The Bellwether District Perimeter Air Monitoring Plan

3144 Passyunk Avenue, Philadelphia, Pennsylvania

Prepared for

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Acronyms and Abbreviations

µg/m^3	micrograms per cubic meter
AEGLs	acute exposure guideline levels
EPA	Environmental Protection Agency
PESRM	Philadelphia Energy Solutions Refining and Marketing LLC
PID	photoionization detector
PAMP	*Perimeter Air Monitoring Plan*
PM	particulate matter
PM-10	particulate matter with a diameter of 10 micrometers or less
Site	3144 Passyunk Avenue, Philadelphia, Pennsylvania
Terraphase	Terraphase Engineering Inc.
VOC	volatile organic compound

1 Introduction

On behalf of Philadelphia Energy Solutions Refining and Marketing LLC (PESRM), Terraphase has prepared this *Perimeter Air Monitoring Plan* (PAMP) that details the monitoring of volatile organic compounds (VOC) and particulates (i.e., respirable dust) in support of the planned earthwork at the Bellwether District located at 3144 Passyunk Avenue in Philadelphia, Pennsylvania (Site).

1.1 Background

The Site was formerly operated as a petroleum refinery between 1860 and 2019. Soil and groundwater investigation and remediation activities have been ongoing at the Site for decades. Known soil contaminants at the Site include various VOCs, various semivolatile organic compounds, and lead.

The development master plan includes an approximately 250-acre innovation campus to be completed in the portions of the former refinery north of Passyunk Avenue. Over 750 acres south of Passyunk Avenue is expected to be developed into an industrial and logistics campus. Earthwork on the industrial and logistics campus began in May 2023. As shown in Figure 1, air monitoring stations 1 through 6 are distributed around the perimeter of the industrial and logistics portion of the development. Earthwork on the innovation campus is expected to begin in spring 2024. Air monitoring stations 7 through 10 are distributed around the perimeter of the innovation campus.

1.2 Purpose and Objective

During implementation of the PAMP, measures will be taken by earthwork and construction contractors to identify and provide effective and timely mitigation measures to minimize potential fugitive dust and VOC emissions at the Site.

The principal purpose of the PAMP is to establish a dust and VOC monitoring program that will be implemented during earthwork activities at the Site. The objectives of the PAMP include:

- Develop project action levels for perimeter dust and VOC levels;
- Establish a real-time monitoring program that provides real-time notifications if dust or VOC levels begin to increase during the work;
- Summarize the protocols to be followed if dust or VOC levels begin to approach project action levels; and
- Establish recordkeeping and reporting.

Implementation of this PAMP will be performed in conjunction with contractor dust and vapor mitigation plans.

2 Action Levels

Terraphase calculated site-specific dust and VOC action levels as described in this section.

2.1 Dust Action Level

To calculate a site-specific, risk-based dust action level for the Site, risk calculations were performed by Terraphase with the assumption that a child would be present immediately adjacent to the Site for 8 hours per day, 5 days per week, for 10 years during earthwork. The dust concentration was assumed to be equal to the Pennsylvania Ambient Air Quality Standard and United States Environmental Protection Agency (EPA) National Ambient Air Quality Standard of 150 micrograms per cubic meter ($\mu g/m^3$).[1] Terraphase used a conservative estimate of the mean concentration (i.e., the 95 percent upper confidence limit (UCL) on the mean) for each constituent in soil at the Site to model dust concentrations. The dust calculations are provided in Appendix A. The child receptor cancer and non-cancer risk estimates, based on these conservative exposure assumptions, are well below the Land Recycling and Environmental Remediation Standards Act cancer and non-cancer risk limits.[2] Based on the results, a level of 150 $\mu g/m^3$ for particulate matter (PM) with a diameter of 10 micrometers or less (PM-10) on a 24-hour average, was chosen as the project dust action level.

2.2 VOC Action Levels

To determine the site-specific action level for VOCs, Terraphase referenced the EPA acute exposure guideline levels (AEGLs).[3] AEGLs represent threshold levels for the general public, designed to protect susceptible subpopulations to exposure to airborne chemicals such as infants, children, the elderly, and persons with asthma or other illnesses. EPA calculates AEGLs for five short exposure periods (10 minutes, 30 minutes, 1 hour, 4 hours, and 8 hours) at three different severity levels, dictated by the severity of the toxic effects. Level 1 is the least severe (notable discomfort/irritation but not disabling or irreversible). A summary of all Level 1 AEGLs for chemicals detected in soil samples collected at the Site is provided in Appendix B. A total VOC level of 4.6 parts per million(ppm) based on an 8-hour average was chosen as the VOC action level for the project. This is the lowest Level 1 AEGL for chemicals detected in soil samples collected at the Site, including benzene.

