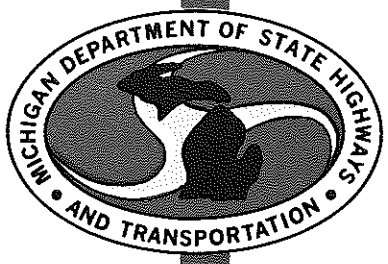
AIR QUALITY REPORT FOR THE I 94 AND M 39 INTERCHANGE



TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION

AIR QUALITY REPORT FOR THE I 94 AND M 39 INTERCHANGE

Research Laboratory Section
Testing and Research Division
Research Project 74 TI-214
Research Report No. R-969R

Michigan State Highway Commission
Peter B. Fletcher, Chairman; Carl V. Pellonpaa,
Vice-Chairman; Hannes Meyers, Jr., Weston E. Vivian
John P. Woodford, Director
Lansing, March 1978

This report presents air quality information for the proposed reconstruction of the I 94 and M 39 interchange in the cities of Allen Park, Dearborn Heights, and Taylor in Wayne County as shown in Figure 1. The existing interchange is shown in Figure 2. Meteorological data, ambient air quality data, and estimates of pollution levels that might occur adjacent to the roadway should it be constructed, are included.

Terrain and Demography

The proposed project is located in a highly developed residential-industrial area. The terrain surrounding the project is generally flat with no tall buildings or structures in the immediate vicinity which might hinder dispersion of pollutants. The populations of the cities involved according to the 1970 census are Allen Park 40,747, Dearborn Heights 80,069, and Taylor 70,020.

Meteorology

Meteorological conditions in Michigan are generally good for dispersion and dilution of air pollutants. According to the air pollution publication AP 101, U. S. Environmental Protection Agency, 1972 (pg. 96) there are few days with a high meteorological potential for air pollution.

Daily weather data recorded every third hour at Detroit Metropolitan Airport were obtained from the National Climatic Center in Asheville, N. C. for the years 1967 through 1973. Figure 3 shows a 36-point bar graph of wind speed and direction occurrences. Figure 4 is a 12-point wind rose obtained by condensing the 36-point wind data.

Figure 5 shows the distribution of wind speeds observed. Wind speeds are greater than 5 mph more than 90 percent of the time. The most probable daytime wind speed was found to be 12 mph.

Existing Ambient Air Quality

Tables 1 through 4 show carbon monoxide concentrations vs hour of the day and vs wind direction for the two van monitoring sites shown in Figure 2. Site 1 is removed far enough from any roadway or stationary source to approximate background air quality. Site 2 is close to the highway, just outside the right-of-way line, so that it represents air quality at the existing interchange. Data were recorded every five minutes 24 hours a day from March 29 to August 22, 1977.

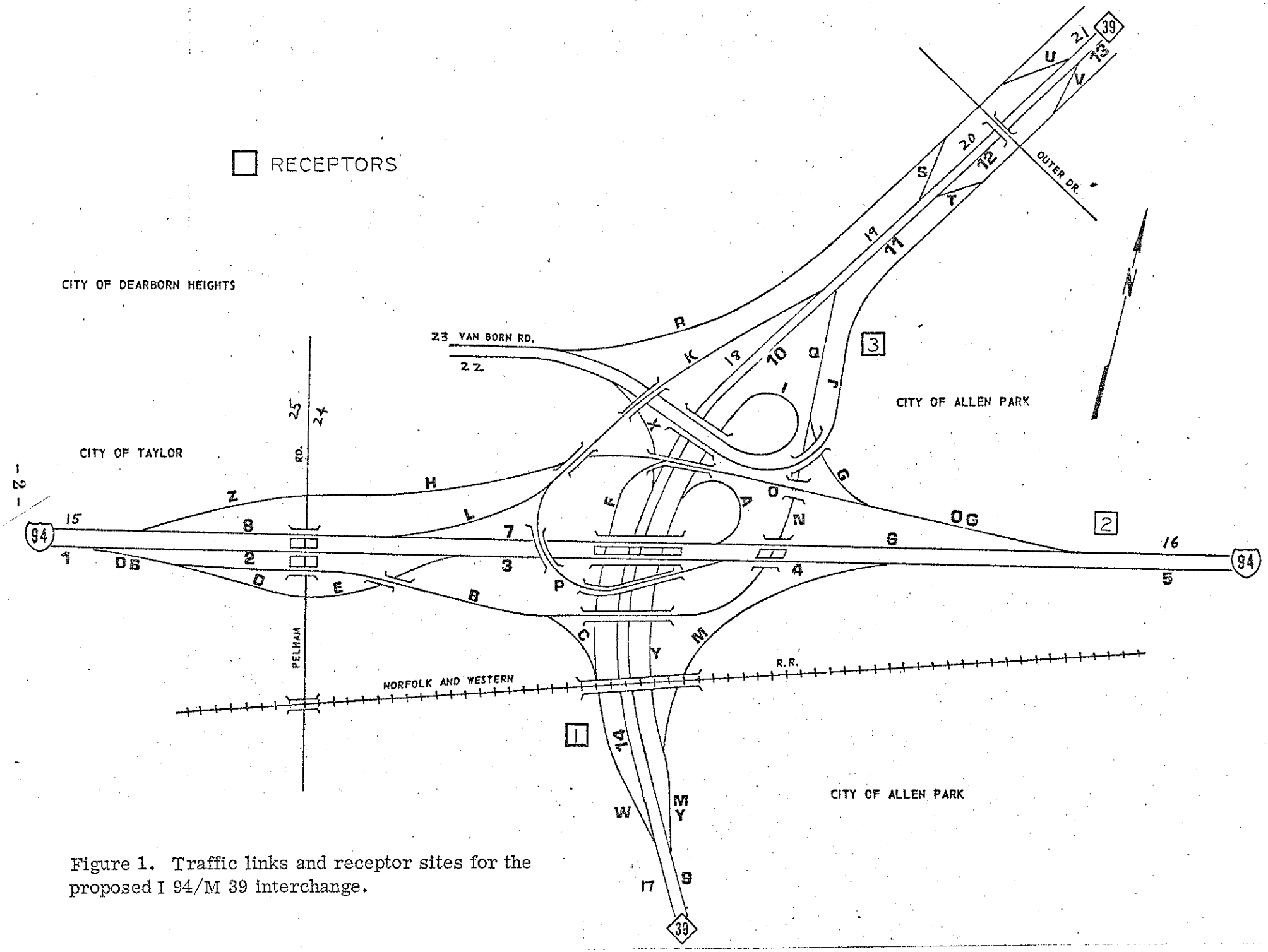


Figure 1. Traffic links and receptor sites for the proposed I 94/M 39 interchange.

