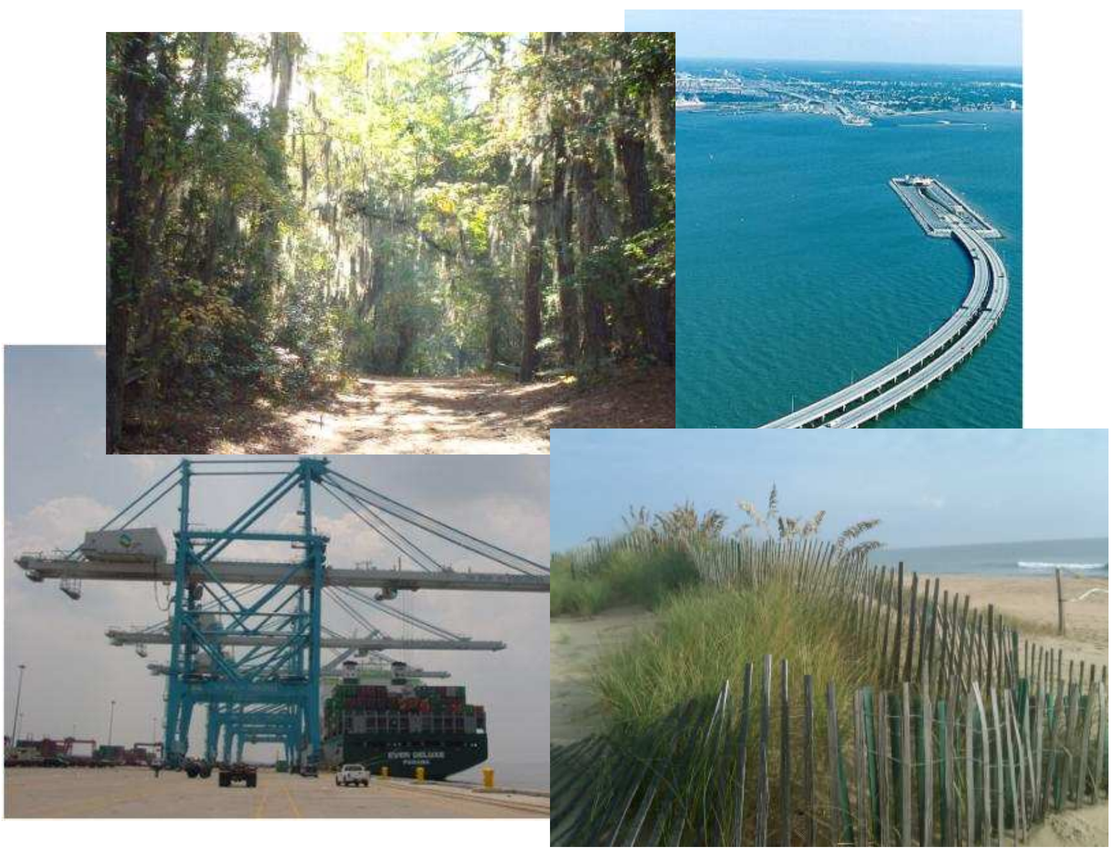
# Ozone Advance Action Plan
# Hampton Roads Area

*Gloucester County*
*Isle of Wight County*
*James City County*
*York County*
*City of Chesapeake*
*City of Hampton*
*City of Newport News*
*City of Norfolk*
*City of Poquoson*
*City of Portsmouth*
*City of Suffolk*
*City of Virginia Beach*
*City of Williamsburg*



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## Summary

This Ozone Advance Action Plan covers the Hampton Roads 1997 ozone National Ambient Air Quality Standards (NAAQS) Maintenance Area, consisting of the counties of Gloucester, Isle of Wight, James City, and York as well as the cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg. On May 21, 2012, the United States Environmental Protection Agency designated this area as attaining the 2008 ozone NAAQS. To help ensure clean, healthy air into the future, the leaders from these jurisdictions have worked cooperatively with the Virginia Department of Environmental Quality and a number of stakeholders to create this Action Plan, which details the numerous clean air programs that are in place and will be implemented to reduce ozone precursors. Many of these programs have the co-benefit of also reducing fine particulate matter ($PM_{2.5}$) precursors. Air quality in the Hampton Roads area will continue to improve through the implementation of these programs. Major stakeholders in this process include the Hampton Roads Transportation Planning Organization; Virginia Department of Mines, Minerals, and Energy; the Virginia Department of Transportation; the Virginia Port Authority; Dominion Virginia Power; Virginia Clean Cities Coalition; and Hampton Roads TRAFFIX. Additionally, participation in the Ozone Advance program and this Action Plan were the subject of numerous area informational sessions, and the Action Plan was provided to the public for comment and review. Air quality in the Hampton Roads area has improved significantly in the last 15 years. Actions taken as part of this Action Plan, and various upwind reductions of ozone and $PM_{2.5}$ precursors, will continue to improve air quality well into the future.

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# Commonly Used Abbreviations

| | | | |
|---|---|---|---|
| APMT | APM Terminal | lb | pound |
| AQS | Air Quality System | lb/hr | pounds/hour |
| ASIP | Association for Southeastern Integrated Planning | lb/mmbtu | pounds/million British thermal units |
| BRAC | Base Realignment and Closure | lb/MWh | pounds/megawatt - hour |
| CAA | Clean Air Act | LEAP | Local Energy Alliance Program |
| CAIR | Clean Air Interstate Rule | LEED | Leadership in Energy and Environmental Design |
| CAMD | Clean Air Markets Division | MACT | maximum achievable control technology |
| CASTNET | Clean Air Status and Trends Network | MAR | marine, air, and rail |
| CEDS | Comprehensive Environmental Data System | MATS | Mercury and Air Toxics Rule |
| CFR | Code of Federal Regulations | mmbtu | million British thermal units |
| CMAQ | Community Multiscale Air Quality model | $\mu g/m^3$ | micrograms per cubic meter |
| CMAQ | Congestion, Mitigation, and Air Quality | MOVES2010b | Motor Vehicle Emission Simulator version 2010b |
| CMPO | Crater Area Metropolitan Planning Organization | MRAQC | Metropolitan Richmond Air Quality Committee |
| CO | carbon monoxide | MW | megawatts |
| DC | direct current | MWh | megawatt-hours |
| DMME | Virginia Department of Mines, Minerals, and Energy | NAAQS | National Ambient Air Quality Standard |
| EGU | electrical generating unit | NBTP | $NO_X$ Budget Trading Program |
| EPA | United States Environmental Protection Agency | NEV | neighborhood electric vehicles |
| EV | electric vehicles | NIT | Norfolk International Terminal |
| FAMPO | Fredericksburg Area Metropolitan Planning Organization | NMHC | nonmethane hydrocarbons |
| FGD | flue gas desulfurization unit | NMIM | National Mobile Inventory Model |
| g/bhp-hr | grams/brake horsepower - hour | NMOC | nonmethane organic carbons |
| g/kWh | grams/kilowatt - hour | NNMT | Newport News Marine Terminal |
| g/MWh | grams/megawatt - hour | $NO_X$ | nitrogen oxides |
| GSHP | ground source heat pump | OTC | Ozone Transport Commission |
| GWAQC | George Washington Air Quality Committee | OTR | Ozone Transport Region |
| HAP | hazardous Air Pollutant | PHEV | Plug-in electric hybrid |
| HRAQC | Hampton Roads Air Quality Committee | PJM | PJM Interconnection LLC |
| HRTPO | Hampton Roads Transportation Planning Organization | PM | particulate matter |
| IRP | Integrated Resource Planning | $PM_{2.5}$ | fine particulate matter less than 2.5 angstroms in diameters |
| ITS | Intelligent Transport System | $PM_{10}$ | fine particulate matter less than 10 angstroms in diameter |
| kg/day | kilograms/day | PMT | Portsmouth Marine Terminal |
| km | kilometer | ppb | parts per billion |
| kW | kilowatts | ppm | parts per million |
| kWh | kilowatt-hours | | |

# Commonly Used Abbreviations, Continued

| | |
|---|---|
| PTE | potential to emit |
| PV | photovoltaic |
| REVi | Richmond Electric Vehicle Initiative |
| RMG | rail mounted gantry cranes |
| RREA | Richmond Regional Energy Alliance |
| SCC | State Corporation Commission |
| SCR | selective catalytic reduction |
| SF | square foot |
| $SO_2$ | sulfur dioxide |
| SPADP | Southeast Propane Autogas Development Program |
| TEU | twenty foot equivalent container units |
| TMP | Transportation Management Plan |
| tpy | tons per year |
| ULSD | ultra low sulfur diesel |
| VCC | Virginia Clean Cities, Inc. |
| VCU | Virginia Commonwealth University |
| VDEQ | Virginia Department of Environmental Quality |
| VDOT | Virginia Department of Transportation |
| VEMP | Virginia Energy Management Program |
| VIP | Virginia Inland Port |
| VOC | volatile organic compounds |
| VPA | Virginia Port Authority |

# 1. Introduction

The Hampton Roads area has been designated attainment for the 2008 ozone National Ambient Air Quality Standard (NAAQS) based on 2009-2011 air quality monitoring data. To preserve and further improve air quality, the regional leaders have decided to explore ways to facilitate additional reductions of nitrogen oxides ($NO_X$) and volatile organic compounds (VOC), the precursor emissions for ozone formation, through the development of an Ozone Advance Action Plan. This Ozone Advance Action Plan provides background data, including emission inventories and modeling analyses, demonstrating that (1) emissions in the Hampton Roads area will significantly decrease between now and 2020 and (2) ozone air quality in this area will also improve significantly between now and 2020. This Plan describes a number of new or on-going programs that will provide additional emission reductions to help further improve both ozone and fine particulate ($PM_{2.5}$) air quality. This document will serve as a framework for the area to comply with any future NAAQS that may be promulgated, such as the next ozone NAAQS that is due to be promulgated in 2014, and it will help address any future violations of the 2008 ozone NAAQS quickly.

The air quality in the Hampton Roads area is expected to benefit from significant reductions in emissions of $NO_X$ and VOC in coming years. Section 2.3, Emission Inventories, provides information on these emissions estimates and their basis. Air quality modeling demonstrates that air quality will be well beneath the 2008 ozone NAAQS by 2020, as noted in Section 2.4, Ozone Air Quality Modeling. The programs included in this Action Plan are generally not included in the area's overall emissions estimates and will provide further air quality benefit beyond that predicted by the air quality modeling. Also, these programs often will provide co-benefits in that they will reduce emissions of sulfur dioxide ($SO_2$), which is a significant precursor to $PM_{2.5}$. The Hampton Roads area has always been and continues to be in compliance with the federal $PM_{2.5}$ NAAQS; however, additional reductions of precursors can only improve air quality further.

The programs in this Action Plan include regulatory programs that are federally enforceable, voluntary programs that are undertaken for air quality purposes as well as for other purposes such as energy savings or fuel savings, and public outreach programs that will help the citizens of the Hampton Roads area understand how their behavior affects air quality so that they can adjust their actions accordingly. The stakeholders involved in this plan include the Virginia Department of Mines, Minerals, and Energy (DMME), the Virginia Department of Transportation (VDOT), the Virginia Port Authority (VPA), the Hampton Roads Transportation Planning Organization (HRTPO), Virginia Clean Cities (VCC), and Dominion Virginia Power. These stakeholders have worked together with the Virginia Department of Environmental Quality (VDEQ) to ensure that the Hampton Roads Ozone Advance Action Plan will help protect healthy air quality and continue to improve air quality into the future.

# 2. Background and Data

The Hampton Roads 1997 ozone NAAQS maintenance area consists of the counties of Gloucester, Isle of Wight, James City, and York and the cities of Chesapeake, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg. Figure 1 presents a map of the area, with locations of the ozone monitoring sites denoted by red triangles. Hampton Roads is a vibrant, diverse area that is experiencing rapid growth, and this growth is expected to continue into the foreseeable future. In 2011, the region was home to approximately 1,687,000 people, a number that is expected to increase to over 2,015,000 people by 2034. Employment in the region is also expected to rise in a similar fashion to population, with the 2011 total of approximately 1,035,000 jobs increasing to around 1,200,000 jobs by 2034. Table 1 provides a summary of the socio-economic data for this area, broken down by individual jurisdiction.

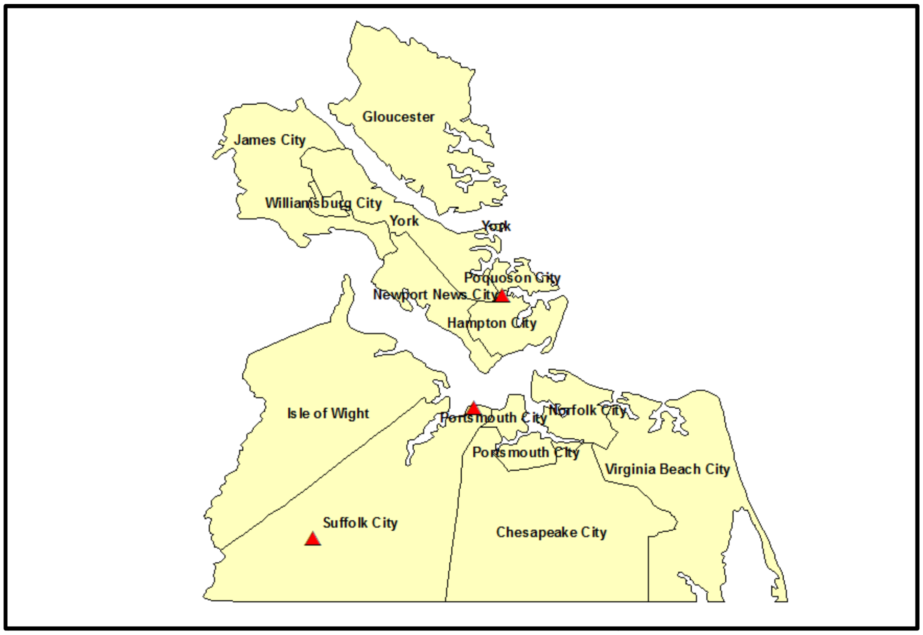


**Figure 1: Hampton Roads Geographical Boundaries**

**Table 1: Hampton Roads Socioeconomic Data, 2011 and 2034**

| Jurisdiction | Population | | Households | | Passenger Vehicles | | Employment | |
|---|---|---|---|---|---|---|---|---|
| Year | 2011 | 2034 | 2011 | 2034 | 2011 | 2034 | 2011 | 2034 |
| Chesapeake | 236,202 | 313,600 | 84,362 | 114,600 | 191,100 | 281,200 | 122,035 | 159,600 |
| Gloucester | 277,777 | 36,700 | 10,823 | 14,700 | 26,793 | 383,900 | 12,462 | 16,400 |
| Hampton | 149,112 | 154,700 | 55,772 | 59,700 | 102,941 | 113,300 | 84,221 | 86,900 |
| Isle of Wight | 42,303 | 68,600 | 16,456 | 27,200 | 41,540 | 73,900 | 21,797 | 36,100 |
| James City | 68,163 | 110,100 | 27,672 | 45,800 | 59,063 | 104,300 | 35,150 | 53,200 |
| Newport News | 191,135 | 214,100 | 74,773 | 85,400 | 147,231 | 188,000 | 124,753 | 140,200 |
| Norfolk | 236,342 | 240,400 | 88,118 | 92,100 | 159,190 | 190,900 | 228,507 | 229,100 |
| Poquoson | 12,678 | 15,000 | 4,630 | 5,600 | 11,736 | 15,300 | 2,713 | 3,200 |
| Portsmouth | 101,841 | 104,500 | 38,765 | 40,000 | 68,087 | 78,400 | 52,233 | 50,300 |
| Suffolk | 101,507 | 180,600 | 38,203 | 69,400 | 88,957 | 173,200 | 44,404 | 81,700 |
| Virginia Beach | 439,475 | 469,200 | 161,684 | 176,800 | 342,068 | 416,700 | 253,000 | 276,100 |

| Jurisdiction | Population | | Households | | Passenger Vehicles | | Employment | |
|---|---|---|---|---|---|---|---|---|
| **Year** | **2011** | **2034** | **2011** | **2034** | **2011** | **2034** | **2011** | **2034** |
| Williamsburg | 14,297 | 19,100 | 4,713 | 7,000 | 12,074 | 16,500 | 25,606 | 29,300 |
| York | 66,716 | 88,500 | 24,078 | 32,600 | 56,489 | 82,400 | 28,217 | 38,300 |
| **Hampton Roads Totals** | **1,687,548** | **2,015,100** | **630,049** | **770,900** | **1,307,269** | **1,773,000** | **1,035,097** | **1,200,400** |

