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SOURCES OF VISIBILITY DEGREDATION IN THE LAKE TAHOE AIR BASIN

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JULY 14, 1977

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ABSTRACT

Air quality in the Lake Tahoe region has been a concern for a number of years. This study was designed to examine some of the sources of the air pollution in the Lake Tahoe basin. The first step was an evaluation of the Air Resources Board sampling of 1973. From this data the local contribution of different gas and particulate pollutants was postulated. A sampling station was then established at South Lake Tahoe and particulates in three size regions were collected and analyzed for elemental content. To determine if the data from this station were representative of the basin, a profile of Lake Tahoe was developed. It was determined that the concentrations of the major elements were quite different from site to site. It was also found that the most polluted site was South Lake Tahoe. A spatial profile in South Lake Tahoe was then conducted to determine the sources in this region. It was possible to identify automotive traffic as one source in the area. The origin of the sulfur aerosols was not identified.

Executive Summary

This study was designed to examine air quality in the Lake Tahoe Basin with emphasis on particulates.

The first step in the study was an examination of the data collected in 1973 at Lake Tahoe by the California Air Resources Board. The data showed that while some sites exhibited very good air quality others exhibited poor air quality. In general mean pollutant concentrations were comparable to other urban areas in California. After separating sites into clean, basin average, and dirty the contribution due to local anthropogenic sources was determined. Estimates indicate that at least 75% of CO, NO_x, and Pb are local. There was no indication of a local source of oxidant.

In October 1975 a Sierra Multiday Impactor was placed at the Park Avenue ARB station. Twenty four hour samples were analyzed in three size regions (20 - 3.6 μ, 3.6 - .65 μ, .65 - .10 μ) for elemental content. Samples were collected for nine months. Four elements were then examined as important tracers; Si as a tracer of soil, Cl as a tracer of road salt, Pb as a tracer of automotive activity and S as a possible tracer of fuel oil combustions. The following trends were observed.

1. Coarse Chlorine and coarse silicon concentrations were at a maximum during January 1976.
2. Fine lead was highest in January.
3. Fine sulfur did not correlate with lead although coarse silicon did during the winter months.
4. Fine sulfur had the highest concentration in the summer.

As part of the project a spatial examination of particulates in the Lake Tahoe Basin was undertaken. In August 1976 multiday impactors were placed at the Park Avenue station, Sugar Pine Point and Tahoe City. Twenty four hour samples were collected for fourteen days. Samples were also collected for one day by means of a total filter at eight sites duplicating the 1973 ARB study. These samples were changed every two hours between 9:00 a.m. and 7:00 p.m. on August 10, 1976. There was a significant difference in the concentration of major elements (Si, S, Fe, Pb) from site to site. The South Lake Tahoe stateline area was found to have the poorest air quality. Because of the findings of the basin profile two small scale profiles were designed to determine the aerosol sources in South Lake Tahoe. Samples were collected in December and January at eight sites.

The most striking trend was the sharp rise in soil and automotive aerosol concentrations downwind of Highway 50. Sulfur did not exhibit this behavior.

From the data gathered during this study the following conclusions can be drawn:

1. The Lake Tahoe basin has a pollution problem comparable to other non-industrial urbanized areas in California. This is consistent with the ARB study of 1973.
2. The elemental aerosol concentrations in the Lake Tahoe basin are spatially non-homogeneous with highest levels associated with the higher population and traffic densities.
3. The South Lake Tahoe profiles indicate the existence of two major sources. The first source is automobile traffic on Highway 50. The second source is characterized by the anomalous behavior of Sulfur. The source of sulfur in the basin could not be identified with the date available.

I. Introduction

Air quality in the Lake Tahoe basin has been the subject of great concern by numerous individuals and agencies. One of the perplexing problems in the basin is the ubiquitous haze formation observed during summer months. The cause of this visibility-degrading process has not been fully understood, Moreover, the origin and movement of pollutants which cause visibility reduction in the basin has not been documented.

The aerosol monitoring study at Lake Tahoe was designed to determine the main basin aerosol concentration and the source (s) of aerosols in the basin. This information can be used to identify the cause of visibility degradation in the basin. Two weeks of monitoring data at three sites around the basin in August 1976 were used to establish the mean basin aerosol concentration. During this monitoring effort, a basin wide (eight stations, see figure 2) temporal sampling effort was initiated to ascertain the temporal fluctuations in aerosol concentration (appendix A contains sites and sampling times). Information gained in this phase of the study indicated that South Lake Tahoe was the major source area in the Basin. An intensive study of South Lake Tahoe was initiated in December 1976 and January 1977 (see appendix A for sampling dates and sites). This study was used to determine the major sources in the South Lake Tahoe area.

It should be noted that all inferences and judgements contained in the report represent only the view of the author.

II. Historical Data

A. 1973 ARB Tahoe Basin Study

During the summer of 1973 the Air Resources Board measured nine pollutant concentrations at the sites shown in figure 1. For most pollutants the concentrations had large spatial variation; the arrangement in Table 1 is from cleanest to most impacted. The gas pollutants are the average maximum concentration in parts per million of air; the particulates are an average of one to seven measurements taken at random and expressed in micrograms per cubic meter of air.

In order to isolate pollutants transported into the Tahoe Basin or produced by biological activities from those due to local anthropogenic sources, an attempt was made to determine background concentrations. For most pollutants, the lowest average concentration at any of the sites were chosen as the background. For carbon monoxide the lowest average hourly concentration was assumed to be the background.

These background concentrations are shown in the upper row of Table 2. The four sites which had the lowest concentrations are averaged in the data for clean sites. The four sites with the largest concentrations are in the row for impacted sites. All ten sites were included in the basin average. For comparison, the concentrations for sites in three other basins in California are included.

Two pollutants, oxidant and total suspended particulates are reasonably uniform around the lake. The data for TSP is insufficient to understand its behavior. For the seven sites where more than one measurement was taken the scatter at the same site was as great as the variation between sites. Most of these pollutants were either transported into the basin or were produced by background biological activities.

The remainder of the pollutants show wide variation in concentrations. The local anthropogenic contribution may be estimated by subtracting the background from the total.

The fractions of the pollutants due to local activities are given in Table 3. The clean and impacted sites are the same as in Table 2.

B. Particulate Monitoring

In August 1974 and December 1974, 24 hour particulate concentrations were measured at the South Lake Tahoe Fire Station #1, using a multiday impactor. The concentrations of twelve elements for all particles below 20 microns are shown in Table 4. The only elements which changed radically from summer to winter were

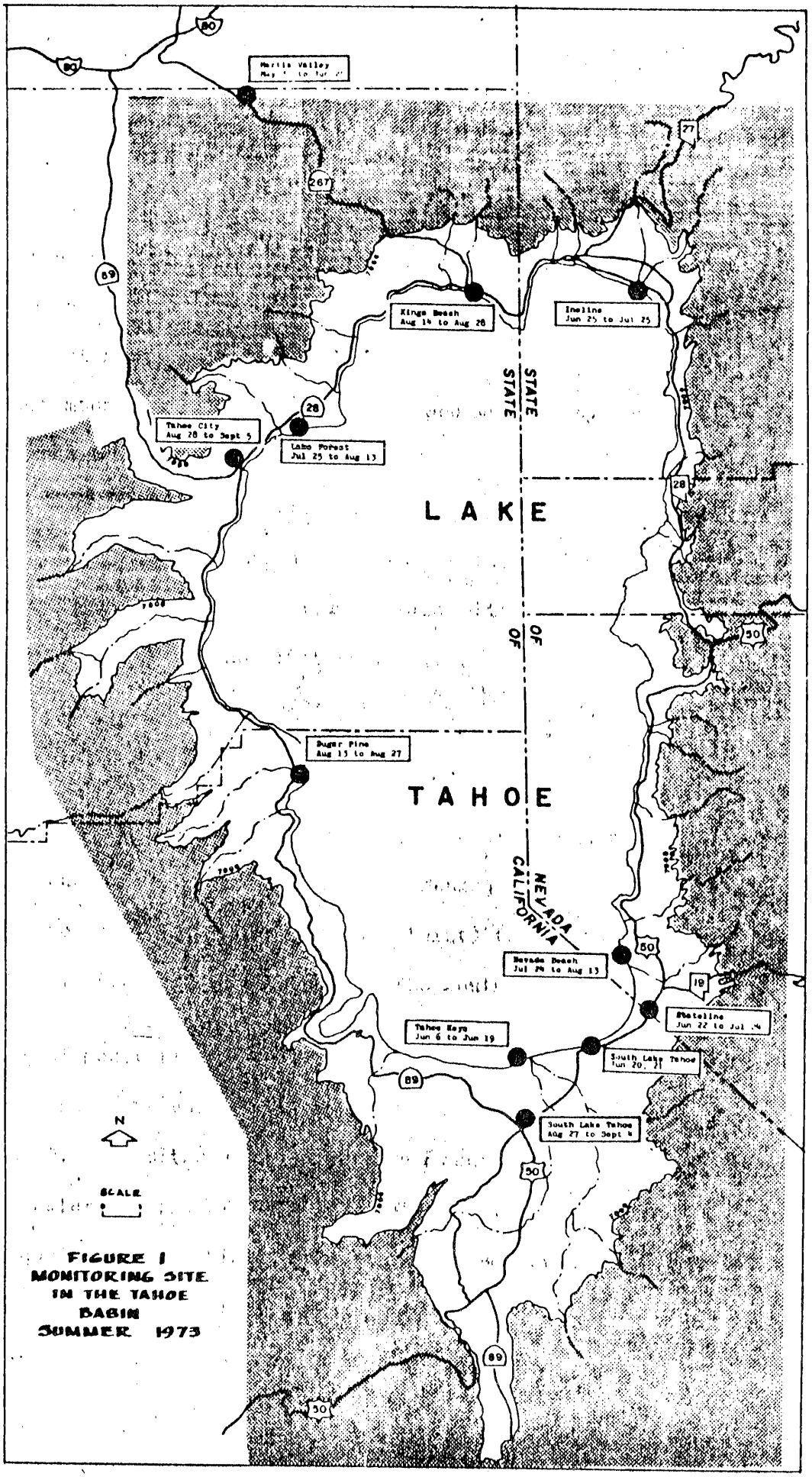


FIGURE 1
MONITORING SITE
IN THE TAHOE
BASIN
SUMMER 1973

TABLE I

Air Pollutants in Lake Tahoe Basin Concentrations Reported in 1973 Study

Sites	OX	CO	HC	NMHC	NO_x	NO_2	NO	Pb	TSP
Sugar Pine Point	.076	1.4	2.4	0.23	.009	.006	.006	.10	77*
Incline Village	.063	1.5	2.5	0.17	.012	.009	.003	.20	95*
Martis Valley	.055	---	---	---	.015	.013	.006	.15	78*
Lake Forrest	.067	1.8	2.1	0.20	.016	.008	.009	.16	64
Tahoe City	.085	1.5	5.8	0.67	.020	.016	.012	.15	50
Tahoe Keys	---	1.5	3.0	1.10	.042	.030	.015	.23	47
King's Beach	.075	3.2	3.2	0.20	.041	.029	.012	.58	43*
Nevada Beach	.052	2.2	4.1	0.86	.057	.048	.010	.25	54
South Lake Tahoe	.062	5.1	3.0	0.80	.065	.028	.039	---	54
Stateline	.049	6.4	5.2	1.97	.068	.041	.024	1.73	87

--- No sample taken

* deleted five values assigned to local sources

GASES: Average of maximum hour; parts per million of air

PARTICULATES: Average of 24 hour samples taken at random times; in micrograms per cubic meter of air.

