GW - 028

FACILITY-WIDE GW MONITORING PLAN
(1 of 3)

2015

HOLLYFRONTIER®

June 29, 2015

Mr. John Kieling
Chief, Hazardous Waste Bureau
New Mexico Environmental Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505

Mr. Carl Chavez
New Mexico Energy, Minerals and Natural Resources Department
Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

RE: Submittal of the *2015 Facility Wide Groundwater Monitoring Work Plan* for the
Navajo Refining Company, L.L.C., Artesia Refinery
RCRA Permit No. NMD048918817
Discharge Permit GW-028

Dear Mr. Kieling and Mr. Chavez:

Enclosed is the annual update to the Facility Wide Groundwater Monitoring Work Plan (FWGMWP) for the Artesia Refinery. This update has been prepared and is being submitted according to the requirements of the Post Closure Care Permit issued by the New Mexico Environment Department Hazardous Waste Bureau. The FWGMWP incorporates the requirements of the Discharge Permit issued by the New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division. The updated FWGMWP is being submitted in both hard copy and electronic format.

If you have any questions or comments regarding this request, please feel free to contact me at 575-746-5487 or Robert Combs at 575-746-5382.

Sincerely,

Scott M. Denton
Environmental Manager
Navajo Refining Company, L.L.C.

c: Robert Combs, NRC
Pamela R. Krueger, ARCADIS

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2015 Facility Wide Groundwater Monitoring Workplan

NMD048918817 and DP GW-028

June 2015

2015 Facility Wide Groundwater Monitoring Workplan NMD048918817 and DP GW-028

Pamela R. Krueger
Senior Project Manager, ARCADIS

Prepared for:

New Mexico Environment Department,
Hazardous Waste Bureau and
New Mexico Energy, Minerals and Natural
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June 29, 2015

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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.

Scott Denton
Environmental Manager, Navajo Refining Company, LLC

Acronyms and Abbreviations

%	percent
CMI	Corrective Measures Implementation
DO	Dissolved Oxygen
DRO	Diesel Range Organics
EP	Evaporation Ponds
EPA	United States Environmental Protection Agency
FWGMWP	Facility Wide Groundwater Monitoring Workplan
GC/FID	Gas Chromatography/Flame Ionization Detection
GRO	Gasoline Range Organics
HFC	HollyFrontier Corporation
HSWA	Hazardous and Solid Waste Amendment
mg/L	milligrams per liter
mm	millimeters
NCL	North Colony Landfarm
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NRC	Navajo Refining Company, L.L.C.
OCD	New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division
ORP	Oxidation-Reduction Potential
OSE	Office of the State Engineer
PCC Permit	Post Closure Care Permit
PIANO	parrafins, isoparaffins, aromatics, naphthenes and olefins
PSH	Phase Separated Hydrocarbons
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SWMU	Solid Waste Management Unit
TCEQ	Texas Commission on Environmental Quality
TDS	Total Dissolved Solids
TEL	Tetra ethyl lead
TMD	Three Mile Ditch
TPH	Total Petroleum Hydrocarbons
TRRP	Texas Risk Reduction Program
VOC	Volatile Organic Compounds
WQCC	Water Quality Control Commission

Executive Summary

The HollyFrontier Corporation (HFC) owns the Navajo Refining Company., L.L.C. (NRC), which operates the Artesia Refinery (Refinery) located in Artesia, New Mexico. HFC is an independent energy company engaged in crude oil refining and wholesale marketing of refined petroleum products.

In October 2003, the Secretary of the New Mexico Environment Department (NMED) issued a Post-Closure Care Permit (PCC Permit) for the Refinery, which has United States Environmental Protection Agency (EPA) ID Number NMD048918817. The PCC Permit was modified in December 2010. Among other action items, the PCC Permit authorizes and requires NRC (the Permittee) to conduct facility wide groundwater monitoring, with the purpose of evaluating the presence, nature and extent of hazardous and regulated constituents pursuant to Section 20.4.1.500 of the New Mexico Administrative Code (NMAC) and the Water Quality Control Commission (WQCC) standards included in NMAC 20.6.2.

Additionally, the New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD) issued a renewal to Discharge Permit GW-028 dated August 22, 2012. The Discharge Permit also requires facility wide groundwater monitoring and submittal of an annual report summarizing the groundwater monitoring and abatement conducted throughout each year.

This annual update to the Facility Wide Groundwater Monitoring Workplan (FWGMWP) is being submitted as per the requirements of Section 4.7.6.a of the PCC Permit and Section 5.A of the Discharge Permit. This FWGMWP is an update of the previous workplan submitted to NMED and OCD in June 2014, which was approved by NMED on February 18, 2015. The purpose of this FWGMWP is to direct the observation and characterization of the nature and extent of groundwater contamination beneath or migrating from the Refinery. This FWGMWP contains all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit requirements.

The groundwater monitoring program is focused specifically on monitoring the following areas:

- The closed Tetra Ethyl Lead (TEL) Impoundment;
- The closed North Colony Landfarm (NCL);

- The inactive Evaporation Ponds (EP);
- Three Mile Ditch (TMD); and
- The impacted vadose zone located beneath the Refinery, extending east along the direction of flow.

This FWGMWP follows the general outline suggested for a workplan provided in Appendix E of the PCC Permit, while incorporating the requirements of Section 5 of the Discharge Permit.

1. Introduction

The HollyFrontier Corporation (HFC) owns the Navajo Refining Company., L.L.C. (NRC), which operates the Artesia Refinery (Refinery) located in Artesia, New Mexico (Figure 1). HFC is an independent energy company engaged in crude oil refining and wholesale marketing of refined petroleum products.

In October 2003, the Secretary of the New Mexico Environment Department (NMED) issued a Post-Closure Care Permit (PCC Permit) for the Refinery, which has United States Environmental Protection Agency (EPA) ID Number NMD048918817 (NMED 2003). The PCC Permit was modified in December 2010 (NMED 2010). Among other action items, the PCC Permit authorizes and requires NRC (the Permittee) to conduct facility wide groundwater monitoring, with the purpose of evaluating the presence, nature and extent of hazardous and regulated constituents pursuant to Section 20.4.1.500 of the New Mexico Administrative Code (NMAC) and the Water Quality Control Commission (WQCC) standards included in NMAC 20.6.2.

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This annual update to the Facility Wide Groundwater Monitoring Workplan (FWGMWP) is being submitted as per the requirements of Section 4.7.6.a of the updated PCC Permit and Section 5.A of the Discharge Permit. This FWGMWP is an update of the previous workplan submitted to NMED and OCD in June 2014 (ARCADIS 2014a), which was approved on February 18, 2015 (NMED 2015). The purpose of this FWGMWP is to direct the observation and characterization of the nature and extent of groundwater contamination beneath or migrating from the Refinery. This FWGMWP contains all groundwater monitoring activities that will be conducted to satisfy both the NMED PCC Permit and the OCD Discharge Permit requirements.

