June 6, 2019

Mr. Chris M. Swartz Sent via U.S. Mail and Electronic Mail
Phillips 66 Company
1380 San Pablo Avenue
Rodeo, CA 94572
Email: Chris.Swartz@p66.com

Dear Mr. Swartz:

SITE CLEANUP PROGRAM: PHILLIPS 66 SANTA MARIA REFINERY (FORMERLY TOSCO/ UNOCAL), 2555 WILLOW ROAD, ARROYO GRANDE, SAN LUIS OBISPO COUNTY (PROJECT SITE) – REVIEW OF LIGHT NON-AQUEOUS PHASE LIQUID CONCEPTUAL SITE MODEL AND RECOMMENDED REMEDIAL ACTION REPORT, SLOPS LINE RELEASE AREA

Central Coast Regional Water Quality Control Board (Central Coast Water Board) staff has reviewed the February 25, 2019 Light Non-Aqueous Phase Liquid Conceptual Site Model and Recommended Remedial Action Report 1 (Report) for the Slops Line Release Area at the above referenced Project Site, prepared by Stantec Consulting Services (Stantec) and submitted on behalf of Phillips 66 Company for the Santa Maria Refinery (SMR).

The Report presents the results of field testing activities performed in general accordance with the Workplan for Additional Assessment/Characterization 2 (Work Plan) prepared by Stantec dated February 15, 2018. The objective of the work was to collect data to develop a light non-aqueous phase liquid (LNAPL) Conceptual Site Model (CSM), and to provide remedial recommendations associated with the Slops Line release at the Project Site.

Summary of LNAPL Conceptual Site Model

- It is unknown when the Slops Line release of hydrocarbons occurred. The release was stopped when the Slops Line was repaired in April 2016. Subsequent investigations indicated an LNAPL plume covering an area of approximately 3.7 acres. The Slops Line was last visually inspected in 2006 during excavation of the road crossing.

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1 The LNAPL CSM and RA Report is available on GeoTracker at: https://geotracker.waterboards.ca.gov/esi/uploads/geo_report/5035620570/SL203121248.PDF
2 The Work Plan and other site documents can be found on GeoTracker at: https://geotracker.waterboards.ca.gov/profile_report.asp?global_id=SL203121248
Field testing at the Slops Line Release Area included evaluating aquifer properties (slug testing) and LNAPL recoverability (baildown and skimming testing) for development of the LNAPL CSM.

Hydraulic conductivity of the first encountered water bearing zone has been estimated to range from 14.74 feet (ft)/day to 48.09 ft/day.

The LNAPL baildown testing in wells MW-40, MW-43, and RW-1 showed that the estimated LNAPL Transmissivity (Tn) ranged from 4.58 square feet per day (ft²/day) in well RW-1 to 10.59 ft²/day in well MW-40. The representative site Tn is 6.37 ft²/day, which is based on the geomean of the resulting transmissivity using three methods of analyses. The results indicate that LNAPL is recoverable at the locations tested.

The LNAPL skim testing in wells MW-43 and RW-1 showed average Tn values that ranged from 1.26 ft²/day to 4.87 ft²/day. The representative site value is 2.48 ft²/day which is lower than the baildown test geomean results of 6.37 ft²/day but still indicates that LNAPL is recoverable at the locations tested.

Skimming test data indicate stabilized LNAPL recovery rates of 6.4 gallons per day (gpd) and 26.6 gpd for wells MW-43 and RW-1, respectively. These rates indicate that the LNAPL is recoverable at the locations tested. As LNAPL is recovered these rates should reduce over time.

LNAPL is generally first encountered in the vadose zone between 50 to 55 feet below ground surface (bgs) and extends to the saturated zone between 60 to 70 feet bgs. The apparent vertical smear zone ranges from 10 to 20 feet in thickness.

Apparent in-well LNAPL thicknesses over time have ranged from 0.01 to 5.67 ft. Monitoring wells nearest the Slops Line release point exhibit the greatest thickness and thicknesses diminish concentrically away from the release point.

Downgradient well MW-42 has high dissolved-phase LNAPL constituents, but no observed LNAPL sheen or apparent measurable LNAPL thickness.