*Data excerpted from Appendix A of the "Hampton Roads, Virginia Eight-Hour Ozone Maintenance Area Regional Conformity Analysis—2034 Long Range Transportation Plan and FY 12-15 Transportation Improvement Program," VDOT, September 2011.*

## 2.1. Ozone Air Quality

The Hampton Roads area has had a long history of planning requirements for various ozone NAAQS. Under the 1991 1-hour ozone NAAQS of 0.012 parts per million (ppm) or 124 parts per billion (ppb), the Hampton Roads area was originally designated a marginal nonattainment area on November 6, 1991 (56 FR 56694). The area's air quality improved, and the Hampton Roads Air Quality Committee (HRAQC), the local planning organization certified under Section 174 of the federal Clean Air Act (CAA), created a redesignation request and maintenance plan for submittal to the United States Environmental Protection Agency (EPA). These documents were subsequently approved by EPA, and the area was redesignated to attainment/maintenance on March 12, 1997 (62 FR 34408). The 1991 ozone NAAQS maintenance plan contained area-wide emissions caps, mobile source budgets, and contingency measures.

On April 30, 2004 (69 FR 23941), the Hampton Roads area was designated as a marginal nonattainment area for the 1997 ozone NAAQS, which was set at a level of 0.08 ppm or 84 ppb. Again, the area implemented a number of control measures that resulted in significant reductions of ozone precursors, and due to the air quality improvements, the area qualified for attainment status. A redesignation request and maintenance plan were developed by HRAQC and sent to EPA. Final approvals of the redesignation request and maintenance plan were published on June 1, 2007 (72 FR 30490), and the area was designated attainment/maintenance for the 1997 ozone NAAQS. This maintenance plan and redesignation request may be found at http://www.deq.state.va.us/Programs/Air/AirQualityPlans/OzoneandPM25RegionalPlanningActivities.aspx.

On May 21, 2012, the Hampton Roads area was designated as attaining the 2008 ozone NAAQS. This standard was set at 0.075 ppm or 75 ppb. The attainment determination was made in large part on air quality monitoring data from 2009-2011. As shown in Figure 2, air quality in the Hampton Roads area has significantly improved in the last 10 years. The data in Figure 2 is provided in Table 2. These data have been quality assured, certified, and provided to EPA's Air Quality System (AQS) database.

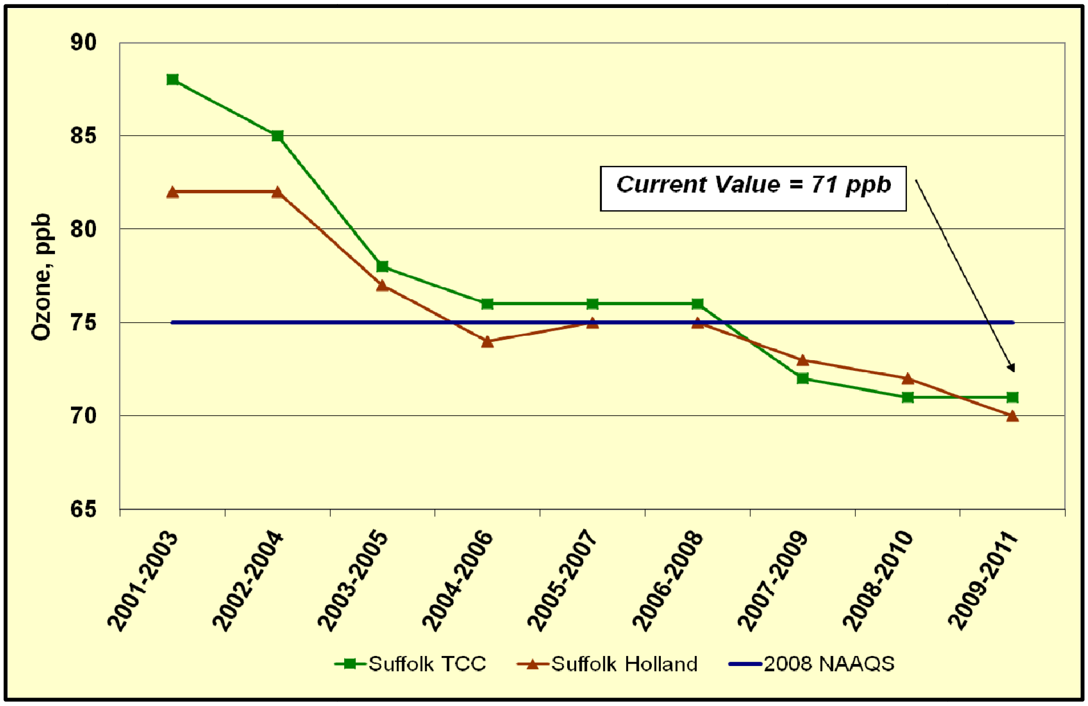


**Figure 2: Hampton Roads Ozone Air Quality**

**Table 2: Hampton Roads Ozone 3-Year Site Average, 4th Highest Values**

| 3 Year Period | Suffolk TCC 51-800-0004 | Suffolk Holland 51-800-0005 |
|---|---|---|
| 2001-2003 | 88 | 82 |
| 2002-2004 | 85 | 82 |
| 2003-2005 | 78 | 77 |
| 2004-2006 | 76 | 74 |
| 2005-2007 | 76 | 75 |
| 2006-2008 | 76 | 75 |
| 2007-2009 | 72 | 73 |
| 2008-2010 | 71 | 72 |
| 2009-2011 | 71 | 70 |

*Data Source: VDEQ-Air Quality Monitoring Division*

## 2.2. $PM_{2.5}$ Air Quality

The Hampton Roads area has historically been in compliance with all $PM_{2.5}$ NAAQS. Figure 3, Table 3, and Figure 4 provide the $PM_{2.5}$ design value data for the area. The strong trend toward improving $PM_{2.5}$ air quality is expected to continue.

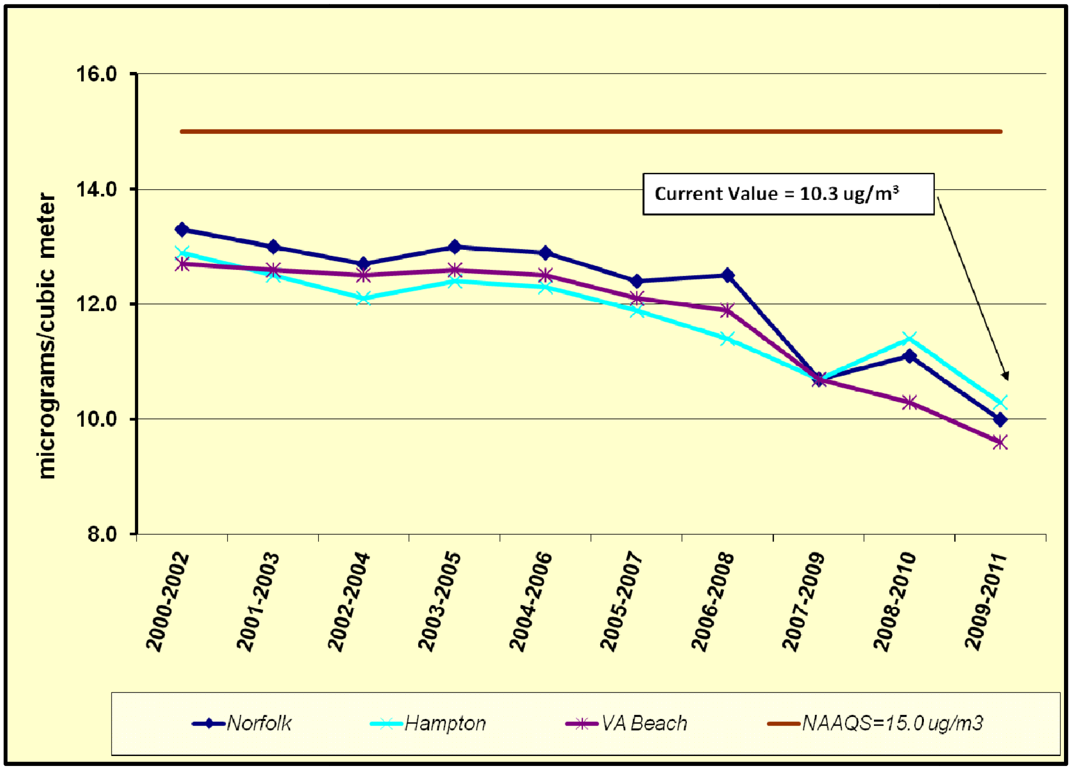


**Figure 3: Annual $PM_{2.5}$ 3-Year Averages**

## Table 3: Annual and 24-Hour $PM_{2.5}$ 3-Year Averages

| 3 Year Period | Norfolk 51-710-0024 | | Hampton 51-650-0004 | | Virginia Beach 51-810-0008 | |
|---|---|---|---|---|---|---|
| | **Annual** | **24-Hour** | **Annual** | **24-Hour** | **Annual** | **24-Hour** |
| 2001-2003 | 13.3 μg/m³ | 30 μg/m³ | 12.9 μg/m³ | 30 μg/m³ | 12.7 μg/m³ | 30 μg/m³ |
| 2002-2004 | 13.0 μg/m³ | 29 μg/m³ | 12.5 μg/m³ | 28 μg/m³ | 12.6 μg/m³ | 29 μg/m³ |
| 2003-2005 | 12.7 μg/m³ | 30 μg/m³ | 12.1 μg/m³ | 29 μg/m³ | 12.5 μg/m³ | 30 μg/m³ |
| 2004-2006 | 13.0 μg/m³ | 30 μg/m³ | 12.4 μg/m³ | 29 μg/m³ | 12.6 μg/m³ | 30 μg/m³ |
| 2005-2007 | 12.9 μg/m³ | 29 μg/m³ | 12.3 μg/m³ | 29 μg/m³ | 12.5 μg/m³ | 30 μg/m³ |
| 2006-2008 | 12.4 μg/m³ | 30 μg/m³ | 11.9 μg/m³ | 29 μg/m³ | 12.1 μg/m³ | 33 μg/m³ |
| 2007-2009 | 12.5 μg/m³ | 25 μg/m³ | 11.4 μg/m³ | 28 μg/m³ | 11.9 μg/m³ | 29 μg/m³ |
| 2008-2010 | 10.7 μg/m³ | 23 μg/m³ | 10.7 μg/m³ | 25 μg/m³ | 10.7 μg/m³ | 29 μg/m³ |
| 2009-2011 | 11.1 μg/m³ | 26 μg/m³ | 11.1 μg/m³ | 25 μg/m³ | 10.3 μg/m³ | 23 μg/m³ |

*Data Source: V DEQ-Air Quality Monitoring Division*

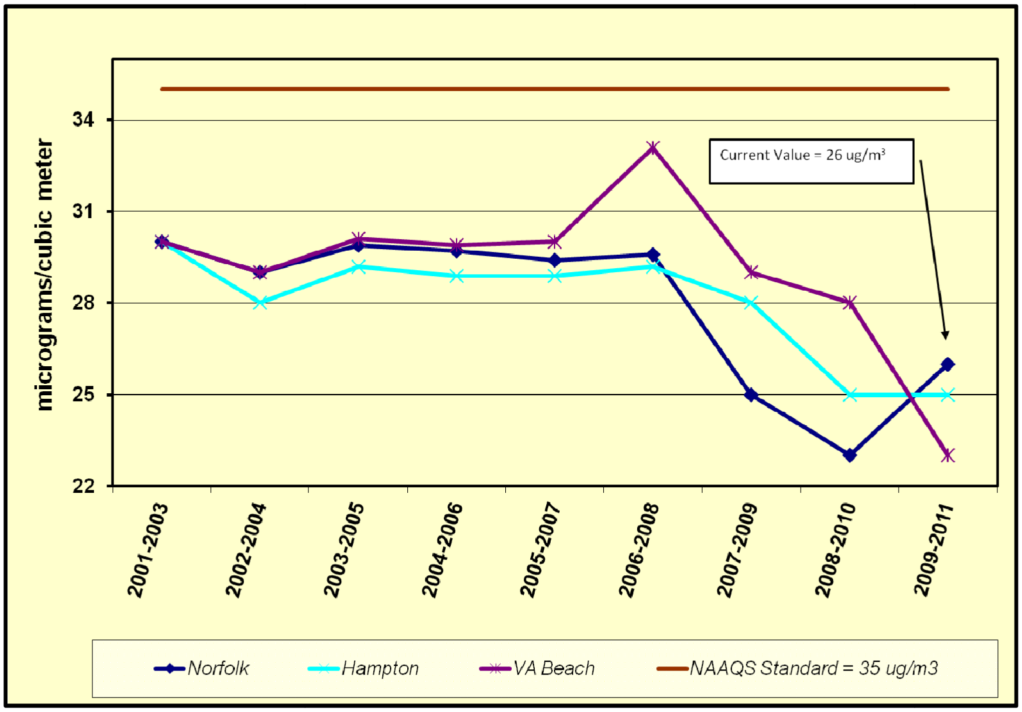


**Figure 4: 24-Hour $PM_{2.5}$ 3-Year Averages**

Figure 5 provides the speciation data from the Henrico County Math and Science Center fine particulate speciation monitor. While this monitor is not located in the Hampton Roads area, the data is considered representative of the entire Commonwealth due to the regional nature of $PM_{2.5}$ air quality. Sulfates are a significant contributor to $PM_{2.5}$ concentrations throughout the Commonwealth. Hampton Roads has experienced significant $SO_2$ reductions in the past few years, and these reductions are expected to continue into the future, as discussed in the following section. The sulfate portion of the $PM_{2.5}$ concentration in the Hampton Roads area should therefore continue to decrease, further improving air quality.

