

Appendix E. Napa Ozone waiver to define monitor as Neighborhood Scale.



**BAY AREA
AIR QUALITY
MANAGEMENT
DISTRICT**

ALAMEDA COUNTY
Tom Bates
Scott Haggerty
Nate Miley
(Vice-Chair)

CONTRA COSTA COUNTY
John Gioia
David Hudson
Mary Piepho
Mark Ross

MARIN COUNTY
Susan Adams

NAPA COUNTY
Brad Wagenknecht

SAN FRANCISCO COUNTY
John Avalos
Edwin M. Lee
Eric Mar

SAN MATEO COUNTY
Carole Groom
(Secretary)
Carol Klatt

SANTA CLARA COUNTY
Ash Kalra
(Chair)
Liz Kniss
Ken Yeager

SOLANO COUNTY
James Spering

SONOMA COUNTY
Susan Gorin
Shirlee Zane

Jack P. Broadbent
EXECUTIVE OFFICER/APCO

February 4, 2013

Matthew Lakin, Ph.D.
Manager, Air Quality Analysis Office
United States Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Dear Dr. Lakin:

As you know, 40 CFR Part 58 requires that sampling for ozone, as well as other gaseous pollutants, must occur a minimum distance from roadways based on Average Daily Traffic (ADT) counts. In addition, the regulation requires that a minimum number of measurements occur in Core Based Statistical Areas (CBSAs) and be representative of defined spatial scales. These requirements minimize chemical reactions between compounds produced at the roadway and compounds being measured at sampling locations.

As discussed in our Annual Network Report, although the Bay Area Air Quality Management District's (Air District's) ozone measurements in Napa (AQS #06-055-0003-44201-1) do not meet the stated requirements for distance from major roadways as described in 40 CFR Part 58, we believe that the rationale for that requirement are still being met. The attached analysis provides data and makes the case that the measurement of ozone at Napa is not affected by oxides of nitrogen produced at the nearest roadway, and is representative of the spatial Neighborhood scale. As a result, measurements of ozone at this location meet the requirements for State and Local Air Monitoring Stations (SLAMS) ozone monitoring in the Napa CBSA. The Air District is requesting a waiver from the roadway distance requirement to qualify Napa as a representative Neighborhood scale SLAMS ozone monitoring site.

Please contact me if you have any questions or concerns about this request at (415) 749-4695. If you have any questions regarding the attached data or analysis, please contact Mark Stoelting, our Quality Assurance Officer, at (415) 749-4619.

Sincerely,

A handwritten signature in black ink, appearing to read "Eric D. Stevenson".

Eric D. Stevenson
Director of Technical Services

cc: G. Yoshimura
M. Kurpius

Napa Ozone Analysis for SLAMS Designation

Prepared by M. Stoelting, Quality Assurance Officer

Problem Context

The primary Bay Air Quality Management District (Air District) Air Monitoring station for the Napa, CA, Core Based Statistical Area (CBSA) is located at 2552 Jefferson St. in Napa. The station is located approximately 1.5 km northwest of downtown Napa and 0.5 km east of Hwy 29, a multi-lane freeway serving the southern part of the Napa Valley (60,000 ADT). The station has existed since March 1, 1972, and is located downwind of the population center during normal wind patterns when maximum pollutant concentrations are expected. Minimum ozone monitoring requirements specified in 40CFR Part 58 Appendix E require one State and Local Monitoring Stations (SLAMS) ozone monitor for the Napa CBSA which is currently located at the Napa station.

Ozone SLAMS monitors must meet Neighborhood scale siting criteria requiring sample collection at minimum distances from roadways (traffic count dependent). The minimum distances from roadways address concerns that vehicular NO_x emissions will scavenge (reduce) maximum ozone concentration measurements. The ozone probe inlet for the Napa station is 15 m east of the nearest traffic lane of Jefferson St., a major road with an Average Daily Traffic (ADT) count of 19,143 (2007). The minimum distance requirement for Napa Neighborhood scale specified in EPA Regulations is 30 m, thereby classifying Napa ozone (and NO_x) monitoring as Middle scale.

Though the Napa ozone monitor location does not strictly meet Neighborhood scale minimum distance requirements, the Air District contends that monitor placement still meets the requirements of Neighborhood scale monitoring and should be considered for SLAMS classification by the EPA Regional office. The supporting arguments are: 1) prevailing wind patterns during periods of high ozone indicate minimal impact on ozone concentrations by Jefferson St. traffic; 2) measurements of collocated NO_x concentrations are very low during high ozone, indicating minimal scavenging chemistry; and, 3) multi-year data indicates mobile NO emissions are continually decreasing as the vehicle fleet modernizes indicating that potential for impacts will continue to decrease over time.

Data Analysis

This narrative provides an analysis in support of Napa ozone SLAMS classification at a Neighborhood scale. Analysis began with suggestions provided by the Region 9 Air Quality Analysis Office:

- Utilizing the past three years of data, look at the four highest days per year (i.e., those days with 8-hr ozone concentrations that would figure into the DV calculation) - 12 days total - and provide diurnal ozone, NO, NO₂, NO₂/NO, wind speed, and wind direction.
- Find some days when the wind is blowing parallel to the road and some days when the wind is blowing perpendicular to the road - provide the same analyses as above.

- Provide some analysis of typical wind patterns during the day (e.g., wind rose for daytime).
- Provide design values for past 5 years.

