Air Quality Conformity Analysis Report

Dover/Kent County Metropolitan Planning Organization
FY 2020-2023 Transportation Improvement Program (TIP)
and 2040 Metropolitan Transportation Plan (MTP)

Prepared for:

Dover/Kent County Metropolitan Planning Organization

In association with:

Delaware Department of Transportation
Delaware Department of Natural Resources and Environmental Control

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INTRODUCTION

The Dover/Kent County Metropolitan Planning Organization (Dover/Kent County MPO) is the federally-designated agency responsible for coordinating transportation planning and programming in Kent County, Delaware, including all of Milford and Smyrna. Plans and programs adopted by the MPO outline how federal transportation funds will be spent and, must comply with federal laws governing clean air and transportation. Dover/Kent County MPO is responsible for developing a Transportation Improvement Program (TIP) and a Metropolitan Long-Range Transportation Plan (MTP) in cooperation with the Delaware Department of Transportation (DelDOT) and affected transit operators.

In accordance with federal planning requirements, a collaborative process has been developed wherein state, county, and local governments and transportation providers are partners in the planning and programming process.

Dover/Kent County MPO is required by law to demonstrate that the MTP and TIP conform to the transportation emission budgets set forth in the Statewide Implementation Plan (SIP) for each state. If emissions generated from the projects programmed in the TIP and MTP are equal to or less than the emission budgets in the SIPs, then conformity has been demonstrated.

Kent County is part of the Philadelphia-Wilmington-Trenton non-attainment area, though it was not cited as a non-attainment county. When the standard was first adopted, Kent County was in attainment and the Dover/Kent County MPO was not required through federal regulations to show that the FY 2020-2023 TIP complied with the requirements of the 1990 CAA and subsequent amendments. A challenge to the ozone standards released by the EPA was partially upheld, however, and Kent County was designated as "Partial Orphan Nonattainment Area" by EPA through the "Transportation Conformity Guidance for the South Coast II Court Decision" released in November 2018[1]. Based on the Guidance, transportation conformity for the 1997 ozone National Ambient Air Quality Standard (NAAQS) will again apply in orphan areas as of February 16, 2019. The Dover/Kent County MPO is now required to comply with the 1997 ozone standard as well.

This report documents the analysis of Air Quality implications of the Dover/Kent County MPO 2020-2023 TIP and 2040 MTP. This document demonstrates the transportation conformity of the Dover/Kent County MPO's 2020-2023 TIP and 2040 MTP under the 8-hour ozone and NAAQS. Kent County has never been designated as non-attainment area for PM2.5. The PM2.5 emission analyses are included in this report to demonstrate the PM2.5 emission in Kent County for the Dover/Kent County MPO's 2020-2023 TIP and 2040 MTP.

The methodology and data assumptions used for the conformity analysis are illustrated. Detailed emission results are presented for each analysis year, by summer weekday and by daily and annual average. Modeling input and output files have been reviewed by Delaware Department of Natural Resources and Environmental Control (DNREC).

NATIONAL AMBIENT AIR QUALITY STANDARD

The Clean Air Act (CAA) requires the Environmental Protection Agency (EPA) to set NAAQS designations for pollutants considered harmful to public health and the environment. A nonattainment area is any area that does not meet the primary or secondary NAAQS. Once a nonattainment area meets the standards and additional redesignation requirements in the CAA (Section 107(d)(3)(E)), EPA will designate the area as a maintenance area.

Kent County is part of the Philadelphia-Wilmington-Trenton non-attainment area, though it was not cited as a non-attainment county. When the standard was first adopted, Kent County was in attainment and the Dover/Kent County MPO was not required through federal regulations to show that the FY 2020-2023 TIP complied with the requirements of the 1990 CAA and subsequent amendments. A challenge to the ozone standards released by the EPA was partially upheld,

[1] https://www.epa.gov/sites/production/files/2018-11/documents/420b18050.pdf

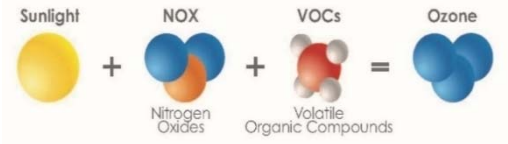
however, and the Dover/Kent County MPO is now required to comply with the 1997 ozone standard as well.

Ozone Background

Ozone is an odorless, colorless gas composed of three atoms of oxygen (O3). While ozone in the stratosphere forms a protective layer, shielding the earth from the sun's harmful rays, ground-level ozone is a harmful air pollutant to people's health and the environment, and it is a key contributor to smog.

Ozone exposure is detrimental to public health. Ozone can irritate lung airways and cause inflammation similar to sunburn. Other symptoms include wheezing, coughing, and pain when taking a deep breath and breathing difficulties during exercise or outdoor activities. People most at risk from breathing air containing ozone include people with asthma, children, older adults, and people who are active outdoors, especially outdoor workers. In addition, people with certain genetic characteristics, and people with reduced intake of certain nutrients, such as Vitamins C and E, are at greater risk from ozone exposure. Even at very low levels, ground-level ozone triggers a variety of health problems including aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses such as pneumonia and bronchitis.[2]

In addition to adverse health effects, ground-level ozone also interferes with the ability of plants to produce and store food, which makes them more susceptible to disease, insects, other pollutants, and harsh weather. As a result, ground-level ozone negatively impacts both agricultural productivity and ecosystem stability. Furthermore, ozone damages the leaves of trees and other plants, ruining the appearance of cities, national parks, and recreation areas.



Ground-level ozone is not emitted directly into the air but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Motor vehicle exhaust, industrial emissions, gasoline vapors, chemical solvents, and natural sources all contribute to NOx and VOC emissions. Since ozone is formed in the presence of heat and sunlight, it is considered a summertime pollutant.

8-Hour Ozone National Ambient Air Quality Standards

On July 18, 1997, EPA published the 1997 8-hour ozone NAAQS via the Federal Register (62 FR 38856) with an effective date of September 16, 1997. An area was in nonattainment of the 1997 8-hour ozone NAAQS if the 3-year average of the individual fourth highest air quality monitor readings, averaged over 8 hours throughout the day, exceeded the NAAQS of 0.08 parts per million (ppm). On May 21, 2013, the EPA published a rule revoking the 1997 8-hour ozone NAAQS, for the purposes of transportation conformity, effective one year after the effective date of the 2008 8-hour ozone NAAQS area designations (77 FR 30160).

On May 21, 2012, EPA issued a final rule via the Federal Register (77 FR 30088) establishing initial air quality designations for the 2008 primary and secondary NAAQS for ozone. The 2008 standard is set at an 8-hour average concentration of 0.075 ppm and retains the same general

[2] *Ozone and your health* - https://www3.epa.gov/airnow/ozone-c.pdf

form and averaging time as the 0.080 ppm NAAQS set in 1997. The effective date of the 2008 ozone standard designations was July 20, 2012.

On October 26, 2015, EPA issued 2015 primary and secondary NAAQS for ozone via Federal Register 80 FR 65292. The 2015 standards revised the levels of primary and secondary standards to 0.070 ppm, and retained their indicator (O3), forms (fourth-highest daily maximum, average across three consecutive years), and averaging time (eight hours).

Under the CAA, the EPA Administrator is required to make all attainment designations within two years after a final rule revising the NAAQS is published. However, the deadline for EPA to issue designations for the 2015 NAAQS for ozone passed on October 1, 2017. Once designations are final, transportation conformity would be required within 12 months for any areas designated nonattainment under the standard.

Kent County is part of the Philadelphia-Wilmington-Trenton non-attainment area under the 1997 8-hour ozone NAAQS, though it was not cited as a non-attainment county. When the standard was first adopted, Kent County was in attainment and the Dover/Kent County MPO was not required through federal regulations to show that the FY 2020-2023 TIP complied with the requirements of the 1990 CAA and subsequent amendments. A challenge to the ozone standards released by the EPA was partially upheld, however, and Kent County was designated as "Partial Orphan Nonattainment Area" by EPA through the "Transportation Conformity Guidance for the South Coast II Court Decision" released in November 2018[3]. Based on the Guidance, transportation conformity for the 1997 ozone NAAQS will again apply in orphan areas as of February 16, 2019. The Dover/Kent County MPO is now required to comply with the 1997 ozone standard as well.