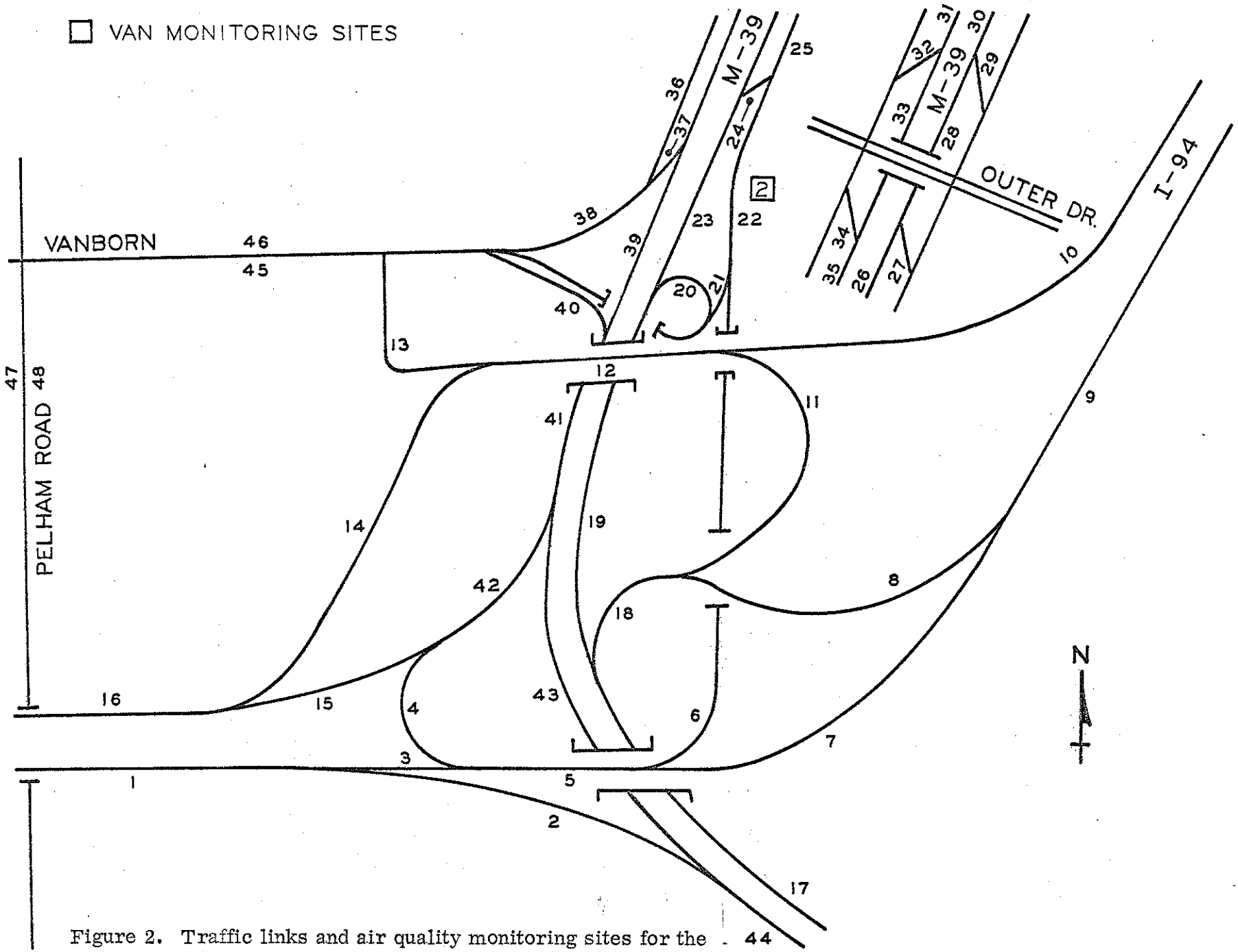


Figure 2. Traffic links and air quality monitoring sites for the existing I 94/M 39 interchange.

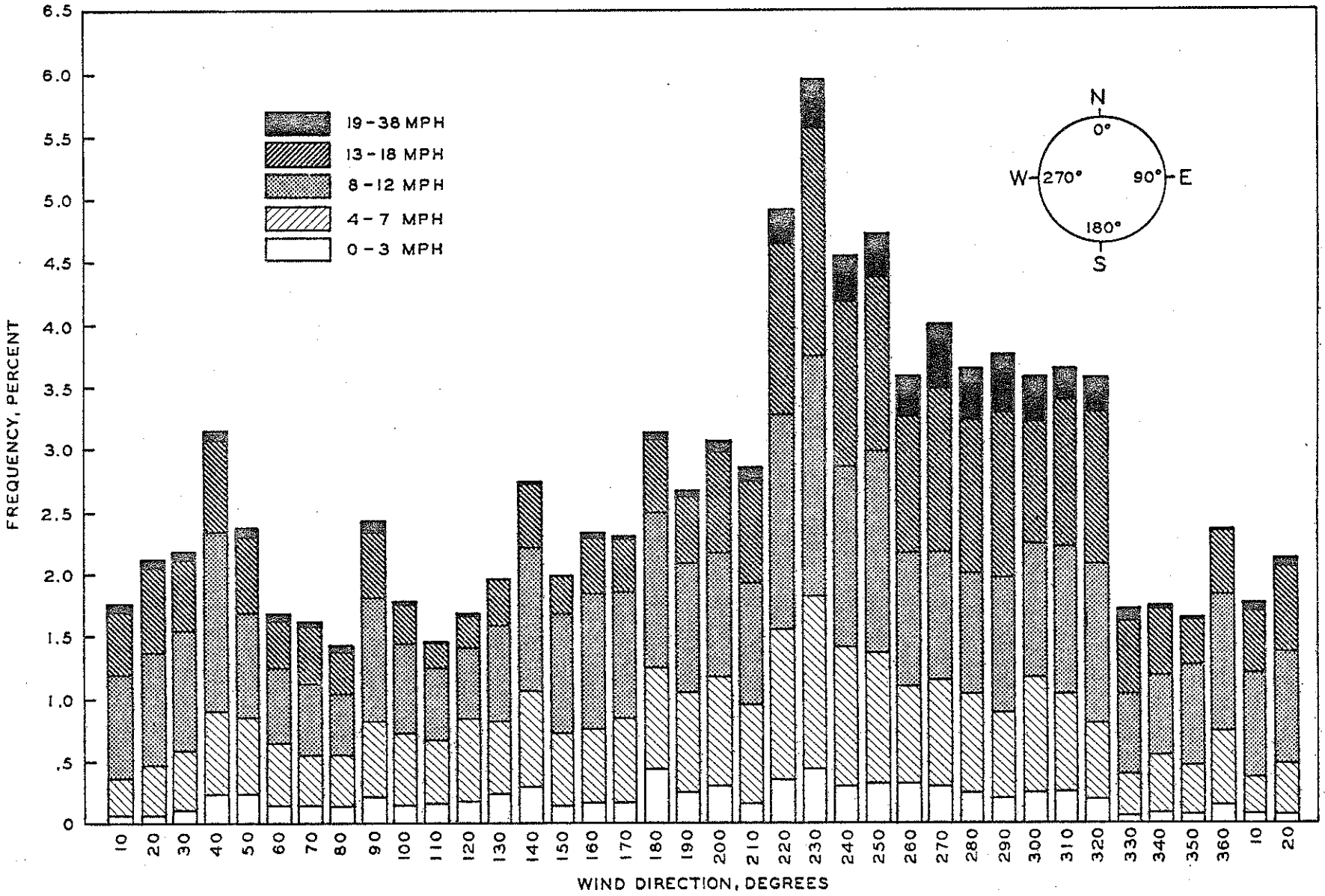


Figure 3. Wind speed and direction occurrences at Detroit Metropolitan Airport.

