

**2008 Attainment Year State Implementation Plan
Emissions Inventory for PM_{2.5}, SO₂ and NO_x**

New Castle County, Delaware

FINAL REPORT

Submitted to:

U.S. Environmental Protection Agency

Region 3 – Philadelphia, PA

Prepared by:

Department of Natural Resources & Environmental Control

Division of Air Quality

Emission Inventory Development Program

655 S. Bay Road
Dover, DE 19901



October 2, 2012

ACKNOWLEDGEMENTS

Collin O'Mara

Secretary, Department of Natural Resources and Environmental Control

Ali Mirzakhali, P.E.

Director, Division of Air Quality

Ronald A. Amirkian

Program Manager, Air Quality Planning Branch

Project Manager & Editor

David F. Fees, P.E.

Manager, Emission Inventory Development (EID) Program

Principal Contributors (EID Program)

Marian A. Hitch

Senior Environmental Compliance Specialist

John L. Outten

Senior Environmental Scientist

Jeffrey P. Bendelewski

Engineer

Mark A. Prettyman

Senior Environmental Scientist

The EID Program wishes to acknowledge the assistance of the staff of the Engineering and Compliance Branch within the Delaware Division of Air Quality for their assistance in review of emissions data reported by permitted facilities.

TABLE OF CONTENTS

	Page
Acknowledgements	ii
List of Tables	v
List of Figures	vi
Acronyms & Abbreviations	vii

SECTION 1 – OVERVIEW AND SUMMARY

1.1	Project Management	1-2
1.1.1	Project Manager	1-2
1.1.2	Point Sources Technical Lead	1-2
1.1.3	Point Sources Support	1-2
1.1.4	Non-point and Off-road Sources.....	1-2
1.1.5	On-road Mobile Sources	1-3
1.2	Inventory Planning	1-3
1.2.1	Inventory Parameters	1-3
1.2.2	Data Collection and Management	1-4
1.3	Inventory Development	1-4
1.4	Emissions Summary	1-5
1.5	References	1-7

SECTION 2 – STATIONARY POINT SOURCES

2.1	Reporting Criteria	2-1
2.2	Initial List of Facilities	2-2
2.3	Facilities Inventoried	2-2
2.4	Survey Methods	2-3
2.4.1	Electronic Reporting	2-4
2.4.2	Activity Data Reporting Forms	2-4
2.4.3	Other Methods	2-4
2.5	Data Collection	2-4
2.5.1	On-line Reporting	2-5
2.5.2	Activity Data Reporting Forms	2-7
2.6	Inventory Tracking	2-7
2.7	Administrative Review	2-8
2.7.1	Administrative Review of On-line Submissions	2-8
2.7.2	Administrative Review of Activity Data Reporting Forms	2-9
2.8	Reported Data and Estimating Emissions	2-9
2.8.1	Emission Estimation Methods	2-10
2.9	Technical Review of Submitted Data and Information	2-11
2.9.1	Facility General	2-12
2.9.2	Group/Point (Emissions Unit)	2-12
2.9.3	Process Unit	2-12
2.9.4	Stack Parameters	2-13

TABLE OF CONTENTS – continued

	Page
2.9.5 Process Unit Control Equipment	2-13
2.9.6 Process Unit Emissions	2-14
2.9.7 A Multi-year Comparison of Facility Level Emissions	2-14
2.10 Technical Review Using Database Queries, Reports and Spreadsheets	2-14
2.11 PM _{2.5} Augmentation of Facility Reported Emissions	2-14
2.12 Review of NO _x and SO ₂ Emissions from EGUs and Other Large Sources	2-15
2.13 Methods for Correcting Erroneous Data	2-16
2.14 Facility Site and Stack Coordinates	2-16
2.15 Database Management	2-16
2.16 Data Submission to EPA’s Emission Inventory System	2-17
2.17 Source Sector Discussions	2-17
2.17.1 Hot-mix Asphalt Plants	2-17
2.17.2 Electricity Generating Units	2-18
2.17.3 Emissions by Source Sector	2-19
2.18 Emissions by Facility	2-19
2.18.1 Sources of PM _{2.5} Emissions	2-21
2.18.2 Sources of SO ₂ Emissions	2-22
2.18.3 Sources of NO _x Emissions	2-23
2.19 Closed Facilities	2-23
2.20 References	2-25

SECTION 3 – STATIONARY NON-POINT SOURCES

3.1 Source Categories	3-1
3.2 Emission Estimation Methodologies and Activity Data	3-2
3.3 Emissions Summary	3-3

SECTION 4 – NON-ROAD MOBILE SOURCES

4.1 Source Categories	4-1
4.2 Emission Estimation Methodologies	4-1
4.2.1 NONROAD Model Equipment	4-2
4.2.2 Aircraft	4-4
4.2.3 Locomotives	4-6
4.2.4 Commercial Marine Vessels	4-8
4.3 2008 Emissions Summary	4-14
4.4 References	4-14

SECTION 5 – ON-ROAD MOBILE SOURCES

5.1 Input Data Specific to New Castle County for 2008	5-2
5.1.1 Vehicle Miles Traveled (VMT) Data	5-2
5.1.2 Meteorological Data	5-4

TABLE OF CONTENTS – continued

	Page
5.2.3 Fuel Data	5-4
5.2.4 Vehicle Populations and Age Distributions	5-5
5.2.5 Vehicle Speeds	5-5
5.2.6 Northeast Ozone Transport Region Low Emission Vehicle Program	5-6
5.2.7 Inspection and Maintenance (I/M)	5-6
5.2 Running the MOVES Model	5-7
5.3 Controls	5-8
5.4 Results	5-8
5.5 References	5-9

LIST OF TABLES

	Page
SECTION 1	
Table 1-1 2008 Demographic Data for New Castle County	1-4
Table 1-2 2008 PM _{2.5} , SO ₂ , and NO _x Emissions by Source Sector	1-5
SECTION 2	
Table 2-1 Inventory Methods	2-5
Table 2-2 <i>i</i> -STEPS [®] Emission Estimation Methods	2-10
Table 2-3 2008 PM _{2.5} and Precursor Emissions for New Castle County EGUs	2-18
Table 2-4 2008 PM _{2.5} and Precursor Emissions by Industry Sector	2-19
Table 2-5 2008 PM _{2.5} and Precursor Emissions for New Castle County Facilities	2-20
Table 2-6 2008 New Castle County Facility Ranking of PM _{2.5} Annual Emissions	2-21
Table 2-7 2008 New Castle County Facility Ranking of SO ₂ Annual Emissions	2-22
Table 2-8 2008 New Castle County Facility Ranking of NO _x Annual Emissions	2-24
Table 2-9 Reporting Facilities That Have Ceased Operations	2-25
SECTION 3	
Table 3-1 Non-point Source Categories Inventoried	3-1
Table 3-2 Summary of 2008 Non-point Source Activity Data	3-4
Table 3-3 Summary of 2008 New castle County Emissions from Non-point Sources..	3-7
SECTION 4	
Table 4-1 SCCs Addressed by the NONROAD Model	4-2
Table 4-2 NONROAD Model Temperature and Fuel Characteristic Input Values by Season for 2008	4-3
Table 4-3 2008 Delaware-specific Geographic Allocation Factors	4-4
Table 4-4 SCCs for Aircraft	4-5
Table 4-5 2008 LTO Data for New Castle County	4-6
Table 4-6 SCCs for Locomotives	4-7

LIST OF TABLES continued

	Page
Table 4-7	2008 New Castle County Locomotive Fuel Consumption Data for Class I Line Haul Operations 4-7
Table 4-8	2008 Switchyard Activity and Estimated Fuel Consumption..... 4-8
Table 4-9	U.S. EPA Marine Engine Category Definitions 4-8
Table 4-10	SCCs for Commercial Marine Vessels 4-8
Table 4-11	Waterway Segment Distances for the Delaware River Area 4-10
Table 4-12	Vessel Types Calling on Delaware River Area Ports in 2008 4-11
Table 4-13	Average Propulsion Engine Power and the 2008 Number of Calls for OGVs Calling on the Delaware River Area (DE, NJ, and PA) 4-12
Table 4-14	Material Dredged in the New Castle County Portion of the Delaware River Area during 2008 4-13
Table 4-15	Summary of 2008 New Castle County Emissions from Non-road Sources in tons/year 4-14

SECTION 5

Table 5-1	SCC Included in On-road Mobile Inventory 5-1
Table 5-2	New Castle County VMT Fractions by Road Type 5-3
Table 5-3	New Castle County VMT Fractions by Vehicle Type 5-3
Table 5-4	Monthly VMT Allocation Fractions 5-4
Table 5-5	2008 Gasoline Fuel Parameters for New Castle County 5-5
Table 5-6	2008 Vehicle Populations for New Castle County 5-5
Table 5-7	2008 Average Speed Matrix 5-6
Table 5-8	LEV Implementation Schedule in the Northeast OTR 5-6
Table 5-9	New Castle County I/M Program Parameters..... 5-7
Table 5-10	2008 Annual On-road Mobile Emissions by Vehicle Type for New Castle County 5-8

LIST OF FIGURES

	Page
Figure 1-1	PM _{2.5} Emissions by Source Sector 1-5
Figure 1-2	SO ₂ Emissions by Source Sector 1-6
Figure 1-3	NO _x Emissions by Source Sector 1-6
Figure 2-1	2008 PM _{2.5} Annual Emissions by Facility 2-22
Figure 2-2	2008 SO ₂ Annual Emissions by Facility 2-23
Figure 2-3	2008 NO _x Annual Emissions by Facility 2-24
Figure 3-1	200 New Castle County PM _{2.5} Emissions by Non-point Source Category... 3-4

ACRONYMS & ABBREVIATIONS

ACD	administrative completeness determination
AERR	Air Emissions Reporting Requirements
AMPD	Air Markets Program Data (EPA)
AP-42	Compilation of Air Pollution Emission Factors (EPA)
ARP	Delaware Accidental Release Prevention Program (DNREC)
ATP	Anti-tampering Program
BOC	Bureau of Census
C&D	Chesapeake and Delaware
CARB	California Air Resources Board
CBP	County Business Patterns
CD	compact disk
CDM	county data manager
CDX	central data exchange
CE	control efficiency
CEM	continuous emission monitor
CERS	consolidated emissions reporting schema
CFR	Code of Federal Register
CMV	commercial marine vessel
CNG	compressed natural gas
CO	carbon monoxide
CROMERR	Cross-media Electronic Reporting Rule
DAQ	Delaware Division of Air Quality
DE	Delaware
DE ANG	Delaware Air National Guard
DE ARNG	Delaware Army National Guard
DE DOL	Delaware Department of Labor
DelDOT	Delaware Department of Transportation
DMV	Delaware Division of Motor Vehicles (DelDOT)
DNREC	Department of Natural Resources and Environmental Control
DOE	U.S. Department of Energy
DPC	Delaware Population Consortium
DRBA	Delaware River and Bay Authority
DSWC	Division of Soil and Water Conservation (DNREC)
DVD	digital video disk
DWT	dead weight tonnage
E&C	Engineering and Compliance Branch (DNREC-DAQ)
EDMS	Emissions and Dispersion Modeling System (FAA)
EF	emission factor
EGU	electric generating unit
EIA	Energy Information Administration (DOE)
EID	Delaware Emission Inventory Development Program (DNREC-DAQ)
EIIP	Emission Inventory Improvement Program
EIS	Emission Inventory System
EPA	U.S. Environmental Protection Agency

ACRONYMS & ABBREVIATIONS continued

ERTAC	Eastern Regional Technical Advisory Committee
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FIRE	Factor Information Retrieval System
FP & GC	fuel pressure and gas cap test
GAF	geographic allocation factor
GHG	greenhouse gas
GIS	geographic information system
GSE	ground support equipment
GTM	gross ton-miles
GVWR	gross vehicle weight rating
HAP	hazardous air pollutant
hp	horsepower
HPMS	Highway Performance Monitoring System
IFO	intermediate fuel oil
I/M	Inspection and Maintenance
LEV	low-emission vehicle
LPG	liquefied petroleum gas
LTO	landing/takeoff
MARAMA	Mid-Atlantic Regional Air Management Association
MC	method code (<i>i</i> -STEPS)
MMBtu	million British thermal units
MOVES	motor vehicle emission simulator
mph	miles per hour
MY	model year
NAAQS	National Ambient Air Quality Standard
NAICS	North American Industry Classification System
NCC	New Castle County (Delaware)
NCDC	National Climatic Data Center
NEI	National Emissions Inventory
NH ₃	ammonia
NLEV	national low emission vehicle
NO _x	oxides of nitrogen
OBD	on-board diagnostics
OGV	ocean-going vessel
OIT	Office of Information Technology (DNREC)
OTR	Ozone Transport Region
pdf	portable document format
PEI	Periodic Emissions Inventory
PM-CON	condensable particulate matter
PM ₁₀ -FIL	filterable portion of PM ₁₀ -PRI
PM _{2.5} -FIL	filterable portion of PM _{2.5} -PRI
PM _{2.5} -PRI	particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers

ACRONYMS & ABBREVIATIONS continued

PM ₁₀ -PRI	particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers
ppm	parts per million
POW	Port of Wilmington
psi	pounds per square inch
QA	quality assurance
QC	quality control
R&D	research and development
RE	rule effectiveness
RP	rule penetration
rpm	revolutions per minute
RSZ	reduced speed zone
RVP	Reid vapor pressure
SARA	Superfund Amendments and Reauthorization Act
SCC	source classification code
SEPTA	Southeast Pennsylvania Transportation Authority
SIP	State Implementation Plan
SO ₂	sulfur dioxide
SQL	structured query language
TIM	time-in-mode
TPY	tons per year
TRI	Toxics Release Inventory
TV	Title V permit classification
US	United States
USACE	U.S. Army Corps of Engineers
VMT	vehicle miles traveled
VOC	volatile organic compound
XML	extensible markup language

SECTION 1

2008 PM_{2.5}, SO₂, AND NO_x INVENTORY OVERVIEW AND SUMMARY

In 2006, the U.S. Environmental Protection Agency (EPA) promulgated a new 24-hour National Ambient Air Quality Standard (NAAQS) for particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (PM_{2.5}). Particles of this size are known as fine particulate matter. EPA established the standard at 35 µg/m³. The previous 24-hour standard established by EPA in 1997 was set at 65 µg/m³.

New Castle County was designated non-attainment for the daily PM_{2.5} standard based on 2006-2008 monitoring data. The 35 µg/m³ 24-hour standard went into effect on December 14, 2009, following final non-attainment area boundary designations (EPA, 2009). New Castle County was included in the Philadelphia-Wilmington, PA-NJ-DE non-attainment area with an attainment date of December 14, 2012.

Particulate matter emitted from sources is known as primary particulate emissions. Primary emissions include filterable (PM_x-FIL) and condensable (PM-CON) material. Filterable matter can be designated as PM-FIL, PM₁₀-FIL, or PM_{2.5}-FIL depending on particle size cut points. PM-CON is always considered smaller than 2.5 micrometers in diameter. The combination of PM_x-FIL and PM-CON is known as primary particulate matter, or PM_x-PRI. Throughout this report, the use of PM_{2.5} refers to primary fine particulate emissions. Particulate matter is also formed in the atmosphere through reactions that form sulfates and nitrates. These emissions are considered secondary emissions of particulate matter. Sulfur dioxide (SO₂) and oxides of nitrogen (NO_x) contribute to the formation of secondary PM emissions.

The Division of Air Quality (DAQ), within the Delaware Department of Natural Resources and Environmental Control (DNREC) established calendar year 2007 as the base year inventory for the 24-hour PM_{2.5} because (1) 2007 coincides with the three years of ambient monitoring data used to designate New Castle County as part of the Philadelphia non-attainment area, and (2) a 2007 regional inventory had already been prepared for modeling and State Implementation Plan (SIP) purposes. This regional inventory, for which Delaware supplied Delaware-specific data for all source sectors, has undergone extensive quality assurance. Details of how the inventory was developed can be found in the regional report, *Technical Support Document for the Development of the 2007 Emission Inventory for Regional Air Quality Modeling in the Northeast/Mid-Atlantic Region* (MARAMA, 2007).

The DAQ established calendar year 2008 as the attainment year inventory for the 24-hour PM_{2.5} because (1) 2008 coincides with the three years of ambient monitoring data used to demonstrate that New Castle County now attains the 24-hour PM_{2.5} standard, and (2) 2008 represents a Periodic Emissions Inventory (PEI) reporting year, for which Delaware has prepared a SIP quality inventory based on Delaware-specific data for all sources of criteria pollutants to include PM_{2.5} emissions and emissions of NO_x and SO₂ as precursors to PM_{2.5}.

This report documents Delaware's completed 2008 inventory of PM_{2.5}, SO₂, and NO_x for New Castle County for all sources including the following four major source sectors: stationary point, stationary non-point, on-road mobile, and off-road mobile.

1.1 Project Management

The Emission Inventory Development (EID) Program within the Planning Branch of DAQ was responsible for preparing the 2008 PEI for criteria pollutants to include emissions PM_{2.5}, SO₂, and NO_x summarized in this report. Internal planning began in September 2008, with focus on the 2008 point source inventory reporting cycle taking place in March/April of 2009.

1.1.1 Project Manager

The overall project manager was David Fees, Managing Engineer for the EID Program. Responsibilities included identifying overall inventory goals, objectives, and deadlines, initiating inventory planning, approving estimation methodologies recommended by staff, reviewing emissions development work, and preparing inventory reports and documentation.

1.1.2 Point Sources Technical Lead

The point source technical planning and review was performed by John Outten, a senior environmental scientist for the EID Program. Responsibilities included:

- Identifying point source inventory goals, objectives, and deadlines;
- Establishing the universe of facilities to inventory;
- Overseeing the development of the survey forms and instructions;
- Providing training and guidance to industry representatives;
- Setting up the on-line electronic reporting system and working with DNREC's Office of Information Technology in preparing the on-line reporting capabilities;
- Performing a technical review of emissions data submitted by facilities;
- Working with facility representatives to correct errors;
- Managing the point source inventory database; and
- Overseeing quality control of point sources data.

1.1.3 Point Sources Support

Support of the point source inventory was performed by Marian Hitch, a senior environmental compliance specialist for the EID Program. Responsibilities included:

- Gathering facility general information on facilities to be surveyed;
- Assisting in developing survey forms and instructions;
- Preparing and mailing reporting packages;
- Receiving and organizing reports submitted by facilities;
- Performing an administrative review of all reports received;
- Tracking reporting status of each facility; and
- Preparing and organizing documentation for the point source inventory.

1.1.4 Non-point and Off-road Sources

Emission estimates of the many non-point and off-road source categories were prepared jointly by Jeffrey Bendelewski, an engineer for the EID program, and Mark Prettyman, a senior environmental scientist for the Planning Branch of DAQ. Their responsibilities included:

- Researching and recommending emission estimation methodologies;
- Defining all simplifying assumptions;
- Obtaining 2008 activity data, current emission factors, and applicable control information
- Using spreadsheets to calculate emissions;
- Downloading and using the EDMS model for developing aircraft emissions;
- Downloading and using the NONROAD model;
- Reviewing emission calculations for accuracy and completeness;
- Preparing report documents; and
- Compiling supporting documentation.

1.1.5 On-road Mobile Sources

Emission estimates of on-road mobile sources were prepared by John Outten, a senior environmental scientist for the EID program. Responsibilities included:

- Downloading the MOVES model;
- Obtaining 2008 vehicle miles traveled (VMT), vehicle registration, and other mobile input data from the Delaware Department of Transportation;
- Obtaining other data for inclusion in the model inputs;
- Preparing the input files for running MOVES;
- Running MOVES and summarizing the model outputs;
- Reviewing emissions for accuracy and completeness;
- Preparing report documents; and
- Compiling supporting documentation.

