NPS Air Resources Division (ARD)
Response to VISTAS[1] Source Selection & Technical Analysis
for Regional Haze State Implementation Plan (SIP) Development
May 14, 2021

INTRODUCTION

Air clarity is essential for experiencing the crisp detail and vivid colors that make the sweeping views of Shenandoah and Great Smoky Mountains National Park so spectacular. It is also critically important for the quality of closer views at Mammoth Cave and Everglades National Parks. Far too often these views and those in other Class I areas are diminished by air pollution.

Under the Clean Air Act, states must develop SIPs and update them every 10-years to prevent future and remedy existing manmade impairment of visibility in Class I national parks and wilderness areas. Clean, clear air is essential to park visitors and their ability to see scenic and cultural views. The Act and implementing regulations also underscore the importance of the federal agencies that manage Class I national parks and wilderness areas meaningfully informing the development of state plans.

In April 2021, NPS received federal land manager (FLM) review draft SIP documents from Florida and North Carolina. Although we have held several early engagement phone calls with states in the VISTAS region, the Florida and North Carolina documents are the first we have had the opportunity to thoroughly review in this round of SIP development. We understand that many of the VISTAS states may be taking a similar approach and are providing the following feedback and analysis products to the larger group in the interest of clear and open communication. We hope this will meaningfully inform the control determinations and long-term strategies adopted by the southeastern states in their final regional haze SIPs for the second planning period.

SUMMARY OF CONCERNS & RECOMMENDED SOLUTIONS

We have three significant concerns with the VISTAS approach to the second round of Regional Haze SIP development:

1. Arbitrary Screening Metrics Resulted in an Unreasonable Source Selection Outcome:

   The individual facility percent-of-total-impact metrics used by VISTAS states to screen sources in the source selection process were arbitrarily high and inherently less protective of the more-impacted Class I areas within the region, including Great Smoky Mountains National Park, Mammoth Cave National Park, and Shenandoah National Park. The small number of sources selected for four-factor analysis by VISTAS states represent a tiny fraction of the visibility impairing emissions that could have been analyzed for emission

[1] "VISTAS" is the Visibility Improvement State and Tribal Association of the Southeast, the Regional Planning Organization (RPO) supporting development of regional haze SIPs. Participating states: AL, FL, GA, KY, MS, NC, SC, TN, VA, and WV. (https://www.metro4-sesarm.org/)

reduction opportunities. Our review of the VISTAS source selection data reveals that the threshold for selecting an individual facility is **80 times** higher in the most-impacted Class I area than in the least-impacted Class I area within the VISTAS region. (This conclusion is based on the absolute value of the Class I area-specific individual-facility percent-based impact thresholds using the Area of Influence (AOI) results as a surrogate for impacts.)

→ This is problematic because the southeast region of the U.S. contains some of the most-impacted NPS Class I areas in the country.[2] The result of the VISTAS approach is that very few sources were selected for four-factor analysis for the Class I areas that still need some of the greatest emission reductions. It also generates a fairness and consistency issue when comparing implementation of Regional Haze requirements among the states. Many states with less impaired Class I areas in the western and northern U.S. evaluated a greater number of facilities for additional control in their second round of haze planning. Given this, it is difficult to construe the VISTAS approach and results as reasonable.

→ Solution: Discard the individual facility percent-based metric(s) and adopt a new source selection method that will capture a more reasonable subset of sources to review in a four-factor analysis using the existing VISTAS AOI data. Our recommendations for potential thresholds that would result in the selection of a more reasonable number of sources are described below. (See detailed descriptions in the following sections.)

2. Exclusion of NO_x/Nitrate in the Source Selection/Four-Factor Analysis Process:

VISTAS states are not considering nitrogen oxides (NO_x) in their four-factor analyses and did not adequately account for recent trends in ammonium nitrate (NH_4NO_3) contribution on the 20% most-impaired days (MID) in their source selection process. The NPS ARD finds that this is because VISTAS relied on an older visibility base year (2011) for their AOI and Photochemical Grid Modeling (PGM) source selection analyses, which does not adequately represent 'current year' NO_x and SO_2 emissions.

→ This is problematic because recent monitoring data demonstrate that ammonium nitrate is an increasingly important component of visibility impairment on the 20% MID for many of the VISTAS region Class I areas. This is an issue at Mammoth Cave, Shenandoah, and Great Smoky Mountains NPs. In Mammoth Cave NP, nitrate was the largest contributor to anthropogenic impairment on the 20% most-impaired days in 2018, comprising 45% of the total extinction. Based on recent 5-year averages, nitrate has surpassed organic carbon as the second-most important contributor to visibility impairment on the 20% most-impaired

[2] The top 10 most impaired NPS Class I areas on the 20% most impaired days (2014-2018) are: 1) Hawaii Volcanoes National Park, 2) Sequoia National Park, **3) Mammoth Cave National Park**, 4) Big Bend National Park, 5) Theodore Roosevelt National Park, 6) Guadalupe Mountains National Park, **7) Shenandoah National Park**, 8) Pinnacles National Park, **9) Great Smoky Mountains National Park**, and 10) Virgin Islands National Park.

days in Shenandoah NP and is on par with organic carbon contributions in Great Smoky Mountains NP.

→ Solution: VISTAS states should rely on the most-recent Class I area monitoring data when determining which pollutants to consider in reasonable progress control technology determinations rather than the modeling that relies on a significantly outdated base year.

3. Impermissible Justifications for Reasonable Progress Control Technology Determinations Using Visibility as a "Fifth Factor" and "Below the Glidepath" Arguments:

    a. We are concerned that many VISTAS states intend to rely on the "visibility benefit" of potential controls rather than the four statutory factors to conclude that additional emission reductions are not reasonable.

        → This is problematic because the Clean Air Act does not allow for considering visibility benefit in the reasonable progress determinations *for individual sources*. Rather, the Act outlines the four factors upon which control determinations are to be based.

        → Solution: Do not use visibility benefit as a "fifth factor" when making reasonable progress determinations for individual facilities.

    b. It appears that many VISTAS states intend to justify their source selection process outcome and control determinations (at least in part) on projections of 2028 visibility relative to the uniform rate of progress (URP) to conclude that, because they are below the URP, few sources need to be analyzed and that no additional measures are necessary or reasonable in this round of regional haze planning.

        → This is problematic because the preamble to the regional haze rule clearly states that the URP is not a "safe harbor" from selecting additional control measures to make reasonable progress in this round of regional haze planning.

        → Solution: States should evaluate a reasonable subset of facilities for four-factor analysis, regardless of where they are, or are projected to be, relative to the URP.

Each of these concerns is discussed in greater detail under the topic-specific headings below. We understand that the states within the VISTAS region intend to rely on the VISTAS data and technical work products to develop their SIPs. Recent FLM review draft SIP submittals from North Carolina and Florida confirm our understanding outlined above. As such, we provide examples from these documents below. *Please note, we anticipate that these comments will apply to states across the VISTAS region because they address broad concerns with the VISTAS approach*.

DETAILED DISCUSSION

ISSUE 1: ARBITRARY SCREENING METRICS RESULTED IN AN UNREASONABLE SOURCE SELECTION OUTCOME IN THE VISTAS REGION

The *individual facility percent-of-total-impact* metrics developed by VISTAS to select facilities for the four-factor analyses provides significantly less protection for the most-impaired Class I areas in the VISTAS region when compared with the less-impaired areas. The outcome of this approach is at odds with the purpose of the visibility protection provisions of the CAA to "remedy existing" visibility impairment. Under the statute and its implementing regulations, all 20 Class I areas in the VISTAS region have the same visibility goal of reaching natural visibility conditions by 2064. It stands to reason that making reasonable progress toward attaining natural visibility conditions the most visually impaired Class I areas will require the most stringent emission reduction efforts. In practice, this is the complete inverse of the VISTAS approach which is more rigorous for the less-impaired Class I areas.

