13.2.1 Paved Roads

13.2.1.1 General

Particulate emissions occur whenever vehicles travel over a paved surface, such as a road or parking lot. In general terms, particulate emissions from paved roads originate from the loose material present on the surface. In turn, that surface loading, as it is moved or removed, is continuously replenished by other sources. At industrial sites, surface loading is replenished by spillage of material and trackout from unpaved roads and staging areas. Figure 13.2.1-1 illustrates several transfer processes occurring on public streets.

Various field studies have found that public streets and highways, as well as roadways at industrial facilities, can be major sources of the atmospheric particulate matter within an area.[1-9] Of particular interest in many parts of the United States are the increased levels of emissions from public paved roads when the equilibrium between deposition and removal processes is upset. This situation can occur for various reasons, including application of snow and ice controls, carryout from construction activities in the area, and wind and/or water erosion from surrounding unstabilized areas.

13.2.1.2 Emissions And Correction Parameters

Dust emissions from paved roads have been found to vary with what is termed the "silt loading" present on the road surface as well as the average weight of vehicles traveling the road. The term silt loading (sL) refers to the mass of silt-size material (equal to or less than 75 micrometers [µm] in physical diameter) per unit area of the travel surface.[4-5] The total road surface dust loading is that of loose material that can be collected by broom sweeping and vacuuming of the traveled portion of the paved road. The silt fraction is determined by measuring the proportion of the loose dry surface dust that passes through a 200-mesh screen, using the ASTM-C-136 method. Silt loading is the product of the silt fraction and the total loading, and is abbreviated "sL". Additional details on the sampling and analysis of such material are provided in AP-42 Appendices C.1 and C.2.

The surface sL provides a reasonable means of characterizing seasonal variability in a paved road emission inventory.[9] In many areas of the country, road surface loadings are heaviest during the late winter and early spring months when the residual loading from snow/ice controls is greatest.

13.2.1.3 Predictive Emission Factor Equations[10]

The quantity of dust emissions from vehicle traffic on a paved road may be estimated using the following empirical expression:

$$E = k\,(sL/2)^{0.65}\,(W/3)^{1.5} \qquad (1)$$

where:

E = particulate emission factor
k = base emission factor for particle size range and units of interest (see below)
sL = road surface silt loading (grams per square meter) (g/m^2)
W = average weight (tons) of the vehicles traveling the road

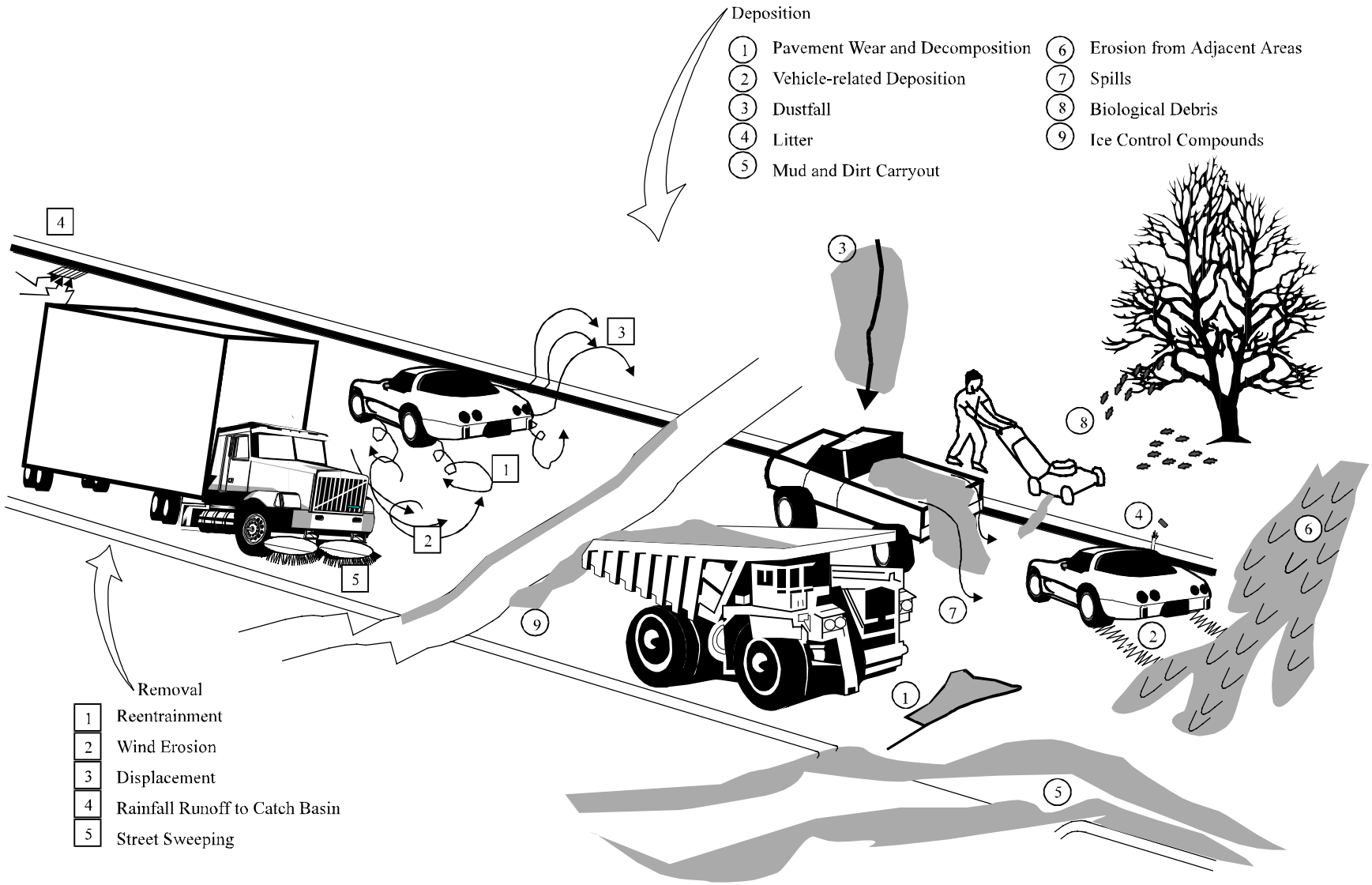

Figure 13.2.1-1. Deposition and removal processes.

It is important to note that Equation 1 calls for the average weight of all vehicles traveling the road. For example, if 99 percent of traffic on the road are 2 Mg cars/trucks while the remaining 1 percent consists of 20 Mg trucks, then the mean weight "W" is 2.2 Mg. More specifically, Equation 1 is *not* intended to be used to calculate a separate emission factor for each vehicle weight class. Instead, only 1 emission factor should be calculated to represent the "fleet" average weight of all vehicles traveling the road.

The particle size multiplier (k) above varies with aerodynamic size range as follows:

Particle Size Multipliers For Paved Road Equation

Size Range[a]	Multiplier k[b]		
	g/VKT	g/VMT	lb/VMT
PM-2.5	2.1	3.3	0.0073
PM-10	4.6	7.3	0.016
PM-15	5.5	9.0	0.020
PM-30[c]	24	38	0.082

[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT).

[c] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

To determine particulate emissions for a specific particle size range, use the appropriate value of k above.