PM2.5 Background

Particulate matter is a mixture of solid particles and liquid droplets found in the air. Particulate matter contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems. Particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream. PM2.5 refers to the fine particulate matter with diameters that are generally 2.5 micrometers and smaller (or about one-thirtieth the diameter of a human hair).

The health effects associated with exposure to fine particles are significant. Scientific studies have shown that long-term exposures have been associated with problems such as reduced lung function, the development of chronic bronchitis, and even premature death. Short-term exposures to particles (hours or days) can aggravate lung disease, causing asthma attacks and acute bronchitis, and may also increase susceptibility to respiratory infections. In people with heart disease, short-term exposures have been linked to heart attacks. While fine particles are unhealthy for anyone to breathe, people with heart or lung disease, asthmatics, older adults, and children are especially at risk.[4]

[3] https://www.epa.gov/sites/production/files/2018-11/documents/420b18050.pdf

[4] https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

Fine particles can be emitted directly (such as smoke from a fire, or as a component of automobile exhaust) or be formed indirectly in the air from reactions of chemicals such as sulfur dioxide and nitrogen oxides that are emitted pollutants from plants, industries and automobiles.

PM2.5 National Ambient Air Quality Standards

In July 1997, EPA issued NAAQS for PM2.5, designed to protect the public from exposure to PM2.5 at levels that may cause health problems. That standard included two elements:

1. An annual standard set at 15 µg/m3, based on a three-year average of the annual mean PM2.5 concentrations, and

2. A 24-hour standard of 65 µg/m3, based on a three-year average of the 98th percentile of 24-hour concentrations.

On October 17, 2006, EPA issued the final rule of 2006 NAAQS for PM2.5 via Federal Register 40 CFR Part 50. The 2006 NAAQS for PM2.5 was effective on December 18, 2006. In the 2006 NAAQS for PM2.5, EPA revised the level of 24-hour PM2.5 standard to 35 micrograms per cubic meter and retained the level of annual PM2.5 standard at 15 micrograms per cubic meter.

To provide requisite protection against health effects associated with long- and short-term PM2.5 exposures, EPA revised the annual PM2.5 standard by lowering the level to 12.0 micrograms per cubic meter and to retain the 24-hour PM2.5 standard at a level of 35 micrograms per cubic meter in the 2012 NAAQS for PM2.5. The EPA issued the final rule of 2012 NAAQS for PM2.5 on January 15, 2013 via Federal Register 40 CFR Parts 50, 51, 52 et al and the final rule was effective on March 18, 2013.

Kent County has never been designated as non-attainment area for PM2.5. There is no PM2.5 conformity budget requirement for Kent County. The PM2.5 emission analysis is conducted and the results are presented to demonstrate the PM2.5 emission in Kent County for the Dover/Kent County MPO's 2020-2023 TIP and 2040 MTP.

TRANSPORTATION CONFORMITY

Transportation conformity was first introduced and included in the 1977 CAA to ensure that federal funding and approval go to the transportation activities are consistent with air quality goals. These goals are set in the air quality State Implementation Plan (SIP) in each state. Transportation conformity requirements were made substantially more rigorous in the CAA Amendments of 1990, and the implementation details of the CAA requirements were first issued in the November 24, 1993 through Federal Register. The regulations establish the criteria and procedures for transportation agencies to demonstrate that air pollutant emissions from MTP, TIP, and projects funded or approved by the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA) are consistent with the State's air quality goals in the SIP. The most recent amendment of transportation conformity implementation requirements was issued in April 2012.

The SIP is a federally-approved and enforceable plan by which an area identifies how it will attain and/or maintain the health-related primary and welfare-related secondary NAAQS. Under the

CAA, transportation and air quality modeling procedures must be coordinated to ensure that the TIP and the LRTP are consistent with the SIP applicable to Kent County.

Transportation conformity requires nonattainment and maintenance areas to demonstrate that all future transportation projects will not hinder the area from reaching and maintaining its attainment goals. The integration of transportation and air quality planning is intended to ensure that transportation plans, programs, and projects will not:

- Cause or contribute to any new violation of any applicable NAAQS
- Increase the frequency or severity of any existing violation of any applicable NAAQS
- Delay timely attainment of any applicable NAAQS, any required interim emissions reductions, or other NAAQS milestones

Status of the Amended Dover/Kent County MPO 2040 MTP and FY 2020-2023 TIP

Dover/Kent County MPO is charged with authoring a long-range MTP with at least a 20-year planning horizon and a short-term TIP. The MTP and TIP present recommendations for enhanced transportation efficiency and functionality, including the construction of new facilities, improved connectivity to multiple travel modes, and the enhancement of existing highway, transit, and bicycle/pedestrian facilities.

The TIP is one of the products that the federal legislation has continually required a metropolitan planning organization to prepare at least every four years. The purpose of the TIP is to disclose transportation projects for which federal funding will be sought over a four-year period. The TIP should reflect the region's priorities, represent a consensus among state and regional officials, show a direct relationship to the regional transportation plan, be financially constrained, and conform with federal air quality regulations as they relate to transportation. Finally, the TIP must be subjected to thorough public review during development and prior to adoption.

The Dover/Kent County MPO FY 2020-2023 TIP deviates from the preceding (FY 2017-2020) TIP from 2017. In the FY 2020-2023 TIP, locations of "state of good repair" activities are summarized as well. The previously-amended TIP was prepared from DelDOT's FY 2017-2023 Capital Transportation Program (CTP) and influenced by the MPO's 2040 MTP adopted January 4, 2017.

The 2040 MTP is the long-range transportation plan for the Dover/Kent County MPO region. The MTP identifies transportation needs, provides strategies to address those needs, guides transportation investment, and provides measurable goals for the region's transportation system through the year 2040. The Plan, which is updated every 4 years, is required of all MPOs, as only projects found in the MTP are eligible for federal funding. The Dover/Kent County MPO prepared its initial long-range transportation plan in 1996, and Vision 2040 is the fifth update to the original plan. In 2016, the Dover/Kent County MPO sought public input through a number of outreach methods to update the most recent plan for 2017-2040. In January 2017, the Dover/Kent County MPO Council adopted the 2017-2040 MTP.

INTERAGENCY CONSULTATION

The federal transportation conformity rule requires that the conformity process include cooperative interaction among federal, state, and local agencies. Interagency consultation for this analysis was conducted, as required by Delaware SIP, through coordination with local county and city representatives, the MPO, and representatives from both state and federal agencies, including:

- Dover/Kent County MPO
- Delaware Transit Corporation (DTC)
- Delaware Department of Transportation (DelDOT)
- Delaware Department of Natural Resources and Environmental Control (DNREC)
- City of Dover
- Kent County
- Federal Highway Administration (FHWA)
- Environmental Protection Agency (EPA)
- Federal Transit Administration (FTA)

As part of the interagency consultation, the Technical Advisory Committee (TAC) and Delaware Transportation Conformity Interagency Consultation Working Group met and collaborated in order to achieve the following goals related to the transportation conformity process:

- Determine planning assumptions
- Develop a definitive list of future year projects to be analyzed
- Develop a format for presenting determination
- Develop and standardize the public participation process

DETERMINE PLANNING ASSUMPTIONS

The transportation conformity determination includes an assessment of future highway emissions for defined analysis years. Emissions are estimated using the latest available planning assumptions and available analytical tools, including EPA's latest approved on-highway mobile sources emissions model, the Motor Vehicle Emission Simulator (MOVES), and the most current version of DelDOT's statewide travel demand model.

Ozone

The emission estimates resulted from the implementation of regionally-significant transportation projects that do not qualify as exempt under 40 CFR 93.126 and 127 are compared to DNREC's Motor Vehicle Emissions Budget (MVEB).

The ozone emissions budgets of record were developed by DNREC using the MOBILE6b for 2009. The following budgets were used:

- VOC: 3.95 tons/summer day
- NOx: 9.04 tons/summer day

The EPA regulations, as outlined in the Final Transportation Conformity Rule, Section 93.118, require emissions analyses for the following years:

- Attainment year
- A near-term year, one to five years in the future
- The last year of the MTP's forecast period
- An intermediate year or years such that analysis years are no more than ten years apart

The following three analysis years were chosen for the ozone analysis:

- 2020 (near-term year)
- 2030 (interim year to keep analysis years less than ten years apart)
- 2040 (Dover/Kent County MPO Plan horizon year)

As discussed above, ozone formation is a direct result of VOC and NOx emissions reacting with each other in the presence of sunlight. The EPA has ruled that both precursor emissions, VOC and NOx, must be included in a regional analysis of 8-hour ozone for transportation conformity.

