PGA 582-16-60851-01, Amendment 2
Task 6.3, Deliverable 6.3.2b

Documentation of Emissions Inputs for Task 6.3 – Sensitivity and Control Strategy Modeling

Prepared by the Capital Area Council of Governments

August 11, 2017

PREPARED UNDER A GRANT FROM THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

The preparation of this report was financed through grants from the State of Texas through the Texas Commission on Environmental Quality. The content, findings, opinions, and conclusions are the work of the author(s) and do not necessarily represent findings, opinions, or conclusions of the TCEQ.

1 Overview

Under Task 6.3 of the Capital Area Council of Governments' (CAPCOG's) fiscal year (FY) 2016-2017 Near-Nonattainment Grant, CAPCOG is evaluating the impact of changes in emissions of nitrogen oxides (NO_X) emissions from key sources within the Austin-Round Rock Metropolitan Statistical Area (MSA) on peak 8-hour Ozone (O_3) concentration. For this project, NO_X includes nitrous acid (HONO), nitrogen oxide (NO), and nitrogen dioxide (NO_2).[1] The Austin-Round Rock MSA includes Bastrop, Caldwell, Hays, Travis, and Williamson Counties. This document describes the emissions inventory inputs that were developed for the seven photochemical modeling runs that were performed by AACOG for this task and details the quality-assurance (QA) and quality-check (QA) procedures used to ascertain the accuracy of these data.

- Run 1 is a reference case using the June 1-30 segment of release 2 of the Texas Commission on Environmental Quality's (TCEQ's) 2012 modeling platform that was used for the December 2016 Houston-Galveston-Brazoria (HGB) attainment demonstration submitted by TCEQ to EPA
- Run 2 modeled the impact of zeroing out NO_X emissions from the Decker Creek Power Plant's boiler 1, a scenario plausible due to Austin Energy's plans to close this unit some time in the next decade
- Run 3 modeled the impact of zeroing out NO_X emissions from the Decker Creek Power Plant's boiler 2, a scenario plausible due to Austin Energy's plans to close this unit some time in the next decade
- Run 4 modeled the impact of zeroing out NO_X emissions from the Decker Creek Power Plant's eight gas turbines, which will enable a better evaluation of the impact of these units, and the discrepancies between the use of EPA's emissions data for these units and the use of TCEQ's emissions data for these units
- Run 5 modeled the impact of using hourly NO_X emissions data for the Texas Lehigh Cement Company's plant in Buda compared to the existing ozone season day emissions inputs
- Run 6 modeled the impact of programs to accelerate NO_X emission reductions from on-road heavy-duty diesel vehicles
- Run 7 modeled the impact of programs to accelerate NO_X emission reductions from heavy-duty diesel non-road equipment

2 Base Case (Run 1) Emissions Inventory Inputs

Run 1 used the 2012 base case developed by TCEQ for the Houston-Galveston-Brazoria area 2008 Ozone Nonattainment Area Attainment Demonstration submitted to EPA in December 2016. These files can be found on TCEQ's FTP site at ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/. Since CAPCOG was only modeling the June segment of the episode developed by TCEQ, only the emissions inputs applicable to June were used for this modeling. The documentation for these inventories can be found in Appendix B to that Attainment Demonstration, available at

[1] Based on page 19 of the MOVES2014a User Interface Manual (available online at https://19january2017snapshot.epa.gov/sites/production/files/2016-11/documents/420b16085.pdf), which refers to the definition of NO_X in MOVES as NO + NO_2 + HONO.

https://www.tceq.texas.gov/assets/public/implementation/air/sip/hgb/HGB_2016_AD_RFP/AD_Adoption/HGB_AD_SIP_Appendix_B_Adoption.pdf.

Sections of the documentation that are particularly relevant to this project include:

- Chapter 2: Point Source Modeling Emissions Development
  - 2.1: Base Case Point Source Modeling Emissions Development
    - 2.1.1: Texas Point Sources
    - 2.1.3: Plume-in-Grid (PiG) Source Selection
- Chapter 3: On-Road Mobile Source Modeling Emissions Development
  - 3.5: On-Road Mobile Source Emissions Inventories for Non-HGB Areas
- Chapter 4: Non-Road, Off-Road, and Area Source Modeling Emissions
  - 4.2: Airports
  - 4.3: Locomotives
  - 4.4: Non-Road/TexN

3 Decker Creek Power Plant (Runs 2-4) Sensitivity Emissions Inventory Inputs

Runs 2, 3, and 4 modeled the ground-level O_3 impacts of NO_X emissions from Austin Energy's Decker Creek Power Plant in Travis County by zeroing out the NO_X emissions from boiler 1 (Run 2), boiler 2 (run 3), and the plants 8 gas turbines (run 4, consisting of units GT-1A, GT-1B, GT-2A, GT-2B, GT-3A, GT-3B, GT-4A, and GT-4B). Decker Creek power plant's NO_X emissions were previously modeled to have the largest impact on ground-level O_3 concentrations in the region of all of the major point sources in the region.[2] As a peaking unit, Decker is not extensively used, but its emissions spike on the hottest days. The plant's two boilers emitted more than 5 tons per day of NO_X in June 2012 on two of the days in the episode, which also means that the facility's emissions exceeded the threshold TCEQ used to determine which point sources would be modeled using CAMx's Plume-in-Grid (PiG) feature that improves the chemistry for larger point sources and allows better representation of those point sources' emissions on O_3 formation. The following table shows the maximum, minimum, average, and median daily NO_X emissions for the 10 electric generating units at Decker in the AFS file prepared by TCEQ for the June 2012 episode in the base case.[3]