[1] https://www.dep.pa.gov/Business/Air/BAQ/PollutantTopics/Pages/Ambient-Standards.aspx and https://www.epa.gov/naaqs, respectively

[2] https://www.legis.state.pa.us/WU01/LI/LI/US/PDF/1995/0/0002..PDF

[3] https://www.epa.gov/aegl

3 Air Monitoring Procedures

Weather-proof air monitoring stations equipped with telemetry and data logging software, solar panels, and batteries have been deployed on perimeter of the site as shown on Figure 1. The data system is set up to notify Terraphase team members and PESRM representatives when action levels are approached for dust and VOCs.

3.1 Dust Monitoring

PM-10 concentrations will be monitored at the perimeter monitoring stations, measuring PM-10 continuously and reporting 15-minute, time-weighted averages. [4] The monitors will be programmed to provide notification to Terraphase and PESRM when the dust level of 150 µg/m^3 is exceeded for any 15-minute, time-weighted average.

3.2 VOC Monitoring

VOC concentrations will be monitored continuously at the perimeter monitoring stations. The VOC monitoring will be performed using a photoionization detector (PID)[5]. The PIDs will collect VOC readings continuously during earthwork activities, and report 15-minute, time-weighted averages. The PIDs will be programmed to provide notification to Terraphase and PESRM when the VOC level of 4.6ppm is exceeded for any 15-minute, time-weighted average.

4 Corrective Measures

If 15-minute time-weighted averages for dust or VOCs are sustained above their respective action levels, Terraphase will notify PESRM, who will notify the contractors working on site. Dust and/or vapor mitigation control measures will then be adjusted by the on-site contractors. The 15-minute, time-weighted average notification will allow for prompt adjustment to dust and/or vapor mitigation measures so that the 24-hour time-weighted action levels are not exceeded.

Corrective measures may include, but are not limited to, increasing the frequency of dust and/or vapor control measures, modifying dust and vapor control procedures, changing material management/ removal procedures, choosing alternative equipment or methods, and/or stopping work. Pending implementation of corrective actions, Terraphase will recheck perimeter air monitoring levels to determine if the corrective measures were effective.

[4] NextPM sensor manufactured by Tera Sensor.

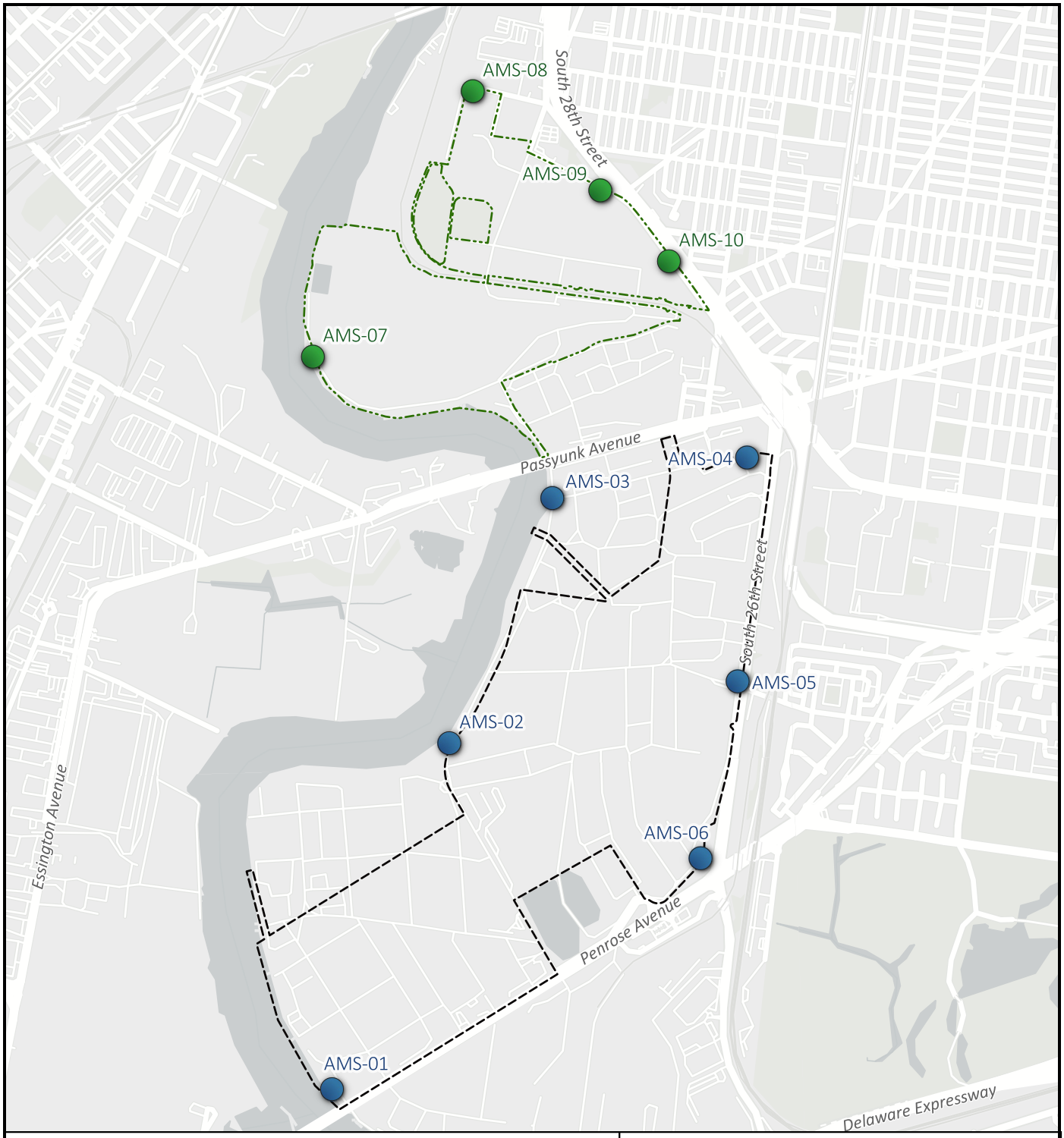
[5] 10.6-electron volt lamp photoionization detector manufactured by IonScience