PM2.5

PM2.5 can result from both direct and indirect sources. Gasoline and diesel on-road vehicles emit both direct PM2.5 and other gases that react in the air to form PM2.5. Transportation-related direct PM2.5 emissions can result from particles in exhaust fumes, from brake and tire wear, from road dust kicked up by vehicles, and from highway and transit construction. Transportation-related indirect PM2.5 emissions can result from one or more of several exhaust components, including nitrogen oxides (NOx), volatile organic compounds (VOCs), sulfur oxides (SOx), and ammonia (NH_3).

For the regional analysis of direct PM2.5 emissions, EPA has ruled that both exhaust and brake/tire wear must be included. However, EPA has ruled that regional emissions analyses for direct PM2.5 should include road dust only if road dust is found to be a significant contributor to PM2.5 by either the EPA Regional Administrator or a state air agency. For the Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Nonattainment area in which Kent County is included, neither of the EPA Regional Administrators nor any of the three state air agencies have found that road dust is a significant PM2.5 contributor. EPA has also ruled that regional direct PM2.5 analyses need only include fugitive dust from construction of transportation projects if the SIP identifies these emissions as significant contributors to the regional PM2.5 problem. The current submitted PM2.5 SIP has not deemed construction-related dust as a contributor to the regional PM2.5 problem. Thus, the only components of direct PM2.5 emissions to be considered in the nonattainment area are tailpipe exhaust and brake/tire wear.

For the regional analysis of indirect PM2.5 emissions (also called PM2.5 precursors), the EPA has identified four potential transportation-related PM2.5 precursors: NOx, VOCs, SOx, and NH_3. The current PM2.5 SIP does not identify any precursors other than NOx as a significant contributor of PM2.5 emissions in Kent County.

The following PM2.5 pollutants and precursors were tested:

- Direct PM2.5 source: tailpipe exhaust, brake and tire wear
- PM2.5 Precursor: NOx

EPA regulations require that emissions analysis be conducted for specific analysis years. Section 93.119(g) of the *Final Rule* states that these analysis years must include a near-term year (one to five years in the future), the last year of the long-range plan, and an intermediate year or years such that analysis years are no more than 10 years apart.

The following analysis years were chosen for the PM2.5 analysis:

- 2020 (near-term year)
- 2030 (interim year to keep analysis years less than ten years apart)
- 2040 (Dover/Kent County MPO Plan horizon year)

ANALYSIS METHODOLOGY AND DATA

Under the CAA, transportation and air quality modeling procedures must be coordinated to ensure that the TIP and the MTP are consistent with the SIP applicable to Kent County. The air quality analysis conducted for the FY 2020-2023 TIP and 2040 MTP used a series of computer-based modeling techniques. These techniques are consistent with methods Dover/Kent County MPO and DelDOT have used in conducting air quality analyses required by the CAA amendments, and are similar to those used by other state and regional transportation agencies in preparing air quality analyses. They are also consistent with the modeling procedures Dover/Kent County MPO and DelDOT have used assisting in the preparation of various SIP documents with DNREC.

Travel Demand Modeling Methodology

A statewide travel demand model for Delaware, including Kent County, is maintained by DelDOT. The model applies a variety of data regarding roadway network conditions, vehicular travel patterns, automobile ownership, and the location of population and employment sites. The model follows a five-step process of trip generation, distribution, mode split, assignment, and feedback that is commonly used throughout the transportation planning industry. The model components were processed through the CUBE Voyager software package. The primary products of the model used in the air quality analysis were estimated volumes and average speeds for each segment or “link” of the roadway system.

The modeling process developed for the FY 2020-2023 TIP and this update of the 2040 MTP used a 2015 base year network. Model networks were developed for the years 2020, 2030, and 2040 for Kent County. Networks included major capacity improvement projects that are expected to be in place and open to service during these years. The types of projects tested included roadway upgrades (such as new or improved shoulders), highway widening (one lane or more), and new construction.

Demographic projections, including employment, households, and population, were developed for each of the analysis years through the Wilmington Area Planning Council (WILMAPCO) Data

& Demographic Subcommittee. These forecasts were approved by the Delaware Population Consortium in 2017.

Travel estimates were developed for this conformity analysis using the five-step travel demand modeling process noted above. This type of process is required by Federal air quality conformity regulations and is a set of planning tools commonly used among MPOs and State DOTs.

The travel demand modeling process uses two sets of primary input data. The first is socio-economic data for Traffic Analysis Zones (TAZs) for the Dover/Kent County MPO region. The modeling process maintained for Dover/Kent County MPO by DelDOT's Division of Planning uses a single, integrated model of the Delaware/Maryland portion of the Delmarva Peninsula. The Delaware Population Consortium (DPC) develops demographic data projections for Kent County and the City of Dover. Dover/Kent County MPO staff assisted in the analysis of DPC annual distribution projections, developed the smaller TAZ geographies, and allocated the DPC projections. This demographic data generally consists of:

1. Population
2. Dwelling Units
3. Total Employment by Place of Work
4. Employment by Job Sector, by Place of Work
5. Total Employed Persons (Employment by Place of Residence)
6. Average Income
7. Income Quartiles
8. Average Vehicle Ownership
9. Vehicle Ownership Quartiles

For each TAZ, the demographic data for each of these items was obtained from the most recent census and updated as needed to the base year of the long-range plan. The 2010 Census was used with other locally obtained information to develop a set of TAZ estimates for 2015 for this conformity analysis. The employment by place of work is developed through a series of local, county, and state-agency data sources to achieve consensus on TAZ-based employment locations.

The second primary travel model input is the so-called "travel network" representation of Kent County and Dover roadways and streets. The network file stores the following data for each street segment:

1. Functional Class (or road type)
2. Number of Lanes
3. Lane Capacity
4. Posted Speed
5. Operating Speed
6. Average Peak Period Capacity (Lanes X Lane Capacity)

The current set of DelDOT/MPO travel demand models is typical of advanced TAZ-based travel models in use in the United States. DelDOT staff (with assistance from Whitman, Requardt & Associates, LLP, an engineering consulting firm) estimated these models using data from the 1997 – 2011 Delaware Travel Monitoring Survey (DTMS). The current TAZ-based models are referred to as "aggregate demand models" because they are applied at an aggregate, zonal level with extensive market segmentation.

The trip generation models include a precursor step, which disaggregates TAZ-based household data using workers per household, persons per household, and vehicles per household data from US Census PUMS, then applies cross classification-based trip generation rates to estimate productions and attractions for each TAZ, for several trip purposes including:

1. Home-Based Work (HBW)
2. Home-Based Local Shopping (HBLS)
3. Home-Based Regional Shopping (HBRS)
4. Home-Based Other (HBO)
5. Non-Home Based (NHB)
6. Journey-to-Work (JTW)
7. Journey-at-Work (JAW)
8. Trucks

The trip distribution models are standard gravity model formulations using trip length frequencies for each trip purpose based on analysis of the entire 1997 – 2011 DTMS dataset.

The mode choice model used by DelDOT and the MPOs is a nested logit choice format. Non-motorized trips (separate modes for bicycling and walking) are included as an option in certain sets of model runs that are based on tax-parcel TAZ geography. Non-motorized trips are not currently modeled in the TAZ-based regional modeling process used for county-based conformity analyses.

The trip assignment procedures use network capacity-constrained equilibrium methods, which emphasize average weekday peak period congestion levels to allocate roadway volumes and speeds by time period of day. Four peak period times are used: AM, Midday, PM, and Offpeak. The process uses customized speed-flow delay curves representing freeway, arterial, collector, and local speeds separately.

The model process methods, as required by conformity regulations, incorporate full feedback from trip assignment back through trip distribution. The travel model was run in the CUBE Voyager software package (Version 6.4.3 of the software dated October 6, 2017) under license from the vendor, Citilabs.[5]

The modeling process for this conformity analysis used a 2015 base year network. Model networks were developed for 2020, 2030, and 2040 for Kent County and for the Delaware/Maryland peninsula counties within the DelDOT/MPO "Peninsula Travel Model." For the horizon years, regionally significant projects from the TIP and MTP were coded onto the networks. Detailed assessments were only performed for those projects which may have significant effect on emissions in accordance with Federal Register 40 CFR Parts 51 and 93. The types of projects tested were corridor improvements, highway widening, and new roadway construction. Regionally significant transportation projects in Kent County that were modeled are listed in Exhibit 1. Projects were included in the network based on the in-service date and falling before the model year.