Table 3-1:Statistics for Daily NO_X Emissions totals at Decker in Base Case and Runs 2-4 (tpd)

Statistic	Run 1 (Base Case)	Run 2 (zero out unit 1)	Run 3 (zero out unit 2)	Run 4 (zero out turbines)
Min.	0.63	0.63	0.00	0.63
Max.	10.28	7.33	7.58	5.65
Avg.	2.50	1.81	1.34	1.84

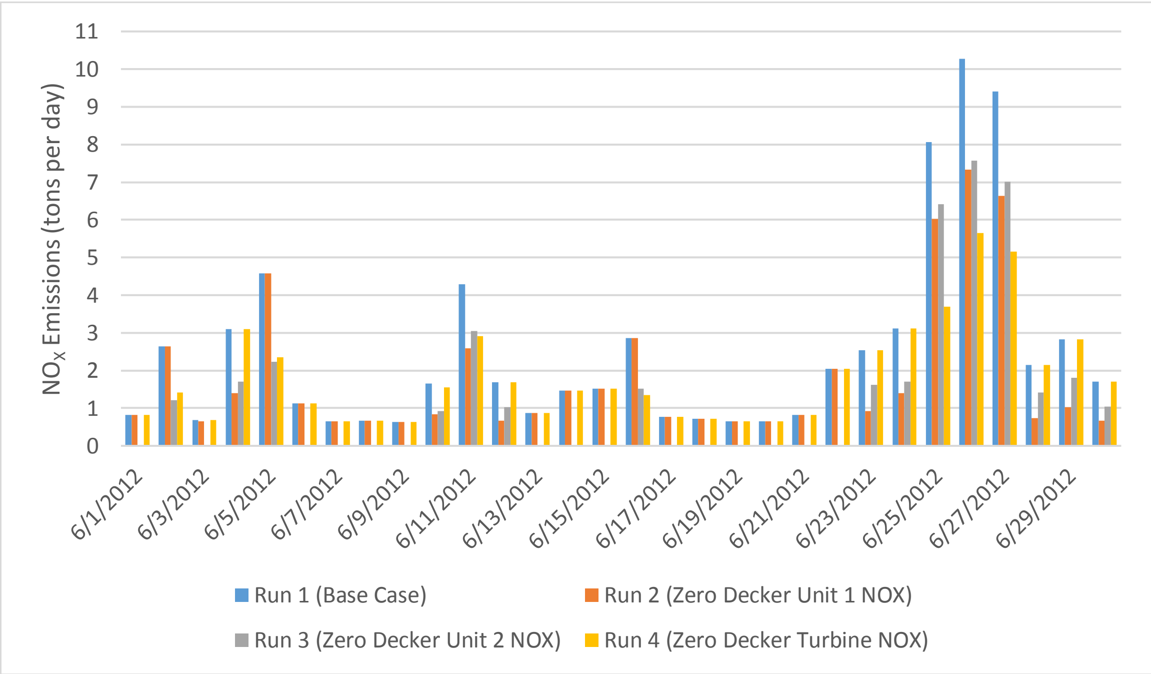
[2] CAPCOG. *Photochemical Modeling Analysis Report*. 9/4/2015. http://www.capcog.org/documents/airquality/reports/2015/Photochemical_Modeling_Analysis_Report_2015-09-04_Final_Combined.pdf. See section 2.3.3: "UT 8-O3 Flex Plan 12-Point Source APCA Modeling," page 36.

[3] ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/point/basecase/AFS/afs.amp_01Jan_to_31Dec12_episode_all_pols_RPOlcp.v6.gz. Uploaded by TCEQ on 7/5/2016; accessed by AACOG and CAPCOG on 3/31/2017.

Statistic	Run 1 (Base Case)	Run 2 (zero out unit 1)	Run 3 (zero out unit 2)	Run 4 (zero out turbines)
Median	1.67	0.90	0.48	1.50

The figure below shows a comparison of the combined NO_X emissions for each day of the June 2012 episode. As the figure shows, there are many days when the only NO_X emissions from Decker were from boiler 2, and that on the days with the highest NO_X emissions, the turbines account for a very large share of the facility's total NO_X emissions.

Figure 3-1. Decker Creek Power Plant Emissions Modeled by Episode Day



CAPCOG developed updated AFS NO_X records for each hour of the episode and provided these updated AFS records to AACOG.

