October 2015

ATTACHMENT H

Part 201 Generic Exposure Assumption Values Update

TECHNICAL SUPPORT DOCUMENT

SUBJECT: Parameters Related to Particle Emissions from Wind Erosion and Vehicular Traffic

MDEQ Introduction

MDEQ contracted SRC, Inc. to evaluate and update the exposure assumptions and fate and transport values, consistent with the Collaborative Stakeholder Advisory (CSA) recommendations. This work is a component of the DEQ's comprehensive cleanup criteria update and is incorporated into the calculation of the health-based cleanup values. The CSA recommendations pertinent to exposure assumptions and fate and transport values are presented in the Decision Framework for Determination of Exposure Values (CSA, 2014). To satisfy the "best available information" requirement of the Framework, SRC followed the Framework's process for evaluating data against the Data Quality Objectives (DQOs) and selecting the values for their recommendations. Refer to the CSA Report (2014) and Cleanup Criteria and Screening Levels Development and Application Resource Materials Section 4.3.

Background

This Technical Support Document (TSD) describes the process used to update generic exposure assumption values for parameters used by Michigan Department of Environmental Quality (MDEQ) in deriving variables for evaluating particle emission due to wind erosion (Ew) and vehicles (Ev) used in Part 201 Particle Soil Inhalation Criteria (PSIC) for addressing inhalation exposures to airborne contaminants in ambient air. The TSD follows the Decision Framework for Updating the Michigan Part 201 Generic Cleanup Criteria Exposure Assumptions (TAG, 2014). As outlined in the Decision Framework, the update process involves searching for Michigan-specific data pertinent to each exposure assumption, revised U.S. Environmental Protection Agency (EPA) exposure assumptions, and other sources of relevant data (e.g., state and federal government agencies, published literature), and evaluating both the existing and any new information against the Data Quality Objectives (DQOs) provided in the Decision Framework.

To identify new information pertinent to each exposure assumption, the search process was as follows. First, Michigan government agencies and select research universities were contacted to determine if relevant data could be provided. Second, particle emission variables recommended by U.S. EPA were considered. Third, searches of the published scientific literature for data or analyses specific to Michigan or to the U.S. as a whole were conducted. For the purpose of this TSD, searches of the published literature were restricted to papers published in 2009 or later. Fourth, websites for U.S. governmental organizations were searched for readily accessible data relevant to the exposure assumptions. Fifth, selected state (including Illinois, Indiana, Minnesota, Ohio, Wisconsin, California, Oregon, Washington, Texas, and Massachusetts) and international (Health Canada and Environment Canada, Ontario Ministry of the Environment, European Commission Joint Research Centre [ECJRC], and the European Centre for Ecotoxicology and Toxicology of Chemicals [ECETOC]) environmental agency websites were searched to identify default exposure assumptions used by these agencies.
The TSD describes the results of each of the searches and the evaluation of new, relevant information against the DQOs.

The DQOs in the framework (TAG, 2014) address the following:

- Relevant and applicable to Michigan;
- Clear and comprehensive;
- Sound and credible;
- Transparent and objective; and
- Certainty.

The current Part 201 generic exposure assumptions (MDEQ, 2007) and new relevant information were evaluated against the DQOs and given a rating of high, medium, or low; an explanation of the ratings is provided as Appendix A of this document. Based on the ratings the data or information that best meets the DQOs, are recommended as the basis for updated values.

Introduction

The MDEQ Part 201 PSIC algorithm addresses exposure to contaminants in soil entrained in ambient air by incorporating a particle emission factor (PEF) that relates concentration of chemical in airborne particles to concentration of chemical in soil. The PEF used by MDEQ includes components that model emissions from wind (Ew) and emissions from vehicle traffic (Ev), and subsequent dispersion after the particulates become airborne.

This TSD consists of three sections: the first (1) addresses selected parameters in the Ew model equation; the second (2) addresses selected parameters in the Ev model equation; and the third (3) provides a summary of the updated information.

Table 1 below provides a comparison of the MDEQ (2007) and 2015 updated values.

