AIR QUALITY REPORT FOR I 75 - ZILWAUKEE BRIDGE

MICHIGAN DEPARTMENT OF STATE HIGHWAYS

AIR QUALITY REPORT FOR I 75 - ZILWAUKEE BRIDGE

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Michigan State Highway and Transportation Commission
E. V. Erickson, Chairman; Charles H. Hewitt,
Vice-Chairman, Carl V. Pellonpaa, Peter B. Fletcher
John P. Woodford, Director
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This report presents air quality information for the proposed bridge over the Saginaw River on I 75 near Zilwaukee, in Saginaw County (see map Fig. 1). Included are meteorological data, and estimates of pollutant levels that might occur adjacent to the proposed bridge.

Terrain

The terrain surrounding this project is quite flat, which facilitates dispersion of air pollutants.

Meteorology

Michigan lies in the normal track of migrating high and low pressure centers at all times of the year. This results in great variations in day to day weather. Frequent changes in wind speed and direction are experienced. Even on occasions when an atmospheric inversion restricts vertical dispersion of pollutants horizontal ventilation continues freely. Figure 2 shows a 36-point bar graph of wind speed and direction occurrences at Bishop Airport (Flint). Meteorological data (hourly observations) were summarized over a five year period from 1967 through 1971 using a one day in nine day statistical sampling with a random start each year. The data were obtained from the National Climatic Center in Asheville, North Carolina. Figure 3 is a 12-point wind rose obtained by condensing the 36-point wind data.

Figure 4 shows the distribution of wind speeds observed. About 97 percent of the time wind speed exceeds 4 mph. The most probable daytime wind speed was found to be 11 mph. Atmospheric mixing depths generally range between 500 and 1,200 meters, which is very favorable for vertical dispersion of pollutants.

Existing Ambient Air Quality

No ambient air quality data are available for the location of this project.

Pollution Estimates

Estimates of pollutant concentrations at a height of 1.8 meters (5 ft) above the ground were made for carbon monoxide and nitrogen oxides (as nitrogen dioxide) under various wind conditions at distances up to 100 meters from the shoulder of the roadway. A mathematical model based on the

Gaussian diffusion equations, modified for a line source was used[1]. This model is accepted by the Federal Highway Administration and the Federal Environmental Protection Agency. Inputs to the model include meteorological conditions, traffic volumes, vehicle emission factors, and design of the highway.

Vehicle emission factors shown in the following table were calculated using procedures from "Compilation of Air Pollutant Emission Factors," AP 42, 2nd edition, U. S. Environmental Protection Agency, April 1973, and interim light duty vehicle standards promulgated by the EPA administrator in September 1973.

EMISSION FACTORS FOR 1990, g/mi

	Speed, mph	Carbon Monoxide	Nitrogen Oxides
Cars	55	1.3	0.8
	60	1.2	0.8
Heavy Duty Vehicles	25	107.6	10.2
	35	82.1	11.4
	55	57.4	13.8

Pollutant concentrations were estimated for:

1) Three representative locations as shown in Figure 1.

Section 1: calculations are representative of the approaches at each end of the bridge
Section 2: on the bridge approximately 75 ft above ground level
Section 3: the crest of the bridge approximately 125 ft above ground level.

2) The year 1990.

3) The area above the roadway (mixing cell) and at a horizontal distance of 100 meters from the roadway shoulder.

[1] J. L. Beaton, A. J. Ranzieri, E. C. Shirley and J. B. Skog, "Mathematical Approach to Estimating Highway Impact on Air Quality." Prepared by California Division of Highways. National Technical Information Service, Springfield, Va. 22157, Report No. FHWA-RD-72-36.

Information used as input to the model consisted of:

1) Estimated 1990 peak traffic (7:00 to 8:00 p.m. Friday) and off-peak traffic volumes, as shown below. Off-peak traffic was taken as 4 percent of ADT.

Traffic Volumes
(Total Both Directions)

ADT	49,080	
Peak	10,360 (55 mph)	8 percent commercial vehicles
Off-Peak	2,036 (60 mph)	14 percent commercial vehicles

Commercial vehicles approach the bridge at 55 mph and slow to 25 mph near the top of the bridge.

