DIVISION OF AIR QUALITY
February 25, 2021

MEMORANDUM

TO: Michael Koerschner, Environmental Engineer, ARO
Patrick Ballard, Permit Coordinator, ARO

FROM: Matthew Porter, Meteorologist, AQAB

THROUGH: Tom Anderson, AQAB Supervisor

SUBJECT: Sitewide Dispersion Modeling Analysis for Madison Asphalt, LLC
Facility ID: 5800063
Application ID: 5800063.19A – GREEN – 300
Marshall, NC Madison County

I have completed a sitewide dispersion modeling analysis for the new hot mix asphalt facility that will be owned and operated by Madison Asphalt, LLC located in Marshall, Madison County, NC. The new asphalt facility will be constructed on leased land located within the property boundaries of the existing permitted source, McCrary Stone Service, Inc. (Facility ID: 5800053). The dispersion modeling analysis was conducted to evaluate the combined toxic and criteria air pollutant ambient impacts from all operations located at the site, which included emissions from the proposed construction and operation of a hot mix asphalt facility and the existing concrete and quarry plant operations. The sitewide total emissions of arsenic, benzene, formaldehyde, and nickel were estimated to exceed the modeling thresholds, also known as the toxic air pollutant (TAP) emission rates (TPERs) outlined in 15A NCAC 02Q .0711. Sitewide criteria pollutants including particulate matter (both $PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and carbon monoxide (CO) were modeled for comparison with the National Ambient Air Quality Standards (NAAQS). Ultimately, the sitewide dispersion modeling analysis of TAPs and criteria air pollutant emissions adequately demonstrated compliance with the Acceptable Ambient Levels (AALs) outlined in 15A NCAC 02D.1104 and the NAAQS, on a source-by-source basis.

Model Selection

AERMOD (version 19191) was selected as the most appropriate dispersion model for the modeling analysis. AERMOD is currently the preferred regulatory dispersion model by the U.S. EPA for evaluating air pollutant impacts from industrial facilities. [1] The AERMOD modeling system has undergone nearly 20 years of performance evaluation studies and model coding refinements during which time NC DAQ has relied on this modeling system for compliance demonstrations under the air toxics and NAAQS programs at small, synthetic minor, and major Title V industrial sources of air pollution in all regions of North Carolina from the mountains to the coastal plain. The AERMOD modeling system includes preprocessors for meteorology inputs (AERMET version 19191 and AERMINUTE version 15272) and complex terrain inputs (AERMAP version 18081). The performance evaluation studies have shown that AERMOD

[1] See preferred models in Appendix A to Appendix W of 40 CFR Part 51. Modeling system details: https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models

predictions of ambient air pollution impacts from various source release types (points, volumes, and area sources) are within acceptable performance ranges for model precision and model bias.[2] AERMOD was designed to simulate steady-state gaussian-shaped plume dispersion under convective, stable, and neutral boundary layer conditions in flat and complex terrain (i.e., above stack height) environments. As such, the acceptable performance model evaluations from EPA and design features of the AERMOD modeling system support selection of AERMOD for the sitewide TAPs and NAAQS modeling demonstrations at the Madison Asphalt facility.

Meteorology Selection

The Madison Asphalt facility is located 15 miles north of Asheville in the northern reaches of the French Broad River Valley nestled between the Great Smoky Mountains to the west and the Blue Ridge Mountains to the east. In terms of air quality dispersion, the controlling micrometeorological conditions at the facility include very stable boundary layer conditions accompanied by calm and light variable winds. Specifically, the very stable boundary layer conditions at the facility are influenced by strong vertical temperature inversions that would occur during evening, nighttime, and early morning hours. As such, selection of the most appropriate meteorology for AERMOD was determined by evaluation of these controlling micrometeorological conditions represented in readily available meteorological databases that also would comply with the stringent quality assurance and data completeness parameters outlined in EPA guidance on meteorology for regulatory modeling applications.[3] There are two meteorological database options available that meet EPA quality assurance and data completeness guidelines for the facility location. These database options include data from the Asheville Airport (KAVL) and data provided by the U.S. EPA in the form of 12-km resolution Weather Research Forecasting (WRF version 3.8) prognostic meteorology. The model performance evaluations of the EPA WRF data (2013-2015) are available online.[4] Given that both databases comply with EPA guidelines, NC DAQ has evaluated the representativeness and conservatism of the hourly KAVL and WRF data in terms of the controlling micrometeorological conditions, and determined that the WRF data was the most appropriate for the Madison Asphalt sitewide AERMOD modeling demonstrations. Further discussions of the evaluation are provided in the following paragraphs.

Note the selection of the 12-km grid node (i.e., 35.764 N, 82.585 W) and subset of the WRF data evaluated was based on proximity to the facility and the overall performance of the controlling synoptic, regional, and micrometeorological conditions represented in the hourly vertical temperature and wind data observed in the French Broad River Valley. The selected WRF grid node is located 0.5 miles northeast of Jupiter, NC, and 4 miles east of the facility.

The strength of atmospheric stability or instability of the boundary layer can be characterized primarily by the vertical profiles of temperature and winds. In terms of dispersion modeling applications for surface releases, the most important and controlling stability parameters can be reduced to simply the vertical temperature profile and surface winds. Consequently, the vertical temperature profile and surface winds for stable boundary layer conditions were compared and evaluated for the KAVL and WRF databases for a representative example hour and day in 2015 (October 15, 2015) when stable conditions and light winds were observed.

[2] AERMOD Model Formulation and Evaluation. August 2019. EPA-454/R-19-014. See: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_mfed.pdf
[3] Meteorological Monitoring Guidance for Regulatory Modeling Applications. February 2000. EPA-454/R-99-005. See: https://www.epa.gov/sites/production/files/2020-10/documents/mmgrma_0.pdf
[4] Weather Research Forecast Version 3.8 Meteorological Model Evaluation Annual 2013-2015 12-km CONUS (PDF). Available here: https://www.epa.gov/scram/air-modeling-reports-and-journal-articles

Figure 1 shows the vertical temperature profile and mixing heights predicted by AERMOD at KAVL and at the selected 12-km grid node from the WRF data (35.764N, 82.585W). As shown, the subadiabatic lapse rate (i.e., temperature inversion) simulated by the WRF data is far stronger than the lapse rate observed at KAVL. Additionally, the 11-meter mixing height predicted from the WRF data is significantly less than the 46-meter mixing height observed at KAVL. This indicates that the WRF data vertical temperature profiles and mixing height during this hour would result in a higher ambient impact for a surface release predicted by AERMOD.