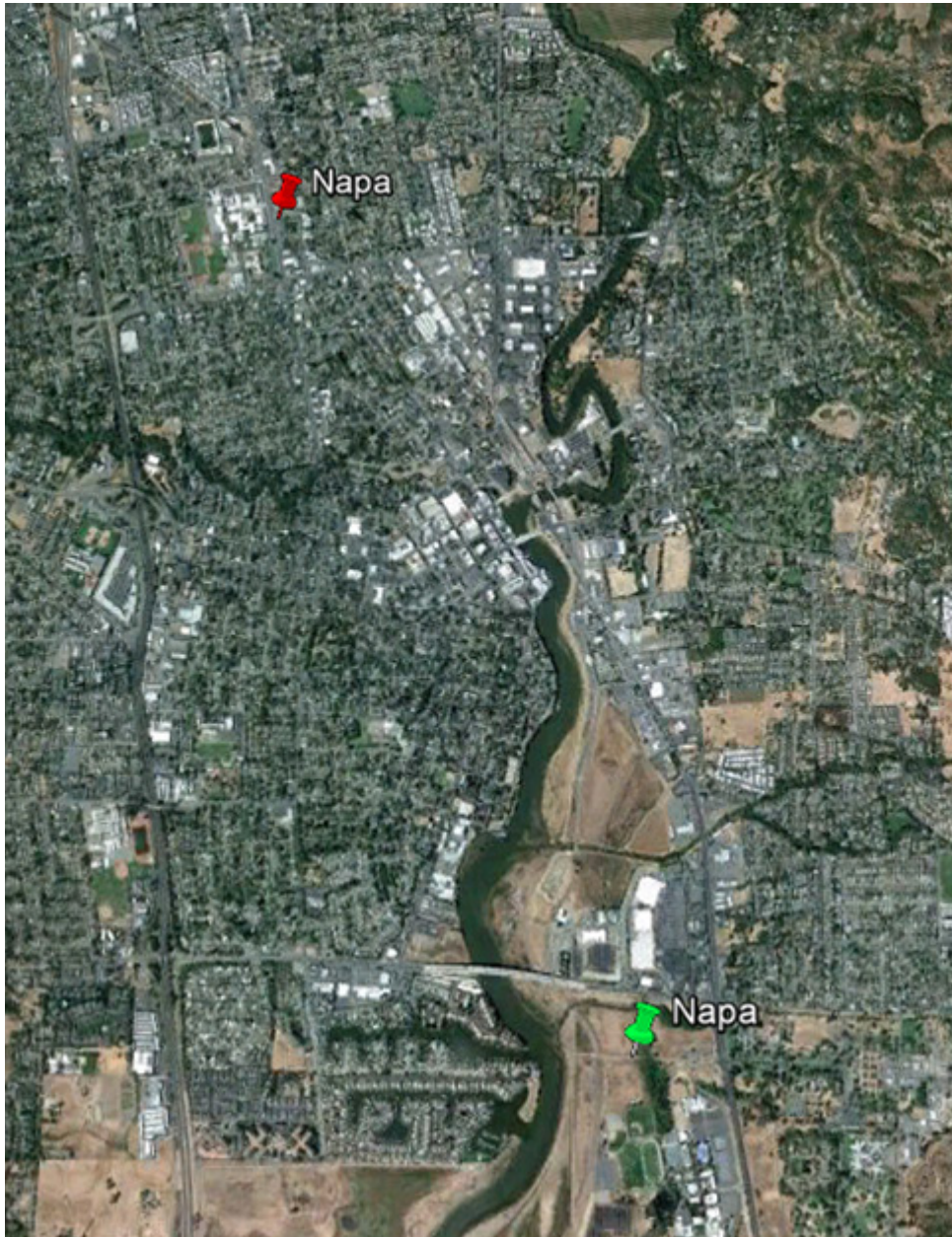
These efforts were augmented with additional NO_x analysis.

The periods of interest include times when 8-hr ozone concentrations have the potential to approach/exceed the National Ambient Air Quality Standards (NAAQS). The facts and constraints on this analysis are:

- Analysis focused on years 2010-12 (attainment determination period); May 1 to October 31, the 184 day period when all high ozone episodes occurred; and the 10 AM through 6 PM hours during which all maximum 8-hr daily values were measured (9 hrs./day, 4,968 hours total)
- Napa met data are available for 4,922 of the 4968 hours under analysis (99.1% completeness)
- The Jefferson St. compass orientation is 348°, so winds from 258° represents a direct crosswind from the street to the gaseous probe inlet
- Distance from the probe inlet to the edge of the nearest Jefferson St. traffic lane is 15 m
- Jefferson St. ADT count is 19,143 (2007)
- Jefferson St. is the predominant NO_x source in the neighborhood around the Napa monitoring station; the bulk of the Napa urban and industrial area lies to the south, typically upwind of the station during periods of elevated ozone concentrations
- To meet neighborhood scale monitoring criteria for ozone, probe must be 30 m from the edge of the nearest traffic lane, as grandfathered in for ozone sites approved before December 18, 2006 (40CFR Pt. 58 as amended); the Napa monitoring station was established on March 1, 1972
- The effective distance from Jefferson St. exceeds 30 m when winds are more than 60° from perpendicular ($\cos^{-1}(15/30) = 60^\circ$); therefore winds in a 120° arc from 198° through 317° are 'crossing winds' of interest (see analysis below)
- 1,430 hours of crossing winds exist (28.7%) at $\pm 60^\circ$ from 258°
- Winds from 10 AM through 6 PM were examined to select only those days with 75% of the hours (>6 of 9) within the crossing winds arc; 85 days met this criteria, or about 28 days each year
- To select maximum impact, only days with average wind direction (WD) $\pm 15^\circ$ from 258° were chosen from this group, further reducing the sample to 11 days.
- To select parallel winds, hours within $\pm 20^\circ$ of 348° and 158° were selected; 843 hours (17.1%) met this parallel wind condition
- Winds from 10 AM through 6 PM were examined to select only those days with 100% of the hours within 20° parallel to Jefferson St.; 83 days met this criteria, or about 28 days each year
- to further refine representative parallel wind days, only days with average WD $\pm 7^\circ$ from 348° Jefferson St axis were used, further reducing the sample to 11 days

Meteorological data used for the Napa analysis was measured at the Air District's Napa met site (green pin on the following map) located 4 Km at 156° from the Air Monitoring Station

(red pin on the following map). District meteorologists believe that the meteorological data is representative of regional conditions in the southern Napa Valley including the city of Napa and the Air Monitoring Station. This region of the valley is bounded on the east and west by ranges of low mountains that tend to channel valley air flow in a north/south direction.



Prevailing Wind Patterns

To establish prevailing, daytime wind patterns when ozone exceedances are most likely to occur, a wind rose was constructed using almost 5,000 hours of data from years 2010-12, May 1 to October 31, and from 10AM through 6PM (9 hours/day). The **Prevailing winds.pdf** wind rose shows a strong southerly wind pattern expected with afternoon, up-

valley winds driven by typical onshore coastal sea breezes. Air from the more heavily populated Bay Area moves north across the city of Napa before crossing the monitoring station northwest of downtown.