The above equation is based on a regression analysis of numerous emission tests, including 65 tests for PM-10.[10] Sources tested include public paved roads, as well as controlled and uncontrolled industrial paved roads. No tests of "stop-and-go" traffic were available for inclusion in the data base. The equations retain the quality rating of A (B for PM-2.5), if applied within the range of source conditions that were tested in developing the equation as follows:

Silt loading:	0.02 -	400 g/m^2
	0.03 -	570 grains/square foot (ft^2)
Mean vehicle weight:	1.8 -	38 megagrams (Mg)
	2.0 -	42 tons
Mean vehicle speed:	16 -	88 kilometers per hour (kph)
	10 -	55 miles per hour (mph)

To retain the quality rating for the emission factor equation when it is applied to a specific paved road, it is necessary that reliable correction parameter values for the specific road in question be determined. The field and laboratory procedures for determining surface material silt content and surface dust loading are summarized in Appendices C.1 and C.2. In the event that site-specific values cannot be obtained, an appropriate value for an industrial road may be selected from the mean values given in Table 13.2.1-1, but the quality rating of the equation should be reduced by 1 level. **Also, recall that Equation 1 refers to emissions due to freely flowing (not stop-and-go) traffic.**

Table 13.2.1-1 (Metric And English Units). TYPICAL SILT CONTENT AND LOADING VALUES FOR PAVED ROADS AT INDUSTRIAL FACILITIES[a]

Industry	No. Of Sites	No. Of Samples	Silt Content (%)		No. Of Travel Lanes	Total Loading x 10^{-3}			Silt Loading (g/m^2)	
			Range	Mean		Range	Mean	Units[b]	Range	Mean
Copper smelting	1	3	15.4-21.7	19.0	2	12.9-19.5 45.8-69.2	15.9 55.4	kg/km lb/mi	188-400	292
Iron and steel production	9	48	1.1-35.7	12.5	2	0.006-4.77 0.020-16.9	0.495 1.75	kg/km lb/mi	0.09-79	9.7
Asphalt batching	1	3	2.6-4.6	3.3	1	12.1-18.0 43.0-64.0	14.9 52.8	kg/km lb/mi	76-193	120
Concrete batching	1	3	5.2-6.0	5.5	2	1.4-1.8 5.0-6.4	1.7 5.9	kg/km lb/mi	11-12	12
Sand and gravel processing	1	3	6.4-7.9	7.1	1	2.8-5.5 9.9-19.4	3.8 13.3	kg/km lb/mi	53-95	70
Municipal solid waste landfill	2	7	—	—	2	—	—	—	1.1-32.0	7.4
Quarry	1	6	—	—	2	—	—	—	2.4-14	8.2

[a] References 1-2,5-6,10-12. Values represent samples collected from *industrial* roads. Public road silt loading values are presented in Figure 13.2.1-2, Figure 13.2.1-3, Figure 13.2.1-4, Figure 13.2.1-5, Figure 13.2.1-6, and Figure 13.2.1-7, and Tables 13.2.1-2 and 13.2.1-3. Dashes indicate information not available.

[b] Multiply entries by 1000 to obtain stated units; kilograms per kilometer (kg/km) and pounds per mile (lb/mi).

With the exception of limited access roadways, which are difficult to sample, the collection and use of site-specific sL data for public paved road emission inventories are strongly recommended. Although hundreds of public paved road sL measurements have been made since 1980,[8, 14-21] uniformity has been lacking in sampling equipment and analysis techniques, in roadway classification schemes, and in the types of data reported.[10] The assembled data set (described below) does not yield any readily identifiable, coherent relationship between sL and road class, average daily traffic (ADT), etc., even though an inverse relationship between sL and ADT had been found for a subclass of curbed paved roads in urban areas.[8] The absence of such a relationship in the composite data set is believed to be due to the blending of data (industrial and nonindustrial, uncontrolled, and controlled, and so on). Further complicating any analysis is the fact that, in many parts of the country, paved road sL varies greatly over the course of the year, probably because of cyclic variations in mud/dirt carryout and in use of anti-skid materials. For example, repeated sampling of the same roads over a period of 3 calendar years at 4 Montana municipalities indicated a noticeable annual cycle. In those areas, silt loading declines during the first 2 calendar quarters and increases during the fourth quarter.

Figure 13.2.1-2 and Figure 13.2.1-3 present the cumulative frequency distribution for the public paved road sL data base assembled during the preparation of this AP-42 section.[10] The data base includes samples taken from roads that were treated with sand and other snow/ice controls. Roadways are grouped into high- and low-ADT sets, with 5000 vehicles per day being the approximate cutpoint. Figure 13.2.1-2 and Figure 13.2.1-3, respectively, present the cumulative frequency distributions for high- and low-ADT roads.

In the absence of site-specific sL data to serve as input to a public paved road inventory, conservatively high emission estimates can be obtained by using the following values taken from the figures. For annual conditions, the median sL values of 0.4 g/m^2 can be used for high-ADT roads (excluding limited access roads that are discussed below) and 2.5 g/m^2 for low-ADT roads. Worst-case loadings can be estimated for high-ADT (excluding limited access roads) and low-ADT roads, respectively, with the 90th percentile values of 7 and 25 g/m^2. Figure 13.2.1-4, Figure 13.2.1-5, Figure 13.2.1-6, and Figure 13.2.1-7 present similar cumulative frequency distribution information for high- and low-ADT roads, except that the sets were divided based on whether the sample was collected during the first or second half of the year. Information on the 50th and 90th percentile values is summarized in Table 13.2.1-2.

Table 13.2.1-2 (Metric Units). PERCENTILES FOR NONINDUSTRIAL SILT LOADING (g/m^2) DATA BASE

Averaging Period	High-ADT Roads		Low-ADT Roads	
	50th	90th	50th	90th
Annual	0.4	7	2.5	25
January-June	0.5	14	3	30
July-December	0.3	3	1.5	5

In the event that sL values are taken from any of the cumulative frequency distribution figures, the quality ratings for the emission estimates should be downgraded 2 levels.

As an alternative method of selecting sL values in the absence of site-specific data, users can review the public (i. e., nonindustrial) paved road sL data base presented in Table 13.2.1-3 and can

select values that are appropriate for the roads and seasons of interest. Table 13.2.1-3 presents paved road surface loading values together with the city, state, road name, collection date (samples collected from the same road during the same month are averaged), road ADT if reported, classification of the roadway, etc. Recommendation of this approach recognizes that end users of AP-42 are capable of identifying roads in the data base that are similar to roads in the area being inventoried. In the event that sL values are developed in this way, and that the selection process is fully described, then the quality ratings for the emission estimates should be downgraded only 1 level.

Limited access roadways pose severe logistical difficulties in terms of surface sampling, and few sL data are available for such roads. Nevertheless, the available data do not suggest great variation in sL for limited access roadways from 1 part of the country to another. For annual conditions, a default value of 0.02 g/m^2 is recommended for limited access roadways. Even fewer of the available data correspond to worst-case situations, and elevated loadings are observed to be quickly depleted because of high ADT rates. A default value of 0.1 g/m^2 is recommended for short periods of time following application of snow/ice controls to limited access roads.

13.2.1.4 Controls[6,22]

Because of the importance of the surface loading, control techniques for paved roads attempt either to prevent material from being deposited onto the surface (preventive controls) or to remove from the travel lanes any material that has been deposited (mitigative controls). Regulations requiring the covering of loads in trucks, or the paving of access areas to unpaved lots or construction sites, are preventive measures. Examples of mitigative controls include vacuum sweeping, water flushing, and broom sweeping and flushing.

In general, preventive controls are usually more cost effective than mitigative controls. The cost-effectiveness of mitigative controls falls off dramatically as the size of an area to be treated increases. That is to say, the number and length of public roads within most areas of interest preclude any widespread and routine use of mitigative controls. On the other hand, because of the more limited scope of roads at an industrial site, mitigative measures may be used quite successfully (especially in situations where truck spillage occurs). Note, however, that public agencies could make effective use of mitigative controls to remove sand/salt from roads after the winter ends.

Because available controls will affect the sL, controlled emission factors may be obtained by substituting controlled silt loading values into the equation. (Emission factors from controlled industrial roads were used in the development of the equation.) The collection of surface loading samples from treated, as well as baseline (untreated), roads provides a means to track effectiveness of the controls over time.