Table 1. Summary of Existing and Updated MDEQ Values for Particle Emission Parameters

Parameter	MDEQ (2007) Value	2015 Updated Value
Selected parameters used in calculation of Ew		
Respirable fraction emission rate (g/m^2-s)	0.036	0.036
V = Fraction of vegetative cover (unitless)	0.5	0.5
$\mathbf{Z_0}$ = Roughness height (m)	0.005	0.005
U*t = Equivalent threshold friction velocity (m/s)	0.42	0.625
Selected parameters used in calculation of Ev		
General		
p = number of days with at least 0.254 mm (0.01 inch) of precipitation per year (days)	135	135
Residential		
M = surface material moisture content (%)	NV	0.2
s = silt content of residential road surface material (%)	15	11
S = mean vehicle speed (km/hr)	20	40
Length of unpaved residential driveway (m)	20	20
Area of residential house (m^2)	58.06	58.06
One way trips or number of vehicles/day	20[a]	20
Nonresidential		
s = silt content of nonresidential road surface material (%)	15	8.3
W = mean vehicle weight (Mg)	2	3
Length of unpaved nonresidential road (m)	45	45
Area of nonresidential building (m^2)	58.06	58.06
One way trips or number of vehicles/day	50[b]	50

NV = no value.
[a]Assumed to be 10 round trips away from home per day.
[b]Assumed to be 50 vehicles per day.

Section 1. Parameters Related to Particle Emissions Due to Wind Erosion

1.1. Introduction

The emission factor for particle emissions due to wind erosion (Ew) represents the mass (g) of uncontrolled soil particle emissions per m^2 surface area of source per second.

This TSD focuses on the following inputs for calculating Ew:

- Respirable fraction emission rate
- V (fraction vegetative cover)
- z_0 (roughness height)
- U*t (Equivalent threshold friction velocity)

MDEQ (2007) recommended a V of 50% (0.5) to be used to adjust Ew. This value was based on professional judgment in the absence of data and was intended to represent a central tendency value (midpoint between the minimum of 0% and maximum of 100%). MDEQ (2007) recommended this value for all land uses, but also indicated that professional judgment should be used to determine whether the 50% assumption was appropriate for a specific nonresidential facility in the conduct of a site-specific risk assessment.

The equation used by MDEQ (2007) to calculate Ew is the equation for the "unlimited reservoir" model from U.S. EPA (1985). This same equation is recommended, and the U.S. EPA (1985) document cited, as the basis for estimating particle entrainment from wind erosion in the most current U.S. EPA guidance on this topic (1996a,b; 2002). In addition, apart from the equivalent threshold friction velocity (U*t), the values recommended by U.S. EPA (1996a,b; 2002) were the same as those used by MDEQ (2007), as summarized in Table 2.

Table 2. Comparison between MDEQ (2007) and U.S. EPA (1996a,b; 2002) recommendations for parameters related to Ew

Parameter	MDEQ (2007) Value	U.S. EPA (1996a,b; 2002) Value
Respirable fraction emission rate (g/m^2-s)	0.036	0.036
V = fraction vegetative cover	0.5	0.5
z_0 = Roughness height (m)	0.005	0.005
U*t = Equivalent threshold friction velocity (m/s)	0.42	0.625

Inquiries to Michigan DEQ's Remediation and Redevelopment Division (RRD) and select Michigan research universities (University of Michigan, Michigan State University, Western Michigan University, and Michigan Technological University) did not yield any information on these variables. Furthermore, searches of the published literature and federal government agency websites (exploring publicly available databases, reports, data briefs, and publications from U.S. Geological Survey [USGS] and the U.S. Department of Agriculture [USDA]) did not yield any information pertinent to these variables.

State and international agencies listed in the background to this TSD were searched for recommended soil properties pertinent to Ew. For all of the U.S. states with recommendations (IL, MN, OH, OR, and TX), the values were the same as those in U.S. EPA (1996a,b; 2002). In their Air Dispersion Modelling Guideline for Ontario, the Ontario Ministry of the Environment

(MOE 2009) presented roughness heights for different land use types and seasons to be used in various models (SCREEN3, AERMOD, and ISCPRIME); the relevance of these values to Ew modeling in Michigan is uncertain.

The threshold friction velocity or U*t is a function of the mode of the size distribution of surface soil aggregates (U.S. EPA, 1985, 1996b). U.S. EPA (1985) presented a graph (Figure 3-4 in that document) reflecting the empirical relationship between threshold friction velocity and mode of the soil aggregate size distribution. MDEQ (2007) selected a value of 0.42 m/s for U*t based on a soil aggregate size mode of 0.35 mm. MDEQ (2007) did not describe the basis for the mode soil aggregate size of 0.35 mm.