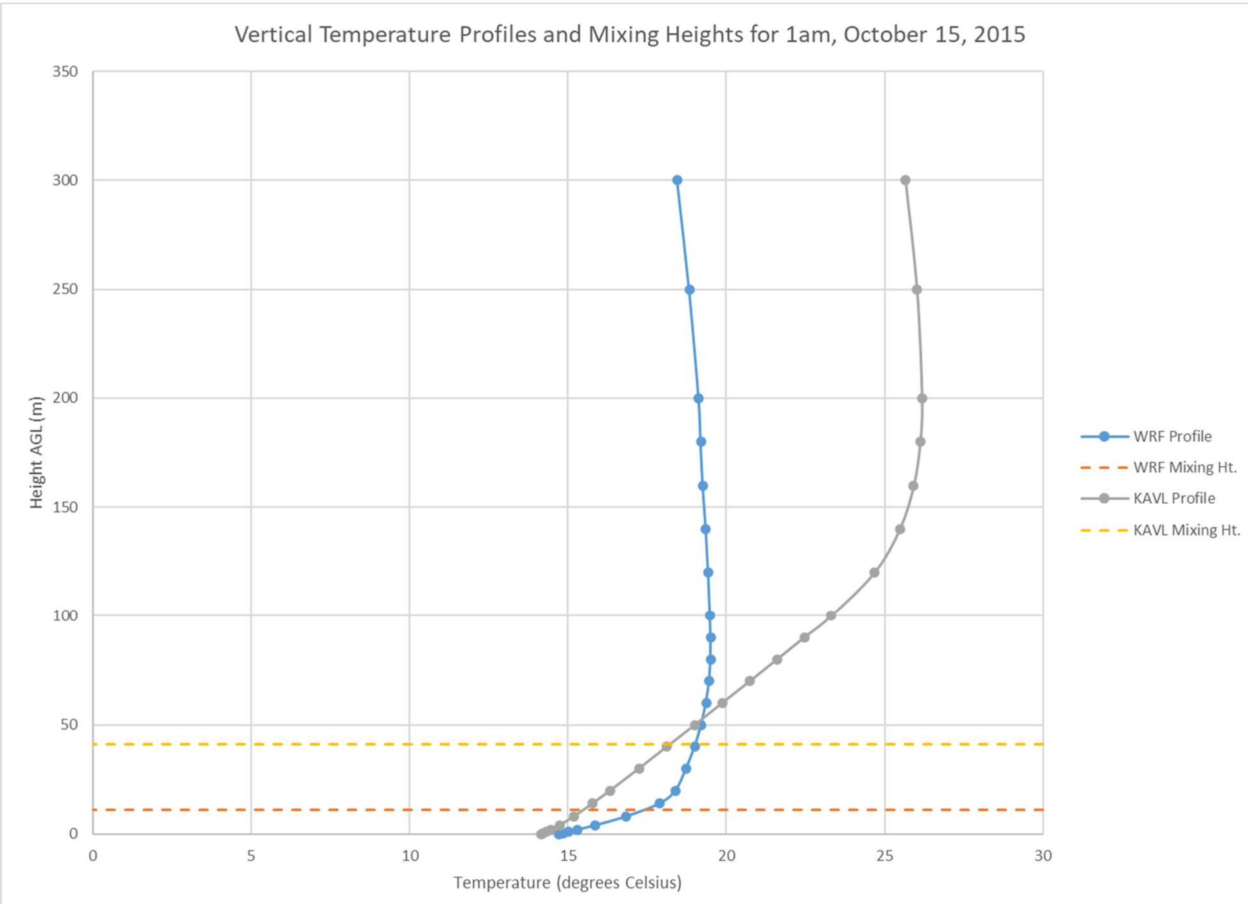

Figure 1. Vertical Temperature Profile and Mixing Height Comparison of WRF data (35.764N, 82.585W) and Asheville Airport (KAVL) for 1am October 15, 2015.

The frequency of light winds during 2015 at KAVL and in the WRF data were evaluated by analyzing the difference between the windroses constructed from hours when winds were below three meters per second (~6.7 mph). The 2015 data period was selected based on preliminary modeling indicating meteorology from this year represented the most conservative, worst-case dispersion conditions common to both the KAVL and WRF databases. Figure 2 shows that the frequency of these light winds in the WRF data was much higher than those observed at KAVL. The higher frequency of light winds in the WRF data (i.e., 5115 records in 2015 versus 5027 records in 2015 for KAVL) indicate higher concentrations would be predicted by AERMOD the same if not more often than what would be predicted when modeling with the KAVL data.