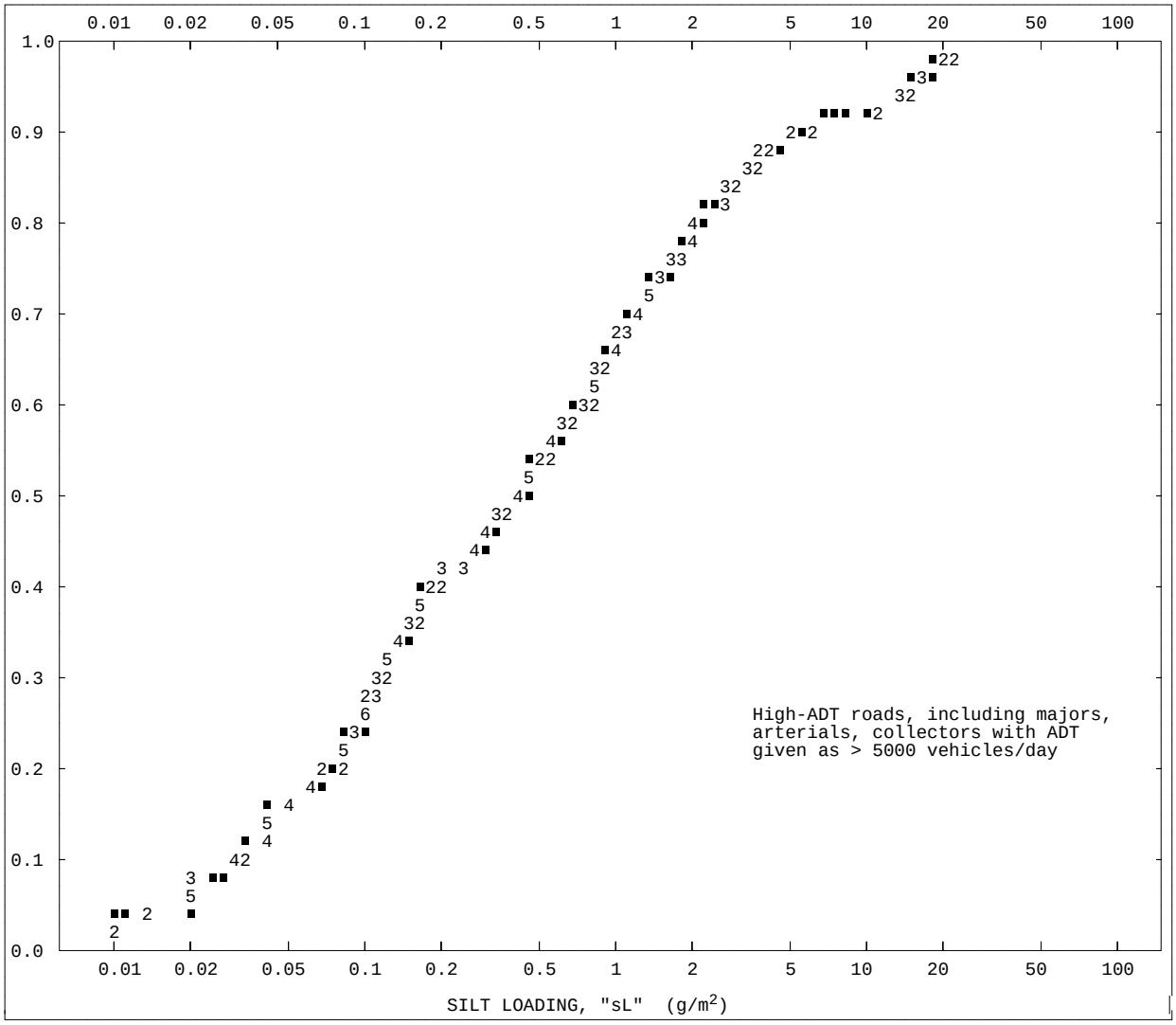

Figure 13.2.1-2. Cumulative frequency distribution for surface silt loading on high-ADT roadways.

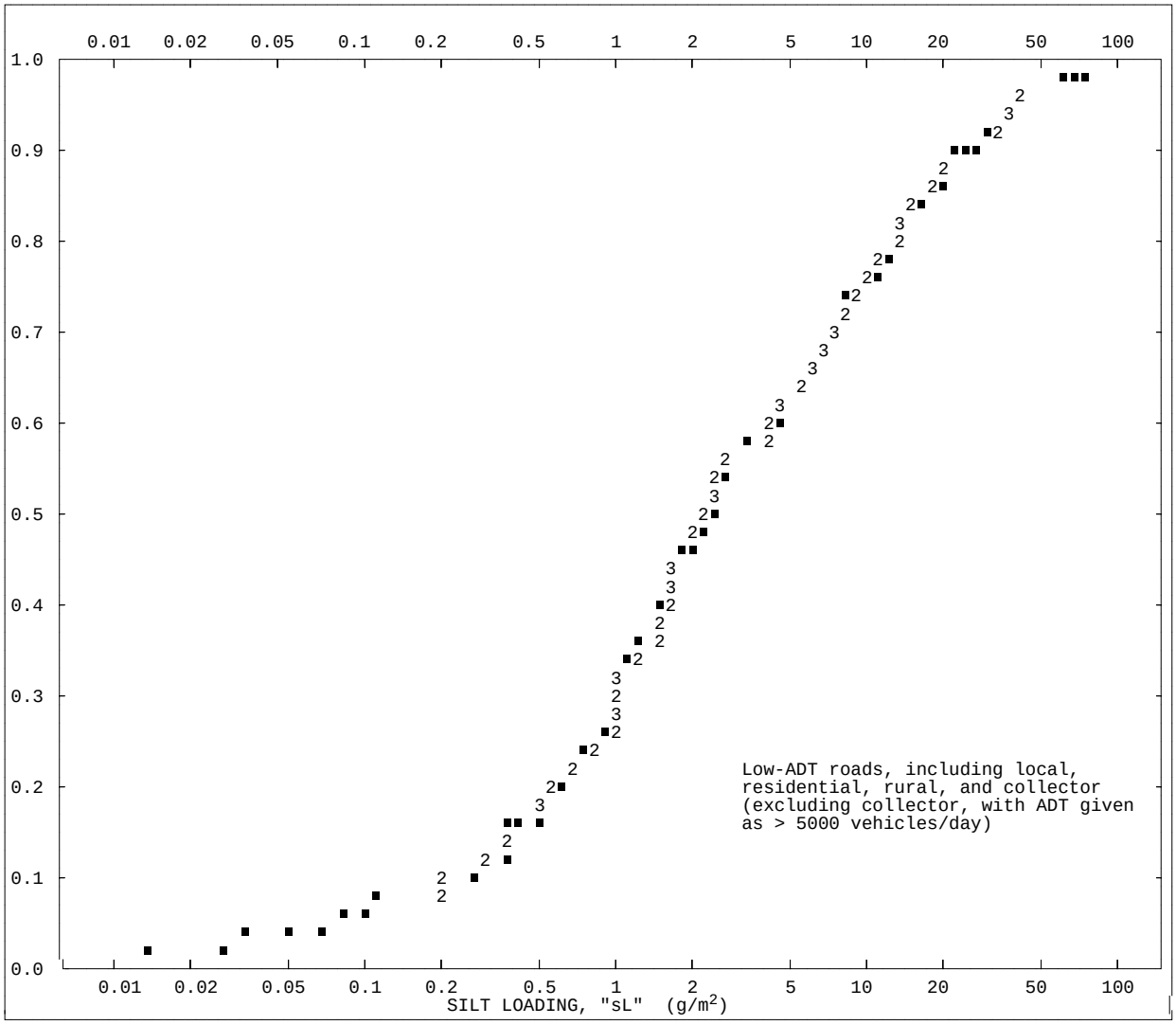

Figure 13.2.1-3. Cumulative frequency distribution for surface silt loading on low-ADT roadways.

