ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Amendments to:

State Air Quality Control Plan

Vol. II: III.D.7.8

Modeling

Public Notice Draft

September 10, 2020

Michael J. Dunleavy, Governor

Jason W. Brune, Commissioner

Note: This document provides revised and/or new language proposed for inclusion in this section of the State Air Quality Control Plan addressing the Fairbanks North Star Borough $PM_{2.5}$ Serious nonattainment area. The revised and/or new proposed language is in bold and underlined format. Language proposed to be deleted or replaced is shown in strikeout format. These revisions are the only part of this section that are open for public review and comment in this update to the plan. To aid in the public comment process, the currently adopted sections of the air quality plan can be found and referenced at the following internet site: http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/

7.8.14 Overview Modeling 2020 Amendment SIP

Since the development of the Serious Area SIP, DEC has collected monitoring data at an additional monitoring site in the Fairbanks area: A Street in the Hamilton Acres Subdivision. This monitoring site was established as the maximum impact site for the Fairbanks portion of the nonattainment area. The monitoring chapter has additional information on the A street site. The 2020 amendment includes new design values for all four monitoring sites, SOB, NCORE, Hurst Road and A street and a new 4 year modeling design value has been calculated (see Section III.D.7.4 Ambient Monitoring and Trends) for the modeling years 2016 to 2019 (Table 7.8.14-1.). The PM 2.5 modeling guidance suggests using one of the three years of nonattainment that include the base year. Maximizing the latest emissions inventory and controls, DEC selected the most current base year possible: 2019. That 2019 base year is then included in the modeling design value and the 3,4- or 5-year design value is calculated to reflect current conditions. The North Pole area monitor has been consistently in the 60-70 µg/m^3 range for PM2.5 and therefore DEC, in consultation with EPA, chose 2016-2019 for the 4-year design value to be representative of Hurst Rd concentrations. Prior to 2016, the PM 2.5 concentration was significantly higher. These additional data add new insights into the future design values. DEC has a separate and ongoing effort to collect new speciation data for PM2.5 and perform a modeling system update. The modeling system update is a long-term process that is detailed in a Technical Analysis Protocol in Appendix III.D.7.8 and will be used for future Fairbanks Area modeling efforts along with updated speciation data.

The updated design value for the 2020 amendment results from the need to update the modeling analyses to a base year of 2019. The base year is typically one of the years used to calculate the modeling design value. In the Serious Area SIP, 2019 was the most recent year with a complete year of data, which is why DEC selected it for use as the base year inventory for the 2020 amendment. Since completing the Serious Area SIP, the emission inventory for the 2019 base year was updated to reflect actual emissions that occurred during the year 2019 for all source sectors. The design value update is presented below in Table 7.8.14-1 and shows a new violating monitor DV at the Hurst Road site of 64.7 µg/m^3 of PM2.5. All future year modeling in the 2020 amendment will be measured against this design value for the Hurst Road monitor. The details of the updates to the emissions inventory are provided in the emission inventory section (III.D.7.7).

Table 7.8.14-1. PM2.5 Design Value updated table for Fairbanks and North Pole monitors in µg/m^3

	PM2.5 yearly 98%- tile				PM2.5 Design Values (3 year DV unless noted)					
Site	2016	2017	2018	2019	2016	2017	2018	2019	Serious SIP Modeling Design Value rolling average 2011-2015 (5 year)	2020 Amendment Modeling Design Value 2016-2019 (4 year)
SOB	39.7	38.0	27	27.7	37	38	35	31	38.9	32.9
NCORE	30.3	34.4	25.3	27.7	33	34	30	29	38.0	29.6
Hurst Road	66.8	75.5	52.8	65	106	85	65	64	131.6	64.7
A St				34.1				N/A		

Note: SOB shut down in June of 2019

7.8.14.1 2019 Base Year Modeling

As described previously, the base year for the 2020 amendment modeling is 2019 and modifications to the 2019 emission inventory since the Serious Area SIP include updates to reflect actual 2019-point source and mobile source emission data as well as updated aircraft emissions. The details of the emissions inventory are presented in Section III.D.7.7. The plots below for total PM2.5 from the Serious SIP 2019 modeling year and the 2020 amendment 2019 base year show very little change. The emissions difference for each category is used in the precursor demonstration update for 2019 and can be found below in the precursor section 7.8.14.3. The base year concentration 64.7 µg/m3 at the Hurst Road monitor and all emission inventory changes are from this base year and starting the relative response factors for all species are 1 and decrease or increase depending on the controls applied.

7.8.14.2 2024 Modeling

For the 2020 amendment, the 2024 model year was rerun with the new design values provided in Table 7.8.14-1. The 2024 future design values for each species were added together to determine the total PM2.5. The modeling used relative response factors (RRFs) for each species to determine if each species increased or decreased in every grid cell in the NAA. The final concentration is subtracted from the base year, which in this case is 2019. The difference plots show the difference in PM2.5 from 2019 to 2024. The analysis starts with the 2019 base year and the design values in Table 7.8.14-1 and then the effects of emissions from future controls change the RRF from a starting value of 1.0.

The details of the RRF calculations are found in the Serious SIP Modeling section, III.D.7.8.11, *2019 Control Run Modeling*.

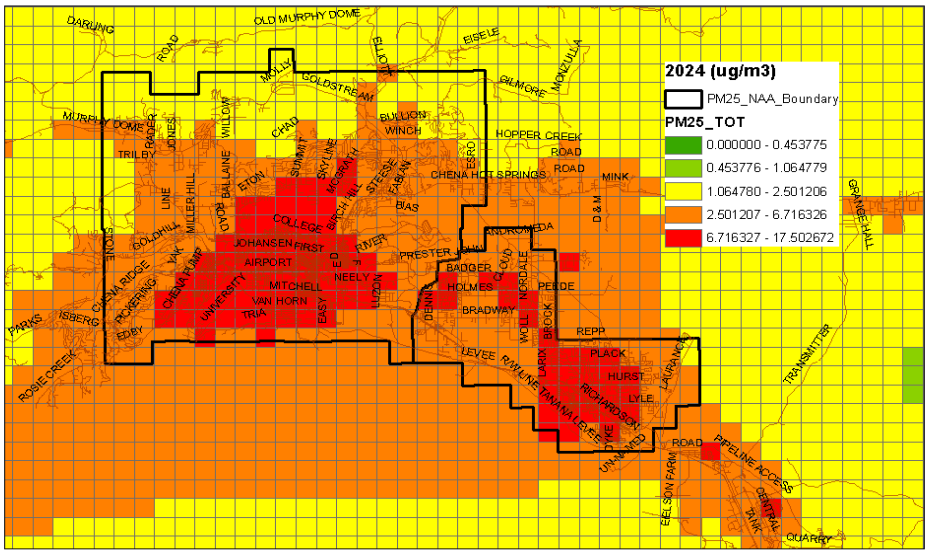

Figure 7.8.14.2-1 Non-attainment area grid cell plot for the modeling year 2024 24-hr average PM 2.5 (µg/m3) for all episode days