(Note that many of the examples provided below address the VISTAS AOI analyses specifically. The same concept/concern applies to the second screening step which involved running a photochemical grid model (Comprehensive Air quality Model with extensions—CAMx) with the Particulate Matter Source Apportionment Technology (PSAT) tool to "tag" specific facilities and apply a 1% of total impairment threshold to trigger analysis for any "tagged" facility.)

The effect of the percent-of-total-impact based approach is aptly described in Florida's FLM review draft Regional Haze SIP:

> Point sources contribute a much smaller absolute amount of visibility impairment in Mm^{-1} at Everglades compared to Point sources contributing to other Class I areas.This makes the 1.00% screening threshold even more stringent for Everglades.[3]

While we are pleased that Florida is emphasizing visibility improvement in Everglades NP, this illustrates the inherent unfairness of the percent-based metrics when applied across all VISTAS Class I areas.

Using the VISTAS AOI results spreadsheets,[4] we compared the absolute values of the total Class I area-specific impacts for each Class I area in the VISTAS region (calculations described below). We found that using the *individual facility percent-of-total-impact* based metric developed by VISTAS results in an absolute value threshold for selecting a source for four-factor analysis that is as much as 80 times greater in the most-impacted Class I area (Dolly Sods Wilderness Area, West Virginia) versus the least-impacted Class I area (Everglades NP, Florida) in the VISTAS region. The results of this comparison are provided in Table 1 below.

---

[3] See the Florida draft FLM review SIP, page 264. *Note, VISTAS initially applied the "1.00% screening threshold" to individual facilities, citing the Cross-State Air Pollution Rule (CSAPR) as its justification. NPS ARD advised VISTAS that the CSAPR contribution threshold applied to an entire state's impact on the ozone NAAQS in a neighboring state and not individual facilities and VISTAS dropped this rationale but kept the 1% threshold.*

[4] See VISTAS AOI results available at: https://www.metro4-sesarm.org/content/task-5-area-influence-analysis

The VISTAS facility selection method is described in the final VISTAS AOI Analysis Results Report, as well as the Florida and North Carolina draft SIPs.[5] We anticipate that the nearly identical language/analysis used in the Florida and North Carolina SIPs is likely to be reiterated in SIPs across the VISTAS region.

NPS Evaluation of the VISTAS AOI Screening Process

The first step in the VISTAS facility selection process was to calculate the extinction-weighted residence time (EWRT) for sulfate (SO_4) and nitrate (NO_3) *for each individual facility* and multiply each EWRT (SO_4 or NO_3) by sulfur dioxide (SO_2) or nitrogen oxide (NOx) emissions (Q) divided by distance (d in kilometers) for a given Class I area. This was done for all sources in the inventory for 2011 and 2028.

To compare the absolute values of the VISTAS individual facility percent-based metrics, the NPS used the 2028 absolute values of the EWRT*Q/d metrics for each source, summed over each Class I area to calculate the cumulative impact in the NPS Class I areas (these are the values in columns AA and AN in the VISTAS AOI analysis results spreadsheets available online).[6] For example, the 2028 total cumulative impact (TCI) for Everglades NP is 0.3000, where the TCI is defined as the sum of each facility's extinction-weighted residence time multiplied by the Q/d for SO_2 and NO_x over the entire Class I area (i.e., $\sum[(EWRT(SO_4)*Q/d(SO_2))+(EWRT(NO_3)*Q/d(NO_x))]$. Examples of this comparison across all VISTAS Class I areas are provided in the attached spreadsheet.[7]

Florida selected three facilities for 4FA due to impacts at Everglades NP. We used the Everglades NP example to develop a "test case" for comparing the percent-based metrics across Class I areas in the VISTAS region to the absolute value threshold for the "least-impacted" Class I area. The source with the smallest impact that was selected by Florida for 4FA is 0.0067 from a Mosaic fertilizer plant that affects Everglades NP.[8] However, selecting the same facility for 4FA at Chassahowitzka National Wildlife Refuge (a mandatory federal Class I areas administered by the US Fish & Wildlife Service) required an absolute value individual facility impact threshold 21 times higher than the value at Everglades NP.[9] Selecting a facility at the most impacted NPS Class I Area, Mammoth Cave NP, would require an individual facility absolute value threshold that is 74 times higher than the threshold at Everglades NP.

---

[5] From the Florida draft FLM review SIP, pages 245-246: "Florida, as well as the other VISTAS states, have used a two-step process for selecting sources. The first step was a screening analysis using the NO_x and SO_2 source category and facility contributions from the AoI analysis described in Section 7.5. The second step was CAMx PSAT modeling of the sources selected in step 1. Sources were then selected for reasonable progress analysis. This two-step process was used to select sources that have the largest contribution to visibility impairment, and thus, greatest opportunity for reasonable progress improvement, at Class I areas."
From the North Carolina draft FLM review SIP, pages 236-237: "North Carolina, as well as the other VISTAS states, used a two-step process for selecting sources. The first step was a screening analysis using the SO_2 and NO_x source category and facility contributions from the AoI analysis described in Section 7.5. The second step was CAMx PSAT modeling of the sources selected in the first step. Sources were then selected for reasonable progress analysis. This two-step process was used to select sources that have the largest contribution to visibility impairment, and thus, greatest opportunity for reasonable progress improvement, at Class I areas.

[6] See: https://www.metro4-sesarm.org/content/vistas-regional-haze-program

[7] See attached spreadsheet: AOI_impacts_threshold_compare.xlsx

[8] Florida selected the Mosaic plant based upon sulfate exceeding a 5% contribution with an absolute value of 0.0066.

[9] The 2028 Total EWRT*Q/d for SO_2 + NOx for Chassahowitzka NWR is 6.362.

North Carolina selected three facilities for 4FA with 2028 EWRT TCI ranging from 0.097 to 2.806. Although five NC facilities had a 2028 TCI value at Great Smoky Mountains NP greater than the 0.0067 absolute value for the facility selected by Florida for Everglades NP, none of these five were selected by North Carolina because their percent-of-total-impacts threshold was much higher at the more-impacted Class I areas. Therefore, the North Carolina facility selection process requires absolute value impacts that are 10 to 20 times greater at their Class I areas than Florida applied for Everglades NP.[10]

Table 1 below demonstrates this concept by comparing the 2028 EWRT TCI for each of the VISTAS Class I areas. This demonstrates that when applying any percent contribution threshold across all VISTAS Class I areas, fewer facilities are selected for 4FA evaluation at the most-impacted Class I areas because the value in the denominator of the percent-of-impact calculation can vary by up to 80 times the value in the least-impacted area.

[10] States used different criteria for "tagging" facilities for further analysis. North Carolina tagged for PSAT modeling all facilities in the state with an AoI contribution of ≥3% (rounded) for sulfate and nitrate combined. Florida requested that all facilities both within and outside Florida with an individual AoI contribution of ≥5% for nitrates (individual facility nitrate contribution divided by total nitrate contributions from EGU + non-EGU point sources) or sulfates (individual facility sulfate contribution divided by total sulfate contributions from EGU + non-EGU point sources) at a Florida Class I area or any nearby Class I area be tagged with PSAT.