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- The closed Tetra Ethyl Lead (TEL) Impoundment;
- The closed North Colony Landfarm (NCL);

- The inactive Evaporation Ponds (EP)

- Three Mile Ditch (TMD); and

- The impacted vadose zone located beneath the Refinery, extending east along the direction of flow.

The closed TEL Impoundment is located near the eastern boundary of the active Refinery and south of Eagle Creek (Figure 2). The closed NCL is located near the northwestern corner of the Refinery (Figure 2). The inactive EP area is located approximately three miles east of the active Refinery, south and west of the Pecos River. Figure 2 shows the locations of wells included in the monitoring program. Figure 3 shows information about tanks located within the Refinery boundary along with a more detailed view of well locations within the Refinery.

This FWGMWP describes the planned activities that will be conducted in 2016 to continue monitoring the groundwater and continue recovery of phase separated hydrocarbons (PSH). The format of this FWGMWP follows the general outline specified for a workplan in Appendix E of the PCC, while incorporating the requirements of Section 5 of the Discharge Permit.

2. Background

The Refinery is an active petroleum refinery located at 501 East Main Street in the city of Artesia, Eddy County, New Mexico. The facility has been in operation since the 1920's and processes crude oil into asphalt, fuel oil, gasoline, diesel, jet fuel, and liquefied petroleum gas. There are no plans to close the facility or reduce the size of the operation. Figure 1 depicts the general location of the Refinery and the inactive EPs, while Figure 2 shows the locations of wells included in the facility wide groundwater monitoring program.

The Refinery is regulated under Resource Conservation and Recovery Act (RCRA), having EPA ID Number NMD 048918817. The NMED issued a Hazardous Waste Facility Permit to NRC effective August 21, 1989 (NMED 1989).

Included as part of the 1989 Hazardous Waste Facility Permit was a Hazardous and Solid Waste Amendment (HSWA) Permit issued by the EPA. This permit required NRC to identify all historical and current non-hazardous solid waste management units (SWMUs) and investigate those that had the potential to pose a threat to human health or the environment. SWMUs which pose a potential threat must undergo additional investigation (a RCRA Facility Investigation [RFI] and possibly Corrective Measures Implementation [CMI]) to minimize the threat.

Following completion of the Phase I RFI in December, 1990 (Mariah Associates, Inc. 1990), it was agreed by EPA and NMED that additional investigations were required for TMD and the EPs located east of the Refinery. The second phase of investigation of those areas was conducted from 1991 through 1993, resulting in the RFI Phase II Report finalized in November, 1993 (K.W. Brown Environmental Services 1993). A final Phase III Investigation Report addressing comments from the EPA and NMED was submitted in January 1996 along with a proposed workplan for removal of waste soils from TMD (K.W. Brown Environmental Services 1996). In December 1997, a consolidated report was submitted to NMED that summarized the various investigations performed up to that time along with recommendations for corrective actions in the TMD and the EP areas (Foster Wheeler 1997). Investigations were also performed at the NCL between 1994 and 1997, as summarized in the Revised RFI Phase II Report (Covenant Technical Associates, Inc. 1997). The investigations of NCL, TMD, and the EPs included installation of monitoring wells in these areas and identified groundwater impacts due to historical operations.

At the request of NMED, NRC submitted a Post-Closure Permit Application in June 1998, with revisions to the application in 2001 (NRC 2001). The original intent of this application, to address only closure and post-closure activities at the EPs and TMD, was expanded to include a complete RCRA Permit renewal application.

The Secretary of the NMED issued a Post-Closure Care Permit (PCC Permit) to NRC, the owner and operator of the Refinery (EPA ID number NMD 048918817) effective October 5, 2003 (NMED 2003). The PCC Permit was modified in December 2010 (NMED 2010). The PCC Permit authorizes and requires the Permittee to monitor the groundwater, maintain all groundwater monitoring wells and comply with applicable regulations of 20.4.1.500 NMAC during the post-closure period. Specific groundwater monitoring requirements are included in the PCC Permit for the areas of the TEL Impoundment, the NCL, the EP area, and other areas identified through implementation of the investigations of various SWMUs.

The OCD issued a renewal of Discharge Permit GW-028 dated August 22, 2012 (OCD 2012). The Discharge Permit authorizes and requires the Permittee to maintain PSH recovery systems and to conduct semiannual groundwater monitoring. The Discharge Permit requires submittal of an annual report summarizing the results of the monitoring and recovery programs.

In 2006, NRC submitted a Groundwater Monitoring Workplan that combined the requirements of the two permits into a comprehensive monitoring program (NRC 2006). This 2015 FWGMWP comprises the annual update of the workplan, as required by Section 4.7.6.a of the PCC Permit and Section 5.A of the Discharge Permit. This FWGMWP includes a revised monitoring schedule based on recent changes to the groundwater monitoring network, as described in the following sections.

3. Site Conditions

3.1 Surface Conditions

3.1.1 Area Land Uses

The area north, south and east of the facility is sparsely populated and used primarily for agricultural and ranching purposes (Figures 1 and 2). The primary business and residential areas of the City of Artesia are located to the west, southwest and northwest of the Refinery. There are a few commercial businesses south of the Refinery along Highway 82, including an oil-field pipe company located at the southeast corner of the plant. Much of the property for one-half mile north of Highway 82 to East Richey Avenue and east of Highway 285 toward Bolton Road is owned by NRC. Much of the area east and northeast of Bolton Road to Haldeman Road is a cultivated pecan orchard or used for other agricultural and ranching purposes.

The active Refinery and much of the surrounding property owned by NRC is fenced and guarded with controlled entry points.

3.1.2 Topography

The Refinery is located on the east side of the City of Artesia in the broad Pecos River Valley of Eastern New Mexico. The topography of the site and surrounding areas is shown in Figure 1. The average elevation of the city is 3,380 feet above mean sea level. The plain on which Artesia is located slopes eastward at about 20 feet per mile or 0.378 percent (%).

3.1.3 Surface Water Drainage Features

Surface drainage in the area is dominated by small ephemeral creeks and arroyos that flow eastward to the Pecos River, located approximately three miles east of the city. The major drainage in the immediate area of the site is Eagle Creek (or Eagle Draw), an ephemeral watercourse normally flowing only following rain events, that runs southwest to northeast through the northern process area of the Refinery and then eastward to the Pecos River. Upstream of the Refinery, Eagle Draw functions as a major stormwater conveyance for the community. It also drains outlying areas west of the city and is periodically scoured by intense rain events.