TABLE 2

Air Pollutants in Lake Tahoe Basin Average Concentrations

	OX	CO	HC	NMHC	NO_x	NO_2	NO	Pb	TSP
Background	.065	0.65	1.75	0.18	.009	.006	.003	.05	45
Clean sites (1)	.065	1.6	2.3	0.20	.013	.009	.006	.15	79
All sites	.065	2.7	3.48	0.68	.035	.024	.014	.40	65
Impacted Sites (2)	.060	4.2	3.9	0.93	.058	.039	.021	.85	60
Monterey	.04	1.0	---	---	.03	.000	.020	.23	36
Sacramento	.09	2.0	2.0	---	.06	.040	.020	.49	78
Los Angeles	.11	6.0	3.0	---	.17	.110	.100	2.7	116

(1) Clean: Sugar Pine Point, Incline Village, Martis Valley, Lake Forest

(2) Impacted: King's Beach, Nevada Beach, South Lake Tahoe, Sahara Tahoe

GASES: parts per million of air

PARTICULATES: micrograms per cubic meter of air

TABLE 3

Estimated Fraction of Pollutant Concentration due to Local Anthropogenic Activities

	CO	HC	NMHC	NO_x	NO_2	NO	Pb
Clean sites	59%	24%	10%	31%	33%	50%	67%
All sites	76%	50%	74%	74%	75%	79%	88%
Impacted sites	85%	55%	81%	81%	85%	86%	95%

sodium and chlorine which were much higher in December and Sulfur which was larger in August. For comparison, the concentrations at four other California sites are included.

From October 1975 through June 1976 similar 24 hour samples were collected at the Park Avenue ARB station in South Lake Tahoe. The particles were separated into three size regions: coarse, 3.6 to 20 microns; intermediate, 0.6 to 3.6 microns; and fine, 0.1 to 0.6 microns. The coarse particles are considered non-respirable and primarily natural; the intermediate and fine are respirable and primarily anthropogenic. Concentrations were measured for twenty elements; of these four are considered tracers: silicon for soil, chlorine for salt, sulfur for fuel combustion and lead for automobiles.

The South Lake Tahoe data were compared with those of other California sites, operating simultaneously in the ten-site ARB particulate monitoring network. All of the tracer elements had size distributions typical of the sites. 75% of the silicon was in the coarse region; for other sites the range was 71% to 79%. Chlorine was distributed approximately equally on each stage (38% coarse, 22% intermediate, 40% fine), as it is at all other inland sites away from marine influences. 59% of the sulfur was in the fine region and 26% in the intermediate. South Lake Tahoe had slightly more coarse sulfur and less intermediate than other sites. Lead was typical with 68% fine and 21% intermediate. The total concentrations of these four elements in South Lake Tahoe is compared with those in four other sites in Table 5. SLT is much cleaner than sites in Southern California, slightly cleaner than Visalia and Chico and approximately as clean as Lakeport. The lead values compare with those obtained in 1973 - 1974 in Salinas.

These four tracer elements were examined for yearly trends at South Lake Tahoe. The average monthly concentration for coarse silicon and chlorine and for fine sulfur and lead are shown in Figure 2. The following important trends were recognized.

1. Coarse silicon and coarse chlorine were at a maximum during January and were well correlated during the nine months period. (However, there is not a correlation between the daily 24 hour concentrations). This peak is peculiar to South Lake Tahoe, as most sites show a level silicon concentration.
2. Coarse silicon and fine lead have a similar pattern during most of the year.

TABLE 5

Average Concentrations of Four Tracer Elements in Selected California Sites in 1975 - 76.

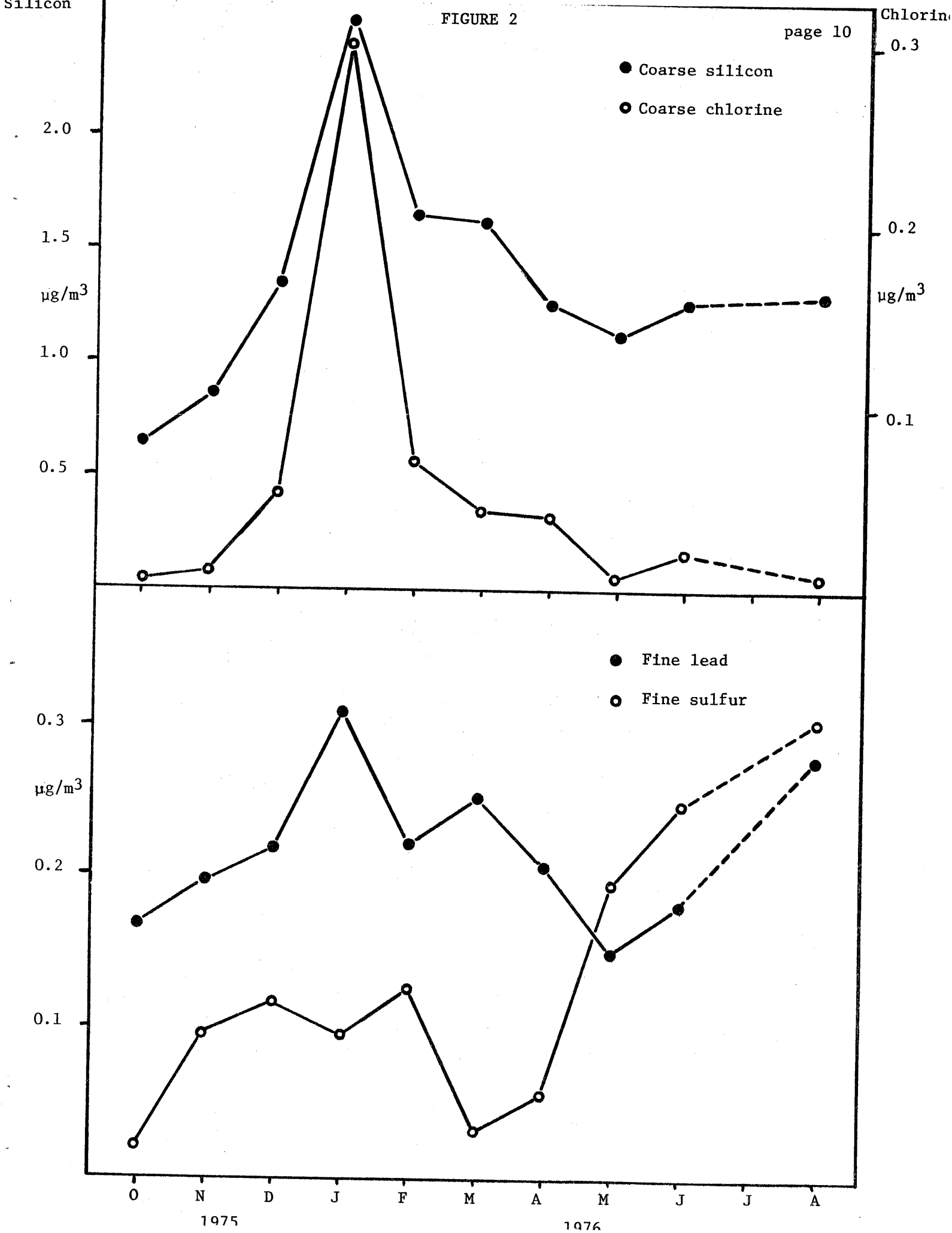
	Micrograms per cubic meter			
	Silicon	Sulfur	Chloride	Lead
South Lake Tahoe	1.7	0.15	0.11	0.31
Los Angeles	2.7	1.01	0.57	2.29
Visalia	4.4	0.88	0.21	0.79
Chico	2.3	0.28	0.14	0.51
Lake County	1.1	0.19	0.15	0.07
Salinas (1973-74)	1.0	0.49	1.15	0.26

TABLE 6

Mean Elemental Concentrations for Selected Elements and Sites at Lake Tahoe

	Park	Tahoe City	Sugar Pine
Si Stage I	1095 ng/m^3	1064	536
Pb Stage 3	287 ng/m^3	110	51
S Stage 3	324 ng/m^3	240	292

FIGURE 2


Silicon
Chlorin
Coarse silicon
Coarse chlorine
2.0
1.5
1.0
0.5
μg/m3
0.3
0.2
0.1
μg/m3
Fine lead
Fine sulfur
0.3
0.2
0.1
μg/m3
O
N
D
J
F
M
A
M
J
J
A
1975
1976

3. The fine lead concentration during two weeks in August 1976 was nearly as high as in January 1976. The Typical pattern for other California sites is a decrease of lead concentration during the summer.
4. The fine sulfur concentration remained near 110 ng/m^3 for November through February, with lower values for October, March and April. A second, much higher peak occurred during the summer.
5. Fine lead and fine sulfur were not correlated.

The monitoring data has been previously reported to the Air Resources Board.