Agency	Class I Area	State	Total Cumulative Impact 2028*	Ratio Relative to Lowest
NPS	Everglades NP	FL	0.30	1
FWS	St. Marks NWR	FL	1.96	7
FWS	Swanquarter NWR	NC	2.96	10
FWS	Okefenokee NWR	GA	3.02	10
USFS	Joyce Kilmer NF	TN	5.00	17
USFS	Linville Gorge WA	NC	5.27	18
USFS	Cohutta WA	GA	5.49	18
NPS	Great Smoky Mountains NP	NC/TN	5.68	19
USFS	Shining Rock WA	NC	5.86	20
FWS	Chassahowitzka NWR	FL	6.36	21
USFS	Sipsey WA	AL	6.47	22
FWS	Cape Romain NWR	SC	8.01	27
USFS	James River Face WA	VA	8.32	28
NPS	Shenandoah NP	VA	9.54	32
USFS	Otter Creek WA	WV	20.65	69
NPS	Mammoth Cave NP	KY	22.35	74
USFS	Dolly Sods WA	WV	23.85	80

*Class I areas ranked from least impacted (using cumulative EWRT*Q/d) to most impacted.

***Table 1**: VISTAS class I areas ranked from least to greatest projected 2028 total cumulative impact*

Background on Raising this Issue

On May 31, 2019, NPS ARD sent lists of facilities recommended for 4FA to John Hornback, Executive Director of Metro 4/SESARM (VISTAS). Our list was based on Q/d as a surrogate for impact and attempted to capture 80% of the impact at NPS VISTAS CIAs.[11] For example, we recommended 27 Florida facilities and 20 facilities in North Carolina. Until April 2, 2020, VISTAS had minimal contact or consultation with ARD. Following VISTAS' April 2, 2020 presentation to ARD, we advised[12] VISTAS of our concern that VISTAS' facility selection process was selecting too few facilities. Since that time, we have held several early engagement consultation calls with VISTAS states and recently received the FLM review draft Florida and North Carolina SIPs (April 2021). We now understand that Tennessee, North Carolina, and Virginia have selected a combined total of nine facilities for 4FA—this is the same number of facilities selected by Idaho—a single state with less impaired Class I areas.

We recognize that states have flexibility in how they select facilities for 4FA, EPA guidance advises that state should apply reasonable methods. We fail to see how methods that result in up

[11] EPA's 2016 draft guidance recommended that states select enough facilities to capture 80% of their impacts.
[12] email dated April 17, 2020 from Melanie Peters to John Hornback, VISTAS

to 80 times less protection to the most-impacted Class I areas compared to the least-impacted Class I areas are reasonable. Further, is not equitable for the VISTAS region states, which contain some of the most impacted Class I national parks, to select far fewer sources for analysis than states in other regional planning organization regions (e.g., WRAP, LADCO), many of which have "cleaner" Class I areas than the VISTAS region. Such an approach establishes an unfair and inconsistent standard for applying the regional haze requirements throughout the country. This issue was addressed in the EPA 2019 Regional Haze Guidance document (Emphasis added):

> (3)(c) Using estimates of visibility impacts to select sources—Selecting a threshold level for visibility impacts for selecting sources:
>
> The appropriate threshold for selecting sources may reasonably differ across states and Class I areas due to varying circumstances. *In setting a threshold, a state may consider the number of emissions sources affecting the Class I areas at issue, the magnitude of the individual sources' impacts, and the amount of anthropogenic visibility impairment at the Class I area.*[41] *Various visibility metrics may be appropriate to use, but metric thresholds should be developed in consideration of the magnitude of an individual metric at an individual Class I area.* For example, if modeling a full year, the maximum modeled day visibility impact may be several orders of magnitude larger than the impact averaged across the 20 percent most impaired days. There may be other approaches and factors that would be appropriate for states to use when setting and explaining such a threshold. If quantifiable, the amount of anthropogenic visibility impairment from a source can be compared to the total anthropogenic impairment at a Class I area. For example, a threshold of "X" Mm-1 *may be reasonable if current visibility impairment is mostly due to relatively few sources with impacts above "X" Mm^{-1}, but may not be reasonable if current visibility impairment is due to a large number of sources* each with impacts below "X" Mm^{-1}. A similar concept applies if source-specific visibility impacts are expressed as percentages of total light extinction.
>
> *Whatever threshold is used, the state must justify why the use of that threshold is a reasonable approach, i.e., why it captures a reasonable set of sources of emissions to assess for determining what measures are necessary to make reasonable progress.* For example, it may be difficult to show reasonableness of a threshold set so high that an uncontrolled or lightly controlled source that is one of the largest contributors to anthropogenic light extinction at a Class I area is excluded.
>
> *Note, footnote references have been removed

NPS ARD Recommendations for Alterative Metrics

Now that we have access to the methods and data used by VISTAS to select facilities for 4FA, we are updating our initial facility selection methods and facility lists. We recognize that EWRT*Q/d approach is superior to a relatively simple Q/d approach because it brings extinction and meteorology on the 20% MID into consideration. Accordingly, we updated our approach using the VISTAS AOI results with EWRT*Q/d and evaluated two alternative threshold metrics that could be used in lieu of the VISTAS individual facility percent-of-total-impact thresholds.

The first approach applied a threshold that captures 80% of the *total* Class I Area impact (e.g., 80% of the TCI), as was recommended in the 2016 draft regional haze guidance. This produced a list of all the facilities that contribute up to 80% of the TCI in a given NPS VISTAS Class I area. We are calling these results the "80% cut-off results."

The second alternative approach applied an absolute value threshold of [(EWRT(SO_4)*Q/d(SO_2))+(EWRT(NO_3)*Q/d (NOx))] = 0.0067 for *an individual facility impact*. This was the lowest absolute value of EWRT*Q/d for sources Florida selected for 4FA at Everglades NP—a Mosaic fertilizer plant. We are calling these results the "absolute value threshold results." Because Everglades NP is the least-impacted Class I Area in the VISTAS region (based on TCI), this likely represents the lowest absolute value threshold used to select a facility for 4FA within the VISTAS region.

Because states have limited resources to conduct 4FAs, we calculated "efficiency factors" to compare our two methods. The efficiency factors considered how many facilities each method identified for each state relative to the total impact from those facilities (i.e., which method would capture the most impact with the fewest sources). The results of this comparison are presented in Table 2 below and in the attached spreadsheet (NPS_alternative_metrics_absolute&80% blend_comparison.xlsx).

It appears that the application of the "absolute value threshold results" is most "efficient" for selecting facilities in Florida and North Carolina. The "80% cut-off" method appears to be most efficient for Alabama, Georgia, Kentucky, South Carolina, Tennessee, Virginia and West Virginia. (No Mississippi facilities were selected by either method.)

State	*Absolute Value Threshold (Source EWRT*Q/d=0.0067)*			*80% cut-off (Percent of Total Class I Impact)*		
	*Combined SO4+NO3 2028 EWRT*Qd*	*# of Facilities*	*Efficiency Factor*	*Combined SO4+NO3 2028 EWRT*Qd*	*# of Facilities*	*Efficiency Factor*
AL	0.0682	6	0.011	0.0959	7	0.014
FL	0.0450	5	0.009	0.2269	34	0.007
GA	0.1978	4	0.049	0.2047	3	0.068
KY	5.3816	42	0.128	4.9598	13	0.382
MS						
NC	0.2508	6	0.042	0.2666	7	0.038
SC	0.0324	3	0.0108	0.0338	3	0.0113
TN	2.1249	25	0.085	2.4401	17	0.144
VA	0.2453	13	0.019	0.1542	4	0.039
WV	2.8367	18	0.158	2.7724	12	0.231
Total	**11.183**	**122**	**0.092**	**11.155**	**100**	**0.112**

Table 1: *Comparison of alternative screening metrics evaluated by NPS ARD with associated efficiency factors. Highlighting identifies the higher efficiency factor by state for these alternative metrics. (Note, results are for NPS Class I areas only.)*

We recommend that the VISTAS states consider these alternate metrics to select additional sources for 4FA in their draft SIPs. Such an approach would result in a more-equitable, fair, and inclusive facility selection method. A revised method, such as those we have proposed, does not penalize the more-impacted Class I areas and would result in a source selection outcome more in keeping with other regions of the country.