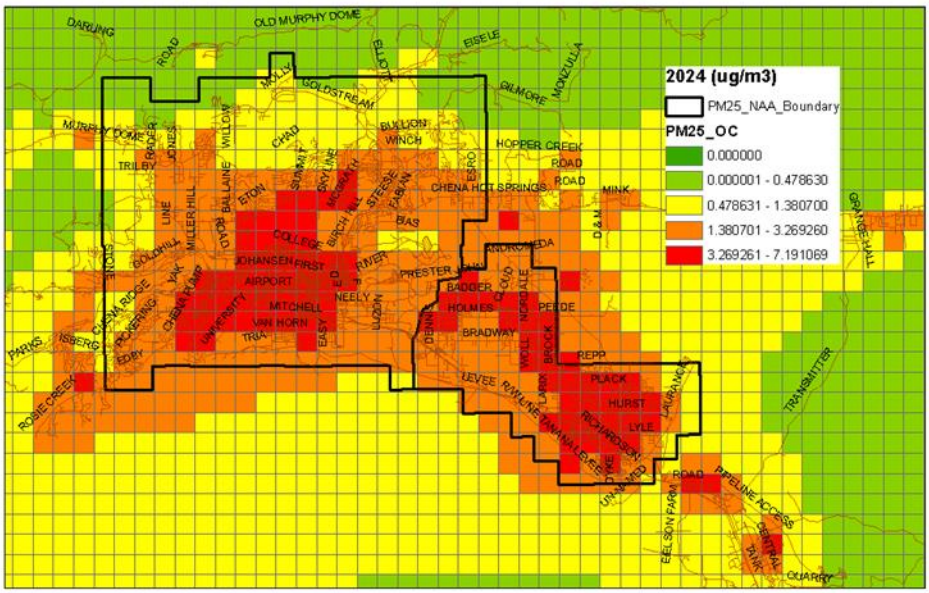

Figure 7.8.14.2-2 Non-attainment area grid cell plot for the modeling year 2024 24-hr average Organic Carbon (µg/m3) for all episode days

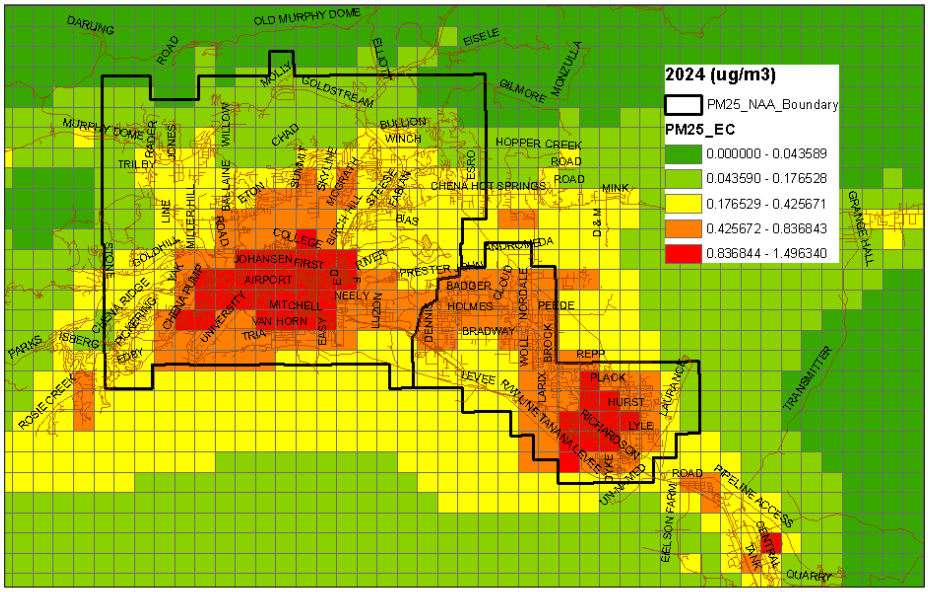

Figure 7.8.14.2-3 Non-attainment area grid cell plot for the modeling year 2024 24-hr average Elemental Carbon (µg/m3) for all episode days

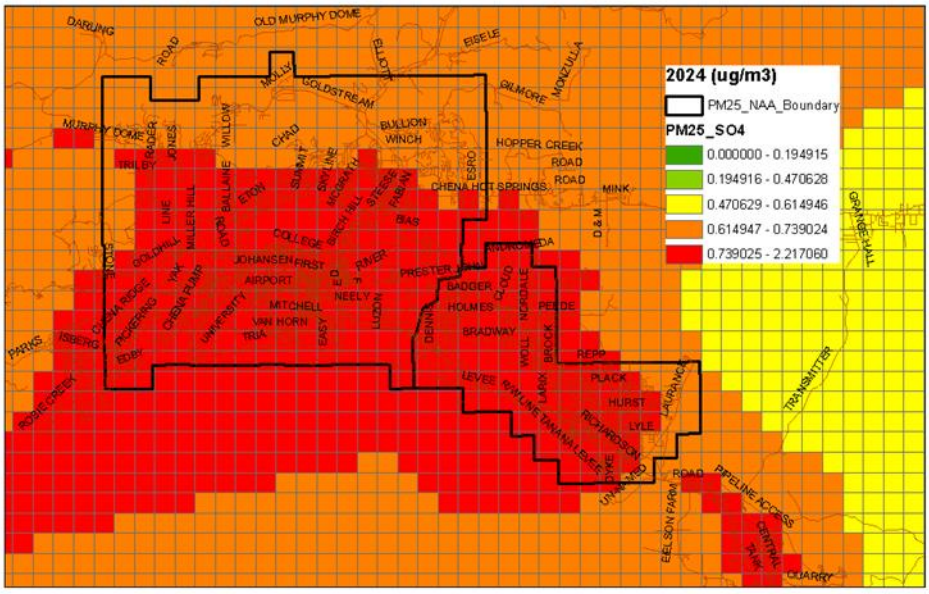

Figure 7.8.14.2-4 Non-attainment area grid cell plot for the modeling year 2024 24-hr average sulfate (µg/m3) for all episode days