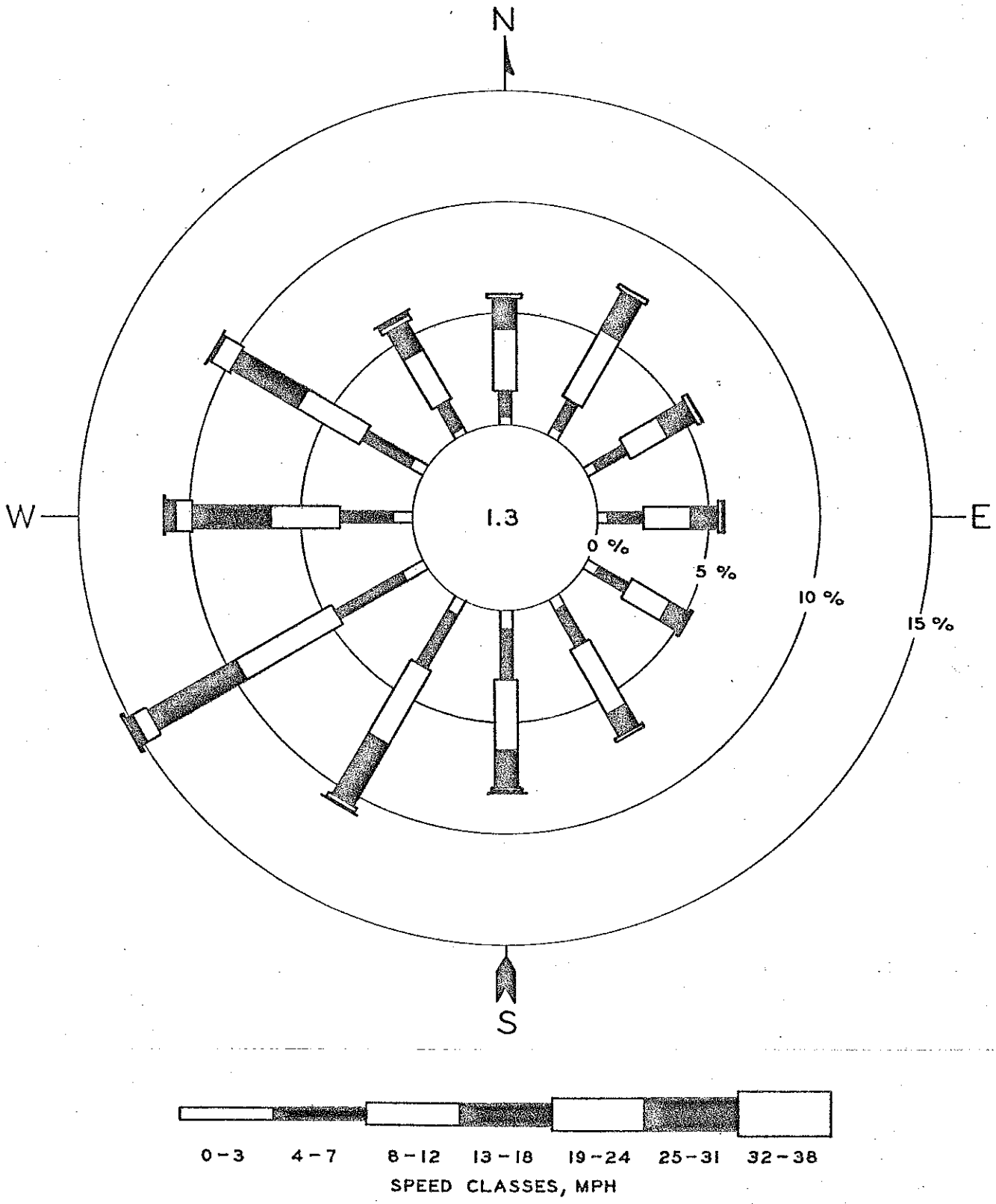


Figure 4. Frequency of wind direction and speed at Detroit Metropolitan Airport (calms, recorded 1.3 percent of the time, are distributed).

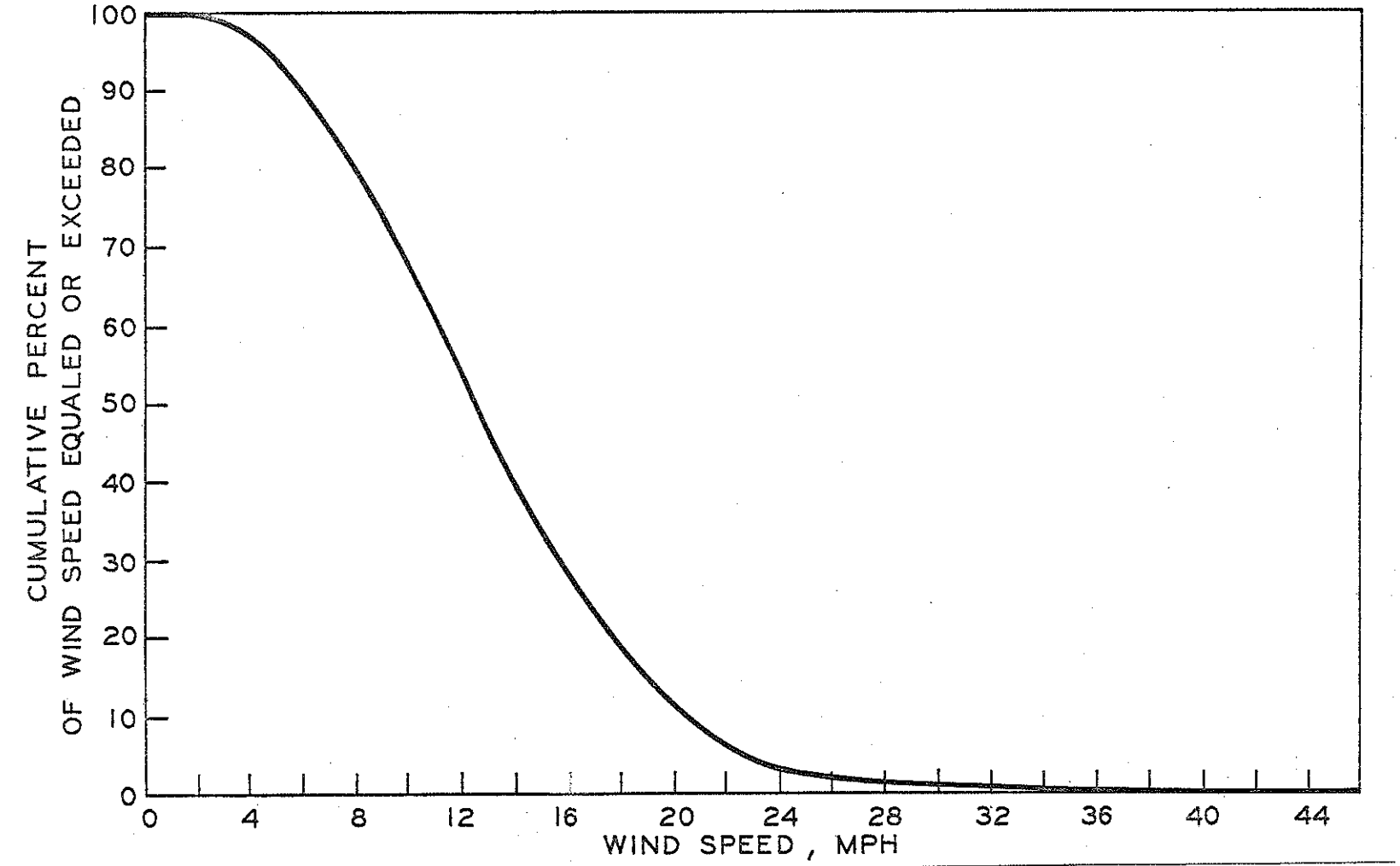


Figure 5. Wind speed distributions at Detroit Metropolitan Airport.

