III.K.7 AIR QUALITY MODELING OF SOURCE REGIONS

A. Overview

While modeling is only explicitly referenced in two sections of the regional haze rule (i.e., Section 501.308(c)(ii) and 308(d)(3)(iii)), it is a critical technical step in many of the planning requirements of the rule. Models are needed for source apportionment, control strategy development and optimization, quantification of incremental impacts of individual source categories, and analysis of cumulate impacts. Air quality and visibility modeling in support of regional haze planning in the WRAP region was the responsibility of the WRAP Modeling Forum's Regional Modeling Center (RMC). The RMC used the air pollution emissions data provided by member states to simulate historic air quality conditions and estimate the benefit of emissions reductions programs in the future. Regional gridded dispersion models were used for these simulations.

Due to delays in emission inventory development for state sources, lack of information on emission inventories for international sources impacting the state, and funding constraints, it was not possible for the WRAP to perform photochemical grid modeling for Alaska. In lieu of photochemical modeling and as a first step toward future modeling, the WRAP evaluated alternate meteorological modeling techniques to simulate the unique and complex meteorological conditions of Alaska. This resulted in the use of the modeling techniques described below to gain insight into which emission sources within the State are impacting the four Class I areas.

- *Back Trajectory Modeling* was conducted to determine the path of air parcels impacting each site. Back trajectories account for the impact of wind direction and wind speed on the delivery of emissions to a site, but do not account for chemical transformation, dispersion and deposition.

- *Weighted Emissions Potential (WEP) Analysis* was used to assess the relative emissions contribution from in-state sources impacting each site. WEP analysis integrates gridded emissions estimates, back trajectory residence time estimates, and the effect of distance to approximate deposition.

- *CALPUFF* was used to assess the impact of emissions from BART-eligible sources on visibility at Denali and Tuxedni. CALPUFF used MM5 data, surface meteorological measurements, and major source specific emission estimates to calculate visibility impacts due to emissions of SO_2, NOx and primary PM emissions. A summary of source specific modeling results and deciview impacts was presented in Section III.K.6. Copies of the source-specific modeling analyses are presented in Appendix III.K.6.

Presented below is brief description of the back trajectory modeling and WEP analysis methodologies, a summary of the results, and an assessment of significance from in-state emission sources.

B. Back Trajectory Analysis

A WRAP contractor—Air Resource Specialists, Inc. (ARS)—generated meteorological back trajectories for IMPROVE monitoring sites. Back trajectory analyses use interpolated measured or modeled meteorological fields to estimate the most likely central path over geographical areas that provided air to a receptor at a given time. The method essentially follows a parcel of air backward in hourly steps for a specified period of time. Back trajectories account for the impact of wind direction and wind speed on delivery of emissions to the receptor, but do not account for chemical transformation, dispersion, and deposition of samples.

Trajectories were generated using the Hybrid-Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model developed by the National Oceanic and Atmospheric Administration's (NOAA) Air Resources Laboratory. HYSPLIT uses archived three-dimensional meteorological fields generated from observations and short-term forecasts. HYSPLIT can be run to generate forward or backward trajectories using several available meteorological data archives.

ARS could not use the National Weather Service's National Center's for Environmental Prediction Eta Data Assimilation System (EDAS) to represent meteorology in Alaska, since it contains data for the continental U.S only. Therefore ARS used the FNL data from the National Weather Service's National Centers for Environmental Prediction (NCEP). The FNL data consist of meteorological model output at 191 km resolution and include late-arriving conventional and satellite data observations that are not available in the EDAS data set. The principal difference the EDAS and FNL datasets is the resolution: EDAS has a horizontal resolution of 80 km before 2004 and a 40 km resolution beginning in 2004. As noted above, the FNL data have a horizontal resolution of 191 km.

Using the FNL data, HYSPLIT prepared back trajectory analyses for each of the four Class I sites in Alaska for the annual 20% worst and 20% best visibility days. The duration of the trajectory was set to 8 days (192 hours backward in time); this value was chosen to represent a compromise between higher certainty (shorter duration) and the expected atmospheric life of sulfate aerosols (one-two weeks.). Residence time maps were constructed to display where air parcels impacting the Class I sites spent the most time before reaching the monitors. The values associated with each color in the map legend are normalized to the maximum percentage value observed, which is generally the grid cell where the receptor site is located. Residence time over an area is indicative of general flow patterns, but does not necessarily imply the area contributed significantly to haze compounds since it does not account for the emissions and removal process.

The results are presented in Figures III.K.7-1 through III.K.7-8, with a 20% worst and 20% best visibility sequence for each Class I area. Starting with Denali (Figures III.K.7-1 and III.K.7-2), the pattern for the 20% worst days shows a relatively dense, almost bull's-eye pattern with nearby locations having the maximum residence time, which diminishes with distance. The pattern is stretched, however, from the southwest to the northeast, suggesting that sources in Anchorage, Mat-Su, and Fairbanks are principal contributors. The pattern for the 20% best days is considerably different and shows significant air flow from the Gulf of Alaska (i.e., the southeast). It is important to remember that the colors are normalized to the maximum residence

Figure III.K.7-1
Denali National Park, AK – Normalized Back-Trajectory Residence Time 20% Worst Visibility Days