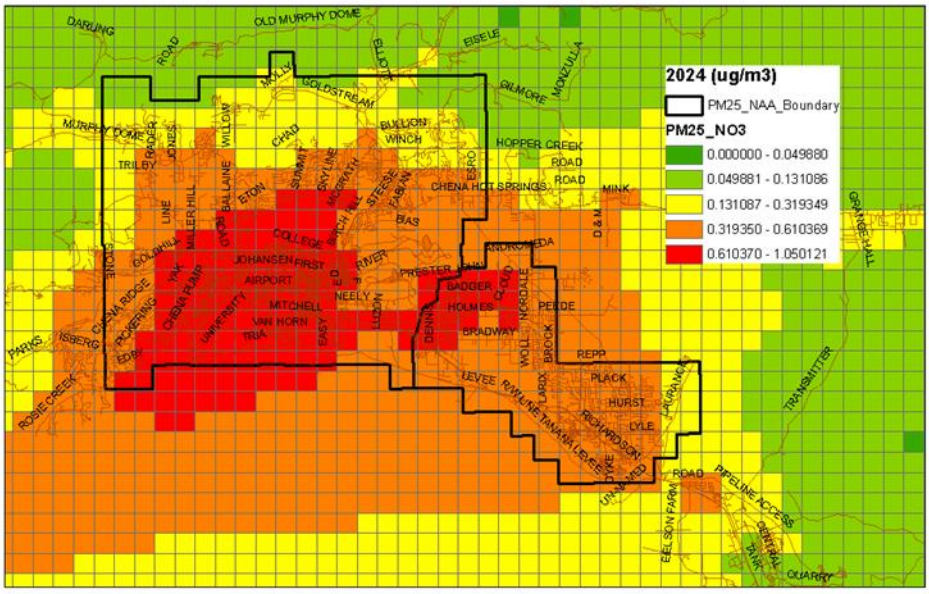

Figure 7.8.14.2-5 Non-attainment area grid cell plot for the modeling year 2024 24-hr average nitrate (µg/m3) for all episode days

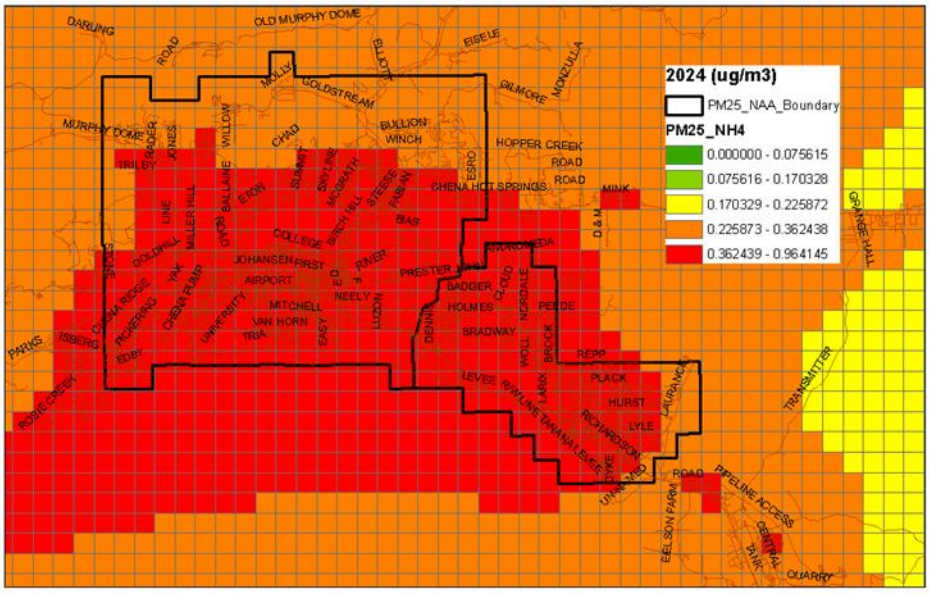

Figure 7.8.14.2-6 Non-attainment area grid cell plot for the modeling year 2024 24-hr average ammonium (µg/m3) for all episode days

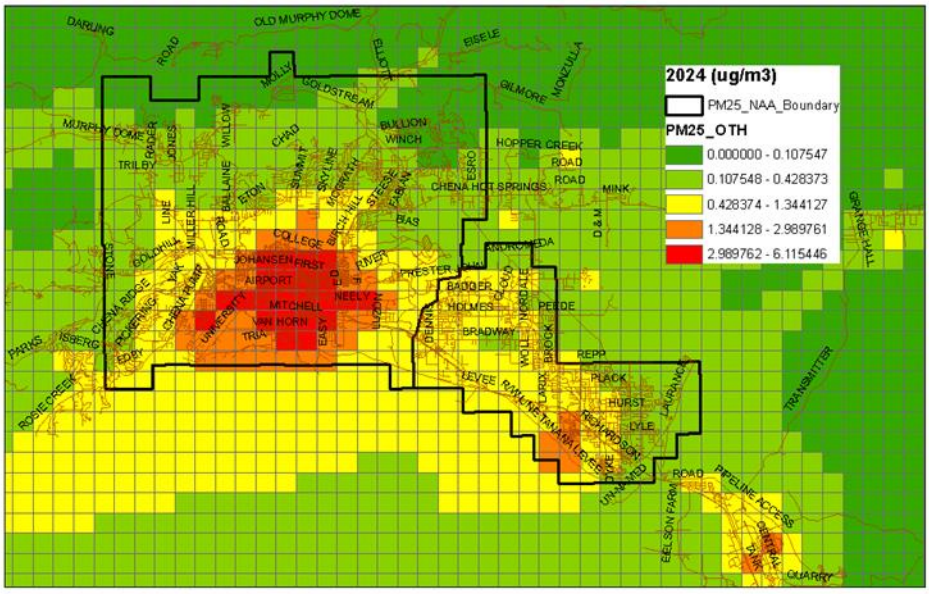

Figure 7.8.14.2-7 Non-attainment area grid cell plot for the modeling year 2024 24-hr average other (µg/m3) for all episode days