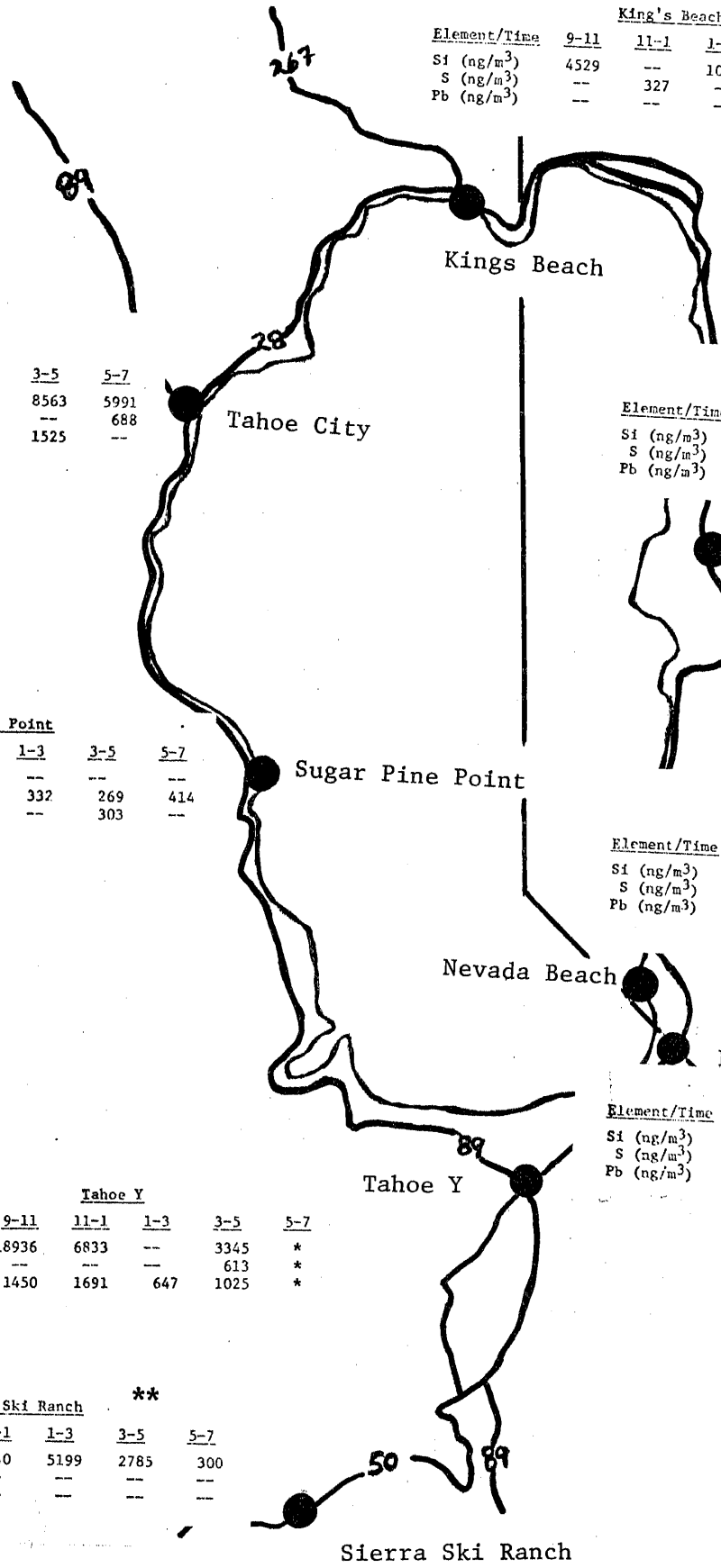
III. Basin Profile Study

As a part of the present study, three multiday impactors were operated at strategic locations around Lake Tahoe. The units were located at Park Avenue (The ARB monitoring station), Sugar Pine point and Tahoe City. Each unit was started on August 4, 1976 and operated for two weeks, ending August 16, 1976. Samples were analyzed for the elements Na → Pb using IEXE. Data for this study are reported in Appendix B. On August 10, during the monitoring period, samples were collected at eight other locations around the Lake. The sites chosen for this sampling were similar to those chosen by the ARB in the 1973 study (See Figure 3). Samples were collected in 2 hour increments starting at 9:00 a.m. and ending at 7:00 p.m. All samples were collected using .8 μm nuclepore filters and were analyzed for elements Na → Pb using IEXE. Data are reported in Appendix C.

Samples collected during the monitoring period exhibited significantly different values at each site (See Table 6). Average silicon values were nearly the same at Tahoe City and Park Avenue, but were significantly lower at Sugar Pine Point. Lead values were generally highest at Park Avenue and lowest at Sugar Pine Point. A similar behavior was exhibited by the Total Mass collected at these stations. Mean sulfur values were slightly higher in South Lake Tahoe, and were lowest at Tahoe City. Examination of the full data Set (See Appendix C) indicated that elemental concentrations varied significantly from site to site around the Lake.

Data from the August 10 study also indicated a variation in elemental concentration around the Lake (Figures 4, 5). In addition, a large temporal variation occurred at each site (Figure 4). Peak concentrations of automotive pollutants

FIGURE 4



King's Beach

Element/Time	9-11	11-1	1-3	3-5	5-7
Si (ng/m^3)	4529	--	1040	3793	2307
S (ng/m^3)	--	327	--	--	335
Pb (ng/m^3)	--	--	--	850	--

Tahoe City

Element/Time	9-11	11-1	1-3	3-5	5-7
Si (ng/m^3)	*	5091	1889	8563	5991
S (ng/m^3)	*	--	--	--	688
Pb (ng/m^3)	*	880	621	1525	--

Nevada Highway 28

Element/Time	9-11	11-1	1-3	3-5	5-7
Si (ng/m^3)	--	--	--	--	--
S (ng/m^3)	731	--	140	325	266
Pb (ng/m^3)	--	--	--	--	--

Sugar Pine Point

Element/Time	9-11	11-1	1-3	3-5	5-7
Si (ng/m^3)	*	--	--	--	--
S (ng/m^3)	*	94	332	269	414
Pb (ng/m^3)	*	--	--	303	--

Nevada Beach

Element/Time	9-11	11-3	1-3	3-5	5-7
Si (ng/m^3)	2709	3588	2805	6842	2287
S (ng/m^3)	298	--	521	569	316
Pb (ng/m^3)	--	--	--	--	--

Park Ave.

Element/Time	9-11	11-1	1-3	3-5	5-7
Si (ng/m^3)	7717	3068	1741	7455	4729
S (ng/m^3)	980	999	707	1663	2404
Pb (ng/m^3)	1881	1931	1590	2215	1576

Tahoe Y

Element/Time	9-11	11-1	1-3	3-5	5-7
Si (ng/m^3)	18936	6833	--	3345	*
S (ng/m^3)	--	--	--	613	*
Pb (ng/m^3)	1450	1691	647	1025	*

Sierra Ski Ranch **

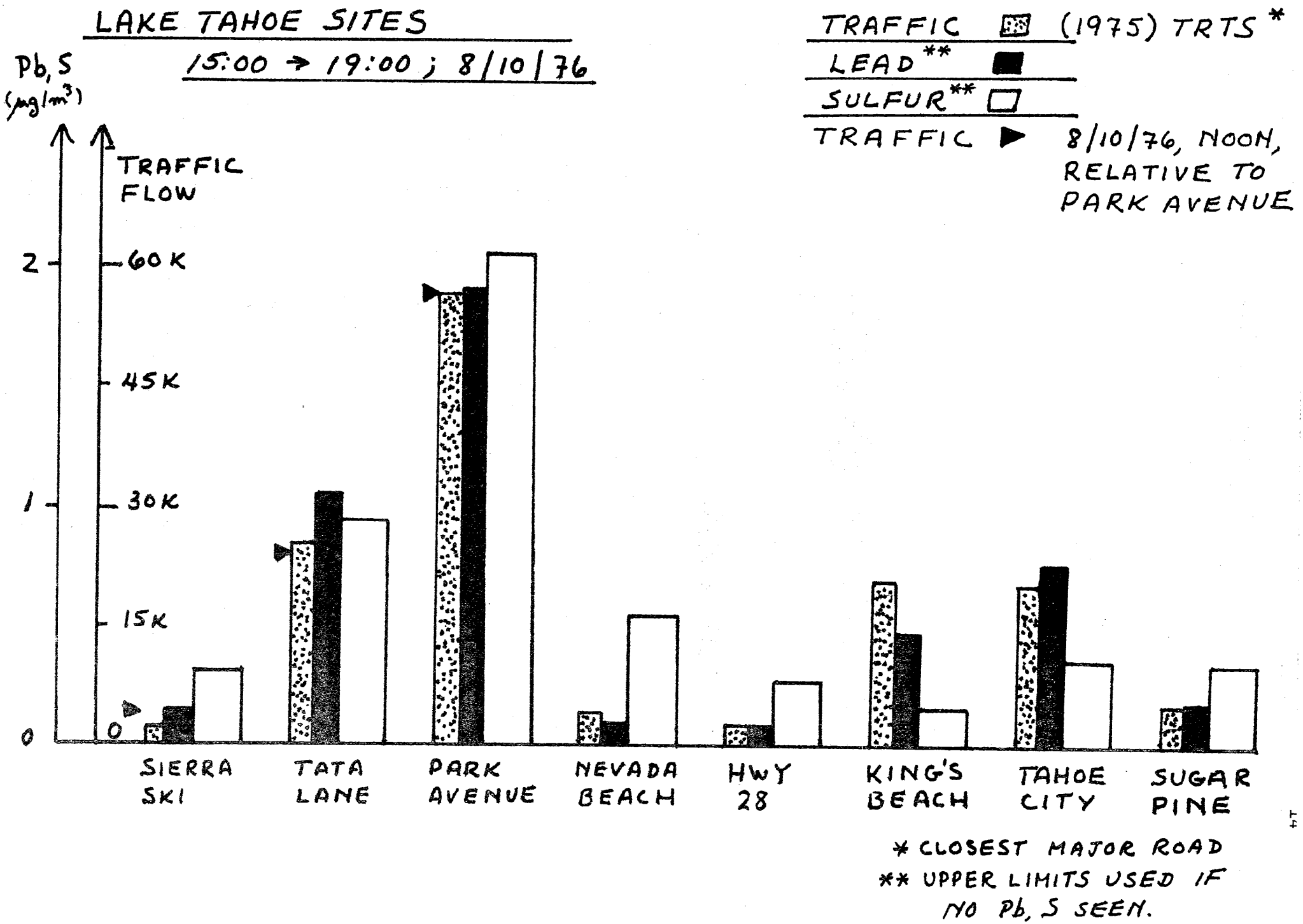
Element/Time	9-11	11-1	1-3	3-5	5-7
Si (ng/m^3)	3952	3740	5199	2785	300
S (ng/m^3)	--	--	--	--	--
Pb (ng/m^3)	--	--	--	--	--

-- Below minimum detection limit

* Samples not taken

**upwind construction, 9 AM - 4:30 PM

FIGURE 5


LAKE TAHOE SITES
15:00 → 19:00 ; 8/10/76
Pb, S (μg/m³)
TRAFFIC FLOW
2
1
0
60K
45K
30K
15K
0
TRAFFIC (1975) TRTS *
LEAD **
SULFUR **
TRAFFIC 8/10/76, NOON, RELATIVE TO PARK AVENUE
SIERRA SKI
TATA LANE
PARK AVENUE
NEVADA BEACH
HWY 28
KING'S BEACH
TAHOE CITY
SUGAR PINE
* CLOSEST MAJOR ROAD
** UPPER LIMITS USED IF NO Pb, S SEEN.

(Pb) ocurred from 3 - 5 in the afternoon. South Lake Tahoe (Park Avenue and Tahoe Y, the latter located on Tata Lane) had the highest lead concentrations in each time period. The only other site that recorded an enhanced lead value was Tahoe City. Sierra Ski Ranch was the cleanest site, although local construction upwind of the sampler from 9 AM to 4:30 PM did enhance soil values, as indicated by the silicon values.

The day selected for the basin profile study was chosen in order to avoid weekend traffic and match, as much as possible, typical weather patterns in the Lake Tahoe area and the Sacramento Valley. Synoptic weather summaries are given in Appendix F for the days before and after the study day, as well as the day itself, and they show typical Sacramento summer conditions in terms of minimum and maximum temperatures, wind speeds and direction. Particulate levels were measured at Davis, and sulfur, specifically, was close the mean values normally observed at Sacramento, although slightly lower. This was also true of oxidant, which was at about 2/3 of typical summer levels. Also in Appendix F is a map, similar to figure 3, that shows the average wind direction around noon on 8/10/76 with noon directions reported in the 1973 ARB study. The directions are similar at all locations for which comparisons are possible, again showing that the day chosen was typical of summer conditions. The wind measured at Sierra Ski Ranch was from the west, thus allowing possible transport from the Sacramento Valley.