ISSUE 2: EXCLUSION OF NO_X/NITRATE IN THE SOURCE SELECTION AND FOUR-FACTOR ANALYSIS PROCESS

VISTAS states are not considering NO_x in their four-factor analyses because the VISTAS analyses do not adequately account for recent monitoring trends on the 20% most-impaired days (MID). VISTAS based this determination on their PGM PSAT modeling results. The base year selected for both the modeling and the AOI analyses is 2011.

The North Carolina FLM review draft SIP, page 24, notes:

> "The year 2011 was selected as the modeling base year because the VISTAS 2028 emissions inventory is based on the 2011 Version 6 EPA modeling platform, which at the commencement of the VISTAS second round of planning for regional haze was the most current, complete modeling platform available."

Page 167 states:

> "These data in these figures indicate that sulfate will continue to be the primary driver of visibility impairment in most VISTAS Class I Federal areas, much more so than nitrate."

And page 168 concludes:

> The [results] "show that sulfates generally contribute more to light extinction in 2028 at VISTAS federal mandatory Class I areas than nitrates. . ."

We are not taking issue with the modeling analysis methods employed which follow EPA modeling recommendations (i.e., develop RRFs to apply to the base year monitoring data five-year averages for 2009-2013). We acknowledge that the availability of modeling platforms frequently drives these types of technical decisions.

The problem is that the 2011 modeling base year is significantly outdated and is no longer representative of current visibility impairment on the 20% MID. Below, we provide examples of more-recent visibility monitoring data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) network that highlights the importance of nitrate to visibility impairment on the 20% MID in affected Class I areas. Graphics for each park affected by this issue are not included in the write up. Figures for each of the VISTAS area parks where this is an issue (Mammoth Cave, Great Smoky Mountains, and Shenandoah NPs) are provided in the attached PDF (VISTAS_IMPROVE-Charts_GRSM-MACA-SHEN_5.2021.pdf).

In Mammoth Cave NP, nitrate was the largest contributor to anthropogenic impairment on the 20% most-impaired days in 2018, comprising 45% of the total extinction. This is compared with 21% in 2011 (Figure 1).

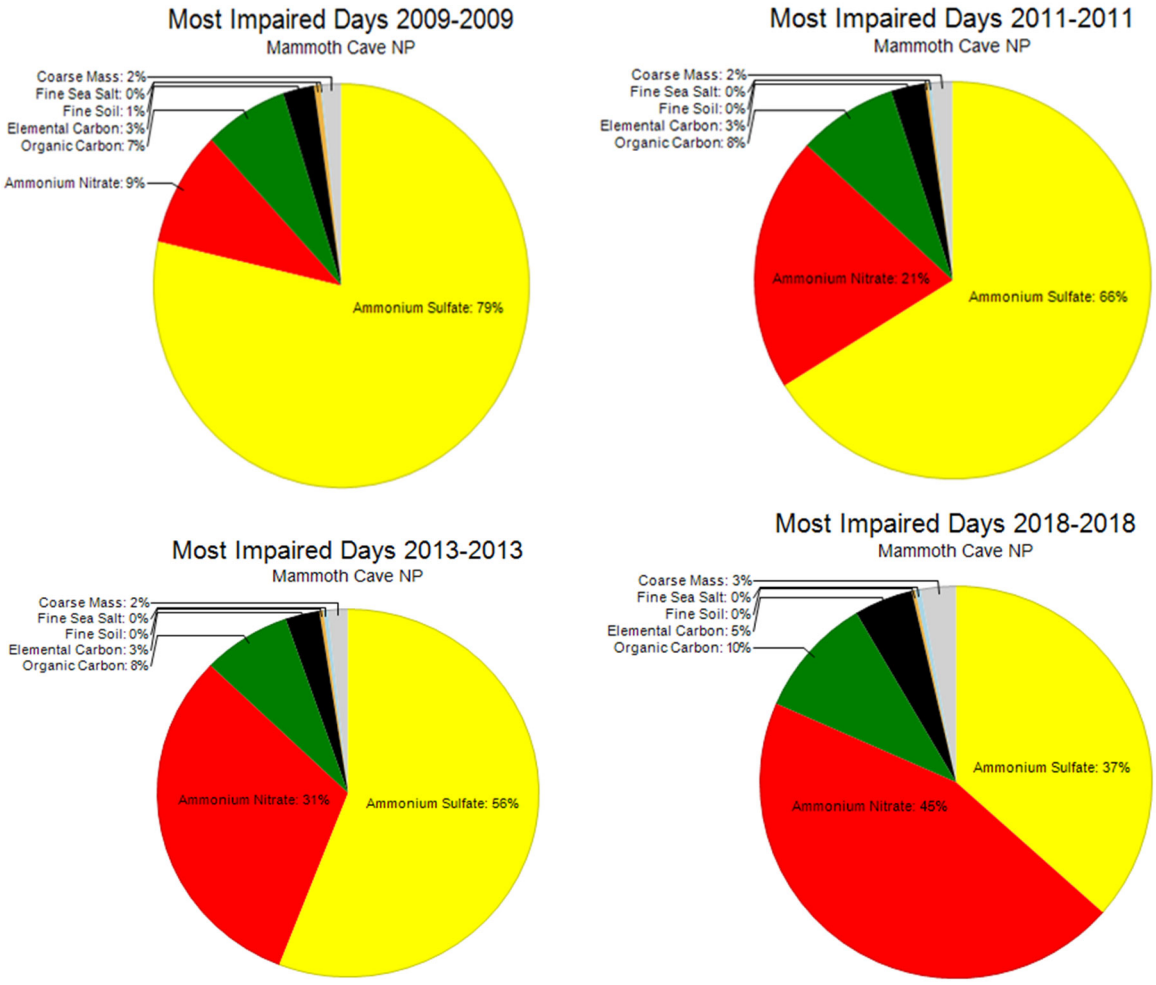


***Figure 1**. Percent contributions to light extinction by particle mass type on the most impaired days at Mammoth Cave NP in 2009, 2011, 2013, and 2018. (http://vista.cira.colostate.edu/Improve/aqrv-summaries/) See attached pdf for additional charts including 5-year averages (VISTAS_IMPROVE-Charts_GRSM-MACA-SHEN_5.2021.pdf).*

The VISTAS modeling used a five-year average centered on 2011 (2009-2013) to define the base model year visibility. As Figure 2 illustrates, total light extinction is lower in more recent five-year periods and, as sulfate declines, nitrate comprises a larger fraction of the impairment on the 20% MID.