TABLE 1
FREQUENCY DISTRIBUTION OF ONE-HOUR AVERAGE
CO LEVELS VS. HOUR OF THE DAY
(For Site No. 1 From March 29 to May 26, 1977)

Hour of the Day	CO Concentration (mg/cu m)											Average CO	Highest One-Hour Average
	<1	1	2	3	4	5	6	7	8	9	10		
1	6	30	9	2	0	1	1	0	0	0	0	1.3	6
2	10	34	3	2	2	1	0	0	0	0	0	1.1	5
3	10	34	4	2	1	1	0	0	0	0	0	1.1	5
4	13	27	7	2	2	1	0	0	0	0	0	1.1	5
5	16	24	9	1	1	1	1	0	0	0	0	1.1	6
6	12	26	7	5	2	0	1	0	0	0	0	1.2	6
7	5	28	9	4	4	1	1	0	0	0	0	1.6	6
8	4	26	10	7	2	1	2	0	0	0	0	1.7	6
9	11	20	10	4	4	1	0	0	0	0	0	1.4	5
10	13	26	8	3	1	1	0	0	0	0	0	1.1	5
11	12	29	5	3	0	0	0	0	0	0	0	1.0	3
12	8	35	4	2	0	0	0	0	0	0	0	0.9	3
13	11	33	7	1	0	0	0	0	0	0	0	0.9	3
14	12	33	8	0	0	0	0	0	0	0	0	0.9	2
15	12	35	5	0	0	0	0	0	0	0	0	0.8	2
16	11	36	3	0	0	0	0	0	0	0	0	0.8	2
17	8	37	4	1	0	0	0	0	0	0	0	0.9	3
18	7	33	9	1	0	0	0	0	0	0	0	0.9	3
19	9	32	9	1	0	0	0	0	0	0	0	1.0	3
20	5	34	11	0	1	0	0	0	0	0	0	1.0	4
21	4	36	11	0	0	0	1	0	0	0	0	1.1	6
22	6	31	15	0	1	0	0	0	0	0	0	1.2	4
23	10	24	10	5	2	0	0	0	0	0	0	1.3	4
24	8	27	10	4	1	1	0	1	0	0	0	1.3	7
Number of Occurrences	223	730	187	50	24	10	7	1	0	0	0		
Percent of Total	18.1	59.3	15.2	4.1	1.9	0.8	0.6	0.1	0.0	0.0	0.0		
Cumulative Total, percent	18.1	77.4	92.5	96.6	98.5	99.4	99.9	100.0					

TABLE 2

FREQUENCY DISTRIBUTION OF ONE-HOUR AVERAGE CO LEVELS VS. WIND DIRECTION[1] FOR SITE NO. 1

Wind Direction	CO Concentration (mg/cu m)																Average CO	Highest One-Hour Average
	<.5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	>14		
N	9	33	1	4	1	1	0	1	0	0	0	0	0	0	0	0	1.1	7
NNE	6	45	16	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	2
NE	6	59	20	5	1	0	0	0	0	0	0	0	0	0	0	0	1.2	4
ENE	3	10	11	7	0	1	0	0	0	0	0	0	0	0	0	0	1.8	5
E	12	55	11	5	1	2	0	0	0	0	0	0	0	0	0	0	1.2	5
ESE	0	30	18	4	3	1	0	0	0	0	0	0	0	0	0	0	1.6	5
SE	2	42	15	1	2	0	0	0	0	0	0	0	0	0	0	0	1.3	4
SSE	4	59	27	0	2	0	0	0	0	0	0	0	0	0	0	0	1.2	4
S	9	43	15	3	0	0	1	0	0	0	0	0	0	0	0	0	1.1	6
SSW	12	20	9	4	0	1	0	0	0	0	0	0	0	0	0	0	1.2	5
SW	38	43	8	1	0	0	1	0	0	0	0	0	0	0	0	0	0.8	6
WSW	58	68	7	3	5	0	0	0	0	0	0	0	0	0	0	0	0.8	4
W	28	85	4	4	0	2	0	0	0	0	0	0	0	0	0	0	0.8	5
WNW	15	61	7	1	1	0	1	0	0	0	0	0	0	0	0	0	0.9	6
NW	7	41	3	2	1	0	0	0	0	0	0	0	0	0	0	0	1.0	4
NNW	14	26	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0.7	3
Total	223	720	175	45	17	8	3	1	0	0	0	0	0	0	0	0		
Percent of Total	18.7	60.4	14.7	3.8	1.4	0.7	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Cumulative Total, percent	18.7	79.1	93.8	97.6	99.0	99.7	99.9	100.0										

[1] Calms not included.

TABLE 3
FREQUENCY DISTRIBUTION OF ONE-HOUR AVERAGE
CO LEVELS VS. HOUR OF THE DAY
(For Site No. 2 From May 26 to August 22, 1977)

Hour of the Day	CO Concentration (mg/cu m)											Average CO	Highest One-Hour Average
	<1	1	2	3	4	5	6	7	8	9	10		
1	1	19	16	14	4	2	3	0	0	0	0	2.3	6
2	2	29	26	5	5	1	4	0	1	0	0	2.0	8
3	4	36	20	7	4	3	0	3	0	0	0	1.9	7
4	5	37	21	7	3	2	2	0	0	0	0	1.7	6
5	8	39	17	8	3	0	2	1	0	0	0	1.6	7
6	2	41	23	9	2	1	2	1	0	0	0	1.8	7
7	3	17	25	17	7	6	2	2	1	0	0	2.6	8
8	0	14	21	19	13	9	3	4	0	0	0	3.0	7
9	2	23	27	21	3	7	1	0	0	0	0	2.2	6
10	4	37	31	9	1	0	0	0	0	0	0	1.5	4
11	3	51	21	5	0	0	0	0	0	0	0	1.3	3
12	2	52	22	2	0	0	0	0	0	0	0	1.2	3
13	2	52	23	4	0	0	0	0	0	0	0	1.3	3
14	1	49	28	1	0	0	0	0	0	0	0	1.3	3
15	1	41	31	1	0	0	0	0	0	0	0	1.4	3
16	2	30	29	10	0	0	0	0	0	0	0	1.6	3
17	2	24	37	5	1	0	0	0	0	0	0	1.7	4
18	0	34	31	6	0	0	0	0	0	0	0	1.6	3
19	3	42	24	4	0	0	0	0	0	0	0	1.4	3
20	3	46	21	2	0	0	0	0	0	0	0	1.3	3
21	3	43	25	2	0	0	0	0	0	0	0	1.4	3
22	0	33	30	13	1	0	0	0	0	0	0	1.7	4
23	0	34	25	12	6	3	0	0	0	0	0	1.9	5
24	3	31	27	7	10	3	0	0	0	0	0	1.9	5
Number of Occurrences	56	854	601	190	63	37	19	11	2	0	0		
Percent of Total	3.1	46.6	32.8	10.4	3.4	2.0	1.0	0.6	0.1	0.0	0.0		
Cumulative Total, percent	3.1	49.6	82.4	92.8	96.2	98.3	99.3	99.9	100.0				