The results of the basin profile for lead and sulfur are compared, in Figure 5, with mean vehicle trips per day from the 1974 Tahoe Regional Transportation Study (TRTS) as estimated for 1975. Traffic values at the south end of the basin around noon on 8/10/76, relative to Park Avenue - Highway 50 values, are also shown, and they are similar to the TRTS values. The agreement between the traffic data and the airborne lead data confirms the conclusions of the 1973 ARB study concerning the local automotive source of this pollutant. The sulfur profile is similar to that of lead, but possesses significant differences, especially on the lack of a sulfur enhancement at the north end of the lake and the easterly shift of the peak at the south end of the lake. Silicon and other soil-like materials followed a profile similar to that of lead and traffic.

IV. South Lake Tahoe Spatial Profiles

The results of the Basin Profile Study indicated that the poorest air quality was highly localized in the vicinity of the South Lake Tahoe/Stateline area. Two small scale profiles were designed to determine the source(s) of pollution in this area. The first sampling period was on December 4, 1976. Little, if any, snow had fallen prior to this date, and unseasonably warm weather had prevented the ground from freezing. As a result, the sources of soil aerosol were fully available. The second sampling period was on January 25, 1977. A small amount of snow had fallen, leaving patches of snow-covered ground. Most other exposed soil areas were frozen or wet, with the result that very little exposed soil surface was available as a source of soil aerosol.

The sampling array (Figure 6) was chosen for the following reasons:

(1) To estimate the effect of Highway 50 on area air quality.

(2) To sample a cross section of the most heavily impacted neighborhood (South Lake Tahoe).

(3) To check the Park Avenue site vs. other parts of the community.

The profile of January 25, 1977, did not include site #7. All other sites were identical for both profiles. Site locations are listed in Appendix A.

During both sampling periods the wind was predominantly from the Lake (Figure 6), although the first profile extended partly into the evening downslope wind regime. An atmospheric stability measurement, the bulk Richardson number, was made periodically on December 4, 1976. Data for both sample periods are reported in Appendices D and E.

The most striking trend observed in the profiles (Figure 7) was the sharp rise in soil and automotive aerosol concentrations downwind of Highway 50. Sulfur, however, did not exhibit similar behavior. Silicon concentrations were high during both sampling periods, but much higher after the snow than before. Lead exhibited the

expected behavior of a sharp rise just downwind of Highway 50, then a decrease downwind. Sulfur, however, was present at very high levels at Site #6, furthest from the highway, and at the beach and Pier Sites, upwind from Highway 50. Site #6 was located at the highest elevation of all sampling sites. Chlorine was detected in higher concentrations in January than in December, although it was not present in sufficient quantities to determine a spatial trend. At the Park Avenue ARB site, concentrations of nearly every element were lower than at the other community sites south of Highway 50 (Sites #4, #7, and #8).

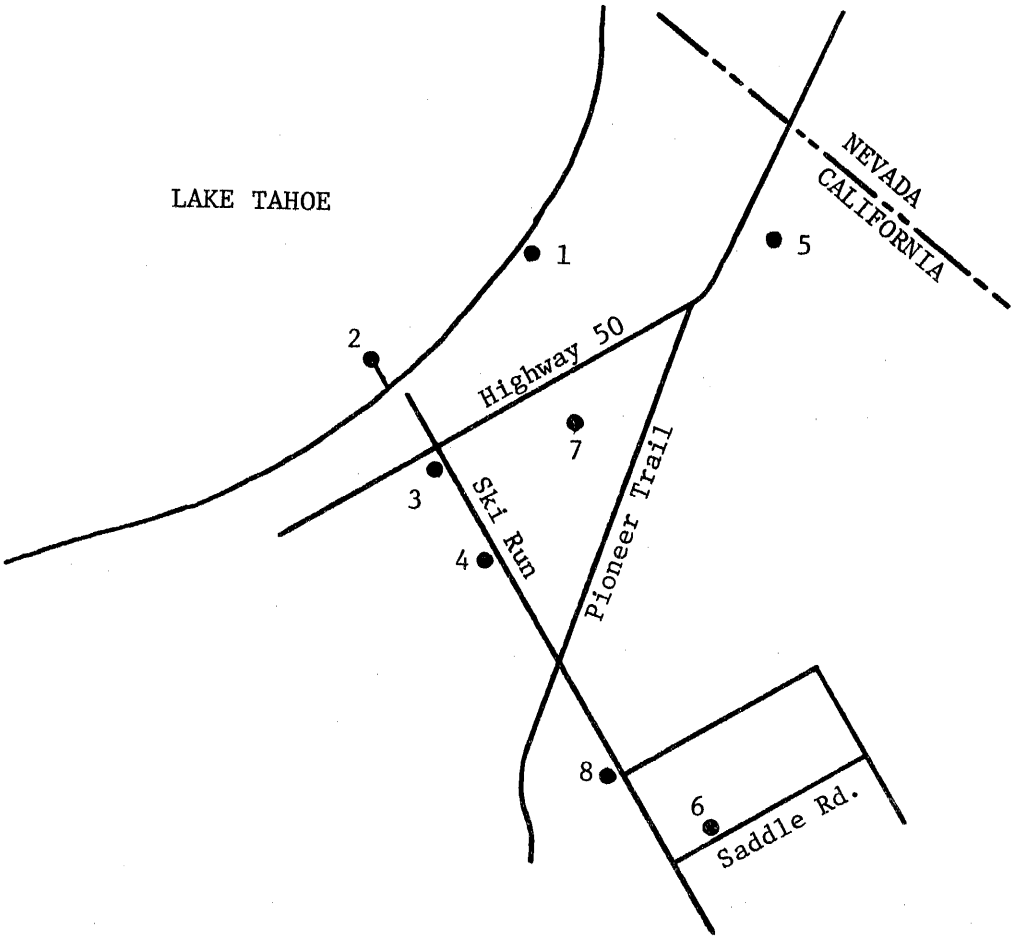


Figure 6

V. Interpretation

A. Seasonal trends

The most cursory examination of the nine months of particulate monitoring data reveals that the Lake Tahoe basin has a pollution problem comparable to other urbanized non-industrial areas in California. This conclusion is consistent with the results of the Air Resources Board study of gaseous pollutants in 1973. Although monitoring data were not collected during the summer of 1976, seasonal trends can be identified with the aid of the two weeks of August data collected for this study (Figure 2). These trends indicate the following:

1. January has the highest particulate load of all winter months. The suspected source of most particulates during this period is area highways. This contention is supported by the very high levels of coarse silicon and chlorine in January, when lead was also at a peak level. The chlorine source is most probably salt spread on the roads. The silicon source during this period, when most soil areas are covered by snow, is most probably sand spread on the roads. The salt and sand is ground into relatively fine particles by passing automobiles, then entrained into the air by traffic-generated turbulence.
2. Lead exhibits a bi-annual peak, one in January and one during the summer. The summer peak is clearly indicated by the two week average for August.
3. Sulfur remains at a relatively constant level during the winter months (November through February). Lower levels occur in October, March, and April. During the summer, however, sulfur is detected in much higher concentrations than in the winter.

B. Pollutant Origins - Basin vs. Transport

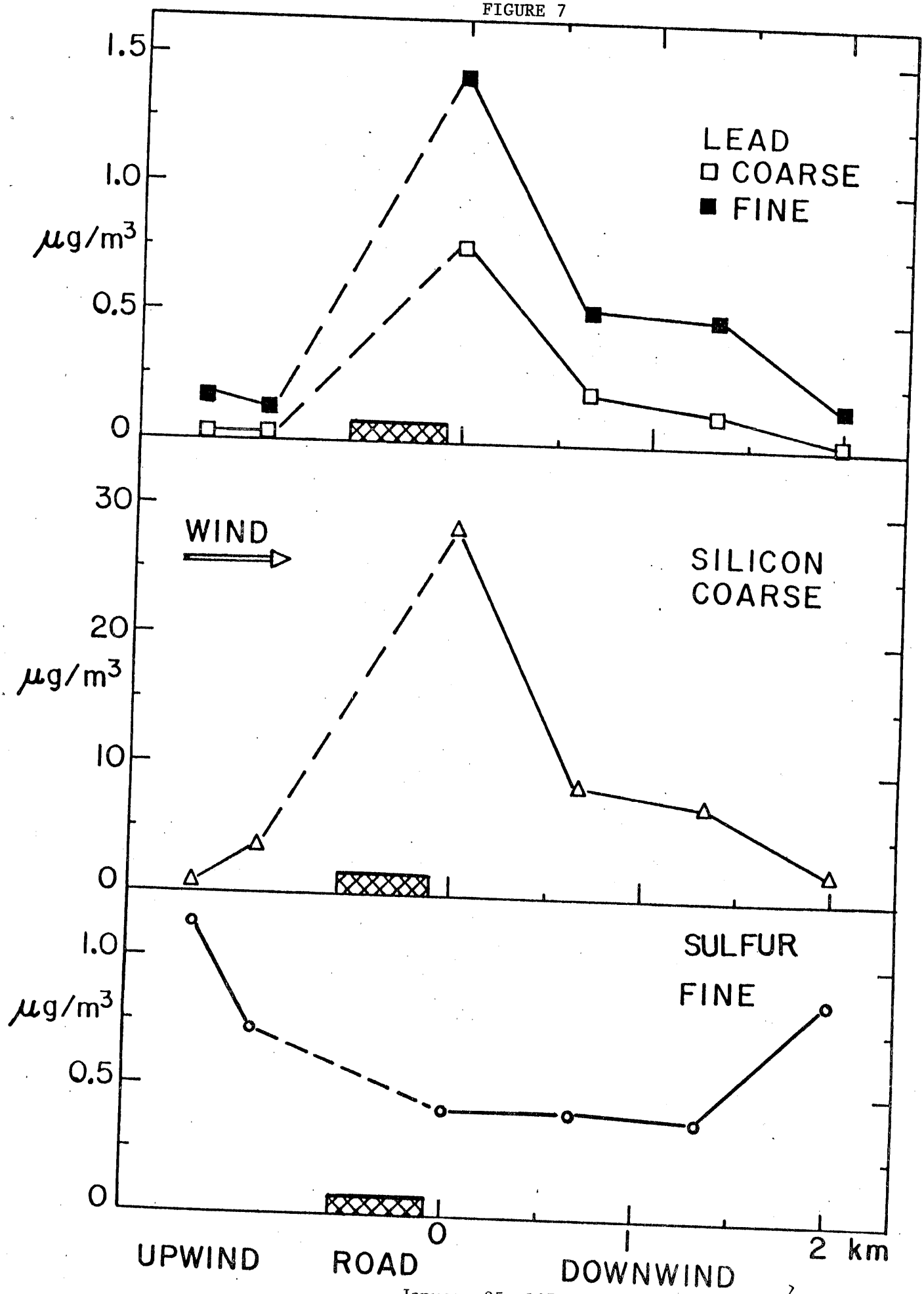
The profiles conducted in August, 1976, by the Air Quality Group, and in the Summer of 1973 by the ARB, clearly indicate that pollution in the Lake Tahoe basin is spatially non-homogeneous (Figure 5, Table 1). The degree of pollution is highly correlated with population and traffic densities around the basin, suggesting that pollution is locally generated. In addition, temporal variations observed during daylight hours at all sites around the Lake further support the hypothesis of local pollutant generation. If the basin air pollution were transported from the Sacramento or Reno area, concentrations would be fairly uniform throughout the basin, both spatially and temporally.