The groundwater flow direction based on data from the wells gauged as part of the Slops Line Release Area monitoring is towards the southwest and southeast. The documented hot water leak has caused a mounding of hot water resulting in localized variations from the typical southwestern groundwater flow direction. An investigation has been ongoing to determine the source of the elevated groundwater temperatures.

SPH recovery events are currently performed by manually operating skimmer pumps in wells RW-1, RW-2, MW-40, and MW-43.

The American Petroleum Institute (API) LNAPL Distribution and Recovery Model Version 2.0 (LDRM) was used to evaluate remedial strategies and included simulating the following remedial technologies: skimming, total fluids extraction (TFE), and dual-phase extraction (DPE) systems.

Two water supply wells used for potable water at the refinery and to feed the reverse osmosis system are located in the vicinity of the Slops Line release point. Bottled water is supplied to workers and visitors. Water supply well WW#2 is located 380 feet to the northwest and WW#5 is located 1,080 feet southwest of the Slops Line release point.

Two additional water supply wells (WW#4 and WW#6) are located at the Project Site. Well WW#4 is used for refinery process water and is located approximately 720 feet northeast of the Slops Line release point. Well WW#6 is used as process water for the
refinery’s carbon plant facility and is located approximately 1,600 feet southwest of the Slops Line release point.

Summary of Remedial Alternatives Analysis and Implementation

- Institutional controls, monitored natural attenuation (MNA), TFE, DPE, and automated skimmer pump LNAPL recovery were evaluated as part of the Remedial Alternatives Analysis. The selected evaluation criteria included effectiveness, implementability, and cost of each alternative.
- Based on the results from the LDRM, TFE, DPE, and automated skimmer pump LNAPL recovery were found to recover LNAPL, to the extent practicable, within the Slops Line Release Area in less than 5 years of operation.
- Based on the evaluation of the five remedial alternatives listed above, automated skimmer pump LNAPL recovery with MNA was identified as the most appropriate to address remediation of LNAPL in groundwater. MNA is a recommended remedial action objective to evaluate post-LNAPL recovery groundwater conditions including analysis of indicators or parameters to demonstrate that attenuation of the plume is occurring.
- Automated skimmer pump LNAPL recovery will employ down-well product recovery pumps in wells that consistently exhibit significant accumulation of recoverable LNAPL.
- The well locations proposed to be included in the automated skimmer pump LNAPL recovery system are within the 50% fluorescence contour from the results of the June 2017 CPT/UVOST investigation and include current wells RW-1, RW-2, MW-40, MW-43 and six proposed recovery well locations [RW-3(P) through RW-8 (P)].
- Baildown testing will be performed on newly installed recovery wells prior to connection to the system to determine the effectiveness of the well for LNAPL recovery.
- Recovered LNAPL will be conveyed to a holding tank and accumulated LNAPL will be transferred to the SMR Slops System.
- Engineering design of the remediation system and planning for the potential expansion of the LNAPL recovery network and possible installation of the additional recovery well(s) will commence upon Water Board approval.
- Periodic evaluation of LNAPL recovery system performance will be conducted to determine the effectiveness. The primary metric for evaluation of the effectiveness will be transmissivity values by performing baildown testing. On a semi-annual frequency, LNAPL thicknesses will be measured in all wells containing measurable LNAPL followed by baildown testing in accordance with procedures previously used at the Project Site.
- Remedial progress reports will be prepared and submitted to the Water Board on a semi-annual frequency.

Central Coast Water Board Comments

Based on the summary provided above and our review of the Report, the Central Coast Water Board concurs with the recommendations and provides the following comments for consideration:

- **Section 6.2 Hydraulic Gradients** – The Report indicates that currently, there is insufficient data to quantify vertical gradients at the site, as there is no groundwater level
data for on-site active production wells WW#2 and WW#5 during the same period of time as the Slops Line investigation activities.

Central Coast Water Board Comment – The February 15, 2018 Work Plan recommended a hydraulic influence evaluation using production well WW#2 and monitoring well MW-46. Additionally, the Work Plan indicated that groundwater from well WW#2 would be sampled on a monthly basis for six months and analyzed for Total Petroleum Hydrocarbons (TPH) as gasoline (TPHg), TPH as diesel (TPHd), and TPH as motor oil (TPHo) by California LUFT/FFP, full-list volatile organic compounds (VOCs) by EPA Method 8260B, and Polynuclear Aromatic Hydrocarbons (PAH) compounds by EPA Method 8270 with selected ion monitoring (SIM).

