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Memorandum

Date: July 28, 2010

To: Eugene Freed, Shell Oil Products US

From: Robert Ettinger and Mark Grivetti, Geosyntec Consultants

Subject: Summary of Site Investigations Completed through July 2010
Former Kast Property, Carson California
Site Cleanup No. 1230, Site ID. 2040330

INTRODUCTION

This technical memorandum has been prepared by Geosyntec Consultants (Geosyntec) for Equilon Enterprises, LLC, doing business as Shell Oil Products US (SOPUS), and presents a summary of the environmental investigation results that have been conducted to date to assess the distribution of petroleum hydrocarbons in soil, soil vapor, and groundwater at the former Kast Property (Site) located in Carson, California. The Site is a former oil storage facility that was sold by Shell Oil Company in the late 1960s and later redeveloped by another owner into the Carousel subdivision containing 285 single family homes. Based on historical operations, the primary Site chemicals of potential concern (COPCs) are related to crude oil and bunker oil.

The Tentative Cleanup and Abatement Order (Tentative CAO) prepared by the Los Angeles Regional Water Quality Control Board (Regional Board), includes a brief discussion of Site investigation activities and contaminant distribution in the section titled "Evidence of Contamination and Basis for Order" (Section 8, Waste Releases). An accurate and detailed summary of the results of the assessment activities to date is necessary in order provide a representative description of site conditions. We believe that this will address some of the comments made during the July 19, 2010 public meeting held by the Regional Board.

To provide a more complete summary of Site conditions than what was presented in the Tentative CAO, a site summary should include (i) more recent site investigation data[1] and

[1] The Tentative CAO only presented results from groundwater monitoring conducted through the end of 2009 and Phase II investigation data collected through January 2010.

(ii) describe the distribution of petroleum hydrocarbons detected at the Site (rather than simply report maximum concentrations).

INVESTIGATION ACTIVITIES

Several environmental investigation studies have been conducted at the site and additional investigations are in progress. Investigations completed as of July 19, 2010 include:

- Phase I Site Characterization Report dated October 15, 2009. This study included the installation of ten CPT/ROST borings, collection and analysis of 175 soil samples, collection and analysis of 147 soil vapor samples, and the installation of 6 groundwater monitoring wells. These borings, soil vapor samples and groundwater monitoring wells were located in public streets.
- Phase II Site Characterization. Data collected during the Phase II Site Characterization include indoor air monitoring for methane, soil sampling and sub-slab soil vapor monitoring at residential properties. As of July 19, 2010 methane indoor monitoring results for 147 homes were reported and soil and sub-slab soil vapor monitoring results for 83 properties were reported. The Phase II Site Characterization work is continuing at the Site.
- IRAP Further Site Characterization Report dated February 15, 2010. This study included the installation of 19 hand auger borings for the collection of soil samples and 16 soil vapor samples.
- Quarterly Groundwater Monitoring Reports. The groundwater monitoring wells located on the Site are gauged and sampled on a quarterly basis. As of July 19, 2010, three quarterly monitoring reports (4Q2009, 1Q2010, and 2Q2010) have been submitted to the Regional Board.

Additional investigations are currently in progress at the Site. These include site characterization efforts described in the plume delineation work plan, soil vapor extraction (SVE) pilot test work plan, background soils evaluation work plan, community outdoor air sampling and analysis work plan, and continued sampling as part of the Phase II Characterization work plan.

REPRESENTATIVE CONTAMINANTS OF CONCERN

Key contaminants of concern (COCs) and related issues at the site are: (i) methane in soil vapor and the potential migration of methane to structures; (ii) distribution of petroleum hydrocarbons in soil vapor and the potential migration to structures; (iii) distribution of

petroleum hydrocarbons in soil; and (iv) distribution of petroleum hydrocarbons in groundwater.

The distribution of contaminants of concern can be evaluated through the following compounds and media.

