as both total and dissolved metals samples. QA/QC samples will be collected to monitor the validity of the groundwater sample collection procedures as follows:

- Field duplicate water samples will be obtained at a frequency of ten percent, with a minimum, of one duplicate sample per sampling event;
- Equipment rinsate blanks will be obtained for chemical analysis at the rate of ten percent or a minimum of one rinsate blank per sampling day. Equipment rinsate blanks will be collected at a rate of one per sampling day if disposable sampling equipment is used. Rinsate samples will be generated by rinsing deionized water through unused or decontaminated sampling equipment. The rinsate sample will be placed in the appropriate sample container and submitted with the groundwater samples to the analytical laboratory for the appropriate analyses; and
- Trip blanks will accompany laboratory sample bottles and shipping and storage containers intended for VOC analyses. Trip blanks will consist of a sample of analyte-free deionized water prepared by the laboratory and placed in an appropriate sample container. The trip

blank will be prepared by the analytical laboratory prior to the sampling event and will be kept with the shipping containers and placed with other water samples obtained from the site each day. Trip blanks will be analyzed at a frequency of one for each shipping container of groundwater samples to be analyzed for VOCs.

4.6.1 Sample Handling

At a minimum, the following procedures will be used at all times when collecting samples during investigation, corrective action, and monitoring activities:

1. Neoprene, nitrile, or other protective gloves will be worn when collecting samples. New disposable gloves will be used to collect each sample;
2. All samples collected of each medium for chemical analysis will be transferred into clean sample containers supplied by the project analytical laboratory with the exception of soil, rock, and sediment samples obtained in Encore® samplers. Sample container volumes and preservation methods will be in accordance with the most recent standard EPA and industry accepted practices for use by accredited analytical laboratories. Sufficient sample volume will be obtained for the laboratory to complete the method-specific QC analyses on a laboratory-batch basis; and
3. Sample labels and documentation will be completed for each sample following procedures discussed below. Immediately after the samples are collected, they will be stored in a cooler with ice or other appropriate storage method until they are delivered to the analytical laboratory. Standard chain-of-custody procedures, as described below, will be followed for all samples collected. All samples will be submitted to the laboratory soon enough to allow the laboratory to conduct the analyses within the method holding times.

Chain-of-custody and shipment procedures will include the following:

1. Chain-of-custody forms will be completed at the end of each sampling day, prior to the transfer of samples off site.
2. Individual sample containers will be packed to prevent breakage and transported in a sealed cooler with ice or other suitable coolant or other EPA or industry-wide accepted method. The drainage hole at the bottom of the cooler will be sealed and secured in case of sample container leakage. Temperature blanks will be included with each shipping container.

3. Each cooler or other container will be delivered directly to the analytical laboratory.
4. Glass bottles will be separated in the shipping container by cushioning material to prevent breakage.
5. Plastic containers will be protected from possible puncture during shipping using cushioning material.
6. The chain-of-custody form and sample request form will be shipped inside the sealed storage container to be delivered to the laboratory.
7. Chain-of-custody seals will be used to seal the sample-shipping container in conformance with EPA protocol.
8. Signed and dated chain-of-custody seals will be applied to each cooler prior to transport of samples from the site.
9. Upon receipt of the samples at the laboratory, the custody seals will be broken, the chain-of-custody form will be signed as received by the laboratory, and the conditions of the samples will be recorded on the form. The original chain-of-custody form will remain with the laboratory and copies will be returned to the relinquishing party.
10. Copies of all chain-of-custody forms generated as part of sampling activities will be maintained on-site.

4.7 Collection and Management of Investigation Derived Waste

Drill cuttings, excess sample material and decontamination fluids, and all other investigation derived waste (IDW) associated with soil borings will be contained and characterized using methods based on the boring location, boring depth, drilling method, and type of contaminants suspected or encountered. All purged groundwater and decontamination water will be characterized prior to disposal unless it is disposed in the refinery wastewater treatment system upstream of the API Separator. An IDW management plan is included as Appendix B.

Field equipment requiring calibration will be calibrated to known standards, in accordance with the manufacturers' recommended schedules and procedures. At a minimum, calibration checks will be conducted daily, or at other intervals approved by the Department, and the instruments will be recalibrated, if necessary. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, its use will be discontinued until the necessary repairs are made. In the interim, a properly calibrated replacement instrument will be used.

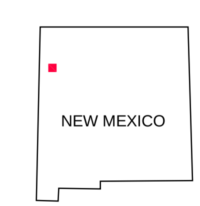
Figures

Aerial Map Source: Google Map, 01/05/2014.

LEGEND

- NEW REPLACEMENT WELL LOCATION
- PROPOSED SONSELA WELL WITH POSSIBLE SHALLOW CLUSTERED WELLS
- PROPOSED SHALLOW WELL LOCATION
- S01 TEMPORARY SUMP
- MONITORING WELL LOCATION (PERMANENT WELL)

0 300
SCALE IN FEET



QUADRANGLE LOCATION

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.:Marathon	DATE: 12/08/19	FILE: Mathon–dB231

FIGURE 4
PROPOSED
MONITORING WELL LOCATIONS

DiSorbo Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Work Plan
2015 Annual Groundwater Report Comments

Marathon Petroleum Company LP

Gallup Refinery
Western Refining Southwest, Inc.
Gallup, New Mexico

EPA ID# NMD000333211

OCTOBER 2018

(Revised June & October 2019)

Scott Crouch
Senior Geologist

DiSorbo
Environmental Consulting Firm

8501 North Mopac Expy | Suite 300 | Austin, TX 78759
512.693.4190 (P) | 512.279.3118 (F) | www.disorboconsult.com

Table of Contents

List of Figures

Appendices

Table of Contents (Continued)

List of Acronyms

benzene, toluene, ethylbenzene, and xylene (BTEX)
Code of Federal Regulations (CFR)
Contract Laboratory Program (CLP)
data quality objective (DQO)
diesel range organics (DRO)
dilution attenuation factor (DAF)
Environmental Protection Agency (EPA)
investigation derived waste (IDW)
Maximum Contaminant Level (MCL)
mean sea level (msl)
monitoring well (MW)
motor oil range organics (MRO)
methyl tert butyl ether (MTBE)
New Mexico Administrative Code (NMAC)
New Mexico Environment Department (NMED)
New Mexico Oil Conservation Division (NMOCD)
photoionization detector (PID)
polynuclear aromatic hydrocarbon (PAH)
polyvinyl chloride (PVC)
quality assurance/quality control (QA/QC)
Resource Conservation and Recovery Act (RCRA)
separate-phase hydrocarbon (SPH)
semi-volatile organic compound (SVOC)
Solid Waste Management Unit (SWMU)
total petroleum hydrocarbon (TPH)
toxicity characteristic leaching procedure (TCLP)
volatile organic compound (VOC)

Executive Summary

The Gallup Refinery, which is located 17 miles east of Gallup, New Mexico, has been in operation since the 1950s. Pursuant to the terms and conditions of the facility Resource Conservation and Recovery Act (RCRA) Post-Closure Care Permit and 20.4.1.500 New Mexico Administrative Code, this Work Plan has been prepared to address comments received on the 2015 Annual Groundwater Monitoring Report for the Gallup Refinery. In the Disapproval letter dated January 31, 2018, the New Mexico Environment Department (NMED) requested additional wells be installed pursuant to Comments No. 18.2, 18.3, 18.4, 20, 22, 25, 39, and 40. In response to these comments, at least eight new monitoring wells will be installed. Soil samples will be collected for chemical analysis based on field screening results. Upon completion and well development, groundwater samples will be collected and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), Skinner List metals, cyanide, iron, manganese, major cations, and major anions.

Section 1
Introduction

The Gallup Refinery is located approximately 17 miles east of Gallup, New Mexico along the north side of Interstate Highway I-40 in McKinley County. The physical address is I-40, Exit #39 Jamestown, New Mexico 87347. The Gallup Refinery is located on 810 acres. Figure 1 presents the refinery location and the regional vicinity.

The Gallup Refinery generally processes crude oil from the Four Corners area transported to the facility by pipeline or tanker truck. Various process units are operated at the facility, including crude distillation, reforming, fluidized catalytic cracking, alkylation, sulfur recovery, merox treater, and hydrotreating. Current and past operations have produced gasoline, diesel fuels, jet fuels, kerosene, propane, butane, and residual fuel.

This work plan addresses requests for additional site monitoring wells in the NMED Disapproval letter dated January 31, 2018 on the 2015 Annual Groundwater Monitoring Report and a subsequent NMED comment letter dated January 28, 2019 on the initial submission of this Work Plan. The specific comment numbers in the January 31, 2018 letter are 18.2, 18.3, 18.4, 20, 22, 25, 39, and 40. The actions, if required, to address these comments are described below:

- Comment 18.2 - A new monitoring well is proposed to the northeast of OW-30;
- Comment 18.3 – Methyl Tert Butyl Ether (MTBE) has been detected in OW-50 and OW-52 since submission of the 2015 Annual Groundwater Monitoring Report and that appears to confirm the down-gradient flow direction to the north in this area, thus no additional wells are proposed. In addition, we note that wells OW-54 and OW-55 have already been installed in the subject area since the 2015 reporting period and a row of six additional temporary wells have already been proposed further to the west (anticipated to be down-gradient) to provide additional information on the subsurface geology as well as hydraulic gradients west and northwest of OW-50, OW-52 and OW-56 (DiSorbo, 2019);
- Comment 18.4 – As noted above, MTBE has been detected down-gradient to the north in wells OW-50 and OW-52 and a new well (OW-56) has already been installed to the west, therefore no additional wells are proposed in the immediate area;

- Comment 20 - Upon further review of the well construction and water levels, it appears that operating a recovery pump in existing RW-2, which is being proposed separately, will lower the water level in RW-2 to below the top of the well screen. Fluid levels will be monitored and if the water level is not lowered below the top of the well screen, then further consideration will be given to installing an additional well with a higher well screen.
- Comment 22 – Recent monitoring data has shown the benzene, toluene, ethylbenzene, and xylenes (BTEX) results have been mostly non-detect in samples collected at OW-1; however, as requested additional wells are proposed to the west of OW-1;
- Comment 25 – A new well will be installed on the southern margin of Evaporation Pond 9 (EP-9);
- Comment 39 – MTBE concentrations have been slowly increasing in groundwater samples collected from OW-13. This well was installed in 1981, approximately 37 years ago, and the quality of the well construction is in question. There is a concern the well itself may be acting as a conduit for contamination in the Chinle/Alluvial Interface zone to migrate vertically to the Sonsela Aquifer. It is recommended to install a new Sonsela well in the same area. In addition, a new Sonsela well will be installed between OW-12 and OW-13; and
- Comment 40
    - Well MKTF-01 will be plugged and replaced with a new well in the same area with the screen set higher to encounter the potentiometric surface;
    - Well MKTF-02 will be plugged and replaced with a new well in the same area with the screen set higher to encounter the potentiometric surface;
    - Well MKTF-04 will be plugged and replaced with a new well with the screen set higher to encounter the potentiometric surface;
    - Wells MKTF-17 and -18 are addressed in the *Investigation Work Plan Area of Concern 35* (July 2019); and.
    - The water level in MKTF-28 has fluctuated above and below the top of the well screen; however, the well produces very little water and the chemical analyses of groundwater samples collected from MKTF-28 have shown only very low concentrations of constituents of concern. There are no indications of the presence of phase-separated hydrocarbons (PSH). No modifications are recommended for MKTF-28.

The investigation activities will be conducted in accordance with Section IV.H.5 of the Post-Closure Care Permit.

Section 2
Background

NMED's review of the 2015 Annual Groundwater Monitoring Report generated numerous requests for the installation of additional monitoring wells. The wells are basically located in three distinct areas on the refinery property. Three of the wells (OW-13 replacement, new Sonsela well between OW-12 and OW-13 and new off-site Chinle/Alluvial Interface well) will be drilled in the northeast portion of the property, with one of these actually located off-site to the northeast. There are no known potential sources in the immediate vicinity of where these wells will be located (north and northeast of the main tank farm); however, they are both potentially located down-gradient of the main tank farm such that it may be possible for contaminants sourced in the tank farm to migrate to these locations.

The second group of wells (MKTF-01R, MKTF-02R and MKTF-04R) is located in the vicinity of the hydrocarbon seep, which is an area on the western portion of the refinery where significant prior investigations of groundwater impacts have been conducted. Once again, this is an area without any known potential sources in the immediate area, but rather in a down-gradient location where impacted groundwater has transported contaminants. Also, in this general area, a new MTKF well will be drilled on the south side of EP-9.

The third location is near Evaporation EP-9 where one well be installed on the south side of EP-9 and additional well(s) will be installed to the west of OW-1.

Section 3
Site Conditions

3.1 Surface Conditions

Site topographic features include high ground in the southeast gradually decreasing to a lowland fluvial plain to the northwest. Elevations on the refinery property range from 7,040 feet to 6,860 feet. Surface soils within most of the area of investigation are primarily Rehobeth silty clay loam. Rehobeth soil properties include a pH ranging from 8 to 9 standard units and salinity (naturally occurring and typically measuring up to approximately 8 mmhos/cm).

Regional surface water features include the refinery evaporation ponds and a number of small ponds (one cattle water pond and two small unnamed spring fed ponds). The site is located in the Puerco River Valley, north of the Zuni Uplift with overland flows directed northward to the tributaries of the Puerco River. The Puerco River continues to the west to the confluence with the Little Colorado River. The South Fork of the Puerco River is intermittent and retains flow only during and immediately following precipitation events.

3.2 Subsurface Conditions

The shallow subsurface soils consist of fluvial and alluvial deposits comprised of clay and silt with minor inter-bedded sand layers. Very low permeability bedrock (e.g., claystones and siltstones) underlie the surface soils and effectively form an aquitard. The Chinle Group, which is Upper Triassic, crops out over a large area on the southern margin of the San Juan Basin. The uppermost recognized local Formation is the Petrified Forest Formation and the Sonsela Sandstone Bed is the uppermost recognized regional aquifer. Aquifer test of the Sonsela Bed northeast of Prewitt indicated a transmissivity of greater than 100 ft^2/day (Stone and others, 1983). The Sonsela Sandstone's highest point occurs southeast of the site and slopes downward to the northwest as it passes under the refinery. The Sonsela Sandstone forms a water-bearing reservoir with artesian conditions throughout the central and western portions of the refinery property.

The diverse properties and complex, irregular stratigraphy of the surface soils across the site cause a wide range of hydraulic conductivity ranging from less than 10^{-2} cm/sec for gravel like sands immediately overlying the Petrified Forest Formation to 10^{-8} cm/sec in the clay soils located near the surface (Western, 2009). Generally, shallow groundwater at the refinery follows the upper contact of the Petrified Forest Formation with prevailing flow from the southeast to the northwest, although localized areas may have varying flow directions (Figures 2 and 2A).

Section 4
Scope of Services

The new and replacement monitoring wells will be installed pursuant Section IV.K. of the RCRA Post-Closure Care Permit. This includes three replacement wells to raise the top of the well screen intervals. One new well is located in a potentially down-gradient location to evaluate the possible migration of MTBE off-site to the east of the refinery and new well(s) will be located west of well OW-1 to delineate the down-gradient extent of the plume. One well will supplement an old well screened in the Sonsela aquifer, which has shown detections of MTBE, and an additional well will be installed down-gradient of this location. A new well is proposed to the south of EP-9. Boring logs of wells being replaced or adjacent wells are provided in Appendix A. The location specific activities are discussed further below. The well installation will commence upon approval of this work plan by NMED.

4.1 New Well Northeast of OW-30

An investigation of groundwater conditions in the area northeast of OW-30 is proposed to determine the hydraulic gradient on the east side of the refinery and the lateral extent of MTBE, which has been detected at elevated concentrations in groundwater samples collected from OW-30. One well will be located approximately 500 feet northeast of OW-30 (Figure 3). The well will be screened in the upper-most saturated interval(s) with a maximum screen length of 20 feet to help ensure the top of the well screen is set above the potentiometric surface.

4.2 New Sonsela Wells

Concentrations of MTBE have been slowly increasing in groundwater samples collected at monitoring well OW-13 since at least 2010. A graph of the concentrations is included in Appendix C. The boring log for OW-13 indicates that the top of the Chinle Formation, which consists of shale, is present at 8 feet below ground level (bgl) and extends to 70 feet bgl before encountering the Sonsela aquifer, Therefore, the aquitard comprised of the Chinle Formation (shale) is approximately 60 feet thick in the area of OW-13. An examination of the boring log for OW-12 indicates the Chinle Formation is approximately 80 feet thick above the Sonsela aquifer. The thickness of the aquitard (Chinle Formation) between the Chinle-Alluvial Interface Zone and the Sonsela aquifer cast doubt on whether the MTBE has migrated through the aquitard or found another migration pathway.

A review of the potentiometric surfaces measured in OW-12 (completed in Sonsela aquifer), OW-13 (completed in Sonsela aquifer) and OW-14 (completed in Chinle-Alluvial Interface Zone) indicates that the potentiometric surface measured in OW-13 tracks more closely with the potentiometric surface in OW-14 than the potentiometric surface in OW-12 (Appendix C). In fluid levels measured from June 2005 through November 2018, all three wells indicate rising water levels. From the lowest potentiometric surfaces recorded in December 2007 to the highest (April 2018 in OW-13 and OW-14 and August 2018 in OW-12), the increases are 2.78 feet, 4.14 feet, and 5.66 feet in OW-12, OW-13 and OW-14, respectively. While the increase at OW-13 is not as great as that measured at OW-14, it is significantly greater than the increase measured at OW-12, the other nearby well completed in the Sonsela aquifer.

The examination of the aquitard thickness and potentiometric surfaces indicates that well OW-13 is a possible migration pathway for contaminations to move vertically downward to the Sonsela aquifer. To address this concern a new well will be installed in the same area as OW-13 (Figure 3). OW-13 will be retained at this time to allow for further evaluation. The new well will be screened within the Sonsela aquifer, with a separate isolation casing set from the land surface to the top of the Chinle Formation.

To evaluate the potential migration of MTBE within the Sonsela aquifer, an additional well will be located approximately halfway between OW-12 and OW-13. The proposed location is shown on Figure 3. To delineate the down-gradient extent of the plume detected at OW-1, a new Sonsela well will be installed approximately five hundred feet down-gradient to the west of OW-1. The proposed location is shown on Figure 3.

4.3 New Wells near EP-9 and west of OW-1

A new shallow monitoring well will be installed adjacent to EP-9 on the south side of the pond for the purpose of leak detection. In addition, a new Sonsela well will be installed west of OW-1. If saturation is encountered in the alluvium deposits above the Chinle Group during the drilling of the new Sonsela well west of OW-1, then up to two “shallow” wells will be completed adjacent to the new Sonsela well consistent with those recently installed at locations BW-4A, BW-4B, BW-5A, and BW-5B. (Figure 4).

4.4 MKTF-01, MKTF-02 and MKTF-04 Replacement Wells

Monitoring wells MKTF-01, MKTF-02 and MKTF-04 will be plugged and abandoned. Replacement wells (MKTF-01R, MKTF-02R and MKTF-04R) will be drilled adjacent to the original well locations. The well screen in MKTF-01 was placed from 4 to 14 feet below ground level (bgl). MKTF-01R will be drilled to a depth of approximately 13 feet with the well screen set from 2 to 12 feet bgl. The well completion will include 1 foot of sand above the well screen and 1 foot of grout extending to the land surface.

The well screen in MKTF-02 was placed from 7 to 17 feet below ground level (bgl). MKTF-02R will be drilled to a depth of approximately 17 feet with the well screen set from 2.5 to 15.5 feet bgl. The well completion will include 1 foot of sand above the well screen and 1.5 feet of grout extending to the land surface.

The well screen in MKTF-04 was placed from 12 to 22 feet bgl. MKTF-04R will be drilled to a depth of approximately 19 feet with the well screen set from 4 to 19 feet bgl. The well completion will include 2 foot of sand above the well screen and 2 feet of grout extending to the land surface.

4.5 Soil Sample Field Screening and Logging

Samples obtained from the soil borings will be screened in the field on 2.0-foot intervals for evidence of contaminants. Field screening results will be recorded on the exploratory boring logs. Field screening results will be used to aid in the possible selection of soil samples for laboratory analysis. The primary screening methods include: (1) visual examination, (2) olfactory examination, and (3) headspace vapor screening for volatile organic compounds.

Visual screening includes examination of soil samples for evidence of staining caused by petroleum-related compounds or other substances that may cause staining of natural soils such as elemental sulfur or cyanide compounds. Headspace vapor screening targets volatile organic compounds and involves placing a soil sample in a plastic sample bag or a foil sealed container allowing space for ambient air. The container will be sealed and then shaken gently to expose the soil to the air trapped in the container. The sealed container will be allowed to rest for a minimum of 5 minutes while vapors equilibrate. Vapors present within the sample bag's headspace will then be measured by inserting the probe of the instrument in a small opening in the bag or through the foil. The maximum value and the ambient air temperature will be recorded on the field boring or test pit log for each sample.

The monitoring instruments will be calibrated each day to the manufacturer's standard for instrument operation. A photoionization detector (PID) equipped with a 10.6 or higher electron volt (eV) lamp or a combustible gas indicator may be used for VOC field screening. Field screening results may be site- and boring-specific and the results may vary with instrument type, the media screened, weather conditions, moisture content, soil type, and type of contaminant, therefore, all conditions capable of influencing the results of field screening will be recorded on the field logs.

Soil samples will be collected for laboratory analysis from zones for which screening indicates the potential for site impacts. In addition, soil samples will be collected at the groundwater interface and termination depths of all soil borings. The physical characteristics of the samples (such as mineralogy, ASTM soil classification, moisture content, texture, color, presence of stains or odors, and/or field screening results), depth where each sample was obtained, method of sample collection, and other observations will be recorded in the field log by a qualified geologist or engineer. Detailed logs of each boring will be completed in the field by a qualified engineer or geologist. Additional information, such as the presence of water-bearing zones and any unusual or noticeable conditions encountered during drilling, will be recorded on the logs.

Quality Assurance/Quality Control (QA/QC) samples will be collected to monitor the validity of the soil sample collection procedures as follows:

- Field duplicates will be collected at a rate of 10 percent; and
- Equipment blanks will be collected from all sampling apparatus at a frequency of one per day.

4.5.1 Drilling Activities

Soil borings will be drilled using hollow-stem augers and it may be necessary to switch to air rotary for the deep well drilled into the Sonsela Aquifer. The drilling equipment will be properly decontaminated before drilling each boring. The NMED will be notified as early as practicable if conditions arise or are encountered that do not allow the advancement of borings to the specified depths or at planned sampling locations. Appropriate actions (e.g., installation of protective surface casing or relocation of borings to a less threatening location) will be taken to minimize any negative impacts from investigative borings. Slotted (0.01 inch) PVC well screen will be placed at the bottom of the borings and 10/20 sand filter pack will be installed to two feet over the top of the well screen. Some locations may have wells screen placed near the land surface and in these locations the sand filter pack may be reduced to 1 foot. Where possible, aboveground surface completions will be used; with in-ground vaults only used in areas where an aboveground completion is not practicable.

4.6 Groundwater Sample Collection

Groundwater samples shall initially be obtained from newly installed monitoring wells between ten and 30 days after completion of well development. Well development and purging prior to sample collection will be in accordance with procedures described in Appendix D. Prior to collection of groundwater samples for laboratory analyses, the fluid levels and the total depths of each well will be measured.

Groundwater samples will be collected from the new monitoring wells within 24 hours of the completion of well purging using disposal bailers. Alternatively, well sampling may also be conducted in accordance with the NMED's Position Paper *Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring* (October 30, 2001, as updated). Sample collection methods will be documented in the field monitoring reports. The samples will be transferred to the appropriate, clean, laboratory-prepared containers provided by the analytical laboratory. Sample handling and chain-of-custody procedures will be in accordance with the procedures presented below in Section 4.4.1.

Groundwater samples intended for metals analysis will be submitted to the laboratory as both total and dissolved metals samples. QA/QC samples will be collected to monitor the validity of the groundwater sample collection procedures as follows:

- Field duplicate water samples will be obtained at a frequency of ten percent, with a minimum, of one duplicate sample per sampling event;
- Equipment rinsate blanks will be obtained for chemical analysis at the rate of ten percent or a minimum of one rinsate blank per sampling day. Equipment rinsate blanks will be collected at a rate of one per sampling day if disposable sampling equipment is used. Rinsate samples will be generated by rinsing deionized water through unused or decontaminated sampling equipment. The rinsate sample will be placed in the appropriate sample container and submitted with the groundwater samples to the analytical laboratory for the appropriate analyses; and
- Trip blanks will accompany laboratory sample bottles and shipping and storage containers intended for VOC analyses. Trip blanks will consist of a sample of analyte-free deionized water prepared by the laboratory and placed in an appropriate sample container. The trip

blank will be prepared by the analytical laboratory prior to the sampling event and will be kept with the shipping containers and placed with other water samples obtained from the site each day. Trip blanks will be analyzed at a frequency of one for each shipping container of groundwater samples to be analyzed for VOCs.

4.6.1 Sample Handling

At a minimum, the following procedures will be used at all times when collecting samples during investigation, corrective action, and monitoring activities:

1. Neoprene, nitrile, or other protective gloves will be worn when collecting samples. New disposable gloves will be used to collect each sample;
2. All samples collected of each medium for chemical analysis will be transferred into clean sample containers supplied by the project analytical laboratory with the exception of soil, rock, and sediment samples obtained in Encore® samplers. Sample container volumes and preservation methods will be in accordance with the most recent standard EPA and industry accepted practices for use by accredited analytical laboratories. Sufficient sample volume will be obtained for the laboratory to complete the method-specific QC analyses on a laboratory-batch basis; and
3. Sample labels and documentation will be completed for each sample following procedures discussed below. Immediately after the samples are collected, they will be stored in a cooler with ice or other appropriate storage method until they are delivered to the analytical laboratory. Standard chain-of-custody procedures, as described below, will be followed for all samples collected. All samples will be submitted to the laboratory soon enough to allow the laboratory to conduct the analyses within the method holding times.

Chain-of-custody and shipment procedures will include the following:

1. Chain-of-custody forms will be completed at the end of each sampling day, prior to the transfer of samples off site.
2. Individual sample containers will be packed to prevent breakage and transported in a sealed cooler with ice or other suitable coolant or other EPA or industry-wide accepted method. The drainage hole at the bottom of the cooler will be sealed and secured in case of sample container leakage. Temperature blanks will be included with each shipping container.

3. Each cooler or other container will be delivered directly to the analytical laboratory.
4. Glass bottles will be separated in the shipping container by cushioning material to prevent breakage.
5. Plastic containers will be protected from possible puncture during shipping using cushioning material.
6. The chain-of-custody form and sample request form will be shipped inside the sealed storage container to be delivered to the laboratory.
7. Chain-of-custody seals will be used to seal the sample-shipping container in conformance with EPA protocol.
8. Signed and dated chain-of-custody seals will be applied to each cooler prior to transport of samples from the site.
9. Upon receipt of the samples at the laboratory, the custody seals will be broken, the chain-of-custody form will be signed as received by the laboratory, and the conditions of the samples will be recorded on the form. The original chain-of-custody form will remain with the laboratory and copies will be returned to the relinquishing party.
10. Copies of all chain-of-custody forms generated as part of sampling activities will be maintained on-site.

4.7 Collection and Management of Investigation Derived Waste

Drill cuttings, excess sample material and decontamination fluids, and all other investigation derived waste (IDW) associated with soil borings will be contained and characterized using methods based on the boring location, boring depth, drilling method, and type of contaminants suspected or encountered. All purged groundwater and decontamination water will be characterized prior to disposal unless it is disposed in the refinery wastewater treatment system upstream of the API Separator. An IDW management plan is included as Appendix B.

Field equipment requiring calibration will be calibrated to known standards, in accordance with the manufacturers' recommended schedules and procedures. At a minimum, calibration checks will be conducted daily, or at other intervals approved by the Department, and the instruments will be recalibrated, if necessary. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, its use will be discontinued until the necessary repairs are made. In the interim, a properly calibrated replacement instrument will be used.

4.8 Documentation of Field Activities

Daily field activities, including observations and field procedures, will be recorded in a field log book. Copies of the completed forms will be maintained in a bound and sequentially numbered field file for reference during field activities. Indelible ink will be used to record all field activities. Photographic documentation of field activities will be performed, as appropriate. The daily record of field activities will include the following:

1. Site or unit designation;
2. Date;
3. Time of arrival and departure;
4. Field investigation team members including subcontractors and visitors;
5. Weather conditions;
6. Daily activities and times conducted;
7. Observations;
8. Record of samples collected with sample designations and locations specified;
9. Photographic log, as appropriate;
10. Field monitoring data, including health and safety monitoring;
11. Equipment used and calibration records, if appropriate;
12. List of additional data sheets and maps completed;
13. An inventory of the waste generated and the method of storage or disposal; and
14. Signature of personnel completing the field record.

4.9 Chemical Analyses

All samples collected for laboratory analysis will be submitted to an accredited laboratory. The laboratory will use the most recent standard EPA and industry-accepted analytical methods for target analytes as the testing methods for each medium sampled. Chemical analyses will be performed in accordance with the most recent EPA standard analytical methodologies and extraction methods.

Groundwater and soil samples will be analyzed by the following methods:

- SW-846 Method 8260 for volatile organic compounds;
- SW-846 Method 8270 for semi-volatile organic compounds; and
- SW-846 Method 8015B gasoline range (C5-C10), diesel range (>C10-C28), and motor oil range (>C28-C36) organics.

Groundwater and soil samples will also be analyzed for the following Skinner List metals and iron and manganese using the indicated analytical methods shown. The groundwater samples collected for metals analysis will be analyzed for total and dissolved concentrations. Groundwater samples will also be analyzed for major cations and anions as listed below.

Analyte	Analytical Method
Antimony	SW-846 method 6010/6020
Arsenic	SW-846 method 6010/6020
Barium	SW-846 method 6010/6020
Beryllium	SW-846 method 6010/6020
Cadmium	SW-846 method 6010/6020
Chromium	SW-846 method 6010/6020
Cobalt	SW-846 method 6010/6020
Cyanide	SW-846 method 335.4/335.2 mod
Lead	SW-846 method 6010/6020
Mercury	SW-846 method 7470/7471
Nickel	SW-846 method 6010/6020
Selenium	SW-846 method 6010/6020
Silver	SW-846 method 6010/6020
Vanadium	SW-846 method 6010/6020
Zinc	SW-846 method 6010/6020
Iron	SW-846 method 6010/6020
Manganese	SW-846 method 6010/6020
Calcium	EPA method 200.7
Manganese	EPA method 200.7
Sodium	EPA method 200.7
Potassium	EPA method 200.7
Carbonate	SM 2320B
Bicarbonate	SM 2320B
Sulfate	EPA method 300.0
Fluoride	EPA method 300.0
Chloride	EPA method 300.0
Nitrate	EPA method 300.0
Nitrite	EPA method 300.0

Groundwater field measurements will be obtained for pH, specific conductance, dissolved oxygen concentrations, oxidation-reduction potential, and temperature.

4.10 Data Quality Objectives

The Data Quality Objectives (DQOs) were developed to ensure that newly collected data are of sufficient quality and quantity to address the project goals, including Quality Assurance/Quality Control (QA/QC) issues (EPA, 2006). The project goals are established to determine and evaluate the presence, nature, and extent of releases of contaminants at specified SWMUs. The type of data required to meet the project goals includes chemical analyses of soil and groundwater to determine if there has been a release of contaminants.

The quantity of data is location specific and is based on the historical operations at individual locations. Method detection limits should be 20% or less of the applicable background levels, cleanup standards and screening levels.

Additional DQOs include precision, accuracy, representativeness, completeness, and comparability. Precision is a measurement of the reproducibility of measurements under a given set of circumstances and is commonly stated in terms of standard deviation or coefficient of variation (EPA, 1987). Precision is also specific to sampling activities and analytical performance. Sampling precision will be evaluated through the analyses of duplicate field samples and laboratory replicates will be utilized to assess laboratory precision.

Accuracy is a measurement in the bias of a measurement system and may include many sources of potential error, including the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analysis techniques (EPA, 1987). An evaluation of the accuracy will be performed by reviewing the results of field/trip blanks, matrix spikes, and laboratory QC samples.

Representativeness is an expression of the degree to which the data accurately and precisely represent the true environmental conditions. Sample locations and the number of samples have been selected to ensure the data is representative of actual environmental conditions. Based on SWMU specific conditions, this may include either biased (i.e., judgmental) locations/depths or unbiased (systematic grid samples) locations. In addition, sample collection techniques (e.g., field monitoring and decontamination of sampling equipment) will be utilized to help ensure representative results.

Completeness is defined as the percentage of measurements taken that are actually valid measurements, considering field QA and laboratory QC problems. EPA Contract Laboratory Program (CLP) data has been found to be 80-85% complete on a nationwide basis and this has been extrapolated to indicate that Level III, IV, and V analytical techniques will generate data that are approximately 80% complete (EPA, 1987). As an overall project goal, the completeness goal is 85%; however, some samples may be critical based on location or field screening results and thus a sample-by-sample evaluation will be performed to determine if the completeness goals have been obtained.

Comparability is a qualitative parameter, which expresses the confidence with which one data set can be compared to another. Industry standard sample collection techniques and routine EPA analytical methods will be utilized to help ensure data are comparable to historical and future data. Analytical results will be reported in appropriate units for comparison to historical data and cleanup levels.

Section 5
References

DiSorbo, 2019, Investigation Report North Drainage Ditch and OW-29 & OW-30 Areas, August 2018 (Revised April 2019)

EPA, 1987, Data Quality Objectives for Remedial Response Activities; United States Environmental Protection Agency, Office of Emergency and Remedial Response and Office of Waste Programs Enforcement, OSWER Directive 9355.0-7B, 85p.

EPA, 2006, Guidance on Systematic Planning Using the Data Quality Objectives Process, United States Environmental Protection Agency, Office of Environmental Information; EPA/240/B-06/001, p. 111.

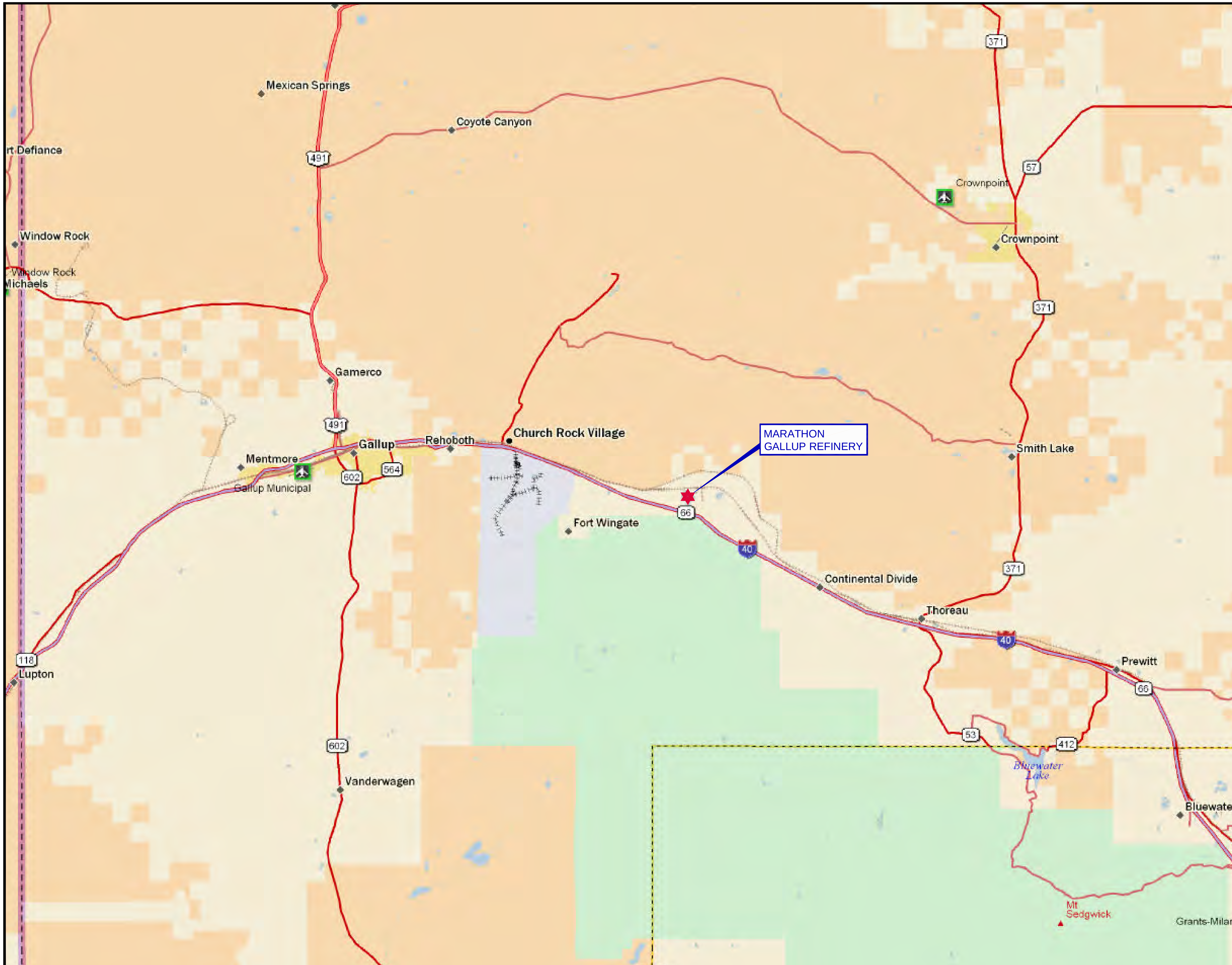
NMED, 2017, Risk Assessment Guidance for Site Investigation and Remediation, New Mexico Environment Department.

Stone, W.J., Lyford, F.P., Frenzel, P.F., Mizel, N.H., and Padgett, E.T., 1983, Hydrogeology and Water Resources of San Juan Basin, New Mexico; Hydrogeologic Report 6, New Mexico Bureau of Mines and Mineral Resources, p. 70.

Western, 2009, Facility-wide Groundwater Monitoring Plan: Gallup Refinery, p. 97.

Figures

Map Source: DeLorme Street Atlas USA 2007 Plus.



MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 03/24/19	FILE: Mathon–dB206

FIGURE 1
SITE LOCATION MAP
GALLUP REFINERY

DiSorbo
Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 03/18/2016.

0 240
SCALE IN FEET

NEW MEXICO

GALLUP SITE LOCATION

LEGEND

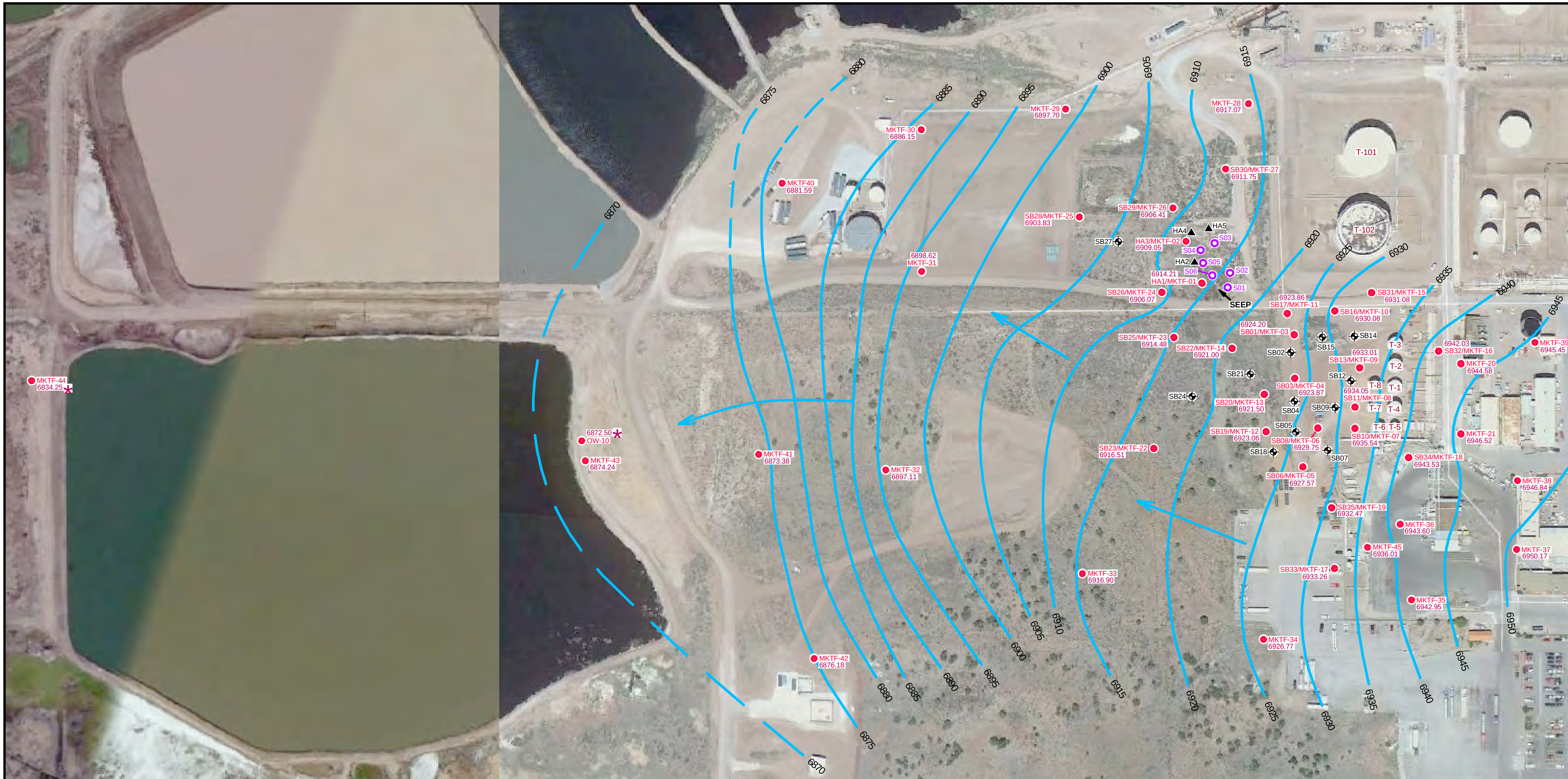
NDD-1	SOIL BORING LOCATION AND IDENTIFICATION NUMBER
NDD-1	TEMPORARY MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
OW-14	ALLUVIUM / CHINLE GP MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
OW-13	SONSELA MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
6900	CONTOUR OF POTENTIOMETRIC SURFACE
6900.69	POTENTIOMETRIC SURFACE AUGUST 2018
*	NOT USED TO CONTOUR

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon | DATE: 06/11/19 | FILE: Mathon–dB218

FIGURE 2
CHINLE / ALLUVIAL INTERFACE
POTENTIOMETRIC MAP
NORTH

DiSorbo
Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759



Aerial Map Source: Google Map, 01/05/2014.

LEGEND

SB01 TEMPORARY WELL LOCATION (PLUGGED)

HA1 HAND AUGER LOCATION (PLUGGED)

S01 TEMPORARY SUMP

MONITORING WELL LOCATION (PERMANENT WELL)

6930 POTENTIOMETRIC CONTOUR (FT) (5 FT INTERVAL)

GROUNDWATER FLOW DIRECTION

6876.18 POTENTIOMETRIC SURFACE MEASURED RELATIVE TO MEAN SEA LEVEL (AUGUST 2018)

* MEASUREMENT NOT USED IN CONTOURING

0 220
SCALE IN FEET

NEW MEXICO

QUADRANGLE LOCATION

MARATHON

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 06/11/19	FILE: Mathon–dB219

FIGURE 2A
CHINLE / ALLUVIAL INTERFACE
POTENTIOMETRIC MAP
WEST

DiSorbo
Environmental Consulting Firm

8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 03/18/2016.

LEGEND

PROPOSED ALLUVIUM / CHINLE GP WELL LOCATION

PROPOSED SONSELA WELL LOCATION

NDD-1 SOIL BORING LOCATION AND IDENTIFICATION NUMBER

NDD-1 TEMPORARY MONITORING WELL LOCATION AND IDENTIFICATION NUMBER

OW-14 ALLUVIUM / CHINLE GP MONITORING WELL LOCATION AND IDENTIFICATION NUMBER

OW-13 SONSELA MONITORING WELL LOCATION AND IDENTIFICATION NUMBER

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 10/19/19	FILE: Mathon–dB220

FIGURE 3
PROPOSED MONITORING WELL LOCATIONS

DiSorbo Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 01/05/2014.

LEGEND

NEW REPLACEMENT WELL LOCATION

PROPOSED SONSELA WELL WITH POSSIBLE SHALLOW CLUSTERED WELLS

PROPOSED SHALLOW WELL LOCATION

S01 TEMPORARY SUMP

MONITORING WELL LOCATION (PERMANENT WELL)

0 300
SCALE IN FEET

NEW MEXICO

QUADRANGLE LOCATION

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon | DATE: 12/08/19 | FILE: Mathon–dB231

FIGURE 4
PROPOSED
MONITORING WELL LOCATIONS

DiSorbo Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Appendix A

Boring Logs

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

PROJECT: Giant Refinery
Ciniza

FILE #: 96-133
ELEVATION: 6921.6
TOTAL DEPTH: 48.4
LOGGED BY: WHK
DATE: 8-28-96
STATIC WATER: 24.4
BORING ID: OW-30(0647)
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
0.0-6.5	///---///		C	**CLAY**, SILTY, DRY, RED BROWN, FIRM, SOME ROOT MATTER	PID-0ppm
	///---///		C		ALL SAMPLES
	///---///		C		
	///---///		C		
	///---///		C		
	///---///		C		
	///---///		C		
	///---///		C		
	///---///		C		
	///---///	5.0	C		
	///---///		C		
	///---///		C		
6.5	///---///		C		
6.5-13.1	/////////		C	**CLAY**, RED BROWN, MOIST, STIFF, SOME ROOT MATTER, SOME CARBONATE NODULES < 1 cm	
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////	10	C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
13.1	/////////		C		
13.1-13.8	///***///		C	**CLAY**, SANDY, CARBONATE NODULES APPROXIMATELY 3mm, STIFF, DAMP, RED BROWN	
	///***///		C		
13.8	///***///		C		
13.8-16.5	///---///	15	C	**CLAY**, SILTY, DAMP-MOIST, RED BROWN, STIFF	
	///---///		C		
	///---///		C		
16.5	///---///		C		
16.5-22.5	/////////		C	**CLAY**, VERY STIFF, RED BROWN, MOIST	
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////	20	C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
22.5	/////////		C		
22.5-23.2	/////////		C	**CLAY**, SILTY, STIFF, MOIST, BROWN	

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

PROJECT: Giant Refinery
Ciniza

FILE #: 96-133
ELEVATION: 6921.6
TOTAL DEPTH: 48.4
LOGGED BY: WHK
DATE: 8-28-96
STATIC WATER: 24.4
BORING ID: OW-30(0647)
PAGE: 2

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
23.2-23.8	***---***		C	**SAND**, FINE, SILTY, BROWN, DAMP, MODERATELY DENSE	PID=0ppm
23.8	***---***		C		ALL SAMPLES
23.8-24.3	///---///		C	**CLAY**, SILTY, BROWN, VERY STIFF, MOIST	
24.3-39.7	/////////	25	C	**CLAY**, BROWM, VERY STIFF, MOIST, SOME CARBONATE SPECKS > 28'	
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////	30	C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////	35	C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
39.7	/////////		C		
39.7-41.7	///***///	40	C	**CLAY**, SANDY, WET, SOFT, RED BROWN, SANDIER @ 41.2-41.7	
	///***///		C		
	///***///		C		
41.7	///***///		C		
41.7-42.6	/////////		C	**CLAY**, BLACK, WET, ABUNDANT CHARCOAL, SOFT, SOME ROOT MATTER	
42.6	/////////		C		
42.6-44.2	///--*///		C	**CLAY**, LIGHT BROWN, WET, SOFT, VERY SLIGHTLY SANDY, SILTY	
	///--*///		C		
44.2	///--*///		C		
44.2-47.3	000SSS000		C	**GRAVEL**, **WATER BEARING**, CHERT, SANDSTONE, SOME LIMESTONE, MODERATELY DENSE	
	000SSS000	45	C		
	000SSS000		C		
	000SSS000		C		

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

PROJECT: Giant Refinery Ciniza

FILE #:	96-133
ELEVATION:	6921.6
TOTAL DEPTH:	48.4
LOGGED BY:	WHK
DATE:	8-28-96
STATIC WATER:	24.4
BORING ID:	OW-30(0647)
PAGE:	3

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
44.2-47.3	000SSS000		C	**GRAVEL**, **WATER BEARING**, CHERT, SANDSTONE, SOME LIMESTONE, MODERATELY DENSE	PID=0ppm ALL SAMPLES
	000SSS000		C		
47.3	000SSS000		C		
47.3-48.4	=========		C	**SHALE**, **CHINLE FORMATION**, MOIST, HARD, RED TO WHITE (CARBONATE INDURATION)	
	=========		C		
TOTAL DEPTH				NOTE: STATIC WATER ELEVATION 33.5 @ .5 HOURS AND 24.4 @ 72 HOURS	
		50			
		55			
		60			
		65			

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

BORING OW-13

SURFACE ELEVATION: 6914 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
0									
10									
20									
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									
130									
140									
150									
160									

PENETRATION RATE MINUTES/FOOT: 1.4, 2.6, 3.6, 4.0, 3.0, 3.0, 3.3, 4.4, 4.8, 4.6, 4.0, 4.3, 7.5, 6.7, 5.0, 6.5, 6.7, 6.0, 5.0, 6.0, 6.7, 10.0, 8.0, 6.4

SYMBOLS	DESCRIPTION
CL	TRIASSIC PERIOD CHINLE FORMATION REDDISH BROWN SILTY FINE SANDY CLAY, SOFT, HIGHLY WEATHERED GRADES WITH GRAVEL FROM 3 TO 6 FEET
SHALE	8 FEET: SHALE, REDDISH BROWN, SILTY WITH SOME FINE SAND, SOFT, FRESH GRADES WITH THIN LIMESTONE INTERBEDS FROM 26 TO 32 FEET GRADES GRAY AND HARD FROM 40 FEET GRADES REDDISH BROWN FROM 55 FEET
SS/MS	70 FEET: SANDSTONE, WHITE TO GRAY, FINE-GRAINED, INTERBEDDED WITH REDDISH BROWN SANDY MUDSTONE, THIN BEDDED, HARD, FRESH
SS	79 FEET: SANDSTONE, LIGHT BROWN, FINE-GRAINED WITH SOME MEDIUM TO COARSE GRAINS, SLIGHTLY CALCAREOUS, COMPOSED OF QUARTZ WITH MINOR LIMESTONE, HARD, FRESH
SHALE	104 FEET: SHALE, REDDISH BROWN, SANDY, WITH OCCASIONAL THIN INTERBEDS OF SANDSTONE AND LIMESTONE, HARD, FRESH

BORING COMPLETED AT 108.0 FEET ON 12/10/80.
BORING ALLOWED TO CAVE FROM 98.2 TO 104.0 FEET.
4-INCH PVC PIEZOMETER INSTALLED WITH PERFORATIONS FROM 78.2 TO 98.2 FEET.
GRAVEL PLACED FROM 74.0 TO 98.2 FEET AND BORING SEALED WITH BENTONITE AND CEMENT TO SURFACE.
GROUND WATER LEVEL MEASURED AT 23.2 FEET BELOW GROUND ON 1/5/81.

LOG OF BORINGS

DAMES & MOORE

RPS

WELL INSTALLATION

Well No.: MKTF-01
Start Date: 11/14/2013
Finish Date: 11/14/2013

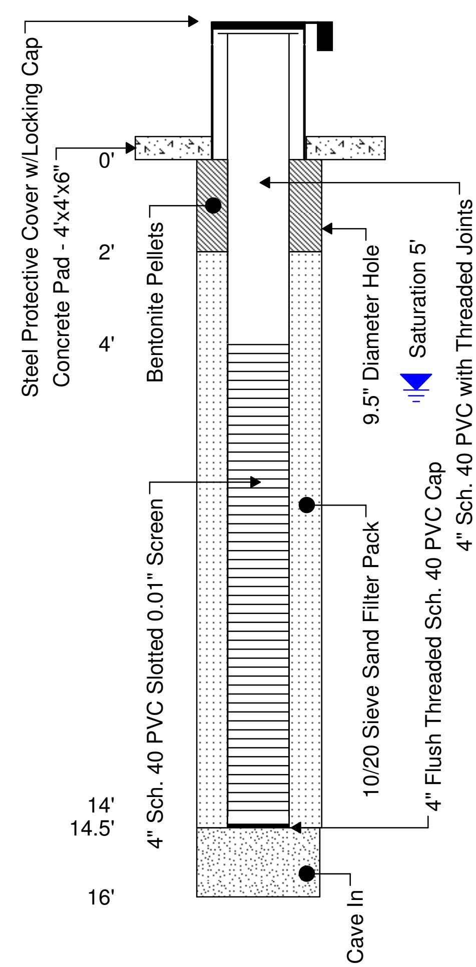
Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.346' W 108°25.782'; Boring ID - HA1

Total Depth: 16' bgl
Ground Water: Saturated @ 5' bgl
Elev., TOC (ft. msl): 6920.67
Elev., PAD (ft. msl): 6918.28
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,864.41 **E** 2,545,561.73

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-3 to 0					Ground Surface
0 to 5				100	**Silty Clay (CL)** Low plasticity, soft, damp, reddish brown to brown, no odor
5 to 16		5'		100	**Silty Clay/Clayey Silt (CL/ML)** Low plasticity, very soft, moist to saturated, brown grading to black, gravelly, bio odor, no phase-separated hydrocarbon
16					Total Depth = 16' BGL

Depth scale: -3, -1, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19

Completion Results



RPS
1250 S. Capital of Texas Hwy., Bldg. 3, Suite 200
Austin, Texas 78746
512/347-7588
512/347-8243

WELL INSTALLATION

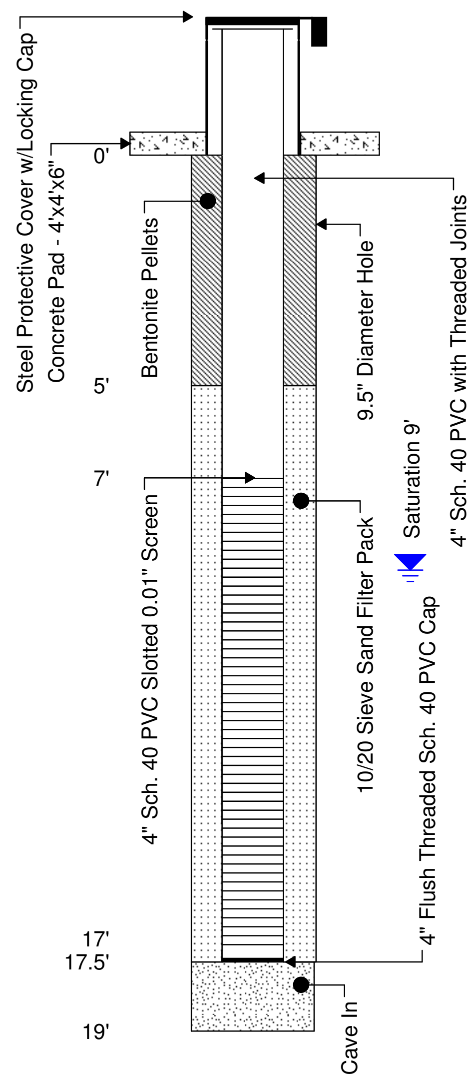
Well No.: MKTF-02
Start Date: 11/14/2013
Finish Date: 11/14/2013

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.360' W 108°25.789'; Boring ID HA3

Total Depth: 19' bgl
Ground Water: Saturated @ 9' bgl
Elev., TOC (ft. msl): 6917.45
Elev., PAD (ft. msl): 6915.00
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,946.93 **E** 2,545,530.46

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-3 to -1					Ground Surface
1, 3, 5	24.6; 20.1		CL	100	**Silty Clay (CL)** Low plasticity, firm, damp, brown-reddish brown, no odor
7	400		CL	100	**Silty Clay (CL)** Similar to above, odor at 6' bgl with black discoloration
9	933; 800	9'	CL	100	**Sandy Clay (CL)** Low plasticity, soft, moist to saturated at 9' bgl, hydrocarbon odor, no phase-separated hydrocarbon
11, 13, 15, 17, 19			SC/CL	100	**Sandy Clay/Clayey Sand (SC/CL)** Fine grain, compact, saturated, dark brown, hydrocarbon odor, no phase-separated hydrocarbon
					Total Depth = 19' BGL

Completion Results



RPS
1250 S. Capital of Texas Hwy., Bldg. 3, Suite 200
Austin, Texas 78746
512/347-7588
512/347-8243

WELL INSTALLATION

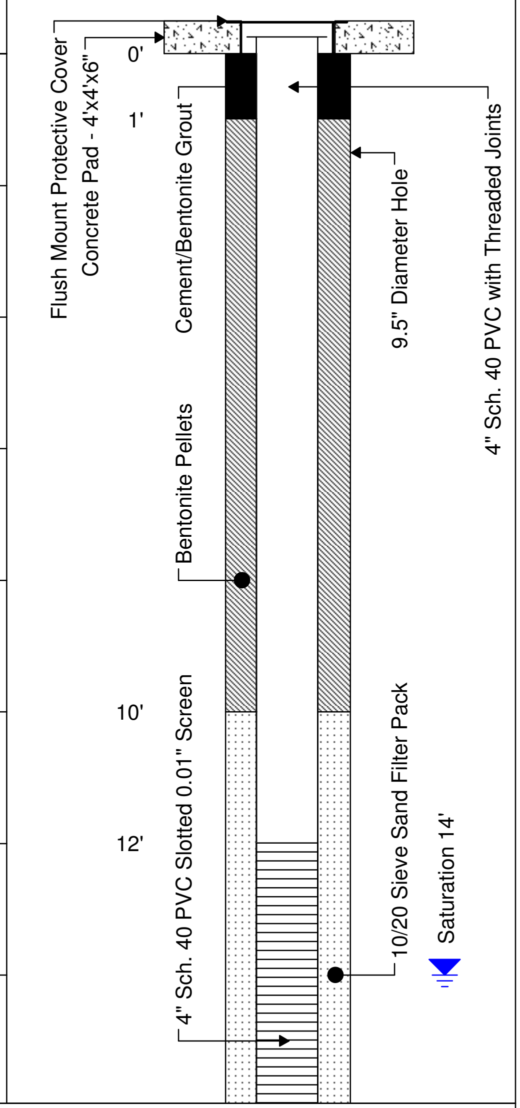
Well No.: MKTF-04
Start Date: 11/12/2013
Finish Date: 11/12/2013

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.310' W 108°25.742'; Boring ID SB03

Total Depth: 24' bgl
Ground Water: Saturated @ 14' bgl
Elev., TOC (ft. msl): 6933.57
Elev., PAD (ft. msl): 6933.90
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,649.46 **E** 2,545,752.83

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-1					Ground Surface
1	10.2			90	**Fill (Silt/Gravel)** Low plasticity, very dense, dry, light brown, no odor
3	11.7			80	**Fill (Silt/Gravel)** Similar to above, black, dense at base, no odor
5	16			90	**Silty Clay (CL)** Low plasticity, stiff, damp, reddish brown, no odor, calcareous
7	26			90	**Gravelly Sandy Clay (CL)** Low plasticity, loose to firm, damp, brown, no odor
9	708			70	**Silty Clay (CL)** Low plasticity, very soft, damp, reddish brown, hydrocarbon odor
11	369			80	**Clay (CH)** High plasticity, firm, damp, reddish brown, hydrocarbon odor
13	660	14'		90	**Sandy Clay/Clayey Sand (SC/CL)** Low plasticity, fine grain, soft, damp, reddish brown, hydrocarbon odor
15	85			90	**Sandy Clay (SC)** Similar to above, saturated sand seams, hydrocarbon odor, brown

Completion Results



WELL INSTALLATION

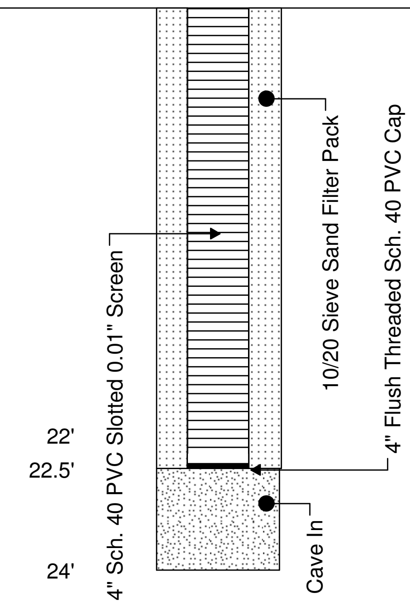
Well No.: MKTF-04
Start Date: 11/12/2013
Finish Date: 11/12/2013

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.310' W 108°25.742'; Boring ID SB03

Total Depth: 24' bgl
Ground Water: Saturated @ 14' bgl
Elev., TOC (ft. msl): 6933.57
Elev., PAD (ft. msl): 6933.90
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,649.46 **E** 2,545,752.83

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
17	64			70	**Sandy Clay (SC)** Similar to above, moist to saturated, hydrocarbon odor, brown
19	33				**Sandy Clay (SC)** Low plasticity, fine grain, soft, moist to saturated, light reddish brown, hydrocarbon odor, gravelly at base
21				90	**Silty Clay (CL)** Low plasticity, stiff, damp, light reddish brown grading to yellowish/greenish gray, becomes more silty at base
23					
25					Total Depth = 24' BGL
27					
29					
31					

Completion Results



BORING OW-1

SURFACE ELEVATION: 6868 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
0									
10									
20									
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									
130									
140									
150									
160									

PENETRATION RATE MINUTES/FOOT	SYMBOLS	DESCRIPTION
6.0, 5.0, 4.0, 4.2	CL	TRIASSIC PERIOD CHINLE FORMATION RED TO REDDISH BROWN CLAY WITH TRACE TO SOME SILT, CALCAREOUS, HIGHLY WEATHERED
3.8, 4.1, 5.6, 5.0, 4.2, 4.6, 5.4, 4.2, 3.6, 4.0, 5.4, 8.0	SHALE	27 FEET: SHALE, REDDISH BROWN, SILTY, CALCAREOUS, SOFT, FRESH GRADES HARD FROM 33 FEET GRADES WITH OCCASIONAL THIN LIMESTONE INTERBEDS FROM 40 TO 50 FEET GRADES WITH THIN SANDSTONE INTERBEDS FROM 45 TO 50 FEET GRADES SOFT FROM 65 FEET GRADES WITH THIN SANDSTONE AND LIMESTONE INTERBEDS FROM 75 FEET, HARD
5.2, 4.2, 3.6	SS	86 FEET: SANDSTONE, VARIEGATED BROWN TO LIGHT GRAY, FINE GRAINED, SILTY, SOFT, WITH ROUNDED TO SUBROUNDED, CLEAR TO FROSTED QUARTZ GRAINS, MICACEOUS, FRESH
	SHALE	98 FEET: SHALE, REDDISH BROWN, SILTY, SOFT, FRESH

BORING COMPLETED AT 99.3 FEET ON 11/10/80.
4-INCH PVC PIEZOMETER INSTALLED WITH PERFORATIONS FROM 89.3 TO 99.3 FEET.
GRAVEL PLACED FROM 88.0 TO 99.3 FEET AND SEALED WITH CEMENT AND BENTONITE TO SURFACE.
GROUND WATER LEVEL MEASURED AT 6.4 FEET BELOW GROUND ON 1/5/81.

KEY TO BORINGS
ROCK SYMBOLS

SHALE SANDSTONE MUDSTONE

NOTES:

1. PENETRATION RATE IN MINUTES PER FOOT WAS DETERMINED BY THE TIME REQUIRED TO DRILL EACH INTERVAL SHOWN WITH A CABLE TOOL RIG.
2. ESTIMATES OF SOIL CONSISTENCY AND ROCK STRENGTH ARE BASED ON PENETRATION RATE USING THE FOLLOWING CRITERIA:
   - $<$ 4.2 MIN./FT.-SOFT
   - $>$ 4.2 MIN./FT.-HARD
3. ELEVATION GIVEN IN FEET ABOVE MEAN SEA LEVEL.
4. SOIL CLASSIFICATION IS BASED ON UNIFIED SOIL CLASSIFICATION SYSTEM (PLATE A2-1).
5. ALL DEPTHS REFER TO DEPTH BELOW GROUND.
6. SEE PLATE 1 FOR LOCATION OF WELLS.

LOG OF BORINGS

DiSorbo
Environmental Consulting Firm

Western Refining SW, Inc
Gallup Refinery
Job No. WEST17020

Geologist	: Tracy Payne
Driller	: Enviro-Drill Inc/Cohagan
Drilling Rig	: CME75
Drilling Method	: Hollow Stem Auger 7 1/4"
Sampling Method	: 2' Split Spoon/
Comments	: Hand Auger to 5' BGL
Total Depth	: 44'
Ground Water	: Not Encountered
Start Date	: 6/14/2017
Finish Date	: 6/14/2017

WELL NO. BW-4A

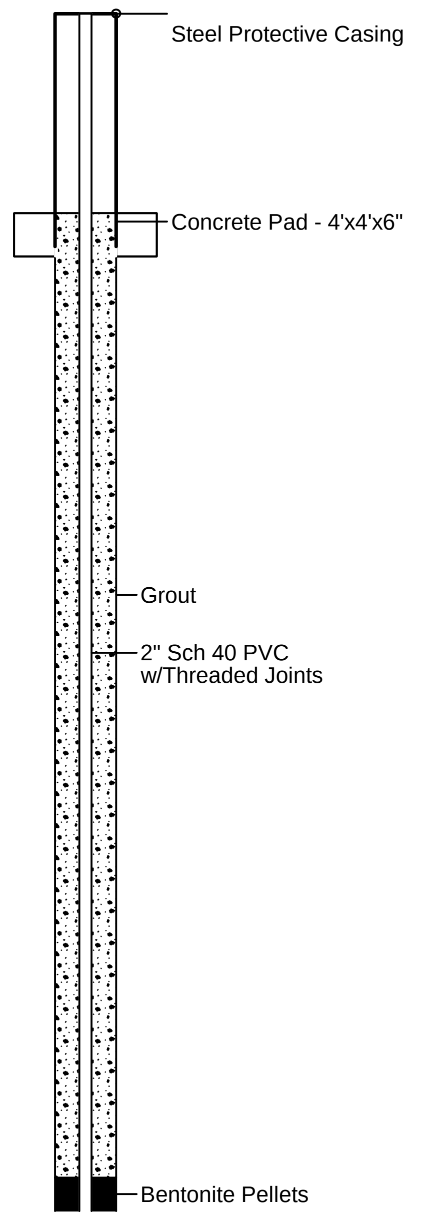
(Sheet 1 of 3)

Elev., TOC (ft.msl)	: 6873.18
Elev., PAD (ft. msl)	: 6870.67
Elev., GL (ft. msl)	:
Site Coordinates	:
N	: N1634063.05
E	: W2542465.22

Depth (ft.)	PID (ppm)	Saturation	Lithology	USCS	Recovery (%)	Sample	DESCRIPTION
-3							
-2							
-1							
0–2	7.7			CL	100		SILTY CLAY, low, firm, dry to damp, brown, no odor,
2–4	9.5			CH	100		CLAY, high, stiff, damp, brown, no odor,
4–6	9.0			CH	100		CLAY, SIMILAR TO ABOVE (STA), very stiff, no odor,
6–8	6.8			CH	90		CLAY, STA, no odor,
8–10	5.4			CH	80		CLAY, STA, no odor,
10–12	3.3			CH	80		CLAY, STA, no odor,
12–14	5.8			CH	50		CLAY, STA, no odor,
14–15	4.0			CH			CLAY, STA, no odor,

Completion Results

Well No. BW-4A



DiSorbo Consulting, LLC

1010 Travis Street
Houston, Texas 77002
713-955-1230

8501 N. MoPac Expy, Suite 300
Austin, Texas 78759
512-693-4190

DiSorbo
Environmental Consulting Firm

Western Refining SW, Inc
Gallup Refinery
Job No. WEST17020

Geologist	: Tracy Payne
Driller	: Enviro-Drill Inc/Cohagan
Drilling Rig	: CME75
Drilling Method	: Hollow Stem Auger 7 1/4"
Sampling Method	: 2' Split Spoon/
Comments	: Hand Auger to 5' BGL
Total Depth	: 44'
Ground Water	: Not Encountered
Start Date	: 6/14/2017
Finish Date	: 6/14/2017

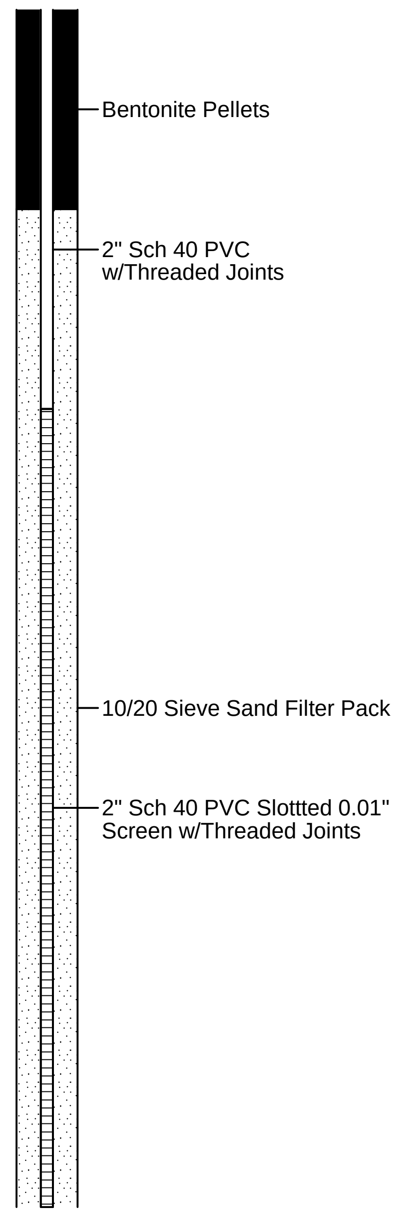
WELL NO. BW-4A

Elev., TOC (ft.msl)	: 6873.18
Elev., PAD (ft. msl)	: 6870.67
Elev., GL (ft. msl)	:
Site Coordinates	:
N	: N1634063.05
E	: W2542465.22

Depth (ft.)	PID (ppm)	Saturation	Lithology	USCS	Recovery (%)	Sample	DESCRIPTION
15–16	4.0			CH	60		
16–18	2.0			CH	80		CLAY, STA, no odor,
18–20	6.9			ML	40		CLAYEY SILT, low, firm/crumbly, damp, light brown/tan, no odor,
20–22	5.0			ML/CL	70		CLAYEY SILT/SILTY CLAY, STA, interbedded, no odor,
22–24	3.6			ML	50		CLAYEY SILT, low, firm/crumbly,damp, tan, no odor,
24–26	3.7			ML/CL	60		CLAYEY SILT/SILTY CLAY, STA, interbedded, no odor,
26–28	6.2			CH	60		CLAY, high, very stiff, damp, brown, no odor,
28–30	3.5			CH	70		CLAY, STA, darker brown, no odor,
30–32	6.1			CH	80		CLAY, STA, no odor,
32–33	6.1			CL			SILTY CLAY, low, very stiff, damp, no odor, light brown (reddish), trace very fine grain sand,

Completion Results

Well No. BW-4A



1010 Travis Street
Houston, Texas 77002
713-955-1230

DiSorbo Consulting, LLC

8501 N. MoPac Expy, Suite 300
Austin, Texas 78759
512-693-4190

DiSorbo
Environmental Consulting Firm

Western Refining SW, Inc
Gallup Refinery
Job No. WEST17020

Geologist	: Tracy Payne
Driller	: Enviro-Drill Inc/Cohagan
Drilling Rig	: CME75
Drilling Method	: Hollow Stem Auger 7 1/4"
Sampling Method	: 2' Split Spoon/
Comments	: Hand Auger to 5' BGL
Total Depth	: 44'
Ground Water	: Not Encountered
Start Date	: 6/14/2017
Finish Date	: 6/14/2017

WELL NO. BW-4A

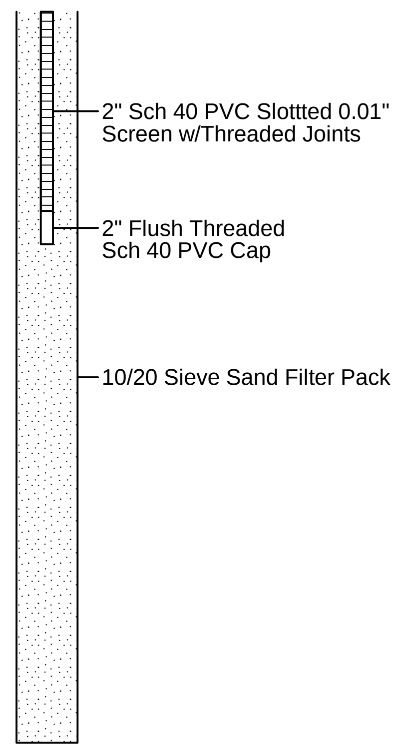
Elev., TOC (ft.msl)	: 6873.18
Elev., PAD (ft. msl)	: 6870.67
Elev., GL (ft. msl)	:
Site Coordinates	:
N	: N1634063.05
E	: W2542465.22

Depth (ft.)	PID (ppm)	Saturation	Lithology	USCS	Recovery (%)	Sample	DESCRIPTION
33–34	6.1			CL	60		
34–36	3.8			ML/CL	80		CLAYEY SILT/SILTY CLAY, low, firm to stiff, damp, reddish brown and grey, alternating silt/clay, no odor,
36–38	6.1			CL	60		SILTY CLAY, low, stiff, damp, reddish brown and grey (less grey than above), no odor,
38–40	5.2			CL	60		SILTY CLAY, STA, no odor,
40–42	4.2			CL	70		SILTY CLAY, STA, reddish brown and grey, no odor,
42–44	3.9			CL	60		SILTY CLAY, STA, no odor.

