Appendix C
Atmospheric Dispersion Modeling Analyses
Petroleum Coke Processing and Handling Operations
Marathon Petroleum Company, Detroit Refinery

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Contents

List of Tables

List of Figures

List of Attachments

Acronyms

AERMOD	AMS/EPA Regulatory Dispersion Model
AQD	Air Quality Division
BPIP	U.S. EPA's Building Profile Input Program
°F	Degrees Fahrenheit
°C	Degrees Centigrade or Celsius
EGLE	Michigan Department of Environment, Great Lakes, and Energy, Air Quality Division
U.S. EPA	United States Environmental Protection Agency
NAAQS	National Ambient Air Quality Standard
NWS	National Weather Service
Point Sources	Emission sources that emit from a defined location, such as a stack or a vent
PM	Particulate matter
$PM_{2.5}$	Fine particulate matter (fine particulate matter, defined as particulate matter less than 2.5 microns in aerodynamic diameter)
PM_{10}	Fine particulate matter (fine particulate matter, defined as particulate matter less than 10 microns in aerodynamic diameter)
PTE	Potential to emit
ROP	Renewable Operating Permit (also known as a Title V Operating Permit)
SIL	Significant Impact Level

1 Executive Summary

Marathon Petroleum Company LP (MPC) owns and operates a petroleum refinery located at 1300 Fort Street, Detroit (the Detroit Refinery). Operations at the Detroit Refinery include a Coker Unit, which processes heavy crude oil and produces various intermediate streams, including petroleum coke, that are further refined into saleable products. The petroleum coke produced at the Coker Unit is processed and loaded into trucks before being trucked off-site. Emissions from the Coker Unit are regulated under Renewable Operating Permit No. MI-ROP-A9831-2012c (the ROP), issued by the Michigan Department of Environment, Great Lakes, and Energy, Air Quality Division (EGLE) on March 26, 2012 and last amended on July 8, 2016. The location of the Detroit Refinery and nearby communities is shown in **Figure 1**.

Figure 1 **Location of the Detroit Refinery and Nearby Communities**

Atmospheric dispersion modeling analyses of potential fine particulate matter emissions (expressed as PM_{10} and $PM_{2.5}$) associated with coke processing, handling, and truck loading operations at the Coker Unit have been conducted to assess the potential for adverse health impacts in communities located near the Detroit Refinery. The analyses were conducted in accordance with applicable federal and State of Michigan modeling guidance, including the applicable provisions of 40 CFR Part 51, Appendix W (Guideline on Air Quality Models) and supporting U.S. EPA memoranda, as well as Rules 336.1240 and 336.1241 of Michigan's Administrative Rules for Air Pollution Control (PA 451 of 1994, as amended). In addition, the modeling analyses were conducted in a manner consistent with modeling analyses of the Detroit Refinery previously reviewed and approved by EGLE.

Based on established health-based ambient air thresholds, the modeling analyses presented in this report demonstrate that the coke processing, handling, and truck loading operations, as currently permitted and controlled, do not pose a health risk to nearby communities.

Databases utilized to assess off-site PM_{10} and $PM_{2.5}$ impacts associated with the coke processing, handling, and truck loading operations are described in **Section 2** of this technical report. The modeling methodology and predicted off-site impacts are presented in **Section 3**.

2 Dispersion Model and Modeling Databases

The successful outcome of an air quality impact analysis depends upon the use of an appropriate dispersion model and application of model-required databases that are representative of dispersion conditions within the study area. Databases utilized in the modeling study are presented below.

2.1 Dispersion Model

Model simulations were conducted using the AMS/EPA Regulatory Dispersion Model (AERMOD, Release No. 19191). AERMOD is currently recommended and approved by the U.S. EPA and AQD for use in industrial source modeling applications. The model is routinely used to assess air quality impacts from industrial sources in Wayne County in support of State Implementation Plan development and emission source permitting.