1.2 Inventory Planning

Calendar year 2008 is a Periodic Emissions Inventory (PEI) year as defined by the Air Emissions Reporting Requirements (AERR) (EPA, 2008). The AERR specifies the emissions data for criteria pollutants that are required to be reported to EPA's National Emission Inventory (NEI). A PEI requires the development of emission estimates from all sources within a state or local area for all criteria pollutants and their precursors. As such, the 2008 inventory can provide the necessary data for the PM_{2.5} 24-hour NAAQS attainment year inventory. While not required, the DAQ also prepared 2008 emission estimates of air toxics and greenhouse gases from all sources.

1.2.1 Inventory Parameters

The inventory parameters defined by the 2008 PM_{2.5} Attainment Year SIP inventory include the following:

- **Inventory year** – 2008;
- **Pollutants** – PM_{2.5}, and SO₂ and NO_x as precursors to PM_{2.5} (DNREC, 2012a);
- **Source coverage** – all sources, including point, non-point, mobile, and non-road sources;
- **Spatial resolution** – county level emissions;
- **Geographic coverage** – New Castle County; and
- **Temporal resolution** – annual emissions (DNREC, 2012b).

1.2.2 Data Collection and Management

For all source categories the gathering of local activity data represented a major task spread over many months. For point sources, most facilities reported their emissions through the use of an on-line reporting system. Data entered into the on-line system were transferred to the DAQ *i*-STEPS[®] database for review and correction.

Microsoft Excel spreadsheets were employed for managing activity data and calculating emissions from stationary non-point sources and some non-road categories. A consistent set of tabs within each source category spreadsheet included activity data, point source data (if applicable, for backouts), emission factors, controls, emission calculations, National Emission Inventory (NEI) input formats, and notes on QA/QC procedures.

On-road mobile source emissions were calculated using the MOVES2010a model. Emissions for most of the non-road vehicles and equipment categories were calculated using the NONROAD2008a model.

Emissions data were transferred from *i*-STEPS[®] (point sources), from the non-point and non-road spreadsheets, and from the model outputs to staging tables in Microsoft Access databases. These databases were then converted to XML files via the EIS bridge tool, and then transmitted to the EIS via CDX web client by June 1, 2010 to meet the reporting requirements of the AERR.

1.3 Inventory Development

For point sources, the EID Program developed a set of criteria to use in establishing the universe of facilities required to report. These criteria are presented in detail in the point source section of this report. Reporting packages were sent to each facility meeting one or more of the reporting criteria. An extensive amount of review and follow up was performed on the point source data submitted by facilities.

For non-point sources, the first main task involved gathering activity data for each source category. In many cases, these data were obtained from Delaware-specific sources. In some cases the activity data were developed through the allocation of a portion of a national activity dataset (i.e., national off-road equipment populations) to Delaware. Basic demographic data were also used for some source categories and are presented in Table 1-1. Once activity data were obtained, spreadsheets were developed to manage the data and combine the activity data with the selected emission factors to obtain uncontrolled emissions. Finally, for those sources where controls applied, emissions were adjusted to account for control efficiency, rule effectiveness, and rule penetration.

Table 1-1. 2008 Demographic Data for New Castle County

Demographic Parameter	New Castle
Population ^a	528,536
Households ^a	204,630
Land Area (square miles)	439
Annual VMT (million miles) ^b	5,273

^a DPC, 2009; ^b DelDOT, 2009.

For on-road mobile and off-road equipment, the MOVES and NONROAD models, respectively, were used to develop emissions from these sources. In the use of these models, activity data were included in the model input files. For any type of data used by the model for which Delaware-specific data did not exist, the model used the system defaults. Details about Delaware-specific and default parameters are discussed in the on-road and non-road sections. The models account for controls, some of which reflect controls specific to Delaware.

1.4 Emissions Summary

The following emission summaries present the entire 2008 emission inventory for PM_{2.5}, SO₂, and NO_x, for New Castle County broken down by source sector. Throughout this document, annual emissions are reported in tons per year (TPY). The totals may not match the sum of the individual values due to independent rounding.

Table 1-2. 2008 PM_{2.5}, SO₂, and NO_x Emissions by Source Sector

Source Sector	Annual Emissions (TPY)		
	PM _{2.5}	SO ₂	NO _x
Point	1,109	10,576	5,589
Non-point	1,191	402	1,287
Non-road	312	1,067	4,317
On-road	282	94	9,311
All Sectors	2,894	12,139	20,504

Figure 1-1. PM_{2.5} Emissions by Source Sector

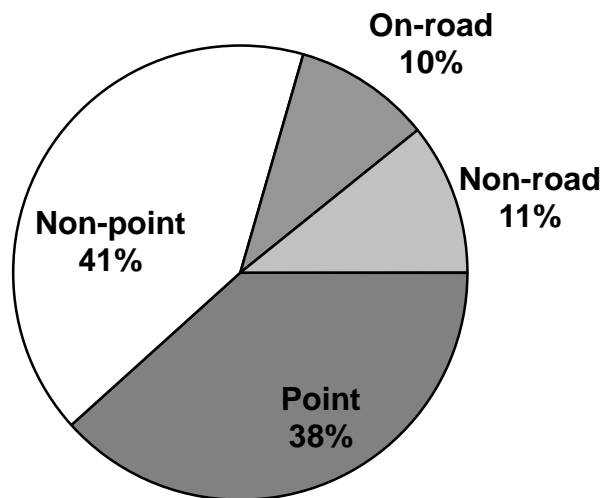


Figure 1-2. SO₂ Emissions by Source Sector

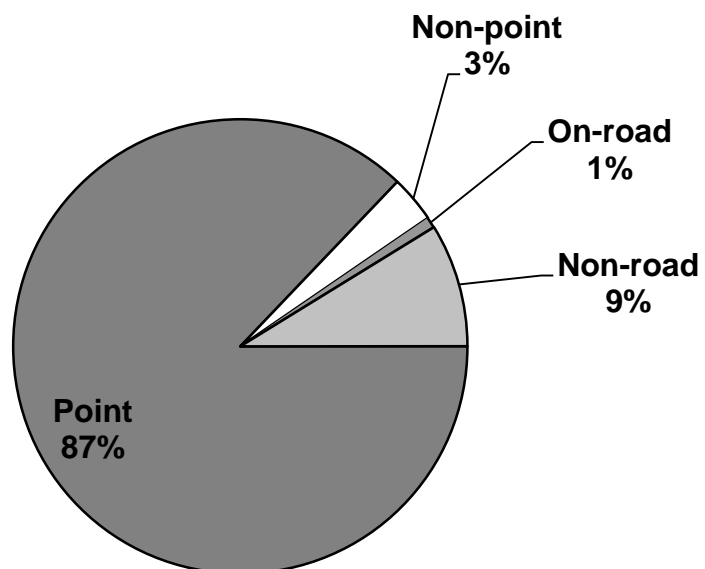
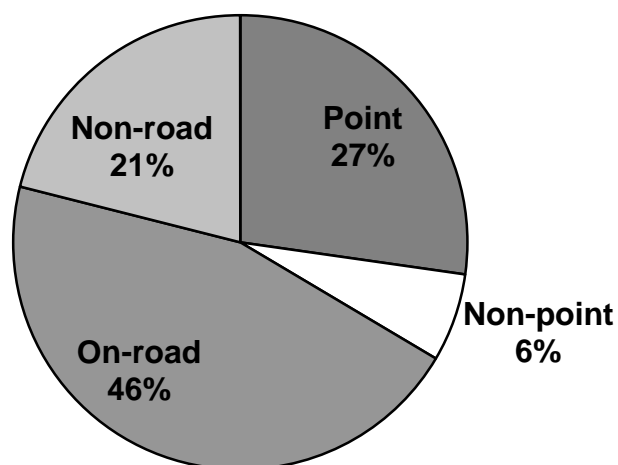


Figure 1-3. NO_x Emissions by Source Sector



1.5 References

- DPC, 2009. Delaware Population Consortium Annual Population Projections, downloaded from http://stateplanning.delaware.gov/information/dpc_projections.shtml, October 31, 2009.
- DELDOT, 2009. *2008 Estimated VMT by County, by Functional Class, by Rural/Urban Designation*, accessed DelDOT website July 10, 2009, per June 29, 2009 e-mail from Mike DuRoss, DelDOT Planning.
- DNREC, 2012a. “*Delaware Redesignation Request and Maintenance Plan Under the 2006 Daily PM_{2.5} National Ambient Air Quality Standard*”, Section 7.2.1, Delaware Department of Natural Resources and Environmental Control, Division of Air Quality, September 2012.
- DNREC, 2012b. “*Delaware Redesignation Request and Maintenance Plan Under the 2006 Daily PM_{2.5} National Ambient Air Quality Standard*”, Section 4.1, Delaware Department of Natural Resources and Environmental Control, Division of Air Quality, September 2012.
- EPA, 2008. Final Rule: “*Air Emission Reporting Requirements*”, Federal Register – Vol. 73 No. 243 page 76539, December 17, 2008.
- EPA, 2009. Final Rule: “*Air Quality Designations for the 2006 24-Hour Fine Particle (PM_{2.5}) National Ambient Air Quality Standards*”, Federal Register – Vol. 74 No. 218 page 58688, November 13, 2009.

SECTION 2

STATIONARY POINT SOURCES

The point source inventory represents facility-specific data for larger stationary sources. Emissions data for all other source categories are reported at the county level. Point sources typically include large industrial, commercial and institutional facilities. Industrial manufacturing facilities comprise the majority of all reporting point sources. The institutional sector includes hospitals, universities, prisons, military bases, landfills, and wastewater treatment plants.

Unlike other source sector emissions which are estimated by DAQ, point source emissions data are submitted to DAQ by the facilities. Emissions are reported at the process level and include both confined (stack) emission points as well as unconfined (fugitive) emission sources. A key aspect of point source data is the inclusion of facility coordinates to accurately allocate emissions spatially within a county for purposes of performing air dispersion modeling.

The planning and execution of the point source inventory was accomplished in the following chronological order:

- Define the purpose of the inventory (defined in Section 1 of this report);
- Establish the reporting criteria and list of facilities to survey;
- Obtain inventory data from facilities;
- Perform administrative and technical review of data received from facilities;
- Seek resubmissions/corrections from facilities based on data review;
- Perform internal data augmentation (for PM_{2.5}); and
- Prepare inventory data files, report, and supporting documentation.

Quality control/assurance is not listed in the chronology above since these activities were performed throughout the point source inventory development process. Quality control/assurance efforts are presented throughout this section.

Since there may be overlap between point sources and stationary non-point source categories, one final activity required of the point source inventory staff is to provide point source back out data where appropriate. Point source back out data includes emissions, throughput, or employees, depending on the non-point source category methodology.

2.1 Reporting Criteria

Based on the several purposes of the 2008 inventory (Ozone PEI, PM_{2.5} PEI, HAPs and GHG inventories, as well as the daily PM_{2.5} Attainment Year SIP inventory) the following criteria were established for defining the universe of facilities to be surveyed:

- Facilities that held a Title V permit in 2008;
- Any facility falling into one of the following industry sectors;
 - Hot-mix asphalt plants,

- Electric generating units (EGUs);
- Facilities using anhydrous ammonia as a refrigerant; and
- Chrome plating operations;
- Any facility with emissions greater than 5 TPY for VOCs or 25 TPY for NO_x in 2006 or 2007, as previously reported to the DAQ inventory program; and
- Any facility that may be a significant source of emissions but for which DAQ does not have previous inventory data, or otherwise of particular interest.

2.2 Initial List of Facilities

Once the reporting criteria were established, DAQ point source inventory staff compiled an initial list of facilities to be compared against the reporting criteria. All 133 facilities reporting statewide for the 2005 Periodic Emissions Inventory (PEI) were included in the initial list. All Title V (TV) permitted facilities are required to report emissions each year. The Engineering and Compliance Branch of DAQ provided a list of TV facilities as of the end of 2008, which contained one facility that had not reported for 2005.

The following additional data sources were reviewed to identify facilities that might have met one or more of the reporting criteria:

- Toxics Release Inventory (TRI, SARA 313) – 2006 and 2007 data;
- Hazardous Chemical Inventory (Tier II, SARA 312) – 2007 data;
- Accidental Release Prevention (ARP) Program facility list.

DAQ inventory staff reviewed the two most recent years of TRI data, and found that all facilities within TRI with more than five tons per year air releases of VOC compounds were already included in the initial list. The Tier II data and information from the ARP Program were reviewed mainly to identify facilities that used anhydrous ammonia; however, no additional facilities were added to the initial list as a result of this review.

Through a review of permit and compliance information, and conversations with the permitting group, one new asphalt plant and six other facilities of interest were added to the initial list. The six facilities of interest were either new facilities needing baseline data, or facilities not recently inventoried, but nonetheless with the potential of having significant PM emissions.

The complete initial list included 142 facilities statewide. A spreadsheet was developed by DAQ point source staff containing a record of every facility included on the initial list of facilities. The spreadsheet includes the reason the facility was placed on the initial list. For facilities that were inventoried, the spreadsheet indicates which reporting criteria were met.

2.3 Facilities Inventoried

The facilities on the initial list were evaluated using the reporting criteria established in Section 2.1. TV facilities are required to report regardless of the amount of emissions. Therefore, all 65 TV facilities were included in the final list of point sources. The remaining 77 of the 142

facilities were evaluated against the other reporting criteria. As a result, 20 facilities were dropped from further consideration since no criterion was met.

Four facilities were identified as being closed prior to calendar year 2008. They were City of Lewes EGUs, Industraplate, Spatz Fiberglass and Tilcon-Horsepond Road. Prior to 2008, permits for the City of Seaford's six EGUs had been modified to allow these units to operate only as emergency generators as defined by Delaware Regulation 1144 (DNREC, 2006). Therefore, this facility is no longer included in the point source inventory. One facility, Tilcon-Terminal Avenue, did not operate in 2008, and has since closed permanently.

Three facilities closed during 2008. Attempts were made to contact the companies. In phone conversations with Perma-Flex Rollers and PTFE Compounds, it was determined both facilities did not meet any of the reporting criteria for 2008. PTFE had closed after having minimal operations for the first six months of 2008. In July 2008 the facility moved their operations to New Jersey. The Perma-Flex Rollers site was used primarily for storage and warehousing and had little or no production during 2008. The third facility that closed in 2008, Pepsi Cola Bottling Company, used ammonia refrigeration, which would require reporting; however DAQ was unable to obtain any information related to potential ammonia emissions.

Through a review of emissions data from 2006 and 2007, recently reported TRI air emissions, and inspection reports, eight facilities were determined to not meet either the VOC or NO_x emission thresholds, and thus were not included in the list of facilities to be inventoried.

Two facilities (the Port of Wilmington and VFL Technologies) that were added to the initial list as facilities of interest were not inventoried due to staff resources. DAQ staff did spend considerable time working with the Port of Wilmington to establish a set of stationary and mobile emission units, but due to time constraints, an inventory was not completed by the site. Due to limited resources VFL Technologies was not contacted and did not submit an emissions inventory. VFL closed in 2010.

Finally, in 2007 SPI Polyols was sold to Croda-Uniqema, an adjacent and contiguous Synthetic Minor permitted facility. Starting with 2008, processes and emissions previously associated with SPI Polyols were reported by Croda.

The final list included 122 facilities inventoried statewide. Of these, 58 facilities in New Castle County reported emissions of particulate matter and/or particulate precursors (SO₂, and NO_x) and are included in the 2008 PM_{2.5} Attainment Year SIP inventory.

2.4 Survey Methods

In December 2008, the DAQ point source inventory staff began reviewing survey methods and preparing reporting packages to be e-mailed to each facility to be inventoried. DAQ used two primary methods to gather information from most facilities for the 2008 inventory. Facilities either used an on-line reporting system or submitted activity data reporting forms by e-mail or facsimile. These two methods are described in detail below.

2.4.1 Electronic Reporting

DAQ offers electronic reporting of emissions data through the Internet. For the 2008 reporting cycle, the Terminal Server Satellite *i*-STEPS[®] application was updated with the latest FIRE and AP-42 emission factors. Satellite *i*-STEPS[®] is capable of calculating emissions based on information supplied on process throughput, operating schedule, and controls. A database specific to each facility was generated based on previously submitted inventories and other information (i.e., permitting files). Information expected to remain the same from year to year was pre-populated in the database, while throughput and emissions data were zeroed out. Facilities were expected to update pre-populated information as necessary and enter 2008 data for fields that were zeroed out.

2.4.2 Activity Data Reporting Forms

Instead of requiring on-line reporting for all facilities, DAQ provides smaller facilities with the option of completing fillable electronic activity data reporting forms that are e-mailed to the facility that can be e-mailed back to DAQ once completed. DAQ used these forms for 2008 to simplify the reporting process. The activity data supplied by facilities (i.e. operating schedule, monthly throughputs), were used by DAQ staff to calculate emissions based on EPA's FIRE emission factors or material balance methodologies.

Activity data reporting forms applicable to the 2008 Attainment Year SIP inventory were developed for the following processes:

- Boilers;
- Stationary diesel engines; and
- Hot-mix asphalt production.

For facilities that used the activity data forms, DAQ already had detailed process and stack information on file.

2.4.3 Other Methods

In a limited number of cases where on-line reporting or the use of the activity data forms was not appropriate or useful, information was obtained from facilities via telephone, e-mail or facsimile. Regardless of the survey methods used to obtain data from facilities, all data were entered into one database within *i*-STEPS[®].

2.5 Data Collection

Reporting packages were sent out in January and February 2009 to facilities identified as meeting one or more of the established reporting criteria.

Table 2.1 provides the number of facilities inventoried by each survey method.

Table 2-1. Inventory Methods

Inventory Method Used	Number of Facilities
On-line reporting	71
Activity data report forms	48
Other methods	3

2.5.1 On-line Reporting

Terminal Server Satellite *i*-STEPS[®] software reporting packages were e-mailed to 71 facilities between February 10 and February 18, 2009. The reporting package contained a cover letter, instructions, and an Optical Media Certification Form. Two facilities (Micropore and CPI Packaging) that received reporting packages for on-line submissions were subsequently handled directly through e-mail and facsimile.

The instructions contained information on how to access the Terminal Server Satellite *i*-STEPS[®], user initials and passwords, DAQ contact information, information specific to the 2008 inventory, and a DAQ web page address where additional inventory documents were available. These documents included:

- Emission Inventory Definitions and Structure
- Common Errors
- Useful Web Pages
- Uncontrolled Coal PM_x Factors or Formula
- Calculating PM₁₀ and PM_{2.5} Emissions for #4, #5 and #6 Fuel Oils Using EPA FIRE 6.24 Formulas
- Regulated Pollutants
- Web FIRE (Factor Information Retrieval System)
- TANKS Software (EPA, 2005a)
- Emissions Factors / AP 42

A database was customized for each facility based on the process structure previously established for the facility. For new facilities using Satellite *i*-STEPS[®], the reporting structure was created by DAQ point source inventory staff with input from the facility. The database was pre-populated with general information about the facility, as well as a few other data elements not expected to change from year to year, such as stack parameters and design capacity. Other data elements were left blank or zeroed out, such as annual process rate, percent sulfur and ash of fuel burned, operating schedule, throughputs, capture and control efficiencies, and emission estimates.

Generally, it was the large, complex facilities with multiple processes that reported on-line. For facility representatives new to emissions inventory reporting or who had not reported in some time, DAQ inventory staff worked with them to understand the inventory structure. Assistance by phone or e-mail in completing the inventory was offered on an on-going basis for many facilities. Terminal Server Satellite *i*-STEPS[®] on-line reporting allowed point source inventory staff to work with a facility simultaneously on-line to resolve any issues a facility may have encountered.

The inventory information requested from facilities for the 2008 inventory is described in several EPA publications including *Emission Inventory Requirements for Ozone State Implementation Plans and Emissions Inventory Guidance* (EPA, 1991a) and *Emissions Inventory Improvement Program (EIIP), Volume II* (EPA, 1997). All emissions were reported at the process level. Facilities were required to provide emission calculations and documentation in the Notes window within Terminal Server Satellite *i*-STEPS[®] or in writing when submitting their certified emissions.