- Methane in soil vapor, sub-slab soil vapor and indoor air;
- Benzene and naphthalene in soil vapor and sub-slab soil vapor;
- Gasoline range total petroleum hydrocarbons (TPH-g), diesel range total petroleum hydrocarbons (TPH-d), motor oil range total petroleum hydrocarbons (TPH-mo), benzene, naphthalene, and benzo(a)pyrene in soil; and
- Benzene and non-aqueous phase liquid (NAPL) thickness in groundwater.

Other petroleum constituents including toluene, ethylbenzene, xylene, alkylbenzene compounds (e.g., isopropylbenzene), and other polycyclic aromatic hydrocarbons (PAHs) have been detected during these investigations, but presentation of the results for these additional compounds is not necessary to evaluate the contaminant distribution or refine the site conceptual model. Consequently, the results for these additional petroleum compounds are not included in this summary.

Other contaminants that are not related to historical operations at Site have been detected during these investigations. These additional constituents include lead, arsenic, chlorinated compounds (e.g., trichloroethene [TCE] and tetrachloroethene [PCE]) and trihalomethane compounds (e.g., chloroform and bromodichloromethane). However, based on the limited frequency of detection of these constituents above risk-based and/or background levels, the investigations do not indicate that the presence of these constituents are a result of historical operations and should not be used to evaluate the nature and extent of sub-surface impacts due to past operations by SOC.

METHANE

Assessment of the distribution of methane at the site has been conducted through the collection of soil vapor samples (i.e., samples collected more than approximately 5 ft below ground surface), sub-slab soil vapor samples (samples collected at residential properties directly beneath paved areas and/or homes), and indoor air monitoring. The range of methane concentrations measured in soil vapor and sub-slab soil vapor are shown in **Table 1**.

- Methane has been analyzed in 157 soil vapor samples collected from approximately 2.5 to 60 feet below ground surface (ft bgs) during the Phase I Site Characterization and the IRAP Further Site Characterization investigations. Samples from these investigations were collected in the public streets and most of these samples were collected at a depth of 5 ft bgs. Methane concentrations in these samples ranged from not detected to 62.6%. In some locations methane concentrations in soil vapor exceed the lower explosive limit (LEL) at depths of 5 ft or more below ground surface; however, methane in soil vapor is not a safety hazard unless it migrates to indoor air at concentrations above the LEL and reaches an ignition source. As discussed below, the data collected in the Phase II Characterization indicates that methane from these soil vapor samples collected at depth are not migrating to structures at concentrations that pose a safety risk.
- Methane was monitored in 217 sub-slab soil vapor samples from 83 residential properties[2]. Methane was detected above 2% of the LEL (1000 ppmv) in one sample location. In that location, the source of methane was determined to be a natural gas line leak, which was subsequently repaired by the homeowner, and was not due to sub-surface petroleum hydrocarbon impacts.
- Methane screening has been conducted in 151 homes between August 27, 2009 and July 23, 2010. Methane detected in indoor air was associated with leaking natural gas lines (gas lines/connections to a stove, clothes dryers, a furnace, and a fireplace). The indoor air monitoring does not indicate that methane resulting from the sub-surface petroleum hydrocarbon contamination is migrating into homes at levels that a potential safety hazard.

BENZENE AND NAPHTHALENE IN SOIL VAPOR

Concentrations of petroleum hydrocarbons including benzene and naphthalene were analyzed in soil vapor (typically 5 feet bgs and greater) and sub-slab soil vapor samples collected from the Site. The range of benzene and naphthalene concentrations measured in soil vapor and sub-slab soil vapor are shown in **Table 1**. The distribution of benzene and naphthalene in sub-slab soil vapor samples are shown in **Figures 1 and 2**, respectively.

- Volatile organic compounds (VOCs) were analyzed in 166 soil vapor samples collected from approximately 2.5 to 60 feet below ground surface (ft bgs) during

[2] These reported results are based on Interim Phase II Site Characterization Reports submitted to the Regional Board as of July 19, 2010.

the Phase I Site Characterization and the IRAP Further Site Characterization investigations. Samples from these investigations were collected in the public streets and most of these samples were collected at a depth of 5 ft bgs.

