Fenceline Air Monitoring Plan

For BAAQMD Rule 12-15

Chevron Richmond Refinery

November 11, 2020

Table of Contents

List of Figures

List of Tables

List of Acronyms

BAAQMD – Bay Area Air Quality Management District

BTEX – Benzene, Toluene, Ethylbenzene, Xylenes

CFR – Code of Federal Regulations

CWS – Contra Costa County Community Warning System

DMS – Data Management System

EPA – Environmental Protection Agency

FTIR – Fourier Transform Infrared

GC-PID – Gas chromatograph followed by photoionization detector

GLM – Ground Level Monitor required by Rules 9-1 and 9-2

H_2S – Hydrogen Sulfide

LFL/LEL – Lower Flammability Limit/Lower Explosive Limit

OEHHA – Office of Environmental Health Hazard Assessment

ppb – Parts Per Billion

ppm – Parts Per Million

QA/QC – Quality Assurance / Quality Control

RCAMP – Richmond Community Air Monitoring Program

REL – Reference Exposure Level from http://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary

SO_2 – Sulfur Dioxide

TDL – Tunable Diode Laser

TRI – Toxic Release Inventory

UV-DOAS – Ultraviolet Differential Optical Absorption Spectroscopy

Section 1. Overview

On April 20, 2016, the Bay Area Air Quality Management District (BAAQMD) published guidelines containing criteria for an approvable Air Monitoring Plan, required by BAAQMD Rule 12-15 Section 403. The Chevron Richmond Refinery (Chevron) has followed these guidelines to generate this Air Monitoring Plan for submission to BAAQMD. As presented in "Air Monitoring Guidelines for Petroleum Refineries, AIR DISTRICT REGULATION 12, RULE 15: PETROLEUM REFINING EMISSIONS TRACKING," the key elements of the BAAQMD guidelines (Guidelines) are as follows (Bay Area Air Quality Management District, 2016):

Element #1 – Gases Requiring Monitoring

Refinery operators must measure benzene, toluene, ethylbenzene, and xylenes (BTEX) and hydrogen sulfide (H_2S) concentrations at refinery fencelines with technology capable of measuring in the parts per billion (ppb) range.

Element #2 – Other Gases to Be Considered for Measurements

Measurement of sulfur dioxide (SO_2), alkanes or other organic compound indicators, 1,3-butadiene, and ammonia concentrations are to be considered in the Air Monitoring Plan. Refinery operators must provide a rationale in the Air Monitoring Plan for not measuring all the above compounds. The rationale must address the following questions:

- Why these compounds are not contained in the compositional matrix of emissions
- Why these compounds are not at expected concentrations measured by available equipment
    - Address the technical or other considerations that make specific measurements inappropriate or unavailable.

Element #3 – Fenceline Coverage

For refineries that do not have open-path monitoring capability in place, measurements must cover populated areas within 1 mile of the refinery fenceline likely to be affected when the annual mean wind direction lies in an arc within 22.5 degrees of a direct line from source to receptors 10% of the time, or greater, based on the most representative meteorological measurements for sources likely to emit the compounds listed above at the refinery. In addition, the monitoring plan should take into consideration seasonal and short-term meteorological events. Refineries that already have open-path monitoring capabilities in place need only provide verification those current systems adequately address population requirements.

Element #4 – Sample Time Resolution and Data Completeness

Open-path fenceline measurements must be continuously measured with a time resolution of five minutes. If this is not the case, refinery operators must provide rationale in the Air Monitoring Plan for lesser time resolutions based on equipment or other operational limitations. Instrumentation must meet a minimum of 75% completeness on an hourly basis and 75% of the time based on annual quarters. Atmospheric conditions beyond the control of the refinery that affect accurate measurements, such as dense fog, shall not be counted against data completeness calculations.

Element #5 – Data Presentation to the Public

Measurements must be provided to the public on a real-time basis, with appropriate Quality Assurance/Quality Control (QA/QC) measures taken to provide assurance of data accuracy.

Element #6 – Develop a Quality Assurance Project Plan

A Quality Assurance Project Plan (QAPP) that follows EPA guidelines must be developed that outlines the QA/QC parameters.

Chevron's policy is to comply with all local and federal environmental regulations including the fenceline monitoring provisions of BAAQMD Rule 12-15. In accordance with Rule 12-15-403, Chevron's goal is to provide the BAAQMD with an approvable Air Monitoring Plan (Plan) and QAPP and then operate and install systems in accordance with the plans.

Section 2. Chevron's Existing Fenceline and Community Monitoring

As of the establishment of Rule 12-15, the Richmond Refinery was operating three open-path fenceline monitors and three community monitors as part of the Richmond Community Air Monitoring Program (RCAMP). The fenceline monitors have been in operation since 2013. The community monitors have been in operation since 2014. Siting of the fenceline and community monitors and the compounds to be monitored were subject to City of Richmond approval. Site locations for the fenceline equipment were selected to strategically position the fenceline monitors using the predominant and variable meteorological conditions and topographical terrain features within and near the refinery.

The fenceline and community monitoring sites were selected with the following considerations, consistent with guidance from EPA and CARB. Environmental requirements were considered in the monitors' placement with respect to on-site and off-site sources. The existing fenceline monitors do not have any large-scale sources between the monitor and the fenceline. The monitors were placed with consideration toward proximity to off-site emissions sources. Sampling requirements were considered. Chevron aimed to make the horizontal distance from a point sampler to an obstacle, such as a building, at least twice the vertical distance that the obstacle protrudes above the sampler. Chevron aimed to make the horizontal distance from 90% of the open-path to obstacles at least twice the vertical distance that the obstacles protrude above the path. For open-path monitors, a direct line of sight between light source and receiver must be available for the monitors to function. Logistical requirements were considered such as proximity to power, capability to access the internet for real-time data reporting and on-line troubleshooting, and adequate security.

Chevron also met on multiple occasions with Shields-Reid, Point Richmond, and Atchison Village Neighborhood Councils, who provided input on the locations of the air monitors between September 2011 and November 2012. These are all the neighborhoods that border the refinery. The compounds to be monitored were selected with input from the City of Richmond, Chevron consultants, and community representatives. The compounds monitored by the fenceline system are considered to be common for refinery operations. The specific chemicals that require monitoring were evaluated for each source from emissions estimates based on available TRI (Toxic Release Report) information. The compounds monitored by the community monitors represent a larger spectrum of compounds that can be attributed to many sources present in the Richmond community. The final siting locations and compounds to be

monitored were approved by the City of Richmond in 2013. The fenceline and community monitoring data are made available to the public online at https://www.richmondairmonitoring.org/index.html. The following sections provide a summary of Chevron's Air Monitoring Plan in accordance with Rule 12-15 Section 403.

Section 3. Evaluation

Element #1 – Gases Requiring Measurements

In 2013, Chevron installed and began operating open-path air monitoring systems in cooperation with the City of Richmond. Chevron compared the BAAQMD Air Monitoring Guidelines with Chevron's existing monitoring system, which quantifies benzene, carbon disulfide, H_2S, ozone, SO_2, toluene, and xylene. Chevron has added capability to our Open-path Ultraviolet Differential Optical Absorption Spectroscopy (UV-DOAS) system to measure ethylbenzene. Benzene, toluene, and xylene will continue to be detected and quantified by UV-DOAS. H_2S will continue to be detected and quantified using an open-path Tunable Diode Laser (TDL) air monitoring system and the Castro Street ground level point monitor, which is used to demonstrate compliance with BAAQMD Rule 9-2-301. Relevant equipment specifications are provided in Section 4 of this Plan.

Element #2 – Other Gases to Be Considered for Open-Path Measurements

Chevron considered the measurement of sulfur dioxide (SO_2), alkanes or other organic compound indicators, 1,3-butadiene, and ammonia for inclusion in the Air Monitoring Plan. Chevron continues to perform fenceline monitoring for SO_2 and has added fenceline monitoring of alkanes. Chevron does not plan to add fenceline monitors for 1,3-butadiene and ammonia.

SO_2

SO_2 will continue to be monitored by the existing UV-DOAS monitoring system and the Castro Street ground level monitor.

Alkanes or other organic compound indicators

Chevron has added monitoring for alkanes at the BAAQMD's suggestion for measuring refinery fugitive leak emissions from process units that do not emit BTEX compounds detectable on the UV-DOAS monitors. Chevron does not expect refinery alkane emissions to be regularly detected and rare detections will contain some ambient alkanes (Stephens and Burleson, 1969).The installed analyzers will provide indication of emissions from process units which do not emit BTEX compounds, namely the Alkylation Unit, Liquid Petroleum Gas spheres and loading racks, and hydrogen plant.