Depth scale: 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51

Completion Results

Well No. BW-4A



DiSorbo Consulting, LLC

1010 Travis Street
Houston, Texas 77002
713-955-1230

8501 N. MoPac Expy, Suite 300
Austin, Texas 78759
512-693-4190

DiSorbo
Environmental Consulting Firm

Western Refining SW, Inc
Gallup Refinery
Job No. WEST17020

Geologist	: Tracy Payne
Driller	: Enviro-Drill Inc/Cohagan
Drilling Rig	: CME75
Drilling Method	: Hollow Stem Auger 7 1/4"
Sampling Method	: 2' Split Spoon -
Comments	: Hand Auger to 5' BGL
Total Depth	: 90'
Ground Water	: Not Encountered
Start Date	: 6/15/2017
Finish Date	: 6/16/2017

WELL NO. BW-4B

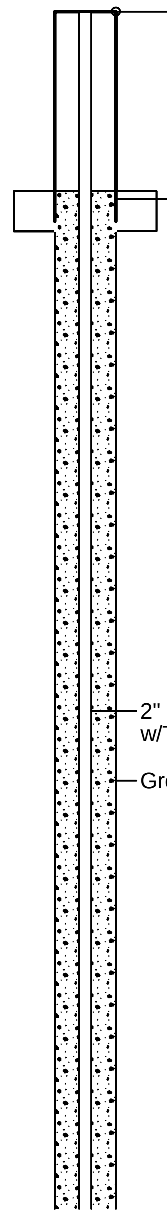
(Sheet 1 of 5)

Elev., TOC (ft.msl)	: 6873.23
Elev., PAD (ft. msl)	: 6870.62
Elev., GL (ft. msl)	:
Site Coordinates	:
N	: N1634043.22
E	: W2542462.98

Depth (ft.)	PID (ppm)	Saturation	Lithology	USCS	Recovery	Sample	DESCRIPTION
0–2	1.3			CL	100		SILTY CLAY, low, firm, dry to damp, brown, no odor,
2–4	1.2			CH	100		CLAY, high, stiff, damp, brown, no odor,
4–6	1.3			CH	100		CLAY, SIMILAR TO ABOVE (STA), very stiff, no odor,
6–8	1.7			CH	90		CLAY, STA, no odor,
8–10	2.0			CH	80		CLAY, STA, no odor,
10–12	2.1			CH	80		CLAY, STA, no odor,
12–14	3.1			CH	80		CLAY, STA, no odor,
14–16	3.4			CH	80		CLAY, STA, no odor,
16–17	5.1			CH			CLAY, STA, no odor,

Completion Results

Well No. BW-4B



DiSorbo
Environmental Consulting Firm

Western Refining SW, Inc
Gallup Refinery
Job No. WEST17020

Geologist	: Tracy Payne
Driller	: Enviro-Drill Inc/Cohagan
Drilling Rig	: CME75
Drilling Method	: Hollow Stem Auger 7 1/4"
Sampling Method	: 2' Split Spoon -
Comments	: Hand Auger to 5' BGL
Total Depth	: 90'
Ground Water	: Not Encountered
Start Date	: 6/15/2017
Finish Date	: 6/16/2017

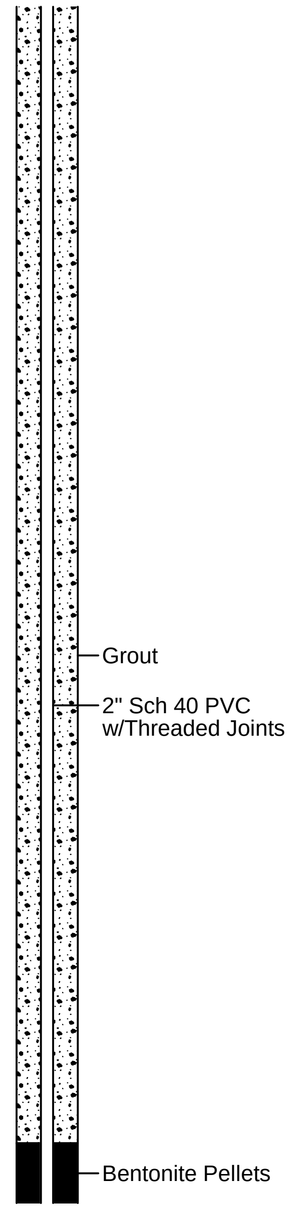
WELL NO. BW-4B

Elev., TOC (ft.msl)	: 6873.23
Elev., PAD (ft. msl)	: 6870.62
Elev., GL (ft. msl)	:
Site Coordinates	:
N	: N1634043.22
E	: W2542462.98

Depth (ft.)	PID (ppm)	Saturation	Lithology	USCS	Recovery	Sample	DESCRIPTION
17–18	5.1			CH	70		
18–20	3.2			ML	60		CLAYEY SILT, low, firm/crumbly, damp, light brown/tan, no odor,
20–22	3.9			ML/CL	70		CLAYEY SILT/SILTY CLAY, STA, no odor, interbedded,
22–24	3.5			ML	60		CLAYEY SILT, low, firm/crumbly, damp, brown and tan, no odor,
24–25				ML/CL	60		CLAYEY SILT/SILTY CLAY, STA, no odor,
25–26	3.9			CH	60		CLAY, high, very stiff, damp, brown, no odor,
26–28	1.8			CH	70		CLAY, STA, darker brown, no odor,
28–30	1.8			CL	80		SILTY CLAY, moderate to low, very stiff, damp, dark brown grading to light reddish brown, trace fine grain sand at base, no odor,
30–31				CL	80		SILTY CLAY, STA,
31–31.75	2.0			CL	80		SANDY GRAVELLY CLAY, low, stiff, dry to damp, light grey and brown, no odor,
31.75–32				CL	80		SILTY CLAY, low, stiff, damp, reddish brown, no odor,
32–34	2.2			ML/CL	80		CLAYEY SILT/SILTY CLAY, low, firm/crumbly, damp, reddish brown and grey,
34–36	5.6			CL	80		SILTY CLAY, STA, no odor,
36–37	3.6			CL			SILTY CLAY, STA, no odor,

Completion Results

Well No. BW-4B



DiSorbo Consulting, LLC

1010 Travis Street
Houston, Texas 77002
713-955-1230

8501 N. MoPac Expy, Suite 300
Austin, Texas 78759
512-693-4190

DiSorbo
Environmental Consulting Firm

Western Refining SW, Inc
Gallup Refinery
Job No. WEST17020

Geologist	: Tracy Payne
Driller	: Enviro-Drill Inc/Cohagan
Drilling Rig	: CME75
Drilling Method	: Hollow Stem Auger 7 1/4"
Sampling Method	: 2' Split Spoon -
Comments	: Hand Auger to 5' BGL
Total Depth	: 90'
Ground Water	: Not Encountered
Start Date	: 6/15/2017
Finish Date	: 6/16/2017

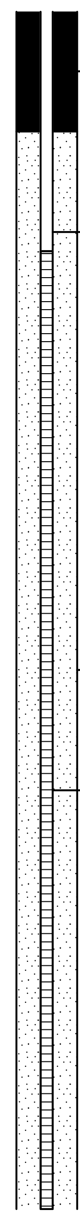
WELL NO. BW-4B

Elev., TOC (ft.msl)	: 6873.23
Elev., PAD (ft. msl)	: 6870.62
Elev., GL (ft. msl)	:
Site Coordinates	:
N	: N1634043.22
E	: W2542462.98

Depth (ft.)	PID (ppm)	Saturation	Lithology	USCS	Recovery	Sample	DESCRIPTION
37–38	3.6			CL	80		
38–40	2.3			CL	80		SILTY CLAY, STA, no odor,
40–42	6.2			CL	80		SILTY CLAY, STA, no odor,
42–44	5.0			CL	70		SILTY CLAY, STA, no odor,
44				CL	80		SILTY CLAY, STA, no odor,
45	2.6			CL	80		GRAVELLY SILTY CLAY, low, firm/crumbly, dry-calcium carbonate nodules, grey and reddish brown, no odor,
45.5				CL	80		
46–48	3.5			CL	80		SANDY CLAY, low, firm/crumbly, dry, grey and reddish brown, very fine grain sand, no odor,
							SILTY CLAY, low, very stiff, dry to damp, reddish brown, no odor,
48–50	1.9			CL	80		SILTY CLAY, STA, no odor,
50–52	5.1			CL	80		SILTY CLAY, STA, no odor,
52–54	5.6			CL	70		SILTY CLAY, STA, trace grey clay, occasional gravel, no odor,
54–56	3.8			CL	70		SILTY CLAY, low, very stiff, dry to damp, reddish brown, no odor,
56–57	3.4			CL			SILTY CLAY, STA, trace grey clay, no odor,

Completion Results

Well No. BW-4B



DiSorbo Consulting, LLC
1010 Travis Street
Houston, Texas 77002
713-955-1230
8501 N. MoPac Expy, Suite 300
Austin, Texas 78759
512-693-4190

DiSorbo Environmental Consulting Firm

Western Refining SW, Inc
Gallup Refinery
Job No. WEST17020

Geologist	: Tracy Payne
Driller	: Enviro-Drill Inc/Cohagan
Drilling Rig	: CME75
Drilling Method	: Hollow Stem Auger 7 1/4"
Sampling Method	: 2' Split Spoon -
Comments	: Hand Auger to 5' BGL
Total Depth	: 90'
Ground Water	: Not Encountered
Start Date	: 6/15/2017
Finish Date	: 6/16/2017

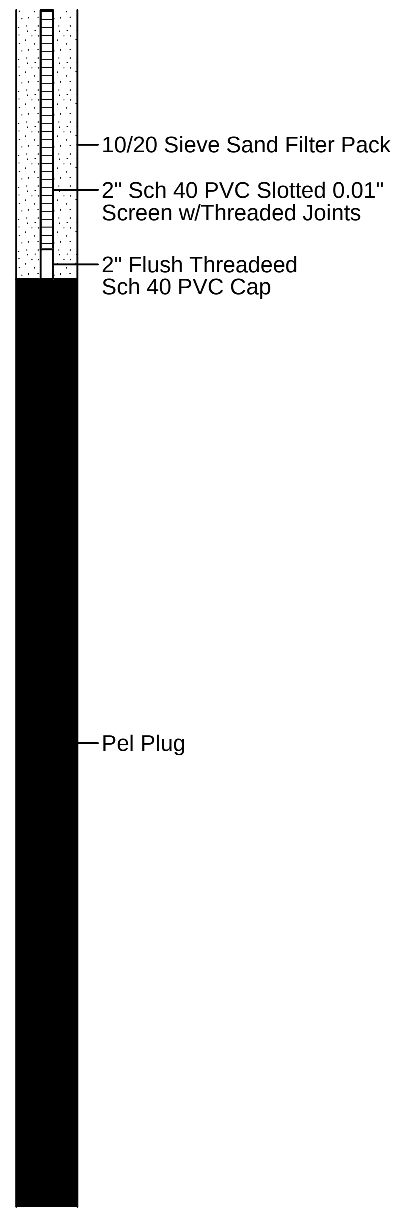
WELL NO. BW-4B

Elev., TOC (ft.msl)	: 6873.23
Elev., PAD (ft. msl)	: 6870.62
Elev., GL (ft. msl)	:
Site Coordinates	:
N	: N1634043.22
E	: W2542462.98

Depth (ft.)	PID (ppm)	Saturation	Lithology	USCS	Recovery	Sample	DESCRIPTION
57–58	3.4			CL	60		
58–60	2.4			CL	80		SILTY CLAY, STA, no odor,
60–62	4.9			CL	80		SILTY CLAY, low, very stiff, dry to damp, reddish brown grey clay, no odor,
62–64	1.7			CL	80		SILTY CLAY, STA, no odor,
64–66	5.8			CL	80		SILTY CLAY, STA, no odor,
66–68	2.7			CL	80		SILTY CLAY, STA,
68–70	3.9			CL	80		SILTY CLAY, low, very stiff, calcareous, dry to damp, brown and blueish grey, no odor,
70–72	1.6			CL	80		SILTY CLAY, low, firm/crumbly, damp, reddish brown, no odor,
72–74	1.7			CL	60		SILTY CLAY, STA, no odor,
74–76	1.0			CL	60		SILTY CLAY, STA, no odor,
76–77	0.1			CL			SILTY CLAY, STA, no odor,

Completion Results

Well No. BW-4B



03-29-2018 C:\Users\cholmes\Documents\M-Tech\samples\Western Refinery\Boundary Wells\BW-4B.bor

DiSorbo
Environmental Consulting Firm

Western Refining SW, Inc
Gallup Refinery
Job No. WEST17020

Geologist	: Tracy Payne
Driller	: Enviro-Drill Inc/Cohagan
Drilling Rig	: CME75
Drilling Method	: Hollow Stem Auger 7 1/4"
Sampling Method	: 2' Split Spoon -
Comments	: Hand Auger to 5' BGL
Total Depth	: 90'
Ground Water	: Not Encountered
Start Date	: 6/15/2017
Finish Date	: 6/16/2017

WELL NO. BW-4B

Elev., TOC (ft.msl)	: 6873.23
Elev., PAD (ft. msl)	: 6870.62
Elev., GL (ft. msl)	:
Site Coordinates	:
N	: N1634043.22
E	: W2542462.98

Depth (ft.)	PID (ppm)	Saturation	Lithology	USCS	Recovery	Sample	DESCRIPTION
77–78	0.1			CL	70		
78–80	0.4			CL	60		SILTY CLAY, STA, no odor,
80–82	0.1			CL	70		SILTY CLAY, STA, no odor,
82–84	0.2			CL	60		SILTY CLAY, STA, no odor,
84–86	0.0			CL	70		SILTY CLAY, STA, very stiff, trace grey clay, no odor,
86–88	0.1			CL	40		SILTY CLAY, STA, no odor,
88–90	0.2			CL/SS	40		SILTY CLAY, STA, imbedded with fine grain sandstone, hard/dense, white.

Depth scale: 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97

Completion Results

Well No. BW-4B

Pel Plug

03-29-2018 C:\Users\cholmes\Documents\M-Tech\samples\Western Refinery\Boundary Wells\BW-4B.bor

Appendix B

Investigation Derived Waste Management Plan

Investigation Derived Waste (IDW) Management Plan

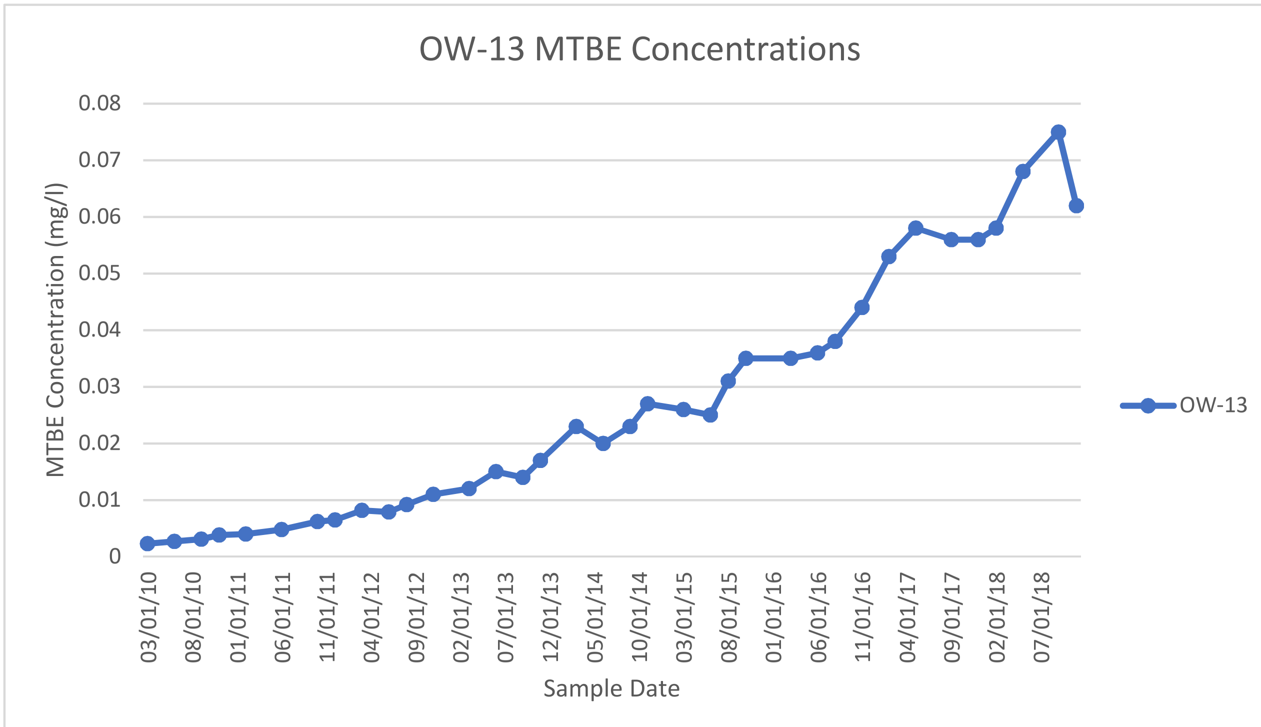
All IDW will be properly characterized and disposed of in accordance with all federal, State, and local rules and regulations for storage, labeling, handling, transport, and disposal of waste. The IDW may be characterized for disposal based on the known or suspected contaminants potentially present in the waste.

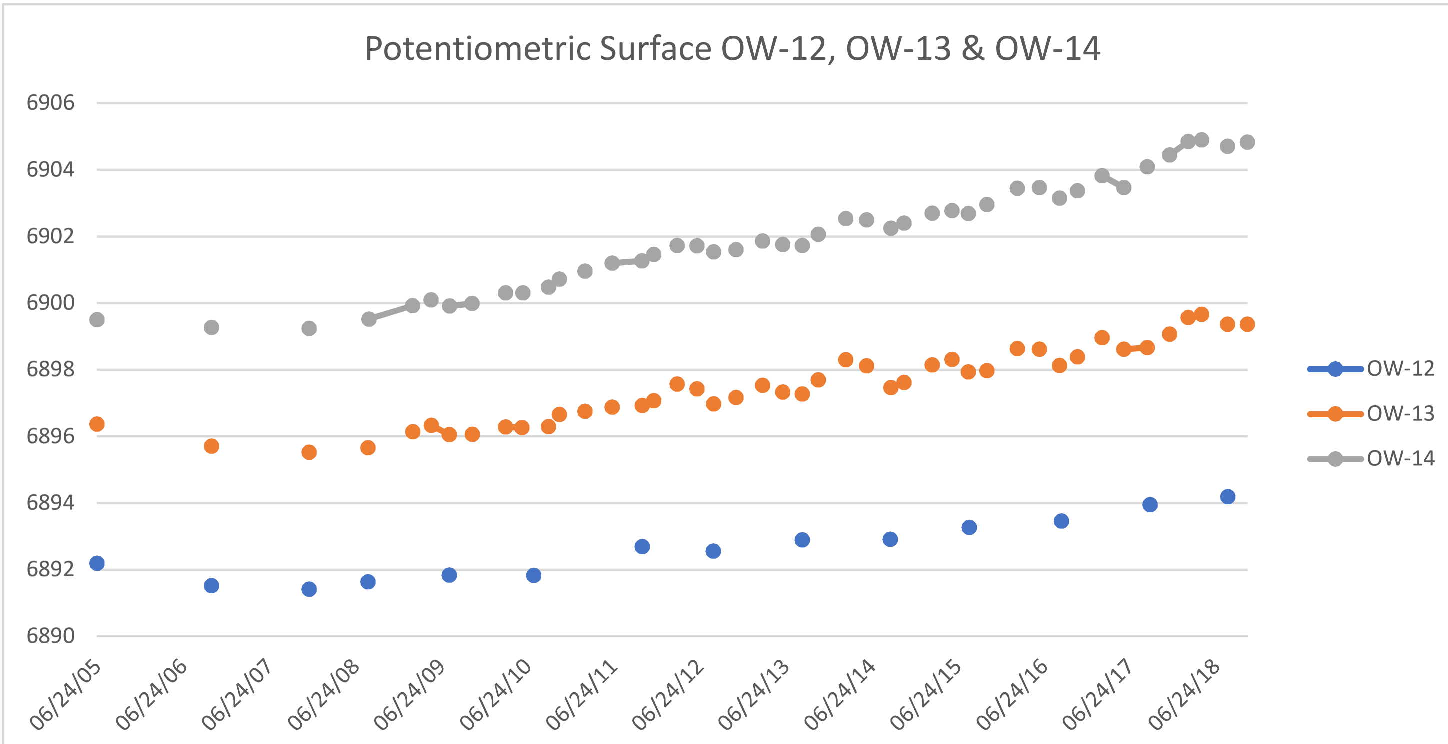
A dedicated decontamination area will be setup prior to any sample collection activities. The decontamination pad will be constructed so as to capture and contain all decontamination fluids (e.g., wash water and rinse water) and foreign materials washed off the sampling equipment. The fluids will be pumped directly into suitable storage containers (e.g., labeled 55-gallon drums), which will be located at satellite accumulation areas until the fluids are disposed in the refinery wastewater treatment system upstream of the API separator. The solids captured in the decontamination pad will be shoveled into 55-gallon drums and stored at the designated satellite accumulation area pending proper waste characterization for off-site disposal.

Drill cuttings generated during installation of soil borings will be placed directly into 55-gallon drums and staged in the satellite accumulation area pending results of the waste characterization sampling. The portion of soil cores, which are not retained for analytical testing, will be placed into the same 55-gallon drums used to store the associated drill cuttings.

The solids (e.g., drill cuttings and used soil cores) will be characterized by testing to determine if there are any hazardous characteristics in accordance with 40 Code of Federal Regulations (CFR) Part 261. This includes tests for ignitability, corrosivity, reactivity, and toxicity. If the materials are not characteristically hazardous, then further testing will be performed pursuant to the requirements of the facility to which the materials will be transported. Depending upon the results of analyses for individual investigation soil samples, additional analyses may include VOCs, TPH and polynuclear aromatic hydrocarbons (PAHs).

Appendix C
OW-13 Data Graphs


OW-13 MTBE Concentrations
MTBE Concentration (mg/l)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
03/01/10
08/01/10
01/01/11
06/01/11
11/01/11
04/01/12
09/01/12
02/01/13
07/01/13
12/01/13
05/01/14
10/01/14
03/01/15
08/01/15
01/01/16
06/01/16
11/01/16
04/01/17
09/01/17
02/01/18
07/01/18
Sample Date
OW-13


Potentiometric Surface OW-12, OW-13 & OW-14
6906
6904
6902
6900
6898
6896
6894
6892
6890
06/24/05
06/24/06
06/24/07
06/24/08
06/24/09
06/24/10
06/24/11
06/24/12
06/24/13
06/24/14
06/24/15
06/24/16
06/24/17
06/24/18
OW-12
OW-13
OW-14

Appendix D

Well Development and Purging Procedures

Well Development

All monitoring wells will be developed to create an effective filter pack around the well screen, correct damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. Newly installed monitoring wells will not be developed for at least 48 hours after the surface pad and outer protective casing are installed. This will allow sufficient time for the well materials to cure before the development procedures are initiated. A new monitoring well will be developed until the column of water in the well is free of visible sediment, and the pH, temperature, turbidity, and specific conductivity have stabilized. In most cases, the above requirements can be satisfied. However, in some cases, the pH, temperature, and specific conductivity may stabilize but the water remains turbid. In this case, continuous flushing may be necessary to complete the well development. If the well is pumped dry, the water level will be allowed to sufficiently recover before the next development period is initiated. The common methods used for developing wells include:

(1) pumping and over-pumping;

(2) backwashing;

(3) surging (with a surge block);

(4) bailing;

(5) jetting; and

(6) airlift pumping.

These development procedures will be used, either individually or in combination, to achieve the most effective well development. However, the most favorable well development methods include pumping, over-pumping, bailing, surging, or a combination of these methods. Well development methods and equipment that alter the chemical composition of the groundwater will not be used.

Development methods that involve adding water or other fluids to the well or borehole, or that use air to accomplish well development will be avoided, if possible. Approval will be obtained from the NMED prior to introducing air, water, or other fluids into the well for the purpose of well development. If water is introduced to a borehole during well drilling and completion, then the same or greater volume of water will be removed from the well during development. In addition, the volume of water withdrawn from a well during development will be recorded, and best efforts will be used to avoid pumping wells dry during development activities.

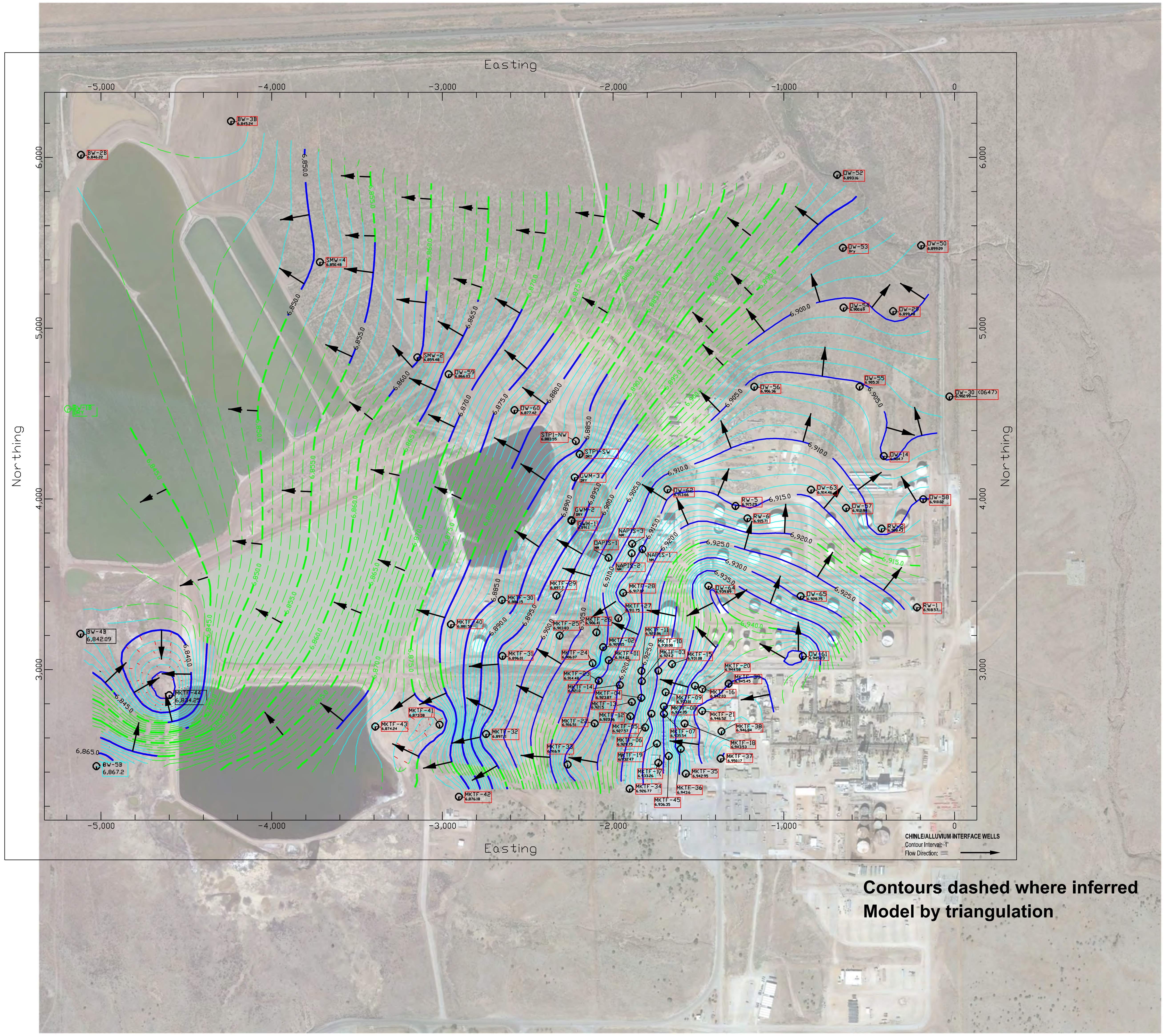
Well Purging

All zones in each monitoring well will be purged by removing groundwater prior to sampling and in order to ensure that formation water is being sampled. Purge volumes will be determined by monitoring, at a minimum, groundwater pH, specific conductance, dissolved oxygen concentrations, turbidity, redox potential, and temperature during purging of volumes and at measurement intervals of not less than ¼ the pre-purge well volume. The groundwater quality parameters and fluid levels will be measured using a YSI Professional Plus Multiparameter Meter, YSI Water Quality Sonde, Hach Portable Turbidimeter, and a Geotech Interface Meter. The volume of groundwater purged, the instruments used, and the readings obtained at each interval will be recorded on the field monitoring log. In general, water samples may be obtained from the well after the measured parameters of the purge water have stabilized to within ten percent for three consecutive measurements. Well purging

may also be conducted in accordance with the NMED's Position Paper "Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring" (October 30, 2001). If necessary, a written request for a variance from the described methods of well purging for individual wells may be submitted to NMED no later than 90 days prior to scheduled sampling activities.

Appendix E

Potentiometric Surface Map



intertek
psi
4601 Ripley
El Paso, Texas 79922
915-584-1317

1"=500'

Project #: 06251762

FIGURE 10
2018 ALLUVIUM / CHINLE GROUP INTERFACE WATER ELEVATION MAP
MARATHON - GALLUP REFINERY

Marathon - Gallup Refinery
92 Giant Crossing Road
Gallup, New Mexico 87301

Date: September 10, 2019

Michelle Lujan Grisham
Governor

Howie C. Morales
Lt. Governor

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6313
Phone (505) 476-6000 Fax (505) 476-6030
www.env.nm.gov

James C. Kenney
Cabinet Secretary

Jennifer J. Pruett
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

November 15, 2019

John Moore
Environmental Superintendent
Western Refining, Southwest Inc., Gallup Refinery
92 Giant Crossing Road
Gallup, New Mexico 87301

RE: APPROVAL WITH MODIFICATIONS
RESPONSE TO SECOND DISAPPROVAL WORK PLAN 2015 ANNUAL GROUNDWATER REPORT COMMENTS
WESTERN REFINING SOUTHWEST INC., GALLUP REFINERY
EPA ID # NMD000333211
HWB-WRG-18-012

Dear Mr. Moore:

The New Mexico Environment Department (NMED) has reviewed the *Response to Second Disapproval Work Plan 2015 Annual Groundwater Report Comments* (Response), dated October 25, 2019, submitted on behalf of Marathon Petroleum Company dba Western Refining Southwest Inc., Gallup Refinery (the Permittee). NMED hereby issues this Approval with Modifications. The Permittee must address the following comments provided by NMED:

Comment 1

The Permittee's response to NMED's *Disapproval* Comment 6 states, "[t]he comment is acknowledged and MPC understands the current focus is on delineation." Comment 1 in NMED's *Disapproval Annual Groundwater Monitoring Report: Gallup Refinery – 2017*, dated March 21, 2019 states, "[p]ropose to submit a work plan to investigate the extent of the contaminant migration in the Sonsela west of well OW-1 [by installing three sets of nested wells 1,500 feet, 2,000 feet and 2,500 feet west of pond EP-9] in a response letter." As a reminder, the response letter was due on **November 8, 2019**. Section 4.2 (New Sonsela Wells) states, "[t]o delineate the down-gradient extent of the plume detected at OW-1, a new Sonsela well will be installed approximately five hundred feet down-gradient to the west of OW-1. The proposed location is shown on Figure 3." Figure 3 (Proposed Monitoring Well Locations) does not depict the proposed well. Figure 4 (MKTF Well Locations) may be the pertinent figure. Provide a clarification in a response letter. In addition, the proposed location and number of wells to be installed west of OW-1 is not consistent with the NMED's direction provided by Comment 1 of the March 21, 2019 *Disapproval*. Revise the Work Plan to be consistent with the direction or provide a justification for the proposed location and the reduced number of well installations in the response letter.

Comment 2

The Permittee's response to NMED's *Disapproval* Comment 10, states, "[t]he well screen and overlying sand pack in MKTF-17 extends from the 12 feet to 25 feet bgl, providing hydraulic connection to the saturated interval from 20 to 23 feet bgl, but not to the saturation encountered in the overlying fill materials." According to the MKTF-17 boring log, the observation of "saturated" and "damp" was likely caused by the difference in the grain size of soils. There is a clay-bearing layer that slows groundwater flow but does not prevent it; it does not appear that confining conditions exit. In order to ensure that the proposed wells adjacent to the MKTF wells produce water, the Permittee must propose to install temporary wells at the locations adjacent to the MKTF wells with screen depths to ten feet bgs as proposed. If the temporary wells produce water, they may be converted to permanent wells. If the temporary wells do not produce water, the Permittee must propose to install the wells with comparable depths to the original wells, but with longer well screens that intersect the water table. Propose the temporary wells in the response letter.

Comment 3

The Permittee's response to NMED's *Disapproval* Comment 10, states, "[w]e do not think it is advisable to install wells as instructed by NMED that will breach the existing clay aquitard to allow a direct conduit for impacts in the fill materials to migrate directly into the lower interval." If borings and wells are installed properly, there is very little chance that the wells will create a conduit. No response required.

Comment 4

Section 4.3 is titled as "New Shallow Wells near EP-9 and West of OW-1". Section 4.3 discusses details for how the proposed shallow monitoring well south of pond EP-9 is installed; however, the section does not include a discussion of the proposed well west of OW-1. Include the discussion and provide a replacement page.

Comment 5

Figure 4 (MKTF Well Locations) depicts a new well location west of well OW-1. According to the legend in Figure 3 (Proposed Monitoring Well Locations), the new well is a proposed Alluvium/Chinle well rather than Sonsela well. However, the new well is proposed to be installed across the Sonsela. Use the same legend included in Figure 3 and revise Figure 4. Provide a replacement figure in the Work Plan.

The Permittee must address all comments in this Approval with Modifications and submit a response letter with replacement pages no later than **December 31, 2019**. In addition, the Permittee must submit an electronic version of the revised Work Plan, as well as an electronic redline-strikeout version of the revised Work Plan showing all changes that have been made to the Work Plan. Two copies of all submittals must be provided (e.g., two copies of the response letter, two copies of the replacement pages, two discs with the electronic versions).

This approval is based on the information presented in the document as it relates to the objectives of the work identified by NMED at the time of review. Approval of this document does not constitute agreement with all information or every statement presented in the document.

If you have questions regarding this letter, please contact Kristen Van Horn of my staff at 505-476-6046.

Sincerely,

Dave Cobrain
Program Manager
Hazardous Waste Bureau

cc: K. Van Horn, NMED HWB
M. Suzuki, NMED HWB
C. Chavez, OCD
L. King, EPA Region 6 (6LCRRC)
B. Moore, WRG

File: Reading File and WRG 2019 File
HWB-WRG-18-012

Marathon Petroleum Company LP

June 28, 2019

Mr. John E. Kieling, Chief
New Mexico Environmental Department
2905 Rodeo Park Drive East, Bldg. 1
Santa Fe, NM 87505-6303

RE: Response to Disapproval
Work Plan 2015 Annual Groundwater Report Comments
Marathon Petroleum Company LP, Gallup Refinery
(dba Western Refining Southwest, Inc.)
EPA ID# NMD000333211
HWB-WRG-18-012

Dear Mr. Kieling:

Marathon Petroleum Company LP (dba Western Refining Southwest, Inc.) Gallup Refinery is submitting the enclosed responses to your comments (dated January 28, 2019) on the referenced Investigation Work Plan. You will please find enclosed a revised Investigation Work Plan. If there are any questions, please call Brian Moore at 505-726-9745.

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,
Marathon Petroleum Company LP, Gallup Refinery

Robert S. Hanks

Robert S. Hanks
Refinery General Manager

Enclosure

cc K. Van Horn NMED
C. Chavez NMOCD
B. Moore Marathon Gallup Refinery

92 Giant Crossing Road
Jamestown, NM 87347

RESPONSE TO COMMENTS
January 28, 2019 Disapproval – Work Plan 2015 Annual Groundwater Report Comments (Oct. 2018)

NMED Comment 1:
The title of the work plan must reflect the topic of the work plan. While this Work Plan was submitted in response to NMED requirements based on review of the Permittee's 2015 Groundwater Monitoring Work Plan, the work plan more specifically addresses installation of new monitoring wells. The Permittee should have titled the document more appropriately in order to be able to track the topic of the document in the future. No revision is required; however, in the future the Permittee must use relevant titles for documents.

MPC Response 1:
None required.

NMED Comment 2:
An electronic version of the response letter was not included in the submittal. Provide an electronic version of the response letter along with Attachments 1 and 2 in the response letter no later than **February 8, 2019.**

MPC Response 2:
The requested information was provided.

NMED Comment 3:
In Section 1, *Introduction,* the Permittee states, "Comment 18.3 - Methyl Tert Butyl Ether (MTBE) has been detected in OW-50 and OW-52 since submission of the 2015 Annual Groundwater Monitoring Report that confirms the down-gradient flow direction to the north, thus no additional wells are proposed." NMED concurs that no additional wells are necessary between wells OW-13 and OW-29 because wells OW-54 and OW-55 were already installed. However, wells OW-50 and OW-52 may be located cross-gradient relative to the groundwater flow direction since the MTBE concentrations in groundwater samples collected from wells located west of OW-13 (e.g., OW-56) are significantly higher than the MTBE concentrations in groundwater samples collected from wells OW-50 and OW-52. The MTBE plume is likely migrating toward west rather than north. Figure 2, *Chinle / Alluvial Interface Potentiometric Map,* indicates that the groundwater flow direction is toward north; however, the potentiometric surface elevations west of well OW-56 were not investigated. Revise the statement in the Work Plan, as necessary.

MPC Response 3:
Considering the latest information available (i.e., data collected since preparation of the 2015 Annual Groundwater Monitoring Report for which these comments originated), we believe the groundwater gradient within the Chinle/Alluvial interface zone is accurately reflected in a regional sense as shown on Figure 10 of the 2015 Annual Groundwater Monitoring Report. As

shown on Figure 10, while the groundwater flows in a generally northerly direction in the area of northeast corner of the tank farm towards OW-50 and OW-52, the gradient is expected to shift more to the northwest as you move further west near OW-56. The statement on page 1-1 is revised to note the northerly gradient is limited in areal extent and that the gradient is anticipated to be more to the northwest as you move further west.

It is also noted that a row of six additional temporary wells have already been proposed further to the west/northwest. In Comment 28 (dated February 28, 2019) on the *Investigation Report for North Drainage Ditch and OW-29 & 30 Area*, NMED stated, "It does not appear that the location of the temporary wells as depicted in Figure 25 makes sense based on the information provided in this Report." We believe that the wells as depicted in Figure 25 of the aforementioned Investigation Report will help to address NMED's concern stated above that "The MTBE plume is likely migrating toward west rather than north." These proposed wells are included in the *Investigation Work Plan North Drainage Ditch Area* (April 2019).

<u>NMED Comment 4:</u>

In Section 1, *Introduction,* the Permittee states, "Comment 20 - Upon further review of the well construction and water levels, it appears that operating a recovery pump in existing RW-2, which is being proposed separately, will lower the water level in RW-2 to below the top of the well screen." Refer to Comment 9 in the *Disapproval for Revised Annual Groundwater Monitoring Report: Gallup Refinery- 2015,* dated January 4, 2019. Comment 9 states, "[i]t is not appropriate to depress the water table in the wells where the screened intervals have historically been submerged, because the depth intervals where free product is present or smeared have not been delineated for these wells." Since the screened interval of well RW-2 has historically been submerged, the Permittee must revise the Work Plan to propose to install a well with an appropriate screened interval at the location of RW-2.

<u>MPC Response 4:</u>

The groundwater impacts at RW-2 do not only consist of floating product (LNAPL). The analytical data from RW-2 indicates that elevated benzene concentrations (over 40 mg/L in 2018) exist in the dissolved phase within the groundwater. The maximum beneficial impact from a recovery well will be realized by pumping from the bottom of the well, capturing as much free product as possible, while capturing as much dissolved phase from the well at the same time. To limit recovery efforts by "skimming" free product will allow the dissolved phase to continue to migrate unabated. This is why Marathon requests that the recovery pumps be placed at the bottom of the well.

Additionally, the NMED recently conducted a site visit to the refinery. Following that site visit, Marathon was informed that the proposed recovery system could be approved following response to NMED concerns. The recovery system proposes to place the pumps at the bottom of the wells for maximum benefit of product recovery and prevention of further dissolved phase migration.

NMED Comment 5:

In Section 1, *Introduction,* the Permittee states, "Comment 22 - Recent monitoring data has shown the benzene, toluene, ethylbenzene, and xylenes (BTEX) results have been non-detect in samples collected at OW-1 and the MTBE results are well below the screening level. Therefore, the leading edge of the plume is adequately defined at OW-1 and there is no benefit to installing additional down-gradient wells at this time." According to Table 8.12 in the *Annual Ground Water Monitoring Report Gallup Refinery - 2017* (2017 Report), dated October 30, 2018, the MTBE concentrations in the groundwater samples collected from well OW-1 were steadily detected below the applicable standard throughout 2017. Since there is a water supply well approximately one mile downgradient from the evaporation ponds, the Permittee must ensure that no contaminants migrate further downgradient of well OW-1. Propose to install a sentinel groundwater monitoring well west of well OW-1 in the revised Work Plan.

MPC Response 5:

MPC is seeking clarification of NMED's directive, "Permittee must ensure that no contaminants migrate further downgradient of well OW-1." Just prior to this directive, NMED acknowledges that MTBE is steadily detected below the applicable standard throughout 2017. Data collected throughout 2018 at OW-1 are summarized in the table below. As can be seen, the reported concentrations are very low and clearly the leading edge of the plume of detectable concentrations is near OW-1. In fact, OW-1 is currently acting as a sentinel well to ensure control of the plume as defined by the groundwater cleanup levels in Section IV.D.1 of the RCRA Post-Closure Permit. Is NMED requiring the use of groundwater standards other than what is specified in Section IV.D.1 of the RCRA Post-Closure Permit?

			PARAMETERS				
STANDARDS			**Benzene (mg/L)**	**Toluene (mg/L)**	**Ethyl Benzene (mg/L)**	**Total Xylenes (mg/L)**	**MTBE (mg/L)**
WQCC 20NMAC 6.2.3103			**0.005**	**1**	**0.7**	**0.62**	**0.1**
40 CFR 141.62 MCL			0.005	1.0	0.7	10	NE
NMED Tap Water (FEB 2019)			0.00455	1.09	0.0149	0.193	0.143
EPA RSL for Tap Water (NOV 2018)			0.00046	1.1	0.0015	0.19	0.014
Well ID	**DATE SAMPLED**	**METHOD**					
OW-1	11/08/18	8260B	0.00058	<0.001	0.00023	<0.0015	0.0018
	09/11/18	8260B	<0.001	<0.001	<0.001	<0.0015	0.0019
	05/15/18	8260B	<0.001	<0.001	<0.001	<0.0015	0.002
	02/27/18	8260B	<0.001	<0.001	<0.001	<0.0015	0.0011
	12/08/17	8260B	<0.001	<0.001	<0.001	<0.0015	0.0014

	09/07/17	8260B	<0.001	<0.001	<0.001	<0.0015	0.002
	05/31/17	8260B	<0.001	<0.001	<0.001	<0.0015	0.0016
	02/27/17	8260B	<0.001	<0.001	<0.001	<0.0015	0.0014

NMED Comment 6:

In Section 1, *Introduction,* the Permittee states, "Comment 25 - A well installed on the southern margin of Evaporation Pond 9 (EP-9) would be cross-gradient to the evaporation pond and be of limited value evaluating potential releases from EP-9. It is also noted that there is a natural depression to south of EP-9 that would make it difficult, if not impossible, to install a monitoring well near the south berm of EP-9. Pursuant to other recent agency requests, new boundary wells (i.e., BW-5A, BW-58, and BW-5C) were recently installed to the west and down-gradient of EP- 9." Refer to Comment 14 in the NMED's January 4, 2019 Disapproval. Comment 14 directs the Permittee to propose to install a groundwater monitoring well at the southern perimeter of pond EP-9. If accessibility is an issue, the Permittee may install the well at a location outside of the depressed area near the berm. Aerial images suggest that there are appropriate locations around midsection of the south berm that appear level. The boundary wells BW-5A, BW-5B and MW-5C are positioned west of pond EP-9 and are unlikely to be adequate for leak detection for the southern perimeter of the pond; therefore, Comment 14 still applies. Revise the Work Plan accordingly.

MPC Response 6:

It may be possible to locate a well to the southeast of EP-9 and we have shown a possible location on revised Figure 4. If there are problems drilling in this area, then NMED will be contacted to discuss alternative locations that are accessible to the drilling rig.

NMED Comment 7

In Section 1, *Introduction,* the Permittee states, "Comment 39 - MTBE concentrations have been slowing [sic] increasing in groundwater samples collected from OW-13. This well was installed in 1981, approximately 37 years ago, and the quality of the well construction is in question. There is a concern the well itself may be acting as a conduit for contamination in the Chinle/Alluvial Interface zone to migrate vertically to the Sonsela Aquifer. It is recommended to plug and abandon well OW-13 and install a new Sonsela well in the same area." Explain the basis for stating that well OW-13 may be a conduit for contaminant migration and the well construction is in question in the revised Work Plan. Well OW-13 must not be abandoned unless sufficient evidence is provided. Replacement of well OW-13 does not address Comment 39. Comment 39 requires the Permittee to investigate the expansion of MTBE plume in the Sonsela formation. Well OW-12 installed in the Sonsela formation is located approximately 800 feet downgradient of well OW-13. MTBE has not been detected to date in the groundwater samples collected from well OW-12. Propose to install a well screened in the Sonsela formation at a location halfway between wells OW-12 and OW-13 in the revised Work Plan.

MPC Response 7:

Additional discussion has been added to Section 4.2 to explain why it is appropriate to plug and abandon OW-13. This is basically due to the thick aquitard that is present in this area above the Sonsela aquifer, which should prevent vertical migration, and an evaluation of the fluid levels in the area suggesting a possible hydraulic connection between the Sonsela and Chinle-Alluvial Interface Zone aquifers. In addition, a new well is proposed between OW-12 and OW-13.

NMED Comment 8

In Section 2, *Background,* the Permittee states, "[t]wo of the wells (OW-13 replacement and new off-site Chinle/Alluvial Interface well) will be drilled in the northeast portion of the property, with one of these actually located off-site to the northeast." In addition to the two wells, Comment 4 requires installation of another well at the location of RW-2 at the northeast portion of the property. Furthermore, Comments 5 and 6 require installation of a sentinel well west of well OW-1, and a groundwater monitoring well south of pond EP-9. Comment 7 requires installation of a well within the Sonsela formation. Address the requirements and revise all applicable sections of the Work Plan.

MPC Response 8:

Section 2 has been revised pursuant to the responses above to referenced Comments 4, 5, 6, and 7.

NMED Comment 9

In Section 4.3, *New Shallow Wells at MKTF-17 and MKTF-18.* the Permittee states, "[t]he wells will be screened in the upper-most saturated interval (logged as Fill in MKTF-17 and MKTF-18) with anticipated maximum well depths of 10 feet." The 2017 depth-to-water (DTW) measurements indicate that the groundwater depths were below nine feet below ground surface (bgs) in well MKTF-17 according to Table 9.2 of the 2017 Report. The well placed next to MKTF-17 must be installed deeper than ten feet bgs. Revise the Work Plan accordingly. In addition, all proposed wells must be installed in a way to accommodate the decreasing trend in groundwater elevations in recent years (e.g., deeper total well depths, longer screened intervals). Furthermore, the designation for all new wells that replace existing wells must be distinguished from the designations for the existing wells (e.g., MKTF-17A). Revise the Work Plan accordingly.

MPC Response 9:

The water levels to which NMED refers are the water levels that exist under confined conditions at MKTF-17 and MKTF-18 and are not necessarily reflective of water levels in the upper fill materials. The two initial wells were drilled through the fill materials and completed in the underlying confined interval with screens set at depths to prevent cross contamination between the fill materials and the silty clayey gravel that occurs at 22 feet bgl in MKTF-17 and the sandy clay/clayey sand that occurs at 23 feet in MKTF-18. The "anticipated" well depth of 10 feet at the two new wells is based on the bottom of the fill being at 8 feet bgl in MKTF-17 and 10 feet bgl in MKTF-18 and is not affected by fluctuating water levels in the lower confined unit (12 feet of confining clay in MKTF-17 and 13 feet in MKTF-18). The screen will be set to encounter the fill down to the top of the underlying clay and upward across and above the water table, while allowing some blank casing to complete the well and isolate from the land surface. The text in Section 4.3 is revised to clarify the screen will extend to the bottom of the fill materials.

<u>NMED Comment 10</u>:
In Section 4.5, *Soil Sample Field Screening and Logging,* the Permittee states, "[s]oil samples will be collected for laboratory analysis if screening indicates the potential for site impacts." Regardless of field screening results, soil samples must also be collected at the groundwater interface and termination depths in each soil boring since some constituents may not be detected by field screening (e.g., metals and semi-volatile organic compounds). Revise the Work Plan accordingly.

<u>MPC Response 10</u>:
The subject text in Section 4.5 has been revised to also include sample collection at the groundwater interface and termination depths in all soil borings.

<u>NMED Comment 11:</u>
In Section 4.5.1, *Drilling Activities,* the Permittee states, "[s]lotted (0.01 inch) PVC well screen will be placed at the bottom of the borings and will extend for 10 feet. A 10/20 sand filter pack will be installed to two feet over the top of the well screen." The statement is contradictory. The longer screened intervals are proposed for the new well northeast of OW-30, and some MKTF wells in Sections 4.1, and 4.4, respectively. Similarly, the length of sand filter pack above screen is less than two feet in wells MKTF-01 and MKTF-02. Resolve the discrepancies in the revised Work Plan.

<u>MPC Response 11</u>:
The subject text in Section 4.5.1 has been revised to eliminate the reference to 10-foot well screens and two feet of filter pack.

<u>NMED Comment 12</u>:
In Section 4.6, *Groundwater Sample Collection,* the Permittee states, "[g]roundwater samples will be collected from the new monitoring wells within 24 hours of the completion of well purging using disposal bailers." Prior to collection of groundwater samples for laboratory analyses, the Permittee must measure DTW and the total depths of each well, and collect groundwater quality parameter data (e.g., dissolved oxygen, pH, temperature, conductivity, redox potential, turbidity) during well purging. Include descriptions of the field procedures in the revised Work Plan. In addition, the discussion regarding well development methodology is not included in the Work Plan. Include a discussion in the revised Work Plan.

<u>MPC Response 12</u>:
Section 4.6 has been revised along with the addition of Appendix D to describe the well development and well purging procedures.

<u>NMED Comment 13:</u>
In Section 4.9, *Chemical Analyses,* the Permittee states, "[g]roundwater samples will also be analyzed for major cations (calcium, magnesium, sodium, and potassium) and anions (e.g., carbonate, bicarbonate, sulfate, fluoride and chloride)." The listed cations and anions are not included in the table titled as Inorganic Analytical Methods (page 4-8). Explain why these inorganic constituents are not included in the table or revise the table to include all inorganic constituents that will be analyzed. In addition, groundwater samples must also be analyzed for nitrate and nitrite because of potential wastewater discharges at the site. Include the nitrate and nitrite analyses for groundwater samples in the revised Work Plan.

<u>MPC Response 13</u>:
The table in Section 4.9 has been revised to include the listed analytes and their associated analytical methods.

<u>NMED Comment 14</u>:
Figure 2, *Chinle / Alluvial Interface Potentiometric Map,* uses the December 2017 groundwater elevation data; however, Figure 2A, *Chinle / Alluvial Interface Potentiometric Map,* uses the March 2015 groundwater data. Figure 2A must be revised to incorporate the December 2017 groundwater elevation data. In addition, Figures 2 and 2A present different maps; Figure 2 presents a northeastern part of the facility and Figure 2A presents entire region of the facility. However, the titles of both figures are identical. Change the titles of the figures for clarity in the revised Work Plan.

<u>MPC Response 14</u>:
Both figures have been revised using data from the August 2018 annual sampling event. The figure titles are also revised to distinguish between the area to the north vs. that to the west.

<u>NMED Comment 15</u>:
In Appendix A, *Boring Logs,* the top of casing elevations for wells MKTF-04, MKTF-17, and MKTF-18 appear to be positioned below ground level. Previously, surface water entered the wells in flush-mounted wells; therefore, an aboveground completion is preferred. The stickup of well casing must be positioned above ground level for all proposed wells, where applicable. Acknowledge the requirements in the revised Work Plan.

<u>MPC Response 15</u>:
Where possible to do so, monitoring wells are completed with aboveground completions, as demonstrated by the fact that few wells have in-ground vaults. However, due to physical limitations accessing some areas (e.g., buildings, pipelines, other infrastructure, etc.) that prevent getting a drilling rig into preferred location, it is necessary to install wells in areas with

high traffic (e.g., roads or loading areas). In this situation, it is only feasible to use in-ground vaults for the surface completion. A good example of this is MKTF-36, which is located on the apron of the truck loading rack where semi-trucks have drive across this area. The only way to locate a well immediately down-gradient of the truck loading rack was to use an in-ground vault for the surface completion. Additional text has been added to Section 4.5.1 to note the preference to use aboveground surface completions for new wells where practicable.

Work Plan
2015 Annual Groundwater Report Comments

Marathon Petroleum Company LP

Gallup Refinery
Western Refining Southwest, Inc.
Gallup, New Mexico

EPA ID# NMD000333211

OCTOBER 2018

(Revised June 2019)

Scott Crouch
Senior Geologist

DiSorbo
Environmental Consulting Firm

8501 North Mopac Expy | Suite 300 | Austin, TX 78759
512.693.4190 (P) | 512.279.3118 (F) | www.disorboconsult.com

Table of Contents

List of Figures

Appendices

Table of Contents (Continued)

List of Acronyms

benzene, toluene, ethylbenzene, and xylene (BTEX)
Code of Federal Regulations (CFR)
Contract Laboratory Program (CLP)
data quality objective (DQO)
diesel range organics (DRO)
dilution attenuation factor (DAF)
Environmental Protection Agency (EPA)
investigation derived waste (IDW)
Maximum Contaminant Level (MCL)
mean sea level (msl)
monitoring well (MW)
motor oil range organics (MRO)
methyl tert butyl ether (MTBE)
New Mexico Administrative Code (NMAC)
New Mexico Environment Department (NMED)
New Mexico Oil Conservation Division (NMOCD)
photoionization detector (PID)
polynuclear aromatic hydrocarbon (PAH)
polyvinyl chloride (PVC)
quality assurance/quality control (QA/QC)
Resource Conservation and Recovery Act (RCRA)
separate-phase hydrocarbon (SPH)
semi-volatile organic compound (SVOC)
Solid Waste Management Unit (SWMU)
total petroleum hydrocarbon (TPH)
toxicity characteristic leaching procedure (TCLP)
volatile organic compound (VOC)

Executive Summary

The Gallup Refinery, which is located 17 miles east of Gallup, New Mexico, has been in operation since the 1950s. Pursuant to the terms and conditions of the facility Resource Conservation and Recovery Act (RCRA) Post-Closure Care Permit and 20.4.1.500 New Mexico Administrative Code, this Work Plan has been prepared to address comments received on the 2015 Annual Groundwater Monitoring Report for the Gallup Refinery. In the Disapproval letter dated January 31, 2018, the New Mexico Environment Department (NMED) requested additional wells be installed pursuant to Comments No. 18.2, 18.3, 18.4, 20, 22, 25, 39, and 40. In response to these comments, seven new monitoring wells will be installed. Soil samples will be collected for chemical analysis based on field screening results. Upon completion and well development, groundwater samples will be collected and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons (TPH), Skinner List metals, cyanide, iron, manganese, major cations, and major anions.

Section 1
Introduction

The Gallup Refinery is located approximately 17 miles east of Gallup, New Mexico along the north side of Interstate Highway I-40 in McKinley County. The physical address is I-40, Exit #39 Jamestown, New Mexico 87347. The Gallup Refinery is located on 810 acres. Figure 1 presents the refinery location and the regional vicinity.

The Gallup Refinery generally processes crude oil from the Four Corners area transported to the facility by pipeline or tanker truck. Various process units are operated at the facility, including crude distillation, reforming, fluidized catalytic cracking, alkylation, sulfur recovery, merox treater, and hydrotreating. Current and past operations have produced gasoline, diesel fuels, jet fuels, kerosene, propane, butane, and residual fuel.

This work plan addresses requests for additional site monitoring wells in the NMED Disapproval letter dated January 31, 2018 on the 2015 Annual Groundwater Monitoring Report and a subsequent NMED comment letter dated January 28, 2019 on the initial submission of this Work Plan. The specific comment numbers in the January 31, 2018 letter are 18.2, 18.3, 18.4, 20, 22, 25, 39, and 40. The actions, if required, to address these comments are described below:

- Comment 18.2 - A new monitoring well is proposed to the northeast of OW-30;
- Comment 18.3 – Methyl Tert Butyl Ether (MTBE) has been detected in OW-50 and OW-52 since submission of the 2015 Annual Groundwater Monitoring Report and that appears to confirm the down-gradient flow direction to the north in this area, thus no additional wells are proposed. In addition, we note that wells OW-54 and OW-55 have already been installed in the subject area since the 2015 reporting period and a row of six additional temporary wells have already been proposed further to the west (anticipated to be down-gradient) to provide additional information on the subsurface geology as well as hydraulic gradients west and northwest of OW-50, OW-52 and OW-56 (DiSorbo, 2019);
- Comment 18.4 – As noted above, MTBE has been detected down-gradient to the north in wells OW-50 and OW-52 and a new well (OW-56) has already been installed to the west, therefore no additional wells are proposed in the immediate area;

- Comment 20 - Upon further review of the well construction and water levels, it appears that operating a recovery pump in existing RW-2, which is being proposed separately, will lower the water level in RW-2 to below the top of the well screen. Fluid levels will be monitored and if the water level is not lowered below the top of the well screen, then further consideration will be given to installing an additional well with a higher well screen.
- Comment 22 – Recent monitoring data has shown the benzene, toluene, ethylbenzene, and xylenes (BTEX) results have been mostly non-detect in samples collected at OW-1 and the MTBE results are very low and well below the screening level. Therefore, the leading edge of the plume is adequately defined at OW-1 and there is no benefit to installing additional down-gradient wells at this time;
- Comment 25 – A new well will be installed on the southern margin of Evaporation Pond 9 (EP-9);
- Comment 39 – MTBE concentrations have been slowly increasing in groundwater samples collected from OW-13. This well was installed in 1981, approximately 37 years ago, and the quality of the well construction is in question. There is a concern the well itself may be acting as a conduit for contamination in the Chinle/Alluvial Interface zone to migrate vertically to the Sonsela Aquifer. It is recommended to plug and abandon well OW-13 and install a new Sonsela well in the same area. In addition, a new Sonsela well will be installed between OW-12 and OW-13; and
- Comment 40
    - Well MKTF-01 will be plugged and replaced with a new well in the same area with the screen set higher to encounter the potentiometric surface;
    - Well MKTF-02 will be plugged and replaced with a new well in the same area with the screen set higher to encounter the potentiometric surface;
    - Well MKTF-04 will be plugged and replaced with a new well with the screen set higher to encounter the potentiometric surface;
    - Wells MKTF-17 and -18 are both screened across deeper intervals in an area where there is a shallow zone of apparent fill material that is saturated and has hydrocarbon impacts. Wells MKTF-17 and MKTF-18 will be retained to monitor the deeper semi-confined interval and a new shallow monitoring well will be added at each location to monitor the fill materials, which are under water table conditions; and.

- The water level in MKTF-28 has fluctuated above and below the top of the well screen; however, the well produces very little water and the chemical analyses of groundwater samples collected from MKTF-28 have shown only very low concentrations of constituents of concern. There are no indications of the presence of phase-separated hydrocarbons (PSH). No modifications are recommended for MKTF-28.

The investigation activities will be conducted in accordance with Section IV.H.5 of the Post-Closure Care Permit.

Section 2
Background

NMED's review of the 2015 Annual Groundwater Monitoring Report generated numerous requests for the installation of additional monitoring wells. The wells are basically located in three distinct areas on the refinery property. Three of the wells (OW-13 replacement, new Sonsela well between OW-12 and OW-3 and new off-site Chinle/Alluvial Interface well) will be drilled in the northeast portion of the property, with one of these actually located off-site to the northeast. There are no known potential sources in the immediate vicinity of where these wells will be located (north and northeast of the main tank farm); however, they are both potentially located down-gradient of the main tank farm such that it may be possible for contaminants sourced in the tank farm to migrate to these locations.

The second group of wells (MKTF-01R, MKTF-02R and MKTF-04R) is located in the vicinity of the hydrocarbon seep, which is an area on the western portion of the refinery where significant prior investigations of groundwater impacts have been conducted. Once again, this is an area without any known potential sources in the immediate area, but rather in a down-gradient location where impacted groundwater has transported contaminants. Also, in this general area, a new MTKF well will be drilled on the south side of EP-9.

The third location is near the truck loading rack, which is considered a potential source of groundwater impacts and is also being investigated as part of Area of Concern 35. Two wells are located in this area as "shallow twin" wells to MKTF-17 and MKTF-18.

Section 3
Site Conditions

3.1 Surface Conditions

Site topographic features include high ground in the southeast gradually decreasing to a lowland fluvial plain to the northwest. Elevations on the refinery property range from 7,040 feet to 6,860 feet. Surface soils within most of the area of investigation are primarily Rehobeth silty clay loam. Rehobeth soil properties include a pH ranging from 8 to 9 standard units and salinity (naturally occurring and typically measuring up to approximately 8 mmhos/cm).

Regional surface water features include the refinery evaporation ponds and a number of small ponds (one cattle water pond and two small unnamed spring fed ponds). The site is located in the Puerco River Valley, north of the Zuni Uplift with overland flows directed northward to the tributaries of the Puerco River. The Puerco River continues to the west to the confluence with the Little Colorado River. The South Fork of the Puerco River is intermittent and retains flow only during and immediately following precipitation events.

3.2 Subsurface Conditions

The shallow subsurface soils consist of fluvial and alluvial deposits comprised of clay and silt with minor inter-bedded sand layers. Very low permeability bedrock (e.g., claystones and siltstones) underlie the surface soils and effectively form an aquitard. The Chinle Group, which is Upper Triassic, crops out over a large area on the southern margin of the San Juan Basin. The uppermost recognized local Formation is the Petrified Forest Formation and the Sonsela Sandstone Bed is the uppermost recognized regional aquifer. Aquifer test of the Sonsela Bed northeast of Prewitt indicated a transmissivity of greater than 100 ft^2/day (Stone and others, 1983). The Sonsela Sandstone's highest point occurs southeast of the site and slopes downward to the northwest as it passes under the refinery. The Sonsela Sandstone forms a water-bearing reservoir with artesian conditions throughout the central and western portions of the refinery property.

The diverse properties and complex, irregular stratigraphy of the surface soils across the site cause a wide range of hydraulic conductivity ranging from less than 10^{-2} cm/sec for gravel like sands immediately overlying the Petrified Forest Formation to 10^{-8} cm/sec in the clay soils located near the surface (Western, 2009). Generally, shallow groundwater at the refinery follows the upper contact of the Petrified Forest Formation with prevailing flow from the southeast to the northwest, although localized areas may have varying flow directions (Figures 2 and 2A).

Section 4
Scope of Services

The new and replacement monitoring wells will be installed pursuant Section IV.K. of the RCRA Post-Closure Care Permit. This includes three replacement wells to raise the top of the well screen intervals and two new wells to monitor additional intervals (e.g., shallow fill materials) that are not currently being monitoring in the areas of concern. One new well is located in a potentially down-gradient location to evaluate the possible migration of MTBE off-site to the east of the refinery. One well will replace an old well screened in the Sonsela aquifer, which has shown detections of MTBE, and an additional well will be installed down-gradient of this location. Boring logs of wells being replaced or adjacent wells are provided in Appendix A. The location specific activities are discussed further below. The well installation will commence upon approval of this work plan by NMED.

4.1 New Well Northeast of OW-30

An investigation of groundwater conditions in the area northeast of OW-30 is proposed to determine the hydraulic gradient on the east side of the refinery and the lateral extent of MTBE, which has been detected at elevated concentrations in groundwater samples collected from OW-30. One well will be located approximately 500 feet northeast of OW-30 (Figure 3). The well will be screened in the upper-most saturated interval(s) with a maximum screen length of 20 feet to help ensure the top of the well screen is set above the potentiometric surface.

4.2 New Sonsela Wells

Concentrations of MTBE have been slowly increasing in groundwater samples collected at monitoring well OW-13 since at least 2010. A graph of the concentrations is included in Appendix C. The boring log for OW-13 indicates that the top of the Chinle Formation, which consists of shale, is present at 8 feet below ground level (bgl) and extends to 70 feet bgl before encountering the Sonsela aquifer, Therefore, the aquitard comprised of the Chinle Formation (shale) is approximately 60 feet thick in the area of OW-13. An examination of the boring log for OW-12 indicates the Chinle Formation is approximately 80 feet thick above the Sonsela aquifer. The thickness of the aquitard (Chinle Formation) between the Chinle-Alluvial Interface Zone and the Sonsela aquifer cast doubt on whether the MTBE has migrated through the aquitard or found another migration pathway.

A review of the potentiometric surfaces measured in OW-12 (completed in Sonsela aquifer), OW-13 (completed in Sonsela aquifer) and OW-14 (completed in Chinle-Alluvial Interface Zone) indicates that the potentiometric surface measured in OW-13 tracks more closely with the potentiometric surface in OW-14 than the potentiometric surface in OW-12 (Appendix C). In fluid levels measured from June 2005 through November 2018, all three wells indicate rising water levels. From the lowest potentiometric surfaces recorded in December 2007 to the highest (April 2018 in OW-13 and OW-14 and August 2018 in OW-12), the increases are 2.78 feet, 4.14 feet, and 5.66 feet in OW-12, OW-13 and OW-14, respectively. While the increase at OW-13 is not as great as that measured at OW-14, it is significantly greater than the increase measured at OW-12, the other nearby well completed in the Sonsela aquifer.

The examination of the aquitard thickness and potentiometric surfaces indicates that well OW-13 is a possible migration pathway for contaminations to move vertically downward to the Sonsela aquifer. To address this concern, monitoring well OW-13 will be plugged and abandoned pursuant to the requirements of the New Mexico Office of the State Engineer (19.27.4 NMAC). A new well will be installed in the same location as OW-13 (Figure 3). The well will be screened within the Sonsela aquifer, with a separate isolation casing set from the land surface to the top of the Chinle Formation.

To evaluate the potential migration of MTBE within the Sonsela aquifer, an additional well will be located approximately halfway between OW-12 and OW-13. The proposed location is shown on Figure 3.

4.3 New Shallow Wells at MKTF-17 and MKTF-18

A new shallow monitoring well will be installed adjacent to MKTF-17 and a new shallow monitoring well will be installed adjacent to MKTF-18 (Figure 4). The wells will be screened in the upper-most saturated interval (logged as Fill in MKTF-17 and MKTF-18) with anticipated maximum well depths of 10 feet to screen to the bottom of the fill materials. The top of the well screen will be placed as near the land surface as possible while allowing adequate surface protection to isolate the wells form potential surface impacts.

4.4 MKTF-01, MKTF-02 and MKTF-04 Replacement Wells

Monitoring wells MKTF-01, MKTF-02 and MKTF-04 will be plugged and abandoned. Replacement wells (MKTF-01R, MKTF-02R and MKTF-04R) will be drilled adjacent to the original well locations. The well screen in MKTF-01 was placed from 4 to 14 feet below ground level (bgl). MKTF-01R will be drilled to a depth of approximately 13 feet with the well screen set from 2 to 12 feet bgl. The well completion will include 1 foot of sand above the well screen and 1 foot of grout extending to the land surface.

The well screen in MKTF-02 was placed from 7 to 17 feet below ground level (bgl). MKTF-02R will be drilled to a depth of approximately 17 feet with the well screen set from 2.5 to 15.5 feet bgl. The well completion will include 1 foot of sand above the well screen and 1.5 feet of grout extending to the land surface.

The well screen in MKTF-04 was placed from 12 to 22 feet bgl. MKTF-04R will be drilled to a depth of approximately 19 feet with the well screen set from 4 to 19 feet bgl. The well completion will include 2 foot of sand above the well screen and 2 feet of grout extending to the land surface.

4.5 Soil Sample Field Screening and Logging

Samples obtained from the soil borings will be screened in the field on 2.0-foot intervals for evidence of contaminants. Field screening results will be recorded on the exploratory boring logs. Field screening results will be used to aid in the possible selection of soil samples for laboratory analysis. The primary screening methods include: (1) visual examination, (2) olfactory examination, and (3) headspace vapor screening for volatile organic compounds.

Visual screening includes examination of soil samples for evidence of staining caused by petroleum-related compounds or other substances that may cause staining of natural soils such as elemental sulfur or cyanide compounds. Headspace vapor screening targets volatile organic compounds and involves placing a soil sample in a plastic sample bag or a foil sealed container allowing space for ambient air. The container will be sealed and then shaken gently to expose the soil to the air trapped in the container. The sealed container will be allowed to rest for a minimum of 5 minutes while vapors equilibrate. Vapors present within the sample bag's headspace will then be measured by inserting the probe of the instrument in a small opening in the bag or through the foil. The maximum value and the ambient air temperature will be recorded on the field boring or test pit log for each sample.

The monitoring instruments will be calibrated each day to the manufacturer’s standard for instrument operation. A photoionization detector (PID) equipped with a 10.6 or higher electron volt (eV) lamp or a combustible gas indicator may be used for VOC field screening. Field screening results may be site- and boring-specific and the results may vary with instrument type, the media screened, weather conditions, moisture content, soil type, and type of contaminant, therefore, all conditions capable of influencing the results of field screening will be recorded on the field logs.

Soil samples will be collected for laboratory analysis from zones for which screening indicates the potential for site impacts. In addition, soil samples will be collected at the groundwater interface and termination depths of all soil borings. The physical characteristics of the samples (such as mineralogy, ASTM soil classification, moisture content, texture, color, presence of stains or odors, and/or field screening results), depth where each sample was obtained, method of sample collection, and other observations will be recorded in the field log by a qualified geologist or engineer. Detailed logs of each boring will be completed in the field by a qualified engineer or geologist. Additional information, such as the presence of water-bearing zones and any unusual or noticeable conditions encountered during drilling, will be recorded on the logs.

Quality Assurance/Quality Control (QA/QC) samples will be collected to monitor the validity of the soil sample collection procedures as follows:

- Field duplicates will be collected at a rate of 10 percent; and
- Equipment blanks will be collected from all sampling apparatus at a frequency of one per day.

4.5.1 Drilling Activities

Soil borings will be drilled using hollow-stem augers and it may be necessary to switch to air rotary for the deep well drilled into the Sonsela Aquifer. The drilling equipment will be properly decontaminated before drilling each boring. The NMED will be notified as early as practicable if conditions arise or are encountered that do not allow the advancement of borings to the specified depths or at planned sampling locations. Appropriate actions (e.g., installation of protective surface casing or relocation of borings to a less threatening location) will be taken to minimize any negative impacts from investigative borings. Slotted (0.01 inch) PVC well screen will be placed at the bottom of the borings and 10/20 sand filter pack will be installed to two feet over the top of the well screen. Some locations may have wells screen placed near the land surface and in these locations the sand filter pack may be reduced to 1 foot. Where possible, aboveground surface completions will be used; with in-ground vaults only used in areas where an aboveground completion is not practicable.

4.6 Groundwater Sample Collection

Groundwater samples shall initially be obtained from newly installed monitoring wells between ten and 30 days after completion of well development. Well development and purging prior to sample collection will be in accordance with procedures described in Appendix D. Prior to collection of groundwater samples for laboratory analyses, the fluid levels and the total depths of each well will be measured.

Groundwater samples will be collected from the new monitoring wells within 24 hours of the completion of well purging using disposal bailers. Alternatively, well sampling may also be conducted in accordance with the NMED's Position Paper *Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring* (October 30, 2001, as updated). Sample collection methods will be documented in the field monitoring reports. The samples will be transferred to the appropriate, clean, laboratory-prepared containers provided by the analytical laboratory. Sample handling and chain-of-custody procedures will be in accordance with the procedures presented below in Section 4.4.1.

Groundwater samples intended for metals analysis will be submitted to the laboratory as both total and dissolved metals samples. QA/QC samples will be collected to monitor the validity of the groundwater sample collection procedures as follows:

- Field duplicate water samples will be obtained at a frequency of ten percent, with a minimum, of one duplicate sample per sampling event;
- Equipment rinsate blanks will be obtained for chemical analysis at the rate of ten percent or a minimum of one rinsate blank per sampling day. Equipment rinsate blanks will be collected at a rate of one per sampling day if disposable sampling equipment is used. Rinsate samples will be generated by rinsing deionized water through unused or decontaminated sampling equipment. The rinsate sample will be placed in the appropriate sample container and submitted with the groundwater samples to the analytical laboratory for the appropriate analyses; and
- Trip blanks will accompany laboratory sample bottles and shipping and storage containers intended for VOC analyses. Trip blanks will consist of a sample of analyte-free deionized water prepared by the laboratory and placed in an appropriate sample container. The trip blank will be prepared by the analytical laboratory prior to the sampling event and will be kept with the shipping containers and placed with other water samples obtained from the

site each day. Trip blanks will be analyzed at a frequency of one for each shipping container of groundwater samples to be analyzed for VOCs.