5 Recordkeeping and Reporting

Monthly reports summarizing the prior month's dust and VOC monitoring results and corrective actions (if any) will be prepared. Monthly dust and VOC monitoring reports will be uploaded to the project website.

Figure

1 Air Monitoring Locations



0 1,800 3,600 Feet

1 Inch = 1800 Feet

N

Legend

- Industrial Redevelopment Phase I Air Monitoring Stations
- Innovation Campus Air Monitoring Stations
- Industrial Redevelopment Phase I Limits of Disturbance
- Innovation Campus Limits of Disturbance

SAFETY FIRST

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CLIENT: Philadelphia Energy Solutions Refining and Marketing LLC

PROJECT: Bellwether District Air Monitoring

PROJECT NUMBER: P069.002

Air Monitoring Locations

FIGURE 1

N:\GIS\Prj\P044.001_PESRM-PES\QGIS_QGZ and GPKG\branch_Air Monitoring\(20240223) QGZ328_P044.001_PESRM_Air_Monitoring.qgz Air Monitoring - Locations Map - Site-Wide 2021-03-26T15:56:13.000 Created By: S.Lowe

Appendix A

Dust Calculations

Respirable Particulate Air Concentration (PM_{10}) Action Level

Terraphase Engineering Inc. (Terraphase) has determined that meeting a respirable particulate air concentration (PM_{10}) of 150 ug/m^3 at the fence line of the former Philadelphia Energy Solutions Refinery (the Facility) will be protective of off-facility receptors (including sensitive receptors). The details of these calculations are presented in **Attachment 1**.

In order to support this determination, conservative risk calculations were performed assuming inhalation exposure of a residential receptor (i.e., a child, 0-10 years old) to PM_{10} in air at the property boundary as the result of dust emissions from the Facility during site redevelopment (i.e., from earthmoving, or from windblown dust). The residential child was assumed to be at the property boundary 8 hours/day, 250 days/year (i.e., 5 days/week for 50 weeks), for 10 years.

The constituent-specific excess cancer risk[1] is calculated as follows:

$$Risk = C_{air} \cdot URF \cdot \frac{ET \cdot EF \cdot ED}{AT_c}$$

Where, C_{air} is the constituent-specific concentration in air (mg/m^3), URF is the chemical specific unit risk factor (m^3/mg), ET is the exposure time (hours/day), EF is the exposure frequency (days/year), ED is the exposure duration (years), and AT_c is the cancer averaging time (hours).

The constituent-specific noncancer hazard quotient (HQ) is calculated as follows:

$$HQ = \frac{C_{air}}{RfC} \cdot \frac{ET \cdot EF \cdot ED}{AT_{nc}}$$

Where, RfC is the chemical-specific reference concentration (mg/m^3) and AT_{nc} is the noncancer averaging time (hours).