TABLE 4
FREQUENCY DISTRIBUTION OF ONE-HOUR AVERAGE
CO LEVELS VS. WIND DIRECTION FOR SITE NO. 2

Wind Direction	CO Concentration (mg/cu m)																Average CO	Highest One-Hour Average
	<.5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	>14		
N	0	22	15	2	0	0	0	0	0	0	0	0	0	0	0	0	1.4	3
NNE	3	25	8	1	0	0	1	0	0	0	0	0	0	0	0	0	1.2	6
NE	1	30	10	0	1	0	0	0	0	0	0	0	0	0	0	0	1.2	4
ENE	2	26	4	3	1	0	0	0	0	0	0	0	0	0	0	0	1.2	4
E	12	52	5	5	0	0	1	0	0	0	0	0	0	0	0	0	1.0	6
ESE	7	50	13	1	0	0	0	0	0	0	0	0	0	0	0	0	1.0	3
SE	3	48	11	2	0	2	0	0	0	0	0	0	0	0	0	0	1.3	5
SSE	2	34	12	3	3	0	0	0	0	0	0	0	0	0	0	0	1.4	4
S	2	42	37	7	5	1	0	0	0	0	0	0	0	0	0	0	1.7	5
SSW	4	69	46	21	6	6	0	0	0	0	0	0	0	0	0	0	1.8	5
SW	3	98	85	38	11	7	4	2	1	0	0	0	0	0	0	0	2.0	8
WSW	6	98	102	31	7	7	1	1	0	0	0	0	0	0	0	0	1.8	7
W	0	78	98	15	1	1	0	1	0	0	0	0	0	0	0	0	1.7	7
WNW	4	66	40	13	2	0	0	0	0	0	0	0	0	0	0	0	1.5	4
NW	4	38	26	3	3	2	0	0	0	0	0	0	0	0	0	0	1.6	5
NNW	1	33	33	3	3	0	0	0	0	0	0	0	0	0	0	0	1.6	4
Total	54	809	545	148	43	26	7	4	1	0	0	0	0	0	0	0		
Percent of Total	3.3	49.4	33.3	9.0	2.6	1.6	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Cumulative Total, percent	3.3	52.7	86.0	95.1	97.7	99.3	99.7	99.9	100.0									

[1] Calms not included.

Background Carbon Monoxide Concentrations

The highest one-hour average carbon monoxide concentrations at Site 1 between March 29 and May 26, 1977 was 7 mg/cu m. Over 98 percent of the hourly average carbon monoxide concentrations were 4 mg/cu m or less. However, these data were not recorded during the season of the year when the highest concentrations are found in the area. Consequently, the highest concentrations recorded were seasonally adjusted to estimate the maximum values which might be expected to occur during a full year of monitoring. The following equation was used from, "Guidelines for Air Quality Maintenance Planning and Analysis," Volume 9, pg. 34, U. S. Environmental Protection Agency, January 1975, based on 1976 data for carbon monoxide from Wayne County Station 08. Station 08 located at 14700 Goddard Rd, Allen Park, 4 km (2.5 miles) south of the interchange, is the nearest year round air monitoring station.

$$\text{Adjusted Concentration} = \frac{\left(\begin{array}{c}\text{Maximum Observed}\\ \text{Concentration at}\\ \text{Applicants Site}\\ \text{During Month}\end{array}\right)\left(\begin{array}{c}\text{Maximum Observed}\\ \text{Concentration at}\\ \text{Historical Site}\\ \text{During Past Year}\end{array}\right)}{\left(\begin{array}{c}\text{Maximum Observed}\\ \text{Concentration at}\\ \text{Historical Site}\\ \text{During Month}\end{array}\right)}$$

Table 5 summarizes carbon monoxide data for 1976 for Station 08. The maximum one-hour concentration for the year was 15.8 mg/cu m in December. The maximum one-hour concentration at Station 08 for April 1976 was 7.4 mg/cu m. At Site 1 the highest one-hour averages (7 and 6 mg/cu m) occurred in April 1977. Then the highest and second highest seasonally adjusted one-hour averages for background carbon monoxide are:

$$\text{For Site 1} \quad 7 \times \frac{15.8}{7.4} = 14.9 \text{ mg/cu m}$$

$$6 \times \frac{15.8}{7.4} = 12.8 \text{ mg/cu m}$$

The five highest eight-hour averages for carbon monoxide at Site 1 are shown below as recorded and seasonally adjusted. Wind speeds were very low when high concentrations were recorded, often 0-2 mph (less than 1 m/sec).

TABLE 5
CARBON MONOXIDE MEASURED AT WAYNE COUNTY
STATION 08 DURING 1976

Month	Arithmetic Average mg/cu m	Maximum One-Hour mg/cu m	Maximum Eight-Hour mg/cu m	Number of Times	
				One-Hour Average Over 40 mg/cu m	Eight-Hour Average Over 10 mg/cu m
Jan.	1.5	11.5	5.8	0	0
Feb.	1.4	9.7	6.5	0	0
Mar.	1.1	11.0	6.2	0	0
Apr.	1.4	7.4	6.2	0	0
May	1.1	7.8	5.1	0	0
June	1.5	8.7	7.5	0	0
July	1.4	6.7	4.6	0	0
Aug.	1.9	10.6	8.0	0	0
Sept.	1.8	10.2	5.9	0	0
Oct.	1.7	12.5	10.2	0	1
Nov.	1.5	7.2	4.8	0	0
Dec.	1.5	15.8	9.7	0	0
Annual Results	1.5	15.8	10.2	0	1

Second highest one-hour value (mg/cu m) - 15.5
Second highest eight-hour value (mg/cu m) - 9.7

Date	Recorded 8-Hour Average, mg/cu m	Adjusted 8-Hour Average, mg/cu m
May 25, 1977	5.1	10.2
April 19, 1977	4.7	7.7
April 19, 1977	4.6	7.6
April 18, 1977	3.7	6.1
May 11, 1977	3.4	6.8

The second highest adjusted value will be used as the estimated eight-hour average carbon monoxide concentration in subsequent calculations of the impact of the proposed interchange, since it is the second highest value that determines compliance with standards.

Ambient Air Quality at the Existing Interchange

At van Site 2 (May 26 to August 22, 1977) close to the interchange the highest one-hour average for carbon monoxide was 8 mg/cu m, during July. Over 96 percent of the one-hour averages between May 26 and August 22 were 4 mg/cu m or less. The seasonally adjusted equivalent of 8 mg/cu m in July is 18.9 mg/cu m, still less than half the air quality standard of 40 mg/cu m.

The five highest eight-hour averages for carbon monoxide at Site 2 are shown below as recorded and as adjusted to estimate maximum annual averages.

Date	Recorded 8-Hour Average, mg/cu m	Adjusted 8-Hour Average, mg/cu m
July 23, 1977	6.5	14.4
May 28, 1977	6.4	12.8
June 4, 1977	5.5	7.5
July 14, 1977	5.2	11.5
August 19, 1977	4.6	5.9

The seasonally adjusted averages do not follow the same decreasing trend as the recorded averages because the adjustment factors vary from month to month.

Based on the seasonally adjusted estimates calculated above, air quality at the existing interchange seems to be:

The maximum estimated one hour concentration of carbon monoxide is less than half the one hour air quality standard of 40 mg/cu m.

The eight hour average air quality standard for carbon monoxide (10 mg/cu m) may occasionally be exceeded.

The background carbon monoxide concentrations were corrected to represent conditions in 1982, the probable time of construction, based on the following:

1. Carbon monoxide in the project area is 80 percent transportation related. Non-transportation related carbon monoxide is not expected to increase significantly and may decrease.