A further example of spatial variance, although on a much smaller scale, is provided by the two South Lake Tahoe studies. The extreme variability of pollutants on a small scale (Figure 7) strongly supports the hypothesis of local sources.

C. Major Sources

The South Lake Tahoe profiles indicate the existence of two major sources. The first source, Highway 50, contributes the greatest aerosol mass in the South Lake Tahoe area (Figures 7, 8). A second source is suggested by the anomalous behavior of sulfur. The sulfur concentration does not correlate with lead spatially, eliminating automobiles as a direct source. The highest sulfur levels occur at South Lake Tahoe, (Park Avenue site). Although it is not possible to directly identify the source of sulfur due to the limited scope of this study, a likely source is combustion of fuel oil within the basin.

FIGURE 7



January 25, 1977

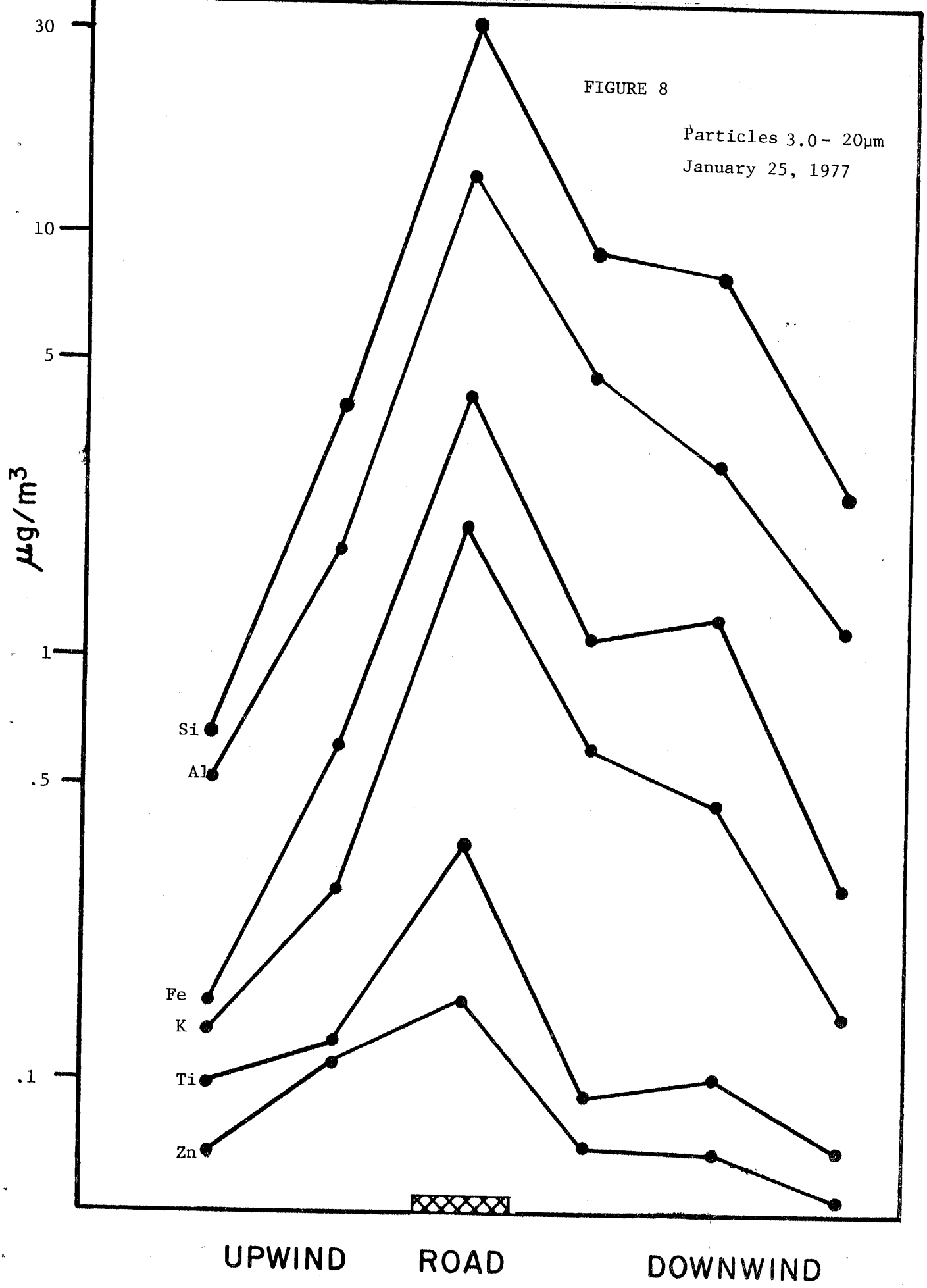


FIGURE 8
Particles 3.0- 20μm
January 25, 1977
30
10
5
1
.5
.1
μg/m3
Si
Al
Fe
K
Ti
Zn
UPWIND
ROAD
DOWNWIND

D. Visibility Reduction

Mie scattering by particulates is the primary mechanism governing reduction of visibility. Previous studies (e.g. ARB Staff Report 75-20-3) have implicated secondary pollutants as the primary light-scattering component of pollution in several California cities. If the same mechanism is at work in the Lake Tahoe area, then the levels of fine sulfates and nitrates control visibility. While it is not possible at this time to identify the specific source of sulfur in the South Lake Tahoe area, it is without doubt local. The suspected sources of secondary sulfur are combustion of fuel oil, natural gas, and automotive effluents. This suggests that visibility reduction is directly related to population levels and traffic volume within the basin.

E. Meteorology

Meteorological data including cloud conditions, visibility, temperature, dew point, and wind speed and direction were collected at the Tahoe Valley Airport and at Truckee. Data for the time periods sampled are tabulated in Appendix F. For the period of August 4 to August 16, 1976 data for morning and afternoon only are presented. For December 4, 1976 and January 25, 1977, all available data are shown.

In addition to the local meteorological data, daily weather maps were examined for the sampling periods. The synoptic weather was examined for non-typical conditions as well as to evaluate the possibility for transport of pollutants from the Sacramento Valley.

During August 1976 typical summertime conditions prevailed during the sampling period until August 14. On that date a low pressure system moved into the Pacific Northwest and rain fell in the Tahoe basin until around noon on the 15th. The upper level disturbance remained in the area through August 16, although no further rainfall was recorded. Prior to August 14 upper level winds were fairly constant from 20-30 knots from the Southwest or West-Southwest. Thus the possibility for transport existed prior to August 14.

On December 4, 1976, the upper level wind pattern showed zonal flow accross the entire U.S. Over California the winds were Westerly at 20-25 knots. Hence, transport from the Sacramento Valley was possible. A similar pattern existed the day before. At the Tahoe Valley Airport, local cloud conditions revealed diurnal convective mixing occurred to about 10,000 feet. Excellent visibility, light to moderate winds, and warmer than average temperatures were recorded.

On January 25, 1977, the upper level winds were very similar to those of December 4, 1976. The only difference was a high pressure ridge in the Gulf of Alaska, causing Northwest winds over the extreme western edge of the U.S. The upper level winds at Reno were 20 knots from the Northwest. The upper level disturbance was reflected in the Tahoe Valley Airport data. Visibilities were slightly reduced, temperatures were somewhat cooler than average and humidity was higher than average. Winds were variable but light. Transport form the Sacramento Valley on this day was less likely than on December 4, 1976.

Conclusions

From the data gathered during this study the following conclusions can be drawn.

1. The Lake Tahoe basin has a pollution problem comparable to other non-industrial urbanized areas in California. This is consistent with the ARB study of 1973.
2. The elemental aerosol concentrations in the Lake Tahoe basin are spatially non-homogeneous with highest levels associated with the higher population and traffice densities. Further examination of particulates shows that:
   a. Lead exhibits a bi-annual peak, one in January and one during the summer.
   b. Sulfur was relatively constant during the winter months but showed elevated levels in the summer.
   c. Particulate loading was highest in January. This can be attributed to the area highways as shown by the high levels of coarse silicon and chlorine and fine sulfur.
3. The South Lake Tahoe profiles indicate the existence of two major sources. The first source is the automobile traffic on Highway 50. The second source is characterized by the anamolous behavior of sulfur. It was not possible to identify the source with the present data.

APPENDIX A

Sampling Locations

Appendix A

Field Studies at Lake Tahoe

1. Lake Profile - August 10, 1976

   Sites: Sierra Ski Ranch
   Tahoe Y (Tata Lane, USFS)
   Park Avenue (ARB site-roof)
   Nevada Beach Recreation Area
   Highway 28 (2 mi N US 50)
   Kings Beach (SRA)
   Tahoe City (SRA)
   Sugar Pine Point State Park

   Samplers: Filter Units (no sizing)
   Measured: Particulates (Na→Pb)
   (by Particle Induced x-ray Emission, UCD)

2. Highway 50 Profile - December 4, 1976

   Sites: #1 Beach near Stateline
   #2 Public Pier, end of Ski Run Blvd
   #3 South of Hwy 50 (30 m) on Ski Run
   #4 South of Hwy 50 (500 m) on Ski Run
   #8 South of Hwy 50 (1200 m) on Ski Run
   #6 South of Hwy 50 (1600 m) just off Ski Run (at end)
   #5 Park Avenue (ARB Site)
   #7 Forest Road, between Wildwood and Pine Grove Avenue

   Samplers: Sequential Filter Units (2 size cuts)
   Measured: Particulates (Na→Pb) coarse, fine
   Flow calibrated on site by spirometer
   Time Period: 9:00 AM to 6:00 PM

3. Highway 50 Profile - January 25, 1977

   All sites same as on 12/4, however site #7 was eliminated
   Samplers: Sequential Filter Units (2 size cuts)
   Measured: Particulates (Na→Pb) coarse, fine
   Time Period : 10:00 AM to 5:00 PM