In order to calculate C_{air} due to emissions from the Facility, a conservative estimate of the mean concentration[2] for each constituent[3] in soil at the Facility was used. Specifically, the constituent-specific concentrations in air as a result of fugitive dust emissions can be calculated as follows:

$$C_{air} = C_{Soil} \cdot PM_{10} \cdot CF$$

[1] As recommended by USEPA (2005), age dependent adjustment factors (ADAFs) are used to adjust toxicity values for carcinogens with a mutagenic mode of action to assess potential exposures of residents. For a resident aged 0-2 years, an ADAF of 10 is used. For a resident aged 2-10 years, an ADAF of 3 is used.

[2] 95 percent upper confidence limit (UCL) on the mean

[3] Estimates of the mean concentration were used for each constituent except for naphthalene, for which the maximum detected concentration was used. ProUCL did not recommend a 95 percent UCL on the mean for naphthalene and so the maximum detected concentration was conservatively used instead.

Where, C_{soil} is the constituent concentration in soil (mg/kg), PM_{10} is the average PM_{10} concentration due to fugitive dust emissions (µg/m^3), and CF is a conversion factor (10^{-9} kg/µg).

The cancer (i.e., URF) and noncancer (i.e., RfC) inhalation toxicity values are compiled from USEPA's hierarchy of sources (USEPA 2003). Assuming an average PM_{10} concentration of 150 µg/m^3 at the fence line during the resident child's exposure period results in an estimated cumulative cancer risk of $8x10^{-8}$ and noncancer hazard index (HI) of 0.04. These estimates are below the risk management goals used by the Pennsylvania Department of Environmental Protection (PADEP) for determining when risk management action would be warranted (i.e., a cumulative excess cancer risk greater than $1x10^{-4}$ and a noncancer HI greater than 1) indicating that the use of this PM_{10} concentration as an action level is protective.

With regards to lead exposure, assuming a conservative estimate of the average lead concentration in soil across the Facility (1,150 mg/kg) results in an estimated lead concentration in air of 0.17 µg/m^3. This is close to the National Ambient Air Quality Standard (NAAQS) for lead in air of 0.15 µg/m^3 which is based upon a rolling 3-month average exposure concentration. This demonstrates, that using a PM_{10} concentration of 150 µg/m^3 at the fence line as an action level would be protective as long as the average concentration at the fence line does not exceed this level over a 3-month period.

References

United States Environmental Protection Agency (USEPA). 2003. Office of Solid Waste and Emergency Response (OSWER). Human Health Toxicity Values in Superfund Risk Assessments. OSWER Directive 92857.7-53. December.

USEPA. 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R 03/003F. March.

USEPA. 2009. Office of Emergency and Remedial Response. Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). USEPA/540/R/070/002. January.

USEPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February 6.

Attachment 1

Risk and Hazard Quotient Calculations for Soil Particulate Inhalation Exposure of Fenceline Resident Age 0-10 to Soil

Appendix A
Attachment 1
Risk and Hazard Quotient Calculations for Soil Particulate Inhalation Exposure of Fenceline Resident Age 0-10 to Soil
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