Terminal Server Satellite *i*-STEPS[®] has built-in system checks for out of range values as well as relational errors. Field specific data entry checks were performed by the software at the time the data were entered or when an attempt was made to save the data. The system prompted the user to make the needed corrections. In most cases a record could not be saved until all edit checks were satisfied. System functions and checks include:

- Data can be entered through the use of look-up tables;
- Data entered directly must match information in the look-up table;
- Total percent quarterly throughputs must be between 95 and 101;
- Alpha-numeric checks;
- Enforced relational database integrity;
- Mandatory field alerts;
- Stack assignment check (each process must have an assigned stack); and
- Automated emissions calculations.

Once a facility completed entering its data and information, the user had the ability to run the following reports:

- Group level emissions (facility summary);
- Process unit level emissions summary; and
- Detailed report (contains all entered and calculated data).

Facilities used the three reports to verify data they entered and the emissions reported and/or calculated by the Terminal Server Satellite *i*-STEPS[®]. Reports could be displayed to the screen or created as an Adobe Acrobat pdf file which is then automatically e-mailed to the user.

The process summary report provided emissions of each criteria pollutant for each process within an emissions unit. The detailed report lists the data following the Terminal Server Satellite *i*-STEPS[®] structure and contains all information that the facility entered as well as information the system used to organize the inventory information or calculate emissions.

The facility summary report tabulates criteria pollutant emissions for each emission unit with a facility total at the bottom. This report also served as the emission certification page and thus contains a signature area for the “Responsible Official”. When DAQ received a signed copy of this report, indicating the facility had completed the reporting process, DAQ set the Terminal Server Satellite *i*-STEPS[®] to read-only for the facility.

EPA's Cross-Media Electronic Reporting Rule (CROMERR), applies to states that choose to receive reports and documents from facilities through the Internet. The requirements of the rule provide for electronic reporting under authorized state and local government programs, apply to the governmental entities administering the authorized programs, and to facilities that submit data through the Internet to those governmental entities. If on-line reporting is offered by the state, an EPA-approved electronic signature process must be in place. Alternatively, on-line reporting can be followed up by the submission of a certified document (on diskette, compact disk (CD), digital video disk (DVD), facsimile, or paper report) containing the same information that was submitted on-line.

Currently, the DAQ on-line reporting system does not have an approved electronic signature system. Therefore, DAQ is required to receive from reporting facilities a certified document in addition to the data submitted on-line. DAQ has created a detailed report that can be easily created in pdf format for use by a facility as the certified document of their on-line submission. The pdf file can be burned to a CD or DVD and sent to DAQ to meet the CROMERR requirements. A signed Optical Media Certification Form is mailed with the CD or DVD to DAQ.

2.5.2 Activity Data Reporting Forms

Activity data reporting form packages were e-mailed to 48 facilities, from January 13 through January 15, 2009. The reporting packages included a cover letter, general facility information page, and the appropriate activity data reporting form(s) for each facility. Reporting forms were in Microsoft® Word format. The general facility information sheet contained pre-printed general information about the facility. This information included facility name, mailing address, contact name, NAICS codes, and phone and facsimile numbers. Facilities made corrections in the space provided on the facility general information page, added activity information to the activity report forms, and returned these documents via e-mail or facsimile to DAQ.

Assistance in completing the activity reports was offered on an on-going basis. Assistance was provided by telephone and e-mail.

2.6 Inventory Tracking

A log book was maintained to record and track the reporting status of the 119 facilities receiving a reporting package. The log book contained the facility name and identification number, the facility contact, the date the reporting package was e-mailed to the facility, the original due date, an extension date, if given, the date the submission was received by DAQ, and notes regarding phone or e-mail communications with the facility.

In addition to the 2008 inventory log book, a Microsoft® Excel spreadsheet was maintained to track each facility from the initial mailing through all tracking and review steps including the final QA/QC process. Communications with facilities are noted in the spreadsheet, especially when facilities failed to meet their deadlines. All facilities receiving reporting packages supplied either complete on-line submissions, or submitted activity forms via e-mail or facsimile.

2.7 Administrative Review

As soon as submissions were received, the review process began. The Administrative Completeness Determination (ACD) was performed as the first step in the review process. The ACD consisted of a one-page checklist which begins the audit trail associated with the review process. The ACD checklist was developed by the DAQ point source inventory staff over many years as a QA/QC tool for ozone SIP inventories. A checklist is completed and maintained in each facility file. An ACD is prepared for all facilities, whether Terminal Server Satellite *i*-STEPS[®] or the activity data reporting forms were used to prepare their submission.

2.7.1 Administrative Review of On-line Submissions

The ACD performed on on-line submissions included the following steps:

Review cover letter - Facilities were asked to identify in their cover letter any operational changes and the impact such changes had on emissions. DAQ staff reviewed the cover letter noting any significant changes and highlighted it for future reference.

Emissions comparison - The 2008 facility-wide reported emissions for each criteria pollutant were compared to the most recent periodic emission inventory year which in most cases was 2005. Annual emissions for other years were used when appropriate. Significant differences between the two years were identified, investigated, and documented. Reviewing past and present submissions, process additions and deletions were compared, identified and highlighted for further investigation. If sufficient information was not provided in the cover letter, the facility was contacted to explain the differences.

Accidental releases - Facilities were asked to identify accidental releases either through the assignment of a separate accidental release process or an explanation in their cover letter as to the accounting of the release(s) in their inventory. Throughout 2008, DAQ staff compiled e-mails of accidental releases sent through DNREC's Environmental Release Notification System list server. This information was checked against accidental releases identified in the emission inventory reports. The Delaware City Refinery (Premcor) had the greatest number of reported accidental releases. DAQ requested and received a spreadsheet of detailed accidental release information from the refinery. DAQ compared this information to the release notification information and to emissions reported as accidental releases by the refinery.

Comments Spreadsheet – DAQ developed a Microsoft[®] Word document to list any data from individual facilities that had significant changes, such as significant decreases or increases in emissions, the reason for the changes in emissions, and a list of issues that needed to be addressed before the QA/QC process could be completed. This information was also listed on the facility's ACD sheet.

Other ACD checks – DAQ staff verified that the emission certification report (facility summary) was signed by the Responsible Official. Any request for confidential business information was forwarded to the DAQ paralegal staff for review. The tracking spreadsheet was updated to include any communications with the facilities and to document when the ACD was completed

for each facility and when all issues, if any, were resolved. The completed ACD, cover letter, signed emissions summary page, submitted supporting calculation sheets, notes and other correspondence (i.e., e-mails) were placed in the facility file.

2.7.2 Administrative Review of Activity Data Report Forms

Activity data report form information was used to update facility general information and calculate emissions. Information from the activity reports were entered into the Terminal Server Satellite *i*-STEPS[®] database by DAQ staff. The database maintained an audit trail (user ID and date stamp) of data added to the system.

Activity data were used by the database to calculate emissions based on emission factors contained in the database. Fuel combustion throughputs for small boilers and generators were used in this way. Once emissions were estimated for a facility that reported activity data, the 2008 emissions could be compared to data from previous years.

All Title V permitted facilities are required to submit a signed emissions certification report as part of their permit requirements. For those Title V facilities that reported activity data, the DAQ point source inventory staff generated the emissions summary page based on emissions calculated within *i*-STEPS[®] and mailed it to the facility for signature by the Responsible Official. The ACD was not complete until the signed emissions summary page was returned to DAQ and the signature verified. The date the emissions summary page was mailed to a facility was documented within the tracking spreadsheet, as well as the due date for receiving the signed document. Finally, the actual date it was received was recorded.

The tracking spreadsheet was updated to include a record of communications with the facilities and to document when the ACD was completed for each facility and when all issues, if any, were resolved. The completed ACD, signed emissions summary page, notes and other correspondence (i.e., e-mails) were placed in the facility file.

2.8 Reported Data and Estimating Emissions

The 2008 stationary point source inventory included all criteria pollutants and their precursors (PM₁₀-PRI, PM_{2.5}-PRI, SO₂, NO_x, NH₃, VOC, and CO), all hazardous air pollutants (HAPs), and the six greenhouse gases as defined by the Kyoto Protocol (UN, 1998). For the 2008 PM_{2.5} Attainment Year SIP inventory, only emissions of PM_{2.5}, SO₂, and NO_x from New Castle County facilities are included in this report.

If PM_{2.5} emissions were missing, DAQ augmented PM_{2.5} emissions within the point source inventory either by using standard emission factors based on throughput information provided by the facility, or as described in Section 2.11.

Emissions of sulfur dioxide were calculated using FIRE emission factors, except for large units that use CEMs to monitor SO₂. Percent sulfur in the fuel is critical in calculating accurate SO₂ emissions for combustion processes using emission factors. DAQ reviewed and worked with the facilities to resolve any issues associated with the reported percent sulfur.

DAQ required facilities to report data to the process level, identified by an eight-digit Standard Classification Code (SCC). Key data reported included SCC identification, product or fuel throughput, operating schedule, control equipment information (type, capture efficiency and control efficiency), stack parameters (height, diameter, flow rate, velocity and temperature), and emission factors, if FIRE factors were not used. Data collected were consistent with EPA's *Procedures Volume I* (EPA, 1991b), the *Air Emission Reporting Requirements (AERR) – Final Rule* (EPA, 2008), *Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Air Quality Standards (NAAQS) and Regional Haze Regulations* (EPA, 2005b) (hereafter referred to as *Emissions Inventory Guidance*), and EIIP documents.

2.8.1 Emission Estimation Methods

Annual emissions could either be calculated within *i*-STEPS[®] using uncontrolled emission factors, throughput data, and control data, or outside the system using mass balance, stack tests, or other means. Terminal Server Satellite *i*-STEPS[®] allowed for the use of nine emission estimation methods, which are presented in Table 2-2.

Table 2-2. *i*-STEPS[®] Emission Estimation Methods

<i>i</i> -STEPS [®] Method Code	Basis for Emissions Estimate
1	Stack test data ^a
2	Material balance
3	Use of emission factor outside of <i>i</i> -STEPS [®] or use of EPA TANKS software
4	Best engineering judgment
5	State or local agency emission factor
6	New construction/not yet operational (zero emissions)
7	Source closed/operation ceased (zero emissions)
8	<i>i</i> -STEPS [®] default emission factor
9	Facility-supplied emission factor

^a includes Continuous and Predictive Emission Monitoring

Annual emissions are calculated by the database when Method Code (MC) 8 or 9 is designated. The monthly fuel or process throughput rates obtained from the facility are summed to an annual rate and then applied to the relevant emission factor, either the system default (MC8) or one supplied by the facility (MC9). This calculation produces an annual emissions estimate in tons per year. Annual emissions may be calculated outside of *i*-STEPS[®] with only the annual emissions entered in *i*-STEPS[®]. Annual emissions calculated outside of *i*-STEPS[®] are identified in the database by MC1 through MC4. Facilities were asked when deriving annual emissions from stack tests to take into consideration operating conditions during the stack tests, such as load and control efficiency, and be aware when stack test conditions were not representative of operating conditions in 2008.

For MC8 or MC9, emissions are calculated by the database through the use of a default or facility-supplied emission factor using the following equation for pollutant x:

$$E_a = [(Q_a) * (EF_x) * (FP) / 2000] * (1 - CE_x)$$

where:

E _a	=	Annual emissions, tons per year
Q _a	=	Annual process throughput
EF _x	=	Emission factor for pollutant x
FP	=	Fuel parameter, such as percent sulfur or ash content
CE _x	=	Overall capture and control efficiency

When a facility chooses MC8 for a process, *i*-STEPS[®] automatically selects the emission factor associated with the process SCC and calculates the emissions. For MC9, facilities were required to document facility-supplied emission factors. The emission factor must be documented by the facility or otherwise verified by DAQ. If not, DAQ replaced it with the current *i*-STEPS[®] SCC emission factor. Facilities may choose to calculate emissions outside of *i*-STEPS[®] and enter the emissions using MC3. If an emission factor is used by the facility to calculate the emissions, the factor must be documented by the facility or otherwise verified by DAQ. If not, DAQ changed the record to an MC8.

2.9 Technical Review of Submitted Data and Information

Once issues from the completeness determination were resolved, the technical review would begin. The technical review was conducted through a series of database queries. The query results were exported to a spreadsheet for ease of review and to compare to previous years' data. The spreadsheets allowed DAQ inventory staff to identify missing, suspicious or conflicting data. Any critical issues were identified and corrected in the database. Questionable data, missing information, and the correction of errors were handled in several ways. When a problem was identified, such as missing data, a typographic error, or other simple errors in the data, a phone call or e-mail to the facility was usually sufficient to resolve and document the issue. Usually no other correspondence was needed.

The following information was included in the technical review:

- General facility information;
- Narrative descriptions of the following: group/point, process, SCC, SCC units, and pollutant;
- Design capacity and standard design capacity units;
- Operating schedule, percent quarterly throughputs, and fuel sulfur and ash content;
- Monthly and annual throughputs provided in the SCC units described;
- Process-level annual emissions for all pollutants for each process;
- Stack ID and parameters;
- Emission calculation method;
- Abatement equipment information, including capture and control efficiencies for each pollutant;
- Calculations and documentation entered by the facility into a Notes field; and
- A summary page of facility-wide annual emissions for each pollutant.

There were six general areas of data and information in the technical review, including facility general, group/point (emissions unit), process unit, stack information, process unit controls and process unit emissions. The review of each section is described in detail below.

2.9.1 Facility General

The following facility general information was reviewed: facility name, facility site identification number, mailing address, year of inventory, North American Industry Classification System (NAICS) code, contact person, and phone number. Any missing or questionable information, such as NAICS code or an incorrect inventory year, was noted and resolved. As an example, the NAICS code was compared to a brief description of the facility's business activity supplied by the facility. DAQ had previously determined facility coordinates and thus this information only needed to be updated for newly inventoried facilities.

2.9.2 Group/Point (Emissions Unit)

Group information defines a piece of equipment, a group of related processes, or a particular activity at a facility. Design capacity, and annual and seasonal operating information were reviewed individually and in context with other information in the Emissions Unit spreadsheet.

A description of the equipment or activity is provided along with the design capacity and design capacity units. If the design capacity is missing for combustion equipment, an attempt was made to determine the design capacity of the equipment by reviewing permits or contacting the facility.

The operating schedule was reviewed for missing or inconsistent data. Hours per day and normal daily start and end times were also provided. The annual hours operated is calculated by *i*-STEPS[®] from the hours per day, days per week and weeks per year the facility enters into the system. A facility could override this calculated value by entering the actual number of hours operated for the year, if the facility had accurate records.

The percent quarterly throughput was corroborated with operating information. *i*-STEPS[®] enforced a range of between 95 and 101 percent for the sum of the four quarterly throughputs. A review of the database indicated that all sums of the quarterly throughputs were within the range of 98 to 101 percent. When necessary, in order to be consistent with the EIS requirements (EPA, 2009), the second quarter (March, April and May) and/or the fourth quarter (September, October and November) percent throughputs were adjusted so the sum of all four quarters would equal 100 percent. The third quarter (summer season) was not adjusted, since it was assumed the facility would have provided an accurate summer season value.

2.9.3 Process Unit

Numerous database queries and spreadsheets were developed to review the process unit level data reported by facilities. The information was reviewed individually and in context with other information in this section and related sections such as the group/emissions unit and stack information. Process unit information includes the process description, stack identifier, Source Classification Code (SCC) and description, percent sulfur and ash (for combustion units), and

monthly throughput for most processes. In a limited number of instances only annual throughput was provided.

The process description field is a text field that is used to describe a process in more detail than is defined by the SCC description. A determination was made whether the process description provided by the facility was consistent with the SCC description. As an example, the process description may mention No.6 oil for a piece of combustion equipment; and therefore the SCC description must be for combustion equipment burning No.6 oil.

In most cases monthly throughputs were provided by facilities. *i*-STEPS[®] sums the monthly throughputs and stores the value in the annual throughput field. In cases where there were significant changes in the group-level emissions as compared to a previous year, the annual throughputs were compared to previous data. If the comparison of throughput explains the difference in emissions, such as fuel switching, or an increase or decrease in fuel usage, this was noted on the Administrative Completeness Determination page and added to the tracking spreadsheet.

Each SCC has associated standard units as defined by EPA in its master list of SCCs and are contained within *i*-STEPS[®]. Facilities are given the option within *i*-STEPS[®] to change the units to make them appropriate to the data they are reporting. DAQ staff compared the SCC units as reported by the facility to the standard units. If the two values did not match, DAQ staff determined if the revised units were properly applied in the emission calculations.

2.9.4 Stack Parameters

Stack parameters and associated group and process unit information were reviewed. Each stack has an identification number and description assigned. The stack parameters include height above ground, diameter, exit gas temperature, velocity, and flow rate. If emissions were considered fugitive, then *i*-STEPS[®] requires only a stack identification number, a release point type (fugitive) and a height value. A default of ten feet was used for stack height when no fugitive height was provided.

If no stack information was provided for a process unit, DAQ would use information provided for the process in previous years and make the appropriate link within *i*-STEPS[®] between the stack and process unit records. If no previous year stack data existed in the database, a stack record was created and linked to the process based on permit file information or subsequent discussions with the facility. During data entry of the process unit record by facilities, Terminal Server Satellite *i*-STEPS[®] flashes a warning message, if a stack is not identified for the process.

2.9.5 Process Unit Control Equipment

Control information for controlled processes was reviewed. A control device identification number, *i*-STEPS[®] control device code, pollutant-specific capture and control efficiencies, and a description of the abatement equipment were reviewed. Control issues were flagged and resolved, if possible. Particulate, SO₂, and NO_x control devices were evaluated to determine if the control efficiency fell within a range expected for the identified control device.

2.9.6 Process Unit Emissions

Process unit emissions and associated information by pollutant were reviewed. The EIS pollutant code, pollutant name, the emission estimation method code, emission factor, the overall capture and control efficiencies, and annual emissions in tons per year were compiled in spreadsheets. The capture and control efficiencies were compared to the process unit control section. Issues associated with pollutant code or capture and control efficiencies were flagged, investigated, and resolved.

In the review a process was flagged if there was throughput or operating information that indicated a process was operating, but no emissions were provided. If emissions were expected, but not provided, the process unit emissions from the most recent year were checked. Usually, in cases such as this, the facility provided an explanation in the process unit or process emissions Notes field. An example of this would be when CEMs are used for NO_x or SO₂ emissions from combustion sources that utilize more than one type of fuel. All NO_x or SO₂ emissions would be reported under the major fuel burned. The secondary fuel would have a throughput, but no process unit emissions.

2.9.7 A Multi-year Comparison of Facility Level Emissions

A spreadsheet of criteria pollutant facility-wide emissions in tons per year was created for the years 2002 through 2008. Any significant differences in the 2008 emissions compared to the previous years' data were flagged. Fuel switching, production changes, or the addition of controls, were the most common reasons for the observed differences.

2.10 Technical Review Using Database Queries, Reports and Spreadsheets

Numerous database queries, reports and spreadsheets were created to identify information that appeared to be missing, in error or inconsistent with other related information. This included analysis of related operating schedule information.

If an issue initially identified by DAQ or the facility, and subsequently corrected in the *i*-STEPS[®] database by DAQ, had a significant impact on the facility's reported total emissions, DAQ requested documentation from the facility acknowledging the change in emissions. The documentation may be in the form of a letter, e-mail, or facsimile from the facility. Title V facilities were required to resubmit a new emissions summary report signed by the Responsible Official.

If issues were unable to be resolved with the facility, DAQ staff updated or modified the information submitted by the facility to the extent needed to develop emission estimates. This usually was acknowledged in correspondence with the facility.