4.6.1 Sample Handling

At a minimum, the following procedures will be used at all times when collecting samples during investigation, corrective action, and monitoring activities:

1. Neoprene, nitrile, or other protective gloves will be worn when collecting samples. New disposable gloves will be used to collect each sample;
2. All samples collected of each medium for chemical analysis will be transferred into clean sample containers supplied by the project analytical laboratory with the exception of soil, rock, and sediment samples obtained in Encore® samplers. Sample container volumes and preservation methods will be in accordance with the most recent standard EPA and industry accepted practices for use by accredited analytical laboratories. Sufficient sample volume will be obtained for the laboratory to complete the method-specific QC analyses on a laboratory-batch basis; and
3. Sample labels and documentation will be completed for each sample following procedures discussed below. Immediately after the samples are collected, they will be stored in a cooler with ice or other appropriate storage method until they are delivered to the analytical laboratory. Standard chain-of-custody procedures, as described below, will be followed for all samples collected. All samples will be submitted to the laboratory soon enough to allow the laboratory to conduct the analyses within the method holding times.

Chain-of-custody and shipment procedures will include the following:

1. Chain-of-custody forms will be completed at the end of each sampling day, prior to the transfer of samples off site.
2. Individual sample containers will be packed to prevent breakage and transported in a sealed cooler with ice or other suitable coolant or other EPA or industry-wide accepted method. The drainage hole at the bottom of the cooler will be sealed and secured in case of sample container leakage. Temperature blanks will be included with each shipping container.
3. Each cooler or other container will be delivered directly to the analytical laboratory.

4. Glass bottles will be separated in the shipping container by cushioning material to prevent breakage.
5. Plastic containers will be protected from possible puncture during shipping using cushioning material.
6. The chain-of-custody form and sample request form will be shipped inside the sealed storage container to be delivered to the laboratory.
7. Chain-of-custody seals will be used to seal the sample-shipping container in conformance with EPA protocol.
8. Signed and dated chain-of-custody seals will be applied to each cooler prior to transport of samples from the site.
9. Upon receipt of the samples at the laboratory, the custody seals will be broken, the chain-of-custody form will be signed as received by the laboratory, and the conditions of the samples will be recorded on the form. The original chain-of-custody form will remain with the laboratory and copies will be returned to the relinquishing party.
10. Copies of all chain-of-custody forms generated as part of sampling activities will be maintained on-site.

4.7 Collection and Management of Investigation Derived Waste

Drill cuttings, excess sample material and decontamination fluids, and all other investigation derived waste (IDW) associated with soil borings will be contained and characterized using methods based on the boring location, boring depth, drilling method, and type of contaminants suspected or encountered. All purged groundwater and decontamination water will be characterized prior to disposal unless it is disposed in the refinery wastewater treatment system upstream of the API Separator. An IDW management plan is included as Appendix B.

Field equipment requiring calibration will be calibrated to known standards, in accordance with the manufacturers' recommended schedules and procedures. At a minimum, calibration checks will be conducted daily, or at other intervals approved by the Department, and the instruments will be recalibrated, if necessary. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, its use will be discontinued until the necessary repairs are made. In the interim, a properly calibrated replacement instrument will be used.

4.8 Documentation of Field Activities

Daily field activities, including observations and field procedures, will be recorded in a field log book. Copies of the completed forms will be maintained in a bound and sequentially numbered field file for reference during field activities. Indelible ink will be used to record all field activities. Photographic documentation of field activities will be performed, as appropriate. The daily record of field activities will include the following:

1. Site or unit designation;
2. Date;
3. Time of arrival and departure;
4. Field investigation team members including subcontractors and visitors;
5. Weather conditions;
6. Daily activities and times conducted;
7. Observations;
8. Record of samples collected with sample designations and locations specified;
9. Photographic log, as appropriate;
10. Field monitoring data, including health and safety monitoring;
11. Equipment used and calibration records, if appropriate;
12. List of additional data sheets and maps completed;
13. An inventory of the waste generated and the method of storage or disposal; and
14. Signature of personnel completing the field record.

4.9 Chemical Analyses

All samples collected for laboratory analysis will be submitted to an accredited laboratory. The laboratory will use the most recent standard EPA and industry-accepted analytical methods for target analytes as the testing methods for each medium sampled. Chemical analyses will be performed in accordance with the most recent EPA standard analytical methodologies and extraction methods.

Groundwater and soil samples will be analyzed by the following methods:

- SW-846 Method 8260 for volatile organic compounds;
- SW-846 Method 8270 for semi-volatile organic compounds; and
- SW-846 Method 8015B gasoline range (C5-C10), diesel range (>C10-C28), and motor oil range (>C28-C36) organics.

Groundwater and soil samples will also be analyzed for the following Skinner List metals and iron and manganese using the indicated analytical methods shown. The groundwater samples collected for metals analysis will be analyzed for total and dissolved concentrations. Groundwater samples will also be analyzed for major cations and anions as listed below.

Analyte	Analytical Method
Antimony	SW-846 method 6010/6020
Arsenic	SW-846 method 6010/6020
Barium	SW-846 method 6010/6020
Beryllium	SW-846 method 6010/6020
Cadmium	SW-846 method 6010/6020
Chromium	SW-846 method 6010/6020
Cobalt	SW-846 method 6010/6020
Cyanide	SW-846 method 335.4/335.2 mod
Lead	SW-846 method 6010/6020
Mercury	SW-846 method 7470/7471
Nickel	SW-846 method 6010/6020
Selenium	SW-846 method 6010/6020
Silver	SW-846 method 6010/6020
Vanadium	SW-846 method 6010/6020
Zinc	SW-846 method 6010/6020
Iron	SW-846 method 6010/6020
Manganese	SW-846 method 6010/6020
Calcium	EPA method 200.7
Manganese	EPA method 200.7
Sodium	EPA method 200.7
Potassium	EPA method 200.7
Carbonate	SM 2320B
Bicarbonate	SM 2320B
Sulfate	EPA method 300.0
Fluoride	EPA method 300.0
Chloride	EPA method 300.0
Nitrate	EPA method 300.0
Nitrite	EPA method 300.0

Groundwater field measurements will be obtained for pH, specific conductance, dissolved oxygen concentrations, oxidation-reduction potential, and temperature.

4.10 Data Quality Objectives

The Data Quality Objectives (DQOs) were developed to ensure that newly collected data are of sufficient quality and quantity to address the project goals, including Quality Assurance/Quality Control (QA/QC) issues (EPA, 2006). The project goals are established to determine and evaluate the presence, nature, and extent of releases of contaminants at specified SWMUs. The type of data required to meet the project goals includes chemical analyses of soil and groundwater to determine if there has been a release of contaminants.

The quantity of data is location specific and is based on the historical operations at individual locations. Method detection limits should be 20% or less of the applicable background levels, cleanup standards and screening levels.

Additional DQOs include precision, accuracy, representativeness, completeness, and comparability. Precision is a measurement of the reproducibility of measurements under a given set of circumstances and is commonly stated in terms of standard deviation or coefficient of variation (EPA, 1987). Precision is also specific to sampling activities and analytical performance. Sampling precision will be evaluated through the analyses of duplicate field samples and laboratory replicates will be utilized to assess laboratory precision.

Accuracy is a measurement in the bias of a measurement system and may include many sources of potential error, including the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analysis techniques (EPA, 1987). An evaluation of the accuracy will be performed by reviewing the results of field/trip blanks, matrix spikes, and laboratory QC samples.

Representativeness is an expression of the degree to which the data accurately and precisely represent the true environmental conditions. Sample locations and the number of samples have been selected to ensure the data is representative of actual environmental conditions. Based on SWMU specific conditions, this may include either biased (i.e., judgmental) locations/depths or unbiased (systematic grid samples) locations. In addition, sample collection techniques (e.g., field monitoring and decontamination of sampling equipment) will be utilized to help ensure representative results.

Completeness is defined as the percentage of measurements taken that are actually valid measurements, considering field QA and laboratory QC problems. EPA Contract Laboratory Program (CLP) data has been found to be 80-85% complete on a nationwide basis and this has been extrapolated to indicate that Level III, IV, and V analytical techniques will generate data that are approximately 80% complete (EPA, 1987). As an overall project goal, the completeness goal is 85%; however, some samples may be critical based on location or field screening results and thus a sample-by-sample evaluation will be performed to determine if the completeness goals have been obtained.

Comparability is a qualitative parameter, which expresses the confidence with which one data set can be compared to another. Industry standard sample collection techniques and routine EPA analytical methods will be utilized to help ensure data are comparable to historical and future data. Analytical results will be reported in appropriate units for comparison to historical data and cleanup levels.

Section 5
References

DiSorbo, 2019, Investigation Report North Drainage Ditch and OW-29 & OW-30 Areas, August 2018 (Revised April 2019)

EPA, 1987, Data Quality Objectives for Remedial Response Activities; United States Environmental Protection Agency, Office of Emergency and Remedial Response and Office of Waste Programs Enforcement, OSWER Directive 9355.0-7B, 85p.

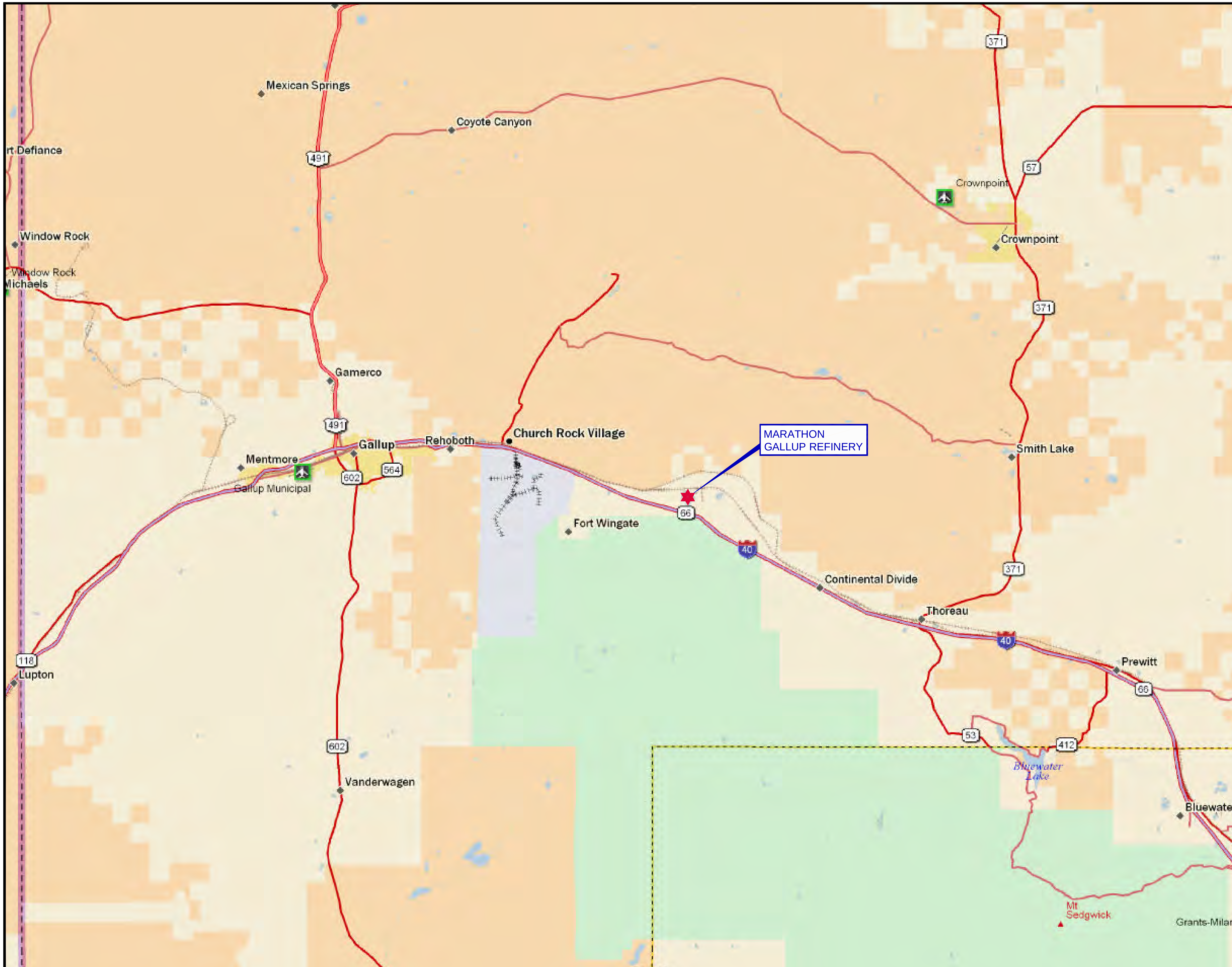
EPA, 2006, Guidance on Systematic Planning Using the Data Quality Objectives Process, United States Environmental Protection Agency, Office of Environmental Information; EPA/240/B-06/001, p. 111.

NMED, 2017, Risk Assessment Guidance for Site Investigation and Remediation, New Mexico Environment Department.

Stone, W.J., Lyford, F.P., Frenzel, P.F., Mizel, N.H., and Padgett, E.T., 1983, Hydrogeology and Water Resources of San Juan Basin, New Mexico; Hydrogeologic Report 6, New Mexico Bureau of Mines and Mineral Resources, p. 70.

Western, 2009, Facility-wide Groundwater Monitoring Plan: Gallup Refinery, p. 97.

Figures



Map Source: DeLorme Street Atlas USA 2007 Plus.

MARATHON

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 03/24/19	FILE: Mathon–dB206

FIGURE 1
SITE LOCATION MAP
GALLUP REFINERY

DiSorbo
Environmental Consulting Firm

8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 03/18/2016.

0 240
SCALE IN FEET

NEW MEXICO

GALLUP SITE LOCATION

LEGEND

NDD-1	SOIL BORING LOCATION AND IDENTIFICATION NUMBER
NDD-1	TEMPORARY MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
OW-14	ALLUVIUM / CHINLE GP MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
OW-13	SONSELA MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
6900	CONTOUR OF POTENTIOMETRIC SURFACE
6900.69	POTENTIOMETRIC SURFACE AUGUST 2018
*	NOT USED TO CONTOUR

MARATHON

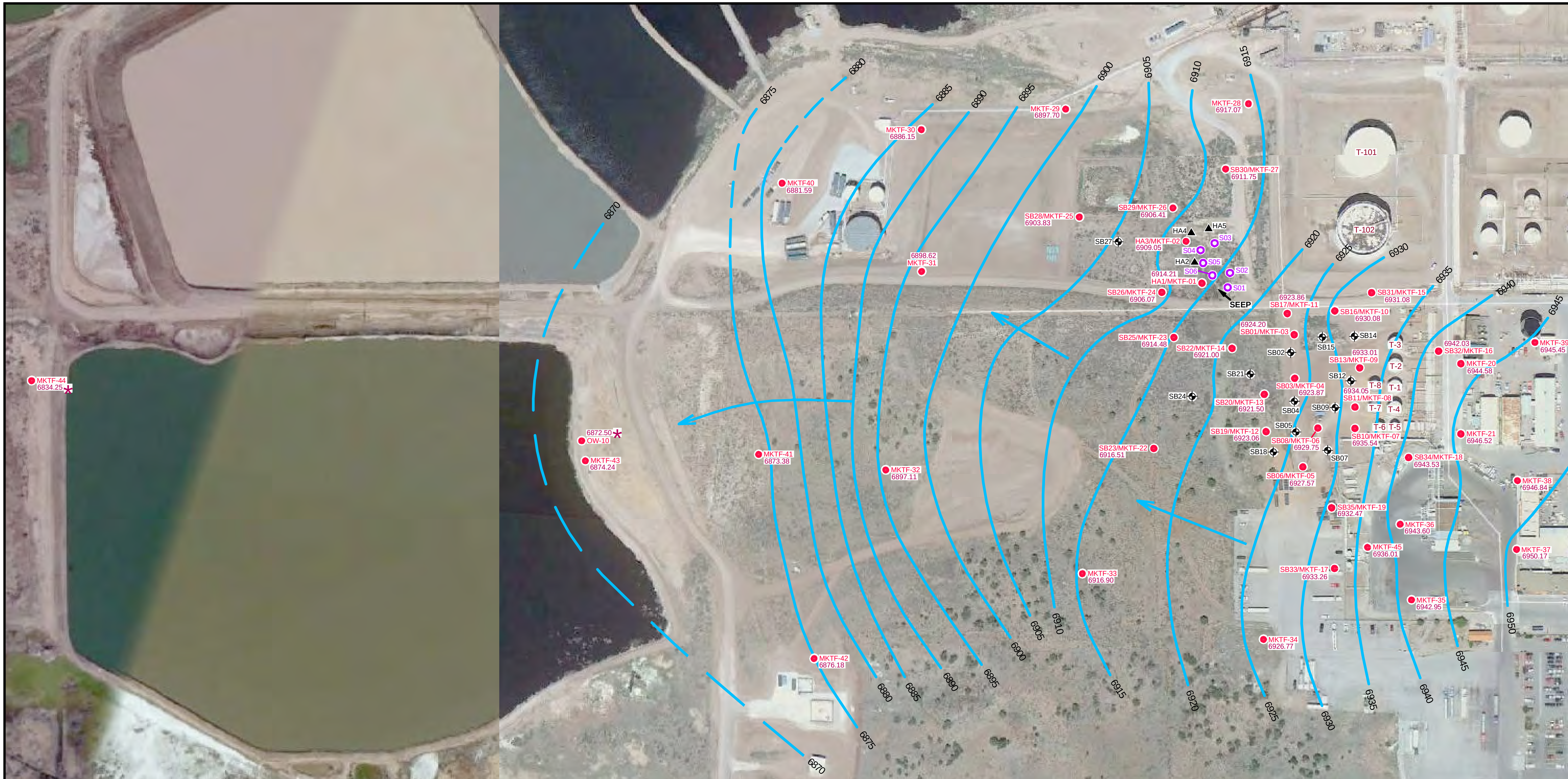
MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon | DATE: 06/11/19 | FILE: Mathon–dB218

FIGURE 2
CHINLE / ALLUVIAL INTERFACE
POTENTIOMETRIC MAP
NORTH

DiSorbo
Environmental Consulting Firm

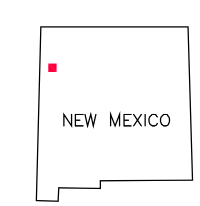
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759



Aerial Map Source: Google Map, 01/05/2014.

LEGEND

SB01	TEMPORARY WELL LOCATION (PLUGGED)	6930	POTENTIOMETRIC CONTOUR (FT) (5 FT INTERVAL)
HA1	HAND AUGER LOCATION (PLUGGED)		GROUNDWATER FLOW DIRECTION
S01	TEMPORARY SUMP	6876.18	POTENTIOMETRIC SURFACE MEASURED RELATIVE TO MEAN SEA LEVEL (AUGUST 2018)
	MONITORING WELL LOCATION (PERMANENT WELL)	*	MEASUREMENT NOT USED IN CONTOURING



QUADRANGLE LOCATION

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

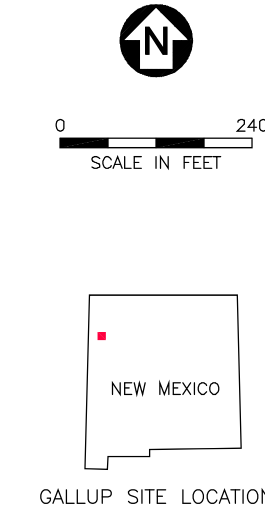
PROJ. NO.: Marathon | DATE: 06/11/19 | FILE: Mathon–dB219

FIGURE 2A
CHINLE / ALLUVIAL INTERFACE
POTENTIOMETRIC MAP
WEST

DiSorbo
Environmental Consulting Firm

8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 03/18/2016.



LEGEND

- PROPOSED WELL LOCATION
- NDD-1 — SOIL BORING LOCATION AND IDENTIFICATION NUMBER
- NDD-1 — TEMPORARY MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
- OW-14 — ALLUVIUM / CHINLE GP MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
- OW-13 — SONSELA MONITORING WELL LOCATION AND IDENTIFICATION NUMBER

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 06/12/19	FILE: Mathon–dB220

FIGURE 3
PROPOSED MONITORING WELL LOCATIONS

DiSorbo Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 01/05/2014.

0 220
SCALE IN FEET

LEGEND

NEW WELL LOCATION

SB01 TEMPORARY WELL LOCATION (PLUGGED)

S01 TEMPORARY SUMP

MONITORING WELL LOCATION (PERMANENT WELL)

NEW MEXICO

QUADRANGLE LOCATION

MARATHON

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 06/12/19	FILE: Mathon-dB202

FIGURE 4
MKTF WELL LOCATIONS

DiSorbo
Environmental Consulting Firm

8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Appendix A

Boring Logs

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

PROJECT: Giant Refinery Ciniza

FILE #: 96-133
ELEVATION: 6921.6
TOTAL DEPTH: 48.4
LOGGED BY: WHK
DATE: 8-28-96
STATIC WATER: 24.4
BORING ID: OW-30(0647)
PAGE: 1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
0.0-6.5	///---///	5.0	C	**CLAY**, SILTY, DRY, RED BROWN, FIRM, SOME ROOT MATTER	PID-0ppm ALL SAMPLES
6.5-13.1	/////////	10	C	**CLAY**, RED BROWN, MOIST, STIFF, SOME ROOT MATTER, SOME CARBONATE NODULES < 1 cm	
13.1-13.8	///***///		C	**CLAY**, SANDY, CARBONATE NODULES APPROXIMATELY 3mm, STIFF, DAMP, RED BROWN	
13.8-16.5	///---///	15	C	**CLAY**, SILTY, DAMP-MOIST, RED BROWN, STIFF	
16.5-22.5	/////////	20	C	**CLAY**, VERY STIFF, RED BROWN, MOIST	
22.5-23.2	/////////		C	**CLAY**, SILTY, STIFF, MOIST, BROWN	

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

PROJECT: Giant Refinery Ciniza

FILE #: 96-133
ELEVATION: 6921.6
TOTAL DEPTH: 48.4
LOGGED BY: WHK
DATE: 8-28-96
STATIC WATER: 24.4
BORING ID: OW-30(0647)
PAGE: 2

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
23.2-23.8	***---***		C	**SAND**, FINE, SILTY, BROWN, DAMP, MODERATELY DENSE	PID=0ppm
23.8	***---***		C		ALL SAMPLES
23.8-24.3	///---///		C	**CLAY**, SILTY, BROWN, VERY STIFF, MOIST	
24.3-39.7	/////////	25	C	**CLAY**, BROWM, VERY STIFF, MOIST, SOME CARBONATE SPECKS > 28'	
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////	30	C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////	35	C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
39.7	/////////		C		
39.7-41.7	///***///	40	C	**CLAY**, SANDY, WET, SOFT, RED BROWN, SANDIER @ 41.2-41.7	
	///***///		C		
	///***///		C		
41.7	///***///		C		
41.7-42.6	/////////		C	**CLAY**, BLACK, WET, ABUNDANT CHARCOAL, SOFT, SOME ROOT MATTER	
42.6	/////////		C		
42.6-44.2	///--*///		C	**CLAY**, LIGHT BROWN, WET, SOFT, VERY SLIGHTLY SANDY, SILTY	
	///--*///		C		
44.2	///--*///		C		
44.2-47.3	000SSS000		C	**GRAVEL**, **WATER BEARING**, CHERT, SANDSTONE, SOME LIMESTONE, MODERATELY DENSE	
	000SSS000	45	C		
	000SSS000		C		
	000SSS000		C		

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

PROJECT: Giant Refinery
Ciniza

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

FILE #: 96-133
ELEVATION: 6921.6
TOTAL DEPTH: 48.4
LOGGED BY: WHK
DATE: 8-28-96
STATIC WATER: 24.4
BORING ID: OW-30(0647)
PAGE: 3

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
44.2-47.3	OOOSSSOOO		C	**GRAVEL**, **WATER BEARING**, CHERT, SANDSTONE, SOME LIMESTONE, MODERATELY DENSE	PID=0ppm
	OOOSSSOOO		C		ALL SAMPLES
47.3	OOOSSSOOO		C		
47.3-48.4	=========		C	**SHALE**, **CHINLE FORMATION**, MOIST, HARD, RED TO WHITE (CARBONATE INDURATION)	
	=========		C		
TOTAL DEPTH				NOTE: STATIC WATER ELEVATION 33.5 @ .5 HOURS AND 24.4 @ 72 HOURS	
		50			
		55			
		60			
		65			

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

BORING OW-12

SURFACE ELEVATION: 6939 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
0									
10									
20									
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									
130									
140									
150									
160									

PENETRATION RATE MINUTES/FOOT: 3.3, 6.4, 6.4, 4.0, 15.0, 7.5, 3.8, 6.2, 6.7, 5.0, 3.0, 3.0, 4.2, 4.4, 6.3, 3.5, 3.3, 3.3, 3.4, 3.6, 3.4, 5.3, 5.0, 4.3, 5.0, 5.6, 4.8, 4.0, 5.0, 4.3, 5.0, 8.3, 5.0

SYMBOLS	DESCRIPTION
GM	TRIASSIC PERIOD
SS	CHINLE FORMATION LIGHT BROWN FINE SAND WITH GRAVEL-SIZED FRAGMENTS OF CHERT, LIMESTONE, AND PETRIFIED WOOD, SOFT, HIGHLY WEATHERED 3 FEET: SANDSTONE, LIGHT BROWN, FINE-GRAINED WITH SOME MEDIUM TO COARSE GRAINS, COMPOSED OF QUARTZ WITH MINOR CHERT AND LIMESTONE, HARD, FRESH GRADES SOFT FROM 17 FEET GRADES HARD FROM 20 TO 24 FEET
SHALE	24 FEET: SHALE, REDDISH BROWN, SILTY, SANDY, WITH GRAVEL-SIZED FRAGMENTS OF PETRIFIED WOOD AND LIMESTONE, SOFT, FRESH GRADES HARD FROM 29 FEET GRADES SOFT FROM 40 FEET GRADES HARD FROM 49 FEET
SS	61 FEET: SANDSTONE, GRAY, SILTY, FINE-TO MEDIUM-GRAINED, CALCAREOUS, HARD, FRESH
SHALE	64 FEET: SHALE, GRAY, SILTY, SANDY, SOFT, FRESH GRADES HARD FROM 90 FEET
SS	104 FEET: SANDSTONE, GRAY TO BLUISH GRAY, FINE-GRAINED, THINLY BEDDED, NONCALCAREOUS, WITH INTERBEDDED REDDISH BROWN SANDY MUDSTONE, HARD, FRESH GRADES BROWN FROM 112 FEET
SHALE	143 FEET: SHALE, GRAY, SILTY, SANDY, HARD, FRESH

BORING COMPLETED AT 145.0 FEET ON 12/15/80.
4-INCH PVC PIEZOMETER INSTALLED WITH PERFORATIONS FROM 117.8 TO 137.8 FEET.
GRAVEL PLACED FROM 105.0 TO 137.8 FEET AND BORING SEALED WITH BENTONITE AND CEMENT TO SURFACE.
GROUND WATER LEVEL MEASURED AT 47.3 FEET BELOW GROUND ON 1/5/81.

LOG OF BORINGS

DAMES & MOORE

BORING OW-13

SURFACE ELEVATION: 6914 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
0									
10									
20									
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									
130									
140									
150									
160									

PENETRATION RATE MINUTES/FOOT: 1.4, 2.6, 3.6, 4.0, 3.0, 3.0, 3.3, 4.4, 4.8, 4.6, 4.0, 4.3, 7.5, 6.7, 5.0, 6.5, 6.7, 6.0, 5.0, 6.0, 6.7, 10.0, 8.0, 6.4

SYMBOLS	DESCRIPTION
CL	TRIASSIC PERIOD CHINLE FORMATION REDDISH BROWN SILTY FINE SANDY CLAY, SOFT, HIGHLY WEATHERED GRADES WITH GRAVEL FROM 3 TO 6 FEET
SHALE	8 FEET: SHALE, REDDISH BROWN, SILTY WITH SOME FINE SAND, SOFT, FRESH GRADES WITH THIN LIMESTONE INTERBEDS FROM 26 TO 32 FEET GRADES GRAY AND HARD FROM 40 FEET GRADES REDDISH BROWN FROM 55 FEET
SS/MS	70 FEET: SANDSTONE, WHITE TO GRAY, FINE-GRAINED, INTERBEDDED WITH REDDISH BROWN SANDY MUDSTONE, THIN BEDDED, HARD, FRESH
SS	79 FEET: SANDSTONE, LIGHT BROWN, FINE-GRAINED WITH SOME MEDIUM TO COARSE GRAINS, SLIGHTLY CALCAREOUS, COMPOSED OF QUARTZ WITH MINOR LIMESTONE, HARD, FRESH
SHALE	104 FEET: SHALE, REDDISH BROWN, SANDY, WITH OCCASIONAL THIN INTERBEDS OF SANDSTONE AND LIMESTONE, HARD, FRESH

BORING COMPLETED AT 108.0 FEET ON 12/10/80.
BORING ALLOWED TO CAVE FROM 98.2 TO 104.0 FEET.
4-INCH PVC PIEZOMETER INSTALLED WITH PERFORATIONS FROM 78.2 TO 98.2 FEET.
GRAVEL PLACED FROM 74.0 TO 98.2 FEET AND BORING SEALED WITH BENTONITE AND CEMENT TO SURFACE.
GROUND WATER LEVEL MEASURED AT 23.2 FEET BELOW GROUND ON 1/5/81.

LOG OF BORINGS

DAMES & MOORE

WELL INSTALLATION

RPS

Well No.: MKTF-01
Start Date: 11/14/2013
Finish Date: 11/14/2013

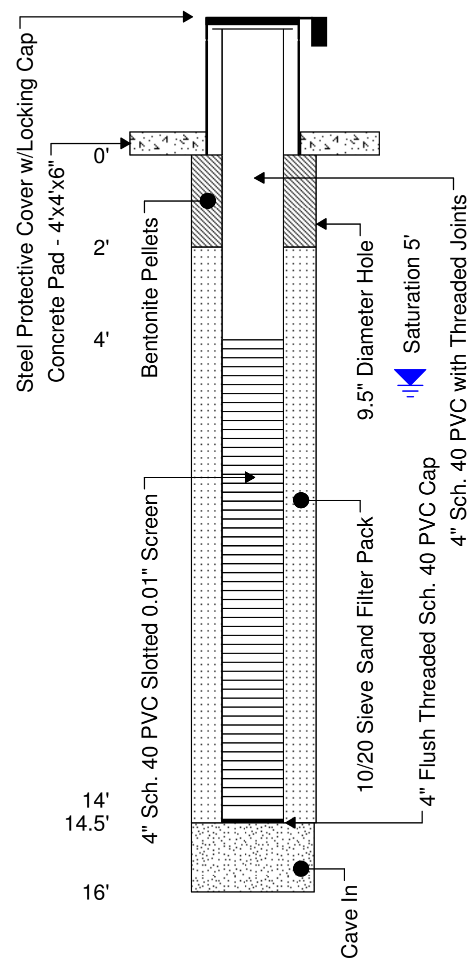
Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.346' W 108°25.782'; Boring ID - HA1

Total Depth: 16' bgl
Ground Water: Saturated @ 5' bgl
Elev., TOC (ft. msl): 6920.67
Elev., PAD (ft. msl): 6918.28
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,864.41 **E** 2,545,561.73

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
0					Ground Surface
0–5			CL	100	**Silty Clay (CL)** Low plasticity, soft, damp, reddish brown to brown, no odor
5–16		5'	CL/ML	100	**Silty Clay/Clayey Silt (CL/ML)** Low plasticity, very soft, moist to saturated, brown grading to black, gravelly, bio odor, no phase-separated hydrocarbon
16					Total Depth = 16' BGL

Depth scale: -3, -1, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19

Completion Results



WELL INSTALLATION

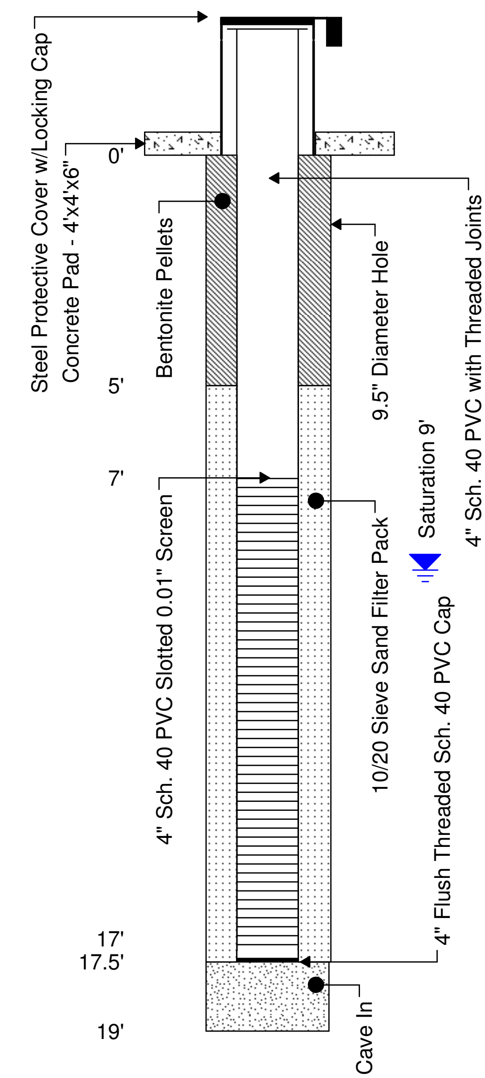
Well No.: MKTF-02
Start Date: 11/14/2013
Finish Date: 11/14/2013

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.360' W 108°25.789'; Boring ID HA3

Total Depth: 19' bgl
Ground Water: Saturated @ 9' bgl
Elev., TOC (ft. msl): 6917.45
Elev., PAD (ft. msl): 6915.00
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,946.93 **E** 2,545,530.46

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
0					Ground Surface
0–5	24.6 (at 3), 20.1 (at 5)			100	**Silty Clay (CL)** Low plasticity, firm, damp, brown-reddish brown, no odor
5–8	400 (at 6.5)			100	**Silty Clay (CL)** Similar to above, odor at 6' bgl with black discoloration
8–9	933 (at 8)	9'		100	**Sandy Clay (CL)** Low plasticity, soft, moist to saturated at 9' bgl, hydrocarbon odor, no phase-separated hydrocarbon
9–19	800 (at 9)			100	**Sandy Clay/Clayey Sand (SC/CL)** Fine grain, compact, saturated, dark brown, hydrocarbon odor, no phase-separated hydrocarbon
19					Total Depth = 19' BGL

Completion Results



RPS
1250 S. Capital of Texas Hwy., Bldg. 3, Suite 200
Austin, Texas 78746

512/347-7588
512/347-8243

WELL INSTALLATION

RPS

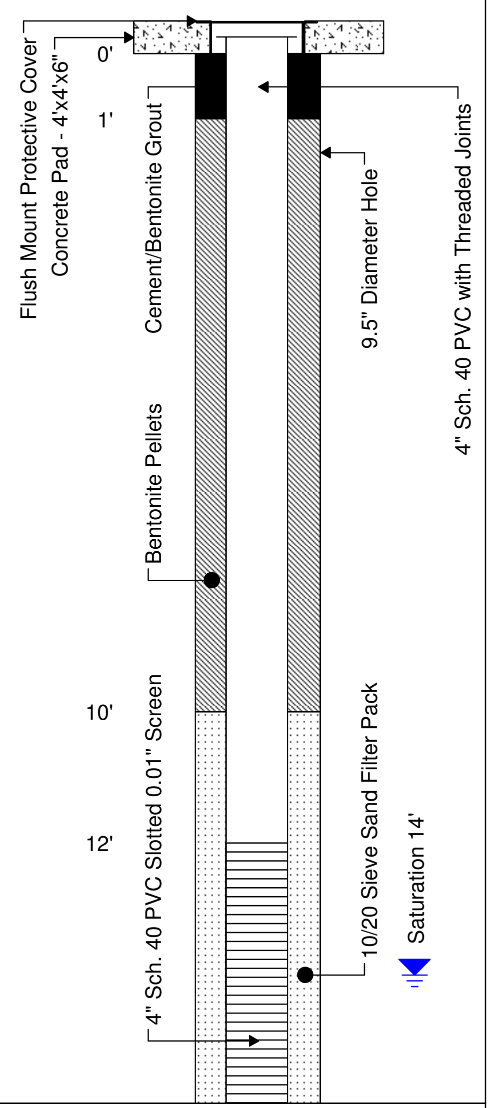
Well No.: MKTF-04
Start Date: 11/12/2013
Finish Date: 11/12/2013

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.310' W 108°25.742'; Boring ID SB03

Total Depth: 24' bgl
Ground Water: Saturated @ 14' bgl
Elev., TOC (ft. msl): 6933.57
Elev., PAD (ft. msl): 6933.90
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,649.46 **E** 2,545,752.83

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-1					Ground Surface
1	10.2			90	**Fill (Silt/Gravel)** Low plasticity, very dense, dry, light brown, no odor
3	11.7			80	**Fill (Silt/Gravel)** Similar to above, black, dense at base, no odor
5	16			90	**Silty Clay (CL)** Low plasticity, stiff, damp, reddish brown, no odor, calcareous
7	26			90	**Gravelly Sandy Clay (CL)** Low plasticity, loose to firm, damp, brown, no odor
9	708			70	**Silty Clay (CL)** Low plasticity, very soft, damp, reddish brown, hydrocarbon odor
11	369			80	**Clay (CH)** High plasticity, firm, damp, reddish brown, hydrocarbon odor
13	660	14'		90	**Sandy Clay/Clayey Sand (SC/CL)** Low plasticity, fine grain, soft, damp, reddish brown, hydrocarbon odor
15	85			90	**Sandy Clay (SC)** Similar to above, saturated sand seams, hydrocarbon odor, brown

Completion Results



RPS

WELL INSTALLATION

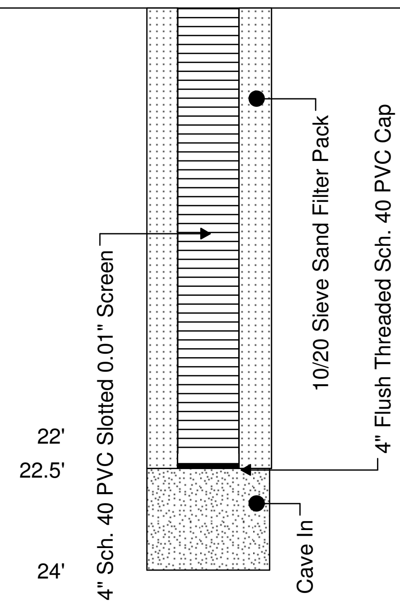
Well No.: MKTF-04
Start Date: 11/12/2013
Finish Date: 11/12/2013

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.310' W 108°25.742'; Boring ID SB03

Total Depth: 24' bgl
Ground Water: Saturated @ 14' bgl
Elev., TOC (ft. msl): 6933.57
Elev., PAD (ft. msl): 6933.90
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,649.46 **E** 2,545,752.83

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
17	64			70	**Sandy Clay (SC)** Similar to above, moist to saturated, hydrocarbon odor, brown
19	33				**Sandy Clay (SC)** Low plasticity, fine grain, soft, moist to saturated, light reddish brown, hydrocarbon odor, gravelly at base
21				90	**Silty Clay (CL)** Low plasticity, stiff, damp, light reddish brown grading to yellowish/greenish gray, becomes more silty at base
23					
24					Total Depth = 24' BGL
25					
27					
29					
31					

Completion Results



WELL INSTALLATION

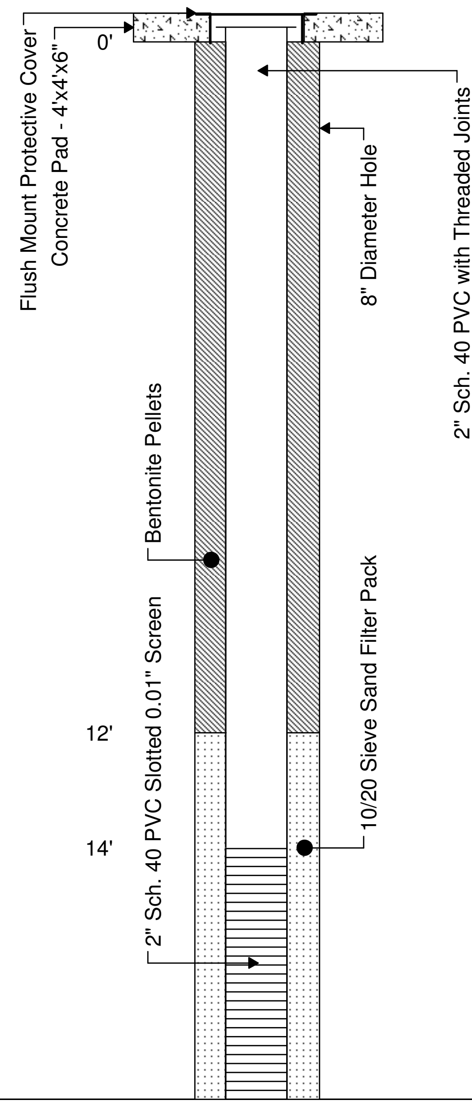
Well No.: MKTF-17
Start Date: 11/14/2013 13:00
Finish Date: 11/14/2013 15:00

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.248' W 108°25.724'; Boring ID - SB33

Total Depth: 25' bgl
Ground Water: Saturated @ 20' bgl
Elev., TOC (ft. msl): 6945.76
Elev., PAD (ft. msl): 6945.79
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,268.93 **E** 2,545,850.73

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-1					Ground Surface
1				10	**Fill (Asphalt/Base/Clay)** Low plasticity, soft, damp, brown
3	150			10	**Fill (Clay)** Similar to above
5	157			90	**Fill (Sand/Gravel/Clay)** Moist to very moist, reddish brown, no odor
7	92.1			20	**Fill (Sand/Gravel/Clay)** Similar to above, saturated, odor
9	65.9			90	**Clay (CH)** High plasticity, firm, damp, faint odor, brown
11	17			60	**Clay (CH)** Similar to above
13	55			70	**Clay (CH)** High plasticity, soft, damp, dark brown and black, odor
15	17.5			60	**Clay (CH)** Similar to above, faint odor
17	11.3			10	**Clay (CH)** Similar to above, trace fine grain sand

Completion Results



WELL INSTALLATION

Well No.: MKTF-17
Start Date: 11/14/2013 13:00
Finish Date: 11/14/2013 15:00

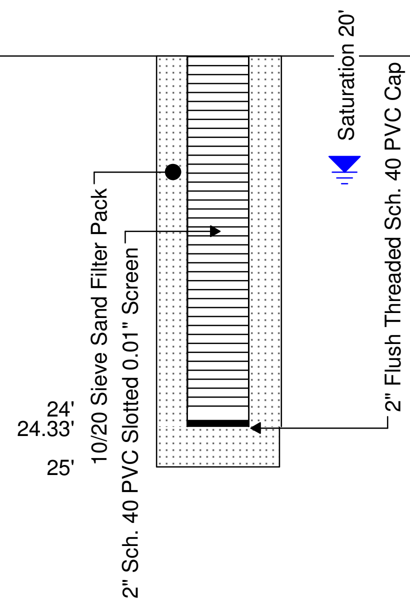
Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.248' W 108°25.724'; Boring ID - SB33

Total Depth: 25' bgl
Ground Water: Saturated @ 20' bgl
Elev., TOC (ft. msl): 6945.76
Elev., PAD (ft. msl): 6945.79
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,268.93 **E** 2,545,850.73

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
19–20	17.2			10	**Clay (CH)** High plasticity, soft, damp, brown
20–22	17.5	20'		70	**Sandy Clay (CH)** Moderate plasticity, soft, very moist to saturated in sand seams
22–23				80	**Silty Clayey Gravel (GM)** Compact to loose, medium grain sand to 1/4" gravel - angular, saturated, brown
23–25				90	**Clay (CH)** Moderate plasticity, firm to stiff, damp, greenish gray
					Total Depth = 25' BGL

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Completion Results



WELL INSTALLATION

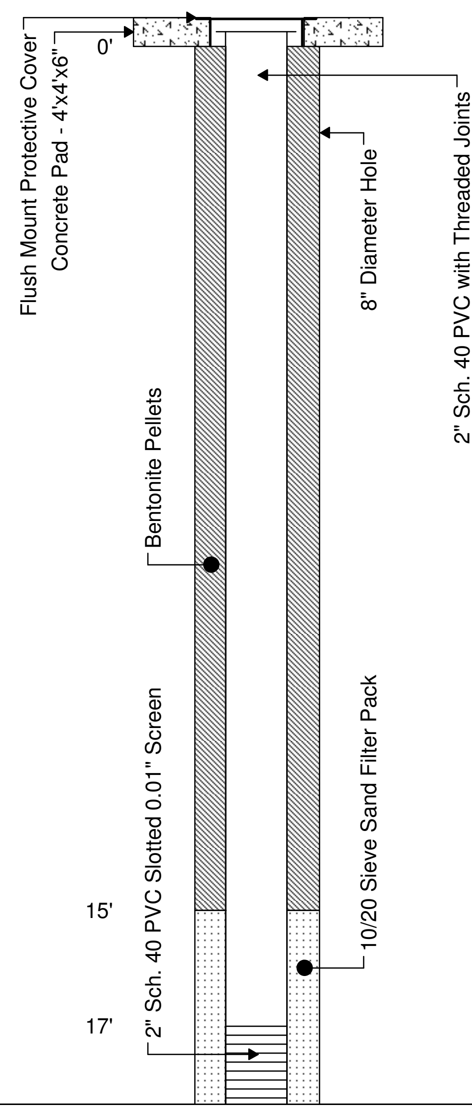
Well No.: MKTF-18
Start Date: 11/15/2013 10:00
Finish Date: 11/15/2013 15:00

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.288' W 108°25.692'; Boring ID - SB34

Total Depth: 27' bgl
Ground Water: Saturated @ 23' bgl
Elev., TOC (ft. msl): 6950.65
Elev., PAD (ft. msl): 6950.97
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,497.53 **E** 2,546,006.29

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-1					Ground Surface
1				--	**Fill (Gravel and Silty Clay)**
3	1009			20	**Fill (Gravel and Silty Clay)** Similar to above, strong hydrocarbon odor, damp
5	693			60	**Fill (Gravel and Silty Clay)** Similar to above
7	1108			70	**Fill (Silty Clay)** Low plasticity, firm, damp, brown, gravel present, strong hydrocarbon odor
9	901			90	**Fill (Clay/Sand/Gravel)** Similar to above, saturated, odor, sheen observed
11	803			60	**Clay (CH)** High plasticity, stiff, damp, brown, hydrocarbon odor
13	254			70	**Clay (CH)** Similar to above, very fine grain, sand in partings
15	200			30	**Clay (CH)** Similar to above
17				--	No recovery

Completion Results



WELL INSTALLATION

Well No.: MKTF-18
Start Date: 11/15/2013 10:00
Finish Date: 11/15/2013 15:00

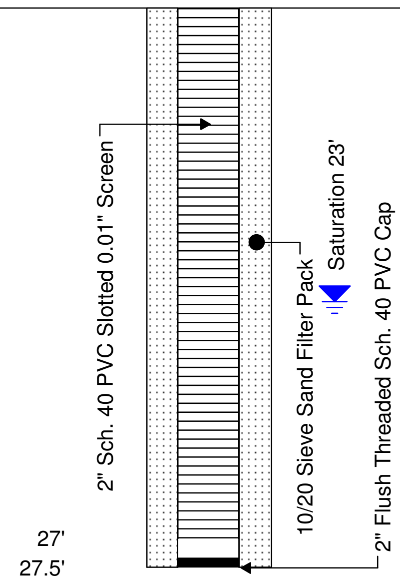
Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.288' W 108°25.692'; Boring ID - SB34

Total Depth: 27' bgl
Ground Water: Saturated @ 23' bgl
Elev., TOC (ft. msl): 6950.65
Elev., PAD (ft. msl): 6950.97
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,497.53 **E** 2,546,006.29

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
18–20	112		CH	30	**Clay (CH)** High plasticity, firm, damp, brown, faint odor
20–22	55		CH	20	**Clay (CH)** Similar to above
22–24	323	23'	CH / SC/CL	80	**Clay (CH)** Similar to above **Sandy Clay/Clayey Sand (SC/CL)** Fine grain, compact, very moist to saturated, brown, hydrocarbon present
24–26			SC	90	**Clayey Sand (SC)** Similar to above, saturated
26–27			CL		**Sandy Clay (CL)** Low plasticity, firm, damp, hydrocarbon odor, greenish gray

Total Depth = 27' BGL

Completion Results



Appendix B

Investigation Derived Waste Management Plan

Investigation Derived Waste (IDW) Management Plan

All IDW will be properly characterized and disposed of in accordance with all federal, State, and local rules and regulations for storage, labeling, handling, transport, and disposal of waste. The IDW may be characterized for disposal based on the known or suspected contaminants potentially present in the waste.

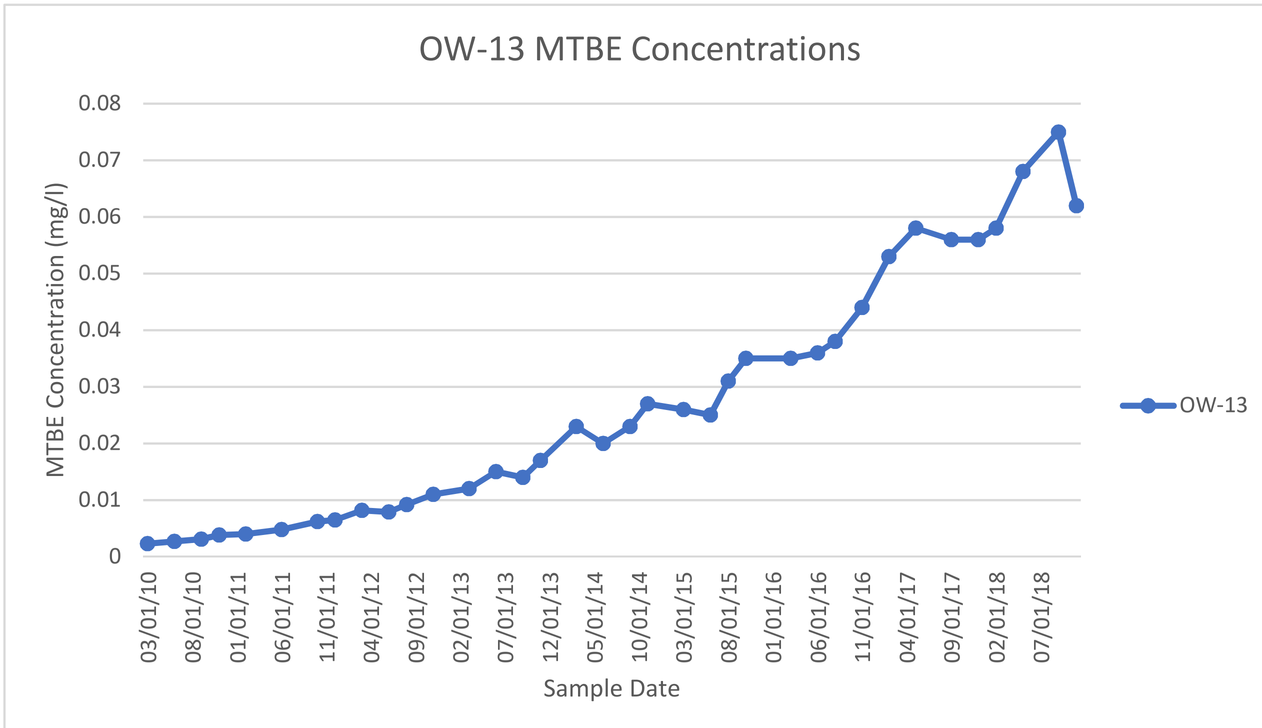
A dedicated decontamination area will be setup prior to any sample collection activities. The decontamination pad will be constructed so as to capture and contain all decontamination fluids (e.g., wash water and rinse water) and foreign materials washed off the sampling equipment. The fluids will be pumped directly into suitable storage containers (e.g., labeled 55-gallon drums), which will be located at satellite accumulation areas until the fluids are disposed in the refinery wastewater treatment system upstream of the API separator. The solids captured in the decontamination pad will be shoveled into 55-gallon drums and stored at the designated satellite accumulation area pending proper waste characterization for off-site disposal.

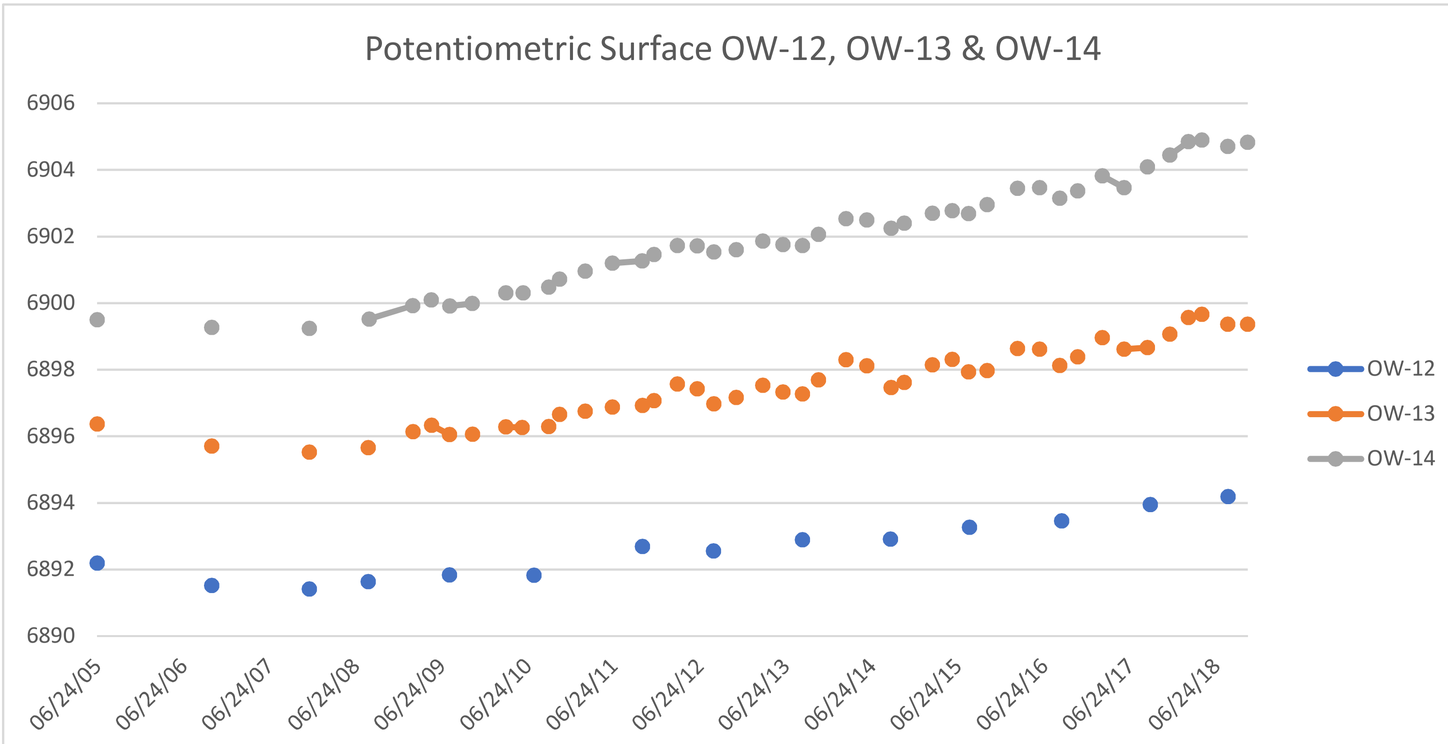
Drill cuttings generated during installation of soil borings will be placed directly into 55-gallon drums and staged in the satellite accumulation area pending results of the waste characterization sampling. The portion of soil cores, which are not retained for analytical testing, will be placed into the same 55-gallon drums used to store the associated drill cuttings.

The solids (e.g., drill cuttings and used soil cores) will be characterized by testing to determine if there are any hazardous characteristics in accordance with 40 Code of Federal Regulations (CFR) Part 261. This includes tests for ignitability, corrosivity, reactivity, and toxicity. If the materials are not characteristically hazardous, then further testing will be performed pursuant to the requirements of the facility to which the materials will be transported. Depending upon the results of analyses for individual investigation soil samples, additional analyses may include VOCs, TPH and polynuclear aromatic hydrocarbons (PAHs).

Appendix C

OW-13 Data Graphs


OW-13 MTBE Concentrations
MTBE Concentration (mg/l)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
03/01/10
08/01/10
01/01/11
06/01/11
11/01/11
04/01/12
09/01/12
02/01/13
07/01/13
12/01/13
05/01/14
10/01/14
03/01/15
08/01/15
01/01/16
06/01/16
11/01/16
04/01/17
09/01/17
02/01/18
07/01/18
Sample Date
OW-13



Potentiometric Surface OW-12, OW-13 & OW-14
6906
6904
6902
6900
6898
6896
6894
6892
6890
06/24/05
06/24/06
06/24/07
06/24/08
06/24/09
06/24/10
06/24/11
06/24/12
06/24/13
06/24/14
06/24/15
06/24/16
06/24/17
06/24/18
OW-12
OW-13
OW-14

Appendix D
Well Development and Purging Procedures

Well Development

All monitoring wells will be developed to create an effective filter pack around the well screen, correct damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. Newly installed monitoring wells will not be developed for at least 48 hours after the surface pad and outer protective casing are installed. This will allow sufficient time for the well materials to cure before the development procedures are initiated. A new monitoring well will be developed until the column of water in the well is free of visible sediment, and the pH, temperature, turbidity, and specific conductivity have stabilized. In most cases, the above requirements can be satisfied. However, in some cases, the pH, temperature, and specific conductivity may stabilize but the water remains turbid. In this case, continuous flushing may be necessary to complete the well development. If the well is pumped dry, the water level will be allowed to sufficiently recover before the next development period is initiated. The common methods used for developing wells include:

(1) pumping and over-pumping;

(2) backwashing;

(3) surging (with a surge block);

(4) bailing;

(5) jetting; and

(6) airlift pumping.

These development procedures will be used, either individually or in combination, to achieve the most effective well development. However, the most favorable well development methods include pumping, over-pumping, bailing, surging, or a combination of these methods. Well development methods and equipment that alter the chemical composition of the groundwater will not be used.

Development methods that involve adding water or other fluids to the well or borehole, or that use air to accomplish well development will be avoided, if possible. Approval will be obtained from the NMED prior to introducing air, water, or other fluids into the well for the purpose of well development. If water is introduced to a borehole during well drilling and completion, then the same or greater volume of water will be removed from the well during development. In addition, the volume of water withdrawn from a well during development will be recorded, and best efforts will be used to avoid pumping wells dry during development activities.

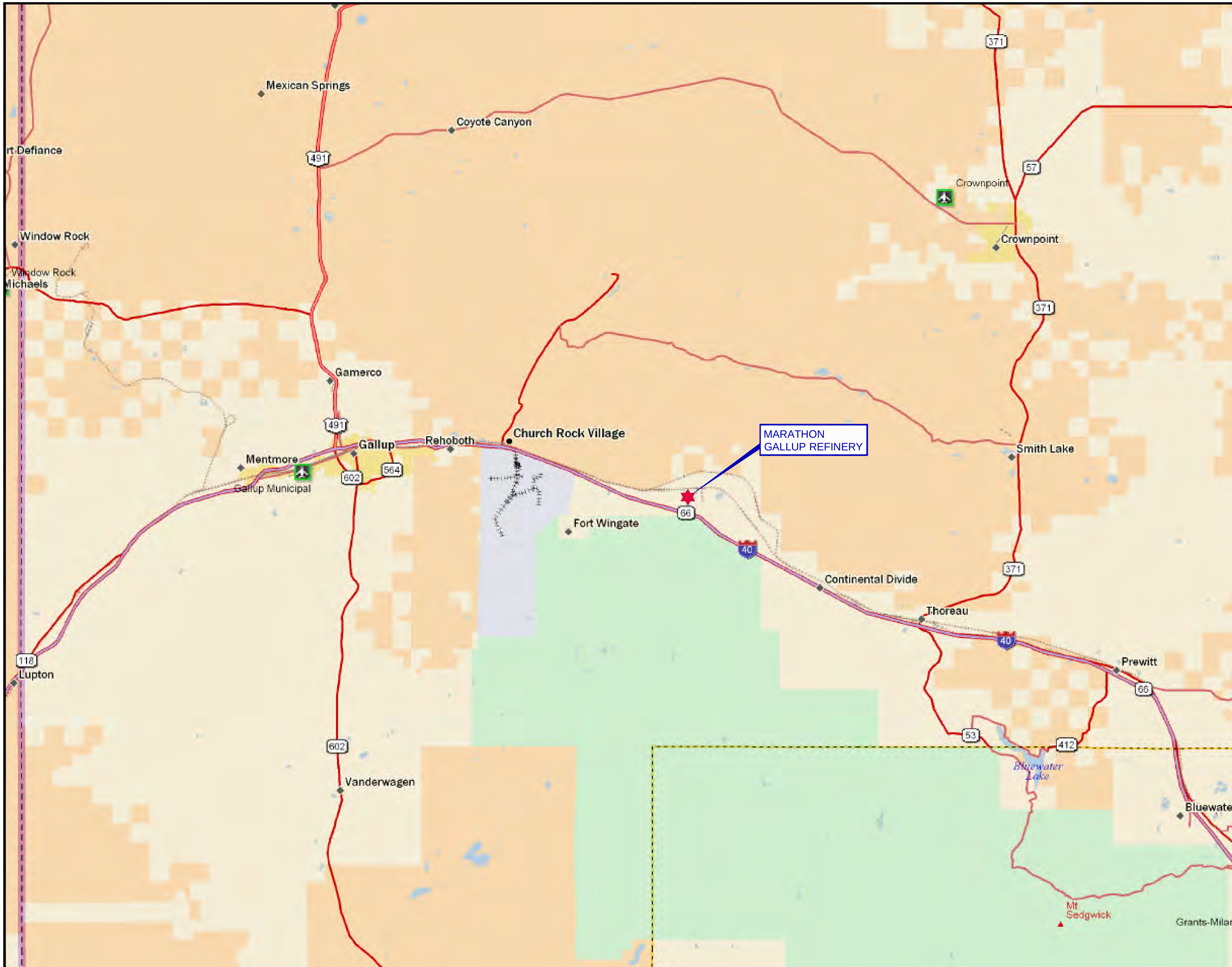
Well Purging

All zones in each monitoring well will be purged by removing groundwater prior to sampling and in order to ensure that formation water is being sampled. Purge volumes will be determined by monitoring, at a minimum, groundwater pH, specific conductance, dissolved oxygen concentrations, turbidity, redox potential, and temperature during purging of volumes and at measurement intervals of not less than ¼ the pre-purge well volume. The groundwater quality parameters and fluid levels will be measured using a YSI Professional Plus Multiparameter Meter, YSI Water Quality Sonde, Hach Portable Turbidimeter, and a Geotech Interface Meter. The volume of groundwater purged, the instruments used, and the readings obtained at each interval will be recorded on the field monitoring log. In general, water samples may be obtained from the well after the measured parameters of the purge water have stabilized to within ten percent for three consecutive measurements. Well purging

may also be conducted in accordance with the NMED's Position Paper "Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring" (October 30, 2001). If necessary, a written request for a variance from the described methods of well purging for individual wells may be submitted to NMED no later than 90 days prior to scheduled sampling activities.

Figures

Map Source: DeLorme Street Atlas USA 2007 Plus.



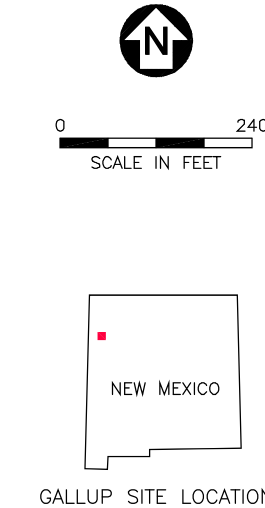
MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 03/24/19	FILE: Mathon–dB206

FIGURE 1
SITE LOCATION MAP
GALLUP REFINERY

DiSorbo Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 03/18/2016.



LEGEND

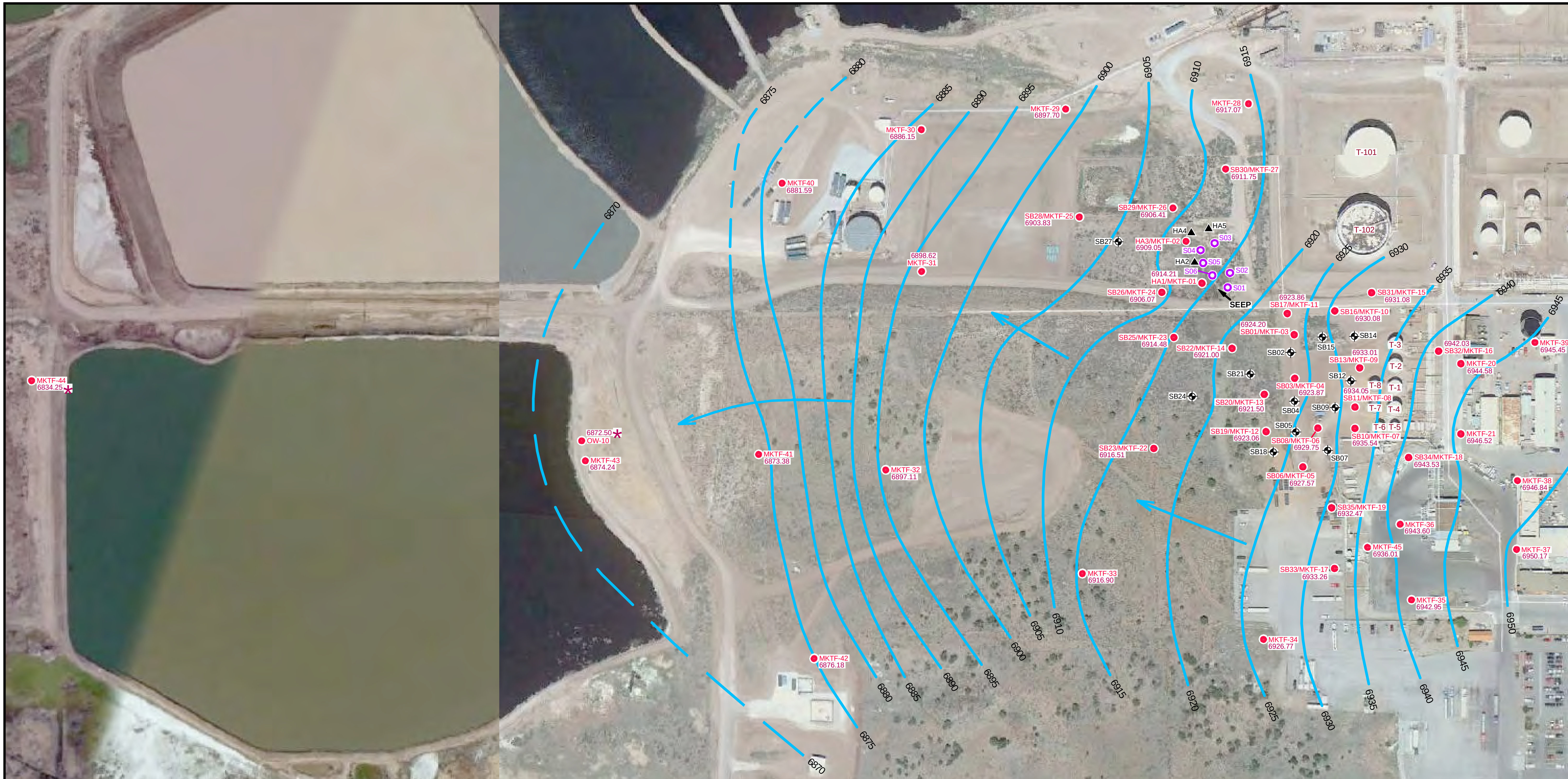
NDD-1	SOIL BORING LOCATION AND IDENTIFICATION NUMBER
NDD-1	TEMPORARY MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
OW-14	ALLUVIUM / CHINLE GP MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
OW-13	SONSELA MONITORING WELL LOCATION AND IDENTIFICATION NUMBER
6900	CONTOUR OF POTENTIOMETRIC SURFACE
6900.69	POTENTIOMETRIC SURFACE AUGUST 2018
*	NOT USED TO CONTOUR

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.:Marathon | DATE: 06/11/19 | FILE:Mathon–dB218

FIGURE 2
CHINLE / ALLUVIAL INTERFACE
POTENTIOMETRIC MAP
NORTH

DiSorbo
Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759



Aerial Map Source: Google Map, 01/05/2014.

SCALE IN FEET

LEGEND

SB01 — TEMPORARY WELL LOCATION (PLUGGED)

HA1 — HAND AUGER LOCATION (PLUGGED)

S01 — TEMPORARY SUMP

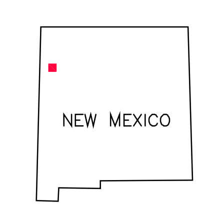
MONITORING WELL LOCATION (PERMANENT WELL)

6930 — POTENTIOMETRIC CONTOUR (FT) (5 FT INTERVAL)

GROUNDWATER FLOW DIRECTION

6876.18 — POTENTIOMETRIC SURFACE MEASURED RELATIVE TO MEAN SEA LEVEL (AUGUST 2018)

* — MEASUREMENT NOT USED IN CONTOURING



QUADRANGLE LOCATION

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 06/11/19	FILE: Mathon–dB219

FIGURE 2A
CHINLE / ALLUVIAL INTERFACE
POTENTIOMETRIC MAP
WEST

DiSorbo Environmental Consulting Firm
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 03/18/2016.

0 240
SCALE IN FEET

NEW MEXICO

GALLUP SITE LOCATION

LEGEND

PROPOSED WELL LOCATION

NDD-1 SOIL BORING LOCATION AND IDENTIFICATION NUMBER

NDD-1 TEMPORARY MONITORING WELL LOCATION AND IDENTIFICATION NUMBER

OW-14 ALLUVIUM / CHINLE GP MONITORING WELL LOCATION AND IDENTIFICATION NUMBER

OW-13 SONSELA MONITORING WELL LOCATION AND IDENTIFICATION NUMBER

MARATHON

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon | DATE: 06/12/19 | FILE: Mathon–dB220

FIGURE 3
PROPOSED MONITORING WELL LOCATIONS

DiSorbo
Environmental Consulting Firm

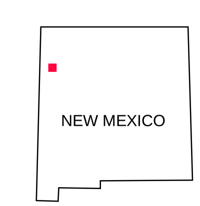
8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Aerial Map Source: Google Map, 01/05/2014.

0 220
SCALE IN FEET

LEGEND

- NEW WELL LOCATION
- SB01 TEMPORARY WELL LOCATION (PLUGGED)
- S01 TEMPORARY SUMP
- MONITORING WELL LOCATION (PERMANENT WELL)



QUADRANGLE LOCATION

MARATHON PETROLEUM COMPANY
GALLUP REFINERY

PROJ. NO.: Marathon	DATE: 06/12/19	FILE: Mathon–dB202

FIGURE 4
MKTF WELL LOCATIONS

DiSorbo
Environmental Consulting Firm

8501 N. MoPac Expy.
Suite 300
Austin, Texas 78759

Appendix A

Boring Logs

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

PROJECT: Giant Refinery
Ciniza

FILE #:	96-133
ELEVATION:	6921.6
TOTAL DEPTH:	48.4
LOGGED BY:	WHK
DATE:	8-28-96
STATIC WATER:	24.4
BORING ID:	OW-30(0647)
PAGE:	1

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
0.0-6.5	///---///	5.0	C	**CLAY**, SILTY, DRY, RED BROWN, FIRM, SOME ROOT MATTER	PID-0ppm ALL SAMPLES
6.5-13.1	/////////	10	C	**CLAY**, RED BROWN, MOIST, STIFF, SOME ROOT MATTER, SOME CARBONATE NODULES < 1 cm	
13.1-13.8	///***///		C	**CLAY**, SANDY, CARBONATE NODULES APPROXIMATELY 3mm, STIFF, DAMP, RED BROWN	
13.8-16.5	///---///	15	C	**CLAY**, SILTY, DAMP-MOIST, RED BROWN, STIFF	
16.5-22.5	/////////	20	C	**CLAY**, VERY STIFF, RED BROWN, MOIST	
22.5-23.2	/////////		C	**CLAY**, SILTY, STIFF, MOIST, BROWN	

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

PROJECT: Giant Refinery Ciniza

FILE #:	96-133
ELEVATION:	6921.6
TOTAL DEPTH:	48.4
LOGGED BY:	WHK
DATE:	8-28-96
STATIC WATER:	24.4
BORING ID:	OW-30(0647)
PAGE:	2

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
23.2-23.8	***---***		C	**SAND**, FINE, SILTY, BROWN, DAMP, MODERATELY DENSE	PID=0ppm
23.8	***---***		C		ALL SAMPLES
23.8-24.3	///---///		C	**CLAY**, SILTY, BROWN, VERY STIFF, MOIST	
24.3-39.7	/////////	25	C	**CLAY**, BROWM, VERY STIFF, MOIST, SOME CARBONATE SPECKS > 28'	
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////	30	C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////	35	C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
	/////////		C		
39.7	/////////		C		
39.7-41.7	///***///	40	C	**CLAY**, SANDY, WET, SOFT, RED BROWN, SANDIER @ 41.2-41.7	
	///***///		C		
	///***///		C		
41.7	///***///		C		
41.7-42.6	/////////		C	**CLAY**, BLACK, WET, ABUNDANT CHARCOAL, SOFT, SOME ROOT MATTER	
42.6	/////////		C		
42.6-44.2	///--*///		C	**CLAY**, LIGHT BROWN, WET, SOFT, VERY SLIGHTLY SANDY, SILTY	
	///--*///		C		
44.2	///--*///		C		
44.2-47.3	000SSS000		C	**GRAVEL**, **WATER BEARING**, CHERT, SANDSTONE, SOME LIMESTONE, MODERATELY DENSE	
	000SSS000	45	C		
	000SSS000		C		
	000SSS000		C		

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

PRECISION ENGINEERING, INC.