CAPCOG reviewed the AFS records relative to EPA's Air Market Program Data (AMPD) for June 2012 and confirmed that all of the NO_X values for Decker's 10 units in the AFS files exactly match the AMPD data. As CAPCOG's analysis in 2015 showed, the NO_X emissions reported to TCEQ for 2012 were 71-83% lower than the emissions recorded in AMPD for the 8 gas turbines.[4]

[4] CAPCOG. *Point Source Emissions Inventory Refinement*. 8/31/2015. http://www.capcog.org/documents/airquality/reports/2015/Point_Source_Emissions_Inventory_Refinement.08-31-15.pdf. See table 3.

4 Texas Lehigh Cement Plant (Run 5) Sensitivity Emissions Inventory Inputs

Texas Lehigh Cement Company is the largest point source of NO_X emissions in the Austin-Round Rock Metropolitan Statistical area, emitting 2,301 tons of NO_X in 2015, 5.6 times the NO_X emissions from Austin White Lime, the next-largest point source of NO_X in the MSA. Texas Lehigh has a single kiln with two emission stacks: DC-2 and DC-9. TCEQ modeled both of these emissions points using average ozone season day (OSD) emissions reported to TCEQ as part of Texas Lehigh's annual emissions reporting. As part of its 2015 Point Source Emissions Inventory Refinement project, CAPCOG was able to obtain hourly NO_X emissions for these two units for the June 2012 episode.

Table 4-1. Statistics for Daily NO_X Emissions at Texas Lehigh Cement Company for June 2012 Episode

Statistic	DC-2 (tpd)	DC-9 (tpd)	Combined (tpd)
Average 2012 OSD NO_X used in Base Case	3.02918	3.88471	**6.91389**
Average Daily June 2012 NO_X	2.89330	3.98013	**6.87343**
Median Daily June 2012 NO_X	2.86700	3.99125	**6.78525**
Max Daily June 2012 NO_X	3.16100	4.25550	**7.32250**
Min Daily June 2012 NO_X	2.57440	3.38800	**6.10100**

These data show that, while the average daily NO_X emissions during June 2012 for Texas Lehigh deviated by less than 1% from the average 2012 ozone season day NO_X emissions in TCEQ's modeling files, the NO_X emissions on any given day during June 2012 were anywhere from 12% lower to 6% higher than the OSD average modeled by TCEQ.

These deviations become more pronounced at the hourly level, as the table below shows. The hourly data shows the tons per hour (tph) for each stack and the combined totals for the facility. As the table shows, there were individual hours when Texas Lehigh's NO_X emissions were 59% below to 51% above the average hourly NO_X emissions modeled using TCEQ's AFS file.[5]

Table 4-2. Statistics for Hourly NO_X Emissions at Texas Lehigh Cement Company for June 2012 Episode

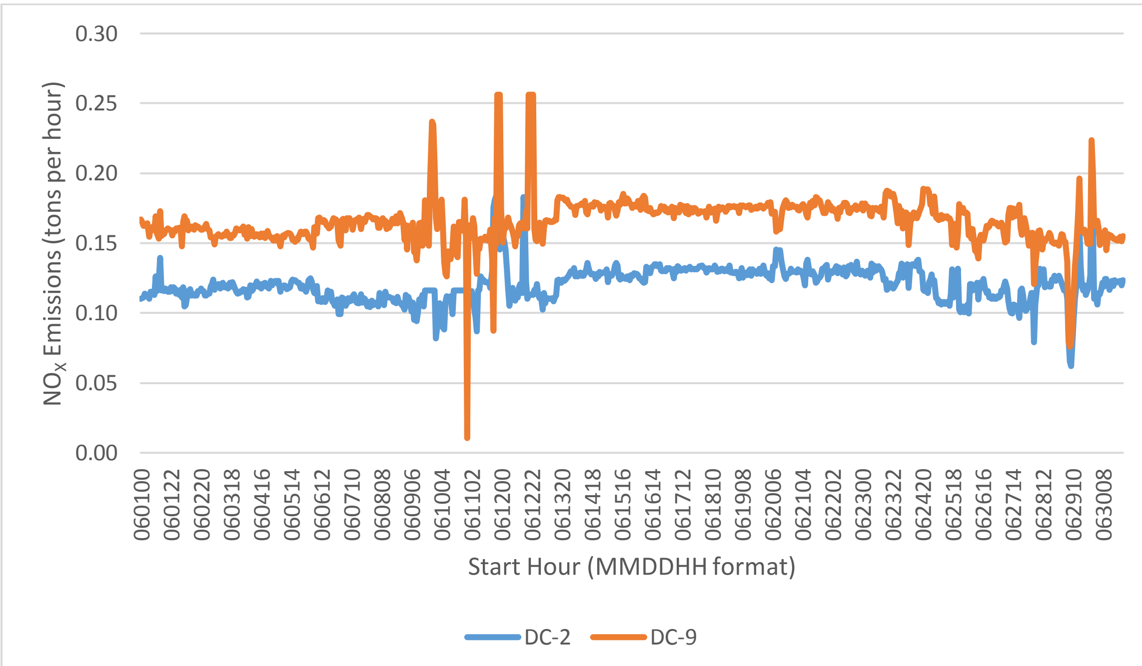
Statistic	DC-2 (tph)	DC-9 (tph)	Combined (tph)
Average 2012 OSD NO_X used in Base Case	0.12622	0.16186	0.28808
Average Hourly June 2012 NO_X	0.12055	0.16584	0.28639
Median Hourly June 2012 NO_X	0.12025	0.16650	0.27750
Max June 2012 NO_X	0.18550	0.25620	0.43370
Min June 2012 NO_X	**0.06200**	**0.01050**	**0.12640**