2.11 PM_{2.5} Augmentation of Facility Reported Emissions

To insure PM_{2.5}-PRI, PM_{2.5}-FIL, and PM-CON were calculated properly for all combustion and non-combustion sources, numerous database queries and spreadsheets were developed to identify

missing emissions or inconsistencies between the PM emission estimates for a given process. Missing emissions were determined as follows:

- With the exception of gaseous fuel fired external combustion processes, AP-42 PM_{2.5}-FIL and PM-CON emission factors were available for nearly all external combustion processes. If filterable or condensable emissions were not reported by the facility, DAQ staff calculated these emissions using the AP-42 factors.
- For external combustion processes burning gaseous fuels, PM_{2.5}-PRI was estimated using factors published in “*Revision of the PM Emissions From Natural Gas Combustion in the Final Version of the 2002 NEP*” (EPA, 2005c) and an EPA Excel file entitled “*Ratios to Adjust PM*” containing SCCs and PM_{2.5}-PRI emission factors (EPA, 2005d). If PM_{2.5}-PRI was not reported, DAQ staff estimated these emissions using these factors. Specific filterable and condensable factors are currently not available for gaseous fuels.
- If PM_{2.5}-PRI was missing, DAQ equated it to the sum of PM_{2.5}-FIL and PM-CON;
- In instances where a facility reported only PM₁₀ (PRI and/or FIL) DAQ assumed that PM_{2.5} conservatively equaled PM₁₀.

Since primary emissions are the sum of the filterable and condensable components, queries and a spreadsheet were developed to insure that PM_{2.5}-PRI matched the sum of its components.

2.12 Review of NO_x and SO₂ Emissions from EGUs and Other Large Sources

In 2002 there were 21 electric generation units (EGUs) in New Castle County. The Madison Street combustion turbine closed in 2004. DAQ staff conducted a review of NO_x and SO₂ emissions for the 20 remaining EGUs in New Castle County. Most of these units report emissions based on continuous emissions monitoring (CEM) data to EPA through their Air Markets Program Data (AMPD) website (EPA, 2010). The website contains emissions data reported to EPA’s Acid Rain and NO_x Budget Programs. DAQ staff compared AMPD 2008 emissions to emissions reported to DAQ.

There were 18 New Castle County EGUs listed in AMPD that had annual 2008 NO_x and SO₂ emissions that could be compared to annual emissions reported to DAQ. An additional two units reported 2008 emissions for six months (April – September). For those units that only reported six-month emissions, an annual estimate was needed to directly compare to the facility reported value. A NO_x emission factor was calculated in pounds of NO_x emissions per MMBtu using the six-month emission amount divided by the heat content of the fuel listed in AMPD for the six months. Annual emissions were then calculated by applying this factor to the annual fuel heat content reported in *i*-STEPS[®].

There were five additional units (non-EGU) reporting annual emissions under the NO_x Budget Program. These units were located at the Delaware City Refinery (Premcor) and were evaluated using the same methodology as above.

Differences in NO_x emissions reported to DAQ compared to EPA’s AMPD data were expected for some units since the Acid Rain Program requires the use of the unit’s maximum load value as a default at times when the CEM is not functioning properly. DAQ staff worked with these facilities to determine the best estimate of actual NO_x emissions for the inventory.

2.13 Methods for Correcting Erroneous Data

Questionable data, missing information, and the correction of errors were addressed in several ways. In all cases DAQ maintained a paper or electronic trail of changes made by staff or the facility. When a problem was identified, such as missing data, typographic error, or other simple errors in the data, a phone call or e-mail usually was sufficient to resolve and document the issue. Usually no other correspondence was needed.

If an issue had a significant impact on the facility's initially reported total emissions, DAQ requested documentation from the facility acknowledging the change in the emissions. The documentation may be in the form of a letter, e-mail, or facsimile from the facility. TV facilities were required to resubmit a new emissions summary report signed by the Responsible Official.

For submissions where there were extensive problems, a facility may have been asked to meet with DAQ staff to outline the issues and to develop ways to address the problems. Once issues had been discussed and resolved, the facility may have been asked to resubmit information through the on-line reporting system. DAQ staff would reopen the facility's record within the Terminal Server Satellite *i*-STEPS[®] on-line system to allow access for corrections and updates.

If issues were unable to be resolved with the facility, DAQ staff updated or modified the information submitted by the facility to the extent needed to develop emission estimates. This usually was acknowledged in correspondence with the facility.

2.14 Facility Site and Stack Coordinates

Facility and stack coordinates were verified during previous PEI inventories. Coordinates were verified through the use of high-resolution aerial photography that DNREC had previously placed in GIS. Existing site coordinates contained in *i*-STEPS[®] were plotted and superimposed on the aerial photography. Staff from the Engineering and Compliance (E&C) Branch met with inventory staff and reviewed the resulting facility locations on the aerial photographs. E&C staff were knowledgeable enough with the layout of the facilities they permit to identify them on the photographs. Based on the permitting engineer's advice, the facility point was moved, if necessary, to place it over the geographic center of emissions activity at the facility. For several facilities, ground reconnaissance was performed to verify a facility's location.

Two New Castle County facilities, Corrado Construction and Micropore, were new to emissions reporting for 2008 and their coordinates were determined using Google Earth.

2.15 Database Management

The 2008 point source inventory database was managed using *i*-STEPS[®] for Microsoft[®] SQL Server 5.0 data management system, associated utilities and applications including the Terminal Server Satellite *i*-STEPS[®] on-line system and Microsoft[®] Access. Microsoft[®] Access was used to create queries and reports from the SQL tables. After the administrative review and a check of reasonableness of the facility-wide emissions were completed for most facilities, a copy of the

Terminal Server database was produced as an archive of data reported by the facilities. A second database was created as the 2008 production database for purposes of developing the several inventories required for 2008. This database was managed using the Agency *i*-STEPS[®].

DNREC's Office of Information Technology (OIT) provides computer network support and routine database management functions. Joseph Handley, Application Support Project Leader, of the OIT office served as liaison between DAQ inventory staff and OIT. Mr. Handley also helped with user network, Internet connectivity, and firewall issues.

i-STEPS[®] utilizes relational databases and contains functions and utilities to maintain database integrity. There are field-sensitive look up tables, and data element and record validation routines that ensure valid data and enforce database integrity. The system has a record level audit trail that documents changes made to the records, identifies the user and the date the change was made. In addition, there are comment/note windows for each record where text can be added by the user and DAQ staff to clarify information provided or supply additional documentation.

2.16 Data Submission to EPA's Emissions Inventory System

Emissions Inventory System (EIS) staging tables (EPA, 2009) in Microsoft[®] Access format were generated from the *i*-STEPS[®] database. EIS is the EPA's air emissions inventory data management system. An application developed in conjunction with the Department's Information Technology staff was used to map information in the *i*-STEPS[®] database to the EIS staging tables. EPA's EIS Bridge Tool was then used to prepare emissions inventory data in the staging tables for submission to EIS. The EIS Bridge Tool transforms emissions inventory data into CERS XML files.

The XML files were submitted to the EIS QA environment to obtain several feedback reports that would identify errors and issues associated with the submitted files. All significant issues associated with mandatory and necessary fields were reviewed and resolved prior to submission of the XML files to the EIS Production environment. Emissions data submitted to the EIS Production environment are used by EPA to populate the National Emissions Inventory. Production submissions of the 2008 emissions data and facility information were initially made during May 2010 to meet the June 1, 2011 EPA reporting requirement, while final corrections and additions were sent to EIS between December 2010 and January 2011.

2.17 Source Sector Discussions

All New Castle County facilities associated with hot-mix asphalt production and electric generation are included in the 2008 PM_{2.5} Attainment Year SIP point source inventory. Details of these industry sectors are presented below.

2.17.1 Hot-mix Asphalt Plants

Hot-mix asphalt (also known as asphaltic concrete or blacktop) production facilities have been historically tracked and permitted by the Department as point sources. There were five facilities

in New Castle County for 2008 and these are all included in the point source inventory. Delaware facilities employ both drum mixer and rotary dryer processes in the production of hot-mix asphalt. The appropriate SCCs were used to identify these processes. In 2008, all New Castle County facilities collectively emitted 12 tons PM_{2.5}-PRI, two tons of SO₂, and 13 tons of NO_x.

The activity data forms were used to obtain throughput data from hot-mix asphalt plants. Data from the completed forms were entered into *i*-STEPS[®] and EPA standard emission factors were used to calculate emissions within *i*-STEPS[®] based on the SCC provided by the facility. In a few instances emissions were based on stack tests.

Many asphalt plants employ crushing operations powered by diesel engines. The emissions from these diesel engines were estimated based on reported fuel usage and FIRE 6.24 emission factors.

2.17.2 Electric Generating Units (EGUs)

New Castle County EGUs are represented by two large generating stations (Calpine Edge Moor and Calpine Hay Road), three Calpine peaking unit stations, and generators at the Delaware City Refinery (Premcor). In total, there are 20 EGUs located at six facilities in New Castle County included in the point source inventory. EGUs in Delaware include external combustion boilers and combustion turbines. Small diesel generators used by businesses and institutions for emergency backup power and load management are not included in this discussion, and are generally not reported to the point source inventory. 2008 PM_{2.5}, SO₂, and NO_x emissions from New Castle County EGUs are presented in Table 2-3. Note that PM_{2.5} emissions given in the following tables represent primary emissions (i.e., filterable plus condensable).

Table 2-3. 2008 PM_{2.5} and Precursor Emissions for New Castle County EGUs

Facility Name	Unit Description	Annual Emissions, TPY		
		PM _{2.5}	SO ₂	NO _x
Calpine Christiana	Turbine #11	< 1	< 1	1
	Turbine #14	< 1	< 1	1
Calpine Delaware City	Turbine #10	< 1	< 1	1
Calpine Edge Moor	Boiler #3	107	2,011	525
	Boiler #4	242	4,923	1,292
	Boiler #5	11	176	163
	Turbine	< 1	< 1	< 1
Calpine Hay Road	Turbine #1	7	2	65
	Turbine #2	7	2	70
	Turbine #3	7	1	47
	Turbine #5	5	2	7
	Turbine #6	5	2	7
	Turbine #7	5	1	6
Calpine West Substation	Turbine	1	1	1
Delaware City Refinery	Boiler #1	14	9	200
	Boiler #2	11	15	41
	Boiler #3	15	54	254
	Boiler #4	3	11	184
	Turbine #1	28	202	83
	Turbine #2	13	49	47
Total		479	7,463	2,994

Emissions from New Castle County EGUs represent 71% and 54% of the county-wide point source emissions of SO₂ and NO_x, respectively. Most peaking units operate exclusively during the summer to meet periods of high demand. Their operation may coincide with days when air quality is most likely to experience an exceedance of the daily fine particulate standard.

2.17.3 Emissions by Source Sector

Table 2-4 provides New Castle County total PM_{2.5}-PRI, SO₂, and NO_x emissions grouped by source sector as defined by the first three digits of the SCC codes assigned to each process.

The source sectors include various combustion and manufacturing processing, material storage and transfer operations, and solid waste disposal. Combustion processes account for the majority of the particulate, SO₂, and NO_x emissions in New Castle County from the point source sector.

Table 2-4. 2008 PM_{2.5} and Precursor Emissions by Industry Sector

SCC	SCC Description	Annual Emissions, TPY		
		PM _{2.5}	SO ₂	NO _x
101	External Comb. Boilers - Utilities	402	7,199	2,659
102	External Comb. Boilers - Industrial	269	1,120	2,061
103	External Comb. Boilers – Commercial	1	28	51
105	Ex. Comb. Boilers - Space Heaters	< 1	< 1	16
201	Internal Comb. Engines - Utilities	37	12	208
202	Internal Comb. Engines - Industrial	41	252	145
203	Internal Comb. Engines - Commercial	< 1	< 1	4
270	Internal Comb. Engines – Off-road		1	12
301	Chemical Manufacturing	55	78	42
303	Primary Metal Production	56	42	190
304	Secondary Metal Production	< 1		
305	Mineral Products	16	2	13
306	Petroleum Industry	199	1782	164
307	Pulp, Paper and Wood Products	< 1		
308	Rubber and Misc. Plastics Products	< 1	< 1	1
309	Fabricated Metal Products	1		
385	Cooling Tower	15		
399	Misc. Manufacturing	< 1		
402	Surface Coating Operations	7	< 1	5
406	Transport/Marketing of Petrol. Prod.	< 1	< 1	1
501	Solid Waste Disposal - Government	1	7	2
502	Solid Waste Disposal – Comm./Inst.	8	24	11
503	Solid Waste Disposal - Industrial	2	28	4
682	Miscellaneous Processes	< 1		
Statewide Total		1,109	10,576	5,589

2.18 Emissions by Facility

Facility-level annual emissions for the 58 facilities included in the 2008 PM_{2.5} Attainment Year SIP inventory are provided in Tables 2-5. For recent facility name changes, the former name is included in parentheses.

Table 2-5. 2008 PM_{2.5} and Precursor Emissions for New Castle County Facilities

Facility Name	Annual Emissions, TPY		
	PM _{2.5}	SO ₂	NO _x
A.I. DuPont Hospital	1	25	13
Amtrak Maintenance Facility	< 1	< 1	4
Ashland Research Center (Hercules)	1	9	6
Astrazeneca Pharmaceuticals	< 1	< 1	7
BASF (Ciba Specialty Chemicals)	2	< 1	10
Calpine – Christiana (Conectiv)	< 1	< 1	2
Calpine - Delaware City (Conectiv)	< 1	< 1	1
Calpine - Edge Moor (Conectiv)	360	7,110	1,980
Calpine - Hay Road (Conectiv)	36	10	202
Calpine - West Substation (Conectiv)		1	1
Christiana Hospital	< 1	4	16
Christiana Materials	3	1	3
Chrysler (DaimlerChrysler)	3	24	34
Clean Earth of New Castle	8	24	11
Contractors Materials	2	< 1	2
Corrado Construction	< 1	< 1	1
Croda (Uniqema)	1	7	49
Dassault Falcon Jet	< 1	< 1	1
Delaware City Refinery (Premcor)	446	2,548	2,525
Delaware City Terminal (Premcor)	< 1	< 1	< 1
Del. Correctional Center - Smyrna	< 1	< 1	6
Delaware Recyclable Products	1	28	3
Diamond Materials	5	1	9
DSWA Cherry Island Landfill	1	7	1
DuPont - Chestnut Run	8	140	45
DuPont - Edge Moor	17	17	32
DuPont - Red Lion	< 1	47	13
DuPont Building - Wilmington	3	57	19
DuPont Experimental Station	27	438	156
DuPont Stine-Haskell Lab	1	8	16
E-A-R Specialty Composites	< 1	< 1	1
Eastern Shore Natural Gas – Del City	< 1	< 1	4
Edgemoor Materials	2	< 1	3
Evrax Claymont Steel	64	42	190
FMC	17	< 1	30
Formosa Plastics	26	< 1	25
FP International	< 1	< 1	1
General Motors	7	< 1	25
Honeywell International		< 1	< 1
Johnson Controls Battery	< 1	< 1	3
Kuehne Chemical	< 1	< 1	1
MacDermid	< 1	< 1	3
Magellan Terminals	< 1	5	3
Medal Air Liquide	< 1	< 1	4
Motech Americas (GE Energy)	< 1	< 1	< 1

continued next page

Table 2-5. continued

Facility Name	Annual Emissions, TPY		
	PM _{2.5}	SO ₂	NO _x
Noramco	< 1	< 1	1
NVF – Yorklyn	< 1	< 1	< 1
Occidental Chemical	< 1	< 1	< 1
Prince Minerals (American Minerals)	< 1	< 1	< 1
Printpack	< 1	< 1	2
Pure Green Industries	< 1	< 1	1
Rohm & Haas Electronic Materials	< 1	< 1	4
St. Francis Hospital	< 1	< 1	4
Sunoco	66	17	83
University of Delaware - Newark	< 1	3	22
Veterans Administration Hospital	< 1	< 1	4
Wilmington Hospital	< 1	< 1	7
Wilmington WWTP	< 1	1	2
New Castle County Total	1,109	10,576	5,589

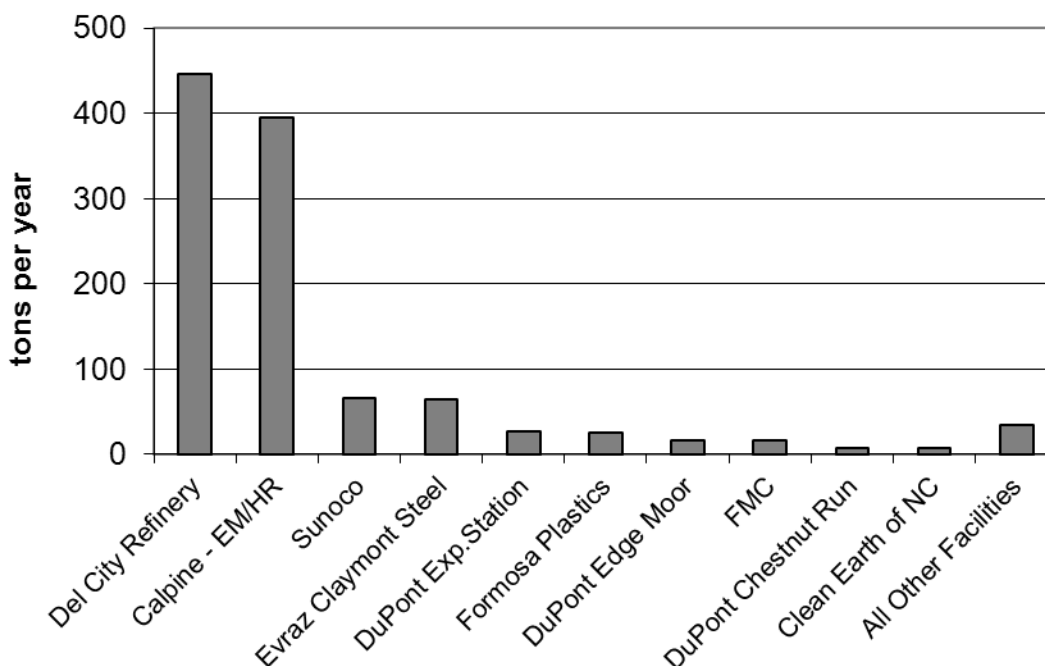
2.18.1 Sources of PM_{2.5} Emissions

The Delaware City Refinery is the largest source of PM_{2.5}-PRI, emitting 446 tons in 2008. 56% of these emissions (263 tons) are associated with the catalytic cracker and coker CO boilers. The Calpine Edge Moor/Hay Road complex is the second largest PM_{2.5}-PRI source in Delaware. The coal-fired units at this facility have particulate controls, which have the ability to capture filterable particulates only. Calpine EM/HR emitted 396 tons of PM_{2.5}-PRI of which 308 tons were condensables. All other facilities in New Castle County emitted less than 100 TPY of NO_x in 2008.

The top ten PM_{2.5} sources, representing 97% of county-wide annual PM_{2.5} emissions for 2008 from point sources in New Castle County, are presented in Table 2-6 and in Figure 2-1.