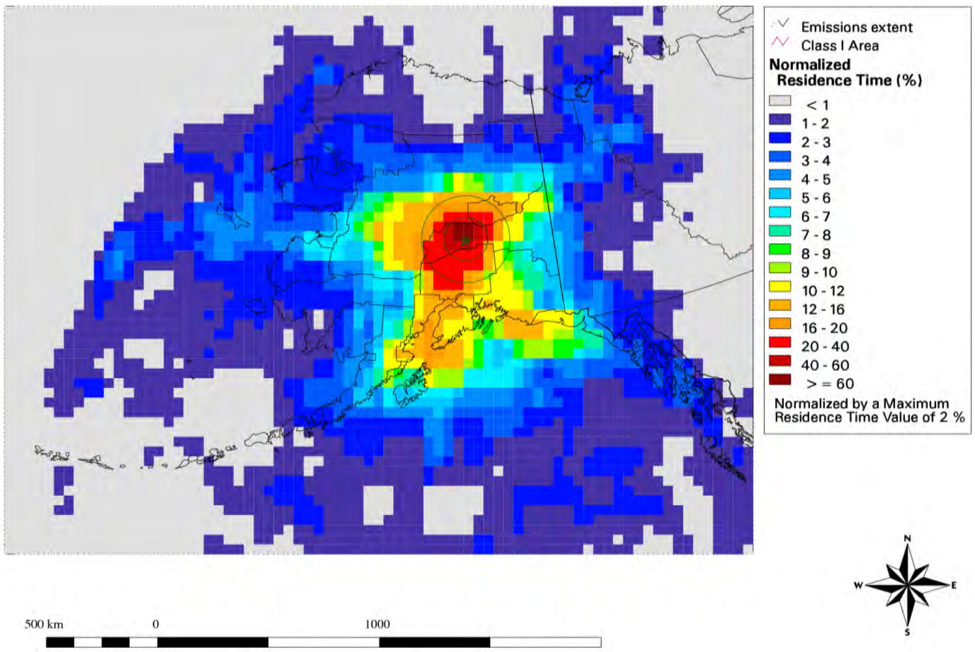


Figure III.K.7-2
Denali National Park, AK – 20% Best Visibility Days

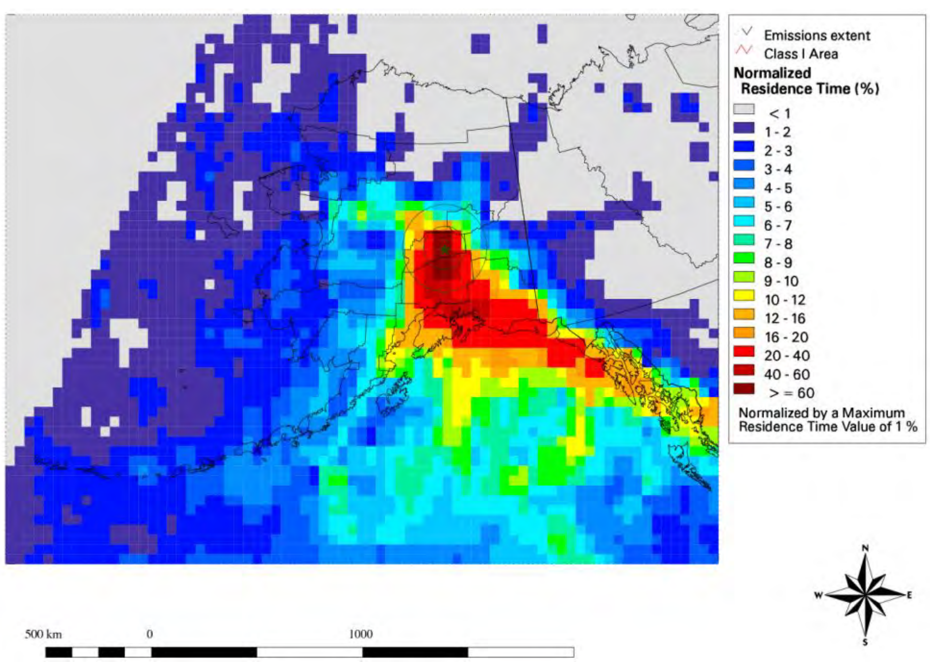


Figure III.K.7-3
Trapper Creek Wilderness, AK – Normalized Back-Trajectory Residence Time 20% Worst Visibility Days

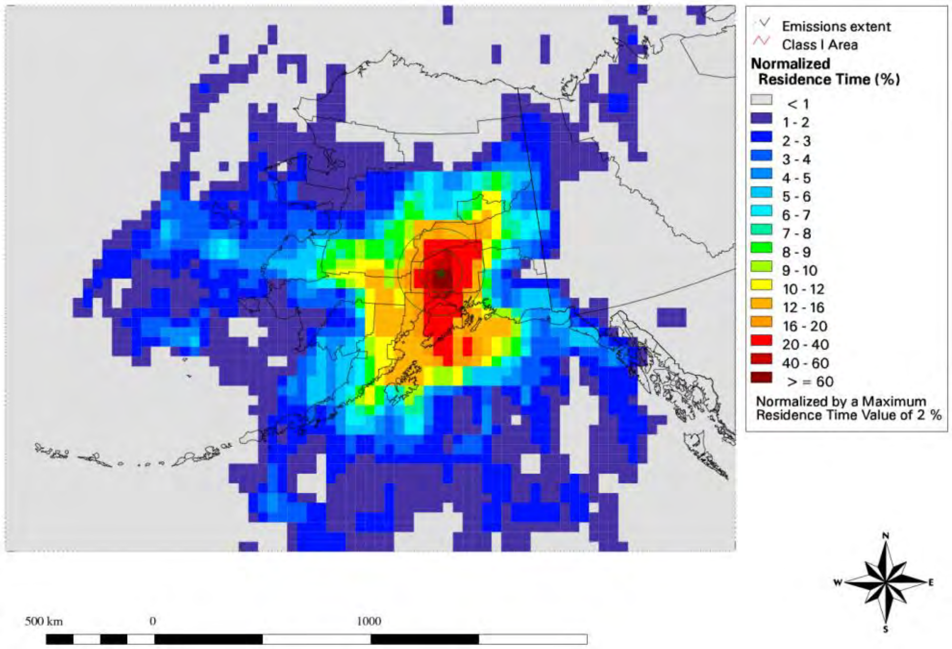


Figure III.K.7-4
Trapper Creek Wilderness, AK – Normalized Back-Trajectory Residence Time 20% Best Visibility Days

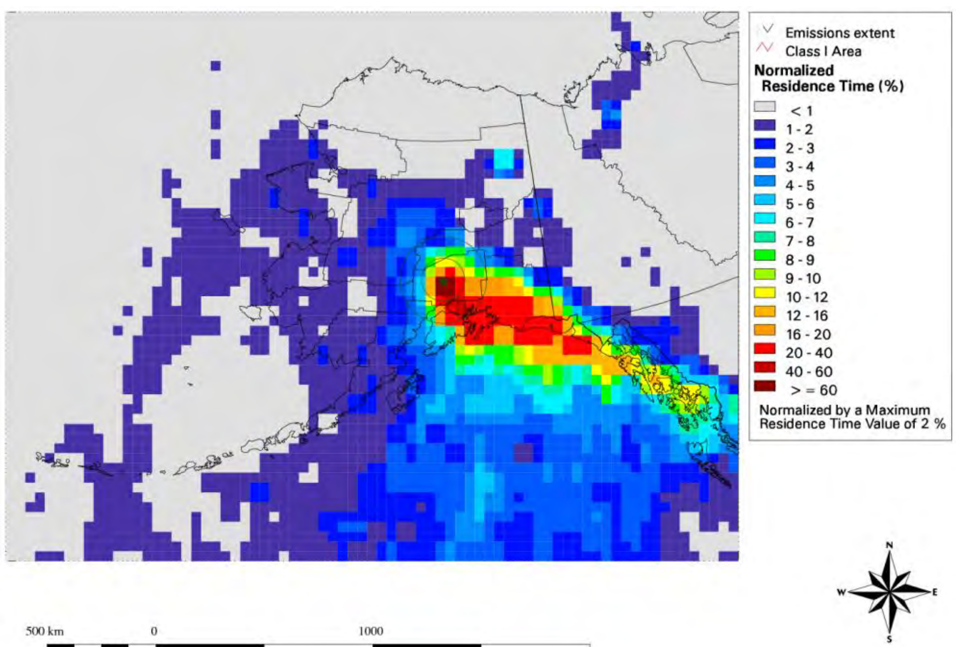


Figure III.K.7-5
Simeonof Wilderness, AK – Normalized Back-Trajectory Residence Time 20% Worst Visibility Days