Highest ozone days

The four highest ozone days for each of the 2010-12 years were identified and diurnal data assembled as noted above in the Excel workbook file **max 8-hr ozone.xlsx**. A wind rose **HiO3 rose 2010-12.pdf** shows winds measured during these 12 events, 96 hours total (8 hours X 12 days). The orientation of Jefferson St. is 348° as indicated on the wind rose. The effective distance of the probe from Jefferson St., d_{eff} , varies as the inverse sine of the angle between Jefferson and the wind (Θ): $d_{\text{eff}} = 15 \text{ m} / \sin \Theta$. With direct crosswinds to Jefferson, $\sin(90)=1$ and the effective distance to road is 15 m. At $\Theta = 30$ or 150° from Jefferson, $\sin \Theta = 0.5$ and the effective distance is 30 m, the SLAMS minimum. Allowing for Jefferson St. orientation, only winds within a 120° arc between 198° and 318° potentially impact ozone measurements below Neighborhood scale siting minimums.

During the 12 peak 8-hour ozone episodes, winds were within the 198° to 318° arc for 37 the 96 hours (see the **Peak O3 hrs** spreadsheet). The average NO and NO₂ concentrations for all 96 hours were calculated at 1.5 and 8.2 ppb. During the 37 hours with winds within the impact arc, concentrations were 1.6 and 8.2 ppb, respectively. During the 59 non-impact hours, NO and NO₂ concentrations were 1.4 and 8.5 ppb.

Time series plots for the 12 peak ozone days are included in in the **max O3 graphs.pdf** file. Every plot shows that by late morning, NO levels are very low and NO₂ remains at a stable concentration, typically about 10 ppb or less, for the remainder of the high ozone period.

Parallel and Crossing Winds to Jefferson St.

Using the selection process outlined above, 11 days were identified where winds consistently blew parallel to Jefferson St. during 10AM through 6PM. All wind was from the south, as expected, except for one day (May 2, 2012) with a late-afternoon, 180° shift. These days are identified with diurnal winds and pollutant data in the **Parallel wind days.xlsx** Excel workbook. The afternoon hours are tabulated in worksheet **Hrs 10-18** to calculate average NO, NO₂, and ozone.

Eleven crosswind days were identified where winds consistently blew across Jefferson St. toward the station during 10AM through 6PM when maximum ozone concentrations are expected. These days are identified with diurnal winds and pollutant data in the **Crosswind days.xlsx** Excel workbook. The afternoon hours are tabulated in worksheet **Hrs 10-18** to calculate average NO, NO₂, and ozone concentrations.

99 hours were evaluated in each direction, equivalent to the 96 hours evaluated during peak ozone days. Though the selection of days is based on ad hoc selection criteria, NO_x concentrations remain consistently low. In fact, they are lower when winds were blowing

across Jefferson St. toward the station and downwind largely from pristine, rural countryside.

NO Concentration Trends

To evaluate long term NO concentrations at Napa, a series of annual ‘pollution roses’ were constructed with NO concentration plotted as a function of wind direction from 10 AM through 6 PM during the May 1 through October 31 ozone season. File **NO roses.pdf** contains plots for 2012, 2011, 2010, and 2004. As expected, the wind pattern emulates the prevailing wind rose pattern presented above. However, all three principal lobes of the roses show a similar color distribution indicating NO concentrations are not dependent on wind direction (i.e. affected by Jefferson St. mobile emissions). More importantly, higher concentrations indicated by the hotter colors evident in the 2004 rose are consistently lower over time.

Napa Ozone Design Values

Design values for ozone were acquired using the AQS AMP480 Design Value Report. Values for the last five years are included in the attached AQS report **Design values.pdf** and summarized below:

Ozone Design Values Year	Napa DV (ppb)	Napa DV % of NAAQS (75 ppb)	District DV Max (ppb)	Max DV Site
2008	61	81	81	Livermore
2009	61	81	78	Livermore
2010	66	88	80	Livermore
2011	65	87	76	Livermore
2012*	63	84	73	Livermore & Bethel Island

*preliminary

Napa Design Values are less than 90% of the NAAQS and are consistently exceeded by other Design Values within the District.

Results Summary

The following is a summary of the average results for peak ozone events, and winds parallel and perpendicular to Jefferson St.:

	data records (max hours)	Avg WSpd (m/s)	Avg NO ppb	Avg NO2 ppb	Avg 1-hr O3 ppb max 8-hr events
Max ozone (all)	96	3.3	1.5	8.4	
High O3	37		1.6	8.2	

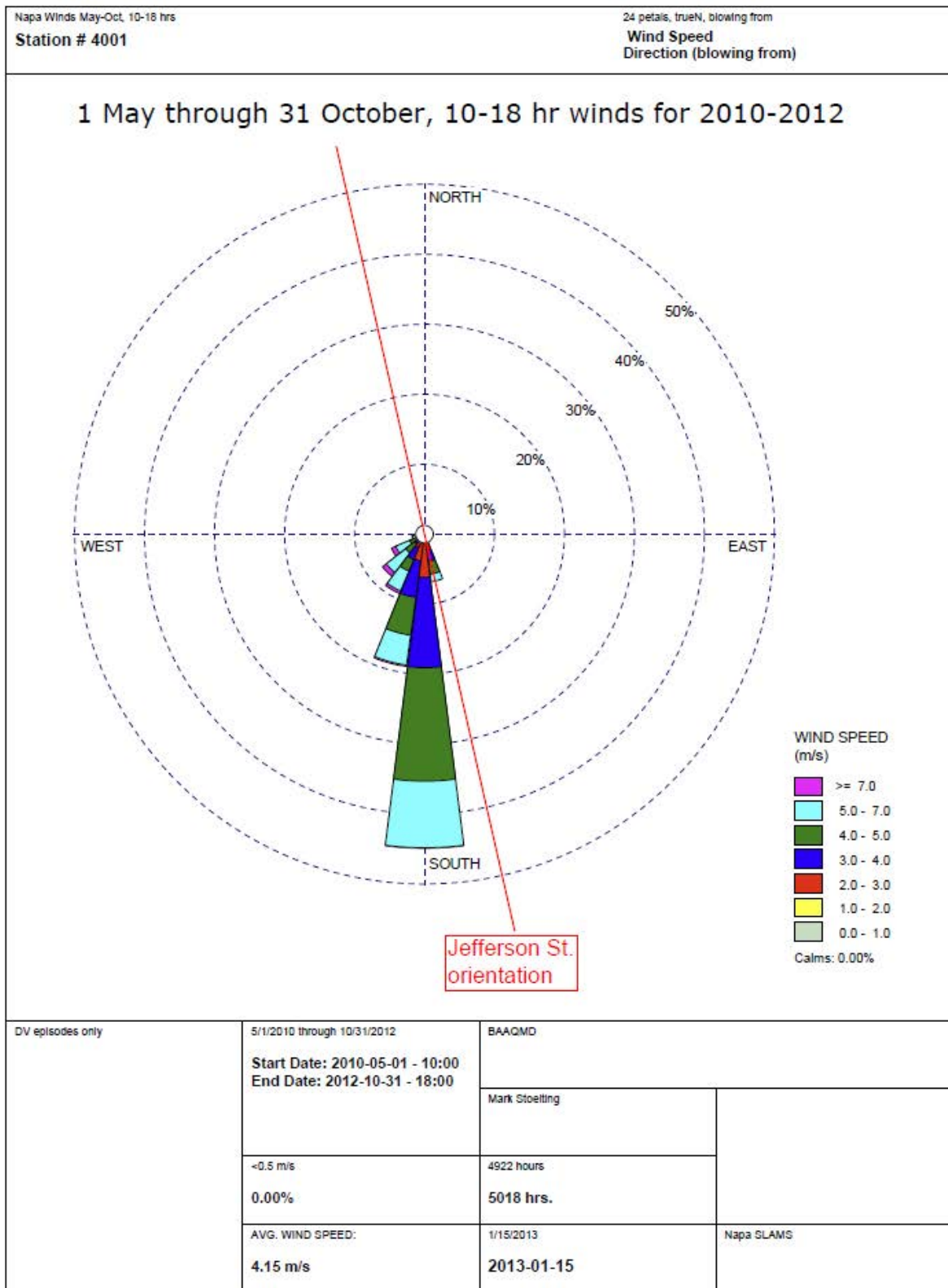
(impact)					
High O3 (no impact)	59		1.4	8.5	
Parallel winds	99	4.2	2.0	5.6	39.9
Cross winds	99	4.8	1.8	2.5	40.0