Natural surface drainage at the Refinery is to the north and east. Stormwater within the process areas is captured and routed to the Refinery wastewater treatment system. Stormwater from non-process areas is contained within the Refinery property inside stormwater berms and routed to stormwater retention basins. Stormwater from within the Refinery boundary is not allowed to discharge to Eagle Draw.

The elevation of Eagle Draw is 3,360 feet at its entrance to the Refinery and decreases to approximately 3,305 feet at its confluence with the Pecos River. Eagle Draw was channelized from west of Artesia to the Pecos River to help control and minimize flood events. In the vicinity of the Refinery, the Eagle Draw channel was cemented to provide further protection during flood events. A check dam was also constructed west of Artesia along Eagle Draw. Federal floodplain maps indicate that most of the city and the Refinery have been effectively removed from the 100 year floodplain.

3.2 Subsurface Conditions

3.2.1 Soils

Soils at the Refinery are primarily of the Pima and Karro series. Soils characterized for permitting the NCL were about 60% Pima and 40% Karro soils. The Pima and Karro soils have similar properties. Pima soils are deep, well drained, dark colored, calcareous soils, which occur on floodplains of narrow drainageways (such as Eagle Creek). These soils have moderate shrink-swell potential and were subject to periodic flooding. Runoff from Pima soils is slow, permeability is moderately low and the water-holding capacity is high. The effective rooting depth is greater than five feet and the water table is deeper than five feet.

The Karro soils are highly calcareous. Calcium carbonate typically accumulates as caliche at a depth of about 45 inches. These soils are found on level to gently sloping terrains and are susceptible to wind erosion. Runoff is slow and water-holding capacity is high. Permeability is moderate and the effective rooting depth and depth to groundwater are both over five feet.

3.2.2 Regional Geology

Artesia is located on the northwest shelf of the Permian Basin. In this region, the deposits are comprised of approximately 250 to 300 feet of Quaternary alluvium uncomformably overlying approximately 2,000 feet of Permian clastic and carbonate rocks. These Permian deposits uncomformably overlie Precambrian syenite, gneiss and diabase crystalline rocks. The relationships between the sedimentary deposits are discussed below.

3.2.2.1 Quaternary Alluvium

The Quaternary alluvium in the Refinery area is dominantly comprised of clays, silts, sands and gravels deposited in the Pecos River Valley. These “valley fill” deposits extend in a north-south belt approximately 20 miles wide, generally west of the Pecos River. The thickness of the valley fill varies from a thin veneer on the western margins of the Pecos River valley to a maximum of 300 feet in depressions, one of which is located beneath the Refinery. These depressions have resulted from dissolution of the underlying Permian carbonates and evaporites. The sedimentology and mineralogy of the valley fill deposits can be divided into three units: the uppermost carbonate gravel unit, the interbedded clay unit, and the underlying quartzose unit.

The carbonate gravel unit blankets the other valley fill units and forms a fairly uniform slope from the Permian rock outcrop areas on the west side of the Permian Valley east to the Pecos River floodplain. The unit consists of coarse-grained carbonate gravel deposits along major drainage ways to the Pecos River, which grade into brown calcareous silts and thin masses of caliche in the interstream regions. The carbonate gravel unit includes the Orchard Park, Blackdom and Lakewood terrace deposits of Fielder and Nye as well as Holocene and Pleistocene Pecos River alluvial deposits.

The agricultural land around Artesia is part of the Orchard Park terrace deposit, which forms a thin veneer overlying older valley fill alluvium. The Orchard Park terrace surface gently rises in elevation to between 5 and 25 feet above the Lakewood terrace. The Orchard Park is generally less than 20 feet in thickness in the Refinery area and is comprised of silt interbedded with poorly sorted lenses of mixed size pebbles in a silt and sand matrix. Chalky caliche commonly occurs in the upper layers.

The Blackdom terrace is about 40 to 50 feet in elevation above the Orchard Park terrace west of Artesia. However, the deposits associated with the Blackdom terrace are generally less than 20 feet in thickness. The Blackdom terrace deposits are coarser grained than the deposits associated with the Orchard Park and Lakewood terraces. In addition, the caliche soils have a higher density than those developed on the Orchard Park terrace.

The Lakewood deposits, the lowest of the three terrace units, are essentially the current alluvial sediments in the floodplain along the river. They consist of brown sandy silt interbedded with lenses of gravel and sand and some localized caliche in higher parts. The Lakewood terrace is confined to the area immediately adjacent to the river and is underlain by Pleistocene alluvium deposited by the Pecos River and its tributaries.

The clay unit is not laterally continuous throughout the valley fill deposits, but occurs in isolated lenses generally overlying the quartzose unit. The clay unit is comprised of light-to-medium-gray clays and silts deposited in localized ponds and lakes. These ponds and lakes may have formed in conjunction with dissolution and collapse of the underlying Permian rocks.

The quartzose unit consists primarily of fragments of quartz and igneous rocks cemented by calcium carbonate. This unit is laterally contiguous throughout the Pecos River Valley and is generally less than 250 feet thick. The quartzose unit unconformably overlies Permian Rocks and lower quartzose gravels are commonly used for groundwater production.

3.2.2.2 Permian Artesian Group

The Permian Artesian Group is comprised of five formations (from shallowest to deepest): the Tansill, Yates, Seven Rivers, Queen and Grayburg Formations. The Tansill and Yates Formations outcrop at the surface east of the Pecos River and are not present in the vicinity of the Refinery.

The uppermost Permian formation in the Artesia area is the Seven Rivers Formation, which outcrops east of the Pecos River. This eastward-dipping formation is eroded and buried by the valley fill alluvium at a depth of 300 feet in the area between the river and the Refinery. Nearer the Refinery, the formation thins and disappears farther west. Where the formation is present, it consists of a sequence of evaporites, carbonates, gypsum and shale with isolated sand and fractured anhydrite/gypsum lenses.

An examination of available borehole logs provided no indication that the Seven Rivers formation has been encountered beneath the Refinery. However, the lithologic logs of wells completed in the Refinery area describe unconsolidated alluvial deposits from depths of about 20 feet to over 250 feet.

In the area of the Refinery, the Queen and Grayburg Formations have been mapped as a single unit by geologists as consisting of about 700 feet of interbedded dolomite and calcareous dolomite, gypsum, fine-grained sandstone, carbonates, siltstone and mudstone. In locations where the Seven Rivers Formation is absent, the upper portion of the Queen Formation acts as a confining bed between the deep artesian aquifer and the valley fill aquifer.