[5] http://www.citilabs.com/

Exhibit 1: Kent County Regionally Significant Projects

Project	*Limit*	*Description*	*In Service*
US 13 Widening, Phase 1 (North)	Puncheon Run Connector to Lochmeath Way	Add a third through lane	2022-2030
US 13 Widening, Phase 2 (South)	Lochmeath Way to Walnut Shade Road (Woodside)	Add a third through lane	2022-2030
US 13 Connector Road	Scarborough Road to Leipsic Road	New collector road east of Dover Mall and Dover Downs	2022-2030

Key MOVES Input Data

A large number of inputs to MOVES are needed to fully account for the numerous vehicle and environmental parameters that affect emissions. These include traffic flow characteristics, vehicle descriptions, fuel parameters, inspection/maintenance (I/M) program parameters, and environmental variables. MOVES includes a default national database of meteorology, vehicle fleet, vehicle activity, fuel, and emissions control program data for every county. EPA, however, cannot certify that the default data is the most current or best available information for any specific area. As a result, local data is recommended for use when completing a regional conformity analysis. Local data sources are used for all inputs that have a significant impact on calculated emission rates. These data items are discussed in the following sections.

Roadway Data

The emission calculation process uses key traffic data from the regional travel demand model to estimate regional Vehicle Miles Traveled (VMT) and speeds. This data includes individual roadway traffic volumes and physical roadway descriptive characteristics including area type, facility type, lanes, distances, capacity, and free-flow speeds. Travel demand model runs are produced for future analysis years and include the impact of regionally significant transportation projects. The model provides a key resource for estimating the impact of population and employment growth on roadway volumes and calculating the diversions due to transportation projects.

VMT was determined for each roadway class/setting by multiplying the length of road by the number of vehicles using the road per day. Additional adjustments were made to convert the VMT to an average monthly day and summer day (including weekday and weekend), including:

- Seasonal adjustment factors reflecting traffic variation within the spring, summer, fall, and winter months and weekday and weekend derived from permanent count station monitoring[6] in Kent County, and

- Highway Performance Monitoring System (HPMS) adjustments used to align annual VMT estimates with HPMS reported totals for the base year for Kent County[7].

Speed data was calculated for each highway segment and hour of the day, based on roadway capacity, traffic volume, and other physical roadway features (e.g. traffic signals). Thus, the travel

[6] https://www.deldot.gov/Publications/manuals/traffic_counts/index.shtml
[7] https://www.deldot.gov/information/projects/hpms/2015/DVMT2015.pdf?081116

demand model provided VMT according to the speed bins required by the MOVES software, thereby accounting for certain physical highway conditions and congestion caused by traffic volume. A speed bin is essentially an increment of speed range; for example: "VMT for the 30-35 mph range." For future horizon years, congestion (and thereby speed) can be affected by traffic growth and changes in physical conditions due to planned transportation improvements and other projects assumed to be "in-service" in horizon years.

Vehicle Class Data

Emission rates within MOVES vary significantly by vehicle type. The MOVES model produces emissions and rates by thirteen MOVES vehicle source types. However, VMT is input into MOVES by five HPMS vehicle groups. MOVES2014b requires that VMT for any 2-axle, 4-tire vehicle weighing less than 10,000 lbs – regardless of wheelbase length – is entered together. The new HPMSVtypeID 25 (short + long wheelbase light-duty vehicles) in MOVES2014b replaces both HPMSVtypeID 20 (passenger car) and HPMSVtypeID 30 (other 4-tire trucks) in MOVES2010b. Exhibit 2 summarizes the MOVES source type and HPMS vehicle class group definitions.

Exhibit 2 MOVES Source Type and HPMS Vehicle Groups

sourceTypeID	sourceTypeName	HPMSVtypeID	HPMSVtypeName
11	Motorcycle	10	Motorcycles
21	Passenger Car	25	Light Duty Vehicles
31	Passenger Truck		
32	Light Commercial Truck		
41	Intercity Bus	40	Buses
42	Transit Bus		
43	School Bus		
51	Refuse Truck	50	Single Unit Trucks
52	Single Unit Short-haul Truck		
53	Single Unit Long-haul Truck		
54	Motor Home		
61	Combination Short-haul Truck	60	Combination Trucks

For this emissions analysis, vehicle type pattern data was developed for Kent County by functional class based on DelDOT (DMV) vehicle registration data collected on July 1, 2018. The vehicle data from DMV are classified to 16 MOBILE6 categories. They were converted to the 13 MOVES source types (vehicle types) using the factors contained in the EPA's tool "VMT-Converter-road-veh16-20100209.xls"[8].

The impact of trucks on traffic flow is accounted for within the travel demand modeling process. A heavy truck weight factor is used by functional class to adjust the rates at which increasing numbers of vehicles (congestion) cause average traveling speeds to drop. This effect generally is due to larger trucks taking up more roadway space than a given number of cars; they also tend to have slower average traveling speeds than cars for most functional classes. The final loaded

[8] https://www.epa.gov/sites/production/files/2016-06/vmt-converter-road-veh16-20100209.xls

speeds from the travel model (used to define which speed bin a given road segment's VMT is placed in) reflect this truck adjustment.

Vehicle Age

Vehicle age distributions were input to MOVES for Kent County by the thirteen source types. The age distributions reflect the percentage of vehicles for each model year in the fleet. The vehicle age distributions were prepared by DNREC based on information obtained from DMV vehicle registration data.

The base year vehicle age distributions for this conformity analysis were based on 2017 DMV vehicle registration data. The future year vehicle age distributions were estimated using the EPA's "Age Distribution Projection" tool for MOVES2014[9] based on the base year data.

Vehicle Population Data

Vehicle fleet information such as the number and age of vehicles has an impact on the forecasted start and evaporative emissions within MOVES. The MOVES model requires the number of vehicles (called "vehicle population") to be defined for each of the thirteen source type categories, for each year emissions estimates are needed including future horizon years.

The base year (2017) vehicle population data was prepared and provided by DNREC based on the 2017 DMV vehicle registration data. For the analysis years 2020, 2030, and 2040, the vehicle populations were estimated for Kent County by developing a growth factor based on the projected increase in total countywide vehicles from 2017 to each horizon year.

Fuel Data

The DNREC Division of Air Quality (DAQ) used the fuel formulation and supply data that has been assigned to Kent County by the EPA in the MOVES model. The EPA obtains data on all fuel shipments from the refineries in the Delaware area and develops the formulations based on these data. Data inputs include fields such as ethanol content, sulfur content, aromatic content, benzene content, olefin content, Methyl ter-butyl ether (MTBE) volume, Ethyl-tertiary-butyl-ether (ETBE) volume, and Tertiary-amyl-methyl-ether (TAME) volume.

Meteorological Data

Evaporative emissions are influenced significantly by the temperatures of the surrounding air. DNREC used the 2017 data from the National Centers for Environmental Information from Dover Air Force Base. These values are presented as month-by-month, hourly data sets for Kent County.

Other Vehicle Technology and Control Strategy Data

The MOVES2014b default I/M data was reviewed and updated by DNREC DAQ for Kent County. The current I/M program known as the Vehicle Emission Inspection Program (VEIP) was utilized for these analysis runs and is described below.

[9] https://www.epa.gov/sites/production/files/2016-06/age-distribution-projection-tool-moves2014.xlsm

DE Vehicle Emission Inspection Program: This program tests the following gasoline-powered and diesel-powered vehicles: model year 1968 and newer light duty passenger cars, as well as 1970 and newer light duty trucks up to 8,500 pounds. The test is done biennially and on change of ownership. There is a seven-year grace period for new vehicles.

In Kent County, 1996 and newer light duty vehicles subject to the regulation receive an On-Board Diagnostics (OBD) II test. Model year 1968-1980 vehicles subject to the regulation receive an idle test; those of model year 1981-1995 receive a two-speed idle test. In addition, model year 1975-1995 vehicles receive a tank and cap pressure test. Finally, all 1975 and newer light duty vehicles in Kent County subject to this regulation receive a visual inspection of the catalytic converter. The compliance factors reflect the fail and waiver rates observed in the program, combined with an assumed 96% compliance rate for vehicles showing up for testing.