2. Transportation-related emissions will decrease by 50 percent between 1977 and 1982, due to Federal controls on emissions of new vehicles. This was estimated by extending 1977 emission standards of 15 gpm through 1979, then dropping to 7 gpm for 1980 through 1982.

3. Traffic volumes in the project area are estimated to increase by 25 percent by 1982.

The second highest one-hour (12.8 mg/cu m) and eight-hour (7.7 mg/cu m) values from 1977 were selected to represent the background carbon monoxide and corrected to 1982 conditions as follows:

Let: V_N = non-transportation related carbon monoxide, which is 20 percent of the 1977 value (0.2 x 1977 value)

V_T = transportation related carbon monoxide, which is 80 percent of the 1977 value increased by 25 percent (multiplied by 1.25) due to the increase in traffic and reduced by 50 percent due to reduction in emissions because of emission controls, thus V_T = 1977 value x 0.8 x 1.25 x 0.5

then: the 1982 value = $V_N + V_T$

and: 1982 background one-hour value = (0.2) (12.8) + 0.8 (12.8) (1.25) (0.5) = 9.0 mg/cu m

1982 background eight-hour value = (0.2) (7.7) + 0.8 (7.7) (1.25) (0.5) = 5.4 mg/cu m

Pollution Estimates

Estimates of carbon monoxide concentrations were made at a height of 1.5 meters (5 ft) above ground level. A mathematical model based on the Gaussian diffusion equation, modified for a line source, was used[1]. Inputs to the model include wind speed and direction, traffic volumes, vehicle emission factors and design of the highway.

Carbon monoxide concentrations were estimated at three receptor sites near the proposed interchange (Fig. 1). The locations are as follows:

1. James Cunningham Park - The park extends to the M 39 right-of-way and is about 15 ft west of an I 94 off-ramp which merges with proposed M 39. The edge of a soccer field in the park is about 140 ft from proposed M 39.

2. John Kennedy Park - The park extends to the I 94 right-of-way and is about 25 ft northwest of an I 94 off-ramp and about 100 ft from proposed I 94.

3. Mt. Hope Lutheran Church - The church is about 75 ft east of the M 39 right-of-way and about 90 ft from the proposed roadway.

Information used as input to the model consisted of:

1) Vehicle emission factors, shown in the following table, were calculated using procedures from "Compilation of Air Pollution Emission Factors," AP 42, Supplement No. 5, December 1975 edition, U. S. Environmental Protection Agency. Emission factors were calculated at 30 F with 5 percent of vehicles in a cold start condition, 5 percent of vehicles in a hot start condition, and the remainder of vehicles in a hot operation mode. Vehicle age mix data used were for Michigan registrations obtained from the Secretary of State. National estimates from AP 42 for average annual miles driven for various age vehicles were used.

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[1] Beaton, J. L., Ranzieri, A. J., Shirley, E. C., and Skog, J. B., "Mathematical Approach to Estimating Highway Impact on Air Quality," Prepared by California Division of Highways, Report No. FHWA-RD-72-36. CALINE 2 modification, programmed March 1975, was used.

EMISSION FACTORS FOR CARBON MONOXIDE, g/mi
(6 percent commercial)

Year	Average Vehicle Speed, mph		
	40	50	55
1982	10.0	---	8.9
1995	5.3	4.8	---

2) Estimated peak p.m. (5:00 to 6:00) and off-peak traffic volumes. Traffic estimates for the roadway sections adjacent to the receptors are shown in Table 6. Off-peak traffic was taken as the median hour volume.

3) Meteorological Conditions

a) Worst meteorological conditions were taken as a 2.2 mph (1 m/sec) wind parallel to the roadway, under atmospheric stability class D.

b) Most probable meteorological conditions, a 12 mph wind at 230 degrees under atmospheric stability class D. Table 7 shows the frequency distribution of atmospheric stability classes for the meteorological data used.

TABLE 6
TRAFFIC ESTIMATES FOR PROPOSED I 94
AND M 39 INTERCHANGE

Year	Receptor 1	Receptor 2	Receptor 3
1982	69,400 ⟨7,660(40)⟩ [2,790(45)]	83,400 ⟨8,610(55)⟩ [3,260(55)]	106,100 ⟨11,910(40)⟩ [4,270(45)]
1995	84,900 ⟨9,320(40)⟩ [3,270(45)]	110,500 ⟨11,410(50)⟩ [4,150(55)]	132,600 ⟨14,850(40)⟩ [5,150(45)]

Traffic is total for both directions.
Commercial Vehicles - 6 percent of peak in 1982 and 5 percent in 1995, 12 percent of off-peak in 1982 and 11 percent in 1995.

000 = Average daily traffic, vehicles in 24 hours
⟨000⟩ = Peak traffic, vehicles per hour
[000] = Off-peak traffic, vehicles per hour
(00) = Average speed

TABLE 7
STABILITY CLASS FREQUENCY DISTRIBUTION BY HOUR
(Percent)

Hour	Stability Class					
	A	B	C	D	E	F
1	0.0	0.0	0.0	49.7	22.0	28.3
4	0.0	0.0	0.0	49.8	21.1	29.1
7	8.8	16.4	10.1	47.4	9.9	7.3
10	3.7	13.9	22.2	60.2	0.0	0.0
13	2.3	9.8	21.6	66.4	0.0	0.0
16	1.3	9.1	22.4	64.7	2.1	0.4
19	0.0	0.0	0.0	62.7	26.4	10.9
22	0.0	0.0	0.0	50.7	24.8	24.4
Overall percent	2.0	6.1	9.5	56.5	13.3	12.6

4) Road Profile. The roadway adjacent to Receptor 1 is depressed 10 ft and at grade adjacent to the other receptors.

5) Roadway Width. The roadway adjacent to Receptors 1 and 3 is two - 36 ft roadways separated by a 12 ft median. The roadway adjacent to Receptor 2 is two - 36 ft roadways separated by a variable (70 ft minimum) median.

All estimates of carbon monoxide levels represent maximum one-hour concentrations and are in addition to existing background levels. Table 8 presents estimates of carbon monoxide, excluding background, at the edge of the right-of-way adjacent to the receptor site.

Comparison of Estimates with Air Quality Standards

a) Eight-hour carbon monoxide air quality standard - 10 mg/cu m (9 ppm), not to be exceeded more than once per year.

The Federal Highway Administration's report "Project Level Considerations to Assure Adequate Air Quality Analyses" suggests a technique for determining the eight-hour carbon monoxide concentration from the one-hour concentrations.

TABLE 8
CARBON MONOXIDE, mg/cu m

Location	Traffic Projection Year	Worst Case, Stability D, Peak Traffic [1] Parallel Wind, 1 m/sec	Most Probable Condition, [2] Stability D
James Cunningham Park	1982	5.9	0.4
Edge of Park	1995	3.8	0.2
John F. Kennedy Park	1982	6.1	1.0
	1995	4.4	0.7
Mt. Hope Lutheran Church	1982	12.2	2.1
Edge of Right-of-Way	1995	8.1	1.4

[1] James Cunningham Park and Mt. Hope Lutheran Church - wind parallel to M 39; John F. Kennedy Park - wind parallel to I 94.