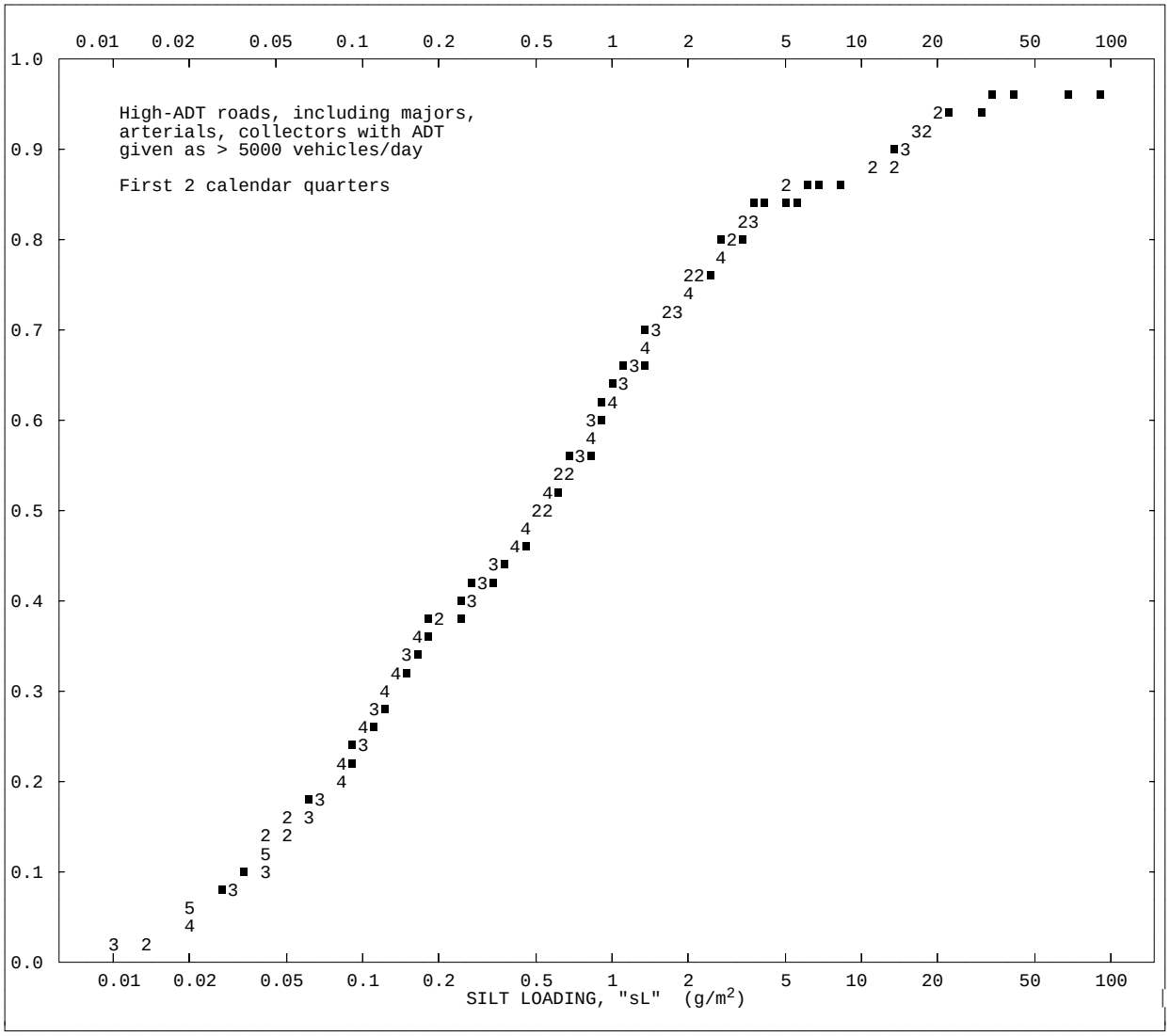

Figure 13.2.1-4. Cumulative frequency distribution for surface silt loading on high-ADT roadways, based on samples during first half of the calendar year.

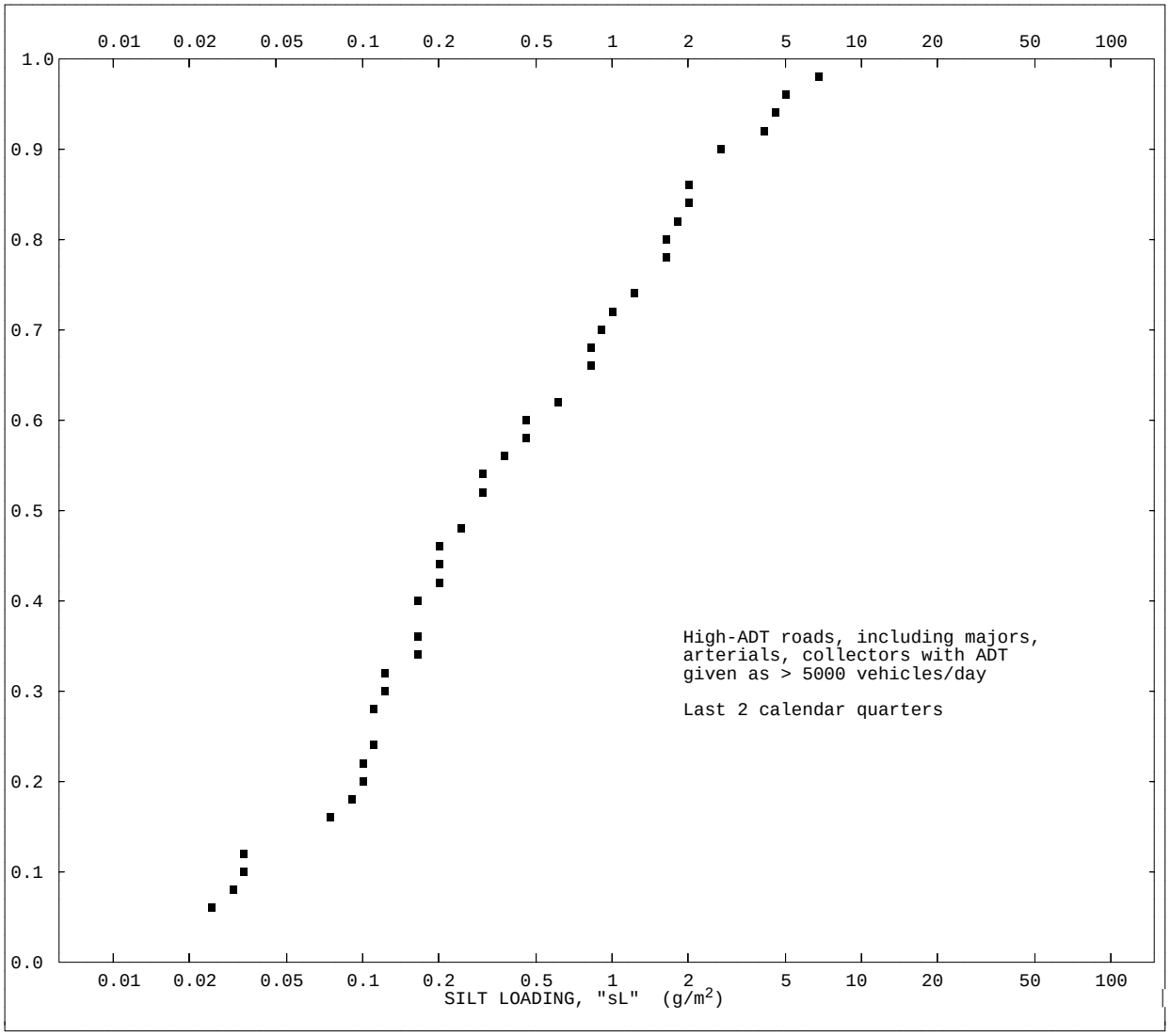

Figure 13.2.1-5. Cumulative frequency distribution for surface silt loading on high-ADT roadways, based on samples during second half of the calendar year.