U.S. EPA (1996b) indicated that the model for Ew is most sensitive to the threshold friction velocity. U.S. EPA (1996b) selected a value of 0.625 m/s for U*t based on a soil aggregate size mode of 0.5 mm and a correction factor of 1.25 (the uncorrected value for U*t was 0.5 m/s). The agency selected a conservative value of 0.5 for the mode soil aggregate size. U.S. EPA (1996b, citing U.S. EPA, 1985) noted that the correction factor accounts for the presence of nonerodible elements such as “clumps of grass or stones…(that will) consume part of the shear stress of the wind which would otherwise be transferred to erodible soil”. U.S. EPA (1996b) further stated that omitting the correction factor is “roughly equivalent to modeling ‘coal dust on a concrete pad.’” It appears that U.S. EPA (1996b) considered the idea of modeling coal dust on a concrete pad to be too conservative, and thus chose a default correction factor of 1.25.
In the 2006 update to Chapter 13.2.5 (Industrial Wind Erosion) of the AP-42 Compilation of Air Pollutant Emission Factors, U.S. EPA (2006) provided a series of threshold friction velocities (Table 13.2.5-2) for various materials ranging from scoria/roadbed material (1.33 m/s) to fine coal dust on a concrete pad (0.54 m/s). As noted above, U.S. EPA (1996b) considered the threshold friction velocity associated with coal dust on a concrete pad as too conservative to use as a default value.

As both the MDEQ (2007) and U.S. EPA (1996b) values were selected based on professional judgment, no evaluation of DQOs was conducted.

1.2. Conclusion

No new data have been identified to provide an alternative basis for the default estimates of respirable fraction emission rate, V, or z_0; thus, the existing values should continue to be used. MDEQ (2007) and U.S. EPA (1996b) selected different values for U*t. The U.S. EPA value was described as a conservative assumption; no information on the basis for the MDEQ assumption was provided in MDEQ (2007). As there is no information to support the value selected by MDEQ (2007) value, while the rationale for the U.S. EPA (1996b) value of 0.625 is clearly described, the value selected by U.S. EPA (1996b) should be used.

Section 2. Parameters Related to Particle Emissions Due to Vehicles (Ev)

2.1. Introduction

The emission factor for particle emissions due to vehicle erosion (Ev) represents the mass (g) of uncontrolled soil particle emissions per m^2 surface area of source per second. For vehicle emissions, the source area is the area of a ½ acre site excluding the area of the house (residential) or building (nonresidential). For vehicle erosion, source extent is a function of the length of road/driveway traveled, and the number of times traveled or the daily traffic count (U.S. EPA, 1985). The equation for calculating Ev recommended by MDEQ (2007) is based on the equation for estimating PM_{10} emissions from vehicle traffic over unpaved surfaces presented in U.S. EPA (1995). MDEQ now uses updated equations for residential and nonresidential Ev calculations; these equations are consistent with the 2006 update to U.S. EPA (1995).
This TSD focuses on the following inputs for calculating Ev:

Table 2. Parameters and MDEQ (2007) values for Particle Emission Parameters Due to Vehicle Traffic

Parameter	MDEQ (2007) Value	Basis
General		
p = number of days with at least 0.254 mm (0.01 inch) of precipitation per year (days)	135	U.S. EPA (1985) contour map, Michigan area
Residential		
M = surface material moisture content (%)	NV	NA
s = silt content of residential road surface material (%)	15	Default value for rural/residential area given in U.S. EPA (1985)
S = mean vehicle speed (km/hr)	20	Professional judgment
Length of unpaved residential driveway (m)	20	Professional judgment
Area of residential house (m^2)	58.06	Professional judgment
One way trips or number of vehicles/day	20	Professional judgment; 10 round trips away from home per day
Nonresidential		
s = silt content of nonresidential road surface material (%)	15	Default value for rural/residential area given in U.S. EPA (1985)
W = mean vehicle weight (Mg)	2	Professional judgment
Length of unpaved nonresidential road (m)	45	Professional judgment
Area of nonresidential building (m^2)	58.06	Professional judgment
One way trips or number of vehicles/day	50	Professional judgment; 50 vehicles per day.

NV = no value; NA = not applicable.

No new data from MDEQ, selected Michigan research universities, U.S. EPA guidance, other federal agencies including USGS and USDA, or other states or international sources (as described earlier in this TSD) were identified to provide a basis for altering or updating MDEQ (2007) values for p, length of unpaved driveway, length of unpaved nonresidential road, area of residential house, area of nonresidential building, or the number of one way trips/vehicles per day (residential or nonresidential). MSU Extension collects soil moisture measurements from more than 80 weather stations across the state. However, because unpaved road surfaces and soils are very different materials in terms of organic carbon content, particle size, etc., soil moisture measurements are not relevant to estimates of road surface moisture content.