Table 2-6. 2008 New Castle County Facility Ranking of PM_{2.5} Annual Emissions

Facility Name	Major Activity	TPY
Delaware City Refinery / Terminal	Petroleum Refinery	446
Calpine – Edge Moor/Hay Road	Electricity Generation	396
Sunoco	Petroleum Refinery	66
Evraz Claymont Steel	Steel Manufacturing	64
DuPont Experimental Station	R&D / Hazardous Waste Incinerator	27
Formosa Plastics	PVC Manufacturing	26
DuPont Edge Moor	Chemical Manufacturing	17
FMC	Chemical Manufacturing	17
DuPont Chestnut Run	Research & Development	8
Clean Earth of New Castle	Contaminated Soil Remediation	8
All Other Facilities		34
County Total		1,109

Figure 2-1. 2008 PM_{2.5} Annual Emissions by Facility

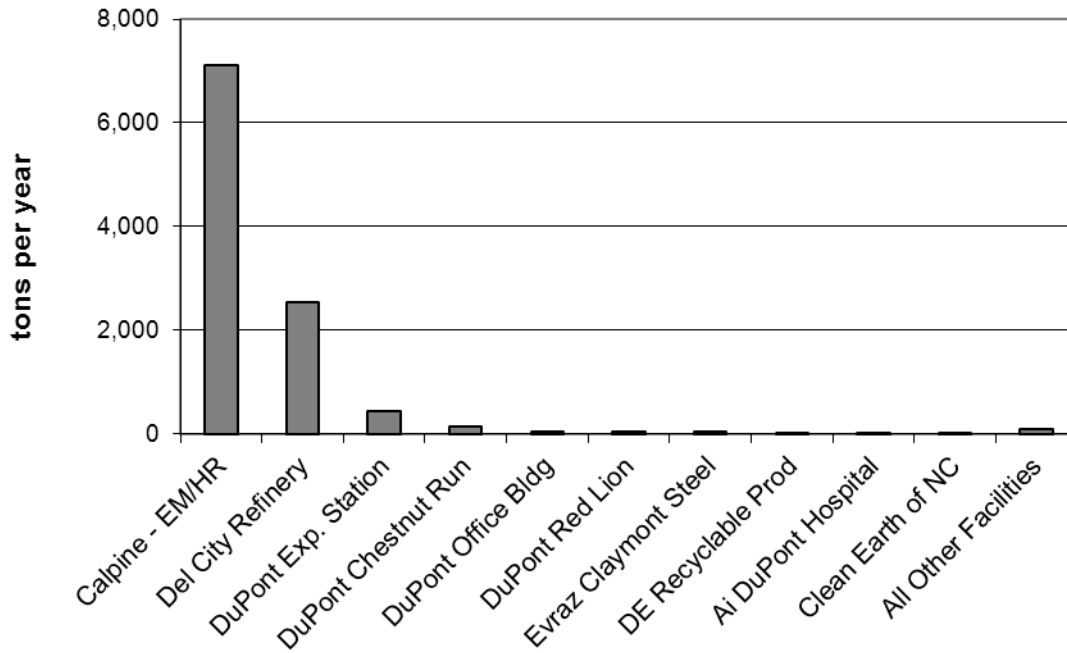
2.18.2 Sources of SO₂ Emissions

The top three facilities account for 96% of the county-wide annual SO₂ emissions from point sources in New Castle County. The top facility, Calpine Edge Moor/Hay Road power plants, burning coal in 2008 to generate electricity, accounted for 67% of county SO₂ emissions. The Delaware City Refinery accounted for another 25% of the county total SO₂ emissions. The third largest source of SO₂ emissions is the DuPont Experimental Station, which utilizes residual oil in its several boilers. The top ten SO₂ sources in New Castle County are presented in Table 2-7 and in Figure 2-2.

Table 2-7. 2008 New Castle County Facility Ranking of SO₂ Annual Emissions

Facility Name	Major Activity	TPY
Calpine Edge Moor/Hay Road	Electricity Generation	7,120
Delaware City Refinery	Petroleum Refinery	2,548
DuPont Experimental Station	R&D / Hazardous Waste Incinerator	438
DuPont Chestnut Run	Research & Development	140
DuPont Building Wilmington	Commercial Building	57
DuPont Red Lion	Chemical Manufacturing	47
Evraz Claymont Steel	Steel Manufacturing	42
Delaware Recyclable Products	Construction Debris Landfill	28
A.I. DuPont Hospital	Health Services	25
Clean Earth of New Castle	Contaminated Soil Remediation	24
All Other Facilities		107
County Total		10,576

Figure 2-2. 2008 SO₂ Annual Emissions by Facility



2.18.3 Sources of NO_x Emissions

The largest source of NO_x emissions in New Castle County for 2008 is the Delaware City Refinery. A large majority of emissions (71%) from the refinery come from just a few processes, including the catalytic cracking unit, the fluidized coking unit, and four boilers used for electricity generation. The second largest source of NO_x emissions is the Calpine Edge Moor/Hay Road electric generation complex. The refinery and Calpine EM/HR combined account for 84% of NO_x emissions from point sources in New Castle County.

The top ten NO_x sources, representing 95% of county-wide NO_x emissions for 2008 from New Castle County point sources, are presented in Table 2-8 and in Figure 2-3.

2.19 Closed Facilities

Several facilities included in the 2008 PM_{2.5} Attainment Year SIP inventory have since permanently closed. Table 2-9 presents a list of closed facilities and the month and year operations ceased. For historical context, all New Castle County facilities that reported for 2002 and 2005 that have since closed are also included in Table 2-9.

Table 2-8. 2008 New Castle County Facility Ranking of NO_x Annual Emissions

Facility Name	Major Activity	TPY
Delaware City Refinery	Petroleum Refinery	2,525
Calpine Edge Moor/Hay Road	Electricity Generation	2,182
Evraz Claymont Steel	Steel Manufacturing	190
DuPont Experimental Station	R&D / Hazardous Waste Incinerator	156
Sunoco	Petroleum Refinery	83
Croda	Chemical Manufacturing	49
DuPont Chestnut Run	Research & Development	45
Chrysler	Automobile Assembly	34
DuPont Edge Moor	Chemical Manufacturing	32
General Motors	Automobile Assembly	25
All Other Facilities		268
County Total		5,589

Figure 2-3. 2008 NO_x Annual Emissions by Facility

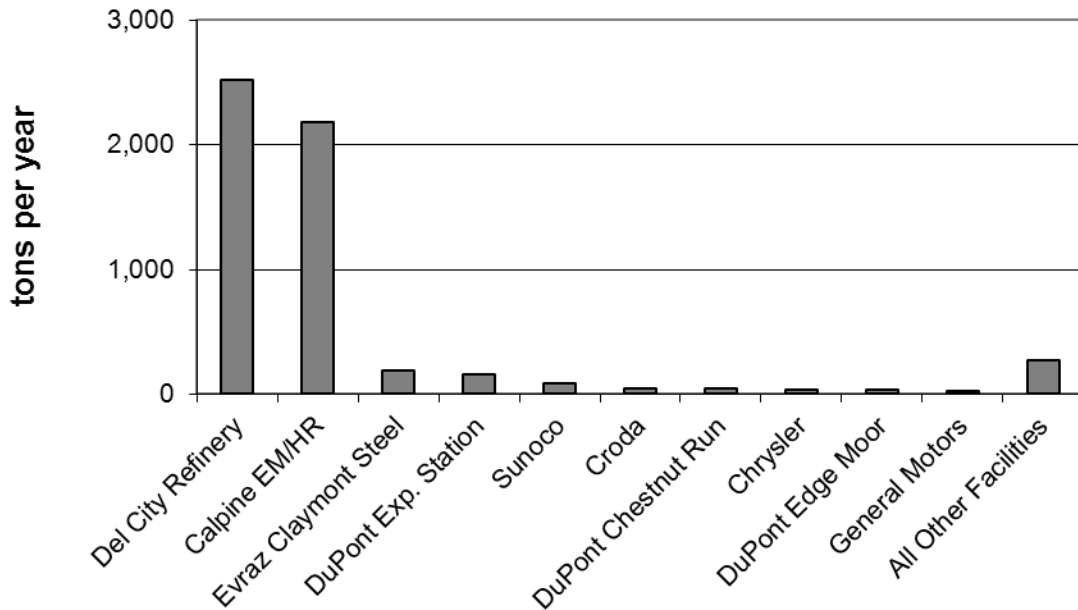


Table 2-9. Reporting Facilities That Have Ceased Operations

Facility Name	Date Closed
Metachem Products	May 2002
Lafarge	November 2002
Westvaco	May 2003
Kaneka	July 2003
VPI Film (VPI Mirrex)	July 2003
Wilmington Piece Dye	September 2003
General Chemical	June 2004
Laidlaw	September 2004
Conectiv - Madison Street	December 2004
Industraplate	March 2005
Ametek	October 2005
Hardcore Composites	January 2006
Spatz Fiberglass	December 2007
PTFE	July 2008
CPI (Unisource)	October 2008
Occidental Chemical	October 2008
Pepsi Cola Bottling	November 2008
NVF Yorklyn	March 2009
Chrysler (DaimlerChrysler)	December 2009
Tilcon – Terminal Avenue	June 2011

2.20 References

- DNREC, 2006. *Regulations Governing the Control of Air Pollution*, Regulation No.1144 – Control of Stationary Generator Emissions, Delaware Department of Natural Resources and Environmental Control, Division of Air Quality, Updated to November 2006.
- EPA, 1991a. *Emission Inventory Requirements for Ozone State Implementation Plans*, EPA-450/4-91-010, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., March 1991.
- EPA, 1991b. *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone*, Volume I: General Guidance for Stationary Sources, EPA-450/4-91-016, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., May 1991.
- EPA, 1997. *Emissions Inventory Improvement Plan (EIIP), Volume II: Point Sources Preferred and Alternative Methods*, Chapter 1, EPA-454/R-97-004b, USEPA, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., July 1997.
- EPA, 2005a. TANKS Version 4.09D, Windows-based computer software program for estimating VOC emissions from storage tanks, 2005.

- EPA, 2005b. *Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations*, EPA-454/R-05-001, USEPA, Emissions Inventory Group Emissions, Monitoring and Analysis Division, Office of Air Quality Planning and Standards, Research Triangle Park, NC, November 2005.
- EPA, 2005c. *Revision of the PM Emissions From Natural Gas Combustion in the Final Version of the 2002 NEI*, USEPA, Emissions Inventory Group, Office of Air Quality Planning and Standards, Research Triangle Park, NC, August 2005. ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/point/pm_adjustment_2002_nei.pdf
- EPA, 2005d. *2002 Final NEI Documentation Containing Ratios to Adjust PM Values for Natural Gas Combustion*, Excel file, Roy Huntley, August 2005., USEPA, Emissions Inventory Group, Office of Air Quality Planning and Standards, Research Triangle Park, NC, August 2005. ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/point/adjustment_point/ratios_to_adjust_pmvalues_in_nei_for_naturalgas_combustion082005.xls
- EPA, 2008. *Air Emission Reporting Requirements (AERR) – Final Rule*, U.S. Environmental Protection Agency, 40 CFR Part 51, Vol. 73, No 2143, December 17, 2008.
- EPA, 2009: *2008 National Emissions Inventory, Emissions Inventory System Implementation Plan, Section 7 Reporting Instruction for Point Emissions*, Revised, August 3, 2009. <http://www.epa.gov/ttn/chief/net/neip/index.html>.
- EPA, 2010. CEM Data for the Acid Rain and NO_x Budget Programs, Clean Air Markets Division, <http://ampd.epa.gov/ampd/QueryToolie.html>, Office of Air and Radiation, USEPA, accessed 2010.
- UN, 1998. *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, Annex A, United Nations, 1998.

SECTION 3

STATIONARY NON-POINT SOURCES

Stationary non-point sources represent a large and diverse set of individual emission source categories. A non-point source category is either represented by small facilities too numerous to individually inventory, such as commercial cooking at restaurants and fuel combustion at a variety of small businesses, or is a common activity, such as residential open burning. Emissions from the non-point source categories were estimated at the county level.

3.1 Source Categories

There are a number of non-point source categories which contribute emissions of PM_{2.5}, SO₂, and NO_x. These categories can be grouped into several category types. These include:

- **Fuel Combustion** – The combustion of fuels in industrial, commercial, institutional, and residential furnaces, engines, boilers, wood stoves, and fireplaces create emissions of PM_{2.5}, SO₂, and NO_x.
- **Open Burning** – Open burning creates emissions of PM_{2.5}, SO₂, and NO_x. Open burning categories include trash burning, prescribed burning, burning of land clearing debris, wildfires, and house and vehicle fires.
- **Fugitive Dust** – Primary crustal particulate is created from construction activities, agricultural production, and as a result of vehicle traffic. Fugitive dust is largely coarse material, with only a small percentage being fine particulate.

Individual facilities are typically grouped with other like sources into a source category. Source categories are grouped in such a way that emissions are estimated collectively using one methodology. For the 2008 inventory, the distinction between point and non-point was defined by an annual emission threshold based on recent point source data (see Section 2 for point source criteria). Table 3-1 lists the source categories for which PM_{2.5}, SO₂, and NO_x for New Castle County were estimated.

Table 3-1. Non-point Source Categories Inventoried

Agricultural Burning	Residential Construction
Agricultural Production	Residential Fuel Combustion
Commercial Construction	Residential Open Burning
Commercial Cooking	Residential Wood Combustion
Commercial Fuel Combustion	Road Construction
Industrial Fuel Combustion	Structure Fires
Land Clearing Debris Burning	Vehicle Fires
Paved & Unpaved Road Dust	Wildfires
Prescribed Burning	

There were several source categories evaluated, but not included, in the non-point source inventory. These include:

- **Crematories** – While there are at least a dozen human/pet crematories and several laboratory animal incinerators in Delaware, DNREC was unable to locate emission factors for ozone precursors. Emissions from fuels used at these facilities are included in the commercial fuel combustion category.
- **Feed Mills and Concrete Plants** - These industry sectors were considered a source of particulate matter, both from material handling processes and fugitive dust (i.e., storage piles). Several large feed mills in Delaware already met the criteria for reporting as a Title V facility due to combustion emissions from process boilers and grain dryers. The lack of quality emissions data (i.e., emission factors) for feed mills persuaded DAQ from inventorying smaller feed mills. Lack of data was also the reason for not further considering concrete plants.
- **Slash Burning** - No activity for the burning of slash from logging for future silvicultural operations was identified. This was confirmed by the Delaware Division of Forestry. However, recently logged lands are occasionally converted to agriculture. This activity, previously reported as slash burning, is now reported under the land clearing debris burning category.

3.2 Emission Estimation Methodologies and Activity Data

The 2005 Delaware Periodic Emission Inventory served as the starting point for non-point source category selection and methodology development. One new category, agricultural burning, was added to the non-point sector. In 2007 agricultural burning was specifically delineated on the prescribed burning approval application form. This allowed DAQ to track the burning of woody debris specific to agricultural activities separate from other prescribed burning activities and other land clearing debris burning, (the latter is not permitted under Delaware Air Regulation 1113.)

New methods were applied to some existing source categories, and emission factors were updated where available. New methods and emission factors came primarily from current *Emission Inventory Improvement Program, Volume III* documents and documented projects performed by the California Air Resource Board (CARB). Other sources of information included the *Compilation of Air Pollutant Emission Factors, Volume I (AP-42)*, the *Factor Information Retrieval System (FIRE)*, and several projects performed by the Mid-Atlantic Regional Air Management Association (MARAMA) and EPA.

Emissions from most non-point source categories were estimated by multiplying an indicator of collective activity by a corresponding emission factor. An indicator is any parameter associated with the activity level of a source, such as production, employment, fuel usage, or population that can be correlated with the emissions from that source. The corresponding emission factors are per unit of production, per employee, per unit of commodity consumed, or per capita, respectively. The basic equation that was applied to emission development for most non-point source categories is as follows:

$$\text{Emissions (E)} = \text{Activity Data (Q)} \times \text{Emission Factor (EF)}$$

If a source category had a regulatory control placed on it at the Federal or State level, the equation expands to the following:

$$E = Q \times EF \times [1 - (CE)(RE)(RP)]$$

where: CE = control efficiency
RE = rule effectiveness
RP = rule penetration

The control efficiency (CE) represents the typical emissions reduction achieved as compared to the otherwise uncontrolled emissions. A control may be a piece of equipment, such as a cyclone used to capture particulates, or it may be an operational control, such as low sulfur fuel.

Rule effectiveness (RE) reflects the ability of the regulatory program to achieve all emissions reductions that could have been achieved by full compliance with the applicable regulations at all sources at all times. If a rule is not being followed by all of the regulated community, then emissions will be higher than would otherwise be if there was 100% compliance. As an example, while the burning of trash is illegal under any circumstances in Delaware, the practice of burning household trash in backyard burn barrels still takes place in many rural areas of the State.

Rule penetration (RP) represents the percent of sources within a source category that are subject to the rule that requires control. As an example, while businesses and developers are prohibited from burning woody debris, Delaware residents may burn small piles of branches and limbs during certain times of the year. Therefore, RP is less than 100%. In the case of the burning of trash or leaves, no person or business is exempt, and thus RP is 100%.

A major portion of the work involved in creating the 2008 non-point source inventory was in collecting activity data for each source category. The activity data gathered was related to the type of emission factors available and, in many cases, obtained from local sources. Surveys, letters, e-mails, and phone calls to individual businesses to obtain representative data for a source category was a technique used for several source categories. The type of activity data and the data source for each category is provided in Table 3-2.

Point source backout was performed for the industrial and commercial fuel combustion categories to avoid double counting of emissions between point and non-point sources. Point source fuel usage was backed out from fuel consumption data obtained from the U.S. Department of Energy's (DOE) Energy Information Administration (EIA).

3.3 2008 Emissions Summary

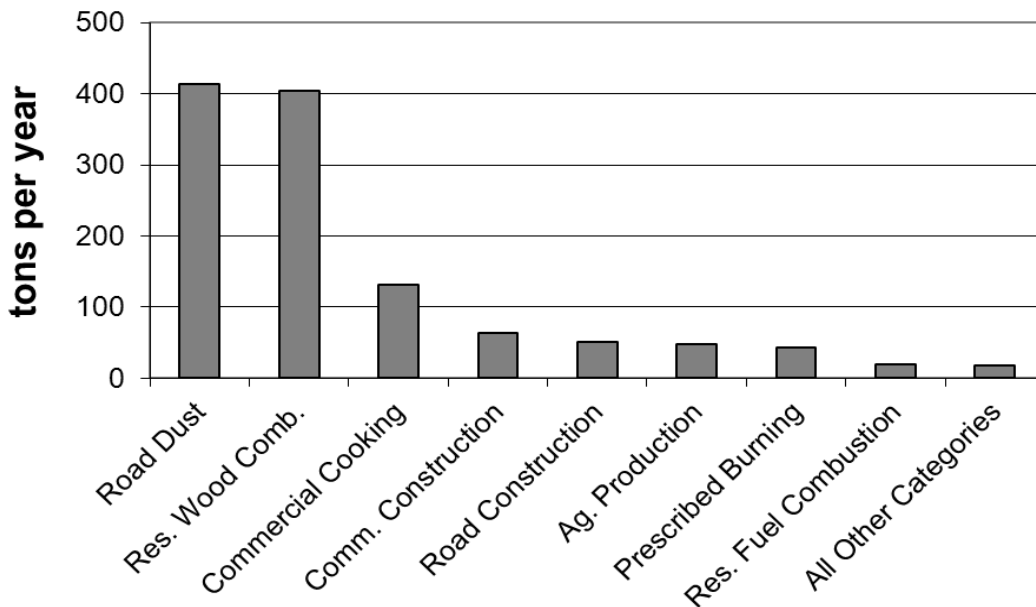
Table 3-3 provides a summary of the 2008 annual (tons per year, TPY) emissions for each non-point source category for New Castle County. The totals may not match the sum of the individual values due to independent rounding.

Table 3-2. Summary of 2008 Non-point Source Activity Data

Source Category	Activity Data	Source of Activity Data
Agricultural Burning	Acreage and vegetation type	DAQ Area Source Compliance Program
Agricultural Production	Planted and harvested crop acreage	Delaware Department of Agriculture
Commercial Construction	Value of construction put in place; construction employment; construction businesses	US Census Bureau County Business Patterns; Delaware Department of Labor
Commercial Cooking	Population	Delaware Population Consortium
Commercial Fuel Combustion	Fuel consumption	DOE Energy Information Admin.
Industrial Fuel Combustion	Fuel consumption	DOE Energy Information Admin.
Land Clearing Debris Burning	Acreage disturbed during road, commercial, and residential construction	DAQ data calculated for the construction dust categories
Paved & Unpaved Road Dust	Vehicle miles traveled	Delaware Department of Transportation
Prescribed Burning	Acreage and vegetation type	DAQ Area Source Compliance Program
Residential Construction	Residential building permits	US Census Bureau
Residential Fuel Combustion	Fuel consumption	DOE Energy Information Admin.
Residential Open Burning	Rural households	US Census Bureau
Residential Wood Combustion	Occupied households	Delaware Population Consortium
Road Construction	Highway capital outlays	Federal Highway Administration
Structure Fires	Number of structures fires	Delaware Fire Marshal and DAQ Area Source Compliance Program
Vehicle Fires	Number of vehicle fires	Delaware Fire Marshal
Wildfires	Acreage and vegetation type	Delaware Division of Forestry

Combustion processes and fugitive dust account for 84% of the direct particulate emissions in New Castle County from the non-point sector. Road dust and residential wood combustion are the two largest non-point source category of direct PM_{2.5}. Figure 3-1 presents the top eight PM_{2.5} non-point sources in New Castle County for 2008.