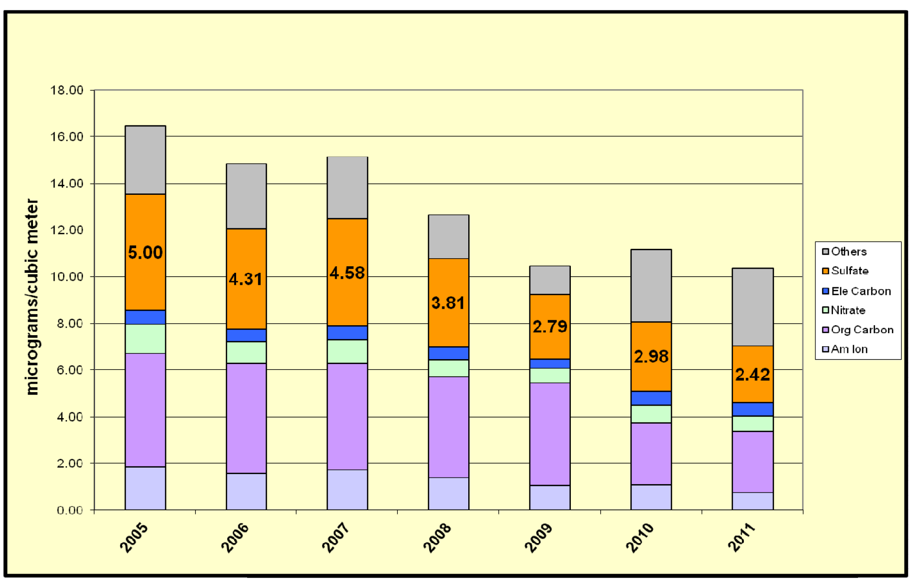


**Figure 5: Henrico Speciation Data: VDEQ Air Quality Monitoring Division**

All data provided in this section have been certified, quality-assured, and submitted to EPA via AQS.

## 2.3. Emission Inventories

This section presents the 2007, 2017, and 2020 emission estimates for the Commonwealth of Virginia and for the Hampton Roads area. These estimates were developed using a variety of methods and data. Emissions of $NO_X$, VOC, and carbon monoxide (CO), the precursors to ozone, are expected to decrease greatly between 2007 and 2017 and through 2020. Emissions of $SO_2$ are also expected to be significantly reduced. While $SO_2$ is not a factor in the formation of ozone, it is a precursor to $PM_{2.5}$. Figure 6 and Figure 7 show the estimated emissions in tons/year (tpy) for the Commonwealth of Virginia, and Figure 8 and Figure 9 show the estimated emissions in tpy for the Hampton Roads area. These figures provide data on emissions from the electrical generating unit (EGU) sector; the area source sector; the industrial sector (Point-NonEGU); the marine, air, and rail transport sector (MAR); the nonroad engine sector (NonRoad); and the on-road vehicle and truck sector (Mobile).

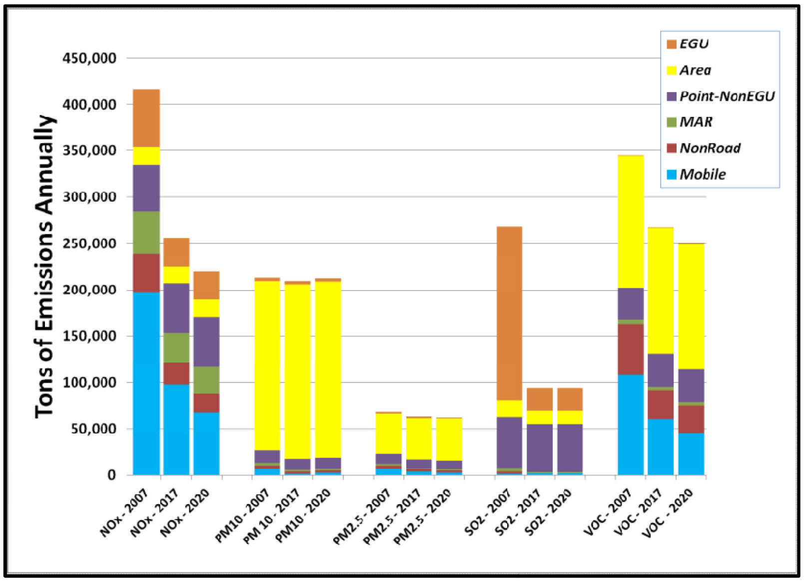


**Figure 6: Virginia Emissions Estimates**

The reductions in the mobile and non-road sectors are generally attributable to several important federal measures that control total hydrocarbons, $PM_{2.5}$, CO, and $NO_X$. These measures are described in more detail in Section 2.3.2 and Section 2.3.3. These already-implemented federal control programs for vehicles, heavy duty diesel on-road engines, and non-road engines continue to provide air quality benefit due to turnover of older equipment for new equipment. The phase-in of reduced sulfur content

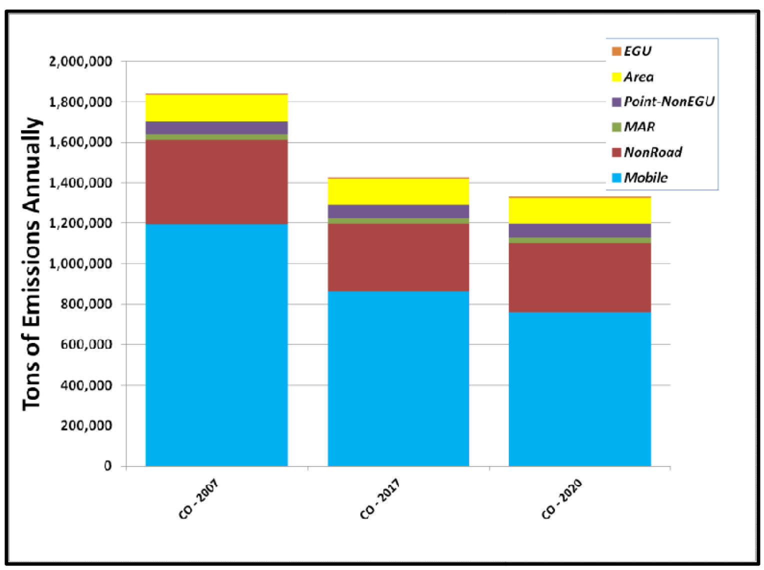


**Figure 7: Virginia Emission Estimates, CO**

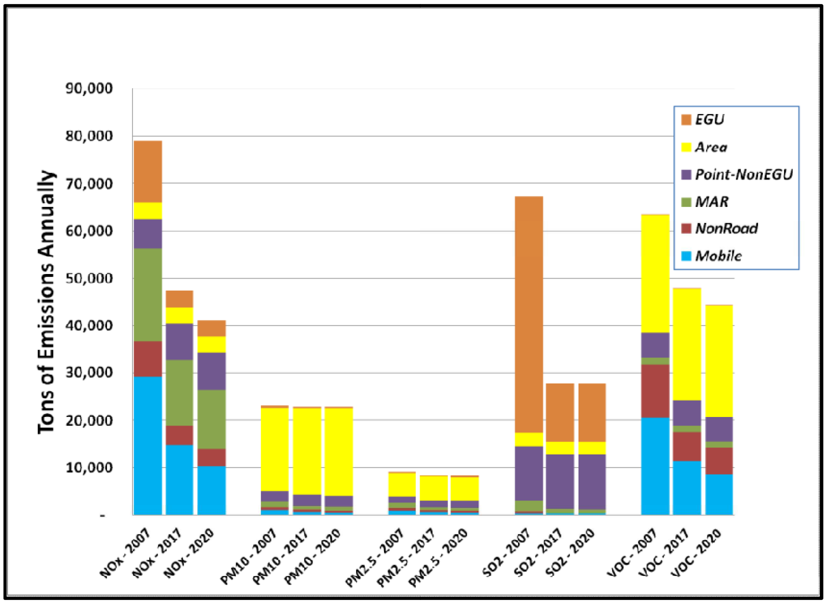


**Figure 8: Hampton Roads Emissions Estimates**

requirements for many types of fuels between 2007 and 2012 has been instrumental in reducing $SO_2$ as well as $NO_X$, CO, and $PM_{2.5}$ since reduced sulfur content in fuel allows control devices to function better. The reduced sulfur content of fuels facilitates the use of state-of-the-art controls on new equipment.

Another factor that must be considered in long range emission estimates is the reduced price of natural gas. Older, inefficient coal-fired power plants that are not economically viable for retrofit with control equipment are being switched to natural gas, which burns much more cleanly than coal. New, state-of-the-art combined cycle operations have been constructed in the Commonwealth, and more of these units are planned for construction to meet existing and future energy needs. These combined cycle operations, which have very low emission rates and produce electricity in a much more efficient manner than older, coal-fired units, are supplanting coal-based generation. Industrial facilities that need steam for manufacturing purposes are retiring coal-fired units and replacing them with new, low emitting, natural gas units. Additionally, more residences are converting to natural gas, where available, and are using high efficiency furnaces and water heaters. These devices not only have lower emission factors per unit of fuel, they also are more efficient and consume less fuel in their operations.

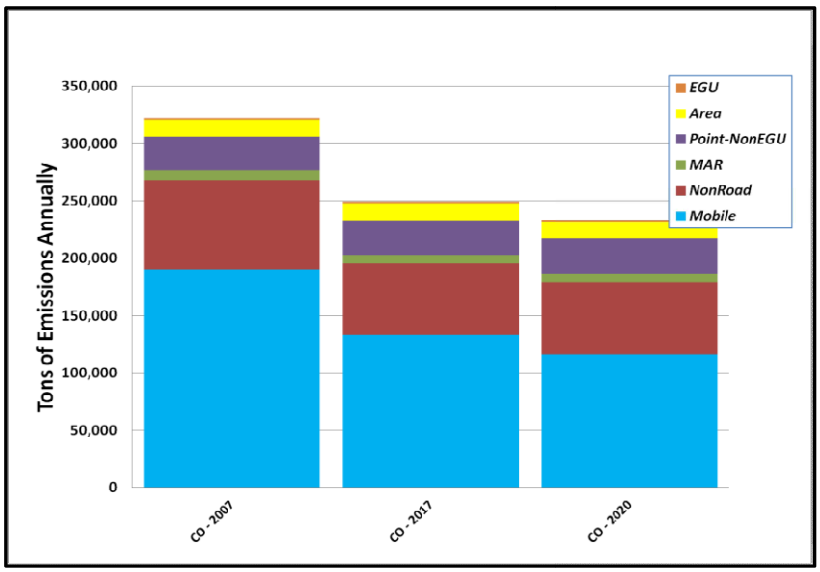


**Figure 9: Hampton Roads Emissions Estimates, CO**

## 2.3.1. *Point Emissions Sector*

Point source emissions are generally larger emitting facilities such as industrial manufacturing facilities and EGUs. In the figures above, the point source emissions sector is represented by the

EGU estimates shown in orange and the point-nonEGU estimates shown in purple. The 2007 emissions data from this emissions source sector was gathered through Virginia's Comprehensive Environmental Data System (CEDS). Facilities reporting to VDEQ use a variety of methodologies to estimate emissions. These methodologies may include federal emission factor estimation techniques, models, throughput records, source-specific emissions testing, and continuous emissions monitors. Facility owners are required to certify their emissions data, and the data is quality-assured by VDEQ staff. For EGUs, hourly emissions of $NO_X$ and $SO_2$, as well as heat input and gross load, are reported to EPA's Clean Air Markets Division (CAMD) on a quarterly basis.

The 2007 data have been extrapolated to 2017 and 2020 using different estimation techniques, depending on the type of industry. Non-EGU point sources are generally developed using factors that are specific to the type of industry represented. Factors that show a decline in emissions or decline in productivity have been updated to unity, so that 2017 and 2020 data are equivalent to 2007 data for those facilities. EGU point sources are analyzed in this inventory using Energy Information Administration data from AEO2011. Since each EGU may have significant emissions, the EGU inventory has also been supplemented with changes based on known permit actions, enforcement orders, and information gleaned from planning documents submitted to the PJM Interconnection LLC (PJM) systems operator and the State Corporation Commission (SCC). For newly permitted facilities that have not yet been constructed, the inventory values included here represent maximum permitted limits. More information on EGU estimates may be found in Appendix A.

As Figure 8 shows, the point source emissions sector dominates the $SO_2$ inventory for the area. Many federal and state programs have decreased emissions significantly from the point source sector. Examples of various point source emission reduction programs that affect these inventory estimates include the $NO_X$ Budget Trading Program and the Clean Air Interstate Rule (CAIR), which greatly reduce the emissions of $NO_X$ and $SO_2$ from power plants; various maximum achievable control technology (MACT) standards, which reduce emissions of VOC and $SO_2$ as a co-benefit of the reductions required for various hazardous air pollutants (HAPs); and federal and state consent agreements, which reduced $SO_2$ emissions at local manufacturing and electrical generating facilities. More emission reductions are expected by 2017 and 2020. These trends hold true for both the Hampton Roads area and the Commonwealth of Virginia.

### 2.3.2. *Mobile Emissions Sector*

Mobile emissions are generated by vehicles and trucks that use the transportation system. The 2007 and 2020 mobile source sector emissions inventories were developed using EPA's most recent model for estimating on-road emissions, MOVES2010b. 2017 mobile source sector emissions estimates were developed using linear interpolation. In the figures above, emissions estimates for the mobile source emissions sector are shown in blue.

$NO_X$ emissions from the mobile sector are the largest contributor to the overall $NO_X$ emissions inventory for the Hampton Roads area in 2007. Between 2007 and 2020, these emissions are expected to decrease significantly, mainly due to the effect of two federal rules, the 2007 Heavy-Duty Diesel Highway Rule and the Tier 2 Vehicle and Gasoline Sulfur Program.

The 2007 Heavy-Duty Diesel Highway Rule (40 CFR Part 86, Subpart P) set a particulate matter (PM) emissions standard for new heavy-duty engines of 0.01 grams per brake-horsepower hour (g/bhp-hr), which took full effect for diesel engines in the 2007 model year. This rule also included standards for $NO_X$ and nonmethane hydrocarbons (NMHC) of 0.20 g/bhp-hr and 0.14 g/bhp-hr, respectively. These diesel engine $NO_X$ and NMHC standards were successfully implemented between 2007 and 2010. The rule also required that sulfur in diesel fuel be reduced to facilitate the use of modern pollution-control technology on these trucks and buses. EPA required a 97% reduction in the sulfur content of highway diesel fuel -- from levels of 500 ppm to 15 ppm.

The Tier 2 Vehicle and Gasoline Sulfur Program (40 CFR Part 80, Subpart H; 40 CFR Part 85; 40 CFR Part 86) is a fleet averaging program for on-road vehicles, modeled after the California LEV II standards. This program became effective in the 2005 model year. The Tier 2 program allows manufacturers to produce vehicles with emissions ranging from relatively dirty to very clean, but the mix of vehicles a manufacturer sells each year must have average $NO_X$ emissions below a specified value. Mobile emissions continue to benefit from this program as motorists replace older, more polluting vehicles with cleaner vehicles.