Federal Programs*:* Current federal vehicle emissions control and fuel programs are incorporated into the MOVES2014b software. These include the National Program standards covering model year vehicles through 2016. Modifications of default emission rates are required to reflect the implementation of the National Low Emission Vehicle (NLEV) program in Delaware. To reflect these impacts, EPA has released instructions and input files that can be used to model these impacts. This inventory utilized the August 2010 version of the files[10].

Delaware Clean Car Program*:* Under the Delaware Low Emission Vehicle Program, 7 DE Admin Code 1140[11], which was revised December 2013, Delaware required manufacturers of 2014 model year vehicles to comply with Non-Methane Organic Gas (NMOG) emission requirements and California Low Emission Vehicle (LEV II) phase-in requirements. The regulation also requires manufacturers of 2015 and subsequent model year vehicles to comply with NMOG plus NOx emission requirements, as well as California LEV III phase-in requirements. Zero emission vehicles are currently not required by this regulation. California adopted the Low-Emission Vehicle regulation entitled LEV III (third generation low emission vehicle standards) in March 2012. These amendments create more stringent emission standards for new motor vehicles. These new standards will be phased in over the 2015-2025 model years.

The impacts of this program were modeled for all analysis years using EPA's guidance document, *Instructions for Using LEV and NLEV Inputs for MOVES14*[12]. EPA provided input files to reflect the CAL LEV III program with the standard phase-in schedules for new emission standards. Modifications to those schedules were done per EPA's instructions, to reflect a later start for the State of Delaware beginning with vehicle model year 2014.

Air Quality Analysis Process

As presented above, a modeling process that integrates DelDOT's travel demand model and the EPA's Motor Vehicle Emission Simulator (MOVES) model is applied for estimating emissions in Kent County.

[10] https://www.epa.gov/emission-standards-reference-guide/all-epa-emission-standards
[11] http://regulations.delaware.gov/AdminCode/title7/1000/1100/1140.shtml#TopOfPage
[12] https://www.epa.gov/sites/production/files/2016-06/lev-and-early-nlev-modeling-information-for-moves2014-20141022.zip

The travel model software, CUBE Voyager, was arranged by DelDOT staff with consultant assistance to include the DNREC "MOVES inventory method" for estimating mobile source emissions in Kent County. That process was incorporated, step-by-step, into the CUBE Voyager software so that conformity analysis process is based directly on the DNREC application of the MOVES inventory method. A series of quality-control checks were performed by DelDOT and the consulting firm staff ensuring the CUBE-model generated emissions data accurately replicated the DNREC spreadsheet method.

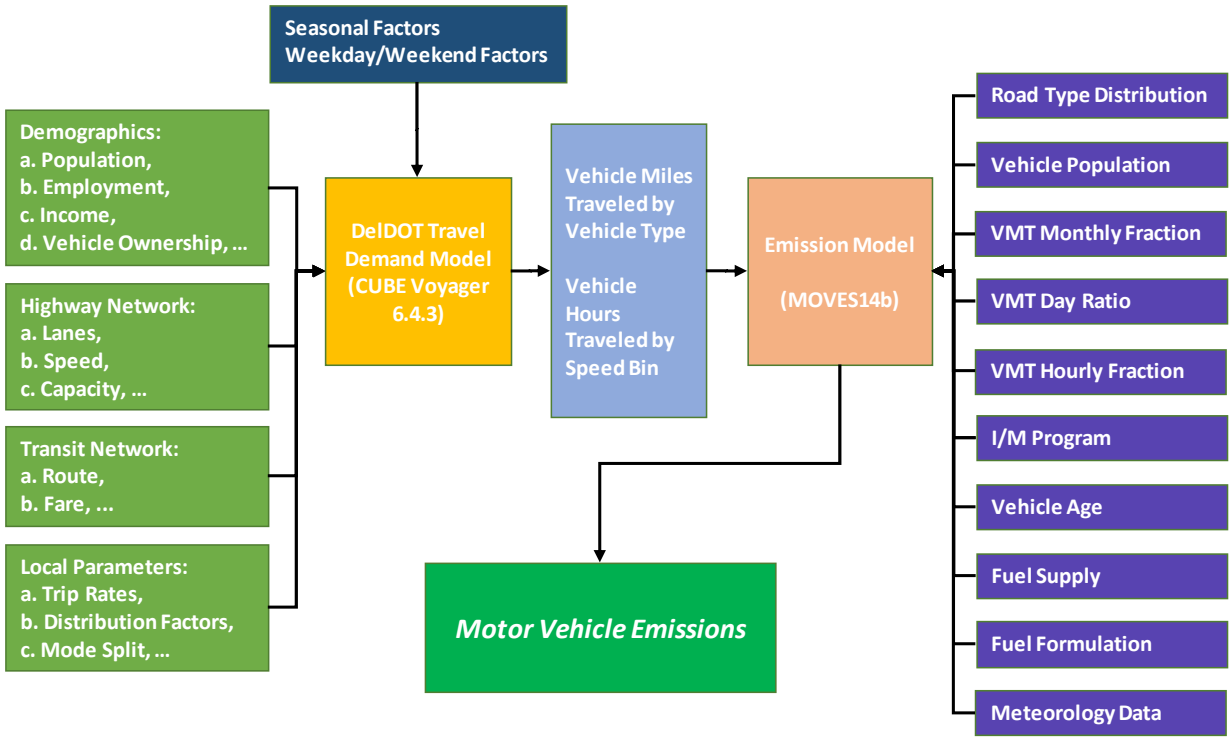
Along with updated socio-economic data and other travel behavior parameters, the regionally significant projects were coded to the network and input into the travel demand model to generate the VMT and speed distribution. Adjustment factors are then used to account for seasonal traffic variations and alignment of Delaware-based VMT estimates with the federally-required Highway Performance Management System (HPMS). The 2015 HPMS data are used to standardize the Delaware specific VMT data as required by the EPA so that direct comparisons can be made among different years and modeling scenarios.

The vehicle characteristics data was generated by DNREC based on the 2017 DelDOT DMV vehicle registration data. The fuel formulation and supply data that has been assigned to Kent County by the EPA in the MOVES model was used in this analysis. The 2017 temperature data from the National Centers for Environmental Information from Dover Air Force Base was used for meteorological input.

The estimates of emissions for Kent County are generated jointly by DelDOT and DNREC. The model post-processor takes data produced by CUBE Voyager model output for Kent County and adjusts it for input into the MOVES mobile emissions process noted above. This process links the estimated roadway speeds and volumes generated by the travel demand model with emission trends derived from MOVES. The product of this process presented in this document is countywide emission estimates.

Exhibit 3 presents an overview of the process used to generate travel model and emission model data for this conformity analysis.

Exhibit 3: Air Quality Analysis Modeling Process


Seasonal Factors
Weekday/Weekend Factors
Demographics:
a. Population,
b. Employment,
c. Income,
d. Vehicle Ownership, ...
Highway Network:
a. Lanes,
b. Speed,
c. Capacity, ...
Transit Network:
a. Route,
b. Fare, ...
Local Parameters:
a. Trip Rates,
b. Distribution Factors,
c. Mode Split, ...
DelDOT Travel Demand Model (CUBE Voyager 6.4.3)
Vehicle Miles Traveled by Vehicle Type
Vehicle Hours Traveled by Speed Bin
Emission Model
(MOVES14b)
Road Type Distribution
Vehicle Population
VMT Monthly Fraction
VMT Day Ratio
VMT Hourly Fraction
I/M Program
Vehicle Age
Fuel Supply
Fuel Formulation
Meteorology Data
Motor Vehicle Emissions

CONFORMITY ANALYSIS RESULTS

Exhibit 4 and Exhibit 5 present the results of the budget tests for ozone emissions. All baselines and budget tests pass, which demonstrates conformity.