The average NO concentrations show that very little NO exists during the targeted hours regardless of the wind direction. All averages are 2 ppb or less, well below the 10 ppb minimum detection limit of the instrumentation. During high ozone events, NO_x concentrations are virtually identical between measurements impacted by Jefferson St, and those that were not. Winds blowing across Jefferson St. had *lower* average NO_x concentrations than those parallel. Annual decreases in measured NO concentrations indicate mobile fleet NO_x emission controls are having the desired result. The trend indicates continued concentration reductions will occur as the vehicular fleet modernizes (with reduced Jefferson St. impact).

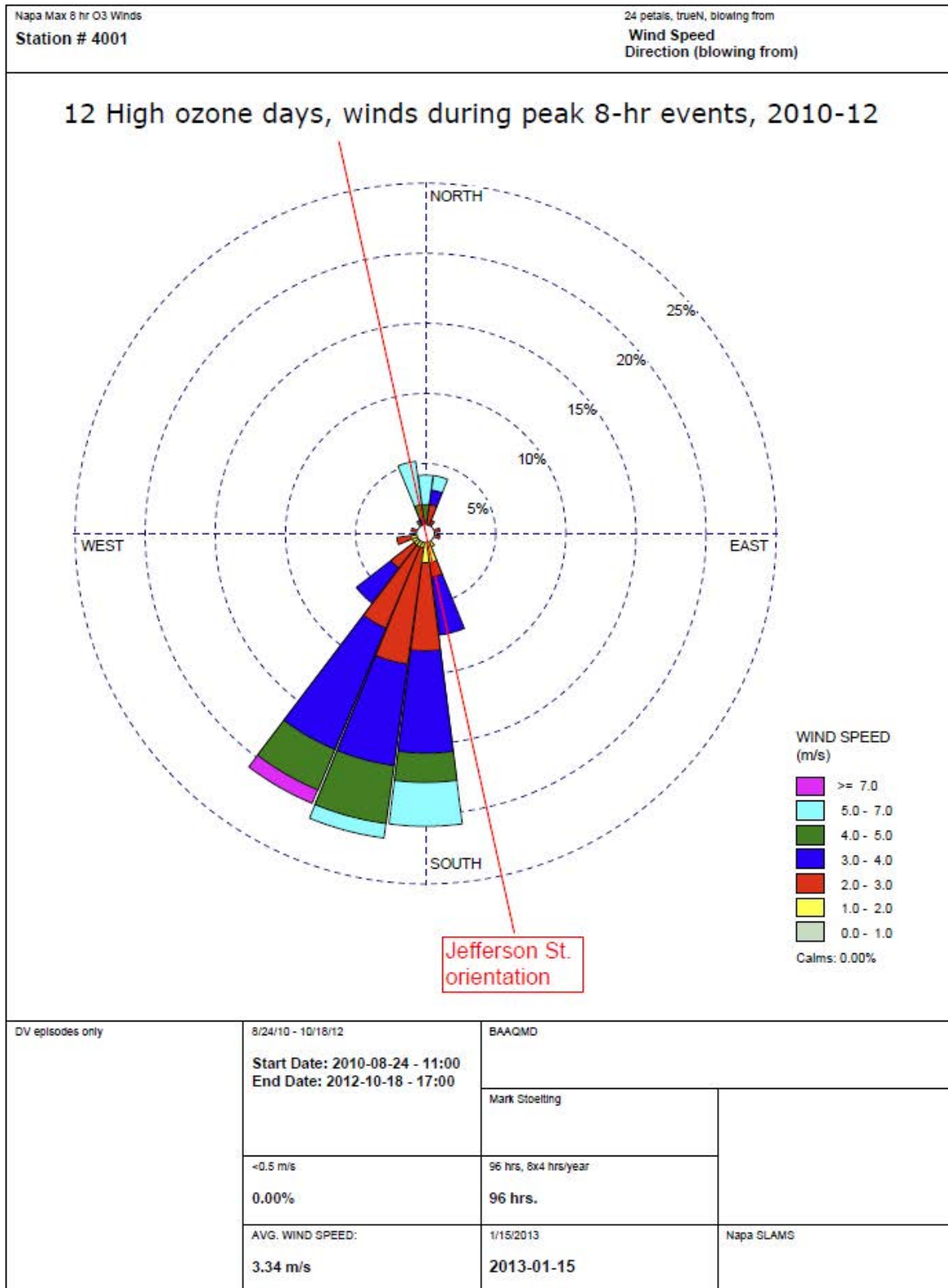
The premise that Jefferson St. mobile sources are titrating high ozone concentrations is not supported by the low NO concentrations measured regardless of wind direction. Further supporting this argument are a series of annual NO pollution roses for May 1-October 31, hours 10 through 18. The roses during 2010 through 2012 show a monotonic NO reduction as the vehicular fleet modernizes with increasingly stringent NO_x emissions. These roses show significantly less NO than a similar rose constructed for 2004. NO_x impact from Jefferson St. will continue to decrease as mobile emissions are further reduced over time.