### 2.3.3. *Non-Road Emissions Sector*

The non-road emissions sector includes estimates of emissions from equipment that contain various types of combustion engines, but these engines are not used to propel equipment on the roads and highways. Examples include pumps, generators, and turbines, as well as engines used for forklifts, earth-moving equipment, lawnmowers, marine transport, rail transport, and air transport.

The majority of the emissions from this source sector are estimated using EPA's National Mobile Inventory Model (NMIM). NMIM was used to estimate 2007, 2017, and 2020 emissions from this source category. While the population estimates for these equipment types increase over time, emissions decrease, due mainly to the Nonroad Diesel Emissions Program (40 CFR Part 89). EPA adopted these $NO_X$, hydrocarbons, and CO emission standards for several groups of nonroad engines. The nonroad diesel rule set standards that reduced emissions by more than 90% from nonroad diesel equipment and, beginning in 2007, the rule reduced fuel sulfur levels by 99% from previous levels. The reduction in fuel sulfur levels applied to most nonroad diesel fuel in 2010 and applied to fuel used in locomotives and marine vessels in 2012.

Emissions from MAR are estimated using category-specific emission estimation tools and emission factors. In the figures above, the nonroad engine sector emission estimates calculated using NMIM are shown in red, and the MAR sector emissions estimates are shown in green. Due to Hampton Roads' proximity to the Chesapeake Bay and Atlantic Ocean, the MAR category is a significant $NO_X$ emitting sector in this region of the Commonwealth.

### *2.3.4. Area Emissions Sector*

The area emissions inventory sector consists of categories where large populations of emitters exist, but each emitter has small emissions. In the figures above, the area emissions sector is represented by the color yellow. This sector is heavily dependent on population and employment. In general, the reductions achieved by the control programs associated with the area emissions inventory sector are offset by growth in population and employment.

### *2.3.5. Emissions Estimates*

Table 4 presents the Virginia-wide emissions estimates. Table 5 presents the emission estimates for the Hampton Roads area. The estimates in these tables include the effects of the federal control programs described above as well as many other federally and state enforceable efforts. They do not include most of the additional reductions that are anticipated through implementation of the programs described in this Action Plan. Where programs listed in the Action Plan are included within these inventories, the description of that program notes this information.

These tables demonstrate that Virginia and the Hampton Roads area are expected to experience significant drops in emissions of $NO_X$, the most important ozone precursor in this area. These reductions should facilitate ozone air quality that complies with the 2008 ozone NAAQS and makes strong progress toward meeting any future NAAQS

## Table 4: Virginia Emission Estimates, 2007-2017-2020

| Year | Mobile | NonRoad | MAR | Point-NonEGU | Area | EGU | Total: |
|---|---|---|---|---|---|---|---|
| **CO, tpy** | | | | | | | |
| **2007** | 1,195,237 | 415,093 | 28,444 | 63,079 | 132,098 | 7,255 | 1,841,208 |
| **2017** | 861,200 | 335,531 | 28,605 | 65,740 | 129,479 | 7,255 | 1,427,809 |
| **2020** | 760,988 | 341,458 | 29,183 | 66,212 | 128,937 | 7,255 | 1,334,034 |
| **$NO_X$, tpy** | | | | | | | |
| **2007** | 197,822 | 41,325 | 45,600 | 50,265 | 19,056 | 62,309 | 416,376 |
| **2017** | 97,694 | 23,658 | 32,268 | 53,236 | 18,411 | 30,650 | 255,917 |
| **2020** | 67,656 | 20,189 | 29,495 | 53,591 | 18,520 | 30,271 | 219,721 |
| **$PM_{10}$, tpy** | | | | | | | |
| **2007** | 6,798 | 4,132 | 2,402 | 13,028 | 183,341 | 3,375 | 213,076 |
| **2017** | 954 | 2,693 | 1,603 | 12,517 | 188,211 | 3,375 | 209,353 |
| **2020** | 2,553 | 2,317 | 1,498 | 12,602 | 190,097 | 3,375 | 212,443 |
| **$PM_{2.5}$, tpy** | | | | | | | |
| **2007** | 6,499 | 3,937 | 2,074 | 10,296 | 44,102 | 1,812 | 68,719 |
| **2017** | 3,365 | 2,548 | 1,321 | 9,885 | 44,851 | 1,812 | 63,781 |
| **2020** | 2,424 | 2,184 | 1,222 | 9,947 | 45,216 | 1,812 | 62,804 |
| **$SO_2$, tpy** | | | | | | | |
| **2007** | 1,434 | 2,329 | 4,674 | 54,486 | 17,098 | 187,671 | 267,692 |
| **2017** | 1,533 | 61 | 1,395 | 52,044 | 14,880 | 24,546 | 94,459 |
| **2020** | 1,562 | 63 | 1,214 | 52,338 | 14,616 | 24,600 | 94,394 |
| **VOC, tpy** | | | | | | | |
| **2007** | 108,001 | 55,135 | 4,312 | 35,018 | 142,218 | 689 | 345,373 |
| **2017** | 59,957 | 32,141 | 3,710 | 35,461 | 135,379 | 689 | 267,338 |
| **2020** | 45,543 | 29,303 | 3,622 | 35,593 | 135,002 | 689 | 249,753 |

## Table 5: Hampton Roads Emission Estimates, 2007-2017-2020

| Year | Mobile | NonRoad | MAR | Point-NonEGU | Area | EGU | Total: |
|---|---|---|---|---|---|---|---|
| **CO, tpy** | | | | | | | |
| **2007** | 189,865 | 78,439 | 8,526 | 29,014 | 15,129 | 1,552 | 322,525 |
| **2017** | 133,265 | 62,214 | 7,380 | 30,357 | 14,708 | 1,552 | 249,476 |
| **2020** | 116,285 | 63,052 | 7,412 | 30,616 | 14,625 | 1,552 | 233,541 |
| **$NO_X$. tpy** | | | | | | | |
| **2007** | 29,170 | 7,362 | 19,823 | 6,228 | 3,458 | 12,974 | 79,015 |
| **2017** | 14,684 | 4,256 | 13,839 | 7,764 | 3,332 | 3,530 | 47,405 |
| **2020** | 10,339 | 3,680 | 12,431 | 7,862 | 3,352 | 3,533 | 41,196 |
| **$PM_{10}$, tpy** | | | | | | | |
| **2007** | 861 | 741 | 1,236 | 2,258 | 17,583 | 456 | 23,109 |
| **2017** | 509 | 461 | 919 | 2,338 | 18,180 | 456 | 22,864 |
| **2020** | 403 | 396 | 872 | 2,358 | 18,414 | 456 | 22,899 |
| **$PM_{2.5}$, tpy** | | | | | | | |
| **2007** | 820 | 679 | 1,039 | 1,383 | 4,887 | 290 | 9,098 |
| **2017** | 484 | 436 | 737 | 1,429 | 4,968 | 290 | 8,344 |
| **2020** | 383 | 373 | 691 | 1,441 | 5,013 | 290 | 8,191 |
| **$SO_2$, tpy** | | | | | | | |
| **2007** | 240 | 391 | 2,382 | 11,412 | 3,088 | 49,815 | 67,815 |
| **2017** | 254 | 12 | 824 | 11,676 | 2,667 | 12,325 | 27,733 |
| **2020** | 258 | 12 | 761 | 11,721 | 2,611 | 12,369 | 27,733 |
| **VOC, tpy** | | | | | | | |
| **2007** | 20,501 | 11,300 | 1,582 | 5,039 | 25,079 | 106 | 63,608 |
| **2017** | 11,362 | 6,286 | 1,323 | 5,148 | 23,794 | 106 | 48,019 |
| **2020** | 8,621 | 5,599 | 1,291 | 5,185 | 23,604 | 106 | 44,406 |

## 2.4. Ozone Air Quality Modeling

Air quality modeling for the Hampton Roads area was performed by the Ozone Transport Commission (OTC) and was conducted for a 2007 base year in addition to a 2020 future year. For 2020 this modeling study predicts air quality concentrations that are well beneath the 2008 ozone NAAQS for all monitoring locations within the Commonwealth. The future year modeling accounts for federal, state, and local control measures that are expected to occur prior to 2020 and are federally enforceable. However, most of the programs listed in this Action Plan are not included in the modeling. These emissions reductions will provide further air quality benefit beyond that predicted by this air quality modeling study.

### *2.4.1. Air Quality Model Configuration*

This analysis used EPA's Models-3/Community Multiscale Air Quality (CMAQ) modeling system. The configuration of the CMAQ modeling system was chosen based on the results of the model sensitivity testing performed during previous OTC ozone modeling efforts. Details on the emissions inventories used in the modeling are provided in Appendix B. The 36/12 kilometer (km) horizontal grid system used in modeling is displayed in Figure 10. The CMAQ configuration is provided in Table 6.

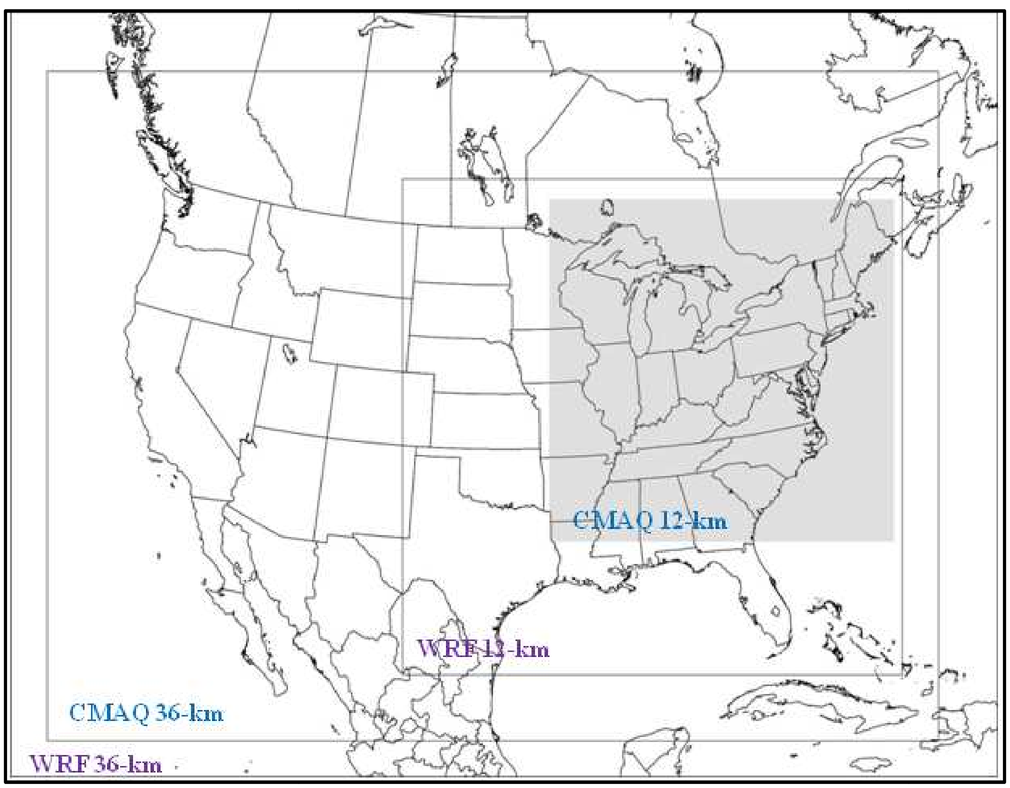


**Figure 10: Modeling Grid**

**Table 6: OTC Modeling CMAQ Configuration**

| Model Option | OTC Level 3 CMAQ Configuration |
|---|---|
| Model Version | CMAQ 4.71 |
| Horizontal Resolution | 36/12 km |
| Vertical Spacing | 34 layers |
| Emissions Inventories | MARAMA/OTC Level 3 |
| Meteorology | WRF v3.1 OTC Modeling |
| Gas Phase Chemistry | CB05 |
| Gas Phase Chemistry Solver | EBI |
| Aerosol Chemistry | AERO5 |
| Aqueous Phase Chemistry | ACM |
| Horizontal Advection | Yamartino |
| Vertical Advection | Yamartino |
| Horizontal Diffusion | Eddy diffusivity dependent on grid |
| Vertical Diffusion | ACM2 (inline) |
| Boundary Conditions | 36 km derived from 2007 GEOS-CHEM -- 12 km derived from 36 km |
| Initial Conditions | Default with 15 day spin-up |

### *2.4.2. Model Performance Evaluation*

To quantify model performance, several statistical measures were calculated and evaluated. The statistical measures selected were based on the recommendations outlined in "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze," (see http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf).

Model performance statistics were calculated for the Ozone Transport Region (OTR) and Virginia. The evaluation included 210 AQS monitoring sites and 20 Clean Air Status and Trends Network (CASTNET) monitoring sites. Figure 11 shows the locations of these AQS and CASTNET sites across the OTR and Virginia.

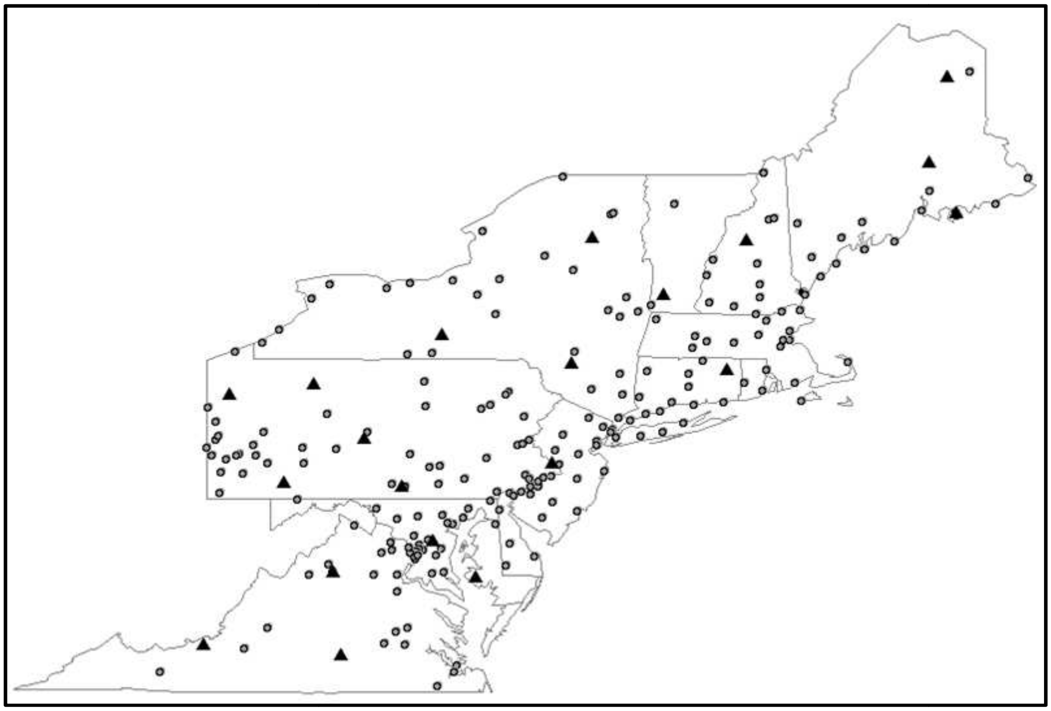

**Figure 11: Locations of AQS (circles) and CASTNET (triangles) Monitoring Sites**

The OTC CMAQ modeling platform performs well and within recommended modeling guidelines. Figure 12 compares predicted to observed average daily maximum 8-hour ozone concentrations for the OTR and Virginia. The model slightly over-predicts ozone, but it captures day-night and seasonal patterns very well. Figure 13 illustrates the average diurnal variation of ozone aggregated across the AQS (top panel) and CASTNET (bottom panel) sites within the OTR and Virginia.