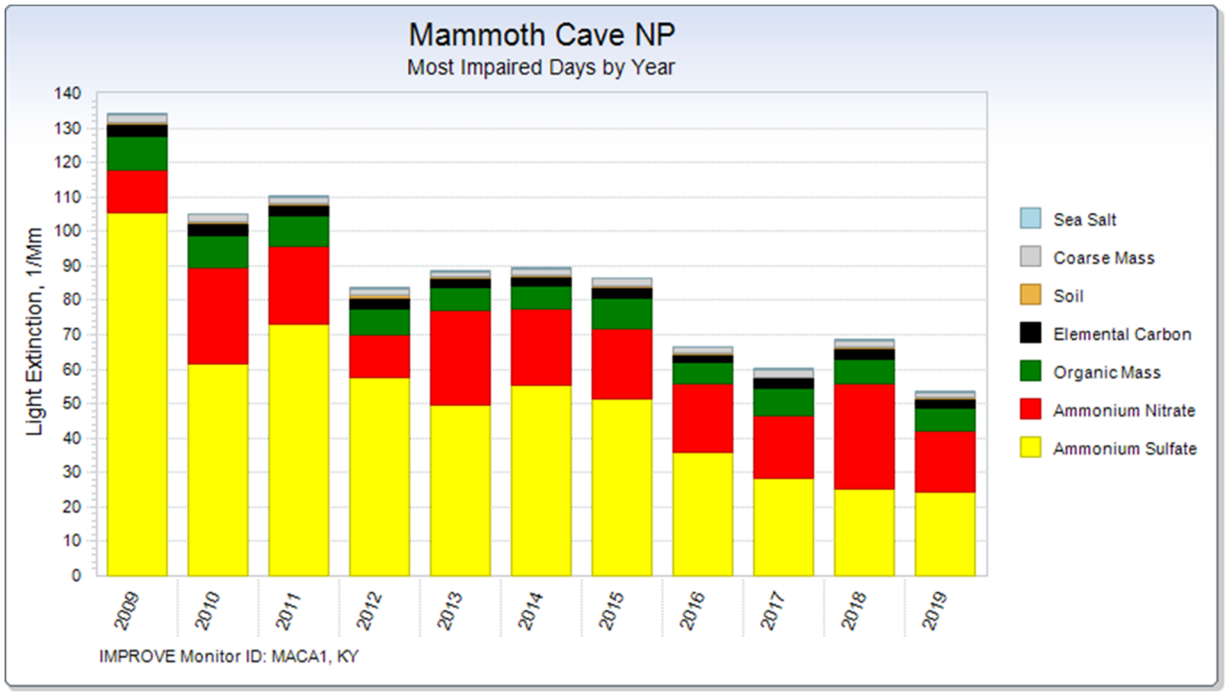
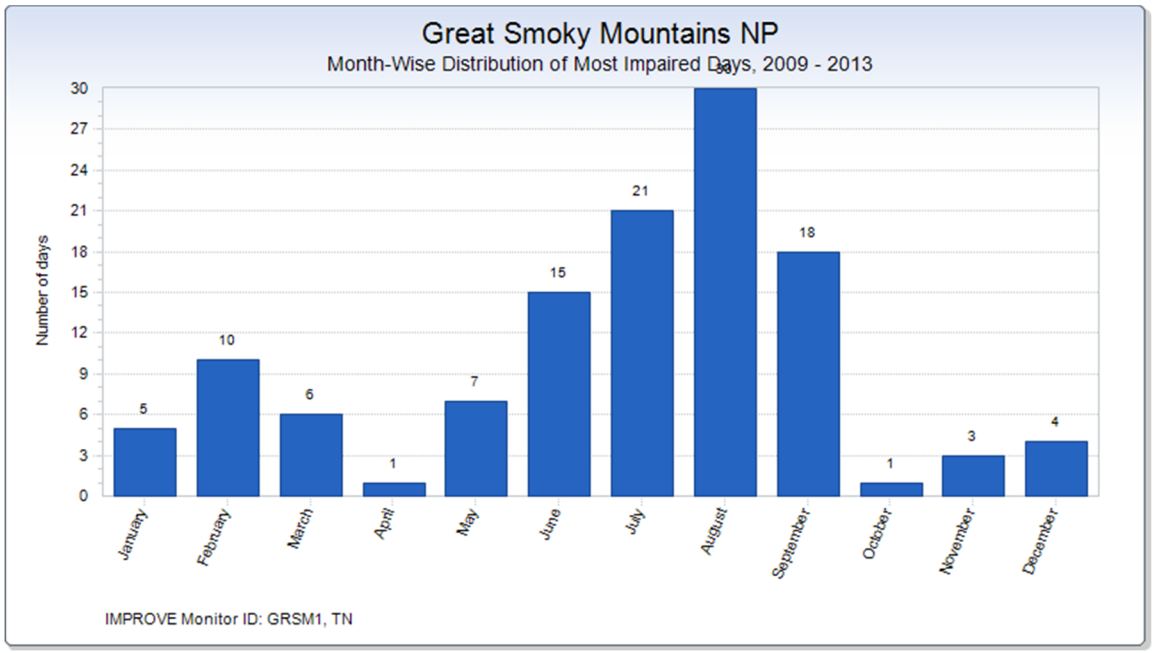
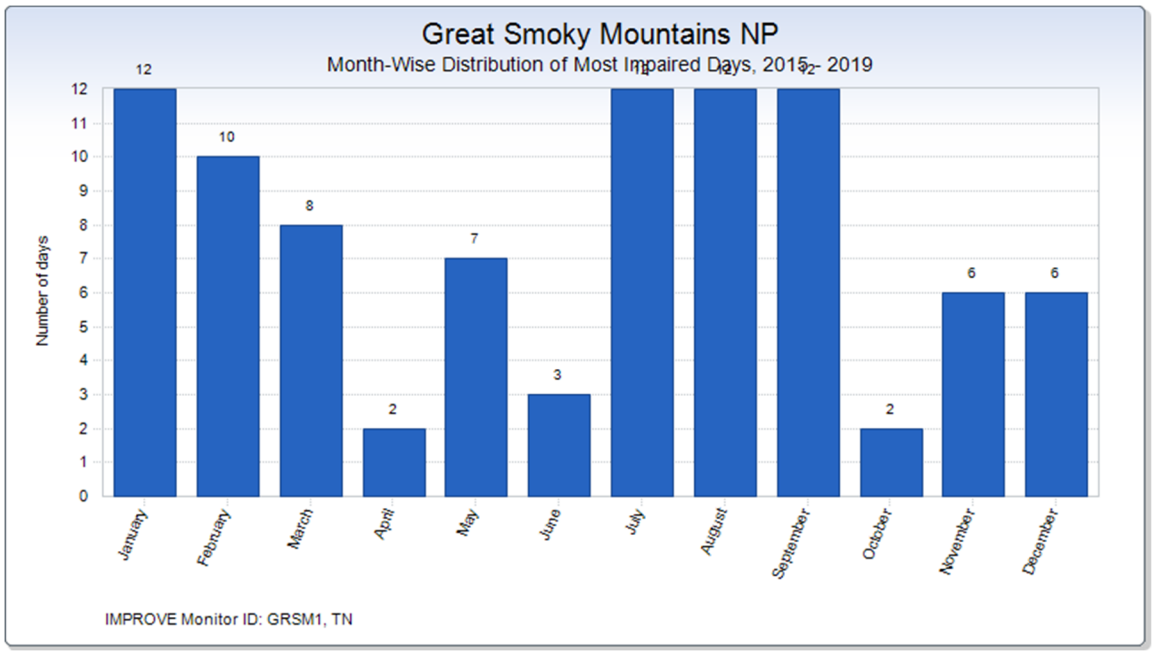


***Figure 2**. Annual contributions to light extinction by particle mass type on the 20% most impaired days at Mammoth Cave NP from 2009 through 2019. The relative contribution of ammonium nitrate to light extinction on the most impaired days generally increased during this period. (http://vista.cira.colostate.edu/Improve/aqrv-summaries/)*

In addition to the percent species contributions, the seasonal distribution of days that comprise the 20% MID is shifting toward wintertime and shoulder season months when nitrate formation is favored. For example, in Great Smoky Mountains NP, the subset of days that make up the 20% MID were primarily summertime days in 2009-2013 (Figure 3a). Sulfate dominates impairment during the warmer summer months. However, in 2015-2019, there are many more wintertime days, when nitrate typically dominates, comprising the 20% MID (Figure 3b). It is expected that this trend will continue as sulfate declines.



a



b

Figure 3*. Monthly distribution of the most impaired days during five-year periods, (a) 2009-2013 (top) and (b) 2015-2019 (bottom) The number of most impaired days occurring in the cooler months (January-April and October-December) was higher during 2015-2019 (46 days) than in 2009-2013 (30 days) (http://vista.cira.colostate.edu/Improve/aqrv-summaries/)*

Because the subset of days that comprise the 20% MID are held constant between the modeled base year and future year (2028) in the VISTAS analysis, it is critically important to analyze whether the base year appropriately represents the current most impaired days. By selecting 2011, VISTAS states are biasing results toward summer months when sulfate concentrations are generally highest and nitrate concentrations are generally low. For this reason, it not surprising that they have concluded that nitrate will not be a concern in 2028. In fact, using the dates based on MID in 2011 and considering measurements from 2018 would suggest that nitrate was not important in 2018. Monitoring data at Mammoth Cave NP in 2018 show that Ammonium Nitrate was the single biggest contributor to light extinction on the worst visibility days sampled in that year (Figure 4).