In summary, the Bay Area Air Quality Management District asserts that high ozone measurements in Napa are driven by transport from ozone precursor sources to the south, and enhanced by greater Napa area emissions. Wind patterns and concentration data presented here show that Jefferson St. NO_x emissions have minimal impact on high ozone values and that Neighborhood scale ozone measurements are collected at the current location. Bay Area requests a Region 9 waiver to qualify Napa as a SLAMS monitoring site to meet the minimum network monitoring requirements for ozone.

Prevailing winds.pdf



HiO3 Rose 2010-12.pdf



Peak O3 hrs spreadsheet from max 8-hr zone.xlsx Excel workbook.

WD during highest four Napa 8-hr O3 days for 2010-12 (96 hrs)

Winds during maximum ozone days

Date (LST)	WDir	WSpd	Jeff St impact?	effective dist to St	NO	NO2	NO2/NO
8/24/2010 11:00	217	2.4	yes	19.9	2.0	12.0	6.0
8/24/2010 12:00	223.4	2.8	yes	18.2	1.0	10.0	10.0
8/24/2010 13:00	213.5	3	yes	21.0	1.0	9.0	9.0
8/24/2010 14:00	218.4	3	yes	19.5	2.0	11.0	5.5
8/24/2010 15:00	212.2	2.9	yes	21.5	2.0	10.0	5.0
8/24/2010 16:00	203	2.7	yes	26.2	2.0	8.0	4.0
8/24/2010 17:00	177.8	2.2		30.0	1.0	10.0	10.0
8/24/2010 18:00	169.8	2.2		30.0	0.0	16.0	999
9/25/2010 10:00	228.5	1.4	yes	17.2	3.0	10.0	3.3
9/25/2010 11:00	239.9	1.8	yes	15.8	1.0	7.0	7.0
9/25/2010 12:00	253.3	1.9	yes	15.1	1.0	6.0	6.0
9/25/2010 13:00	226	3.8	yes	17.7	1.0	5.0	5.0
9/25/2010 14:00	216.8	3.5	yes	19.9	2.0	6.0	3.0
9/25/2010 15:00	220.5	3.2	yes	18.9	1.0	4.0	4.0
9/25/2010 16:00	211.4	2.9	yes	21.8	1.0	5.0	5.0
9/25/2010 17:00	195.4	2.7		30.0	2.0	6.0	3.0
9/27/2010 10:00	147.7	1.3		30.0	6.0	14.0	2.3
9/27/2010 11:00	207.3	2.4	yes	23.7	4.0	13.0	3.3
9/27/2010 12:00	201	3	yes	27.5	2.0	10.0	5.0
9/27/2010 13:00	214.3	3.2	yes	20.7	2.0	12.0	6.0
9/27/2010 14:00	206.9	3.1	yes	23.9	2.0	14.0	7.0
9/27/2010 15:00	203.6	3.2	yes	25.8	3.0	13.0	4.3
9/27/2010 16:00	194.8	2.6		30.0	2.0	13.0	6.5
9/27/2010 17:00	159.4	1.8		30.0	4.0	28.0	7.0
9/28/2010 11:00	211.6	1.8	yes	21.8	2.0	12.0	6.0
9/28/2010 12:00	199	2.6	yes	29.1	1.0	8.0	8.0
9/28/2010 13:00	191.8	3.5		30.0	1.0	8.0	8.0
9/28/2010 14:00	196.5	3		30.0	2.0	12.0	6.0
9/28/2010 15:00	182.9	2.3		30.0	2.0	11.0	5.5
9/28/2010 16:00	194.5	2.4		30.0	2.0	15.0	7.5
9/28/2010 17:00	168.4	3		30.0	2.0	19.0	9.5
9/28/2010 18:00	176.9	1.8		30.0	1.0	19.0	19.0
6/21/2011 10:00	184.4	3		30.0	2.6	8.9	3.4
6/21/2011 11:00	189.1	2.9		30.0	2.0	9.4	4.7
6/21/2011 12:00	184.3	3.3		30.0	1.6	8.1	5.1
6/21/2011 13:00	189.8	4		30.0	1.1	7.0	6.4
6/21/2011 14:00	183.7	4.8		30.0	1.2	7.7	6.4
6/21/2011 15:00	185.8	5.4		30.0	1.0	6.9	6.9
6/21/2011 16:00	177.7	5.8		30.0	1.6	7.2	4.5
6/21/2011 17:00	177.5	5.6		30.0	1.2	7.3	6.1
8/23/2011 11:00	187.1	2.7		30.0	2.4	7.8	3.3
8/23/2011 12:00	184.9	3.3		30.0	1.6	7.9	4.9
8/23/2011 13:00	193.4	3.9		30.0	1.5	7.5	5.0
8/23/2011 14:00	197.4	4.4		30.0	2.3	9.1	4.0
8/23/2011 15:00	201.8	4.3	yes	27.0	2.0	8.2	4.1
8/23/2011 16:00	203	4.1	yes	26.2	1.5	7.2	4.8
8/23/2011 17:00	186.8	3.4		30.0	1.3	8.2	6.3
8/23/2011 18:00	168.4	3.1		30.0	0.6	10.3	17.2

WD during highest four Napa 8-hr O3 days for 2010-12 (96 hrs)