2) Meteorological conditions

a) Worst meteorological conditions, which seldom occur according to weather records, were taken as a 3 mph wind parallel to the roadway, under atmospheric stability class D.

b) Most probable meteorological conditions (shown with data tables) were chosen for the time of day involved, and the overall most likely stability class (D) was used. Table 1 shows the frequency distribution of atmospheric stability classes for the meteorological data used.

3) Width of the roadway at the representative locations was as follows:

No. 1 - two 36-ft roadways separated by a 26-ft median
No. 2 - 48-ft roadway separated from a 36-ft roadway by a 26-ft median
No. 3 - two 48-ft roadways separated by a 26-ft median

Table 2 presents estimates of carbon monoxide concentrations. Table 3 presents estimates of nitrogen oxide concentrations (as nitrogen dioxide) for information only. There is no emission factor for nitrogen dioxide as such, so no comparison of the estimates with an air quality standard is possible.

Federal air quality standards for carbon monoxide and nitrogen dioxide are:

CO: (a) 10 mg/cu m maximum 8 hr average concentration not to be exceeded more than once per year.

(b) 40 mg/cu m maximum 1 hr concentration not to be exceeded more than once per year.

NO_2: 100 μg/cu m annual arithmetic mean.

The estimated concentrations of carbon monoxide on and near the proposed bridge are low. No adverse environmental effects are expected. The elevation of the proposed I 75 bridge being approximately 75 ft above M 13 (Section 2) results in dispersion and dilution of pollutants generated on the bridge so that only insignificant levels reach M 13, as shown by the Section 2 data in Table 2 for a distance of 100 meters. Thus there will be no adverse environmental effect caused by the addition of carbon monoxide generated on the bridge to carbon monoxide generated on M 13. This project is consistent with the state implementation plan for meeting air quality standards.