The Water Board concurs with the recommendation to perform a hydraulic influence evaluation using water supply well WW#2 and also recommends using WW#5 to evaluate the potential for hydraulic connection between the shallow groundwater and deeper groundwater aquifers. We also recommend sampling water supply wells WW#2 and WW#5 for TPHg, TPHd, TPHo, VOCs, and PAHs using the above referenced analytical methods. Please also consider performing geochemical testing of groundwater from wells screened in the shallow and deeper aquifers and evaluating the results using a Piper Diagram to determine the potential for hydraulic connection between aquifers.

- Section 6.5 Water Supply Wells and Use and Section 9.0 LNAPL CSM Conclusions – Section 6.5 indicates that well WW#2 is upgradient of the LNAPL plume and up/cross-gradient of the current groundwater flow direction and well WW#5 is cross/down-gradient of the current groundwater flow direction, which is generally to the southwest.

Section 9.0 states that a water line release has caused a mounding of hot water in the Slops Line Release Area resulting in localized variations from the typical southwestern groundwater flow direction.

Central Coast Water Board Comment – Figure 5 from the Report shows the mounding effect resulting in a variation of the typical west and southwesterly flow directions however the contours are based on the groundwater elevations only using the data from monitoring wells in the Slops Line Release Area and does not include all of the site monitoring well data. Figure 4 from the Groundwater Monitoring and Separate-Phase Hydrocarbon Recovery Report, Second Half 2018, Slops Line Release Area\(^3\) presents the groundwater contours using all of the site monitoring wells showing the mounding effect with the overall groundwater flow from the Slops Line Release Area moving to the west and southwest. Based on the groundwater contours presented on Figure 4 which includes all of the site monitoring well data, water well WW#2 is located downgradient from the northern portion of the Slops Line Release LNAPL plume and water well WW#5 is located downgradient of the southern portion of the Slops Line Release LNAPL plume.

- Section 7.2.1 In-Well LNAPL Thickness – The following is stated in this section: 1) The hydrographs also show increasing apparent LNAPL thickness over time. This suggests a transient or non-equilibrium condition within the immediate area of wells RW-2, MW-40, MW-41, and MW-43 and is consistent with vertically migrating LNAPL; 2) Wells RW-2, MW-40, and MW-41 show increasing LNAPL apparent thickness over time; and 3) Downgradient well MW-42 has high dissolved-phase LNAPL constituents, but no

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\(^3\) The Groundwater Monitoring and Separate-Phase Hydrocarbon Recovery Report can be found on GeoTracker at: https://geotracker.waterboards.ca.gov/esi/uploads/geo_report/7616171717/SL203121248.PDF
observed LNAPL sheen or apparent measurable LNAPL thickness. Accordingly, current data suggests that lateral equilibrium has occurred at the plume boundary.

Central Coast Water Board Comment – An increasing apparent LNAPL thickness over time may be consistent not only with vertically migrating LNAPL but also horizontally migrating LNAPL. Additional lines of evidence, as described in the comment below on Section 9.0, are necessary to make the distinction between mobile and migrating LNAPL (vertically and horizontally).

The LNAPL thickness in well MW-41 has been over 1 foot since Second Quarter 2018 (2Q18) and has been consistently increasing since LNAPL was measured in the well for the first time in 3Q17. Please implement monthly manual LNAPL recovery in any well with an LNAPL thickness over 1 foot that is not connected to or proposed as part automated LNAPL recovery system. Additionally, please consider whether well MW-41 should be added to the proposed automated LNAPL recovery system. If well MW-41 is added to the proposed LNAPL recovery system, it could potentially replace proposed recovery well RW-4(P).

While LNAPL has not been observed in well MW-42 it should be noted that a TPHd concentration in soil of 14,000 milligrams per kilogram (mg/Kg) was detected approximately 5 feet above the observed groundwater level during drilling. The boring log also indicates that a sheen was observed on the sampler and in groundwater. This indicates that the LNAPL plume in soil likely extends beyond this location. Additionally, TPH in soil at this concentration has the potential to produce a sheen or apparent LNAPL thickness in a monitoring well with changes in groundwater conditions or through LNAPL migration from the upgradient plume.