For p, the most current U.S. EPA analysis (2006) included the same graph from U.S. EPA (1985) for the purpose of estimating precipitation frequency. Precipitation measurements are also collected by MSU Extension at the same monitoring stations where soil measurements are collected. This program is managed by Dr. Jeff Andresen, Associate Professor of Meteorology/Climatology in the Department of Geography and State Climatologist for Michigan. Dr. Andresen was contacted and asked whether these data could be used to inform state-wide estimates of average annual number of "wet days" (more than 0.01 inch precipitation). Dr. Andresen indicated that the Enviro-weather database is an inadequate source for obtaining the relevant precipitation frequency data because the instrumentation used to measure precipitation cannot currently measure precipitation in a solid form (e.g, snow). However, Dr. Andresen also indicated that precipitation data are available through the State Climatologist's office Michigan Map resource[1]. This resource links to historical (30 year period; 1971-2010) climatological summary tables presented in PDF reports. Summary tables have been generated that report the number of days with precipitation of 0.1 inch or above, but tables that report the number of days with precipitation of 0.01 inch or above are not currently available. Dr. Andresen clarified that these data have been collected, but that summary reports of this metric are not currently available. When available, these data could be used to update or supplement the MDEQ recommendation for p.

Another potential source for data relevant to p is NOAA's National Centers for Environmental Information (NCEI). NOAA NCEI provides public access to national climate and historical weather data and information. The online database can be queried for quality-controlled daily, monthly, seasonal, and yearly measurements of temperature, precipitation, wind, and degree days, as well as radar data and 30-year Climate Normals. There are 518 NOAA reporting stations in Michigan. Data are collected from a variety of sources including the NWS reporting stations, volunteer cooperative observers, Federal Aviation Administration (FAA), utility companies, and others. Precipitation data are available in the online database as a number of different metrics including daily 30-year normal (reported as a probability of precipitation ≥0.01 inches for 29-day windows centered on each day of the year), historical 15-minute or hourly precipitation observations, extreme maximum daily precipitation, maximum snow depth, number of days with snow depth >1 inch, number of days with greater than or equal to 0.1 inch of precipitation, total precipitation, and total snow fall. In addition to the online database, Daily Precipitation Reports by state are available as monthly PDF reports. NOAA's NCEI may

[1] http://climate.geo.msu.edu/

provide robust data to inform the default p value. However, extensive curation and/or analysis of these data would be required, as the data are not currently summarized in a form readily used for this purpose. This effort could not be completed in the timeframe of developing this TSD.

In the absence of new, readily useable information on p, length of unpaved driveway, length of unpaved nonresidential road, area of residential house, area of nonresidential building, or the number of one way trips/vehicles per day (residential or nonresidential), DQO evaluations for these parameters were not conducted, and it is recommended that the existing values for these parameters be retained.

New information pertaining to M, S, W, and s was located; the remainder of this section contains DQO evaluations for these parameters.

2.2. MDEQ (2007) Value

The equations used by MDEQ (2007) did not include the M parameter, as this is a new parameter added for the 2015 algorithm update.

MDEQ (2007) recommended a value of 20 km/hr for S in the residential scenario; the basis for this value was not provided. U.S. EPA (1985) recommended a default value of 48 km/hr (range of measured values, 40-64 km/hr) for rural and residential sites. MDEQ (2007) did not provide a rationale for departing from the U.S. EPA (1985) recommended default of 48 km/hr.
MDEQ (2007) recommended a value of 2 Mg for W in the nonresidential scenario; the basis for this value was not provided. U.S. EPA (1985) recommended a default value of 3 Mg for W at industrial sites. MDEQ (2007) did not provide a rationale for departing from the U.S. EPA (1985) recommended default of 3 Mg.

MDEQ (2007) recommended an s of 15% for both residential and nonresidential scenarios, citing U.S. EPA (1985). U.S. EPA (1985) recommended default values of 15% for rural/residential sites (range of measured values, 5-68%) and 8% for industrial sites (range of measured values, 2-29%). MDEQ (2007) did not provide a rationale for departing from the U.S. EPA (1985) recommended default of 8% for industrial sites.
Because the basis for the values selected by MDEQ (2007) was not described, an evaluation of DQOs for these values was not possible.