Exhibit 4: VOC Emission Test Results – MVEB Test (tons/summer weekday)

VOC (tpsd)	2020	2030	2040
Emissions	1.66	0.78	0.60
2009 Budget	3.95	3.95	3.95
Result	Pass	Pass	Pass

Exhibit 5: NOx Emission Test Results – MVEB Test (tons/summer weekday)

NOx (tpsd)	2020	2030	2040
Emissions	2.57	1.00	0.74
2009 Budget	9.04	9.04	9.04
Result	Pass	Pass	Pass

Exhibit 6 to Exhibit 9 illustrate the baseline emission results for PM2.5 emissions. Since Kent County has never been in non-attainment for PM2.5, there is no PM2.5 conformity budget requirement for Kent County.

Exhibit 6: Annual Direct PM2.5 Emission Test Results – MVEB Test (tons/year)

Direct PM2.5 (tpy)	2020	2030	2040
Emissions	30.84	17.49	14.62

Exhibit 7: Annual Indirect (NOx) PM2.5 Emission Test Results – MVEB Test (tons/year)

Indirect (Nox) PM2.5 (tpy)	2020	2030	2040
Emissions	901	363	278

Exhibit 8: Daily Direct PM2.5 Emission Test Results – MVEB Test (tons/day)

Direct PM2.5 (tpd)	2020	2030	2040
Emissions	0.084	0.048	0.040

Exhibit 9: Daily Indirect (NOx) PM2.5 Emission Test Results – MVEB Test (tons/day)

Indirect (Nox) PM2.5 (tpd)	2020	2030	2040
Emissions	2.46	0.99	0.76

RESOURCES

1. *EPA Motor Vehicle Emission Simulator Model MOVES14b*. https://www.epa.gov/moves/latest-version-motor-vehicle-emission-simulator-moves

2. *MOVES2014a User Guide*, US EPA Office of Transportation and Air Quality, EPA-420-B-15-095, November. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NNCY.pdf

3. Policy Guidance on the Use of MOVES2014 for State Implementation Plan Development, Transportation Conformity, and Other Purposes, US EPA Office of Air and Radiation, EPA-420-B-14-008, July 2014. https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100K4EB.txt

4. *LEV and Early NLEV Modeling Information for MOVES2014*. https://www.epa.gov/sites/production/files/2016-06/lev-and-early-nlev-modeling-information-for-moves2014-20141022.zip

5. Age Distribution Projection Tool From MOVES14. https://www.epa.gov/sites/production/files/2016-06/age-distribution-projection-tool-moves2014.xlsm

6. Delaware Low Emission Vehicle Program. http://regulations.delaware.gov/register/october2017/proposed/21%20DE%20Reg%20278%2010-01-17.htm

7. *National Ambient Air Quality Stands for Ozone*, Federal Register/Vol. 80, 206/Monday, October 26, 2015. https://www.gpo.gov/fdsys/pkg/FR-2015-10-26/pdf/2015-26594.pdf

8. National Ambient Air Quality Stands for Particle Pollution. https://www.epa.gov/sites/production/files/2016-04/documents/2012_aqi_factsheet.pdf

9. Dover/Kent County MPO 2040 Metropolitan Transportation Plan. https://doverkentmpo.delaware.gov/files/2015/06/MTP-for-Web-1.pdf

10. Dover/Kent County MPO 2020-2023 Transportation Improvement Plan. (under development as of March 2019. Report will be available at https://doverkentmpo.delaware.gov/the-transportation-improvement-program/)

AIR QUALITY ANALYSIS GLOSSARY

AADT	Average Annual Daily Traffic, average of ALL days
CAA	Clean Air Act as amended
CARB	California Air Resources Board
CFR	Code of Federal Regulations
CH4	Methane
CO2	Carbon Dioxide
CO2Eq	Carbon Dioxide Equivalent. A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents (MMTCO2Eq)."
DAQ	Division of Air Quality
DelDOT	Delaware Department of Transportation
DMV	Department of Motor Vehicles
DNREC	Department of Natural Resources and Environmental Control
DPC	Delaware Population Consortium
EPA	Environmental Protection Agency
FC	Functional code. Applied to road segments to identify their type (freeway, local, etc.).
FHWA	Federal Highway Administration
FR	Federal Register
FTA	Federal Transit Administration
HPMS	Highway Performance Monitoring System
I/M	Vehicle emissions inspection/maintenance programs
LEV	Low Emission Vehicle
LRTP	Long Range Transportation Plan
MMT	Million Metric Tons
MOBILE6b	EPA earlier version motor vehicle emission estimation model
MOVES	Motor Vehicle Emission Simulator
MPO	Metropolitan Planning Organization
MVEB	Motor vehicle emissions budget
MTP	Metropolitan Transportation Plan
NAAQS	National Ambient Air Quality Standard
NOx	Oxides of nitrogen
PM2.5	Particulate Matter less than 2.5 microns in diameter
Road Type	Functional code, applied in data management to road segments to identify their type (rural/urban highways, rural/urban arterials, etc.)
RMS	Roadway Management System
SIP	State Implementation Plan
Source Type	One of thirteen vehicle types used in MOVES modeling
TIP	Transportation Improvement Plan
VHT	Vehicle hours traveled
VMT	Vehicle miles traveled
VOC	Volatile organic compound emissions

APPENDICES

Appendix A Conformity Review Check List

Exhibit A 1: Conformity Review List

Regulation (40 CFR Part 93)	Criteria	Yes	No	Comments
§§93.11	Are the conformity determinations based upon the latest planning assumptions?			
(a)	Is the conformity determination, with respect to all other applicable criteria in §§93.111 - §§93.119, based upon the most recent planning assumptions in force at the time of the conformity determination?			
(b)	Are the assumptions derived from the estimates of current and future population, employment, travel, and congestion most recently developed by the MPO or other designated agency? Is the conformity determination based upon the latest assumptions about current and future background concentrations?			
(c)	Are any changes in the transit operating policies (including fares and service levels) and assumed transit ridership discussed in the determination?			
(d)	The conformity determination must include reasonable assumptions about transit service and increases in transit fares and road and bridge tolls over time.			
(e)	Key assumptions shall be specified and included in the draft documents and supporting materials used for the interagency and public consultation required by §93.105			
§§93.111	Is the conformity determination based upon the latest emissions model?			
	Did the MPO make the conformity determination according to the consultation procedures of the conformity rule or the state's conformity SIP?			
§§93.106(a)(1)	Are the Horizon Years correct?			
§§93.106(a) (2)(i)	Does the plan quantify and document the demographic and employment factors influencing transportation demand?			

§§93.106(a)(2)(ii)	Is the highway and transit system adequately described in terms of the regionally significant additions or modifications to the existing transportation network which the transportation plan envisions to be operational in the horizon years?			
§§93.108	Is the Transportation Plan Fiscally Constrained?			
§§93.113(b)	Are TCMs being implemented in a timely manner			
§§93.118	For Areas with SIP Budgets: Is the Transportation Plan, TIP or Project consistent with the motor vehicle emissions budget(s) in the applicable SIP?			

Regulation (40 CFR Part 93)	Criteria	Yes	No	Comments
§§93.11	Are the conformity determinations based upon the latest planning assumptions?			
(a)	Is the conformity determination, with respect to all other applicable criteria in §§93.111 - §§93.119, based upon the most recent planning assumptions in force at the time of the conformity			
(b)	Are the assumptions derived from the estimates of current and future population, employment, travel, and congestion most recently developed by the MPO or other designated agency? Is the conformity determination based upon the latest assumptions about current and future background			
(c)	Are any changes in the transit operating policies (including fares and service levels) and assumed transit ridership discussed in the determination?			
(d)	The conformity determination must include reasonable assumptions about transit service and increases in transit fares and road and bridge tolls			
(e)	Key assumptions shall be specified and included in the draft documents and supporting materials used for the interagency and public consultation			
§§93.111	Is the conformity determination based upon the latest emissions model?			
	Did the MPO make the conformity determination according to the consultation procedures of the conformity rule or the state's conformity SIP?			
§§93.106(a)(1)	Are the Horizon Years correct?			
§§93.106(a) (2)(i)	Does the plan quantify and document the demographic and employment factors influencing transportation demand?			
§§93.106(a) (2)(ii)	Is the highway and transit system adequately described in terms of the regionally significant additions or modifications to the existing transportation network which the transportation plan envisions to be operational in the horizon			
§§93.108	Is the Transportation Plan Fiscally Constrained?			
§§93.113(b)	Are TCMs being implemented in a timely manner			
§§93.118	For Areas with SIP Budgets: Is the Transportation Plan, TIP or Project consistent with the motor vehicle emissions budget(s) in the applicable SIP?			