5 ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/point/basecase/AFS/afs.osd_for_2012_amp_based_on_2012v7a.v6.gz (Uploaded by TCEQ, 2/18/2016, downloaded by CAPCOG 4/5/2017)

CAPCOG created new hourly AFS records for Texas Lehigh's two stacks connected to its kiln for each hour of the June 2012 episode. The inventory is labeled as "SI12" in the "source" field of the AFS file (columns 482-432).

The figure below shows the NO_X emissions for each stack for each hour of the episode.

Figure 4-1. Hourly Texas Lehigh NO_X Emissions in the June 2012 Episode



5 Accelerated Diesel Engine Fleet Turnover (Runs 6 and 7) Control Strategy Emissions Inventory Inputs

Inputs for runs 6 and 7 involve the application of adjustment factors to summer ozone season day NO_X emissions from on-road heavy-duty diesel vehicles (run 6) and non-road equipment (run 7) emissions in the Austin-Round Rock MSA (Bastrop, Caldwell, Hays, Travis, and Williamson Counties) in order to model the effect of an accelerated engine turnover program.

Since the Texas Emission Reduction Plan (TERP) Diesel Emission Reduction Incentive (DERI) grant program was already in place in 2012, CAPCOG decided to use the grant's program data in order to develop the adjustment factors needed for on-road and non-road emissions to model the impact of an accelerated engine retirement program.

For on-road sources, since model year age distribution is a direct input into the MOVES2014 emissions model, it was necessary to create adjustment factors that would *increase* the NO_X emissions from on-road diesels to show what the ozone levels would have been if the emission reductions from the program had not occurred. Therefore, the adjustment factors for on-road sources needed to be 1 or greater. Conversely, the TexN model does not use actual in-use age distribution data, and so the existing 2012 non-road emissions generated by TCEQ do not account for the newer age distribution resulting from TERP grants. Therefore, the adjustment factor needed to model the impact of TERP grants on 2012 ozone levels would require an adjustment factor for non-road sources of 1 or less. The difference between the modeled ozone levels from Runs 6 and 7 would provide the total modeled impact of TERP on ozone levels in the region.

In order to develop the adjustment factors, CAPCOG did the following:

- For on-road emissions, CAPCOG calculated the weighted average ozone season day NO_X emissions by source classification code (SCC) using the “weekday” (Monday, Tuesday, Wednesday, and Thursday, indicated by “wkd” in the files), Friday, Saturday, and Sunday on-road emissions inventory files.
- For non-road emissions CAPCOG calculated the weighted average ozone season day NO_X emissions by SCC using the “weekday” (Monday-Friday), Saturday, and Sunday non-road emissions inventory files.
- CAPCOG calculated of the average ozone season day emission reductions from TERP projects that were achieving NO_X reductions during the 2012 ozone season.
- CAPCOG assigned each TERP project active during the 2012 ozone season with operations primarily in the Austin area to a type of on-road or non-road source classification code (or group of source classification codes)
- CAPCOG calculated appropriate adjustment factors by dividing the calculated uncontrolled on-road emissions by the existing controlled on-road emissions for run 6 and dividing the calculated controlled non-road emissions by the existing uncontrolled non-road emissions for run 7
- CAPCOG then transferred the information into the appropriate format for a “CNTLEM” file that can be used in the photochemical modeling

5.1 Structure of Custom On-Road SCCs

TCEQ’s files include a custom SCC structure designed as follows: “MV”-Fuel Type-Source Use Type-Roadway Type-Emissions Process (see description at ftp://amdaftp.tceq.texas.gov/pub/EI/EPS3/0ReadMe_EPS3_Files.txt):

- Fuel Types
  - GS: Gasoline
  - DS: Diesel
  - CN: Compressed Natural Gas
  - LP: Liquefied Petroleum Gas
  - ET: Ethanol
  - EL: Electricity
- Source Use Type (SUT)
  - MC: Motorcycle
  - PC: Passenger Car
  - PT: Passenger Truck
  - LC: Light Commercial Truck
  - IB: Intercity Bus