LOG OF TEST BORINGS

PROJECT: Giant Refinery Ciniza

FILE #:	96-133
ELEVATION:	6921.6
TOTAL DEPTH:	48.4
LOGGED BY:	WHK
DATE:	8-28-96
STATIC WATER:	24.4
BORING ID:	OW-30(0647)
PAGE:	3

DEPTH	PLOT	SCALE	SAMPLE	MATERIAL CHARACTERISTICS (MOISTURE,CONDITION,COLOR,GRAINSIZE,ETC.)	PID (ppm)
44.2-47.3	000SSS000		C	**GRAVEL**, **WATER BEARING**, CHERT, SANDSTONE, SOME LIMESTONE, MODERATELY DENSE	PID=0ppm
	000SSS000		C		ALL SAMPLES
47.3	000SSS000		C		
47.3-48.4	=========		C	**SHALE**, **CHINLE FORMATION**, MOIST, HARD, RED TO WHITE (CARBONATE INDURATION)	
	=========		C		
TOTAL DEPTH				NOTE: STATIC WATER ELEVATION 33.5 @ .5 HOURS AND 24.4 @ 72 HOURS	
		50			
		55			
		60			
		65			

LOGGED BY: WHK

SIZE AND TYPE OF BORING: 4 1/4" ID Hollow Stemmed Auger

BORING OW-12

SURFACE ELEVATION: 6939 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
0									
10									
20									
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									
130									
140									
150									
160									

PENETRATION RATE MINUTES/FOOT: 3.3, 6.4, 6.4, 4.0, 15.0, 7.5, 3.8, 6.2, 6.7, 5.0, 3.0, 3.0, 4.2, 4.4, 6.3, 3.5, 3.3, 3.3, 3.4, 3.6, 3.4, 5.3, 5.0, 4.3, 5.0, 5.6, 4.8, 4.0, 5.0, 4.3, 5.0, 8.3, 5.0

SYMBOLS	DESCRIPTION
GM	TRIASSIC PERIOD
SS	CHINLE FORMATION LIGHT BROWN FINE SAND WITH GRAVEL-SIZED FRAGMENTS OF CHERT, LIMESTONE, AND PETRIFIED WOOD, SOFT, HIGHLY WEATHERED 3 FEET: SANDSTONE, LIGHT BROWN, FINE-GRAINED WITH SOME MEDIUM TO COARSE GRAINS, COMPOSED OF QUARTZ WITH MINOR CHERT AND LIMESTONE, HARD, FRESH GRADES SOFT FROM 17 FEET GRADES HARD FROM 20 TO 24 FEET
SHALE	24 FEET: SHALE, REDDISH BROWN, SILTY, SANDY, WITH GRAVEL-SIZED FRAGMENTS OF PETRIFIED WOOD AND LIMESTONE, SOFT, FRESH GRADES HARD FROM 29 FEET GRADES SOFT FROM 40 FEET GRADES HARD FROM 49 FEET
SS	61 FEET: SANDSTONE, GRAY, SILTY, FINE-TO MEDIUM-GRAINED, CALCAREOUS, HARD, FRESH
SHALE	64 FEET: SHALE, GRAY, SILTY, SANDY, SOFT, FRESH GRADES HARD FROM 90 FEET
SS	104 FEET: SANDSTONE, GRAY TO BLUISH GRAY, FINE-GRAINED, THINLY BEDDED, NONCALCAREOUS, WITH INTERBEDDED REDDISH BROWN SANDY MUDSTONE, HARD, FRESH GRADES BROWN FROM 112 FEET
SHALE	143 FEET: SHALE, GRAY, SILTY, SANDY, HARD, FRESH

BORING COMPLETED AT 145.0 FEET ON 12/15/80.
4-INCH PVC PIEZOMETER INSTALLED WITH PERFORATIONS FROM 117.8 TO 137.8 FEET.
GRAVEL PLACED FROM 105.0 TO 137.8 FEET AND BORING SEALED WITH BENTONITE AND CEMENT TO SURFACE.
GROUND WATER LEVEL MEASURED AT 47.3 FEET BELOW GROUND ON 1/5/81.

LOG OF BORINGS

DAMES & MOORE

BORING OW-13

SURFACE ELEVATION: 6914 FEET

LABORATORY TEST DATA

DEPTH IN FEET	TESTS REPORTED ELSEWHERE	ATTERBERG LIMITS: LIQUID LIMIT (%)	ATTERBERG LIMITS: PLASTICITY INDEX (%)	STRENGTH TEST DATA: TYPE OF TEST	STRENGTH TEST DATA: NORMAL OR CONFINING PRESSURE (PSF)	STRENGTH TEST DATA: SHEAR STRENGTH (PSF)	STRENGTH TEST DATA: DEVIATOR STRESS (PSF)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)
0									
10									
20									
30									
40									
50									
60									
70									
80									
90									
100									
110									
120									
130									
140									
150									
160									

PENETRATION RATE MINUTES/FOOT: 1.4, 2.6, 3.6, 4.0, 3.0, 3.0, 3.3, 4.4, 4.8, 4.6, 4.0, 4.3, 7.5, 6.7, 5.0, 6.5, 6.7, 6.0, 5.0, 6.0, 6.7, 10.0, 8.0, 6.4

SYMBOLS	DESCRIPTION
CL	TRIASSIC PERIOD CHINLE FORMATION REDDISH BROWN SILTY FINE SANDY CLAY, SOFT, HIGHLY WEATHERED GRADES WITH GRAVEL FROM 3 TO 6 FEET
SHALE	8 FEET: SHALE, REDDISH BROWN, SILTY WITH SOME FINE SAND, SOFT, FRESH GRADES WITH THIN LIMESTONE INTERBEDS FROM 26 TO 32 FEET GRADES GRAY AND HARD FROM 40 FEET GRADES REDDISH BROWN FROM 55 FEET
SS/MS	70 FEET: SANDSTONE, WHITE TO GRAY, FINE-GRAINED, INTERBEDDED WITH REDDISH BROWN SANDY MUDSTONE, THIN BEDDED, HARD, FRESH
SS	79 FEET: SANDSTONE, LIGHT BROWN, FINE-GRAINED WITH SOME MEDIUM TO COARSE GRAINS, SLIGHTLY CALCAREOUS, COMPOSED OF QUARTZ WITH MINOR LIMESTONE, HARD, FRESH
SHALE	104 FEET: SHALE, REDDISH BROWN, SANDY, WITH OCCASIONAL THIN INTERBEDS OF SANDSTONE AND LIMESTONE, HARD, FRESH

BORING COMPLETED AT 108.0 FEET ON 12/10/80.
BORING ALLOWED TO CAVE FROM 98.2 TO 104.0 FEET.
4-INCH PVC PIEZOMETER INSTALLED WITH PERFORATIONS FROM 78.2 TO 98.2 FEET.
GRAVEL PLACED FROM 74.0 TO 98.2 FEET AND BORING SEALED WITH BENTONITE AND CEMENT TO SURFACE.
GROUND WATER LEVEL MEASURED AT 23.2 FEET BELOW GROUND ON 1/5/81.

LOG OF BORINGS

WELL INSTALLATION

Well No.: MKTF-01
Start Date: 11/14/2013
Finish Date: 11/14/2013

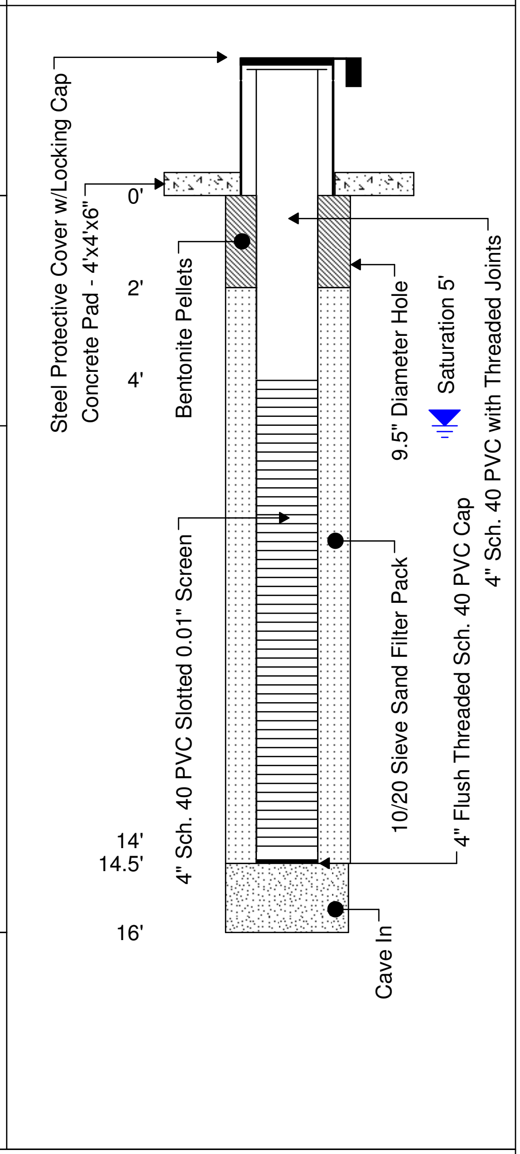
Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.346' W 108°25.782'; Boring ID - HA1

Total Depth: 16' bgl
Ground Water: Saturated @ 5' bgl
Elev., TOC (ft. msl): 6920.67
Elev., PAD (ft. msl): 6918.28
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,864.41 **E** 2,545,561.73

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
0					Ground Surface
0–5			CL	100	**Silty Clay (CL)** Low plasticity, soft, damp, reddish brown to brown, no odor
5–16		5'	CL/ML	100	**Silty Clay/Clayey Silt (CL/ML)** Low plasticity, very soft, moist to saturated, brown grading to black, gravelly, bio odor, no phase-separated hydrocarbon
16					Total Depth = 16' BGL

Depth scale: -3, -1, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19

Completion Results



WELL INSTALLATION

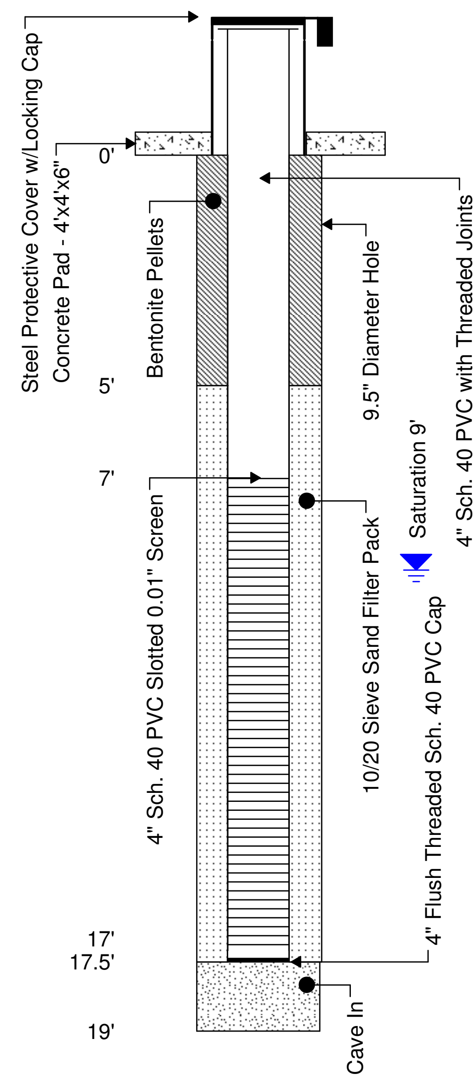
Well No.: MKTF-02
Start Date: 11/14/2013
Finish Date: 11/14/2013

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.360' W 108°25.789'; Boring ID HA3

Total Depth: 19' bgl
Ground Water: Saturated @ 9' bgl
Elev., TOC (ft. msl): 6917.45
Elev., PAD (ft. msl): 6915.00
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,946.93 **E** 2,545,530.46

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
0					Ground Surface
0–5	24.6 (3); 20.1 (5)		CL	100	**Silty Clay (CL)** Low plasticity, firm, damp, brown-reddish brown, no odor
5–8	400 (6.5)		CL	100	**Silty Clay (CL)** Similar to above, odor at 6' bgl with black discoloration
8–9	933 (8); 800 (9)	9'	CL	100	**Sandy Clay (CL)** Low plasticity, soft, moist to saturated at 9' bgl, hydrocarbon odor, no phase-separated hydrocarbon
9–19		Saturated	SC/CL	100	**Sandy Clay/Clayey Sand (SC/CL)** Fine grain, compact, saturated, dark brown, hydrocarbon odor, no phase-separated hydrocarbon
19					Total Depth = 19' BGL

Completion Results



RPS
1250 S. Capital of Texas Hwy., Bldg. 3, Suite 200
Austin, Texas 78746
512/347-7588
512/347-8243

WELL INSTALLATION

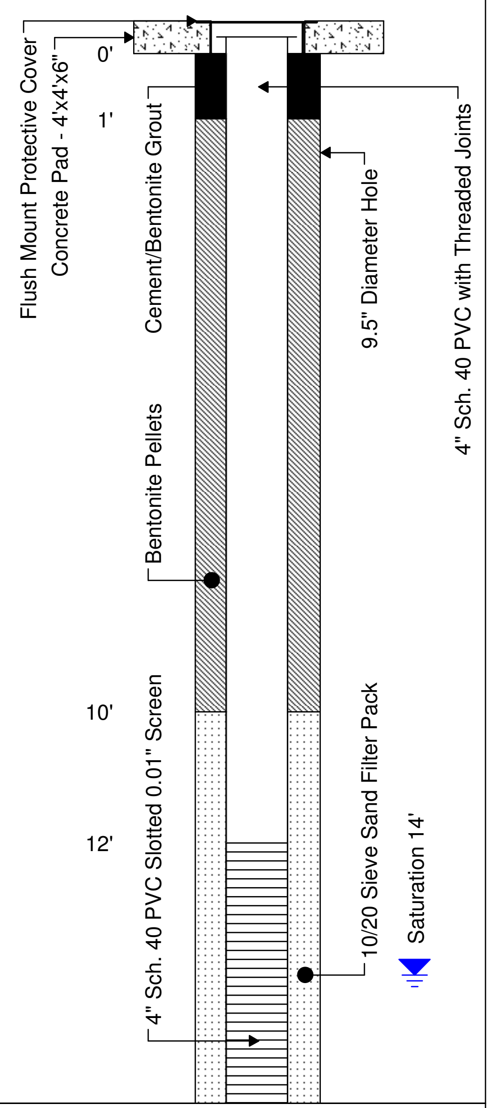
Well No.: MKTF-04
Start Date: 11/12/2013
Finish Date: 11/12/2013

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.310' W 108°25.742'; Boring ID SB03

Total Depth: 24' bgl
Ground Water: Saturated @ 14' bgl
Elev., TOC (ft. msl): 6933.57
Elev., PAD (ft. msl): 6933.90
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,649.46 **E** 2,545,752.83

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-1					Ground Surface
1	10.2			90	**Fill (Silt/Gravel)** Low plasticity, very dense, dry, light brown, no odor
3	11.7			80	**Fill (Silt/Gravel)** Similar to above, black, dense at base, no odor
5	16			90	**Silty Clay (CL)** Low plasticity, stiff, damp, reddish brown, no odor, calcareous
7	26			90	**Gravelly Sandy Clay (CL)** Low plasticity, loose to firm, damp, brown, no odor
9	708			70	**Silty Clay (CL)** Low plasticity, very soft, damp, reddish brown, hydrocarbon odor
11	369			80	**Clay (CH)** High plasticity, firm, damp, reddish brown, hydrocarbon odor
13	660	14'		90	**Sandy Clay/Clayey Sand (SC/CL)** Low plasticity, fine grain, soft, damp, reddish brown, hydrocarbon odor
15	85			90	**Sandy Clay (SC)** Similar to above, saturated sand seams, hydrocarbon odor, brown

Completion Results



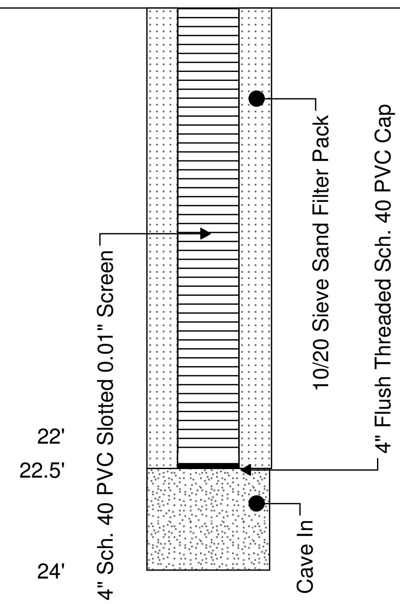
RPS
1250 S. Capital of Texas Hwy., Bldg. 3, Suite 200
Austin, Texas 78746
512/347-7588
512/347-8243

WELL INSTALLATION

Well No.: MKTF-04
Client: Western Refining Southwest, Inc.
Total Depth: 24' bgl
Start Date: 11/12/2013
Site: Gallup Refinery - Seep West of Tank 102
Ground Water: Saturated @ 14' bgl
Finish Date: 11/12/2013
Job No.: UEC01809
Elev., TOC (ft. msl): 6933.57
Geologist: Tracy Payne
Elev., PAD (ft. msl): 6933.90
Driller: Enviro-Drill, Inc.
Elev., GL (ft. msl): --
Drilling Rig: CME 75
Site Coordinates:
Drilling Method: Hollow Stem Augers
N 1,633,649.46 **E** 2,545,752.83
Sampling Method: Split Spoon
Comments: N 35°29.310' W 108°25.742'; Boring ID SB03

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
17	64			70	**Sandy Clay (SC)** Similar to above, moist to saturated, hydrocarbon odor, brown
19	33				**Sandy Clay (SC)** Low plasticity, fine grain, soft, moist to saturated, light reddish brown, hydrocarbon odor, gravelly at base
21				90	**Silty Clay (CL)** Low plasticity, stiff, damp, light reddish brown grading to yellowish/greenish gray, becomes more silty at base
23					
25					Total Depth = 24' BGL
27					
29					
31					

Completion Results



WELL INSTALLATION

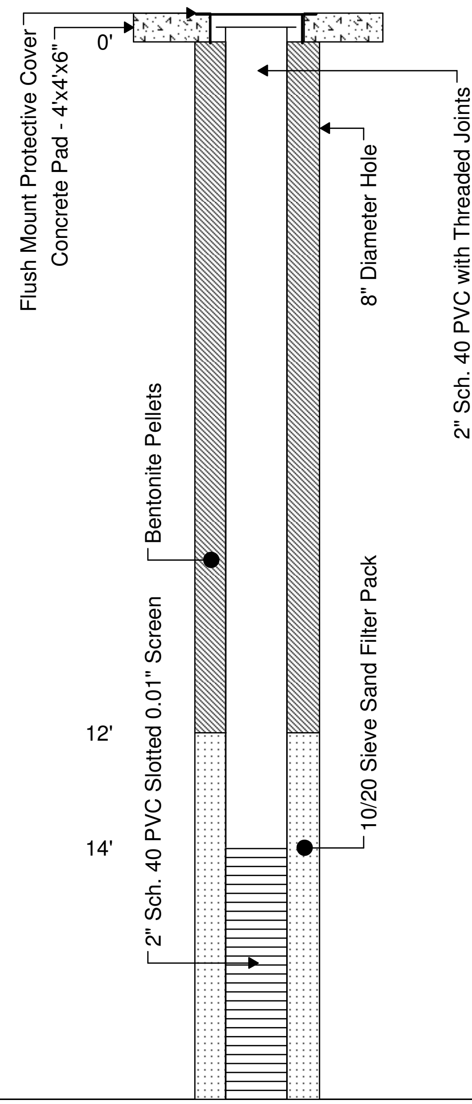
Well No.: MKTF-17
Start Date: 11/14/2013 13:00
Finish Date: 11/14/2013 15:00

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.248' W 108°25.724'; Boring ID - SB33

Total Depth: 25' bgl
Ground Water: Saturated @ 20' bgl
Elev., TOC (ft. msl): 6945.76
Elev., PAD (ft. msl): 6945.79
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,268.93 **E** 2,545,850.73

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-1					Ground Surface
1				10	**Fill (Asphalt/Base/Clay)** Low plasticity, soft, damp, brown
3	150			10	**Fill (Clay)** Similar to above
5	157			90	**Fill (Sand/Gravel/Clay)** Moist to very moist, reddish brown, no odor
7	92.1			20	**Fill (Sand/Gravel/Clay)** Similar to above, saturated, odor
9	65.9			90	**Clay (CH)** High plasticity, firm, damp, faint odor, brown
11	17			60	**Clay (CH)** Similar to above
13	55			70	**Clay (CH)** High plasticity, soft, damp, dark brown and black, odor
15	17.5			60	**Clay (CH)** Similar to above, faint odor
17	11.3			10	**Clay (CH)** Similar to above, trace fine grain sand

Completion Results



WELL INSTALLATION

Well No.: MKTF-17
Start Date: 11/14/2013 13:00
Finish Date: 11/14/2013 15:00

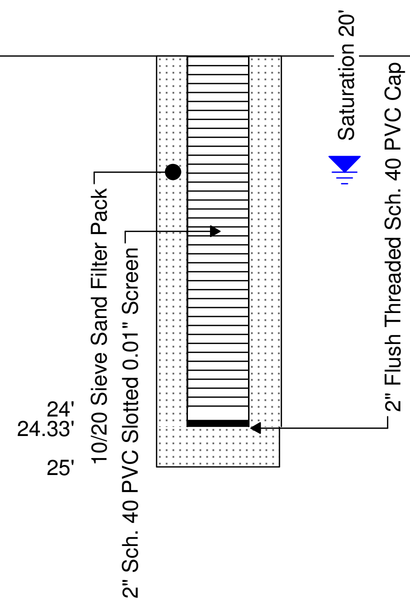
Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.248' W 108°25.724'; Boring ID - SB33

Total Depth: 25' bgl
Ground Water: Saturated @ 20' bgl
Elev., TOC (ft. msl): 6945.76
Elev., PAD (ft. msl): 6945.79
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,268.93 **E** 2,545,850.73

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
18–20	17.2	20'		10	**Clay (CH)** High plasticity, soft, damp, brown
20–22	17.5			70	**Sandy Clay (CH)** Moderate plasticity, soft, very moist to saturated in sand seams
22–23				80	**Silty Clayey Gravel (GM)** Compact to loose, medium grain sand to 1/4" gravel - angular, saturated, brown
23–25				90	**Clay (CH)** Moderate plasticity, firm to stiff, damp, greenish gray
					Total Depth = 25' BGL

Depth scale: 20, 22, 24, 26, 28, 30, 32, 34, 36

Completion Results



WELL INSTALLATION

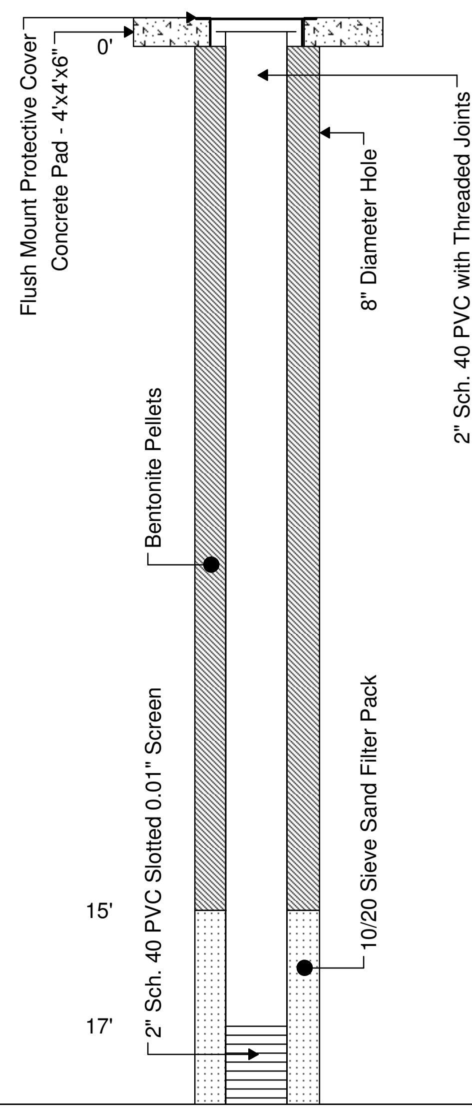
Well No.: MKTF-18
Start Date: 11/15/2013 10:00
Finish Date: 11/15/2013 15:00

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.288' W 108°25.692'; Boring ID - SB34

Total Depth: 27' bgl
Ground Water: Saturated @ 23' bgl
Elev., TOC (ft. msl): 6950.65
Elev., PAD (ft. msl): 6950.97
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,497.53 **E** 2,546,006.29

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
-1					Ground Surface
1				--	**Fill (Gravel and Silty Clay)**
3	1009			20	**Fill (Gravel and Silty Clay)** Similar to above, strong hydrocarbon odor, damp
5	693			60	**Fill (Gravel and Silty Clay)** Similar to above
7	1108			70	**Fill (Silty Clay)** Low plasticity, firm, damp, brown, gravel present, strong hydrocarbon odor
9	901			90	**Fill (Clay/Sand/Gravel)** Similar to above, saturated, odor, sheen observed
11	803			60	**Clay (CH)** High plasticity, stiff, damp, brown, hydrocarbon odor
13	254			70	**Clay (CH)** Similar to above, very fine grain, sand in partings
15	200			30	**Clay (CH)** Similar to above
17				--	No recovery

Completion Results



RPS
1250 S. Capital of Texas Hwy., Bldg. 3, Suite 200
Austin, Texas 78746

512/347-7588
512/347-8243

WELL INSTALLATION

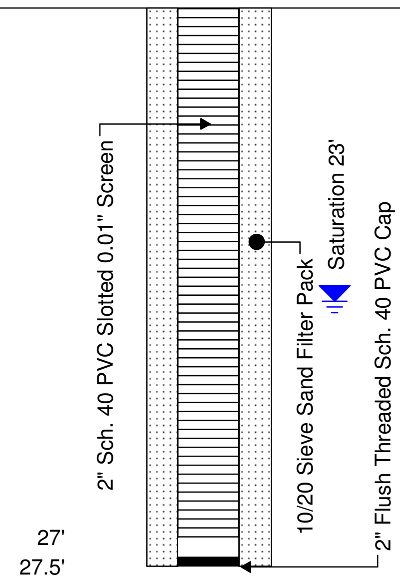
Well No.: MKTF-18
Start Date: 11/15/2013 10:00
Finish Date: 11/15/2013 15:00

Client: Western Refining Southwest, Inc.
Site: Gallup Refinery - Seep West of Tank 102
Job No.: UEC01809
Geologist: Tracy Payne
Driller: Enviro-Drill, Inc.
Drilling Rig: CME 75
Drilling Method: Hollow Stem Augers
Sampling Method: Split Spoon
Comments: N 35°29.288' W 108°25.692'; Boring ID - SB34

Total Depth: 27' bgl
Ground Water: Saturated @ 23' bgl
Elev., TOC (ft. msl): 6950.65
Elev., PAD (ft. msl): 6950.97
Elev., GL (ft. msl): --
Site Coordinates:
N 1,633,497.53 **E** 2,546,006.29

Depth (ft.)	PID (ppm)	Saturation	USCS Class	Recovery (%)	Sample Description
	112			30	**Clay (CH)** High plasticity, firm, damp, brown, faint odor
20	55			20	**Clay (CH)** Similar to above
22	323	23'		80	**Clay (CH)** Similar to above
					Sandy Clay/Clayey Sand (SC/CL) Fine grain, compact, very moist to saturated, brown, hydrocarbon present
24				90	**Clayey Sand (SC)** Similar to above, saturated
26					**Sandy Clay (CL)** Low plasticity, firm, damp, hydrocarbon odor, greenish gray
28					Total Depth = 27' BGL
30					
32					
34					
36					

Completion Results



Appendix B

Investigation Derived Waste Management Plan

Investigation Derived Waste (IDW) Management Plan

All IDW will be properly characterized and disposed of in accordance with all federal, State, and local rules and regulations for storage, labeling, handling, transport, and disposal of waste. The IDW may be characterized for disposal based on the known or suspected contaminants potentially present in the waste.

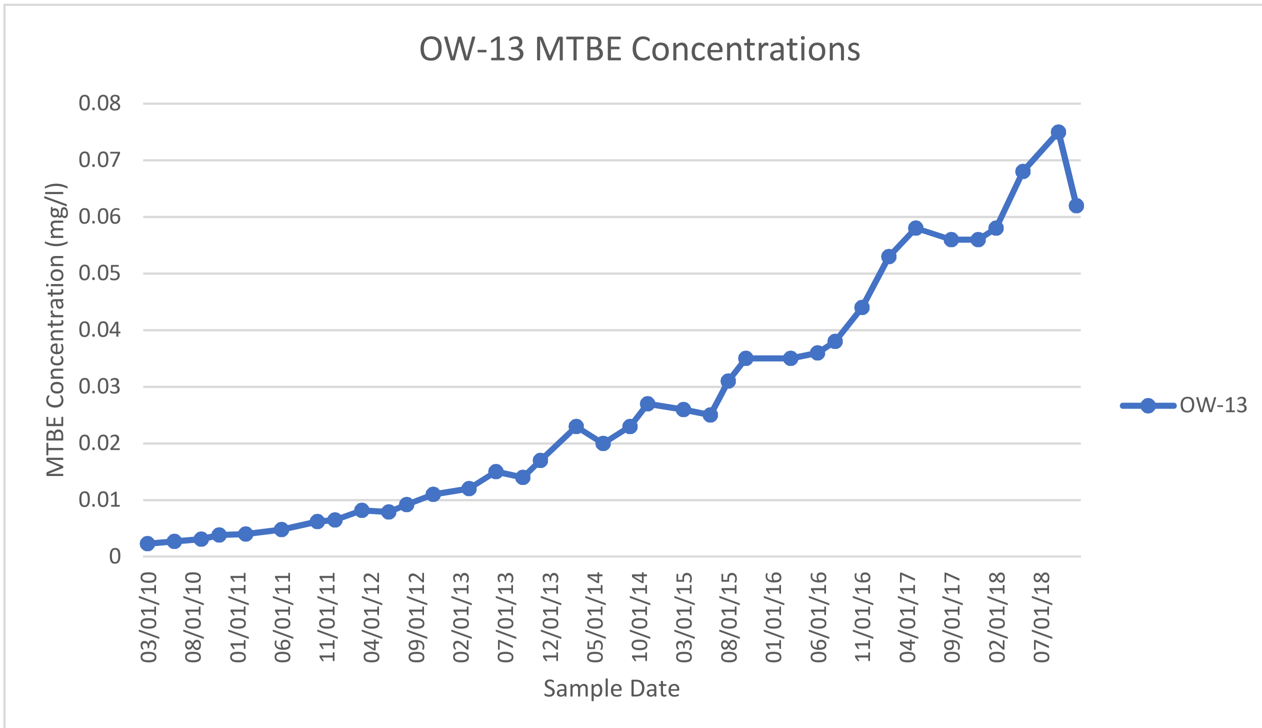
A dedicated decontamination area will be setup prior to any sample collection activities. The decontamination pad will be constructed so as to capture and contain all decontamination fluids (e.g., wash water and rinse water) and foreign materials washed off the sampling equipment. The fluids will be pumped directly into suitable storage containers (e.g., labeled 55-gallon drums), which will be located at satellite accumulation areas until the fluids are disposed in the refinery wastewater treatment system upstream of the API separator. The solids captured in the decontamination pad will be shoveled into 55-gallon drums and stored at the designated satellite accumulation area pending proper waste characterization for off-site disposal.

Drill cuttings generated during installation of soil borings will be placed directly into 55-gallon drums and staged in the satellite accumulation area pending results of the waste characterization sampling. The portion of soil cores, which are not retained for analytical testing, will be placed into the same 55-gallon drums used to store the associated drill cuttings.

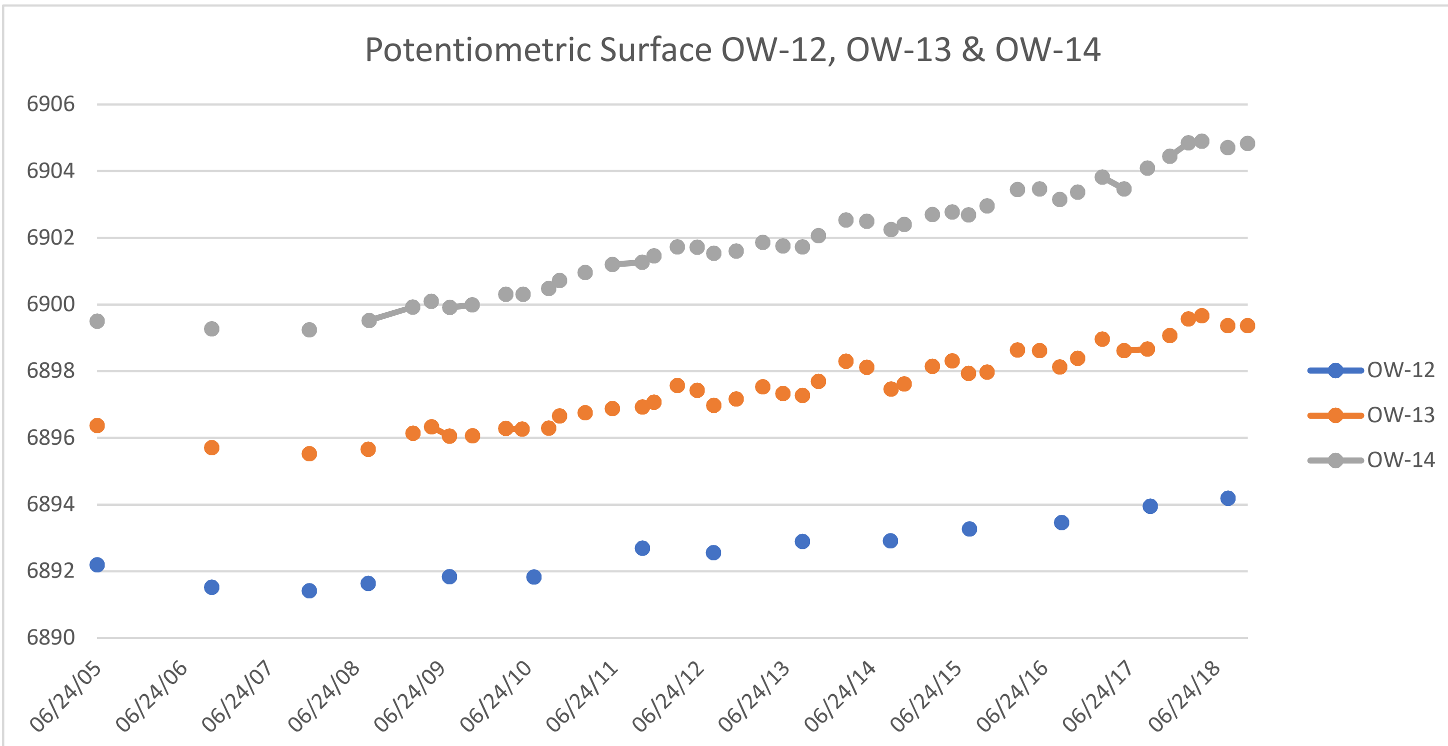
The solids (e.g., drill cuttings and used soil cores) will be characterized by testing to determine if there are any hazardous characteristics in accordance with 40 Code of Federal Regulations (CFR) Part 261. This includes tests for ignitability, corrosivity, reactivity, and toxicity. If the materials are not characteristically hazardous, then further testing will be performed pursuant to the requirements of the facility to which the materials will be transported. Depending upon the results of analyses for individual investigation soil samples, additional analyses may include VOCs, TPH and polynuclear aromatic hydrocarbons (PAHs).

Appendix C

OW-13 Data Graphs



OW-13 MTBE Concentrations
MTBE Concentration (mg/l)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
03/01/10
08/01/10
01/01/11
06/01/11
11/01/11
04/01/12
09/01/12
02/01/13
07/01/13
12/01/13
05/01/14
10/01/14
03/01/15
08/01/15
01/01/16
06/01/16
11/01/16
04/01/17
09/01/17
02/01/18
07/01/18
Sample Date
OW-13



Potentiometric Surface OW-12, OW-13 & OW-14
6906
6904
6902
6900
6898
6896
6894
6892
6890
06/24/05
06/24/06
06/24/07
06/24/08
06/24/09
06/24/10
06/24/11
06/24/12
06/24/13
06/24/14
06/24/15
06/24/16
06/24/17
06/24/18
OW-12
OW-13
OW-14

Appendix D
Well Development and Purging Procedures

Well Development

All monitoring wells will be developed to create an effective filter pack around the well screen, correct damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. Newly installed monitoring wells will not be developed for at least 48 hours after the surface pad and outer protective casing are installed. This will allow sufficient time for the well materials to cure before the development procedures are initiated. A new monitoring well will be developed until the column of water in the well is free of visible sediment, and the pH, temperature, turbidity, and specific conductivity have stabilized. In most cases, the above requirements can be satisfied. However, in some cases, the pH, temperature, and specific conductivity may stabilize but the water remains turbid. In this case, continuous flushing may be necessary to complete the well development. If the well is pumped dry, the water level will be allowed to sufficiently recover before the next development period is initiated. The common methods used for developing wells include:

(1) pumping and over-pumping;

(2) backwashing;

(3) surging (with a surge block);

(4) bailing;

(5) jetting; and

(6) airlift pumping.

These development procedures will be used, either individually or in combination, to achieve the most effective well development. However, the most favorable well development methods include pumping, over-pumping, bailing, surging, or a combination of these methods. Well development methods and equipment that alter the chemical composition of the groundwater will not be used.

Development methods that involve adding water or other fluids to the well or borehole, or that use air to accomplish well development will be avoided, if possible. Approval will be obtained from the NMED prior to introducing air, water, or other fluids into the well for the purpose of well development. If water is introduced to a borehole during well drilling and completion, then the same or greater volume of water will be removed from the well during development. In addition, the volume of water withdrawn from a well during development will be recorded, and best efforts will be used to avoid pumping wells dry during development activities.

Well Purging

All zones in each monitoring well will be purged by removing groundwater prior to sampling and in order to ensure that formation water is being sampled. Purge volumes will be determined by monitoring, at a minimum, groundwater pH, specific conductance, dissolved oxygen concentrations, turbidity, redox potential, and temperature during purging of volumes and at measurement intervals of not less than ¼ the pre-purge well volume. The groundwater quality parameters and fluid levels will be measured using a YSI Professional Plus Multiparameter Meter, YSI Water Quality Sonde, Hach Portable Turbidimeter, and a Geotech Interface Meter. The volume of groundwater purged, the instruments used, and the readings obtained at each interval will be recorded on the field monitoring log. In general, water samples may be obtained from the well after the measured parameters of the purge water have stabilized to within ten percent for three consecutive measurements. Well purging

may also be conducted in accordance with the NMED's Position Paper "Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring" (October 30, 2001). If necessary, a written request for a variance from the described methods of well purging for individual wells may be submitted to NMED no later than 90 days prior to scheduled sampling activities.

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6313
Phone (505) 476-6000 Fax (505) 476-6030
www.env.nm.gov

MICHELLE LUJAN GRISHAM
Governor

HOWIE C. MORALES
Lt. Governor

JAMES C. KENNEY
Cabinet Secretary Designate

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

January 28, 2019

John Moore
Environmental Superintendent
Western Refining, Southwest Inc., Gallup Refinery
92 Giant Crossing Road
Gallup, New Mexico 87301

RE: DISAPPROVAL
WORK PLAN 2015 ANNUAL GROUNDWATER REPORT COMMENTS
WESTERN REFINING SOUTHWEST INC., GALLUP REFINERY
EPA ID # NMD000333211
HWB-WRG-18-012

Dear Mr. Moore:

The New Mexico Environment Department (NMED) has reviewed the *Work Plan 2015 Annual Groundwater Report Comments* (Work Plan), dated October 2018, submitted on behalf of Marathon Petroleum Company dba Western Refining Southwest Inc., Gallup Refinery (the Permittee). NMED hereby issues this Disapproval. The Permittee must address the following comments provided by both NMED and the New Mexico Energy Minerals and Natural Resources Department Oil Conservation Division (OCD):

Comment 1

The title of the work plan must reflect the topic of the work plan. While this Work Plan was submitted in response to NMED requirements based on review of the Permittee's 2015 Groundwater Monitoring Work Plan, the work plan more specifically addresses installation of new monitoring wells. The Permittee should have titled the document more appropriately in order to be able to track the topic of the document in the future. No revision is required; however, in the future the Permittee must use relevant titles for documents.

Comment 2

An electronic version of the response letter was not included in the submittal. Provide an electronic version of the response letter along with Attachments 1 and 2 in the response letter no later than **February 8, 2019**.

Comment 3

In Section 1, *Introduction,* the Permittee states, "Comment 18.3 - Methyl Tert Butyl Ether (MTBE) has been detected in OW-50 and OW-52 since submission of the 2015 Annual Groundwater Monitoring Report that confirms the down-gradient flow direction to the north, thus no additional wells are proposed." NMED concurs that no additional wells are necessary between wells OW-13 and OW-29 because wells OW-54 and OW-55 were already installed. However, wells OW-50 and OW-52 may be located cross-gradient relative to the groundwater flow direction since the MTBE concentrations in groundwater samples collected from wells located west of OW-13 (e.g., OW-56) are significantly higher than the MTBE concentrations in groundwater samples collected from wells OW-50 and OW-52. The MTBE plume is likely migrating toward west rather than north. Figure 2, *Chinle / Alluvial Interface Potentiometric Map,* indicates that the groundwater flow direction is toward north; however, the potentiometric surface elevations west of well OW-56 were not investigated. Revise the statement in the Work Plan, as necessary.

Comment 4

In Section 1, *Introduction,* the Permittee states, "Comment 20 - Upon further review of the well construction and water levels, it appears that operating a recovery pump in existing RW-2, which is being proposed separately, will lower the water level in RW-2 to below the top of the well screen." Refer to Comment 9 in the *Disapproval for Revised Annual Groundwater Monitoring Report: Gallup Refinery – 2015,* dated January 4, 2019. Comment 9 states, "[i]t is not appropriate to depress the water table in the wells where the screened intervals have historically been submerged, because the depth intervals where free product is present or smeared have not been delineated for these wells." Since the screened interval of well RW-2 has historically been submerged, the Permittee must revise the Work Plan to propose to install a well with an appropriate screened interval at the location of RW-2.

Comment 5

In Section 1, *Introduction,* the Permittee states, "Comment 22 - Recent monitoring data has shown the benzene, toluene, ethylbenzene, and xylenes (BTEX) results have been non-detect in samples collected at OW-1 and the MTBE results are well below the screening level. Therefore, the leading edge of the plume is adequately defined at OW-1 and there is no benefit to installing additional down-gradient wells at this time." According to Table 8.12 in the *Annual Ground Water Monitoring Report Gallup Refinery – 2017* (2017 Report), dated October 30, 2018, the MTBE concentrations in the groundwater samples collected from well OW-1 were steadily detected below the applicable standard throughout 2017. Since there is a water supply well approximately one mile downgradient from the evaporation ponds, the Permittee must ensure that no contaminants migrate further downgradient of well OW-1. Propose to install a sentinel groundwater monitoring well west of well OW-1 in the revised Work Plan.

Comment 6

In Section 1, *Introduction,* the Permittee states, "Comment 25 - A well installed on the southern margin of Evaporation Pond 9 (EP-9) would be cross-gradient to the evaporation pond and be of limited value evaluating potential releases from EP-9. It is also noted that there is a natural depression to south of EP-9 that would make it difficult, if not impossible, to install a monitoring well near the south berm of EP-9. Pursuant to other recent agency requests, new boundary wells (i.e., BW-5A, BW-5B, and BW-5C) were recently installed to the west and down-gradient of EP-9." Refer to Comment 14 in the NMED's January 4, 2019 Disapproval. Comment 14 directs the Permittee to propose to install a groundwater monitoring well at the southern perimeter of pond EP-9. If accessibility is an issue, the Permittee may install the well at a location outside of the depressed area near the berm. Aerial images suggest that there are appropriate locations around midsection of the south berm that appear level. The boundary wells BW-5A, BW-5B and MW-5C are positioned west of pond EP-9 and are unlikely to be adequate for leak detection for the southern perimeter of the pond; therefore, Comment 14 still applies. Revise the Work Plan accordingly.

Comment 7

In Section 1, *Introduction,* the Permittee states, "Comment 39 - MTBE concentrations have been slowing [sic] increasing in groundwater samples collected from OW-13. This well was installed in 1981, approximately 37 years ago, and the quality of the well construction is in question. There is a concern the well itself may be acting as a conduit for contamination in the Chinle/Alluvial Interface zone to migrate vertically to the Sonsela Aquifer. It is recommended to plug and abandon well OW-13 and install a new Sonsela well in the same area." Explain the basis for stating that well OW-13 may be a conduit for contaminant migration and the well construction is in question in the revised Work Plan. Well OW-13 must not be abandoned unless sufficient evidence is provided. Replacement of well OW-13 does not address Comment 39. Comment 39 requires the Permittee to investigate the expansion of MTBE plume in the Sonsela formation. Well OW-12 installed in the Sonsela formation is located approximately 800 feet downgradient of well OW-13. MTBE has not been detected to date in the groundwater samples collected from well OW-12. Propose to install a well screened in the Sonsela formation at a location halfway between wells OW-12 and OW-13 in the revised Work Plan.

Comment 8

In Section 2, *Background,* the Permittee states, "[t]wo of the wells (OW-13 replacement and new off-site Chinle/Alluvial Interface well) will be drilled in the northeast portion of the property, with one of these actually located off-site to the northeast." In addition to the two wells, Comment 4 requires installation of another well at the location of RW-2 at the northeast portion of the property. Furthermore, Comments 5 and 6 require installation of a sentinel well west of well OW-1, and a groundwater monitoring well south of pond EP-9. Comment 7 requires installation of a well within the Sonsela formation. Address the requirements and revise all applicable sections of the Work Plan.

Comment 9

In Section 4.3, *New Shallow Wells at MKTF-17 and MKTF-18,* the Permittee states, "[t]he wells will be screened in the upper-most saturated interval (logged as Fill in MKTF-17 and MKTF-18) with anticipated maximum well depths of 10 feet." The 2017 depth-to-water (DTW) measurements indicate that the groundwater depths were below nine feet below ground surface (bgs) in well MKTF-17 according to Table 9.2 of the 2017 Report. The well placed next to MKTF-17 must be installed deeper than ten feet bgs. Revise the Work Plan accordingly. In addition, all proposed wells must be installed in a way to accommodate the decreasing trend in groundwater elevations in recent years (e.g., deeper total well depths, longer screened intervals). Furthermore, the designation for all new wells that replace existing wells must be distinguished from the designations for the existing wells (e.g., MKTF-17A). Revise the Work Plan accordingly.

Comment 10

In Section 4.5, *Soil Sample Field Screening and Logging,* the Permittee states, "[s]oil samples will be collected for laboratory analysis if screening indicates the potential for site impacts." Regardless of field screening results, soil samples must also be collected at the groundwater interface and termination depths in each soil boring since some constituents may not be detected by field screening (e.g., metals and semi-volatile organic compounds). Revise the Work Plan accordingly.

Comment 11

In Section 4.5.1, *Drilling Activities,* the Permittee states, "[s]lotted (0.01 inch) PVC well screen will be placed at the bottom of the borings and will extend for 10 feet. A 10/20 sand filter pack will be installed to two feet over the top of the well screen." The statement is contradictory. The longer screened intervals are proposed for the new well northeast of OW-30, and some MKTF wells in Sections 4.1, and 4.4, respectively. Similarly, the length of sand filter pack above screen is less than two feet in wells MKTF-01 and MKTF-02. Resolve the discrepancies in the revised Work Plan.

Comment 12

In Section 4.6, *Groundwater Sample Collection,* the Permittee states, "[g]roundwater samples will be collected from the new monitoring wells within 24 hours of the completion of well purging using disposal bailers." Prior to collection of groundwater samples for laboratory analyses, the Permittee must measure DTW and the total depths of each well, and collect groundwater quality parameter data (e.g., dissolved oxygen, pH, temperature, conductivity, redox potential, turbidity) during well purging. Include descriptions of the field procedures in the revised Work Plan. In addition, the discussion regarding well development methodology is not included in the Work Plan. Include a discussion in the revised Work Plan.

Comment 13

In Section 4.9, *Chemical Analyses,* the Permittee states, "[g]roundwater samples will also be analyzed for major cations (calcium, magnesium, sodium, and potassium) and anions (e.g., carbonate, bicarbonate, sulfate, fluoride and chloride)." The listed cations and anions are not included in the table titled as Inorganic Analytical Methods (page 4-8). Explain why these inorganic constituents are not included in the table or revise the table to include all inorganic constituents that will be analyzed. In addition, groundwater samples must also be analyzed for nitrate and nitrite because of potential wastewater discharges at the site. Include the nitrate and nitrite analyses for groundwater samples in the revised Work Plan.

Comment 14

Figure 2, *Chinle / Alluvial Interface Potentiometric Map,* uses the December 2017 groundwater elevation data; however, Figure 2A, *Chinle / Alluvial Interface Potentiometric Map,* uses the March 2015 groundwater data. Figure 2A must be revised to incorporate the December 2017 groundwater elevation data. In addition, Figures 2 and 2A present different maps; Figure 2 presents a northeastern part of the facility and Figure 2A presents entire region of the facility. However, the titles of both figures are identical. Change the titles of the figures for clarity in the revised Work Plan.

Comment 15

In Appendix A, *Boring Logs,* the top of casing elevations for wells MKTF-04, MKTF-17, and MKTF-18 appear to be positioned below ground level. Previously, surface water entered the wells in flush-mounted wells; therefore, an aboveground completion is preferred. The stickup of well casing must be positioned above ground level for all proposed wells, where applicable. Acknowledge the requirements in the revised Work Plan.

The Permittee must address all comments in this Disapproval and submit a revised Work Plan. Two bound hard copies and an electronic version must be submitted to NMED. In addition, include a red-line strikeout version in electronic format showing where all revisions to the Work Plan have been made. The revised Work Plan must be accompanied with a response letter that details where revisions have been made, cross-referencing NMED's numbered comments. The revised Work Plan must be submitted to NMED no later than **June 3, 2019**.

If you have questions regarding this Disapproval, please contact Michiya Suzuki of my staff at 505-476-6059.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: K. Van Horn, NMED HWB
D. Cobrain, NMED HWB
M. Suzuki, NMED HWB
C. Chavez, OCD
L. King, EPA Region 6
B. Moore, WRG

File: Reading File and WRG 2019 File
HWB-WRG-18-012

NEW MEXICO
ENVIRONMENT DEPARTMENT

Hazardous Waste Bureau

MICHELLE LUJAN GRISHAM
Governor
HOWIE MORALES
Lieutenant Governor

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6313
Phone (505) 476-6000 Fax (505) 476-6030
www.env.nm.gov

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

January 4, 2019

John Moore
Environmental Superintendent
Western Refining, Southwest Inc., Gallup Refinery
92 Giant Crossing Road
Gallup, New Mexico 87301

RE: DISAPPROVAL
REVISED ANNUAL GROUNDWATER MONITORING REPORT
GALLUP REFINERY – 2015
WESTERN REFINING SOUTHWEST INC., GALLUP REFINERY
EPA ID # NMD000333211
HWB-WRG-17-007

Dear Mr. Moore:

The New Mexico Environment Department (NMED) has reviewed the *Revised Annual Groundwater Monitoring Report: Gallup Refinery - 2015* (Report), dated September 2018, submitted on behalf of Marathon Petroleum Company dba Western Refining Southwest Inc., Gallup Refinery (the Permittee). NMED hereby issues this Disapproval. The Permittee must address the following comments provided by both NMED and the New Mexico Energy Minerals and Natural Resources Department Oil Conservation Division (OCD):

<u>Comment 1</u>

An electronic version of the response to comments table was not included in the submittal. For all future submittals including the revised Report, provide an electronic version of the response to comments table along with other required documentation. In addition, the Permittee did not list sections, tables and/or figures in the Report where changes were made as required in the response to comments table. Indicate where all changes were made to the Report in the response to comments table.

Comment 2

All revisions were not identified in the Redline Strikeout (RLSO) version. The RLSO version must identify all revisions made to the previous version of the Report, including the revisions made to the tables, charts and figures. Failure to provide an accurate RLSO version slows review, creates the potential for changes to be overlooked, and may be misleading. Provide an accurate RLSO version of the revised Report.

Comment 3

The depth-to-water (DTW) measurement data for MKTF and STP1 wells are tabulated in Appendix B, *Field Inspection Logs*; however, DTW data for other wells are not tabulated. A table showing the 2015 DTW data for all groundwater monitoring wells must be included in the revised Report.

Comment 4

The Permittee's response to NMED's *Disapproval* Comment 4 states, "[d]ue to the remote nature of the refinery, the laboratory felt that it was best to use the nitrate/nitrite analyses in case the delivery truck ran late, or if a sample had to be re-analyzed due to QC failures, or if the lab was unable to meet holding times with instruments. In the future, samples will be analyzed in accordance with the approved sampling plan." Comment 7 in NMED's September 21, 2018 *Approval with Modifications for Revised Facility-Wide Ground Water Monitoring Work Plan – Updates for 2018* (Work Plan) requires inclusion of nitrite analysis to all monitoring wells where anion analysis is included as a requirement. Resolve the issue of holding time for nitrite (e.g., overnight delivery). If the issue cannot be resolved, propose to use a field instrument (e.g., colorimeter) to report nitrate and nitrite separately, on site. Discuss the options to resolve the issues in the revised Report and note the deviation from the approved Work Plan.

Comment 5

The Permittee's response to NMED's *Disapproval* Comment 5 states, "[a]ll DRO, GRO, and MRO cleanup criteria have been adjusted to reflect those provided in the 2017 Guidance Document reference above." The Permittee elected to use the groundwater screening levels of #3 and #6 fuel oil for diesel range organics (DRO), kerosene and jet fuel for gasoline range organics (GRO), and mineral oil dielectric fluid for oil range organics (MRO). However, since all specific sources of the hydrocarbon constituents are not known, compare all concentrations to the groundwater screening level for unknown oil (39.8 ug/L) listed in Table 6-4 of the 2017 Guidance. Revise the Report accordingly.

Comment 6

The Permittee's response to NMED's *Disapproval* Comment 6, Item 4 states, "[a] discussion of the fluoride levels detected in the BW wells has been added." The discussion found in Section 6.1.1, *Boundary Wells (BW-1A/1B/1C, BW-2A/2B/2C, BW-3A/3B/3C)*, states that the ponds are likely not the source, but fluoride may be migrating from an area upgradient of the ponds since similar concentrations are observed in the upgradient direction. In the revised Report, provide a reference to the specific monitoring wells where fluoride concentrations are observed.

Comment 7

The Permittee's response to NMED's *Disapproval* Comment 14 states, "Table 8.7.2 has been modified to reflect a regulatory standard of 0.0014 mg/L for cyanide." According to Table 8.7.2, *Total Metals Analytical Result Summary*, EPA regional screening level (RSL) for Tap Water and NMED Tap Water screening level are listed as 0.015 mg/L and 0.00146 mg/L for cyanide, respectively. In Section 6.4.2, *Groundwater Monitoring Well: OAPIS-1,* the Permittee states that total cyanide exceeded the EPA RSL standard (0.0014 mg/L). The statement is contradictory. Resolve the discrepancy in the revised Report.

Comment 8

The Permittee's response to NMED's *Disapproval* Comment 16 states, "[t]he STP-1 unit is lined, and is not suspected of leakage. The purpose of the STP-1 monitoring wells is to monitor the chlorides and nitrates that were detected in the groundwater samples. It is noted that similar concentrations of chloride and/or nitrate have been detected in groundwater samples collected from nearby (up-gradient) wells NAPIS-1, NAPIS-2, NAPIS-3, GMW-1, GMW-2, and GMW-3, which may indicate an up-gradient source." Comment 3 in NMED's June 20, 2016 *Disapproval for 2014 Annual Groundwater Monitoring Report,* directed the Permittee to provide an explanation for why these wells were installed and how the locations were selected. The Permittee did not adequately address the comment in the response letter or in the revised 2014 Report, dated November 9, 2016. Even if the STP-1 unit is lined, leakage may still occur. The STP-1 monitoring wells are appropriately located for the detection of potential leakage from the STP-1 unit. State the original purpose of the STP-1 monitoring wells in the revised Report.

Comment 9

The Permittee's response to NMED's *Disapproval* Comment 20 states, "[a]dditionally, Gallup Refinery intends to place pneumatic pumps in all of the RW wells to recover both free product and dissolved phase hydrocarbons in the area. Following the installation of the pumps, the well screens will no longer be submerged." Prior to installation, the Permittee must submit a work plan to NMED for review. It is not appropriate to depress the water table in the wells where the screened intervals have historically been submerged, because the depth intervals where free product is present or smeared have not been delineated for these wells. A depressed water table in these wells may result in free product seeping to depths where it was initially absent. Once free product is introduced to the depths below the free product smear zone, it will be more difficult to recover. Examine historical DTW and depth-to-product (DTP) data to make an appropriate recommendation for extracting free product and groundwater from the RW wells. The extraction depths must not be set deeper than the depths where free product has previously been present. Provide a work plan to NMED to install wells with appropriate screened intervals.

Comment 10

The Permittee's response to NMED's *Disapproval* Comment 22 states, "[a]lthough low concentrations of BTEX (below regulatory standards) were reported in 2015 and 2016, the analytical results for 2017 were all below the detection limits for both OW-1 and OW-10." The referenced 2017 groundwater monitoring report has not been submitted to NMED; therefore, the statement must be removed.

Comment 11

The Permittee's response to NMED's *Disapproval* Comment 23, Item 1 states, "[l]anguage has been added to the report which addresses the presence of SPH." In Section 6.6, *Constituent Levels for MKTF Wells,* the Permittee states that the SPH thickness in the MKTF wells ranged from 0 to 1.98 feet at MKTF-7." Section 6.6 was revised to address Comment 23, Item 1; however, the statement is not accurate. The SPH thickness in well MKTF-45 was more than three feet during the second quarter in 2015. Correct the statement for accuracy in the revised Report.

Comment 12

The Permittee's response to NMED's *Disapproval* Comment 24, Item 2 states, "[i]t is not necessary to reiterate the analytical results for each well in the text of the report when it is summarized in detail in the analytical summary tables." NMED's comment did not require this. NMED's comment required the Permittee to be more specific when making statements such as "at least one". State which wells specifically contained contaminant concentrations above their respective groundwater contaminant levels. Listing the compounds detected above the screening levels without providing the designation of wells is not useful to understand site groundwater conditions. Tables should support statements made in the text. Include the information in the revised Report.

Comment 13

The Permittee's response to NMED's *Disapproval* Comment 24, Item 7 states, "1-methylnaphthalene will be removed from the VOC summary table as well as the discussion of VOCs in future reports." The 1-methylnaphthalene concentrations exceeded the screening level in the groundwater samples collected from the MKTF wells according to Table 8.15.5, *MKTF Wells Volatile Organic Compounds Analytical Results.* Therefore, the response is not appropriate. The Permittee must include the analytical results and discussion for the exceedance of 1-methylnaphthalene. Comment 24, Item 7 states that 1-methylnaphthalene is listed twice in page 45. Listing the same compound twice is not necessary; remove one of the listings from the revised Report, but include the constituent in both the table and the discussion.

Comment 14

The Permittee's response to NMED's *Disapproval* Comment 25 states that this issue was discussed with the NMED in our last meeting (2018), and asserts that a new monitoring well installed in that location would be cross-gradient from the source and would add little value to the monitoring system as it would provide no downgradient coverage for the pond. After the meeting referenced in the response, NMED reviewed information including laboratory data from groundwater collected in upgradient wells that demonstrate that the Permittee's explanation is not technically defensible. The Permittee also states, "[a]s illustrated on the potentiometric maps, well MKTF-43 is upgradient from well MKTF-44 suggesting that the source of the chlorides and sulfates is located in an upgradient direction of pond EP-9. Therefore, no additional wells are proposed for the southern margin of pond EP-9." The statement is not accurate. The closest wells positioned upgradient of pond EP-9 and well MKTF-43 are wells MKTF-32 and MKTF-41. The highest chloride and sulfate concentrations reported in 2015 for the groundwater samples collected from well MKTF-32 were 580 mg/L and 110 mg/L, respectively. Similarly, the highest chloride and sulfate concentrations reported in 2015 for the groundwater samples collected from well MKTF-41 were 900 mg/L and 79 mg/L, respectively. These concentrations are significantly lower than those recorded in the samples collected from well MKTF-43 and pond EP-9. The source of elevated chloride and sulfate concentrations likely does not originate upgradient from pond EP-9. The source may originate from the eastern perimeter of pond EP-9. As stated in Comment 25, there is no monitoring well on the southern perimeter of pond EP-9; therefore, a leak from that area cannot be detected or prevented. Installation of a groundwater monitoring well is required. Propose to submit a work plan for the installation of a groundwater monitoring well at the southern perimeter of pond EP-9; otherwise, provide a detailed description of the existing leak detection system installed at the southern perimeter of pond EP-9 in the revised Report.

Comment 15

The Permittee's response to NMED's *Disapproval* Comment 27 states, "[a]ll detected compounds (VOCs, SVOCs, metals, etc.) were evaluated for trends associated with increasing concentrations of monitored parameters. No clear association was observed in any of the monitored parameters." The Permittee's response does not address Comment 27. To clarify, Comment 27 directed the Permittee to evaluate 1) accumulation of vinyl chloride and cis-1,2-DCE, and 2) occurrence of anaerobic dechlorination in every MKTF well where chlorinated compounds were detected. The occurrence of anaerobic dechlorination and potential accumulation of related daughter products must be evaluated using the existing data (e.g., concentrations of chlorinated compounds, groundwater quality parameters, and anions concentrations). Include the discussion in the revised Report.

Comment 16

The Permittee's response to NMED's *Disapproval* Comment 28, Item 2 states, "[t]he anion results were removed from table 8.16.1." The anion results are still listed in Tables 8.16 and 8.16.1. Remove the redundant data from the revised Report.

Comment 17

The Permittee's response to NMED's *Disapproval* Comment 28, Item 3 states, "[t]he specific conductance results were moved to table 8.16.1." The specific conductance results are listed twice with two separate columns in Table 8.16.1. Remove the specific conductance results from Table 8.16.1. Comment 28, Item 3 states, "[t]he measurement of specific conductance must be presented in a separate table along with other water quality parameters (e.g., dissolved oxygen concentration, redox potential)." Provide the table required by Comment 28, Item 3 in the revised Report.

Comment 18

The Permittee's response to NMED's *Disapproval* Comment 29, Item 6 states, "[t]he requested language has been added to the report." Comment 29, Item 6 directs the Permittee to address the exceedance of dissolved chromium concentrations in the samples collected from ponds EP-7 and EP-9. However, Section 6.7.1, *Evaporation Ponds 1 through 12B,* does not address the dissolved chromium concentration exceeding the standard in the sample collected from pond EP-9 (0.064 mg/L). Address the exceedance in the revised Report.

Comment 19

The Permittee's response to NMED's *Disapproval* Comment 30 states, "[p]onds 12A and 12B are shallow evaporation ponds that do not receive untreated wastewater of any type... Additionally, in the summer of 2018 these ponds were observed to be completely dry as a result of high evaporation rates." The Permittee's response provides adequate explanation for the elevated e-coli concentrations in ponds 12A and 12B; however, Comment 30 requires the Permittee to provide an explanation regarding the flow path from STP-1 unit to the last evaporation pond. Include the information in the revised Report.

Comment 20

The Permittee's response to NMED's *Disapproval* Comment 32 states, "[h]owever, the boiler water is very pure to prevent the buildup of hardness within the piping so it is possible that the discharge line that carried the BW to pond EP-2 could have had leaks that allowed sulfate reducing bacteria to live in the warm water around leaks in the pipe which resulted in the sulfate detections." It should be noted that sulfate reducing bacteria (SRB) do not produce sulfate or cause sulfate detections. SRB rather drive the reduction of sulfate or sulfur to utilize small carbon substrates including petroleum hydrocarbons under anaerobic conditions. Since the boiler water is pure as a result of reverse osmosis (RO), SRB unlikely utilizes sulfate or small carbon substrates to flourish. Provide a clarification for the statement or an alternate explanation for the elevated sulfate concentrations in the boiler water.

Comment 21

The Permittee's response to NMED's *Disapproval* Comment 36 states, "[t]he NMED is aware that benzene was discharged into the aeration lagoon possible due to porous piping that served as a conduit for transport to the benzene to the aeration lagoon." This statement does not make sense. NMED is not aware of the assertion stated in the response. The Permittee must provide a better description or clarify the meaning of the statement and provide specific references to document(s) describing the benzene discharge into the aeration lagoon in the response to comments.

Comment 22

The Permittee's response to NMED's *Disapproval* Comment 39 states, "[t]here have been many wells installed in the Group C area since the submission of this report with more planned. Specifically, wells OW-53 and OW-54 were installed in the area between OW-13 and OW-29." Wells OW-53 and OW-54 were screened in the Chinle-Alluvium interface. Comment 39 directs the Permittee to propose to submit a work plan for installation of a monitoring well screened in the Sonsela formation between wells OW-13 and OW-29. Address the comment in the response to comments submitted with the revised Report.

Comment 23

NMED's *Disapproval* Comment 41 states, "[i]n addition, revise the charts to include the ground surface and SPH elevations." Neither the ground surface or SPH elevations were included in Figures 11.1, 11.2, and 11.3. The charts with ground surface, groundwater and SPH elevations will provide information regarding the extent of the SPH smear zone. The information is an important design parameter for a SPH recovery system, if needed in the future. Include ground surface, groundwater and SPH elevations in the figures. Revise the Report accordingly.

Comment 24

The Permittee's response to NMED's *Disapproval* Comment 42, Item 1 states, "[t]he priority for any volume of water obtained is to obtain analytical data, not field parameters... Gallup Refinery will ensure that field parameters are measured and recorded when adequate amounts of water are available." A collection of field parameters is required prior to sampling in accordance with Section 2.2, *Sampling Methods and Procedures.* Field parameters must be measured to ensure that groundwater samples are representative of aquifer's natural conditions. Note that field parameters also provide valuable information regarding the site's groundwater conditions. Describe the cases when sampling for the collection of laboratory analytical data is conducted while field parameters are not collected, and provide a step-by-step explanation of field sampling methods used by technicians in the field for the MKTF wells in the revised Report.

Comment 25

The Permittee's response to NMED's *Disapproval* Comment 42, Item 3, states, "[f]inal stabilized readings are on the sampling forms." NMED's *Disapproval* Comment 42, Item 3 states, "[a]ll water quality parameters must be tabulated and presented in an organized manner. The final (stabilized) readings must be recorded in the table." As stated in Comment 24 above, field parameters provide valuable information regarding the site's groundwater conditions. Providing field parameter data on sampling forms, but not in a summary table is equivalent to providing analytical results on laboratory reports but not in a summary table. The Permittee must tubulate all field parameter data collected in 2015 and provide a table summarizing the data in the revised Report.

Comment 26

The Permittee's response to NMED's *Disapproval* Comment 42, Item 4 states, "[a]lthough the sampling form indicates that the units of dissolved oxygen are "%", it is actually recorded in mg/L." The unit of dissolved oxygen (DO) in the sampling forms is still indicated as "%". If making the correction on each field form is retrospectively impracticable, insert a note clarifying the correction in Appendix B of the revised Report. However, all future sampling forms must be corrected to report DO in mg/L. In addition, the reported DO concentrations often significantly exceed the solubility limit of oxygen at the given temperature. For example, the DO concentrations in well NAPIS-3 were reported from 71.8 mg/L to 59.6 mg/L at a temperature of approximately 20 °C. The solubility limit of oxygen in fresh water at a temperature of 20 °C under the atmospheric pressure is slightly less than 10 mg/L. The solubility limit of oxygen in more saline water, which may be more representative of site's groundwater conditions, is even lower than the solubility limit in fresh water. The field instrument must be calibrated daily (according to manufacturer specifications) prior to conducting the measurements in all future sampling events. The required calibration for the instrument must be described in Section 2.2 of the revised Report. If the issue of DO readings cannot be resolved, investigate alternate instruments for measuring DO concentrations and justify a recommendation in future reports.

Comment 27

The Permittee's response to NMED's *Disapproval* Comment 42, Item 5 states, "[i]f there is sufficient water present to obtain the readings and fill sample containers for analysis, the field readings are recorded on the forms. However, if a bailer is used to remove modest amounts of water from a well then no readings are taken due to insufficient water. Water quality readings are provided for wells where the data was recorded." In case groundwater recharge is slow in a well after purging, a sampler may allow no more than 24 hours to recharge groundwater in the well; then, measure field parameters and collect samples. In any case, all activities and observations must be recorded accurately in the field forms. Presenting blank forms without explanation or providing inaccurate information is misleading.

Comment 28

The Permittee's response to NMED's *Disapproval* Comment 43 states, "[t]he analytical report and Form C-141 for the November 2015 wastewater spill has been added to the revised report." The laboratory analytical report for the wastewater was not attached to the Form C-141. Provide a reference (e.g., laboratory report number if it is already included in the appendices) or include the laboratory analytical report for the wastewater as an attachment to the Form C-141 in the revised Report.

The Permittee must address all comments in this Disapproval and submit a revised Report. Two bound hard copies and an electronic version must be submitted to NMED. In addition, include a red-line strikeout version in electronic format showing where all revisions to the Report have been made. The revised Report must be accompanied with a response letter that details where revisions have been made, cross-referencing NMED's numbered comments. The revised Report must be submitted to NMED no later than **April 5, 2019.**

If you have questions regarding this Disapproval, please contact Michiya Suzuki of my staff at 505-476-6059.

Sincerely,

John E. Kieling
Chief
Hazardous Waste Bureau

cc: K. Van Horn, NMED HWB
D. Cobrain, NMED HWB
M. Suzuki, NMED HWB
C. Chavez, OCD
L. King, EPA Region 6
B. Moore, WRG

File: Reading File and WRG 2018 File
HWB-WRG-17-007

Revised: Annual Groundwater Monitoring Report
Gallup Refinery – 2015

Western Refining
Gallup, New Mexico
~~August~~ September 2018~~6~~

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

__________________________ Date ________________________
Daniel Statile
Vice President, Gallup Refinery

~~Reviewed by:~~

~~Ed Riege, MPH~~

~~Manager Remediation~~

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

TABLE OF CONTENTS - continued

LIST OF FIGURES – SECTION 11

APPENDICES

LIST OF ACRONYMS

AC	Alternating Current
AL	Aeration Lagoon
API	American Petroleum Institute
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BW	Boundary Well
COC	Chain of Custody
COD	Chemical Oxygen Demand
DC	Direct Current
DGF	Dissolved Gas Flotation
DO	Dissolved Oxygen
DRO	Diesel Range Organics
DTB	Depth to Bottom
DTP	Depth to Product
DTW	Depth to Water
EP	Evaporation Pond
EPA	Environmental Protection Agency
FT	Foot/Feet
FWGWMP	Facility Wide Groundwater Monitoring Plan
GPM	Gallons Per Minute
GRO	Gasoline Range Organics
GWM	Groundwater Monitoring Well
HP	Horse Power
HWB	Hazardous Waste Bureau
IDW	Investigation Derived Waste
ISE	Ion Selective Electrode

LIST OF ACRONYMS - continued

LDU	Leak Detection Unit
LPG	Liquefied Petroleum Gas
LTU	Land Treatment Unit
MCL	Maximum Contaminant Level
MPPE	Macro Porous Polymer Extraction
MRO	Motor Oil Range Organics
MTBE	Methyl Tert Butyl Ether
mg/L	Milligrams/liter
mV	Millivolts
MW	Monitoring Well
NAIC	North American Industry Classification System
NAPIS	New American Petroleum Institute Separator
NAPL	Non Aqueous Petroleum Liquid
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NOD	Notice of Disapproval
NPDES	National Pollutant Discharge Elimination System
OBSM	Oil Bearing Secondary Material
OCD	Oil Conservation Division
OW	Observation Well
ORP	Oxidation Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbon
PSTB	Petroleum Storage Tank Bureau
PVC	Polyvinyl Chloride
PW	Process Well
RCRA	Resource Conservation and Recovery Act
<RL	Less than the Applicable standards Detection Limit

LIST OF ACRONYMS - continued

RSL	Regional Screening Level
RW	Recovery Well
SMW	Shallow Monitoring Well
SPH	Separate Phase Hydrocarbon
STP	Sanitary Treatment Pond
SVOC	Semi-volatile Organic Compound
SMWU	Solid Waste Management Unit
SWPPP	Storm Water Pollution and Prevention Plan
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbon
µm	Micrometer
UPS	United Parcel Service
VOC	Volatile Organic Compounds
WQCC	Water Quality Control Commission
WWTP	Waste Water Treatment Plant
YTD	Year to Date

EXECUTIVE SUMMARY

The Annual Groundwater Monitoring Report for 2015 (Report) incorporates all of the field monitoring, sampling, and inspection of all active wells located on the facility. Analytical data and field notes are incorporated into this report to show any changes or discoveries of various constituents found in the groundwater collected for sampling. On February 15, 2012, Groundwater Discharge Permit GW-032 was rescinded by the Oil Conservation Division (OCD) of New Mexico. We are: however, required to continue to abate pollution of groundwater pursuant to 19.15.30 NMAC (Remediation) under case number AP-111 with remediation activities already in place under Groundwater Discharge Permit GW-032. Monitoring and field work activities conducted for 2015 followed the guidelines of the approved 2010, Revision 1, Annual Groundwater Monitoring Report, approved on December 12, 2012 and Approval with Modifications Facility Wide Ground Water Monitoring Work Plan 2012 Updates; 2013 Updates; 2014 Updates for 2015, dated July 24, 2015 from New Mexico Environmental Department Hazard Waste Bureau (NMED HWB).