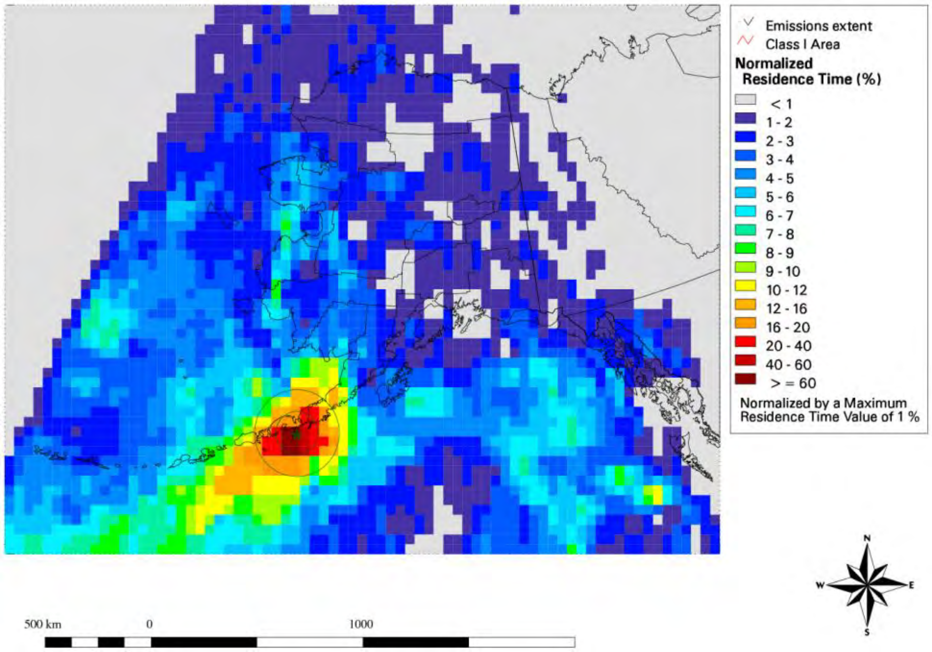


Figure III.K.7-6
Simeonof Wilderness, AK – Normalized Back-Trajectory Residence Time 20% Best Visibility Days

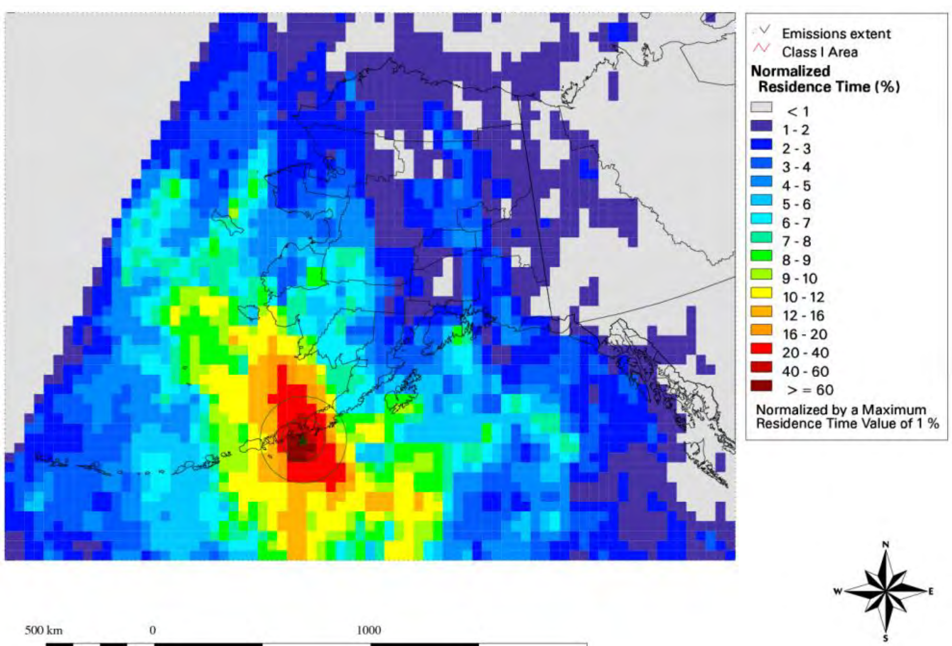


Figure III.K.7-7
Tuxedni – Normalized Back-Trajectory Residence Time 20% Worst Visibility Days

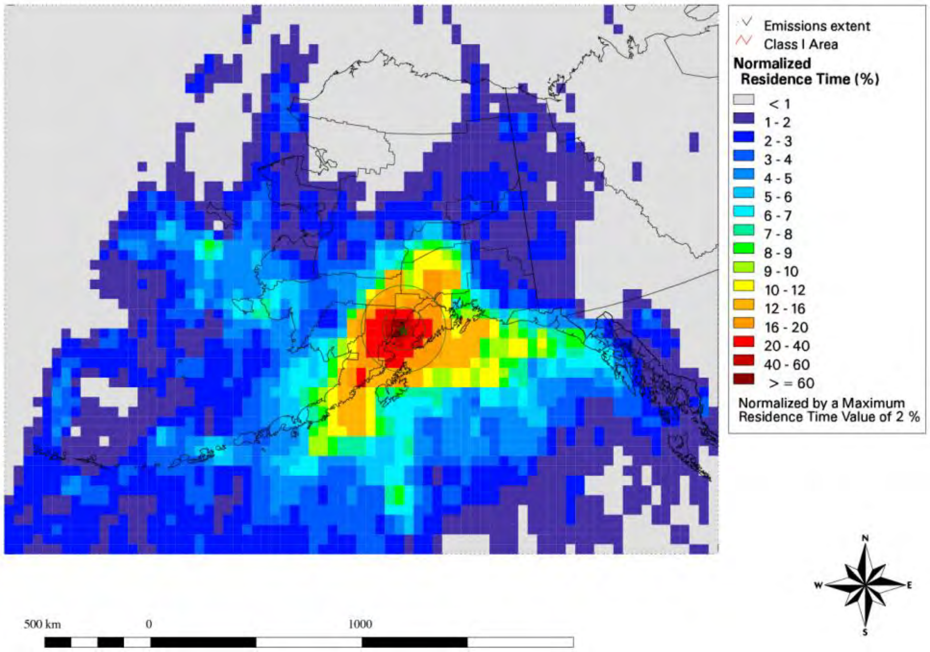
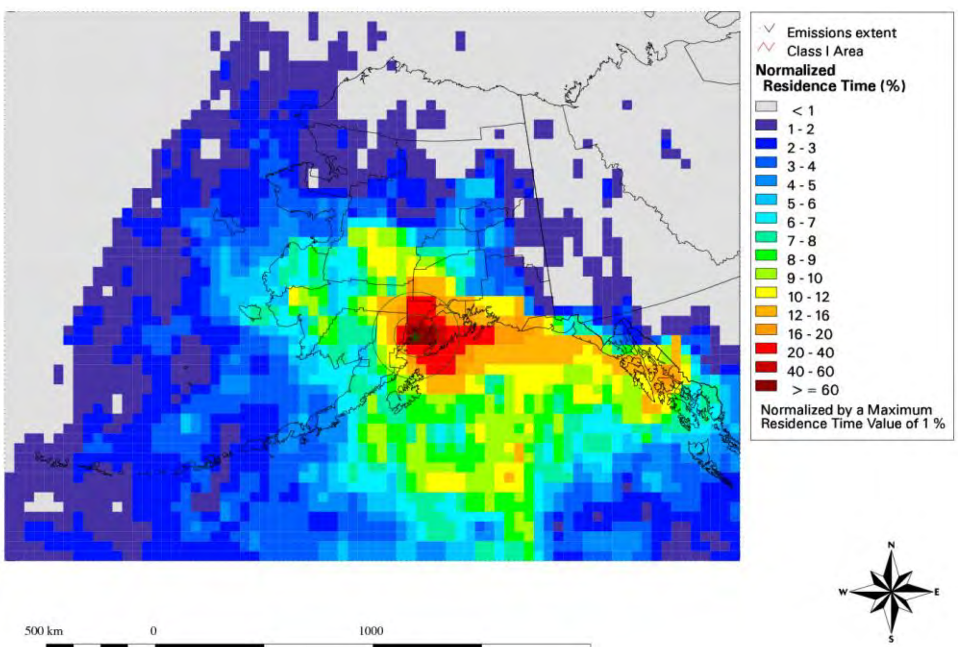