The alkanes being monitored include methane, ethane, propane, butane, and pentane. Methane and alkane (C2 through C5) concentrations would be reported on the website. C6 and greater would not be measured, because process streams such as gasoline, naphtha and crude containing C6 and greater also contain BTEX compounds, which are measured on the UV-DOAS monitors. Chevron has installed open-path Fourier Transform Infrared (FTIR) monitors for monitoring alkanes to accommodate the public's preference for open-path monitors. Chevron appreciates that open-path monitors span long distances around a refinery and are more likely than point monitors to capture a possible plume that may cross the

fenceline. Chevron received a manufacturer's guarantee based on results of a study conducted in Atlanta, Georgia in December 2017 that an open-path FTIR with 500 meters path length will measure alkanes C2 through C4 at 200 ppb concentration with 75% accuracy at 2 vol% water vapor in ambient air. In the Atlanta study, at 800 meters path length and 1.1 vol% water in ambient air, water vapor did not cause interference in alkane measurements. Interpolation of data justifies the manufacturer's guarantee.

The FTIR monitoring technology has the ability to detect ambient methane at greater than 1.7 ppm (Fairley and Fischer, 2015) and part per billion detection limits for C2 through C5 alkanes. The FTIRs will also be designed to operate at least 75% of time based on annual quarters consistent with the Guidelines. Relevant equipment specifications are provided in Section 4 of this plan.

Existing measures for monitoring alkane and organic compound leaks

The systems would not serve as a first alert to Chevron of an alkane leak because Chevron has numerous systems in place for detecting an alkane leak. On most days, seven contracted individuals are monitoring background hydrocarbon concentrations and components in the refinery using Method 21. Method 21 is described in 40 Code of Federal Regulations Subpart 60 Appendix A-7. In accordance with Rule 8-18, Chevron repairs any source of a leak causing background concentration higher than 50 ppmv. Chevron Method 21 monitors light liquid pumps monthly, valves and pressure relief devices quarterly, and connectors annually. Leaks are typically repaired within 24 hours of discovery. Tank floating roof seals are inspected on a quarterly, semiannual or annual basis per the requirements of BAAQMD Regulation 8, Rule 5. The liquid petroleum gas sphere area has five lower flammability limit (LFL) analyzers that alarm operators inside and outside the console when 5% of the LFL is detected. Chevron employees also wear personal LFL monitors while inside the process units that alarm at 5% of the LFL. All contractors entering Chevron process units are required to wear personal LFL monitors that alarm at 5% of the LFL.

1,3-Butadiene

1,3-Butadiene is not produced as an intermediate or end product and is only present in trace quantities at the refinery. Chevron reports about 100 lb. per year of 1,3 butadiene emissions to the Environmental Protection Agency (EPA) in its annual Toxic Release Inventory Report. Chevron does not expect 1,3-butadiene to be present in measurable concentrations at the fenceline.

Ammonia

Chevron proposes to exclude ammonia from fenceline monitoring because it is not emitted in measurable amounts at the fenceline as anhydrous ammonia, which is BAAQMD's primary toxicity concern. Sources of ammonia leaks are not as prevalent as alkanes. Ammonia is produced at Refinery plants 8 and 18; however, it is otherwise isolated to three anhydrous ammonia vessels for storage/loading or use in small streams in process units, primarily for pollution control devices. Anhydrous ammonia is sold as a by-product. Anhydrous ammonia loading points are tightly sealed and closely monitored by operators as explained below. Chevron's aqueous ammonia emission rates are already monitored through direct measurement in source tests submitted to BAAQMD. Aqueous ammonia reduces nitrogen oxide emissions from furnace stacks and filterable particulate emissions from the fluidized catalytic cracking unit (FCCU). Ammonia slip emissions from the FCCU have dramatically decreased following Regulation 6-5 compliance implementation.

Additionally, Chevron already has numerous systems in place, developed in cooperation with the City of Richmond, for preventing, detecting, and mitigating an anhydrous ammonia leak. The bulk of the refinery's anhydrous ammonia is kept in storage vessels near the ammonia loading rack and rail cars. Anhydrous ammonia is produced at 8 and 18 plants and consumed at the cogeneration units, FCC, hydrogen plant, and Richmond Lube Oil Project (RLOP). The ammonia storage vessels are elevated above normal vehicle height and surrounded by steel barricades to prevent a motor vehicle from puncturing a vessel. Chevron also documented in its Risk Management Plan that the ammonia storage vessels will not be filled more than 45 percent. Redundant high-level alarms sound at 41 percent and emergency alarms sound at 43 percent to ensure operators do not fill the ammonia storage vessels past 45 percent. Ammonia pumps are protected from cavitation by ensuring the ammonia storage vessels are at least 10 percent filled. Redundant low-level alarms sound at 15 percent and emergency low level alarms sound at 10 percent. As shown in Appendix A, anhydrous ammonia storage is located away from the refinery perimeter to minimize the effect on the public in the event of a release.

The ammonia storage area is equipped with excess flow valves and emergency block valves (EBV) to prevent or limit the severity of a release. EBVs are installed at the train loading racks' liquid and vapor lines, suction lines on the ammonia storage vessels, and on the common header. EBVs close with emergency shutdown switches, hand activation, and fusible plugs. When an EBV closes, the associated pumps are interlocked to shut down as well. Operators routinely test the EBVs.

In the event of a fire, each storage vessel is equipped with a firewater deluge system to scrub vapor from the atmosphere and cool the vessel. The fusible plugs on the EBVs cause the EBVs to close in the event of a fire. The ammonia storage area is encircled by a firewater-monitor fog system. One large water fog spray can be remotely operated. In the case of a leak, operators wearing air-supplying respirators, immediately begin mitigation by isolating the line where the leak is located, applying water spray, and/or shutting down the process unit.

Any significant release of ammonia would be detected by the refinery, and if off-site impacts are possible, this would be communicated by Chevron to the community via the Contra Costa County Community Warning System (CWS). Numerous ammonia sensors located throughout the refinery would alert operators if a leak would occur. If more than 100 lb. of ammonia are released in a 24-hour period, Chevron would immediately notify the Contra Costa County Health Services (CHS) Department on-call pager via the CWS as Level 1 and would call the Bay Area Air Quality Management District, the National Response Center, and the California Governor's Office of Emergency Services (COES). In the case of possible off-site health impacts, CHS would alert the community with sirens.

Lastly, Chevron voluntarily measures ammonia on three community monitors. The monitors collect five-minute average concentration data similar to fenceline monitors and post the five-minute average concentrations to a website. Since measurement began in 2014, ammonia concentration data through December 31, 2016, has been consistently well below the California health standards at all three community locations. **Figure 3.1** compares the community monitor data with health standards. Figure 3.1 shows that the maximum one-hour average concentration was less than four percent of the acute health standard. To determine the maximum one-hour average concentrations for comparison with the acute health standard, 60-minute averages were calculated for every five minutes of data from the community monitor's start of operation in 2014 through December 31, 2016. During periods that a chemical was not detected, one ppb was substituted for calculating the average concentration. The average concentration

measured at each community monitoring station was less than two percent of the chronic health standard. OEHHA publishes reference exposure levels (REL), which are health standards at https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary. Lastly, as described in Section 2, compounds expected to be commonly emitted by refinery operations were required to be monitored at the existing fenceline monitors, of which ammonia was not selected.

Figure 3.1 – Comparison of Richmond Community Monitors One Hour Average Concentrations with Acute (One-Hour Average) OEHHA Health Standard

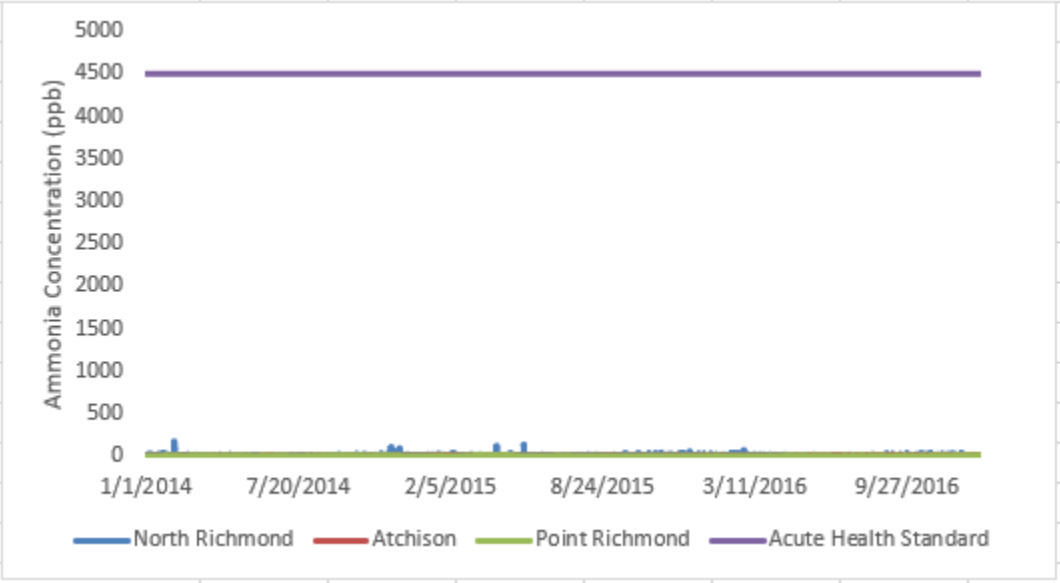


Table 3.1 summarizes the gases to be included in the Rule 12-15 fenceline air monitoring program and the equipment to be used to detect them.