GROUNDWATER MONITORING

There are a total of 87 monitoring wells located throughout the refinery property. The groundwater program consists of a number of sampling locations, target analytes, and monitoring frequencies which are monitored on a quarterly, semi-annual, and annual basis. A brief analytical summary is included while a more detailed summary is discussed in Section 7. In addition to the monitoring wells, there are two leak detection units (LDUs) at the new API Separator. These monitoring wells and LDUs have been grouped as follows:

GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
BW-1A, 1B, 1C	GWM-1, 2, 3	OW-13, 14, 29, 30	PW-2, 3, 4	MKTF-1 thru
BW-2A, 2B, 2C	NAPIS-1, 2, 3, KA-3	OW-50, 52	OW-1, 10	MKTF-45
BW-3A, 3B, 3C	OAPIS-1	RW-1, 2, 5, 6	OW-11, 12	
MW-1, 2, 4, 5	East LDU, West LDU			
SMW-2, 4	STP1-NW			
	STP1-SW			

GROUP A - WELLS

- There are a total of nine boundary wells located on the northwest section of the refinery property. Three (BW-1A, 1B, 1C) are located between evaporation ponds 7 and 8, and three (BW-2A, 2B, 2C) are located on the west end of evaporation pond 11. BW-3A, 3B, 3C are located on flat terrain directly northwest of evaporation pond 12A. Three of the seven wells (BW-1A, BW-1B, and BW-3A) continue to indicate no water level since original installation in 2003 and 2004.
- No benzene, toluene, ethylbenzene, or total xylenes (BTEX) or methyl tert butyl ether (MTBE) constituents have been detected in any of the boundary wells to date.
- Bis(2-ethylhexyl)phthalate was first detected in BW-3B in 2009, BW-3C in 2011, and in BW-1C in 2013. The detection of this organic compound is suspected to be a laboratory contaminant or possibly from the polyvinyl chloride (PVC) pipe materials used in the well. Subsequent annual sample results have indicated non-detectable levels of the organic constituent in each of these wells.

Within this area of the refinery, three Resource Conservation Recovery Act (RCRA) land treatment units (LTU) exist. Each of the three LTU cells measure 480 feet x 240 feet and received hazardous waste application until 1990. Non-hazardous waste application ceased in 1993. Each section is diked and encompasses a surface area of 2.6 acres.

The MW series (MW-1, 2, 4, and 5) and SMW series (SMW-2, and SMW-4) of wells were installed to monitor the detection of hazardous constituents from the LTU in groundwater. On the northern edge (up gradient) of the LTU are three monitoring wells (MW-1, SMW-4 and MW-2). Down gradient along the eastern edge of the LTU are two monitoring wells (MW-5, SMW-2). MW-4 is located on the northwest corner of evaporation pond 2 (EP-2) and was installed as a background monitoring well. A summary of the laboratory analyses for these wells through 2015 includes:

- Low concentrations of MTBE were detected in SMW-2 from 2008 through 2015.
- Manganese and uranium concentrations have exceeded the WQCC standard since 2012 in SMW-2. SMW-4 has exceeded the standard for uranium concentrations since 2011.

In addition to the annual sampling requirements, the LTU monitoring wells are on a once every ten year sample schedule per the RCRA Post Closure Care Permit. The next RCRA Post Closure Care Permit sample event is scheduled to occur in 2019.

GROUP B - WELLS

The Group B wells are located within and around the aeration basin. Wells GWM-1, GWM-2 and GWM-3 are located on the west edge of Aeration Lagoon 2 (AL-2) and Pond 1. The NAPIS-2, NAPIS-3, and KA-3 wells are adjacent to the west bay of the New American Petroleum Institute Separator (NAPIS) and NAPIS-1 is located upstream on the southeast side of the east bay of the NAPIS. A leak detection unit (LDU) well, the West LDU, is located on the west bay of the NAPIS. The Oil Sump LDU and East Bay LDU wells are located on the east bay of the NAPIS. In July 2012, a well (OAPIS-1) was installed on the northwest side of Aeration Lagoon 1 (AL-1). The installation of this well resulted from the Solid Waste Management Units (SMWU) No. 1, Aeration Basin and SMWU No. 14, Old API Separator site investigation. The investigation work was implemented to determine if there had been a release from the aeration basin and to delineate impacts associated with any such releases. Information collected from this site investigation is also used to track groundwater in monitoring wells GWM-2 and GWM-3.

Two monitoring wells (STP1-NW and STP1-SW) were installed at the new sanitary treatment pond in May of 2014. STP1-NW is located on the west end of the north bay of STP-1, and STP1-SW is located on the southwest corner of the south bay of STP-1. Both of these wells were added to the ground water sampling plan.

A brief summary of laboratory analyses for the Group B wells for 2015 is listed below:

GWM 1, GWM-2, GWM-3

- No groundwater was present in GWM-2 and GWM-3 in 2015
- An SPH level was detected in GWM-1 in third quarter 2015 and no samples were collected in fourth quarter 2015. .
- High benzene concentrations have been detected in GWM-1 with low concentrations of toluene, ethylbenzene, total xylene and MTBE.
- Diesel range organics (DRO) were detected in GWM-1 during all four quarters of 2015. Gasoline range organics (GRO) were detected in the first and third quarters (not analyzed in the second quarter due to oil sample collection) and motor oil range organics (MRO) were detected only in the fourth quarter of 2015.
- Arsenic, iron, and manganese have been detected in GWM-1 at concentrations exceeding applicable standards in 2015.

- Twelve organic compounds were detected in GWM-1 in the third quarter all at concentration levels above the applicable standards.

NAPIS-1, NAPIS-2, NAPIS-3, and KA-3

- High concentrations of benzene and MTBE continue to be detected in NAPIS 2 throughout 2015.
- DRO/GRO have been detected in NAPIS 2 in 2015.
- Barium, iron and manganese were detected in NAPIS 2 at concentration levels exceeding the applicable standards in 2015.
- Iron and uranium were detected in all four quarters of 2015 in NAPIS 3 at concentration levels exceeding the WQCC standards Manganese was detected in NAPIS 3 during the first quarter of 2015 at a concentration level exceeding the WQCC standard.
- Manganese was detected in all four quarters of 2015 above the applicable standard in KA-3.
- Naphthalene and 1-methylnaphthalene were detected exceeding the applicable standards for NAPIS-2 in 2015.

East LDU and West LDU

- BTEX and DRO/GRO were detected in the East and West LDU at levels exceeding applicable standards in 2015.
- Chromium, iron, and manganese have been detected in concentrations exceeding applicable standards in each of the LDU wells sampled in 2015. Neither total nor dissolved uranium was detected.
- The organic constituents 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and 1-methylnaphthalene have shown concentrations exceeding applicable standards in each of the LDU wells in 2015.

OAPIS-1

- Benzene and MTBE have exceeded the applicable standards in OAPIS-1 since 2013.
- Concentrations of fluoride, chloride, and DRO have shown exceedances in OAPIS-1 since 2013.
- Arsenic, iron, manganese, uranium, and cyanide have exceeded applicable standards in OAPIS-1 since 2013.
- Naphthalene and 1-methylnaphthalene have exceeded applicable standards in 2015.

STP1-NW and STP1=SW

- STP1-SW was dry in all of 2015.
- There were no detections of BTEX, MTBE, DRO, GRO, or MRO above applicable standards in 2015 in STP-1 NW.
- Chloride, nitrite and nitrate concentrations in STP1-NW exceeded applicable standards during each 2015 sampling event.

- Iron was detected in concentrations in STP1-NW exceeding applicable standards during the first three quarters of 2015.
- Total and dissolved uranium concentrations in STP1-NW were detected during all 2015 sampling events, but did not exceed applicable standards. Low concentrations of arsenic, barium, manganese, selenium, and zinc were detected during each 2015 event. A low concentration of chromium was detected during the second quarter sampling event in 2015.

GROUP C WELLS

Group C wells include six observation wells and four recovery wells. Observation well OW-14 is adjacent to the liquefied petroleum gas (LPG) compound while OW-13, OW-29, and OW-30 are located north of the tank farm. Observation wells OW-50 and OW-52 were installed in 2009 per NMED and monitor the potential for contaminant migration offsite. Recovery well RW-1 is located within the tank farm east of Tank 568 while RW-2 is located on the southwest side of Tank 576. Recovery well RW-5 and RW-6 are located northeast of Tank 345. The recovery wells were installed during a subsurface investigation conducted between 1987 and 1992 near the tank farm. BTEX concentrations and separate-phase hydrocarbons (SPH) were detected in the groundwater.

SPH recovery continues quarterly. When applicable, recovery is completed using a disposable hand-bailer in RW-5 and RW-6 and completed in RW-1 using a portable submersible pump. Measureable SPH has not been detected in RW-2. SPH was not detected in RW-5 and RW-6 during all of 2015. The SPH column thickness in RW-1 has increased during 2015.

A summary of the observation wells and recovery well laboratory analyses through 2015 is as follows:

<u>OW-13, OW-14, OW-29, OW-30, OW-50, and OW-52</u>

- Benzene has exceeded the EPA MCL standard in OW-14 since 2008 through 2015. MTBE concentrations have shown exceedances in OW-14, OW-29, and OW-30 since 2007 (2010 for OW-29) through 2015. No BTEX or MTBE constituents have been detected in OW-13, OW-50, and OW-52.
- Chloride has been detected above applicable standard in OW-14 from 2013 through 2015.
- DRO and GRO have been detected in OW-14, OW-29 and OW-30 in 2015.

<u>RW-1, RW-2, RW-5, and RW-6</u>

- BTEX concentrations have exceeded standards in RW-1 and RW-2 wells since 2011. RW-5 and RW-6 have exceeded standards for benzene since 2011. Total xylenes concentrations exceeded the standard for RW-6 from 2012 through 2015.

- During 2015, the organic constituents 1,2,4-trimethylbenzene exceeded the applicable standards in RW-2. In RW-5 and RW-6, the organic constituents 1,2,4-trimethylbenzene, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene concentrations exceeded the applicable standards in 2015.
- Hydrocarbon recovery from RW-1 has shown a steady decrease from 2005 through 2015. In 2015, total hydrocarbon recovery is estimated at 2.0 gallons in 54 gallons of water purged compared to the 2005 estimate of 431 gallons of hydrocarbons in 1,210 gallons of water. No measureable hydrocarbons have been detected in RW-2, RW-5 and RW-6 in 2015.

GROUP D WELLS

The Group D wells can be found within the refinery property and include three process/production wells (PW-2, PW-3 and PW-4) and four observation wells (OW-1, OW-10, OW-11, and OW-12). The process/production wells are used to provide process water for the refinery and drinking water for both the refinery and the Pilot Travel Center. PW-2 is located on the central west side of the refinery directly west of Evaporation Pond 6 (EP-6). PW-3 is centrally located on the refinery property north of the maintenance shop and west of the domestic water tank Z-86-T2. PW-4 is located south of the Pilot Lift Station. Each of the PW wells is screened at a depth of 1,000 feet. The observation well OW-1 is found west of PW-2 and is an artesian well. Observation well OW-10 is located east of Evaporation Pond 9 (EP-9), OW-11 is located on the west side of the main access road, and OW-12 is centrally located west of the refinery tank farm.

A summary of the Group D Wells laboratory analyses through 2015 is as follows:

PW-2, PW-3, and PW-4

- No BTEX or MTBE constituents were detected in the process wells in 2015.
- Low concentrations of fluoride, chloride and sulfate were detected in PW-3.
- Low concentrations of arsenic, barium and iron were detected in PW-3 but did not exceed applicable standards. Low total and dissolved uranium was detected in PW-3 at concentrations below the applicable standard.
- No VOCs SVOCs were detected in the process wells in 2015.

OW-1, OW-10, OW-11, and OW-12

- Low concentrations of BTEX and MTBE were detected in OW-1 and OW-10 during the last quarter of 2015, and low concentrations of MTBE were detected in OW-10 during all four quarters in 2015.
- Iron concentrations exceeded the WQCC standard in well OW-1 during the third quarter of 2015 and had a low concentration detected in fourth quarter 2015.

- Chloride concentrations exceeded the WQCC standard in well OW-10, and fluoride and sulfate exceeded the applicable standards in OW-11 and OW-12 during 2015.
- Uranium concentrations have exceeded the constituent standards in OW-1, OW-10, and OW-11 for 2015.
- During the 2013 annual sampling event, bis-2(ethylhexyl)phthalate was detected in OW-11 at a concentration exceeding the standard of 0.006 mg/L; however, this is suspected to be either a lab artifact or from the PVC well materials.

GROUP E WELLS

To date, a total of 44 monitoring wells (MKTF-1 through MKTF-44) have been installed to aid in delineating the extent of a hydrocarbon seep discovered in 2013 in an isolated area approximately 100 yards west of the crude tanks T-101 and T-102. A pre-existing well located in the seep investigation site area at the loading rack was added to the marketing wells and has been labeled as MKTF-45. Site investigations have included excavations within the seep area, soil/water samples, and the installation of six temporary sumps to recover the non-aqueous phase liquid (NAPL). Liquid recovery from the six sumps in 2015 is estimated at 189,707 gallons of NAPL and ground water. In the past, a hole was identified in the refinery's waste water process sewer line near the bundle cleaning pad and a leaking transmix transfer line was also identified in the area. Hydrocarbon recovery of twelve of the MKTF wells that have SPH in 2015 is estimated to be 11.2 gallons. Recovery of SPH from six temporary sumps and from the 12 wells that have a product layer are on-going. The measured SPH thickness is shown on Figure 13.

The MKTF wells are sampled quarterly. BTEX, MTBE, DRO, GRO, total and dissolved metals including uranium, and several VOCs and SVOCs have been detected in many of the wells above the referenced standards.

ADDITIONAL SITES MONITORED

The new waste water treatment plant (WWTP) and the new holding pond Sanitary Treatment Pond (STP-1) were completed and put in service in May of 2012. All waste water flow was routed to the WWTP in May 2012 and in January 2013, the demolition and removal of the benzene strippers was completed. Pilot effluent was routed to the WWTP in June of 2013 and the aeration lagoons and pond 1 are no longer receiving any flow. All influent and effluent sample sites continued between lagoons and pond 1 as long as there was continued gravitational flow.

Outfall BW to EP-2

- The flow from the boiler unit discharges into EP-2. It is sampled at its discharge point to the pond on an ~~semi-~~annual basis for major cations/anions.
- The sulfate concentration exceeded the standard of 600 mg/L during the 2015 sample event.

Outfall STP1 to EP-2

- The EP-2 Inlet designation was changed to STP1 to EP-2 in the second half of 2012 as flow to the aeration lagoons and pond 1 were diverted to the new WWTP. Aeration lagoons and pond 1 were taken out of service and no longer receiving flow. STP-1 effluent now flows into the northeast corner of EP-2. The outfall is sampled on a quarterly basis.
- DRO concentrations exceeded the constituent respective standards in 2015.
- A low concentration of acetonewas detected but is below applicable standards.

Evaporation Ponds

There are a total of eleven evaporation ponds that are sampled semi-annually or annually. Pond 2 (EP-2) thru evaporation pond 6 (EP-6) are centrally located on the west end of the refinery property (west of the aeration basin) and evaporation pond 9 is located on the south section of the refinery property divided by a dirt road separating EP-9 from EP-2 through EP-6. Evaporation ponds 7, 8, 11, 12A/B are located on the northwest corner of the refinery boundary.

- Pond 1 is no longer in service, so it is no longer sampled.
- Low concentrations of benzene and toluene were detected in EP-2, EP-3, EP-4, and EP-12B in 2015.
- In 2015, concentrations of fluoride, chloride, sulfates, and COD exceeded the applicable WQCC standards in all of the evaporation pond samples. In 2015, BOD concentrations exceeded the applicable standards in all the evaporation pond samples except EP-5, EP-6, EP-7, and EP-9.
- Total and dissolved arsenic and manganese concentrations exceeded applicable standards in all of the ponds throughout 2015 with the exception EP-12A (dissolved manganese was less than applicable standard). Dissolved selenium and chromium exceeded applicable standards in EP-7 and dissolved chromium exceeded applicable standards in EP-9.
- Selenium concentrations exceeded applicable standards in E-7, EP-9, and EP-11,
- Low concentrations of total or dissolved uranium were detected in EP-2, EP-3, EP-4, EP-12A, and EP-12B
- The only VOC constituent detected in all the EP wells was a low concentration of acetone in EP-3.
- SVOC constituents that exceeded applicable standards for 2015 were bis(2-theylhexyl)phthalate (EP-11) and phenol (EP-2 and EP-12B). Low concentrations of 3,4-methylphenol (EP-2, EP-4 and EP-12B).

ADDITIONAL APPLICABLE STANDARDS REQUIREMENTS

OCD Discharge Permit is now titled GW-032/AP111. The Discharge Permit was rescinded by NM-OCD on February 15, 2012; however Gallup is still required to continue with abatement of pollution of groundwater pursuant to 19.15.30 NMAC (Remediation), with remediation activities already in place.

This report includes:

Monitoring of the aeration lagoons, ponds and outfalls between the lagoons and ponds on a quarterly, semi-annual and annual basis. (Section 8)

- Major Refinery Activities and Events (Summary EPA/NMED/RCRA Activity) (AppendixD)
- Summary of All Leaks, Spills, and Releases (Appendix E)
- Temporary Land Farm Analytical Results (Appendix F – on CD)
- Analytical Data (Appendix G – on CD)

SECTION 1

INTRODUCTION

The 2015 Annual Groundwater Monitoring Report has been prepared to describe monitoring and remediation activities undertaken throughout 2015. Groundwater sampling is performed on a quarterly, semi-annual and annual basis and includes sampling of the evaporation ponds located on the northwest section of the refinery property. The activities completed include analysis of all active monitoring wells and evaporation ponds. The data generated is used to characterize the nature and extent of impacts to the groundwater at the refinery from historical releases and to monitor any levels of constituents that exceed applicable standards.

This report presents the results of the groundwater monitoring activities and contains the following information:

- Scope of activities
- Sampling methods and procedures
- Groundwater elevation surveys
- Regulatory criteria
- Groundwater monitoring results
- Conclusions and recommendations

1.1 FACILITY OWNERSHIP, OPERATION AND LOCATION

This report pertains to the Western Refining Southwest Inc., Gallup Refinery, located at Exit 39 on Interstate I-40, approximately 17 miles east of Gallup, New Mexico, in Jamestown, New Mexico. Figure 1 shows the regional location of the refinery.

Owner:	Western Refining 123 West Mills Avenue, El Paso, TX 79901	(Parent Corporation)

Operator:	Western Refining Southwest, Inc. Gallup Refinery 92 Giant Crossing Road, Gallup, NM 87301	(Postal address)
	Western Refining Southwest, Inc. Gallup Refinery I-40, Exit 39, Jamestown, New Mexico 87347	(Physical address)

The following regulatory identification and permit governs the Gallup Refinery:

- SIC code 2911 (Petroleum Refining) applies to the Gallup Refinery
- U.S. EPA ID Number NMD000333211
- OCD Discharge case number AP-111(GW-032/AP-111)
- 2015 NPDES MSGP, ID #NMR053168

The refinery status is corrective action/compliance. Annual, semi-annual, and quarterly groundwater sampling is conducted at the refinery to evaluate present conditions. The refinery is situated on an 810 acre irregular shaped tract of land that is substantially located within the lower one-quarter of Section 28 and throughout Section 33 of Township 15 North, Range 15 west, of the New Mexico Prime Meridian. A small component of the property lies within the northeastern one-quarter of Section 4 of Township 14 North, Range 15 West. Figure 2 is a topographic map showing the general layout of the refinery in comparison to the local topography.

1.2 BACKGROUND INFORMATION

The refinery primarily receives crude oil via two 6-inch diameter pipelines; two pipelines from the Four Corners Area enter the refinery property from the north. In addition, the refinery also receives natural gasoline feed stocks via a 4-inch diameter pipeline that comes in from the west along the Interstate 40 corridor from the Wingate Plant, formerly Conoco gas plant. Crude oil and other products also arrive at the site via railroad cars. These feed stocks are then stored in tanks until refined into products.

The refinery incorporates various processing units that refine crude oil and natural gasoline into finished products. These units are briefly described as follows:

- Crude Distillation Unit: separates crude oil into various fractions; including gas, naphtha, light oil, heavy oil, and residuum
- Fluidized Catalytic Cracking Unit (FCCU): dissociates long-chain hydrocarbon molecules into smaller molecules, and essentially converts heavier oils into naphtha and lighter oils.\
- Alkylation Unit: combines specific types of hydrocarbon molecules into a high octane gasoline blending component.
- Reforming Unit: breaks up and reforms low octane naphtha molecules to form high octane naphtha.
- Hydro Treating Unit: removes undesirable sulfur and nitrogen compounds from intermediate feed stocks, and also saturates the feed stocks with hydrogen to make diesel fuel.
- Additional Treater Units: remove impurities from various intermediate and blending feed stocks to produce finished products that comply with sales specifications.
- A set of Acid Gas Treating and Sulfur Recovery Units: convert and recover various sulfur compounds from other processing units in order to produce either ammonium thiosulfate or a solid elemental sulfur byproduct.
- Waste Water Treatment Plant – process and treat refinery waste and storm water before releasing to treatment ponds.

As a result of these processing steps, the refinery produces a wide range of petroleum products including propane, butane, unleaded gasoline, diesel, kerosene, and residual fuel. In addition to the aforementioned processing units and various other equipment and systems support the operation of the refinery and are briefly described as follows: Storage tanks are used throughout the refinery to hold and store crude oil, natural gasoline, intermediate feed stocks, finished products, chemicals, and water. These tanks are all located aboveground and the capacity ranges from 80,000 barrels to less than 1,000 barrels.Pumps, valves, and piping systems are used throughout the refinery to transfer various liquids among storage tanks and processing units. A railroad spur track and a railcar loading rack are used to transfer feed stocks and products from refinery storage tanks into and out of railcars. Several tank truck loading areas are used at the refinery to load out finished products and also may receive crude oil, other feed stocks, additives, and chemicals.

Gasoline and diesel are delivered to the Pilot Travel Center via tanker truck. An underground diesel pipeline exists between the refinery and the Pilot Travel Center. As a result of an off-refinery release in 2011, the pipeline was purged of product, filled with nitrogen and temporarily taken out of service. Western worked with the NMED – PSTB (Petroleum Storage Tank Bureau) and the NM OCD (Oil Conservation Division) to place this line back in service. In 2013 the underground diesel line from the Gallup Refinery to the Pilot Travel Center was replaced. The replaced line runs above ground from the marketing area of the refinery for approximately 150 feet and continues underground to the Pilot Travel Center. The diesel line was re-commissioned and put back in service on February 3, 2014.A designated area is used to conduct employee firefighting training. During these training activities waste water and/or wash water drains directly into a dedicated tank that is located in the vicinity. The waste water is removed via a vacuum truck and drained into a process sewer leading to the NAPIS after each training exercise. Oily water and sludge is transferred via vacuum truck to the NAPIS for processing and oil-water separation.The process waste water system is a network of curbing, paving, catch basins, and underground piping that collects waste water effluent from various processing areas within the refinery. The waste water effluent flows into T-27, T-28 and into T-35 (which works in parallel to T-27 and T-28) and into the NAPIS which provides the first stage oil-water separation where the removal of free oil is separated from waste water by gravity. The clarified water is routed to the waste water treatment plant (WWTP) Dissolved Gas Flotation (DGF) system which provides the second stage oil-water separation process. The DGF process involves the pressurization of waste water in the presence of air or nitrogen, creating a super-saturated solution called coagules that are carried to the surface. The float is removed to disposal by mechanical float scrapers and the effluent is recycled back to the flotation chamber. The skimmed float is sent to the DGF float management system, “float tanks”. Oily solids collected in the float tanks are recycled through the refining process (on-site) or handled as a K048 listed hazardous waste for proper disposal.The clarified effluent from the DGF system was designed with the Macro Porous Polymer Extraction (MPPE) system however, the MPPE unit did not perform as expected from a flow rate standpoint. It removed benzene efficiently, but became plugged so that flow rates decreased below adequate levels. In December 2014, the MPPE was removed from service and replaced with the carbon canister system. The two systems ran in parallel for three months in the second half of 2014 followed by trial with carbon canisters for two months before the MPPE was removed from service. Flow rates up to 500 GPM can now be achieved through the carbon system. The waste water that passes through the carbon canisters discharges into the sanitary treatment pond (STP-1). STP-1 has two bays, north and south and each bay is equipped with five aerators. The treated waste water is mixed with air in order to oxidize any remaining organic constituents and increase the dissolved oxygen concentration available in the water for growth of bacteria and other microbial organisms. The microbes degrade most of the hydrocarbons into carbon dioxide and water. Five 15-hp mechanical aerators provide aeration in each bay (North and South) in STP-1. Effluent from STP-1 then flows into evaporation pond 2 (EP-2) and is gravitated to the rest of the ponds.The initial startup of the new WWTP was in May of 2012 which resulted in the decommissioning of Benzene Strippers 1, 2, and 3, and the Aeration Lagoons 1 and 2 (AL-1 and AL-2). In November of 2012, the benzene strippers were taken off-line permanently and completely demolished in January of 2013.At the evaporation ponds, waste water is converted into vapor via solar and mechanical wind-effect evaporation. There are a total of four evaporators located at the ponds. Two 80 GPM, electrically driven water evaporators are located between evaporation ponds 4 and 5 (EP-4 and EP-5) and two additional 66 GPM sprayers were installed between ponds 3 and 4 in October 2014. No waste water is discharged from the refinery to surface waters of the U.S. All treated waste water is routed into several evaporation ponds which have large surface areas that are designed to efficiently evaporate water by sunlight and exposure to the changing ambient temperatures.The stormwater system is a network of valves, gates, berms, embankments, culverts, trenches, ditches, natural arroyos, and retention ponds that collect, convey, control, treat, and release stormwater that falls within or passes through refinery property. Stormwater that falls within the processing areas is handled with the process waste water and is sent to tanks T-27, T-28 and T-35, NAPIS, WWTP, STP-1 and into EP-2 where flow is gravitated to the rest of the evaporation ponds.Stormwater discharge from the refinery is infrequent due to the arid desert-like nature of the surrounding geographical area. Gallup Refinery maintains a Storm Water Pollution Prevention Plan (SWPPP) that includes Best Management Practices (BMPs) for effective storm water pollution prevention and control. The refinery has constructed several berms in various areas and improved outfalls (installed barrier dams equipped with gate valves) to minimize the possibility of potentially impacted runoff leaving the refinery property.

1.3 SITE CHARACTERISTICS

Built in the 1950's, the refinery is located within a rural and sparsely populated section of McKinley County, Jamestown, New Mexico, and located 17 miles east of Gallup, New Mexico. The setting is a high desert plain on the western slope of the Continental Divide. The surrounding land is comprised primarily of public lands and is used for cattle and sheep grazing at a density of less than six cattle or 30 sheep per section. The nearest population centers are the Pilot Travel Center (formerly Giant) refueling plaza, the Interstate 40 highway corridor, and a small cluster of residential homes located on the south side of Interstate 40, approximately 2 miles southwest of the refinery (Jamestown). Surface vegetation consists of native xerophytic vegetation including grasses, shrubs, small junipers and some prickly pear cacti. Average rainfall is less than ten inches per year with the maximum average precipitation occurring during the month of August.

Local topography consists of an inclined down-slope from high ground in the southeast to a lowland fluvial plain in the northwest. The highest point on refinery property is located at the southeast corner boundary (elevation approximately 7,040 feet) and the lowest point is located at the northwest corner boundary (elevation approximately 6,860 feet). The refinery processing facility is located on a flat man-made terrace at an elevation of approximately 6,950 feet.

Surface water in this region consists of man-made evaporation ponds and aeration basins located within the refinery, a livestock watering pond (Jon Myer's Pond) located one mile east of the refinery, two small unnamed spring fed ponds located south of the refinery, and the South Fork of the Puerco River and its tributary arroyos. The various ponds and basins typically contain water consistently throughout the year. The South Fork of the Puerco River and its tributaries are intermittent and generally only contain water during, and immediately after, the occurrence of precipitation.

The 810 acre refinery property site is located on a layered geologic formation. Surface soils generally consist of fluvial and alluvial deposits; primarily clay and silt with minor inter-bedded sand layers. Below the surface layer is the Chinle Formation, which consists of very low permeability clay stones and siltstones that comprise the shale of this formation. As such, the Chinle Formation effectively serves as an aquiclude. Inter-bedded within the Chinle Formation is the Sonsela Sandstone bed, which represents the uppermost potential aquifer in the region. The Sonsela Sandstone bed lies within and parallels the dip of the Chinle Formation. As such, its high point is located southeast of the refinery and it slopes downward to the northwest as it passes under the refinery. Due to the confinement of the Chinle Formation aquiclude, the Sonsela Sandstone bed acts as a water-bearing reservoir and is artesian at its lower extremis. Artesian conditions exist through much of the central and western portions of the refinery property.

Groundwater flow within the Chinle Formation is extremely slow and typically averages less than 10^{-10} centimeters per second (less than 0.01 feet per year). Groundwater flow within the surface soil layer, above the Chinle Formation, is highly variable due to the presence of complex and irregular stratigraphy; including sand stringers, cobble beds, and dense clay layers. As such, hydraulic conductivity may range from 10^{-8} centimeters per second in the clay soil layers located near the surface and up to 10^{-2} centimeters per second in the gravelly sands immediately overlying the Chinle Formation. Figure 4 depicts the regional surface water flows are in a westerly direction and Figure 5 depicts surface water bodies and flow lines.

Shallow groundwater located under refinery property generally flows along the upper contact of the Chinle Formation. Although the prevailing flow direction is from the southeast and toward the northwest; a subsurface ridge has been identified and is thought to deflect some flow in a northeasterly direction in the vicinity of the refinery tank farm.

SECTION 2

SCOPE OF ACTIVITIES 2015

The 2015 quarterly and annual groundwater sampling, and semi-annual evaporation pond sampling was conducted by Western. The third quarter groundwater sampling was combined with the annual sampling event per approval from NMED and OCD and conducted in August 2015. The following is a list of monitoring and inspections completed for 2015:

- Separate Phase Hydrocarbon Recovery Logs – Appendix A
- Field Inspection Logs–Appendix B
- Temporary Land Farm Semi-Annual Sampling – Appendix J
- Data Tables, Analytical Data – Section 8
- Well Data DTW/DTB Measurements (Elevations) – Section 9
- Quarterly, Semiannual, Annual Inspections Summary – Section 10

2.1 MONITORING AND SAMPLING PROGRAM

The primary objective of groundwater monitoring program is to analyze groundwater samples collected and use data to assess groundwater quality at and near the refinery. Groundwater elevation data was collected to evaluate groundwater flow conditions. The groundwater monitoring program for the refinery consists of sample collection and analysis from a series of monitoring, recovery, boundary, process, and shallow monitoring wells, and includes evaporation pond locations.

The groundwater monitoring network is separated into five investigation areas (Group A, Group B, Group C, Group D, and Group E) plus the evaporation ponds and effluent from STP-1 to Pond 1. The sampling frequency, analyses and target analytes vary for each investigation areas. The combined data from these investigation area were used to assess groundwater quality beneath and immediately down-gradient of the refinery, and to evaluate local groundwater flow conditions. Samples were collected annually from all monitoring wells with the exception of recovery and/or monitoring wells that had a measurable separate-phase hydrocarbon (SPH) level. Wells that were purged dry, samples were collected if recharge volume was sufficient for sample collection within a 24-hour period. Wells not sampled due to insufficient recharge were documented in the field logs.

Daily field activities, including observations and field procedures, were recorded for each activity and are maintained at the refinery. Field logs include the following information:

- Sample Location Identification
- Date
- Start and finish sampling time
- Field team members, including visitors
- Weather conditions
- Daily activities and times conducted
- Observations
- Record of samples collected with sample designations
- Photo log (if needed)
- Field monitoring data, including health and safety monitoring (if needed)
- Equipment used and calibration records, if appropriate
- List of additional data sheets and maps completed
- An inventory of the waste generated and the method of storage or disposal
- Signature of personnel completing the field record

All samples collected for analysis are recorded in the field report or data sheets. Chain-of-Custody (COC) forms are completed at the end of each sampling day, prior to the transfer of samples off-site. The signed copy of the COC is placed inside sample containers with the samples and shipped to the laboratory. A custody seal is affixed to the lid of the shipping container. Copies of all COC forms generated are kept at the refinery.

2.2 SAMPLING METHODS AND PROCEDURES

Each monitoring well was gauged for depth to water (DTW), total depth, and depth to product (DTP), if applicable, to determine the amount of water to purge. A minimum of two well volumes is purged from each well prior to sampling. If water level is at a minimum or the well has a low recharge rate, the well is allowed to recharge within 24 hours before a sample is collected. For wells that are not supplied with dedicated pumps, a portable pump is lowered slowly into the well to minimize disturbance to a depth of the midpoint of the screened interval of the well. The pump controller is started at a slow rate and gradually increased until water is discharged. Field water quality measurements must stabilize for a minimum of three consecutive readings taken at 2 to 5-minute intervals, within the following limits before purging will be discontinued and sampling may begin: dissolved oxygen (DO) (10%), specific conductance (3%), temperature (3%), pH (10%).

Groundwater samples were obtained from each well within 24 hours of the completion of well purging. The samples were transferred to an appropriate, clean, laboratory-prepared containers provided by the analytical laboratory. Sample collection methods have been documented in the field monitoring reports. Weather conditions, the volume of groundwater purged, description of water, the instruments used, and the water quality readings obtained at each interval were recorded on the field-monitoring log.

Well purging and sampling were performed using disposable polyethylene bailers and/or appropriate portable sampling pumps where applicable. Some of the wells have dedicated pumps installed where a controller is used to power the submersible pump to purge water. In shallow wells, new disposable bailers were used for each well to hand bail purge water and retrieve water samples. All purged groundwater was collected in 55 gallon drum(s) and/or 5 gallon bucket(s) and drained into the refinery waste water treatment system upstream of the NAPIS. Groundwater samples intended for metals analysis were submitted to the laboratory as total and dissolved metals samples.

At a minimum, the following procedure was followed when collecting/shipping samples:

- Protective eye wear (safety glasses, goggles and or face shield)
- Neoprene, nitrile, or other protective gloves are worn when collecting samples. New disposable gloves are used to collect sample at each sample point.
- All samples collected for chemical analysis are transferred into clean sample containers supplied by the analytical laboratory. Sample containers are clearly marked and labeled.
- Groundwater samples obtained for dissolved metals analysis are filtered through a 0.45 µm (micrometer) mesh size disposable filter on site.
- Samples are labeled, sealed, placed in cooler with ice until they are shipped via United Parcel Service (UPS) Red, Federal Express Overnight or personally delivered to the analytical laboratory.
- Standard COC procedures are followed for all samples collected. The COC form and sample request form are shipped inside the sealed storage container to be delivered to the laboratory, signed and dated.
- Field duplicates and trip blanks are obtained for quality assurance during sampling activities. Trip blanks accompany laboratory sample bottles and shipping and storage containers intended for volatile organic compound (VOC) analyses. Trip blanks consist of a sample of analyte free de-ionized water placed in an appropriate sample container. Trip blanks are analyzed at a frequency of one for each shipping event involving twenty or more samples.

In order to prevent cross-contamination, field equipment that came into contact with water or soil was decontaminated before each sampling event. The decontamination procedure for the portable pump consists of rinsing/washing the equipment with a detergent water mixture followed by two rinses before use in another well. Any equipment that came in contact with each well, such as data loggers or tape measure, was decontaminated with a detergent water mixture and rinsed with distilled water before each use. Decontamination of equipment when feasible is done at the bundle pad where decontamination water is drained into the sewer system.

Decontamination water from field work was caught in an appropriate container and drained into the sewer system upstream of the NAPIS.

2.2.1 EQUIPMENT

- A submersible bladder pump 2 inch, 115 volt AC to DC converter, Grundfos Redi-flo2 constructed of stainless steel with check valve and 1/2 in. Teflon tubing, adjustable rate controller powered by a gas generator is used to purge groundwater from monitoring wells. Equipment is located downwind and at least 20 feet from the well so that exhaust fumes do not cross-contaminate the samples.
- Water level instrument used is a WaterMark Oil Water Interface Meter 100 feet, Model 101L/SMOIL. This instrument measures water and hydrocarbon level; indication is a steady audible tone for water and hydrocarbon indication is an erratic audible tone.
- Parameter Instrument – YSI Model 556 MPS Multi Probe System which simultaneously measures DO, conductivity, temperature, and optional pH and ORP (Oxidation Reduction Potential). As a backup, we also have an IQ Scientific Instrument, Model IQ180GLP which measures pH, DO, TDS (Total Dissolved Solids), conductivity, salinity, ISE (Ion Selective Electrode), mV (Millivolts) and temperature.
- Disposable Bailers – Polyethylene bailer 1.5 inches X 36 inches overall length (OAL) with a capacity of approximately 1 liter and 3 inches X 36 inches OAL. Individually sealed packaging, single check valve bailer with slide in angle cut nozzle for sample removal. A new bailer is used for each well that requires hand bailing for purging and sample retrieval.
- Field equipment parameter instruments were calibrated to known standards in accordance with the manufacturers' recommended schedules and procedures. Calibration checks are conducted before a sampling event and the instruments recalibrated as deemed necessary. Calibration of equipment was noted in the daily field logs.
- If field equipment becomes inoperable, a properly calibrated replacement instrument is used in the interim. Type of instrumentation used during a sampling event is recorded in the daily field logs.

2.3 COLLECTION AND MANAGEMENT OF INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during each groundwater sampling event includes purged water, decontamination water, excess sample material, and disposable sampling equipment. All water purged from monitoring wells generated during sampling and decontamination activities was temporarily stored in a labeled 55-gallon drum(s) and/or 5 gallon bucket(s) and then drained into the refinery sewer system upstream of the NAPIS.

2.4 COLLECTION OF SURFACE WATER SAMPLES

At the evaporation ponds, grab samples were collected near the inlets (pond edge). This location was noted in the field notebooks. For outfalls, a grab sample was collected at the pipe end, and recorded in the field log.

2.5 ANALYTICAL METHODS

Groundwater and surface water samples collected during the monitoring events were analyzed for the constituents listed in Table 1, Section 10.0. In addition, the WQCC standard was used for total and dissolved metals analysis.

2.6 PERIMETER INSPECTION

Perimeter inspections are part of the daily routine for refinery personnel to report any hydrocarbon staining, spills or any release that could result in material leaving the property boundary.

2.7 REMEDIATION ACTIVITIES

A site investigation of the refinery tank farm network conducted in 1987 indicated high concentrations of BTEX constituents in the groundwater as well as hydrocarbons. As a result of the findings from additional site investigations conducted from 1987 through 1990, four recovery wells (RW-1, RW-2, RW-5, and RW-6) were installed to recover the SPH. SPH has been recovered from RW-1 using a submersible bladder pump and from RW-5 and RW-6 by hand-bailing using a disposable polyethylene bailer. Tables in Appendix A summarizes measurements, volume of product and water purged and also provides year to date (YTD) product purged from each well. RW-2 is listed as a recovery well but to date no visible hydrocarbon layer or odor has been observed in this well during quarterly inspections.

In RW-1 a bladder pump was used to pump out SPH on a quarterly basis into a labeled 55-gallon drum. Visible layer of floating product in the drum was measured with a tape measure and calculated as best as possible for volume of product recovered. In RW-5 and RW-6, a 3 foot disposable hand bailer was used to extract product and water from the wells. Bailed water was collected in a 5-gallon bucket and the visible layer of floating product was then measured with a tape measure to estimate volume of SPH recovered. The purged water was drained into the refinery waste water treatment system upstream of the NAPIS.

Although the SPH thickness level in RW-1 has generally increased since the first quarter of 2013, hydrocarbon recovery from RW-1 has shown a general decrease from 2005 through 2015. In 2015, total hydrocarbon recovery is estimated at 2.0 gallons in 54 gallons of water purged compared to the 2005 estimate of 431 gallons of hydrocarbons in 1,210 gallons of water. No measureable hydrocarbons have been detected in RW-2 since the well was installed. RW-5 and RW-6 have shown a steady decrease in hydrocarbons since 2005 and no SPH has not been detected since February 2009 and November 2011, respectively. Hydrocarbon recovery logs are included in Appendix A.

On June 26, 2013, notification of the discovery of a hydrocarbon seep to the land surface was made to NMED and OCD. The area has been identified as the “Hydrocarbon Seep”, located directly west of crude Tanks 101 and 102. Response actions have included installation of six temporary sumps, and to date a total of 44 permanent monitoring wells (MKTF-1 through MKTF-44) have been installed to monitor ground water impacts. From June 2013 through December 2015 total hydrocarbon recovery is estimated to be 1,071 gallons and 188,634 gallons of water from the sumps. Of the 44 permanent monitoring wells installed, twelve (MKTF 3, 5, 6, 7, 8,12, 13, 14, 15, 36, 37, and 45) wells had measureable layers of product in 2015. Hydrocarbon recovery from these wells is estimated at 11.2 gallons when wells were pumped in February and June 2015. The twelve wells identified to have a product layer will be pumped on a more frequent basis to determine recharge rate and recovery of hydrocarbons. Hydrocarbon recovery data is included in Appendix A.

SECTION 3

GROUNDWATER DTW / DTP ELEVATION

Groundwater elevation data were collected from the wells listed in Table 1, Section 10.0. A summary of field measurements (DTW, DTP) taken during the quarterly, semi-annual and annual inspections is included in Section 9. Groundwater levels and SPH column thickness measurements (from the RW series of wells as well as the MKTF wells) were collected quarterly to monitor groundwater elevation and product column thickness fluctuations over time. Maps were generated using elevation data collected from surveys conducted by DePauli Engineering and from Hammon Enterprises Inc., professional surveyor and data from the 2015 field inspection logs.

Field notes and measurement data were recorded in field logs for each well for 2015 and are located in Appendix B. The depth to groundwater and SPH column thickness levels were measured to the nearest 0.01-ft. The depth to groundwater and SPH column thickness are recorded relative to the surveyed well casing rim or other surveyed datum. A corrected water table elevation is provided in wells containing SPH by adding 0.8 times the measured SPH column thickness to the measured water table elevation (Section 9).

All water/product levels are measured to an accuracy of the nearest 0.01-ft using a WaterMark Oil Water Interface Meter, Model 101L/SMOIL (100 ft)I. After the water level is determined, the well volume is calculated using the height of the liquid column and the internal cross sectional area of the well. The purge volume is a minimum of two times the well volume.

Groundwater and SPH levels were measured in all wells within 48 hours of the start of groundwater sampling activities. All manual extraction of SPH and water from recovery wells, observation wells, and collection wells is discontinued for 48 hours prior to the measurement of water and SPH levels. Figure 6 (Section 11) shows the locations of all active wells.

SECTION 4

REGULATORY CRITERIA

Laboratory analytical data is compared to the most current regulatory standards (Appendix C) at time of submission of report.

- New Mexico 20NMAC 20.6.2.3103 (WQCC). Standards for Groundwater of 10,000 mg/L TDS Concentration or Less
- EPA 40 CFR 141.62. National Primary Drinking Water Regulations (Updated November 2015) (EPA MCL)
- NMED Tap Water Screening Levels (July 2015)
- EPA Regional Screening Levels set for Residential Risk-Based Screening Levels (EPA RSL) for Tap Water (Ross) (November 2015)

SECTION 5

GROUNDWATER ELEVATIONS

Groundwater elevations are depicted in the following maps using data from the 2015 quarterly, annual sampling event. In addition, graphs of the water levels are included in Figures 11 – 11.4, 11-A and 11-B

- Figure 7 (Section 11) presents a south-north geologic profile (east side of the refinery) showing contours of monitoring wells with reference to stratigraphic locations in which the water bearing zones are located.
- Figure 8 (Section 11) presents a south-north section on the west side of the refinery showing contours of monitoring wells with reference to stratigraphic locations in which the water bearing zones are located.
- Figure 14 (Section 11) represents a geologic profile for the west-east well locations.

SECTION 6

GROUNDWATER MONITORING RESULTS

All analytical data tables referenced in the following subsections are included in Section 8 of this report. Bold and highlighted values indicate a constituent exceeds a listed standard(s). Due to requirements for field preservation of samples, some samples have the results for nitrite and nitrate reported as a single value of nitrogen. In these instances, the value is conservatively listed for both nitrite and nitrate and a comparison is made between the reported concentration and the regulatory standards for both nitrite and nitrate. This may result in false indication of nitrite exceeding the regulatory standard. Plots of the reported concentrations are provided in a series of Figures numbered 15 through 17.Laboratory data for 2015 sampling events are available on the CD provided in Appendix G.

6.1 CONSTITUENT LEVELS IN GROUP A MONITORING WELLS

Group A wells are located within the northwest corner of the refinery property. Nine monitoring wells are situated along the refinery boundary and six monitoring wells are within the RCRA LTU area.

6.1.1 Boundary Wells (BW-1A/1B/1C, BW-2A/2B/2C, BW-3A/3B/3C)

The nine boundary wells (BW), down gradient of the Refinery property, are screened within three different stratigraphic units. BW-1A, BW-2A, and BW-3A are screened within the Upper Sand stratigraphic unit (Figure 12); BW-1B, BW-2B, and BW-3B are screened in the Chinle/Alluvium Interface stratigraphic unit (Figure 10); and BW-1C, BW-2C and BW-3C are screened within the Sonsela stratigraphic unit (Figure 9).

The BW-1A, BW-1B, and BW-1C wells are located on the elevated dike separating evaporation pond 7 (EP-7) and evaporation pond 8 (EP-8). BW-2A, 2B, and 2C are located on the northwest edge of evaporation pond 11 (EP-11) and BW-3A, 3B, and 3C are located in the field north of evaporation ponds 12A and 12B (EP-12A and EP-12B). The boundary wells are sampled on an annual basis and evaluated for the following analytes: 8260B plus MTBE,gasoline range organics, (GRO), diesel range organics (DRO) and motor oil range organics (MRO), major cations/anions, and WQCC total and dissolved metals.

Wells BW-1A, BW-3A, and BW-1B contained no water on the fluid-level gauging date of August 10, 2015, and were not sampled. The boundary wells were sampled and/or inspected on the following dates:

WELL ID	DATE
BW-1C	8/12/15
BW-2A	8/12/15
BW-2B	8/12/15
BW-2C	8/12/15
BW-3B	8/12/15
BW-3C	8/12/15

- The 2015 annual sample event results indicate BTEX and MTBE constituents were not detected in BW-1C, BW-2A, BW-2B, BW-2C, BW-3B or BW-3C. BTEX and MTBE constituents have not been detected in these wells since 2006 (Table 8.1)..

- Fluoride was detected above the WQCC standard of 1.6 mg/L in BW-1C (2.5 mg/L), BW-2B (1.8 mg/L) and BW-2C (1.9 mg/L). Nitrite was detected in one sample (BW-2B at 1.5 mg/l) above the standard of 1.0 mg/l Low concentrations of chloride and sulfate were detected in each of the BW wells sampled in 2015. Low concentrations of bromide were detected in BW-2A, BW-2B, BW-2C, ~~and~~ BW-3B and BW-3C. Phosphorus exceeded applicable standards in BW-2A and BW-3B (Table 8.1.1).

- Low concentrations of arsenic, barium, iron, ~~and~~ manganese, uranium and zinc were detected in the BW wells with BW-2B and BW-3C exceeding the WQCC standard for iron in 2015. Chromium was previously detected in BW-1C (2012) and cadmium in BW-2C (2012) at concentrations above applicable cleanup standards. Both constituents were reported below the detection limits since August 2012. The remaining total metals analyzed for each well did not exceed applicable standards (Table 8.1.2). No dissolved metals analyzed exceeded applicable standards; however, low concentrations of arsenic, barium, iron, lead, ~~and~~ manganese, uranium and zinc were detected in most of the wells (Table 8.1.3).

- Bis(2-ethylhexyl)phthalate was detected in BW-1C in 2013, in BW-3B in 2009, and BW-3C in 2011 and may possibly be a lab contaminant or from the PVCC pipe materials used as casing in these wells. The constituent was not detected in any of the BW wells sampled in 2014. As of 2015, SVOCs were removed from analytical requirement (Table 8.1.4).

- It is noted that the fluoride concentrations detected in BW-1C, BW-2B and 2C are slightly above the WQCC standard of 1.6 mg/L. Inspection of the analytical data obtained from the pond samples (Table 8.16) indicates that if they were the source, the slightly elevated fluoride concentration would also be accompanied by elevated chloride concentrations since they are encountered at substantially higher concentrations in the ponds than the fluorides. Since the chloride concentrations detected in the BW wells are well below the regulatory standards, it is unlikely that the ponds are the source of the fluoride concentrations. It is possible that the fluorides are

Formatted: Font color: Auto

migrating from an area upgradient of the ponds as similar concentrations are observed in that direction.

6.1.2 Land Treatment Unit (MW-1, MW-2, MW-4, MW-5, SMW-2, and SMW-4)

The LTU groundwater monitoring wells include MW-1, MW-2, MW-4, MW-5, SMW-2, and SMW-4. MW-1, SMW-4, and MW-2 are located down gradient along the north edge of the closed RCRA LTU. MW-5 and SMW-2 are located on the eastern perimeter of the LTU and MW-4 is located up gradient (south) of the LTU. MW-1, MW-2, MW-4, MW-5 are screened within the Sonsela stratigraphic unit. SMW-4 is screened within the Chinle/Alluvium Interface and SMW-2 is screened in both the Chinle/Alluvium Interface and Upper Sand stratigraphic units.

The LTU monitoring wells are sampled on an annual basis. In addition, MW-1, MW-2, MW-4, and MW-5, SMW-2 and SMW-4 are sampled every 10 years to comply with the RCRA Post Closure Permit. Annual samples were analyzed for the following analyses: 8260B plus MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, cyanide, and additional VOCs and SVOCs.

Annual sampling and inspections for 2015 on the LTU monitoring wells were completed on the following dates:

WELL ID	Date
MW-1	8/14/15
MW-2	8/14/15
MW-4	8/17/15
MW-5	8/14/15
SMW-2	8/17/15~~17~~
SMW-4	8/14/15

The next 10 year RCRA Post Closure Permit sampling event for MW-1, MW-2, MW-4, MW-5, SMW-2 and SMW-4 is scheduled to occur in 2019. The following analyses are evaluated during the RCRA Post Closure Permit sample event: modified Skinner List for VOCs, SVOCs, total petroleum hydrocarbons (TPH), DRO, GRO, MRO, metals to include mercury and cyanide, and major cations/anions with pH and conductance.

- With the exception of a low concentration of MTBE in SMW-2, no concentrations of BTEX or MTBE were not detected in any of the LTU wells in 2015. Low concentrations of MTBE, not exceeding applicable standards (0.~~0.~~143 mg/L), have historically been detected in SMW-2 (Table 8.3).

- In accordance with the NMED Disapproval letter dated January 31, 2018, Andeavor has reference the groundwater cleanup levels for DRO, GRO, and MRO provided in the 2017 Risk Assessment Guidance for Investigating and Remediation document, Table 6-4 (page 95). At the time that this report was submitted for review, there were no cleanup levels established by the NMED. Therefore, the groundwater protection standard provided in the 2017 guidance have been used for comparison to groundwater analytical data. In using the 2017 cleanup standards it is noted that the detection limits for DRO (1.0 mg/L) and MRO (5.0 mg/L) are higher than the groundwater protection standards published in the 2017 guidance document of 0.0452 mg/L and 0.0902 mg/L respectively. Since 2011~~08~~, GRO has been detected in SMW-2 (0.78 mg/L for 2015). DRO and GRO were not detected above the applicable analytical detection limits ~~standards limits~~ for the remaining LTU monitoring wells. Concentrations of MRO have not been reported above the applicable detection limits ~~standards~~ in any of the LTU monitoring well since being added to the sampling plan in 2010.

- Low concentrations of fluoride were detected in each of the LTU monitoring wells with the exception of SMW-2. In SMW-2, concentrations of chloride (3000 mg/L) and sulfate (1600 mg/L) have exceeded the WQCC standards of 250 mg/L and 600 mg/L, respectively. SMW-2 has a history of exceeding the WQCC standard for these two anions. The remaining LTU monitoring wells had concentrations of chloride and sulfate below the applicable standards. Concentrations for the remaining major list of anions and cations were not detected above the applicable standards in each of the LTU monitoring wells (Tables 8.2.1 and 8.3.1).

- Concentrations of arsenic and barium remain below the applicable standards for each of the LTU monitoring wells. Concentrations of selenium, mercury and zinc were not detected above the detection limits in 2015 in each of the LTU monitoring wells. Low concentrations of barium and manganese were detected in all of the LTU monitoring wells with the exception of SMW-2. SMW-2 exceeded the WQCC standard for manganese (0.2 mg/L) since 2011 with a 2015 concentration of 0.33 mg/L. Low concentrations of total iron were detected in MW-1, MW-2, SMW-2, and SMW-4, and low concentrations of total lead were detected in MW-1 and SMW-4. A low concentration of dissolved iron was detected in SMW-2. Total and dissolved uranium levels have exceeded the WQCC standard (0.03 mg/L) for SMW-2 and SMW-4 since 2011 and again in 2015 with uranium detected at 0.12 mg/L (total) in SMW-2 and at 0.036 mg/L (total) in SMW-4. Uranium was detected in lower concentrations for the remaining LTU monitoring wells (Tables 8.2.2 and 8.3.2).

- Neither VOCs nor SVOCs were detected above applicable standards in any of the LTU wells in 2015 (Tables 8.2.4 and 8.3.4).

6.2 CONSTITUENT LEVELS IN GROUP B MONITORING WELLS

There are ten monitoring wells in Group B, not including the three leak detection units. These wells are located within the aeration basin west of the refinery tank farm. Group B includes three groundwater monitoring wells (GWM), four monitoring wells for the New American Petroleum Institute Separator (NAPIS), three leak detection units (LDU), OAPIS-1 installed in 2012 as a result of the Solid Waste Management Units (SMWU) No. 1, Aeration Basin and SMWU No. 14, Old API Separator site investigation. Two new monitoring wells (STP1-NW and STP1-SW), were installed at the sanitary treatment pond (STP-1) in May 2014.

6.2.1 GROUNDWATER MONITORING WELLS (GWM-1, GWM-2, GWM-3)

The GWM series of wells are all screened in the Chinle/Alluvium Interface stratigraphic unit. GWM-1 and GWM-2 are located on the west side of the aeration basin straddling the dike that separates AL-2 and EP-1. Downgradient from GWM-1 and GWM-2 is GWM-3 located on the northwest corner of EP-1. These wells are inspected and sampled on a quarterly basis. No groundwater was detected in GWM-2 and GWM-3 during 2014 and 2015.

Groundwater samples from GMW-1 were analyzed for the following constituents: BTEX, MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, and VOCs and SVOCs.

Quarterly inspections and sampling of the GMW wells were completed on the following dates:

Well ID	Date	Date	Date	Date
GWM-1	3/10/15	6/2/15	8/24/15	10/29/15
GWM-2	3/10/15	6/2/15	8/11/15	10/29/15
GWM-3	3/10/15	6/2/15	8/11/15	10/29/15

- No groundwater sample was collected from GWM-1 in the fourth quarter 2015 due to presence of PSH.

- Concentrations of benzene in GWM-1 exceeded the EPA MCL standard (0.005 mg/L) for all four quarters since 2006 with the exception of the fourth quarter in 2012. The highest concentration of benzene (0.012 mg/L) for first quarter of 2010, fourth quarter of 2014, and second quarter of 2015 ~~was recorded in the fourth quarter~~. Concentrations of ethylbenzene, toluene, xylenes, and MTBE remain within the applicable standards for GWM-1 in 2015 (Table 8.4).

- Concentrations of DRO and GRO were detected in GWM-1 with DRO exceeding the WQCC 2013 standard (0.2 mg/L) throughout 2013, 2014 and 2015. DRO has also exceeded applicable standards since quarter 3 of 2010 through quarter one of 2012. The highest concentration of DRO in GMW-1 was detected in the third quarter 2015 at a concentration of 250 mg/L.

- Concentrations of fluoride exceeding the WQCC standard (1.6 mg/L) have been prevalent since 2006 in GWM-1 with the exception of quarter four in 2011. In 2015, quarter two recorded the highest concentration of fluoride in GWM-1 at 2.7 mg/L. Chloride has exceeded the WQCC standard (250 mg/L) consistently in GWM-1 since 2006 with the highest 2015 readings recorded during quarter two and three at 1,100 mg/L. ~~Bromide concentrations have consistently been detected in GWM-1 since 2006.~~ Nitrate and nitrite concentrations remain within applicable standards (Table 8.4.1).

- Concentrations of total and dissolved arsenic, iron, and manganese in GWM-1 have exceeded applicable standards since 2008. The highest total arsenic and iron concentrations for 2015 were detected in quarter three. Manganese concentrations for 2015 averaged 2.2 mg/L which exceeds the WQCC standard (0.2 mg/L). Low concentrations of total chromium were detected in the second quarter of 2015. ~~and~~ Low concentrations of zinc were detected during ~~quarter three~~ the first, second and third quarters of 2015. Low concentrations of both total and dissolved zinc have been detected in GWM-1 since 2009. Total and dissolved barium and total lead concentrations, were detected within the applicable standards for all of 2015. Concentrations of the remaining total and dissolved metals did not exceed the applicable standards during 2015 (Tables 8.4.2 and 8.4.3).

- Concentrations of VOCs and SVOCs detected above the applicable standards in the third quarter 2015 include naphth~~th~~alene, 1-methyl naphthalene, benz(a)anthracene, benzo(a)pyrene, chrysene, fluorene, 1-methyl naphthalene, 2-methyl naphthalene, phenanthrene, and pyrene. Low concentrations of 1,2,4-trimethylbenzene have historically been detected in GWM-1, but constituent concentrations have been below the applicable standard (0.015 mg/L) since the second quarter of 2013 (Table 8.4.4). Low concentrations of 1,3,5-trimethylbenzene were detected in GMW-1 in 2015.

GWM-2 and GWM-3 were installed and developed in 2005. The wells are checked quarterly for the presence of water. If water is detected, NMED and OCD are notified within 24 hours of discovery. The water is purged from the well and re-measured to calculate the potential recharge rate. Groundwater samples are collected when water level is sufficient.

Groundwater was first observed in GWM-2 during the first quarter of 2008. The depth to water was 18.45 feet with an estimated water column height of 0.36 feet. Samples were collected and the well was bailed dry. GWM-2 did not recharge and remained dry until quarter three of 2010. GWM-2 continued to recharge as samples were collected throughout 2011, 2012, and most of 2013. GWM-2 has had an insufficient volume for sampling since quarter four of 2013 and remained dry throughout 2015. Similar to GWM-2; GWM-3 was first sampled in the third quarter of 2010. Samples were consistently collected throughout 2011 and 2012. In late 2012 through early 2013 the levels in the aeration lagoons dropped approximately one to two feet and gravitational flow between lagoons to EP-1 began to decrease. GWM-3 has remained dry since quarter one of 2013.

6.2.2 GROUNDWATER MONITORING WELLS: NAPIS-1, NAPIS-2, NAPIS-3, AND KA-3

The NAPIS groundwater monitoring wells are located east of AL-1. NAPIS-1 is an up gradient well located on the southeast side of the separator. The NAPIS-2 monitoring well is located in the southwest corner of the bay to the separator, and NAPIS-3 is located in the northwest corner. KA-3 is located between NAPIS-2 and NAPIS-3 on the west side of the bay to the separator unit. These wells are screened in the Chinle/Alluvium stratigraphic unit with three of the wells (NAPIS-2, NAPIS-3, and KA-3) installed subsurface.

The NAPIS and KA wells are sampled on a quarterly basis. In agreement with OCD and approved by NMED, the third quarter sampling is combined with the annual sampling event. Groundwater samples were analyzed for the following parameters: BTEX, MTBE, major cations/anions, WQCC total and dissolved metals, and VOCs and SVOCs. When applicable, standing water is removed from the vault of the three sub-surface wells prior to opening and sampling each well. The standing water is placed into a container for proper disposal.

Quarterly inspections and sampling were completed for the NAPIS and KA wells on the following dates:

Well ID	DATE	DATE	DATE	DATE
NAPIS-1	3/10/15	6/2/15	8/11/15	10/28/15
NAPIS-2	3/10/15	6/2/15	8/11/15	10/28/15
NAPIS-3	3/10/15	6/2/15	8/11/15	10/28/15
KA-3	3/10/15	6/2/15	8/11/15	10/28/15

- BTEX and MTBE have remained below the applicable standards since 2008 for NAPIS-1. Benzene and MTBE concentrations in NAPIS-2 have exceeded the applicable standards since 2008 and remained in exceedance for 2015. BTEX and MTBE were not detected in NAPIS-3. Monitoring well KA-3 has had concentrations of benzene and MTBE exceeding applicable standards prior to the third quarter of 2013; however, concentrations have remained below the applicable standards since the fourth quarter of 2013 (Table 8.5).
- Concentrations of DRO, GRO, or MRO have been below the applicable standards since 2008 for NAPIS-1 and NAPIS-3 (MRO since 2010) (Table 8.5.1).
- In NAPIS-2, DRO concentrations have consistently exceeded the WQCC standard from 2008 through quarter three of 2012 with exceedances also recorded in quarter one, two, and four of 2013, the first three quarters of 2014 and quarters one and four in 2015. Low concentrations of GRO have also been detected in NAPIS-2 (Table 8.5.1).
- KA-3 has historically exhibited exceedances in DRO from 2009 through early 2012 (Table 8.5.1), but has not been detected since the first quarter of 2012.
- Low concentrations of fluoride, chloride, ~~nitrite,~~ nitrate, and sulfate were detected in NAPIS-1 in 2015. Concentrations of nitrite were above the applicable cleanup standard in all four quarters of 2015 (Table 8.5.1).

- Fluoride and chloride concentrations in NAPIS-2 have exceeded the WQCC standards of 1.6 mg/L and 250 mg/L, respectively, for at least one quarter of each year since 2008 (since 2009 for fluoride) and continued to occasionally exceed applicable standards in 2015 (Table 8.5.1).

- Chloride, nitrite and nitrate concentrations in NAPIS-3 exceeded applicable standards (250 mg/L, 1~~0~~ mg/L and 10 mg/L, respectively) during most of 2015 and have historically exceeded these standards since 2008. Fluoride levels have remained below the applicable standards for NAPIS-3 since 2008 (Table 8.5.1).

- Fluoride, chloride and sulfate concentrations in KA-3 have remained below the WQCC standard since June of 2013 (Table 8.5.1).

- Concentrations of bromide and sulfate were detected in all of the NAPIS and KA wells during 2015. Nitrite and nitrate concentrations exceeding the applicable standards (1~~0~~ mg/L and 10 mg/L, respectively) have historically been sporadic for each of the NAPIS and KA wells. There were no exceedances of any of these parameters in 2015 (Table 8.5.1).

- Total iron concentrations exceeded the WQCC standard of 1.0 mg/L in NAPIS-2 (3.3 mg/L) and NAPIS-3 (1.6 mg/L), and total manganese concentrations exceeded the WQCC standard of 0.2 mg/L in NAPIS-2 (1.2 mg/L) and KA-3 (1.7 mg/L) as shown on Table 8.5.2.

- From 2010 through 2015, total and dissolved barium, iron, and manganese have exceeded the applicable standards in NAPIS-2 (Tables 8.5.2 and 8.5.3).

- In NAPIS-3, total and dissolved uranium and total iron exceeded applicable standards during 2015 (Tables 8.5.2 and 8.5.3).

- The total manganese concentration for NAPIS-3 exceeded the applicable standard in the first quarter of 2015.

- In monitoring well KA-3, total and dissolved manganese detected above the applicable standards during 2015 (Tables 8.5.2 and 8.5.3).

- Concentrations of 1-methyl naphthalene (0.0061 mg/L) and naphthalene (0.0033 mg/L) exceeded applicable standards (0.0011 mg/L and 0.00165 mg/L, respectively) in NAPIS-2 during 2015. No other VOCs or SVOCs were detected in the NAPIS and KA wells during 2015 (Table 8.5.4).

6.2.3 LEAK DETECTION UNITS (LDU): EAST LDU, OIL SUMP LDU, WEST LDU

The NAPIS secondary containment units otherwise known as leak detection units (LDU) are installed on the east and west bay of the NAPIS unit. The East LDU is located on the southeast corner in the east bay of the NAPIS unit between the unit and NAPIS-1. The Oil Sump LDU is located north of the East LDU on the northeast corner of the NAPIS unit. The West LDU is located in the southwest corner of the west bay of the NAPIS unit. The LDUs were monitored in 2010 as part of the 2010 Facility Wide Groundwater Monitoring Work Plan (FWGWMP).

The LDU are sampled and inspected on a quarterly basis. In agreement with OCD and approved by NMED, the third quarter sampling was combined with the annual sample event. The LDUs were sampled for the following analytes in 2015: BTEX, MTBE, DRO, GRO, MRO, WQCC total and dissolved metals, and VOCs.

Oil Sump LDU was dry all four quarters and therefore not sampled. There was not enough water in West LDU to collect a sample during the second quarter 2015.

Quarterly inspections and sampling were completed for the LDU wells on the following dates:

Sample ID	Quarter 1	Quarter 2	Quarter 3	Quarter 4
East LDU	3/10/15	6/3/15	8/11/15	10/29/15
West LDU	3/10/15	6/3/15 (not enough water to sample)	8/11/15	10/29/15

- Benzene, total xylenes, DRO, and GRO concentrations exceeded the applicable standards in the East LDU during each quarter of 2015. The toluene standard was exceeded in the second and third quarters of 2015 Low concentrations of ~~toluene and~~ ethyl benzene were also detected in the East LDU during each quarter of for 2015. MTBE was also detected in the fourth quarter at concentrations below the cleanup standard.

- All BTEX parameters exceeded the applicable standards in the West LDU with the highest detection of benzene (2.7 mg/L) in quarter three 2015. DRO and GRO exceeded the NMED Tap Water standard (0.2 mg/L) in each well since 2010 (Table 8.6).

- Total and dissolved chromium, iron, and manganese concentrations were detected above the applicable standards in the East and West LDU wells during 2015. Concentrations of arsenic, barium and zinc were also present in these two ~~wells~~LDUs and have historically been present in all three LDU wells. Historically, low concentrations of total and dissolved selenium have been present in each of the LDU wells while cadmium, lead, and silver remained below the applicable standards. Manganese has been present in each of the three wells since 2010. Chromium levels have fluctuated; falling below the applicable standards for the East LDU in September of 2010 through March of 2011 and falling below applicable standards for the West LDU in quarter one and two for 2012 and 2013, respectively (Tables 8.6.1 and 8.6.2).

- Concentrations of 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, naphthalene, 2-methyl naphthalene, and 1-methylnaphthalene exceeded the EPA RSL and NMED standards in the East LDU. Concentrations of 1,2,4-trimethylbenzene, naphthalene, and 2-methylnaphthalene exceeded EPA RSL and NMED standards in the West LDU (Table 8.6.3).

6.2.4 GROUNDWATER MONITORING WELL: OAPIS-1

The OAPIS-1 groundwater monitoring well was installed in 2012 on the southeast edge of AL-2 as a result of the Investigation Work Plan for SMWU No. 1 (Aeration Basin) and SMWU No. 14 (Old API Separator). The OAPIS–1 well is screened in the Chinle/Alluvium Interface stratigraphic unit. The OAPIS-1 well was added to the quarterly sample schedule in 2013. In agreement with OCD and as approved by NMED, the third quarter sample event was combined with the annual sample event.

In 2015, groundwater samples were collected from OAPIS-1 for the following analytes: BTEX, MTBE, , DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, cyanide, VOCs and SVOCs.

The OAPIS-1 well was inspected and sampled on the following dates in 2015:

WELL ID	Date	Date	Date	Date
OAPIS-1	3/10/15	6/2/15	8/11/15	10/29/15

Formatted Table

- Benzene and MTBE concentrations exceeded the EPA MCL standards (0.005 mg/L and 0.143 mg/L, respectively) for each quarterly sample event during 2014 and 2015. Concentrations of ethylbenzene were also present but remained below the applicable standard. Toluene and xylenes were below the applicable standards for 2015 (Table 8.7).
- In 2015, DRO and GRO concentrations were detected at 7.1 mg/L and 0.8 mg/L, respectively. Fluoride and chloride concentrations exceeded the WQCC standards of 1.6 mg/L and 250 mg/L, respectively, with the highest concentration recorded in 2015 at (1.9 mg/L fluoride; 2000 mg/L chloride). Concentrations of bromide and sulfate were also present but remain below the applicable standards (Table 8.7.1).
- Total and dissolved arsenic, iron, and manganese concentrations exceeded the applicable standards in most of 2015~~ with the exception of dissolved arsenic~~. Total cyanide exceeded the EPA RSL standard (0.0014 mg/L) during 2015 with the highest concentration recorded in quarter two (0.0887 mg/L). Total and dissolved cadmium and silver, total mercury, and dissolved chromium and copper were below the detection limits with the exception of quarter two in 2015 when low concentrations of dissolved chromium were detected (Tables 8.7.2 and 8.7.3).
- Naphthalene and 1-methylnaphthalene concentrations exceeded applicable standards in 2015. No other VOCs or SVOCs exceeded the applicable standards in 2015 (Table 8.7.4).

6.2.5 STP1-NW and STP1-SW

Monitoring well STP1-NW is located on the west end of STP-1 north bay and STP1-SW is located on the southwest corner of the south bay of STP-1. These wells were installed in May of 2013. Ground water samples were analyzed for the following analystes: 8260B plus MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, cyanide and SVOCs. The sample location was inspected and sampled on the following dates:

The STP1-NW and STP1-SW wells were inspected and sampled on the following dates in 2015:

Well ID	Date	Date	Date	Date
STP1-NW	3/10/15	6/2/15	8/11/15	10/29/15
STP1-SW	3/10/15	6/2/15	8/11/15	10/29/15

- STP1-SW was dry during all quarters of 2015 and therefore not sampled.
- There were no BTEX, MTBE, DRO, GRO, or MRO constituents detected above applicable standards in 2015 (Table 8.8).
- With the exception of the third quarter 2015, chloride, nitrite and nitrate concentrations exceeded applicable standards during each sampling event (Table 8.8).
- Total iron concentrations exceeded the standard of 1.0 mg/L during the first three quarters of 2015. Low concentrations of arsenic, barium, chromium, lead, manganese, selenium, uranium, and zinc were also detected (Tables 8.8.1 and 8.8.2).
- No VOCs or SVOCs were detected above applicable standards (Table 8.8.3).

6.3 CONSTITUENT LEVELS IN GROUP C MONITORING WELLS

The Group C wells include six observation wells (OW-13, OW-14, OW-29, OW-30, OW-50, and OW-52) located on level terrain northeast of the refinery tank farm, and four recovery wells (RW-1, RW-2, RW-5, and RW-6) located within the refinery tank farm. Observation wells OW-50 and OW-52 were installed in 2009 to monitor potential migration of constituents. The recovery wells were installed between 1987 and 1990 and have been used to recover SPH.

6.3.1 OBSERVATION WELLS: OW-13, OW-14, OW-29, and OW-30

The observation wells OW-14, OW-29, and OW-30 are screened in the Chinle/Alluvium Interface; observation well OW-13 is screened in the Sonsela stratigraphic unit. OW-13 is down gradient (north) of the tank farm and OW-14 is up gradient and adjacent to the LPG tank farm. OW-29 is located directly north of OW-14 and OW-30 is situated northeast of OW-14 along the east side of the railroad spur entering the refinery property from the north. These observation wells are sampled quarterly and in agreement with OCD, approved by NMED, the third quarter sampling event is combined with the annual sampling requirement per the OCD discharge permit.

Groundwater samples were collected from these observation wells and submitted for laboratory analyses of the following analytes: BTEX, MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, and VOCs and SVOCs.

Observation wells OW-13, OW-14, OW-29, and OW-30 were sampled on the following dates in 2015:

Well ID	Quarter 1	Quarter 2	Quarter 3	Quarter 4
OW-13	3/9/15	6/1/15	8/11/15	10/27/15
OW-14	3/9/15	6/1/15	8/10/15	10/27/15
OW-29	3/9/15	6/1/15	8/11/15	10/27/15
OW-30	3/9/15	6/2/15	8/10/15	10/27/15

- BTEX constituents were not detected in OW-29 or OW-30 during 2015; the wells have not had detectable BTEX concentrations since 2006. (Table 8.9). However, it is noted that the benzene concentrations in OW-14 have been rising since it's installation in 2010. A revised work plan for investigating the source of the rising concentrations was submitted to the NMED for review and approval. Upon execution of the work plan a report will be generated that discusses the issue in detail.

- Low concentrations of MTBE were detected in OW-13 in 2015, but each detected concentration was well below the standard. Concentrations of MTBE in OW-14, OW-29, and OW-30 during 2015 were all above the standard, with the highest being in OW-30 during the first quarter at 4.0 mg/L. MTBE concentrations in these three observation wells have been above the standard since at least 2009 (Table 8.9).

- Low concentrations of GRO were detected in each observation well during 2015 except for well OW-13. MRO was not detected in any of these observation wells during 2015. Low concentrations of DRO were detected in OW-14 and OW-30. (Table 8.9.1).

- In 2015, concentrations of fluoride, bromide, nitrate, and sulfate were detected in each of the four observation wells, however concentrations remain below applicable standards. Concentrations of chloride have exceeded the standard of 250 mg/L in OW-14 in 2013 through 2015 (Table 8.9.1).