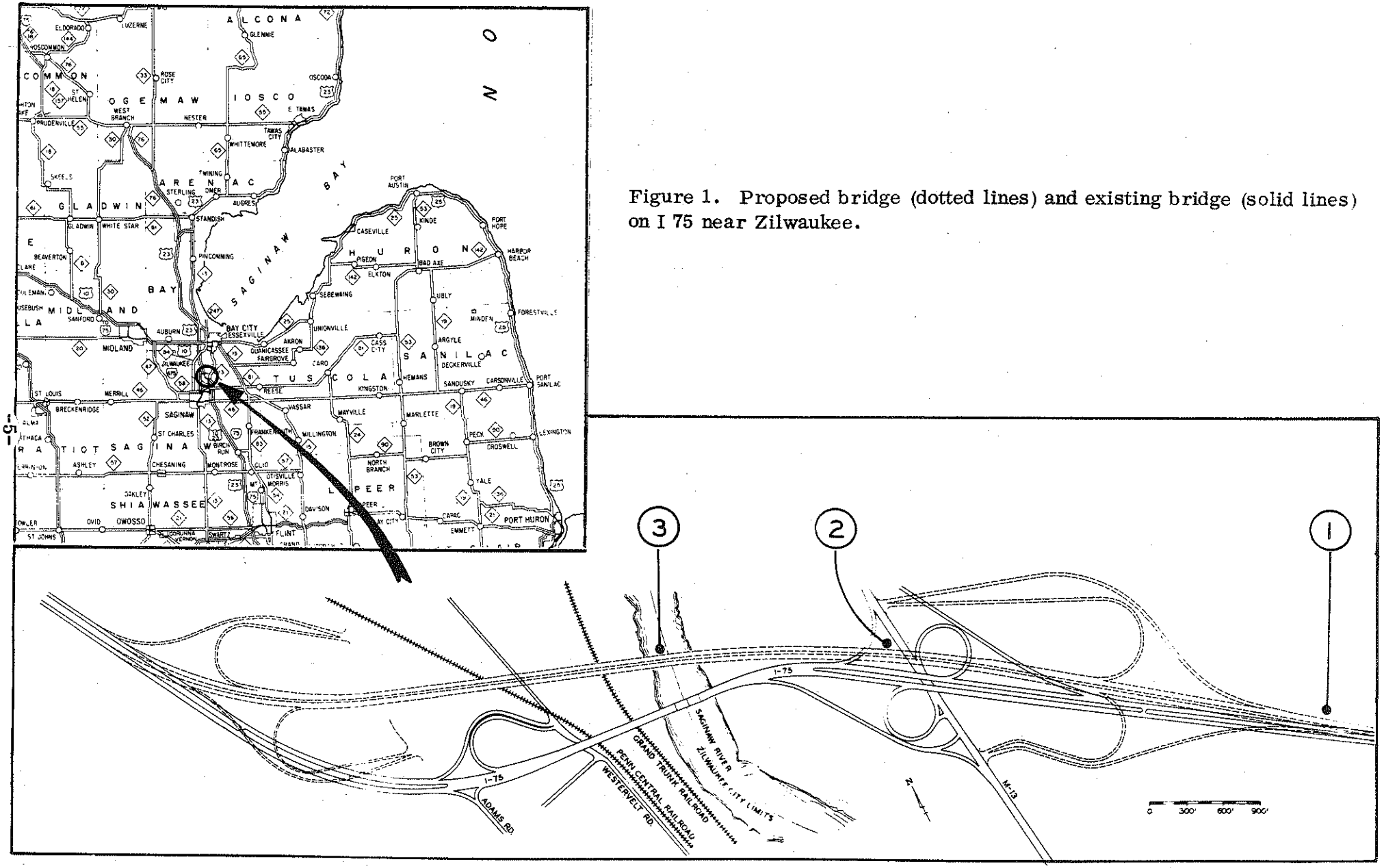

Figure 1. Proposed bridge (dotted lines) and existing bridge (solid lines) on I 75 near Zilwaukee.