3.2.2.3 San Andres Formation

The San Andres Formation lies beneath the Grayburg and Queen Formations and immediately above the Precambrian crystalline basement rocks. The San Andres Formation is composed mainly of limestone and dolomite containing irregularly and erratic solution cavities, which range up to several feet in diameter. Its thickness is greater than 700 feet. The upper portion of the formation is composed of oolitic dolomite with some anhydrite cement.

3.2.3 Regional Groundwater

The principal aquifers in the Artesia area are within the San Andres Formation and the valley fill alluvium. A near-surface water-bearing zone is present in the vicinity of the Refinery process area, which is apparently limited in vertical extent, is shallow with respect to the surface, but exhibits artesian properties at some monitoring wells. The deeper carbonate aquifer is referred to as the deep artesian aquifer, whereas the water-bearing zones of the shallower valley fill alluvium are referred to as the shallow saturated zone and the valley fill zone.

3.2.3.1 Shallow Saturated Zone

Lithologic logs from monitor wells installed within and near the Refinery document a near-surface saturated zone overlying the main valley fill alluvium and containing water of variable quality in fractured caliche and sand and gravel lenses at depths of 15 to 30 feet below ground surface. This water is under artesian pressure for at least some or most of the year with static water levels 3 to 5 feet above the saturated zones.

Figure 2 depicts the monitoring wells installed in the area of the Refinery and the EPs east of the Refinery. Isopleths of the potentiometric surface, as measured in November 2014 in the shallow saturated zone, are shown in Figure 4. The general direction of flow in this near-surface saturated zone is to the east toward the Pecos River; however, localized groundwater depressions are present surrounding portions of the recovery system wells and slight groundwater mounding is observed in the immediate vicinity of the discharge locations where reverse osmosis reject fluids are discharged.

The water in the shallow saturated zone is highly variable in quality, volume, areal extent and saturated thickness. Concentrations of total dissolved solids (TDS) exceeding 2,000 milligrams per liter (mg/L) and sulfate exceeding 500 mg/L have been recorded on the northwest side of the Refinery near the NCL. The most probable sources of the water present in the shallow saturated zone are thought to be recharge from Eagle Creek and lawn watering runoff from the grass-covered urban park that occupies the Eagle Creek Channel immediately upstream of the Refinery.

As reported in the *2014 Annual Groundwater Report* (ARCADIS 2015), the shallow groundwater beneath the Refinery and beneath the EPs is impacted with constituents typically associated with hydrocarbons. Concentrations of the organic constituents in the shallow groundwater exhibit an overall stable or declining trend in most locations (ARCADIS 2015).

Recharge of the shallow water bearing zone is generally attributed to irrigation return flow from pumpage of the aquifers and from infiltration from the Pecos River. The general direction of groundwater flow in the shallow saturated zone follows the regional stratigraphic dip eastward toward the Pecos River, then southward subparallel to the river.

3.2.3.2 Valley Fill Zone

Quaternary alluvial deposits of sand, silt, clay and gravel are the main components of the valley fill zone. These sediments are about 300 feet thick in the area between the City of Artesia near the Refinery and the Pecos River. The three principal units in the valley fill are the carbonate gravel, clay and quartzose.

The carbonate gravel unit, described in an earlier section, is the uppermost alluvial unit in the valley fill. Coarse-grained gravels deposited in the major tributaries to the Pecos River grade to calcareous silts and thin zones of caliche in the interstream areas. Near the surface, groundwater is localized in thin discontinuous gravel beds typical of braided channel material deposited during flood events originating in the foothills and Sacramento Mountains to the west.

Irrigation and water production wells completed in the valley fill zone typically are screened across from one to five water-producing zones. Thicknesses of up to 170 feet have been reported for water-production zones, but most are less than 20 feet. Producing zones are principally sand and gravel separated by less permeable lenses of silt and clay. Wells in the valley fill range from 40 to 60 feet below ground level and the formation yields water containing TDS ranging from 500 to 1,500 mg/L. The average transmissivity of the alluvium has been estimated at 100,000 to 150,000 gallons per day per square foot.

Figure 2 depicts the locations of monitoring wells that have been installed in the valley fill zone in the vicinity of the Refinery and the evaporation ponds. In areas of the valley where the San Andres aquifer and valley fill zone are hydraulically connected in the subsurface, water tends to flow up from the deep aquifer to the shallow water bearing zones, except in areas of heavy San Andres pumpage. Adjacent to the Pecos River, the valley fill alluvium contains groundwater beginning at a depth of 6 to 12 feet. The alluvium is predominately silty sand, which possibly contains lenses of higher permeability material.

Silt and clay deposits in the valley fill zone are not continuous, but occur as isolated lenses, generally overlying the quartzose unit. Most logs of wells located immediately to the north and east of the Refinery show considerable thicknesses of clays or clay mixtures. However, these clays may be more closely related to the fine-grained materials of the carbonate gravel unit found in the interstream areas between the major drainage ways.

The thickness of these clay/clay mixtures ranges from 20 to 160 feet. The intervals of occurrence differ from well to well, and thin zones or gravels are interspersed in the upper 100 feet. Drillers seeking deep artesian water drill through the valley fill zone and usually log large intervening zones as “clay and cap”. This lack of detail makes it difficult to correlate specific zones of coarse-grained sediments within the silt and clay deposits.

The quartzose unit is considered the primary production unit in the valley fill zone. Away from the Pecos River, the unit consists of fragments of sandstone, quartzite, quartz chert, igneous and carbonate rocks. The fragments range from medium grained (1/4 mm) to pebble size (16 mm) and are commonly cemented with calcium carbonate. By contrast, in the vicinity of the river, the unit contains principally medium to coarse uncemented quartz grains.

3.2.3.3 Deep Artesian Aquifer

The deep artesian aquifer is closely related to the Permian San Andres Limestone and generally consists of one or more water producing zones of variable permeability located in the upper portion of the carbonate rocks. However, in the Artesia area, the producing interval rises stratigraphically and includes the lower sections of the overlying Grayburg and Queen formations. Near the Refinery, the depth to the top of the producing interval is estimated to be about 440 feet. The Seven Rivers formation and the other members of the Artesia Group are generally considered confining beds although some pumpage occurs locally from fractures and secondary porosity in the lower Grayburg and Queen members.

The deep artesian aquifer has been extensively developed for industrial, municipal and agricultural use. The quality of water from this aquifer ranges from 500 mg/L to more than 5,000 mg/L TDS depending on location. In the Artesia area, water is generally derived from depths ranging from 850 feet to 1,250 feet below ground surface. The aquifer recharge is in the Sacramento Mountains to the west of Artesia. Extensive use of this aquifer in recent decades has lowered the potentiometric head in the aquifer in some locations from 50 to 80 feet below ground level, although extensive rainfall in some years may bring the water levels in some wells close to the surface.