- Benzene concentrations ranged from not detected to 3,800 µg /L. Benzene was detected in approximately 87% of the samples and detected concentrations were above the California Human Health Screening Level (CHHSL) of 0.036 µg/L in approximately 65% of the samples.
- Naphthalene concentrations ranged from not detected to 5.2 µg /L. Naphthalene was detected in approximately 13% of the samples and detected concentrations were above the CHHSL of 0.032 µg /L in approximately 10% of the samples.
- Note that the California EPA (Cal-EPA) has stated that "the presence of a chemical at concentrations in excess of a CHHSL does not indicate that adverse impacts to human health are occurring or will occur, but suggest that further evaluation of potential human health concerns is warranted" (Cal-EPA, 2005). Additionally, CHHSLs are not intended to "set final cleanup or action levels to be applied at contaminated site" (Cal-EPA, 2005).

- As of July 19, 2010, sub-slab soil vapor samples were reported for 217 samples collected from 83 residential properties.
  - Benzene concentrations ranged from not detected to 6.5 µg /L. Benzene was detected in approximately 28% of the samples. The risk-based screening level for benzene in sub-slab soil vapor samples is 0.0084 µg /L (URS, 2009; Geosyntec, 2009). Detected benzene concentrations were above the risk-based screening level in approximately 10% of the samples.
  - Naphthalene concentrations ranged from not detected to 0.18 µg /L. Naphthalene was detected in approximately 27% of the samples. The risk-based screening level for naphthalene in sub-slab soil vapor samples is 0.0072 µg /L (Geosyntec, 2009). Detected naphthalene concentrations were above the risk-based screening level in approximately 27% of the samples.
  - Figures 1 and 2 show the locations of sub-slab soil vapor samples exceeding the CHHSLs for benzene and naphthalene[3]. As noted above,

[3] Figures 1 and 2 show the analytical results have been received and validated by SOPUS as of July 19, 2010. This entire dataset has not yet been reported to the Regional Board, but will be included in Interim Phase II Site Characterization Reports currently in preparation.

concentrations above risk-based levels do not indicate adverse impacts to human health are occurring, but suggest that additional evaluation is warranted.

- Based on comparison of the Phase I Characterization and Phase II Characterization results, the concentrations of benzene detected in soil vapor from samples located beneath the public streets at depth (typically 5 ft bgs) are not representative of sub-slab soil vapor concentrations near the residential structures. The attenuation of benzene in the vadose zone is likely due to the natural biodegradation of this constituent under aerobic conditions seen in the shallow vadose zone.

PETROLEUM HYDROCARBONS IN SOIL

Concentrations of petroleum hydrocarbons including TPH-g, TPH-d, TPH-mo, benzene, naphthalene, and PAHs were analyzed in soil samples collected from public areas and residential properties. The ranges of measured concentrations for these constituents measured in soil are shown in **Table 1**. The distributions of measured concentrations for these constituents in soil are shown in **Figures 3 through 8**.

- A total of 228 soil samples were collected during the Phase I Site Characterization (175 samples) and IRAP Further Site Characterization (53 samples) investigations.
    - TPH-g concentrations ranged from not-detected to 9,800 mg/kg. TPH-g was detected in approximately 51% of the samples. Detected TPH-g concentrations exceed the Regional Board screening level for protection of groundwater (500 mg/kg; LARWQCB, 1996) in approximately 28% of the samples.
    - TPH-d concentrations ranged from not-detected to 22,000 mg/kg. Detected TPH-d was detected in approximately 44% of the samples. TPH-d concentrations exceed the Regional Board screening level for protection of groundwater (1000 mg/kg; LARWQCB, 1996) in approximately 14% of the samples.
    - TPH-mo concentrations ranged from not-detected to 21,000 mg/kg. TPH-mo was detected in approximately 48% of the samples. Detected TPH-mo concentrations exceed the Regional Board screening level for protection of groundwater (10,000 mg/kg, LARWQCB, 1996) in approximately 7% of the samples.