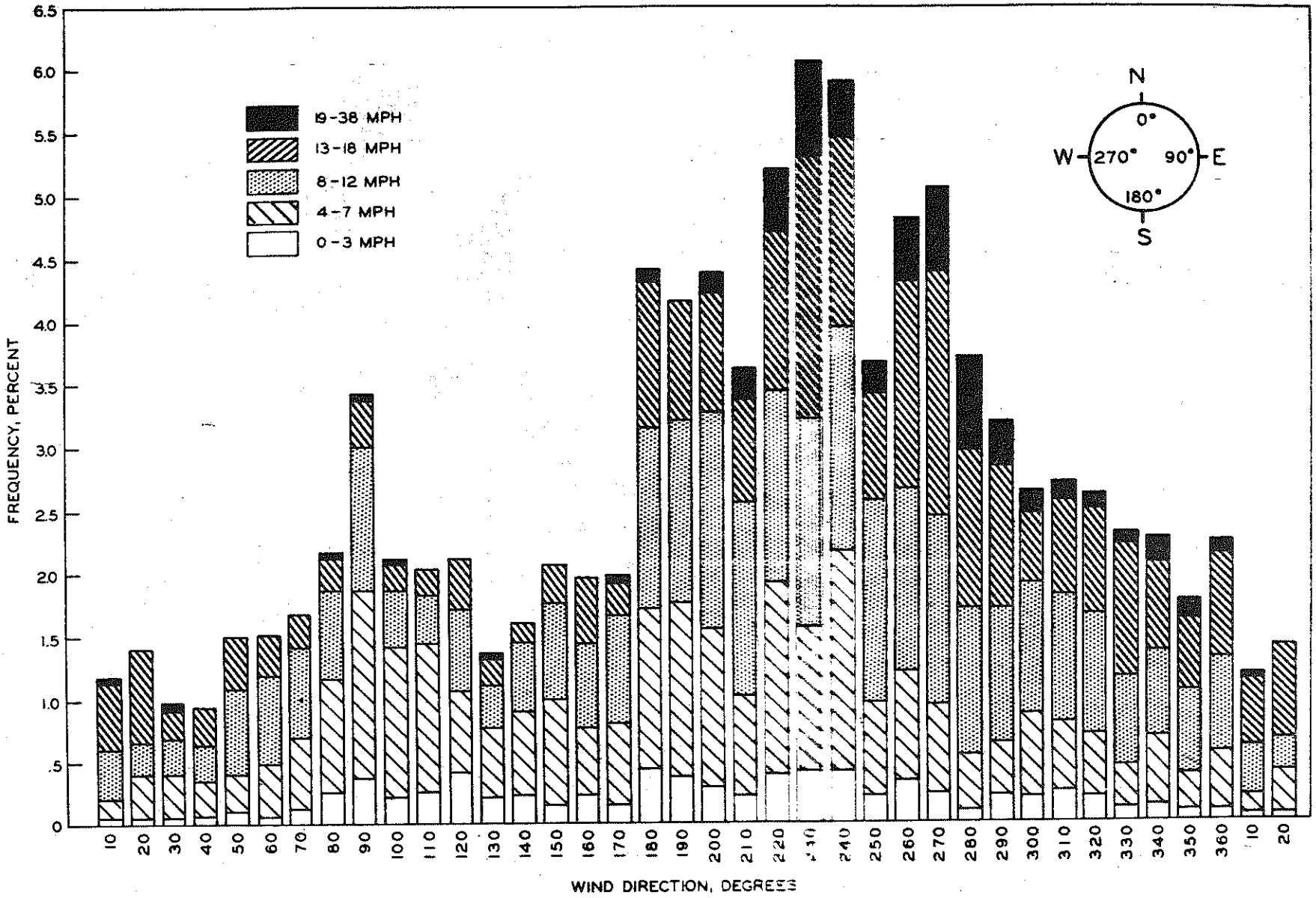

Figure 2. Wind speed and direction occurrences at Bishop Airport.