Figure 3-1. 2008 New Castle County PM_{2.5} Emissions by Non-point Source Category



The important precursor pollutants to the formation of secondary fine particulate emissions are SO₂ and NO_x. The non-point sector is a small contributor of these pollutants to the overall county totals. Nearly all of the SO₂ and NO_x emissions result from the combustion of fossil fuels.

Table 3-3. Summary of 2008 New Castle County Emissions from Non-point Sources

Source Categories	PM _{2.5}	SO ₂	NO _x
	TPY	TPY	TPY
FUEL COMBUSTION			
Commercial/Institutional	3	16	246
Industrial	3	34	445
Residential Fossil Fuel	20	339	535
Residential Wood	404	8	47
Fuel Combustion Total	429	399	1,273
OPEN BURNING			
Agricultural Burning	4	---	1
Land Clearing Debris Burning	0	---	0
Prescribed Burning	43	3	11
Residential Open Burning	2	< 1	< 1
Structure Fires	3	---	< 1
Vehicle Fires	4	---	< 1
Wildfires	1	< 1	< 1
Open Burning Total	56	3	13
FUGITIVE DUST			
Agricultural Production	48	---	---
Commercial Construction	63	---	---
Paved and Unpaved Road Dust	413	---	---
Residential Construction	2	---	---
Road Construction	51	---	---
Fugitive Dust Total	576	---	---
OTHER SOURCES			
Commercial Cooking	131	---	---
Other Sources Total	131	---	---
NON-POINT SECTOR TOTAL	1,191	402	1,287

SECTION 4

NON-ROAD MOBILE SOURCES

Non-road mobile sources represent a large and diverse set of off-road vehicles and non-stationary equipment. Emission estimates of PM_{2.5}, SO₂, and NO_x for this source sector account for exhaust emissions from engine fuel combustion.

4.1 Source Categories

Non-road vehicles and equipment are grouped into four source category types for the purpose of developing emission estimates. These include:

- **Aircraft** – Commercial, military, and private aircraft are considered under this source category.
- **Locomotives** – Commercial line haul and yard locomotives are considered under this source category.
- **Commercial Marine Vessels (CMVs)** – Various types of vessels that navigate the Delaware Bay and River and the Chesapeake and Delaware Canal are included under this source category. Recreational boats are included in the next category.
- **Other Off-road Vehicles and Equipment** – All other off-road emission sources are accounted for through the use of EPA's NONROAD model. The NONROAD model compiles off-road equipment pertinent to Delaware into the following subcategories:
 - Recreational (land-based);
 - Construction;
 - Industrial;
 - Lawn and Garden;
 - Agricultural;
 - Commercial;
 - Logging;
 - Airport Ground Support;
 - Recreational Marine; and
 - Railway Maintenance.

Individual equipment SCCs covered in the NONROAD model are further broken down by the fuel type, including 2-stroke gasoline, 4-stroke gasoline, diesel, liquefied petroleum gas (LPG), and compressed natural gas (CNG).

4.2 Emission Estimation Methodologies

The 2005 Delaware Periodic Emission Inventory served as the starting point for non-road source category selection and methodology development. No new sources were added to Delaware's off-

road mobile source inventory. However, new versions of EPA's NONROAD model and the Federal Aviation Administration's (FAA) Emissions and Dispersion Modeling System (EDMS) were used for 2008.

Similar to the estimation of stationary non-point emissions, off-road equipment emissions were estimated by multiplying an indicator of collective activity within the inventory area for a source category by a corresponding emission factor. The indicators of activity for off-road sources include landing and take-offs (LTOs), vessel port-of-calls, time-in-mode (TIMs, which are pertinent to aircraft and CMVs), gross ton miles (locomotives), equipment populations and economic activity (both pertinent to NONROAD equipment) that can be correlated with the emissions from that source. The corresponding emission factors are amount of pollutant (either grams or pounds) per unit of fuel used (locomotives and military/commercial aircraft), per LTO (air taxi and general aviation) or per unit of power output in brake horsepower or kilowatt-hours (NONROAD equipment and CMVs, respectively).

A major portion of the work involved in creating the 2008 non-road source inventory was in collecting activity data for each source category. The activity data gathered was related to the type of emission factors available and, in many cases, obtained from local sources. More information about gathering activity data for each source category is presented below.

There are no point source data that must be backed out of the non-road mobile source sector. Even though larger airports may report as a point source, their reported point source emissions do not include ground support equipment or aircraft engine emissions. Also, aircraft emissions are estimated only for LTOs that take place at a Delaware airport. Emissions from aircraft that transit Delaware airspace are not included in Delaware's inventory.

4.2.1 NONROAD Model Equipment

DAQ used NONROAD2008a to develop 2008 annual emission estimates for New Castle County. Most equipment covered by the NONROAD model is powered by diesel-fueled compression-ignition engines or gasoline-fueled spark-ignition engines. Engines fueled by compressed natural gas (CNG) and liquefied petroleum gas (LPG) engines are also included in the NONROAD model. Table 4-1 lists general SCCs addressed by the NONROAD model. Equipment categories are defined at the 7-digit SCC level (with recreational marine and railway maintenance being exceptions) and specific equipment are defined at the 10-digit SCC level.

To estimate pollutant emissions, the NONROAD model multiplies equipment populations and their associated activity by the appropriate emission factors. Geographic allocation factors (GAFs) are used to distribute national equipment populations to states/counties. These factors are based on surrogate indicators of equipment populations. For example, harvested cropland is the surrogate indicator used in allocating agricultural equipment. A national average engine activity (i.e., load factor times annual hours of use) is used in NONROAD.

To improve the accuracy of the model runs, default inputs were replaced in the NONROAD model option files for select parameters. In the options packet, inputs that can be replaced include: Reid vapor pressure (RVP), temperature, oxygenated fuel weight percent, and fuel sulfur levels. Local activity data inputs, such as equipment populations or activity (e.g., hours of use or load factors), can also replace default values in the model.

Table 4-1. SCCs Addressed by the NONROAD Model

Nonroad SCCs	SCC Descriptions	Nonroad SCCs	SCC Descriptions
2260xxxxxx	2-stroke gasoline engines	2268xxxxxx	CNG engines
2260001xxx	- recreational vehicles	2268002xxx	- construction equipment
2260002xxx	- construction equipment	2268003xxx	- industrial equipment
2260003xxx	- industrial equipment	2268005xxx	- agricultural equipment
2260004xxx	- lawn & garden equipment	2268006xxx	- light commercial equipment
2260005xxx	- agricultural equipment	226801xxxx	- oil field equipment
2260006xxx	- light commercial equipment	2270xxxxxx	Diesel engines
2260007xxx	- logging equipment	2270001xxx	- recreational vehicles
2265xxxxxx	4-stroke gasoline engines	2270002xxx	- construction equipment
2265001xxx	- recreational vehicles	2270003xxx	- industrial equipment
2265002xxx	- construction equipment	2270004xxx	- lawn & garden equipment
2265003xxx	- industrial equipment	2270005xxx	- farm equipment
2265004xxx	- lawn & garden equipment	2270006xxx	- light commercial equipment
2265005xxx	- agricultural equipment	2270007xxx	- logging equipment
2265006xxx	- light commercial equipment	2270008xxx	- airport service equipment
2265007xxx	- logging equipment	2270009xxx	- underground mining equipment
2265008xxx	- airport service equipment	227001xxxx	- oil field equipment
226501xxxx	- oil field equipment	2282xxxxxx	Recreational marine equipment
2267xxxxxx	LPG engines	2285xxx015	Railway maintenance equipment
2267001xxx	- recreational vehicles		
2267002xxx	- construction equipment		
2267003xxx	- industrial equipment		
2267004xxx	- lawn & garden equipment		
2267005xxx	- agricultural equipment		
2267006xxx	- light commercial equipment		
2267008xxx	- airport service equipment		

NONROAD model option files were prepared to account for temperatures and fuel characteristics representative of each county for each of the four seasons (winter, spring, summer, and fall). Temperature and fuel input values for each three-month period (December-February, March-May, June-August, and September-November) were averaged to estimate seasonal values. Minimum, maximum, and average temperatures per month were obtained from the National Weather Service for the New Castle County Airport. Table 4-2 presents a summary of New Castle County temperature and gasoline fuel characteristics data used for each season. A sulfur content of 351 ppm for off-road diesel fuel was used for 2008 based on an EPA recommendation report (EPA, 2009a).

Table 4-2. NONROAD Model Temperature and Fuel Characteristic Input Values by Season for 2008

County	Season	Oxygen Weight %	RVP psi	Gasoline Sulfur ppm	Temperature, °F		
					Minimum	Maximum	Average
New Castle	Summer	3.55	6.82	39	66	86	76
New Castle	Autumn	3.2	8.06	40.67	48	66	57
New Castle	Winter	3.29	10.54	44	30	46	37
New Castle	Spring	3.2	8.06	40.67	44	64	53

DAQ researched the availability of state and county-specific data to improve upon the default equipment populations and GAFs incorporated in the model. DAQ replaced the default equipment population of recreational marine equipment with Delaware-specific data. DAQ used

recreational boat registration data provided by the Delaware Division of Fish and Wildlife (DNREC, 2009) to estimate the total recreational marine equipment population in use within Delaware waters. DAQ determined this to be a preferable approach to the NONROAD default approach of a top-down allocation of the national equipment population. However, registration data were not used to allocate recreational marine activity to the county level because residents may register their boats in one county, but use their boats in other parts of the State or neighboring counties.

DAQ updated GAFs for numerous equipment categories. Table 4-3 provides a list of GAFs and the associated equipment populations that use the GAFs that were updated with 2008 Delaware-specific data. For golf carts, DAQ replaced the GAFs based on the number of golf courses in each county with the county total square kilometers of golf courses in each county. DAQ believes that golf cart usage is more directly related to the size of each golf course than to the number of courses that exist in each county. If an equipment population is not identified in Table 4-3, then the model default GAFs were used in the 2008 runs.

Table 4-3. 2008 Delaware-specific Geographic Allocation Factors

Geographic Allocation Factor	Data Source	Equipment Population
Population	DE Population Consortium	
Aircraft NOx emissions	Delaware 2008 inventory	Airport ground support equipment
Dollar value of construction	US Census Bureau and DE DOL	Construction equipment
Harvested acres	DE Department of Agriculture	Agricultural equipment
Area of golf courses	Delaware State Golf Association	Golf carts
Wholesale businesses	BOC County Business Patterns	Commercial equipment
Single and duplex housing	BOC FactFinder website	Residential lawn & garden equipment
Landscaping businesses	BOC County Business Patterns	Commercial lawn & garden equipment
Manufacturing employees	BOC County Business Patterns	Industrial equipment
Snowfall	Weather Warehouse website	Snow blowers and snowmobiles

4.2.2 Aircraft

The aircraft source category includes emissions from commercial, air taxi, general aviation, and military aircraft. These sub-categories are described as follows:

- Commercial aircraft are used for scheduled service transporting passengers, freight, or both;
- Air taxis are used for scheduled service carrying passengers and/or freight, but are smaller aircraft that operate on a more limited basis than the commercial carriers;
- General aviation includes other non-military aircraft used for recreational flying, business, personal transportation, and various other activities; and
- Military aircraft are used by the U.S. military in a wide range of missions.

Airport-specific emissions for all aircraft sub-categories were allocated to the county in which each airport is located. Where there are multiple airports in a given county, the emissions were summed to provide a county-level emissions estimate. Aircraft emissions are reported under the following SCCs:

Table 4-4. SCCs for Aircraft

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2275001000	Mobile Sources	Aircraft	Military Aircraft	Total
2275020000	Mobile Sources	Aircraft	Commercial Aircraft	Total: All Types
2275050000	Mobile Sources	Aircraft	General Aviation	Total
2275060000	Mobile Sources	Aircraft	Air Taxi	Total

DAQ estimated annual aircraft emissions using a combination of airport-specific activity data and Federal Aviation Administration (FAA)/EPA emission factors. Estimating aircraft emissions focuses on the “mixing zone,” which has a height (mixing height) equal to the thickness of the inversion layer. Air emissions within this zone are trapped by the inversion layer and ultimately affect ground-level pollutant concentrations. When aircraft are above the mixing zone, emissions tend to disperse and have no ground-level effects. The aircraft operations within the mixing zone are defined by the landing and take-off (LTO) cycle. Each LTO cycle consists of five specific operating modes:

- Approach – aircraft operates in this mode when it approaches the airport on its descent from the mixing height to when it lands on the runway.
- Taxi/idle-in – aircraft operates in this mode when it taxis from the runway to the gate and turns its engines off.
- Taxi/idle-out – this period occurs from engine start-up to take-off as the aircraft taxis from the gate back out to the runway.
- Take-off – this mode is characterized primarily by full-throttle operation that typically lasts until the aircraft reaches between 500 and 1000 feet above ground, which is when engine power is reduced.
- Climb-out – this mode begins right after the take-off mode and lasts until the aircraft passes out of the mixing height.

The operation time in each of these modes is dependent on the aircraft category, local meteorological conditions, and operational considerations at a given airport. The time-in-mode (TIM) for the take-off operating mode is the least variable.

The following are the general steps to be used to estimate aircraft emissions:

- Determine the mixing height to be used to define the LTO cycle;
- Define the fleet make-up for each airport;
- Determine airport activity in terms of the number of LTOs by aircraft/engine type;
- Select emission factors for each engine model associated with the aircraft fleet;
- Estimate the TIM for the aircraft fleet at each airport;
- Calculate emissions based on aircraft LTOs, emission factors for each aircraft engine model, and estimated aircraft TIM; and
- Aggregate the emissions across aircraft.

DAQ contacted the New Castle County and Summit airports to request the number of aircraft LTOs for calendar year 2008 for each of the four aircraft types. Additionally, each airport was

requested to provide LTOs by aircraft make and engine type; however this level of detail was not provided by the airports for 2008. DAQ assumed 2008 aircraft were of the same mix of aircraft/engine types as reported for 2002. Table 4-5 provides the LTO data by the four aircraft types for the two airports in New Castle County.

Table 4-5. 2008 LTO Data for New Castle County

Airport	County	Category	LTOs
New Castle County	New Castle	Military	4,618
New Castle County	New Castle	Commercial	488
New Castle County	New Castle	Air Taxi	5,244
New Castle County	New Castle	General Aviation	40,342
Summit	New Castle	General Aviation	34,700

DNREC used these airport-specific LTO data to estimate commercial and military aircraft emissions using FAA’s Emissions and Dispersion Modeling System (EDMS), Version 5.1 (FAA, 2008). The model requires detailed inputs on aircraft operation by aircraft and engine type. DNREC matched the aircraft LTO data to the existing aircraft/engine types in EDMS, and used the default EDMS TIM data. A mixing height of 2,300 feet was used for both airports in New Castle County based on an isopleth chart of annual average morning mixing heights for the continental U.S. as provided in EPA’s *Procedures Manual* (EPA, 1992). The Delaware Army National Guard (DE ARNG) and the Delaware Air National Guard (DE ANG) operate units at the New Castle County Airport and contribute to the military LTOs at that airport.

EDMS generates emissions for SO₂ and NO_x in tons per year. EDMS does not estimate particulate emissions by aircraft/engine type. As such, DAQ used fleet average PM_{2.5} emission rates applied to total LTOs outside EDMS. The model also generates emissions for ground support equipment (GSE). However, DAQ used the GSE estimates generated from the NONROAD model, so these were subtracted from the EDMS results. EPA fleet average emission factors were applied to the LTO data to estimate annual general aviation and air taxi emissions.

4.2.3 Locomotives

Railroad locomotives are a combustion source of emissions with most significant emissions occurring where there is a concentration of railroad activity (such as a large switch yard). The primary fuel consumed by railroad locomotives is distillate oil (diesel fuel). Locomotives can perform two different types of operations: line haul and yard (or switch). Line haul locomotives generally travel between distant locations, such as from one city to another. Yard locomotives are primarily responsible for moving railcars within a particular railway yard. Locomotive emissions are reported under the SCCs provided in Table 4-6.

For line haul locomotives, DAQ calculated Class I operation emissions separately from Class II/III operations. Line haul locomotive emissions for passenger trains and commuter lines were estimated to be zero since rail service in Delaware (Amtrak and SEPTA) is electric powered. Fuel consumption was used to estimate locomotive engine emissions. Fuel consumption rates are usually known only for the entire interstate operating region, therefore, it is necessary to allocate the total amount of fuel consumed "system-wide" to Delaware and its counties.

Table 4-6. SCCs for Locomotives

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2285002006	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class I Operations
2285002007	Mobile Sources	Railroad Equipment	Diesel	Line Haul Locomotives: Class II/Class III Operations
2285002010	Mobile Sources	Railroad Equipment	Diesel	Yard Locomotives

Line Haul Locomotives – Class I Operations

Norfolk Southern and CSX Transportation operate Class I locomotives within New Castle County. DAQ contacted these companies to obtain estimates of fuel consumption or data to calculate fuel consumption (e.g., gross ton-miles (GTM) and gallons of fuel consumed per GTM).

Norfolk Southern provided GTM data at the county level for each county in Delaware in which they operated. Norfolk Southern provided a fuel consumption index (GTM/fuel consumed) for the system that includes operations in Delaware. CSX provided GTM and fuel consumption data for New Castle County, the only county in which CSX operates in Delaware. The system-wide fuel consumption indices, county-specific GTM, and calculated county-level fuel consumption are provided in Table 4-7.

Table 4-7. 2008 New Castle County Locomotive Fuel Consumption Data for Class I Line Haul Operations

Class I Railroad	Gross Ton Miles (GMT)	System-wide GMT/Gallon Diesel	Fuel Consumed, gallons/year
Norfolk Southern	307,435,000	811.27	377,748
CSX Transportation	683,000,000	886.83	770,161

Line Haul Locomotives – Class II/III Operations

The Maryland & Delaware Railroad is the only Class II/III railroad that operates in New Castle County. The company provided 2008 statewide fuel consumption data. The Maryland & Delaware Railroad operates in New Castle and Sussex Counties. Track miles within each county were used to allocate statewide fuel consumption to each county. The Maryland & Delaware Railroad estimated 3,013 gallons of diesel fuel was used in New Castle County for 2008.

Yard Locomotives

Norfolk Southern, CSX Transportation, and Maryland & Delaware have yard operations within New Castle County. These companies provided the number of locomotives by switchyard location. Table 4-8 provides a summary of switchyard operations and fuel consumption. CSX and Maryland & Delaware provided Delaware-specific fuel consumption for 2008. An average switchyard engine fuel consumption estimate of 32,447 gallons per year was applied based on a recent regional study coordinated through the Eastern Regional Technical Advisory Committee (ERTAC, 2010).

Table 4-8. 2008 Switchyard Activity and Estimated Fuel Consumption

Class I Switchyard	No. of Yard Locomotives	Fuel Consumed, gallons/year
Norfolk Southern	9	292,024
Maryland & Delaware	1	9,640
CSX Transportation	2	120,000

4.2.4 Commercial Marine Vessels

The CMV sector includes many types of vessels, such as large deep-draft vessels, barge towboats, harbor tugs, dredging vessels, ferries, excursion vessels, and commercial fishing vessels. In addition to the numerous vessel types, each vessel type engages in different activities such as hoteling, maneuvering within the port, and cruising.