Information available for irrigation well RA-4798 indicates that it is screened at 840 to 850 feet below ground surface, in the deep artesian aquifer. Historic analytical data from this well does not indicate the presence of hydrocarbon impacts from refinery operations.

4. Modifications to the Groundwater Monitoring Network

This section of the FWGMWP discusses the modifications to the groundwater monitoring network that have occurred since submittal of the 2014 FWGMWP (ARCADIS 2014a).

4.1 New Monitoring Wells

The following new permanent monitoring wells have been installed since the 2014 FWGMWP was submitted.

- Monitoring wells MW-136 and UG-4 were installed in July and August 2014 according to an approved work plan for performance of a background groundwater evaluation (ARCADIS 2014d).

- MW-137 was installed in November 2014 near the Main API Separator (SWMU 22) according to the well installation work plan (ARCADIS 2014c).

The locations of the new wells are shown in Figure 2 while well construction details are provided in Table 1.

MW-138 was also to be installed in November 2014 near the Main API Separator, but installation was delayed due to the presence of hydrogen sulfide in the area. MW-138 is scheduled to be installed prior to the second semiannual monitoring event of 2015.

Copies of the well construction logs for MW-136 and UG-4 were provided to NMED in the 2014 annual report (ARCADIS 2015). The well completion log for MW-137 is provided in Appendix A of this 2015 FWGMWP.

4.2 Well Abandonments

No wells were plugged and abandoned in 2014. A work plan to plug and abandon the former recovery wells RW-12, RW-13, and RW-14 adjacent to Bolton Road north of Highway 82 was submitted to the Office of the State Engineer (OSE) in November 2014 (ARCADIS 2014c). These three recovery wells are no longer required since replacement wells were installed in 2012. Abandonment of the wells was recommended due to the proximity of the wells to a public roadway.

OSE approved the work plan and abandonment activities were initiated in November 2014. However, high levels of hydrogen sulfide were encountered and work was halted. The abandonment activities were delayed until the groundwater levels have declined, reducing the conditions that are believed to have led to the high levels of hydrogen sulfide, and to design effective methods to mitigate hydrogen sulfide if the conditions do not change. Abandonment activities should be completed in 2015 and will be documented in the 2015 annual groundwater monitoring report.

4.3 Well Repairs and Modifications

In November 2014, the following repairs and/or modifications were made to existing monitoring wells:

- MW-2A: replaced concrete pad and installed outer metal shroud with locking cap
- MW-6A: replaced concrete pad and installed outer metal shroud with locking cap
- MW-80: cut well casing down so that it did not extend above the outer steel shroud
- OCD-1R: replaced concrete pad, no modifications to well
- OCD-7AR: unburied the concrete pad, no modifications to well or pad
- OCD-7B: unburied the concrete pad, no modifications to well or pad
- OCD-7C: unburied the concrete pad, no modifications to well or pad

MW-80 was re-surveyed to determine the new top of casing elevation following the modification described above. None of the remaining modifications affected the elevations of the wells.

5. Scope of Services

This section of the FWGMWP provides a detailed description of groundwater monitoring activities to be conducted.

5.1 Health and Safety Considerations

Groundwater monitoring activities will be performed in both active and historical process areas of the Refinery, in the inactive EP area, along TMD, and in agricultural fields adjacent to the Refinery. The primary health and safety considerations associated with the monitoring activities include the potential for the presence of harmful vapors and environmental hazards.

Any deviations from proposed sample collection procedures due to health and safety considerations will be documented and discussed in the annual monitoring report.

5.2 Routine Monitoring Activities

The groundwater monitoring program includes the following activities:

- Semiannual gauging of monitoring and recovery wells.
- Semiannual collection of analytical samples from monitoring wells as well as from select recovery and irrigation wells.
- Collection and disposal of purge water generated during sample collection and decontamination water generated during gauging and sample collection.

5.3 Groundwater Sample Analyses

5.3.1 2014 Groundwater Analytical Requirements

The 2014 FWGMWP included the following general sampling and analysis plan described below:

- All active and accessible monitoring and recovery wells will be gauged semiannually with an oil/water interface probe to monitor the presence and thickness of PSH and to measure the depth to groundwater and total depth of each well.

- Monitoring wells that contain PSH, as indicated by an oil/water interface probe, will not be sampled during any event that PSH is present with a thickness of 0.03 feet or greater.

- Monitoring wells located along or near the downgradient edges of the impacted areas will be sampled semiannually.

- Select monitoring wells within the impacted areas will be sampled semiannually to monitor the concentrations within the dissolved phase plume areas. The wells selected to be sampled on a semiannual basis should provide adequate information to assess the fate of dissolved phase constituents within known impacted areas.

- Wells interior to known impacted areas will be sampled annually to monitor the concentrations throughout the dissolved phase plume areas.

- Upgradient wells will be sampled annually.

- Active and accessible irrigation wells will be sampled either semiannually or annually based on the proximity to known PSH presence.

- Recovery wells will be sampled annually, if PSH is not present or is present with a thickness of less than 0.03 feet.

- Selected wells completed in the deeper valley fill zone will be sampled biennially, beginning in the spring of 2011.

Groundwater samples were required to be analyzed for some or all of the following parameters:

- Volatile organic compounds (VOCs) by EPA Method 8260;

- Diesel Range Organics (DRO) by EPA Method 8015B;

- Gasoline Range Organics (GRO) by EPA Method 8015B;

- Total Metals (arsenic, barium, chromium, lead, selenium, iron, manganese, mercury, nickel and vanadium);

- Dissolved Metals (arsenic, barium, chromium, lead, selenium, iron, manganese, nickel and vanadium) – to be analyzed only in the samples collected during the spring events;
- Cyanide;
- Major cations and anions;
- TDS; and,
- Nitrates/nitrites.

Not all wells were required to be analyzed for all of the parameters listed above. Table 1 of the 2014 FWGMWP summarized the analyses performed under that approved monitoring plan.

5.3.2 Revised Groundwater Monitoring Program

This section provides a description of revisions to the groundwater sample analyses recommended to occur in 2016. The revisions described below relate to analytical methods for metals and total petroleum hydrocarbons (TPH) only.

No changes to the sample collection frequency described in the approved 2014 FWGMWP have been proposed in this 2015 FWGMWP. Figure 5 provides a graphical depiction of the monitoring plan, specifically the frequency of sampling proposed for each well.

5.3.2.1 Dissolved Metals Analyses

In 2011, NRC proposed to remove dissolved metals analyses from the monitoring program because the monitoring program includes analysis of total metals. After discussions with both NMED and OCD, it was determined that total metals would be analyzed during both semiannual monitoring events of each year and that dissolved metals analyses would be performed only during the first semiannual event of each year.