• Section 8.3.2 LDRM Input Parameters and Appendix III – This section indicates that soil characteristics including porosity are required for the LDRM. In Appendix III, Table 1 the soil characteristics for recovery well RW-1 were used for the LDRM input parameters and indicates the soil type surrounding the well screen is silt with a porosity of 0.475.

WATER BOARD Comment – The boring log for recovery well RW-1 indicates the soil type surrounding the screen is sand which typically has a porosity ranging from 0.23 to 0.43. While this may not significantly change the results of the LDRM, the characteristics for the appropriate soil type should be used in the modeling.

• Section 9.0 LNAPL CSM Conclusions – This section states that based on multiple lines of evidence, the LNAPL plume boundary appears to be stable. Furthermore, while some recoverable LNAPL may be present, risk management decisions should consider the non-migrating characteristics of the residual LNAPL.

Central Coast Water Board Comment – The hot water line release within the Slops Line Release Area may change the fluid properties such as viscosity and interfacial tension (as noted in Section 7.1 of the Report) and is causing groundwater mounding both which have the potential to increase LNAPL mobility and contribute to the potential migration of

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4 The boring log for monitoring well MW-42 can be found on GeoTracker at: https://geotracker.waterboards.ca.gov/esi/uploads/geo_bore/1334106683/SL203121248.PDF

5 The boring log for recovery well RW-1 can be found on GeoTracker at: https://geotracker.waterboards.ca.gov/esi/uploads/geo_bore/6413095295/SL203121248.PDF

(footnote continued on next page)
LNAPL. It is encouraging that in the First Half 2019 Groundwater Monitoring Report it is reported that the potential source of the hot water affecting the first water bearing zone has been removed and that the flow direction and gradients are expected to return to historical values.

Additional lines of evidence (i.e. LNAPL gradient and LNAPL saturations) and continued groundwater monitoring are needed to make a distinction between mobile and migrating LNAPL and to further understand whether the LNAPL plume boundary is stable.

- **Section 11.1 Automated Skimmer Pump LNAPL Recovery System** – This section includes discussion on the potential expansion of the LNAPL recovery network. Up to six recovery wells, identified as RW-3(P) through RW-8(P) are proposed to be installed. As shown on Figure 11, the recommended well locations are within the 50% fluorescence contour calculated from the results of the June 2017 CPT/UVOST investigation.

  **Central Coast Water Board Comment** – Please consider placing two additional proposed recovery wells to the north between RW-7(P) and CPT-03 and to the south between RW-5(P) and CPT-04 to provide LNAPL removal in these areas which are upgradient of water wells WW#2 and WW#5, respectively.

It is encouraging that manual LNAPL recovery has removed over 1,500 gallons from the subsurface since early 2017 and that the proposed automated LNAPL recovery system will increase the efficiency of recovering LNAPL in groundwater from the Slops Line release.

As indicated in the Report, please provide quarterly status reports on the progress and estimated completion dates for remediation equipment installation and system start-up. Once the automated LNAPL recovery system is operational please summarize ongoing remediation activities in semi-annual remedial progress reports. Failure to comply with these requirements may subject Phillips 66 Company to enforcement action by the Central Coast Water Board, including potential issuance of an order under Water Code Sections 13267 and/or 13304, and potential administrative civil liabilities.

Central Coast Water Board staff appreciates Phillip 66 Company’s efforts to remediate pollution related to the subject property and look forward to your continued cooperation.

If you have any questions or comments about this letter please contact **Amber Sellinger at (805) 549-3866** ([Amber.Sellinger@waterboards.ca.gov](mailto:Amber.Sellinger@waterboards.ca.gov)) or Sheila Soderberg at (805) 549-3592 ([Sheila.Soderberg@waterboards.ca.gov](mailto:Sheila.Soderberg@waterboards.ca.gov)).

Sincerely,

**Sheila Soderberg**

Digitally signed by Sheila Soderberg

Date: 2019.06.06 08:43:26 -07'00'

for John M. Robertson

Executive Officer

cc list on next page

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