APPENDIX B

Basin Monitoring

August 4-16, 1976

Park Ave. Monitoring

STAGE 1

Aug	Al	Si	S	Cl	K	Ca	Ti	Mn	Fe	Zn	Br	Pb
4	342	994	--	--	133	164	37	10	418	6	9	29
5	329	944	--	--	123	150	34	10	392	6	--	19
6	395	1100	--	--	150	181	41	12	456	--	--	23
7	286	790	--	10	106	134	28	8	315	--	7	20
8	464	1210	--	--	166	204	43	10	530	7	--	31
9	482	1241	--	--	181	203	48	15	575	9	--	31
10	702	1496	16.2	--	133	160	37	8.3	398	8.7	--	33
11	882	1873	18.4	--	179	212	49	9.4	529	9.3	--	37
12	815	1587	10.9	--	150	174	42	6.5	441	9.2	--	28
13	784	1759	13.1	--	156	189	40	7.5	449	11.2	9.7	31
14	47	84	17.6	7.6	9	10	3	--	24	--	6.0	21
15	195	448	10.6	--	41	48	11	2.0	110	3.7	--	23
16	271	717	14.0	--	66	82	19	2.8	166	6.8	8.2	32

STAGE 2

4	52	192	22	17	40	43	12	4	127	--	24	51
5	74	211	21	--	39	31	8	--	89	--	16	32
6	48	157	18	10	35	28	6	--	71	--	--	41
7	112	274	16	--	37	40	10	--	113	--	14	49
8	101	242	43	--	34	31	14	4	102	--	14	52
9	177	426	60	--	67	58	15	6	170	--	21	52
10	173	332	45	--	42	45	12	--	132	7	18	51
11	183	409	83	--	55	51	14	3.4	151	7	22	64
12	164	367	57	--	48	45	12	--	131	4.3	17	56
13	154	390	22	18	40	49	11	2.3	140	5.5	22	77
14	19	53	15	--	7	9	3	--	21	--	26	76
15	49	62	21	--	9	9	--	--	30	--	17	49
16	44	102	22	15	11	18	3	--	39	--	25	59

STAGE 3

4	--	--	209	--	38	11	--	--	--	13	49	208
5	36	--	278	--	80	30	--	--	--	15	68	230
6	--	--	378	--	73	30	--	--	--	11	80	248
7	--	--	206	--	59	14	--	--	24	9	73	210
8	--	--	313	--	62	18	--	--	25	22	79	200
9	59	--	378	34	63	20	--	--	30	14	101	264
10	102	61	361	--	99	7	--	--	21	8	59	291
11	23	158	620	--	123	--	--	--	53	--	74	335
12	79	120	574	106	160	--	20	--	32	15	89	404
13	27	87	149	64	42	--	--	--	16	--	73	349
14	51	31	--	56	183	--	--	--	--	--	129	383
15	--	--	122	--	--	--	--	--	--	--	97	327
16	20	--	300	--	--	--	26	--	--	--	73	290

-- Below Minimum Detection Limit

Sugar Pine Point Monitoring

STAGE 1

Aug	Al	Si	S	Cl	K	Ca	Ti	Mn	Fe	Zn	Br	Pb
4	213	424	--	7	59	79	23	9	208	--	--	--
5	355	687	--	7	93	119	35	15	336	--	--	--
6	279	665	--	7	87	118	32	11	296	--	--	--
7	175	331	--	--	46	53	16	7	156	--	--	--
8	182	370	--	8	46	58	19	7	184	--	--	--
9	221	424	--	--	54	69	21	8	201	--	--	--
10	621	1648	--	16	190	369	55	9	662	19	7	99
11	527	850	5	--	79	95	27	7	265	--	--	--
12	670	953	3.8	--	83	115	31	9	397	4	--	--
13	112	140	24.7	5.3	23	21	--	3	38	--	--	--
14	62	103	20.7	--	12	15	5	--	27	--	--	--
15	84	134	20	10.4	16	22	--	--	37	--	--	--
16	99	203	20.6	--	20	30	9	--	56	--	--	--

STAGE 2

4	34	83	92	--	15	11	--	2	30	--	--	--
5	41	87	48	--	25	13	--	4	34	--	--	9
6	51	128	70	--	27	22	4	--	51	--	--	--
7	60	96	33	7	18	13	4	3	40	--	--	--
8	62	118	34	6	18	14	6	3	47	--	--	--
9	81	126	38	10	21	17	6	3	56	--	--	--
10	85	151	84	4	23	22	8	--	58	--	6	19
11	69	115	71	--	16	14	7	--	45	2	--	--
12	77	123	38	--	15	15	6	--	45	3	--	--
13	30	62	44	--	20	11	3	--	20	3	--	--
14	18	24	30	--	4	--	6	--	6	3	--	--
15	--	37	38	--	4	3	--	--	4	--	--	5
16	31	36	114	8	10	13	3	--	12	--	--	7

STAGE 3

4	49	--	372	--	58	20	--	--	--	--	10	32
5	43	--	162	--	97	--	--	--	--	10	--	50
6	55	--	327	--	65	16	--	--	--	--	--	--
7	--	--	182	--	33	16	--	--	14	--	--	39
8	45	--	239	--	41	12	--	--	14	14	--	65
9	64	--	179	--	48	20	--	--	18	7	--	60
10	--	267	250	39	53	22	11	--	31	7	--	54
11	83	160	566	--	124	20	--	--	34	--	--	104
12	128	227	611	--	133	25	--	--	34	--	--	70
13	143	139	341	--	88	15	9	--	45	--	--	46
14	152	170	166	30	71	--	22	--	24	--	--	35
15	--	133	118	--	--	--	--	--	--	--	--	38
16	--	--	--	--	--	--	--	--	--	--	--	24

-- Below Minimum Detection Limit

Tahoe City Monitoring

STAGE I

AUG	Al	Si	S	CL	K	Ca	Ti	Mn	Fe	Zn	Br	Pb
4	247	700	–	11	82	145	29	7	271	8	–	24
5	341	872	–	14	102	176	37	9	370	6	–	23
6	301	897	–	6	112	183	41	11	380	–	–	25
7	346	1110	–	26	119	199	39	9	359	–	–	28
8	392	1228	–	20	130	223	44	12	440	–	–	34
9	375	1052	–	18	114	235	43	8	392	9	–	25
10	829	1883	–	11	141	253	52	7	480	8	–	42
11	663	1401	8	8	107	177	38	5	352	6	–	21
12	909	2034	–	8	163	272	55	7	533	9	8	33
13	813	1724	–	11	131	223	48	9	432	6	7	36
14	79	136	6	4	28	20	5	–	48	6	–	9
15	138	322	13	5	34	46	10	–	70	–	4	9
16	197	476	9	10	39	65	14	–	112	–	–	11

STAGE 2

4	59	168	42	–	22	25	7	3	54	–	10	29
5	102	212	27	11	37	32	8	–	74	–	10	35
6	117	336	61	–	52	53	12	4	108	–	8	28
7	95	254	15	–	31	39	9	4	80	–	13	27
8	121	340	19	20	36	47	9	–	114	–	4	33
9	124	333	17	–	39	54	10	4	114	–	12	40
10	72	215	28	–	31	29	5	2	72	4	8	30
11	123	309	98	–	40	38	10	1	106	–	10	40
12	123	271	43	–	29	38	10	2	88	–	13	26
13	145	329	28	–	31	44	11	2	102	–	8	33
14	16	50	20	2	9	5	2	1	15	–	4	–
15	9	40	23	–	6	7	–	–	9	–	7	17
16	22	67	42	8	11	9	2	–	15	–	7	20

Tahoe City Monitoring

STAGE 3

AUG	Al	Si	S	Cl	K	Ca	Ti	Mn	Fe	Zn	Br	Pb
4	-	-	86	11	-	25	-	-	-	-	-	-
5	87	-	-	18	-	-	-	-	-	-	-	-
6	33	-	346	-	121	28	-	-	18	-	-	127
7	116	-	299	-	52	30	-	-	14	-	-	88
8	61	-	173	-	39	22	-	-	16	-	-	77
9	-	-	153	-	35	15	-	-	19	-	37	90
10	197	177	288	-	66	26	-	-	49	-	31	206
11	70	241	392	65	122	9	-	-	31	-	21	123
12	52	180	451	37	116	16	-	-	64	12	20	143
13	67	188	386	-	60	-	-	-	57	-	35	143
14	138	-	117	94	65	-	-	-	-	-	17	45
15	127	-	178	103	-	6	-	-	-	-	19	102
16	17	72	252	-	-	-	-	-	6	9	15	70

BASIN PROFILE

9:00 AM - 11:00 AM

Station	Al	Si	S	Cl	K	Ca	Ti	Mn	Fe	Zn	Br	Pb
(1)	751	3952	--	--	322	237	--	--	660	--	--	--
(2)	10855	18937	--	1544	3285	5774	1416	--	14752	883	--	1450
(3)	5962	7717	980	--	1970	2486	560	171	6165	413	399	1880
(4)	--	2709	298	--	--	--	--	--	--	--	--	--
(5)	--	--	731	--	333	113	--	--	244	--	--	--
(6)	--	4529	--	--	337	592	204	--	859	228	--	--
(7)	--	--	--	--	--	--	--	--	--	--	--	--
(8)	--	--	--	--	--	--	--	--	--	--	--	--

11:00 AM - 1:00 PM

(1)	941	3739	--	380	--	158	--	--	482	--	--	--
(2)	5582	6833	--	--	1935	3820	744	172	6525	527	372	1691
(3)	6180	3068	999	--	1797	1860	408	--	4765	203	--	1930
(4)	779	3588	--	--	372	660	--	--	683	148	--	--
(5)	--	--	--	--	121	--	--	--	65	--	--	--
(6)	621	--	327	--	575	210	--	--	839	175	--	--
(7)	1661	5091	--	--	702	543	--	--	1141	118	--	880
(8)	863	--	95	--	236	302	--	--	817	103	--	--

1:00 PM - 3:00 PM

(1)	2259	5199	--	--	1022	407	197	--	1903	--	--	--
(2)	4125	--	--	--	1369	4676	613	--	3650	860	--	648
(3)	4285	1741	708	--	1304	1799	384	--	3879	226	485	1590
(4)	807	2805	521	--	--	151	--	--	--	--	--	--
(5)	--	--	140	--	137	90	70	--	--	49	--	--
(6)	1087	1040	--	--	--	346	184	--	--	347	--	--
(7)	--	1889	--	--	240	301	--	--	548	--	--	622
(8)	595	--	332	--	143	133	71	--	170	--	--	--

--Below minimum detection limit

Stations
(1) Sierra Ski
(2) Tahoe Y
(3) Park Avenue
(4) Nevada Beach
(5) Highway 28
(6) King's Beach
(7) Tahoe City
(8) Sugar Pine Point

3:00 PM - 5:00 PM

Station	Al	Si	S	Cl	K	Ca	Ti	Mn	Fe	Zn	Br	Pb
(1)	878	2786	--	--	675	271	245	--	752	154	--	309
(2)	4876	3345	613	--	1650	2886	500	--	5730	--	--	1025
(3)	6255	7455	1663	--	2046	2589	509	--	6278	254	673	2215
(4)	2768	6842	569	--	978	1133	278	--	2251	--	--	--
(5)	265	--	325	--	--	146	--	--	217	113	--	--
(6)	1332	3793	--	--	--	553	239	--	1568	--	--	850
(7)	2877	8563	--	--	796	893	220	--	2364	150	--	1525
(8)	637	--	269	--	294	133	--	--	347	--	--	303