    - TB: Transit Bus
    - SB: School Bus
    - RT: Refuse Truck
    - SS: Single-Unit Short-Haul Truck
    - SL: Single-Unit Long-Haul Truck
    - MH: Motor Home
    - CS: Combination Short-Haul Truck
    - CL: Combination Long-Haul Truck
- Highway Performance Management System (HPMS) Roadway Types:
    - 11: Rural Interstate
    - 13: Rural Other Principal Arterial
    - 15: Rural Minor Arterial
    - 17: Rural Major Collector
    - 19: Rural Minor Collector
    - 21: Rural Local
    - 23: Urban Interstate
    - 25: Urban Other Freeways and Expressways
    - 27: Urban Other Principal Arterial
    - 29: Urban Minor Arterial
    - 31: Urban Collector
    - 33: Urban Local
- Emissions Process
    - RE: Running Exhaust
    - CR: Crankcase Running Exhaust
    - RX: Total Running Exhaust
    - SE: Start Exhaust
    - CS: Crankcase Start Exhaust
    - SX: Total Start Exhaust
    - IE: Extended Idle Exhaust
    - CI: Crankcase Extended Idle Exhaust
    - IX: Total Idle Exhaust
    - AX: Auxiliary Power Exhaust
    - EP: Evaporative Permeation
    - EL: Evaporative Fuel Leaks
    - EV: Evaporative Fuel Vapor Venting

5.2 Source Data for On-Road Emissions

The source data CAPCOG used for this project can be found at the following locations:

Pre-Processed Inputs:

- On-Road HPMS: ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/onroad/tex/ams_inputs.onroad_hpms_mvs14.tex_2012.16Jul13.tar.gz (9/26/16, downloaded 3/29/2017)

    - Austin-Area HPMS: https://www.dropbox.com/s/xwq028bn71hc6nd/mvs14_hpms.AUSTIN_MSA.2012_sum.pream_in?dl=0
- On-Road Off-Network: ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/onroad/tex/ams_inputs.onroad_offn_mvs14.tex_2012.16Jul13.tar.gz (9/26/2016, downloaded 3/29/2017)
- On-Road Idling: ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/onroad/tex/ams_inputs.onroad_idle_mvs14.tex_2012.16Jul13.tar.gz (9/26/2016, downloaded 3/29/2017)

Intermediate files and sums, etc. can be found here:

- https://capcog.sharepoint.com/RS/Air Quality/TCEQ NNA Grant Program/FY 2016-2017/Task 6.3 - Sensitivity/2012/2012/On-Road HPMS/
- https://capcog.sharepoint.com/RS/Air Quality/TCEQ NNA Grant Program/FY 2016-2017/Task 6.3 - Sensitivity/2012/2012/On-Road Idling/
- https://capcog.sharepoint.com/RS/Air Quality/TCEQ NNA Grant Program/FY 2016-2017/Task 6.3 - Sensitivity/2012/2012/On-Road Off-Network/

Post-Processed "Message" Files:

ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/onroad/tex/eps3_msg.cb6p.tx_4km.mvs14.tex_2012_sum.16Jul13.tar.gz

- Didn't use these, but can be used as an extra QA check

5.3 Analysis of On-Road Data

CAPCOG first screened the on-road files to target only diesel emissions sources. Therefore, all files had the following structure: MVDSxxxxxx. Next, CAPCOG screened the records by source use type to exclude light-duty vehicles (passenger cars, passenger trucks, and light commercial trucks). The following three tables show the total NO_X emissions from heavy-duty diesel vehicles by source use type by process.

Table 5-1. Heavy-Duty Diesel On-Road NO_X Emissions - On-Network Running Exhaust by Source Use Type (tpd)

Source Use Type	Weekday	Friday	Saturday	Sunday	Avg.
Intercity Bus	0.7215	0.7705	0.5503	0.4386	0.6637
Transit Bus	0.1621	0.1720	0.1249	0.1005	0.1494
School Bus	0.3652	0.3889	0.2805	0.2233	0.3362
Refuse Truck	0.1826	0.1955	0.1420	0.1147	0.1689
Short-Haul Single-Unit Truck	3.2039	3.3372	2.0171	1.4776	2.8068
Long-Haul Single-Unit Truck	0.3105	0.3171	0.1860	0.1350	0.2686
Motor Home	0.2947	0.3149	0.2271	0.1826	0.2719
Combination Short-Haul Truck	6.1830	6.2746	4.2230	3.1881	5.4882
Combination Long-Haul Truck	9.7134	10.2750	7.2204	5.4653	8.8306
TOTAL	**21.1369**	**22.0458**	**14.9714**	**11.3257**	**18.9844**

Table 5-2. Heavy-Duty Diesel On-Road NO_X Emissions - Start Exhaust by Source Use Type (tpd)

Source Use Type	Weekday	Friday	Saturday	Sunday	Avg.
Intercity Bus	0.0006	0.0006	0.0002	0.0002	0.0005
Transit Bus	0.0000	0.0000	0.0000	0.0000	0.0000
School Bus	0.0001	0.0001	0.0000	0.0000	0.0001
Refuse Truck	0.0000	0.0000	0.0000	0.0000	0.0000
Short-Haul Single-Unit Truck	0.0522	0.0523	0.0128	0.0127	0.0409
Long-Haul Single-Unit Truck	0.0030	0.0029	0.0012	0.0013	0.0025
Motor Home	0.0004	0.0004	0.0004	0.0004	0.0004
Combination Short-Haul Truck	0.0000	0.0000	0.0000	0.0000	0.0000
Combination Long-Haul Truck	0.0000	0.0000	0.0000	0.0000	0.0000
TOTAL	**0.0563**	**0.0563**	**0.0147**	**0.0146**	**0.0444**