Winds during maximum ozone days

Date (LST)	WDir	WSpd	Jeff St impact?	effective dist to St	NO	NO2	NO2/NO
9/19/2011 11:00	225.6	2.2	yes	17.8	1.4	7.5	5.4
9/19/2011 12:00	216.4	3.1	yes	20.1	1.4	8.5	6.1
9/19/2011 13:00	212.8	3.4	yes	21.3	1.3	9.4	7.2
9/19/2011 14:00	203.9	3.3	yes	25.6	2.2	9.6	4.4
9/19/2011 15:00	197.4	3.4		30.0	2.0	8.8	4.4
9/19/2011 16:00	187.2	3.3		30.0	1.7	10.4	6.1
9/19/2011 17:00	202.5	2.9		30.0	2.0	11.4	5.7
9/19/2011 18:00	167.5	3.4		30.0	0.7	10.0	14.3
9/28/2011 12:00	251.7	2.2	yes	15.1	1.6	7.4	4.6
9/28/2011 13:00	286	2.4	yes	17.0	1.7	6.8	4.0
9/28/2011 14:00	209.1	4.5	yes	22.8	1.1	6.5	5.9
9/28/2011 15:00	209.2	3.6	yes	22.8	1.7	8.2	4.8
9/28/2011 16:00	200.2	3	yes	28.1	1.4	7.6	5.4
9/28/2011 17:00	188.8	1.7		30.0	1.0	14.2	14.2
9/28/2011 18:00	159	1.8		30.0	0.5	21.3	42.6
9/28/2011 19:00	175.1	1.9		30.0	0.4	15.7	39.3
5/5/2012 11:00	357.9	4.9		30.0	1.2	3.4	2.8
5/5/2012 12:00	348.5	5.5		30.0	1.3	3.6	2.8
5/5/2012 13:00	343.7	5		30.0	0.8	3.1	3.9
5/5/2012 14:00	342.2	5.2		30.0	0.7	3.0	4.3
5/5/2012 15:00	333.8	4.6		30.0	0.7	2.8	4.0
5/5/2012 16:00	345.4	4.7		30.0	0.6	3.4	5.7
5/5/2012 17:00	355.3	4.9		30.0	0.4	3.0	7.5
5/5/2012 18:00	10	2.9		30.0	0.0	2.6	999
5/6/2012 10:00	13.9	5.3		30.0	1.0	2.5	2.5
5/6/2012 11:00	355.8	5.5		30.0	0.8	2.7	3.4
5/6/2012 12:00	355.9	5.3		30.0	0.6	2.0	3.3
5/6/2012 13:00	348.5	3.9		30.0	0.4	2.1	5.3
5/6/2012 14:00	16	3.2		30.0	0.3	2.0	6.7
5/6/2012 15:00	31.1	2.5		30.0	0.1	1.3	13.0
5/6/2012 16:00	21.8	2.4		30.0	0.0	1.0	999
5/6/2012 17:00	201.7	3.5	yes	27.0	0.1	2.0	20.0
9/30/2012 11:00	176.2	2.2		30.0	1.3	5.9	4.5
9/30/2012 12:00	190.9	2		30.0	1.2	5.6	4.7
9/30/2012 13:00	197.9	2.6		30.0	0.6	3.7	6.2
9/30/2012 14:00	179.3	3		30.0	1.5	5.5	3.7
9/30/2012 15:00	176.2	2.9		30.0	1.6	7.8	4.9
9/30/2012 16:00	185.2	3.1		30.0	0.7	7.6	10.9
9/30/2012 17:00	165.2	3.3		30.0	0.3	9.5	31.7
9/30/2012 18:00	180.5	2.5		30.0	0.4	13.4	33.5
10/18/2012 10:00	82.2	2.9		30.0	6.3	16.7	2.7
10/18/2012 11:00	105	2.3		30.0	1.0	5.1	5.1
10/18/2012 12:00	200.1	2.9	yes	28.2	1.1	5.1	4.6
10/18/2012 13:00	206	4.8	yes	24.4	1.2	5.6	4.7
10/18/2012 14:00	208.8	7.3	yes	23.0	1.3	6.0	4.6
10/18/2012 15:00	199.3	6.6	yes	28.9	1.3	5.8	4.5
10/18/2012 16:00	189.8	4.8		30.0	1.7	8.0	4.7
10/18/2012 17:00	180.3	4.4		30.0	1.3	7.6	5.8

Hrs 10-18 worksheet from Parallel wind days.xlsm Excel workbook.

Napa winds parallel to Jefferson St.

Hours 10-18 from selected days							
Date (LST)	WDir	WSpd	NO	NO2	NO2/NO	O3	
5/2/2012 10:00	338.6	4.4	2	3		2	54
5/2/2012 11:00	338.2	4.9	2	3		2	58
5/2/2012 12:00	338.9	6.3	2	3		2	64
5/2/2012 13:00	345.7	7.3	2	3		2	69
5/2/2012 14:00	351.3	5.8	1	3		3	70
5/2/2012 15:00	352.5	5.1	1	3		3	70
5/2/2012 16:00	186.1	3.5	1	3		3	68
5/2/2012 17:00	176.1	2.5	1	4		4	62
5/2/2012 18:00	156.8	2.3	1	5		5	47
6/29/2012 10:00	181.5	2.3	4	5		1	29
6/29/2012 11:00	176	2.4	3	5		2	35
6/29/2012 12:00	175.7	3.6	3	6		2	39
6/29/2012 13:00	172.9	4.1	3	6		2	40
6/29/2012 14:00	179.7	6.2	3	6		2	39
6/29/2012 15:00	156.3	6.3	3	6		2	37
6/29/2012 16:00	156	6.3	3	6		2	35
6/29/2012 17:00	162.3	6.8	2	6		3	33
6/29/2012 18:00	162.9	6.6	2	5		3	30
5/11/2012 10:00	175.2	2.5	2.5	8.3		3	41.7
5/11/2012 11:00	177.8	3.5	2.9	10.5		4	45.7
5/11/2012 12:00	180	4	3	11.5		4	49
5/11/2012 13:00	177.9	4.2	2.3	9.1		4	55.9
5/11/2012 14:00	185.4	4.8	2.1	8.8		4	58.1
5/11/2012 15:00	178.6	5	2	8.4		4	55.4
5/11/2012 16:00	175.4	4.8	2.4	8.5		4	47.7
5/11/2012 17:00	161.9	4.6	1.3	7.7		6	46.2
5/11/2012 18:00	157.1	5.1	0.6	8.5		14	43.4
7/7/2012 10:00	185.6	2.5	2.1	5.1		2	28.9
7/7/2012 11:00	183.4	3.1	1.4	5.7		4	36.6
7/7/2012 12:00	174	3.7	1.1	5.5		5	45.8
7/7/2012 13:00	178.9	4.3	0.8	5.4		7	53.7
7/7/2012 14:00	184.3	4.7	1	6.2		6	53.5
7/7/2012 15:00	173.7	4.9	0.9	5.2		6	49.2
7/7/2012 16:00	156.5	4.9	0.5	2.8		6	55.3
7/7/2012 17:00	168.7	4.7	0.9	3.8		4	45.6
7/7/2012 18:00	166.3	5.3	0.7	3.9		6	36.4
8/6/2012 10:00	157.2	1.8	3.1	3.7		1	21.4
8/6/2012 11:00	177.1	3.1	2.1	3.8		2	27.6
8/6/2012 12:00	184.4	3.8	1.5	4		3	34.6
8/6/2012 13:00	170	3.8	1.7	5.2		3	37.9
8/6/2012 14:00	171.6	4.6	1.2	4.4		4	42.2
8/6/2012 15:00	170.8	4.3	2.3	4.7		2	38.8
8/6/2012 16:00	177	4.5	2.7	3.8		1	33
8/6/2012 17:00	178.6	4.6	2.2	4.6		2	28.9

Napa winds parallel to Jefferson St.