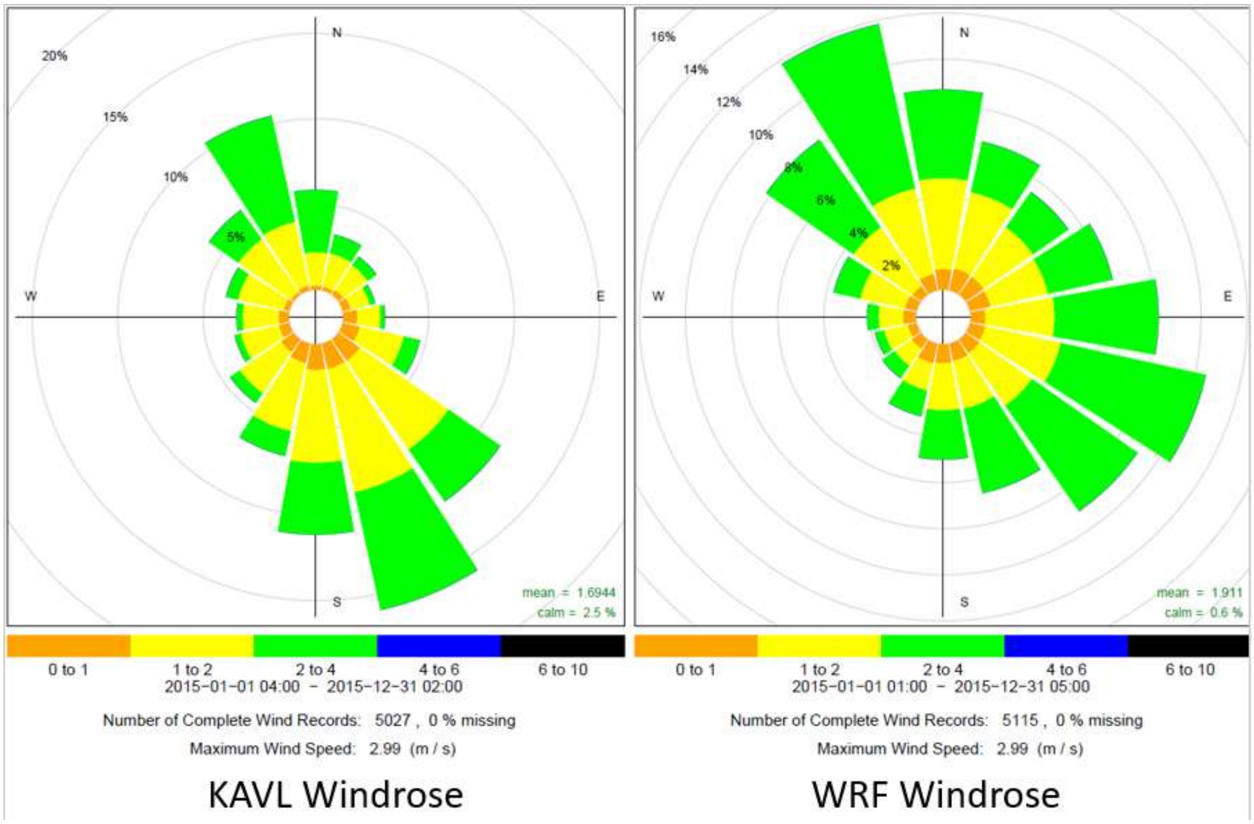

Figure 2. Windrose plots comparing 2015 KAVL and WRF hourly wind data with winds less than three meters per second (~6.7 mph).

NC DAQ has determined that the duration, frequency and magnitude of light winds and associated temperature inversions contained in the WRF data adequately represents worst-case, controlling dispersion conditions at the facility location. Therefore, the WRF data was selected as the most representative and conservative for the sitewide modeling demonstrations.

Terrain Data and Receptor Grids

Receptors were modeled around the quarry property boundary at 25-meter intervals. Two nested receptor grids were modeled beyond the facility property extending 1 km with 50-meter receptor spacing and extending farther out to 5 km with 100-meter receptor spacing. Additional receptors were modeled at nearby sensitive community locations including the nearest residence, a nursing home, childcare center, and nearby baseball fields. In all, a total of 11,395 receptors were modeled. Building, source, and receptor elevations and receptor dividing streamline heights were calculated from 1/9th-arc-second resolution (1-meter) USGS NED terrain data using the AERMOD terrain pre-processor AERMAP (version 18081). All modeled buildings, sources, and receptors were geo-located within the modeling domain based on the horizontal North American Datum of 1983 (NAD83) and Zone 17 of the Universal Transverse Mercator (UTM) coordinate system.

Building Downwash

Direction-specific building downwash parameters, calculated using EPA's BPIP-PRIME program (04274), were used as input to AERMOD to determine building downwash effects on plume rise and effects on entrainment of stack emissions into the cavity and turbulent wake zones downwind of existing buildings at the new asphalt facility. The building downwash analysis included five buildings and three point sources.

Sitewide Modeling for North Carolina Air Toxics

Sitewide air toxics modeling included five point sources and one volume source from the proposed new asphalt plant, concrete batch plant, and quarry operations. Point source and volume source parameters are provided in the attached Tables A1 and A2, respectively. Sitewide modeled air toxics emission rates are provided in attached Table A3. All emission rates were conservatively modeled 8,760 hours per year without daily operating restrictions.

Sitewide emissions impacts for each TAP and associated averaging period are shown in Table 1 below as a percentage of the applicable AAL. Note that the sitewide modeling results were lower than the modeling results provided by Madison Asphalt because the sitewide modeling expanded the ambient air boundary receptors beyond the leased boundary to represent the impacts at the quarry property boundary, in accordance with NC DAQ policy.[5] Modeled air toxics impacts at sensitive receptors is provided in Table 2.

Table 1.
Maximum Modeled Toxics Impacts from Sitewide Emissions
Madison Asphalt, LLC, Marshall, NC

Pollutant	Averaging Period	AAL (µg/m^3)	Modeled Impact (µg/m3)	% of AAL
Arsenic	Annual	0.0021	0.00012	5.71%
Benzene	Annual	0.12	0.05243	43.7%
Formaldehyde	1-hour	150	18.12	12.1%
Nickel	24-hour	6	0.1098	1.83%

Table 2.
Modeled Toxics Impacts from Sitewide Emissions at Sensitive Receptors
Madison Asphalt, LLC, Marshall, NC

Pollutant	Sensitive Receptor	AAL (µg/m3)	Modeled Impact (µg/m3)	% of AAL
Arsenic (Annual)	Nearest Residence	0.0021	0.00005	2.4%
	Nursing Home		0.00000	0.0%
	Childcare Center		0.00000	0.0%
	Ballfields		0.00000	0.0%

[5] Lease Arrangement Modeling Procedures for 15A NCAC 2D.1100. July 7, 1999. See: https://files.nc.gov/ncdeq/Air%20Quality/permits/memos/19990121.pdf

