Comments to EPA Regarding Improvements for Modeling and Permitting Procedures

American Iron and Steel Institute Presentation
at EPA's 12th Modeling Conference

October 3, 2019

Outline of Presentation

- Advances achieved with 2017 Appendix W
  - Partial promulgation of low wind improvements
  - Recognition of urban effects of large industrialized areas
  - Modeling of nearby sources – more realistic emission rates
  - NO_2 modeling advances

- Areas where more work is needed for Appendix W future updates
  - Additional progress with low wind improvements
  - Additional source characterization improvements that result in more accurate plume rise predictions
  - NO_2 modeling improvements
  - Modeling of secondary $PM_{2.5}$ and ozone formation
  - Haul road modeling improvements
  - Modeling of sources with partial utilization and/or variable emissions

AISI Acknowledges Advances in the 2017 Appendix W Modeling Updates

- The ADJ_U* option was implemented, although the last-minute “bug fix” without public review was rather awkward
- EPA acknowledged the role that an emission source has in changing the dispersion environment – urban-like large industrial areas
- Advances in Tier 2 and Tier 3 NO_2 modeling were approved
- More realism in modeling emissions from nearby sources was implemented

Modeling Areas Where Further Progress is Needed for Appendix W Updates

Additional Low Wind Improvements

- Minimum sigma-v should be higher than the current value of 0.2 m/s
- Consider adding a minimum sigma-w option as well
- An option should be also added to adjust the meander fraction (e.g., using the random time scale as a variable)
- Minimum Monin-Obukhov length is needed to account for mechanical mixing caused by buildings at industrial sources
- Need improved vertical potential temperature gradient profiling in low wind conditions (when surface layer is very shallow)
- Additional model evaluation work will be needed

Source Characterization Issue (Plume Rise): Role of Fugitive Heat for Building Downwash ("LIFTOFF")

- Peer-reviewed Hanna-Briggs-Chang paper in *J. Haz. Mat.* describes approach for modeling buoyancy effects (fugitive heat releases) on building downwash.
- Tendency for stack release to resist building downwash effects is important for large fugitive heat and low winds.
- This concept has been implemented as a post-processor in AERMOD for weighting on an hourly basis the results of runs with and without downwash.
- A 4-month field study at an AISI member facility has demonstrated the better performance of this approach.
- What will it take to advance this option to routine use? It has been discussed in a peer-reviewed Atm. Env. paper*.
- Many iron & steel facilities have fugitive heat releases that would benefit from this modeling approach.

*Paine, R., Warren, L.L., Moore, G.E., Source Characterization Refinements for Routine Modeling Applications, *Atm. Env.* 129 (2016), 55-67. doi: 10.1016/j.atmosenv.2016.01.003.

NO_2 Modeling Improvements for Short Travel Times

- Peak NO_2 concentrations are often predicted near the plant fenceline
- Travel times can be on the order of 10 seconds under high wind conditions
- In the peer-reviewed 1999 Hanrahan paper that discussed the PVMRM technique, the issue of a finite time needed for the conversion of NO to NO_2 was noted, but this issue is still not accounted for in AERMOD
- The result can be at least a factor-of-2 overprediction of the NO_2/NOx ratio at near-field receptors
- EPA should implement this option in the next release of AERMOD (beta option; the science is well established)

Modeling for Secondarily-Formed Ozone and $PM_{2.5}$

- EPA's additional MERP guidance in Spring 2019 was helpful
- The ability to use a Tier 1 approach in most cases helps to expedite permitting
- EPA's presentation at the 2018 modeling workshop to now require direct $PM_{2.5}$ modeling for emissions < SER if secondary emissions are > SER was a step backward
- This is because the direct and secondary peak impacts are rarely at the same distance from the source, so they should either not be added, or be added as a function of distance
- For $PM_{2.5}$ modeling, EPA has access to distance-dependent $PM_{2.5}$ CAMx results, and these should be readily available for public use for all MERP sites

Issues for Mobile Sources and Haul Road Modeling

- RLINE is an advancement in line source modeling
- Issues that need further review and enhancement in AERMOD / RLINE are:
  - How does the RLINE option compare to the previous volume or area source characterization?
  - Does RLINE account for enhanced traffic-caused turbulence, especially in low-wind conditions?
  - Does RLINE account for the effects of roadway barriers (especially vegetation screens) on the capture and reduction of PM emissions?
- Can removal of road source particulate by agglomeration and deposition be accounted for by a control efficiency?