  - Benzene concentrations ranged from not-detected to 34 mg/kg. Benzene was detected in approximately 29% of the samples. The risk-based screening level for benzene in soil samples is 0.22 mg/kg (Geosyntec, 2009). Detected benzene concentrations exceed the risk-based screening level in approximately 21% of the samples.
  - Naphthalene concentrations ranged from not-detected to 47 mg/kg. Naphthalene was detected in approximately 30% of the samples. The risk-based screening level for naphthalene in soil samples is 4.1 mg/kg (Geosyntec, 2009). Detected naphthalene concentrations exceed the risk-based screening level in approximately 21% of the samples.
  - Benzo(a)pyrene was not detected in samples collected during these investigations. The analytical reporting limits for these samples were typically in the range of 0.5 to 5 mg/kg.
  - As noted above, concentrations above risk-based levels do not indicate adverse impacts to human health are occurring, but suggest that additional evaluation is warranted.

- Over 1000 soil samples were collected from 83 properties during the Phase II Site Characterization and reported to the Regional Board as of July 30, 2010. Additional data are being collected as part of the Phase II Site Characterization and the results presented below may be revised as additional data are reported.
  - TPH-g concentrations ranged from not-detected to 5,500 mg/kg. TPH-g was detected in approximately 44% of the samples. Detected TPH-g concentrations exceed the Regional Board screening level for protection of groundwater (500 mg/kg; LARWQCB, 1996) in approximately 5% of the samples.
  - TPH-d concentrations ranged from not-detected to 33,000 mg/kg. TPH-d was detected in approximately 72% of the samples. TPH-d concentrations exceed the Regional Board screening level for protection of groundwater (1000 mg/kg; LARWQCB, 1996) in approximately 17% of the samples.
  - TPH-mo concentrations ranged from not-detected to 41,000 mg/kg. TPH-mo was detected in approximately 75% of the samples. Detected TPH-mo concentrations exceed the Regional Board screening level for protection of groundwater (10,000 mg/kg, LARWQCB, 1996)) in approximately 4% of the samples.
  - Benzene concentrations ranged from not-detected to 14 mg/kg. Benzene was detected in approximately 55% of the samples. Detected benzene concentrations exceed the risk-based screening level of 0.22 mg/kg in approximately 3% of the samples.

  - Naphthalene concentrations ranged from not-detected to 61 mg/kg. Naphthalene was detected in approximately 44% of the samples. Detected naphthalene concentrations exceed the risk-based screening level of 4.1 mg/kg in approximately 5% of the samples.
  - Benzo(a)pyrene concentrations ranged from not-detected to 3.6 mg/kg. Benzo(a)pyrene was detected in approximately 67% of the samples. Detected benzo(a)pyrene concentrations exceed the typical background of 0.9 mg/kg (DTSC, 2009) in less than 1% of the samples.

- **Figures 3 through 8**[4] show the spatial distribution for the petroleum hydrocarbons in soil based on samples collected during these investigations. These figures show that concentrations are generally higher within the footprints of the former reservoirs and concentrations in the shallower depth interval (i.e., 0-2 ft bgs) are lower than those in deeper intervals depicted (2-5 ft bgs and 5-10 ft bgs).

PETROLEUM HYDROCARBONS IN GROUNDWATER

Six groundwater monitoring wells have been installed on-site to evaluate the migration of petroleum hydrocarbons to groundwater. These groundwater wells are monitored on a quarterly basis.

- Depth to groundwater is approximately 53 – 65 ft bgs.
- Groundwater flow direction of the first encountered groundwater zone is to the northeast.
- NAPL has been observed in one monitoring well (MW-03). Thickness of the separate phase hydrocarbon in this well has ranged from 0.14 to 9.0 ft.
- Benzene concentrations ranged from not detected to 140 µg /L. The median concentration of benzene detected in groundwater is 6.5 µg /L.

