MINNESOTA POLLUTION CONTROL AGENCY

520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300

800-657-3864 | Use your preferred relay service | info.pca@state.mn.us | Equal Opportunity Employer

October 23, 2018

John Mooney
U.S. Environmental Protection Agency, Region 5
77 West Jackson Blvd.
Mail Code: AR-18J
Chicago, IL 60604-3507

RE: Objection to the use of the CTDMplus Air Quality Dispersion Model for the USG-Red Wing Action

Dear John Mooney:

This correspondence presents the Minnesota Pollution Control Agency's (MPCA) objection to the proposal by USG Corporation's Red Wing facility to use the Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMplus) as part of a Minnesota State Implementation Plan (SIP) modeling demonstration for the one-hour Sulphur dioxide ($SO_2$) National Ambient Air Quality Standards (NAAQS). Specifically, the CTDMplus model has been proposed as a viable option to model one-hour $SO_2$ air quality conditions for the USG Corporation (USG-Red Wing) Red Wing facility located at 27384 Highway 61 Boulevard, Red Wing, Minnesota.

USG-Red Wing claims that the CTDMplus model provides more realistic predictions (i.e., lower predicted concentration values) of the one-hour $SO_2$ conditions than provided by the commonly used American Meteorological Society / Environmental Protection Agency Regulatory Model Improvement Committee's Dispersion Model (AERMOD) platform. The MPCA has reviewed this proposal and objects to the use of CTDMplus for technical and programmatic reasons. We maintain that AERMOD is the appropriate tool for the requested modeling demonstration and that a deviation from this practice is not supported.

**Background**

On May 1, 2017, USG-Red Wing submitted a one-hour $SO_2$ modeling demonstration to the U.S. Environmental Protection Agency (EPA) that identified an exceedance of the 2010 one-hour NAAQS. USG-Red Wing conducted this modeling demonstration unrelated to the EPA one-hour $SO_2$ NAAQS designation process. The modeled exceedance occurred on a portion of unimproved and vacant real estate located at 27321 Highway Boulevard, Red Wing, Minnesota (Goodhue County). On September 7th, 2017, USG-Red Wing provided documentation to the MPCA on the methods that would be used to restrict the general public from accessing the property area corresponding to the location of the modeled one-hour $SO_2$ NAAQS exceedance. At that time, the EPA stated that unless the property is secured from the general public, they would place Goodhue County in nonattainment for the one-hour $SO_2$ NAAQS. On October 2nd, 2017, USG-Red Wing secured the area corresponding to the modeled exceedance.

To complete the enforcement action, the EPA has requested new NAAQS modeling with proposed permitted allowable emission limits. To accomplish this task, USG-Red Wing proposed a new modeling demonstration using CTMDplus for the valley areas, and AERMOD for the remaining locations. This is a substantial departure from typical dispersion modeling practices, where AERMOD is the only modeling platform used to complete

the demonstration. USG-Red Wing claims that the conditions in the Upper Mississippi River Valley warrant the use of the CTDMplus model. To support their argument, USG-Red Wing maintained that the CTDMplus model appears on EPA's list of preferred and recommended models, further justifying its use in this situation. Based on a September 27th, 2018, telephone call between the MPCA and EPA Region 5, it is EPA's belief that since CTDMplus appears on their list of preferred and accepted models, they cannot object to its use in this situation. The MPCA disagrees with this position and provides support for rejecting the use of CTDMplus.

**Background on the CTDMplus model**

The CTDMplus model was the result of an initiative to create a complex terrain model in the late 1970's. EPA sponsored the Complex Terrain Model Development (CTDM) project in 1980 and noted that "Its purpose is to develop, evaluate, and refine practical plume models for calculating ground-level air pollutant concentrations that result from elevated emission sources located in complex terrain (i.e., terrain which rises to heights well above expected plume levels)." [1] The CTDMplus model provided an advantage for modeling pollutants in complex terrain scenarios not present in the ISC platform. As noted in a 2003 EPA study "The model calculates on an hourly basis how the plume trajectory is deformed by each hill. The computed concentration at each receptor is then derived from the receptor position on the hill and the resultant plume position and shape." [2] CTDMplus does not include a building downwash component. The last modification to the CTDMplus model was in March, 1993, which updated algorithms for unstable situations. [3] To date, this model has not been used in Minnesota, largely due to the lack of terrain suitable to justify its use and the age of its last update.