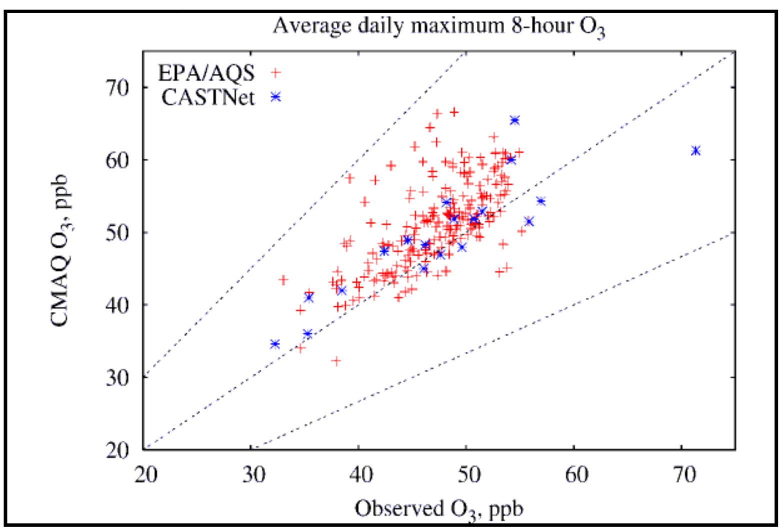


**Figure 12: Predicted Versus Observed Average Daily Maximum 8-Hour Ozone**

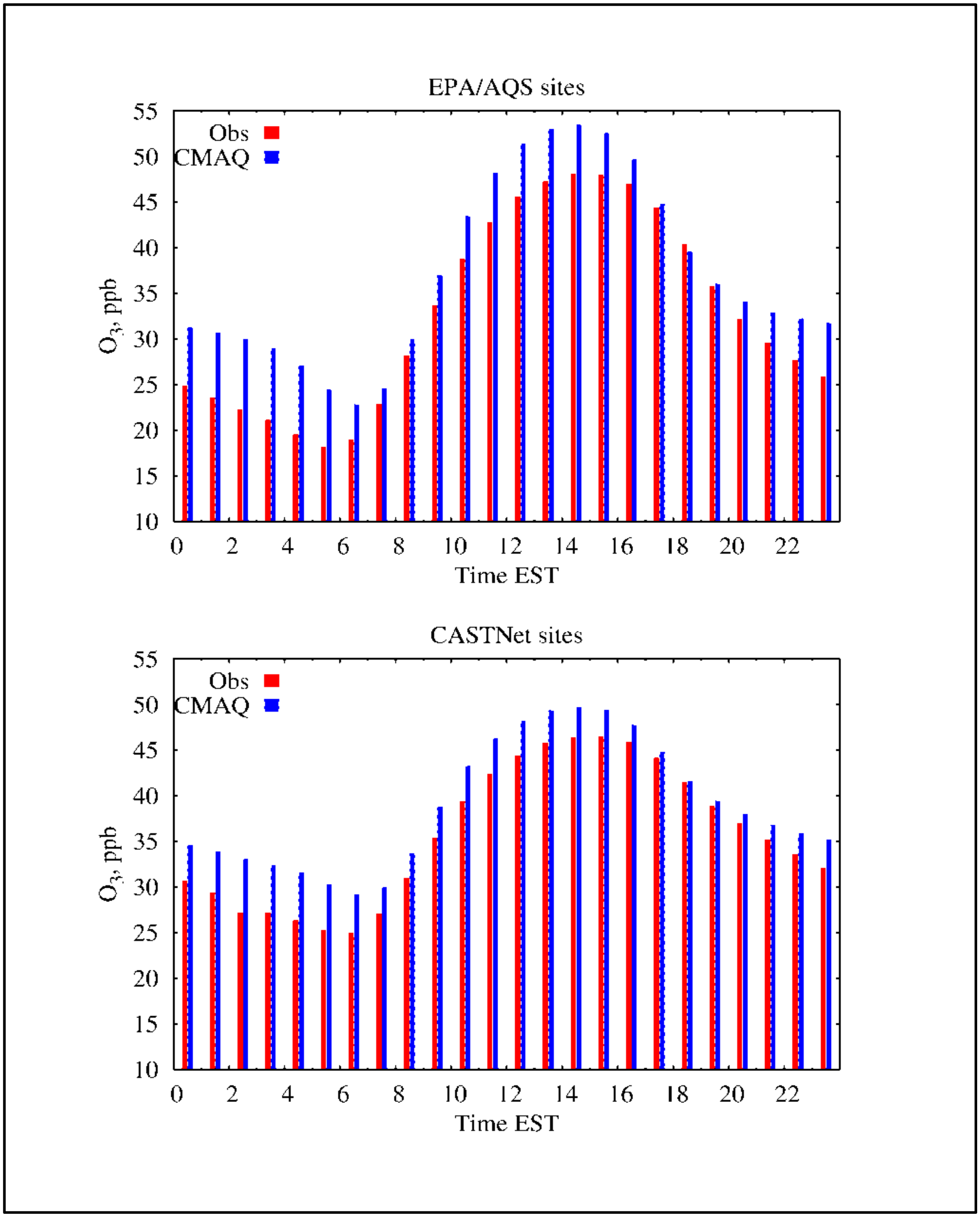


**Figure 13: Average Diurnal Variation in Ozone**

Additional statistical information on CMAQ ozone model performance for the 2007 base case is provided in Appendix B.

### *2.4.3. Ozone Modeling Results for 2020*

The air quality modeling results based on the 12-km grid modeling domain are presented in Figure 14. These modeling results clearly demonstrate that the entire Commonwealth of Virginia, and the majority of the modeling domain, are projected to be in compliance with the 2008 ozone NAAQS of 75 ppb by 2020. In addition, there is a significant margin of safety in the Hampton Roads area should the standard be lowered in the future.

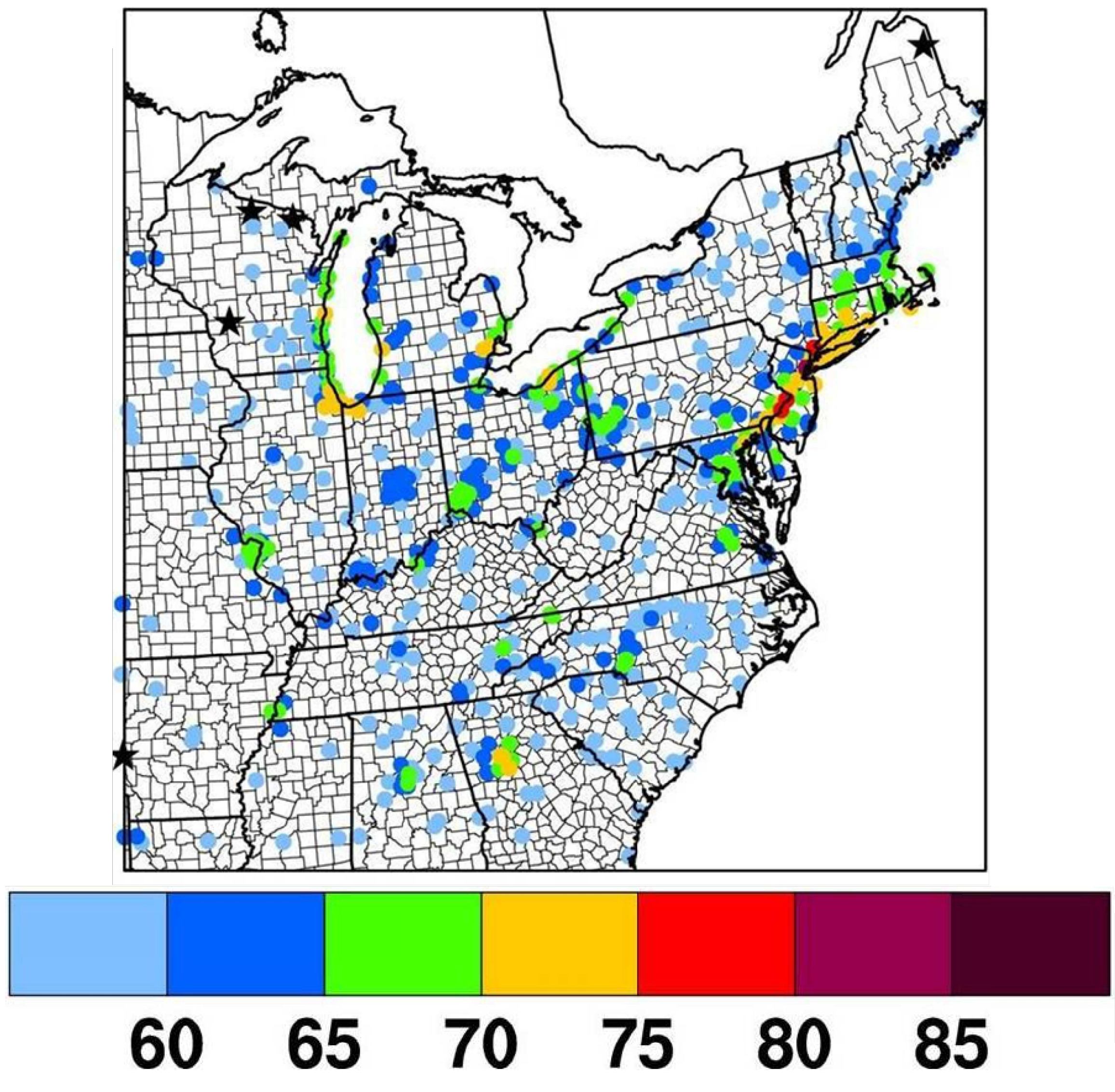


**Figure 14: 2020 Ozone Modeling Results, ppb**

Table 7 provides a summary of the 2007 base year and 2020 future year modeling results for the Hampton Roads area.

**Table 7: Hampton Roads Ozone Modeling Results**

| AIRS I.D. | Site Location | Latitude | Longitude | 2007 Base Design Value | 2020 Future Design Value |
|---|---|---|---|---|---|
| 51-650-0004 | Hampton* | 37.0010 | -76.3986 | 76.5 ppb | 64 ppb |
| 51-800-0004 | Suffolk | 36.9012 | -76-4381 | 74.7 ppb | 63 ppb |
| 51-800-0005 | Suffolk-Holland | 36.6653 | -76.7308 | 74.3 ppb | 59 ppb |

**This site was discontinued in 2009 due to construction activity.*

Many of the programs included in this Action Plan are not included in the area's overall emissions estimates and will provide further air quality benefit beyond that predicted by the air quality modeling.

The modeling included in this Action Plan may be updated in the future or as part of the annual Action Plan report to reflect updated SIP quality modeling platforms.

## 2.5. Assessment of Relative Air Quality Impacts

Ozone formation is driven by two major classes of directly emitted precursors: $NO_X$ and VOC. The relationship of peak ozone concentrations can be plotted as a function of VOC and $NO_X$ emission rates as illustrated in Figure 15. This figure is a simplified illustration but shows that two distinct regimes exist with different ozone-$NO_X$-VOC sensitivity. In the $NO_X$-limited regime (with relatively low $NO_X$ and high VOC), ozone increases with increasing $NO_X$ and changes little in response to increasing VOC. The $NO_X$ saturated or VOC-limited regime has ozone decreases with increasing $NO_X$ and ozone increases with increasing VOC. The dotted line represents a local maximum for ozone versus $NO_X$ and VOC, separating the $NO_X$-limited and VOC-limited regimes. The relationship between ozone, $NO_X$, and VOC is driven by complex nonlinear photochemistry. No simple rule of thumb exists for distinguishing $NO_X$-limited from VOC-limited conditions. Ozone-precursor sensitivity predictions are usually derived from three-dimensional Eulerian

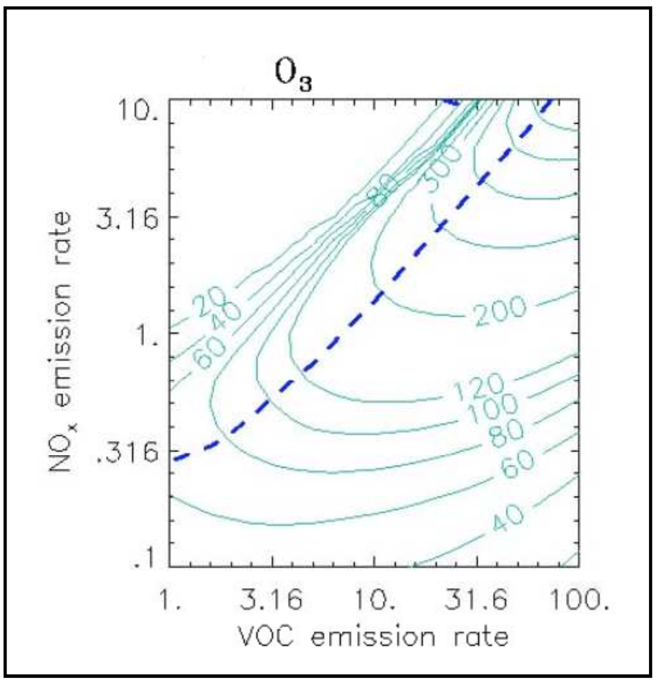


**Figure 15: Peak Ozone Concentrations as a Function of VOC and $NO_X$ Emission Rates**

chemistry/transport models such as CMAQ. CMAQ includes state-of-the-science capabilities for modeling multiple air quality issues, including tropospheric ozone formation, and accounts for the reactivity of the various VOC species.

Studies in recent years have examined the sensitivity of surface ozone formation to precursor species concentrations of VOC and $NO_X$. These studies have invariably concluded that peak ozone concentrations are more sensitive to $NO_X$ emissions over most of the United States. This conclusion is due in part to substantial decreases in $NO_X$ emissions, primarily from stationary sources and particularly over the last two decades, which have lead to an additional reduction in the $NO_X$-VOC emissions ratio. Another factor is that peak summertime ozone formation is more sensitive to changes in $NO_X$ with increasing temperature because emissions of highly reactive, biogenic isoprene increase with temperature and thus increase the total VOC emissions available for reaction. Very few exceptions exist to this rule; only a few urban core areas such as Chicago and New York City have historically shown reductions in ozone due to the implementation of VOC emissions control measures.