Table 3.1 – Gases Included in the Fenceline Air Monitoring Plan

Gas	Equipment
Alkanes (C2 through C5)	Five open-path FTIRs
Benzene	Three open-path UV-DOAS North Richmond community monitor Sorbent tubes at sample stations 6 and 7*
Ethylbenzene	Three open-path UV-DOAS North Richmond community monitor
Hydrogen Sulfide	Five open-path TDLs Castro Street ground level monitor
Methane	Five Open-path FTIRs
SO_2	Three open-path UV-DOAS Castro Street ground level monitor
Toluene	Three open-path UV-DOAS North Richmond community monitor
Xylene	Three open-path UV-DOAS North Richmond community monitor

*Sampled and analyzed in accordance with 40 CFR 63.658

Element #3 – Fenceline Coverage

This section describes the process used to determine where fenceline air monitoring equipment would be installed and/or made part of the Rule 12-15 fenceline monitoring compliance program. In accordance with the Guidelines, wind rose analyses were completed to determine the monitor locations needed to cover populated areas within 1 mile of the refinery fenceline likely to be affected when the annual mean wind direction lies in an arc within 22.5 degrees of a direct line from source to receptors 10% of the time or greater, given site topography.

Meteorological data collected from January 1, 2012, through December 31, 2016, from the Gertrude Meteorological Station, associated with the Rules 9-1 and 9-2 ground level monitors, were used to generate the wind roses in **Figures 3.2 and 3.3** and summary in **Table 3.2**. Figure 3.2 compares the 2016 wind rose with the five-year wind rose to show a consistent wind pattern with wind primarily blowing from the south. Wind occurred greater than 10% of the time from 0 degrees north and from 135 degrees to 225 degrees. Thus, the Guidelines suggest monitoring for Rule 12-15 in the arc from 292.5 degrees to 67.5 degrees and in the arc from 157.5 degrees to 202.5 degrees if there are receptors downwind of sources within 1 mile of the refinery fenceline, depending upon site topography.

Figure 3.2 – Wind Rose (1/1/12 – 12/31/16) Consistent Wind Pattern Primarily from South

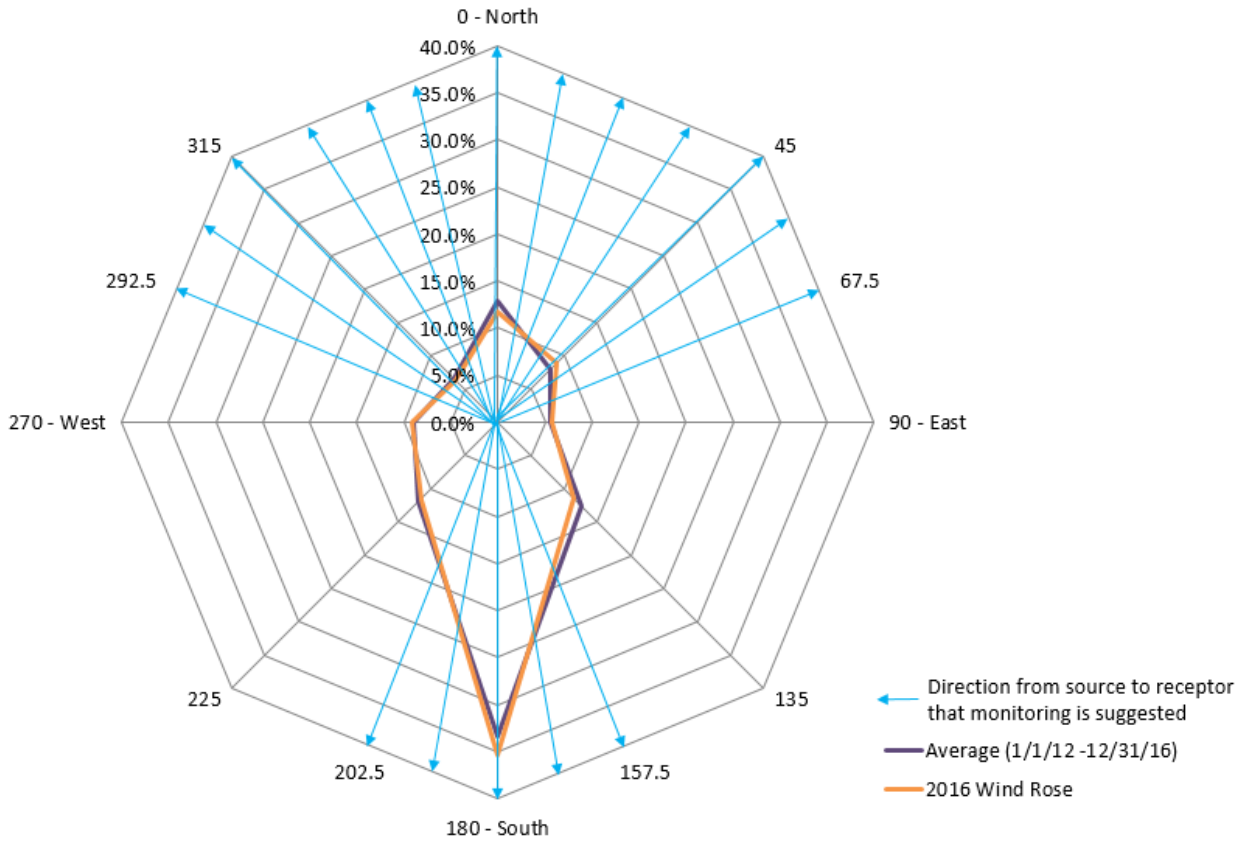
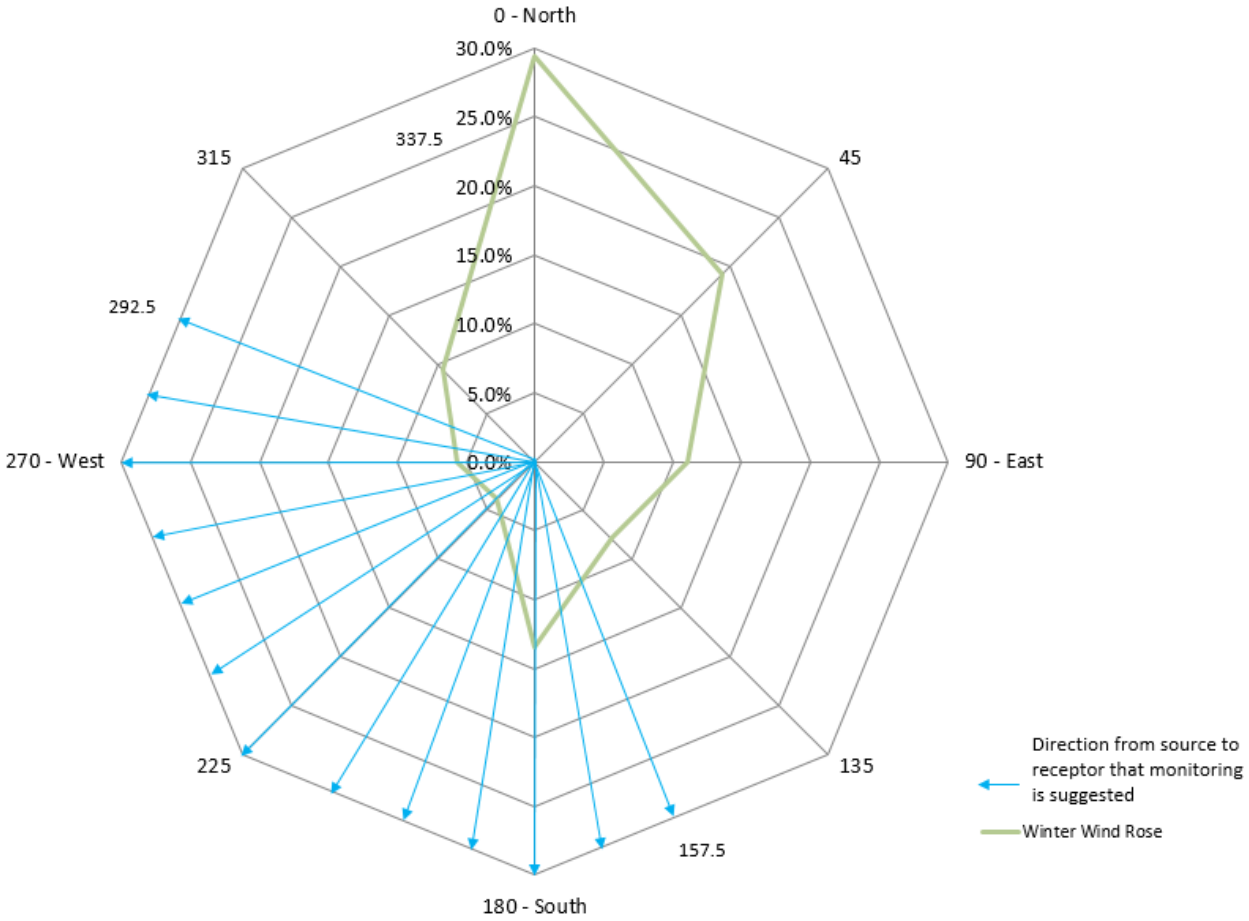


Figure 3.3 contains a wind rose of winter winds from November 1 through February 15 in the years 2012 through 2016. This figure shows winds blowing primarily from the north and north east during winter months. The wind direction is from 0 degrees north through 90 degrees east more than 10% of the time during winter months. Per the Guidelines, fenceline monitoring coverage should be considered in the arc between 157.5 and 292.5 degrees if there are receptors downwind from sources within one mile of a receptor, depending upon site topography.