Pollutant	Sensitive Receptor	AAL (µg/m3)	Modeled Impact (µg/m3)	% of AAL
Benzene (Annual)	Nearest Residence	0.12	0.02115	17.6%
	Nursing Home		0.00152	1.3%
	Childcare Center		0.00133	1.1%
	Ballfields		0.00099	0.8%
Formaldehyde (1-hour)	Nearest Residence	150	7.67	5.1%
	Nursing Home		3.07	2.0%
	Childcare Center		3.66	2.4%
	Ballfields		1.68	1.1%
Nickel (24-hour)	Nearest Residence	6	0.04737	0.8%
	Nursing Home		0.00973	0.2%
	Childcare Center		0.00799	0.1%
	Ballfields		0.00425	0.1%

Sitewide Modeling for NO_2, SO_2, and CO

The sitewide modeling demonstration for the NO_2, SO_2, and CO NAAQS included three combustion point sources from the proposed new asphalt plant and quarry operations. Point source parameters are provided in the attached Table A1. Sitewide modeled NO_2, SO_2, and CO emission rates are provided in attached Table A4. With exception to the 1-hour NO_X emissions from the 250-hp quarry engine, all emission rates were conservatively modeled 8,760 hours per year without daily operating restrictions. The 250-hp quarry engine NO_X emissions were modeled 7am-5pm based on typical quarry operations to demonstrate compliance with the 1-hour NO_2 NAAQS.

The 1-hour NO_2 NAAQS modeling demonstration relied on the EPA Tier 2 regulatory option, Ambient Ratio Method Version 2 (ARM2) regulatory option in AERMOD.[6] The ARM2 option simulates the atmospheric chemistry conversion of NOX to ambient NO_2 based on polynomial correlations developed from data taken from EPA's Air Quality System.[7] The ARM2 regulatory option is recommended as a Tier 2 approach in Section 4.2.3.4 of Appendix W to 40 CFR Part 51.

Maximum modeled impacts for NO_2, SO_2, and CO are provided in Table 2. NO_2 and CO background concentrations were taken from 2017-2019 data from the Great Smoky Mountains NP Look Rock site. SO_2 background concentrations were conservatively based on 2017-2019 data from the Skyland DRR site located near Duke-Asheville. Modeled impacts at sensitive receptors is provided in Table 4.

[6] Ambient Ratio Method Version (ARM2) for use with AERMOD for 1-hr NO_2 Modeling. September 20, 2013. See: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/ARM2_Development_and_Evaluation_Report-September_20_2013.pdf

[7] Podrez, M. 2015. An Update to the Ambient Ratio Method for 1-hr NO_2 Air Quality Standards Dispersion Modeling. Atmospheric Environment, 103: 163–170.

Table 3.
Maximum NO_2, SO_2, and CO Impacts from Sitewide Emissions
Madison Asphalt, LLC, Marshall, NC

Pollutant	Avg. Period	NAAQS (µg/m3)	Background Concentration (µg/m3)	Modeled Impact (µg/m3)	Total Impact (µg/m3)	% of NAAQS
NO_2	1-hour	188	9.40	138.4	147.8	79%
	Annual	100	1.12	10.4	11.5	11%
SO_2	1-hour	196	31.4	102.7	134.1	68%
	3-hour	1300	14.9	95.4	110.3	8%
CO	1-hour	40000	1424	932	2356	6%
	8-hour	10000	1029	406	1434	14%

Table 4.
NO_2, SO_2, and CO Impacts from Sitewide Emissions at Sensitive Receptors
Madison Asphalt, LLC, Marshall, NC

Pollutant	Sensitive Receptor	NAAQS (µg/m3)	Background Concentration (µg/m3)	Modeled Impact (µg/m3)	Total Impact (µg/m3)	% of NAAQS
1hr NO_2	Nearest Residence	188	9.4	101.3	110.7	59%
1hr NO_2	Nursing Home	188	9.4	27.1	36.5	19%
1hr NO_2	Childcare Center	188	9.4	20.6	30.0	16%
1hr NO_2	Ballfields	188	9.4	13.0	22.4	12%
Annual NO_2	Nearest Residence	100	1.12	4.6	5.7	6%
Annual NO_2	Nursing Home	100	1.12	0.3	1.4	1%
Annual NO_2	Childcare Center	100	1.12	0.3	1.4	1%
Annual NO_2	Ballfields	100	1.12	0.2	1.4	1%
1hr SO_2	Nearest Residence	196	31.4	20.1	51.5	26%
1hr SO_2	Nursing Home	196	31.4	1.6	33.0	17%
1hr SO_2	Childcare Center	196	31.4	1.5	32.9	17%
1hr SO_2	Ballfields	196	31.4	1.4	32.8	17%
3hr SO_2	Nearest Residence	1300	14.9	13.2	28.1	2%
3hr SO_2	Nursing Home	1300	14.9	1.3	16.2	1%
3hr SO_2	Childcare Center	1300	14.9	1.1	16.0	1%
3hr SO_2	Ballfields	1300	14.9	1.0	15.9	1%

Pollutant	Sensitive Receptor	NAAQS (µg/m3)	Background Concentration (µg/m3)	Modeled Impact (µg/m3)	Total Impact (µg/m3)	% of NAAQS
1hr CO	Nearest Residence	40000	1424	447.8	1871.8	5%
	Nursing Home			193.0	1617.0	4%
	Childcare Center			153.7	1577.7	4%
	Ballfields			151.9	1575.9	4%
8hr CO	Nearest Residence	10000	1029	217.0	1246.0	12%
	Nursing Home			33.5	1062.5	11%
	Childcare Center			23.2	1052.2	11%
	Ballfields			19.0	1048.0	10%

Sitewide PM_{10} and $PM_{2.5}$ Modeling

The sitewide modeling demonstration for the $PM_{2.5}$ and PM_{10} NAAQS included five combustion point sources, eight volume sources, 331 line-volume sources, 19 area sources, and one open pit source from the proposed new asphalt plant, concrete batch plant, and quarry operations. Point and volume source parameters are provided in the attached Tables A1 and A2, respectively. Line-volume line sources are provided in the attached Table A4. Area and open pit source parameters are provided in attached Tables A6 and A7. Sitewide modeled PM_{10} and $PM_{2.5}$ emission rates are provided in attached Table A8.