Modeling of Sources with Variable Emissions

- Permit modeling typically requires a very conservative assumption of constant operation (esp. for “nearby sources”)
- Many sources have unscheduled elevated emissions
- AERMOD cannot easily model random elevated emissions
- Modeling these sources with constant peak emissions is unrepresentative and can distort modeling results
- Consider modeling actual hourly emissions if likely to be conservative for future operation
- An alternative approach is to use an agreed-upon emissions distribution and many (e.g., 100) random sequences of hourly emissions: “Randomly Reassigned Emissions”

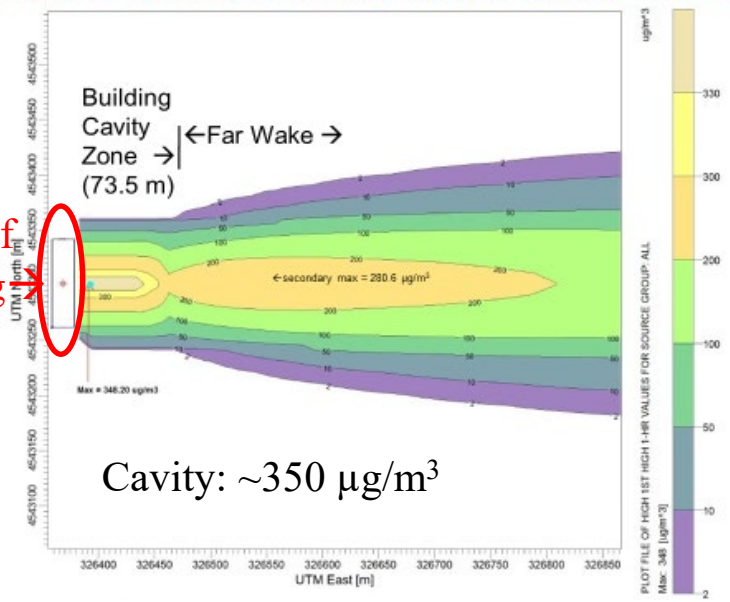
Improvements for Appendix W Table 8-1

Nearby Source(s) [6]			
Annual & quarterly	Maximum allowable emission limit or federally enforceable permit limit.[6]	Annual level when actually operating, averaged over the most recent 2 years.[3]	Actual operating factor averaged over the most recent 2 years.[3,8]
Short term (≤ 24 hours)	Maximum allowable emission limit or federally enforceable permit limit.[6]	Temporally representative level when actually operating, reflective of the most recent 2 years.[3,7]	Continuous operation, i.e., all hours of each time period under consideration (for all hours of the meteorological database).[5]

- The only factor that was changed for short-term emission rates for nearby sources was the operating level (MMBtu/hr)
- The 3 factors (lb/MMBtu, MMBtu/hr, and hr/day) do not act independently; should be combined as simply a short-term lb/hr emission rate that might vary by hour and season, much like regional background monitoring data
- “Nearby sources” should include sources at the same facility being changed if those sources are not affected by the proposed change