Figure 3.3 – Winter Wind Rose (2012-2016): Wind Primarily from North/Northeast



Based on the wind rose analyses, the Guidelines suggest some additional fenceline monitor coverage beyond the pre-existing RCAMP fenceline monitors. As described in Section 2, the existing fenceline monitor open-path locations were already agreed upon with the City of Richmond and developed in cooperation with local neighborhood councils. In adhering to this agreement, Chevron aims to either keep the monitors in the same locations or expand the path to capture more sources. **Table 3.2** shows the percentage of time that wind blew from each wind rose sector. Sectors where wind blows in that quadrant greater than 10% of the time are highlighted in blue. Table 3.2 lists the additional monitors that will have data posted to the public RCAMP website for Rule 12-15 compliance.

Table 3.2 – Additional Monitors Based on Wind Rose Analyses

Direction From	Range (Degrees)	Percent	Coverage on Existing Public Website	Proposed Additional Coverage for Rule 12-15
North	337.5-22.5	12.61%	Partial coverage by Point Richmond open-path UV-DOAS and TDL	• Extending Point Richmond UV-DOAS and TDL path lengths to ~910 meters • Adding open-path FTIR monitor
Northeast	22.5-67.5	7.68%	Southwest refinery perimeter is not populated	
East	67.5-112.5	5.49%	West refinery perimeter is not populated	
Southeast	112.5-157.5	12.68%	Northwest refinery perimeter is not populated	
South	157.5-202.5	33.74%	North refinery perimeter is not populated	
Southwest	202.5-247.5	12.18%	• Atchison Village and North Richmond open-path UV-DOAS and TDL • North Richmond community monitor	• Adding open-path FTIR monitors • Including benzene sorbent tube sample stations 6 and 7 • Including Castro Street ground level monitor
West	247.5-292.5	9.04%	• Atchison Village and North Richmond open-path UV-DOAS and TDLs • North Richmond community monitor	• Including benzene sorbent tube sample stations 6 and 7 • Including Castro Street ground level monitor
Northwest	292.5-337.5	6.59%	Atchison Village and Point Richmond UV-DOAS and TDL open-path monitors	Adding open-path FTIR monitors

Based on the 2012 through 2016 wind rose analysis, the proposed monitors cover populated areas within 1 mile of the refinery fenceline likely to be affected when the annual mean wind direction lies in an arc within 22.5 degrees of a direct line from source to receptors 10% of the time or greater, given site topography. Refinery emission sources, and existing and proposed air monitoring equipment, including the option of point or open-path FTIRs, are shown on a map of the refinery in Appendix A. The open-path monitors are located south, east, and northeast of refinery processes in between the processes and populated areas. The North Richmond UV-DOAS and TDL open-path monitors are located northeast of the refinery. The Atchison Village UV-DOAS and TDL open-path monitors are located east of the refinery. The Point Richmond UV-DOAS and TDL open-path monitors are located south/southeast of the refinery. The map shows that the refinery is surrounded on the north, west, and southwest parts of the refinery by large water bodies, which are not populated.

Chevron has installed open-path FTIR analyzer and retroreflector pairs along the Point Richmond and Atchison UV-DOAS and TDL paths. The path lengths for the UV-DOAS, TDL, and FTIR paths are provided in **Table 3.3**.

Table 3.3 – Fenceline Open-Path Lengths

Fenceline	Path Designation	Open-Path Equipment	Approximate Path Length (meters)	
North Richmond	D	UV-DOAS, TDL	692	
Atchison	E	UV-DOAS, TDL	790	
Atchison (North)	E1	FTIR	420	
Atchison (South)	E2	FTIR	380	
Point Richmond	F	UV-DOAS, TDL	897	
Point Richmond (East)	F1	FTIR	510	
Point Richmond (West)	F2	FTIR	405	

Chevron has included measurements from benzene sample stations 6 and 7, the Castro Street ground level monitors, and the North Richmond community monitor BTEX measurements in the Rule 12-15 program. **Figure 3.4** provides a visual summary of the proposed monitoring locations that will be part of Rule 12-15 compliance.

Figure 3.4 – Locations of Rule 12-15 Monitors

The City of Richmond was interested in capturing emissions from as many refinery sources as possible, including elevated sources, such as flares and furnaces. At BAAQMD's suggestion, Chevron moved the Point Richmond open-path monitors to a lower elevation so that fugitive emissions are primarily measured. The manufacturer of the open-path analyzers, who is experienced with operating and maintaining the monitors, indicated that the current minimum detection limits for BTEX, SO_2, and H_2S should be achievable at the planned path length, which is less than 920 meters. Flare and furnace stack emissions are already measured continuously with sampling systems, flow meters, and stack analyzers. Most fugitive emissions are measured at each component periodically using Method 21, but site-wide fugitive emissions can only be measured continuously with fenceline monitors. Thus, the BAAQMD is primarily interested in using the fenceline monitors to measure fugitive emissions, which occur near ground level.

During winter winds from the north, the Point Richmond and Atchison Village open-path monitors provide the suggested monitoring coverage when terrain is considered. Due to the mountainous terrain and presence of the Interstate 580 freeway, it is not practicable to install an open-path monitor west of the Point Richmond monitor. Appendix A shows a mountain ridge line southwest of the Point Richmond open-path monitor that is expected to direct wind from refinery tanks away from receptors. It is expected

that for the tanks located northwest of the Point Richmond open-path monitor and to the west of the mountain ridge that runs north-south, the mountains would cause wind across the tanks to move westward away from the community. It is expected that for the tanks located northwest of the Point Richmond open-path monitor and to the east of the mountain ridge that runs north-south, the mountains would cause wind across the tanks to pass through the Point Richmond open-path fenceline monitor. Also, the tanks are compliant with Rule 8-5 storage-vessel requirements, which limit organic compound emissions. The seals are inspected at least semiannually to verify proper function of the emission control technology. It is expected that a potential seal leak from a tank located northwest of the Point Richmond open-path monitor would be detected on the Point Richmond open-path monitor, because wind direction varies throughout the day.

Monitoring coverage is not planned for wind directions from the northeast, east, southeast and south because the downwind areas are not populated.

Monitoring coverage between the North Richmond and Atchison open-path monitors would be fulfilled with point monitors. The following point monitors will become part of the Rule 12-15 compliance program.

- Castro Street ground level monitor fulfills H_2S and SO_2 monitoring
- One sorbent tube at each sample station 6 and 7 fulfills suggested benzene monitoring
- North Richmond community monitor fulfills benzene, ethylbenzene, toluene and xylene monitoring

The two sorbent tube samples would continue to be analyzed for benzene at frequencies specified in 40 CFR 63 Subpart CC. In April 2019, the Environmental Protection Agency (EPA) began reporting benzene sorbent tube data over a public website on a quarterly basis. The link to the EPA website is: https://cfpub.epa.gov/webfire/reports/eSearchResults.cfm. To access the Chevron Richmond data, enter or select the following search criteria:

- Report Type: All, then Submit
- Facility Name: Chevron
- Facility Location: California, Contra Costa County, Richmond
- Regulatory Part and Subpart:
    - CFR Part: 63-NESHAP
    - CFR Subpart: NESHAP-CC: Petroleum Refineries

Then submit the search. Once the search results appear, select the row with the submission date of interest and download the file in the document column.

Five-minute average Castro Street GLM data and five-minute average North Richmond community monitor data will be posted to the public website.

The only sources located within one mile upwind of a receptor greater than 10% of the time that are between the North Richmond and Atchison monitors are the bioreactor and two recovered oil storage tanks. We expect that the Atchison open-path monitor, which crosses the bioreactor, or North Richmond open-path monitor typically catches any possible plumes from these sources. However, in the rare

instance when wind direction is between the North Richmond and Atchison open-path monitors, it is expected that the previously mentioned point monitors will measure possible emissions.

A review of ten years of GLM reports showed that Chevron has not caused exceedance of the sulfur dioxide ground level concentration limits in Rule 9-1-301 or the hydrogen sulfide limits in Rule 9-2-301 at the Castro Street GLM. Additionally, the GLM has much lower detection limits than open-path monitors. The GLM's H_2S detection limit is about 0.5 ppb versus an open-path monitor detection limit is over 50 ppb. The GLM's SO_2 detection limit is also about 0.5 ppb and the open-path monitor's detection limit is about 0.5 ppb.