5:00 PM - 7:00 PM

(1)	--	--	--	--	467	150	--	--	408	--	--	--
(2)	4877	2557	1249	--	1783	1921	373	--	5298	243	--	1025
(3)	6200	4730	2405	--	2164	2099	626	198	5240	185	419	1576
(4)	670	2287	316	--	450	194	--	--	397	--	--	--
(5)	520	--	266	--	136	91	--	--	194	--	--	--
(6)	1231	2307	336	--	290	568	191	--	1261	--	--	--
(7)	2358	5992	688	--	775	727	240	--	1700	--	--	--
(8)	506	--	415	--	267	140	--	--	312	--	--	--

--Below minimum detection limit

Stations

(1) Sierra Ski
(2) Tahoe Y
(3) Park Avenue
(4) Nevada Beach
(5) Highway 28
(6) King's Beach
(7) Tahoe City
(8) Sugar Pine Point

APPENDIX D

SOUTH LAKE TAHOE PROFILE

December 4,1976

Appendix D

Stage 1 (3.0 - 20 μm)

Site #	Al	Si	S	Cl	K	Ca	Ti	Cr	Fe	Zn	Br	Pb
1	351	1537	189	--	128	192	--	36	239	--	80	189
2	2999	3909	--	243	163	382	39	155	510	64	198	412
3	1644	3756	676	202	141	303	93	87	340	--	356	954
4	2539	5215	261	--	332	446	94	--	1021	71	246	787
8	2410	4054	408	--	253	613	54	--	698	57	90	315
6	--	--	183	--	--	182	60	54	111	--	--	--
5	--	2614	420	--	120	369	148	--	456	47	83	268
7	2233	3471	522	--	286	441	83	150	620	--	103	263

Stage 2 (< 3.0 μm)

1	202	371	--	187	--	143	--	--	80	50	188	691
2	503	499	--	--	--	--	56	--	147	--	277	1224
3	--	--	--	--	--	39	--	--	134	--	672	2096
4	--	--	--	272	--	97	--	--	121	41	575	1696
8	--	455	--	251	60	178	--	--	289	--	421	1390
6	--	1753	--	--	147	144	108	109	193	57	--	236
5	301	468	--	387	102	--	--	--	253	--	230	790
7	--	--	--	--	--	112	--	--	177	70	334	1031

-- Below minimum detection limit

(Values for fine S unavailable
due to high min. det. limit)

Bulk Richardson Number

Site	Time	R_B
3	1035	+0.029
2	1400	-0.019
3	1435	-0.038
3	1640	+0.097

APPENDIX E

SOUTH LAKE TAHOE PROFILE

January 25, 1977

Appendix E

Stage 1 (3.0 - 20 μm)

Site #	Al	Si	S	Cl	K	Ca	Ti	Cr	Fe	Zn	Br	Pb
1	--	691	135	274	133	235	100	71	156	68	57	--
2	1841	3935	--	--	284	529	127	157	622	109	--	--
3	23559	30197	118	236	2097	2862	367	112	4198	155	216	848
4	4757	9167	115	376	625	710	94	--	1124	70	70	216
8	2984	8145	--	224	468	849	104	66	1272	68	103	159
6	1213	2509	430	70	148	227	72	122	290	--	--	--
5	1323	2623	286	--	168	276	58	129	333	90	40	--

Stage 2 (< 3.0 μm)

1	1343	1793	1147	379	298	--	--	--	150	--	--	183
2	550	1181	724	184	162	147	115	--	88	--	42	125
3	679	2817	414	190	287	364	--	--	512	--	420	1462
4	414	2538	411	139	345	315	80	77	547	--	201	522
8	2714	4054	396	593	415	1070	--	--	917	--	177	511
6	--	2999	860	194	158	315	96	207	200	--	--	162
5	477	1371	1039	--	139	81	--	--	--	--	--	179

-- Below minimum detection limit

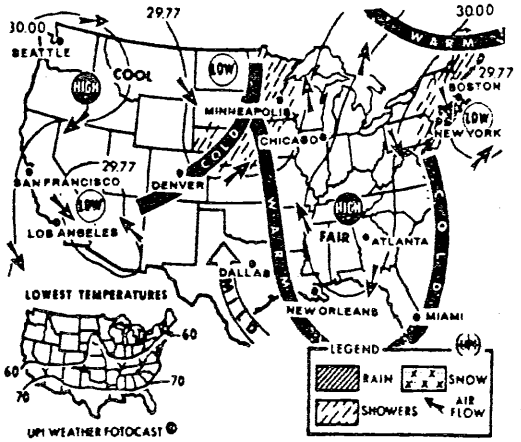
APPENDIX F

METEOROLOGICAL DATA

TAHOE PROFILE TEST DAY

Monday, August 9, 1976

The Weather



Monday night will find thunderstorms over the mid Plains, the upper Mississippi Valley and the Northeast area, according to the National Weather Service. Mostly fair weather is expected elsewhere.

The Forecasts

SACRAMENTO AREA — Fair through tomorrow. Highs in the upper 80s and 90s. Lows tonight in the upper 50s to mid 60s. Southerly winds 5 to 15 m.p.h. in afternoons except southwest to 25 m.p.h. in the delta.

SIERRA NEVADA — Fair through tomorrow with some afternoon clouds. Tahoe Valley 37 and 77, Yosemite Valley 45 and 94.

NAPA AND SONOMA VALLEYS — Fair through tomorrow. Southerly winds 5 to 15 m.p.h. afternoons and evenings. Santa Rosa 53 and 92.

BAY AREA — Fair through tomorrow with coastal low clouds extending inland locally night and morning. Highs in the 60s near the coast and 70s inland. Lows tonight in the 50s. Small craft advisory including Suisun Bay and west delta for westerly winds 15 to 25 m.p.h. afternoon and evenings. San Francisco 66 and 55, Oakland Airport 71 and 58, Redwood City 77 and 54.

LOS ANGELES — Mostly sunny through tomorrow but low clouds near the coast in the late night and early morning hours. Highs near 80. Low tonight near 60.

Sacramento Data

Sacramento's highest temperature yesterday was 92 degrees; the low during the night was 63 degrees.

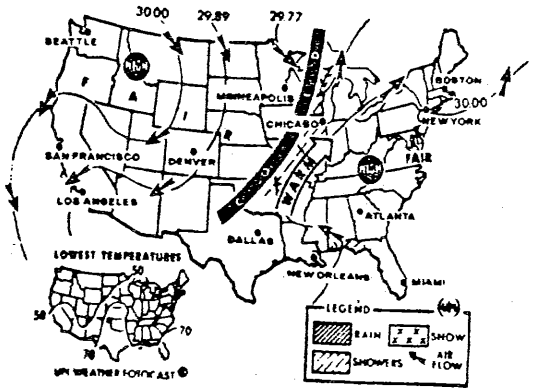
Rainfall — Sacramento City to 4 a.m. today: none. This season none; last season .02 inches; normal none. Relative humidity (Exec. Arpt): 4 p.m. yesterday 29 per cent. 4 a.m. today 75 per cent. Highest temperature on record this date 104 in 1971. Lowest 50 in1931.

LOCAL TIME — TOMORROW:

Sunrise 6:15 a.m.; Sunset 8:07 p.m. Moonrise 8:22 p.m., Moonset 7:09 a.m.

Tuesday, August 10, 1976

The Weather



Showers and thunderstorms will be found tonight scattered across parts of the mid-Mississippi Valley, western Lakes region and the east Gulf coast. For the rest of the states, fair weather should prevail.

The Forecasts

VALLEY — Fair through tomorrow. Little temperature change. Highs 95 to 105 except upper 80s in the delta. Lows in the upper 50s and 60s. Southerly winds 5 to 15 m.p.h. except southwest to 25 m.p.h. in the delta.

SIERRA NEVADA — Fair through tomorrow but with some afternoon clouds. Little change in temperature. Tahoe Valley 35 and 75, Yosemite Valley 40 and 98.

BAY AREA — Fair through tomorrow except coastal low clouds extending inland locally nights and mornings. Little temperature change. Highs in the 60s near the coast and 70s to low 80s inland. Lows in the 50s. Small craft advisory including Suisun Bay and West Delta for westerly winds 15 to 25 h. mainly afternoon and evenings. San Francisco 65 and 55. Oakland airport 70 and 58, Redwood City 78 and 55.

LOS ANGELES — Mostly sunny tomorrow but late night and early morning low clouds. Little temperature change with the highs near 80. Low in low 60s.

Sacramento Data

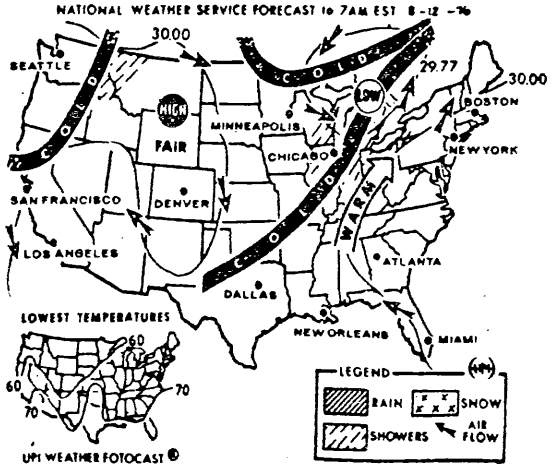
Sacramento's highest temperature yesterday was 96 degrees; the low during the night was 61 degrees.

Rainfall — Sacramento City to 4 a.m. today: 0. This season. 0; last season. .02 in.; normal 0. Relative humidity (Exec. Arpt.): 4 p.m. yesterday. 24 per cent: 4 a.m. today. 75 per cent. Highest temperature on record this date: 108 in 1971. Lowest 50 in 1919.

Sunrise 6:16 a.m.; sunset, 8:05 p.m.; moonrise, 8:53 p.m.; moonset,8:08 a.m., local time tomorrow.

Wednesday, August 11, 1976

The Weather



Showers are forecast by the National Weather Service for parts of the Great Lakes region and the Northern Rockies this evening. Elsewhere, fair weather will predominate. Highs today will range from 72 in Seattle to 101 in Phoenix.

The Forecasts

VALLEY — Fair through tomorrow but with variable high clouds. Not quite so warm. Highs in the 80s to low 90s except in mid 70s to low 60s in Delta. Lows in the upper 50s and 60s. Southerly winds 5 to 15 m.p.h. except southwest to 25 m.p.h. in the delta. Shasta Dam 64 and 88.

SIERRA NEVADA — Fair through tomorrow but with some afternoon clouds and chance of isolated thundershowers. Slightly cooler. Tahoe Valley 38 and 65, Yosemite valley 45 and 89.