Georgia Institute of Technology (Georgia Tech) conducted a series of emissions sensitivities in 2009 as part of the Association for Southeastern Integrated Planning (ASIP) project. The study examined the impact of $NO_X$ and VOC emission reductions on 8-hour ozone concentrations using CMAQ model simulations for a summer ozone episode (June 1 – July 10, 2002). One of the sensitivity runs examined the effects of a 30% reduction in domain-wide anthropogenic VOCs on ozone formation. The impacts were then normalized by emissions. A summary of the results for Virginia is provided in Figure 16.

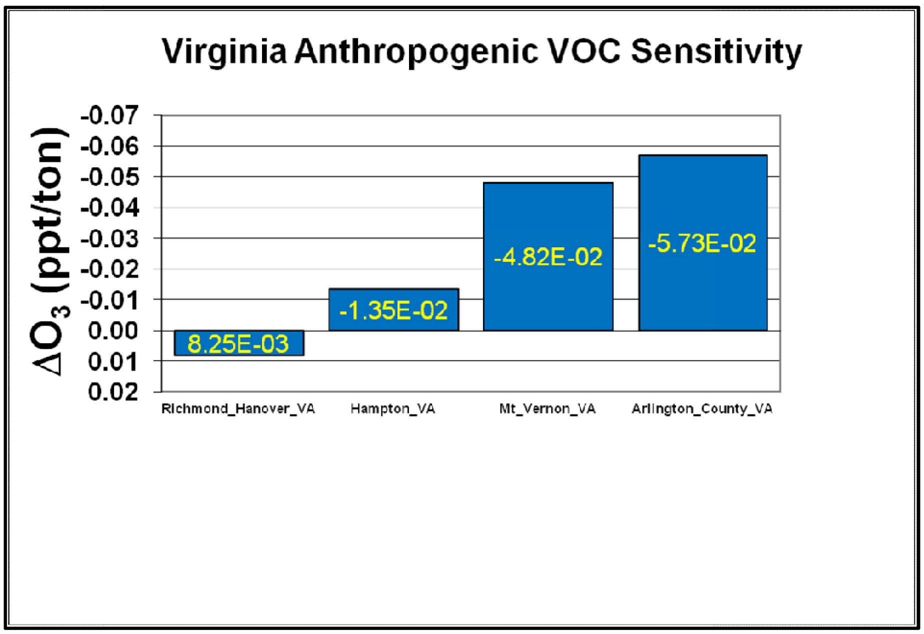


**Figure 16: Ozone Response to Reductions in Anthropogenic VOC (Boylan, 2009)**

A second sensitivity run examined the effects of a 30% reduction in ground level $NO_X$ for jurisdictions within Virginia on ozone formation. The impacts were then normalized by emissions. A summary of the results of the receptor locations in Virginia is provided in Figure 17. The model response to ground level $NO_X$ reductions was two orders of magnitude (i.e., more than 100 times) greater than the response from anthropogenic VOC reductions.

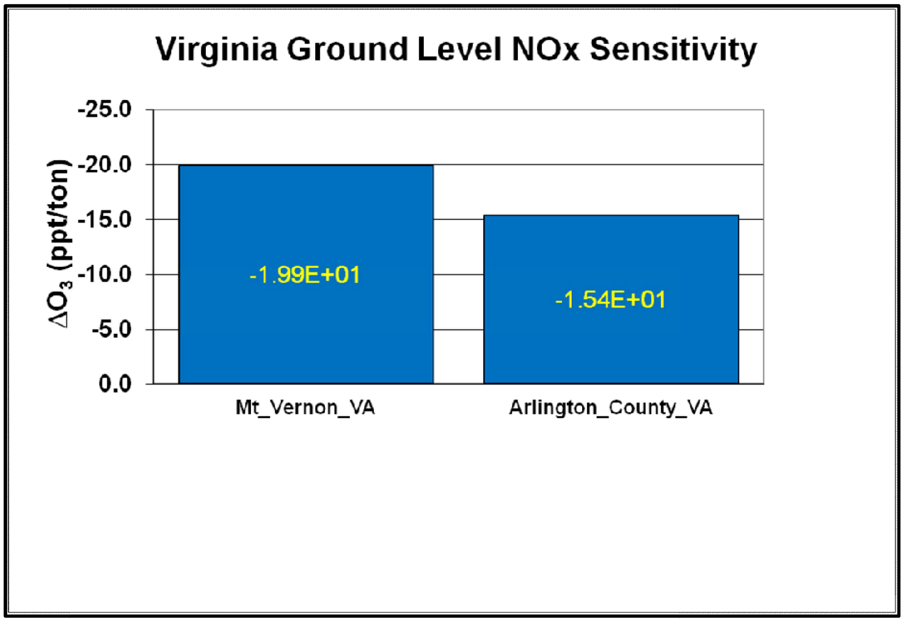


**Figure 17: Ozone Response to Reductions in Ground Level $NO_X$ (Boylan, 2009)**

Similarly, a third sensitivity run examined the effects of a 30% reduction in Virginia point source $NO_X$ on ozone formation. The impacts were again normalized by emissions. A summary of the results is provided in Figure 18. The model response to point source $NO_X$ reductions was two to three orders of magnitude (i.e., more than 100-1,000 times) greater than the response from anthropogenic VOC reductions. The model response for this sensitivity was more variable and dependent on the location of the point source relative to the receptor locations as compared to the sensitivity run for ground level $NO_X$.

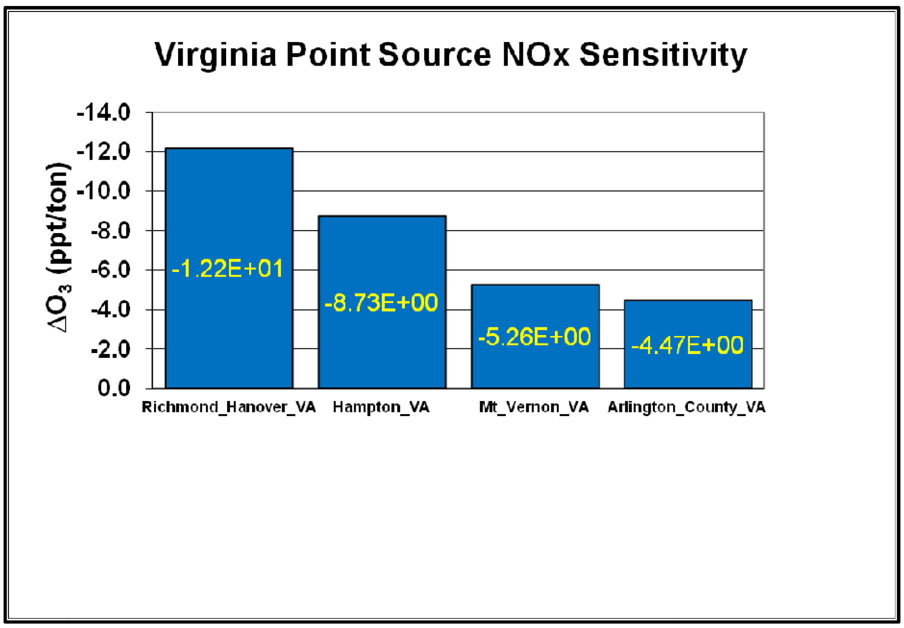


**Figure 18: Ozone Response to Reductions in Point Source $NO_X$ (Boylan, 2009)**

These sensitivities demonstrate that $NO_X$ reductions are more efficacious than VOC reductions for improvement in ozone air quality in the Commonwealth.

# 3. Action Plan Programs

The following sections give detailed information on a number of new and ongoing programs that will provide additional emission reduction benefits to Virginia and the Hampton Roads area. These programs are directionally correct. They will reduce ozone precursors, and many of these programs will also reduce $PM_{2.5}$ precursors. The reductions from the programs are quantified, where possible, and the organizations responsible for the implementation of each program are provided. Timelines for implementation of each new program are also provided. Each program description specifically states if the reductions associated with the program or action have been included in the emissions inventories listed in Table 4 and Table 5.

## 3.1. Virginia Port Authority

The VPA, established in 1952 as a political subdivision of the Commonwealth of Virginia, is the third largest ocean container terminal complex on the East Coast. During the fiscal year ending June 30, 2012, the VPA had a container volume of 1,968,849 twenty-foot equivalent container units (TEUs), with operating revenues of $101,200,000. The VPA owns and is responsible for three marine terminals: Norfolk International Terminals (NIT), located in Norfolk, Virginia; Portsmouth Marine Terminal (PMT), located in Portsmouth, Virginia; and Newport News Marine Terminal (NNMT), located in Newport News, Virginia. The VPA also owns the Virginia Inland Port (VIP) in Front Royal, Virginia; leases the APM Terminal (APMT) in Portsmouth, Virginia; and leases the Port of Richmond in Richmond, Virginia. All of the VPA marine terminals and the VIP are certified under the ISO 14001 environmental management system, and the VPA is the only major port on the East Coast to receive this certification. The VPA has instituted a number of environmentally beneficial programs that will help to improve air quality, some of which are detailed in the following sections. More information on VPA environmental matters may be found at http://www.portofvirginia.com/Environment.aspx. The benefits of these programs are not included in the emissions estimates provided in Table 4 and Table 5.

### *3.1.1. VPA Green Operator Program*

VPA's Green Operator (GO) Program provides incentives to truck operators to retrofit or replace older engines and exhaust systems to improve emissions. At the close of 2011, 250 vehicles had participated in the program.

The VPA estimated the potential contribution of this program toward overall emissions improvements using the following assumptions:

- 183 trucks were retrofitted to generate the equivalent emissions of a 2004 engine.
- 67 trucks replaced their engines with 2008 equivalent models.
- Each truck is assumed to make two or three trips daily to the terminal on about 250 days annually.

Emissions from the annual trips were calculated using MOVES2010B and compared to trucks in the expected age range to determine the current benefits from the program. The $NO_X$ benefits are shown in Table 8.

**Table 8: Annual $NO_X$ Benefits from the VPA GO Program, 2011**

| | 2 Trips Daily | 3 Trips Daily |
|---|---|---|
| **Baseline** | 87 tons | 131 tons |
| **GO Program** | 55 tons | 83 tons |
| ***Benefit*** | ***32 tons*** | ***48 tons*** |

*Data Source: Virginia Port Authority 2011 Air Emissions Inventory, Appendix A, Page A-4*

On September 12, 2012, EPA approved a Diesel Emissions Retrofit Act grant in the amount of $153,543 to provide rebates for participants in this program. These rebates will be used to offset the cost to purchase and install verified emission control devices. This directionally correct program will grow through such grants, providing further air quality benefit to the region.

### *3.1.2. Maersk Low Sulfur Fuel Use*

In 2012, the Maersk Line announced that its vessels berthed at NIT and APMT will use low sulfur fuel to reduce emissions. Maersk is switching to low sulfur fuel well ahead of the 2015 timeline for doing so outlined in the International Maritime Association agreement for all vessels operating within the U.S. Emission Control Areas. Vessels will use low sulfur fuel while berthed at the terminal and will operate generators to power hotel loads.

In 2011, Maersk Line vessels called on Virginia ports 196 times for a cumulative 2,167 hours of berth time. Future operations are expected to be at least at these levels. Table 9 shows emissions reductions expected from this program for operations at 2011 levels.

While these reductions will not necessarily improve ozone air quality, this program is directionally correct and will help ensure the area continues to enjoy healthy $PM_{2.5}$ air quality.

**Table 9: Annual Emission Reductions from the Maersk Low Sulfur Fuel Program**

| | $PM_{2.5}$ | $SO_2$ |
|---|---|---|
| Typical Fuel (1% S content) | 2.0 tons | 19.2 tons |
| Low Sulfur Fuel (0.1% S Content) | 0.8 tons | 1.9 tons |
| ***Benefit*** | ***1.2 tons*** | ***17.3 tons*** |

*Data Source: Virginia Port Authority 2011 Air Emissions Inventory, Appendix A, Page A-3*

### *3.1.3. Terminal Operations*

VPA employs a number of different types of equipment to move containers. A review of cargo handling operations has allowed the VPA to maximize the use of electric rail-mounted gantry (RMG) cranes in place of other types of diesel-powered equipment, which reduces emissions from the use of these diesel-powered engines. Based on the 2011 emissions inventory, Table 10 compares the two operations, normalized to 1,000,000 TEUs. Using the RMG cranes to handle equipment provides significant decreases in emissions from cargo handling equipment, and maximizing the use of the electric equipment will enable the VPA to minimize their air emissions from this category of equipment.

**Table 10: Cargo Handling Operations Emissions Benefit**

| | Emissions (Tons per 1,000,000 TEUs) | | | |
|---|---|---|---|---|
| **Handling Mode** | **HC/VOC** | **CO** | **$NO_X$** | **$PM_{2.5}$** |
| Straddle Carrier | 7.7 | 37.3 | 83.8 | 3.6 |
| RMG | 2.0 | 11.4 | 16.2 | 1.6 |
| ***Benefit*** | ***5.7*** | ***25.9*** | ***67.6*** | ***2.0*** |

*Data Source: Virginia Port Authority 2011 Air Emissions Inventory, Appendix A, Page A-5*

## 3.2. Metropolitan Planning Efforts

The Hampton Roads area has been proactive in establishing a strong planning effort aimed at reducing emissions from vehicle miles traveled. The area has access to Congestion Mitigation and Air Quality (CMAQ) funding, which has been used by the HRTPO for a wide variety of efforts designed to improve air quality between 2012 and 2018. These efforts include improvements and construction of new bicycle paths, park and ride lots, signal enhancements, support for the VPA's Green Operators Program, ferry replacements, Intelligent Transport System (ITS) signal systems, and transit system improvements, as well as those described in greater detail below. The total estimated reductions of $NO_X$ and VOC from these programs are significant. A thorough report on all CMAQ programs in the Hampton Roads area, entitled "Hampton Roads Transportation Planning Organization-CMAQ/RSTP Projects and Allocations 2011," is included in Appendix C and may be found at http://www.hrtpo.org/uploads/docs/2011%20CMAQ-RSTP%20PSP%20Report%20-%20Final.pdf. More information on the Hampton Roads planning efforts may be found at www.hrtpo.org. These emissions reductions are not included in the emissions estimates provided in Table 4 and Table 5.

### *3.2.1. 64 Express*

Beginning in late 2008, a container-on-barge service began operating between the Port of Richmond and the VPA terminals in Hampton Roads. This service, called the 64 Express, started as a partnership between the VPA, the Richmond Area Metropolitan Planning Organization, and the HRTPO. Initially, the program was funded via a grant from the U.S. Maritime Administration's America's Marine Highway Program, funds from the CMAQ program, and other state and local funding sources. This service provides an alternative to trucking imports bound for regional distribution or export from the region to international markets. The service mitigates highway system impacts associated with goods movement by shifting individual containers from truck to barge. Each barge transit reduces congestion, reduces maintenance and operations-related highway system costs, and on a per-ton-mile basis produces fewer VOC or $NO_X$ emissions than either rail or truck alternatives. A fully loaded barge has the capacity to carry up to 100 containers (see Figure 19).