Analyses of sorbent tubes installed in preparation for compliance with 40 CFR 63.658 indicate that benzene concentrations at sample stations 6 and 7 along the fenceline between the North Richmond and Atchison open-path monitors are much lower than the OEHHA chronic health standard of 3 $\mu g/m^3$. Sorbent tubes were replaced and analyzed for benzene approximately every 14 days. Sorbent tube data available to date for sample points 5 through 8 located between and nearby the North Richmond and Atchison open-path monitors are provided in **Table 3.4**. The refinery map in Appendix A shows the sorbent tube locations. Sample point 5A located on refinery property near the heavy traffic intersection of Gertrude, Castro, and Richmond Parkway had the highest readings of all the sample points in the refinery. The benzene concentrations decreased when the sample station was moved closer to the refinery processes around March 7, 2017. The current location is labeled as sample point 5. The elevated results at sample point 5A were attributed to off-site sources, likely traffic congestion at the Gertrude intersection or nearby off-site excavation of contaminated soil.

Table 3.4 – Benzene Sorbent Tube Results Are Within OEHHA Chronic Health Standard

Sample Start Date	**Sample End Date**	**Sample Point / Benzene Concentration* (ug/m^3)**				
		5A	**5**	**6**	**7**	**8**
7/27/2016	8/10/2016	0.19		Not Detectable	0.18	Not Detectable
8/10/2016	8/24/2016	0.18		0.24	0.25	0.20
8/24/2016	9/7/2016	0.36		0.38	0.29	0.40
9/7/2016	9/21/2016	0.52		0.34	0.38	0.29
9/21/2016	10/5/2016	0.69		0.52	0.51	0.52
10/5/2016	10/19/2016	0.68		0.44	0.46	0.41
10/19/2016	11/2/2016	0.97		0.57	0.60	0.55
11/2/2016	11/16/2016	2.41		0.96	0.75	0.77
11/16/2016	11/30/2016	1.34		0.67	0.79	0.76
11/30/2016	12/14/2016	1.44		0.65	0.64	0.71
12/14/2016	12/28/2016	0.94		0.63	0.63	0.58
12/28/2016	1/11/2017	1.03		0.85	0.48	0.50
1/11/2017	1/25/2017	1.09		0.62	0.64	0.60
1/25/2017	2/8/2017	1.07		0.65	0.58	0.59
2/8/2017	2/22/2017	0.86		0.49	0.44	0.55
2/22/2017	3/8/2017	1.04		0.51	0.49	0.55
3/8/2017	3/22/2017		0.44	0.46	0.40	0.41
3/22/2017	4/5/2017		0.38	0.34	0.31	0.44

Sample Start Date	Sample End Date	Sample Point / Benzene Concentration* (ug/m^3)				
		5A	5	6	7	8
4/5/2017	4/19/2017		0.34	0.33	0.30	0.38
4/19/2017	5/3/2017		0.26	0.28	0.28	0.29
5/3/2017	5/17/2017		0.21	0.20	0.21	0.23
5/17/2017	5/31/2017		0.17	0.21	0.18	0.22
5/31/2017	6/14/2017		0.20	0.18	0.19	0.25

* Values less than 0.37 are less than the analytical reporting limit, but greater than the method detection limit.

Lastly, Chevron continues to operate the existing North Richmond community monitor, located at Richmond fire station 62 on 7th Street, to deliver BTEX data to meet Rule 12-15 needs. The North Richmond community monitor is located downwind of the refinery when wind is from the west or southwest. The monitor also measures H_2S, ammonia, several alkanes, trimethylbenzenes, 3-methylpentane, 2,2,4-trimethylpentanes, $PM_{2.5}$, and black carbon. All data from the North Richmond community monitoring station is posted at https://www.richmondairmonitoring.org/index.html.

Table 3.5 shows that BTEX concentrations measured at the North Richmond community monitor for any wind direction are far below California Office of Environmental Health Hazard Assessment (OEHHA) acute health standards. The North Richmond community monitor collects five-minute average concentration data and posts the five-minute averages to the website similar to fenceline monitors. To determine the maximum one-hour average concentrations for comparison with the acute health standard, 60-minute averages were calculated for every five minutes of data from January 1, 2014, through December 31, 2016. During periods that a chemical was not detected, one half the detection limit of 0.25 ppb was substituted for calculating the average concentration. The table shows that the maximum one-hour average concentration was equal to 34% (2.75 ppb one-hour average/8 ppb acute health standard) of a health standard.

Table 3.5 shows that BTEX concentrations measured at the North Richmond community monitor for any wind direction are far below OEHHA chronic health standards. To determine the average concentration for comparison with the chronic health standard, all five-minute average data was averaged from January 1, 2014, through December 31, 2016. During periods that a chemical was not detected, one half the detection limit of 0.25 ppb was substituted for calculating the average concentration. The table shows that for the worst-case chemical (benzene), the average concentration was about 25% (0.25 ppb average/1 ppb benzene of the chronic health standard) of a chronic health standard.

Given the data in Table 3.5, Chevron does not expect BTEX to be regularly detectable by an open-path fenceline monitor between the North Richmond and Atchison open-path monitors and does not expect any exceedance of a health standard. The community monitor is more sensitive than open-path fenceline monitors, and only half a mile downwind (westerly wind) from the N. Richmond fenceline.

Table 3.5 – North Richmond Community Monitor Data Is Within Health Standards (1/1/2014 – 12/31/2016)

Chemicals	Maximum One Hour Average Concentration (ppb)	Acute OEHHA REL (ppb)	Average Concentration (ppb)	Chronic OEHHA REL (ppb)
Benzene	2.75	8	0.25	1
Ethylbenzene	12	None published	0.25	400
Toluene	111	9,800	0.30	70
Xylenes	65	5,000	0.57	200

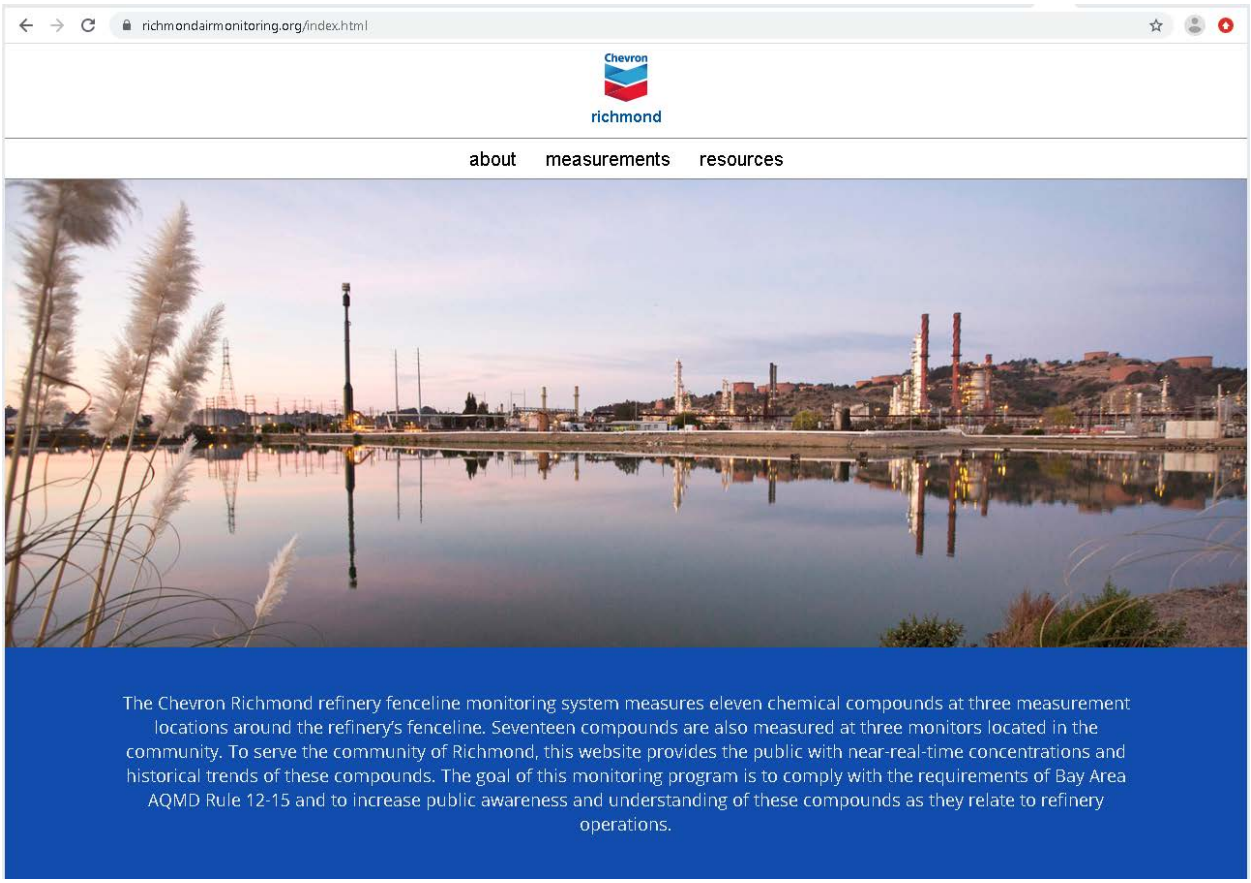
Element #4 – Sample Time Resolution and Data Completeness

Fenceline continuous monitoring equipment specified for the Chevron fenceline system will collect data on five-minute averages and report the five-minute averages. Chevron will aim to meet a minimum of 75% completeness on an hourly basis 75% of the time based on annual quarters. Atmospheric conditions beyond the control of the refinery that affects accurate measurements, such as dense fog, will not be counted against data completeness requirements. In addition to rain and fog, other types of environmental conditions beyond the control of the refinery can occur. These environmental factors include but are not limited to strong winds, dust, and earthquakes, which can impact the ability of open-path instruments' ability to provide accurate measurements.