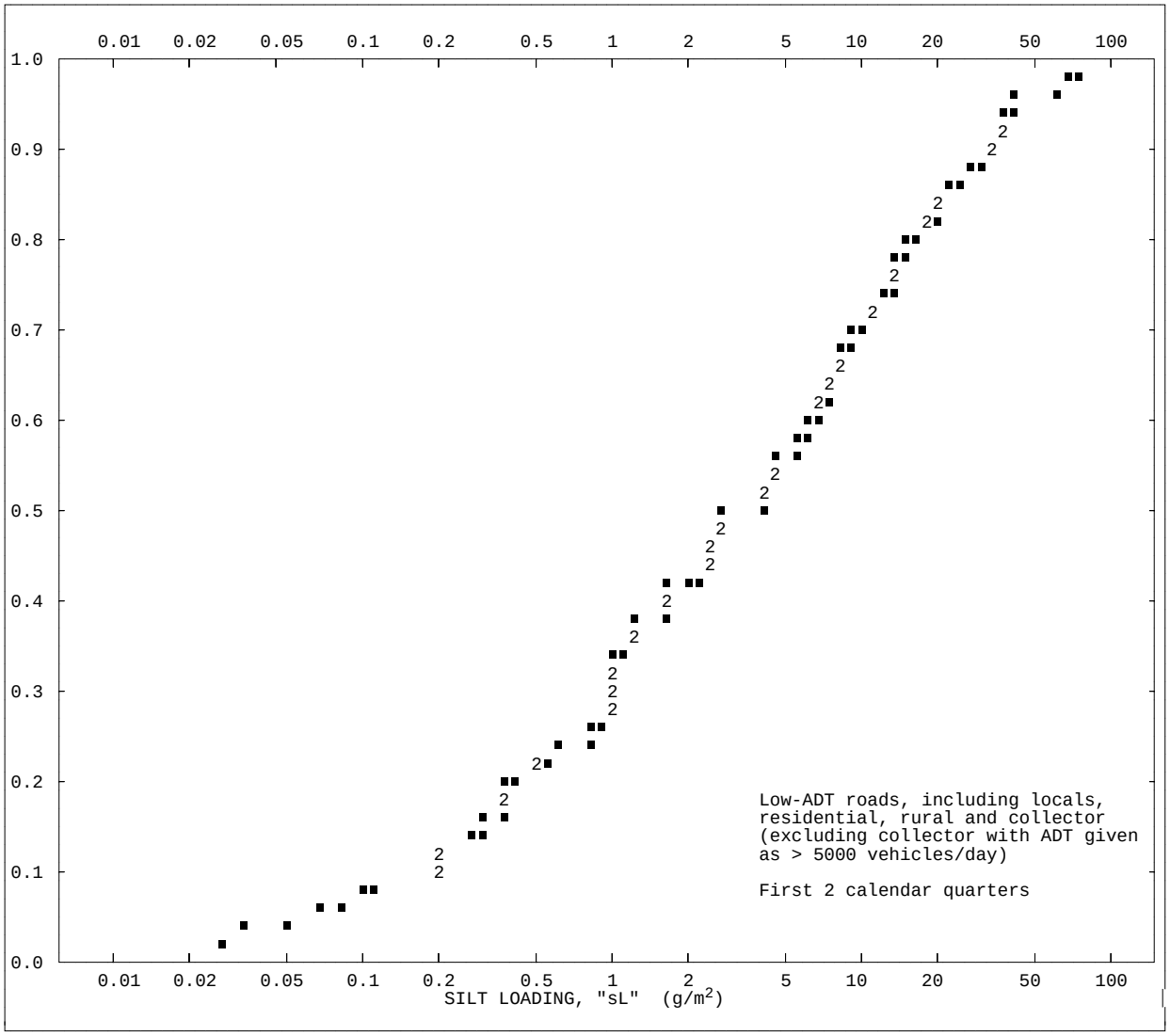

Figure 13.2.1-6. Cumulative frequency distribution for surface silt loading on low-ADT roadways, based on samples during first half of the calendar year.

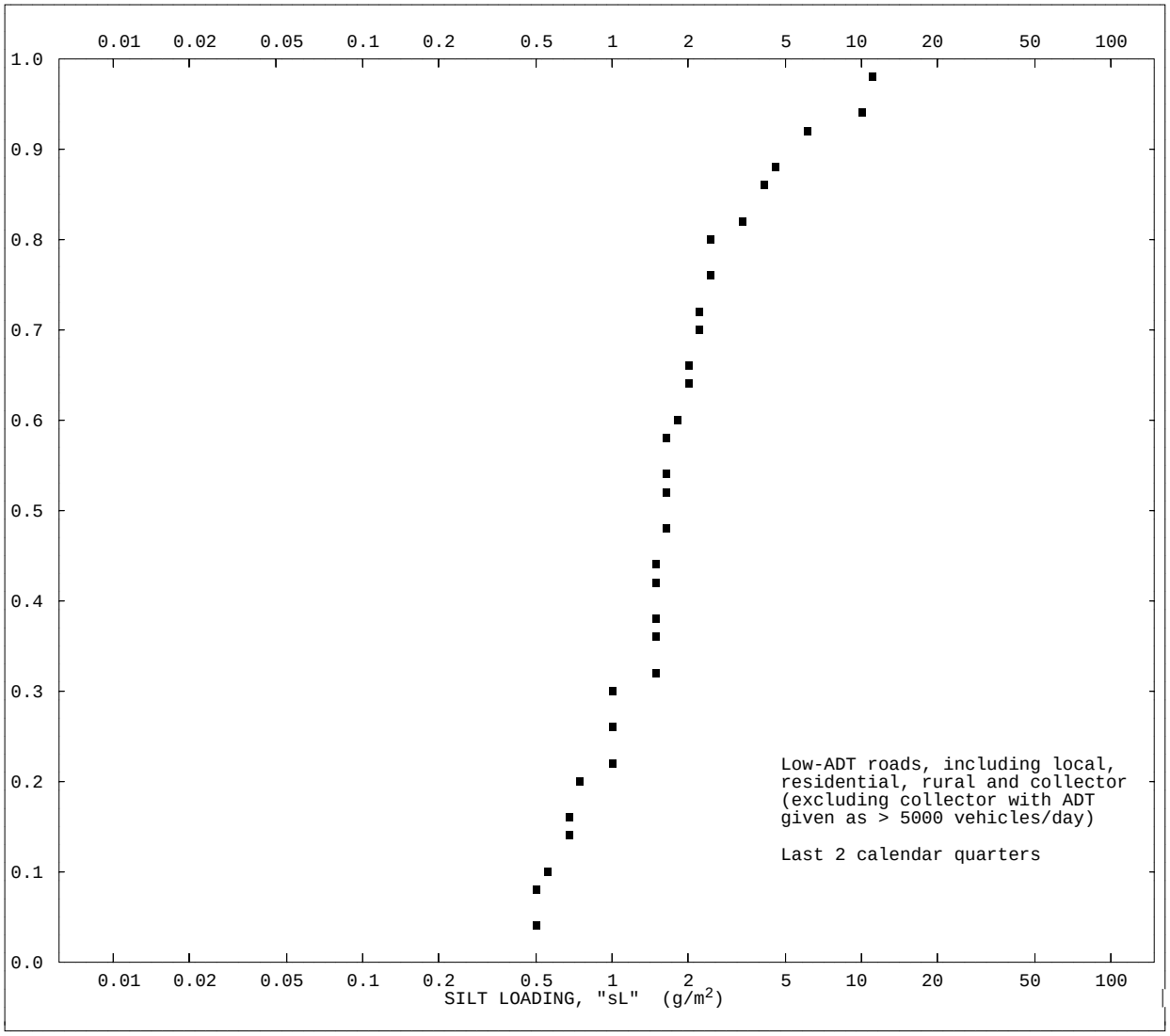

Figure 13.2.1-7. Cumulative frequency distribution for surface silt loading on low-ADT roadways, based on samples during second half of the calendar year.