**Figure 19: 64 Express Barge Operations**

During the first year of operation, the barge transported approximately 6,000 containers, removing 12,000 truck trips from the I-64 corridor. Since then, additional barges and weekly trips have been added to the route as demand has increased. According to the VPA, in 2011 4% of the port's cargo was moved by barges, which is equivalent to 28,800 trucks per year or 79 trucks per day on regional roadways. A VPA study estimates that the 64 Express will remove about 285 trucks per day from this corridor in 2040.

This program received a national award from the Association of Metropolitan Planning Organizations in October of 2009 for Innovative Practices in Metropolitan Transportation

Planning.  Additionally, several areas of the country are now looking at the 64 Express as a model for implementation in their regions.

This program is highly beneficial to air quality.  Estimates indicate that the program is responsible for 11,200 kilograms/day (kg/day) of VOC reductions and 3,563 kg/day of $NO_X$ reductions, roughly 4,400 tpy of VOC and 1,400 tpy of $NO_X$.  As the program expands, these benefits will continue to increase.  This program will also improve the quality of life for all citizens using the I-64 corridor by reducing truck traffic congestion.  Emission reduction estimates from this program were not included in the emissions estimations provided in Table 4 and Table 5.  More information may be found at http://www.64express.com/.  Emissions estimates may be found at https://fhwaapps.fhwa.dot.gov/cmaq_pub/HomePage/ using case number VA20090013.

### *3.2.2. Inter-Terminal Barge Service*

The HRTPO has allocated a total of $8,190,480 in CMAQ funds between fiscal year 2012 and fiscal year 2015 to a VPA project for the Inter-Terminal Barge Service.  This project will provide a container-on-barge intra-harbor terminal service to shuttle containers between NIT and PMT and includes requirements to use ultra low sulfur diesel (ULSD).  The project is expected to reduce emissions and traffic congestion, while also improving safety.

### *3.2.3. TRAFFIX*

TRAFFIX is a travel demand management service funded through CMAQ.  This service aims to reduce traffic congestion by reducing the number of single occupancy vehicles commuting to work.  The service promotes transportation alternatives, such as carpooling, vanpooling, public transportation, teleworking, and alternate work schedules.  This directionally correct program not only provides air quality benefits, it also improves the daily routine of citizens by offering less stressful methods of commuting and by reducing the number of cars on the road during peak traffic hours.

The TRAFFIX NuRide program is a commuter incentive program that rewards commuters who use alternate commuting methods.  When a commuter works, bikes, telecommutes, carpools, vanpools, uses public transportation, or works a compressed work week, he or she can log the trip into the NuRide system to receive points.  The points can be redeemed for restaurant, shops, or grocery store credits.  In fiscal year 2008, the program logged 1,700 initial registrations. Since 2008, the system has logged between 500 and 700 new registrations per year, with a total of 3,643 users in the NuRide system currently.  The total number of trips per year recorded in the system doubled from approximately 150,000 trips in fiscal year 2010 to over 300,000 trips in fiscal year 2011.  The NuRide program resulted in a reduction of 7,041,068 vehicle miles traveled in fiscal year 2011.

TRAFFIX operates the Commuter Computer as another method to match individuals for carpooling. Registering for the Commuter Computer allows individuals to take advantage of the Guaranteed Ride Program, a service designed to encourage alternate commutes by providing rides for unexpected trips. This system matches just over 100 carpool participants annually.

TRAFFIX provides vanpools for lease to groups of commuters. As of the end of fiscal year 2011, all 60 of TRAFFIX's van pools had been leased, along with two vans owned by a private vanpool company. The average number of commuters per vanpool has ranged between 9 and 10 commuters over the past five years, and the vanpool program is serving 613 commuters as of the end of fiscal year 2012.

Emissions reductions associated with these directionally correct programs are not part of the emissions estimate included in Table 5. This program is expected to continue to grow into the future, providing additional air quality benefit in coming years. More information on TRAFFIX may be found at http://www.gohrt.com/services/traffix/ and in Appendix C.

### *3.2.4. The Tide*

The Tide, Virginia's first light rail system, opened for service in Norfolk on August 19, 2011. It extends 7.4 miles from the Eastern Virginia Medical Center complex east through downtown Norfolk and adjacent to I-264 to Newtown Road, as shown in Figure 20. Eleven stations provide access to dining, shopping and entertainment as well as the Norfolk State University and Tidewater Community College (Norfolk) campuses. There are four park-and-ride lots where free parking is available.

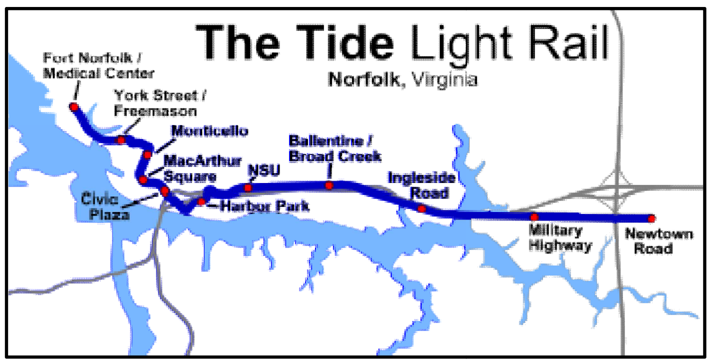


**Figure 20: The Tide Route Map**

The trains generally run every 15 minutes, with trains running every 10 minutes during peak periods. The Tide offers both online ticketing and onboard WiFi access. The Tide is designed so that transit-oriented development will be constructed along the light rail line, creating a smart growth transit corridor to help guide future development using compact mixed-use development practices. Hampton Roads Transit is studying the possibility of extending the current route. Future extensions may connect the Norfolk Naval Base and Old Dominion University to the existing route. These facilities are both major employers in the area. Hampton Roads Transit is currently collecting ridership data to evaluate and calibrate the travel forecasting model on actual data.

This directionally correct program not only will benefit air quality going forward, it will also add to the quality of life in the Hampton Roads area and enhance tourism opportunities for the area.

## 3.3. DMME - Division of Energy Programs

DMME's Division of Energy serves as the state energy office and oversees a variety of programs that aim to reduce the consumption of energy throughout the Commonwealth of Virginia. These energy savings, which are facilitated in part by the programs described below, will have a beneficial effect on all facets of the Commonwealth's environment. The generation of electricity is a significant contributor to the ozone precursor $NO_X$. As these energy efficiency programs are developed and take full effect, the reduction in $NO_X$ emissions should help to improve ozone air quality in all parts of the Commonwealth. The emission reductions associated with the programs listed below have not been included in the inventory estimates listed in Table 4 and Table 5. More detail on the following programs, as well as other programs offered by DMME, may be found at www.dmme.virginia.gov/divisionenergy.shtml.

### *3.3.1. Virginia Energy Management Program*

The Virginia Energy Management Program (VEMP) was selected for expansion within DMME in response to Governor McDonnell's Executive Order 19 "Conservation and Efficiency in the Operation of State Government" (see http://www.governor.virginia.gov/PolicyOffice/Executive Orders/). VEMP provides direction for Virginia's energy management program. The current staff of five employees has developed a roadmap to meet the Governor's order, which increases the scope of the public facilities energy efficiency retrofit program. The objectives of this program that relate directly to improving air quality are:

- Retrofitting 27 million square feet of public buildings by 2020,
- Reducing energy expenses by 20% at executive branch agencies and colleges by 2020,
- Deploying $177 million of private capital between 2011 and 2020 in energy-efficiency improvements to Virginia's public buildings,
- Reducing peak energy demand by 88 megawatts (MW) no later than 2020.

Quantification of air quality benefits from the reduction of 88 MW of peak electrical demand can be estimated in a number of ways. One approach is to assume that avoided peak demand would have been supplied by the demand response programs and therefore would have been generated primarily by diesel engines burning ULSD. Emissions from these types of engines can be approximated very conservatively through the manufacturer's engine certification for Tier 4 regulatory requirements, which mandate an emission rate of no more than 0.67 grams/kilowatt-hour (g/kWh) of $NO_X$. The equation below demonstrates this methodology. This approach results in estimated avoided emissions of 130 pounds/hour (lb/hr) of $NO_X$.

$$88\,MW * 1{,}000\frac{kW}{MW} * 0.67\frac{grams}{kWh} * 0.0022\frac{lbs}{grams} = 130\ \frac{lbs\ NOx}{hr}$$

Another way to quantify the potential air quality benefit from the reduction of 88 MW at peak demand is to use PJM system mix information for summer months with high demand. This data is available on PJM's website (see http://www.pjm-eiscom/reports-and-news/public-reports.aspx). The PJM system mix for June and July of 2012 emitted approximately 1.1802 pounds/megawatt-hour (lb/MWh) of $NO_X$ and 3.6374 lb/MWh of $SO_2$. As demonstrated by the equations below, this approach results in estimated emission reductions of approximately 103 lb/hr of $NO_X$ and 320 lb/hr of $SO_2$.

$$88\ MW * 1.1802 \frac{lbs\ NOx}{MWh} = 103.9 \frac{lbs\ NOx}{hr}$$

$$88\ MW * 3.6374 \frac{lbs\ SO2}{MWh} = 320.1\ \frac{lbs\ SO2}{hr}$$

These reductions are especially important since peak electrical demand hours often correspond with high ozone readings and poor air quality.

### *3.3.2. Energize Virginia*

Energize Virginia is a revolving loan fund administered by DMME that supports qualifying energy efficiency and renewable energy projects and programs. The first request for proposals for this fund was issued December 5, 2011, and awards from this fund are expected to be approximately $10,500,000. Loans from Energize Virginia may be used to finance renewable energy generation systems and energy conservation equipment, technology, controls, measures, and programs, including those that advance the goals of Governor McDonnell's Executive Order 19. Also eligible are differential costs for alternative fuel and advanced technology vehicles, alternative fuel refueling equipment, and vehicle energy conservation programs, including those that advance the goals of Executive Order 36, "Moving Toward Alternative Fuel Solutions for State-Owned Vehicles" (see http://www.governor.virginia.gov/PolicyOffice/Executive Orders/). This program is directionally correct and will help improve air quality through the use of cleaner alternative fuels and the reduction in use of various fossil fuels.

## 3.4. Dominion Virginia Power Programs

Dominion is one of the nation's largest producers and transporters of energy, with a portfolio of approximately 27,400 megawatts of generation; 11,000 miles of natural gas transmission, gathering, and storage pipeline; and 6,300 miles of electric transmission lines. Dominion has taken a number of steps over the last 15 years to reduce emissions from its electric generation fleet corporate wide and in Virginia. Since 1998, the company has reduced $NO_X$ and $SO_2$ emissions from its generation fleet that serves Virginia by 77% and 81%, respectively. Mercury emissions have also been reduced by about 65% from 1998 levels. The company anticipates further reductions over the next several years to meet new EPA regulations through coal unit retirements, conversion from coal to other fuel sources including natural gas and biomass, and new transmission capacity. The SCC approved a plan filed by Dominion to establish a program to meet the Commonwealth's voluntary renewable energy portfolio goals, which set a target that the utility meet 15% of retail electric sales with renewable sources by 2025. The Company's current initiatives in this regard include coal-to-biomass conversions and pursuing commercial possibilities for off-shore wind off the coast of Virginia. In addition, the company has implemented a large number of programs designed to promote the use of alternative fuels and alternative fuel vehicles as well as energy conservation programs for its residential and business customers. The company also offers its customers the option to voluntarily support renewable energy through its Dominion Green Power® Program. The directionally correct programs listed below are not included in the emissions estimates listed in Table 4 and Table 5, with the exception of the programs noted in Section 3.4.2. These programs will assist the Hampton Roads area in maintaining and further improving air quality.

### *3.4.1. Energy Conservation Program*

Dominion is voluntarily working toward helping the Commonwealth of Virginia meet its energy goal of 10% voluntary energy conservation enacted by the Virginia General Assembly in 2007 (Chapter 933 of the 2007 Acts of Assembly). To help meet this goal, Dominion has implemented a number of energy conservation programs designed to help residential and commercial customers better manage their energy use. Each of these programs will provide environmental benefits, and the energy efficiency programs translate into financial savings for customers. Information is not available to quantify the expected impact on air emissions from these programs. However, the programs are directionally correct and should help to improve air quality by shaving peak demand or reducing energy consumption, thereby reducing emissions resulting from generating sources that otherwise may be called upon to meet the needs of the grid. Dominion's approved energy conservation programs are listed below.

Residential Programs:

- Income-Qualifying Home Improvement
- Home Energy Check-Up
- Heat Pump Tune-Up
- Heat Pump Upgrade
- Duct Testing and Sealing

Business Programs:

- Energy Audit
- Duct Testing & Sealing
- Commercial Lighting Rewards Program
- Commercial HVAC Rewards Program

As of May 2012, the Commercial Lighting Rewards Program and the Commercial HVAC Rewards Program are fully subscribed. More information on each of these programs may be found at www.dom.com/dominion-virginia-power/customer-service/energy-conservation/ec-programs.jsp.

### *3.4.2. Generating Unit Retrofits, Retirements, and Fuel Conversions*

As part of a federally-enforceable April 2003 Consent Decree between Dominion Virginia Power and EPA (United States v. Virginia Electric and Power Co., Civil Action No. 03-CV-517A, entered 10/10/2003), Dominion has installed $SO_2$ and/or $NO_X$ control devices on a number of coal-fired units in the Commonwealth of Virginia. The company has significantly reduced emissions from its generating fleet in Virginia. The Chesapeake Power Station, located in the Hampton Roads area, retrofitted Units 3 and 4 with selective catalytic reduction (SCR) for $NO_X$ control in 2003. Beginning in 2013, the Consent Decree requires year round operation of the SCRs. These units must achieve and maintain a 0.10 pound/million British thermal units (lb/mmbtu) $NO_X$ emission rate on a 30-day rolling average basis unless a demonstration can be made that the units cannot consistently achieve this standard.

Additionally, Dominion filed its annual Integrated Resource Plan (IRP) with the SCC on August 31, 2012. The IRP is a mandatory 15-year, forward-looking plan for matching generation, transmission, and demand side management resources with expected electricity demand. Information in the IRP is not a commitment to build any particular project or retire any particular unit but represents the company's evaluation at the time of plans to meet the expected needs of its customers in a cost-effective manner over the next 15 years. This document notes that current plans call for the retirement of all four coal-fired units at the Chesapeake Energy Center as well as the retirement of Units 1 and 2 at the Yorktown Power Station in the 2015 timeframe. The Yorktown Power Station is also in the Hampton Roads area, and Units 1 and 2 are coal-fired electric generating units. Dominion's IRP is available at https://www.dom.com/about/integrated-resource-planning.jsp.

The emissions benefits from the Chesapeake Power Station and the Yorktown Power Station retirements have been included in the emissions estimates listed in Table 4 and Table 5. More detail on these assumptions and estimates may be found in Appendix A.

Dominion Virginia Power is in the process of converting three formerly coal-fired power plants to biomass, a renewable energy source, and will be completing these projects some time in 2013. The current capacity of each of these facilities is 63 MW, and one of these power plants is located in Southampton, Virginia, which is just outside of the Hampton Roads area. The switch to biomass as the primary fuel should reduce emissions of $NO_X$, $SO_2$, and mercury from these facilities. The benefits of the conversions to biomass have been included in Table 4, and more information on these estimates may be found in Appendix A.