The annual $PM_{2.5}$ NAAQS demonstration assumed modeled emissions based on annual limits from all sources for 8,760 hours per year. The 24-hour $PM_{2.5}$ and PM_{10} demonstrations included separate daytime and nighttime sitewide operating scenarios. The daytime scenario assumed all asphalt emission activities operating 7am-7pm (1300 tons per day), and concrete plant and quarry emission activities operating 7am-5pm. The nighttime scenario was based on asphalt operations 6pm-3am (400 tons asphalt per night) coinciding with concrete batch plant and quarry operations following the same daytime schedule 7am-5pm. In general, asphalt plant emission activities were based on permit allowable emissions and concrete plant and quarry emissions were based on maximum expected actuals derived from review of historical site activities.

The PM_{10} and $PM_{2.5}$ sitewide emission inventory includes combustion sources and fugitive emissions from crushing, screening, conveyors, material transfers, material handling, trucking and loader traffic on unpaved roads, wind erosion from sorted and unsorted aggregate stock piles, and drilling and loader activities in the open pit. Fugitive emission source parameters and model emissions methodologies were taken from EPA and applicable nationally available guidance documents.[8, 9, 10]

Sitewide modeled impacts for 24hr and annual $PM_{2.5}$ and 24hr PM_{10} are provided in Table 5. PM_{10} background concentrations were based on 2019 data from the Great Smoky Mountains NP Look Rock site. $PM_{2.5}$ 24-hour and annual background concentrations were taken from 2017-2019 data collected at the Asheville Board of Ed. Bldg. site in Buncombe County. Modeled impacts at sensitive receptors for the daytime and nighttime operating scenarios are provided in Tables 6 and 7, respectively.

Table 5.
Maximum Modeled PM_{10} and $PM_{2.5}$ Impacts from Sitewide Emissions
Madison Asphalt, LLC, Marshall, NC

Pollutant	Asphalt Plant Operating Scenarios	NAAQS (µg/m3)	Background Concentration (µg/m3)	Modeled Impact (µg/m3)	Total Impact (µg/m3)	% of NAAQS
24hr PM_{10}	7am-7pm (day)	150	20.7	106.6	127.3	85%
	6pm-3am (night)			105.5	126.2	84%
24hr $PM_{2.5}$	7am-5pm (day)	35	13.0	6.9	19.9	57%
	6pm-3am (night)			11.9	24.9	71%
Annual $PM_{2.5}$	Annual Limits	12	6.3	1.7	8.0	66%

Table 6.
Modeled PM_{10} and $PM_{2.5}$ Impacts from Sitewide Emissions at Sensitive Receptors (Day)
Madison Asphalt, LLC, Marshall, NC

Pollutant	Sensitive Receptor	NAAQS (µg/m3)	Background Concentration (µg/m3)	Modeled Impact (µg/m3)	Total Impact (µg/m3)	% of NAAQS
24hr PM_{10}	Nearest Residence	150	20.7	13.2	33.9	23%
	Nursing Home			3.9	24.6	16%
	Childcare Center			5.2	25.9	17%
	Ballfields			3.7	24.4	16%
24hr $PM_{2.5}$	Nearest Residence	35	13.0	2.3	15.3	44%
	Nursing Home			0.3	13.3	38%
	Childcare Center			0.5	13.5	39%
	Ballfields			0.4	13.4	38%

[8] Haul Road Workgroup Final Report Submission to EPA-OAQPS. March 2, 2012. U.S. EPA. See: https://gaftp.epa.gov/Air/aqmg/SCRAM/conferences/2012_10th_Conference_On_Air_Quality_Modeling/Review_Material/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf
[9] WRAP Fugitive Dust Handbook. September 7, 2006. Western Regional Air Partnership (WRAP). See: https://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf
[10] Air/Superfund National Technical Guidance Study Series; Volume III – Estimation of Air Emissions from Cleanup Activities at Superfund Sites, Interim final report EPA-450/1-89-003. January 1989. U.S. EPA

Pollutant	Sensitive Receptor	NAAQS (µg/m3)	Background Concentration (µg/m3)	Modeled Impact (µg/m3)	Total Impact (µg/m3)	% of NAAQS
Annual $PM_{2.5}$	Nearest Residence	12	6.3	0.4	6.7	56%
	Nursing Home			0.02	6.3	53%
	Childcare Center			0.02	6.3	53%
	Ballfields			0.01	6.3	53%

Table 7.
Modeled PM_{10} and $PM_{2.5}$ Impacts from Sitewide Emissions at Sensitive Receptors (Night)
Madison Asphalt, LLC, Marshall, NC

Pollutant	Sensitive Receptor	NAAQS (µg/m3)	Background Concentration (µg/m3)	Modeled Impact (µg/m3)	Total Impact (µg/m3)	% of NAAQS
24hr PM_{10}	Nearest Residence	150	20.7	15.1	35.8	24%
	Nursing Home			3.7	24.4	16%
	Childcare Center			4.5	25.2	17%
	Ballfields			2.3	23.0	15%
24hr $PM_{2.5}$	Nearest Residence	35	13.0	4.6	17.6	50%
	Nursing Home			0.5	13.5	39%
	Childcare Center			0.4	13.4	38%
	Ballfields			0.3	13.3	38%
Annual $PM_{2.5}$	Nearest Residence	12	6.3	0.4	6.7	56%
	Nursing Home			0.02	6.3	53%
	Childcare Center			0.02	6.3	53%
	Ballfields			0.01	6.3	53%

This review assumes the emissions scenarios, sources modeled, source parameters, and pollutant emission rates used in the dispersion modeling analysis are correct.

cc: Tom Anderson
Matthew Porter

Table A1. Modeled Release Parameters for Point Sources

Model ID	Source Description	X-Utm (m)	Y-Utm (m)	Elevation (m)	Stack Height (m)	Temp. (K)	Velocity (m/s)	Stack Diameter (m)	Release Configuration
DRYER	Dryer/baghouse	350121.70	3961925.90	599.80	8.10	436.00	19.40	1.03	Vertical
SILO	Silo Filling	350139.40	3961929.90	606.60	10.81	339.00	1.50	0.10	Horizontal
TANKHEAT	Asphalt Tank Heater	350126.10	3961939.70	604.30	2.22	450.00	6.50	0.30	Vertical
QUARENGN	Primary Crusher Engine (250 hp)	350236.70	3961901.50	596.00	5.12	488.71	156.48	0.08	Horizontal
CONBFLTR	Concrete Plant Bagfilter	350236.30	3962249.90	651.20	5.33	0.00	15.13	0.52	Horizontal