Table 13.2.1-3. NONINDUSTRIAL PAVED ROAD SAMPLING DATA[a]

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	Billings	ND	Rural	04/78	50	0.6	18.5	3.4	
MT	Billings	Yellowstone	Residential	04/78	115	0.5	14.3	3.5	
MT	Missoula	Bancroft	Residential	04/78	4000	8.4	33.9	24.9	
MT	Butte	1st St	Residential	04/78	679	24.6	10.6	232.4	
MT	Butte	N Park Pl	Residential	04/78	60	103.7	7	1480.8	
MT	Billings	Grand Ave	Collector	04/78	6453	1.6	19.1	13.05	2 samples, range: 1.0 - 2.2
MT	Billings	4th Ave E	Collector	04/78	3328	7.7	7.7	99.5	
MT	Missoula	6th St	Collector	04/78	3655	26	62.9	6	
MT	Butte	Harrison	Arterial	04/78	22849	1.9	5	37.3	
MT	Missoula	Highway 93	Arterial	04/78	18870	1.9	55.9	3.3	
MT	Butte	Montana	Arterial	04/78	13529	0.8	6.6	11.9	
MT	East Helena	Thurman	Residential	04/83	140	13.1	4.3	305.2	
MT	East Helena	1st St	Local	04/83	780	4	13.6	29	
MT	East Helena	Montana	Collector	04/83	2700	8.2	9.4	86.6	
MT	East Helena	Main St	Collector	04/83	1360	4.7	8.4	55.3	
MT	Libby	6th	Local	03/88	1310	ND	14.8	ND	
MT	Libby	5th	Local	03/88	331	ND	16.5	ND	
MT	Libby	Champion Int So gate	Collector	03/88	800	ND	27.5	ND	
MT	Libby	Mineral Ave	Collector	03/88	5900	7	16	43.5	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	Libby	Main Ave btwn 6th &	Collector	03/88	536	61	20.4	299.2	
MT	Libby	California	Collector	03/88	4500	ND	12.1	ND	
MT	Libby	US 2	Arterial	03/88	10850	ND	12.3	ND	
MT	Butte	Garfield Ave	Residential	04/88	562	2.1	10.9	19.3	
MT	Butte	Continental Dr	Arterial	04/88	5272	0.9	10.1	8.8	
MT	Butte	Garfield Ave	Residential	06/89	562	1	8.7	11.2	
MT	Butte	So Park Ave	Residential	06/89	60	2.8	10.9	25.5	
MT	Butte	Continental Dr	Arterial	06/89	5272	7.2	3.6	197.6	
MT	East Helena	Morton St	Local	08/89	250	1.7	6.8	24.6	
MT	East Helena	Main St	Collector	08/89	2316	0.7	4.1	17	
MT	East Helena	US 12	Arterial	08/89	7900	2.1	12.5	16.5	
MT	Columbia Falls	7th St	Residential	03/90	390	ND	9.5	ND	
MT	Columbia Falls	4th St	Residential	03/90	400	18.8	14.3	131.5	
MT	Columbia Falls	3rd Ave	Residential	03/90	50	ND	14.3	ND	
MT	Columbia Falls	4th Ave	Residential	03/90	1720	ND	5.4	ND	
MT	Columbia Falls	CF Forest	Local	03/90	240	ND	16.3	ND	
MT	Columbia Falls	12th Ave	Collector	03/90	1510	ND	8.8	ND	
MT	Columbia Falls	3rd St	Collector	03/90	1945	ND	7	ND	
MT	Columbia Falls	Nucleus	Collector	03/90	4730	15.4	10	153.9	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	Columbia Falls	Plum Creek	Collector	03/90	316	ND	6.2	ND	
MT	Columbia Falls	6th Ave	Collector	03/90	1764	ND	4.2	ND	
MT	Columbia Falls	US 2	Arterial	03/90	13110	2.7	18.7	14.6	
MT	East Helena	Morton	Residential	07/90	250	1.6	17	9.3	
MT	East Helena	Main St	Collector	07/90	2316	5.6	10.6	52.5	
MT	East Helena	US 12	Arterial	07/90	7900	3.2	15.4	20.9	
MT	Columbia Falls	4th Ave	Local	08/90	400	1.5	4	37.7	
MT	Libby	Main Ave 4th &	Collector	08/90	530	2.4	17.9	13.2	
MT	Columbia Falls	Nucleus	Collector	08/90	5730	0.8	5.3	16	
MT	Columbia Falls	US 2	Arterial	08/90	13039	0.2	7	2.9	
MT	East Helena	Morton	Local	10/90	250	3.4	10.2	33.6	
MT	East Helena	Main	Collector	10/90	2316	4.5	5.6	81.3	
MT	East Helena	US 12	Arterial	10/90	7900	0.6	13.9	4.3	
MT	Columbia Falls	Nucleus	Collector	11/06/90	5670	5.2	13.5	38	
MT	Columbia Falls	US 2	Arterial	11/06/90	15890	1.7	24.1	7.2	
MT	Libby	US 2	Arterial	12/08/90	10000	21.5	9.6	223.9	
MT	Libby	Main Ave 4th &	Collector	12/09/90	530	13.6	27.1	50.3	
MT	Butte	Texas	Collector	12/13/90	3070	1	15.4	6.4	
MT	East Helena	King	Local	01/91	75	1	3.4	30.6	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	East Helena	Prickly Pear	Local	01/91	425	12	1.8	666.5	
MT	East Helena	Morton	Local	01/91	250	14.1	3.5	402.3	
MT	East Helena	Main St	Collector	01/91	2316	36.7	12.1	303.4	
MT	East Helena	US 12	Arterial	01/91	7900	0.8	14	5.6	
MT	Thompson Falls	Preston	Local	01/23/91	920	9.2	9.9	93	
MT	Thompson Falls	Highway 200	Collector	01/23/91	5000	33.3	27.2	122.2	
MT	East Helena	Seaver Park Rd	Local	02/91	150	21.6	7.1	304.7	
MT	East Helena	New Lake Helena Dr	Collector	02/91	2140	19.2	9	213.4	
MT	East Helena	Porter	Collector	02/91	850	74.4	7.7	966.8	
MT	Libby	Main Ave 4th &	Collector	02/14/91	530	33.3	18.7	178.2	
MT	Libby	US 2	Arterial	02/17/91	10000	69.3	21	330.3	
MT	Butte	Texas	Collector	02/21/91	3070	1.2	11	10.9	
MT	Butte	Harrison	Arterial	02/21/91	22849	2.9	7.9	36.6	
MT	Kalispell	3rd btwn Main & 1st	Collector	02/24/91	2653	30.5	24.8	122.9	
MT	Kalispell	Main	Arterial	02/24/91	14730	17.4	20.4	85.2	
MT	Thompson Falls	Preston	Local	02/25/91	920	35.7	17.9	199.6	
MT	Thompson Falls	Highway 200	Collector	02/25/91	5000	66.8	17.8	375.3	
MT	Helena	Montana	Arterial	03/91	21900	15.4	6.2	248.3	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	Kalispell	3rd btwn Main & 1st	Collector	03/09/91	2653	39.1	29.1	134.5	
MT	Columbia Falls	Nucleus	Collector	03/91	5670	30.1	17	174.6	2 samples, range: 0.8 - 0.8
MT	Kalispell	Main	Arterial	03/09/91	14730	17.6	24.7	71.4	
MT	Thompson Falls	Preston	Local	03/91	920	4.4	8.3	51	2 samples, range: 2.8 - 5.9
MT	Thompson Falls	Highway 200	Collector	03/91	5000	4.3	15.5	28.9	2 samples, range: 1.0 - 7.5
MT	Libby	Main Ave 4th &	Collector	03/91	530	14.8	33.1	44.9	2 samples, range: 13.5 - 16.1
MT	Libby	US 2	Arterial	03/91	11963	20	19.5	111.9	3 samples, range: 11.4 - 32.4
MT	East Helena	Morton	Local	04/91	250	4.3	8.8	48.7	
MT	East Helena	US 12	Arterial	04/91	7900	0.5	8.7	5.7	
MT	Thompson Falls	Preston	Local	04/91	920	1.2	15.7	6.3	4 samples, range: 0.3 - 4.0
MT	Thompson Falls	Highway 200	Collector	04/04/91	5000	2	13.4	14.7	2 samples, range: 1.1 - 2.2
MT	Libby	Main Ave 4th &	Collector	04/91	530	3.5	44	7.8	2 samples, range: 2.5 - 4.4
MT	Libby	US 2	Arterial	04/91	12945	11.8	20.5	57.2	4 samples, range: 1.2 - 22.9
MT	Kalispell	3rd btwn Main & 1st	Collector	04/14/91	2653	15.1	37.1	40.9	
MT	Columbia Falls	Nucleus	Collector	04/91	5670	9	19.8	47.6	
MT	Kalispell	Main	Arterial	04/14/91	14730	13	44.5	29.4	
MT	Columbia Falls	Nucleus	Collector	05/91	5670	2.4	17.5	15.9	4 samples, range: 1.3 - 3.8
MT	Columbia Falls	US 2	Arterial	05/91	14712	5.5	20.7	24.8	5 samples, range: 1.5 - 14.2
MT	Libby	Main Ave 4th &	Collector	05/19/91	530	1.7	31	5.7	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	Libby	Main Ave 4th &	Collector	06/27/91	530	1.7	24.3	7.1	
MT	Libby	US 2	Arterial	06/27/91	10000	3.8	12.6	30.6	
MT	East Helena	Morton	Local	07/91	250	1.7	11.4	15.3	
MT	East Helena	Main	Collector	07/91	2316	8.8	11	79.7	
MT	Thompson Falls	Preston	Local	07/09/91	920	10.9	11	98.7	
MT	Thompson Falls	Highway 200	Collector	07/09/91	5000	2.1	8.1	25.9	
MT	Helena	Montana	Arterial	07/17/91	21900	0.9	4.7	19.4	
MT	Butte	Texas	Collector	07/26/91	3070	2.5	28.2	8.9	
MT	Butte	Harrison	Arterial	07/26/91	22849	1.6	28.2	5.8	
MT	Kalispell	3rd btwn Main & 1st	Collector	08/03/91	2653	5.8	23	25.3	
MT	Kalispell	Main	Arterial	08/03/91	14730	4	21	19.3	
MT	Columbia Falls	US 2	Arterial	08/11/91	15890	0.1	5.6	2.3	
MT	Missoula	Russel btwn 4th & 5th	Road	08/30/91	5270	1.6	8.3	19.3	
MT	East Helena	US 12	Arterial	08/30/91	7900	7	20.5	34.3	
MT	Butte	Texas	Collector	10/03/91	3070	1	17.7	5.4	
MT	Butte	Harrison	Arterial	10/03/91	22849	2.1	23.1	9.1	
MT	Kalispell	3rd btwn Main & 1st	Collector	10/06/91	2653	10	31.3	31.9	
MT	Kalispell	Main	Arterial	10/06/91	14730	4.3	27.7	15.7	
MT	East Helena	Morton	Local	10/16/91	250	1.8	31	5.9	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	East Helena	Main St	Collector	10/16/91	2316	1.6	20.5	7.7	
MT	East Helena	US 12	Arterial	10/16/91	7900	1	6.7	14.9	
MT	Columbia Falls	Nucleus	Collector	10/20/91	5670	1.9	13.9	13.3	
MT	Columbia Falls	US 2	Arterial	10/20/91	15890	1.2	11.3	10.2	
MT	Kalispell	3rd btwn Main & 1st	Collector	11/06/91	2653	2.2	12.3	17.8	
MT	Kalispell	Main	Arterial	11/28/91	14730	2.7	8.6	30.8	
MT	Thompson Falls	Preston	Local	12/17/91	920	4	18.1	22.5	
MT	Thompson Falls	Highway 200	Collector	12/17/91	5000	1.5	13.2	11.6	
MT	Butte	Texas	Collector	02/02/92	3070	19.1	11.6	164.5	
MT	Butte	Harrison	Arterial	02/02/92	22849	8.3	12	69.3	
MT	East Helena	Morton	Local	02/03/92	250	78.3	9.5	824.7	
MT	Libby	W 4th St	Local	02/03/92	350	36.3	56.3	64.5	
MT	Libby	Main Ave 4th &	Collector	02/03/92	530	10.7	49.9	21.4	
MT	East Helena	Main St	Collector	02/03/92	2316	57.9	14.8	391	
MT	Columbia Falls	Nucleus	Collector	02/03/92	5670	29.2	20.1	145.4	
MT	Columbia Falls	US 2	Arterial	02/92	12945	51.3	32.2	143.1	2 samples, range: 13.0 - 89.5
MT	East Helena	US 12	Arterial	02/03/92	7900	2.9	14.3	20.7	
MT	Thompson Falls	Preston	Local	02/22/92	920	0.5	18	2.6	
MT	Thompson Falls	Highway 200	Collector	02/22/92	5000	1.2	14.6	8.1	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	Kalispell	3rd btwn Main & 1st	Collector	03/15/92	2653	81.1	37.3	217.3	
MT	Kalispell	Main	Arterial	03/15/92	14730	16.5	32.1	51.3	
MT	Thompson Falls	Preston	Local	04/92	920	0.43	14.9	3.2	
MT	Thompson Falls	Highway 200	Collector	04/92	5000	0.8	18.2	4.7	3 samples, range: 0.4 - 1.0
MT	Kalispell	3rd btwn 2nd & 3rd	Local	04/26/92	450	20.9	45.8	45.5	
MT	Kalispell	3rd btwn Main & 1st	Collector	04/26/92	2653	19.2	50.9	37.7	
MT	Kalispell	Main	Arterial	04/26/92	14730	10.7	33.5	32.1	
MT	Kalispell	3rd btwn 2nd & 3rd	Local	05/92	450	8.3	35.6	23.5	3 samples, range: 6.6 - 10.3
MT	Kalispell	3rd btwn Main & 1st	Collector	05/92	2653	8.5	32.4	25.8	3 samples, range: 6.3 - 11.4
MT	Kalispell	Main	Arterial	05/92	14730	5.1	23.6	21.7	3 samples, range: 3.8 - 5.9
MT	Libby	W 4th St	Local	05/11/92	350	13.4	56.5	23.7	
MT	Libby	Main Ave 4th &	Collector	05/11/92	530	5.6	58.9	9.4	
MT	Libby	US 2	Arterial	05/92	12945	10.4	25.6	29.4	
MT	East Helena	Morton	Local	05/15/92	250	6.9	6.7	103	
MT	East Helena	Main St	Collector	05/15/92	2316	6.4	10.2	62.8	
MT	East Helena	US 12	Arterial	05/15/92	7900	1.2	6.9	17	
MT	Columbia Falls	Nucleus	Collector	05/25/92	5670	1	21.7	4.5	
MT	Missoula	Inez btwn 4th & 5th	Local	06/04/92	500	1	17.4	5.6	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
MT	Missoula	Russel btwn 3rd & 4th	Collector	06/04/92	5270	15.2	14	108.4	
MT	Missoula	3rd btwn Prince & In	Arterial	06/04/92	12000	2	13.1	15.7	
CO	Denver	E. Colfax	Princ. Arterial[b]	03/89	1994[c]	0.21	2	19.9	4 samples, range: 0.04 - 0.47
CO	Denver	E. Colfax	Princ. Arterial[b]	04/89	2228[c]	0.73	1.7	106.7	18 samples, range: 0.08 - 1.76
CO	Denver	York St	Princ. Arterial[b]	04/89	780[c]	0.86	1.2	74.8	2 samples, range: 0.83 - 0.89
CO	Denver	E. Belleview	Princ. Arterial[b]	04/89	ND	0.07	4.2	2	3 samples, range: 0.03 - 0.09
CO	Denver	I-225	Expressway[b]	04/89	4731[c]	0.02	3.6	0.4	3 samples, range: 0.01 - 0.02
CO	Denver	W. Evans	Princ. Arterial[b]	05/89	1905[c]	0.76	1.9	74	11 samples, range: 0.03 - 2.24
CO	Denver	W. Evans	Princ. Arterial[b]	06/89	1655[c]	0.71	1.2	66.1	12 samples, range: 0.07 - 3.34
CO	Denver	E. Louisiana	Minor Arterial[b]	06/89	515[c]	0.14	4.66	3.5	5 samples, range: 0.08 - 0.24
CO	Denver	E. Louisiana	Minor Arterial[b]	01/90	ND	1.44[d]	ND	ND	6 samples, range: 0.12 - 2.8
CO	Denver	E. Jewell Ave	Collector[b]	01/24/90	ND	2.24[d]	ND	ND	
CO	Denver	State Highway 36	Expressway[b]	01/30/90	ND	0.56[d]	ND	ND	2 samples, range: 0.56 - 0.56