- No concentrations of total or dissolved metals were detected above applicable standards in well OW-13 in 2015. In well OW-14, concentrations of total and dissolved barium, iron, and manganese were above applicable standards in 2015; the concentrations detected are similar to previous years. In well OW-29 during 2015, concentrations of total and dissolved manganese and uranium were above applicable standards, and are similar to previous years. In well OW-30, concentrations of total and dissolved uranium were above the standard of 0.03 mg/L and have been since 2012 (Tables 8.9.2 and 8.9.3).

- In 2015, no VOCs and SVOCs were detected in OW-13, OW-14, OW-29, and OW-30 (Table 8.9.4).

6.3.2 OBSERVATION WELLS: OW-50 and OW-52

Observation wells OW-50 and OW-52 were installed up gradient from OW-13 and OW-29 in 2009 to monitor possible migration of MTBE. The two observation wells are screened in the Chinle/Alluvium Interface stratigraphic unit. A request to change the 2010 FWGWMP sample frequency from quarterly to annual for OW-50 and OW-52 was approved by NMED in 2012 (2011 Updates, Comment 6).

In 2015, groundwater samples were collected from observation wells OW-50 and OW-52 for the following analytes: BTEX, MTBE, DRO, GRO, MRO, major anions/cations, WQCC total and dissolved metals, and VOCs, SVOCs.

Observation wells OW-50 and OW-52 were sampled on the following dates in 2015:

Well ID	Sample Date
OW-50	**8/10/15**
OW-52	**8/10/15**

- BTEX, MTBE, DRO, GRO, and MRO constituents have not been detected in either OW-50 or OW-52 since 2010 through 2015 (Tables 8.10 and 8.10.1).
- Low concentrations of fluoride, chloride bromide and sulfate were detected in 2015 but remain below the applicable standards (Table 8.10.1).
- Low concentrations of total and dissolved barium, manganese, and uranium been detected in OW-50 and OW-52 in 2015, but all concentrations were below applicable standards (Tables 8.10.2 and 8.10.3).
- No VOCs or SVOCs were detected above applicable standards in OW-50 and OW-52 during 2015. In quarter one 2010, bis(2-ethylhexyl)phthalate exceeded the standard of 0.006 mg/L in OW-50 and a low concentration of benzoic acid was detected but have remained below this standard through 2015. The detection of these two organic compounds may possibly be lab contaminants or from the PVC pipe casing materials used for this well (Table 8.10.4).

6.3.3 RECOVERY WELLS: RW-1, RW-2, RW-5, RW-6

The recovery wells RW-1, RW-2, RW-5, and RW-6 are shallow wells installed in the refinery tank farm located in the east-central portion of the refinery property. The recovery wells are screened within the Chinle/Alluvium Interface stratigraphic unit and are used to recover SPH. RW-1 is located east of Tank 568; RW-2 is located between Tanks 581 and 582; and RW-5 and RW-6 are located in the northwest corner of the tank farm, east of Tanks 337 and 345.

Quarterly inspections for the RW wells include product recovery of SPH using disposable bailers in RW-5 and RW-6, and a portable 2-inch bladder pump for RW-1. Hydrocarbon thickness is measured prior to being removed. Purge water is collected and disposed upstream of the NAPIS. Hydrocarbon recovery is estimated based on measurements and observations.

The RW wells were added to the annual sampling schedule in 2011, per the *Approval with Modifications* in the 2010 FWGWMP. For 2015, the wells were sampled and evaluated for the following analytes: BTEX, MTBE, DRO, GRO, and MRO.

The recovery wells were inspected and sampled in 2015 on the following dates:

WELL ID	Date	Date	Date	Date
RW-1	3/23/15	6/9/15	8/23/15	10/29/15
RW-2	3/23/15	6/9/15	8/23/15	10/29/15
RW-5	3/23/15	6/9/15	8/23/15	10/29/15
RW-6	3/23/15	6/9/15	8/23/15	10/29/15

- No samples were collected from RW-1 due to SPH levels
- BTEX and MTBE concentrations exceeded applicable standards in RW-2 in 2015. Benzene exceeded the applicable standard in RW-5, and benzene and total xylenes concentrations exceeded applicable standards in RW-6. Concentrations of total xylenes and ethyl benzene were detected in RW-5, and low concentrations of toluene, ethyl benzene and MTBE were detected in RW-6 but did not exceed the standard. MTBE concentrations have frequently exceeded applicable standards for RW-1 and RW-2 since 2011 (Table 8.11).
- Major cations and anions were not analyzed in 2015 (Table 8.11.1).
- DRO and GRO concentrations were detected in RW-2, RW-5 and RW-6 during both sample events in 2015. The highest concentrations of DRO were detected in RW-6 at 1,400 mg/L (Aug. 2015) and 340 mg/L (Oct. 2015). MRO was not detected in any of the RW wells during 2015.
- Total and dissolved metals were not analyzed in 2015 (8.11.2 and 8.11.3) Hydrocarbon recovery from RW-1 has shown a steady decrease from 2005 through 2015. In 2015, total hydrocarbon recovery is estimated at 2.0 gallons in 55 gallons of water purged compared to the 2005 estimate of 431 gallons of hydrocarbons in 1,210 gallons of water. It is noted that even though the hydrocarbon cut has decreased in the purge water, the hydrocarbon thickness observed in RW-1 has consistently ranged from 1.9 to 4.6 feet thick within RW-1. No measureable hydrocarbons have been detected in RW-2 since the well was installed. RW-5 and RW-6 have shown a steady

decrease in hydrocarbons since 2005. SPH has not been detected in RW-5 and RW-6 since February 2009 and November 2011, respectively.

6.4 CONSTITUENT LEVELS IN GROUP D MONITORING WELLS

The Group D wells include three process/production wells, PW-2, PW-3, and PW-4 that supply water to the refinery and for domestic uses. These process wells reach approximately 1,000 ft and are screened in the San Andreas/Yeso aquifer. Additionally, Group D also includes four observations wells OW-1, OW-10, OW-11, and OW-12. The OW-1 and OW-10 wells are located in the northwest portion of the refinery. OW-11 is located near the entrance of the refinery and OW-12 is west of the tank farm in the surplus yard.

6.4.1 PROCESS WELLS: PW-2, PW-3, PW-4

PW-2, PW-3 and PW-4 are all process/production wells which supply process water to the refinery and domestic water to the company housing and Pilot Travel Center. PW-2 is located west of evaporation pond 6 (EP-6). PW-3 is centrally located directly north of the maintenance shop, and PW-4 is located on the southern edge of the refinery property and adjacent to the Pilot Lift Station.

The production wells are on a staggered 3-year sampling schedule, with the exception of PW-3 which is sampled annually since the detection of 2-methylnaphthalene exceeding the applicable standard in 2008. In 2015, a groundwater sample was collected from P PW-3 for the following analytes: BTEX, MTBE, nitrate, WQCC total and dissolved metals, and VOCs and SVOCs.

The process well PW-3 was sampled in 2015 on the following dates:

Well ID	Date
PW-3	**8/23/15**

- BTEX and MTBE were not detected in PW-3 in 2015 (Table 8.12).
- Low concentrations of fluoride and chloride were present in PW-3 in 2015. The sulfate concentration (750 mg/L) exceeded the applicable standard (600 mg/L).
- In 2015, low concentrations of total and dissolved arsenic, barium, iron, selenium, and uranium were detected in well PW-3. Each of the detected concentrations was below applicable standards (Table 8.12.1 and 8.12.2)
- No VOCs or SVOCs were detected in PW-3 in 2015 (Table 8.12.3).

6.4.2 OBSERVATION WELLS: OW-1 AND OW-10

Observation well OW-1 is an artesian well located on the west side of EP-6. Well OW-10 is located down gradient from OW-1 on the east side of EP-9. Wells OW-1 and OW-10 are screened in the Sonsela stratigraphic unit. Inspection requirements for these two wells were modified in 2010, per the 2010 FWGWMP, and included sampling on a quarterly basis. In agreement with OCD, approved by NMED, the third quarter sampling was combined with the annual sampling event. In 2015, groundwater samples from OW-1 and OW-10 were evaluated for the following analytes: BTEX, MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, VOCs, and SVOCs.

Groundwater samples were collected from OW-1 and OW-10 in 2015 on the following dates:

Well ID	Date	Date	Date	Date
OW-1	3/9/15	6/3/15	8/12/15	10/28/15
OW-10	3/9/15	6/3/115	8/12/15	10/28/15

- In the last quarter of 2015, low concentrations of benzene, toluene, total xylenes, and MTBE were detected in OW-1, and low concentrations of toluene, ethyl benzene, total xylenes, and MTBE were detected in OW-10. MTBE was detected in all four quarters of 2015 in OW-10 (Table 8.13).
- DRO and MRO were not detected above applicable standards in either OW-1 or OW-10 during 2015. Low concentrations of GRO were detected in quarters two and three in OW-10, but the constituent was not detected in OW-1 in 2015 (Table 8.13.1).

- In 2015, low concentrations of fluoride, chloride, bromide, and sulfate were detected in OW-1 but remain below the applicable standards. Low concentrations of sulfate and GRO were detected in OW-10 but were below the applicable standards. The chloride concentration in OW-10 continues to exceed the standard of 250 mg/L, but constituent concentrations remains below the standard for OW-1 (77 mg/L, quarter 2) (Table 8.13.1).
- In well OW-1, concentrations of total uranium were detected above the applicable standards in all four quarters of 2015. Concentrations of dissolved iron (quarter 3) and uranium (all four quarters) were detected above the applicable standards in 2015. In well OW-10, total and dissolved concentrations of uranium have exceeded the applicable standard of 0.03 mg/L from 2010 through 2015. Low concentrations below applicable standards of other total and dissolved metals were detected in OW-1 and OW-10 (Tables 8.13.2 and 8.13.3).
- In well OW-10, in the third quarter, the constituent 1,1-dichloroethane was detected but concentrations did not exceed the standard of 0.025 mg/L (Table 8.13.4).

6.4.3 OBSERVATION WELLS: OW-11 AND OW-12

Observation well OW-11 is located within the refinery property (southeast) on the west side of the main entrance. Well OW-12 is located within the surplus or bone yard located west and slightly north of the primary tank farm. OW-11 and OW-12 are screened in the Sonsela stratigraphic unit.

Well inspections and sampling are conducted annually. In 2015, groundwater samples from the two wells were evaluated for the following analytes: BTEX, MTBE, major anions/cations, GRO, DRO, MRO, WQCC total and dissolved metals, VOCs, and SVOCs. Observation well OW-11 and OW-12 were sampled in the third quarter of 2015 on the following dates:

Well ID	Date
OW-11	**8/17/15**
OW-12	**8/13/15**

- BTEX and MTBE have not been detected in OW-11 and OW-12 since 2006 and remained non-detect for 2015 (Table 8.14).
- Fluoride and sulfate concentrations continue to exceed the applicable standards (1.6 mg/L and 600 mg/L, respectively) in OW-11 with fluoride detected at 1.9 mg/L and sulfate at 880 mg/L in 2015. In 2015, chloride concentrations were detected in both wells but did not exceed the standard. Bromide was detected below applicable standards in OW-11 and OW-12 (Table 8.14.1).
- GRO, DRO and MRO were not detected in OW-11 and OW-12 in 2015 (Table 8.14.1).
- In OW-11, total and dissolved uranium concentrations continue to exceed the standard of 0.03 mg/L; the constituent was detected at 0.23 mg/L in 2015. Uranium concentrations were detected in OW-12 but remain below the standard. Low concentrations of barium and manganese were detected in both wells. Selenium was detected in OW-11 but did not exceed the applicable standard (Tables 8.14.2 and 8.14.3).

- Bis(2-ethylhexyl)phthalate was not detected in OW-11 during 2015 (Table 8.14.4).

6.5 CONSTITUENT LEVELS IN GROUP E MONITORING WELLS

To date, a total of 44 monitoring wells (MKTF-1 through MKTF-44) have been installed to aid in delineating the extent of a hydrocarbon seep discovered in 2013, directly west of crude tanks T-101 and T102. During the investigation, a pre-existing well (labeled as MKTF-45) was found directly west of the truck-loading rack. Each of the wells has been constructed into permanent monitoring wells, and these wells are designated as Group E wells.

6.6 CONSTITUENT LEVELS FOR MKTF WELLS

In 2015, groundwater samples were collected from the MKTF wells and evaluated for the following analytes: BTEX, MTBE, DRO, GRO, MRO, major cations/anions, metals, VOCs, and SVOCs. Wells that had a hydrocarbon layer were not sampled.

- As indicated in Figure 13 (Product Thickness Map), the SPH thickness in the MKTF wells ranged from 0 to 1.98 feet at MKTF-7. The SPH plume is located along the southwest portion of the refinery near the truck loading area and storage tanks.

- Benzene concentrations exceeded the standard of 0.005 mg/L in the following wells: MKTF-1, MKTF-2, MKTF-4, MKTF-9, MKTF-10, MKTF-11, MKTF-16, ~~and~~ MKTF-17 through MKTF-26, and MKTF-35 through MKTF-39. The greatest benzene concentration (28 mg/L) during 2015 occurred in well MKTF-16 during quarter four (Table 8.15).

- Toluene concentrations exceeded the standard of 0.75 mg/L in the following wells: MKTF-1, MKTF-10, MKTF-11, MKTF-16, MKTF-20, and MKTF-23. The highest toluene concentration (22 mg/L) occurred in well MKTF-10 during quarter four (Table 8.15).

- Ethylbenzene concentrations exceeded the standard of 0.7 mg/L in the following wells: MKTF-1, MKTF-10, MKTF-11, MKTF-16, ~~and~~ MKTF-19 and MKTF-36. The highest concentration (1.7 mg/L) occurred in MKTF-16 during quarter four (Table 8.15).

- Total xylenes concentrations exceeded the standard of 0.62 mg/L in the following wells: MKTF-1, MKTF-4, MKTF-10, MKTF-11, MKTF-16, MKTF-19 MKTF-20, MKTF-21, MKTF-23, and MKTF-37. The highest concentration (9.6 mg/L) occurred in well MKTF-20 (Table 8.15).

- MTBE concentrations exceeded the standard of 0.143 mg/L in the following wells: MKTF-1, MKTF-4, MKTF-9, MKTF-16, MKTF-17, MKTF-19, MKTF-21, MKTF-22, MKTF-23, MKTF-24, MKTF-25, MKTF-32, MKTF-33, and MKTF-36. The highest concentration (9.7 mg/L) occurred in well MKTF-19 during quarter one (Table 8.15).

- The constituent DRO and GRO were detected in MKTF-1 through MKTF-23, MKTF-25, MKTF-31, MKTF-35, MKTF-36, MKTF-37, MKTF-39, and MKTF-42. Detectable concentrations of GRO were also detected in MKTF-24, MKTF-26, MKTF-27, MKTF-30, MKTF-32, MKTF-33, and MKTF-38. There were no detectable concentrations of MRO in any well above the applicable standards. (Table 8.15.1).

- Chloride concentration exceedances above the standard (250 mg/L) were noted in the following wells: MKTF-1, MKTF-2, MKTF-4, MKTF-10, MKTF-11, MKTF-16, MKTF-23, MKTF-24, MKTF-25, MKTF-26, MKTF-27, MKTF-28, MKTF-30, MKTF-31, MKTF-32, MKTF-34, MKTF-39, MKTF-40, MKTF-41, MKTF-42, and MKTF-43. Fluoride concentration exceedances above the standard (1.6 mg/L) was noted in MKTF-2 (Table 8.15.1).

- The sulfate concentrations in the samples collected from wells MKTF-29 (650 mg/L), MKTF-40 (890 mg/L) and MKTF-43 (1,700 mg/L) exceeded the standard (600 mg/L} in 2015.

- Total metals concentrations above applicable standards were noted in the following wells (values in parentheses represent cleanup levels) (Table 8.15.2):

- Arsenic (0.01 mg/L): MKTF-4, MKTF-10, MKTF-16, MKTF-17, MKTF-18, MKTF-19, MKTF-20, MKTF-21, MKTF-23, and MKTF-36.
- Barium (1 mg/L): MKTF-1, MKTF-4, MKTF-10, MKTF-11, MKTF-15, MKTF-16, MKTF-17, MKTF-18, MKTF-19, MKTF-20, MKTF-21, MKTF-22, MKTF-24, MKTF-33, MKTF-35, MKTF-36, and MKTF-39.
- Chromium (0.005 mg/L): MKTF-10, MKTF-18, and MKTF-22.
- Iron (1 mg/L): all wells sampled.
- Lead (0.015 mg/L): MKTF-4, MKTF-10, MKTF-17, , MKTF-18, MKTF-19, MKTF-21, MKTF-22, MKTF-24, MKTF-25, MKTF-35, MKTF-36, MKTF-37, MKTF-38, MKTF-39, and MKTF-44.
- Manganese (0.2 mg/L): all wells sampled except MKTF-34.
- Selenium (0.05 mg/L): MKTF-41 and MKTF-43.
- Uranium (0.03 mg/L): MKTF-2, MKTF-10, MKTF-17, MKTF-18, MKTF-22, MKTF-23 through MKTF-28, MKTF-30 through MKTF-34, and MKTF-40 through MKTF-44.

- Dissolved metals concentrations above applicable standards were noted in the following wells (Table 8.15.3):

- Arsenic: MKTF-4, MKTF-10, MKTF-16, MKTF-19, MKTF-20, MKTF-21, MKTF-23, and MKTF-36.
- Barium: MKTF-1, MKTF-4, MKTF-10, MKTF-11, MKTF-15, MKTF-16, MKTF-18, MKTF-19, MKTF-20, MKTF-21, MKTF-22, MKTF-36, and MKTF-39.
- Iron: MKTF-1, MKTF-4, MKTF-9, MKTF-10, MKTF-11, MKTF-15, MKTF-16, MKTF-18, MKTF-19, MKTF-20, MKTF-21, MKTF-22, MKTF-23, MKTF-24, MKTF-27, MKTF-30, MKTF-35, MKTF-36, MKTF-37, MKTF-39, MKTF-41, MKTF-43, and MKTF-44.
- Manganese: all wells except MKTF-28, MKTF-30, MKTF-31, MKTF-32, MKTF-34, MKTF-41, and MKTF-44.

- Uranium: MKTF-2, MKTF-24 through MKTF-28, MKTF-30 through MKTF-33, and MKTF-40 through MKTF-44.
- No VOCs ~~or SVOCs~~ were detected above applicable standards in wells MKTF-17, MKTF-27, MKTF-28, MKTF-29, MKTF-33, MKTF-34, MKTF-38, MKTF-40, MKTF-41, MKTF-43, and MKTF-44.
- No SVOCs were detected above applicable standards in wells MKTF-17, MKTF-27, MKTF-28, MKTF-29, MKTF-33, MKTF-34, MKTF-38, MKTF-40, MKTF-41, MKTF-43, and MKTF-44.
-

The remaining wells had concentrations of the following constituents, which exceeded the referenced standards in at least one of the MKTF wells. The specific compounds identified in each well are summarized in ~~(~~Tables 8.15.4 and 8.15.5.~~):~~

- Aniline (0.013 mg/L)
- cis-1,2-DCE (0.005 mg/L)
- 1-methyl naphthalene (0.0011 mg/L)
- 2-methylnaphthalene (0.0036 mg/L)
- ~~3,4-methylphenol (0.93 mg/L)~~
- Naphthalene (0.00~~0~~165~~7~~ mg/L)
- ~~Phenanthrene (0.17 mg/L)~~
- Phenol (0.005 mg/L)
- 1,2,4-trimethylbenzene (0.015 mg/L)
- 1,3,5-trimethylbenzene (0.12 mg/L)
- 1,2-dichloroethane (0.005~~17~~ mg/L)
- 1-methylnaphthalene (0.0011 mg/L)
- 1,1-dichloroethane (0.025 mg/L)
- 1,1-dichloroethene (0.005 mg/L)
- Tetrachloroethene (0.005 mg/L)
- 1,1,1-Trichloroethane (0.06~~05~~ mg/L)
- Trichloroethene (0.005 mg/L)
- Vinyl chloride (0.001 mg/L)

6.7 CONSTITUENT LEVELS FOR EVAPORATION PONDS, INFLUENTS, AND EFFLUENTS

There are eleven evaporation ponds located within the northwest section of the refinery. Evaporation pond 1 is more commonly known as Pond 1 and is considered separate from the remaining SMWU No. 2 Evaporation Ponds. Pond 1, which is out of service, is separated by a dike along the north side of aeration lagoon 1 (AL-1) and aeration lagoon 2 (AL-2), and was used as a holding pond for the aeration lagoons. Evaporation ponds 2 through 6 are separated by dikes and are located west of AL-2. Evaporation pond 9 (EP-9) is to the south and is separated from EP-2 through EP-6 by a two-track road. Evaporation ponds 7, 8, 11, 12A, and 12B are also separated by dikes and are located on the northwest corner of the refinery. In addition to the evaporation ponds, there are three influents and three effluent points that are routinely monitored.

6.7.1 EVAPORATION PONDS 1 THROUGH 12B

Samples have been collected annually from Pond 1 and EP-2 through EP-8 since 2007. In 2011, EP-9, EP-11, EP-12A, and EP-12B were added to the sample list, per the 2010 FWGWMP, and the sample frequency was increased to semi-annually for all of the ponds. Pond 1 has been taken out of service.

In 2015, samples were collected from the evaporation ponds for the following analytes: BTEX, MTBE, major anions/cations, biochemical oxygen demand (BOD), chemical oxygen demand (COD), e-coli bacteria, WQCC total and dissolved metals, and VOCs and SVOCs. EP-2 through EP-9, EP-11, EP-12A, and EP-12B were sampled in 2015 on the following dates:

Sample Location	Date	Date
Ponds 2 – 12B	3/26/15	9/2/15

- Bezene concentrations were detected above the applicable standard (0.005 mg/L) in the first quarter of 2015 in the following evaporation ponds: EP-2, EP-3, EP-4, and EP-12B. The rest of the BTEX constituents and MTBE were below applicable standards for the remaining EPs in 2015 (Table 8.16).
- Concentrations of fluoride, chloride, and sulfates exceeded the applicable WQCC standards in each evaporation pond during 2015 (Table 8.16). In 2015, BOD concentrations exceeded the general requirement of the 20 NMAC 6.2.3103 (<30 mg/L) in each of the evaporation ponds except for EP-7 and EP-9. COD concentrations exceeded the general requirement (<125 mg/L) in each of the ponds. The e-coli standard of 500 organisms/100 mL was exceeded in EP-2 (5,475 CFU/100 mL), EP-3 (24,196 CFU/100 mL), EP-4 (5,475 CFU/100mL), EP-5

(1,515 CFU/100mL), EP-12A (12,033 CFU/100mL), and EP-12B (~~>2,419.6~~17,329 CFU/100mL) (Table 8.16.1).

- Fluoride, chloride and sulfate concentrations exceeded the applicable standards in each evaporation pond during 2015 (Table 8.16.~~2~~1).
- Total metals concentrations in pond samples were detected as follows (Table 8.16.~~3~~2):

- Arsenic, manganese and iron concentrations in each pond exceeded the applicable standards in one or more of the samples.
- Detectable concentrations of barium and chromium were found in one or more samples, but were below applicable standards with the exception of exceedance of chromium in EP-~~6~~7 (~~1.6~~0.064 mg/L). EP-7 also had a concentration of dissolved chromium of 0.062 mg/L.
- Cadmium, copper, and lead were below applicable standards in each pond sample.
- ~~A low concentration of mercury (0.0.00032 mg/L) was detected in one EP-1 sample, but the concentration was below the applicable standard.~~
- Selenium concentrations exceeded applicable standard in EP-7, EP-8, EP-9 and EP-11.
- A low concentrations of uranium were detected in EP-2, EP-3, EP-4, EP-12A, and EP-12B, but the concentrations were below the applicable standard. Low concentrations of zinc were detected in the evaporation ponds samples, but each was below the constituent applicable standards.

- Dissolved metals concentrations in pond samples were detected as follows (Table 8.16.3):

- Arsenic and manganese concentrations in each pond exceeded the applicable standards in one or more semiannual samples.
- Iron concentrations exceeded the standard in one or more samples of EP-2, EP-4, and EP-12B.
- Selenium concentrations exceeded the applicable standard in one sample of EP-7, EP-8, EP-9, and EP-11.
- Low concentrations of barium were detected in each pond, but all were below the applicable standard.
- A low concentration of uranium was detected in EP-2 (0.0031 mg/L), EP-4 (0.0026 mg/L) and EP-12A (0.0025 mg/L) but these concentrations are below the applicable standard.
- Cadmium, copper, lead, and silver were not detected in any pond samples.
- No VOCs were detected in any of the ponds during 2015 with the exception of low concentrations of acetone in EP-3 and EP -12B (Table 8.16.~~5~~4).

- Although aniline was detected in concentrations exceeding the standard of 0.013 mg/L during March 2014 in EP-2, EP-3, EP-4, and EP-5, aniline was not detected in any of the ponds in 2015. Phenol concentrations exceeded the standard of 0.005 mg/L in September 2015 for EP-2 (0.22 mg/L) and EP-12B (0.086 mg/L). Low concentrations of 3,4-methylphenol were detected in ~~EP-1,~~ EP-2, EP-3, EP-4, and EP-12B but did not exceed the applicable standard of 0.093 mg/L (Table 8.16.~~6~~5).

6.7.2 INFLUENTS: AL-1, AL-2, AND EP-1

The start-up of the new WWTP occurred in May 2012. By the end of June 2012, all of the processed water going into AL-1 was re-routed to the WWTP, via Tank 35 and the NAPIS unit, with the exception of the Pilot lift station. Some gravitational flow continued from AL-1 to AL-2 and from AL-2 to Pond 1 (EP-1) through the second half of 2013.

The aeration lagoons and pond 1 are no longer in service and no samples were collected in 2015.

6.7.3 EFFLUENTS: AL-2 TO EP-1, PILOT, AND NAPIS

All effluents have been non-existent since June 2013 due to re-routing waters to the WWTP. The last effluent sample from AL-2 was in June 2013. The Pilot effluent was rerouted in June 2013 while the NAPIS unit was re-routed mid-June 2012. No effluent analyses are available for 2015.

6.7.4 OUTFALL BW TO EP-2

BW is defined as reverse osmosis water coming from the boiler unit. The flow from the boiler unit discharges into EP-2 through a 4-inch PVC pipe. EP-2 is directly west of EP-1. The BW to EP-2 sample is evaluated for the following analytes: major anions/cations.

The BW to EP-2 sample was taken March 23, 2015.

Sample Location	Date
BW to EP-2	3/23/15

- The sulfate concentration (2,000 mg/L) exceeded the standard of 600 mg/L. All other constituents were either below applicable standards or were not detected (Tables 8.17).

6.7.5 OUTFALL STP1 to EP-2 Inlet

The EP-2 Inlet designation was changed to STP1 to EP-2 in the second half of 2012 due to the startup of the new WWTP and the new sanitary treatment pond (STP-1). STP-1 effluent now flows into the northeast corner of EP-2. The STP1 to EP-2 inlet is sampled on an quarterly ~~annual~~ basis, and sampled for the following analytes: BTEX, MTBE, VOCs, GRO, DRO, MRO, BOD, COD, and TDS.

The EP-2 inlet was sampled August 24, 2015.

Sample Location	Sample Date
EP-2 Inlet	4/24/15

- The DRO concentration of 2.3 mg/L exceeded the applicable standard (0.2 mg/L). The TDS concentration of 2,420 mg/L exceeded the standard of 1,000 mg/L. All other BTEX and 8015 constituents were below the applicable standards (Table 8.18).
- The BOD ~~and COD~~ concentrations exceeded the applicable standards in 2015 (Tables 8.18.1).

- A low concentration of acetone was detected but is below applicable standards. No other VOCs were detected in 2015 (Tables 8.18.2).

6.8 ADDITIONAL SAMPLING AND/OR CHANGES

Requirements by NMED:

- Sample wells upgradient from the NAPIS wells, OW-1, OW-10, and OW-11 and review analytical results to determine if uranium detections are similar in concentrations in unaffected wells.
- Sample upgradient wells from the NAPIS wells, OW-1, OW-10, and OW-11 for total and dissolved metals.

The marketing (MKTF) wells from the hydrocarbon seep investigation have been added to the ground water sampling plan.

SECTION 7

CONCLUSIONS AND RECOMMENDATIONS

This section is an overview of the analytical water quality data collected to identify potential impacts to the groundwater and determine if further monitoring or site investigations are required.

7.1 GROUP A

The boundary wells (BW-1A, BW-1B, BW-1C, BW-2A, BW-2B, BW-2C, BW-3A, BW-3B, and BW-3C) located in the northwest corner of the refinery along the west sides of evaporation ponds 7, 8 and 11 have not shown any detection of BTEX or MTBE constituents during annual sampling events (BW-1A, BW-1B and BW-3A contained no water on the fluid-level gauging date and were not sampled). Fluoride concentrations were detected above WQCC standards in BW-1C, BW-2B, and BW-2C, which may be naturally occurring in the groundwater. In 2015, iron exceeding the applicable standard was detected in wells BW-2B and BW-3C, but this metal may be naturally occurring as well. Low concentrations of barium, lead, manganese, and uranium are frequently detected in most of the boundary wells. The semi-volatile organic compound bis(2-ethylhexyl) phthalate was detected in BW-3B (0.01 mg/L) in 2009, BW-3C (0.01 mg/L) in 2011 and BW-1C (0.01 mg/L) in 2013. Detection of this organic compound in the groundwater sample may be a laboratory contaminate or possibly originate from the PVC pipe materials used as casing for the wells.

The MW (MW-1, MW-2, MW-4, and MW-5) series of wells are located around the RCRA LTU. No detectable concentration levels of BTEX or MTBE constituents have been found in the groundwater samples collected from these wells. No metals (total or dissolved) exceeded the applicable standards; however, very low concentrations of arsenic, barium, iron, manganese, and uranium were detected in most of the MW series of wells. MW-1 showed low concentrations of lead in 2014 and 2015. 2015 analytical data indicates no detection of VOCs or SVOCs in any of the MW wells; however, in 2008, bis(2-ethylhexyl)phthalate was detected in the groundwater collected from MW-4. The detection of this particular constituent in the groundwater sample may have been a laboratory contaminant or from the PVC pipe materials used in this well. These wells are also monitored under the RCRA Post Closure Permit on a 10-year cycle. The first cycle was completed in 2009/2010.

The SMW (SMW-2, SMW-4) wells are also located around the RCRA LTU and are screened in the Chinle/Alluvium Interface stratigraphic unit. These wells are also monitored under the RCRA Post Closure Permit on a 10-year cycle. The first cycle was completed in 2009/2010. No detectable concentration levels of BTEX constituents were found in these wells from 2006 through 2015. MTBE was only detected in SMW-2 in 2008 and 2010 through 2015 at concentration levels below the NMED Tap Water standard of 0.143 mg/L. SMW-2 also had elevated chloride and sulfate levels, and two metals (total and dissolved), manganese and uranium that were detected exceeding the WQCC standards. In SMW-4, uranium (0.036 mg/L total and 0.035 mg/L dissolved) was the only metal that exceeded the WWCC standard of 0.03 mg/L in 2015. In 2015 no detections of any organic compounds have been detected in SMW-2 or SMW-4.

7.2 GROUP B – GROUNDWATER MONITORING

Benzene concentrations from all 2015 sampling events at GWM-1 have exceed applicable standards. This would indicate the potential for historical releases from the aeration lagoons. There was an insufficient volume of water in GWM-2 during the fourth quarter of 2013 for sample collection, and the well was reported dry for all of 2014 and 2015. GWM-3 was dry during 2013, 2014 and 2015.

Pond levels in the aeration lagoons and pond 1 decreased in 2013 because all the influent into the aeration lagoons was diverted to the WWTP plant. The lagoons and pond 1 were taken out of service and no longer receive any water. Water levels in the aeration lagoons and pond 1 have been significantly lower and slowly evaporating. It was noted that the decrease in pond volumes did affect the water levels detected in the GWM wells. There were no significant changes in contaminant detections noticed in the GWM wells. However, it is noted that SPH appeared in GWM-1 in October 2015 and no sample was collected for chemical analysis. Even though no sample was collected for analysis, it is noted that the benzene concentration decreased from 0.011 mg/L in March to 0.0085 mg/L in August 2015. The aeration lagoon is currently awaiting closure and available options are being evaluated.

Also at the aeration basin are four monitoring wells situated around the NAPIS installed in 2007 and 2008 to address potential hydrocarbon leaks from the NAPIS. NAPIS-1 located on the east side (up-gradient) of the NAPIS has had no detectable contaminants since 2008. Down gradient of the NAPIS on the west side, NAPIS-2 ~~and KA-3 have~~ had concentrations of benzene and MTBE above the applicable standards. Samples collected from NAPIS-3 have not shown any BTEX or MTBE constituents since September 2010.

1-methylnaphthalene and naphthalene were detected above applicable standards during the third quarter 2013 in NAPIS-2. These constituents were detected in NAPIS-2 in 2015 but below applicable standards.

There are three leak detection units on the NAPIS Unit which are inspected for fluid level. Quarterly inspections of the units have indicated the presence of fluids. All three leak detection units (East LDU, West LDU, and Oil Sump LDU) continue to have a fluid level and are pumped out on a regular basis. During 2015, there was insufficient water for sampling in the Oil Sump LDU during the year. Recent water column measurements on the West LDU indicate that the bay is leaking into the LDU. The East LDU also contains water but it has been out of service for the last year. Plans are to inspect the east bay, place it back in service and then take the west bay out of service for inspection. The LDUs are pumped out every few months and the maximum recharge to the LDUs takes place over a few weeks following water removal..

A new well was installed on July 17, 2012, designated as OAPIS-1. The installation of this well is from a site investigation conducted according to the Investigation Work Plan Solid Waste Management Unit (SMWU) No. 1 Aeration Basin and SMWU No. 14 Old API Separator. Benzene and MTBE concentrations were above applicable standards for all 2015 sampling events.. Arsenic, iron and manganese concentrations were also above applicable standards in OAPIS-1 in 2015.

Initial sampling of STP1-NW began in the second quarter of 2014. Chloride concentrations exceeded WQCC standards during the first and fourth quarter of 2015, and iron concentrations exceeded WQCC standards during the first three quarters. Analytical results show no detections of BTEX, VOCs, or SVOCs.

7.3 GROUP C – GROUNDWATER MONITORING

Groundwater monitoring activities from the Group A wells (northeast side of the Refinery) have shown that an MTBE plume exists between wells OW-13, OW-14, OW-29, and OW-30. In March of 2010, dedicated pumps were installed in all four wells to prevent possible cross contamination from sampling equipment and or field activities. Although concentration levels of MTBE in OW-13 does not exceed the applicable standard of 0.143 mg/L, sample data indicates a steady increase of MTBE from year to year. Of the three wells OW-14 is the only well where two constituents (benzene and MTBE) have been consistently detected in the groundwater samples collected since 2006 that have exceeded the applicable standards. These two constituents continued to increase from year to year through 2015. OW-14 is located down-gradient from two recovery wells RW-1 and RW-2. RW-1 is the only well where hydrocarbons are continually recovered. 2015 analytical data from RW-1 and RW-2 indicate high levels of BTEX, MTBEand phenol.

Down gradient from OW-14 is OW-29 and OW-30 and the analytical data from both of these wells indicates that MTBE is present in the groundwater at concentration levels exceeding the NMED Tap Water standard of 0.143 mg/L since March of 2010 in OW-29 and December 2007 in OW-30. Analytical data for these four wells indicate a steady increase of MTBE concentration levels indicating that the MTBE plume is slowly migrating in a north, north-west direction down-gradient from RW-1 and RW-2. The stratigraphic units in which these wells exist are screened in the Chinle/Alluvium Interface.

Two new wells (OW-50 and OW-52) were installed in October 2009 downgradient of OW-13, OW-14 and OW-29 to monitor possible migration of MTBE in a north, north-east direction. To date, no detectable concentration levels of BTEX or MTBE constituents have been detected in OW-50 and OW-52. Based on the analytical data from these two new wells the migration of MTBE may be in a north-northwest direction from OW-29.

The inspection of the four recovery wells (RW-1, RW-2, RW-5 and RW-6) will continue as scheduled along with SPH recovery. No changes in product recovery are required and will continue with scheduled quarterly inspections. These wells were added to the annual sampling schedule beginning in 2011. Product recovery continues in RW-1 as there is a measureable hydrocarbon column thickness. Field notes indicate that although the SPH thickness level in RW-1 has generally increased since the first quarter of 2013, hydrocarbon recovery has shown a general decrease from 2005 through 2015. Total hydrocarbon recovery is estimated at 2 gallons for 2015 compared to 431 gallons in 2005. Additional information regarding characteristics of RW-1 will be collected during field work from the approved Work Plan for investigation at OW-14. RW-5 and RW-6 product recovery has also been declining. From 2010 through 2015, no product has been recovered from RW-5 and no product was recovered from RW-6 between 2012 to 2015. Although there is no measureable product level in RW-5 and RW-6 both wells will continue to be bailed as there is evidence of hydrocarbons in the wells from observing the bailed water (slight odor with a visible sheen).

7.4 GROUP D – GROUNDWATER MONITORING

PW-2, PW-3 and PW-4 are all process/production wells that are all set at around 1000 feet. All three of these wells are sampled every three years with the exception of PW-3 which was changed to annual in 2009 due to the detection of 2-methylnaphthalene in January 2008. Although the samples collected in August 2008 were all non-detect, it was determined by NMED that annual sampling was required for PW-3. No organic compounds have been detected in PW-3 from 2009 through 2015. Based on the analytical data the remaining two process wells remain relatively free of contaminants. Three organic compounds (1,2,4-trimethyl benzene, 1,3,5-trimethyl benzene and n-propyl benzene) were detected for the first time at low concentrations in PW-4 in 2013. PW-3 continues to be sampled on an annual basis pending approval from NMED for a request to return PW-3 to the 3-year sampling schedule. The next three-year sample event is schedules in 2017 for PW-2 and 2016 for PW-4.

OW-1 is an artesian well located on the west section of the refinery property. Historically, OW-1 is a relatively clean well, however, low concentrations of benzene, toluene, total xylenes, and MTBE were detected for the first time in the fourth quarter of 2015. The only contaminants that have exceeded the WQCC standard is iron and uranium which are naturally occurring elements found in rock, soil, and water.

OW-10 is developed in the Sonsela Aquifer and is located directly east of evaporation pond 9 (EP-9).

Concentrations of toluene, ethyl benzene and total xylenes have been detected for the first time in the fourth quarter 2015 at levels below applicable standards. MTBE was detected in all four quarters of 2015 at concentrations below the applicable standard and has decreased since concentrations were detected above the applicable standard in 2012 and 2013. As the result of the presence of MTBE in OW-10, NMED has requested that an additional monitoring well be installed. Uranium concentration levels have has also exceeded the WQCC standard of 0.03 mg/L since 2010, however it is believed to be naturally occurring. Concentrations of 1,1-dichloroethane have been detected at levels below applicable standards in the well since 2011 .

Observation well OW-11 is located within the refinery property (southeast) on the west side of the main entrance. The well is screened in the Sonsela stratigraphic unit. No BTEX, MTBE, VOCs, SVOCs (other than bis(2-ethylhexyl)p hthalate detected in 2013 that is suspected to be either a lab artifact or from the PVC materials used to construct the well) have been detected OW-11. Total and dissolved uranium concentrations continue to exceed the standard of 0.03 mg/L.

RECOMMENDATIONS: *Continue with current sampling schedule.*

7.5 GROUP E – GROUNDWATER MONITORING

To date, a total of 44 permanent monitoring wells (MKTF-1 through MKTF-44) have been installed to aid in delineating the extent of a hydrocarbon seep discovered in 2013, directly west of crude tanks T-101 and T-

102. During the investigation, a pre-existing well (labeled as MKTF-45) was found directly west of the truck-loading rack. The MKTF wells are sampled quarterly. BTEX, MTBE, DRO, GRO, total and dissolved metals, and several VOCs and SVOCs have been detected in many of the wells above the referenced standards. Recovery of SPH in several of the permanent wells will continue.

It is also noted that well MKTF-29 is under artesian conditions and has a water level that rises above ground level. It is assumed that the hydrogeology is such that area is under confined conditions since a potential source associated with either the sanitary pond or the wastewater pipeline (which is above the ground surface) would most likely have olfactory evidence indicating the wastewater source. However, there is no such odor associated with the produced water. It is worth noting that it has been reported that the ground surface to the north of MKTF-29 stays damp as if there is a leak or the water is naturally rising to an elevation that is near the surface. Additional evaluation will be necessary to determine the exact nature of the elevated potentiometric surface.

7.6 ADDITIONAL MONITORING

- Continue with the sampling requirements of the most current approved Facility Wide Groundwater Monitoring Work Plan.
- In order to prevent duplication and potential conflict of documentation, recommendations and/or changes to monitoring requirements will be included in future investigation work plans..
- Submit the Annual Groundwater Monitoring Report on or before September 1 of every year.
- Submit recommendations to change or modify sampling requirements as needed.
- Conduct site assessments as required when spills/leaks are discovered.

SECTION 8

DATA TABLES

SECTION 9

WELL DATA DTW / DTB MEASUREMENTS

The 2015 Well Data DTB/DTW Measurements has been updated with survey information submitted to and approved by NMED per notification received “Approval with Modifications, Requirement to Resurvey Groundwater Monitoring Wells and Recovery Wells issued on September 26, 2012. Western was required to resurvey the monitoring wells due to discrepancies found in applicable standards ground level elevation, well casing elevation, well casing bottom elevation and stick up lengths. All monitoring wells were surveyed by a licensed professional surveyor, DePauli Engineering 0.on June 7, 2011, April 2014, September 2014, December 2014, and January 2015. The Well Data Table is attached as Section 9.1.

The additional wells from the hydrocarbon seep (MKTF series) and the two new wells STP1-NW and STP1-SW were surveyed by Hammon Enterprises Inc., professional surveyor on September 15, 2014, December 16, 2014 and on December 16, 2014.

SECTION 10

2015 MONITORING SCHEDULE

The 2015 Well Data DTB/DTW Measurements has been updated with survey information submitted to and approved by NMED per notification received "Approval with Modifications, Requirement to Resurvey Groundwater Monitoring Wells and Recovery Wells issued on September 26, 2012. Western was required to resurvey the monitoring wells due to discrepancies found in applicable standards ground level elevation, well casing elevation, well casing bottom elevation and stick up lengths. All monitoring wells were surveyed by a licensed professional surveyor, DePauli Engineering 0.

Tables and Appendices F and G

(Please see attached CD)

Appendix F – Temporary Land Farm Analytical Results

Appendix G – Hall Laboratory Analytical Data

TABLES

(ON ATTACHED CD)

FIGURES

APPENDIX A

SEPARATE PHASE HYDROCARBON RECOVERY LOGS

APPENDIX B

FIELD INSPECTION LOGS

APPENDIX C

APPLICABLE STANDARDS

APPENDIX D

SUMMARY OF EPA/NMED/RCRA ACTIVITY

APPENDIX E

SUMMARY OF ALL LEAKS, SPILLS AND RELEASES

APPENDIX F

TEMPORARY LAND FARM ANALYTICAL RESULTS

(ON ATTACHED CD)

APPENDIX G

HALL LABORATORY ANALYTICAL DATA

(ON ATTACHED CD)

Revised: Annual Groundwater Monitoring Report
Gallup Refinery – 2015

Western Refining

Gallup, New Mexico

~~August 2016~~ September 2018

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

____________________________ Date __________________________
Daniel Statile
Vice President, Gallup Refinery

~~Reviewed by:~~

~~Ed Riege, MPH~~

~~Manager Remediation~~

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

TABLE OF CONTENTS - continued

LIST OF FIGURES – SECTION 11

APPENDICES

LIST OF ACRONYMS

AC	Alternating Current
AL	Aeration Lagoon
API	American Petroleum Institute
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BW	Boundary Well
COC	Chain of Custody
COD	Chemical Oxygen Demand
DC	Direct Current
DGF	Dissolved Gas Flotation
DO	Dissolved Oxygen
DRO	Diesel Range Organics
DTB	Depth to Bottom
DTP	Depth to Product
DTW	Depth to Water
EP	Evaporation Pond
EPA	Environmental Protection Agency
FT	Foot/Feet
FWGWMP	Facility Wide Groundwater Monitoring Plan
GPM	Gallons Per Minute
GRO	Gasoline Range Organics
GWM	Groundwater Monitoring Well
HP	Horse Power
HWB	Hazardous Waste Bureau
IDW	Investigation Derived Waste
ISE	Ion Selective Electrode

LIST OF ACRONYMS - continued

LDU	Leak Detection Unit
LPG	Liquefied Petroleum Gas
LTU	Land Treatment Unit
MCL	Maximum Contaminant Level
MPPE	Macro Porous Polymer Extraction
MRO	Motor Oil Range Organics
MTBE	Methyl Tert Butyl Ether
mg/L	Milligrams/liter
mV	Millivolts
MW	Monitoring Well
NAIC	North American Industry Classification System
NAPIS	New American Petroleum Institute Separator
NAPL	Non Aqueous Petroleum Liquid
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NOD	Notice of Disapproval
NPDES	National Pollutant Discharge Elimination System
OBSM	Oil Bearing Secondary Material
OCD	Oil Conservation Division
OW	Observation Well
ORP	Oxidation Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbon
PSTB	Petroleum Storage Tank Bureau
PVC	Polyvinyl Chloride
PW	Process Well
RCRA	Resource Conservation and Recovery Act
<RL	Less than the Applicable standards Detection Limit

LIST OF ACRONYMS - continued

RSL	Regional Screening Level
RW	Recovery Well
SMW	Shallow Monitoring Well
SPH	Separate Phase Hydrocarbon
STP	Sanitary Treatment Pond
SVOC	Semi-volatile Organic Compound
SMWU	Solid Waste Management Unit
SWPPP	Storm Water Pollution and Prevention Plan
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbon
µm	Micrometer
UPS	United Parcel Service
VOC	Volatile Organic Compounds
WQCC	Water Quality Control Commission
WWTP	Waste Water Treatment Plant
YTD	Year to Date

EXECUTIVE SUMMARY

The Annual Groundwater Monitoring Report for 2015 (Report) incorporates all of the field monitoring, sampling, and inspection of all active wells located on the facility. Analytical data and field notes are incorporated into this report to show any changes or discoveries of various constituents found in the groundwater collected for sampling. On February 15, 2012, Groundwater Discharge Permit GW-032 was rescinded by the Oil Conservation Division (OCD) of New Mexico. We are: however, required to continue to abate pollution of groundwater pursuant to 19.15.30 NMAC (Remediation) under case number AP-111 with remediation activities already in place under Groundwater Discharge Permit GW-032. Monitoring and field work activities conducted for 2015 followed the guidelines of the approved 2010, Revision 1, Annual Groundwater Monitoring Report, approved on December 12, 2012 and Approval with Modifications Facility Wide Ground Water Monitoring Work Plan 2012 Updates; 2013 Updates; 2014 Updates for 2015, dated July 24, 2015 from New Mexico Environmental Department Hazard Waste Bureau (NMED HWB).

GROUNDWATER MONITORING

There are a total of 87 monitoring wells located throughout the refinery property. The groundwater program consists of a number of sampling locations, target analytes, and monitoring frequencies which are monitored on a quarterly, semi-annual, and annual basis. A brief analytical summary is included while a more detailed summary is discussed in Section 7. In addition to the monitoring wells, there are two leak detection units (LDUs) at the new API Separator. These monitoring wells and LDUs have been grouped as follows:

GROUP A	GROUP B	GROUP C	GROUP D	GROUP E
BW-1A, 1B, 1C	GWM-1, 2, 3	OW-13, 14, 29, 30	PW-2, 3, 4	MKTF-1 thru
BW-2A, 2B, 2C	NAPIS-1, 2, 3, KA-3	OW-50, 52	OW-1, 10	MKTF-45
BW-3A, 3B, 3C	OAPIS-1	RW-1, 2, 5, 6	OW-11, 12	
MW-1, 2, 4, 5	East LDU, West LDU			
SMW-2, 4	STP1-NW			
	STP1-SW			

GROUP A - WELLS

- There are a total of nine boundary wells located on the northwest section of the refinery property. Three (BW-1A, 1B, 1C) are located between evaporation ponds 7 and 8, and three (BW-2A, 2B, 2C) are located on the west end of evaporation pond 11. BW-3A, 3B, 3C are located on flat terrain directly northwest of evaporation pond 12A. Three of the seven wells (BW-1A, BW-1B, and BW-3A) continue to indicate no water level since original installation in 2003 and 2004.
- No benzene, toluene, ethylbenzene, or total xylenes (BTEX) or methyl tert butyl ether (MTBE) constituents have been detected in any of the boundary wells to date.
- Bis(2-ethylhexyl)phthalate was first detected in BW-3B in 2009, BW-3C in 2011, and in BW-1C in 2013. The detection of this organic compound is suspected to be a laboratory contaminant or possibly from the polyvinyl chloride (PVC) pipe materials used in the well. Subsequent annual sample results have indicated non-detectable levels of the organic constituent in each of these wells.

Within this area of the refinery, three Resource Conservation Recovery Act (RCRA) land treatment units (LTU) exist. Each of the three LTU cells measure 480 feet x 240 feet and received hazardous waste application until 1990. Non-hazardous waste application ceased in 1993. Each section is diked and encompasses a surface area of 2.6 acres.

The MW series (MW-1, 2, 4, and 5) and SMW series (SMW-2, and SMW-4) of wells were installed to monitor the detection of hazardous constituents from the LTU in groundwater. On the northern edge (up gradient) of the LTU are three monitoring wells (MW-1, SMW-4 and MW-2). Down gradient along the eastern edge of the LTU are two monitoring wells (MW-5, SMW-2). MW-4 is located on the northwest corner of evaporation pond 2 (EP-2) and was installed as a background monitoring well. A summary of the laboratory analyses for these wells through 2015 includes:

- Low concentrations of MTBE were detected in SMW-2 from 2008 through 2015.
- Manganese and uranium concentrations have exceeded the WQCC standard since 2012 in SMW-2. SMW-4 has exceeded the standard for uranium concentrations since 2011.

In addition to the annual sampling requirements, the LTU monitoring wells are on a once every ten year sample schedule per the RCRA Post Closure Care Permit. The next RCRA Post Closure Care Permit sample event is scheduled to occur in 2019.

GROUP B - WELLS

The Group B wells are located within and around the aeration basin. Wells GWM-1, GWM-2 and GWM-3 are located on the west edge of Aeration Lagoon 2 (AL-2) and Pond 1. The NAPIS-2, NAPIS-3, and KA-3 wells are adjacent to the west bay of the New American Petroleum Institute Separator (NAPIS) and NAPIS-1 is located upstream on the southeast side of the east bay of the NAPIS. A leak detection unit (LDU) well, the West LDU, is located on the west bay of the NAPIS. The Oil Sump LDU and East Bay LDU wells are located on the east bay of the NAPIS. In July 2012, a well (OAPIS-1) was installed on the northwest side of Aeration Lagoon 1 (AL-1). The installation of this well resulted from the Solid Waste Management Units (SMWU) No. 1, Aeration Basin and SMWU No. 14, Old API Separator site investigation. The investigation work was implemented to determine if there had been a release from the aeration basin and to delineate impacts associated with any such releases. Information collected from this site investigation is also used to track groundwater in monitoring wells GWM-2 and GWM-3.

Two monitoring wells (STP1-NW and STP1-SW) were installed at the new sanitary treatment pond in May of 2014. STP1-NW is located on the west end of the north bay of STP-1, and STP1-SW is located on the southwest corner of the south bay of STP-1. Both of these wells were added to the ground water sampling plan.

A brief summary of laboratory analyses for the Group B wells for 2015 is listed below:

<u>GWM 1, GWM-2, GWM-3</u>

- No groundwater was present in GWM-2 and GWM-3 in 2015
- An SPH level was detected in GWM-1 in third quarter 2015 and no samples were collected in fourth quarter 2015. .
- High benzene concentrations have been detected in GWM-1 with low concentrations of toluene, ethylbenzene, total xylene and MTBE.
- Diesel range organics (DRO) were detected in GWM-1 during all four quarters of 2015. Gasoline range organics (GRO) were detected in the first and third quarters (not analyzed in the second quarter due to oil sample collection) and motor oil range organics (MRO) were detected only in the fourth quarter of 2015.
- Arsenic, iron, and manganese have been detected in GWM-1 at concentrations exceeding applicable standards in 2015.

- Twelve organic compounds were detected in GWM-1 in the third quarter all at concentration levels above the applicable standards.

NAPIS-1, NAPIS-2, NAPIS-3, and KA-3

- High concentrations of benzene and MTBE continue to be detected in NAPIS 2 throughout 2015.
- DRO/GRO have been detected in NAPIS 2 in 2015.
- Barium, iron and manganese were detected in NAPIS 2 at concentration levels exceeding the applicable standards in 2015.
- Iron and uranium were detected in all four quarters of 2015 in NAPIS 3 at concentration levels exceeding the WQCC standards Manganese was detected in NAPIS 3 during the first quarter of 2015 at a concentration level exceeding the WQCC standard.
- Manganese was detected in all four quarters of 2015 above the applicable standard in KA-3.
- Naphthalene and 1-methylnaphthalene were detected exceeding the applicable standards for NAPIS-2 in 2015.

East LDU and West LDU

- BTEX and DRO/GRO were detected in the East and West LDU at levels exceeding applicable standards in 2015.
- Chromium, iron, and manganese have been detected in concentrations exceeding applicable standards in each of the LDU wells sampled in 2015. Neither total nor dissolved uranium was detected.
- The organic constituents 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and 1-methylnaphthalene have shown concentrations exceeding applicable standards in each of the LDU wells in 2015.

OAPIS-1

- Benzene and MTBE have exceeded the applicable standards in OAPIS-1 since 2013.
- Concentrations of fluoride, chloride, and DRO have shown exceedances in OAPIS-1 since 2013.
- Arsenic, iron, manganese, uranium, and cyanide have exceeded applicable standards in OAPIS-1 since 2013.
- Naphthalene and 1-methylnaphthalene have exceeded applicable standards in 2015.

STP1-NW and STP1=SW

- STP1-SW was dry in all of 2015.
- There were no detections of BTEX, MTBE, DRO, GRO, or MRO above applicable standards in 2015 in STP-1 NW.
- Chloride, nitrite and nitrate concentrations in STP1-NW exceeded applicable standards during each 2015 sampling event.

- Iron was detected in concentrations in STP1-NW exceeding applicable standards during the first three quarters of 2015.
- Total and dissolved uranium concentrations in STP1-NW were detected during all 2015 sampling events, but did not exceed applicable standards. Low concentrations of arsenic, barium, manganese, selenium, and zinc were detected during each 2015 event. A low concentration of chromium was detected during the second quarter sampling event in 2015.

GROUP C WELLS

Group C wells include six observation wells and four recovery wells. Observation well OW-14 is adjacent to the liquefied petroleum gas (LPG) compound while OW-13, OW-29, and OW-30 are located north of the tank farm. Observation wells OW-50 and OW-52 were installed in 2009 per NMED and monitor the potential for contaminant migration offsite. Recovery well RW-1 is located within the tank farm east of Tank 568 while RW-2 is located on the southwest side of Tank 576. Recovery well RW-5 and RW-6 are located northeast of Tank 345. The recovery wells were installed during a subsurface investigation conducted between 1987 and 1992 near the tank farm. BTEX concentrations and separate-phase hydrocarbons (SPH) were detected in the groundwater.

SPH recovery continues quarterly. When applicable, recovery is completed using a disposable hand-bailer in RW-5 and RW-6 and completed in RW-1 using a portable submersible pump. Measureable SPH has not been detected in RW-2. SPH was not detected in RW-5 and RW-6 during all of 2015. The SPH column thickness in RW-1 has increased during 2015.

A summary of the observation wells and recovery well laboratory analyses through 2015 is as follows:

<u>OW-13, OW-14, OW-29, OW-30, OW-50, and OW-52</u>

- Benzene has exceeded the EPA MCL standard in OW-14 since 2008 through 2015. MTBE concentrations have shown exceedances in OW-14, OW-29, and OW-30 since 2007 (2010 for OW-29) through 2015. No BTEX or MTBE constituents have been detected in OW-13, OW-50, and OW-52.
- Chloride has been detected above applicable standard in OW-14 from 2013 through 2015.
- DRO and GRO have been detected in OW-14, OW-29 and OW-30 in 2015.

<u>RW-1, RW-2, RW-5, and RW-6</u>

- BTEX concentrations have exceeded standards in RW-1 and RW-2 wells since 2011. RW-5 and RW-6 have exceeded standards for benzene since 2011. Total xylenes concentrations exceeded the standard for RW-6 from 2012 through 2015.

- During 2015, the organic constituents 1,2,4-trimethylbenzene exceeded the applicable standards in RW-2. In RW-5 and RW-6, the organic constituents 1,2,4-trimethylbenzene, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene concentrations exceeded the applicable standards in 2015.

- Hydrocarbon recovery from RW-1 has shown a steady decrease from 2005 through 2015. In 2015, total hydrocarbon recovery is estimated at 2.0 gallons in 54 gallons of water purged compared to the 2005 estimate of 431 gallons of hydrocarbons in 1,210 gallons of water. No measureable hydrocarbons have been detected in RW-2, RW-5 and RW-6 in 2015.

GROUP D WELLS

The Group D wells can be found within the refinery property and include three process/production wells (PW-2, PW-3 and PW-4) and four observation wells (OW-1, OW-10, OW-11, and OW-12). The process/production wells are used to provide process water for the refinery and drinking water for both the refinery and the Pilot Travel Center. PW-2 is located on the central west side of the refinery directly west of Evaporation Pond 6 (EP-6). PW-3 is centrally located on the refinery property north of the maintenance shop and west of the domestic water tank Z-86-T2. PW-4 is located south of the Pilot Lift Station. Each of the PW wells is screened at a depth of 1,000 feet. The observation well OW-1 is found west of PW-2 and is an artesian well. Observation well OW-10 is located east of Evaporation Pond 9 (EP-9), OW-11 is located on the west side of the main access road, and OW-12 is centrally located west of the refinery tank farm.

A summary of the Group D Wells laboratory analyses through 2015 is as follows:

<u>PW-2, PW-3, and PW-4</u>

- No BTEX or MTBE constituents were detected in the process wells in 2015.
- Low concentrations of fluoride, chloride and sulfate were detected in PW-3.
- Low concentrations of arsenic, barium and iron were detected in PW-3 but did not exceed applicable standards. Low total and dissolved uranium was detected in PW-3 at concentrations below the applicable standard.
- No VOCs SVOCs were detected in the process wells in 2015.

<u>OW-1, OW-10, OW-11, and OW-12</u>

- Low concentrations of BTEX and MTBE were detected in OW-1 and OW-10 during the last quarter of 2015, and low concentrations of MTBE were detected in OW-10 during all four quarters in 2015.
- Iron concentrations exceeded the WQCC standard in well OW-1 during the third quarter of 2015 and had a low concentration detected in fourth quarter 2015.

- Chloride concentrations exceeded the WQCC standard in well OW-10, and fluoride and sulfate exceeded the applicable standards in OW-11 and OW-12 during 2015.
- Uranium concentrations have exceeded the constituent standards in OW-1, OW-10, and OW-11 for 2015.
- During the 2013 annual sampling event, bis-2(ethylhexyl)phthalate was detected in OW-11 at a concentration exceeding the standard of 0.006 mg/L; however, this is suspected to be either a lab artifact or from the PVC well materials.

GROUP E WELLS

To date, a total of 44 monitoring wells (MKTF-1 through MKTF-44) have been installed to aid in delineating the extent of a hydrocarbon seep discovered in 2013 in an isolated area approximately 100 yards west of the crude tanks T-101 and T-102. A pre-existing well located in the seep investigation site area at the loading rack was added to the marketing wells and has been labeled as MKTF-45. Site investigations have included excavations within the seep area, soil/water samples, and the installation of six temporary sumps to recover the non-aqueous phase liquid (NAPL). Liquid recovery from the six sumps in 2015 is estimated at 189,707 gallons of NAPL and ground water. In the past, a hole was identified in the refinery's waste water process sewer line near the bundle cleaning pad and a leaking transmix transfer line was also identified in the area. Hydrocarbon recovery of twelve of the MKTF wells that have SPH in 2015 is estimated to be 11.2 gallons. Recovery of SPH from six temporary sumps and from the 12 wells that have a product layer are on-going. The measured SPH thickness is shown on Figure 13.

The MKTF wells are sampled quarterly. BTEX, MTBE, DRO, GRO, total and dissolved metals including uranium, and several VOCs and SVOCs have been detected in many of the wells above the referenced standards.

ADDITIONAL SITES MONITORED

The new waste water treatment plant (WWTP) and the new holding pond Sanitary Treatment Pond (STP-1) were completed and put in service in May of 2012. All waste water flow was routed to the WWTP in May 2012 and in January 2013, the demolition and removal of the benzene strippers was completed. Pilot effluent was routed to the WWTP in June of 2013 and the aeration lagoons and pond 1 are no longer receiving any flow. All influent and effluent sample sites continued between lagoons and pond 1 as long as there was continued gravitational flow.

Outfall BW to EP-2

- The flow from the boiler unit discharges into EP-2. It is sampled at its discharge point to the pond on an ~~semi-~~annual basis for major cations/anions.
- The sulfate concentration exceeded the standard of 600 mg/L during the 2015 sample event.

Outfall STP1 to EP-2

- The EP-2 Inlet designation was changed to STP1 to EP-2 in the second half of 2012 as flow to the aeration lagoons and pond 1 were diverted to the new WWTP. Aeration lagoons and pond 1 were taken out of service and no longer receiving flow. STP-1 effluent now flows into the northeast corner of EP-2. The outfall is sampled on a quarterly basis.
- DRO concentrations exceeded the constituent respective standards in 2015.
- A low concentration of acetonewas detected but is below applicable standards.

Evaporation Ponds

There are a total of eleven evaporation ponds that are sampled semi-annually or annually. Pond 2 (EP-2) thru evaporation pond 6 (EP-6) are centrally located on the west end of the refinery property (west of the aeration basin) and evaporation pond 9 is located on the south section of the refinery property divided by a dirt road separating EP-9 from EP-2 through EP-6. Evaporation ponds 7, 8, 11, 12A/B are located on the northwest corner of the refinery boundary.

- Pond 1 is no longer in service, so it is no longer sampled.
- Low concentrations of benzene and toluene were detected in EP-2, EP-3, EP-4, and EP-12B in 2015.
- In 2015, concentrations of fluoride, chloride, sulfates, and COD exceeded the applicable WQCC standards in all of the evaporation pond samples. In 2015, BOD concentrations exceeded the applicable standards in all the evaporation pond samples except EP-5, EP-6, EP-7, and EP-9.
- Total and dissolved arsenic and manganese concentrations exceeded applicable standards in all of the ponds throughout 2015 with the exception EP-12A (dissolved manganese was less than applicable standard). Dissolved selenium and chromium exceeded applicable standards in EP-7 and dissolved chromium exceeded applicable standards in EP-9.
- Selenium concentrations exceeded applicable standards in E-7, EP-9, and EP-11,
- Low concentrations of total or dissolved uranium were detected in EP-2, EP-3, EP-4, EP-12A, and EP-12B
- The only VOC constituent detected in all the EP wells was a low concentration of acetone in EP-3.
- SVOC constituents that exceeded applicable standards for 2015 were bis(2-theylhexyl)phthalate (EP-11) and phenol (EP-2 and EP-12B). Low concentrations of 3,4-methylphenol (EP-2, EP-4 and EP-12B).

ADDITIONAL APPLICABLE STANDARDS REQUIREMENTS

OCD Discharge Permit is now titled GW-032/AP111. The Discharge Permit was rescinded by NM-OCD on February 15, 2012; however Gallup is still required to continue with abatement of pollution of groundwater pursuant to 19.15.30 NMAC (Remediation), with remediation activities already in place.

This report includes:

Monitoring of the aeration lagoons, ponds and outfalls between the lagoons and ponds on a quarterly, semi-annual and annual basis. (Section 8)

- Major Refinery Activities and Events (Summary EPA/NMED/RCRA Activity) (AppendixD)
- Summary of All Leaks, Spills, and Releases (Appendix E)
- Temporary Land Farm Analytical Results (Appendix F – on CD)
- Analytical Data (Appendix G – on CD)

SECTION 1

INTRODUCTION

The 2015 Annual Groundwater Monitoring Report has been prepared to describe monitoring and remediation activities undertaken throughout 2015. Groundwater sampling is performed on a quarterly, semi-annual and annual basis and includes sampling of the evaporation ponds located on the northwest section of the refinery property. The activities completed include analysis of all active monitoring wells and evaporation ponds. The data generated is used to characterize the nature and extent of impacts to the groundwater at the refinery from historical releases and to monitor any levels of constituents that exceed applicable standards.

This report presents the results of the groundwater monitoring activities and contains the following information:

- Scope of activities
- Sampling methods and procedures
- Groundwater elevation surveys
- Regulatory criteria
- Groundwater monitoring results
- Conclusions and recommendations

1.1 FACILITY OWNERSHIP, OPERATION AND LOCATION

This report pertains to the Western Refining Southwest Inc., Gallup Refinery, located at Exit 39 on Interstate I-40, approximately 17 miles east of Gallup, New Mexico, in Jamestown, New Mexico. Figure 1 shows the regional location of the refinery.

Owner: Western Refining (Parent Corporation)
123 West Mills Avenue, El Paso, TX 79901

Operator:	Western Refining Southwest, Inc. Gallup Refinery 92 Giant Crossing Road, Gallup, NM 87301	(Postal address)
	Western Refining Southwest, Inc. Gallup Refinery I-40, Exit 39, Jamestown, New Mexico 87347	(Physical address)

The following regulatory identification and permit governs the Gallup Refinery:

- SIC code 2911 (Petroleum Refining) applies to the Gallup Refinery
- U.S. EPA ID Number NMD000333211
- OCD Discharge case number AP-111(GW-032/AP-111)
- 2015 NPDES MSGP, ID #NMR053168

The refinery status is corrective action/compliance. Annual, semi-annual, and quarterly groundwater sampling is conducted at the refinery to evaluate present conditions. The refinery is situated on an 810 acre irregular shaped tract of land that is substantially located within the lower one-quarter of Section 28 and throughout Section 33 of Township 15 North, Range 15 west, of the New Mexico Prime Meridian. A small component of the property lies within the northeastern one-quarter of Section 4 of Township 14 North, Range 15 West. Figure 2 is a topographic map showing the general layout of the refinery in comparison to the local topography.

1.2 BACKGROUND INFORMATION

The refinery primarily receives crude oil via two 6-inch diameter pipelines; two pipelines from the Four Corners Area enter the refinery property from the north. In addition, the refinery also receives natural gasoline feed stocks via a 4-inch diameter pipeline that comes in from the west along the Interstate 40 corridor from the Wingate Plant, formerly Conoco gas plant. Crude oil and other products also arrive at the site via railroad cars. These feed stocks are then stored in tanks until refined into products.

The refinery incorporates various processing units that refine crude oil and natural gasoline into finished products. These units are briefly described as follows:

- Crude Distillation Unit: separates crude oil into various fractions; including gas, naphtha, light oil, heavy oil, and residuum

- Fluidized Catalytic Cracking Unit (FCCU): dissociates long-chain hydrocarbon molecules into smaller molecules, and essentially converts heavier oils into naphtha and lighter oils.\

- Alkylation Unit: combines specific types of hydrocarbon molecules into a high octane gasoline blending component.

- Reforming Unit: breaks up and reforms low octane naphtha molecules to form high octane naphtha.

- Hydro Treating Unit: removes undesirable sulfur and nitrogen compounds from intermediate feed stocks, and also saturates the feed stocks with hydrogen to make diesel fuel.

- Additional Treater Units: remove impurities from various intermediate and blending feed stocks to produce finished products that comply with sales specifications.

- A set of Acid Gas Treating and Sulfur Recovery Units: convert and recover various sulfur compounds from other processing units in order to produce either ammonium thiosulfate or a solid elemental sulfur byproduct.

- Waste Water Treatment Plant – process and treat refinery waste and storm water before releasing to treatment ponds.

As a result of these processing steps, the refinery produces a wide range of petroleum products including propane, butane, unleaded gasoline, diesel, kerosene, and residual fuel. In addition to the aforementioned processing units and various other equipment and systems support the operation of the refinery and are briefly described as follows: Storage tanks are used throughout the refinery to hold and store crude oil, natural gasoline, intermediate feed stocks, finished products, chemicals, and water. These tanks are all located aboveground and the capacity ranges from 80,000 barrels to less than 1,000 barrels.Pumps, valves, and piping systems are used throughout the refinery to transfer various liquids among storage tanks and processing units. A railroad spur track and a railcar loading rack are used to transfer feed stocks and products from refinery storage tanks into and out of railcars. Several tank truck loading areas are used at the refinery to load out finished products and also may receive crude oil, other feed stocks, additives, and chemicals.

Gasoline and diesel are delivered to the Pilot Travel Center via tanker truck. An underground diesel pipeline exists between the refinery and the Pilot Travel Center. As a result of an off-refinery release in 2011, the pipeline was purged of product, filled with nitrogen and temporarily taken out of service. Western worked with the NMED – PSTB (Petroleum Storage Tank Bureau) and the NM OCD (Oil Conservation Division) to place this line back in service. In 2013 the underground diesel line from the Gallup Refinery to the Pilot Travel Center was replaced. The replaced line runs above ground from the marketing area of the refinery for approximately 150 feet and continues underground to the Pilot Travel Center. The diesel line was re-commissioned and put back in service on February 3, 2014.A designated area is used to conduct employee firefighting training. During these training activities waste water and/or wash water drains directly into a dedicated tank that is located in the vicinity. The waste water is removed via a vacuum truck and drained into a process sewer leading to the NAPIS after each training exercise. Oily water and sludge is transferred via vacuum truck to the NAPIS for processing and oil-water separation.The process waste water system is a network of curbing, paving, catch basins, and underground piping that collects waste water effluent from various processing areas within the refinery. The waste water effluent flows into T-27, T-28 and into T-35 (which works in parallel to T-27 and T-28) and into the NAPIS which provides the first stage oil-water separation where the removal of free oil is separated from waste water by gravity. The clarified water is routed to the waste water treatment plant (WWTP) Dissolved Gas Flotation (DGF) system which provides the second stage oil-water separation process. The DGF process involves the pressurization of waste water in the presence of air or nitrogen, creating a super-saturated solution called coagules that are carried to the surface. The float is removed to disposal by mechanical float scrapers and the effluent is recycled back to the flotation chamber. The skimmed float is sent to the DGF float management system, “float tanks”. Oily solids collected in the float tanks are recycled through the refining process (on-site) or handled as a K048 listed hazardous waste for proper disposal.The clarified effluent from the DGF system was designed with the Macro Porous Polymer Extraction (MPPE) system however, the MPPE unit did not perform as expected from a flow rate standpoint. It removed benzene efficiently, but became plugged so that flow rates decreased below adequate levels. In December 2014, the MPPE was removed from service and replaced with the carbon canister system. The two systems ran in parallel for three months in the second half of 2014 followed by trial with carbon canisters for two months before the MPPE was removed from service. Flow rates up to 500 GPM can now be achieved through the carbon system. The waste water that passes through the carbon canisters discharges into the sanitary treatment pond (STP-1). STP-1 has two bays, north and south and each bay is equipped with five aerators. The treated waste water is mixed with air in order to oxidize any remaining organic constituents and increase the dissolved oxygen concentration available in the water for growth of bacteria and other microbial organisms. The microbes degrade most of the hydrocarbons into carbon dioxide and water. Five 15-hp mechanical aerators provide aeration in each bay (North and South) in STP-1. Effluent from STP-1 then flows into evaporation pond 2 (EP-2) and is gravitated to the rest of the ponds.The initial startup of the new WWTP was in May of 2012 which resulted in the decommissioning of Benzene Strippers 1, 2, and 3, and the Aeration Lagoons 1 and 2 (AL-1 and AL-2). In November of 2012, the benzene strippers were taken off-line permanently and completely demolished in January of 2013.At the evaporation ponds, waste water is converted into vapor via solar and mechanical wind-effect evaporation. There are a total of four evaporators located at the ponds. Two 80 GPM, electrically driven water evaporators are located between evaporation ponds 4 and 5 (EP-4 and EP-5) and two additional 66 GPM sprayers were installed between ponds 3 and 4 in October 2014. No waste water is discharged from the refinery to surface waters of the U.S. All treated waste water is routed into several evaporation ponds which have large surface areas that are designed to efficiently evaporate water by sunlight and exposure to the changing ambient temperatures.The stormwater system is a network of valves, gates, berms, embankments, culverts, trenches, ditches, natural arroyos, and retention ponds that collect, convey, control, treat, and release stormwater that falls within or passes through refinery property. Stormwater that falls within the processing areas is handled with the process waste water and is sent to tanks T-27, T-28 and T-35, NAPIS, WWTP, STP-1 and into EP-2 where flow is gravitated to the rest of the evaporation ponds.Stormwater discharge from the refinery is infrequent due to the arid desert-like nature of the surrounding geographical area. Gallup Refinery maintains a Storm Water Pollution Prevention Plan (SWPPP) that includes Best Management Practices (BMPs) for effective storm water pollution prevention and control. The refinery has constructed several berms in various areas and improved outfalls (installed barrier dams equipped with gate valves) to minimize the possibility of potentially impacted runoff leaving the refinery property.