Appendix B Detailed Emission Results

Exhibit B 1: Kent County Annual Ozone & PM2.5 Emission (Tons)

Month	2020			2030			2040		
	VOC	NOx	PM2.5	VOC	NOx	PM2.5	VOC	NOx	PM2.5
1	50.2	70.7	2.5	26.0	29.8	1.3	22.1	23.5	1.1
2	43.9	70.0	2.3	22.4	28.9	1.3	18.7	22.5	1.0
3	48.2	75.9	2.5	24.5	31.4	1.4	20.4	24.5	1.1
4	44.6	73.8	2.4	22.0	29.6	1.4	17.6	22.7	1.2
5	47.5	77.1	2.6	23.5	31.0	1.5	18.6	23.6	1.3
6	48.2	73.8	2.6	23.0	28.7	1.5	17.7	21.4	1.3
7	50.8	75.1	2.7	24.0	29.1	1.6	18.5	21.6	1.4
8	49.5	77.7	2.7	23.6	30.3	1.6	18.1	22.6	1.4
9	46.5	73.3	2.5	22.4	28.8	1.5	17.4	21.7	1.3
10	46.1	72.9	2.4	22.4	28.8	1.4	17.7	21.8	1.2
11	46.4	78.6	2.6	23.3	32.1	1.4	19.2	24.9	1.2
12	53.1	82.1	3.0	27.7	34.4	1.6	23.6	27.1	1.2
Total	**574.9**	**901.1**	**30.8**	**284.7**	**362.9**	**17.5**	**229.5**	**278.0**	**14.6**

Exhibit B 2: Kent County Summer Weekday Ozone & PM2.5 Emission (Tons)

Month	2020			2030			2040		
	VOC	NOx	PM2.5	VOC	NOx	PM2.5	VOC	NOx	PM2.5
6	1.65	2.57	0.09	0.78	1.00	0.05	0.60	0.74	0.05
7	1.68	2.53	0.09	0.79	0.98	0.05	0.60	0.72	0.05
8	1.65	2.62	0.09	0.77	1.02	0.05	0.59	0.76	0.05
Average	**1.66**	**2.57**	**0.09**	**0.78**	**1.00**	**0.05**	**0.60**	**0.74**	**0.05**

Exhibit B 3: Kent County Annual Greenhouse Gas Emission (MMT)

Month	2020			2030			2040		
	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4
1	44,691	64.3	2.5	38,152	27.1	2.0	38,333	21.4	2.0
2	45,988	63.6	2.1	39,233	26.3	1.7	39,437	20.5	1.7
3	49,579	69.0	2.3	42,300	28.5	1.9	42,517	22.2	1.8
4	53,973	67.1	1.9	46,007	26.9	1.5	46,268	20.6	1.5
5	58,769	70.1	2.1	50,086	28.2	1.7	50,375	21.5	1.6
6	62,755	67.1	1.9	53,465	26.1	1.4	53,795	19.5	1.3
7	67,513	68.3	2.0	57,511	26.4	1.5	57,874	19.6	1.4
8	66,484	70.7	2.0	56,644	27.5	1.5	56,993	20.6	1.4
9	59,303	66.7	1.9	50,525	26.2	1.5	50,828	19.7	1.4
10	54,628	66.3	1.9	46,555	26.2	1.4	46,823	19.8	1.4
11	53,746	71.5	2.2	45,838	29.2	1.8	46,086	22.6	1.7
12	53,212	74.7	2.7	45,413	31.3	2.2	45,642	24.6	2.2
Total	**670,639**	**819.2**	**25.4**	**571,728**	**329.9**	**20.2**	**574,972**	**252.7**	**19.5**

Exhibit B 4: Kent County Summer Weekday Greenhouse Gas Emission (MMT)

Month	2020			2030			2040		
	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4
6	2,188	2.33	0.07	1,864	0.91	0.05	1,876	0.68	0.05
7	2,278	2.30	0.07	1,940	0.89	0.05	1,952	0.66	0.05
8	2,244	2.38	0.07	1,912	0.92	0.05	1,923	0.69	0.05
Average	**2,237**	**2.34**	**0.07**	**1,906**	**0.91**	**0.05**	**1,917**	**0.67**	**0.05**

Exhibit B 5: Kent County Annual Road Type Ozone & PM2.5 Emission (Tons)

Road Type	2020			2030			2040		
	VOC	NOx	PM25	VOC	NOx	PM25	VOC	NOx	PM25
Off-Network	454.9	258.4	4.4	228.5	123.6	2.3	181.3	102.8	1.4
Rural Restricted Access	10.4	61.3	2.3	5.3	24.9	1.4	4.6	19.0	1.1
Rural Unrestricted Access	34.5	180.6	7.6	15.7	64.1	4.3	13.8	47.6	3.8
Urban Restricted Access	16.0	99.1	3.4	7.8	39.6	1.9	5.9	27.4	1.4
Urban Unrestricted Access	59.0	301.7	13.1	27.6	110.7	7.7	24.0	81.2	6.9
Total	**574.9**	**901.1**	**30.8**	**284.7**	**362.9**	**17.5**	**229.5**	**278.0**	**14.6**

Exhibit B 6: Kent County Summer Weekday Road Type Ozone & PM2.5 Emission (Tons)

Road Type	2020			2030			2040		
	VOC	NOx	PM25	VOC	NOx	PM25	VOC	NOx	PM25
Off-Network	1.25	0.67	0.01	0.59	0.29	0.00	0.43	0.22	0.00
Rural Restricted Access	0.03	0.18	0.01	0.02	0.07	0.00	0.02	0.05	0.00
Rural Unrestricted Access	0.11	0.52	0.02	0.05	0.18	0.01	0.05	0.14	0.01
Urban Restricted Access	0.06	0.30	0.01	0.03	0.12	0.01	0.02	0.08	0.00
Urban Unrestricted Access	0.20	0.91	0.04	0.10	0.33	0.03	0.08	0.24	0.02
Total	**1.66**	**2.57**	**0.09**	**0.78**	**1.00**	**0.05**	**0.60**	**0.74**	**0.05**

Exhibit B 7: Kent County Annual Road Type Greenhouse Gas Emission (MMT)

Road Type	2020			2030			2040		
	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4
Off-Network	33,364	234.9	16.9	28,935	112.3	13.1	28,443	93.4	12.7
Rural Restricted Access	58,135	55.7	0.8	52,740	22.6	0.7	55,162	17.3	0.7
Rural Unrestricted Access	182,901	164.2	2.4	151,335	58.3	1.9	154,618	43.2	1.9
Urban Restricted Access	89,775	90.1	1.3	77,789	36.0	1.1	73,246	24.9	0.9
Urban Unrestricted Access	306,464	274.3	4.0	260,928	100.6	3.4	263,503	73.8	3.3
Total	**670,639**	**819.2**	**25.45**	**571,728**	**329.9**	**20.21**	**574,972**	**252.7**	**19.45**

Exhibit B 8: Kent County Summer Weekday Road Type Greenhouse Gas Emission (MMT)

Road Type	2020			2030			2040		
	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4
Off-Network	70	0.61	0.04	60	0.26	0.03	59	0.20	0.02
Rural Restricted Access	191	0.16	0.00	173	0.06	0.00	181	0.05	0.00
Rural Unrestricted Access	601	0.47	0.01	497	0.17	0.01	508	0.12	0.01
Urban Restricted Access	310	0.27	0.00	269	0.11	0.00	253	0.07	0.00
Urban Unrestricted Access	1,065	0.83	0.01	907	0.30	0.01	916	0.22	0.01
Total	**2,237**	**2.3**	**0.07**	**1,906**	**0.9**	**0.05**	**1,917**	**0.7**	**0.05**

Exhibit B 9: Kent County Annual Source Type Ozone & PM2.5 Emission (Tons)