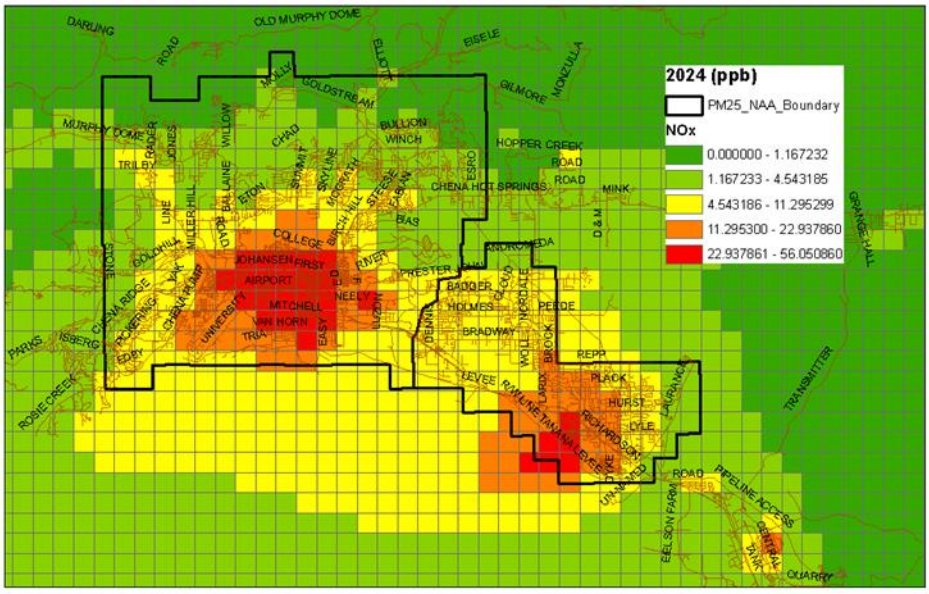

Figure 7.8.14.2-8 Non-attainment area grid cell plot for the modeling year 2024 24-hr average NOx (µg/m3) for all episode days

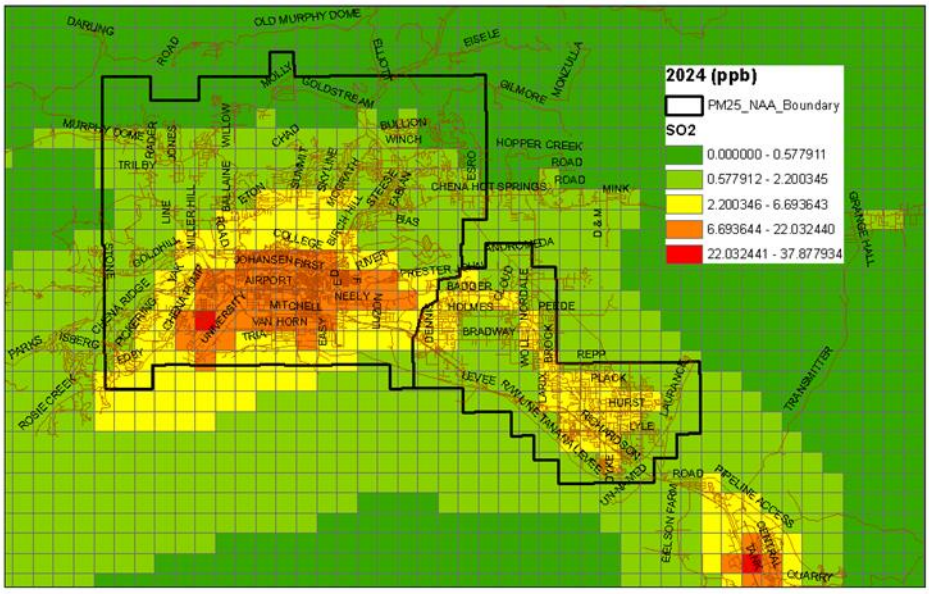

Figure 7.8.14.2-9 Non-attainment area grid cell plot for the modeling year 2024 24-hr average SO2 (µg/m3) for all episode days

The 2024 species plots are consistent with what is expected in the non-attainment area. For the SO2, the two highest grid cells are the Fairbanks and Eielson airport. The organic carbon is the largest species concentration compared to the total PM 2.5. The sulfate is higher in Fairbanks where there is more fuel oil burned compared to North Pole. The total PM 2.5 is highest where expected, but absolute concentrations are low. These are raw model outputs and have not gone through SMAT. The SMAT concentrations used to calculate a Future Design Value are in section 7.8.14.5.

7.8.14.3 Precursor Demonstration Update – 2020 Amendment SIP

The precursor demonstration is based on the 2019 emissions inventory developed for the Serious Area SIP. The additional information added to that emissions inventory since the Serious Area SIP is the actual 2019 point source emissions, aircraft and updates to motor vehicle emissions. These updates resulted in a small change in the inventory and less overall PM2.5, from 3.67 tons per day in the Serious Area SIP to 3.17 tons per day in the 2020 amendment. Since the result is a small decrease, the 100% and 75% off precursor runs from the Serious Area SIP were not updated. In the clarifying document associated with the Serious Area SIP, a 50% knock-out quantitative analysis was completed for NO_x emissions from anthropogenic sources to demonstrate that NO_x emissions were insignificant in the nonattainment area. For the 2020 amendment, an actual precursor model run was

performed for this NOx comprehensive precursor demonstration, to further support the weight of evidence presented in the Serious Area SIP.

Table 7.8.14.3-1 Episodic emissions for all precursors and PM 2.5 in tons per day for the year 2019 for the Serious SIP

	Modeling Domain Episodic Emissions (tons/day)				
Source Sector	PM2.5	NOx	SO2	VOC	NH3
Point	0.59	10.36	5.87	0.03	0.073
Area, Space Heat, All	2.21	2.61	4.16	9.55	0.145
Area, Space Heat, Wood	2.05	0.45	0.17	9.31	0.096
Area, Space Heat, Oil	0.07	1.94	3.87	0.11	0.004
Area, Space Heat, Coal	0.08	0.06	0.10	0.12	0.016
Area, Space Heat, Other	0.01	0.17	0.02	0.01	0.029
Area, Other	0.24	0.38	0.03	2.25	0.050
On-Road Mobile	0.27	2.30	0.01	4.90	0.055
Non-Road Mobile	0.36	1.75	7.78	5.26	0.003
TOTALS	3.67	17.40	17.85	22.00	0.325

Table 7.8.14.3-2 Episodic emissions for the Fairbanks non-attainment area for the year 2019 for precursors and PM 2.5 for the 2020 amendment

	NA Area Episodic Emissions (tons/day)				
Source Sector	PM2.5	NOx	SO2	VOC	NH3
Point	0.57	10.31	5.68	0.03	0.073
Area, Space Heat, All	1.91	2.43	3.88	8.60	0.132
Area, Space Heat, Wood	1.77	0.39	0.16	8.38	0.086
Area, Space Heat, Oil	0.06	1.82	3.62	0.10	0.004
Area, Space Heat, Coal	0.07	0.05	0.09	0.11	0.014
Area, Space Heat, Other	0.01	0.17	0.02	0.01	0.029
Area, Other	0.22	0.36	0.03	2.10	0.046
On-Road Mobile	0.22	1.70	0.01	3.83	0.040
Non-Road Mobile	0.26	0.94	5.41	4.16	0.002
TOTALS	3.17	15.73	15.01	18.72	0.293

The results of the 50% off NO_x precursor modeling run are plotted in Figure 7.8.14.3-1 through 3.