Element #5 – Data Presentation to the Public

Data from the fenceline monitors will be transmitted to an Internet website where near-real-time results can be viewed by the public. **Figure 3.5** shows the home page of the fenceline webpage, located at https://www.richmondairmonitoring.org/index.html.

Figure 3.5 – Sample Real-Time Fenceline and Community Air Monitoring Webpage



Data generated by the fenceline monitoring equipment undergoes review throughout the measurement and reporting process. Included in this process are automated QA/QC checks that occur before data is reported on the real-time website. Under normal circumstances a 5-minute average measurement will appear on the website within 10 minutes of the end of the measurement period. However, the data uploaded may be impacted by Internet traffic. An automated system conducts the Quality Assurance checks listed in **Table 3.6** before the data is reported to the website. The website will also make available a rolling 1-hour trend of the 5-minute data for each gas reported.

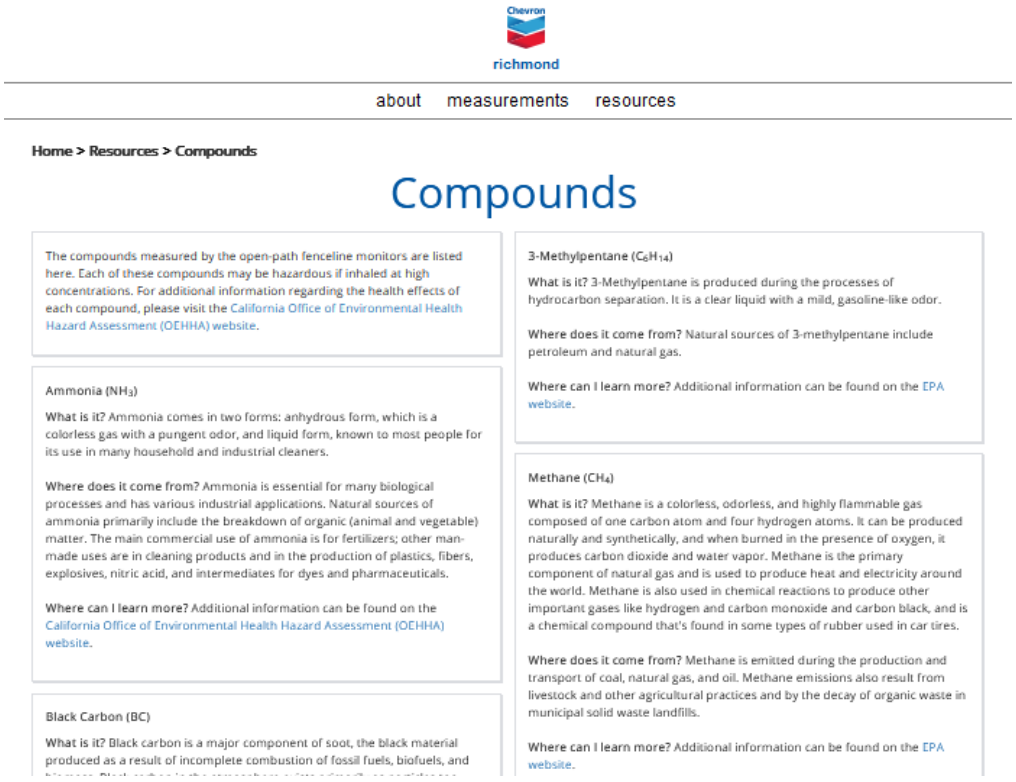
Once QA/QC of the final data is completed within 60 days after the end of each calendar quarter, the refinery will provide one-hour average concentration data in tabular format through a csv (comma-separated variable) data file to the BAAQMD. The BAAQMD may make the one-hour average data available to the public through a BAAQMD website or through public records request. The refinery will make data available to BAAQMD upon request prior to the report submittal. All data will be retained by Chevron for a period of five years, consistent with Regulation 12-15-302.

Table 3.6 – Response to Potential Monitor Problems

Potential Problem	Response
Analyzer has low signal (integration time >250 ms for UV, less than 2% for IR)	Website updated with low signal message for specific analyzer. If the low signal is not due to weather conditions, a Field Technician corrects the issue.
Analyzer off-line	Website updated with analyzer off-line message. Field Technician corrects issue.
Workstation fails	Website updated with analyzer off-line message. Technician corrects the issue.
Internet communication failure	Backup Internet connection activated

Figure 3.6 shows an example page from the website that appears when a person clicks the Compounds page of the Resources section of the website. The web page describes the chemical's properties, common sources of the chemical, and links to the OEHHA health standards.

Figure 3.6 – Example Website Display of Compound Descriptions and Resources



Additional information is available on the website to help the public understand how the fenceline monitoring system works and to help explain the data. Fenceline monitor locations, how the locations were selected, and descriptions of equipment used are included. Context of what fenceline measurements

represent as compared to other regional air quality measurements, as outlined by BAAQMD, are provided on the website.

To facilitate public feedback, a feedback button will be provided on the resources page of the website. When a user clicks on the button, an email form will pop up for the user to submit comments about the website. The email will be delivered to a Chevron contact or a designated consultant responsible for deciding how to respond to the public comments. The emails received through the website will be archived. Although not all comments have to be addressed, all comments will be made available to BAAQMD upon request. Some of the comments will aid in the creation of frequently asked questions to be published on the website.

Element #6 – Quality Assurance Project Plan

Chevron submitted a Quality Assurance Project Plan to the Air District for approval on January 8th, 2020. An updated QAPP is included with this monitoring plan as Appendix B.

Section 4. Monitoring Equipment Description

The fenceline monitoring program for Rule 12-15 will integrate the equipment currently used as part of RCAMP along with additional equipment to monitor additional target gases, namely alkanes, and extend spatial coverage. This equipment used to meet the monitoring requirements for Rule 12-15 are described below.

Section 4.1 – Fundamentals of Operation

The following paragraphs describe how the equipment measures compound concentrations. Open-path monitors report average concentration over the path length. Point monitors measure the concentration at the point of the monitor's intake line.

Castro Street Sulfur Dioxide and Hydrogen Sulfide Pulsed Fluorescence GLMs

The sulfur dioxide and hydrogen sulfide GLMs comply with the BAAQMD Manual of Procedures Volume VI. The sulfur dioxide GLM is a trace level pulsed fluorescence sulfur dioxide analyzer. The analyzer operates by measuring the emitted fluorescence of SO_2 produced by the absorption of ultraviolet (UV) light. Pulsating UV light is focused through a narrow band-pass filter mirror allowing only light wavelengths of 190 to 230 nm to pass into the fluorescence chamber. SO_2 absorbs light in this region without any quenching by air or most other molecules found in ambient air. The SO_2 molecules are excited by UV light and emit fluorescence light at a longer wavelength (lower energy). A second filter allows only this fluorescent light to contact a photomultiplier tube (PMT). The PMT converts the optical signal from the fluorescent light into a voltage that is recorded and turned into a concentration value.

The hydrogen sulfide GLM operates using similar technology as the GLM SO_2 analyzer. Continuous H_2S monitoring is accomplished by conversion of the H_2S in the sample to SO_2 and its subsequent detection by the SO_2 analyzer.

North Richmond Community Monitor Auto Gas Chromatograph

Automated Gas Chromatographs are point sampling technologies. The systems work by inserting a sample of ambient air into a narrow tube known as the column. A carrier gas flows through the column and carries the sample through the column; depending on the chemical composition, the various sample gases exit the column at different times. As the chemicals exit the end of the column, they are detected using a photoionization detector. The major advantage of the Auto GC air monitoring system is its sensitivity in that it can measure gases such as BTEX at very low concentrations in the air.