A statistical evaluation of the analytical results of total and dissolved metals analyses obtained for samples collected between 2012 and 2014 was performed. A copy of the statistical analysis memo is provided in Appendix B to this 2015 FWGMWP. The purpose of the evaluation was to determine whether analysis of total metals in groundwater provides a conservative measure of the presence of specific metals concentrations in groundwater. To answer the question, a series of comparisons were performed to compare the dissolved metals data set to the total metals data set. The statistical correlations between the data sets were evaluated.

A total of 313 pairs of dissolved and total metals data points were used to conduct the evaluation. The means and variances of the data were evaluated using non-parametric tests, including the Mann-Whitney U test (comparison of means) and the Kruskal-Wallis test (comparison of variances).

A summary of the statistical tests is shown in Table 2, which shows that the arithmetic mean of the total metals data is always higher than the arithmetic mean of the dissolved metals data, for each metal evaluated. This statistical evaluation supports the expectation that the dissolved metals result is less than the total metals result, since the dissolved metals samples are field filtered to remove suspended solids, which are expected to contain some metals.

The arithmetic mean of chromium and iron were found to be statistically elevated for total concentrations when compared to the dissolved concentrations. This result supports the belief that chromium and iron are present in colloidal mass included in the suspended solids. The difference in adjusted arithmetic mean of the remaining metals was not statistically significant for total concentrations when compared to the dissolved concentrations.

The statistical evaluation also included development of correlation coefficients that may be used to estimate the dissolved concentration of a metal based on the total concentration. The correlation equation takes the form of:

$$C_d = (C_t * a) + b$$

where

C_d = dissolved metal concentration
C_t = total metal concentration
a = slope
b = intercept

Table 3 provides a summary of values for the slope and intercept of the correlation equation for each of the metals, and a crossover concentration below which the equation is no longer valid. It should be noted that the crossover concentration for each of the metals is below the WQCC standard for each of the metal compounds. It should be noted that correlation for lead was poor due to the low number of detected concentrations in the dissolved samples.

The statistical evaluation of dissolved and total metals concentrations has confirmed that dissolved metals concentrations are less than the total metals concentrations. Thus, NRC proposes to analyze groundwater samples for total metals only, and will continue to compare the total metals results to the WQCC standards, which are based on a dissolved metals concentration. This approach provides a conservative evaluation of potential impacts by overestimating the concentration of dissolved metals in the groundwater.

5.3.2.2 Total Petroleum Hydrocarbons Analytical Method

The analysis of TPH in groundwater has been performed as part of the facility-wide groundwater monitoring for many years. TPH provides a screening level evaluation of the presence of a complex mixture of compounds, including both regulated and non-regulated constituents. TPH analyses have historically been performed by EPA Method 8015 Modified (Method 8015) with the analyses reported as Gasoline Range Organics (GRO) and Diesel Range Organics (DRO). Method 8015 results for GRO correspond to hydrocarbon compounds in the C6 to C10 range while the results for DRO correspond to hydrocarbon compounds in the C10 to C28 range.

The December 2014 guidance document removed the groundwater screening value for TPH included in previous versions of this guidance document. The previous versions of the guidance document provided a screening value only for DRO and not for GRO in groundwater. Thus, the annual groundwater reports have included a discussion of the concentrations of GRO present in samples analyzed for that parameter along with a trend in the concentrations in each well. The DRO results have been compared to the groundwater screening values included in the previous version of the guidance document and reported results exceeding those values have been utilized to define the extent of impacted groundwater.

The December 2014 version of the NMED guidance document (NMED 2014) states "…site cleanup decisions cannot be based solely on the results of TPH sampling." However, the evaluation of TPH in groundwater provides a useful evaluation of impacts to groundwater. In order to improve the evaluation of TPH in groundwater, a change in analytical methodology is recommended, utilizing the TPH analytical methods developed by the Texas Commission on Environmental Quality (TCEQ). The Texas Risk Reduction Program (TRRP) was developed by the TCEQ and is used to evaluate potential site impacts and develop remediation goals utilizing protective concentration levels (PCLs) for contaminants of concern. TCEQ publishes tables of PCLs for various compounds based on potential exposure pathways which are quite similar to the exposure pathways utilized in the NMED guidance document. A copy of the guidance document “Development of Human Health PCLs for Total Petroleum Hydrocarbon Mixtures” (TRRP-27, TCEQ 2010) is provided as Appendix C for reference.

As described in TRRP-27, there are two analytical methods that have been developed to evaluate TPH: TCEQ Method 1005 (Method 1005) and TCEQ Method 1006 (Method 1006). Method 1005 utilizes an n-pentane extraction followed by gas chromatography/flame ionization detection (GC/FID) analysis to quantify the hydrocarbon compounds in the C6 to C35 ranges. The analytical results from Method 1005 are reported for three separate boiling point ranges: C6 to C12, C12 to C28, and C28 to C35. Method 1006 uses a silica gel fractionation of the n-pentane extract to separate the sample into aliphatic and aromatic compounds within several different boiling point ranges (seven aliphatic ranges and six aromatic ranges).

The results of the Method 1005 analyses are typically used for screening level evaluations and to identify unique source areas, utilizing the chromatogram from the analyses. The results from this method may be compared to default screening level PCLs (Tier 1 PCLs) for either residential or commercial/industrial exposure pathways, as appropriate. If warranted, samples from the locations with the highest TPH concentration reported by Method 1005 from each unique source area can then be analyzed by Method 1006. The Method 1006 results may then be compared to default screening level PCLs for each aliphatic and aromatic boiling point range, or they may be used to calculate a source-specific PCL using risk-based calculations. The TRRP-27 guidance document provides the calculations used to develop a source-specific PCL. TCEQ provides an electronic spreadsheet on the website that contains the equations listed in TRRP-27, simplifying and standardizing the calculation process.

Analytical results obtained utilizing Method 1005 are expected to be similar to but not directly comparable to the analytical results obtained utilizing Method 8015. To evaluate the similarity of the results, duplicate samples will be collected during the fall 2015 monitoring event from 10 monitoring wells to be analyzed by Method 1005 in addition to analyses by Method 8015, as follows:

- EP Area:
    - MW-22A
    - MW-77
    - MW-120
    - MW-122
    - MW-123

- Refinery and Field East of Refinery:
    - MW-49
    - MW-127
    - MW-130
    - MW-131
    - MW-135

The selected locations include wells that are listed in the approved 2014 FWGMWP as having both DRO and GRO analyses by Method 8015. Five of the wells were selected in the area of the EPs and five of the wells were selected within the known dissolved phase plume located within the Refinery and emanating to the east. One of the five wells selected from each area has historically contained no detectable DRO or GRO. One of the five wells selected from each area had the highest reported concentration of either DRO or GRO during the spring 2014 sampling event. The remaining three wells in each area were selected based on location to provide a geographically diverse data set, but each well that was selected contained reportable DRO during the spring 2014 sampling event.