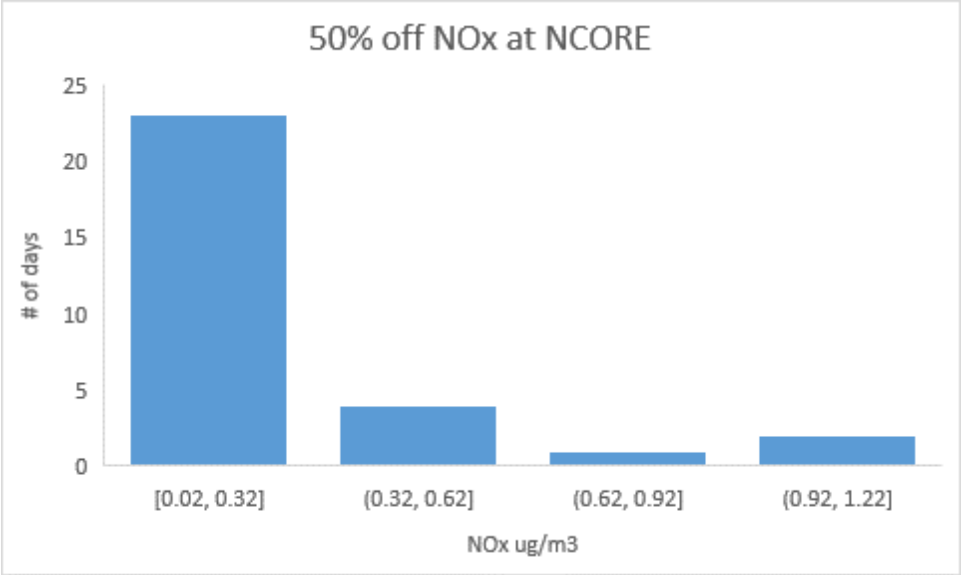

Figure 7.8.14.3-1 Precursor 50% off model run results for 2019 all days at NCORE and SOB monitor grid cell for NOx comprehensive

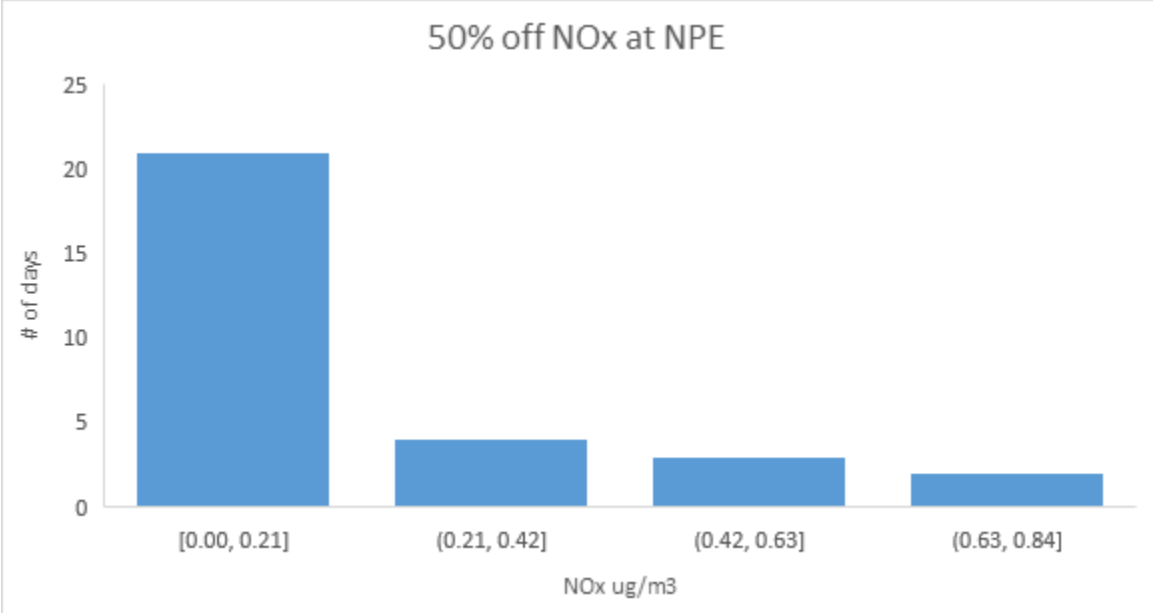

Figure 7.8.14.3-2 Precursor 50% off model run results for 2019 all days at the NPE monitor grid cell for NOx comprehensive