Figure III.K.7-8
Tuxedni – Normalized Back-Trajectory Residence Time 20% Best Visibility Days



time value observed, which is 2% for the 20% worst days at Denali. A similar, but a less symmetrical, pattern is seen in Figure III.K.7-3 for the 20% worst visibility days at Trapper Creek. It shows the area of maximum impact ranges in a more north south direction and suggests the Kenai could be a significant contributor in addition to Anchorage, Mat-Su, and Fairbanks. The influence of air from the Gulf of Alaska is also evident in Figure III.K.7-4 for the 20% best visibility days at Trapper Creek.

The pattern for the 20% worst visibility days at Simeonof displayed in Figure III.K.7-5 shows the area of maximum impact stretches toward the southwest, which is primarily open water. The residence time of locations in the central part of the state is shown to be much less. However, since the density of emissions within the Aleutian Islands is significantly lower than from the areas within the mainland, it will be important to account for the effect of residence time, distance, and emissions density when determining which sources are having the largest impact at Simeonof (and each of the other sites). Figure III.K.7-6 shows the 20% best days pattern of air impacting Simeonof is more from the northwest and southeast, with air from open water in both the Bering Sea and the Gulf of Alaska having significant residence time.

Figure III.K.7-7 shows that the pattern on the 20% worst days for Tuxedni is more symmetrical for the areas with the greatest residence time, and areas to the east have greater influence than those to the west. Clearly, sources located in the Kenai, Anchorage, and Mat-Su are likely to have a significant impact on this site. The pattern for the 20% best visibility days displayed in Figure III.K.7-8 is less symmetrical and shows again the influence of air parcels coming from the Gulf of Alaska.

It should be clear that residence time information by itself provides limited insight into assessing source significance. For this reason, as explained in the following section, it was combined with gridded emissions inventory estimates and distance to provide a more informed assessment of source apportionment.

C. Weighted Emissions Potential Analysis

The WEP analysis was developed as a screening tool for states to decide which source regions have the potential to contribute to haze formation at specific Class I areas, based on both the baseline 2002 and 2018 emissions inventories. Unlike the SOx/NOx Tracer analysis, this method does not account for chemistry and removal processes. Instead, the WEP analysis relies on an integration of gridded emissions data, meteorological back trajectory residence time data, a one-over-distance factor to approximate deposition and dispersion, and a normalization of the final results. Residence time over an area is indicative of general flow patterns, but does not necessarily imply the area contributed significantly to haze at a given receptor. Therefore, where possible it is important to use WEP analysis as one piece of a larger, more comprehensive weight of evidence analysis. For Alaska, however, no additional evidence is available from modeling to provide additional insight. For this reason, the results of the WEP analysis provide the principal insight into location and source significance and how that significance is forecast to change over time.

A description of the emissions data and source categories used in the WEP analysis was presented in Section III.K.5. Annual estimates from the statewide emissions inventory were processed into 45-km grid cells for six pollutants:

- $PM_{2.5}$
- VOC
- SOx
- NOx
- NH_3
- PM_{10}

As described earlier in this Section III.K.7.B, back trajectory residence time estimates were prepared using NOAA's HYSPLIT model. ENVIRON prepared the WEP analysis for Alaska, which consisted of weighting the annual gridded emissions (by pollutant and source category) by the worst and best extinction days' residence times for the five-year baseline period. To account for the effect of deposition along the trajectories, the result was further weighted by a one-over-distance factor, measured as the distance in km between the centroid of each emissions grid cell and the centroid of the grid cell containing the Class I area monitoring site.

The home grid cell was weighted by one-fourth of the 45-km grid cell difference to avoid an overly large response in that grid cell. The resulting weighted emissions field was normalized by the highest grid cell to ease interpreting the results. The WEP results were also normalized to baseline calendar year 2002 emissions. In other words, for each site and pollutant, WEP values total 100 (or 100%) across all source sectors and grid cells. The 2018 results were then scaled relative to the normalized 2002 baseline so that actual changes in weighted emissions between calendar years are evident.

ENVIRON prepared a series of maps to display the results of the Alaska analysis. Figures III.K.7-9 and III.K.7-10 display the results for the 20% worst days in 2002-2004 and 2018 for $PM_{2.5}$ impacting Denali. As with the back trajectory plots, color is used to identify differences in that magnitude of WEP values calculated for each location. They show areas with the highest values are located nearby to the north, east, and west of the site. Areas with lower impacts are more broadly scattered throughout the state. A comparison between the 2002-2004 and 2018 displays shows that higher values were calculated for some nearby locations in 2018. The problem with these maps is that it is difficult to determine the identity of the areas impacting the sites and they provide no insight into individual sources. Thus, a different method was needed to organize the data so it would be easier to determine which locations and sources are most significant and how they change over time.

This was accomplished by aggregating the WEP results for each grid cell into counties (i.e., boroughs) in which the emission sources are located. These values were organized by Class I site, year, pollutant, source category, and county, and the WEP values for the top three boroughs[*]

[*] After examining the data, it was determined that the top 3-Boroughs, with a few exceptions, accounted for 97+% of pollutant specific WEP values impacting each monitor.