1.3 SITE CHARACTERISTICS

Built in the 1950's, the refinery is located within a rural and sparsely populated section of McKinley County, Jamestown, New Mexico, and located 17 miles east of Gallup, New Mexico. The setting is a high desert plain on the western slope of the Continental Divide. The surrounding land is comprised primarily of public lands and is used for cattle and sheep grazing at a density of less than six cattle or 30 sheep per section. The nearest population centers are the Pilot Travel Center (formerly Giant) refueling plaza, the Interstate 40 highway corridor, and a small cluster of residential homes located on the south side of Interstate 40, approximately 2 miles southwest of the refinery (Jamestown). Surface vegetation consists of native xerophytic vegetation including grasses, shrubs, small junipers and some prickly pear cacti. Average rainfall is less than ten inches per year with the maximum average precipitation occurring during the month of August.

Local topography consists of an inclined down-slope from high ground in the southeast to a lowland fluvial plain in the northwest. The highest point on refinery property is located at the southeast corner boundary (elevation approximately 7,040 feet) and the lowest point is located at the northwest corner boundary (elevation approximately 6,860 feet). The refinery processing facility is located on a flat man-made terrace at an elevation of approximately 6,950 feet.

Surface water in this region consists of man-made evaporation ponds and aeration basins located within the refinery, a livestock watering pond (Jon Myer's Pond) located one mile east of the refinery, two small unnamed spring fed ponds located south of the refinery, and the South Fork of the Puerco River and its tributary arroyos. The various ponds and basins typically contain water consistently throughout the year. The South Fork of the Puerco River and its tributaries are intermittent and generally only contain water during, and immediately after, the occurrence of precipitation.

The 810 acre refinery property site is located on a layered geologic formation. Surface soils generally consist of fluvial and alluvial deposits; primarily clay and silt with minor inter-bedded sand layers. Below the surface layer is the Chinle Formation, which consists of very low permeability clay stones and siltstones that comprise the shale of this formation. As such, the Chinle Formation effectively serves as an aquiclude. Inter-bedded within the Chinle Formation is the Sonsela Sandstone bed, which represents the uppermost potential aquifer in the region. The Sonsela Sandstone bed lies within and parallels the dip of the Chinle Formation. As such, its high point is located southeast of the refinery and it slopes downward to the northwest as it passes under the refinery. Due to the confinement of the Chinle Formation aquiclude, the Sonsela Sandstone bed acts as a water-bearing reservoir and is artesian at its lower extremis. Artesian conditions exist through much of the central and western portions of the refinery property.

Groundwater flow within the Chinle Formation is extremely slow and typically averages less than 10^{-10} centimeters per second (less than 0.01 feet per year). Groundwater flow within the surface soil layer, above the Chinle Formation, is highly variable due to the presence of complex and irregular stratigraphy; including sand stringers, cobble beds, and dense clay layers. As such, hydraulic conductivity may range from 10^{-8} centimeters per second in the clay soil layers located near the surface and up to 10^{-2} centimeters per second in the gravelly sands immediately overlying the Chinle Formation. Figure 4 depicts the regional surface water flows are in a westerly direction and Figure 5 depicts surface water bodies and flow lines.

Shallow groundwater located under refinery property generally flows along the upper contact of the Chinle Formation. Although the prevailing flow direction is from the southeast and toward the northwest; a subsurface ridge has been identified and is thought to deflect some flow in a northeasterly direction in the vicinity of the refinery tank farm.

SECTION 2

SCOPE OF ACTIVITIES 2015

The 2015 quarterly and annual groundwater sampling, and semi-annual evaporation pond sampling was conducted by Western. The third quarter groundwater sampling was combined with the annual sampling event per approval from NMED and OCD and conducted in August 2015. The following is a list of monitoring and inspections completed for 2015:

- Separate Phase Hydrocarbon Recovery Logs – Appendix A
- Field Inspection Logs–Appendix B
- Temporary Land Farm Semi-Annual Sampling – Appendix J
- Data Tables, Analytical Data – Section 8
- Well Data DTW/DTB Measurements (Elevations) – Section 9
- Quarterly, Semiannual, Annual Inspections Summary – Section 10

2.1 MONITORING AND SAMPLING PROGRAM

The primary objective of groundwater monitoring program is to analyze groundwater samples collected and use data to assess groundwater quality at and near the refinery. Groundwater elevation data was collected to evaluate groundwater flow conditions. The groundwater monitoring program for the refinery consists of sample collection and analysis from a series of monitoring, recovery, boundary, process, and shallow monitoring wells, and includes evaporation pond locations.

The groundwater monitoring network is separated into five investigation areas (Group A, Group B, Group C, Group D, and Group E) plus the evaporation ponds and effluent from STP-1 to Pond 1. The sampling frequency, analyses and target analytes vary for each investigation areas. The combined data from these investigation area were used to assess groundwater quality beneath and immediately down-gradient of the refinery, and to evaluate local groundwater flow conditions. Samples were collected annually from all monitoring wells with the exception of recovery and/or monitoring wells that had a measurable separate-phase hydrocarbon (SPH) level. Wells that were purged dry, samples were collected if recharge volume was sufficient for sample collection within a 24-hour period. Wells not sampled due to insufficient recharge were documented in the field logs.

Daily field activities, including observations and field procedures, were recorded for each activity and are maintained at the refinery. Field logs include the following information:

- Sample Location Identification
- Date
- Start and finish sampling time
- Field team members, including visitors
- Weather conditions
- Daily activities and times conducted
- Observations
- Record of samples collected with sample designations
- Photo log (if needed)
- Field monitoring data, including health and safety monitoring (if needed)
- Equipment used and calibration records, if appropriate
- List of additional data sheets and maps completed
- An inventory of the waste generated and the method of storage or disposal
- Signature of personnel completing the field record

All samples collected for analysis are recorded in the field report or data sheets. Chain-of-Custody (COC) forms are completed at the end of each sampling day, prior to the transfer of samples off-site. The signed copy of the COC is placed inside sample containers with the samples and shipped to the laboratory. A custody seal is affixed to the lid of the shipping container. Copies of all COC forms generated are kept at the refinery.

2.2 SAMPLING METHODS AND PROCEDURES

Each monitoring well was gauged for depth to water (DTW), total depth, and depth to product (DTP), if applicable, to determine the amount of water to purge. A minimum of two well volumes is purged from each well prior to sampling. If water level is at a minimum or the well has a low recharge rate, the well is allowed to recharge within 24 hours before a sample is collected. For wells that are not supplied with dedicated pumps, a portable pump is lowered slowly into the well to minimize disturbance to a depth of the midpoint of the screened interval of the well. The pump controller is started at a slow rate and gradually increased until water is discharged. Field water quality measurements must stabilize for a minimum of three consecutive readings taken at 2 to 5-minute intervals, within the following limits before purging will be discontinued and sampling may begin: dissolved oxygen (DO) (10%), specific conductance (3%), temperature (3%), pH (10%).

Groundwater samples were obtained from each well within 24 hours of the completion of well purging. The samples were transferred to an appropriate, clean, laboratory-prepared containers provided by the analytical laboratory. Sample collection methods have been documented in the field monitoring reports. Weather conditions, the volume of groundwater purged, description of water, the instruments used, and the water quality readings obtained at each interval were recorded on the field-monitoring log.

Well purging and sampling were performed using disposable polyethylene bailers and/or appropriate portable sampling pumps where applicable. Some of the wells have dedicated pumps installed where a controller is used to power the submersible pump to purge water. In shallow wells, new disposable bailers were used for each well to hand bail purge water and retrieve water samples. All purged groundwater was collected in 55 gallon drum(s) and/or 5 gallon bucket(s) and drained into the refinery waste water treatment system upstream of the NAPIS. Groundwater samples intended for metals analysis were submitted to the laboratory as total and dissolved metals samples.

At a minimum, the following procedure was followed when collecting/shipping samples:

- Protective eye wear (safety glasses, goggles and or face shield)
- Neoprene, nitrile, or other protective gloves are worn when collecting samples. New disposable gloves are used to collect sample at each sample point.
- All samples collected for chemical analysis are transferred into clean sample containers supplied by the analytical laboratory. Sample containers are clearly marked and labeled.
- Groundwater samples obtained for dissolved metals analysis are filtered through a 0.45 µm (micrometer) mesh size disposable filter on site.
- Samples are labeled, sealed, placed in cooler with ice until they are shipped via United Parcel Service (UPS) Red, Federal Express Overnight or personally delivered to the analytical laboratory.
- Standard COC procedures are followed for all samples collected. The COC form and sample request form are shipped inside the sealed storage container to be delivered to the laboratory, signed and dated.
- Field duplicates and trip blanks are obtained for quality assurance during sampling activities. Trip blanks accompany laboratory sample bottles and shipping and storage containers intended for volatile organic compound (VOC) analyses. Trip blanks consist of a sample of analyte free de-ionized water placed in an appropriate sample container. Trip blanks are analyzed at a frequency of one for each shipping event involving twenty or more samples.

In order to prevent cross-contamination, field equipment that came into contact with water or soil was decontaminated before each sampling event. The decontamination procedure for the portable pump consists of rinsing/washing the equipment with a detergent water mixture followed by two rinses before use in another well. Any equipment that came in contact with each well, such as data loggers or tape measure, was decontaminated with a detergent water mixture and rinsed with distilled water before each use. Decontamination of equipment when feasible is done at the bundle pad where decontamination water is drained into the sewer system.

Decontamination water from field work was caught in an appropriate container and drained into the sewer system upstream of the NAPIS.

2.2.1 EQUIPMENT

- A submersible bladder pump 2 inch, 115 volt AC to DC converter, Grundfos Redi-flo2 constructed of stainless steel with check valve and 1/2 in. Teflon tubing, adjustable rate controller powered by a gas generator is used to purge groundwater from monitoring wells. Equipment is located downwind and at least 20 feet from the well so that exhaust fumes do not cross-contaminate the samples.
- Water level instrument used is a WaterMark Oil Water Interface Meter 100 feet, Model 101L/SMOIL. This instrument measures water and hydrocarbon level; indication is a steady audible tone for water and hydrocarbon indication is an erratic audible tone.
- Parameter Instrument – YSI Model 556 MPS Multi Probe System which simultaneously measures DO, conductivity, temperature, and optional pH and ORP (Oxidation Reduction Potential). As a backup, we also have an IQ Scientific Instrument, Model IQ180GLP which measures pH, DO, TDS (Total Dissolved Solids), conductivity, salinity, ISE (Ion Selective Electrode), mV (Millivolts) and temperature.
- Disposable Bailers – Polyethylene bailer 1.5 inches X 36 inches overall length (OAL) with a capacity of approximately 1 liter and 3 inches X 36 inches OAL. Individually sealed packaging, single check valve bailer with slide in angle cut nozzle for sample removal. A new bailer is used for each well that requires hand bailing for purging and sample retrieval.
- Field equipment parameter instruments were calibrated to known standards in accordance with the manufacturers' recommended schedules and procedures. Calibration checks are conducted before a sampling event and the instruments recalibrated as deemed necessary. Calibration of equipment was noted in the daily field logs.
- If field equipment becomes inoperable, a properly calibrated replacement instrument is used in the interim. Type of instrumentation used during a sampling event is recorded in the daily field logs.

2.3 COLLECTION AND MANAGEMENT OF INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during each groundwater sampling event includes purged water, decontamination water, excess sample material, and disposable sampling equipment. All water purged from monitoring wells generated during sampling and decontamination activities was temporarily stored in a labeled 55-gallon drum(s) and/or 5 gallon bucket(s) and then drained into the refinery sewer system upstream of the NAPIS.

2.4 COLLECTION OF SURFACE WATER SAMPLES

At the evaporation ponds, grab samples were collected near the inlets (pond edge). This location was noted in the field notebooks. For outfalls, a grab sample was collected at the pipe end, and recorded in the field log.

2.5 ANALYTICAL METHODS

Groundwater and surface water samples collected during the monitoring events were analyzed for the constituents listed in Table 1, Section 10.0. In addition, the WQCC standard was used for total and dissolved metals analysis.

2.6 PERIMETER INSPECTION

Perimeter inspections are part of the daily routine for refinery personnel to report any hydrocarbon staining, spills or any release that could result in material leaving the property boundary.

2.7 REMEDIATION ACTIVITIES

A site investigation of the refinery tank farm network conducted in 1987 indicated high concentrations of BTEX constituents in the groundwater as well as hydrocarbons. As a result of the findings from additional site investigations conducted from 1987 through 1990, four recovery wells (RW-1, RW-2, RW-5, and RW-6) were installed to recover the SPH. SPH has been recovered from RW-1 using a submersible bladder pump and from RW-5 and RW-6 by hand-bailing using a disposable polyethylene bailer. Tables in Appendix A summarizes measurements, volume of product and water purged and also provides year to date (YTD) product purged from each well. RW-2 is listed as a recovery well but to date no visible hydrocarbon layer or odor has been observed in this well during quarterly inspections.

In RW-1 a bladder pump was used to pump out SPH on a quarterly basis into a labeled 55-gallon drum. Visible layer of floating product in the drum was measured with a tape measure and calculated as best as possible for volume of product recovered. In RW-5 and RW-6, a 3 foot disposable hand bailer was used to extract product and water from the wells. Bailed water was collected in a 5-gallon bucket and the visible layer of floating product was then measured with a tape measure to estimate volume of SPH recovered. The purged water was drained into the refinery waste water treatment system upstream of the NAPIS.

Although the SPH thickness level in RW-1 has generally increased since the first quarter of 2013, hydrocarbon recovery from RW-1 has shown a general decrease from 2005 through 2015. In 2015, total hydrocarbon recovery is estimated at 2.0 gallons in 54 gallons of water purged compared to the 2005 estimate of 431 gallons of hydrocarbons in 1,210 gallons of water. No measureable hydrocarbons have been detected in RW-2 since the well was installed. RW-5 and RW-6 have shown a steady decrease in hydrocarbons since 2005 and no SPH has not been detected since February 2009 and November 2011, respectively. Hydrocarbon recovery logs are included in Appendix A.

On June 26, 2013, notification of the discovery of a hydrocarbon seep to the land surface was made to NMED and OCD. The area has been identified as the “Hydrocarbon Seep”, located directly west of crude Tanks 101 and 102. Response actions have included installation of six temporary sumps, and to date a total of 44 permanent monitoring wells (MKTF-1 through MKTF-44) have been installed to monitor ground water impacts. From June 2013 through December 2015 total hydrocarbon recovery is estimated to be 1,071 gallons and 188,634 gallons of water from the sumps. Of the 44 permanent monitoring wells installed, twelve (MKTF 3, 5, 6, 7, 8,12, 13, 14, 15, 36, 37, and 45) wells had measureable layers of product in 2015. Hydrocarbon recovery from these wells is estimated at 11.2 gallons when wells were pumped in February and June 2015. The twelve wells identified to have a product layer will be pumped on a more frequent basis to determine recharge rate and recovery of hydrocarbons. Hydrocarbon recovery data is included in Appendix A.

SECTION 3

GROUNDWATER DTW / DTP ELEVATION

Groundwater elevation data were collected from the wells listed in Table 1, Section 10.0. A summary of field measurements (DTW, DTP) taken during the quarterly, semi-annual and annual inspections is included in Section 9. Groundwater levels and SPH column thickness measurements (from the RW series of wells as well as the MKTF wells) were collected quarterly to monitor groundwater elevation and product column thickness fluctuations over time. Maps were generated using elevation data collected from surveys conducted by DePauli Engineering and from Hammon Enterprises Inc., professional surveyor and data from the 2015 field inspection logs.

Field notes and measurement data were recorded in field logs for each well for 2015 and are located in Appendix B. The depth to groundwater and SPH column thickness levels were measured to the nearest 0.01-ft. The depth to groundwater and SPH column thickness are recorded relative to the surveyed well casing rim or other surveyed datum. A corrected water table elevation is provided in wells containing SPH by adding 0.8 times the measured SPH column thickness to the measured water table elevation (Section 9).

All water/product levels are measured to an accuracy of the nearest 0.01-ft using a WaterMark Oil Water Interface Meter, Model 101L/SMOIL (100 ft)I. After the water level is determined, the well volume is calculated using the height of the liquid column and the internal cross sectional area of the well. The purge volume is a minimum of two times the well volume.

Groundwater and SPH levels were measured in all wells within 48 hours of the start of groundwater sampling activities. All manual extraction of SPH and water from recovery wells, observation wells, and collection wells is discontinued for 48 hours prior to the measurement of water and SPH levels. Figure 6 (Section 11) shows the locations of all active wells.

SECTION 4

REGULATORY CRITERIA

Laboratory analytical data is compared to the most current regulatory standards (Appendix C) at time of submission of report.

- New Mexico 20NMAC 20.6.2.3103 (WQCC). Standards for Groundwater of 10,000 mg/L TDS Concentration or Less
- EPA 40 CFR 141.62. National Primary Drinking Water Regulations (Updated November 2015) (EPA MCL)
- NMED Tap Water Screening Levels (July 2015)
- EPA Regional Screening Levels set for Residential Risk-Based Screening Levels (EPA RSL) for Tap Water (Ross) (November 2015)

SECTION 5

GROUNDWATER ELEVATIONS

Groundwater elevations are depicted in the following maps using data from the 2015 quarterly, annual sampling event. In addition, graphs of the water levels are included in Figures 11 – 11.4, 11-A and 11-B

- Figure 7 (Section 11) presents a south-north geologic profile (east side of the refinery) showing contours of monitoring wells with reference to stratigraphic locations in which the water bearing zones are located.

- Figure 8 (Section 11) presents a south-north section on the west side of the refinery showing contours of monitoring wells with reference to stratigraphic locations in which the water bearing zones are located.

- Figure 14 (Section 11) represents a geologic profile for the west-east well locations.

SECTION 6

GROUNDWATER MONITORING RESULTS

All analytical data tables referenced in the following subsections are included in Section 8 of this report. Bold and highlighted values indicate a constituent exceeds a listed standard(s). Due to requirements for field preservation of samples, some samples have the results for nitrite and nitrate reported as a single value of nitrogen. In these instances, the value is conservatively listed for both nitrite and nitrate and a comparison is made between the reported concentration and the regulatory standards for both nitrite and nitrate. This may result in false indication of nitrite exceeding the regulatory standard. Plots of the reported concentrations are provided in a series of Figures numbered 15 through 17.Laboratory data for 2015 sampling events are available on the CD provided in Appendix G.

6.1 CONSTITUENT LEVELS IN GROUP A MONITORING WELLS

Group A wells are located within the northwest corner of the refinery property. Nine monitoring wells are situated along the refinery boundary and six monitoring wells are within the RCRA LTU area.

6.1.1 Boundary Wells (BW-1A/1B/1C, BW-2A/2B/2C, BW-3A/3B/3C)

The nine boundary wells (BW), down gradient of the Refinery property, are screened within three different stratigraphic units. BW-1A, BW-2A, and BW-3A are screened within the Upper Sand stratigraphic unit (Figure 12); BW-1B, BW-2B, and BW-3B are screened in the Chinle/Alluvium Interface stratigraphic unit (Figure 10); and BW-1C, BW-2C and BW-3C are screened within the Sonsela stratigraphic unit (Figure 9).

The BW-1A, BW-1B, and BW-1C wells are located on the elevated dike separating evaporation pond 7 (EP-7) and evaporation pond 8 (EP-8). BW-2A, 2B, and 2C are located on the northwest edge of evaporation pond 11 (EP-11) and BW-3A, 3B, and 3C are located in the field north of evaporation ponds 12A and 12B (EP-12A and EP-12B). The boundary wells are sampled on an annual basis and evaluated for the following analytes: 8260B plus MTBE,gasoline range organics, (GRO), diesel range organics (DRO) and motor oil range organics (MRO), major cations/anions, and WQCC total and dissolved metals.

Wells BW-1A, BW-3A, and BW-1B contained no water on the fluid-level gauging date of August 10, 2015, and were not sampled. The boundary wells were sampled and/or inspected on the following dates:

WELL ID	DATE
BW-1C	8/12/15
BW-2A	8/12/15
BW-2B	8/12/15
BW-2C	8/12/15
BW-3B	8/12/15
BW-3C	8/12/15

- The 2015 annual sample event results indicate BTEX and MTBE constituents were not detected in BW-1C, BW-2A, BW-2B, BW-2C, BW-3B or BW-3C. BTEX and MTBE constituents have not been detected in these wells since 2006 (Table 8.1)..

- Fluoride was detected above the WQCC standard of 1.6 mg/L in BW-1C (2.5 mg/L), BW-2B (1.8 mg/L) and BW-2C (1.9 mg/L). Nitrite was detected in one sample (BW-2B at 1.5 mg/l) above the standard of 1.0 mg/l Low concentrations of chloride and sulfate were detected in each of the BW wells sampled in 2015. Low concentrations of bromide were detected in BW-2A, BW-2B, BW-2C, ~~and~~ BW-3B and BW-3C. Phosphorus exceeded applicable standards in BW-2A and BW-3B (Table 8.1.1).

- Low concentrations of arsenic, barium, iron, ~~and~~ manganese, uranium and zinc were detected in the BW wells with BW-2B and BW-3C exceeding the WQCC standard for iron in 2015. Chromium was previously detected in BW-1C (2012) and cadmium in BW-2C (2012) at concentrations above applicable cleanup standards. Both constituents were reported below the detection limits since August 2012. The remaining total metals analyzed for each well did not exceed applicable standards (Table 8.1.2). No dissolved metals analyzed exceeded applicable standards; however, low concentrations of arsenic, barium, iron, lead, ~~and~~ manganese, uranium and zinc were detected in most of the wells (Table 8.1.3).

- Bis(2-ethylhexyl)phthalate was detected in BW-1C in 2013, in BW-3B in 2009, and BW-3C in 2011 and may possibly be a lab contaminant or from the PVCC pipe materials used as casing in these wells. The constituent was not detected in any of the BW wells sampled in 2014. As of 2015, SVOCs were removed from analytical requirement (Table 8.1.4).

- It is noted that the fluoride concentrations detected in BW-1C, BW-2B and 2C are slightly above the WQCC standard of 1.6 mg/L. Inspection of the analytical data obtained from the pond samples (Table 8.16) indicates that if they were the source, the slightly elevated fluoride concentration would also be accompanied by elevated chloride concentrations since they are encountered at substantially higher concentrations in the ponds than the fluorides. Since the chloride concentrations detected in the BW wells are well below the regulatory standards, it is unlikely that the ponds are the source of the fluoride concentrations. It is possible that the fluorides are migrating from an area upgradient of the ponds as similar concentrations are observed in that direction.

6.1.2 Land Treatment Unit (MW-1, MW-2, MW-4, MW-5, SMW-2, and SMW-4)

The LTU groundwater monitoring wells include MW-1, MW-2, MW-4, MW-5, SMW-2, and SMW-4. MW-1, SMW-4, and MW-2 are located down gradient along the north edge of the closed RCRA LTU. MW-5 and SMW-2 are located on the eastern perimeter of the LTU and MW-4 is located up gradient (south) of the LTU. MW-1, MW-2, MW-4, MW-5 are screened within the Sonsela stratigraphic unit. SMW-4 is screened within the Chinle/Alluvium Interface and SMW-2 is screened in both the Chinle/Alluvium Interface and Upper Sand stratigraphic units.

The LTU monitoring wells are sampled on an annual basis. In addition, MW-1, MW-2, MW-4, and MW-5, SMW-2 and SMW-4 are sampled every 10 years to comply with the RCRA Post Closure Permit. Annual samples were analyzed for the following analyses: 8260B plus MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, cyanide, and additional VOCs and SVOCs.

Annual sampling and inspections for 2015 on the LTU monitoring wells were completed on the following dates:

WELL ID	Date
MW-1	8/14/15
MW-2	8/14/15
MW-4	8/17/15
MW-5	8/14/15
SMW-2	8/17/15~~17~~
SMW-4	8/14/15

The next 10 year RCRA Post Closure Permit sampling event for MW-1, MW-2, MW-4, MW-5, SMW-2 and SMW-4 is scheduled to occur in 2019. The following analyses are evaluated during the RCRA Post Closure Permit sample event: modified Skinner List for VOCs, SVOCs, total petroleum hydrocarbons (TPH), DRO, GRO, MRO, metals to include mercury and cyanide, and major cations/anions with pH and conductance.

- With the exception of a low concentration of MTBE in SMW-2, no concentrations of BTEX or MTBE were not detected in any of the LTU wells in 2015. Low concentrations of MTBE, not exceeding applicable standards (0.~~0.~~143 mg/L), have historically been detected in SMW-2 (Table 8.3).

- In accordance with the NMED Disapproval letter dated January 31, 2018, Andeavor has reference the groundwater cleanup levels for DRO, GRO, and MRO provided in the 2017 Risk Assessment Guidance for Investigating and Remediation document, Table 6-4 (page 95). At the time that this report was submitted for review, there were no cleanup levels established by the NMED. Therefore, the groundwater protection standard provided in the 2017 guidance have been used for comparison to groundwater analytical data. In using the 2017 cleanup standards it is noted that the detection limits for DRO (1.0 mg/L) and MRO (5.0 mg/L) are higher than the groundwater protection standards published in the 2017 guidance document of 0.0452 mg/L and 0.0902 mg/L respectively. Since 2011~~08~~, GRO has been detected in SMW-2 (0.78 mg/L for 2015). DRO and GRO were not detected above the applicable analytical detection limits ~~standards limits~~ for the remaining LTU monitoring wells. Concentrations of MRO have not been reported above the applicable detection limits ~~standards~~ in any of the LTU monitoring well since being added to the sampling plan in 2010.

- Low concentrations of fluoride were detected in each of the LTU monitoring wells with the exception of SMW-2. In SMW-2, concentrations of chloride (3000 mg/L) and sulfate (1600 mg/L) have exceeded the WQCC standards of 250 mg/L and 600 mg/L, respectively. SMW-2 has a history of exceeding the WQCC standard for these two anions. The remaining LTU monitoring wells had concentrations of chloride and sulfate below the applicable standards. Concentrations for the remaining major list of anions and cations were not detected above the applicable standards in each of the LTU monitoring wells (Tables 8.2.1 and 8.3.1).

- Concentrations of arsenic and barium remain below the applicable standards for each of the LTU monitoring wells. Concentrations of selenium, mercury and zinc were not detected above the detection limits in 2015 in each of the LTU monitoring wells. Low concentrations of barium and manganese were detected in all of the LTU monitoring wells with the exception of SMW-2. SMW-2 exceeded the WQCC standard for manganese (0.2 mg/L) since 2011 with a 2015 concentration of 0.33 mg/L. Low concentrations of total iron were detected in MW-1, MW-2, SMW-2, and SMW-4, and low concentrations of total lead were detected in MW-1 and SMW-4. A low concentration of dissolved iron was detected in SMW-2. Total and dissolved uranium levels have exceeded the WQCC standard (0.03 mg/L) for SMW-2 and SMW-4 since 2011 and again in 2015 with uranium detected at 0.12 mg/L (total) in SMW-2 and at 0.036 mg/L (total) in SMW-4. Uranium was detected in lower concentrations for the remaining LTU monitoring wells (Tables 8.2.2 and 8.3.2).

- Neither VOCs nor SVOCs were detected above applicable standards in any of the LTU wells in 2015 (Tables 8.2.4 and 8.3.4).

6.2 CONSTITUENT LEVELS IN GROUP B MONITORING WELLS

There are ten monitoring wells in Group B, not including the three leak detection units. These wells are located within the aeration basin west of the refinery tank farm. Group B includes three groundwater monitoring wells (GWM), four monitoring wells for the New American Petroleum Institute Separator (NAPIS), three leak detection units (LDU), OAPIS-1 installed in 2012 as a result of the Solid Waste Management Units (SMWU) No. 1, Aeration Basin and SMWU No. 14, Old API Separator site investigation. Two new monitoring wells (STP1-NW and STP1-SW), were installed at the sanitary treatment pond (STP-1) in May 2014.

6.2.1 GROUNDWATER MONITORING WELLS (GWM-1, GWM-2, GWM-3)

The GWM series of wells are all screened in the Chinle/Alluvium Interface stratigraphic unit. GWM-1 and GWM-2 are located on the west side of the aeration basin straddling the dike that separates AL-2 and EP-1. Downgradient from GWM-1 and GWM-2 is GWM-3 located on the northwest corner of EP-1. These wells are inspected and sampled on a quarterly basis. No groundwater was detected in GWM-2 and GWM-3 during 2014 and 2015.

Groundwater samples from GMW-1 were analyzed for the following constituents: BTEX, MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, and VOCs and SVOCs.

Quarterly inspections and sampling of the GMW wells were completed on the following dates:

Well ID	Date	Date	Date	Date
GWM-1	3/10/15	6/2/15	8/24/15	10/29/15
GWM-2	3/10/15	6/2/15	8/11/15	10/29/15
GWM-3	3/10/15	6/2/15	8/11/15	10/29/15

- No groundwater sample was collected from GWM-1 in the fourth quarter 2015 due to presence of PSH.
- Concentrations of benzene in GWM-1 exceeded the EPA MCL standard (0.005 mg/L) for all four quarters since 2006 with the exception of the fourth quarter in 2012. The highest concentration of benzene (0.012 mg/L) for first quarter of 2010, fourth quarter of 2014, and second quarter of 2015 ~~was recorded in the fourth quarter~~. Concentrations of ethylbenzene, toluene, xylenes, and MTBE remain within the applicable standards for GWM-1 in 2015 (Table 8.4).
- Concentrations of DRO and GRO were detected in GWM-1 with DRO exceeding the WQCC 2013 standard (0.2 mg/L) throughout 2013, 2014 and 2015. DRO has also exceeded applicable standards since quarter 3 of 2010 through quarter one of 2012. The highest concentration of DRO in GMW-1 was detected in the third quarter 2015 at a concentration of 250 mg/L.
- Concentrations of fluoride exceeding the WQCC standard (1.6 mg/L) have been prevalent since 2006 in GWM-1 with the exception of quarter four in 2011. In 2015, quarter two recorded the highest concentration of fluoride in GWM-1 at 2.7 mg/L. Chloride has exceeded the WQCC standard (250 mg/L) consistently in GWM-1 since 2006 with the highest 2015 readings recorded during quarter two and three at 1,100 mg/L. Bromide concentrations have consistently been detected in GWM-1 since 2006. Nitrate and nitrite concentrations remain within applicable standards (Table 8.4.1).
- Concentrations of total and dissolved arsenic, iron, and manganese in GWM-1 have exceeded applicable standards since 2008. The highest total arsenic and iron concentrations for 2015 were

detected in quarter three. Manganese concentrations for 2015 averaged 2.2 mg/L which exceeds the WQCC standard (0.2 mg/L). Low concentrations of total chromium were detected in the second quarter of 2015. ~~and~~ Low concentrations of zinc were detected during ~~quarter three~~ the first, second and third quarters of 2015. Low concentrations of both total and dissolved zinc have been detected in GWM-1 since 2009. Total and dissolved barium and total lead concentrations, were detected within the applicable standards for all of 2015. Concentrations of the remaining total and dissolved metals did not exceed the applicable standards during 2015 (Tables 8.4.2 and 8.4.3).

- Concentrations of VOCs and SVOCs detected above the applicable standards in the third quarter 2015 include naphth~~th~~alene, 1-methyl naphthalene, benz(a)anthracene, benzo(a)pyrene, chrysene, fluorene, 1-methyl naphthalene, 2-methyl naphthalene, phenanthrene, and pyrene. Low concentrations of 1,2,4-trimethylbenzene have historically been detected in GWM-1, but constituent concentrations have been below the applicable standard (0.015 mg/L) since the second quarter of 2013 (Table 8.4.4). Low concentrations of 1,3,5-trimethylbenzene were detected in GMW-1 in 2015.

GWM-2 and GWM-3 were installed and developed in 2005. The wells are checked quarterly for the presence of water. If water is detected, NMED and OCD are notified within 24 hours of discovery. The water is purged from the well and re-measured to calculate the potential recharge rate. Groundwater samples are collected when water level is sufficient.

Groundwater was first observed in GWM-2 during the first quarter of 2008. The depth to water was 18.45 feet with an estimated water column height of 0.36 feet. Samples were collected and the well was bailed dry. GWM-2 did not recharge and remained dry until quarter three of 2010. GWM-2 continued to recharge as samples were collected throughout 2011, 2012, and most of 2013. GWM-2 has had an insufficient volume for sampling since quarter four of 2013 and remained dry throughout 2015. Similar to GWM-2; GWM-3 was first sampled in the third quarter of 2010. Samples were consistently collected throughout 2011 and 2012. In late 2012 through early 2013 the levels in the aeration lagoons dropped approximately one to two feet and gravitational flow between lagoons to EP-1 began to decrease. GWM-3 has remained dry since quarter one of 2013.

6.2.2 GROUNDWATER MONITORING WELLS: NAPIS-1, NAPIS-2, NAPIS-3, AND KA-3

The NAPIS groundwater monitoring wells are located east of AL-1. NAPIS-1 is an up gradient well located on the southeast side of the separator. The NAPIS-2 monitoring well is located in the southwest corner of the bay to the separator, and NAPIS-3 is located in the northwest corner. KA-3 is located between NAPIS-2 and NAPIS-3 on the west side of the bay to the separator unit. These wells are screened in the Chinle/Alluvium stratigraphic unit with three of the wells (NAPIS-2, NAPIS-3, and KA-3) installed subsurface.

The NAPIS and KA wells are sampled on a quarterly basis. In agreement with OCD and approved by NMED, the third quarter sampling is combined with the annual sampling event. Groundwater samples were analyzed for the following parameters: BTEX, MTBE, major cations/anions, WQCC total and dissolved metals, and VOCs and SVOCs. When applicable, standing water is removed from the vault of the three sub-surface wells prior to opening and sampling each well. The standing water is placed into a container for proper disposal.

Quarterly inspections and sampling were completed for the NAPIS and KA wells on the following dates:

Well ID	DATE	DATE	DATE	DATE
NAPIS-1	3/10/15	6/2/15	8/11/15	10/28/15
NAPIS-2	3/10/15	6/2/15	8/11/15	10/28/15
NAPIS-3	3/10/15	6/2/15	8/11/15	10/28/15
KA-3	3/10/15	6/2/15	8/11/15	10/28/15

- BTEX and MTBE have remained below the applicable standards since 2008 for NAPIS-1. Benzene and MTBE concentrations in NAPIS-2 have exceeded the applicable standards since 2008 and remained in exceedance for 2015. BTEX and MTBE were not detected in NAPIS-3. Monitoring well KA-3 has had concentrations of benzene and MTBE exceeding applicable standards prior to the third quarter of 2013; however, concentrations have remained below the applicable standards since the fourth quarter of 2013 (Table 8.5).

- Concentrations of DRO, GRO, or MRO have been below the applicable standards since 2008 for NAPIS-1 and NAPIS-3 (MRO since 2010) (Table 8.5.1).

- In NAPIS-2, DRO concentrations have consistently exceeded the WQCC standard from 2008 through quarter three of 2012 with exceedances also recorded in quarter one, two, and four of 2013, the first three quarters of 2014 and quarters one and four in 2015. Low concentrations of GRO have also been detected in NAPIS-2 (Table 8.5.1).

- KA-3 has historically exhibited exceedances in DRO from 2009 through early 2012 (Table 8.5.1), but has not been detected since the first quarter of 2012.

- Low concentrations of fluoride, chloride, ~~nitrite,~~ nitrate, and sulfate were detected in NAPIS-1 in 2015. Concentrations of nitrite were above the applicable cleanup standard in all four quarters of 2015 (Table 8.5.1).

- Fluoride and chloride concentrations in NAPIS-2 have exceeded the WQCC standards of 1.6 mg/L and 250 mg/L, respectively, for at least one quarter of each year since 2008 (since 2009 for fluoride) and continued to occasionally exceed applicable standards in 2015 (Table 8.5.1).

- Chloride, nitrite and nitrate concentrations in NAPIS-3 exceeded applicable standards (250 mg/L, 1~~0~~ mg/L and 10 mg/L, respectively) during most of 2015 and have historically exceeded these standards since 2008. Fluoride levels have remained below the applicable standards for NAPIS-3 since 2008 (Table 8.5.1).

- Fluoride, chloride and sulfate concentrations in KA-3 have remained below the WQCC standard since June of 2013 (Table 8.5.1).

- Concentrations of bromide and sulfate were detected in all of the NAPIS and KA wells during 2015. Nitrite and nitrate concentrations exceeding the applicable standards (1~~0~~ mg/L and 10 mg/L, respectively) have historically been sporadic for each of the NAPIS and KA wells. There were no exceedances of any of these parameters in 2015 (Table 8.5.1).

- Total iron concentrations exceeded the WQCC standard of 1.0 mg/L in NAPIS-2 (3.3 mg/L) and NAPIS-3 (1.6 mg/L), and total manganese concentrations exceeded the WQCC standard of 0.2 mg/L in NAPIS-2 (1.2 mg/L) and KA-3 (1.7 mg/L) as shown on Table 8.5.2.

- From 2010 through 2015, total and dissolved barium, iron, and manganese have exceeded the applicable standards in NAPIS-2 (Tables 8.5.2 and 8.5.3).

- In NAPIS-3, total and dissolved uranium and total iron exceeded applicable standards during 2015 (Tables 8.5.2 and 8.5.3).

- The total manganese concentration for NAPIS-3 exceeded the applicable standard in the first quarter of 2015.

- In monitoring well KA-3, total and dissolved manganese detected above the applicable standards during 2015 (Tables 8.5.2 and 8.5.3).

- Concentrations of 1-methyl naphthalene (0.0061 mg/L) and naphthalene (0.0033 mg/L) exceeded applicable standards (0.0011 mg/L and 0.00165 mg/L, respectively) in NAPIS-2 during 2015. No other VOCs or SVOCs were detected in the NAPIS and KA wells during 2015 (Table 8.5.4).

6.2.3 LEAK DETECTION UNITS (LDU): EAST LDU, OIL SUMP LDU, WEST LDU

The NAPIS secondary containment units otherwise known as leak detection units (LDU) are installed on the east and west bay of the NAPIS unit. The East LDU is located on the southeast corner in the east bay of the NAPIS unit between the unit and NAPIS-1. The Oil Sump LDU is located north of the East LDU on the northeast corner of the NAPIS unit. The West LDU is located in the southwest corner of the west bay of the NAPIS unit. The LDUs were monitored in 2010 as part of the 2010 Facility Wide Groundwater Monitoring Work Plan (FWGWMP).

The LDU are sampled and inspected on a quarterly basis. In agreement with OCD and approved by NMED, the third quarter sampling was combined with the annual sample event. The LDUs were sampled for the following analytes in 2015: BTEX, MTBE, DRO, GRO, MRO, WQCC total and dissolved metals, and VOCs.

Oil Sump LDU was dry all four quarters and therefore not sampled. There was not enough water in West LDU to collect a sample during the second quarter 2015.

Quarterly inspections and sampling were completed for the LDU wells on the following dates:

Sample ID	Quarter 1	Quarter 2	Quarter 3	Quarter 4
East LDU	3/10/15	6/3/15	8/11/15	10/29/15
West LDU	3/10/15	6/3/15 (not enough water to sample)	8/11/15	10/29/15

-
- Benzene, total xylenes, DRO, and GRO concentrations exceeded the applicable standards in the East LDU during each quarter of 2015. The toluene standard was exceeded in the second and third quarters of 2015 Low concentrations of ~~toluene and~~ ethyl benzene were also detected in the East LDU during each quarter of for 2015. MTBE was also detected in the fourth quarter at concentrations below the cleanup standard.
- All BTEX parameters exceeded the applicable standards in the West LDU with the highest detection of benzene (2.7 mg/L) in quarter three 2015. DRO and GRO exceeded the NMED Tap Water standard (0.2 mg/L) in each well since 2010 (Table 8.6).
- Total and dissolved chromium, iron, and manganese concentrations were detected above the applicable standards in the East and West LDU wells during 2015. Concentrations of arsenic, barium and zinc were also present in these two ~~wells~~LDUs and have historically been present in all three LDU wells. Historically, low concentrations of total and dissolved selenium have been present in each of the LDU wells while cadmium, lead, and silver remained below the applicable standards. Manganese has been present in each of the three wells since 2010. Chromium levels have fluctuated; falling below the applicable standards for the East LDU in September of 2010 through March of 2011 and falling below applicable standards for the West LDU in quarter one and two for 2012 and 2013, respectively (Tables 8.6.1 and 8.6.2).
- Concentrations of 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, naphthalene, 2-methyl naphthalene, and 1-methylnaphthalene exceeded the EPA RSL and NMED standards in the East LDU. Concentrations of 1,2,4-trimethylbenzene, naphthalene, and 2-methylnaphthalene exceeded EPA RSL and NMED standards in the West LDU (Table 8.6.3).

6.2.4 GROUNDWATER MONITORING WELL: OAPIS-1

The OAPIS-1 groundwater monitoring well was installed in 2012 on the southeast edge of AL-2 as a result of the Investigation Work Plan for SMWU No. 1 (Aeration Basin) and SMWU No. 14 (Old API Separator). The OAPIS–1 well is screened in the Chinle/Alluvium Interface stratigraphic unit. The OAPIS-1 well was added to the quarterly sample schedule in 2013. In agreement with OCD and as approved by NMED, the third quarter sample event was combined with the annual sample event.

In 2015, groundwater samples were collected from OAPIS-1 for the following analytes: BTEX, MTBE, , DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, cyanide, VOCs and SVOCs.

The OAPIS-1 well was inspected and sampled on the following dates in 2015:

WELL ID	Date	Date	Date	Date
OAPIS-1	3/10/15	6/2/15	8/11/15	10/29/15

- Benzene and MTBE concentrations exceeded the EPA MCL standards (0.005 mg/L and 0.143 mg/L, respectively) for each quarterly sample event during 2014 and 2015. Concentrations of ethylbenzene were also present but remained below the applicable standard. Toluene and xylenes were below the applicable standards for 2015 (Table 8.7).
- In 2015, DRO and GRO concentrations were detected at 7.1 mg/L and 0.8 mg/L, respectively. Fluoride and chloride concentrations exceeded the WQCC standards of 1.6 mg/L and 250 mg/L, respectively, with the highest concentration recorded in 2015 at (1.9 mg/L fluoride; 2000 mg/L chloride). Concentrations of bromide and sulfate were also present but remain below the applicable standards (Table 8.7.1).
- Total and dissolved arsenic, iron, and manganese concentrations exceeded the applicable standards in most of 2015 ~~with the exception of dissolved arsenic~~. Total cyanide exceeded the EPA RSL standard (0.0014 mg/L) during 2015 with the highest concentration recorded in quarter two (0.0887 mg/L). Total and dissolved cadmium and silver, total mercury, and dissolved chromium and copper were below the detection limits with the exception of quarter two in 2015 when low concentrations of dissolved chromium were detected (Tables 8.7.2 and 8.7.3).
- Naphthalene and 1-methylnaphthalene concentrations exceeded applicable standards in 2015. No other VOCs or SVOCs exceeded the applicable standards in 2015 (Table 8.7.4).

6.2.5 STP1-NW and STP1-SW

Monitoring well STP1-NW is located on the west end of STP-1 north bay and STP1-SW is located on the southwest corner of the south bay of STP-1. These wells were installed in May of 2013. Ground water samples were analyzed for the following analys~~t~~es: 8260B plus MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, cyanide and SVOCs. The sample location was inspected and sampled on the following dates:

The STP1-NW and STP1-SW wells were inspected and sampled on the following dates in 2015:

Well ID	Date	Date	Date	Date
STP1-NW	3/10/15	6/2/15	8/11/15	10/29/15
STP1-SW	3/10/15	6/2/15	8/11/15	10/29/15

- STP1-SW was dry during all quarters of 2015 and therefore not sampled.
- There were no BTEX, MTBE, DRO, GRO, or MRO constituents detected above applicable standards in 2015 (Table 8.8).
- With the exception of the third quarter 2015, chloride, nitrite and nitrate concentrations exceeded applicable standards during each sampling event (Table 8.8).
- Total iron concentrations exceeded the standard of 1.0 mg/L during the first three quarters of 2015. Low concentrations of arsenic, barium, chromium, lead, manganese, selenium, uranium, and zinc were also detected (Tables 8.8.1 and 8.8.2).
- No VOCs or SVOCs were detected above applicable standards (Table 8.8.3).

6.3 CONSTITUENT LEVELS IN GROUP C MONITORING WELLS

The Group C wells include six observation wells (OW-13, OW-14, OW-29, OW-30, OW-50, and OW-52) located on level terrain northeast of the refinery tank farm, and four recovery wells (RW-1, RW-2, RW-5, and RW-6) located within the refinery tank farm. Observation wells OW-50 and OW-52 were installed in 2009 to monitor potential migration of constituents. The recovery wells were installed between 1987 and 1990 and have been used to recover SPH.

6.3.1 OBSERVATION WELLS: OW-13, OW-14, OW-29, and OW-30

The observation wells OW-14, OW-29, and OW-30 are screened in the Chinle/Alluvium Interface; observation well OW-13 is screened in the Sonsela stratigraphic unit. OW-13 is down gradient (north) of the tank farm and OW-14 is up gradient and adjacent to the LPG tank farm. OW-29 is located directly north of OW-14 and OW-30 is situated northeast of OW-14 along the east side of the railroad spur entering the refinery property from the north. These observation wells are sampled quarterly and in agreement with OCD, approved by NMED, the third quarter sampling event is combined with the annual sampling requirement per the OCD discharge permit.

Groundwater samples were collected from these observation wells and submitted for laboratory analyses of the following analytes: BTEX, MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, and VOCs and SVOCs.

Observation wells OW-13, OW-14, OW-29, and OW-30 were sampled on the following dates in 2015:

Well ID	Quarter 1	Quarter 2	Quarter 3	Quarter 4
OW-13	3/9/15	6/1/15	8/11/15	10/27/15
OW-14	3/9/15	6/1/15	8/10/15	10/27/15
OW-29	3/9/15	6/1/15	8/11/15	10/27/15
OW-30	3/9/15	6/2/15	8/10/15	10/27/15

- BTEX constituents were not detected in OW-29 or OW-30 during 2015; the wells have not had detectable BTEX concentrations since 2006. (Table 8.9). However, it is noted that the benzene concentrations in OW-14 have been rising since it's installation in 2010. A revised work plan for investigating the source of the rising concentrations was submitted to the NMED for review and approval. Upon execution of the work plan a report will be generated that discusses the issue in detail.

- Low concentrations of MTBE were detected in OW-13 in 2015, but each detected concentration was well below the standard. Concentrations of MTBE in OW-14, OW-29, and OW-30 during 2015 were all above the standard, with the highest being in OW-30 during the first quarter at 4.0 mg/L. MTBE concentrations in these three observation wells have been above the standard since at least 2009 (Table 8.9).

- Low concentrations of GRO were detected in each observation well during 2015 except for well OW-13. MRO was not detected in any of these observation wells during 2015. Low concentrations of DRO were detected in OW-14 and OW-30. (Table 8.9.1).

- In 2015, concentrations of fluoride, bromide, nitrate, and sulfate were detected in each of the four observation wells, however concentrations remain below applicable standards. Concentrations of chloride have exceeded the standard of 250 mg/L in OW-14 in 2013 through 2015 (Table 8.9.1).

- No concentrations of total or dissolved metals were detected above applicable standards in well OW-13 in 2015. In well OW-14, concentrations of total and dissolved barium, iron, and manganese were above applicable standards in 2015; the concentrations detected are similar to previous years. In well OW-29 during 2015, concentrations of total and dissolved manganese and uranium were above applicable standards, and are similar to previous years. In well OW-30, concentrations of total and dissolved uranium were above the standard of 0.03 mg/L and have been since 2012 (Tables 8.9.2 and 8.9.3).

- In 2015, no VOCs and SVOCs were detected in OW-13, OW-14, OW-29, and OW-30 (Table 8.9.4).

6.3.2 OBSERVATION WELLS: OW-50 and OW-52

Observation wells OW-50 and OW-52 were installed up gradient from OW-13 and OW-29 in 2009 to monitor possible migration of MTBE. The two observation wells are screened in the Chinle/Alluvium Interface stratigraphic unit. A request to change the 2010 FWGWMP sample frequency from quarterly to annual for OW-50 and OW-52 was approved by NMED in 2012 (2011 Updates, Comment 6).

In 2015, groundwater samples were collected from observation wells OW-50 and OW-52 for the following analytes: BTEX, MTBE, DRO, GRO, MRO, major anions/cations, WQCC total and dissolved metals, and VOCs, SVOCs.

Observation wells OW-50 and OW-52 were sampled on the following dates in 2015:

Well ID	Sample Date
OW-50	8/10/15
OW-52	8/10/15

- BTEX, MTBE, DRO, GRO, and MRO constituents have not been detected in either OW-50 or OW-52 since 2010 through 2015 (Tables 8.10 and 8.10.1).
- Low concentrations of fluoride, chloride bromide and sulfate were detected in 2015 but remain below the applicable standards (Table 8.10.1).
- Low concentrations of total and dissolved barium, manganese, and uranium been detected in OW-50 and OW-52 in 2015, but all concentrations were below applicable standards (Tables 8.10.2 and 8.10.3).
- No VOCs or SVOCs were detected above applicable standards in OW-50 and OW-52 during 2015. In quarter one 2010, bis(2-ethylhexyl)phthalate exceeded the standard of 0.006 mg/L in OW-50 and a low concentration of benzoic acid was detected but have remained below this standard through 2015. The detection of these two organic compounds may possibly be lab contaminants or from the PVC pipe casing materials used for this well (Table 8.10.4).

6.3.3 RECOVERY WELLS: RW-1, RW-2, RW-5, RW-6

The recovery wells RW-1, RW-2, RW-5, and RW-6 are shallow wells installed in the refinery tank farm located in the east-central portion of the refinery property. The recovery wells are screened within the Chinle/Alluvium Interface stratigraphic unit and are used to recover SPH. RW-1 is located east of Tank 568; RW-2 is located between Tanks 581 and 582; and RW-5 and RW-6 are located in the northwest corner of the tank farm, east of Tanks 337 and 345.

Quarterly inspections for the RW wells include product recovery of SPH using disposable bailers in RW-5 and RW-6, and a portable 2-inch bladder pump for RW-1. Hydrocarbon thickness is measured prior to being removed. Purge water is collected and disposed upstream of the NAPIS. Hydrocarbon recovery is estimated based on measurements and observations.

The RW wells were added to the annual sampling schedule in 2011, per the *Approval with Modifications* in the 2010 FWGWMP. For 2015, the wells were sampled and evaluated for the following analytes: BTEX, MTBE, DRO, GRO, and MRO.

The recovery wells were inspected and sampled in 2015 on the following dates:

WELL ID	Date	Date	Date	Date
RW-1	3/23/15	6/9/15	8/23/15	10/29/15
RW-2	3/23/15	6/9/15	8/23/15	10/29/15
RW-5	3/23/15	6/9/15	8/23/15	10/29/15
RW-6	3/23/15	6/9/15	8/23/15	10/29/15

- No samples were collected from RW-1 due to SPH levels
- BTEX and MTBE concentrations exceeded applicable standards in RW-2 in 2015. Benzene exceeded the applicable standard in RW-5, and benzene and total xylenes concentrations exceeded applicable standards in RW-6. Concentrations of total xylenes and ethyl benzene were detected in RW-5, and low concentrations of toluene, ethyl benzene and MTBE were detected in RW-6 but did not exceed the standard. MTBE concentrations have frequently exceeded applicable standards for RW-1 and RW-2 since 2011 (Table 8.11).
- Major cations and anions were not analyzed in 2015 (Table 8.11.1).
- DRO and GRO concentrations were detected in RW-2, RW-5 and RW-6 during both sample events in 2015. The highest concentrations of DRO were detected in RW-6 at 1,400 mg/L (Aug. 2015) and 340 mg/L (Oct. 2015). MRO was not detected in any of the RW wells during 2015.
- Total and dissolved metals were not analyzed in 2015 (8.11.2 and 8.11.3) Hydrocarbon recovery from RW-1 has shown a steady decrease from 2005 through 2015. In 2015, total hydrocarbon recovery is estimated at 2.0 gallons in 55 gallons of water purged compared to the 2005 estimate of 431 gallons of hydrocarbons in 1,210 gallons of water. It is noted that even though the hydrocarbon cut has decreased in the purge water, the hydrocarbon thickness observed in RW-1 has consistently ranged from 1.9 to 4.6 feet thick within RW-1. No measureable hydrocarbons have been detected in RW-2 since the well was installed. RW-5 and RW-6 have shown a steady

decrease in hydrocarbons since 2005. SPH has not been detected in RW-5 and RW-6 since February 2009 and November 2011, respectively.

6.4 CONSTITUENT LEVELS IN GROUP D MONITORING WELLS

The Group D wells include three process/production wells, PW-2, PW-3, and PW-4 that supply water to the refinery and for domestic uses. These process wells reach approximately 1,000 ft and are screened in the San Andreas/Yeso aquifer. Additionally, Group D also includes four observations wells OW-1, OW-10, OW-11, and OW-12. The OW-1 and OW-10 wells are located in the northwest portion of the refinery. OW-11 is located near the entrance of the refinery and OW-12 is west of the tank farm in the surplus yard.

6.4.1 PROCESS WELLS: PW-2, PW-3, PW-4

PW-2, PW-3 and PW-4 are all process/production wells which supply process water to the refinery and domestic water to the company housing and Pilot Travel Center. PW-2 is located west of evaporation pond 6 (EP-6). PW-3 is centrally located directly north of the maintenance shop, and PW-4 is located on the southern edge of the refinery property and adjacent to the Pilot Lift Station.

The production wells are on a staggered 3-year sampling schedule, with the exception of PW-3 which is sampled annually since the detection of 2-methylnaphthalene exceeding the applicable standard in 2008. In 2015, a groundwater sample was collected from P PW-3 for the following analytes: BTEX, MTBE, nitrate, WQCC total and dissolved metals, and VOCs and SVOCs.

The process well PW-3 was sampled in 2015 on the following dates:

Well ID	Date
PW-3	8/23/15

- BTEX and MTBE were not detected in PW-3 in 2015 (Table 8.12).
- Low concentrations of fluoride and chloride were present in PW-3 in 2015. The sulfate concentration (750 mg/L) exceeded the applicable standard (600 mg/L).
- In 2015, low concentrations of total and dissolved arsenic, barium, iron, selenium, and uranium were detected in well PW-3. Each of the detected concentrations was below applicable standards (Table 8.12.1 and 8.12.2)
- No VOCs or SVOCs were detected in PW-3 in 2015 (Table 8.12.3).

6.4.2 OBSERVATION WELLS: OW-1 AND OW-10

Observation well OW-1 is an artesian well located on the west side of EP-6. Well OW-10 is located down gradient from OW-1 on the east side of EP-9. Wells OW-1 and OW-10 are screened in the Sonsela stratigraphic unit. Inspection requirements for these two wells were modified in 2010, per the 2010 FWGWMP, and included sampling on a quarterly basis. In agreement with OCD, approved by NMED, the third quarter sampling was combined with the annual sampling event. In 2015, groundwater samples from OW-1 and OW-10 were evaluated for the following analytes: BTEX, MTBE, DRO, GRO, MRO, major cations/anions, WQCC total and dissolved metals, VOCs, and SVOCs.

Groundwater samples were collected from OW-1 and OW-10 in 2015 on the following dates:

Well ID	Date	Date	Date	Date
OW-1	3/9/15	6/3/15	8/12/15	10/28/15
OW-10	3/9/15	6/3/115	8/12/15	10/28/15

- In the last quarter of 2015, low concentrations of benzene, toluene, total xylenes, and MTBE were detected in OW-1, and low concentrations of toluene, ethyl benzene, total xylenes, and MTBE were detected in OW-10. MTBE was detected in all four quarters of 2015 in OW-10 (Table 8.13).
- DRO and MRO were not detected above applicable standards in either OW-1 or OW-10 during 2015. Low concentrations of GRO were detected in quarters two and three in OW-10, but the constituent was not detected in OW-1 in 2015 (Table 8.13.1).

- In 2015, low concentrations of fluoride, chloride, bromide, and sulfate were detected in OW-1 but remain below the applicable standards. Low concentrations of sulfate and GRO were detected in OW-10 but were below the applicable standards. The chloride concentration in OW-10 continues to exceed the standard of 250 mg/L, but constituent concentrations remains below the standard for OW-1 (77 mg/L, quarter 2) (Table 8.13.1).

- In well OW-1, concentrations of total uranium were detected above the applicable standards in all four quarters of 2015. Concentrations of dissolved iron (quarter 3) and uranium (all four quarters) were detected above the applicable standards in 2015. In well OW-10, total and dissolved concentrations of uranium have exceeded the applicable standard of 0.03 mg/L from 2010 through 2015. Low concentrations below applicable standards of other total and dissolved metals were detected in OW-1 and OW-10 (Tables 8.13.2 and 8.13.3).

- In well OW-10, in the third quarter, the constituent 1,1-dichloroethane was detected but concentrations did not exceed the standard of 0.025 mg/L (Table 8.13.4).

6.4.3 OBSERVATION WELLS: OW-11 AND OW-12

Observation well OW-11 is located within the refinery property (southeast) on the west side of the main entrance. Well OW-12 is located within the surplus or bone yard located west and slightly north of the primary tank farm. OW-11 and OW-12 are screened in the Sonsela stratigraphic unit.

Well inspections and sampling are conducted annually. In 2015, groundwater samples from the two wells were evaluated for the following analytes: BTEX, MTBE, major anions/cations, GRO, DRO, MRO, WQCC total and dissolved metals, VOCs, and SVOCs. Observation well OW-11 and OW-12 were sampled in the third quarter of 2015 on the following dates:

Well ID	Date
OW-11	8/17/15
OW-12	8/13/15

- BTEX and MTBE have not been detected in OW-11 and OW-12 since 2006 and remained non-detect for 2015 (Table 8.14).

- Fluoride and sulfate concentrations continue to exceed the applicable standards (1.6 mg/L and 600 mg/L, respectively) in OW-11 with fluoride detected at 1.9 mg/L and sulfate at 880 mg/L in 2015. In 2015, chloride concentrations were detected in both wells but did not exceed the standard. Bromide was detected below applicable standards in OW-11 and OW-12 (Table 8.14.1).

- GRO, DRO and MRO were not detected in OW-11 and OW-12 in 2015 (Table 8.14.1).

- In OW-11, total and dissolved uranium concentrations continue to exceed the standard of 0.03 mg/L; the constituent was detected at 0.23 mg/L in 2015. Uranium concentrations were detected in OW-12 but remain below the standard. Low concentrations of barium and manganese were detected in both wells. Selenium was detected in OW-11 but did not exceed the applicable standard (Tables 8.14.2 and 8.14.3).

- Bis(2-ethylhexyl)phthalate was not detected in OW-11 during 2015 (Table 8.14.4).

6.5 CONSTITUENT LEVELS IN GROUP E MONITORING WELLS

To date, a total of 44 monitoring wells (MKTF-1 through MKTF-44) have been installed to aid in delineating the extent of a hydrocarbon seep discovered in 2013, directly west of crude tanks T-101 and T102. During the investigation, a pre-existing well (labeled as MKTF-45) was found directly west of the truck-loading rack. Each of the wells has been constructed into permanent monitoring wells, and these wells are designated as Group E wells.

6.6 CONSTITUENT LEVELS FOR MKTF WELLS

In 2015, groundwater samples were collected from the MKTF wells and evaluated for the following analytes: BTEX, MTBE, DRO, GRO, MRO, major cations/anions, metals, VOCs, and SVOCs. Wells that had a hydrocarbon layer were not sampled.

- As indicated in Figure 13 (Product Thickness Map), the SPH thickness in the MKTF wells ranged from 0 to 1.98 feet at MKTF-7. The SPH plume is located along the southwest portion of the refinery near the truck loading area and storage tanks.
- Benzene concentrations exceeded the standard of 0.005 mg/L in the following wells: MKTF-1, MKTF-2, MKTF-4, MKTF-9, MKTF-10, MKTF-11, MKTF-16, ~~and~~ MKTF-17 through MKTF-26, and MKTF-35 through MKTF-39. The greatest benzene concentration (28 mg/L) during 2015 occurred in well MKTF-16 during quarter four (Table 8.15).
- Toluene concentrations exceeded the standard of 0.75 mg/L in the following wells: MKTF-1, MKTF-10, MKTF-11, MKTF-16, MKTF-20, and MKTF-23. The highest toluene concentration (22 mg/L) occurred in well MKTF-10 during quarter four (Table 8.15).
- Ethylbenzene concentrations exceeded the standard of 0.7 mg/L in the following wells: MKTF-1, MKTF-10, MKTF-11, MKTF-16, ~~and~~ MKTF-19 and MKTF-36. The highest concentration (1.7 mg/L) occurred in MKTF-16 during quarter four (Table 8.15).
- Total xylenes concentrations exceeded the standard of 0.62 mg/L in the following wells: MKTF-1, MKTF-4, MKTF-10, MKTF-11, MKTF-16, MKTF-19 MKTF-20, MKTF-21, MKTF-23, and MKTF-37. The highest concentration (9.6 mg/L) occurred in well MKTF-20 (Table 8.15).
- MTBE concentrations exceeded the standard of 0.143 mg/L in the following wells: MKTF-1, MKTF-4, MKTF-9, MKTF-16, MKTF-17, MKTF-19, MKTF-21, MKTF-22, MKTF-23, MKTF-24, MKTF-25, MKTF-32, MKTF-33, and MKTF-36. The highest concentration (9.7 mg/L) occurred in well MKTF-19 during quarter one (Table 8.15).
- The constituent DRO and GRO were detected in MKTF-1 through MKTF-23, MKTF-25, MKTF-31, MKTF-35, MKTF-36, MKTF-37, MKTF-39, and MKTF-42. Detectable concentrations of GRO were also detected in MKTF-24, MKTF-26, MKTF-27, MKTF-30, MKTF-32, MKTF-33, and MKTF-38. There were no detectable concentrations of MRO in any well above the applicable standards. (Table 8.15.1).

- Chloride concentration exceedances above the standard (250 mg/L) were noted in the following wells: MKTF-1, MKTF-2, MKTF-4, MKTF-10, MKTF-11, MKTF-16, MKTF-23, MKTF-24, MKTF-25, MKTF-26, MKTF-27, MKTF-28, MKTF-30, MKTF-31, MKTF-32, MKTF-34, MKTF-39, MKTF-40, MKTF-41, MKTF-42, and MKTF-43. Fluoride concentration exceedances above the standard (1.6 mg/L) was noted in MKTF-2 (Table 8.15.1).

- The sulfate concentrations in the samples collected from wells MKTF-29 (650 mg/L), MKTF-40 (890 mg/L) and MKTF-43 (1,700 mg/L) exceeded the standard (600 mg/L} in 2015.

- Total metals concentrations above applicable standards were noted in the following wells (values in parentheses represent cleanup levels) (Table 8.15.2):

- Arsenic (0.01 mg/L): MKTF-4, MKTF-10, MKTF-16, MKTF-17, MKTF-18, MKTF-19, MKTF-20, MKTF-21, MKTF-23, and MKTF-36.
- Barium (1 mg/L): MKTF-1, MKTF-4, MKTF-10, MKTF-11, MKTF-15, MKTF-16, MKTF-17, MKTF-18, MKTF-19, MKTF-20, MKTF-21, MKTF-22, MKTF-24, MKTF-33, MKTF-35, MKTF-36, and MKTF-39.
- Chromium (0.005 mg/L): MKTF-10, MKTF-18, and MKTF-22.
- Iron (1 mg/L): all wells sampled.
- Lead (0.015 mg/L): MKTF-4, MKTF-10, MKTF-17, , MKTF-18, MKTF-19, MKTF-21, MKTF-22, MKTF-24, MKTF-25, MKTF-35, MKTF-36, MKTF-37, MKTF-38, MKTF-39, and MKTF-44.
- Manganese (0.2 mg/L): all wells sampled except MKTF-34.
- Selenium (0.05 mg/L): MKTF-41 and MKTF-43.
- Uranium (0.03 mg/L): MKTF-2, MKTF-10, MKTF-17, MKTF-18, MKTF-22, MKTF-23 through MKTF-28, MKTF-30 through MKTF-34, and MKTF-40 through MKTF-44.

- Dissolved metals concentrations above applicable standards were noted in the following wells (Table 8.15.3):

- Arsenic: MKTF-4, MKTF-10, MKTF-16, MKTF-19, MKTF-20, MKTF-21, MKTF-23, and MKTF-36.
- Barium: MKTF-1, MKTF-4, MKTF-10, MKTF-11, MKTF-15, MKTF-16, MKTF-18, MKTF-19, MKTF-20, MKTF-21, MKTF-22, MKTF-36, and MKTF-39.
- Iron: MKTF-1, MKTF-4, MKTF-9, MKTF-10, MKTF-11, MKTF-15, MKTF-16, MKTF-18, MKTF-19, MKTF-20, MKTF-21, MKTF-22, MKTF-23, MKTF-24, MKTF-27, MKTF-30, MKTF-35, MKTF-36, MKTF-37, MKTF-39, MKTF-41, MKTF-43, and MKTF-44.
- Manganese: all wells except MKTF-28, MKTF-30, MKTF-31, MKTF-32, MKTF-34, MKTF-41, and MKTF-44.

- Uranium: MKTF-2, MKTF-24 through MKTF-28, MKTF-30 through MKTF-33, and MKTF-40 through MKTF-44.
- No VOCs ~~or SVOCs~~ were detected above applicable standards in wells MKTF-17, MKTF-27, MKTF-28, MKTF-29, MKTF-33, MKTF-34, MKTF-38, MKTF-40, MKTF-41, MKTF-43, and MKTF-44.
- No SVOCs were detected above applicable standards in wells MKTF-17, MKTF-27, MKTF-28, MKTF-29, MKTF-33, MKTF-34, MKTF-38, MKTF-40, MKTF-41, MKTF-43, and MKTF-44.
-

The remaining wells had concentrations of the following constituents, which exceeded the referenced standards in at least one of the MKTF wells. The specific compounds identified in each well are summarized in ~~(~~Tables 8.15.4 and 8.15.5.~~):~~

- Aniline (0.013 mg/L)
- cis-1,2-DCE (0.005 mg/L)
- 1-methyl naphthalene (0.0011 mg/L)
- 2-methylnaphthalene (0.0036 mg/L)
- ~~3,4-methylphenol (0.93 mg/L)~~
- Naphthalene (0.00~~0~~165~~7~~ mg/L)
- ~~Phenanthrene (0.17 mg/L)~~
- Phenol (0.005 mg/L)
- 1,2,4-trimethylbenzene (0.015 mg/L)
- 1,3,5-trimethylbenzene (0.12 mg/L)
- 1,2-dichloroethane (0.005~~17~~ mg/L)
- 1-methylnaphthalene (0.0011 mg/L)
- 1,1-dichloroethane (0.025 mg/L)
- 1,1-dichloroethene (0.005 mg/L)
- Tetrachloroethene (0.005 mg/L)
- 1,1,1-Trichloroethane (0.06~~05~~ mg/L)
- Trichloroethene (0.005 mg/L)
- Vinyl chloride (0.001 mg/L)

6.7 CONSTITUENT LEVELS FOR EVAPORATION PONDS, INFLUENTS, AND EFFLUENTS

There are eleven evaporation ponds located within the northwest section of the refinery. Evaporation pond 1 is more commonly known as Pond 1 and is considered separate from the remaining SMWU No. 2 Evaporation Ponds. Pond 1, which is out of service, is separated by a dike along the north side of aeration lagoon 1 (AL-1) and aeration lagoon 2 (AL-2), and was used as a holding pond for the aeration lagoons. Evaporation ponds 2 through 6 are separated by dikes and are located west of AL-2. Evaporation pond 9 (EP-9) is to the south and is separated from EP-2 through EP-6 by a two-track road. Evaporation ponds 7, 8, 11, 12A, and 12B are also separated by dikes and are located on the northwest corner of the refinery. In addition to the evaporation ponds, there are three influents and three effluent points that are routinely monitored.

6.7.1 EVAPORATION PONDS 1 THROUGH 12B

Samples have been collected annually from Pond 1 and EP-2 through EP-8 since 2007. In 2011, EP-9, EP-11, EP-12A, and EP-12B were added to the sample list, per the 2010 FWGWMP, and the sample frequency was increased to semi-annually for all of the ponds. Pond 1 has been taken out of service.

In 2015, samples were collected from the evaporation ponds for the following analytes: BTEX, MTBE, major anions/cations, biochemical oxygen demand (BOD), chemical oxygen demand (COD), e-coli bacteria, WQCC total and dissolved metals, and VOCs and SVOCs. EP-2 through EP-9, EP-11, EP-12A, and EP-12B were sampled in 2015 on the following dates:

Sample Location	Date	Date
Ponds 2 – 12B	3/26/15	9/2/15

- Bezene concentrations were detected above the applicable standard (0.005 mg/L) in the first quarter of 2015 in the following evaporation ponds: EP-2, EP-3, EP-4, and EP-12B. The rest of the BTEX constituents and MTBE were below applicable standards for the remaining EPs in 2015 (Table 8.16).
- Concentrations of fluoride, chloride, and sulfates exceeded the applicable WQCC standards in each evaporation pond during 2015 (Table 8.16). In 2015, BOD concentrations exceeded the general requirement of the 20 NMAC 6.2.3103 (<30 mg/L) in each of the evaporation ponds except for EP-7 and EP-9. COD concentrations exceeded the general requirement (<125 mg/L) in each of the ponds. The e-coli standard of 500 organisms/100 mL was exceeded in EP-2 (5,475 CFU/100 mL), EP-3 (24,196 CFU/100 mL), EP-4 (5,475 CFU/100mL), EP-5

(1,515 CFU/100mL), EP-12A (12,033 CFU/100mL), and EP-12B (~~>2,419.6~~17,329 CFU/100mL) (Table 8.16.1).

- Fluoride, chloride and sulfate concentrations exceeded the applicable standards in each evaporation pond during 2015 (Table 8.16.~~2~~1).
- Total metals concentrations in pond samples were detected as follows (Table 8.16.~~3~~2):

- Arsenic, manganese and iron concentrations in each pond exceeded the applicable standards in one or more of the samples.
- Detectable concentrations of barium and chromium were found in one or more samples, but were below applicable standards with the exception of exceedance of chromium in EP-~~6~~7 (~~1.6~~0.064 mg/L). EP-7 also had a concentration of dissolved chromium of 0.062 mg/L.
- Cadmium, copper, and lead were below applicable standards in each pond sample.
- ~~A low concentration of mercury (0.0.00032 mg/L) was detected in one EP-1 sample, but the concentration was below the applicable standard.~~
- Selenium concentrations exceeded applicable standard in EP-7, EP-8, EP-9 and EP-11.

- A low concentrations of uranium were detected in EP-2, EP-3, EP-4, EP-12A, and EP-12B, but the concentrations were below the applicable standard. Low concentrations of zinc were detected in the evaporation ponds samples, but each was below the constituent applicable standards.

- Dissolved metals concentrations in pond samples were detected as follows (Table 8.16.3):

- Arsenic and manganese concentrations in each pond exceeded the applicable standards in one or more semiannual samples.
- Iron concentrations exceeded the standard in one or more samples of EP-2, EP-4, and EP-12B.
- Selenium concentrations exceeded the applicable standard in one sample of EP-7, EP-8, EP-9, and EP-11.
- Low concentrations of barium were detected in each pond, but all were below the applicable standard.
- A low concentration of uranium was detected in EP-2 (0.0031 mg/L), EP-4 (0.0026 mg/L) and EP-12A (0.0025 mg/L) but these concentrations are below the applicable standard.
- Cadmium, copper, lead, and silver were not detected in any pond samples.
- No VOCs were detected in any of the ponds during 2015 with the exception of low concentrations of acetone in EP-3 and EP -12B (Table 8.16.~~5~~4).

- Although aniline was detected in concentrations exceeding the standard of 0.013 mg/L during March 2014 in EP-2, EP-3, EP-4, and EP-5, aniline was not detected in any of the ponds in 2015. Phenol concentrations exceeded the standard of 0.005 mg/L in September 2015 for EP-2 (0.22 mg/L) and EP-12B (0.086 mg/L). Low concentrations of 3,4-methylphenol were detected in ~~EP-1,~~ EP-2, EP-3, EP-4, and EP-12B but did not exceed the applicable standard of 0.093 mg/L (Table 8.16.~~6~~5).

6.7.2 INFLUENTS: AL-1, AL-2, AND EP-1

The start-up of the new WWTP occurred in May 2012. By the end of June 2012, all of the processed water going into AL-1 was re-routed to the WWTP, via Tank 35 and the NAPIS unit, with the exception of the Pilot lift station. Some gravitational flow continued from AL-1 to AL-2 and from AL-2 to Pond 1 (EP-1) through the second half of 2013.

The aeration lagoons and pond 1 are no longer in service and no samples were collected in 2015.

6.7.3 EFFLUENTS: AL-2 TO EP-1, PILOT, AND NAPIS

All effluents have been non-existent since June 2013 due to re-routing waters to the WWTP. The last effluent sample from AL-2 was in June 2013. The Pilot effluent was rerouted in June 2013 while the NAPIS unit was re-routed mid-June 2012. No effluent analyses are available for 2015.

6.7.4 OUTFALL BW TO EP-2

BW is defined as reverse osmosis water coming from the boiler unit. The flow from the boiler unit discharges into EP-2 through a 4-inch PVC pipe. EP-2 is directly west of EP-1. The BW to EP-2 sample is evaluated for the following analytes: major anions/cations.

The BW to EP-2 sample was taken March 23, 2015.

Sample Location	Date
BW to EP-2	3/23/15

- The sulfate concentration (2,000 mg/L) exceeded the standard of 600 mg/L. All other constituents were either below applicable standards or were not detected (Tables 8.17).

6.7.5 OUTFALL STP1 to EP-2 Inlet

The EP-2 Inlet designation was changed to STP1 to EP-2 in the second half of 2012 due to the startup of the new WWTP and the new sanitary treatment pond (STP-1). STP-1 effluent now flows into the northeast corner of EP-2. The STP1 to EP-2 inlet is sampled on an quarterly ~~annual~~ basis, and sampled for the following analytes: BTEX, MTBE, VOCs, GRO, DRO, MRO, BOD, COD, and TDS.