Table A2. Modeled Release Parameters for Volume Sources

Model ID	Source Description	X-Utm (m)	Y-Utm (m)	Elevation (m)	Release Height (m)	Init. Sigma-Y (m)	Init. Sigma-Z (m)	Drop Height AGL (m)	Drop Distance (m)
ASPHRAP	Asphalt Plant RAP Crushing, Screening, Handling	350098.10	3961950.20	597.30	1.52	0.35	0.71	2.28	1.53
ASPHXFER	Asphalt Plant Aggregate Handling Material Transfer to/from stockpiles and cold bin	350083.50	3961883.70	596.00	1.52	0.35	0.71	2.28	1.53
LOADOUT	Asphalt Plant Loadout	350138.90	3961927.90	605.10	3.50	0.70	1.63	5.25	3.50
QPLANT1	Quarry Jaw Plant 1 Crushing, Screening, and Conveyors	350236.70	3961901.50	596.00	1.52	0.35	0.71	2.28	1.53
QPLANT2	Quarry Shorthead Cone Plant 2 Crushing, Screening, and Conveyors	350293.80	3961821.80	604.90	1.52	0.35	0.71	2.28	1.53
QLOADJAWMT1	Quarry Plant 1 Loading MT1	350203.10	3961881.40	602.40	0.76	0.71	0.35	1.14	0.75

Model ID	Source Description	X-Utm (m)	Y-Utm (m)	Elevation (m)	Release Height (m)	Init. Sigma-Y (m)	Init. Sigma-Z (m)	Drop Height AGL (m)	Drop Distance (m)
QLOADCONEMT2	Quarry Plant 2 Loading MT2	350291.60	3961792.70	604.60	0.76	0.71	0.35	1.14	0.75
CONXFER	Concrete Batch Plant Material Handling	350205.80	3962257.60	650.50	0.76	0.50	0.35	1.14	0.75

Table A3. Air Toxics Modeled Hourly Emission Rates (lb/hr)

Model ID	Source Description	Arsenic	Benzene	Formaldehyde	Nickel
DRYER	Dryer/baghouse	9.524E-05	6.627E-02	5.270E-01	1.071E-02
SILO	Silo Filling	0.000E+00	6.667E-04	1.429E-02	0.000E+00
TANKHEAT	Asphalt Tank Heater	5.635E-06	2.778E-05	4.841E-04	4.206E-05
QUARENGN	Primary Crusher Engine (250 hp)	1.598E-06	3.733E-04	2.070E-03	5.250E-06
CONBFLTR	Concrete Plant Bagfilter	1.929E-06	0.000E+00	0.000E+00	3.333E-04
LOADOUT	Silo Loadout	0.000E+00	3.651E-04	6.714E-04	0.000E+00

Table A4. NO_2, SO_2, and CO Modeled Hourly Emission Rates (lb/hr)

Model ID	Source Description	Annual NO_2	1-hour NO_2	3-hour SO_2	1-HOUR SO_2	CO 1-hour and 8-hour
DRYER	Dryer/baghouse	9.350E+00	9.350E+00	4.000E-02	4.000E-02	2.210E+01
TANKHEAT	Asphalt Tank Heater	2.000E-01	2.000E-01	2.150E-03	2.150E-03	5.040E-02
QUARENGN	Primary Crusher Engine (250 hp)	7.750E+00	7.750E+00	1.010E+00	1.010E+00	1.670E+00

Table A5. Modeled Release Parameters for Unpaved Haul Road Line-Volume Sources

Road Segment ID	Source Description	Vehicle Ht. (m)	Vehicle Width (m)	Vehicle Length (m)	Road Width (m)	Road Length (m)	Top of Plume (m)	Release Height (m)	Width of Plume (m)	Init. Sigma-Y (m)	Init. Sigma-Z (m)
A	Asphalt plant to gate (A_001-A_040)	3	3	9	10	809.0	5.1	2.55	3.6	1.67	2.37
A1	Asphalt front-end loader yard traffic (A1_001-A1_036)	3	3	9	10	61.0	5.1	2.55	3.6	1.67	2.37
A2	Quarry piles to aggregate piles (A2_001-A2_034)	3	3	9	10	347.0	5.1	2.55	3.6	1.67	2.37
C	Concrete plant to gate (C_001-C_021)	3	3	9	10	439.0	5.1	2.55	3.6	1.67	2.37
C1	Concrete front-end loader yard traffic (C1_001-C1_016)	3	3	9	10	26.9	5.1	2.55	3.6	1.67	2.37
C2	Quarry aggregate to concrete plant (C2_001-C2_029)	3	3	9	10	600.0	5.1	2.55	3.6	1.67	2.37
Q	Quarry aggregate to gate Truck Sales to Public (Q_001-Q_035)	3	3	9	10	707.0	5.1	2.55	3.6	1.67	2.37
Q1	Shorthead Cone to Stock Piles (Q1_001-Q1_016)	3	3	9	10	167.0	5.1	2.55	3.6	1.67	2.37
Q2	Jaw to ABC Stock Pile (Q2_001-Q2_014)	3	3	9	10	146.0	5.1	2.55	3.6	1.67	2.37
Q3	ABC Stock Pile to Shorthead Cone Crusher Feeder Bin (Q3_001-Q3_021)	3	3	9	10	212.0	5.1	2.55	3.6	1.67	2.37

Road Segment ID	Source Description	Vehicle Ht. (m)	Vehicle Width (m)	Vehicle Length (m)	Road Width (m)	Road Length (m)	Top of Plume (m)	Release Height (m)	Width of Plume (m)	Init. Sigma-Y (m)	Init. Sigma-Z (m)
Q4	Quarry Aggregate Loader Sales to Public (Q4_001-Q4_016)	3	3	9	10	27.3	5.1	2.55	3.6	1.67	2.37
P	Pit to crusher bin (P_001-P_053)	3	3	9	10	1032.0	5.1	2.55	3.6	1.67	2.37
P1	Pit Loader Traffic (modeled in openpit)	--	--	--	--	12.0	--	--	--	--	--