The analytical results obtained by Method 1005 will be compared to the GRO and DRO results obtained by Method 8015 and a qualitative comparison will be made between the results in the 2015 annual groundwater monitoring report. If the results are comparable, then the recommendation will be made to cease the Method 8015 analyses and begin analyses using Method 1005 beginning with the spring 2016 event.

The chromatograms for the Method 1005 analyses will be obtained for all of the samples analyzed by this method during the spring 2016 event. An evaluation of the chromatograms will be performed to establish unique “source” areas. During the fall 2016 event, all of the samples scheduled for TPH analyses will be analyzed by Method 1005 and samples collected from the well that contained the highest TPH reported by Method 1005 for each unique source area will also be analyzed by Method 1006. The Method 1006 results will be used to develop a risk-based screening level for groundwater within each unique source area. The results of the evaluation of the Method 1005 chromatograms and the calculations of the source-specific risk-based screening levels will be included in the 2016 annual groundwater report.

6. Groundwater Sampling Methodology

This section provides a summary of the procedures that will be used to implement this FWGMWP.

6.1 Well Gauging

At the beginning of each semiannual sampling event, all monitoring and recovery wells listed on Table 1 will be gauged to record the depth to PSH (if present), the depth to water, and the total depth of the well. The gauging will be performed using an oil/water interface probe attached to a measuring tape capable of recording measurements to the nearest 0.01 foot. All readings will be made in relation to the marked survey datum at the top of casing of each well. All survey measurements were made at the northern edge of each well casing. In the event that the survey datum mark is not present, the measurements will be made at the top of the well casing, on the northern side of well casing.

In order to provide accurate data for development of groundwater potentiometric surface contours, the groundwater gauging will be performed in as short a time period as possible, typically in no more than two 48-hour periods. All wells located within the Refinery security fence, wells located immediately south of the Refinery and those wells located east of the Southeast Tank Farm will be gauged within one 48-hour period. All remaining wells, including those wells in and near the Evaporation Ponds and those wells between the Refinery and the Evaporation Ponds, will be gauged within a second 48-hour period, if necessary. Every effort will be made to ensure that, if necessary, the two 48-hour gauging periods are sequential.

Gauging measurements will be recorded either on a paper field gauging form, or in an electronic format in a database used for electronic data capture. The date, time and measurements will be recorded for each well during each event. Any weather events that occur during and/or between the gauging periods will be recorded.

Data obtained from the gauging will be reported in the annual groundwater monitoring report. The data will be used to develop groundwater contour maps and PSH thickness isopleths, which will also be included in the annual report.

6.2 Well Purging

All zones in each monitoring well shall be purged by removing groundwater prior to sampling in order to ensure that formation water is being sampled. Purging will be accomplished with the use of either a peristaltic or submersible pump. The peristaltic pump will be used where practical to apply low-flow purging and sampling procedures. A submersible pump will be used where the depth to water in a monitoring well is greater than 25 feet (limitation of peristaltic pump) and for sample collection from recovery wells. In the event that purge parameters do not stabilize, as specified below, a maximum of ten well casing volumes will be removed prior to sample collection.

Irrigation wells located on adjacent property are included in the groundwater monitoring program. These wells have dedicated electric pumps and do not have access to allow for gauging of the water level; thus, the volume of water present in the well casing cannot be calculated. If access is available and power is provided to the pump, these wells will be purged using the irrigation pump. Purging will continue until the purge parameters stabilize, as described below.

Parameters that will be monitored during purging include, at a minimum, groundwater pH, specific conductance, temperature, dissolved oxygen (DO) concentrations, and oxidation-reduction potential (ORP). These measurements will be made using appropriate equipment, such as a multiparameter water quality monitoring meter such as a YSI 600XL or similar device, and a flow-through cell. The readings and the volume of water purged between intervals will be obtained at routine intervals during the purging process and recorded either on a paper sampling log or in the electronic data gathering form.

Purging will be considered complete when four of the five purge parameters have stabilized. The specified stabilization criteria for pH, temperature and DO are plus or minus 0.2 units (standard pH units for pH, degrees Celsius for temperature, and mg/L for DO), specific conductance is plus or minus 0.02 units (Siemens per meter or milliSiemens per centimeter) and ORP is plus or minus 20 units (millivolts). The units used for measurement of purge parameters will be recorded.

If a well should purge dry, then it will be allowed to recover. When the water level has returned to a minimum of 75 % of the level measured at the beginning of the sampling event, a sample will be collected for analysis.

The equipment used for the field measurements (such as a YSI multiparameter water quality meter or similar device) will be calibrated at least once during each day of the sampling event. Calibration will be performed according to the equipment manufacturer's directions. Calibration data will be recorded in the daily field notes.

Purged groundwater will be collected and disposed of properly, as described in Section 6.7.

6.3 Groundwater Sample Collection and Handling

Samples will be collected following purging and will consist of pumping groundwater directly into the laboratory provided sample containers. Dedicated tubing will be used for each well to prevent the potential for cross-contamination. Unfiltered samples will be collected for organic and total metals analyses.

As discussed in Section 5.3.2.1, routine analyses of dissolved metals is no longer recommended. However, if dissolved metals analyses are required for a specific event, a 0.45 micron filter will be attached to the tubing after all other containers have been filled, and the filtered samples for analysis of dissolved metals will be collected.

Containers will be labeled and placed into appropriate containers (coolers) with ice for shipment to the analytical laboratory. Each label will clearly identify the sample identifier, the date and time of collection, the analytical method to be performed, and the sampler's initials. Separate sample identifications will be used to indicate filtered samples for analysis of dissolved metals, as necessary.

Shipping containers (coolers) will be packed with ice or similar cooling materials to maintain appropriate sample temperatures. Adequate padding will be provided to prevent breakage or puncture of sample containers during shipment. The containers will be shipped via express courier to the laboratory for analyses. Chain-of-custody forms will be shipped inside each container to properly track the samples in each container. A chain-of-custody seal will be placed on each shipping container and inspected upon arrival at the laboratory to ensure the integrity of the shipped samples.

6.4 Analytical Methods

The groundwater samples will be analyzed for the parameters listed in Table 1, which include the following COCs:

- TPH;
- VOCs;
- Total Metals (arsenic, barium, chromium, iron, lead, manganese and selenium for all samples, and mercury, nickel, and vanadium from select wells);
- Cyanide;
- Major cations and anions (calcium, chloride, fluoride, potassium, sodium, sulfate);
- Nitrates/nitrites (as nitrogen); and
- TDS.