### *3.4.3. Dominion Solar Partnership Program and Renewable Generation Tariffs*

Under the Dominion Solar Partnership Program, the company will own and install up to 30 MW of solar generation located on public and private property at strategic sites around the company's Virginia service area. This solar demonstration will enable the company to study the impact and assess the benefits of solar power on its electric distribution system. Dominion is currently reviewing applications and expects to begin installations in the second quarter of 2013 as part of a five-year initial demonstration project. More information on this new program may be found at https://www.dom.com/about/stations/renewable/solar/solar-partnership-program.jsp.

The company has also asked state regulators to authorize two new renewable generation tariffs. A special tariff would allow residential and commercial owners of solar installations to sell their energy output and renewable energy credits to Dominion. A second tariff would allow commercial and industrial customers to voluntarily purchase a larger percentage of renewable energy from Dominion than is now available with the company's current generation supply.

### *3.4.4. Alternative Vehicles and Fuels Programs*

Dominion is actively participating in the development and deployment of alternative vehicle technologies and fuels. Vehicles powered by alternative fuels make up more than 28% of Dominion's multi-state fleet, which contains close to 5,600 cars and trucks.

Electric technologies make up a small, but growing, portion of its alternative-fuel fleet. The company is adding electric vehicles (EVs) in its service fleet to reduce fuel use and to test the value of this clean technology. Dominion has partnered with General Motors and the Electric Power Research Institute to test the Chevrolet Volt Extended Range Electric Vehicle and supporting charging infrastructure.

The company began testing bio-diesel fuel in its Virginia fleet in 2007. Since then, it has used more than 6.5 million gallons of biodiesel fuel at 32 locations in Virginia and North Carolina. More than 800 Dominion service vehicles currently operate on biodiesel fuel.

## 3.5. Virginia Clean Cities Programs

The mission of the VCC is to increase national energy security; improve air quality and public health in the Commonwealth of Virginia; and develop economic, academic, and resource opportunities in the Commonwealth through petroleum reduction. VCC draws stakeholders from all levels of government, the commercial sector, and the manufacturing sector in its quest to cultivate an advanced transportation community in which citizens may learn about a wide range of options and technologies for on road and off road engines. The "2011 Annual Report for Virginia Clean Cities" (see http://www.vacleancities.org/tools-resources/reports/) estimates that in 2011, this program helped to reduce Virginia's reliance on petroleum products by the equivalent of over 8,700,000 gallons of gasoline. This directionally correct program is expanding every year to take on more challenges and will continue to provide air quality benefit for the Hampton Roads area as well as throughout the Commonwealth by promoting clean, alternative fuels as well as energy efficiency improvements. The sections below provide information on a few of the notable projects facilitated by VCC. The emission benefits from these projects are not included in the emissions inventories presented in Table 4 and Table 5. More information on this organization may be found at www.vacleancities.org.

### *3.5.1. Virginia Get Ready Project*

VCC created and manages the Virginia Get Ready effort, which recently produced the Virginia Get Ready: Electric Vehicle Plan. The goal is to establish Virginia as a leader in the adoption of electric vehicles in order to reduce vehicle emissions, increase energy independence, and generate economic development for the Commonwealth. More information on this directionally correct program may be found at www.virginiaev.org.

### *3.5.2. Southeast Propane Autogas Development Program*

Virginia Clean Cities manages the Southeast Propane Autogas Development Program (SPADP). SPADP is a large-scale Recovery Act alternative fuel project aimed at building propane autogas infrastructure in the southeastern United States and encouraging public and private fleets in the region to adopt propane autogas. Propane fuel savings in the program exceed $1.50 per gallon, and the fuel represents reductions of 20% in CO and of 40% in $NO_X$. The program is converting over 1,200 vehicles from gasoline to propane autogas including 125 in Virginia, implementing propane autogas fueling stations along high-traffic routes with partner Alliance AutoGas, and deploying a wide-reaching communications campaign to increase awareness and usage of propane autogas. SPADP provides Virginia a platform for the state fleet alternative fuel transition effort, which was initiated in October 2012. Although this program is not specific to the Hampton Roads area, the environmental benefits from this program should help to improve local air quality as well as air quality across the Commonwealth.

## 3.6. Ozone Forecasting

VDEQ-Air Division provides to the public daily reports and forecasts of regional air quality for several areas in the Commonwealth. These areas include Winchester, Roanoke, Hampton Roads, and Richmond-Petersburg. The staff meteorologists at VDEQ also coordinate daily with the meteorologists at the Metropolitan Washington Council of Governments and the Maryland Department of the Environment to predict air quality in the Metropolitan Washington, D.C. area. These air quality forecasts are provided to the public via email distribution listing and on VDEQ's website at http://vadeq.ipsmtx.com/cgi-bin/air_quality_forecast.pl no later than 3:00 pm of the prior business day. Many different entities use this information to make decisions concerning their daily activities. In some instances, local governments, businesses, and citizens may use these forecasts to alter pollutant-emitting activities, as in the case of Code Orange and Code Red days, where air quality is predicted to be unhealthy. These episodic, directionally correct programs allow citizens and businesses to reduce pollution during very critical time periods. VDOT provides notification of predicted poor air quality on electronic signs so that commuters can choose to carpool or use public transit. Citizens may also make use of this information on a more personal level, such as deciding when to participate in athletic or outdoor activities. VDEQ-Air Division will continue this important public service as long as resource constraints allow.

## 3.7. Regional Reductions

Since air quality is not solely dictated by emissions within any particular area, but is heavily influenced in the case of the Commonwealth by transported emissions, this section describes other emission reduction efforts that are occurring outside of the Hampton Roads area. Depending on meteorological conditions on any summer day, the reductions described in this section could improve the air quality in the Hampton Roads area and may lessen the transported ozone and precursor load. These reductions are taking place at industrial sites and electric generating facilities. Each of these facilities has received federally enforceable permits for these reductions or is in the permitting process. The emission reductions associated with these facility upgrades are considerable. Except for reductions described in Section 3.7.4, these reductions have not been included in the summary of emissions for Virginia found in Table 4.

### *3.7.1. Invista*

Invista owns and operates a synthetic fiber production facility located in Waynesboro, Virginia. The facility has a powerhouse consisting of three boilers that predominantly use coal, with a total heat input of approximately 600 million British thermal units/hour (mmbtu/hr). Table 11 provides emissions inventory information on the existing powerhouse for the facility.

**Table 11: Invista Powerhouse Emissions 2007-2011, $SO_2$ and $NO_X$**

| Year | Tons $NO_X$/Year | Tons $SO_2$/Year |
|---|---|---|
| 2011 | 184.0 | 567.8 |
| 2010 | 198.5 | 629.1 |
| 2009 | 237.7 | 768.1 |
| 2008 | 275.7 | 843.2 |
| 2007 | 353.2 | 924.2 |

*Data Source: CEDS*

The facility received a federally enforceable permit from VDEQ to retire the existing boilers and in their place install two new, natural gas-fired boilers that use distillate oil and liquefied petroleum gas as back-up fuels. These new units are permitted for 33.8 tpy $NO_X$ and 2.3 tpy $SO_2$. This change would reduce the $NO_X$ emissions by more than 100 tpy and the $SO_2$ emissions by more than 500 tpy, as compared to 2011 values. These reductions have not been included in the Virginia emissions estimates listed in Table 4. The facility commenced construction on these boilers in December of 2012.

### *3.7.2. Celco*

Celanese Acetate, LLC (Celco) is a large manufacturing facility located in Giles County, Virginia. The facility primarily manufactures cellulose acetate flake and fiber using wood pulp and acetic acid as raw materials. To facilitate operations, the facility has a steam plant consisting of seven coal-fired boilers and two natural gas-fired boilers. The seven coal-fired boilers have a capacity of approximately 1,400 mmbtu/hr heat input. The facility received a federally enforceable permit on December 6, 2012, allowing the construction of six natural gas-fired boilers that will be used in place of the seven coal-fired boilers. The retirement of the seven coal-fired boilers, which operate with minimal pollution control, and their subsequent replacement by natural gas-fired boilers with low $NO_X$ burners will reduce emissions of $SO_2$ and $NO_X$ significantly from this facility. Table 12 provides the steam plant emissions since 2007 from this facility.

The total emissions from the new natural gas boilers are limited to no more than 333 tpy of $NO_X$ and 6 tpy of $SO_2$. Therefore, the steam plant will emit 3,000 tons of $NO_X$ and 6,000 tons of $SO_2$ less than previous years, once these changes are made. The estimated time frame for these changes to take effect is 2015. These reductions were not included in the overall emissions estimates provided in Table 4.

**Table 12: Celco Powerhouse Emissions 2007-2011, $SO_2$ and $NO_X$**

| Year | Tons $NO_X$/Year | Tons $SO_2$/Year |
|---|---|---|
| 2011 | 3,539.9 | 6,540.2 |
| 2010 | 3,438.8 | 6,325.1 |
| 2009 | 3,775.9 | 6,551.1 |
| 2008 | 3,907.1 | 6,631.5 |
| 2007 | 3,609.2 | 6,499.9 |

*Data Source: CEDS*

### *3.7.3. Honeywell*

Honeywell International Inc.-Hopewell Plant is a chemical manufacturing facility in Hopewell, Virginia. As a result of negotiations to resolve federal compliance issues, VDEQ issued a federally enforceable permit to this facility dated June 28, 2011, that requires the installation and operation of eight SCR systems on eight of the ten largest-emitting units on site. Each SCR is expected to achieve $NO_X$ reductions of at least 95%. Once the eight SCRs are installed and operating, the collective $NO_X$ potential to emit (PTE) of the ten units will be reduced to 1,850 tpy. The permit requires installation of the SCR in a phased manner, where two SCR were required to begin operating on December 31, 2012. Others are required on a timeline such that all eight SCR are installed and operating by June 30, 2019.

Table 13 provides data on the actual emissions of these units from 2007 through 2011, and the expected emission rates after control, as listed in the June 28, 2011 permit. As the table demonstrates, the emissions from this equipment are historically between 7,400 tpy and 8,100 tpy $NO_X$.

**Table 13: Honeywell Hopewell $NO_X$ Reductions**

| | Actual Emissions of NOx, tpy | | | | | Permitted Limits of NOx, tpy | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **2007** | **2008** | **2009** | **2010** | **2011** | **6/30/13** | **6/30/15** | **6/30/2017** | **6/30/2019** |
| **Nitrite Towers** | | | | | | | | | |
| A | 969.4 | 1,151.6 | 1,305.3 | 1,228.7 | 1,152.3 | 1,673.0 | 1,673.0 | 117.0 | 117.0 |
| B | 863.6 | 881.4 | 855.1 | 971.7 | 938.4 | 1,844.0 | 123.0 | 123.0 | 123.0 |
| C | 949.2 | 1,129.9 | 1,090.1 | 1,055.5 | 1,001.4 | 102.0 | 102.0 | 102.0 | 102.0 |
| D | 366.3 | 435.5 | 451.8 | 420.8 | 332.2 | 600.0 | 600.0 | 600.0 | 33.0 |
| E | 426.6 | 495.0 | 541.0 | 454.4 | 422 | 600.0 | 600.0 | 600.0 | 600.0 |
| **Disulfonate Towers** | | | | | | | | | |
| A | 1,129.1 | 1,029.4 | 1,085.3 | 1,004.2 | 1,124.8 | 1,244.0 | 1,244.0 | 87.0 | 87.0 |
| B | 898.8 | 891.6 | 954.4 | 879.4 | 895.7 | 1,092 | 84.0 | 84.0 | 84.0 |
| C | 882.3 | 899.4 | 812.5 | 878.1 | 843.7 | 72.0 | 72.0 | 72.0 | 72.0 |
| D | 518.7 | 534.7 | 493.9 | 577.1 | 399.7 | 600.0 | 600.0 | 600.0 | 32.0 |
| E | 471.6 | 552.8 | 518.6 | 538.5 | 531.4 | 600.0 | 600.0 | 600.0 | 600.0 |
| **Totals:** | **7,475.6** | **8,001.3** | **8,108.0** | **8,008.4** | **7,641.6** | **8,427.0** | **5,698.0** | **2,985.0** | **1,850.0** |

*Data Source: VDEQ-CEDS*

After installation of controls, this equipment will be allowed to emit no more than 1,850 tpy of $NO_X$. This control program represents the reduction of at least 5,791.6 tpy of $NO_X$ by June 30, 2019, as compared to actual 2011 annual emissions. The benefits from this program are not included in the overall $NO_X$ emission estimates listed in Table 4 and should help improve ozone air quality throughout the Commonwealth.

### *3.7.4. Dominion Virginia Power - Bremo Power Station*

Dominion expects additional reductions from the EGU sector over the next several years to meet new EPA regulations, including the Mercury and Air Toxics (MATS) rule. As part of its strategy to comply with these requirements and as required by a condition in the federally-enforceable construction permit issued by VDEQ to the Virginia City Hybrid Energy Center, which is located in southwest Virginia, Dominion plans to convert the Bremo Power Station to natural gas, pending SCC approval. Bremo Power Station is a 222 MW coal-fired electrical generating facility consisting of two coal-fired units, Unit 3 and Unit 4. The facility is located in Fluvanna County. This conversion is expected to be completed in the 2014 time frame. Table 14 shows historical emissions of $NO_X$, $SO_2$, and $PM_{2.5}$ from this facility.

The emissions of $NO_X$ and $PM_{2.5}$ are expected to be reduced significantly. The emissions of $SO_2$ are expected to be reduced by more than 98%. These reductions have been included in the summary of emissions for Virginia found in Table 4.

**Table 14: Dominion-Bremo Power Station Emissions 2007-2011**

| Year | Unit 3 | | | Unit 4 | | |
|---|---|---|---|---|---|---|
| | $NO_X$, tpy | $PM_{2.5}$, tpy | $SO_2$, tpy | $NO_X$, tpy | $PM_{2.5}$, tpy | $SO_2$, tpy |
| 2011 | 430 | 6 | 1,048 | 1,451 | 22 | 5,433 |
| 2010 | 921 | 5 | 2,014 | 1,388 | 20 | 5,728 |
| 2009 | 644 | 10 | 1,445 | 959 | 12 | 5,524 |
| 2008 | 1,243 | 18 | 2,505 | 1,576 | 15 | 6,186 |
| 2007 | 1,603 | 24 | 3,485 | 1,839 | 17 | 6,967 |

*Data Source: VDEQ-CEDS*

# 4. Ozone Advance Reporting and Check List

As part of the Action Plan process, VDEQ intends to report annually to EPA on the programs contained in this document. To facilitate the reporting process, VDEQ will coordinate with stakeholders and report to EPA using the check list in Appendix D. This checklist is not intended to be prescriptive or a mandate. Rather, it provides a structure to the reporting process and potential milestones for each program listed within this action plan. The table in Appendix D may also be used to report on other initiatives not included in this plan or future initiatives that are still being formulated.