Source Type	2020			2030			2040		
	VOC	NOx	PM25	VOC	NOx	PM25	VOC	NOx	PM25
Motorcycle	29.9	11.9	0.4	29.7	13.2	0.4	30.0	14.6	0.4
Passenger Car	195.6	160.3	6.9	107.0	66.6	5.1	85.5	50.1	4.3
Passenger Truck	205.4	253.9	7.0	86.2	81.9	4.8	65.5	49.6	4.0
Light Commercial Truck	116.9	155.6	4.3	49.0	51.7	2.8	37.5	31.9	2.4
Intercity Bus	0.6	12.1	0.5	0.3	6.1	0.2	0.1	2.6	0.1
Transit Bus	0.8	11.9	0.3	0.3	5.6	0.2	0.2	3.5	0.1
School Bus	1.4	12.4	0.5	0.8	8.1	0.3	0.6	6.4	0.2
Refuse Truck	0.1	1.1	0.1	0.0	0.4	0.0	0.0	0.4	0.0
Single Unit Short-haul Truck	8.2	28.9	1.3	3.5	13.2	0.5	3.0	12.1	0.5
Single Unit Long-haul Truck	0.5	2.9	0.1	0.2	1.4	0.1	0.1	1.3	0.1
Motor Home	0.4	0.7	0.0	0.2	0.3	0.0	0.1	0.2	0.0
Combination Short-haul Truck	3.2	66.7	2.6	1.3	30.9	1.0	1.1	28.6	0.9
Combination Long-haul Truck	11.9	182.8	6.9	6.2	83.5	2.1	5.9	76.5	1.6
Total	**574.9**	**901.1**	**30.8**	**284.7**	**362.9**	**17.5**	**229.5**	**278.0**	**14.6**

Exhibit B 10: Kent County Summer Weekday Source Type Ozone & PM2.5 Emission (Tons)

Source Type	2020			2030			2040		
	VOC	NOx	PM25	VOC	NOx	PM25	VOC	NOx	PM25
Motorcycle	0.09	0.03	0.00	0.09	0.04	0.00	0.09	0.04	0.00
Passenger Car	0.55	0.43	0.02	0.28	0.16	0.02	0.21	0.11	0.01
Passenger Truck	0.60	0.72	0.02	0.24	0.22	0.01	0.17	0.12	0.01
Light Commercial Truck	0.34	0.45	0.01	0.13	0.14	0.01	0.10	0.08	0.01
Intercity Bus	0.00	0.04	0.00	0.00	0.02	0.00	0.00	0.01	0.00
Transit Bus	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.01	0.00
School Bus	0.00	0.04	0.00	0.00	0.02	0.00	0.00	0.02	0.00
Refuse Truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Single Unit Short-haul Truck	0.03	0.09	0.00	0.01	0.04	0.00	0.01	0.04	0.00
Single Unit Long-haul Truck	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Motor Home	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Combination Short-haul Truck	0.01	0.20	0.01	0.00	0.09	0.00	0.00	0.08	0.00
Combination Long-haul Truck	0.04	0.54	0.02	0.02	0.24	0.01	0.02	0.22	0.01
Total	**1.66**	**2.57**	**0.09**	**0.78**	**1.00**	**0.05**	**0.60**	**0.74**	**0.05**

Exhibit B 11: Kent County Annual Source Type Greenhouse Gas Emission (MMT)

Source Type	2020			2030			2040		
	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4
Motorcycle	5,286	10.8	0.4	6,037	12.0	0.5	6,688	13.3	0.5
Passenger Car	217,361	145.7	5.2	175,277	60.6	3.9	171,708	45.5	3.3
Passenger Truck	222,194	230.8	8.3	178,430	74.4	4.5	174,703	45.1	3.6
Light Commercial Truck	121,212	141.5	5.4	99,864	47.0	3.4	98,946	29.0	2.9
Intercity Bus	2,967	11.0	0.1	3,200	5.5	0.1	3,397	2.4	0.1
Transit Bus	3,199	10.8	0.1	3,565	5.1	0.1	4,038	3.2	0.1
School Bus	5,759	11.3	0.5	6,339	7.4	0.5	6,764	5.8	0.6
Refuse Truck	441	1.0	0.0	480	0.4	0.0	531	0.4	0.0
Single Unit Short-haul Truck	13,672	26.3	0.9	14,620	12.0	1.2	16,140	11.0	1.3
Single Unit Long-haul Truck	1,283	2.7	0.1	1,383	1.3	0.1	1,523	1.2	0.1
Motor Home	236	0.6	0.0	223	0.2	0.0	238	0.2	0.0
Combination Short-haul Truck	29,283	60.6	0.8	31,900	28.1	0.9	35,164	26.0	1.1
Combination Long-haul Truck	47,746	166.2	3.6	50,409	75.9	5.0	55,132	69.6	5.8
Total	**670,639**	**819.2**	**25.4**	**571,728**	**329.9**	**20.2**	**574,972**	**252.7**	**19.5**

Exhibit B 12: Kent County Summer Weekday Source Type Greenhouse Gas Emission (MMT)

Source Type	2020			2030			2040		
	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4	CO2Eq	NOx	CH4
Motorcycle	16.9	0.03	0.00	19	0.03	0.00	21	0.04	0.00
Passenger Car	721.6	0.39	0.01	580	0.15	0.01	568	0.10	0.01
Passenger Truck	739.4	0.66	0.02	593	0.20	0.01	580	0.11	0.01
Light Commercial Truck	403.0	0.41	0.01	332	0.13	0.01	329	0.07	0.01
Intercity Bus	10.1	0.03	0.00	11	0.02	0.00	12	0.01	0.00
Transit Bus	10.9	0.03	0.00	12	0.01	0.00	14	0.01	0.00
School Bus	19.6	0.03	0.00	22	0.02	0.00	23	0.02	0.00
Refuse Truck	1.5	0.00	0.00	2	0.00	0.00	2	0.00	0.00
Single Unit Short-haul Truck	46.6	0.08	0.00	50	0.04	0.00	55	0.03	0.00
Single Unit Long-haul Truck	4.4	0.01	0.00	5	0.00	0.00	5	0.00	0.00
Motor Home	0.8	0.00	0.00	1	0.00	0.00	1	0.00	0.00
Combination Short-haul Truck	99.5	0.18	0.00	108	0.08	0.00	120	0.08	0.00
Combination Long-haul Truck	162.3	0.49	0.01	171	0.22	0.02	187	0.20	0.02
Total	**2,237**	**2.34**	**0.07**	**1,906**	**0.91**	**0.05**	**1,917**	**0.67**	**0.05**

Exhibit B 13: Kent County Annual VMT by Vehicle Type

HPMSVTypeID	Kent County HPMS Annual VMT		
	2020	2030	2040
Motorcycles	13,851,002	15,734,175	17,480,784
Light Duty Vehicles	1,829,344,340	2,078,060,765	2,308,740,802
Buses	11,601,875	13,179,258	14,642,253
Single Unit Trucks	17,464,533	19,838,999	22,041,274
Combination Trucks	47,018,094	53,410,643	59,339,617
Total	**1,919,279,844**	**2,180,223,840**	**2,422,244,730**

Exhibit B 14: Kent County Vehicle Population by Vehicle Type

sourceTypeName	Kent County Vehicle Population		
	2020	2030	2040
Motorcycle	6,184	6,591	6,918
Passenger Car	69,592	74,167	77,854
Passenger Truck	54,888	58,497	61,404
Light Commercial Truck	29,124	31,039	32,582
Intercity Bus	33	36	37
Transit Bus	100	107	112
School Bus	729	777	816
Refuse Truck	23	24	25
Single Unit Short-haul Truck	1,937	2,065	2,167
Single Unit Long-haul Truck	142	151	159
Motor Home	212	226	238
Combination Short-haul Truck	375	399	419
Combination Long-haul Truck	264	281	295
Total	**163,603**	**174,360**	**183,027**

Exhibit B 15: Kent County Average Daily VMT by Functional Classification

Functional Class	Kent County HPMS Adjusted VMT		
	2020	2030	2040
Interstate-rural	-	-	-
Freeway-rural	492,987	703,746	815,211
PA-rural	413,260	465,410	539,125
Minor Arterial-rural	306,140	372,623	420,431
Major collector-rural	278,049	302,494	339,563
minor collector-rural	158,532	245,522	279,618
Local-rural	286,011	257,851	279,844
Interstate-urban	-	-	-
Freeway-urban	686,546	749,315	788,874
PA-urban	619,739	604,037	644,100
Minor Arterial-urban	1,086,669	1,276,890	1,459,917
Major collector-urban	403,233	417,438	444,299
Minor collector-urban	68,660	116,704	109,977
Local-urban	444,107	461,186	497,196
Total	**5,243,933**	**5,973,216**	**6,618,155**