Figure III.K.7-9
Denali National Park, AK – Normalized Weighted Emission Potential (WEP) for Fine Particulate Matter ($PM_{2.5}$) 2002-04 Baseline, 20% Worst Visibility Days

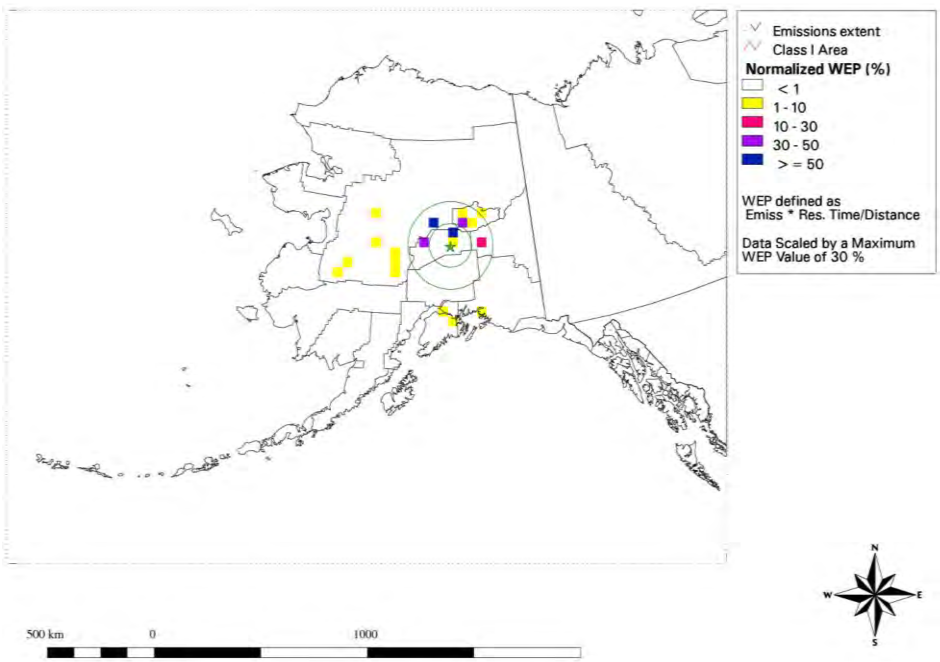
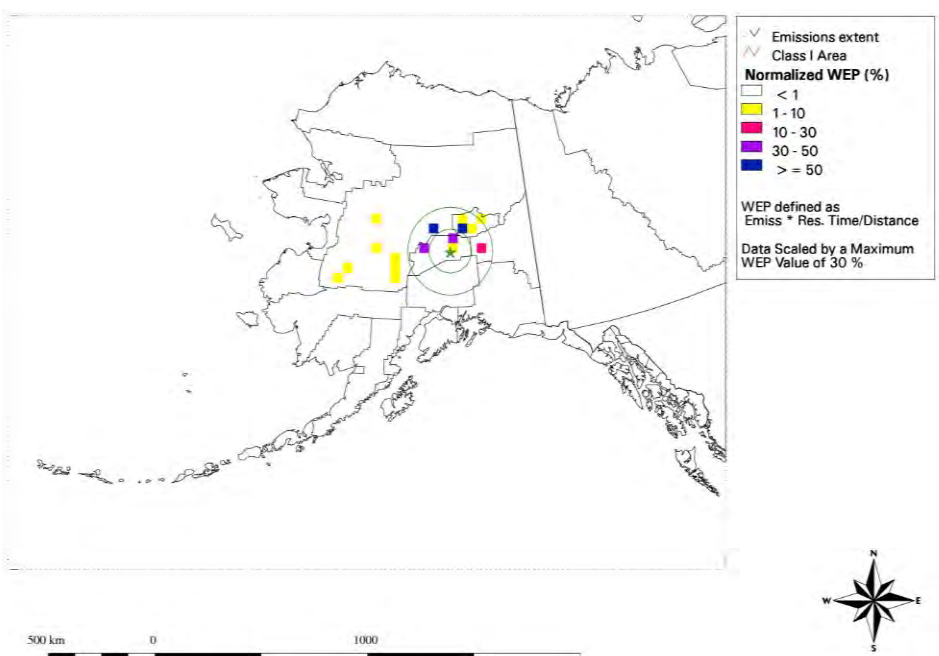


Figure III.K.7-10
Denali National Park, AK – Normalized Weighted Emission Potential (WEP) for Fine Particulate Matter ($PM_{2.5}$) 2018 Base Case, 20% Worst Visibility Days



impacting each site were extracted. Those values are displayed in Tables III.K.7-1 through III.K.7-4 for sources impacting each Class I area. Color is used to direct attention to the most significant WEP values, a legend for the values represented by each color is located at the bottom of each table. Red is the most significant and ―clear" (i.e., no shading) is the least (values less than 10).

1. Denali

Table III.K.7-1 summarizes the WEP values from the top three boroughs for each pollutant on the 20% worst days. The right-most column presents the total normalized WEP value for each pollutant, year, and borough across all source types.* As can be seen for $PM_{2.5}$, the total WEP value for the three boroughs is 95.5 in 2002 and 95.9 in 2018, an increase of 0.4. Changes in the total values across the boroughs provide insight into which pollutants are being impacted by anthropogenic activity since the values from the natural fires and anthropogenic fires are held constant. The most striking feature of the table is that natural fires are the dominant source for all of the pollutants displayed—no other source is significant for $PM_{2.5}$. For VOC, the stationary area source is the second largest source, but the forecast shows that its share is declining as is the total predicted WEP. For NOx, the Fairbanks point sources are shown to have a WEP increase of roughly 3. Offsetting reductions in the other boroughs and sources, however, limit the overall increase in NOx to 1.5. More significantly, Fairbanks point sources are forecast to have a SOx WEP increase of 11.6.

Overall, the information presented in Table III.K.7-1 demonstrates that the only anthropogenic source of concern impacting Denali is Fairbanks point source SOx emissions.

2. Simeonof

A summary of the WEP values from the top three boroughs impacting Simeonof is presented in Table III.K.7-2. It shows that the natural fires in Yukon-Koyukuk are the dominant source of all pollutants impacting the site. The totals for each pollutant demonstrate that there is little change forecast, either up or down, which means that none of the anthropogenic sources is forecast to have a significant change in activity or emissions impacting the site.

Overall, the information presented in Table III.K.7-2 shows that natural fires are the dominant source of emissions impacting the site and that no anthropogenic source is identified as having a significant impact on the site.

3. Trapper Creek

The information presented in Table III.K.7-3 also shows that natural fires are the largest source of emissions impacting that site. WEP values, however, are highlighted for several other source

* Anthropogenic fires are prescribed fires and are not displayed because their WEP values are barely detectible (i.e., 4th decimal place) or zero for all boroughs impacting the Class I sites. Similarly, values for aviation were not displayed because their values, with a few exceptions, that will be discussed when relevant, are well less than and not a significant contributor to the WEP. The totals displayed in Tables III.K.7-1 – III.K.7-.4, however, include the contribution of anthropogenic fires and aviation for the boroughs displayed.

categories. On-road mobile sources are shown to have a VOC value of greater than 10. However, they are also shown to have a declining impact over the 2002-2018 period reflecting the benefits of fleet turnover and increasingly stringent federal motor vehicle emissions standards. Point source NOx emissions are also shown to have WEP values exceeding 10; however, they are forecast to have a declining impact over the forecast period. Stationary area sources in Mat-Su are shown to have WEP values above 10 and to be increasing for $PM_{2.5}$, VOC, and SOx over the forecast period. Reductions from other anthropogenic sources, however, reduce the increase in the total VOC WEP to 1.6.

Overall, the information presented in Table III.K.7-3 shows that while natural fires are the largest source of emissions, stationary area sources from Mat-Su are forecast to experience a WEP increase of 5.5 for $PM_{2.5}$ and 9.2 for SOx. The 4.1 increase forecast for Mat-Su VOC is largely offset by reductions in other sources.