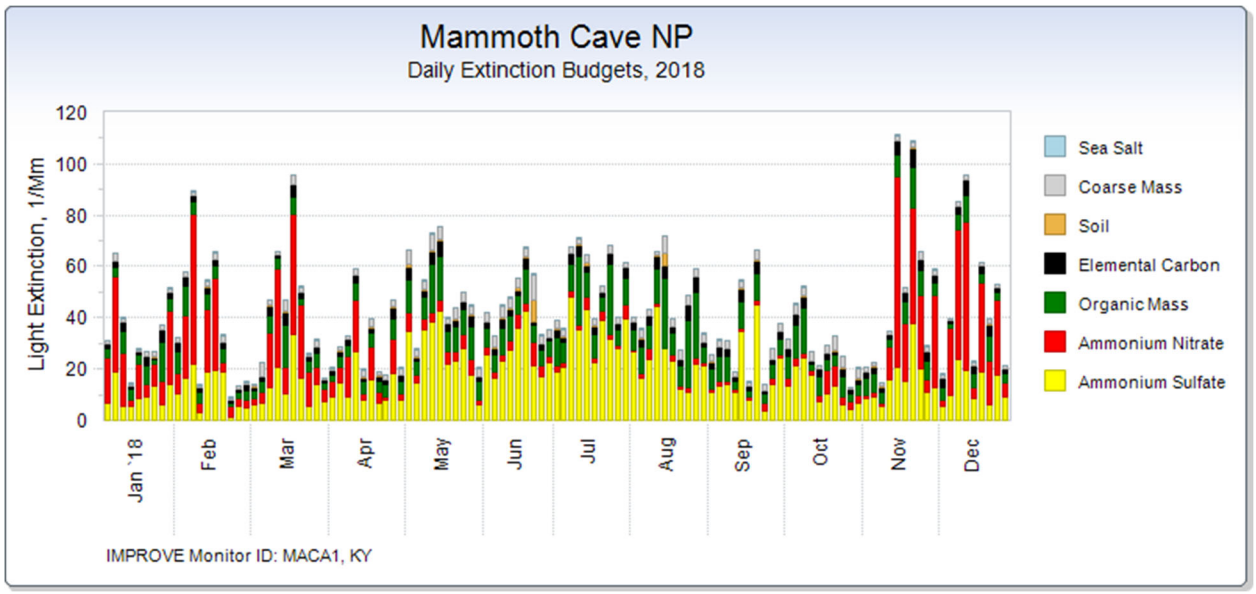


***Figure 4**. Daily light extinction by particle mass type on individual sample days at Mammoth Cave NP in 2018. (http://vista.cira.colostate.edu/Improve/aqrv-summaries/)*

By using 2011 as the base year, VISTAS is relying on outdated data that are not representative of current conditions and are perpetuating this issue into the future year projections. Consequently, the 2028 future year analysis likely underestimates the potential impact of NOx emissions and should not be used on its own to determine which pollutants to consider in the 4FAs. Furthermore, this is also an issue for the AOI back-trajectory analyses. The impact from large NOx sources is likely underrepresented in the AOI results, as the extinction-weighted residence times were based on 2011 IMPROVE data.

We are not suggesting that the VISTAS modeling should be rerun or that the modeling methods were technically inaccurate, only that VISTAS did not thoroughly evaluate how representative the results are of current conditions. By relying on current monitoring information and evaluating the modeling in a different way, VISTAS may arrive at a different conclusion. For instance, LADCO recently investigated model results in an evaluation that looked at seasonal impacts (both in 2011 and 2016). LADCO found significant wintertime nitrate contributions on their most impaired days (https://www.ladco.org/wp-content/uploads/Projects/Regional-Haze/Round2/LADCO_RegionalHaze_Round2_TSD_05May2021.pdf).

As shown in the map below (Figure 5), many point sources that were on the original NPS list for consideration in the 4FAs are currently significant sources of NO_x. Given the increasing importance of ammonium nitrate to light extinction on MID we recommend that the VISTAS states evaluate opportunities to reduce NO_x emissions in their 4FAs in this planning period.

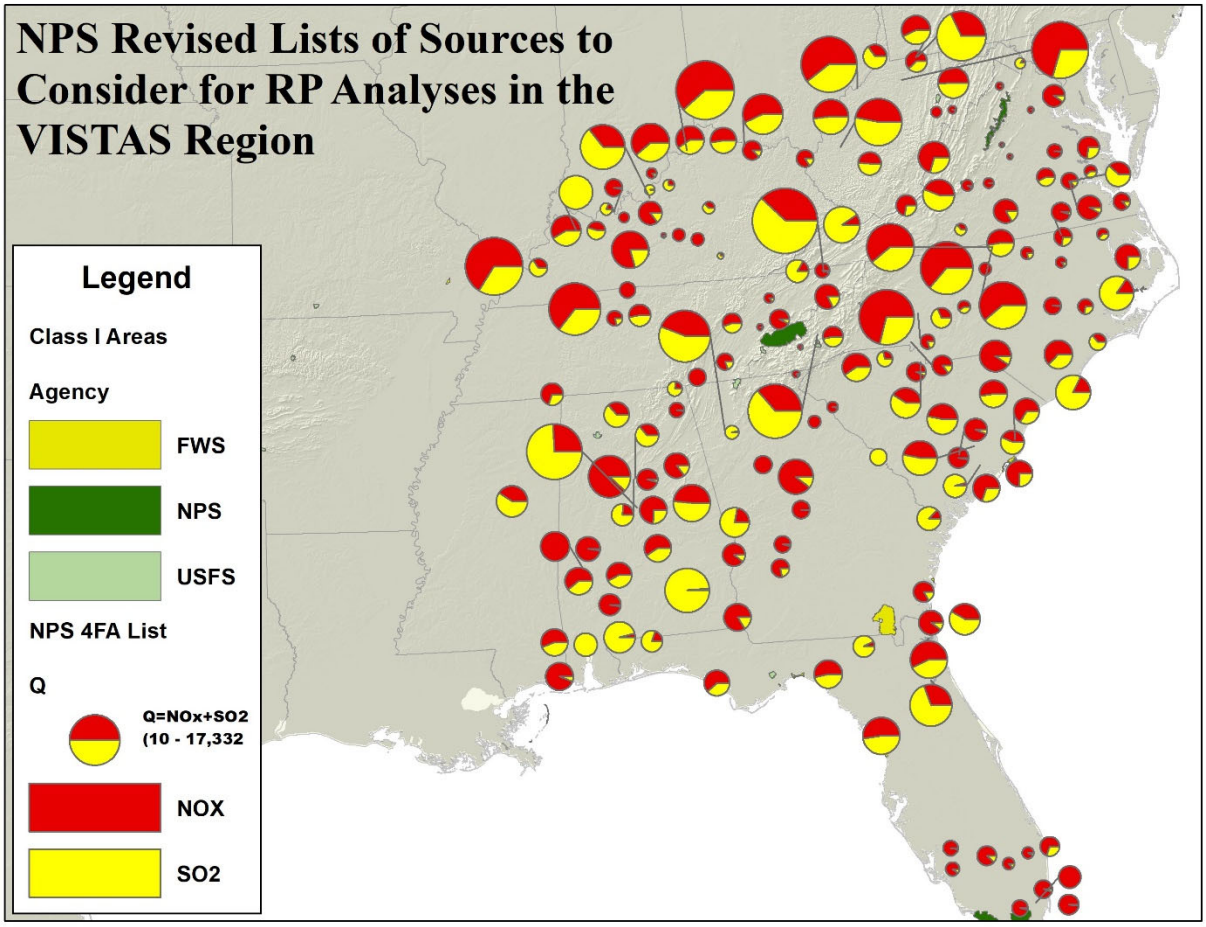


Figure 5. *Facilities on the map were included in NPS recommendations to VISTAS states regarding sources to consider for 4FA using Q/d as a surrogate for impacts. Emissions are based on 2018-2020 CAMD data and 2014-2017 NEI data. Map produced by the NPS ARD.*