Downwash Issue for Cavity Amplification Needs Fixing

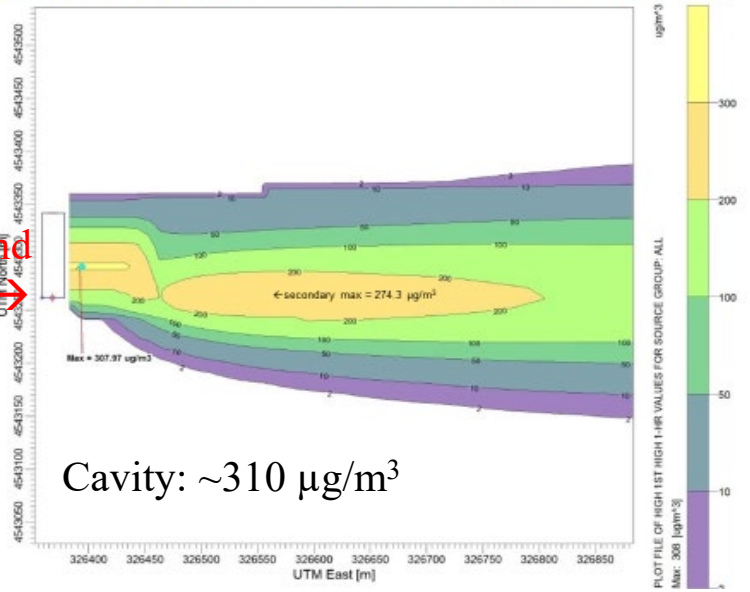
Concentration Isopleths for Stack in Center of Building



stack at center of building →

Cavity: ~350 µg/m³

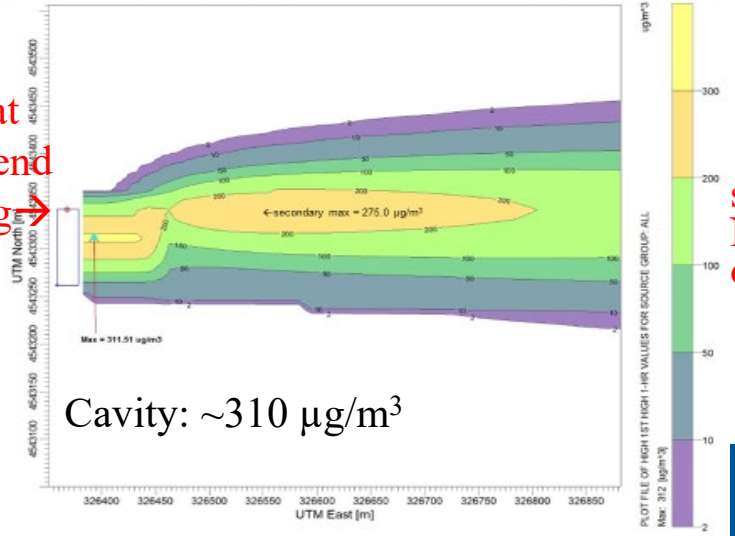
Isopleths for Stack on Southern Edge of Building



stack at south end of bldg →

Cavity: ~310 µg/m³

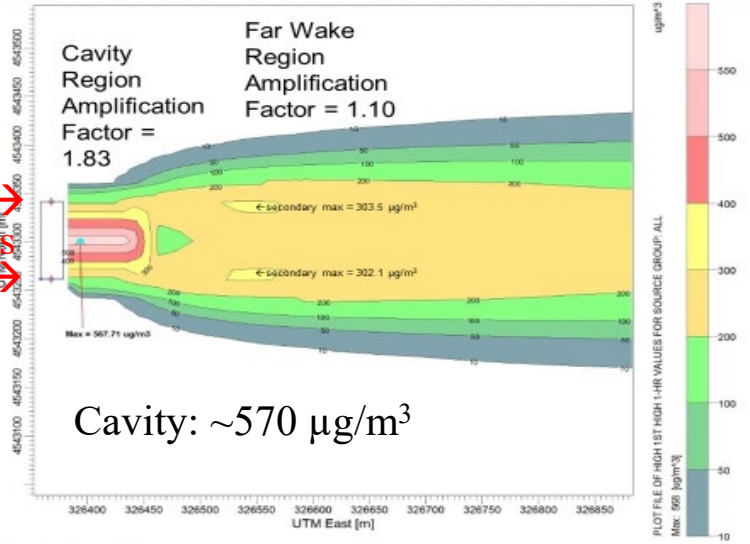
Isopleths for Stack on Northern Edge of Building



stack at north end of bldg →

Cavity: ~310 µg/m³

Isopleths for Stacks on Northern and Southern Edges of Build



stacks at N&S ends of bldg. →

Cavity: ~570 µg/m³