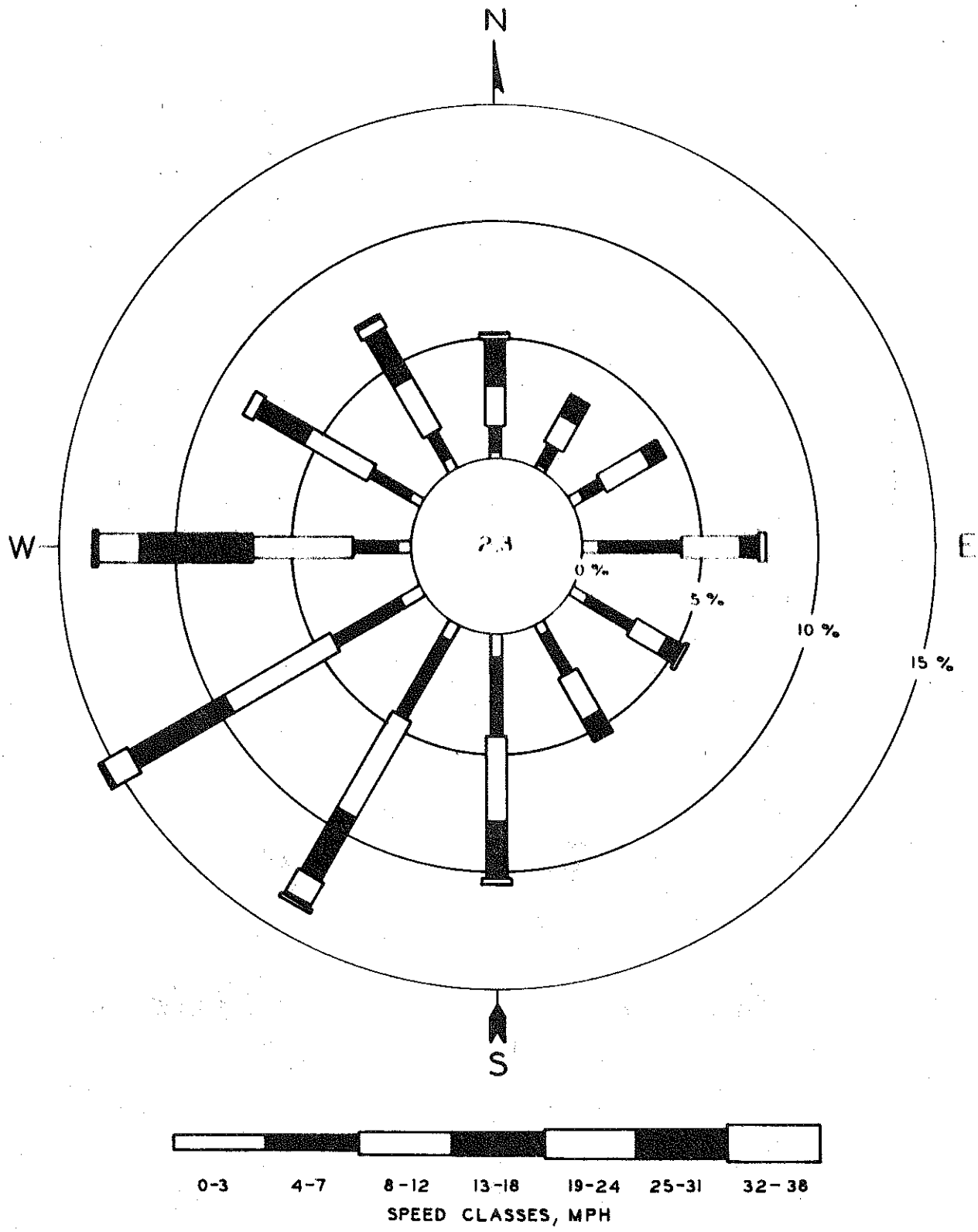

Figure 3. Frequency of wind direction and speed, percent (calms distributed).

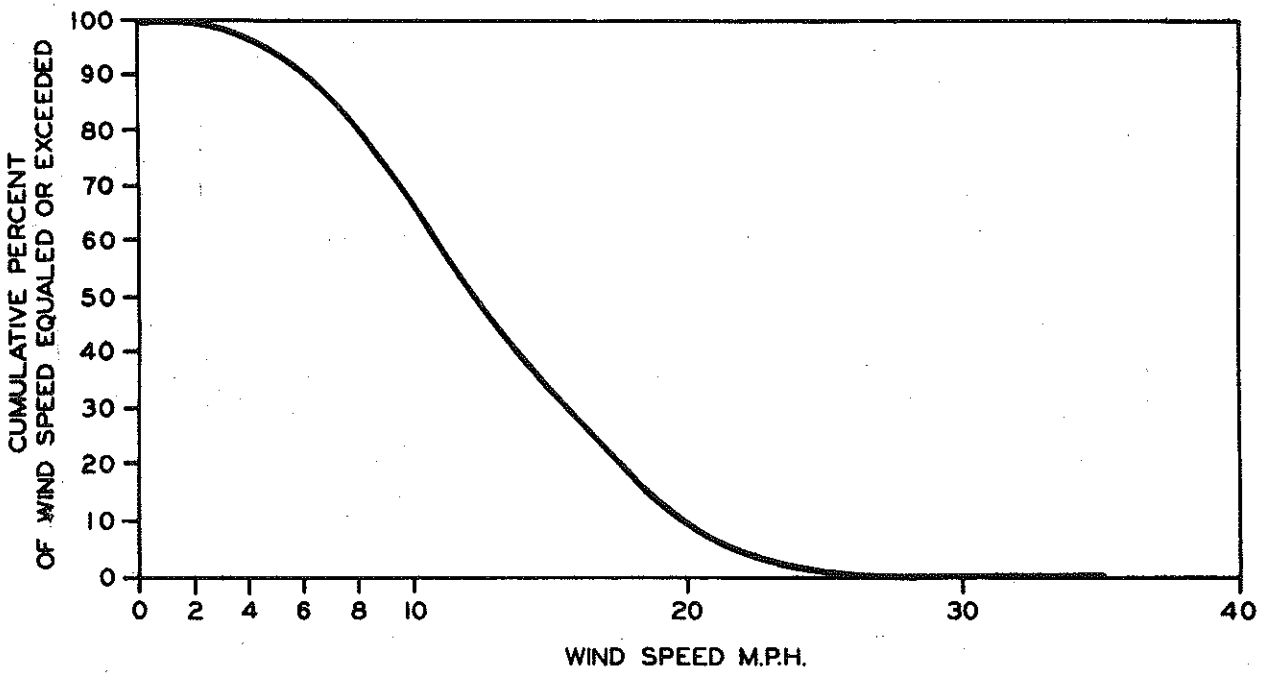

Figure 4. Wind speed distribution at Bishop Airport.