OTHER CONSTITUENTS IN SOIL VAPOR, SOIL, AND GROUNDWATER

In addition to the petroleum hydrocarbons discussed above, other compounds that are not related to the petroleum operations have been detected in soil vapor, soil, and

[4] Figure 8 shows the results for benzo(a)pyrene-equivalents [B(a)P-equivalents]. The measured concentrations for carcinogenic PAHs (except for naphthalene) were converted to B(a)P-equivalents using the Cal-EPA potency equivalency factors.

groundwater. These constituents include chlorinated compounds and trihalomethanes detected in soil vapor and sub-slab soil vapor, inorganic constituents detected in soil, and chlorinated compounds detected in groundwater.

Chlorinated solvents have been detected in soil vapor and sub-slab soil vapor samples collected at the Site. The chlorinated compounds have been detected above screening levels in sub-slab soil vapor samples; however, these constituents are not associated with the historical operations of SOC at the Kast Site and are believed to be due to other sources.

Trihalomethane compounds (chloroform and bromodichloromethane) have been detected in sub-slab soil vapor samples collected at the site. These compounds have been detected at some locations above risk-based screening levels; however, these constituents are not associated with the historical operations of SOC at the Kast Site and are believed to be due to the residential water supply (trihalomethane compounds are a by-product of the chlorination process used to disinfect the drinking water supply).

Inorganic constituents including arsenic and lead have been analyzed in soil samples collected from the site. The concentrations and distribution of these constituents detected during the site investigations indicate that they are not associated with the historical Site operations of SOC at the Kast Site.

- Arsenic and lead were detected in soil samples collected during Phase I Site Characterization and IRAP Further Site Characterization investigations. The maximum concentration reported for arsenic was 53.2 mg/kg; however only 12 of the 228 samples (5.3%) had concentrations greater than the typical background concentration of 12 mg/kg. The maximum concentration reported for lead was 52.5 mg/kg which is below the CHHSL for lead for residential scenarios of 80 mg/kg.
- Arsenic and lead were detected in soil samples collected during the Phase II Characterization. The maximum concentration reported for arsenic was 35.4 mg/kg; however only 35 of the 1015 samples (3.4%) had concentrations greater than the typical background concentration of 12 mg/kg. The maximum concentration reported for lead was 307 mg/kg, however only 4 of the 1015 samples (0.4%) had concentrations greater than the CHHSL for lead for residential scenarios (80 mg/kg).

PCE and TCE have also been detected in groundwater at maximum concentrations of 100 µg/L and 300 µg/L, respectively. However, based on site soil and soil vapor data, these impacts appear to be from an off-Site source at either the former Turco Products facility or the former OTC Trucking facility, which was located at the current location of the Monterey Pines community.

SUMMARY

The data collected during the Phase I Site Characterization, IRAP Further Site Characterization, Phase II Site Characterization, and groundwater monitoring efforts have been reviewed to evaluate the nature and extent of petroleum hydrocarbon impacts at the Site. Findings of this data review may be summarized as follows:

- Methane detected in soil vapor samples collected from within the public streets and at depth (i.e., typically at 5 ft bgs and deeper) is not migrating to structures at levels that pose a safety risk. Additional monitoring for the potential for methane to migrate to structures is in progress.
- The maximum benzene concentration detected in soil vapor samples collected within the public streets and at depth (i.e., typically at 5 ft bgs and deeper) is not representative of soil vapor conditions near the structures. Benzene concentrations measured in sub-slab soil vapor samples collected near the structures are significantly lower than those reported in the Phase I Site Characterization. Based on the presence of oxygen measured in soil vapor samples near the structures, it appears that natural biodegradation in the shallow vadose zone limits the vapor migration of benzene.
- The vertical distribution of petroleum hydrocarbons in soil indicates that concentrations in the uppermost zone (i.e., 0-2 ft bgs) are lower than concentrations measured at greater depths. The lateral distribution of petroleum hydrocarbons in soil indicates that concentrations tend to be higher within the footprints of former reservoirs and lower outside the reservoirs. However, there are areas within the former reservoirs where low concentrations of petroleum hydrocarbons were observed.

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