		Hours 10-18 from selected days					
Date (LST)		WDir	WSpd	NO	NO2	NO2/NO	O3
8/6/2012 18:00	175.8	4.4	1.2	3.8		3	24
8/7/2012 10:00	171.2	3.1	4.4	6.3		1	21.4
8/7/2012 11:00	172.9	3.2	4.2	6.7		2	25.6
8/7/2012 12:00	179.4	4.1	2.8	6		2	31.9
8/7/2012 13:00	185.1	4.9	1.8	5		3	36.1
8/7/2012 14:00	172.8	5.6	2	4.5		2	35.5
8/7/2012 15:00	167.9	5.2	2.1	4.2		2	31.7
8/7/2012 16:00	165.5	5.6	2.4	3.5		1	31.3
8/7/2012 17:00	173.7	5.4	1.5	3.6		2	28.7
8/7/2012 18:00	166.7	5.7	1.1	3.6		3	26.3
8/16/2012 10:00	168.6	2.6	n/a	n/a			
8/16/2012 11:00	178.2	3.2	n/a	n/a			
8/16/2012 12:00	180.5	3.7	n/a	n/a			
8/16/2012 13:00	174.8	4.3	1.5	5.4		4	46.2
8/16/2012 14:00	177.6	4.5	1.9	6.3		3	45.4
8/16/2012 15:00	177.3	5.1	1.1	4.8		4	44.7
8/16/2012 16:00	168.4	5.2	1.5	5.1		3	39.5
8/16/2012 17:00	173.1	4.8	0.8	4.3		5	38.9
8/16/2012 18:00	164.6	4.6	0.6	4		7	33.1
9/7/2012 10:00	179.3	2.2	3.7	7.3		2	30.4
9/7/2012 11:00	167.7	3.1	1.7	4.5		3	38
9/7/2012 12:00	176	3.6	1.6	4.5		3	41.2
9/7/2012 13:00	174.1	3.7	1.7	5.6		3	43.9
9/7/2012 14:00	176.1	4.3	2.3	7.1		3	45.5
9/7/2012 15:00	173.5	5	2.3	7.1		3	45.5
9/7/2012 16:00	169	5.2	1.5	6.2		4	40.4
9/7/2012 17:00	169.4	5.2	1.6	7.3		5	34.6
9/7/2012 18:00	174.5	4.2	1.1	6.3		6	31.6
9/14/2012 10:00	176.5	3	3.7	4.7		1	27.2
9/14/2012 11:00	176.1	4	2	4.3		2	33.3
9/14/2012 12:00	179.3	3.7	3.1	6.1		2	34.6
9/14/2012 13:00	174.6	3.7	2.3	6.6		3	38.3
9/14/2012 14:00	179.5	4.3	2.1	6.3		3	41.6
9/14/2012 15:00	175.1	4.6	4.5	9.4		2	38.7
9/14/2012 16:00	166.3	5	4.1	6.9		2	36
9/14/2012 17:00	165.8	4.9	1.1	6.4		6	33.8
9/14/2012 18:00	162.3	4.2	0.9	7		8	30
9/15/2012 10:00	172.8	2.1	3.3	4.3		1	28
9/15/2012 11:00	173.7	2.3	2.5	3.8		2	30.8
9/15/2012 12:00	172.5	2.7	1.7	4.2		2	34.8
9/15/2012 13:00	172.3	3.1	1.5	4.9		3	39.3
9/15/2012 14:00	176.2	3.8	1.5	6.3		4	43.2
9/15/2012 15:00	175.4	3.5	1.5	6.4		4	43.2
9/15/2012 16:00	183.1	3.9	2	6		3	39.8

Napa winds parallel to Jefferson St.

Hours 10-18 from selected days						
Date (LST)	WDir	WSpd	NO	NO2	NO2/NO	O3
9/15/2012 17:00	177	4.1	1.4	5.4	4	33.1
9/15/2012 18:00	159.2	4	1.2	6.2	5	28.1
9/20/2012 10:00	168.7	2.2	n/a	n/a		
9/20/2012 11:00	172.8	2.5	n/a	n/a		
9/20/2012 12:00	174	3.3	n/a	n/a		
9/20/2012 13:00	180.4	4.1	n/a	n/a		
9/20/2012 14:00	178.1	4.7	4.1	9.5	2	34.7
9/20/2012 15:00	172.2	4.5	2.9	7.3	3	35.6
9/20/2012 16:00	166	5	2.7	7.3	3	32.6
9/20/2012 17:00	167	4.4	1.8	7.3	4	29.2
9/20/2012 18:00	158.8	4.2	0.9	9	10	25.8
averages:		4.2	2.0	5.6		39.9

Hrs 10-18 worksheet from Crosswind days.xlsx Excel workbook.

Napa winds perpendicular to Jefferson St.