2.3. Evaluation of New Information Using Decision Framework

2.3.1. Michigan-Specific Data

The MDEQ RRD and the Michigan Department of Transportation were contacted by email and/or phone to determine if either Department was aware of research or could provide data pertinent to M, S, or s; however, neither provided research or data relevant to this exposure parameter within the timeframe of development of this TSD. Similarly, the following research universities were contacted by email and/or phone to determine if each was aware of research

or could provide data: University of Michigan, Michigan State University, Western Michigan University, and Michigan Technological University; none provided research or data relevant to this exposure parameter within the timeframe of development of this TSD.

2.3.2. Most Recent EPA Recommended Value(s)

U.S. EPA's SSG (1996a,b) did not consider particle emissions from soil due to vehicle traffic for residential or nonresidential scenarios. U.S. EPA (2002) considered this emission source, and referenced U.S. EPA (1985) and U.S. EPA's AP-42 guidance (described in further detail below) as the basis for evaluating nonresidential scenarios. Otherwise, U.S. EPA (2002) primarily provided guidance on evaluating particle emissions due to vehicle traffic in the context of a construction worker scenario. The MDEQ equation for Ev is not intended to evaluate a construction scenario; thus, such information from U.S. EPA (2002) is not relevant. However, U.S. EPA (2002) did provide support to MDEQ's value of 45 m for the length of a nonresidential road; U.S. EPA (2002) recommended calculating the length of a road segment as the square root of site surface contamination configured as a square (i.e., assuming a 0.5 acre site; $\sqrt{2{,}023\ m^2} = 45$ m).

The Fifth Edition of AP-42 (U.S. EPA, 1995), *Compilation of Air Pollutant Emission Factors*, was published by U.S. EPA in January 1995; this document included a section (13.2.2) on emissions from unpaved roads. Since then, the U.S. EPA has published supplements and updates to the fifteen chapters. Based on the available background documents (U.S. EPA 1998, 2006), it appears that Section 13.2.2 Unpaved Roads was updated in 1998, and again most recently in 2006. All values included in AP-42 were derived based on field testing to support development of the Ev equation. U.S. EPA (1998) presented the background information and the review of specific datasets considered in development of U.S. EPA (2006). Table 4 summarizes the default values presented in the 2006 update for the Ev variables described in this TSD.

Table 4. Summary U.S. EPA (1995, 1998, 2006) Values for Particle Emission Parameters Due to Vehicle Traffic

Parameter	Value
M = surface material moisture content (%) (residential)	0.2
S = mean vehicle speed (km/hr) (public roads)	16 - 88[a]
W = mean vehicle weight (Mg) (industrial roads)	1.8 – 260
s = silt content of residential road surface material (%)	6.4 (gravel) 11(dirt)
s = silt content of nonresidential road surface material (%)	4.3 - 24[b]

[a]Public roads. Reported as range of source conditions used to derive the equation.
[b]Industrial roads; minimum and maximum averages across 15 data points corresponding to 9 different industries (See Table 13.2.2-1).

With regard to M, U.S. EPA (1995, 1998, 2006) indicated that the recommended default value of 0.2% represents a reasonably conservative (worst case) scenario of dry condition moisture content. This value was higher than 20% of the comparable dataset (the range of moisture

values considered in derivation of the Ev equations was reported as 0.03 to 13%). U.S. EPA (1995, 1998, 2006) indicated that although this represents a conservative value relative to the general U.S., it should not lead to unacceptable emission estimates.

U.S. EPA (1995, 1998, 2006) did not provide a default value for S in a residential setting, but reported a range of source conditions (including mean vehicle speeds of 16-88 km/hr for public roads) that were tested in the development of the Ev equations.

For s in the residential scenarios, statistical analyses comparing silt content of gravel and dirt roads showed differences, leading U.S. EPA (1995, 1998, 2006) to recommend separate defaults (6.4 and 11%, respectively) for these two road surfaces. These two surface types are distinguished from one another as follows: “dirt” refers to a road surface constructed from soils in the general vicinity of the site without crushed aggregate, whereas crushed aggregate is included in “gravel” road surfaces.