[2] Most probable wind, 12 mph; angle between wind direction and road direction; 75 degrees at James Cunningham Park, 25 degrees at John F. Kennedy Park, and 20 degrees at Mt. Hope Lutheran Church.

$$\frac{V_8}{V_1} \times (\text{1-hr CO concentration}) \times P = \text{8-hr CO concentration}$$

where V_8 = average hourly traffic volume in both directions during the eight-hour period of interest

V_1 = peak hour traffic volume in both directions

P = one- to eight-hour meteorological persistence factor for the eight-hour period

A value of $P = 0.6$ is suggested unless data are available to calculate a persistence factor for the proposed highway project.

If this technique is used to calculate the eight-hour carbon monoxide levels for 1982 and 1995 the highest eight-hour concentration from the roadway at the right-of-way line adjacent to each receptor is:

Receptor 1

1982 $\frac{2,790 \text{ vehicles per hour}}{7,660 \text{ vehicles per hour}} \times 5.9 \text{ mg/cu m} \times 0.6 = 1.3 \text{ mg/cu m}$

1995 $\frac{3,270 \text{ vehicles per hour}}{9,320 \text{ vehicles per hour}} \times 3.8 \text{ mg/cu m} \times 0.6 = 0.8 \text{ mg/cu m}$

Receptor 2

1982 $\frac{3,260 \text{ vehicles per hour}}{8,610 \text{ vehicles per hour}} \times 6.1 \text{ mg/cu m} \times 0.6 = 1.4 \text{ mg/cu m}$

1995 $\frac{4,150 \text{ vehicles per hour}}{11,410 \text{ vehicles per hour}} \times 4.4 \text{ mg/cu m} \times 0.6 = 1.0 \text{ mg/cu m}$

Receptor 3

1982 $\frac{4,270 \text{ vehicles per hour}}{11,910 \text{ vehicles per hour}} \times 12.2 \text{ mg/cu m} \times 0.6 = 2.6 \text{ mg/cu m}$

1995 $\frac{5,150 \text{ vehicles per hour}}{14,850 \text{ vehicles per hour}} \times 8.1 \text{ mg/cu m} \times 0.6 = 1.7 \text{ mg/cu m}$

Adding these concentrations to the 5.4 mg/cu m estimated eight-hour background results in total carbon monoxide concentrations of 6.7 and 6.2 mg/cu m for Receptor 1 for 1982 and 1995, respectively; 6.8 and 6.4 mg/cu m for Receptor 2; and 8.0 and 7.1 mg/cu m for Receptor 3. Carbon monoxide concentrations for all of the receptors are below the air quality standard.

b) One-hour carbon monoxide standard - 40 mg/cu m (36 ppm), not to be exceeded more than once per year.

The maximum estimated one-hour concentrations of carbon monoxide from the roadway at the right-of-way line adjacent to each receptor is 6.9 and 3.8 mg/cu m for Receptor 1 for 1982 and 1995, respectively; and 6.1 and 4.4 mg/cu m for Receptor 2; and 12.2 and 8.1 mg/cu m for Receptor 3. Adding these concentrations to the 9.0 mg/cu m estimated background results in total one-hour concentrations of 14.9 and 12.8 mg/cu m for Receptor 1 for 1982 and 1995, respectively; 15.1 and 13.4 mg/cu m for Receptor 2; and 21.2 and 17.1 mg/cu m for Receptor 3. All are below the 40 mg/cu m standard.

The estimated concentrations of carbon monoxide, including existing background at each of the receptors near the proposed interchange are within the national air quality standards. The project is consistent with the State implementation plan for meeting national air quality standards for carbon monoxide.

Total Pollutant Burden Analysis

A total pollutant burden analysis for carbon monoxide, hydrocarbons and oxides of nitrogen was prepared for both the no-build and build alternates for the years 1982 (Estimated Time of Completion, ETC) and 1992. The total pollutant burden data are presented in the following table and show a slight decrease in all pollutants if the project is completed. Figure 2 shows traffic links on the existing interchange. Figure 1 shows traffic links on the proposed interchange. The emissions program BIGAP42, Supplement No. 5 of AP-42, December 1975 edition, U. S. Environmental Protection Agency was used to calculate vehicle emissions. Tables 9 and 10 show traffic data which were used to calculate total emissions for the existing (no-build) and the proposed (build) interchange.

ESTIMATES OF TOTAL POLLUTANT BURDEN

Traffic Projection Year	Alternate	Pollutant (tons per day)					
		Carbon Monoxide		Hydro-carbons		Oxides of Nitrogen	
		30 F	60 F	30 F	60 F	30 F	60 F
1982	No Build	8.18	5.47	1.54	1.30	1.76	1.62
	Build	7.75	5.18	1.46	1.24	1.68	1.55
1992	No Build	5.48	3.70	0.87	0.74	1.46	1.37
	Build	5.19	3.51	0.83	0.70	1.39	1.31

TABLE 9
TRAFFIC ESTIMATES FOR THE EXISTING
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC + 10
VMT	1	46,300	57,500
Average Speed (mph)		50	50
Percent Commercial		8.5	8.5
VMT	2	1,190	1,500
Average Speed (mph)		40	40
Percent Commercial		6.5	6.5
VMT	3	2,360	2,930
Average Speed (mph)		50	50
Percent Commercial		9	9
VMT	4	660	820
Average Speed (mph)		35	35
Percent Commercial		7	7
VMT	5	11,070	13,740
Average Speed (mph)		45	45
Percent Commercial		8.5	8.5
VMT	6	4,530	5,520
Average Speed (mph)		40	40
Percent Commercial		7	7
VMT	7	8,170	10,210
Average Speed (mph)		50	50
Percent Commercial		9.5	9.5
VMT	8	230	280
Average Speed (mph)		40	40
Percent Commercial		7	7
VMT	9	42,540	53,180
Average Speed (mph)		50	50
Percent Commercial		9	9
VMT	10	43,350	53,300
Average Speed (mph)		50	50
Percent Commercial		9	9
VMT	11	790	980
Average Speed (mph)		35	35
Percent Commercial		6.5	6.5
VMT	12	14,430	17,750
Average Speed (mph)		45	45
Percent Commercial		8.5	8.5

TABLE 9 (Cont.)
TRAFFIC ESTIMATES FOR THE EXISTING
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC + 10
VMT	13	1,770	2,200
Average Speed (mph)		30	30
Percent Commercial		7	7
VMT	14	13,180	16,180
Average Speed (mph)		50	50
Percent Commercial		9	9
VMT	15	3,460	4,440
Average Speed (mph)		40	40
Percent Commercial		7	7
VMT	16	35,130	43,620
Average Speed (mph)		50	50
Percent Commercial		8.5	8.5
VMT	17	27,190	31,530
Average Speed (mph)		45	45
Percent Commercial		5	5
VMT	18	2,830	3,490
Average Speed (mph)		40	40
Percent Commercial		6.5	6.5
VMT	19	6,480	7,340
Average Speed (mph)		45	45
Percent Commercial		4	4.5
VMT	20	850	1,060
Average Speed (mph)		30	30
Percent Commercial		7.5	7.5
VMT	21	2,840	3,520
Average Speed (mph)		30	30
Percent Commercial		6	6
VMT	22	5,020	6,150
Average Speed (mph)		35	35
Percent Commercial		6.5	6.5
VMT	23	4,870	5,450
Average Speed (mph)		50	50
Percent Commercial		4	4
VMT	24	220	270
Average Speed (mph)		40	40
Percent Commercial		4	4