AERMOD is designed to simulate atmospheric transport conditions associated with this air quality impact analysis, including:

- Applies an algorithm and surface roughness routine designed to simulate dispersion conditions in an urban setting;
- Simulates dispersion in high and low wind conditions;
- Handles dispersion influenced by building downwash effects;
- Flat and simple terrain features; and
- Provides concentration estimates over short-term and annual averaging periods.

Consistent with U.S. EPA and AQD guidance, the AERMOD simulations were conducted in the Regulatory Default mode.

2.2 Modeling Databases

2.2.1 Land Use and Dispersion Mode

Atmospheric conditions affecting the downwind dispersion of air emissions may be influenced by localized land use. Dispersion coefficients have been developed for both rural and urban environments. Based on U.S. EPA guidance[1], the selection of either rural or urban dispersion coefficients may follow a typing scheme recommended by Auer; which is considered the more definitive of the allowable procedures.

Following the Auer land use classification scheme, land use within a three kilometer radius of the Detroit Refinery exhibits urban typing. Therefore, consistent with recent AQD-approved modeling analyses of the Detroit Refinery, the AERMOD simulations were conducted using the urban dispersion algorithm and a regulatory default urban roughness length of one meter. Population data is required when modeling in

[1] Unless otherwise cited in this document, references to U.S. EPA guidance will mean the Guideline on Air Quality Models, 40 CFR Part 51, Appendix W, U.S. EPA, January 2017.

urban mode. Utilizing 2010 census data for Detroit, Melvindale, Lincoln Park, Allen Park, Dearborn, and River Rouge, a population of 999,558 (URBANOPT 999558) was input to AERMOD.

2.2.2 Receptor Points

AERMOD-predicted concentrations may be estimated at discrete receptor locations. Accordingly, a discrete Cartesian receptor grid was developed at a lateral extent and density sufficient to assess PM_{10} and $PM_{2.5}$ impacts from the coke processing, handling, and truck loading operations in nearby communities. The receptor grid extends approximately 15 kilometers from the center of the Detroit Refinery at the following receptor density:

- No greater than 25 meter spacing along the refinery property boundary;
- 50 meter spacing out to a distance of approximately 2.5 kilometers;
- 100 meter spacing out to a distance of approximately 5 kilometers;
- 250 meter spacing out to a distance of approximately 7.5 kilometers;
- 500 meter spacing out to a distance of approximately 10 kilometers; and
- 1 kilometer spacing out to a distance of approximately 15 kilometers.

The modeled grid consisted of 10,224 discrete receptor points. The extent and density of the receptor grid, overlaid on aerial imagery, is shown in **Figure 2**.