For s in nonresidential scenarios, U.S. EPA (1995, 1998, 2006) presented a table with 15 different mean silt content values corresponding to various surface materials on industrial unpaved roads. The reported mean values ranged from 4.3 to 24%. Because the ranges for silt content vary over two orders of magnitude, U.S. EPA (1995, 1998, 2006) did not recommend a single default value, but rather encouraged collection of site-specific data to inform this parameter. In the absence of site-specific data, U.S. EPA noted that a mean value corresponding to one of the road types in Table 5 below (adapted from Table 13.2.2-1 in U.S. EPA (2006) may be used.

Table 5. Typical Silt Content of Surface Material on Industrial Unpaved Roads

Industry	Road Use or Surface Material	Silt Content (%)	
		Mean	Range
Copper smelting	Plant road	17	16 – 19
Iron and steel production	Plant road	6.0	0.2 – 19
Sand and gravel processing	Plant road	4.8	4.1 – 6.0
	Material storage area	7.1	-
Stone quarrying and processing	Plant road	10	2.4 – 16
	Haul road to/from pit	8.3	5.0 – 15
Taconite mining and processing	Service road	4.3	2.4 – 7.1
	Haul road to/from pit	5.8	3.9 – 9.7
Western surface coal mining	Haul road to/from pit	8.4	2.8 – 18
	Plant road	5.1	4.9 – 5.3
	Scraper route	17	7.2 – 25
	Haul road (freshly graded)	24	18 – 29
Construction sites	Scraper routes	8.5	0.56 – 23
Lumber sawmills	Log yards	8.4	4.8 – 12
Municipal solid waste landfills	Disposal routes	6.4	2.2 – 21

Adapted from Table 13.2.2-1 in U.S. EPA (1995, 1998, 2006).

2.3.2.2 Evaluation of Data Quality Objectives

Relevance and applicability to Michigan (geographic, temporal, and demographic representativeness). U.S. EPA (1995, 1998, 2006) recommendations for M, S, W, and s are based on data derived from controlled testing environments that are assumed to be representative of general conditions across the U.S. Rating: Medium.

Clarity and comprehensiveness (completeness of method and data reporting, completeness of literature search). The recommended values presented in U.S. EPA (1995, 1998, 2006) were based on empirical data collected during field testing at various sites under a number of different conditions. The information considered by U.S. EPA (1995, 1998, 2006) appears to be comprehensive, and the document provides a thorough discussion of the data considered in deriving the recommended values. Rating: High.

Soundness and credibility (*adequacy of approach; intrinsic sources of bias; sample size*). U.S. EPA applied a quality rating system to the data generated during field testing. U.S. EPA (1995, 1998, 2006) indicated that data considered in the development of the recommendations were subjected to the fairly rigorous criterion that all data points must lie within a factor of two of the central value. Although it was recognized that this strict criterion may be an issue for a sufficiently large test series, it was not considered a problem as most of the single-valued factors are based on relatively small sample sizes. The test data included at least three tests for each source and more than two plant sites. However, the recommendations are based on a range without supporting guidance for choosing a representative value within that range in the absence of site-specific data. Rating: Medium.

Transparency and objectivity (availability of supporting data; funding source; peer-review). The basis for the recommendations for Ev variables was described in detail in U.S. EPA (1995, 1998, 2006). The documents were prepared by U.S. EPA and internally reviewed. Rating: High.

Certainty (number and agreement of studies). U.S. EPA (1995, 1998, 2006) considered 15 studies of particle emissions on unpaved roads. Data considered for derivation of the recommended values were held to a strict criterion resulting in the use of data that were in general agreement across studies. Rating: Medium.

2.3.3. New Scientific Literature

A search of the open scientific literature (PubMed and ToxLine) for data on variables used to calculate Ev from studies published since 2009 was conducted. This search did not yield any potentially relevant studies.

2.3.4. New Federal Information

A search of federal sources of data on particle emission from vehicle traffic variables was conducted. The search included evaluating publicly available databases, reports, data briefs, and publications from federal agencies including the USGS, USDA, U.S. Department of Transportation (USDOT), and the National Oceanic and Atmospheric Administration (NOAA) including the National Weather Service (NWS).

2.3.5. Other State and/or International Searches

2.3.5.1. Summary of Search Results

State and international agencies listed in the background to this TSD were searched for recommended Ev related parameters. Table 6 below summarizes the recommended values identified in the search, for states reporting recommendations for Ev. The state and international values were either based on U.S. EPA recommendations, based on data or assumptions specific to each location, or a basis was not reported; thus, further evaluation of DQOs for these values was not conducted.

Table 6. Comparison of state and international default values pertaining to particle emissions due to vehicle traffic, for states with relevant information.