								Cancer				Noncancer	
Chem Group	**Chemical**	**CASRN**	**Cancer Class**	**ADAF**		**C_{soil}** (mg/kg)	**C_{air}** (mg/m^3)	**URF** $(mg/m^3)^{-1}$	**f_{inh}**	**Risk**		**RfC** (mg/m^3)	**HQ**
VOC	Benzene	71-43-2	A	N		4.65E+01	6.98E-06	7.8E-03		1.8E-09		3.0E-02	5.3E-05
VOC	Cumene	98-82-8	D	N		2.65E+02	3.97E-05					4.0E-01	2.3E-05
VOC	1,2-Dibromoethane	106-93-4	LC	N		5.37E-04	8.06E-11	6.0E-01		1.6E-12		9.0E-03	2.0E-09
VOC	1,2-Dichloroethane	107-06-2	B2	N		6.65E-04	9.97E-11	2.6E-02		8.5E-14		7.0E-03	3.3E-09
VOC	Ethyl Benzene	100-41-4	D	N		7.46E+00	1.12E-06					1.0E+00	2.6E-07
VOC	Methyl tert-butyl ether	1634-04-4	C	N		3.73E-01	5.60E-08	2.6E-04		4.7E-13		3.0E+00	4.3E-09
VOC	Toluene	108-88-3	ID	N		3.01E+01	4.51E-06					5.0E+00	2.1E-07
VOC	1,2,4-Trimethylbenzene	95-63-6	ID	N		1.75E+01	2.62E-06					6.0E-02	1.0E-05
VOC	1,3,5-Trimethylbenzene	108-67-8	ID	N		6.41E+00	9.62E-07					6.0E-02	3.7E-06
VOC	Xylenes (total)	1330-20-7	ID	N		5.21E+01	7.81E-06					1.0E-01	1.8E-05
SVOC	Anthracene	120-12-7	ID	N		1.96E+00	2.93E-07						
SVOC	Benzo(a)anthracene	56-55-3	B2	Y		2.63E+00	3.95E-07	6.0E-02	1	3.4E-09			
SVOC	Benzo(a)pyrene	50-32-8	HC	Y		2.29E+00	3.44E-07	6.0E-01	1	3.0E-08		2.0E-06	3.9E-02
SVOC	Benzo(b)fluoranthene	205-99-2	B2	Y		2.66E+00	3.98E-07	6.0E-02	1	3.4E-09			
SVOC	Benzo(g,h,i)perylene	191-24-2	D	N		1.41E+00	2.12E-07						
SVOC	Chrysene	218-01-9	B2	Y		3.17E+00	4.75E-07	6.0E-04	1	4.1E-11			
SVOC	Ethanol	64-17-5		N								1.9E+01	
SVOC	Fluorene	86-73-7	D	N		4.40E+00	6.60E-07						
SVOC	Indeno(1,2,3-cd)pyrene	193-39-5	B2	Y		1.52E+00	2.28E-07	6.0E-02	1	2.0E-09			
SVOC	Naphthalene	91-20-3	C	N		2.19E+02	3.29E-05	3.4E-02		3.6E-08		3.0E-03	2.5E-03
SVOC	Phenanthrene	85-01-8	D	N		7.97E+00	1.20E-06						
SVOC	Pyrene	129-00-0	NC	N		4.88E+00	7.32E-07						
SVOC	Tetraethylene Glycol	112-60-7		N									
INORG	Lead	7439-92-1	B2	N		1.15E+03	1.73E-04						
				Cumulative Risk/HI:						**8E-08**			**4E-02**

Notes:
The concentration of particulates in the air is assumed to be no more than the former annual National Ambient Air Quality Standards (NAAQS) for PM_{10} of 150 ug/m^3.
f_{inh} is the fraction of the inhalation toxicity value that USEPA identified as having a mutagenic mode of action.

Exposure Factors

Exposure Time	ET	8	hours/day
Exposure Frequency	EF	250	days/year
Exposure Duration	ED	10	years
Averaging Time (Cancer)	AT_c	613,200	hours
Averaging Time (Noncancer)	AT_{nc}	87,600	hours

Appendix B

Acute Exposure Guideline Levels (AEGLs)

Appendix B
Acute Exposure Guideline Levels (AEGL)
Philadelphia Energy Solutions Refining & Marketing LLC (PESRM) Philadelphia Refining Complex, Philadelphia, Pennsylvania

Chem Group	Chemical	CASRN	10 min (ppmv)	30 min (ppmv)	60 min (ppmv)	4 hr (ppmv)	8 hr AEGL (ppmv)
VOC	Benzene	71-43-2	130	73	52	18	9
VOC	Cumene	98-82-8	50	50	50	50	50
VOC	1,2-Dibromoethane	106-93-4	52	26	17	7.1	4.6
VOC	1,2-Dichloroethane	107-06-2	--	--	--	--	--
VOC	Ethyl Benzene	100-41-4	33	33	33	33	33
VOC	Methyl tert-butyl ether	1634-04-4	50	50	50	50	50
VOC	Toluene	108-88-3	67	67	67	67	67
VOC	1,2,4-Trimethylbenzene	95-63-6	180	180	140	90	45
VOC	1,3,5-Trimethylbenzene	108-67-8	180	180	140	90	45
VOC	Xylenes (total)	1330-20-7	130	130	130	130	130
SVOC	Naphthalene	91-20-3	--	--	--	--	--
		Minimum:	33	26	17	7.1	4.6

Notes:

1. United States Environmental Protection Agency AEGLs
2. AEGL Level 1 is used, which is dictated by notable discomfort, irritation, or certain asymptomatic non-sensory effects

hr = hours
min = minutes
ppmv = parts per million by volume
SVOC = semivolatile organic compounds
VOC = volatile organic compounds