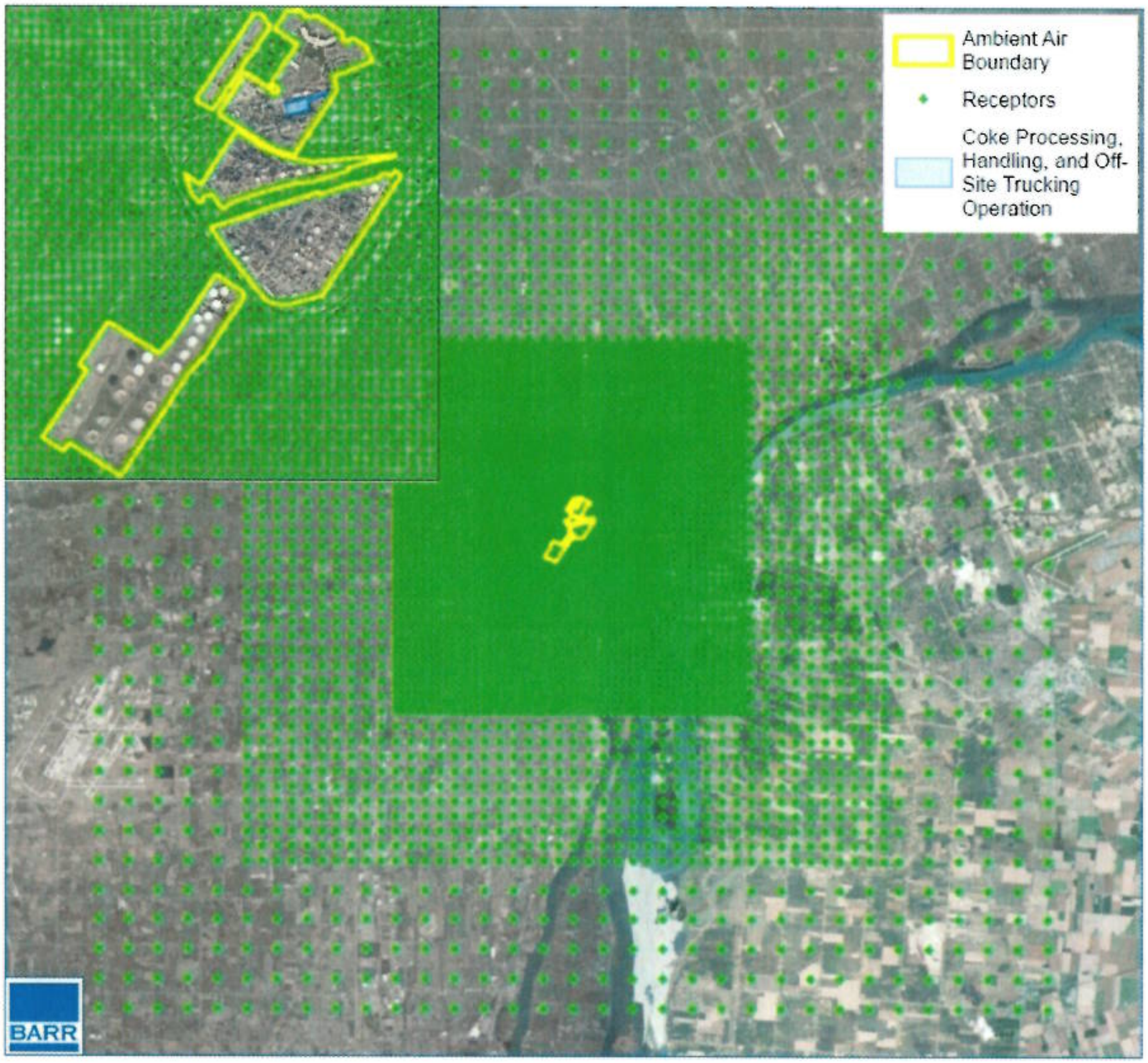

Figure 2 **Receptor Grid Used in the Air Quality Impact Analysis**

2.2.3 Topography

Elevated terrain features may affect the transport of atmospheric contaminants as well as serve as areas of potentially higher pollutant impacts. Where appropriate, terrain features should be included in the modeling analysis. A review of topographic projection data reveals only minor variations in terrain elevations at and nearby the Detroit Refinery. To account for these minor variations, terrain elevations for each modeled receptor point and emission source were obtained using the U.S. EPA's AERMAP preprocessor (Release No. 18081)) along with 1/3 arc second National Elevation Model (NEM) terrain files obtained from the U.S. Geologic Survey. AERMAP-calculated terrain elevations were subsequently input to AERMOD.

2.2.4 Meteorological Data

Consistent with previous EGLE-approved modeling analyses of the Detroit Refinery, model simulations were conducted using surface observations measured at the Detroit City Airport (Station No. 14822), combined with coincident upper air observations measured at the National Weather Service (NWS) station located in White Lake, Michigan (Station No. 72632).[2] The meteorological database was obtained in one minute, U* adjusted format from EGLE website.

To ensure that worst-case meteorological conditions are represented, the U.S. EPA recommends that model simulations use five years of NWS observations. In accordance with the guidance, the model simulations were conducted using five years of the Detroit City/White Lake meteorological database (2014-2018).