Parameter	MI	IL[a]	CA[b]	WA[c]	OH[d]	Canada[e]
M (%)	ND	0.1%[a]	0.5%	1%	0.2%	multiple values based on land use/season
s (%)	15%	ND	4.3%	3.2%	ND	ND
S = (km/hr)	20	ND	40	30	ND	ND
W (Mg)	2	ND	2.2	multiple values based on road type	7.3	ND

ND = no data.
[a]Value represents surface soil (top 1 meter); subsurface soil (below 1 meter) = 0.2 (Illinois EPA, Title 35 – Part 742 TACO).
[b]URBEMIS (2007).
[c]WDOE (2014).
[d]OEPA (2014).
[e]MOE (2009).

2.3.6. Comparison of Results of DQO Evaluations.

Table 7 provides a comparison of the DQO evaluations for the MDEQ (2007) and the alternate estimates from key studies considered in this review. For each DQO, the assessments have been compiled and rated from low to high.

Table 7. Summary of DQO evaluation for Selected Ev Variables

Parameter	MDEQ (2007)	New Michigan Data	U.S. EPA (1995, updated 2006)	New scientific literature	Federal Sources
M = surface material moisture content (%)	NV	ND	0.2	ND	ND
S = mean vehicle speed (km/hr) (public roads)	20		16-88		
W = mean vehicle weight (Mg) (industrial roads)	2		1.8 – 260		
s = silt content of residential road surface material (%)	15		6.4 (gravel) 11 (dirt)		
s = silt content of nonresidential road surface material (%)	15		4.3 - 24		
Data Quality Objective Scoring					
Relevance and applicability to Michigan	Unable to rate	NA	M	NA	NA
Clarity and comprehensiveness			H		
Soundness and credibility			M		
Transparency and objectivity			H		
Certainty			M		

2.4. Conclusion

No new data have been identified that provide a basis for changing the existing MDEQ recommendations for p, length of unpaved driveway, length of unpaved nonresidential road, area of residential house, area of nonresidential building, or the number of one way trips/vehicles per day; thus, it is recommended that the MDEQ (2007) values for these parameters be retained.

Available data on M, S, W, and s from U.S. EPA (1995, 1998, 2006) best meet the Part 201 DQOs for these parameters, as the basis for these is clearly described. U.S. EPA (1995, 1998, 2006) only recommended a single default value for M; for S, W, and s, ranges or multiple values were given.

To select a single value for S, it is recommended that the Michigan *prima facie* maximum speed limit for residential areas be used. Michigan State Police Traffic Control Orders[2] report that the *prima facie*[3] speed limit for business and residential areas is 25 miles/hour (40 km/hour). Thus, the recommended default for S is 40 km/hour. This value falls within the recommended range reported by U.S. EPA (1995, 1998, 2006).

[2] http://www.michigan.gov/msp/0,4643,7-123-72297_30536_25802-16169--,00.html, accessed 10/01/2015.
[3] The *prima facie* speed limit is the default speed limit that applies when no other speed limit is posted.

For s in a residential scenario, U.S. EPA (1995, 1998, 2006) recommended values of 6.4 and 11 % for gravel and dirt roads. The higher of these two values (11%) provides a more conservative (i.e., health protective) estimate of Ev; thus, 11% is recommended as the default value.
For s in an industrial scenario, U.S. EPA (1995, 1998, 2006) recommended a range of mean silt contents for specific industries. The median of the mean silt contents across the various industries is 8.3%; this value is recommended as the default value. The median value is recommended as a measure of central tendency instead of the mean. The available silt content measurements are not evenly distributed across industries or road types, and sample sizes associated with each mean value vary widely (from 1 to 135 samples). Unlike the median, the mean value would be skewed by values at extremes of the distribution, even if those values are based on very few samples.

U.S. EPA (2006) only reported a range of values for W across all vehicles on industrial roads; a mean value was not given, nor were individual weights for specific vehicle types. U.S. EPA (1985) reported three weights for industrial sites, for vehicles with 4, 6, or 10 wheels (respectively): 3, 15, and 26 Mg; other than number of wheels, no information on the type(s) of vehicles corresponding to each value was provided. U.S. EPA (2006) recommended that the value of W should reflect the mean weight across the various vehicle types traveling on the site. However, the types of vehicles and proportions of vehicles of different types/weight classes will vary by site, and default estimates are not currently available. In the absence of information on the proportion of vehicles of various weight classes traveling on commercial or industrial sites, it is difficult to define a default value. However, as a default value is needed, MDEQ has selected a value of 3 Mg (3.3 tons) reflecting 4 wheel vehicles on industrial sites from U.S. EPA (1985) as a reasonable assumption for commercial and small industrial sites, and is within the range reported by U.S. EPA (2006). This value appears to be more appropriate for nonresidential light trucks than the current default of 2.2 tons, but does not reflect an overly conservative assumption, based on the information presented in U.S. EPA (1985).