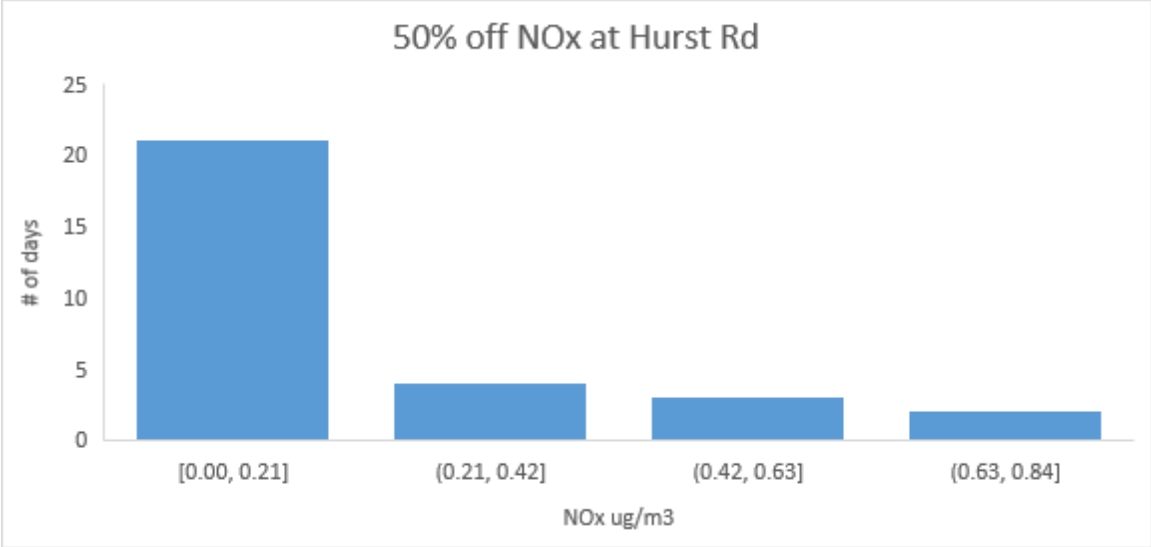

Figure 7.8.14.3-3 Precursor 50% off model run results for 2019 all days at the Hurst monitor grid cell for NOx comprehensive

The plots represent the difference in the 2019 base year to the 50% off emissions inventory precursor model run. All days at all monitors and all anthropogenic sources (NOx comprehensive) are below the threshold of 1.5 µg/m3 for NOx comprehensive at 50%. The closest day or largest difference is 1.2 µg/m3 at the NCORE monitor on November 8, 2008 model run day for the meteorology. The NCORE and SOB monitors are in the same grid cell, and these are raw model output results. Since SOB and NCORE have the same grid cell value, only NCORE is shown.

7.8.14.4 Modeling Future Design Value

The modeling future design values as stated above are calculated by multiplying the relative response factors (RRFs) by the concentration in the monitored grid cell in a process called SMAT (speciated modeled attainment test). The SMAT process uses the design values in Table 7.8.14-1 and the SMAT calculations that can be found in the Serious SIP modeling section III.D.7.8.9.4 *SMAT Methods*. The species concentration percentage of the PM2.5 used in the calculations are below for each monitor grid cell. Note that new speciation data was not available for the 2020 amendment, and the 5 years of speciation data used in the SMAT calculations are 2011 to 2015. The NCORE speciation data was analyzed for 2016 to 2018 and the difference between the new data and the 2011-2015 data was minimal (Figure 7.8.13.3-3). NCORE is the only monitor that had speciation data collected during the updated design value years of 2016 to 2019 with enough data to perform SMAT , Hurst Rd speciation began in the fall of 2019 . For consistency, all SMAT calculations were completed using 2011 to 2015 speciation data, but the analyzation of 2016-2018 is included. The 2016 to 2018 data is similar to 2011 to 2015, there was identified issue with using 2011 to 2015 for all moninotrs. Note for the updated design value of 2016 to 2019 the NPE monitor is no longer included, because it has not operated since 2009. The A street monitor will be added to future modeling analyses once there is sufficient speciation data collected and analyzed from the site.

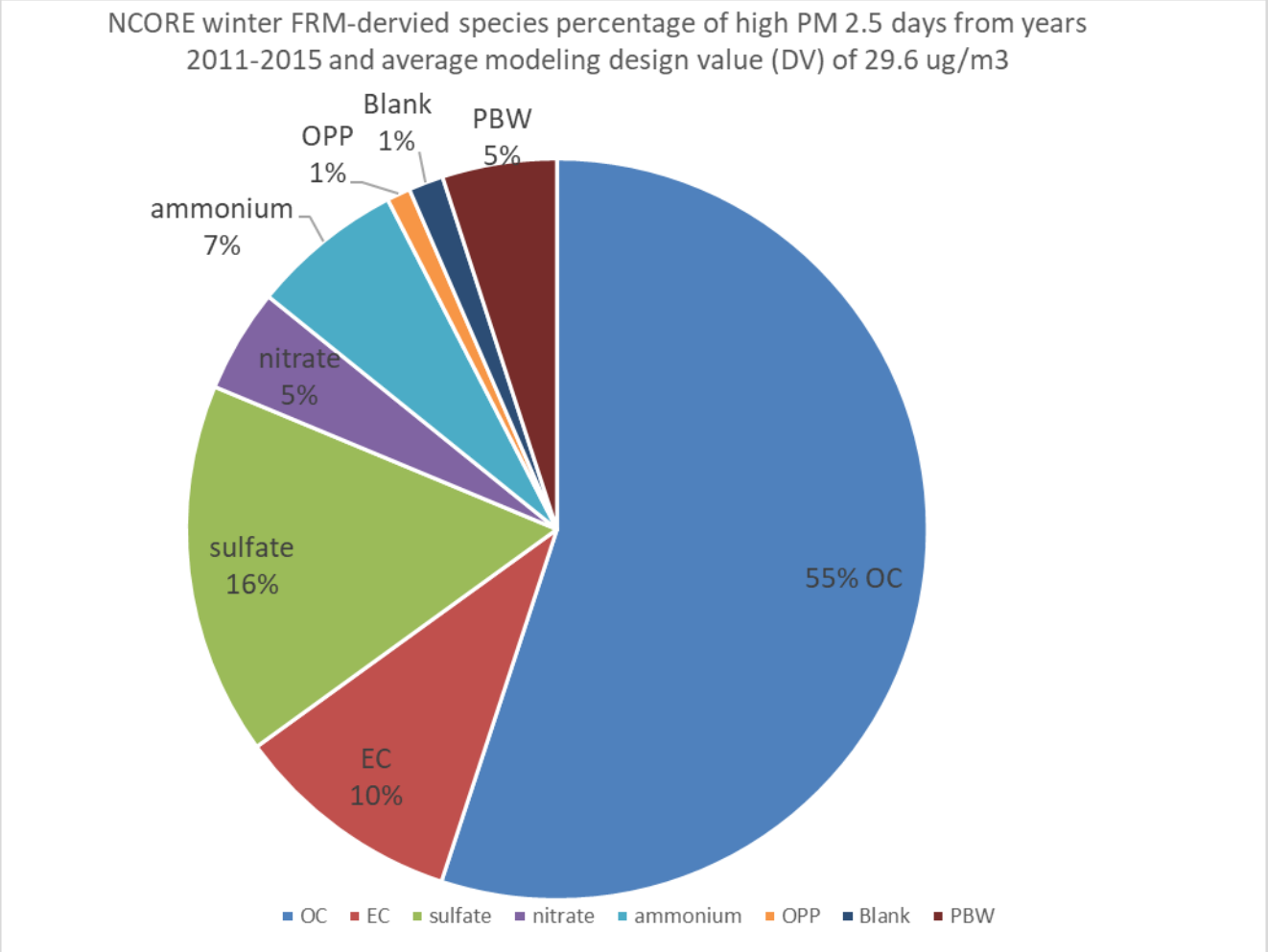

Figure 7.8.14.4-1 NCORE winter FRM – derived species percentage of high PM2.5 days from years 2011 to 2015 and average modeling design value (DV) of 29.6 µg/m3 .