Open-Path FTIRs

Open-path FTIR air monitoring systems use a beam of infrared (IR) light to detect and measure alkanes in the air. A beam of light passes across ambient air to a reflector that sends the light beam back to the light detector. If a gas is present that absorbs IR light, it can be identified by the specific wavelengths of light that were absorbed. The concentration of a gas can be determined by measuring the amount of each specific wavelength of light that was absorbed. The primary interferents associated with FTIR air monitoring systems are water vapor and carbon dioxide gas. The two gases absorb light in the same region as alkanes and can be mistaken for the target gas. Also, due to the similarity in chemical structure, the C1 through C5 alkanes absorb light in a similar region and may interfere with measurements of total alkanes. However, the presence of potentially interfering gases can be accounted for through the analytical software of the system.

Open-path FTIRs can theoretically achieve lower detection limits than extractive FTIRs because the beam path is much longer. The primary limitations for these systems are that the light signal cannot penetrate heavy fog or rain. Thus, they may not be effective during situations where dense fog or heavy rain are present.

Open-Path TDLs

Open-path TDLs are similar to open-path FTIR air monitoring systems in that they use beams of infrared light to measure gases. The primary difference between the two systems is the TDL system uses a laser as its light source whereas a FTIR uses a broad band beam of light as its source. TDL systems are designed to measure single gases which, for this application, is hydrogen sulfide. The primary interferents of the TDL air monitoring systems are water vapor and carbon dioxide, because both absorb light in the same region as hydrogen sulfide. The primary limitation for the system is that the light signal cannot penetrate heavy fog or rain.

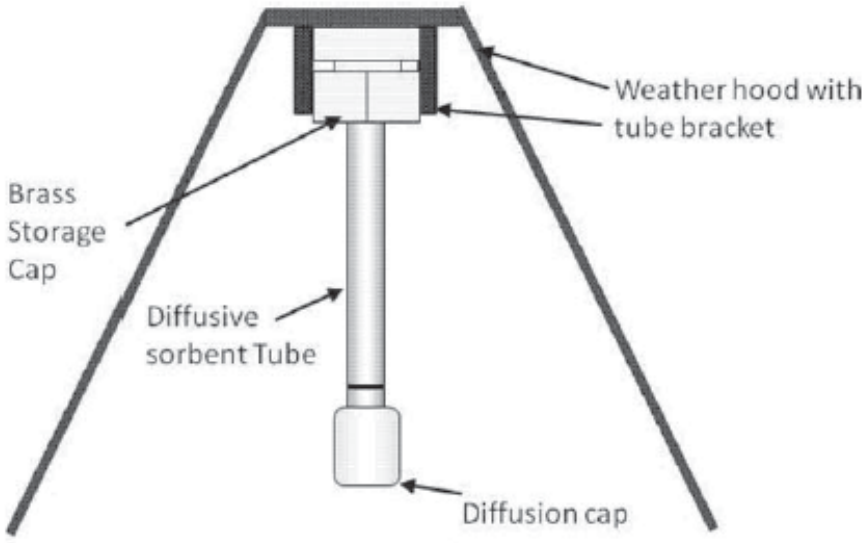
Open-Path UVs

The open-path UV system differs from the open-path FTIR and TDL systems in two major ways. First the system has a light source at one end of the path that sends a beam directly to the light detector at the other end of the light beam. The other difference is that the system uses ultraviolet light as a light source. The open-path UV air monitoring system is used to detect BTEX and sulfur dioxide. The primary interferents associated with the UV air monitoring systems are ozone and oxygen gas, because both absorb light in the same region as the target gases. However, the presence of these gases can be accounted for with the system's analytical software. The primary limitation for the systems is that the light signal cannot penetrate heavy fog or rain.

Sorbent Tubes

Sorbent tubes placed approximately six feet above ground level absorb benzene, if present, from the ambient air during the sampling period, which is about 14 days. The sorbent tubes are installed at locations along the refinery perimeter specified in 40 CFR 63 Appendix A Method 325A Section 8.2. The tubes are analyzed in a laboratory at the end of the sampling period in accordance with 40 CFR 63 Appendix A Method 325B. The sorbent tubes are placed in shelters similar to **Figure 4.1** to protect them from rain. Thus, the tubes can provide average benzene concentrations in the ambient air during nearly all weather conditions including fog, the exception for periods of extremely high winds with rain. The sorbent tube method also achieves benzene concentration measurements at concentrations lower than open-path monitor minimum detection levels.

Figure 4.1 – Benzene Sorbent Tube and Shelter



Section 4.2 – Monitoring Equipment Capabilities

Table 4.1 summarizes monitoring equipment capabilities, interferences, limitations, and measurement errors.

Table 4.1 – Monitoring Technology Capabilities, Interferences, Limitations, Measurement Errors

Equipment	Capabilities	Interferences	Limitations	Measurement Errors
Sorbent tubes	Absorbs benzene from ambient air, if present, at a point over approximately 14-day periods; Lower detection limit than open-path monitors	Sorbent artifacts, Water (rain)	Heavy rains with high winds; Continuous reporting not possible	Within 30% (Per 40 CFR 63 Appendix A Method 325B Section 9.7)
North Richmond Community Monitor Auto Gas Chromatograph	Measures BTEX continuously at a point with lower detection limit than open-path monitors		Measures at point vs. open-path	Within 25%
Open-path FTIR	Measures alkanes across an open path continuously; Likely lower detection limit than extractive FTIR	Water (humidity), CO_2, and C2-C5 alkanes may interfere with each other	Heavy Fog and Rain	Within 25%; Uses Single Regression Analysis to quantify data
Open-path UV-DOAS	Measures BTEX and SO_2 across an open path continuously	Ozone and oxygen	Heavy Fog and Rain	Within 25%; Uses Single Regression Analysis to quantify data
Open-path TDL	Measures H_2S continuously across an open path	Water (humidity) and CO_2	Heavy Fog and Rain	Within 25%
Castro St. GLM H_2S and SO_2 Pulsed Florescence Analyzers	Measures H_2S and SO_2 at a point continuously; Lower detection limit than open-path monitors	High concentrations of hydrocarbons; Mercaptans interfere with H_2S measurement	Measures at a point vs. open path	Within 10% for SO_2, within 15% for H2S (BAAQMD MOP Volume VI)

Section 4.3 – Detection Range

Table 4.2 summarizes the expected detection ranges of the open-path monitors. Alkane detection ranges are based on an initial study conducted in Atlanta, Georgia, in December 2017. The alkane detection ranges shown are accurate when multiple alkanes are present. The detection ranges are much wider if only an individual alkane is present. An open-path FTIR manufacturer is working to expand the detection ranges before installation. As mentioned previously, the FTIR should always show methane readings greater than 1,800 ppb due to the inherent presence of methane in the ambient air. Detection limits for H_2S open-path monitors have not been established at this time, as this monitoring technology is currently undergoing field trials and review by Air District staff. Detection limits will be provided when the field trails and Air District review has been completed and the technology is deemed acceptable for fenceline monitoring applications by the BAAQMD.

Table 4.2 – Messages Displayed on the Website with Each Compound and Data Value (Hover Over the Data Point to View the Message)

Condition	Message
Valid	X parts per billion of Compound Y were measured at this location
Below detection	The concentration of the compound is so low that the instrument cannot accurately detect it.
Questionable	No additional information available. Pending further review.
Missing	A problem (such as power failure, calibration, etc.) prevented the instrument from collecting or reporting the data.
Invalid	No additional information available. Pending further review.
Not Measured	There is no instrumentation at the given site to measure this chemical.

The minimum detection limit of the sorbent tubes is dependent upon several analytical factors, including the presence of moisture. The minimum detection limit for benzene is typically 0.07 ug/m^3, equivalent to 0.02 ppb, while the minimum reporting limit, which is the lowest end of the calibration range is typically 0.37 ug/m^3, equivalent to 0.12 ppb. The minimum detection limit of the Castro Street GLMs and North Richmond BTEX community monitor is 0.5 ppb for each compound.

Section 4.4 – Monitoring Equipment Locations

Table 4.3 lists the locations of the fenceline monitoring equipment.