4. Tuxedni

The information presented in Table III.K.7-4 shows a more complex mixture of source contributions than seen for the previous sites. While natural fires are still a significant source for many of the pollutants, several other source categories show a large and even greater contribution for some of the pollutants. Point sources located in the Kenai Peninsula are shown to be the largest source of NOx emissions, but they are forecast to decline substantially. They are also shown to be the largest source of NH_3 emissions in 2018; the WEP is forecast to almost double from 2002 to 2018. While VOC levels from point sources in the Kenai are shown to increase by 5.2 from 2002 to 2018, that increase is largely offset by decreases in other sources since the overall value from the three boroughs is predicted to increase by 0.5. Stationary area sources in the Kenai are shown to have slight increases for $PM_{2.5}$, VOC, and SOx emissions. Again, the increase in overall VOC is shown to be only 0.5, so the impact of the area source increase is not significant. Similarly, the WEP increase of 3.2 forecast for Kenai area SOx sources is dramatically offset by the reduction in commercial marine vessels values so that the overall forecast for SOx values drops by more than 12.

Overall, the information presented for Tuxedni shows that the only concern is the very large increase in NH_3 emissions coming from point sources in the Kenai Peninsula.

5. Summary

Before reaching conclusions from the WEP values displayed in Tables III.K.7-1 – III.K.7-4, it is important to review the trends in total WEP values forecast for all boroughs impacting each site. A summary of those values is presented in Table III.K.7-5. Overall, it shows a mixed picture for each site, with some values decreasing and some increasing. Denali and Simeonof are shown to have no significant change in emissions. Trapper Creek is shown to have WEP increases of 6.0 and 7.7 for $PM_{2.5}$ and for NH_3 respectively. Tuxedni is shown to have a very large increase in NH_3 with either declines or modest increases in the other pollutants.

Table III.K.7-1
Summary of Boroughs With Highest Weighted Emission Potential, Impacting Denali Monitoring Site on 20% Worst Days

Borough	Year	Commercial Marine Vessels	Natural Fires	Non-Road Mobile	On-Road Mobile	Point	Stationary Area	Total
$PM_{2.5}$								
Yukon-Koyukuk CA	2002	0.0	61.6	0.0	0.0	0.0	0.3	61.9
	2018	0.0	61.6	0.0	0.0	0.0	0.3	61.9
Southeast Fairbanks	2002	0.0	28.7	0.0	0.0	0.0	1.1	29.8
	2018	0.0	28.7	0.0	0.0	0.0	1.4	30.1
Fairbanks North Star	2002	0.0	2.3	0.0	0.0	0.0	1.3	3.7
	2018	0.0	2.3	0.0	0.0	0.0	1.5	3.9
Total	2002	0.0	92.6	0.0	0.0	0.0	2.7	95.5
	2018	0.0	92.6	0.0	0.0	0.0	3.2	95.9
VOC								
Yukon-Koyukuk CA	2002	0.0	43.6	0.1	0.0	0.0	1.7	45.3
	2018	0.0	43.6	0.0	0.0	0.0	1.5	45.2
Southeast Fairbanks	2002	0.0	19.3	0.1	0.0	0.0	6.4	25.9
	2018	0.0	19.3	0.2	0.0	0.0	8.2	27.8
Denali Borough	2002	0.0	0.0	0.4	0.0	0.0	21.3	21.8
	2018	0.0	0.0	0.4	0.0	0.0	19.2	19.7
Total	2002	0.0	62.9	0.6	0.1	0.0	29.3	93.1
	2018	0.0	62.9	0.6	0.1	0.0	28.9	92.6
NOx								
Yukon-Koyukuk CA	2002	0.0	44.1	0.0	0.1	0.0	0.2	44.4
	2018	0.0	44.1	0.0	0.0	0.0	0.1	44.3
Southeast Fairbanks	2002	0.0	19.6	0.0	0.0	1.0	1.5	22.2
	2018	0.0	19.6	0.0	0.0	0.8	1.9	22.5
Fairbanks North Star	2002	0.0	1.6	0.5	2.5	10.8	0.4	16.3
	2018	0.0	1.6	0.2	0.8	13.7	0.4	17.5
Total	2002	0.0	65.3	0.6	2.6	11.8	2.0	82.9
	2018	0.0	65.3	0.3	0.9	14.5	2.5	84.4
SOx								
Fairbanks North Star	2002	0.0	1.3	0.0	0.3	23.7	2.6	28.0
	2018	0.0	1.3	0.0	0.0	35.3	3.0	39.8
Yukon-Koyukuk CA	2002	0.0	35.8	0.0	0.0	0.0	0.1	35.9
	2018	0.0	35.8	0.0	0.0	0.0	0.1	35.9
Southeast Fairbanks	2002	0.0	15.9	0.0	0.0	1.3	0.1	17.4
	2018	0.0	15.9	0.0	0.0	0.8	0.2	16.9
Total	2002	0.0	52.9	0.0	0.4	25.0	2.8	81.3
	2018	0.0	52.9	0.0	0.0	36.1	3.3	92.6
NH_3								
Yukon-Koyukuk CA	2002	0.0	65.9	0.0	0.0	0.0	0.0	65.9
	2018	0.0	65.9	0.0	0.0	0.0	0.0	65.9
Southeast Fairbanks	2002	0.0	29.2	0.0	0.0	0.0	0.0	29.2
	2018	0.0	29.2	0.0	0.0	0.0	0.0	29.2
Fairbanks North Star	2002	0.0	2.4	0.0	0.7	0.1	0.0	3.2
	2018	0.0	2.4	0.0	0.7	0.1	0.0	3.3
Total	2002	0.0	97.5	0.0	0.7	0.1	0.0	98.3
	2018	0.0	97.5	0.0	0.8	0.1	0.0	98.4

Shading: clear (0-9.9), yellow (10-24.9), orange (25-49.9), red (50+), gray (totals)

Table III.K.7-2
Summary of Boroughs With Highest Weighted Emission Potential, Impacting Simeonof Monitoring Site on 20% Worst Days