2.2.5 Modeled Emission Rates and Source Release Parameters

The coke processing, handling, and truck loading operations have the potential to emit limited quantities of PM_{10} and $PM_{2.5}$. Emission sources along the process line extending from the coke pit to trucks include the coke pit, multiple transfer operations, and an enclosed coke crusher. The coke pit is enclosed on all sides by 30 foot tall walls and was, therefore, modeled as an elevated area source. The coke feed bin – the location in the process line where coke is transferred from the overhead crane to the crusher – is located in the coke pit and was also modeled as an elevated area source. Emissions generated in the coke crusher building and the truck transfer building are controlled by a fabric filter dust collector that vent to horizontal stacks. These types of stacks are simulated in AERMOD as horizontal point sources using the POINTHOR algorithm. Modeled source release parameters are summarized in **Table 1** below.

Table 1 Modeled Source Release Parameters

Modeled Source ID	Modeled Source Description	Stack Coordinate (UTM)		Release Height		Side Length		Side Length		Rotation Angle
		Easting	Northing	(ft)	(m)	(ft)	(m)	(ft)	(m)	θ
Area Sources Associated with Coke Pile Operation										
PILE	Unload, Maintenance, Wind Erosion	322242.5	4683789.1	30	9.14	250	76.20	135	41.15	342
FEEDBIN	Drop to Feed Bin	322265.0	4683830.9	30	9.14	18	5.49	18	5.49	342

[2] Though meteorological data is collected at two on-site Detroit Refinery weather stations, the measured surface observations are not designed to be used in a refined dispersion model such as AERMOD.

Modeled Source ID	Modeled Source Description	Stack Coordinate (UTM)		Stack Diameter		Stack Height		Exit Gas Temperature		Exit Velocity
		Easting	Northing	(ft)	(m)	(in)	(m)	(F)	(K)	(m/s)
Point Sources Associated with Coke Pile Operation										
DRP2BLT	Drop to Belt Feeder	322256.6	4683843.0	10	3.05	27	8.23	(1)	0.0	(2)
CRUSHER	Crushing, Drop to Belt Conveyor	322226.7	4683836.5	10	3.05	22	6.71	(1)	0.0	(2)
SILO	Drop to Silo, Drop to Truck/Rail	322425.4	4683890.4	10	3.05	120	36.58	(1)	0.0	(2)

Notes:

(1) – Sources with an exhaust temperature equal to ambient temperature are identified in the model by setting the exhaust temperature to 0.0 ° K.

(2) – The source is setup as a horizontal point source. Exit velocities were set to 0.001 m/s to represent the most conservative flow with regards to dispersion.

To ensure that worst-case possible off-site impacts were assessed, the model simulations were based on each source's maximum potential to emit rather than at the lower emission levels that have actually occurred since the commencement of operation in 2012. Accordingly, potential PM_{10} and $PM_{2.5}$ emissions associated with the coke processing, handling, and truck loading operations were estimated based on the maximum permit-allowable coke production rate, emission factors published by the U.S. EPA, and emission control measures required under the ROP. Operation of the coke processing, handling, and truck loading operations is effectively limited by the ROP-allowable Coker Unit coke production limit of 500 tons per hour (daily average).[3] The modeled emission rates summarized below in **Table 2** are based on the ROP-allowable coke production limit.

Table 2 Modeled PM_{10} and $PM_{2.5}$ Emission Rates

Modeled Source ID	Modeled Source Description	PM10				PM2.5			
		Short-term		Annual		Short-Term		Annual	
		(lb/hr)	(g/s/m²)	(ton/yr)	(g/s/m²)	(lb/hr)	(g/s/m²)	(ton/yr)	(g/s/m²)
Area Sources Associated with Coke Pile Operation									
PILE	Coke Pile Load/Unload, Maintenance, Wind Erosion	0.014	5.524E-07	0.015	1.383E-07	0.003	1.261E-07	0.007	6.474E-08
FEEDBIN	Drop to Feed Bin	0.104	4.361E-04	0.080	7.660E-05	0.016	6.603E-05	0.012	1.160E-05

[3] Condition II.1, EU70-COKER-S1.