TABLE 1
STABILITY CLASS FREQUENCY DISTRIBUTION BY HOUR
(Percent)

Hour	Stability Class					
	A	B	C	D	E	F
1	0.0	0.0	0.0	55.2	16.3	28.6
2	0.0	0.0	0.0	53.7	16.7	29.6
3	0.0	0.0	0.0	50.2	20.2	29.6
4	0.0	0.0	0.0	49.8	17.7	32.5
5	0.0	0.0	0.0	52.2	17.7	30.0
6	9.9	4.4	2.5	52.7	11.3	19.2
7	9.4	12.3	13.3	48.3	9.4	7.4
8	6.9	13.8	17.2	56.2	2.0	3.9
9	5.4	13.8	18.2	62.6	0.0	0.0
10	3.0	16.7	14.3	66.0	0.0	0.0
11	3.4	17.2	17.7	61.6	0.0	0.0
12	3.0	14.3	16.3	66.5	0.0	0.0
13	2.0	12.8	20.7	64.5	0.0	0.0
14	1.0	13.8	22.2	63.1	0.0	0.0
15	3.0	10.8	20.7	65.5	0.0	0.0
16	1.5	13.3	20.2	62.6	1.5	1.0
17	3.4	9.9	18.7	62.6	3.9	1.5
18	3.0	7.4	10.3	60.1	12.8	6.4
19	0.0	0.0	0.0	62.1	22.7	15.3
20	0.0	0.0	0.0	57.1	24.1	18.7
21	0.0	0.0	0.0	54.7	25.1	20.2
22	0.0	0.0	0.0	51.7	26.6	21.7
23	0.0	0.0	0.0	51.2	25.6	23.2
24	0.0	0.0	0.0	52.2	19.7	28.1
Overall percent	2.3	6.7	8.8	57.6	11.4	13.2

TABLE 2
ESTIMATES OF CARBON MONOXIDE CONCENTRATION, mg/cu m[1]

Location	Traffic Projection Year	Mixing Cell				100 Meter Distance From Edge of Freeway Shoulder			
		Worst Condition Parallel Wind, 3 mph		Most Probable Condition[2]		Worst Condition Parallel Wind, 3 mph		Most Probable Condition[2]	
		Peak Traffic	Off Peak Traffic	Peak Traffic	Off Peak Traffic	Peak Traffic	Off Peak Traffic	Peak Traffic	Off Peak Traffic
Section 1	1990	6.1	2.2	0.5	0.2	0.2	0.1	0.2	0.1
Section 2	1990	6.4	1.4	0.8	0.2	0.1	*	*	*
Section 3	1990	13.7	3.2	1.7	0.3	*	*	*	*

1 average vehicle speeds are reported on page 3.

2 angle between wind direction and roadway direction - All sections, probable (peak) = 50°, 10 mph; all sections, probable (off peak) = 60°, 11 mph.

* value less than 0.1.

TABLE 3

ESTIMATES OF NITROGEN OXIDES (as NO_2), $\mu g/cu\ m$ [1]

Location	Traffic Projection Year	Mixing Cell				100 Meter Distance From Edge of Freeway Shoulder			
		Worst Condition Parallel Wind, 3 mph		Most Probable Condition [2]		Worst Condition Parallel Wind, 3 mph		Most Probable Condition [2]	
		Peak Traffic	Off Peak Traffic	Peak Traffic	Off Peak Traffic	Peak Traffic	Off Peak Traffic	Peak Traffic	Off Peak Traffic
Section 1	1990	1908	636	177	53	74	24	56	16
Section 2	1990	1413	327	160	30	11	3	10	3
Section 3	1990	1825	425	226	46	2	*	3	*

1 average vehicle speeds are reported on page 3.

2 angle between wind direction and roadway direction - All sections, probable (peak) = 50°, 10 mph; all sections, probable (off peak) = 60°, 11 mph.

* value less than 1.0.