Table 4.3 – Monitoring Equipment Locations

ID	Fenceline Name	Equipment	Approx Elevation (ft agl)	Location
D	North Richmond	UV source; TDL & FTIR reflectors (D)	28.5	Next to Gertrude GLM
D	North Richmond	UV, TDL, FTIR analyzers (D)	23	Near Maintenance Building
6	North Richmond	Sorbent tube site 6	5	Reclamation Yard Gate to Castro St.
A	North Richmond Community Monitor	Auto-gas chromatograph	13	Fire Station #62
7	Atchison Village	Sorbent tube site 7	5	Solar-panel field
H	Atchison Village - Castro GLM	Pulsed fluorescence analyzers	8	Gate 91
E	Atchison Village	UV source & TDL reflector (E)	38.5	Parking lot south of RARE Plant
E1	Atchison Village	FTIR reflector (E1)	38.5	Parking lot south of RARE Plant
E1/E2	Atchison Village	FTIR analyzer (E1), FTIR reflector (E2)	37	Next to Warehouse 8
E2	Atchison Village	FTIR analyzer (E2)	64.5	Top Level Roof of Lube Plant

ID	Fenceline Name	Equipment	Approx Elevation (ft agl)	Location
E	Atchison Village	UV & TDL analyzers (E)	64.5	Top Level Roof of Lube Plant
F	Point Richmond	UV & TDL analyzers (F)	31.5	Near SW Corner of Lube Plant Roof
F1	Point Richmond	FTIR analyzer (F1)	31.5	Near SW Corner of Lube Plant Roof
F1/F2	Point Richmond	FTIR reflector (F1), FTIR analyzer (F2)	37.5	Next to Permits Office
F2	Point Richmond	FTIR reflector (F2)	23.5	Hill SW of Chevron Fire Department
F	Point Richmond	UV source & TDL reflector (F)	23.5	Hill SW of Chevron Fire Department

ID	Fenceline Name	Equipment	Approx Elevation (ft agl)	Location
D	North Richmond	UV source; TDL & FTIR reflectors (D)	28.5	Next to Gertrude GLM
D	North Richmond	UV, TDL, FTIR analyzers (D)	23	Near Maintenance Building
6	North Richmond	Sorbent tube site 6	5	Reclamation Yard Gate to Castro St.
A	North Richmond Community Monitor	Auto-gas chromatograph	13	Fire Station #62
7	Atchison Village	Sorbent tube site 7	5	Solar-panel fField
H	Atchison Village - Castsro GLM	Pulsed fFluorescencse aAnalyzers	8	Gate 91
E	Atchison Village	UV source & TDL reflector (E)	38.5	Parking lot south of RARE Plant
E1	Atchison Village	FTIR reflector (E1)	38.5	Parking lot south of RARE Plant
E1/E2	Atchison Village	FTIR analyzser (E1), FTIR reflector (E2)	37	Next to Warehouse 8

E2	Atchison Village	FTIR analyzer (E2)	64.5	Top Level Roof of Lube Plant
E	Atchison Village	UV & TDL analyzers (E)	64.5	Top Level Roof of Lube Plant
F	Point Richmond	UV & TDL analyzers (F)	31.5	Near SW Corner of Lube Plant Roof
F1	Point Richmond	FTIR analyzer (F1)	31.5	Near SW Corner of Lube Plant Roof
F1/F2	Point Richmond	FTIR reflector (F1), FTIR analyzser (F2)	37.5	Next to Permits Office
F2	Point Richmond	FTIR reflector (F2)	23.5	Hill SW of Chevron Fire Department
F	Point Richmond	UV source & TDL reflector (F)	23.5	Hill SW of Chevron Fire Department

Section 5. Timing

Chevron reports near real-time data over a website from open-path TDL, UV DOAS and FTIR monitors. As stated above, Chevron will install BAAQMD-approved open-path H_2S analyzers, once acceptance testing has been completed by the BAAQMD. Operation of these instruments will be conducted in accordance with this Plan pursuant to the timing requirements in Rule 12-15.

Section 6. References

Bay Area Air Quality Management District (2016) Air monitoring guidelines for petroleum refineries: Air District Regulation 12, Rule 15: Petroleum Refining Emissions Tracking; April. Available at http://www.baaqmd.gov/~/media/files/planning-and-research/public-hearings/2016/9-14-and-12-15/042016-hearing/1215-amg-041416-pdf.pdf?la=en.

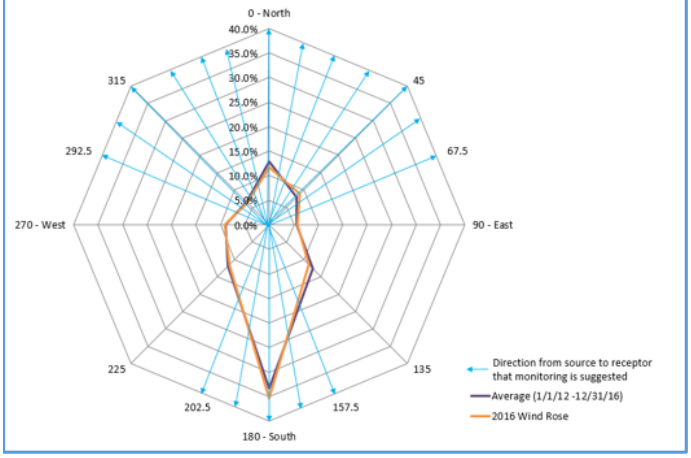
Fairley, D., Fischer, M.L., Top-Down Methane Emissions Estimates for the San Francisco Bay Area from 1990 to 2012, *Atmospheric Environment* (2015), doi: 10.1016/j.atmosenv.2015.01.065. http://calgem.lbl.gov/Fairley-2015-Atm-Env-1990-2010-SFBayArea-CH4-SK76R4HS2.pdf.

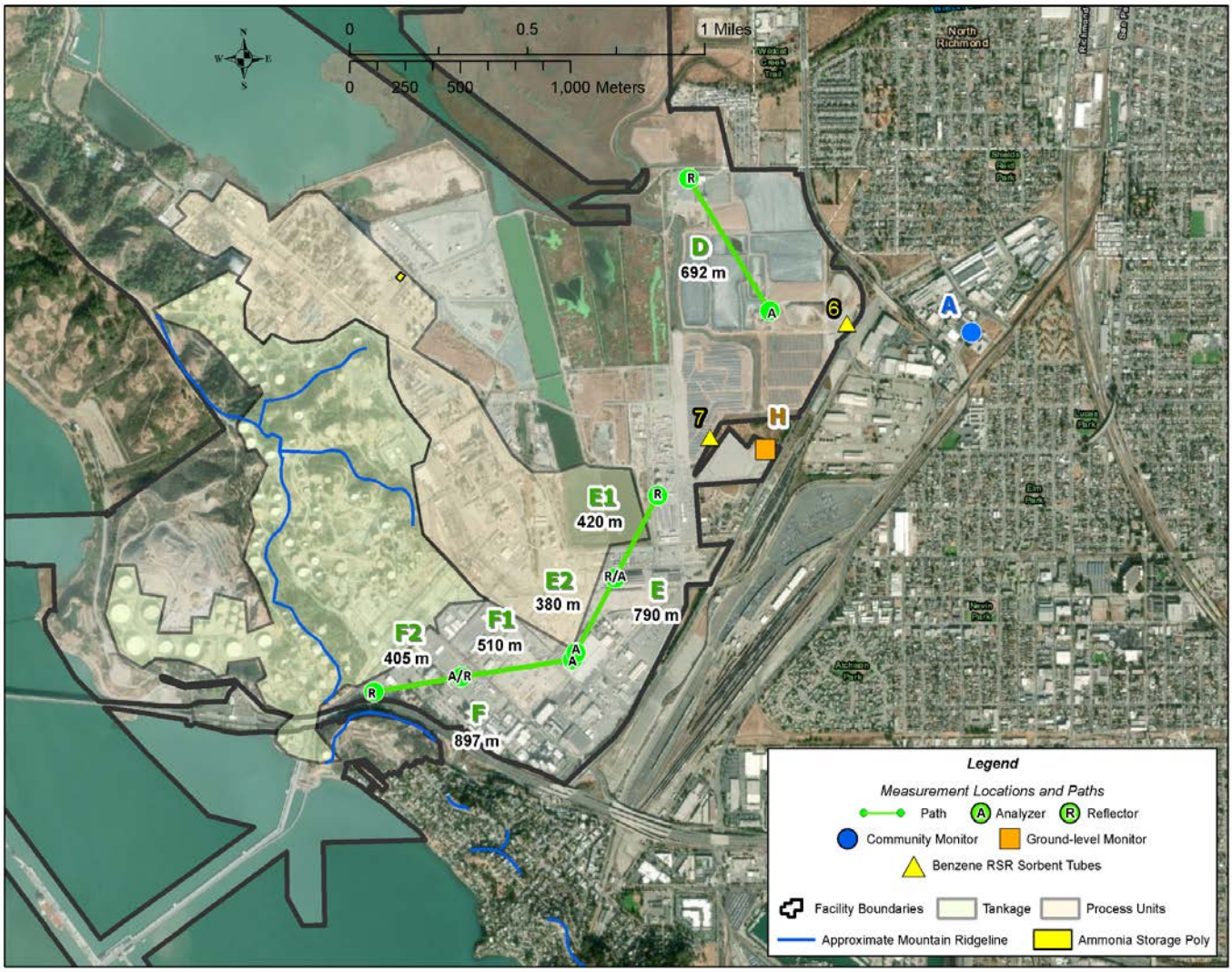
Edgar R. Stephens & Frank R. Burleson (1969) Distribution of Light Hydrocarbons in Ambient Air, *Journal of the Air Pollution Control Association, 19:12, 929-936,* doi: 10.1080/00022470.1969.10469359, https://doi.org/10.1080/00022470.1969.10469359

APPENDIX A

Wind Roses and Refinery Map of Fenceline Monitoring Equipment

Figure 3.2 – Wind Rose (1/1/12 – 12/31/16) Consistent Wind Pattern Primarily from South





APPENDIX B

Quality Assurance Project Plan for the
Chevron Richmond Refinery Fenceline Air Monitoring Program