Modeled Source ID	Modeled Source Description	PM10				PM2.5			
		Short-term		Annual		Short-Term		Annual	
		(lb/hr)	(g/s/m²)	(ton/yr)	(g/s/m²)	(lb/hr)	(g/s/m²)	(ton/yr)	(g/s/m²)
Point Sources Associated with Coke Pile Operation									
DRP2BLT	Drop to Belt Feeder	0.010	1.313E-03	0.008	2.306E-04	0.002	1.988E-04	0.001	3.492E-05
CRUSHER	Drop to Crusher, Crushing, Drop to Belt Conveyor	0.055	6.878E-013	0.042	1.208E-03	0.037	4.650E-03	0.028	8.168E-04
SILO	Drop to Silo, Drop to Truck/Rail	0.00021	2.625E-05	0.00016	4.611E-06	0.00003	3.975E-06	0.00002	6.983E-07

These emission rates were reviewed and approved by EGLE as part of the Detroit Heavy Oil Upgrade Project (DHOUP) permitting in 2008.

2.2.6 Building Downwash

Structures have the potential to influence emissions from the three point sources associated with the coke handling operations (refer to **Table 2** for point source descriptions). The U.S. EPA-approved BPIP-PRIME program (Release No. 04274) was used to assess aerodynamic downwash effects on the modeled emission points. Maximum projected lateral and vertical dimensions of influencing structures, calculated by BPIP-PRIME on a wind direction-specific basis, were subsequently input to AERMOD.

Building projections in relation to the emission points are illustrated in **Figure 3**.

Figure 3 **Emission Points in Relation to Building Structures**

3 Air Quality Impact Analysis

3.1 Modeling Methodology

Atmospheric dispersion modeling analyses of potential PM_{10} and $PM_{2.5}$ emissions associated with coke processing, handling, and truck loading operations at the Coker Unit have been conducted to assess the potential for adverse health impacts in communities located near the Detroit Refinery. The modeling analyses were conducted in accordance with applicable federal and State of Michigan modeling guidance, including the applicable provisions of 40 CFR Part 51, Appendix W (Guideline on Air Quality Models) and supporting U.S. EPA memoranda, as well as Rules 336.1240 and 336.1241 of Michigan's Administrative Rules for Air Pollution Control.

The U.S. EPA has established national ambient air quality standards (NAAQS) designed to be protective of public health and the environment. An existing facility may not cause an air quality impact that exceeds the NAAQS. The primary PM_{10} NAAQS is 150 $\mu g/m^3$ over a 24-hour averaging period.[4] The primary $PM_{2.5}$ NAAQS is 35 $\mu g/m^3$ over a 24-hour averaging period[5] and 12 $\mu g/m^3$ over an annual averaging period.[6]

The U.S. EPA has also established significant impact levels (SILs) that are much lower than the NAAQS. When conducting dispersion modeling of a new or modified emission source (typically as part of an air permit application), model-predicted concentrations lower than a SIL indicate that the source does not have a significant or meaningful impact on air quality and will, therefore, not cause or contribute to an exceedance of the NAAQS.[7] The PM_{10} SIL is 5 $\mu g/m^3$ over a 24-hour averaging period.[8] The $PM_{2.5}$ SIL is 1.2 $\mu g/m^3$ over a 24-hour averaging period[9] and 0.2 $\mu g/m^3$ over an annual averaging period.[10]

Though the coke processing, handling, and truck loading operations do not constitute a new or modified source, the results of the model simulations conducted as part of this analysis were compared against the more restrictive SILs (as well as the NAAQS).

3.2 Evaluation of Model-Predicted Impacts

Utilizing AERMOD over the five-year meteorological database (2014-2018 Detroit City/White Lake), model simulations of potential PM_{10} and $PM_{2.5}$ emissions from the coke processing, handling, and truck loading operations were modeled and resultant predicted off-site impacts were compared against the U.S. EPA-established SILs and NAAQS. Everywhere in nearby communities where model-predicted impacts are less

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[4] Not to be exceeded more than once per year on average over three years.

[5] 98th percentile averaged over three years.

[6] Annual mean concentration averaged over three years.

[7] Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program, U.S. EPA Memorandum to Regional Air Division Directors, April 17, 2018.

[8] Not to be exceeded.

[9] 98th percentile averaged over three years.