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
CO	Denver	State Highway 36	Expressway[b]	02/01/90	ND	1.92[d]	ND	ND	4 samples, range: 1.92 - 1.92
CO	Denver	W. Evans Ave	Princ. Arterial[b]	02/03/90	ND	1.64[d]	ND	ND	2 samples, range: 1.64 - 1.64
CO	Denver	E. Mexico St	Local[b]	02/07/90	ND	2.58[d]	ND	ND	3 samples, range: 2.58 - 2.58
CO	Denver	E. Colfax Ave	Princ. Arterial[b]	02/90	ND	0.09[d]	ND	ND	16 samples, range: 0.02 - 0.17
CO	Denver	State Highway 36	Expressway[b]	03/90	ND	ND	ND	ND	7 samples
CO	Denver	E. Louisiana Ave	Minor Arterial[b]	03/10/90	ND	ND	ND	ND	3 samples
CO	Denver	W. Evans Ave	Princ. Arterial[b]	03/90	ND	1.27[d]	ND	ND	5 samples, range: 0.07 - 3.38
CO	Denver	W. Colfax Ave	Princ. Arterial[b]	03/90	ND	0.41[d]	ND	ND	21 samples, range: 0.04 - 2.61
CO	Denver	Parker Rd	Local[b]	04/90	ND	0.05[d]	ND	ND	6 samples, range: 0.01 - 0.11
CO	Denver	W. Byron Pl	Princ. Arterial[b]	04/90	ND	0.3[d]	ND	ND	6 samples, range: 0.21 - 0.35
CO	Denver	E. Colfax Ave	Princ. Arterial[b]	04/18/90	ND	0.21[d]	ND	ND	
UT	Salt Lake County	700 East	Arterial	—[e]	42340	0.137	11.5	1.187	4 samples, range: 0.107 - 0.162