The EP-2 inlet was sampled August 24, 2015.

Sample Location	Sample Date
EP-2 Inlet	4/24/15

- The DRO concentration of 2.3 mg/L exceeded the applicable standard (0.2 mg/L). The TDS concentration of 2,420 mg/L exceeded the standard of 1,000 mg/L. All other BTEX and 8015 constituents were below the applicable standards (Table 8.18).
- The BOD ~~and COD~~ concentration~~s~~ exceeded the applicable standard~~s~~ in 2015 (Tables 8.18.1).
- A low concentration of acetone was detected but is below applicable standards. No other VOCs were detected in 2015 (Tables 8.18.2).

6.8 ADDITIONAL SAMPLING AND/OR CHANGES

Requirements by NMED:

- Sample wells upgradient from the NAPIS wells, OW-1, OW-10, and OW-11 and review analytical results to determine if uranium detections are similar in concentrations in unaffected wells.
- Sample upgradient wells from the NAPIS wells, OW-1, OW-10, and OW-11 for total and dissolved metals.

The marketing (MKTF) wells from the hydrocarbon seep investigation have been added to the ground water sampling plan.

SECTION 7

CONCLUSIONS AND RECOMMENDATIONS

This section is an overview of the analytical water quality data collected to identify potential impacts to the groundwater and determine if further monitoring or site investigations are required.

7.1 GROUP A

The boundary wells (BW-1A, BW-1B, BW-1C, BW-2A, BW-2B, BW-2C, BW-3A, BW-3B, and BW-3C) located in the northwest corner of the refinery along the west sides of evaporation ponds 7, 8 and 11 have not shown any detection of BTEX or MTBE constituents during annual sampling events (BW-1A, BW-1B and BW-3A contained no water on the fluid-level gauging date and were not sampled). Fluoride concentrations were detected above WQCC standards in BW-1C, BW-2B, and BW-2C, which may be naturally occurring in the groundwater. In 2015, iron exceeding the applicable standard was detected in wells BW-2B and BW-3C, but this metal may be naturally occurring as well. Low concentrations of barium, lead, manganese, and uranium are frequently detected in most of the boundary wells. The semi-volatile organic compound bis(2-ethylhexyl) phthalate was detected in BW-3B (0.01 mg/L) in 2009, BW-3C (0.01 mg/L) in 2011 and BW-1C (0.01 mg/L) in 2013. Detection of this organic compound in the groundwater sample may be a laboratory contaminate or possibly originate from the PVC pipe materials used as casing for the wells.

The MW (MW-1, MW-2, MW-4, and MW-5) series of wells are located around the RCRA LTU. No detectable concentration levels of BTEX or MTBE constituents have been found in the groundwater samples collected from these wells. No metals (total or dissolved) exceeded the applicable standards; however, very low concentrations of arsenic, barium, iron, manganese, and uranium were detected in most of the MW series of wells. MW-1 showed low concentrations of lead in 2014 and 2015. 2015 analytical data indicates no detection of VOCs or SVOCs in any of the MW wells; however, in 2008, bis(2-ethylhexyl)phthalate was detected in the groundwater collected from MW-4. The detection of this particular constituent in the groundwater sample may have been a laboratory contaminant or from the PVC pipe materials used in this well. These wells are also monitored under the RCRA Post Closure Permit on a 10-year cycle. The first cycle was completed in 2009/2010.

The SMW (SMW-2, SMW-4) wells are also located around the RCRA LTU and are screened in the Chinle/Alluvium Interface stratigraphic unit. These wells are also monitored under the RCRA Post Closure Permit on a 10-year cycle. The first cycle was completed in 2009/2010. No detectable concentration levels of BTEX constituents were found in these wells from 2006 through 2015. MTBE was only detected in SMW-2 in 2008 and 2010 through 2015 at concentration levels below the NMED Tap Water standard of 0.143 mg/L. SMW-2 also had elevated chloride and sulfate levels, and two metals (total and dissolved), manganese and uranium that were detected exceeding the WQCC standards. In SMW-4, uranium (0.036 mg/L total and 0.035 mg/L dissolved) was the only metal that exceeded the WWCC standard of 0.03 mg/L in 2015. In 2015 no detections of any organic compounds have been detected in SMW-2 or SMW-4.

7.2 GROUP B – GROUNDWATER MONITORING

Benzene concentrations from all 2015 sampling events at GWM-1 have exceed applicable standards. This would indicate the potential for historical releases from the aeration lagoons. There was an insufficient volume of water in GWM-2 during the fourth quarter of 2013 for sample collection, and the well was reported dry for all of 2014 and 2015. GWM-3 was dry during 2013, 2014 and 2015.

Pond levels in the aeration lagoons and pond 1 decreased in 2013 because all the influent into the aeration lagoons was diverted to the WWTP plant. The lagoons and pond 1 were taken out of service and no longer receive any water. Water levels in the aeration lagoons and pond 1 have been significantly lower and slowly evaporating. It was noted that the decrease in pond volumes did affect the water levels detected in the GWM wells. There were no significant changes in contaminant detections noticed in the GWM wells. However, it is noted that SPH appeared in GWM-1 in October 2015 and no sample was collected for chemical analysis. Even though no sample was collected for analysis, it is noted that the benzene concentration decreased from 0.011 mg/L in March to 0.0085 mg/L in August 2015. The aeration lagoon is currently awaiting closure and available options are being evaluated.

Also at the aeration basin are four monitoring wells situated around the NAPIS installed in 2007 and 2008 to address potential hydrocarbon leaks from the NAPIS. NAPIS-1 located on the east side (up-gradient) of the NAPIS has had no detectable contaminants since 2008. Down gradient of the NAPIS on the west side, NAPIS-2 ~~and KA-3 have~~ had concentrations of benzene and MTBE above the applicable standards. Samples collected from NAPIS-3 have not shown any BTEX or MTBE constituents since September 2010.

1-methylnaphthalene and naphthalene were detected above applicable standards during the third quarter 2013 in NAPIS-2. These constituents were detected in NAPIS-2 in 2015 but below applicable standards.

There are three leak detection units on the NAPIS Unit which are inspected for fluid level. Quarterly inspections of the units have indicated the presence of fluids. All three leak detection units (East LDU, West LDU, and Oil Sump LDU) continue to have a fluid level and are pumped out on a regular basis. During 2015, there was insufficient water for sampling in the Oil Sump LDU during the year. Recent water column measurements on the West LDU indicate that the bay is leaking into the LDU. The East LDU also contains water but it has been out of service for the last year. Plans are to inspect the east bay, place it back in service and then take the west bay out of service for inspection. The LDUs are pumped out every few months and the maximum recharge to the LDUs takes place over a few weeks following water removal..

A new well was installed on July 17, 2012, designated as OAPIS-1. The installation of this well is from a site investigation conducted according to the Investigation Work Plan Solid Waste Management Unit (SMWU) No. 1 Aeration Basin and SMWU No. 14 Old API Separator. Benzene and MTBE concentrations were above applicable standards for all 2015 sampling events.. Arsenic, iron and manganese concentrations were also above applicable standards in OAPIS-1 in 2015.

Initial sampling of STP1-NW began in the second quarter of 2014. Chloride concentrations exceeded WQCC standards during the first and fourth quarter of 2015, and iron concentrations exceeded WQCC standards during the first three quarters. Analytical results show no detections of BTEX, VOCs, or SVOCs.

7.3 GROUP C – GROUNDWATER MONITORING

Groundwater monitoring activities from the Group A wells (northeast side of the Refinery) have shown that an MTBE plume exists between wells OW-13, OW-14, OW-29, and OW-30. In March of 2010, dedicated pumps were installed in all four wells to prevent possible cross contamination from sampling equipment and or field activities. Although concentration levels of MTBE in OW-13 does not exceed the applicable standard of 0.143 mg/L, sample data indicates a steady increase of MTBE from year to year. Of the three wells OW-14 is the only well where two constituents (benzene and MTBE) have been consistently detected in the groundwater samples collected since 2006 that have exceeded the applicable standards. These two constituents continued to increase from year to year through 2015. OW-14 is located down-gradient from two recovery wells RW-1 and RW-2. RW-1 is the only well where hydrocarbons are continually recovered. 2015 analytical data from RW-1 and RW-2 indicate high levels of BTEX, MTBEand phenol.

Down gradient from OW-14 is OW-29 and OW-30 and the analytical data from both of these wells indicates that MTBE is present in the groundwater at concentration levels exceeding the NMED Tap Water standard of 0.143 mg/L since March of 2010 in OW-29 and December 2007 in OW-30. Analytical data for these four wells indicate a steady increase of MTBE concentration levels indicating that the MTBE plume is slowly migrating in a north, north-west direction down-gradient from RW-1 and RW-2. The stratigraphic units in which these wells exist are screened in the Chinle/Alluvium Interface.

Two new wells (OW-50 and OW-52) were installed in October 2009 downgradient of OW-13, OW-14 and OW-29 to monitor possible migration of MTBE in a north, north-east direction. To date, no detectable concentration levels of BTEX or MTBE constituents have been detected in OW-50 and OW-52. Based on the analytical data from these two new wells the migration of MTBE may be in a north-northwest direction from OW-29.

The inspection of the four recovery wells (RW-1, RW-2, RW-5 and RW-6) will continue as scheduled along with SPH recovery. No changes in product recovery are required and will continue with scheduled quarterly inspections. These wells were added to the annual sampling schedule beginning in 2011. Product recovery continues in RW-1 as there is a measureable hydrocarbon column thickness. Field notes indicate that although the SPH thickness level in RW-1 has generally increased since the first quarter of 2013, hydrocarbon recovery has shown a general decrease from 2005 through 2015. Total hydrocarbon recovery is estimated at 2 gallons for 2015 compared to 431 gallons in 2005. Additional information regarding characteristics of RW-1 will be collected during field work from the approved Work Plan for investigation at OW-14. RW-5 and RW-6 product recovery has also been declining. From 2010 through 2015, no product has been recovered from RW-5 and no product was recovered from RW-6 between 2012 to 2015. Although there is no measureable product level in RW-5 and RW-6 both wells will continue to be bailed as there is evidence of hydrocarbons in the wells from observing the bailed water (slight odor with a visible sheen).

7.4 GROUP D – GROUNDWATER MONITORING

PW-2, PW-3 and PW-4 are all process/production wells that are all set at around 1000 feet. All three of these wells are sampled every three years with the exception of PW-3 which was changed to annual in 2009 due to the detection of 2-methylnaphthalene in January 2008. Although the samples collected in August 2008 were all non-detect, it was determined by NMED that annual sampling was required for PW-3. No organic compounds have been detected in PW-3 from 2009 through 2015. Based on the analytical data the remaining two process wells remain relatively free of contaminants. Three organic compounds (1,2,4-trimethyl benzene, 1,3,5-trimethyl benzene and n-propyl benzene) were detected for the first time at low concentrations in PW-4 in 2013. PW-3 continues to be sampled on an annual basis pending approval from NMED for a request to return PW-3 to the 3-year sampling schedule. The next three-year sample event is schedules in 2017 for PW-2 and 2016 for PW-4.

OW-1 is an artesian well located on the west section of the refinery property. Historically, OW-1 is a relatively clean well, however, low concentrations of benzene, toluene, total xylenes, and MTBE were detected for the first time in the fourth quarter of 2015. The only contaminants that have exceeded the WQCC standard is iron and uranium which are naturally occurring elements found in rock, soil, and water.

OW-10 is developed in the Sonsela Aquifer and is located directly east of evaporation pond 9 (EP-9).

Concentrations of toluene, ethyl benzene and total xylenes have been detected for the first time in the fourth quarter 2015 at levels below applicable standards. MTBE was detected in all four quarters of 2015 at concentrations below the applicable standard and has decreased since concentrations were detected above the applicable standard in 2012 and 2013. As the result of the presence of MTBE in OW-10, NMED has requested that an additional monitoring well be installed. Uranium concentration levels have has also exceeded the WQCC standard of 0.03 mg/L since 2010, however it is believed to be naturally occurring. Concentrations of 1,1-dichloroethane have been detected at levels below applicable standards in the well since 2011 .

Observation well OW-11 is located within the refinery property (southeast) on the west side of the main entrance. The well is screened in the Sonsela stratigraphic unit. No BTEX, MTBE, VOCs, SVOCs (other than bis(2-ethylhexyl)p hthalate detected in 2013 that is suspected to be either a lab artifact or from the PVC materials used to construct the well) have been detected OW-11. Total and dissolved uranium concentrations continue to exceed the standard of 0.03 mg/L.

RECOMMENDATIONS: *Continue with current sampling schedule.*

7.5 GROUP E – GROUNDWATER MONITORING

To date, a total of 44 permanent monitoring wells (MKTF-1 through MKTF-44) have been installed to aid in delineating the extent of a hydrocarbon seep discovered in 2013, directly west of crude tanks T-101 and T-

102. During the investigation, a pre-existing well (labeled as MKTF-45) was found directly west of the truck-loading rack. The MKTF wells are sampled quarterly. BTEX, MTBE, DRO, GRO, total and dissolved metals, and several VOCs and SVOCs have been detected in many of the wells above the referenced standards. Recovery of SPH in several of the permanent wells will continue.

It is also noted that well MKTF-29 is under artesian conditions and has a water level that rises above ground level. It is assumed that the hydrogeology is such that area is under confined conditions since a potential source associated with either the sanitary pond or the wastewater pipeline (which is above the ground surface) would most likely have olfactory evidence indicating the wastewater source. However, there is no such odor associated with the produced water. It is worth noting that it has been reported that the ground surface to the north of MKTF-29 stays damp as if there is a leak or the water is naturally rising to an elevation that is near the surface. Additional evaluation will be necessary to determine the exact nature of the elevated potentiometric surface.

7.6 ADDITIONAL MONITORING

- Continue with the sampling requirements of the most current approved Facility Wide Groundwater Monitoring Work Plan.
- In order to prevent duplication and potential conflict of documentation, recommendations and/or changes to monitoring requirements will be included in future investigation work plans..
- Submit the Annual Groundwater Monitoring Report on or before September 1 of every year.
- Submit recommendations to change or modify sampling requirements as needed.
- Conduct site assessments as required when spills/leaks are discovered.

SECTION 8

DATA TABLES

8.1 **BW-1A/B/C, BW-2A/B/C, BW-3A/B/C**

8.2 **MW-1, MW-2, MW-4, MW-5**

8.3 **SMW-2, SMW-4**

8.4 **GWM-1, GWM-2, GWM-3**

8.5 **NAPIS-1, NAPIS-2, NAPIS-3, KA-3**

8.6 **Leak Detection Units (East LDU, West LDU, Oil Sump LDU)**

8.7 **OAPIS-1**

8.8 **STP1-NW**

8.9 **OW-13, OW-14, OW-29, OW-30**

8.10 **OW-50, OW-52**

8.11 **RW-1, RW-2, RW-5, RW-6**

8.12 **PW-2, PW-3, PW-4**

8.13 **OW-1, OW-10**

8.14 **OW-11, OW-12**

8.15 **MKTF Wells**

8.16 **EVAPORATION PONDS 1 - 12B**

8.17 **Boiler Water to EP2 (BW to EP2)**

8.18 **STP1 to EP2**

SECTION 9

WELL DATA DTW/DTB MEASUREMENTS

The 2015 Well Data DTB/DTW Measurements has been updated with survey information submitted to and approved by NMED per notification received “Approval with Modifications, Requirement to Resurvey Groundwater Monitoring Wells and Recovery Wells issued on September 26, 2012. Western was required to resurvey the monitoring wells due to discrepancies found in applicable standards ground level elevation, well casing elevation, well casing bottom elevation and stick up lengths. All monitoring wells were surveyed by a licensed professional surveyor, DePauli Engineering 0.on June 7, 2011, April 2014, September 2014, December 2014, and January 2015. The Well Data Table is attached as Section 9.1.

The additional wells from the hydrocarbon seep (MKTF series) and the two new wells STP1-NW and STP1-SW were surveyed by Hammon Enterprises Inc., professional surveyor on September 15, 2014, December 16, 2014 and on December 16, 2014.

SECTION 10

2015 MONITORING SCHEDULE

The 2015 Well Data DTB/DTW Measurements has been updated with survey information submitted to and approved by NMED per notification received “Approval with Modifications, Requirement to Resurvey Groundwater Monitoring Wells and Recovery Wells issued on September 26, 2012. Western was required to resurvey the monitoring wells due to discrepancies found in applicable standards ground level elevation, well casing elevation, well casing bottom elevation and stick up lengths. All monitoring wells were surveyed by a licensed professional surveyor, DePauli Engineering 0.

Tables and Appendices F and G

(Please see attached CD)

Appendix F – Temporary Land Farm Analytical Results

Appendix G – Hall Laboratory Analytical Data

TABLES

(ON ATTACHED CD)

FIGURES

APPENDIX A

SEPARATE PHASE HYDROCARBON RECOVERY LOGS

APPENDIX B

FIELD INSPECTION LOGS

APPENDIX C

APPLICABLE STANDARDS

APPENDIX D

SUMMARY OF EPA/NMED/RCRA ACTIVITY

APPENDIX E

SUMMARY OF ALL LEAKS, SPILLS AND RELEASES

APPENDIX F

TEMPORARY LAND FARM ANALYTICAL RESULTS

(ON ATTACHED CD)

APPENDIX G

HALL LABORATORY ANALYTICAL DATA

(ON ATTACHED CD)

Comment Number	NMED Comment	Gallup Refinery Response
1	The Report was written and submitted before receipt of NMED's comments regarding the 2014 Report. The Permittee must revise the Report to address NMED's comments regarding the 2014 Report (see NMED correspondence dated June 20, 2016 and June 1, 2017), as many of the comments from the 2014 Report carry over to the 2015 Report. Revise the Report to address NMED's previous comments.	A revised report is attached to this response. A response to the 2014 Disapproval letter was provided to the NMED in a letter dated November 9, 2016. Appropriate changes are included in this submittal in response to the 2015 Annual Groundwater Report.
2	The Permittee included a red-line strikeout version with the Report. A red-line strikeout version is only required to be submitted with a revised document; however, the Report was a first-time submittal. Generally, when NMED disapproves a document, it must be re-submitted as a revised document with a red-line strikeout version that illustrates where all changes to text, tables and figures were made to aid in review of the revised document. When the revised Report is submitted pursuant to this correspondence, the Permittee must submit a red-line strikeout of the revisions along with the revised Report.	Revised document and red-line strikeout is attached to this response.
3	The Permittee has been including an analysis of uranium in groundwater samples per an NMED comment in the December 12, 2012 Approval with Modifications for the 2010 Facility-Wide Groundwater Monitoring Report. While some crude oil may contain uranium, the refinery is likely not a source of uranium in groundwater. The Permittee may discontinue the analysis of uranium in groundwater samples. Include this change in the next updated Facility-Wide Groundwater Monitoring Work Plan. No revision to the Report is necessary.	The analysis for uranium will be eliminated from the future analytical program per NMED suggestion. This change has been requested in the most recent Groundwater Monitoring Work Plan.
4	In Section 6, Groundwater Monitoring Results, page 26, the Permittee states, "[d]ue to requirements for field preservation of samples, some samples have the results for nitrite and nitrate reported as a single value of nitrogen. In these instances, the value is conservatively listed for both nitrite and nitrate and a comparison is made between the reported concentration and the regulatory standards for both nitrite and nitrate. This may result in false indication of nitrite exceeding the regulatory standard." The Permittee must elaborate why requirements for field preservation hinder separate analysis of nitrite and nitrate. Actual nitrate and nitrite concentrations provide valuable information regarding to evaluate groundwater conditions. Investigate the possibility of using alternative methods to obtain separate nitrate and nitrite concentrations (e.g., colorimeters), if applicable. Revise the Report to provide further discussion regarding the field methods and the reasons why nitrate and nitrite cannot be reported separately.	The analytical laboratory (Hall Environmental Analysis Laboratory) instructed the sample personnel that nitrate analysis has a 48-hour hold time and that nitrate/nitrite analyses has a 28-day hold time. Due to the remote nature of the refinery, the laboratory felt that it was best to use the nitrate/nitrite analyses in case the delivery truck ran late, or if a sample had to be re-analyzed due to QC failures, or if the lab was unable to meet holding times with instruments. In the future, samples will be analyzed in accordance with the approved sampling plan.
5	Although Diesel Range Organics (DRO), Gasoline Range Organics (GRO) and/or Motor Oil Range Organics (MRO) concentrations are compared with the screening levels to evaluate exceedances throughout the Report (Sections 6.1.2, 6.2.1, 6.2.2, 6.2.3, 6.6, and 6.7.5), all corresponding tables {Tables 8.3.1, 8.4.1, 8.5.1, 8.6, 8.15.1 and 8.18) indicate that these standards are not established (NE). Revise the Report to address the discrepancy. The groundwater standards referenced are Water Quality Control Commission (WQCC) standards, according to the Permittee's statement in Section 6.2.1, page 30; however, NMED is not aware of a Total Petroleum Hydrocarbon (TPH), DRO or GRO standard in the WQCC regulations. Provide the specific reference for the standards (e.g., NMAC title, chapter, part, section and subsection numbers). NMED's 2015 Risk Assessment Guidance for Investigations and Remediation did not contain TPH groundwater standards; however, the updated 2017 Guidance includes TPH standards in Table 6-4 (page 95). In the response letter, acknowledge that TPH groundwater standards are available in the 2017 Guidance and evaluate the TPH data in accordance with the standards in the 2017 Report.	As requested, Gallup Refinery obtained a copy of the 2017 Guidance and referenced the appropriate TPH cleanup standards in the revised document. All DRO, GRO, and MRO cleanup criteria have been adjusted to reflect those provided in the 2017 Guidance Document referenced above. Appropriate text within the report has also been revised to reflect these target cleanup levels. It should be noted that Gallup Refinery considers such changes as a retroactive application of standards that were not effective at the time of the intial report preparation.
6	There are multiple issues in Section 6.1.1, Boundary Wells: BW-1A/IB/IC, BW-2A/2B/2C, BW- 3A/3B/3C, page 27:	
6.1	The Permittee states, "[l]ow concentrations of bromide were detected in BW-2A, BW- 2B, BW-2C, and BW-3B." Bromide also was detected in the sample collected from well BW-3C according to the Table 8.1.1 (General Chemistry Analytical Result Summary) in 2015. Revise the Report to include this detection in the discussion.	The report has been revised to include the requested information.

Comment Number	NMED Comment	Gallup Refinery Response
6.2	The Permittee states, "[c]hromium was previously detected in BW-lC (2012) and cadmium in BW-2C (2012)." These metals were not only detected but also detected above the standards from these wells. Revise the Report for clarification.	The report has been revised to include the requested information.
6.3	The Permittee states, "[n]o dissolved metals analyzed exceeded applicable standards; however, low concentrations of barium, iron, lead, and manganese were detected in most of the wells (Table 8.1.3)." Low concentrations of arsenic, uranium, and zinc also were detected according to Table 8.1.3 (Dissolved Metals Analytical Result Summary). Revise the Report to include these detections.	The report has been revised to include the requested information.
6.4	Elevated fluoride levels relative to the standard have been observed in most of the BW wells. Provide an explanation for the detections in the revised Report.	A discussion of the fluoride levels detected in the BW wells has been added.
7	There are two errors in Section 6.1.2, Land Treatment Unit: MW-I, MW-2, MW-4, MW-5, SMW- 2, SMW-4, page 28:There are two errors in Section 6.1.2, Land Treatment Unit: MW-I, MW-2, MW-4, MW-5, SMW- 2, SMW-4, page 28:	
7.1	There is a typographical error on the sampling date of SMW-2 (8/17/17). Revise the Report to correct the date.	The report has been revised to include the requested information.
7.2	The Permittee states, "[l]ow concentrations of MTBE, not exceeding applicable standards (0.0.143 mg/L), have historically been detected in SMW-2 (Table 8.3)." There is a typographical error in the reported value (0.0.143 mg/L). Revise the Report accordingly. The correct value is 0.143 mg/L according to Table 8.3.	The report has been revised to include the requested information.
8	There are multiple issues in Section 6.2.1, Groundwater Monitoring Wells: GMW-1, GMW-2, GMW-3, page 30:	
8.1	The Permittee states, "[t]he highest concentration of benzene (0.012 mg/L) for 2014 was recorded in the fourth quarter." The benzene concentration of0.012 mg/L was also detected in the first quarter of 2010, and the second quarter of 2015. Revise the Report to address the other detections.	The report has been revised to include the requested information.
8.2	The Permittee states, "[b]romide concentrations have consistently been detected in GWM-1 since 2006." The analytical result for bromide is not included in Table 8.4.1 (General Chemistry and DRO/GRO Analytical Result Summary). Revise the Report to include the bromide detection.	Bromide is not a constituent listed under the water quality contaminants allowable concentrations in groundwater under the human health standards (NMED WQCC standards). It will no longer be reported in the groundwater analytical summaries.
8.3	The Permittee states, "[l]ow concentrations of total chromium and zinc were detected during quarter three of 2015." The total chromium concentration was detected during the second quarter of 2015 and the total zinc concentration was detected during the first, second and third quarters of 2015. Revise the Report to address the detections.	The report has been revised to include the requested information.
8.4	The Permittee states, "[c]oncentrations of VOCs and SVOCs detected above the applicable standards in the third quarter 2015 include napththalene, I-methyl naphthalene, benz(a)anthracene, benzo(a)pyrene, chrysene, tluorene, I-methyl naphthalene, 2-methyl naphthalene, phenanthrene, and pyrene." There is a spelling error (napththalene). Revise the Report accordingly.	The report has been revised to include the requested information.
8.5	According to Table 8.4.4 (Volatile and Semi-Volatile Organic Compound Analytical Result Summary), the 2-methyl naphthalene concentration exceeded the standard but the value was not highlighted to indicate the exceedance. Revise the Report accordingly.	The report has been revised to include the requested information.
8.6	According to Table 8.4.4, the 1,2-dichloroethane (EDC) concentration in the sample collected from well GMW-1 was highlighted to indicate an exceedance during the August 2015 sampling event although it did not exceed the standard value of 0.005 mg/L. Revise the Report for accuracy.	The report has been revised to include the requested information.
9	In Section 6.2.2, Groundwater Monitoring Wells: NAPIS-1, NAPIS-2, NAPIS-3, and KA-3, page 31, the Permittee states, "[w]hen applicable, standing water is removed from the vault of the three sub-surface wells prior to opening and sampling each well. The standing water is placed into a container for proper disposal." The Permittee must ensure that surface water is prevented from entering the wells and maintain the well vault seals so that no water enters the vault.	Groundwater monitoring wells NAPIS-2, NAPIS-3 and KA-3 were all repaired by raising the flush mount casings above ground level on August 8, 2016. This is reflected in Appendix C-1 with new elevations.

Comment Number	NMED Comment	Gallup Refinery Response
10	Section 6.2.2, pages 32 and 33:	
10.1	The Permittee states, "[l]ow concentrations of fluoride, chloride, nitrite, nitrate, and sulfate were detected in NAPIS-1 in 2015 (Table 8.5.1)." The nitrite concentrations have consistently exceeded the standard throughout 2015. Revise the Report to address the exceedance.	The report has been revised to include the requested information.
10.2	The Permittee states, "[c]hloride, nitrite and nitrate concentrations in NAPIS-3 exceeded applicable standards (250 mg/L, 10 mg/L and 10 mg/L, respectively) during most of 2015 and have historically exceeded these standards since 2008." The standard for nitrite is 1 mg/L rather than 10 mg/L according to the EPA MCLs (40 CFR 141.62). Revise the Report for accuracy.	The report has been revised to include the requested information.
10.3	The Permittee states, "[i]n NAPIS-3, total and dissolved uranium and total iron exceeded applicable standards during 2015 (Tables 8.5.2 and 8.5.3)." The dissolved iron concentration did not exceed the standard in the sample collected from well NAPIS-3 during 2015 according to Table 8.5.3 (Dissolved Metals Analytical Result Summary).	The report states, "…total and dissolved uranium and total iron…", dissolved iron is not mentioned as suggested. The total manganese exceedance has been added to the report.
10.4	The Permittee states, "[c]oncentrations of I-methyl naphthalene (0.0061 mg/L) and naphthalene (0.0033 mg/L) exceeded applicable standards (0.0011 mg/Land 0.00165 mg/L, respectively) in NAPIS-2 during 2015." These values were not highlighted to indicate the exceedances in Table 8.5.4 (Volatile and Semi - Volatile Organic Compound Analytical Result Summary). Revise the Report to indicate the exceedances.	The report has been revised to include the requested information.
11	Although identical values of nitrate and nitrite concentrations are reported separately in most analytical tables, Table 8.9.1 reports the nitrate and nitrite concentrations together as one value "nitrate+ nitrite as N". The method used by the Permittee to quantify the nitrate and nitrite concentrations is not acceptable. For all future monitoring, the method must be revised to provide actual and separate nitrate and nitrite concentrations. See Comment 4 above.	See response to Comment 4 above.
12	In Section 6.2.3, Leak Detection Units (LDU): East LDU, Oil Sump LDU, West LDU, page 33, the Permittee states, "[t]he LDUs were sampled for the following analytes in 2015: BTEX, MTBE, DRO, GRO, MRO, WQCC total and dissolved metals, and VOCs. Oil Sump LDU was dry all four quarters and therefore not sampled. There was not enough water in West LDU to collect a sample during the second quarter 2015." The fluid collected in LDUs is the unprocessed water leaking from the New American Petroleum Institute Separator (NAPIS). Although the fluid has been analyzed for various contaminants and compared with the standards according to OCD's directive, the problem has not been resolved. The sources of the leaks must be identified and repaired in the NAPIS. Submit a work plan that includes a schedule, to ensure this is completed in a timely manner. Alternatively, the Permittee may provide a discussion of recent repairs conducted to address the leaks in a separate letter report.	A letter documenting repairs to the NAPIS was provided to Mr. John Kieling of the NMED, and the OCD was copied, on July 16, 2018. No further actions are planned at the unit.
13	There are multiple issues in Section 6.2.3, pages 33 and 34:	
13.1	The Permittee states, "[b]enzene, total xylenes, DRO, and GRO concentrations exceeded the applicable standards in the East LDU. Low concentrations of toluene and ethyl benzene were also detected in the East LDU for 2015." The toluene concentration exceeded the standard during the second and third quarters of 2015. Revise the Report to address the toluene exceedances.	The report has been revised to include the requested information.
13.2	The Permittee states, "[c]oncentrations of arsenic, barium and zinc were also present in these two wells and have historically been present in all three LDU wells." LDUs are not wells. Remove the designation as wells for the LDUs from the Report.	The report has been revised to include the requested information.
13.3	The Permittee states, "[c]hromium levels have fluctuated; falling below the applicable standards for the East LDU in September of 2010 through March of 2011 and falling below applicable standards for the West LDU in quarter one and two for 2012 and 2013, respectively (Tables 8.6.1 and 8.6.2)." Because the fluid collected from LDUs is the unprocessed wastewater leaking from the NAPIS unit, the contaminant concentrations in LDUs will be directly influenced by the composition of the process flow. Collect an influent sample to the NAPIS when LDUs are sampled during future sampling events. It will be necessary to update the sampling and analysis plan in the revised Groundwater Monitoring Work Plan with this addition.	An influent sample to the NAPIS will be collected when LDU wells are sampled in future sampling events. The sampling and analysis plan will be updated in the revised Groundwater Monitoring Work Plan.

Comment Number	NMED Comment	Gallup Refinery Response
13.4	The Permittee states, "[c]oncentrations of 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, naphthalene, 2-methyl naphthalene, and 1-methylnaphthalene exceeded the EPA RSL and NMED standards in the East LDU. Concentrations of 1,2,4-trimethylbenzene, naphthalene, and 2-methylnaphthalene exceeded EPA RSL and NMED standards in the West LDU {Table 8.6.3)." Although the concentrations of naphthalene and 2-methyl naphthalene exceeded the standards, the values were not highlighted to indicate the exceedance in Table 8.6.3 (Volatile and Semi - Volatile Organic Compound Analytical Result Summary). Revise the Report to highlight the exceedances.	Table 8.6.3 (Volatile and Semi-volatile Organic Compound Analytical Result Summary) has been modified to highlight the exceedances of naphthalene and 2-methyl naphthalene.
14	In Section 6.2.4, Groundwater Monitoring Well: OAPIS-1, pages 34 and 35, the Permittee states, "[t]otal cyanide exceeded the EPA RSL standard (0.0014 mg/L) during 2015 with the highest concentration recorded in quarter two (0.0887 mg/L)." Table 8.7.2 (Total Metals Analytical Result Summary) lists the MCL for cyanide as 0.2 mg/L. Revise the Report for accuracy.	Table 8.7.2 has been modified to reflect a regulatory standard of 0.0014 mg/L for cyanide.
15	In Section 6.2.4, page 34, the Permittee states, "[t]otal and dissolved arsenic, iron, and manganese concentrations exceeded the applicable standards in 2015 with the exception of dissolved arsenic." The dissolved arsenic concentration exceeded the standard in the sample collected from well OAPIS-1 during the second, third and fourth quarters of 2015 according to Table 8.7.3 (Dissolved Metals Analytical Result Summary). Also, these values were not highlighted to indicate the exceedance in Table 8.7.3. Revise the Report as necessary to address the exceedance.	The text has been revised in the report and Table 8.7.3 has been modified to highlight the second, third and fourth quarter concentrations for dissolved arsenic.
16	Revise the Report to explain why wells STPl-NW and STPl-SW were installed, and how the locations for the wells were selected. Because the water sample analytical results for well STPl- NW indicate elevated chloride and nitrate concentrations relative to the applicable standards according to Table 8.8 (BTEX, General Chemistry Analytical Result Summary), the Permittee must discuss all issues associated with the operation of STP-1 and discuss any other potential sources for the elevated concentrations in the revised Report.	As discussed in Section 6.2.5 (STP1-NW and STP1-SW) of the 2014 Annual Groundwater Monitoring Report – Gallup Refinery, the wells were initially installed in order to "…assess geotechnical and permeability characteristics of soil below the down-gradient perimeter of STP-1 and confirm the presence or absence of continuous groundwater regime as seen during construction." The borings were converted into monitoring wells when "…mostly dry to damp clay.." was encountered. The STP-1 unit is lined, and is not suspected of leakage. The purpose of the STP-1 monitoring wells is to monitor the chlorides and nitrates that were detected in the groundwater samples. Additionally, as noted in the 2014 Groundwater Report, "Chloride and nitrate concentrations exceeded applicable standards during each sampling event. Additionally, nitrite exceeded its standard during quarter two (Table 8.8.1)." It is noted that similar concentrations of chloride and/or nitrate have been detected in groundwater samples collected from nearby (up-gradient) wells NAPIS-1, NAPIS-2, NAPIS-3, GMW-1, GMW-2, and GMW-3, which may indicate an up-gradient source. Therefore, in order to monitor the potential up-gradient source, the STP-1 wells were left in place as additional sampling points. No additional language discussing this issue has been added to the 2015 Groundwater Report.

Comment Number	NMED Comment	Gallup Refinery Response
17	In Section 6.3.1, Observation Wells: OW-13, OW-14, OW-29, and OW-30, page 36, the Permittee states, "[B]TEX constituents were not detected in OW-29 or OW-30 during 2015; the wells have not had detectable BTEX concentrations since 2006. (Table 8.9)." Although the Permittee's statement is true, the statement must also address the fact that the benzene concentration has exceeded the standard (0.005 mg/L) in the samples collected from well OW-14 since 2010 according to Table 8.9 (BTEX Analytical Result Summary). In addition, the benzene concentration in well OW-14 has been increasing since 2009; the highest benzene concentration was observed at 6.2 mg/Lin the last quarter of 2015. NMED received the Revised Investigation Work Plan OW-14 Source Area on April 18, 2016, which was before the Report was submitted; the work plan proposed an investigation to determine the cause of increasing benzene concentrations in well OW-14. Revise the Report to discuss the increasing benzene concentrations in well OW-14 and reference the work plan to indicate that the issue is being addressed.	The requested language has been added to the report.
18	In Section 6.3.1, page 36, the Permittee states, "[c]oncentrations of MTBE in OW-14, OW-29, and OW-30 during 2015 were all above the standard, with the highest being in OW-30 during the first quarter at 4.0 mg/L." Also, in Section 7.3, Group C - Groundwater Monitoring, page 52, the Permittee states, "[d]own gradient from OW-14 is OW-29 and OW-30 and the analytical data from both of these wells indicates that MTBE is present in the groundwater at concentration levels exceeding the NMED Tap Water standard of 0.143 mg/L since March of 20IO in OW-29 and December 2007 in OW-30. Analytical data for these four wells indicate a steady increase of MTBE concentration levels indicating that the MTBE plume is slowly migrating in a north, north-west direction down-gradient from RW-1 and RW-2." If the MTBE plume had been moving to north or northwest from the vicinity of tank T-568 (MTBE source) with a mass transport velocity comparable to previous observations, MTBE should have been already detected in wells OW-50 and OW-52 by 2015. However, MTBE has not been detected in wells OW-50 and OW-52 as of 2015. An incomplete understanding of the groundwater flow direction may be the cause of the discrepancy. NMED has identified four approaches to address the issue. The Permittee must explore the approaches in order to understand the nature of plume expansion and coordinate with NMED to develop a course of action.	
18.1	The MTBE plume may be migrating in a north, northwest direction with considerably slower mass transport velocity. The slower rate of mass transport may be contributed from various retardation factors (e.g., variability of hydraulic conductivity, adsorption and biodegradation). In this case, continuous monitoring of the MTBE concentration is recommended for the verification. No revision to the Report would be necessary.	Acknowledged.
18.2	The MTBE plume may be migrating in a northeast direction. Since there is no monitoring well to define northeastern extent of the plume beyond the property boundary, this approach would require the submittal of a work plan to install a monitoring well approximately 500 feet northeast of well OW-30 to delineate the plume. The proposed monitoring well must be screened across the Chinle-Alluvium interface.	Acknowledged. It is worth noting here that there are now many more monitoring wells in the Group C area and landowner consent is being sought to allow the installation of wells on the adjacent property to evaluate potential offsite migration.
18.3	Wells OW-50 and OW-52 may be located cross-gradient relative to the piezometric groundwater flow direction. A change of flow direction from north to west may be occurring between well OW-13 (screened in the Sonsela formation) and well OW-29. This approach would require the submittal of a work plan to install a monitoring well screened across the Chinle-Alluvium interface between well OW-13 and well OW-29.	Wells OW-54 and OW-55 are located between wells OW-13 and OW-29. There are also many other new wells in the Group C area. See comment 2 above.
18.4	The MTBE plume may be migrating in a westerly direction. Although well OW-13 is appropriately located to define western boundary of the plume, well OW-13 is screened in the Sonsela formation; thus, the screened interval of well OW-13 is not monitoring the same stratigraphic units as other monitoring wells in the area; it will not provide relevant information to characterize the groundwater flow direction. This approach would require the submittal of a work plan to install a monitoring well screened across the Chinle-Alluvium interface in the vicinity of well OW-13.	Acknowledged. See comment 2 above.

Comment Number	NMED Comment	Gallup Refinery Response
19	Section 6.3.3, Recovery Wells: RW-1, RW-2, RW-5, RW-6, pages 38 and 39:	
19.1	The Permittee states, "[p]urge water is collected and disposed upstream of the NAPIS." Provide a justification for placing the purge water into the leaking sewer line in the revised Report.	Repairs to the sewer line were completed in January 2014, therefore no revision is warranted.
19.2	The Permittee states, "[h]ydrocarbon recovery from RW-1 has shown a steady decrease from 2005 through 2015. In 2015, total hydrocarbon recovery is estimated at 2.0 gallons in 55 gallons of water purged compared to the 2005 estimate of 431 gallons of hydrocarbons in 1,210 gallons of water." While this statement is true, it omits the fact that a persistent product thickness (from l.94 to 4.6 feet) has been recorded during 2015 monitoring events. Revise the Report to address the persistent product thickness.	The requested language has been added to the report.
20	The screened intervals of all RW wells were submerged below the water table during 2015 gauging events. When the screened interval is submerged below the water table, Separate Phase Hydrocarbon (SPH) will likely not be detected if present. Also, a well with a submerged screen will not provide accurate information regarding the vertical extent of the hydrocarbon smear zone. The average depth to groundwater in well RW-2 is approximately five feet higher than the top of the screen; the inappropriate depth of the screened interval may be contributing to the lack of observed SPH. Include a proposal to submit a work plan to abandon well RW-2 and replace it with a well screened across the water table.	In discussions with the NMED, it was stated that rather than plug RW-2 it would be preferable to add one or two new wells to provide better coverage of saturated intervals. Additionally, Gallup Refinery intends to place pneumatic pumps in all of the RW wells to recover both free product and dissolved phase hydrocarbons in the area. Following the installation of the pumps, the well screens will no longer be submerged.
21	In Section 6.4.1, Process Wells: PW-2, PW-3, PW-4, page 39, the Permittee states, "[t]he production wells are on a staggered 3-year sampling schedule, with the exception of PW-3 which is sampled annually since the detection of 2-methylnaphthalene exceeding the applicable standard in 2008." Even if there is no apparent hydraulic connection between the shallow and deep aquifers, pollutants may leach to the deep aquifer through well construction and because well PW-3 is surrounded by the facility infrastructure. Provide all available construction details for PW-3.	As indicated in the attached form from the NMED Drinking Water Bureau, Sanitary Survey Form, PW-3 (Well #3) has an artesian flow rate of 278 GPM. Based on that type of artesian flow rate, it is unlikely that any contaminants would migrate vertically downward and impact the drinking water aquifer in a well drilled to a depth of 1030 feet. A copy of the actual well log could not be located. However, it is noted that in subsequent groundwater sampling events, there were no constituents detected in PW-3.
22	In Section 6.4.2, Observation Wells: OW-I and OW-10, page 40, the Permittee states, "[i]n the last quarter of 2015, low concentrations of benzene, toluene, total xylenes, and MTBE were detected in OW-1, and low concentrations of toluene, ethylbenzene, total xylenes and MTBE were detected in OW-10." The detected contaminants in well OW-I may indicate the leading edge of plume migration. The plume may be further expanding to the west of well OW-1. Although the installation of two shallow wells near well OW-I and three clustered wells approximately 750 feet south of well OW-I is proposed in the Permittee's Work Plan SMW-2 Area Investigation and Boundary Well Installations, dated October 2016, these proposed wells do not address the extent of the plume west of well OW- 1. Propose a work plan to install a monitoring well screened within the Sonsela formation west of well OW- I. It should be noted that MTBE was not detected in the neighboring wells (wells MKTF-43 and MKTF-44), screened in the Chinle-Alluvium interface.	Although low concentrations of BTEX (below regulatory standards) were reported in 2015 and 2016, the analytical results for 2017 were all below the detection limits for both OW-1 and OW-10. Additionally, boundary well BW-5C is also in the area to provide additional coverage of groundwater quality. MTBE concentrations in OW-1 and OW-10 have also remained well below the regulatory standard of 0.143 mg/L. For these reasons, Gallup Refinery proposes to continue monitoring the groundwater quality using the existing wells.
23	There are multiple issues in Section 6.6, Constituent Levels for MKTF Wells, pages 42 and 43:	
23.1	The observation of SPH in MKTF wells must be included in the list of bullet points. Revise the Report accordingly.	Language has been added to the report which addresses the presence of SPH.
23.2	The Permittee states, "[b]enzene concentrations exceeded the standard of 0.005 mg/L in the following wells: MKTF-1, MKTF-2, MKTF-4, MKTF-9, MKTF-10, MKTF-11, MKTF-16, and MKTF-17 through MKTF-26." The benzene concentrations also exceeded the standard in the samples collected from wells MKTF-35 through MKTF-39 during the 2015 sampling events according to Table 8.15 {BTEX Analytical Results). Revise the Report for accuracy.	The requested language has been added to the report.

Comment Number	NMED Comment	Gallup Refinery Response
23.3	The Permittee states, "[t]oluene concentrations exceeded the standard of 0.75 mg/Lin the following wells: MKTF-1, MKTF-10, MKTF-11, MKTF-20, and MKTF-23." The toluene concentration also exceeded the standard of 0.75 mg/L in the sample collected from well MKTF-16 during the sampling event in the second quarter of 2015 according to Table 8.15. Revise the Report accordingly.	The requested language has been added to the report.
23.4	The Permittee states, "[e]thylbenzene concentrations exceeded the standard of 0.7 mg/L in the following wells: MKTF-1, MKTF-10, MKTF-11, MKTF-16, and MKTF-19." The ethylbenzene concentration also exceeded the standard of 0.7 mg/L in the sample collected from well MKTF-36 during the sampling events in the first, second and third quarters of 2015 according to Table 8.15. Revise the Report accordingly.	The requested language has been added to the report.
23.5	The 2015 analytical data for well 15 is missing from Table 8.15.1 (General Chemistry Analytical Results). Include the data for well MKTF-15 in the revised Report; alternatively, provide the reason why it is not provided.	Sampling records indicate that well MKTF-15 contained SPH, thus in accordance with the approved sampling plan, no sample was collected.
23.6	Although the fluoride concentration in well MKTF-2 (2.5 mg/L) exceeded the applicable standard (1.6 mg/L) in 2015, the value is not highlighted to indicate the exceedance in Table 8.15.1. Similarly, although the chloride concentration in well MKTF-39 (6,400 mg/L) exceeded the applicable standard (250 mg/L) in 2015, the value is not highlighted to indicate the exceedance in Table 8.15.1. Revise the Report to highlight the exceedances.	The requested changes have been added to Table 8.15.1.
23.7	The sulfate concentrations in the samples collected from wells MKTF-29 (650 mg/L), MKTF-40 (890 mg/L) and MKTF-43 (1,700 mg/L) exceeded the standard (600 mg/L} in 2015 according to Table 8.15.1. These exceedances are not included in the list of bullet points. Include the exceedances in the revised Report.	The requested language has been added to the report.
23.8	Although the chromium concentration in the sample collected from well MKTF-33 (6.2E-03 mg/L} did not exceed the standard (0.05 mg/L) in 2015, the value was highlighted to indicate the exceedance in Table 8.15.2 (Total Metal Analytical Result Summary). Revise the Report as necessary.	The requested language has been added to the report.
23.9	The Permittee states, "[d]issolved metals concentrations above applicable standards were noted in the following wells (Table 8.15.3): Manganese: all wells except MKTF-30, MKTF-31, MKTF-32, MKTF-34, MKTF-41, and MKTF-44." The manganese concentration did not exceed the standard in well MKTF-28 during 2015 sampling event according to Table 8.15.3 (Dissolved Metals Analytical Result Summary). Revise the Report accordingly.	The requested language has been added to the report.
23.10	Page 43, the discussion of dissolved uranium and VOCs and SVOCs detections are stated in the same paragraph. Use new bullet points to address the findings regarding VOCs and SVOCs. Also, the discussion of VOCs must be separate from the discussion of SVOCs. Revise the Report accordingly.	The requested language has been added to the report.
24	In Section 6.6. page 44, a list of SVOCs and VOCs where concentrations exceeded the standards in MKTF wells during the 2015 sampling events is presented. However, there are multiple issues regarding the list:	
24.1	Define the concentration value in parenthesis after each compound name in the revised Report. It is not clear whether the value represents maximum detected concentration or applicable standard value.	The values represent applicable cleanup standard for each constituent although three of the values were incorrect. The cleanup values for 2-methylnapthalene, naphthalene, and 1,2-dichloroethane were incorrectly stated in the text and have been corrected.
24.2	Provide specific designation(s) for MKTF well(s), where the concentration(s) exceeded the standard(s) in the revised Report. For example, the Permittee's statement "at least one of the MKTF wells... " is not sufficient.	The analytical summary tables referenced in the text of the report (Tables 8.15.4 and 8.15.5) provided detailed summary of the historic results of constituent analyses for each well. It is not necessary to reiterate the analytical results for each well in the text of the report when it is summarized in detail in the analytical summary tables.
24.3	Although 3,4-methylphenol is listed as a compound for which the concentration exceeded the standard, the exceedance was not detected in any MKTF well during 2015 according to Table 8.15.4 (Semi-Volatile Organic Compound Analytical Result Summary). Remove the compound from the list in the revised Report.	The requested language has been added to the report.

Comment Number	NMED Comment	Gallup Refinery Response
24.4	Although phenanthrene is listed as a compound for which the concentration exceeded the standard, the exceedance was not detected in any MKTF well during 2015 according to Table 8.15.4. Remove the compound from the list in the revised Report.	The requested language has been added to the report.
24.5	Although cis-1,2-DCE was detected above the standard in the samples collected from eleven MKTF wells in 2015 according to Table 8.15.5 (Volatile Organic Compounds Analytical Results), the compound is not listed. Revise the Report to add the compound in the list.	The requested language has been added to the report.
24.6	Although 1,1,1-trichloroethane was detected above the standard in the samples collected from two MKTF wells in 2015 according to Table 8.15.5, the compound is not listed. Revise the Report to add the compound in the list.	The requested language has been added to the report.
24.7	1-methyl naphthalene is listed twice presumably because the compound appears as a target analyte in both VOCs and SVOCs. The discussion of VOCs and SVOCs must be separated in the revised Report. See Comment 23 (10).	1-Methylnaphthalene will be removed from the VOC summary table as well as the discussion of VOCs in future reports.
24.8	Vinyl chloride is listed; however, the unit is missing in the parenthesis. Revise the Report to add the appropriate unit within the parenthesis.	The requested language has been added to the report.
24.9	Trichloroethane is listed with a standard of 0.005 mg/L. Specify whether the compound is 1,1,I-trichloroethane or 1,1,2-trichloroethane in the revised Report. If the compound is 1,1,2-trichloroethane, the value in the parenthesis will match with the standard of 0.005 mg/L. However, 1,1,2-trichloroethane was not detected above the standard in samples collected from any MKTF well in 2015. If the compound is 1,1,1-trichloroethane, the value in the parenthesis will not match, as its standard is 0.06 mg/L. 1,1,1- trichloroethane was detected above the standard in wells MKTF-9 and MKTF-25 during 2015, according to Table 8.15.5.	The requested language has been added to the report.
25	The chloride and sulfate concentrations in the sample collected from well MKTF-43 were recorded as 17,000 and 1,700 mg/L, respectively, in the August 2015 sampling event according to Table 8.15.1 (General Chemistry Analytical Results). The concentrations are the highest among the samples collected from all MKTF wells. Well MKTF-43 is located on the eastern perimeter of pond EP-9. The chloride and sulfate concentrations in the samples collected from pond EP-9 have been consistently high (exceeding 30,000 and 4,500 mg/L, respectively, in 2015) according to Table 8.16 (BTEX and General Chemistry Analytical Result Summary). The detected chloride and sulfate concentrations in the sample collected from well MKTF-44 were only 110 and 120 mg/L, respectively in the August 2015 sampling event. Well MKTF-44 is located on the western perimeter of pond EP-9. Based upon the data, it appears that the wastewater stored in pond EP-9 is leaking from the eastern perimeter and leaching into groundwater causing the elevated chloride and sulfate concentrations in well MKTF-43. According to the revised Summary Report - Evaporation Pond Repairs, dated February 15, 2017, the entire northern and parts of the eastern and western perimeters of pond EP-9 were strengthened and repaired in 2016. The repair may have already addressed the issue; however, during future sampling events, samples must be collected from the influent to pond EP-9 and wells MKTF-43 and MKFT-44 for further analysis of chloride and sulfate to verify whether the leak has been repaired. In addition, there is no monitoring well on the southern perimeter of pond EP-9. Submit a work plan to propose to install a monitoring well at the southern perimeter of pond EP-9 to evaluate for the presence of chloride and sulfate.	This issue was discussed with the NMED in our last meeting (2018). In that meeting it was pointed out that a new monitoring well installed in that location would be cross-gradient from the source (see potentiometric maps in 2015 Annual Groundwater Report) and would add little value to the monitoring system as it would provide no downgradient coverage for the pond. Additionally, as shown in the 2016 groundwater sampling data, the chlorides and sulfates concentrations are much higher in well MKTF-43 (upgradient) than they are in well MKTF-44 (downgradient). As illustrated on the potentiometric maps, well MKTF-43 is upgradient from well MKTF-44 suggesting that the source of the chlorides and sulfates is located in an upgradient direction of pond EP-9. Therefore, no additional wells are proposed for the southern margin of pond EP-9. The sampling of the influent to pond EP-9 for chlorides and sulfates will be added to the scope of work for groundwater sampling.
26	Concentrations of trichloroethylene (TCE), vinyl chloride, and EDC were detected in groundwater samples collected from MKTF wells. Since EDC is a lead scavenger, the Permittee must add analysis for EDB in all monitoring wells where EDC has been detected; this change must be incorporated into the next updated Facility-Wide Groundwater Monitoring Work Plan. The Permittee must use an analytical method capable of detecting EDB at concentrations less than 0.004 micrograms per liter (i.e., EPA Method 8011). No revision is required.	The requirement for analysis for EDB (by EPA Method 8011) to all wells where EDC has been detected will be added to a revised 2018 Groundwater Sampling Work Plan.

Comment Number	NMED Comment	Gallup Refinery Response
27	Vinyl chloride and cis-1,2-DCE were detected in samples collected from many MKTF wells according to Table 8.15.5 (Volatile Organic Compounds Analytical Results). The accumulation of these compounds may be occurring at the site. Evaluate the groundwater quality parameters pertinent to accumulation or degradation of vinyl chloride (e.g., concentrations of chlorinated compounds, groundwater quality parameters, and anions). Include all previously acquired data and interpretation of the existing data in the revised Report.	All detected compounds (VOCs, SVOCs, metals, etc.) were evaluated for trends associated with increasing concentrations of monitored parameters. No clear association was observed in any of the monitored parameters. No changes to the report were made.
28	There are multiple issues on the tables presenting the analytical results for evaporation ponds EP- 1 through 12B:	
28.1	Table 8.16 (BTEX and General Chemistry Analytical Result Summary) presents analytical results of BTEX, MTBE, and anions. The analytical method for anions is not specified in the table. Revise the Report to specify the analytical method used for anions.	As indicated in Table 8.16.1, these anions were analyzed using Method 300.0 (ion chromatography) was used. This is also indicated on the laboratory provided analytical reports which were provided with the report. Table 8.16 has been modified to reflect Method 300.0 was utilized for the anions analyses.
28.2	Both Table 8.16 and 8.16.1 (General Chemistry Analytical Result Summary) present identical analytical results for anions. It is redundant to present same data in two tables. Remove the data from one of the tables in the revised Report.	The anion results were removed from table 8.16.1.
28.3	Both Table 8.16 and 8.16.1 include the specific conductance data. The measurement of specific conductance must be presented in a separate table along with other water quality parameters (e.g., dissolved oxygen concentration, redox potential). Include a water quality parameter summary table in the revised Report.	The specific conductance results were moved to table 8.16.1.
28.4	Although the arsenic concentration exceeded the standard in pond EP-8 during the September 2015 sampling event, according to Table 8.16.3 (Dissolved Metals Analytical Result Summary), it was not highlighted to indicate the exceedance. Revise the Report to indicate the exceedance.	The requested changes have been added to the report.
28.5	The March 2015 SVOC analytical result for pond EP-12B is missing from Table 8.16.5 (Semi Volatile Organic Compound Analytical Result Summary). Provide the result in the revised Report; alternatively, explain why it is not provided.	Apparently this data was overlooked when Table 8.16.5 was being updated. The Hall Report #1503B60, May 7, 2015 indicates that the only detection SVOC constituents was phenol at a concentration of 0.21 mg/L. The phenol result was added to the table.
28.6	There is a typographical error on the description of analytical method for pond EP-7 in Table 8.16.5. Revise the Report accordingly.	The analytical method number for the March 25, 2015 sampling event in table 8.16.5 has been changed to Method 8270C.
29	In Section 6.7.1, Evaporation Ponds 1 through 12B, pages 45 and 46, provides a discussion of the analytical results for pond EP-1 through I2B; however, there are multiple inaccuracies and discrepancies:	
29.1	The Permittee states, "[t]he e-coli standard of 500 organisms/100 mL was exceeded in EP-2 (5,475 CFU/100 mL), EP-3 (24,196 CFU/100 mL), EP-4 (5,475 CFU/lOO mL), EP- 5 (1,515 CFU/lOO mL), EP-12A (12,033 CFU/lOO mL), and EP-12B (>2,419.6 CFU/lOO mL) (Table 8.16.1)." Thee-coli concentration in the sample collected from pond EP-12B is recorded as 17,329 CFU/lOO mL during the March 2015 sampling event according to Table 8.16.1 (General Chemistry Analytical Result Summary). Revise the Report accordingly.	The requested language has been added to the report.
29.2	The Permittee states, "[f]luoride, chloride and sulfate concentrations exceeded the applicable standards in each evaporation pond during 2015 (Table 8.16.2)." The concentrations of anions are presented in Table 8.16 and Table 8.16.1 (rather than Table 8.16.2). Revise the Report to correct the reference.	The requested language has been added to the report.
29.3	The Permittee states, "[t]otal metals concentrations in pond samples were detected as follows (Table 8.16.3):" Table 8.16.3 presents the summary for dissolved metals analytical results (not total metals analytical results). Revise the Report to correct the reference.	The requested language has been added to the report.

Comment Number	NMED Comment	Gallup Refinery Response
29.4	The Permittee states, "[d]etectable concentrations of barium and chromium were found in one or more samples, but were below applicable standards with the exception of exceedance of chromium in EP-6 (1.6 mg/L)." The total chromium concentration was detected in all evaporation pond samples and one concentration exceeded the standard (from pond EP-7) according to Table 8.16.2 (Total Metals Analytical Result Summary). The total and dissolved chromium concentrations in the sample collected from pond EP-6 during the 2015 sampling events were below the standard of 0.05 mg/L. Revise the Report accordingly.	The requested language has been added to the report.
29.5	The Permittee states, "[a] low concentration of mercury (0.0.00032 mg/L) was detected in one EP-1 sample, but the concentration was below the applicable standard." There is a typographical error in the value (0.0.00032 mg/L). Also, the last sampling event for pond EP-1 was conducted in 2014; thus, the finding is not applicable to the discussion of analytical result. Remove the statement from the revised Report.	The requested language has been added to the report.
29.6	The dissolved chromium concentrations exceeded the standard in the samples collected from ponds EP-7 (0.064 mg/L) and EP-9 (0.064 mg/L) according to Table 8.16.3; however, the exceedances were not noted. Address the exceedances in the revised Report.	The requested language has been added to the report.
29.7	The Permittee states, "[n]o VOCs were detected in any of the ponds during 2015 with the exception of low concentrations of acetone in EP-3 and EP -12B (Table 8.16.5)." The concentrations of VOCs are presented in Table 8.16.4 not Table 8.16.5. Revise the Report to correct the reference.	The requested language has been added to the report.
29.8	The Permittee states, "[p]henol concentrations exceeded the standard of 0.005 mg/Lin September 2015 for EP-2 (0.22 mg/L)." The phenol concentration also exceeded the standard in the sample collected from pond EP-12B during the September 2015 sampling event. Address the EP-128 exceedance in the revised Report.	The requested language has been added to the report.
29.9	The Permittee states, "[l]ow concentrations of 3,4-methylphenol were detected in EP-1, EP-2, EP-3, and EP-12B but did not exceed the applicable standard of 0.093 mg/L (Table 8.16.6)." 3,4-methylphenol was also detected in pond EP-4 during the September 2015 sampling event. Address the detection in the revised Report. The last sampling event for pond EP-1 was conducted in 2014; thus, the discussion is not applicable for the 2015 analytical result. Remove the reference to EP-1 from the revised Report. Additionally, the concentrations of SVOCs are presented in Table 8.16.5 rather than Table 8.16.6. Revise the Report accordingly.	The requested language has been added to the report.
30	The chloride and sulfate concentrations and specific conductance in samples collected from pond EP-11 were one order of magnitude higher than the values from ponds EP-12A and EP-12B in 2015. Conversely, the e-coli concentration in the sample collected from pond EP-11 was two to three orders of magnitude lower compared to the concentrations in samples collected from ponds EP-12A and EP-12B according to Table 8.16.1. From the data, it appears that the water in evaporation ponds does not flow from pond EP-11 to EP-12A and EP-12B. Provide an explanation for the increased e-coli concentrations in ponds EP-12A and EP-12B. Ensure that raw sewage is not being discharged directly into the evaporation ponds. If there is any new sanitary effluent discharge at the facility beyond the Pilot Travel Center, the Permittee must direct all sanitary effluent to the new WWTP (STP-1). Provide an explanation regarding all flow path(s) in the evaporation ponds and the e-coli concentration in ponds EP-12A and EP-12B in the revised Report.	Ponds 12A and 12B are shallow evaporation ponds that do not receive untreated wastewater of any type. It has been observed that many water fowl congregate in shallow, warm ponds and forage for food. Perhaps the presence of elevated e-coli can be associated with foraging waterfowl as there are no direct discharges of any kind that enter ponds 12A and 12B. The birds could easily transfer the e-coli from one pond to another as they wade and swim through the ponds foraging for food. Additionally, in the summer of 2018 these ponds were observed to be completely dry as a result of high evaporation rates.
31	In Section 6.7.4, Outfall BW to EP-2, page 47, the Permittee states, "[t]he BW to EP-2 sample was taken March 23, 2015." The sample was collected once in 2015; however, in Executive Summary, page 8, the Permittee states, "[i]t is sampled at its discharge point to the pond on a semi-annual basis for major cations/anions." Revise the Report to address the discrepancy. Also, on page 47, the boxes exhibiting the sampling location and date are blank. Revise the Report to fill in the boxes.	The requested language has been added to the report.

Comment Number	NMED Comment	Gallup Refinery Response
32	In Section 6.7.4, page 47, the Permittee states, "[B]W is defined as reverse osmosis water coming from the boiler unit." The sulfate concentration in sample collected at the discharge point has consistently exceeded the standard (600 mg/L) since 2010 according to Table 8.17 (General Chemistry and Total Recoverable Metals Analytical Result Summary). Provide an explanation for the elevated sulfate concentration in the revised Report.	The pipeline carrying the boiler water to EP-2 was taken out of service at the end of 2015. The reverse osmosis water no longer discharges to EP-2 and has been rerouted back into the units for reuse. However, the boiler water is very pure to prevent the buildup of hardness within the piping so it is possible that the discharge line that carried the BW to pond EP-2 could have had leaks that allowed sulfate reducing bacteria to live in the warm water around leaks in the pipe which resulted in the sulfate detections.
33	There are three issues in Section 6.7.5, Outfall STP1 to EP-2 Inlet, page 47:	
33.1	The Permittee states, "[t]he STPl to EP-2 inlet is sampled on an annual basis". NMED's June 2016 Disapproval Comment 8 for the 2014 Report requires quarterly sampling. The Permittee must collect the sample on a quarterly basis rather than annual basis.	Future samples will be collected on a quarterly basis.
33.2	The boxes exhibiting the sampling location and date are blank. Revise the Report to add the information.	The requested language has been added to the report.
33.3	The Permittee states, "[B]OD and COD concentrations exceeded the applicable standards." The COD concentration (80.6 mg/L) was detected below the standard (<125 mg/L) in 2015 according to Table 8.18.1 (BOD/COD Analytical Result Summary). Revise the Report to accordingly.	The requested language has been added to the report.
34	In Section 6.8, Additional Sampling and/or Changes, page 47, the Permittee states, "[r]equired by NMED: sample wells upgradient from the NAPIS wells, OW-1, OW-10, and OW-11 and review analytical results to determine if uranium detections are similar in concentrations in unaffected wells." The Permittee may discontinue the analysis for uranium in groundwater samples. See Comment 3.	The elimination of uranium will be proposed in a revised Facility-Wide Groundwater Monitoring Work Plan.
35	In Section 7.1, Group A, page 50, the Permittee states, "[n]o detectable concentration levels of BTEX constituents were found in these wells from 2006 through 2014." There is a typographical error (it should be through 2015). Revise the Report for accuracy.	The requested language has been added to the report.
36	In Section 7.2, Group B- Groundwater Monitoring, page 50, the Permittee states, "[b]enzene concentrations from all 2015 sampling events at GWM-1 have exceed[ed] applicable standards. This would indicate the potential for historical releases from the aeration lagoons." The Permittee must further discuss the causes of persistent BTEX and MTBE concentrations in well GMW-1 despite the fact that all discharges to the aeration lagoons ceased in 2013. The contaminant concentrations should exhibit decreasing trends if historical releases are the only cause of the contamination. Provide an explanation of persistent contaminant concentrations in well GMW-1 in the revised Report.	The NMED is aware that benzene was discharged into the aeration lagoon possible due to porous piping that served as a conduit for transport of the benzene to the aeration lagoon. The former disposal unit is currently awaiting closure and no additional discharges of benzene are known to be ongoing into the unit. No new language was added to the report.
37	In Section 7.2, page 50, the Permittee states, "[t]here were no significant changes in contaminant detections noticed in the GMW wells." SPH appeared in well GMW-1 for the first time during the last quarter of 2015. The SPH appearance is a significant change from previous observations; revise the statement for accuracy in the revised Report.	The requested language has been added to the report.

Comment Number	NMED Comment	Gallup Refinery Response
38	In Section 7.2, page 50, the Permittee states, "[d]own gradient of the NAPIS on the west side, NAPIS-2 and KA-3 have had concentrations of benzene and MTBE above the applicable standards." The benzene concentration was below the detection limit in the samples collected from well KA-3 during 2015 according to Table 8.5 {BTEX Analytical Result Summary). Similarly, the MTBE concentration was detected but did not exceed the applicable standard in the samples collected from well KA-3 during 2015 according to Table 8.5. Revise the Report as necessary.	The requested language has been added to the report.
39	In Section 7.3, Group C - Groundwater Monitoring, page 51, the Permittee states, "[a]lthough concentration levels of MTBE in OW-13 does not exceed the applicable standard of 0.143 mg/L, sample data indicates a steady increase of MTBE from year to year." Well OW-13 is screened in the Sonsela formation. All other Group C wells (OW-14, OW-29, OW-30, OW-50, OW-52, RW-1, RW-2, RW-5, and RW-6) are screened in the Chinle-Alluvium interface. The increasing trend of MTBE concentration in well OW-13 indicates that the plume may be expanding laterally as well as vertically. The Permittee must investigate the expansion of MTBE plume. Propose to submit a work plan to install a monitoring well screened in the Sonsela formation between wells OW-13 and OW-29.	There have been many wells installed in the Group C area since the submission of this report with more planned. Specifically, wells OW-53 and OW-54 were installed in the area between OW-13 and OW-29.
40	In Section 7.5, Group E - Groundwater Monitoring, pages 53 and 54, the Permittee states, "[t]o date, a total of 44 permanent monitoring wells (MKTF-1 through MKTF-44) have been installed to aid in delineating the extent of a hydrocarbon seep discovered in 2013, directly west of crude tanks T-101 and T-102." The well screen intervals of many MKTF wells are submerged below the water table and are not suitable for SPH measurement. The following table (modified from Section 6 Data Table) shows the comparison in depths to the top of screened interval and fluid level in MKTF wells during the 2015 gauging events:	A work plan for evaluating and/or replacing MKTF-1, -2, -4, -17, -18 and -28 will be submitted to the NMED for review and approval. It is noted that well MKTF-29 is under artesian conditions and has a water level that rises above ground level. It is assumed that the hydrogeology is such that the area is under confined conditions. Additional evaluation will be necessary to determine the exact nature of the elevated potentiometric surface. It is noted that all sampling activities are conducted in accordance with the approved Groundwater Sampling Plan.

Date	Well ID	Depth to the top of well screen (ft - g.s.)	Depth to the top of fluid level (ft - g.s.)	Date	Well ID	Depth to the top of well screen (ft - g.s.)	Depth to the top of fluid level (ft - g.s.)	Date	Well ID	Depth to the top of well screen (ft - g.s.)	Depth to the top of fluid level (ft - g.s.)	Date	Well ID	Depth to the top of well screen (ft - g.s.)	Depth to the top of fluid level (ft - g.s.)
3/11/2015			3.46	3/12/2015			12.84	3/11/2015			-0.75	3/11/2015			2.42
6/9/2015	MKTF-01	5	4.76	6/8/2015	MKTF-17	14	13.43	6/10/2015	MKTF-29	10	-0.1	6/10/2015	MKTF-43	2	0.85
8/21/2015			3.84	8/18/2015			12.01	8/20/2015			-0.49	8/21/2015			1.02
11/4/2015			3.48	11/3/2015			12.37	11/4/2015			-0.39	11/5/2015			2.34
3/11/2015			4.43	3/17/2015			9.24	3/11/2015			5.37	3/12/2015			35.9
6/9/2015			5.1	6/8/2015	MKTF-18	17	9.18	6/10/2015	MKTF-31	6	5.14	6/10/2015	MKTF-44	38	27.01
8/21/2015	MKTF-02	7	4.85	8/18/2015			9.15	8/21/2015			5.48	8/17/2015			28.69
11/4/2015			4.8	11/3/2015			8.84	11/4/2015			5.53	11/9/2015			30.78
3/16/2015			10.58	3/11/2015			3.79	3/12/2015			17.54				
6/4/2015	MKTF-04	10	11.33	6/9/2015	MKTF-28	3	2.55	6/9/2015	MKTF-41	22	17.24				
8/18/2015			10.97	8/20/2015			3.57	8/21/2015			17.37				
11/3/2015			4.56	11/4/2015			2.89	11/5/2015			17.24				

The highlighted values (both yellow and red) indicate that the fluid levels are higher than the level of screened intervals; thus, the well screens in these wells are submerged. Among the wells having submerged screens, wells MKTF-01, 02, 04, 17, 18 and 28 are located near the SPH plume and critical for more accurate SPH plume delineation. These wells must be replaced with wells with appropriate screened intervals. Propose to submit a work plan to abandon these wells and replace them with wells with appropriate screened intervals. In addition, well MKTF-29 has a fluid level above the ground surface elevation (see red highlighted values). Well MKTF-29 is located adjacent to the wastewater pipeline to the tanks T-27, 28 and 35. The elevated water level may be associated with a leak from the pipeline. Other possibilities include survey error and overflow from the sanitary lagoon located 100 feet southeast of well MKTF-29. Provide a discussion of the elevated water level in well MKTF-29 in the revised Report.

Comment Number	NMED Comment	Gallup Refinery Response
41	Figures 11.1, 11.2 and 11.3, Groundwater Elevation vs. Time - 2015, include the charts for the groundwater elevations in MKTF wells. It appears identical figures titled as Figures 1lA, l1B and 1lC are included subsequent to Figures 11.1, 11.2 and 11.3. Delete the redundant figures (Figures 1lA, l 1B and 1lC) from the revised Report. In addition, revise the charts to include the ground surface and SPH elevations.	The requested language has been added to the report.
42	There are multiple issues in Appendix B, Field Inspection Logs:	
42.1	The field log for MKTF wells is presented as a table form in Appendix B, but does not include any water quality parameters (e.g., pH, temperature, conductivity). The table must be revised to include all water quality parameters. If water quality parameters have not been collected previously from MKTF wells, collect measurements of pH, conductivity, temperature, dissolved oxygen and ORP during all future sampling events.	Field logs are used to monitor and record the water quality during sampling activities. The field logs provide a record of pH, temperature, conductivity, TDS, salinity, dissolved oxygen and oxidation/reduction potential (ORP). If insufficient water is accessible from the well during sampling, or if SPH is encountered, then these parameters are not recorded. The priority for any volume of water obtained is to obtain analytical data, not field parameters. Appendix B of the Annual Groundwater Monitoring Report provides copies of the field sampling forms. Gallup Refinery will ensure that field parameters are measured and recorded when adequate amounts of water are available.
42.2	Water quality parameters must be recorded for every well where a groundwater sample is collected. Provide an explanation for the circumstances where data collection is not feasible.	See response to Item 1 above.
42.3	All water quality parameters must be tabulated and presented in an organized manner. The final (stabilized) readings must be recorded in the table. Include the table in the revised Report.	See response to Item 1 above. Final stabilized readings are on the sampling forms.
42.4	The unit of dissolved oxygen concentration presented in the Field Inspection Logs is shown as a percent(%). Clarify whether the reported concentration represents the percent of the solubility limit at a given temperature. It is conventional to report the concentration with a unit in milligrams per liter {mg/L). Convert the unit of dissolved oxygen concentration from percent (%) to mg/L in the revised Report.	Although the sampling form indicates that the units of dissolved oxygen are "%", it is actually recorded in mg/L. Gallup Refinery will request that the form be modified to reflect the units as mg/L.
42.5	Some field inspection logs presented water quality readings although these wells were listed as dry (e.g., BW-3A 3rd Quarter). The others were left blank for water quality readings although the presence of water was indicated in the well (e.g., water appearance-clear, no odor detected in well BW-3C during the 3rd Quarter 2015). Ensure that the descriptions on the logs are accurate; revise the Report to correct all errors and omissions.	If there is sufficient water present to obtain the readings and fill sample containers for analysis, the field readings are recorded on the forms. However, if a bailer is used to remove modest amounts of water from a well then no readings are taken due to insufficient water. Water quality readings are provided for wells where the data was recorded.
42.6	The dissolved oxygen readings fluctuate significantly. For example, initial readings decreased from 15.3 to 8.4%; then, the final reading suddenly increased to 40.3% in well OW-30 during the first quarter of 2015. The field techniques utilized during the measurement must be consistent. In addition, ensure the instrument is properly calibrated prior to use.	Noted.
43	In Appendix E, Summary of All Leaks, Spills and Releases, the Permittee states, "[t]he wastewater believed to contain < .5 ppm benzene was vacuumed up with vacuum truck and placed back into the WW treatment system." Include a laboratory analytical report for the wastewater as an attachment to the Form C-141 in the revised Report.	The analytical report and Form C-141 for the November 2015 wastewater spill has been added to the revised report.