TABLE 9 (Cont.)
TRAFFIC ESTIMATES FOR THE EXISTING
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC + 10
VMT	25	4,320	5,300
Average Speed (mph)		35	35
Percent Commercial		6	6
VMT	26	5,350	5,870
Average Speed (mph)		50	50
Percent Commercial		4	4
VMT	27	870	1,080
Average Speed (mph)		35	35
Percent Commercial		6	6
VMT	28	13,330	14,370
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	29	380	470
Average Speed (mph)		40	40
Percent Commercial		5	5
VMT	30	12,410	14,510
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	31	15,610	18,540
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	32	440	550
Average Speed (mph)		40	40
Percent Commercial		5	5
VMT	33	11,570	13,620
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	34	330	410
Average Speed (mph)		40	40
Percent Commercial		5	5
VMT	35	12,340	14,620
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	36	1,150	1,430
Average Speed (mph)		35	35
Percent Commercial		6	6

TABLE 9 (Cont.)
TRAFFIC ESTIMATES FOR THE EXISTING
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC + 10
VMT	37	540	670
Average Speed (mph)		40	40
Percent Commercial		6	6
VMT	38	2,180	2,700
Average Speed (mph)		35	35
Percent Commercial		6	6
VMT	39	11,190	13,120
Average Speed (mph)		50	50
Percent Commercial		4.5	4.5
VMT	40	2,140	2,650
Average Speed (mph		40	40
Percent Commercial		7.5	7.5
VMT	41	3,040	3,620
Average Speed (mph)		45	45
Percent Commercial		5.5	5.5
VMT	42	2,980	3,780
Average Speed (mph)		40	40
Percent Commercial		7	7
VMT	43	4,920	5,620
Average Speed (mph)		45	45
Percent Commercial		4.5	4.5
VMT	44	25,350	29,400
Average Speed (mph)		45	45
Percent Commercial		5	5
VMT	45	5,020	6,240
Average Speed (mph)		40	40
Percent Commercial		6.5	6.5
VMT	46	5,720	7,090
Average Speed (mph)		40	40
Percent Commercial		6.5	6.5
VMT	47	5,610	6,960
Average Speed (mph)		30	30
Percent Commercial		6	6
VMT	48	5,290	6,560
Average Speed (mph)		30	30
Percent Commercial		6	6

TABLE 10
TRAFFIC ESTIMATES FOR THE PROPOSED
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC + 10
VMT	A	1,390	1,720
Average Speed (mph)		30	30
Percent Commercial		9	6.5
VMT	B	6,870	8,510
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	C	1,450	1,790
Average Speed (mph)		40	40
Percent Commercial		6.5	6.5
VMT	D	410	500
Average Speed (mph)		45	45
Percent Commercial		8.5	8.5
VMT	E	730	910
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	F	980	1,220
Average Speed (mph)		40	40
Percent Commercial		7	7
VMT	G	660	820
Average Speed (mph)		40	40
Percent Commercial		7	7
VMT	H	1,200	1,510
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	I	1,250	1,540
Average Speed (mph)		30	30
Percent Commercial		7.5	7.5
VMT	J	7,200	8,920
Average Speed (mph)		35	35
Percent Commercial		6	6
VMT	K	4,730	5,870
Average Speed (mph)		45	45
Percent Commercial		7	7

TABLE 10 (Cont.)
TRAFFIC ESTIMATES FOR THE PROPOSED
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC + 10
VMT	L	3,000	3,730
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	M	1,440	1,780
Average Speed (mph)		40	40
Percent Commercial		7	7
VMT	N	6,870	8,540
Average Speed (mph)		40	40
Percent Commercial		7	7
VMT	O	2,040	2,540
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	P	990	1,230
Average Speed (mph)		35	35
Percent Commercial		7	7
VMT	Q	1,980	2,460
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	R	6,060	7,510
Average Speed (mph)		35	35
Percent Commercial		6	6
VMT	S	330	410
Average Speed (mph)		40	40
Percent Commercial		5	5
VMT	T	440	550
Average Speed (mph)		40	40
Percent Commercial		5	5
VMT	U	440	550
Average Speed (mph)		40	40
Percent Commercial		5	5
VMT	V	440	550
Average Speed (mph)		40	40
Percent Commercial		5	5

TABLE 10 (Cont.)
TRAFFIC ESTIMATES FOR THE PROPOSED
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC + 10
VMT	W	1,180	1,460
Average Speed (mph)		45	45
Percent Commercial		6.5	6.5
VMT	X	420	520
Average Speed (mph)		40	40
Percent Commercial		7.5	7.5
VMT	Y	1,920	2,360
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	Z	720	870
Average Speed (mph)		45	45
Percent Commercial		8.5	8.5
VMT	DB	4,220	5,220
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	MY	1,370	1,700
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	OG	2,700	3,360
Average Speed (mph)		45	45
Percent Commercial		7	7
VMT	1	13,840	17,160
Average Speed (mph)		50	50
Percent Commercial		8.5	8.5
VMT	2	20,220	25,110
Average Speed (mph)		50	50
Percent Commercial		9.5	9.5
VMT	3	9,070	11,280
Average Speed (mph)		50	50
Percent Commercial		9	9
VMT	4	11,290	14,030
Average Speed (mph)		50	50
Percent Commercial		9	9

TABLE 10 (Cont.)
TRAFFIC ESTIMATES FOR THE PROPOSED
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC +10
VMT	5	36,870	45,810
Average Speed (mph)		50	50
Percent Commercial		9	9
VMT	6	17,660	21,930
Average Speed (mph)		50	50
Percent Commercial		9.5	9.5
VMT	7	14,500	17,990
Average Speed (mph)		50	50
Percent Commercial		9	9
VMT	8	19,760	24,520
Average Speed (mph)		50	50
Percent Commercial		8.5	8.5
VMT	9	18,000	20,900
Average Speed (mph)		45	45
Percent Commercial		5	5
VMT	10	15,510	17,420
Average Speed (mph)		50	50
Percent Commercial		4	4
VMT	11	13,030	15,230
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	12	12,240	14,160
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	13	12,380	14,530
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	14	8,880	10,060
Average Speed (mph)		50	50
Percent Commercial		4.5	4.5
VMT	15	18,090	22,440
Average Speed (mph)		50	50
Percent Commercial		8.5	8.5

TABLE 10 (Cont.)
TRAFFIC ESTIMATES FOR THE PROPOSED
I 94/M 39 INTERCHANGE TOTAL POLLUTANT
BURDEN (MESOSCALE) ANALYSIS

	Link	1982 ETC	1992 ETC + 10
VMT	16	27,340	33,970
Average Speed (mph)		50	50
Percent Commercial		9	9
VMT	17	20,210	23,460
Average Speed (mph)		45	45
Percent Commercial		5	5
VMT	18	6,060	6,810
Average Speed (mph)		50	50
Percent Commercial		4	4
VMT	19	11,450	13,390
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	20	10,200	11,800
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	21	14,030	16,470
Average Speed (mph)		50	50
Percent Commercial		5	5
VMT	22	3,390	4,200
Average Speed (mph)		40	40
Percent Commercial		6.5	6.5
VMT	23	3,640	4,500
Average Speed (mph)		40	40
Percent Commercial		6.5	6.5
VMT	24	4,890	6,050
Average Speed (mph)		30	30
Percent Commercial		6	6
VMT	25	4,890	6,050
Average Speed (mph)		30	30
Percent Commercial		6	6