Table 5-3. Heavy-Duty Diesel On-Road NO_X Emissions - Off-Network Idling and Auxiliary Power Exhaust by Source Use Type (tpd)

Source Use Type	Weekday	Friday	Saturday	Sunday	Avg.
Intercity Bus	0.0000	0.0000	0.0000	0.0000	0.0000
Transit Bus	0.0000	0.0000	0.0000	0.0000	0.0000
School Bus	0.0000	0.0000	0.0000	0.0000	0.0000
Refuse Truck	0.0000	0.0000	0.0000	0.0000	0.0000
Short-Haul Single-Unit Truck	0.0000	0.0000	0.0000	0.0000	0.0000
Long-Haul Single-Unit Truck	0.0000	0.0000	0.0000	0.0000	0.0000
Motor Home	0.0000	0.0000	0.0000	0.0000	0.0000
Combination Short-Haul Truck	0.0000	0.0000	0.0000	0.0000	0.0000
Combination Long-Haul Truck	0.5675	0.5766	0.4154	0.3437	0.5151
TOTAL	**0.5675**	**0.5766**	**0.4154**	**0.3437**	**0.5151**

As these tables show, the vast majority (over 97%) of the on-road NO_X emissions from heavy-duty diesel vehicles come from on-network emissions. Based on the small contribution from off-network activities and the limited extent to which engine turnover would affect the emissions rates for off-network activity (i.e., would only be expected to affect the 1st hour of an 8-hour extended idling period), CAPCOG decided to target the emission reductions just at on-network activities.

5.4 Structure of Non-Road SCCs

While the "Non-Road" emissions category technically include all sources included in EPA's NONROAD model (which is now incorporated into the MOVES 2014 model and is incorporated into TCEQ's "Texas NONROAD" or "TexN" model) as well as aviation sources, locomotive emissions, commercial marine emissions, and drill rig emissions, CAPCOG only analyzed the sources included in EPA's NONROAD model. The SCC structure is described in detail in Appendix B of the NONROAD model user guide, available at: http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1004L24.pdf. The basic structure is as follows:

- 22xx0010yy: Recreational Vehicles
    - XX = fuel type

        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
    - yy = individual equipment type (20 – 60)
- 22xx0020yy: Construction and Mining equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
    - yy = individual equipment type (03 – 81)
- 22xx0030yy: Industrial Equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
    - yy = individual equipment type (10 – 70)
- 22xx0040yy: Lawn and Garden Equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
    - yy = individual equipment type (10 – 76)
- 22xx0050yy: Agricultural Equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
    - yy = individual equipment type (10 – 60)
- 22xx0060yy: Commercial Equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG

        - 70 = diesel
    - yy = individual equipment type (10 – 35)
- 22xx0070yy: Logging Equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
    - yy = individual equipment type (10 – 15)
- 22xx008005: Airport Ground Support Equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
- 22xx009010: Underground Mining Equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
- 22xx010010: Other Oil Field Equipment
    - XX = fuel type
        - 60 = 2-stroke gasoline
        - 65 = 4-stroke gasoline
        - 67 = LPG
        - 68 = CNG
        - 70 = diesel
- 22820xxxxx: Recreational Marine
    - xxxxx = equipment type
        - 05010 = Gasoline Outboards
        - 05015 = Personal Watercraft
        - 10005 = Gasoline Inboards
        - 20005 = Diesel Inboards
        - 20010 = Diesel Outboards
        - 20025 = Diesel Sailboat Auxiliary
- 228500x015 = Railway Maintenance Equipment
    - X = fuel type
        - 2 = Diesel
        - 3 = 2-Stroke Gasoline
        - 4 = 4-Stroke Gasoline

- 6 = LPG

5.5 Source Data for Non-Road Diesel Emissions

CAPCOG obtained the weekday, Saturday, and Weekend Day non-road MSG files from TCEQ's website:

- File: ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/nonroad/tex/eps3_msg.cb6n.tx_4km.nonroad.tex_2012.16Jul18.tar\eps3_msg.cb6n.tx_4km.NONROAD.tex_2012.16Jul18.tar.gz
  - Directory: \eps3_msg.cb6n.tx_4km.NONROAD.tex_2012.16Jul18.tar\ei\nonroad\grdem\tx_4km\msg.grdem.cb6n.wkd.060607.tx_4km.NONROAD_12_b14_etx92co.15Sep14.gz
- File: ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/nonroad/tex/eps3_msg.cb6n.tx_4km.nonroad.tex_2012.16Jul18.tar
  - Directory: \eps3_msg.cb6n.tx_4km.NONROAD.tex_2012.16Jul18.tar\ei\nonroad\grdem\tx_4km\msg.grdem.cb6n.sat.060610.tx_4km.NONROAD_12_b14_etx92co.15Sep14.gz
- File: ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/nonroad/tex/eps3_msg.cb6n.tx_4km.nonroad.tex_2012.16Jul18.tar.gz
  - Directory: \eps3_msg.cb6n.tx_4km.NONROAD.tex_2012.16Jul18.tar\ei\nonroad\grdem\tx_4km\msg.grdem.cb6n.sun.060611.tx_4km.NONROAD_12_b14_etx92co.15Sep14.gz

5.6 Analysis of Non-Road Data

The following table shows the total NO_X emissions by sector for diesel-powered equipment modeled in TCEQ's Texas NONROAD (TexN) model.