Not all of the COCs will be analyzed for every sample or during every sampling event. Table 1 summarizes which samples will be analyzed for which parameters during each event.

6.5 Quality Assurance/Quality Control Samples

Quality assurance/quality control (QA/QC) samples will be collected to monitor the validity of the sample collection procedures. The following samples will be collected for QA/QC purposes:

- Field duplicates will be collected at a rate of 10 %, or one field duplicate for every ten groundwater samples. Field duplicates will be analyzed for the same COCs as the parent sample.
- Equipment blanks will be collected from non-dedicated sampling apparatus at a frequency of 5 %, with a minimum of one equipment blank per day. Equipment blanks will consist of laboratory-provided deionized water poured over non-dedicated sampling equipment into sample containers, after the equipment has

been decontaminated. Equipment blank samples will be analyzed for the same COCs as the sample associated with the equipment blank (sample collected immediately prior to the equipment blank). When dedicated sampling materials are used, such as dedicated tubing and a peristaltic pump, no equipment blank samples will be collected.

- Trip blanks will accompany each shipping container (cooler) that contains samples to be analyzed for VOCs.

Laboratory QA/QC samples will be performed according to the test methodologies specified for each method run on a field sample. The laboratory QA/QC samples will include reagent or method blanks, surrogates, matrix spike/matrix spike duplicates, blank spike/blank spike duplicates and/or laboratory duplicates, as appropriate for each method. The laboratory QA/QC samples will be run at the frequency specified by each method.

6.6 PSH Sample Collection

In the event that PSH is present in any of the monitoring wells that have not historically contained PSH, samples may be collected when sufficient volume (80 mL) is present for analysis. The desired analyses for evaluation of PSH include paraffins, isoparaffins, aromatics, naphthenes, and olefins (PIANO) as well as specific gravity and simulated distillation. In the event that PSH is present in locations where PSH has not previously be encountered, NRC will notify the NMED within seven calendar days, as required by the PCC Permit.

PSH samples will be collected using a hand bailer. The bailer will be lowered into the well slightly into the PSH and water column. The bailer will be slowly removed and groundwater decanted from the bottom of the bailer. The PSH remaining in the bailer will then be placed into the sample container, and the container will be sealed and properly labeled for shipment. Excess groundwater and PSH will be collected and disposed of in the Refinery wastewater treatment system, upstream of the oil/water separator.

6.7 Decontamination Procedures and Investigation Derived Wastes

6.7.1 Liquid Wastes

All reusable groundwater sampling and gauging equipment will be decontaminated prior to coming in contact with the sample media to minimize the potential for cross-contamination of samples. This equipment includes all downhole well gauging devices, submersible pumps, water quality parameter meters and flow-through cell. The equipment will be washed with a brush in a bath of soap and water, then rinsed twice with distilled water. The soap and water bath will consist of clean water and a non-phosphate detergent such as Liquinox^{TM} or Alconox^{TM} or similar.

Decontamination fluids will be contained and placed in a 55 gallon drum or similar container for later disposal in the plant wastewater treatment system, upstream of the oil/water separator.

Groundwater removed from each well during purging will be containerized in a labeled drum or similar container then disposed of within the plant wastewater treatment system, upstream of the oil/water separator.

Records of the volume of liquid wastes disposed of at the Refinery will be maintained and included in the annual report.

6.7.2 Solid Wastes

Dedicated disposable sampling equipment, including tubing and bailers, will be containerized in appropriate containers, a waste determination will be made, and the waste will be properly disposed of in accordance with applicable requirements.

All sampling personnel will wear disposable latex or nitrile gloves while collecting and handling samples. Gloves will be replaced prior to collection of each sample in order to ensure that field-induced cross-contamination does not affect the monitoring results. Gloves will be collected and disposed of along with tubing and bailers, as described above.

7. Reporting

Both the PCC Permit and the Discharge Permit require submittal of an annual report that summarizes the results of the groundwater monitoring program as well as remediation activities conducted for groundwater. NRC currently submits a combined annual report that meets the requirements of both permits. The report follows the general outline provided in Appendix E of the PCC Permit and incorporates the requirements of Sections 2.F and 2.G of the Discharge Permit.

At a minimum, the report will contain the following:

- Description of groundwater monitoring and remediation activities conducted throughout the reporting period, including sample collection procedures, decontamination procedures, sample handling procedures and management of wastes;
- Summary table of semiannual groundwater and PSH gauging data, with corrected water table elevation for all wells containing PSH;
- Summary table of groundwater quality parameters recorded in the field (purge parameters);
- Summary of laboratory analytical data with comparison to screening levels;
- Summary of QA/QC data review and validation;
- Groundwater contour maps depicting the groundwater gradient for each semiannual monitoring event of the reporting period, including site features and the direction and magnitude of the hydraulic gradient;
- PSH thickness isopleths maps for each semiannual monitoring event during the reporting period;
- Isoconcentration maps for major constituents of concern;
- Plots of static water elevation versus time in key wells, specifically those that contain PSH;

- Tabulation of the monthly and cumulative volume of PSH removed from recovery wells or monitoring wells throughout the reporting period; and

- Recommendations, including any recommended changes to the groundwater monitoring program.

The annual report will be submitted in hardcopy and electronic format to both NMED and OCD for their review.

8. Schedule

The groundwater monitoring program is conducted on a semiannual basis. The first semiannual event will occur no more than 30 days prior to the start of the irrigation season but no later than April 30 of each year. Typically, the first semiannual event occurs in March or April of each calendar year.

The second semiannual event will occur no later than 30 days after the conclusion of the irrigation season or November 15 each year. Typically, the second semiannual event occurs in September or October of each calendar year.

The wells that will be sampled on an annual basis only will be sampled during the first semiannual event of each calendar year.

Wells that are to be sampled biennially will be sampled every other year, beginning in the first semiannual event of 2011. As such, these wells will be sampled during the first semiannual event of each odd numbered year.

NRC will notify both NMED and OCD at least 15 calendar days prior to the initiation of each semiannual sampling event.

The annual groundwater monitoring report will be submitted to NMED and OCD no later than February 28 of the calendar year following sample collection.

9. References

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ARCADIS 2014b. Background Groundwater Evaluation Work Plan, July 3, 2014.

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Tables

Figures

Appendix A

Well Completion Logs

ARCADIS

Appendix B

Statistical Comparison between Dissolved and Total Concentrations of Metals

ARCADIS

Appendix C

Development of Human Health PCLs
for Total Petroleum Hydrocarbon
Mixtures (TRRP-27)