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
UT	Salt Lake County	State St	Collector	—[e]	27140	0.288	17	1.692	4 samples, range: 0.212 - 0.357
UT	Salt Lake County	I-80	Freeway	—[e]	77040	0.023	21.4	0.1	5 samples, range: 0.011 - 0.034
UT	Salt Lake County	I-15	Freeway	—[e]	146180	0.096	23.5	0.419	6 samples, range: 0.078 - 0.126
UT	Salt Lake County	400 East	Local	—[e]	5000	1.967	4.07	46.043	14 samples, range: 0.177 - 5.772
NV	Las Vegas	Lake Mead	Major	07/15/87	ND	0.81	12.4	6.51	
NV	Las Vegas	Perliter	Local	07/15/87	ND	2.23	31.2	7.14	
NV	Las Vegas	Bruce	Collector	07/15/87	ND	1.64	26.1	6.3	
NV	Las Vegas	Stewart	Major	09/29/87	ND	0.38	24	1.63	3 samples, range: 0.24 - 0.46
NV	Las Vegas	Ambler	Local	09/29/87	ND	1.38	23	6.32	3 samples, range: 0.64 - 2.00
NV	Las Vegas	28th St	Collector	09/29/87	ND	0.52	15.8	3.4	3 samples, range: 0.51 - 0.54
NV	Las Vegas	Lake Mead	Major	10/07/87	ND	0.19	14.9	1.26	2 samples, range: 0.17 - 0.20
NV	Las Vegas	Perliter	Local	10/07/87	ND	1.5	31.9	4.76	2 samples, range: 1.48 - 1.52
NV	Las Vegas	Bruce	Collector	10/07/87	ND	0.9	24.1	3.74	2 samples, range: 0.76 - 1.03
AZ	Phoenix	Broadway	Arterial	—[f]	ND	0.127	12.2	1.071	
AZ	Phoenix	South Central	Arterial	—[f]	ND	0.085	5	1.726	
AZ	Phoenix	Indian School & 28th	Arterial	—[f]	ND	0.035	3.1	1.021	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
AZ	Glendale	43rd & Vista	Arterial	—[f]	ND	0.042	3.9	1.049	
AZ	Glendale	59th & Peoria	Arterial	—[f]	ND	0.099	8.2	1.183	
AZ	Mesa	Mesa Drive	Arterial	—[f]	ND	0.099	8.9	1.085	
AZ	Mesa	E. McKellips & Olive	Arterial	—[f]	ND	0.014	17	0.092	
AZ	Phoenix	17th & Highland	Collector	—[f]	ND	0.028	13.4	0.232	
AZ	Mesa	3rd & Miller	Collector	—[f]	ND	0.07	11.8	0.627	
AZ	Phoenix	Avalon & 25th	Collector	—[f]	ND	0.528	11.1	4.79	
AZ	Phoenix	Apache	Collector	—[f]	ND	0.282	6.4	4.367	
AZ	Phoenix	N. 28th St & E. Glenrosa	Collector	—[f]	ND	0.035	2.3	1.479	
AZ	Pima County	6th Ave	Collector	—[f]	ND	1.282	6.417	19.961	
AZ	Pima County	Speedway Blvd	Arterial	—[f]	ND	0.401	8.117	4.937	
AZ	Pima County	22nd St	Arterial	—[f]	ND	0.028	16.529	0.176	
AZ	Pima County	Amklam Rd	Collector	—[f]	ND	0.014	5.506	0.197	
AZ	Pima County	Fort Lowel Rd	Arterial	—[f]	ND	0.113	3.509	3.268	
AZ	Pima County	Oracle Rd	Arterial	—[f]	ND	0.014	1.556	0.725	
AZ	Pima County	Inn Rd	Arterial	—[f]	ND	0.021	18.756	0.127	
AZ	Pima County	Orange Grove	Arterial	—[f]	ND	0.162	21.989	0.725	
AZ	Pima County	La Canada	Arterial	—[f]	ND	0.106	3.975	2.571	

Table 13.2.1-3 (cont.).

ST	City	Sampling Location, Street, Road Name	Class[a]	Date	ADT[a]	Silt Loading (g/m^2)	Silt Content (%)	Total Loading (g/m^2)	Comments
KS	Kansas City	7th	Arterial	02/80	ND	0.29	6.8	4.2	3 samples, range: 0.15 - 0.46
MO	Kansas City	Volker	Arterial	02/80	ND	0.67	20.1	3.5	3 samples, range: 0.43 -1.00
MO	Kansas City	Rockhill	Arterial	02/80	ND	0.68	21.7	3.3	
KS	Tonganoxie	4th	Collector	03/80	ND	2.5	14.5	17.1	
KS	Kansas City	7th	Arterial	03/80	ND	0.29	12.2	2.4	
MO	St. Louis	I-44	Expressway	05/80	ND	0.02	ND	ND	4 samples
MO	St. Louis	Kingshighway	Collector	05/80	ND	0.08	10.9	0.7	3 samples, range: 0.05 - 0.11
IL	Granite City	24th	Arterial	05/80	ND	0.78	6.4	12.3	2 samples, range: 0.7 - 0.83
IL	Granite City	Benton	Collector	05/80	ND	0.93	8.6	10.8	
MN	Duluth	US 53 (northbound lanes)	Highway	03/19/92	5000	0.23	28	1.94	8 samples, range: 0.04 - 0.77
MN	Duluth	US 53 (southbound lanes)	Highway	02/26/92	5000	0.24	13.4	2.3	5 samples, range: 0.05 - 0.37

[a] References 7,13-20. Classifications and values as given in reference, except as noted. ADT = average daily traffic. ND = no data.
[b] Reference 16.
[c] Value given is the hourly traffic rate observed during testing. ADT values not reported.
[d] Samples are said to wet sieved. Wet sieving results are not directly comparable to those for the dry sieving described in AP-42 Appendix C.2.
[e] No specific date given for sampling. Samples are said to be "post storm".
[f] No specific date given for sampling.

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