[10] Annual mean concentration averaged over three years.

than a SIL are considered to be insignificant and will not cause an exceedance of the health-based NAAQS. Everywhere where modeled impacts are greater than a SIL indicates that further evaluation may be necessary before concluding that the source does not cause or contribute to an exceedance of the NAAQS. The results of the model simulations are summarized below in **Table 3**.

Table 3 **Comparison of Model-predicted Impacts to the Significant Impact Levels (NAAQS also shown)**

Pollutant	Maximum Modeled Concentration [$\mu g/m^3$]	SIL [$\mu g/m^3$]	NAAQS [$\mu g/m^3$]	Averaging Period	Statistical Metric for the SIL Over a Three-Year Period
PM_{10}	7.6	5	150	24-Hour	Not to be exceeded.
$PM_{2.5}$	3.1	1.2	35	24-Hour	98^{th} percentile.
	0.08	0.2	12	Annual	Annual mean.

As shown above, maximum modeled concentrations were predicted above the 24-hour PM_{10} and $PM_{2.5}$ SILs, but well under the NAAQS. Model-predicted 24-hour PM_{10} and $PM_{2.5}$ concentrations were then plotted onto aerial imagery to assess whether impacts above the SILs extend into nearby communities. The location and extent of model-predicted concentrations above the 24-hour PM_{10} SIL are shown in **Figure 4**, while the location and extent of model-predicted concentrations above the 24-hour $PM_{2.5}$ SIL are shown in **Figure 5**.

Figure 4 **Extent of Modeled 24-Hour PM_{10} Significant Impact Area from Coke Handling Operations**

Figure 5 **Extent of Modeled 24-Hour $PM_{2.5}$ Significant Impact Area from Coke Handling Operations**

As shown in the figures, maximum model-predicted 24-hour PM_{10} and $PM_{2.5}$ concentrations are less than the SILs over all nearby communities. Model-predicted concentrations above the SILs are limited to a small area encompassing the refinery property boundary, a section of Oakwood Boulevard no longer accessible to the public, and adjacent industrial property. Therefore, based on established health-based ambient air thresholds, the modeling analyses demonstrate that the coke processing, handling, and truck loading operations, as currently permitting and controlled, do not pose a health risk to nearby communities.

It should be noted that the modeling results are likely an over-prediction and are, therefore, conservative for the following reasons:

- Modeled-predicted concentrations are based on potential to emit, which is the theoretical maximum rate that each modeled source can emit concurrently. To date, this level of emissions has never occurred, as verified through actual emission reports submitted annually to EGLE through its air emission reporting program (MAERS). Modeling of actual emissions from the coke processing, handling, and truck loading operations would result in even lower impacts.

- The modeling represents the contribution of all emission sources associated with the coke processing, handling, and truck loading operations. The contribution of the coke pit and dewatering pad – the only portion of the operation for which a partial variance is requested – is only a fraction of the total contribution, and is less than the SILs over all off-site receptors.

The dispersion modeling input/output files and databases supporting this air quality impact analysis are enclosed in electronic format (USB Flash Drive) in **Attachment A**.

Attachment A

Dispersion Modeling Input/Output Files and Supporting Databases

(USB Drive – Found in Appendix D of the MRD Bulk Solid Materials Ordinance Variance Technical Report)

Appendix D

Electronic Submittal (USB Drive)

Records of Visible Emissions Observations and Dispersion Modeling Input/Output Files

Appendix E

Review of Existing Emissions Controls – Coking.com

Prepared for the Detroit Buildings, Safety, Environmental and Engineering Department (July 2, 2019)

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Detroit Buildings, Safety, Environmental and Engineering Department
Coleman A. Young Municipal Center
2 Woodward Ave #401
Detroit, MI 48226

July 2, 2019

Re: Marathon Detroit Coke Pad Cover Variance

Dear Director Bell –

Coking.com is an independent provider of delayed coking technical consulting and a coking specific conference host. Our mission is to improve the safety and reliability of the coking industry through sharing of best practices and lessons learned. We have interacted, whether it be online, at our events, or onsite consulting, with nearly every delayed coker operating company in the world. From this position, we support the variance request on behalf of the Marathon Detroit coker to leave the coke pit uncovered. The existing emissions control systems exceed industry norms. The operations team ensures the control systems are functional and properly working routinely. The cleanliness of the unit and the surrounding area demonstrates the facts clearly. We were recently onsite to personally verify these observations. Adding the cover to the pit would create additional hazards to operation and would not materially reduce the dust emissions. For all these reasons, we support the variance request.