Table 5-4. Diesel Non-Road NO_X Emissions by Day Type and Sector (tpd)

Sector	Weekday	Saturday	Sunday	Avg.
Agricultural Equipment	5.1144	5.1144	5.1144	5.1144
Commercial Equipment	0.7833	0.7833	0.7833	0.7833
Construction and Mining Equipment	8.0432	4.0208	2.4131	6.6643
Industrial Equipment	1.0588	0.7412	0.4229	0.9226
Lawn and Garden Equipment	0.2028	0.1275	0.1275	0.1812
Logging Equipment	0.0000	0.0000	0.0000	0.0000
Railway Maintenance	0.0186	0.0186	0.0186	0.0186
Recreational Marine	0.0364	0.1818	0.1818	0.0780
Recreational Vehicles	0.0143	0.0281	0.0281	0.0183
TOTAL	**15.2718**	**11.0156**	**9.0897**	**13.7806**

5.7 Analysis of TERP Projects

CAPCOG used the "TERP Active Project List" provided by TCEQ[6] in order to estimate the amount of average daily NO_X emission reductions that diesel emission reduction incentive (DERI) projects were achieving during the June 2012 period.

First, CAPCOG calculated the annual NO_X reductions for every record by dividing the total NO_X reduced by the project life.

Next, CAPCOG then divided the annual NO_X reduction totals for each project by 365 in order to obtain daily average emission reduction estimates.

Then, CAPCOG filtered all of the records so that only projects listing Austin as the primary area of operation were included.

Next, CAPCOG categorized each project into one of the following categories:

- On-Road:
    - Transit Bus
    - School Bus
    - Refuse Truck
    - Single-Unit Short-Haul Truck
    - Combination Short-Haul Truck
- Non-Road:
    - Agricultural Equipment
    - Construction and Mining Equipment
    - Industrial Equipment
- Locomotives
- Stationary Equipment

CAPCOG assumed that all trucks were short-haul trucks based on the project description and the companies implementing the grants. Since the projects were specifically listed as having a primary area of operation in the Austin area, CAPCOG assumed that any such trucks were short-haul trucks rather than long-haul trucks.

Based on CAPCOG's review of TERP projects funded in 2012, the only applicable non-road sectors (excluding the locomotive projects applicable to the Austin area) appear to be Agricultural equipment, Construction and Mining Equipment, and Industrial Equipment. While more detailed equipment type data were available for non-road equipment types, all agricultural equipment use the same spatial and temporal surrogates, as do all construction and mining equipment and industrial equipment, so it was not necessary to get to a lower level of detail.

In a few situations, there were both on-road and non-road sources affected by a single project. CAPCOG either used the first project type listed or the project type with the larger number of activities in order to categorize these records.

[6] "TERP DERI Active Project List w Dates.xlsx" E-mailed from Steve Dayton to Andrew Hoekzema March 28, 2017.

After categorizing each project in the Austin area, CAPCOG then calculated the average ozone season day NO_X emissions that the grants were achieving during each day from the start of the TERP grants in September 2001 to the end of September 2017. CAPCOG did this by using "SUMIFS" functions to identify the incremental NO_X emission reductions achieved with the addition of each new project based on its contract start date, the cumulative emission reductions achieved over this time, the expiration of any emission reductions based on the contract end date, and the cumulative expiration of emission reductions up through a given date. The net NO_X reductions applicable to any given date would be the difference between the cumulative emission reductions achieved up through that date and the cumulative expiration of emission reductions that occurred up through that date. CAPCOG then calculated the average NO_X reductions that were applicable to each source category over each ozone season by averaging the daily net NO_X reduction estimates for each day within that period. For this project, since the June 2012 base case is being used as the modeling platform, CAPCOG used the June 1 – June 30 net NO_X reduction averages for the calculated totals.

This produced NO_X emission reduction totals for each source category for the June 2012 episode. CAPCOG was then able to use these to calculate the relevant adjustment factors for each source category.

5.8 Adjustment Factors and CNTLEM Text Strings

In order to generate adjustment factors for the CNTLEM packet, CAPCOG needed to divide the emissions scenario being modeled by the base case emissions scenario.