ISSUE 3: VISIBILITY AS A "FIFTH FACTOR" AND "BELOW THE GLIDEPATH" JUSTIFICATIONS FOR RP CONTROL DETERMINATIONS

Visibility as a Fifth Factor

In their FLM review draft SIP, North Carolina concludes that adding a wet scrubber at the Domtar facility was not "reasonable" because the costs do not justify the "very small improvement" in "visual range" at the nearest Class I area, even though the cost of control was well below $5,000/ton, a cost threshold which is widely accepted as cost-effective. North Carolina also noted that the Class I areas are currently under the Uniform Rate of Progress. No other impediments to scrubber installation were identified when evaluating the three remaining statutory factors (time necessary for compliance, remaining useful life and energy and non-air quality environmental impacts). Given that North Carolina relied on the VISTAS PSAT modeling to make this conclusion, we note it is likely other VISTAS states may consider doing the same.

Visibility benefits of emission reductions are not part of Reasonable Progress (RP) determinations as described by the Clean Air Act and should not be considered a fifth factor "off-ramp" in control determinations. The Clean Air Act established a two-part program for implementing emission reductions under the regional haze requirements; best available retrofit technology (BART) and reasonable progress (RP). The best available retrofit technology provisions were initially applied in the first planning period[13] and target the oldest sources that predate the prevention of significant deterioration amendments. The BART provisions ensure that states will address the oldest, least-controlled sources first. The reasonable progress provisions address all remaining sources, recognizing that eventually, smaller sources of pollution will need to be controlled. RP and BART are defined separately in §7491 (g) of the CAA:

> For the purpose of this section—
>
> (1) in determining reasonable progress there shall be taken into consideration the costs of compliance, the time necessary for compliance, and the energy and nonair quality environmental impacts of compliance, and the remaining useful life of any existing source subject to such requirements;
>
> (2) in determining best available retrofit technology the State (or the Administrator in determining emission limitations which reflect such technology) shall take into consideration the costs of compliance, the energy and nonair quality environmental impacts of compliance, any existing pollution control technology in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology;

The Clean Air Act explicitly sets nearly identical evaluation standards for RP and BART yet omits "the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology" from the RP determination. This omission addresses the cumulative nature of visibility impairment from regional haze. Addressing numerous smaller

[13] We acknowledge that some BART determinations have yet to be fully resolved. We also believe it may be appropriate to revisit BART control determinations from the first planning period in subsequent planning periods, as necessary under RP.

sources will be necessary for progress toward the ultimate visibility goal of no manmade visibility impairment in 2064.

We acknowledge that the 2019 EPA Regional Haze Guidance document allows states to consider the degree of visibility improvement in individual facility RP determinations. We also note that states are applying the "fifth factor" using methods that do not adhere to the 2019 guidance recommendations. For instance, the guidance advises that *if* visibility benefits are considered, the "benefit" of any control measure should be evaluated against a "clean" or "natural background" condition. The analysis should not rely on a 2028 "dirty" background. See the quote from Guidance below, noting the reference to modeling impacts in a "dirty" background in footnote 66:

> In particular, a state should not use the difference in projected 2028 visibility with and without the control measure (e.g., the effect on the 2028 RPG) as its only characterization of the visibility benefit of the measure.[66]
>
> [66] In the first implementation period and in comments submitted in the rulemaking for the 2017 revisions to the Regional Haze Rule, some stakeholders stated that, when considering visibility benefits as one of the five statutory factors for BART or when considering visibility along with the four statutory factors for reasonable progress, it is appropriate to consider only the amount by which a potential measure or combination of measures would change the projected overall ambient deciview index value as of the end of the implementation period, i.e., the incremental effect on the RPGs. The Rule requires RPGs to represent the expected actual overall visibility conditions at the end of the implementation period. The RPGs are values that will be compared in a progress report to actual visibility conditions. *In contrast, estimates of the visibility benefits of emission control measures have a different purpose, which is to help guide decisions on the control of individual sources. In this context, relying solely on a quantification of visibility benefits relative to "dirty background" (i.e., conditions with greater impairment than natural background visibility conditions) obscures the full potential benefits of control measures and makes it less likely that a measure would appear reasonable from a visibility benefit perspective.* EPA has used a natural background light extinction value when expressing baseline source impacts in delta deciview units in the North Dakota (77 FR 20894, April 6, 2012), Montana (77 FR 57864, September 18, 2012), Arizona (79 FR 52420, September 3, 2014), and Texas (81 FR 296, January 5, 2016) FIPs and partial disapprovals of North Dakota (77 FR20894, April 6, 2012) and Texas (81 FR 296, January 5, 2016) SIPs that relied on modeling employing high- deciview ambient background conditions. This approach has been upheld by the Eighth Circuit. *North Dakota v. EPA*. 730 F.3d 750, 764-766 (8th Cir. 2013) ("Although the State was free to employ its own visibility model and to consider visibility improvement in its reasonable progress determinations, it was not free to do so in a manner that was inconsistent with the CAA. *Because the goal of § 169A is to attain natural visibility conditions in mandatory Class I Federal areas, see 42 U.S.C. § 7491(a)(1), and EPA has demonstrated that the visibility model used by the State would serve instead to maintain current degraded conditions*, we cannot say that EPA acted in a manner that was arbitrary, capricious, or an abuse of discretion by disapproving the State's reasonable progress determination based upon its cumulative source visibility modeling.") [Emphasis added.]

On page 16 of the final guidance, EPA states:

> A state should not evaluate the visibility impact of a source by only using a delta deciview value for which the current visibility condition, or the projected 2028 condition, is the "background" in the delta deciview calculation.

And on page 38 of the final guidance, EPA states:

> If a state uses a visibility benefit threshold to evaluate control measures, *it must explain how its approach is consistent with the requirement to consider the statutory factors* in making reasonable progress determinations. Additionally, EPA has previously explained that, *because regional haze results from a multitude of sources over a broad geographic area, a measure may be necessary for reasonable progress even if that measure in isolation does not result in perceptible visibility improvement.* [Emphasis added.]

The EPA additionally stated why it is not appropriate to evaluate "visibility benefit" from controls against a "dirty background" in its Texas Federal Implementation Plan:

> "The 'clean' vs. 'dirty' background issue can be conceptualized in an analogy by realizing that the deciview scale of visibility is similar to the decibel scale of sound. If a pin is dropped on a table in a quiet room (analogous to a clean background CALPUFF run), it can be easily heard. If on the other hand, the same pin is dropped on the same table in a noisy room (analogous to a dirty background CAMx run), it will not seem as loud in a relative sense. In both cases, the dropped pin makes the same sound (analogous to extinction level), but in the latter case, that sound is partially obscured by the noisy room."