BAY AREA — Fair through tomorrow except coastal low clouds extending inland nights and mornings. Little temperature change. Highs in the 60s near the coast and 70 inland. Lows in the 50s. Small craft advisory including Suisun Bay and West Delta for westerly winds 15 to 30 m.p.h. mainly afternoon and evenings. San Francisco 66 and 55. Oakland Airport 70 and 59. Redwood City 75 and 58

LOS ANGELES — Low clouds late night through midmorning hours. Otherwise fair through tomorrow with sunny days. Little temperature change with highs near 80. Lows in low 60s.

Sacramento Data

Sacramento's highest temperature yesterday was 92 degrees; the low during the night was 58 degrees.

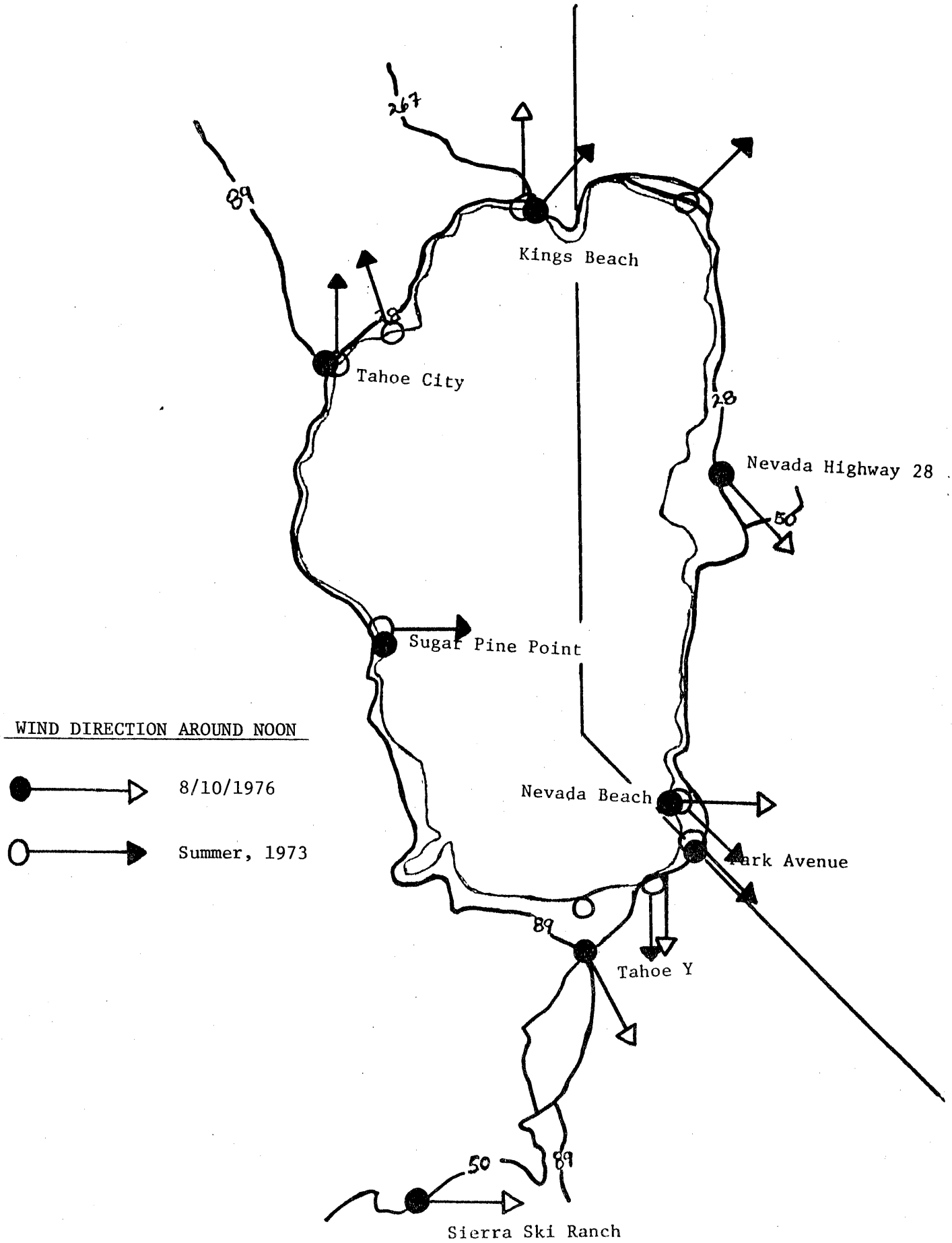
Rainfall — Sacramento city to 4 a.m. today: 0. This season 0 inches. Last season .02 inches, normal 0 inches. Relative humidity (Exec. Arpt.): 4 p.m. yesterday 29 per cent 4 a.m. today 84 per cent. Highest temperature on record this date: 110 in 1898. Lowest 49 in 1910.

LOCAL TIME — TOMORROW: Sunrise 6:17 a.m.; Sunset 8:04 p.m.; Moonrise 9:24 p.m.; Moonset 9:07 a.m.

Smog Report

Yesterday's peaks downtown: Oxidant .05; Carbon Monoxide 1.

Oxidant readings above .08 parts per million and carbon monoxide readings above 35 parts per million are considered adverse to sensitive persons, animals and vegetation.


267
89
Kings Beach
28
Tahoe City
28
Nevada Highway 28
50
Sugar Pine Point
WIND DIRECTION AROUND NOON
8/10/1976
Summer, 1973
Nevada Beach
Park Avenue
89
Tahoe Y
50
89
Sierra Ski Ranch

TAHOE VALLEY AIRPORT

August 1976

Date	Time	Clouds*	(miles) Visibility	(°F) Temp.	(°F) Dew Point	Wind Direction	(knots) Wind Speed	Remarks
4	1200	40 SCT	50	61	34	200	7	
	1500	40 SCT	50	64	40	210	10 - 20	
5	900	50 SCT	50	58	40	---	0	
	1500	50 SCT	50	66	37	190	12 - 25	
6	1000	40 SCT	50	55	36	220	10 - 20	
	1500	50 SCT 100 SCT	50	58	35	230	10 - 20	
7	900	CLR	50	57	27	180	8	
	1500	50 SCT 100 SCT	50	65	38	220	10 - 20	
8	900	100 SCT	50	60	40	10	8	
	1500	50 SCT	50	68	40	350	10	
9	900	150 SCT	50	61	44	360	8	
	1500	50 SCT 150 SCT	50	73	44	20	10	
10	900	CLR	50	66	47	30	10	
	1500	E60 BKN 150 BKN	50	72	42	190	7	Towering cumulus all quads. Rain to SE.
11	900	CLR	50	67	47	---	0	Few cumulus SE
	1500	50 SCT 250 SCT	50	75	43	230	10 - 18	Cumulus to N. Towering cumulus to NE. Wind variable 18 - 28 knots.

*Clouds - Height in hundred feet

TAHOE VALLEY AIRPORT

August 1976

Date	Time	Clouds*	(miles) Visibility	(°F) Temp.	(°F) Dew Point	Wind Direction	(knots) Wind Speed	Remarks
12	900	50 SCT	50	67	38	190	12	
	1500	50 SCT	50	75	40	200	15	Towering cumulus NE
13	900	E250 BKN	50	67	27	210	14-20	
	1500	E200 OVC	50	65	33	230	15-25	
14	900	20 SCT E30 OVC	7R-**	47	45	180	8	Clouds topping mountains all quads.
	1500	20 SCT E30 OVC	7R-	49	45	220	12	Clouds topping mountains all quads.
15	900	15 SCT E30 OVC	7R-	44	39	200	10-20	Clouds topping mountains all quads.
	1500	E40 BKN 150 BKN	50	49	37	200	15-30	
16	900	40 SCT 80 SCT 150 BKN	50	51	36	220	7	
	1500	40 SCT E150 BKN	50	52	40	250	12	

*Clouds - Height in hundred feet SCT - Scattered BKN - Broken E - Estimated OVC - Overcast CLR - Clear

**R- = light rain

TRUCKEE

August 1976

Date	Time	Clouds*	(miles) Visibility	(°F) Temp.	(°F) Dew Point	Wind Direction	(knots) Wind Speed	Remarks
4	1500	50 SCT	30	66	36	270	12	
5	No data taken							
6	1500	40 SCT	25	62	30	200	10-20	
7	1500	60 SCT	30	69	33	290	5-15	
8	900	60 SCT 150 SCT	30	68	44	---	0	
	1500	60 SCT	30	73	34	290	15	
9	1500	60 SCT 140 SCT	30	80	28	280	10-20	
10	900	CLR	30	64	33	---	0	
11	900	CLR	30	61	48	---	0	
	1500	60 SCT	30	78	40	270	10	
12	1500	60 SCT 250 SCT	30	75	35	300	10-20	
13	900	80 SCT 140 SCT	25	68	28	210	10-20	
	1500	E80 OVC	25	66	36	210	10	
14	1500	E10 OVC	15	58	50	260	10	
15	1500	E40 BKN	30	46	38	180	10	
16	1500	50 SCT 150 SCT	30	54	37	250	10-20	

*Clouds - Height in hundred feet

TAHOE VALLEY AIRPORT

12/4/76

Date	Time	Clouds*	(miles) Visibility	(°F) Temp.	(°F) Dew Point	Wind Direction	(knots) Wind Speed	Remarks
12/4/76	700	CLR	50	18	17	---	0	
	900	CLR	50	20	22	---	0	
	1000	150 SCT	50	41	23	---	0	
	1100	E150 BKN	50	46	25	20	5	
	1200	150 SCT 200 SCT	50	48	27	20	9	
	1300	50 SCT 100 SCT	50	49	29	320	8	
	1400	E100 BKN	50	47	18	20	7	
	1500	E80 BKN	30	44	16	170	10	
	1600	E80 BKN	30	41	16	90	7	
	1700	80 SCT	30	39	19	20	7	
	2200	CLR	20	27	19	---	0	

*Clouds - Height in hundred feet

TAHOE VALLEY AIRPORT

1/25/77

Date	Time	Clouds*	(miles) Visibility	(°F) Temp.	(°F) Dew Point	Wind Direction	(knots) Wind Speed	Remarks
1/25/77	700	100 SCT	30	13	13	180	5	
	800	20 SCT 100 SCT	30	12	12	160	4	Clouds obscuring mountains NE
	900	20 SCT 100 SCT	30	19	17	---	0	Clouds obscuring mountains NE - E
	1000	10 SCT 100 SCT	30	26	21	---	0	Clouds obscuring mountains all quads
	1100	20 SCT 100 SCT	30	32	26	---	0	Clouds obscuring mountains NE
	1200	20 SCT 100 SCT	30	33	26	340	8	Clouds obscuring mountains NE
	1300	20 SCT 100 BKN	30	34	26	360	7	Clouds obscuring mountains NE
	1400	100 BKN	30	34	25	340	7	Clouds obscuring Pass NE
	1500	40 SCT 100 BKN	30	34	27	10	10	Clouds obscuring Pass NE
	1600	40 SCT	30	33	25	20	5	Clouds obscuring Pass NE
	1700	40 SCT	30	31	25	---	0	Clouds obscuring Pass NE
	2200	50 SCT	20	20	20	---	0	Clouds obscuring Pass NE

*Clouds - Height in hundred feet