- For on-road emissions source categories:
    - CAPCOG added the TERP emission reductions to the 2012 emissions totals for those source categories in order to generate "uncontrolled" on-road emissions estimates
    - CAPCOG then divided the uncontrolled emissions estimates by the "controlled" emissions estimates (the base case) in order to generate the required adjustment factors.
- For non-road emissions source categories:
    - CAPCOG subtracted the TERP emission reductions from the 2012 emissions totals for agricultural equipment, construction and mining equipment, and industrial equipment categories in order to obtain the "controlled" estimates
    - CAPCOG divided these controlled estimates by the "uncontrolled" estimates (the base case) to obtain the appropriate adjustment factors for these three source categories.

The table below shows the adjustment factors and basis for each adjustment factor.

Table 5-5. Adjustment Factors to Account for TERP

Source Category	Base NO_X Emissions (tpd)	Change in NO_X Emissions Modeled (tpd)	Adjustment Factor
On-Road Transit Bus	0.1494	+0.0788	1.52765772

Source Category	Base NO_X Emissions (tpd)	Change in NO_X Emissions Modeled (tpd)	Adjustment Factor
On-Road School Bus	0.3362	+0.0141	1.04204139
On-Road Refuse Truck	0.1689	+0.0374	1.22166284
On-Road Single-Unit Short-Haul	2.8068	+0.0185	1.00660501
On-Road Combination Short-Haul	5.4882	+1.2234	1.22291292
Non-Road Agricultural Equipment	5.1144	-0.0900	0.98240997
Non-Road Construction and Mining Equipment	6.6643	-0.3202	0.95195361
Non-Road Industrial Equipment	0.9226	-0.0545	0.94096924

CAPCOG incorporated these adjustment factors into a spreadsheet formatted consistent with a "CNTLEM" packet used by EPS3 and CAMx to apply adjustment factors to an existing emissions inventory input file. The key inputs for this packet are county FIPS code, SCC, and adjustment factor. Adjustment factors were calculated for HONO (pollutant code 42308), NO (pollutant code 42601), and NO_2 (pollutant code 42602). CAPCOG used the same adjustment factors for each day type and NO_X species, and for each targeted SCC code. For on-road sources, this included all "running exhaust" NO_X emissions from diesel-powered vehicles in the source use types described above. For non-road sources, the adjustment factor applied to all diesel-powered equipment types within the three applicable sectors.

6 QA and QC

This section provides details on the QA/QC steps taken by CAPCOG and AACOG prior to finalizing the emissions inventory inputs. Consistent with the level III QAPP applicable to this project, at least 10% of calculations were checked for each run.

6.1 QA for Decker Creek Power Plant Inputs

CAPCOG first checked the AFS file against the emissions estimates from EPA's AMPD, verifying that the emissions totals for the Decker Creek Power Plant's turbines were based on the AMPD emissions rates rather than those in the EIQ Austin Energy submits to TCEQ for the facility. The rates in AMPD are about 5 times higher than the rates in the EIQ. Following creation of the spreadsheets and text strings for the AFS files, CAPCOG submitted copies to AACOG to check to ensure all of the data and fields were setup correctly. Once this was verified, the inputs for runs 2, 3, and 4 were finalized.

6.2 QA for Texas Lehigh Inputs

CAPCOG staff checked the base case ozone season data by comparing the AFS data to the TCEQ EIQ data for 2012. CAPCOG staff then checked the hourly data inputs by independently extracting the source data, subtracting it from the files created by the staff member who generated the AFS data, and verifying that all values equaled zero. No problems were found. Once submitted to AACOG, they also verified that the file was formatted properly.

6.3 QA for Diesel Engine Fleet Turnover Inputs

CAPCOG staff independently downloaded all relevant mobile source and TCEQ program data files described above. Staff verified "intermediate" files that had been generated and the final data included in the files to be submitted to AACOG.

- CAPCOG staff verified the on-road HPMS, off-network, and extended idling intermediate data files for Bastrop County for all day types (20% of the data)
- CAPCOG staff checked that all of the correct SCC codes were being used for on-road and non-road sources and to verify the emissions totals for agricultural, construction & mining, and industrial non-road sources
- CAPCOG staff verified the calculations and categorization of the TERP active project list to verify that the first 75 cells were correct, and that net NO_X emission reduction totals for 2001-2004, 2001-2003, and 2002-2003 were correct
- CAPCOG staff verified the final calculations for adjustment factors

Once submitted to AACOG, they also verified that the files were properly formatted.

7 Reference: Other Non-Road Inputs

Airports:
ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/offroad/airport/tex/ams_inputs.airport.tex_2012.16Jul20.tar.gz (7/19/2016, downloaded 4/5/2017)

Line Haul Locomotives:
ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/offroad/locomotive/tex/ams_inputs.loco_linehaul.tex_2012.16Jul19.tar.gz (7/19/2016, downloaded 4/5/2017)

Switcher Locomotives:
ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/offroad/locomotive/tex/ams_inputs.loco_switcher.tex_2012.16Jul19.tar.gz (7/19/2016, downloaded 4/5/2017)

Non-Road:
ftp://amdaftp.tceq.texas.gov/pub/EI/2012_episodes/hgb_sip/base_2012/nonroad/tex/ams_inputs.nonroad_texn.2012.16Jul18.tar.gz (7/17/2016, downloaded 4/5/2017)