**MPCA Position**

MPCA objects to the use of CTMDplus for any facility located in Minnesota for technical and programmatic reasons. We believe that our arguments are reasonable, supported by the available technical literature, and within the legitimate scope of our state program interests.

**Technical Objections**

In light of the published performance of the AERMOD/CTDMplus comparison, the MPCA would not approve the use of CTDMplus by USG-Red Wing for its one-hour $SO_2$ NAAQS demonstration. We think the same performance considerations provide EPA with the ability to reject USG-Red Wing's use of CTDMplus in the current enforcement case.

The MPCA bases this conclusion on the comparison of AERMOD to CTDMplus. An early analysis indicated that AERMOD was an equivalent or better modeling platform in comparison to the CTDMplus approach. [4] In this 1999 compaison, EPA noted that "The model evaluation report indicates that the current version of AERMOD outperforms all the other four models (ISCST3, ISC-PRIME, CDTMPLUS and the proposed version of AERMOD)."[4] A 2005 study was published, noting a statistical emphasis to describe model abilities to reproduce upper end concentration predictions, reporting similar findings.[5]

---

[1] Strimaitis, D. G., Paine, R. J., Egan, B. A., & Yamartino, R. J. (1987). EPA complex terrain model development: Final report. Contract, (68-02), 3421. (See page 4.)

[2] *Ibid*, 9.

[3] United States Environmental Protection Agency, (1993) Modifications to User's Guide to the Complex Terrain Dispersion Model Plus Algorithms for Unstable Situations (CTDMPLUS): Volume 1. Model Description and User Instructions. Addendum to user's guide (1989).

[4] Lee, R. F., Wilson, R. B., Region, X., & Venkatram, A. (1999). Comparison of Regulatory Design Concentrations: AERMOD Versus ISCST3 and CTDMPLUS. Draft EPA (See page 36)

[5] Perry, S. G., Cimorelli, A. J., Paine, R. J., Brode, R. W., Weil, J. C., Venkatram, A., ... & Peters, W. D. (2005). AERMOD: A dispersion model for industrial source applications. Part II: Model performance against 17 field study databases. *Journal of applied meteorology*, 44(5), 694-708.

The same 2005 EPA study results were presented by Roger Brode, PhD, at the 2006 EPA Regional/State/Local Modelers Workshop in San Diego, California.[6] Dr. Brode's presentation, titled *AERMOD Technical Forum*, included a discussion of the physics behind AERMOD as well as performance evaluation and model consequence information. Dr. Brode described the evaluation of AERMOD, ISCST3, ISC-Prime, and CTDMplus using 17 field study databases. Based on the summary provided, 13 databases featured flat or rolling terrain, while 4 featured complex terrain. Dr. Brode concluded that "AERMOD Consistently Outperformed ISCST3, ISC-PRIME and CTDMPLUS"[7] Slide 23 of this same presentation featured the Lovett $SO_2$ complex terrain evaluation (Q/Q plot) for one-hour $SO_2$ concentrations, indicating that CTDMplus predicted higher concentrations than AERMOD. Dr. Brode noted that "AERMOD Generally Predicts Lower – More Realistic –Concentrations in Complex Terrain".[8]

The 2005 EPA compared AERMOD to the 1993 version of CTDMplus. The AERMOD platform has undergone significant revisions since 2005, resulting in a dozen or more updated versions that have improved AERMOD performance since that time. In addition, AERMET, the meteorological data model that supports the AERMOD platform, has also improved since the 2005 EPA model comparison study. As a result, the MPCA recognizes the nearly two decades of AERMOD improvements further eclipses the CTDMplus model performance. For the technical reasons presented above that the MPCA objects to the use of CTDMplus and supports the use of AERMOD in this instance and for all facility modeling demonstrations in Minnesota.