In its 1999 final rule for commercial marine diesel engines, EPA defined three categories of marine diesel engines based on engine displacement, power and revolutions per minute (rpm) (EPA, 1999a). Table 4-9 presents the definitions for each category.

Table 4-9. U.S. EPA Marine Engine Category Definitions

Category	Displacement per cylinder	Power range (kW)	RPM range
1	disp. < 5 liters and power \geq 37 kW	37 - 2,300	1,800 - 3,000
2	$5 \leq$ displacement < 30 liters	1,500 - 8,000	750 - 1,500
3	displacement $>$ 30 liters	2,500 - 80,000	60 - 900

The EPA classifies CMV emissions by fuel type (residual and diesel) and by mode of operation (port and underway). CMVs often burn multiple types of fuel and may burn different fuels for different operating modes or locations (i.e., near ports). DAQ used the port and underway SCCs to characterize the CMV emissions as listed in Table 4-10. The SCC classification is based on the most common type of fuel utilized by the vessel category. Ocean-going vessels (OGV) predominately burn intermediate fuel oil (IFO). DAQ placed emissions from OGVs burning IFO in the residual fuel SCC. This is consistent with how petroleum product sales data are reported by the Energy Information Administration and EPA's classification of fuels (EPA 1999b).

Table 4-10. SCCs for Commercial Marine Vessels

SCC	Descriptor 1	Descriptor 3	Descriptor 6	Descriptor 8
2280002100	Mobile Sources	Marine Vessels, Commercial	Diesel	Port emissions
2280002200	Mobile Sources	Marine Vessels, Commercial	Diesel	Underway emissions
2280003100	Mobile Sources	Marine Vessels, Commercial	Residual	Port emissions
2280003200	Mobile Sources	Marine Vessels, Commercial	Residual	Underway emissions

There are four activity modes for CMV; cruise, reduced speed zone (RSZ), maneuver, and hotel. Underway emissions are estimated as the combined activity of cruise and RSZ modes. Port

emissions are estimated as the combined activity of maneuvering and hoteling modes. Emissions from ferries and dredging are considered port emissions since these vessels operate primarily within the port area.

DAQ calculated emissions for ocean-going vessels, towboats, tug-assist vessels, ferries and vessels associated with dredging operations. CMV engine emissions are assumed to be a function of the following:

- Mode of operation,
- Vessel type (bulk carrier, tanker, towboat, etc.);
- Vessel dead weight tonnage (DWT);
- Type of engine (2-stroke, 4-stroke, or steam); and
- Length of waterway segment.

Therefore, DAQ accounted for these variations when estimating CMV activity. The four modes of operation that are performed by vessels are defined below:

Cruise - This mode is assumed to begin 25 miles out from the port breakwater until the vessel reaches the breakwater (EPA, 1999c). The breakwater is located at the mouth of the Delaware Bay. Cruise mode is not applicable to New Castle County.

Reduced Speed Zone (RSZ) - This mode begins at the breakwater and continues until the vessel is one to two nautical miles from the berth or anchorage. The vessel is assumed to have a speed of twelve knots during this mode (EPA, 2009c). This mode is also referred to as transit, and escort for towboats and tug-assist vessels.

Maneuvering - This mode is defined as the time the vessel slows to below four knots until the dock lines are secure. This mode is also referred to as assist mode for tug-assist vessels.

Hoteling - This mode is defined as the time the vessel is at dock. During this mode, the vessel operates auxiliary engines for electrical power.

The waterway segment distances used to estimate activity and to allocate the activity to New Castle County were estimated from the Google Earth website in 2008 by tracing the shipping channel. Segment distances are shown in Table 4-11. The distance South is given to the breakwater at the mouth of the Delaware Bay. The distance north is given to the Delaware-Pennsylvania border. The distance for the C&D Canal East is given from the Delaware-Maryland border to the entrance of the Delaware River (Reedy Point).

The engine activity for each mode is calculated using the following equation:

$$Activity_{mode} = Power \times LoadFactor \times Time_{mode} \times Calls$$

where:

- Activity_{mode} = activity by mode (kilowatt-hours)
- Power = rated engine power by vessel and engine type (kilowatts)
- Load Factor = load factor of the engine by vessel type and mode
- Time = time in mode per call by vessel type (hours)

Calls = number of calls by vessel and engine type

Table 4-11. Waterway Segment Distances for the Delaware River Area

Waterway Segment	Distance (mi.)
Point	South
DE/PA Border	83.8
Oceanport	83.3
Port of Wilmington	76.1
Magellan Terminal	75.6
Delaware City Refinery	66.0
C&D Canal	62.6
Latitude 39°30'	57.7
New Castle Co/Kent Co	48.5
Kent Co/Sussex Co	15.9
Point	North
Port of Wilmington	7.7
C&D Canal	21.2
Point	East
C&D Canal	13.0

This calculation must be performed for both propulsion and auxiliary engines and for each mode. Both propulsion engines and auxiliary engines are operating during cruise, RSZ and maneuvering modes. Only auxiliary engines operate during hoteling. Once the activity is calculated, it is allocated to the county level using county allocation factors.

This approach to calculating activity of CMVs was used for all vessel types except vessels involved in dredging activity. For dredging, the activity data used for emissions calculations was the volume of material dredged. Details on the sources and development of activity data are provided in the following subsections.

Ocean-Going Vessels

DAQ obtained vessel call data for ocean-going vessels (OGVs) during calendar year 2008 from the Marine Exchange for the Delaware River and Bay (ME, 2010). Data were obtained for vessels that called on ports in Delaware, New Jersey and Pennsylvania. The data for the entire port area is required since the majority of vessels pass through Delaware waters en route to other ports. The vessel call data included the vessel name, ship type, DWT, pier, and the date of the call. The ship types calling on the Delaware River Area ports in 2008 are shown in Table 4-12.

Vessels may shift between piers during the same call on the Delaware River area. DAQ adjusted the vessel call data to remove shifts between piers, where possible, to avoid double counting using a methodology recommended by the staff of the Marine Exchange. Data on the engine power and engine type (2-stroke, 4-stroke, and steam) used on OGVs were not available through the Marine Exchange. Therefore, DAQ assigned engine power and engine type based on average engine data obtained from other sources.

For propulsion engines, the average engine power and the engine type were obtained from the EPA report *Commercial Marine Activity for Deep Sea Ports in the United States (Deep Sea Ports)* (EPA, 1999c). This report presents data for vessels that called on the Delaware River area

ports during calendar year 1996. Note that the Delaware River area includes ports in Delaware, New Jersey and Pennsylvania, which are located on the Delaware River. The number of calls by vessel and engine type is presented for specific DWT ranges. The average engine power is also given.

Table 4-12. Vessel Types Calling on Delaware River Area Ports in 2008

Codes	Main Vessel Type	Additional Vessel Types Included w/ Main Type
BU	Bulk	Chemical (CH), Ore (OR)
CC	Container	Container/Bulk (CB), Part Container (PC)
GC	General Cargo	
MS	Miscellaneous	Cable Ship (CL), Heavy Lift (HL), Livestock (LV), Tall Ship (TS)
PR	Passenger	
RF	Refrigerated Cargo (Reefer)	Container Reefer (CR)
RR	Roll on-Roll off (RORO)	RORO Container (RC)
TA	Tanker	Bulk Oil (BO), Gas Carrier (PG)
VE	Vehicle Carrier	

In order to calculate underway emissions, the number of calls (by vessel type and DWT range) had to be allocated to each port. The ports in Delaware include the Port of Wilmington, Magellan Terminal, Delaware City Refinery, and Oceanport. One port in New Jersey, Bermuda International on Salem Creek, is located adjacent to Delaware. All other ports in New Jersey and all ports in Pennsylvania are located north of the Delaware/Pennsylvania state line. Vessels calling on New Jersey and Pennsylvania ports must be included in underway emission calculations for Delaware since the vessels travel through the Delaware portion of the bay and river.

Table 4-13 presents the assigned propulsion engine power and the number of calls by vessel type, DWT range and engine type for calls on the Delaware River area in 2008. In addition to vessels traveling in the Delaware River Bay and River, 424 OGVs traversed the C&D Canal to or from the Chesapeake Bay.

Towboats and Tug Assists

Towboats are used to transport non-self-propelled vessels, either dry cargo or tanker barges, throughout the Delaware River area, including the C&D Canal. DAQ obtained data on the number of towboat trips during calendar year 2008 from *Waterborne Commerce of the United States* (USACE, 2010a). DAQ subtracted the number of towboat trips for the Port of Wilmington (POW) and the C&D Canal from the number of trips on the Delaware River (PA to the Sea). For towboats traveling to and from the POW and traveling through the C&D Canal, DAQ assumed that half the vessels travel north and the other half travel south to/from the POW and the canal.

In 2008, 13,203 towboat trips transited Delaware waters on the Delaware River, with a trip defined as a one-way passage. 1,184 towboat trips entered or exited the Port of Wilmington, and 3,597 towboat trips transited the C&D Canal.

Table 4-13. Average Propulsion Engine Power and the 2008 Number of Calls for OGVs Calling on the Delaware River Area (DE, NJ and PA)

Code	DWT Range	Engine Type	Power (hp)	Calls	Code	DWT Range	Engine Type	Power (hp)	Calls
BU	< 25,000	2-stroke	9,665	41	RF	15,000-25,000	2-stroke	18,467	72
BU	< 25,000	4-stroke	7,504	6	RR	<15,000	2-stroke	8,280	13
BU	25,000 - 35,000	2-stroke	9,696	85	RR	<15,000	4-stroke	8,553	13
BU	35,000 - 45,000	2-stroke	10,320	56	RR	15,000 - 30,000	2-stroke	12,852	16
BU	> 45,000	2-stroke	16,328	90	RR	>30,000	2-stroke	26,562	0
CC	< 25,000	2-stroke	17,757	126	TA	<30,000	2-stroke	10,008	75
CC	< 25,000	4-stroke	10,898	67	TA	<30,000	4-stroke	7,077	18
CC	25,000 - 35,000	2-stroke	16,327	145	TA	<30,000	Steam	14,646	8
CC	35,000 - 45,000	2-stroke	34,467	117	TA	30,000 - 60,000	2-stroke	12,616	195
CC	> 45,000	2-stroke	30,856	54	TA	30,000 - 60,000	4-stroke	15,360	13
GC	< 15,000	2-stroke	5,784	45	TA	30,000 - 60,000	Steam	15,498	135
GC	< 15,000	4-stroke	3,944	57	TA	60,000 - 90,000	2-stroke	16,026	69
GC	15,000 - 30,000	2-stroke	10,456	30	TA	60,000 - 90,000	4-stroke	14,305	10
GC	15,000 - 30,000	4-stroke	7,536	5	TA	90,000 - 120,000	2-stroke	15,451	302
GC	30,000 - 45,000	2-stroke	12,876	33	TA	90,000 - 120,000	Steam	23,923	7
GC	> 45,000	2-stroke	12,170	2	TA	120,000 - 150,000	2-stroke	23,046	56
MS	< 10,000	2-stroke	3,500	6	TA	> 150,000	2-stroke	25,559	113
MS	< 10,000	4-stroke	11,671	3	TA	> 150,000	Steam	36,324	35
PR	< 5,000	4-stroke	16,108	12	VE	<12,500	2-stroke	11,877	13
PR	5,000 - 10,000	4-stroke	20,776	0	VE	<12,500	4-stroke	13,150	3
PR	5,000 - 10,000	steam	40,649	1	VE	12,500 - 15,000	2-stroke	12,859	30
RF	5,000 - 10,000	2-stroke	9,706	115	VE	12,500 - 15,000	4-stroke	14,770	6
RF	5,000 - 10,000	4-stroke	6,837	20	VE	15,000 - 17,500	2-stroke	13,911	30
RF	10,000 - 15,000	2-stroke	12,500	173	VE	> 17,500	2-stroke	15,224	51
RF	10,000 - 15,000	4-stroke	15,672	3					

Tugs assist OGVs from the shipping channel to its intended berth and then back to the channel when the vessel leaves port. This activity is considered the maneuvering mode for OGVs. Two tugs are typically required to assist an OGV with a DWT greater than 20,000 tons; for smaller OGVs, one tug suffices (EPA, 2009b). The number of tug assists (3,428 in 2008) is directly related to the number of OGVs calling to a Delaware port. Note that a tug assisting a vessel to Bermuda International in New Jersey and the piers at the oil refineries in Marcus Hook, PA will require a tug to pick up the OGV in Delaware waters, thus tug assists are included for these docks. The tug meeting time to the docking time is usually within one hour (Anderson, 2010).

In addition to assisting OGVs to maneuver into port, tugboats escort gas carriers through the Delaware Bay and River (Andersen, 2010). Other vessels typically do not utilize an escort. Tug escort trips are included in the number of towboat trips transiting Delaware waters presented above. DNREC did not estimate emissions from hoteling of towboats and tugs due to lack of activity data.

Vessel speeds, average maneuvering and hoteling time, propulsion and auxiliary engine horsepower ratings, and engine load factors for OGVs, towboats, and tugs were obtained from EPA's *Deep Sea Ports* (EPA, 1999c) and *Preparing Port Emission Inventories* (EPA, 2009b).

For RSZ mode, time-in-mode for each vessel was calculated based on vessel speeds and waterway segment distances provided in Table 4-11.

Dredging

Maintenance dredging is performed routinely on the Delaware River to keep the channels to their required depths. Dredging involves multiple vessels, including dredges, assist tugs, and generator barges that provide additional power. Estimating emissions from dredging vessel engine activity is time-consuming. Therefore, DAQ developed emissions based on the volume of material dredged during calendar year 2008 rather than engine activity in kilowatt-hours.

DAQ obtained the dredging activity data from both the USACE and from within DNREC. The amount of material dredged by USACE contractors was obtained from the USACE report on dredging contracts awarded for the year 2008 (USACE, 2010b). DAQ also contacted the Delaware Division of Soil and Water Conservation to obtain the amount of material dredged by the Division (DSWC, 2010). Table 4-14 presents the estimated amount of material dredged and the type of dredge used. DAQ assumed all the dredging activity is maintenance dredging. New cut dredging results in higher emissions, therefore this assumption may result in lower emission estimates than are actually occurring in the area.

Table 4-14. Material Dredged in the New Castle County Portion of the Delaware River Area during 2008

Project Location	Type of Equipment	Total Material Dredged (cubic yards)
Philadelphia to the Sea	Hydraulic Dredge	732,697
Chesapeake & Delaware Canal	Hydraulic Dredge	600,000
Port of Wilmington	Hydraulic Dredge	650,000
Premcor Berth Maintenance	Hydraulic Dredge	230,000

Ferries

The Three Forts Ferry was identified as the only ferry service in New Castle County. This ferry travels from either Delaware City, DE or Fort Mott, NJ to Fort Delaware located on Pea Patch Island in the Delaware River. Monthly trip count data for the ferry was obtained by contacting the Delaware River & Bay Authority (DRBA, 2010). The Three Forts Ferry made 2,280 one-way trips in 2008. The Delaware River and Bay Authority also provided the engine and time-in-mode data for the Three Forts Ferry.

Spatial Allocation

DAQ developed county allocation factors for CMV activity data based on the location of the activity on the various waterways and length of the waterway segment. In developing county allocation factors, DAQ assumed that from latitude 39°30' to 25 miles beyond the mouth of the Delaware Bay, the activity is split evenly between Delaware and New Jersey since the ship channel roughly corresponds to the boundary between the two states. Above latitude 39°30', all emissions are allocated to Delaware since the entire breadth of the river is under Delaware's

jurisdiction. Allocations were developed for each activity mode, since the activity takes place in different areas depending on the mode.

For OGV maneuvering and hoteling modes, the activity is allocated to the county in which the port is located. All the Delaware ports are located in New Castle County. Therefore, all maneuvering and hoteling activity was allocated to New Castle County.

For the RSZ mode, county allocation factors were developed for the four ports in Delaware (Port of Wilmington, Magellan Terminal, Oceanport, and Delaware City Refinery), Bermuda International in New Jersey, and from the Pennsylvania-Delaware border to the breakwater (PA/DE to the Sea).

Allocating dredging to each county was based on the river miles in each county, and split between Delaware and New Jersey below latitude 39°30'. While the Three Forts Ferry travels to Fort Mott on the New Jersey side of the Delaware River, at that latitude, Delaware's jurisdictional waters extend the breadth of the river. Therefore, all activity for the Three Forts Ferry was allocated to New Castle County.

4.3 2008 Emissions Summary

Table 4-15 provides a summary of the 2008 annual (tons per year, TPY) New Castle County emissions for aircraft, locomotives, commercial marine vessels, and all equipment emissions estimated using EPA's NONROAD model. The non-road sector is a significant contributor to PM_{2.5} emissions and emissions of NO_x and SO₂ as precursors to the secondary formation of PM_{2.5} in New Castle County. The totals may not match the sum of the individual values due to independent rounding.

Table 4-15. Summary of 2008 New Castle County Emissions from Non-road Sources in tons/year

Source Categories	PM _{2.5}	SO ₂	NO _x
NONROAD Model Equipment	148	28	1,676
Aircraft	8	2	13
Locomotives	9	3	239
Commercial Marine Vessels	146	1,034	2,389
NON-ROAD SECTOR TOTAL	312	1,067	4,317

4.4 References

Anderson, 2010: Scott Anderson, Maritime Exchange for the Delaware River and Bay, Philadelphia PA, e-mail to David Fees, DNREC, on March 24, 2010.

DNREC, 2009: Delaware Department of Natural Resources and Environmental Control, Division of Fish and Wildlife, *Delaware Annual Boating Statistics*.

DRBA, 2010: Monthly trips data for the Three Forts Ferry, provided by J. Fred Coldren, Delaware River and Bay Authority, via e-mail to David Fees, DNREC, March 22, 2010.

- DSWC, 2010: Brian Kelly, Delaware Division of Soil and Water Conservation, e-mail to David Fees, DNREC, on February 23, 2010.
- EPA, 1992: U.S. Environmental Protection Agency, Office of Air and Radiation, *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources*, EPA-450/4-81-026d (Revised), 1992.
- EPA, 1999a: *Final Regulatory Impact Analysis: Control of Emissions from Marine Diesel Engines*. U.S. Environmental Protection Agency, Office of Mobile Sources, Engine Programs and Compliance Division, EPA420-R-99-026, November 1999.
- EPA, 1999b: In-Use Marine Diesel Fuel, U.S. Environmental Protection Agency, Office of Mobile Sources, Engine Programs and Compliance Division, EPA 420-R-99-027, August 1999.
- EPA, 1999c: *Commercial Marine Activity for Deep Sea Ports in the United States*. U.S. Environmental Protection Agency. Prepared by ARCADIS Geraghty & Miller, Inc. EPA420-R-99-020, September 1999.
- EPA, 2009a: *Suggested Nationwide Average Fuel Properties*. Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency. EPA-420-B-09-018, April 2009.
- EPA, 2009b: *Current Methodologies in Preparing Mobile Source Port-Related Emission Inventories*. U.S. Environmental Protection Agency. Prepared by ICF International, 09-024, April 2009.
- ERTAC, 2010. “ERTAC Rail Emissions Inventory – Part 2: Class I Railyard Switcher Locomotives”, Eastern Regional Technical Advisory Committee, October 2010.
- FAA, 2008: Federal Highway Administration, “Emissions and Dispersion Modeling System (EDMS) User’s Manual”, Version 5.1, FAA-AEE-07-01, Revision 5, September 19, 2008.
- ME, 2010: “Ship Traffic: Delaware River Ports: 2008” [data files], from Scott Anderson, Maritime Exchange for the Delaware River and Bay, Philadelphia PA, via e-mail to David Fees, Division of Air Quality, DNREC, February 2010.
- USACE, 2010a: *Waterborne Commerce of the United States – Calendar Year 2008 – Part 1 Waterways and Harbors Atlantic Coast*. Department of the Army Corps of Engineers, Institute of Water Resources, WR-WCUS-08-1, March 2010.
- USACE, 2010b: “U.S. Army Corps of Engineers Dredging Contracts Awarded; Fiscal Year 2008 Awards”, U.S. Army Corps of Engineers, information retrieved in 2010 from <http://www.iwr.usace.army.mil/ndc/dredge/pdf/awards08.pdf>

SECTION 5

ON-ROAD MOBILE SOURCES

The 2008 on-road mobile source inventory is an estimate of vehicle emissions based on actual vehicle miles traveled (VMT) on Delaware roadways in 2008 using EPA's Motor Vehicle Emission Simulator (MOVES) model. Vehicles include passenger cars, light-duty trucks, including sport utility vehicles, heavy-duty trucks, buses, and motorcycles. Emissions were calculated for vehicles fueled by gasoline or diesel. Controls as of 2008 were incorporated into the MOVES model inputs, and thus emissions account for controls. Engine exhaust emissions for PM_{2.5}, SO₂, and NO_x, as well as for other criteria pollutants, air toxics, and greenhouse gases were calculated. In addition, particulate matter brake and tire wear emissions were separately calculated. Monthly emissions were calculated by roadway class, vehicle type, and county.