Borough	Year	Commercial Marine Vessels	Natural Fires	Non-Road Mobile	On-Road Mobile	Point	Stationary Area	Total
$PM_{2.5}$								
Yukon-Koyukuk CA	2002	0.0	88.0	0.0	0.0	0.0	0.2	88.3
	2018	0.0	88.0	0.0	0.0	0.0	0.2	88.3
Southeast Fairbanks	2002	0.0	2.5	0.0	0.0	0.0	0.3	2.8
	2018	0.0	2.5	0.0	0.0	0.0	0.4	2.9
Fairbanks North Star	2002	0.0	0.7	0.0	0.0	0.0	0.2	0.9
	2018	0.0	0.7	0.0	0.0	0.0	0.2	0.9
Total	2002	0.0	91.3	0.0	0.0	0.0	0.7	92.0
	2018	0.0	91.3	0.0	0.0	0.0	0.8	92.1
VOC								
Yukon-Koyukuk CA	2002	0.0	67.5	0.0	0.0	0.0	1.1	68.7
	2018	0.0	67.5	0.0	0.0	0.0	1.0	68.5
Dillingham CA	2002	0.0	0.0	0.2	0.0	0.0	4.7	5.0
	2018	0.0	0.0	0.2	0.0	0.0	4.9	5.2
Southeast Fairbanks	2002	0.0	1.8	0.0	0.0	0.0	2.1	3.9
	2018	0.0	1.8	0.1	0.0	0.0	2.6	4.5
Total	2002	0.0	69.3	0.3	0.0	0.0	7.9	77.6
	2018	0.0	69.3	0.3	0.0	0.0	8.5	78.3
NOx								
Yukon-Koyukuk CA	2002	0.0	53.8	0.0	0.0	0.1	0.1	54.0
	2018	0.0	53.8	0.0	0.0	0.1	0.1	54.0
North Slope Borough	2002	0.0	0.0	0.0	0.0	9.6	0.0	9.6
	2018	0.0	0.0	0.0	0.0	7.4	0.0	7.5
Kenai Peninsula	2002	0.4	0.0	0.0	0.1	6.2	0.2	7.0
	2018	0.7	0.0	0.0	0.1	5.3	0.2	6.2
Total	2002	0.4	53.8	0.1	0.2	15.8	0.3	70.6
	2018	0.7	53.8	0.1	0.1	12.8	0.3	67.6
SOx								
Yukon-Koyukuk CA	2002	0.0	73.9	0.0	0.0	0.0	0.1	74.0
	2018	0.0	73.9	0.0	0.0	0.0	0.1	74.0
Fairbanks North Star	2002	0.0	0.6	0.0	0.1	3.2	0.4	4.3
	2018	0.0	0.6	0.0	0.0	4.4	0.5	5.5
Dillingham CA	2002	0.1	0.0	0.1	0.0	0.6	2.0	2.8
	2018	0.0	0.0	0.1	0.0	0.6	2.1	2.7
Total	2002	0.1	74.5	0.1	0.1	3.7	2.5	81.1
	2018	0.0	74.5	0.1	0.0	5.0	2.6	82.3
NH_3								
Yukon-Koyukuk CA	2002	0.0	91.0	0.0	0.0	0.0	0.0	91.0
	2018	0.0	91.0	0.0	0.0	0.0	0.0	91.0
Kenai Peninsula	2002	0.0	0.0	0.0	0.1	2.0	0.0	2.1
	2018	0.0	0.0	0.0	0.1	3.8	0.0	3.9
Southeast Fairbanks	2002	0.0	2.5	0.0	0.0	0.0	0.0	2.5
	2018	0.0	2.5	0.0	0.0	0.0	0.0	2.5
Total	2002	0.0	93.5	0.0	0.1	2.0	0.0	95.5
	2018	0.0	93.5	0.0	0.1	3.8	0.0	97.4

Shading: clear (0-9.9), yellow (10-24.9), orange (25-49.9), red (50+), gray (totals)

Table III.K.7-3
Summary of Boroughs With Highest Weighted Emission Potential, Impacting Trapper Creek Monitoring Site on 20% Worst Days

Borough	Year	Commercial Marine Vessels	Natural Fires	Non-Road Mobile	On-Road Mobile	Point	Stationary Area	Total
				$PM_{2.5}$				
Yukon-Koyukuk CA	2002	0.0	63.7	0.0	0.0	0.0	0.2	63.8
	2018	0.0	63.7	0.0	0.0	0.0	0.1	63.8
Matanuska-Susitna	2002	0.0	4.0	0.3	0.2	0.0	10.9	16.3
	2018	0.0	4.0	0.2	0.1	0.0	16.4	22.0
Southeast Fairbanks	2002	0.0	14.8	0.0	0.0	0.0	0.8	15.6
	2018	0.0	14.8	0.0	0.0	0.0	1.0	15.8
Total	2002	0.0	82.4	0.3	0.2	0.0	11.8	95.7
	2018	0.0	82.4	0.2	0.1	0.0	17.5	101.6
				VOC				
Yukon-Koyukuk CA	2002	0.0	43.7	0.0	0.0	0.0	0.7	44.4
	2018	0.0	43.7	0.0	0.0	0.0	0.6	44.3
Matanuska-Susitna	2002	0.0	2.6	5.0	10.2	0.2	8.5	28.0
	2018	0.0	2.6	6.2	4.6	0.3	12.6	28.4
Southeast Fairbanks	2002	0.0	9.6	0.1	0.0	0.0	4.5	14.3
	2018	0.0	9.6	0.1	0.0	0.0	5.8	15.6
Total	2002	0.0	56.0	5.1	10.2	0.2	13.7	86.7
	2018	0.0	56.0	6.3	4.6	0.3	19.0	88.3
				NOx				
Matanuska-Susitna	2002	0.1	1.7	3.6	14.3	8.2	4.5	37.8
	2018	0.1	1.7	2.6	6.9	9.0	6.4	33.3
Yukon-Koyukuk CA	2002	0.0	28.3	0.0	0.0	0.0	0.0	28.4
	2018	0.0	28.3	0.0	0.0	0.0	0.0	28.4
Kenai Peninsula	2002	2.9	0.0	0.1	0.3	18.0	0.4	21.7
	2018	4.6	0.0	0.1	0.1	15.7	0.5	21.0
Total	2002	3.0	30.0	3.7	14.6	26.2	5.0	87.9
	2018	4.7	30.0	2.7	7.1	24.7	6.9	82.6
				SOx				
Yukon-Koyukuk CA	2002	0.0	44.1	0.0	0.0	0.0	0.1	44.2
	2018	0.0	44.1	0.0	0.0	0.0	0.1	44.2
Matanuska-Susitna	2002	0.1	2.6	0.0	3.9	0.0	14.5	25.0
	2018	0.0	2.6	0.0	0.5	0.0	23.7	31.7
Fairbanks North Star	2002	0.0	0.8	0.0	0.1	6.3	0.8	8.1
	2018	0.0	0.8	0.0	0.0	8.8	1.0	10.6
Total	2002	0.1	47.5	0.0	4.0	6.3	15.4	77.2
	2018	0.0	47.5	0.0	0.5	8.9	24.7	86.5
				NH_3				
Yukon-Koyukuk CA	2002	0.0	66.5	0.0	0.0	0.0	0.0	66.5
	2018	0.0	66.5	0.0	0.0	0.0	0.0	66.5
Southeast Fairbanks	2002	0.0	14.7	0.0	0.0	0.0	0.0	14.7
	2018	0.0	14.7	0.0	0.0	0.0	0.0	14.7
Matanuska-Susitna	2002	0.0	4.0	0.0	7.0	0.0	0.0	11.0
	2018	0.0	4.0	0.1	9.7	0.0	0.0	13.9
Total	2002	0.0	85.2	0.0	7.0	0.0	0.0	92.3
	2018	0.0	85.2	0.1	9.7	0.0	0.0	95.2

Shading: clear (0-9.9), yellow (10-24.9), orange (25-49.9), red (50+), gray (totals)

Table III.K.7-4
Summary of Boroughs With Highest Weighted Emission Potential, Impacting Tuxedni Monitoring Site on 20% Worst Days