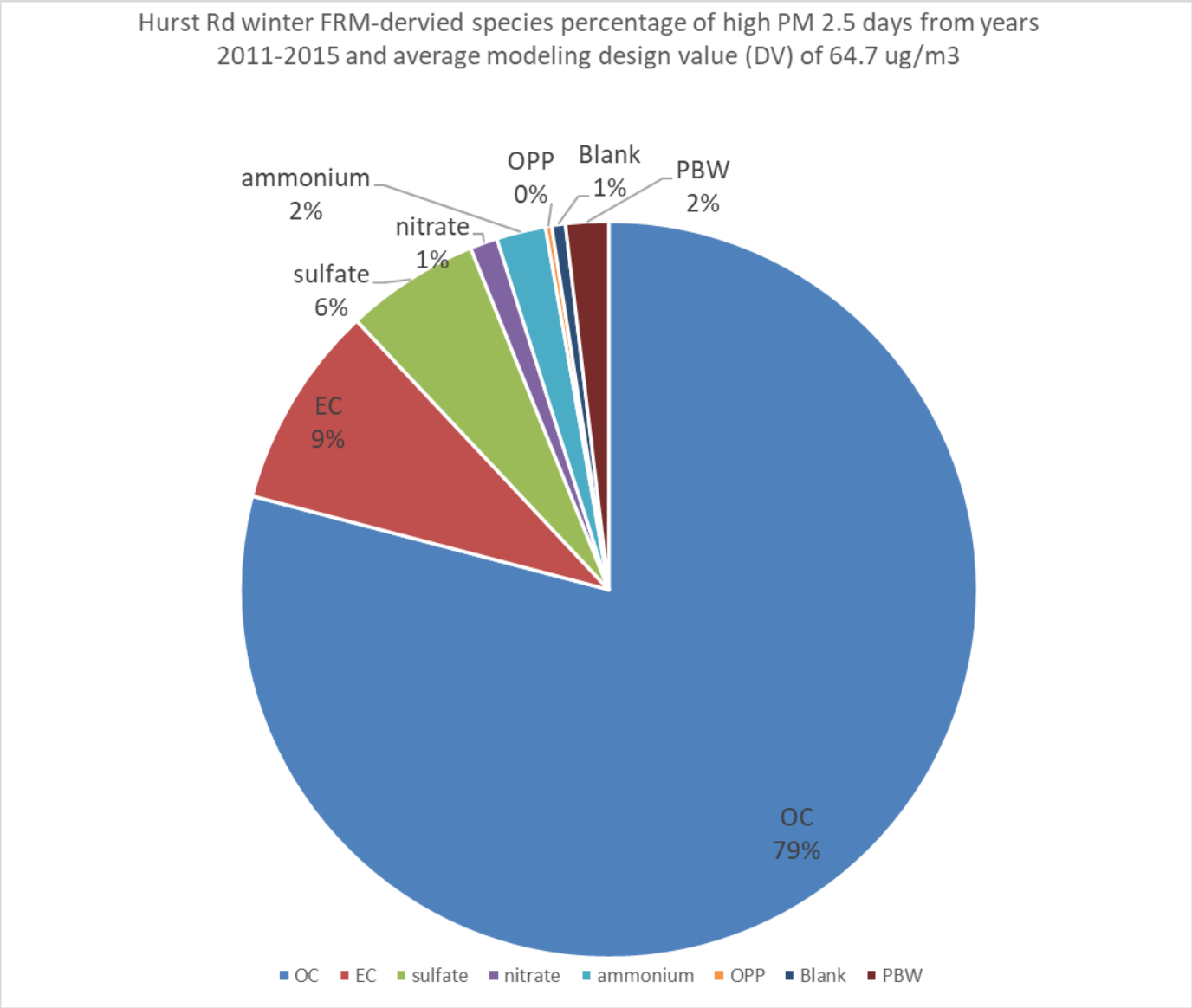

Figure 7.8.14.4-2 Hurst Rd. winter FRM – derived species percentage of high PM2.5 days from years 2011 to 2015 and average modeling design value (DV) of 64.7 µg/m3 .