The applicable Standard Classification Codes (SCCs) comprising vehicle type, roadway class, and emission process (exhaust, evaporative, brake wear, and tire wear) are shown in Table 5-1. As an example, the SCC applicable to exhaust emissions from a passenger car fueled by gasoline on an urban interstate would be 220100123X, with the "2201001" indicating that the vehicle is a light-duty gasoline vehicle, the "23" indicating the activity is occurring on an urban interstate, and the "X" indicating that the emissions are exhaust emissions.

Table 5-1. SCCs Included in On-road Mobile Inventory

SCC Digits	Applicable Portion of SCC Code	Portion that SCC Describes	Description
1 - 7	2201001	Vehicle type	Light-duty gasoline vehicles (passenger cars)
1 - 7	2201020	Vehicle type	Light-duty gasoline trucks 1 (0-6,000 lb gross vehicle weight rating [GVWR])
1 - 7	2201040	Vehicle type	Light-duty gasoline trucks 2 (6,001-8,500 lb GVWR)
1 - 7	2201070	Vehicle type	Heavy-duty gasoline vehicles (> 8,500 lb GVWR)
1 - 7	2201080	Vehicle type	Motorcycles (gasoline)
1 - 7	2230001	Vehicle type	Light-duty diesel vehicles (passenger cars)
1 - 7	2230060	Vehicle type	Light-duty diesel trucks (0-8,500 lb GVWR)
1 - 7	2230071	Vehicle type	Class 2b heavy-duty diesel vehicles (8,501-10,000 lb GVWR)
1 - 7	2230072	Vehicle type	Class 3, 4, and 5 heavy-duty diesel vehicles (10,001-19,500 lb GVWR)
1 - 7	2230073	Vehicle type	Class 6 and 7 heavy-duty diesel vehicles (19,501-33,000 lb GVWR)
1 - 7	2230074	Vehicle type	Class 8 heavy-duty diesel vehicles (> 33,000 lb GVWR)
1 - 7	2230075	Vehicle type	Diesel buses
8 - 9	11	Roadway type	Rural interstates
8 - 9	13	Roadway type	Rural other principal arterials
8 - 9	15	Roadway type	Rural minor arterials
8 - 9	17	Roadway type	Rural major collectors
8 - 9	19	Roadway type	Rural minor collectors

Continued next page

Table 5-1. continued

SCC Digits	Applicable Portion of SCC Code	Portion that SCC Describes	Description
8 - 9	21	Roadway type	Rural locals
8 - 9	23	Roadway type	Urban interstates
8 - 9	25	Roadway type	Urban other freeways and expressways
8 - 9	27	Roadway type	Urban other principal arterials
8 - 9	29	Roadway type	Urban minor arterials
8 - 9	31	Roadway type	Urban collectors
8 - 9	33	Roadway type	Urban locals
10	X	Emission process	Exhaust
10	V	Emission process	Evaporative
10	B	Emission process	Brake wear
10	T	Emission process	Tire wear

5.1 Input Data Specific to New Castle County for 2008

The 2008 inventory was the first year that DAQ used the MOVES model to develop on-road mobile emissions. The MOBILE6.2 model was used previously. The MOVES model allows for adjustments to a variety of model inputs, and as such, DAQ, with assistance from the Delaware Department of Transportation (DelDOT), put forth considerable effort in creating a suite of county-specific 2008 input data files. The New Castle County-specific input data types created for the 2008 inventory include VMT (by vehicle and roadway type), vehicle registration data (vehicle populations and age distributions), meteorological data (temperature and relative humidity), average speeds in the form of speed bin fractions (weekday versus weekend and by roadway type), fuel formulations and supply, and inspection and maintenance program specifications. Each of these input data sets are discussed separately below.

5.1.1 Vehicle Miles Traveled (VMT) Data

The activity data used for developing the on-road emission inventory is VMT. DelDOT provided 2008 VMT data by roadway type for New Castle County. DelDOT is required to submit calendar year VMT data annually to the Federal Highway Administration's (FHWA) Highway Performance Monitoring System (HPMS). The VMT is estimated based on data from permanent traffic count stations throughout the county. DelDOT's traffic count program provides daily and seasonal variation data. Additional temporary stations provide shorter-term counts that are expanded with factors derived from appropriate permanent count stations. Counting and expansion activities are consistent with FHWA guidelines. The traffic data submitted to HPMS are considered the most accurate VMT totals for New Castle County.

Since the VMT provided by DelDOT is supplied by HPMS roadway type, the task of creating VMT by MOVES road type fractions only requires mapping the twelve HPMS road types to the four MOVES road types. The road type allocations for New Castle County for 2008 are provided in Table 5-2.

Table 5-2. New Castle County VMT Fractions by Road Type

MOVES Road Type Code	Road Type Description	VMT Fraction by Road Type
2	Rural Restricted Access	0.0000
3	Rural Unrestricted Access	0.1274
4	Urban Restricted Access	0.2813
5	Urban Unrestricted Access	0.5914
Total		1.0000

VMT Fractions by Vehicle Type

VMT by vehicle type data are not collected in Delaware, so an alternate procedure was developed using the local registration data in calculating the VMT mixes rather than using the default MOVES VMT distribution by vehicle type. This methodology uses national default MOVES mileage accumulation and diesel sales fraction data in combination with the Delaware county-specific registration data to develop estimates of VMT by vehicle type. The number of vehicles registered in Delaware by model year, vehicle type, and county was multiplied first by the MOBILE6.2 default gasoline or diesel sales fraction corresponding to that vehicle type and model year, and then by the average number of miles accumulated annually by vehicles of the same age and vehicle type in the MOBILE6.2 default mileage accumulation database. This provided an estimate of VMT by vehicle age and vehicle type. These VMT estimates were then summed for all years by vehicle type. The total VMT for each vehicle type was divided by the total calculated VMT to give VMT fractions by vehicle type. Table 5-3 presents the resulting VMT fractions by vehicle type for New Castle County.

Table 5-3. New Castle County VMT Fractions by Vehicle Type

MOVES Vehicle Type Code	Vehicle Description	VMT Fraction by Vehicle Type
11	Motorcycle	0.0072
21	Passenger Car	0.4469
31	Passenger Truck	0.3738
32	Light Commercial Truck	0.1325
41	Intercity Bus	0.0031
42	Transit Bus	0.0011
43	School Bus	0.0018
51	Refuse Truck	0.0003
52	Single Unit Short-haul Truck	0.0078
53	Single Unit Long-haul Truck	0.0007
54	Motor Home	0.0003
61	Combination Short-haul Truck	0.0122
62	Combination Long-haul Truck	0.0123
Total		1.0000

VMT Temporal Allocations

The MOVES model input files include allocations of VMT by month. Monthly allocation of VMT is accomplished through the use of permanent count station data provided by DelDOT. For 2008, DelDOT provided monthly VMT data from 27 permanent count stations throughout New Castle County. Each month's data for all 27 count station were summed and divided by the sum of the annual VMT recorded by the 27 stations. The monthly VMT fractions created in this way are provided in Table 5-4.

Table 5-4. Monthly VMT Allocation Fractions

Month	VMT Fraction	Month	VMT Fraction
January	0.0795	July	0.0877
February	0.0735	August	0.0905
March	0.0834	September	0.0819
April	0.0859	October	0.0795
May	0.0901	November	0.0784
June	0.0860	December	0.0836

5.1.2 Meteorological Data

Temperature and relative humidity are the meteorological data required for MOVES runs. Hourly data were obtained from the National Climatic Data Center (NCDC, 2010) from data collected at the New Castle County airport. These data were compiled as monthly averages of each hour of the day for input into the MOVES runs.

5.1.3 Fuel Data

The entire State receives Federal reformulated gasoline. However, the fuel parameters vary seasonally as well as by county, based on information from EPA's Reformulated Gasoline Fuel Survey. This survey reports in-use gasoline parameters during winter and summer. New Castle County is well-represented in this survey, as the Philadelphia, PA-Wilmington, DE-Trenton, NJ area is one of the surveyed areas. Thus, it was felt that the parameters obtained from this study could be directly applied for use in the Delaware inventory. Fuel parameters were obtained from the survey for calendar year 2008 and obtained directly from EPA (EPA, 2009) since the Office of Transportation and Air Quality ceased posting such data on their RFG fuel survey data web page after 2006.

The MOVES model has nearly 9,000 choices in its library of fuel formulations. Summertime fuel survey data for 2008 from 21 gasoline stations located in New Castle County were averaged for Reid Vapor Pressure (RVP) to determine the fuel formulation that best matched in-use fuel characteristics in New Castle County. The summer fuel data were applied to the ozone season months of May through September. The summer fuel data were also applied to October as data indicated that fuel formulations are slow to switch to wintertime fuel. The winter fuel data were applied to January, February, and December, based on survey data. Fuel RVP for the remaining months (March, April, and November) were calculated using a straight line interpolation method

between summer and winter fuel data. The resulting RVP and sulfur content for New Castle County by month are provided in Table 5-5.

Table 5-5. 2008 Gasoline Fuel Parameters for New Castle County

Months	Reid Vapor Pressure (psi)	Sulfur Content (ppm)
Jan, Feb and Dec	13.4	51.8
Mar, Apr and Nov	10.6	52.4
May - Oct	6.86	53.1

Source: EPA Reformulated Gasoline Survey, 2009.

5.1.4 Vehicle Populations and Age Distributions

Vehicle registration data were obtained from the Delaware Division of Motor Vehicles (DMV). The data are a snapshot of DMV’s registration database as of July 1, 2008. The data show the number of vehicles registered by model year for each of the 16 MOBILE6.2 vehicle classes. The 16 vehicle classes were converted to the 13 MOVES vehicle types using a converter provided by EPA. New Castle vehicle populations by MOVES vehicle type are provided in Table 5.6. Vehicle age distribution fractions were developed for each of the 13 vehicle types based on model year. Vehicle 30 years and older were lumped into one fraction.

Table 5-6. 2008 Vehicle Populations for New Castle County

Vehicle Code	Vehicle Type	Number of Vehicles
11	Motorcycle	12,505
21	Passenger Vehicle	244,034
31	Passenger Truck	149,742
32	Light Commercial Truck	49,542
41	Intercity Bus	398
42	Transit Bus	244
43	School Bus	997
51	Refuse Truck	77
52	Single Unit Short-Haul Truck	3,103
53	Single Unit Long-Haul Truck	216
54	Motor Home	390
61	Combination Short-Haul Truck	1,211
62	Combination Long-Haul Truck	917

5.1.5 Vehicle Speeds

The MOVES model represents average vehicle speeds by roadway type through the use of speed bin fractions. There are 16 speed bins with the first representing speeds less than 2.5 miles per hour (mph), with each subsequent bin having a range of 5 mph (i.e., 42.5 mph – 47.5 mph). The final bin represents speeds equal to or greater than 72.5 mph. For 2008, DelDOT provided seasonal speed bin fractions for each of the four MOVES roadway types, for each hour of the day, and for weekday and weekend driving patterns. DelDOT estimated speeds using the Peninsula travel demand model. The model accounts for traffic volumes and variations in travel

according to purpose, which impact average speeds. Table 5-7 summarizes the matrix of parameters that results in 12,288 records for speeds in New Castle County.

Table 5-7. 2008 Average Speed Matrix

Parameter	Number of Variables
Season	4
Hour	24
Roadway Type	4
Weekday/Weekend	2
Speed Bins	16

5.1.6 Northeast Ozone Transport Region Low Emission Vehicle Program

Delaware belongs to the Northeast Ozone Transport Region (OTR). The States in this region have adopted a low-emission vehicle program that began with the 1999 model year. The National LEV program (NLEV), which began with the 2001 model year, is the default modeled in MOVES. Therefore, to correctly model the Northeast Ozone Transport Region LEV program in place in Delaware, the early NLEV database was used in the MOVES run specification. The phase-in schedule of the Northeast Ozone Transport Region LEV program is shown in Table 5-8. This phase-in schedule was applied to gasoline-powered passenger cars, passenger trucks, and light commercial trucks under 8,501 GVWR.

Table 5-8. LEV Implementation Schedule in the Northeast OTR

Model Year	Federal Tier I Standards	Transitional LEV Standards	LEV Standards	Tier 2 Standards
1999	30%	40%	30%	
2000		40%	60%	
2001 - 2003			100%	
2004 and later				100%

5.1.7 Inspection and Maintenance (I/M)

The I/M programs for New Castle County include a biennial onboard diagnostic testing program (OBD II) since 2002 for 1996 and later model year vehicles. Vehicle emission computer systems are checked for any diagnostic trouble codes present, a symptom of excess emissions which is a failing result for the vehicle. Older vehicles, starting with model year (MY) 1968, are given a curb idle test (MY 1968-1980) or a two-speed idle test (MY 1981- 1995). A tailpipe probe is inserted for 60 seconds to determine exhaust concentrations of hydrocarbons and carbon monoxide. Depending on the model year, vehicles with an excess emission concentration of either pollutant will fail the test. Older vehicles (MY 1975-1995) are also given a fuel system pressure test (FP) and a gas cap (GC) test. Air pressure is applied to the fuel system from the fuel inlet to the canister. After air pressure has been applied, pressure degradation is monitored.

Vehicles fail the fuel system pressure test if it cannot maintain the equivalent pressure of eight inches of water for up to two minutes after being pressurized to 14.0 ± 0.5 inches of water. A similar pressure test is applied to the vehicle's gas cap.

Table 5-9. New Castle County I/M Program Parameters

Test Type	IDLE	2500/IDLE	FP & GC	OBD I/M
Test Frequency	Biennial	Biennial	Biennial	Biennial
Program Type	Test Only	Test Only	Test Only	Test Only
Model Years	1968-1980	1981-1995	1975-1995	1996-2003
Compliance Factors				
Passenger Vehicle	88.57	94.82	96.00	95.23
Passenger Truck	84.60	89.17	90.24	89.53
Light Comm. Truck	79.20	83.48	84.48	83.82
Vehicles Tested (gasoline only)				
Passenger Vehicle	Yes	Yes	Yes	Yes
Passenger Truck	Yes	Yes	Yes	Yes
Light Comm. Truck (up to 8,500 GVWR)	Yes	Yes	Yes	Yes
School Bus	No	No	No	No
Single Unit Short-Haul Truck	No	No	No	No
Single Unit Long-Haul Truck	No	No	No	No
Refuse Truck	No	No	No	No
Combination Short-Haul Truck	No	No	No	No
Combination Long-Haul Truck	No	No	No	No
Motor Home	No	No	No	No
Intercity Bus	No	No	No	No
Transit Bus	No	No	No	No
Motorcycle	No	No	No	No

5.2 Running the MOVES Model

Running the MOVES model is accomplished through the development of (1) a run specification unique to a particular scenario of interest (2) the County Data Manager (CDM) that contains the various model inputs as described in Section 5.1 of this report, and (3) the form of the desired data output files. Unlike the MOBILE6 model that generated only emission factors that then were matched with the corresponding activity data, such as VMT, to develop emission estimates, the MOVES model, when executed in the Inventory Mode, provides final emissions.

The run specification, or “runspec”, is where a user identifies the modeling scale (national, county, or project-level domain), and scenario parameters such as whether to run MOVES in inventory or lookup table mode, geographic boundaries (a county or multiple counties), time spans (year, month(s), hour(s) of the day, weekdays and weekends), fuel types, vehicle types, road types, and pollutants. The runspec is also where input data sets (other than the CDM) are identified. Two input data sets were prepared for 2008 MOVES runs, including the early NLEV program (see Section 5.1.6) and Stage 2 vapor recovery controls. All other inputs are provided in the CDM.

The CDM for New Castle for 2008 included county-specific data for all of the parameters provided in Section 5.1 of this report. Conversely, model default data were used for the following parameters: VMT daily and hourly fractions, ramp fractions, and diesel sales fractions by vehicle type. In addition, speed bin profiles and road type VMT fractions were not vehicle type specific.

The MOVES emissions outputs were specified by county and month at the SCC level (see Table 5-1).

5.3 Controls

All MOVES-recognized on-road control measures known to be in place in Delaware in 2008 were included in the MOVES emission inventory mode modeling. Local control programs include Delaware’s I/M program, the Federal reformulated gasoline program, and the Northeast Ozone Transport Region LEV program. The MOVES model internally includes all national control programs, such as the Tier 1 and Tier 2 gasoline fuel and light duty engine emission standards as well as the ultra-low sulfur diesel fuel and heavy duty engine standards.

Two Delaware control programs, the anti-tampering procedures (ATP) performed at the inspections lanes and the anti-idling regulation (DNREC, 2005) were not accounted for in the MOVES runs since the model does not provide for inputting these programs. For the ATP control program, vehicles that are tested are also checked to see if the catalytic converter, gas cap and fuel inlet restrictor are present. Vehicles will fail inspection if any of these devices are missing.

Regulation 1145, Excessive Idling of Heavy Duty Vehicles, is designed to eliminate emissions caused by extending idling. While MOVES delineates emissions processes for extended idling, currently the available control programs within MOVES do not account for anti-idling measures. Delaware currently has no off-model method to determine emission benefits from either ATP or Reg. 1145.

5.4 Results

The PM_{2.5} exhaust emissions are comprised of elemental carbon, organic carbon, and sulfates, while total PM_{2.5} shown in Table 5-10 includes exhaust, brake wear, and tire wear emissions. PM_{2.5} exhaust emissions account for 91.4% of total PM_{2.5} emissions.

Table 5-10. 2008 Annual On-road Mobile Emissions by Vehicle Type for New Castle County

Vehicle Type	Annual Emissions, TPY		
	PM _{2.5}	SO ₂	NO _x
Light-duty Gasoline Vehicles	49	31	2,188
Light-duty Gasoline Trucks	55	44	3,310
Heavy-duty Gasoline Vehicles	5	4	324
Motorcycles	2	1	40
Light-duty Diesel Vehicles	1	0	11
Light-duty Diesel Trucks	8	1	130
Heavy-duty Diesel Vehicles	142	12	2,879
Total	282	94	9,311

5.5 References

- DNREC, 2005: *Regulations Governing the Control of Air Pollution*, Regulation 1145, Delaware Department of Natural Resources and Environmental Control, Division of Air Quality, April 11, 2005.
- EPA, 2009: U.S. Environmental Protection Agency, "Reformulated Gasoline Parameters for 2008" spreadsheet containing fuel survey data send via e-mail by Jamiee Dong, Office of Transportation and Air Quality, to Steven Potter, Bureau of Air Management, CT DEM, March 4, 2009.
- NCDC, 2009: Annual Climatological Summary, National Climatic Data Center, Asheville, NC, website accessed December 2009.