Sincerely,

Evan Hyde
Director of Field Services
Refining Community
Coking.com Inc

Detroit Refinery
Petroleum Coke Handling

Overview

Marathon Petroleum's Detroit Refinery is home to a world-class Petroleum Coke Processing unit that allows for the safe, efficient and clean use during the refining process.

During construction of the petroleum coke unit, Marathon implemented a number of state-of-the-art controls to eliminate any fugitive dust from the petroleum coke process. In accordance with the operating permit for this process, Marathon implemented an approved Fugitive Dust Control Plan. Below are the methods outlined in this plan to prevent and control fugitive dust.

During Production

> **Water Curtain** – Once the pet coke has been hardened, a high-powered water jet is used to cut the coke from the drums. The wet pet coke is then discharged through an intense water curtain into a containment pit full of water the size of two Olympic-sized swimming pools. This wet process prevents fugitive dust emissions.

> **Containment Pit** – The coke containment pit and staging pad are surrounded by 30' tall walls. A crane retrieves coke from the pit full of water for temporary staging, allowing excess water to drain. Water is recycled back into the process. Coke height is maintained below the height of the wall to prevent any blowing or spreading.

> **Coke Pad Sprinkler System** – A high-volume sprinkler system is used to maintain the moisture content of the coke within the containment pit as an additional safeguard against fugitive dust.

> **Enclosed Transfer/Crusher System** – The crane moves the coke on to a fully-enclosed conveyor. This fully enclosed conveyor has an air handling system equipped with a bag house filter system and a water wash to remove any fugitive dust that may have formed.

During Transportation

> **Truck Load-out Building** – Truck loading occurs in an enclosed building with an air curtain and bag house filter system, ensuring that the quality of air in the building is safe for our employees. Coke samples are collected and analyzed three times per week for moisture.

> **Vehicle Covers** – All transport trailers are covered before leaving the truck load-out building.

> **Truck Wheel Wash and Rumble Strips** – Before exiting the load-out building, trucks pass over rumble strips and through a wheel wash designed to ensure all vehicles are clean prior to entering public roadways. All wash water is recycled back into the process.

> **Visible Emissions Monitoring** – Visible emissions observations are conducted daily by the coke handling operators to confirm that the fugitive dust control system is properly preventing emissions from the coke processing and transport operations.

Additional Dust Control Practices

> **On-site Speed Limits** – All vehicles travel at posted speed limits (5 mph in coke handling area).

> **Vehicle Covers** – Material transport trailers are kept covered, except when loading or unloading.

> **On-site Road Cleaning** – If needed, a street sweeper or water truck operates to clean refinery roads.

> **Visible Emissions Monitoring** – Visible emissions observations are conducted by trained 3rd party personnel, on a monthly basis, to confirm that the fugitive dust control system is properly controlling emissions.

> **Enhanced Street Sweeping Program** – The Detroit Refinery has voluntarily implemented an enhanced street sweeping program designed to control fugitive dust emissions from nearby roadways, including Oakwood Blvd., Dix Road, Schaefer Ave., and Fort Street.

> **Perimeter Air Monitoring System (PAMS)** – The refinery maintains four air monitoring stations surrounding the refinery that continuously measure a variety of components including particulate matter.

Bulk solid material handling operations at the Detroit Refinery are regulated by the Michigan Department of Environment, Great Lakes, and Energy's Air Quality Division (Renewable Operating Permit No. MI-ROP-A9831-2012c). In accordance with this permit, Marathon has implemented an approved Fugitive Dust Control Plan that complies with the applicable emission control requirements of the Natural Resources and Environmental Protection Act and Michigan's Administrative Rules for Air Pollution Control.