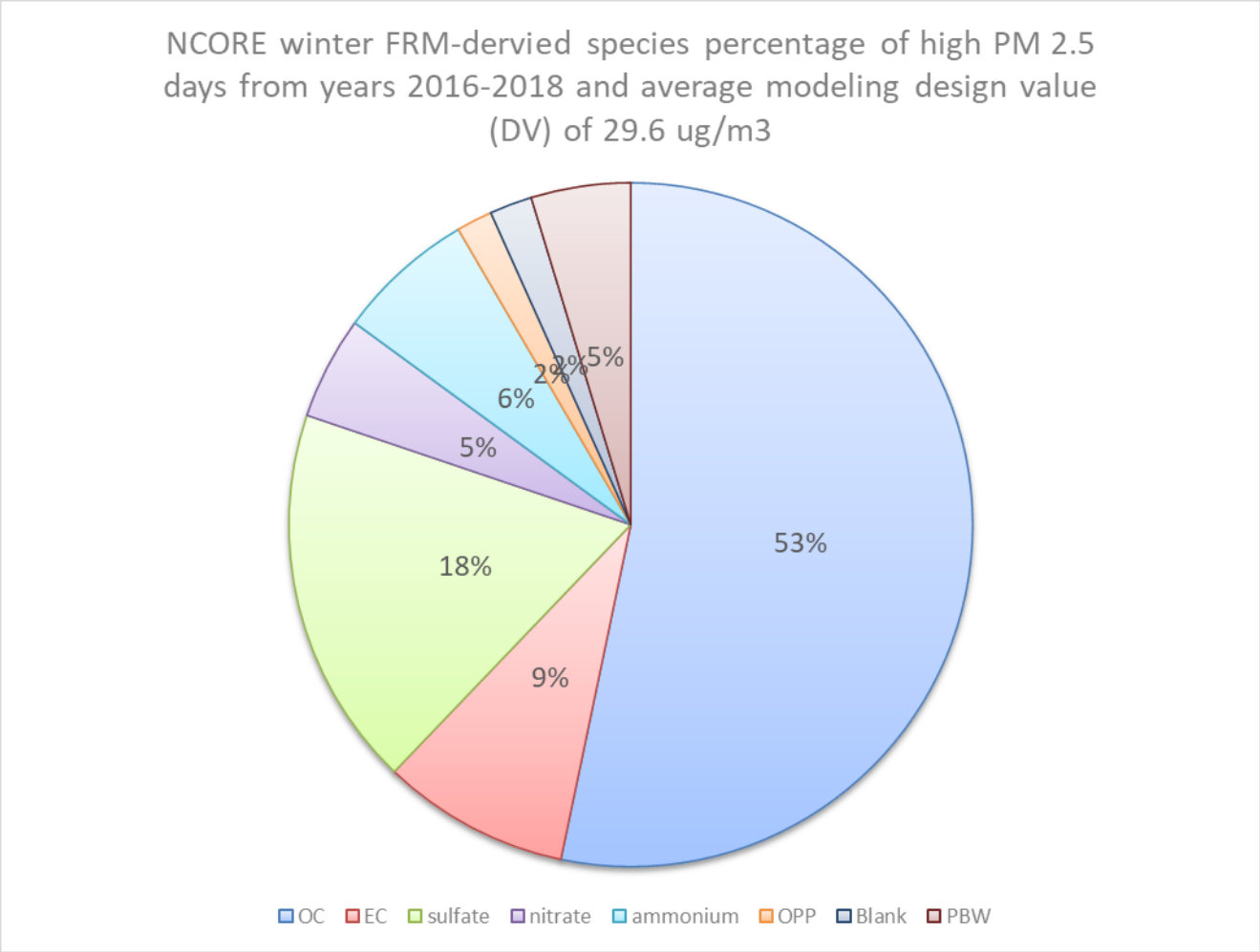

Figure 7.8.14.4-3 NCORE winter FRM – derived species percentage of high PM2.5 days from years 2016 to 2018 and average modeling design value (DV) of 29.6 µg/m3 .

Table 7.8.14.4-1 Summary of Future Design Values (FDV) and species RRF at the Hurst Rd. monitor for base year modeling 2019, attainment year 2024, and sensitivity analysis for future and prior year 2026 and 2023

	OC	EC	SO4	NO3	NH4	OTH	FDV
2019	1.00	1.00	1.00	1.00	1.00	1.00	64.7
2023	0.52	0.67	0.82	0.93	0.86	0.97	37.0
2024	0.42	0.46	0.81	0.88	0.83	0.96	30.9
2026	0.34	0.37	0.81	0.90	0.84	0.98	26.7

Note: 2026 was completed with a preliminary emissions inventory

Table 7.8.14.4-2 Summary of the Future Design Values (FDV) and species RRF at the NCORE monitor for base year modeling 2019, attainment year 2024 and sensitivity analysis for future and prior years 2026 and 2023.

NCORE							
	OC	EC	SO4	NO3	NH4	OTH	FDV
2019	1.00	1.00	1.00	1.00	1.00	1.00	29.60
2023	0.61	0.91	1.00	0.96	0.92	1.13	23.2
2024	0.52	0.59	0.92	0.94	0.92	1.15	21.0
2026	0.42	0.51	0.88	0.92	0.89	1.15	19.3

Note: 2026 was completed with a preliminary emission inventory

The current modeling FDV shows attainment at the Hurst Road monitor in 2024. The largest reductions in species is the Organic Carbon (OC) at 0.45 RRF compared to 1. Initially DEC conducted a model run for the future year 2026 and attainment was shown so far below the 35 µg/m3 threshold, that a 2024 emissions inventory was completed for another updated modeling run to determine the modeled attainment year. The detailed discussion on the modeled attainment of the monitor Hurst Road grid cell and its meaning on the attainment of the Fairbanks and North Pole nonattainment area are discussed in the attainment section III.D.7.9. The model run for future year 2023 was included as a sensitivity run to show that the expeditious attainment year is 2024. The modeling run for 2023 clearly shows the area would not reach attainment at 37.0 µg/m3 . Additional analysis on the changes in the emission inventory were calculated to estimate the most expeditious year for attainment possible.

Table 7.8.14.4-3 Summary of Hurst Rd 2023 FDV estimated by emission reductions to all sources and home heating sector only.

Inventory-Interpolated Estimation of 2023 DV at Hurst Road Monitor				
	CMAQ-Based DVs		% Red'n (2019-2024)	
	2019	2024	No Bkgnd	With Bkgd
Hurst Road DV (µg/m3):	64.7	30.9	52.2%	49.6%
% of DV from Bkgnd & Outside NA Area:	5%			

	NA Area Emissions (tpd)			2023 % of
	2019	2023	2024	2024 Redn
Direct PM Emissions (all sources):	3.370	2.147	1.993	
PM Emission Reductions (relative to 2019):	n/a	36.3%	40.8%	88.8%
Direct PM Emissions (space heating):	2.106	1.086	0.740	
PM Emission Reductions (relative to 2019):	n/a	48.4%	64.9%	74.7%
	No Bkgnd	With Bkgd		
Linearly-Interpolated 2023 DV (µg/m3):	37.7	39.0		
EI-Interpolated 2023 DV (µg/m3), All Sources:	34.7	36.2		
EI-Interpolated 2023 DV (µg/m3), Space Heating Sources:	39.5	40.7		

The additional analysis of the estimated FDV based on emission inventory and an assumed background is at 36.2 µg/m3 to 40.7 µg/m3 depending on the interpolation (Table 7.14.4.-3). The 39.5 µg/m3 concentration is only the heating source category changed and the 40.7 µg/m3 is the 5% background added in that contains what other sources are estimated to affect that grid cell. The 40.7 µg/m3 is a variable number that changes with the assumed background percentage in Table 7.8.14.4-8. The attainment demonstration in section 7.9 has more details on this table the emission inventory changes.

The 2023 model run most closely represents a linear change in the emission inventory for all sources and including a background estimate of 5%. This is logical since most of the changes in the emissions inventory are for organic carbon and primarily emitted. The attainment demonstration section 7.9 has the details of 2024 being the most expeditious year for attainment. Future modeling efforts will include the A street monitor design value as a max impact site. The modeling will be completed with an updated modeling platform (meteorology, emissions and CMAQ version) and details can be found in the modeling protocol the modeling appendix.