Borough	Year	Commercial Marine Vessels	Natural Fires	Non-Road Mobile	On-Road Mobile	Point	Stationary Area	Total
$PM_{2.5}$								
Yukon-Koyukuk CA	2002	0.0	71.7	0.0	0.0	0.0	0.1	71.9
	2018	0.0	71.7	0.0	0.0	0.0	0.1	71.9
Kenai Peninsula	2002	0.2	0.0	0.3	0.2	0.6	16.3	17.8
	2018	0.4	0.0	0.2	0.1	0.0	17.9	18.8
Matanuska-Susitna	2002	0.0	0.8	0.1	0.0	0.0	2.4	3.6
	2018	0.0	0.8	0.1	0.0	0.0	3.3	4.5
Total	2002	0.2	72.5	0.4	0.3	0.6	18.8	93.2
	2018	0.4	72.5	0.3	0.1	0.0	21.4	95.2
VOC								
Kenai Peninsula	2002	0.1	0.0	5.7	8.9	16.9	15.4	47.1
	2018	0.2	0.0	5.0	3.0	22.1	17.2	47.7
Yukon-Koyukuk CA	2002	0.0	36.2	0.0	0.0	0.0	0.5	36.6
	2018	0.0	36.2	0.0	0.0	0.0	0.4	36.6
Matanuska-Susitna	2002	0.0	0.4	0.7	1.9	0.1	1.8	5.2
	2018	0.0	0.4	0.9	0.8	0.1	2.6	5.1
Total	2002	0.1	36.6	6.4	10.8	17.0	17.7	88.9
	2018	0.3	36.6	5.9	3.8	22.2	20.2	89.4
NOx								
Kenai Peninsula	2002	3.5	0.0	1.8	8.0	60.9	2.1	76.3
	2018	5.0	0.0	0.9	2.7	48.7	2.3	59.6
Yukon-Koyukuk CA	2002	0.0	13.9	0.0	0.0	0.0	0.0	13.9
	2018	0.0	13.9	0.0	0.0	0.0	0.0	13.9
Matanuska-Susitna	2002	0.0	0.2	0.4	1.5	1.6	0.6	5.3
	2018	0.0	0.2	0.3	0.7	1.8	0.8	4.9
Total	2002	3.5	14.0	2.2	9.5	62.6	2.7	95.6
	2018	5.1	14.0	1.2	3.4	50.5	3.1	78.5
SOx								
Yukon-Koyukuk CA	2002	0.0	39.3	0.0	0.0	0.0	0.0	39.3
	2018	0.0	39.3	0.0	0.0	0.0	0.0	39.3
Kenai Peninsula	2002	13.7	0.0	0.0	3.9	4.3	25.7	47.7
	2018	0.7	0.0	0.0	0.3	5.0	28.9	35.0
Matanuska-Susitna	2002	0.0	0.4	0.0	0.8	0.0	1.3	3.7
	2018	0.0	0.4	0.0	0.1	0.0	2.1	4.1
Total	2002	13.8	39.7	0.0	4.7	4.3	27.0	90.7
	2018	0.7	39.7	0.0	0.4	5.0	31.1	78.4
NH_3								
Kenai Peninsula	2002	0.0	0.0	0.0	5.3	37.9	0.0	43.3
	2018	0.0	0.0	0.0	5.7	72.4	0.0	78.1
Yukon-Koyukuk CA	2002	0.0	51.5	0.0	0.0	0.0	0.0	51.5
	2018	0.0	51.5	0.0	0.0	0.0	0.0	51.5
Matanuska-Susitna	2002	0.0	0.6	0.0	1.2	0.0	0.0	1.8
	2018	0.0	0.6	0.0	1.6	0.0	0.0	2.2
Total	2002	0.0	52.1	0.0	6.6	37.9	0.0	96.6
	2018	0.0	52.1	0.0	7.3	72.4	0.0	131.8

Shading: clear (0-9.9), yellow (10-24.9), orange (25-49.9), red (50+), gray (totals)

Table III.K.7-5
Summary of Total Weighted Emission Potential From All Boroughs Impacting Each Site on 20% Worst Days

Class I Site	Year	$PM_{2.5}$	VOC	NOx	SOx	NH_3
Denali	2002	100.0	100.0	100.0	100.0	100.0
	2018	100.2	99.1	99.5	100.8	101.1
	Change	0.2	-0.9	-0.5	0.8	1.1
Simeonof	2002	100.0	100.0	100.0	100.0	100.0
	2018	100.3	102.8	97.2	97.8	102.0
	Change	0.3	2.8	-2.8	-2.2	2.0
Trapper Creek	2002	100.0	100.0	100.0	100.0	100.0
	2018	106.0	102.2	94.9	100.9	107.7
	Change	6.0	2.2	-5.1	0.9	7.7
Tuxedni	2002	100.0	100.0	100.0	100.0	100.0
	2018	102.1	101.0	82.9	87.0	135.2
	Change	2.1	1.0	-17.1	-13.0	-35.2

It is useful to contrast the change in total WEP values with the summaries reached for the top three boroughs for each site to see if any revisions are needed:

- Denali – The large increase in point source SOx from the Kenai seen in Table III.K.7-1 is largely offset by reductions from other sources to a value of less than 1.0. All of the other anthropogenic sources show either a decline or a negligible increase. These forecasts do not account for the emissions from the HCCP at the GVEA facility in Healy (i.e., unit # 2). That facility did not operate in 2002 and is not currently operating, but is permitted to operate. If brought on line, the point source NOx emitted within the Denali Borough would increase by a factor of 4.0 and the SOx would increase by a factor of 2.8 (based on permitted not actual emissions). This increase would make the Denali Borough the largest sources of anthropogenic emissions and the second largest source of all emissions impacting the Denali monitors. It should be noted that HCCP will likely emit less than its permit emission threshold when actually operating, thus this analysis is highly conservative in representing potential impacts from the future operation of this unit.

- Simeonof – Table III.K.7-2 showed that natural fires are the dominant source of pollutants impacting this site; no anthropogenic source was shown to have a significant impact. The totals displayed in Table III.K.7-5 show the addition of the other boroughs change that assessment since a small WEP increase in VOC and NH_3 is shown along with a small WEP decrease in NOx and SOx; the increase shown for $PM_{2.5}$ is negligible.

- Trapper Creek – The addition of the other boroughs significantly offsets the increase in SOx and VOC WEP values seen in Table III.K.7-3. SOx is reduced to a value of less than 1.0 and VOC is reduced to 2.2. On the other hand, the WEP increase seen for $PM_{2.5}$

increased slightly from 5.5 to 6.0 when all boroughs are considered, with most of the increase coming from Mat-Su area sources. The NH_3 WEP increase of 2.8 seen across the three boroughs increased to 7.7 when all of the boroughs are considered, with 2.7 of that increase being attributable to on-road vehicle activity in Mat-Su. The remainder comes from increased vehicle activity in other boroughs.

- Tuxedni – The principal finding that there is a large increase in NH_3 emissions coming from point sources in the Kenai Peninsula. The NH_3 emissions are primarily from a BART-eligible facility, the Agrium Chem-Urea plant, which was operational in 2002 and projected to 2018, but that is currently shut down. As discussed in Section III.K.6, these emissions effectively no longer exist and if the facility restarts would be subject to PSD permitting.