Finally, the 2019 EPA RH guidance also recommends considering the cumulative benefit of any potential controls across all impacted Class I areas:

> *If multiple Class I areas would experience visibility benefits from a control measure, we recommend that the state consider all of those benefits.*

North Carolina chose to consider the individual source visibility benefits of potential control measures and quantified the "visibility benefits" relative to a "dirty background," concluding that the additional visibility benefit of controls was "minimal." North Carolina used this conclusion to reject control measures that otherwise could have been selected based upon the four statutory factors. In our view, the state failed to sufficiently explain why this is still "reasonable."

Below the "Glidepath"

In their FLM review draft SIP North Carolina states:

> "The 2028 RPGs for the 20% most-impaired days for North Carolina's Class I areas may be ambitious since they are 59% to 90% below the 2028 URP. The NCDAQ acknowledges that there are uncertainties associated with the emissions and modeling of the RPGs. However, the LTS will reduce SO_2 and NO_x emissions to keep the state on track toward achieving the RPGs."

We note that the rule does not allow states to dismiss controls that are otherwise reasonable based on the four statutory factors simply because Class I area visibility is below the uniform rate of progress. In the preamble to the final EPA Regional Haze Rule, EPA discusses these concepts (see Federal Register, Vol. 82, No. 6, Tuesday, January 10, 2017, pg. 3078-3129 [Emphasis added]):

Another commenter contended that the EPA's proposed revisions failed to include a necessary step where states evaluate the control measures identified as necessary to make reasonable progress in light of the RPGs themselves. This commenter requested a mechanism whereby a state could determine that some of the initially evaluated control measures were unnecessary in light of the RPGs themselves. In particular, this commenter suggested that a state should be able to reject ''costly'' control measures if (1) the RPG for the most-impaired days is on or below the URP line or (2) the RPGs are not ''meaningfully'' different than current visibility conditions.

We disagree that the states should be able to reevaluate whether a control measure is necessary to make reasonable progress based on the RPGs. The CAA requires states to determine what emission limitations, compliance schedules and other measures are necessary to make reasonable progress by considering the four factors. *The CAA does not provide that states may then reject some control measures already determined to be reasonable if, in the aggregate, the controls are projected to result in too much or too little progress*. Rather, the rate of progress that will be achieved by the emission reductions resulting from all reasonable control measures is, by definition, a reasonable rate of progress.

In regards to the commenter's first suggestion, if a state has reasonably selected a set of sources for analysis and has reasonably considered the four factors in determining what additional control measures are necessary to make reasonable progress, then the state's analytical obligations are complete if the resulting RPG for the most impaired days is below the URP line. *The URP is not a safe harbor, however, and states may not subsequently reject control measures that they have already determined are reasonable*. If a state's RPG for the most-impaired days is above the URP line, then the state has an additional analytical obligation to ensure that no reasonable controls were left off the table.

The commenter's second suggestion, that states should be able to reject ''costly'' control measures if the RPG for the most-impaired days is not ''meaningfully'' different than current visibility conditions, is counterintuitive and at odds with the purpose of the visibility program. In this situation, the state should take a second look to see whether more effective controls or additional measures are available and reasonable. Whether the state takes this second look or not, it may not abandon the controls it has already determined are reasonable based on the four factors. Regional haze is visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. At any given Class I area, hundreds or even thousands of individual sources may contribute to regional haze. Thus, it would not be appropriate for a state to reject a control measure (or measures) because its effect on the RPG is subjectively assessed as not ''meaningful.'' *Also, for Class I areas where visibility conditions are considerably worse than natural conditions because of continuing anthropogenic impairment from numerous sources, the logarithmic nature of the deciview index makes the effect of a control measure on the value of the RPG less than its effect would be if visibility conditions at the Class I area were better. Thus, if a state could reject a control measure based on its individual effect on the RPG, the state would be more likely to reject those measures that are necessary to make reasonable progress at the dirtiest Class I areas, which would thwart Congress' national goal.*

We recommend that this concept not only applies to conclusions and determinations regarding final 4FAs, but also to the source selection process. A source selection process that aims to exempt rather than consider sources in the SIP based on the presumption that nothing more is needed if the Class I Area is well below the glidepath would likewise thwart the overall regional haze program goals.

EPA 2017:

Some commenters stated a desire for corresponding rule text dealing with situations where RPGs are equal to (''on'') or better than (''below'') the URP or glidepath. Several commenters stated that the URP or glidepath should be a ''safe harbor,'' *opining that states should be permitted to analyze whether projected visibility conditions for the end of the implementation period will be on or below the glidepath based on on-the-books or on-the-way control measures, and that in such cases a four- factor analysis should not be required.* Other commenters suggested a somewhat narrower entrance to a ''safe harbor,'' by suggesting that if current visibility conditions are already below the end-of-planning-period point on the URP line, a four-factor analysis should not be required. We do not agree with either of these recommendations.

The CAA requires that each SIP revision contain long-term strategies for making reasonable progress, and that in determining reasonable progress states must consider the four statutory factors.[101] *Treating the URP as a safe harbor would be inconsistent with the statutory requirement that states assess the potential to make further reasonable progress towards natural visibility goal in every implementation period. Even if a state is currently on or below the URP, there may be sources contributing to visibility impairment for which it would be reasonable to apply additional control measures in light of the four factors.* Although it may conversely be the case that no such sources or control measures exist in a particular state with respect to a particular Class I area and implementation period, this should be determined based on a four-factor analysis for a reasonable set of in-state sources that are contributing the most to the visibility impairment that is still occurring at the Class I area.[102] *It would bypass the four statutory factors and undermine the fundamental structure and purpose of the reasonable progress analysis to treat the URP as a safe harbor, or as a rigid requirement.*

Footnotes to the text:

[101] CAA section 169A(b)(2)(B), (g)(1).

[102] The point that having a RPG that is on or below the URP line is not a safe harbor has been articulated in past actions such as the disapproval of the reasonable progress element of Arkansas' SIP (see fn 32). Our approval of the reasonable progress element of South Dakota's SIP is an example in which we approved the state's RPGs even though the RPG for the most-impaired days for two Class I areas were above the respective URP lines, based on the state having adequately considered the four statutory factors for important contributing sources. 76 FR 76646 (December 8, 2011) (proposed action) and 77 FR 24845 (April 26, 2012) (final action).

Conclusions & Recommendations

A proper consideration of visibility impacts on Class I areas includes use of visibility impact surrogates in selecting facilities for 4FA. If applied in a fair and reasonable manner, the VISTAS EWRT*Q/d approach represents a useful tool for selecting facilities that are most likely to contribute to visibility impairment. Likewise, modeling the results of the suite of emission reduction measures included in the SIP provides insight as to how effective that SIP might be in making reasonable progress in improving visibility. However, introducing visibility as a fifth "off-ramp" for avoiding otherwise cost-effective emission controls is an improper inclusion of individual visibility estimates that are not consistent with the goals of the Clean Air Act and the Regional Haze program.

With this in mind, we recommend that:

- VISTAS states adopt a facility selection process that treats all Class I areas equitably and represents a "level playing field" relative to other states/RPOs.
- VISTAS states recognize that recent monitoring data clearly show that nitrate is a significant and increasing contributor to visibility impairment at many Class I areas in the southeast and that NO_x emission sources must be addressed in this planning period.
- Emission control decisions should be based upon the four factors identified in the Clean Air Act and not introduce an unintended fifth visibility factor.
- 2028 projections below the URP glidepath do not represent a "safe harbor" for avoiding otherwise reasonable emission controls.

We sincerely appreciate the technical work that VISTAS states have undertaken. By making the suggested improvements VISTAS states have an opportunity to identify substantial emission reductions in this planning period that would reduce haze and improve clean air and clear views for our shared national treasures. We look forward to continuing engagement in this and future planning periods. If you have any questions, do not hesitate to reach out to us. Also, feel free to let us know if you have any edits to this summary and especially if any corrections are needed.