Table A6. Modeled Release Parameters for Area Sources

Source ID	Source Description	Easting (X)	Northing (Y)	Base Elevation	Release Height	Easterly Length	Northerly Length	Angle from North	Initial Vert. Dimension	Area
		(m)	(m)	(m)	(m)	(m)	(m)		(m)	(acres)
QABCP1	Quarry ABC Pile Q1	350181.70	3961825.70	603.40	2.29	38.55	38.55	0.00	1.11	0.36721
QABCP2	Quarry ABC Pile Q2	350139.00	3961855.80	612.40	2.29	53.49	53.49	0.00	1.11	0.70700
QRRP	Quarry Rip Rap Pile Q3	350321.40	3961684.50	604.30	1.22	17.24	17.24	0.00	0.59	0.07344
QFP	Quarry Fines Q4	350254.40	3961682.20	606.40	2.29	53.84	53.84	0.00	1.11	0.71628
Q57AGP	Quarry #57 Agg. Pile Q5	350281.80	3961755.40	613.00	1.22	21.12	21.12	0.00	0.59	0.11022
Q78AGP	Quarry #78 Agg. Pile Q6	350328.30	3961754.90	604.80	1.22	21.12	21.12	0.00	0.59	0.11022
RRBLSTP	Rail Road Ballast Pile Q7	350327.80	3961720.50	604.50	1.22	17.24	17.24	0.00	0.59	0.07344
CONAG1P	Concrete 1a (aggregate)	350175.60	3962264.40	649.10	1.22	9.44	9.44	0.00	0.59	0.02202
CONSND1P	Concrete 1s (sand)	350180.20	3962269.80	650.10	1.22	11.24	11.24	0.00	0.59	0.03122
CONAG2P	Concrete 2a (aggregate)	350195.10	3962275.40	651.40	1.22	8.09	8.09	0.00	0.59	0.01617
CONRRP	Concrete 3a (river rock)	350202.00	3962275.10	651.60	1.22	5.72	5.72	0.00	0.59	0.00808
CONAG4P	Concrete 4a (aggregate)	350207.20	3962271.30	651.30	1.22	5.72	5.72	0.00	0.59	0.00808

CONSND2	Concrete 2s (sand)	350213.40	3962268.20	651.10	1.22	6.71	6.71	0.00	0.59	0.01113
CONSND3	Concrete 3s (sand)	350334.90	3962075.30	636.60	1.22	15.39	15.39	0.00	0.59	0.05853
ASPHAG1P	Asphalt 1A (aggregate)	350077.90	3961878.10	596.00	1.22	9.88	9.88	0.00	0.59	0.02412
ASPHAG2P	Aspalt 2A (aggregate)	350081.70	3961876.20	594.20	1.22	9.88	9.88	0.00	0.59	0.02412
ASPHFP1P	Asphalt 1F (fines)	350086.30	3961870.00	591.50	1.22	9.88	9.88	0.00	0.59	0.02412
ASPHAG3P	Asphalt 3A (aggregate)	350092.60	3961866.80	589.60	1.22	9.88	9.88	0.00	0.59	0.02412
ASPHRR1P	Asphalt R1 (RAP)	350098.80	3961862.70	587.70	1.22	9.88	9.88	0.00	0.59	0.02412

Table A7. Modeled Release Parameters for Open Pit Sources

Source ID	**Source Description**	**Easting (X)**	**Northing (Y)**	**Base Elevation**	**Release Height**	**X-dim.**	**Y-dim.**	**Angle from North**	**Volume**	**Area**
		(m)	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(degs)**	**(m^3)**	**(acres)**
QUARPIT	Quarry Pit (loader traffic P1, material handling, and drilling)	350303.70	3961374.10	541.00	0.76	150.00	200.00	-10	1.11	7.41

Table A8. $PM_{2.5}$ and PM_{10} Modeled Hourly Emission Rates (lb/hr)

Model ID	**Description**	**Source Type**	**$PM_{2.5}$ 24hr 7am-7pm**	**$PM_{2.5}$ 24hr 6pm-3am**	**$PM_{2.5}$ Annual**	**PM_{10} 24hr 7am-7pm**	**PM_{10} 24hr 6pm-3am**
DRYER	Dryer/baghouse	Point	3.350E+00	3.350E+00	2.200E-01	3.910E+00	3.910E+00
SILO	Silo Filling	Point	9.000E-02	9.000E-02	6.000E-03	9.000E-02	9.000E-02
TANKHEAT	Asphalt Tank Heater	Point	3.000E-02	3.000E-02	3.000E-02	3.000E-02	3.000E-02
QUARENGN	Primary Crusher Engine (250 hp)	Point	5.500E-01	5.500E-01	2.291E-01	5.500E-01	5.500E-01
CONBFLTR	Concrete Plant Bagfilter	Point	1.300E-01	1.300E-01	2.000E-03	7.200E-01	7.200E-01
ASPHRAP	Asphalt Plant RAP Crushing, Screening, Handling	Volume	3.817E-03	3.817E-03	4.018E-04	2.975E-02	2.975E-02
ASPHXFER	Asphalt Plant Aggregate Handling Material Transfer to/from stockpiles and cold bin	Volume	1.508E-01	1.508E-01	1.586E-02	5.391E-01	5.391E-01
LOADOUT	Asphalt Plant Loadout	Volume	1.000E-01	1.000E-01	7.000E-03	1.000E-01	1.000E-01
QPLANT1	Quarry Jaw Plant 1 Crushing, Screening, and Conveyors	Volume	9.960E-02	9.960E-02	1.592E-02	6.440E-01	6.440E-01
QPLANT2	Quarry Shorthead Cone Plant 2 Crushing, Screening, and Conveyors	Volume	4.440E-02	4.440E-02	3.784E-03	2.634E-01	2.634E-01
QLOADJAWMT1	Quarry Plant 1 Loading MT1	Volume	4.630E-02	4.630E-02	7.397E-03	3.060E-01	3.060E-01
QLOADCONEMT2	Quarry Plant 2 Loading MT2	Volume	4.630E-02	4.630E-02	7.397E-03	3.060E-01	3.060E-01
CONXFER	Concrete Batch Plant Material Handling	Volume	2.800E-02	2.800E-02	3.653E-03	1.850E-01	1.850E-01
A	Asphalt plant to gate (A_001-A_040)	Line-Volumes	2.413E-01	2.413E-01	1.705E-02	2.413E+00	2.413E+00
A1	Asphalt front-end loader yard traffic (A1_001-A1_036)	Line-Volumes	1.226E-01	1.226E-01	8.714E-03	1.226E+00	1.226E+00
A2	Quarry piles to aggregate piles (A2_001-A2_034)	Line-Volumes	9.849E-02	9.849E-02	6.989E-03	9.849E-01	9.849E-01
C	Concrete plant to gate (C_001-C_021)	Line-Volumes	8.633E-02	8.633E-02	7.633E-03	8.633E-01	8.633E-01