Section 3. Summary of Recommendations

The table (8) below summarizes the recommended values for parameters related to Ew and Ev based on the DQO evaluations described in this TSD.

Table 8. Summary of Updated MDEQ Values for Particle Emission Parameters

Parameter	2015 Updated Value
Selected parameters used in calculation of Ew	
Respirable fraction emission rate (g/m^2-s)	0.036
V = Fraction of vegetative cover (unitless)	0.5
Z_0 = Roughness height (m)	0.005
U*t = Equivalent threshold friction velocity (m/s)	0.625
Selected parameters used in calculation of Ev	
General	
p = number of days with at least 0.254 mm (0.01 inch) of precipitation per year (days)	135
Residential	
M = surface material moisture content (%)	0.2
s = silt content of residential road surface material (%)	11
S = mean vehicle speed (km/hr)	40
Length of unpaved residential driveway (m)	20
Area of residential house (m^2)	58.06
One way trips or number of vehicles/day	20 (10 round trips/day)
Nonresidential	
s = silt content of nonresidential road surface material (%)	8.3
W = mean vehicle weight (Mg)	3
Length of unpaved nonresidential road (m)	45
Area of nonresidential building (m^2)	58.06
One way trips or number of vehicles/day	50 (vehicles/day)

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APPENDIX A

EXPLANATION OF RELATIVE DQO RATINGS

This appendix provides a broad outline of how the DQO ratings were applied. To some extent, professional judgment was used in the application of the ratings, as a set of rating characteristics that would apply to the many different data sources used to develop exposure assumptions was not feasible. The ratings should be considered relative rather than absolute. In other words, the ratings may be compared across sources of data for a single exposure assumption, but a rating of high for one exposure assumption may not be equivalent to a rating of high for another exposure assumption.

Relevance and applicability to Michigan (g*eographic, temporal, and demographic representativeness*).

High: Based on recent data obtained in Michigan, in members of its population, or developed based on data specific to Michigan (e.g., exposure frequency based on climate conditions in Michigan).

Medium: Based on recent data obtained outside Michigan or its population, but in an area or population with comparable geographic, temporal, and demographic conditions.

Low: Based on data obtained outside Michigan or its population, in an area or population with different geographic, temporal, and demographic conditions, or with unknown geographic, temporal, and demographic conditions.

Clarity and comprehensiveness (completeness of method and data reporting, completeness of literature search).

High: Derived value with complete documentation of the selection process, and based on known or apparently thorough literature search, OR, single study with thorough description of methods and results.

Medium: Derived value with incomplete documentation of the selection process, and/or based on limited literature search, OR, single study with some noncritical information missing from methods and results.

Low: Derived value with little or no documentation of the selection process, and/or without accompanying literature search, OR, single study lacking critical information from method or results.

Soundness and credibility (adequacy of approach; intrinsic sources of bias; sample size).

High: Using an established method to estimate the parameter, without intrinsic sources of bias, and with adequate sample size(s).

Medium: Using an established method to estimate the parameter, with some known or expected intrinsic sources of bias, and with adequate sample size(s).

Low: Using a novel or uncertain method to estimate the parameter, with or without intrinsic sources of bias, and with inadequate sample size(s).

Transparency and objectivity (availability of supporting data; funding source; peer-review).

High: Based on peer-reviewed study(s) performed by researcher(s) without demonstrable conflict of interest and supported by other studies.

Medium: Based on peer-reviewed study(s) performed by researcher(s) without demonstrable conflict of interest but without support from other studies.

Low: Based on unpublished study(s) and/or performed by researcher(s) with potential conflict of interest and/or based on professional judgment, without support from other studies.

Certainty (number and agreement of studies).

High: Based on > 3 studies with values ranging up to ±50% from the selected value.

Medium: Based on at least 2 or 3 studies with values ranging up to ±100% from the selected value.

Low: Based on a single study or more than one study with variability ranging >±100% from the selected value, or based on professional judgment.