**Programmatic Objections**

The MPCA objects to the use of CTDMplus based on the programmatic inconsistency it would impose on Minnesota modeling practices, along with added complications to Minnesota air quality permitting and SIP administration. We have identified three reasons that support our programmatic objection.

First, it is unclear how the use of CTDMplus over the MPCA's objection, for a facility located in Minnesota, respects the cooperative federalism provided by the Clean Air Act. This is particularly important since Minnesota has an approved state air quality permitting program with sufficient capacity to review and approve air quality dispersion modeling. In this situation, it is unclear how EPA decision in this situation would effectively protect Minnesota's air quality, given that EPA's own analysis clearly demonstrates the the CTDMplus model is inferior to AERMOD, even for areas with complex terrain.

Second, if EPA allows the use of CTDMplus, the MPCA may need to issue an amended air quality permit to USG-Red Wing that includes new emission limits or operational conditions. Under this scenario, the MPCA would have to determine if emission limits or operational conditions resulting from the use of CTDMplus are adequate for Minnesota's air quality permitting requirements. To remedy the issue, USG-Red Wing may be required to compile a new modeling demonstration based on AERMOD. In addition, any facilities modeled with CTDMplus will be difficult to use as nearby sources for future modeling by other permit holders in Minnesota.

Lastly, EPA's use of CTDMplus in Minnesota opens the door to future requests in our state to pursue this outdated modeling approach. EPA's approval to use CTDMplus in this instance would establish a past practice from our federal counterpart that would require the MPCA to expend precious resources to review requests to use CTDMplus. In addition, EPA's use in this instance could also serve as a justification that other areas of the

---

[6] Dr. Brode is currently with EPA OAQPS, and at the time, was with MACTEC Federal Programs, Inc.

[7] Brode, R.W., (2006). AERMOD Technical Forum. Presentation. EPA R/S/L Modelers Workshop in San Diego, California on May 16, 2006. (See slide 22).

[8] *Ibid*, slide 25

state should be considered "complex terrain" for modeling review purposes, which the MPCA does not support.

**Recommendations**

For the technical and programmatic purposes described above, the MPCA strongly objects to use the CTDMplus model for a facility emitting air pollution within Minnesota. Based on our review of the facts of this situation and the published technical literature, we propose the following three recommendations:

1. Direct the Company to use AERMOD for evaluating the one-hour $SO_2$ NAAQS. This is the most direct solution under the given circumstances and is consistent with EPA's rules and guidance for the one-hour $SO_2$ NAAQS. The published AERMOD performance data does not support the use of CTDMplus regardless whether it appears on the approved model list of Appendix W; or,
2. If EPA proceeds with CTDMplus, EPA should request an updated modeled/monitored evaluation specific to the USG-Red Wing location, consistent with the 2005 EPA model consequence study; and lastly,
3. Remove CTDMplus from the EPA list of preferred and approved models during the next revision of Appendix W, as EPA's own publications clearly demonstrate that AERMOD out-performs CTDMplus in complex terrain scenarios.

Thank you for the opportunity to provide input on this action. If you have any questions or comments about this correspondence, please contact me at frank.kohlasch@state.mn.us or 651-757-2500.

Sincerely,

Frank Kohlasch
Manager, Air Assessment Section
Environmental Analysis & Outcomes Division

FK:je

cc: Pam Blakely, EPA Region 5
Randy Robinson, EPA Region 5
Cory Boeck, Supervisor, Air Enforcement Unit, MPCA
David Brown, Risk Evaluation and Air Modeling Unit, MPCA
Steve Pak, Supervisor, Air Permitting Unit, MPCA
Jim Sullivan, Risk Evaluation and Air Modeling Unit, MPCA