Model ID	Description	Source Type	$PM_{2.5}$ 24hr 7am-7pm	$PM_{2.5}$ 24hr 6pm-3am	$PM_{2.5}$ Annual	PM_{10} 24hr 7am-7pm	PM_{10} 24hr 6pm-3am
C1	Concrete front-end loader yard traffic (C1_001-C1_016)	Line-Volumes	8.978E-03	8.978E-03	8.025E-04	8.978E-02	8.978E-02
C2	Quarry aggregate to concrete plant (C2_001-C2_029)	Line-Volumes	3.452E-02	3.452E-02	3.084E-03	3.452E-01	3.452E-01
Q	Quarry aggregate to gate Truck Sales to Public (Q_001-Q_035)	Line-Volumes	1.369E-01	1.369E-01	3.667E-02	1.369E+00	1.369E+00
Q1	Shorthead Cone to Stock Piles (Q1_001-Q1_016)	Line-Volumes	1.435E-01	1.435E-01	8.178E-03	1.435E+00	1.435E+00
Q2	Jaw to ABC Stock Pile (Q2_001-Q2_014)	Line-Volumes	1.667E-01	1.667E-01	1.789E-02	1.667E+00	1.667E+00
Q3	ABC Stock Pile to Shorthead Cone Crusher Feeder Bin (Q3_001-Q3_021)	Line-Volumes	7.733E-02	7.733E-02	4.417E-03	7.733E-01	7.733E-01
Q4	Quarry Aggregate Loader Sales to Public (Q4_001-Q4_016)	Line-Volumes	1.177E-02	1.177E-02	3.340E-03	1.177E-01	1.177E-01
P	Pit to crusher bin (P_001-P_053)	Line-Volumes	3.453E-01	3.453E-01	3.685E-02	3.453E+00	3.453E+00
QABCP1	Quarry ABC Pile Q1	Area	8.761E-03	8.761E-03	8.761E-03	5.841E-02	5.841E-02
QABCP2	Quarry ABC Pile Q2	Area	1.687E-02	1.687E-02	1.687E-02	1.124E-01	1.124E-01
QRRP	Quarry Rip Rap Pile Q3	Area	9.558E-05	9.558E-05	9.558E-05	6.371E-04	6.371E-04
QFP	Quarry Fines Q4	Area	6.214E-03	6.214E-03	6.214E-03	4.143E-02	4.143E-02
Q57AGP	Quarry #57 Agg. Pile Q5	Area	1.434E-04	1.434E-04	1.434E-04	9.562E-04	9.562E-04
Q78AGP	Quarry #78 Agg. Pile Q6	Area	1.434E-04	1.434E-04	1.434E-04	9.562E-04	9.562E-04
RRBLSTP	Rail Road Ballast Pile Q7	Area	9.558E-05	9.558E-05	9.558E-05	6.371E-04	6.371E-04
CONAG1P	Concrete 1a (aggregate)	Area	4.060E-05	4.060E-05	4.060E-05	2.707E-04	2.707E-04
CONSND1P	Concrete 1s (sand)	Area	8.803E-05	8.803E-05	8.803E-05	5.869E-04	5.869E-04
CONAG2P	Concrete 2a (aggregate)	Area	2.982E-05	2.982E-05	2.982E-05	1.988E-04	1.988E-04
CONRRP	Concrete 3a (river rock)	Area	1.491E-05	1.491E-05	1.491E-05	9.938E-05	9.938E-05
CONAG4P	Concrete 4a (aggregate)	Area	1.491E-05	1.491E-05	1.491E-05	9.938E-05	9.938E-05

Model ID	Description	Source Type	$PM_{2.5}$ 24hr 7am-7pm	$PM_{2.5}$ 24hr 6pm-3am	$PM_{2.5}$ Annual	PM_{10} 24hr 7am-7pm	PM_{10} 24hr 6pm-3am
CONSND2	Concrete 2s (sand)	Area	3.137E-05	3.137E-05	3.137E-05	2.091E-04	2.091E-04
CONSND3	Concrete 3s (sand)	Area	1.650E-04	1.650E-04	1.650E-04	1.100E-03	1.100E-03
ASPHAG1P	Asphalt 1A (aggregate)	Area	5.232E-05	5.232E-05	5.232E-05	3.488E-04	3.488E-04
ASPHAG2P	Aspalt 2A (aggregate)	Area	5.232E-05	5.232E-05	5.232E-05	3.488E-04	3.488E-04
ASPHFP1P	Asphalt 1F (fines)	Area	5.232E-05	5.232E-05	5.232E-05	3.488E-04	3.488E-04
ASPHAG3P	Asphalt 3A (aggregate)	Area	5.232E-05	5.232E-05	5.232E-05	3.488E-04	3.488E-04
ASPHRR1P	Asphalt R1 (RAP)	Area	5.232E-05	5.232E-05	5.232E-05	3.488E-04	3.488E-04
QUARPIT	Quarry Pit (loader traffic P1, material handling, and drilling)	Openpit	3.100E-02	3.100E-02	4.338E-03	1.350E-01	1.350E-01