Hours 10-18 from selected days						
Date (LST)	WDir	WSpd	NO	NO2	NO2/NO	O3
5/9/2010 10:00	247	4	2	2	1	42
5/9/2010 11:00	238.5	6	1	2	2	44
5/9/2010 12:00	256.3	5.4	2	2	1	41
5/9/2010 13:00	245.7	4.6	2	2	1	41
5/9/2010 14:00	248.4	5.3	2	3	2	40
5/9/2010 15:00	259.2	5.7	1	2	2	42
5/9/2010 16:00	254.6	4.7	1	2	2	43
5/9/2010 17:00	241.9	4.4	1	2	2	42
5/9/2010 18:00	243.1	4.3	1	2	2	40
5/10/2010 10:00	220	7	3	4	1	34
5/10/2010 11:00	215.3	6.4	4	5	1	38
5/10/2010 12:00	324.6	4.5	2	4	2	44
5/10/2010 13:00	195.8	2.9	3	4	1	43
5/10/2010 14:00	256.7	5.8	5	4	1	43
5/10/2010 15:00	274.9	6.3	3	2	1	43
5/10/2010 16:00	257.8	4.3	3	3	1	42
5/10/2010 17:00	292.7	3	3	3	1	42
5/10/2010 18:00	259.4	3.5	2	3	2	44
5/21/2010 10:00	275.1	4.6	3	3	1	39
5/21/2010 11:00	266.8	4.9	4	3	1	38
5/21/2010 12:00	249.5	6.3	3	3	1	39
5/21/2010 13:00	247.1	5.4	3	3	1	40
5/21/2010 14:00	254.8	6.4	4	3	1	40
5/21/2010 15:00	243	7.8	4	2	1	41
5/21/2010 16:00	242.7	7.1	3	4	1	40
5/21/2010 17:00	243.1	6.9	3	3	1	39
5/21/2010 18:00	241.5	5	2	3	2	39
5/23/2010 10:00	336.8	3.6	3	2	1	38
5/23/2010 11:00	303.4	3.2	2	2	1	39
5/23/2010 12:00	275.2	4.1	2	2	1	39
5/23/2010 13:00	260.8	5.7	2	2	1	38
5/23/2010 14:00	248.1	6.9	2	2	1	38
5/23/2010 15:00	244.5	7.6	1	2	2	39
5/23/2010 16:00	240	7.1	2	2	1	37
5/23/2010 17:00	235.3	6.4	2	2	1	36
5/23/2010 18:00	241.4	5.4	1	3	3	36
5/26/2011 10:00	283.9	2.3	1.6	3.9	2	42.8
5/26/2011 11:00	234.7	3.8	2.5	3.2	1	45.4
5/26/2011 12:00	240	4.6	1.4	2.5	2	45.7
5/26/2011 13:00	260	4.4	1.1	2.2	2	45.6
5/26/2011 14:00	239.5	5.9	2	2.8	1	43.1
5/26/2011 15:00	255.7	6.1	2	2.2	1	40.8
5/26/2011 16:00	258.8	4.9	1.6	2.4	2	39.7
5/26/2011 17:00	254.5	4.6	1.7	1.8	1	38.7

Napa winds perpendicular to Jefferson St.

Hours 10-18 from selected days						
Date (LST)	WDir	WSpd	NO	NO2	NO2/NO	O3
5/26/2011 18:00	240.7	3.3	1.8	2.5	1	36.7
5/27/2011 10:00	224.8	3.7	n/a	n/a		
5/27/2011 11:00	251.7	3.8	n/a	n/a		
5/27/2011 12:00	237.3	4.9	n/a	n/a		
5/27/2011 13:00	231.9	5.7	1.3	1.5	1	44.5
5/27/2011 14:00	233.5	5.8	1.3	1.4	1	43.3
5/27/2011 15:00	243.5	5.7	1.4	1.4	1	42.6
5/27/2011 16:00	259.9	5.5	1.4	1.4	1	42.8
5/27/2011 17:00	249.2	5.4	1.6	1.3	1	43.5
5/27/2011 18:00	246.3	3.9	0.9	1.5	2	42
5/28/2011 10:00	221.9	5.3	1	1.6	2	44.2
5/28/2011 11:00	240.2	6.6	1.2	1.2	1	44.1
5/28/2011 12:00	239.1	5.4	1.1	1.3	1	44.5
5/28/2011 13:00	264.7	5.2	0.8	1.5	2	45
5/28/2011 14:00	265.4	4.1	1.4	1.5	1	40.4
5/28/2011 15:00	236	2.6	1.7	2.8	2	39.4
5/28/2011 16:00	326.1	1.2	0.7	2.5	4	36.2
5/28/2011 17:00	265.5	2.2	1.4	2.9	2	35.2
5/28/2011 18:00	230.2	3.5	0.6	1.6	3	37.4
9/11/2011 10:00	270.4	2.7	1	1.9	2	37.2
9/11/2011 11:00	276.4	2.9	0.9	1.9	2	38.7
9/11/2011 12:00	256.2	3.1	1.3	2.3	2	40.6
9/11/2011 13:00	253.5	3.5	1.1	2	2	42.4
9/11/2011 14:00	241.3	4.1	0.6	1.9	3	44
9/11/2011 15:00	231.3	4.5	0.8	2.2	3	44
9/11/2011 16:00	214.4	4.6	0.6	1.9	3	43.6
9/11/2011 17:00	220.7	3.8	0.5	2.9	6	43.6
9/11/2011 18:00	226.4	3.5	1.1	3.5	3	39.5
5/23/2012 10:00	191.3	1.9	1.3	4.7	4	41.9
5/23/2012 11:00	244.5	1.5	1.3	3.6	3	46
5/23/2012 12:00	264.2	3.3	1.1	2.2	2	48.4
5/23/2012 13:00	271.1	4.5	1.1	2.6	2	46.7
5/23/2012 14:00	247	6.6	1.5	4.2	3	45.1
5/23/2012 15:00	246.1	6.3	1.1	2.2	2	45.4
5/23/2012 16:00	245.7	5.5	1.1	2.2	2	42.5
5/23/2012 17:00	260.6	4.4	1	2.4	2	42.3
5/23/2012 18:00	285.3	3.9	0.7	2.2	3	40.6
6/4/2012 10:00	235.1	4.1	1.7	3.7	2	35.6
6/4/2012 11:00	232.1	4.6	2.5	3.7	1	36.4
6/4/2012 12:00	243.9	5.8	2.1	2.8	1	37.9
6/4/2012 13:00	250.4	6.3	1.2	2.1	2	38.4
6/4/2012 14:00	243.7	7.4	1.3	2.4	2	38.5
6/4/2012 15:00	244.7	7.4	1.3	2.4	2	38.5
6/4/2012 16:00	247.5	6.7	1.6	1.7	1	37.7

Napa winds perpendicular to Jefferson St.

Hours 10-18 from selected days						
Date (LST)	WDir	WSpd	NO	NO2	NO2/NO	O3
6/4/2012 17:00	257.8	5.5	0.7	1.7	2	38.1
6/4/2012 18:00	259.2	4.7	0.9	1.5	2	37
10/5/2012 10:00	234.5	4.1	n/a	n/a		
10/5/2012 11:00	246.5	4.2	2.3	2.6	1	31
10/5/2012 12:00	265.9	3.9	2.4	2.9	1	31.2
10/5/2012 13:00	242.6	4.7	1.8	2.1	1	32.2
10/5/2012 14:00	250.5	5.1	2.2	2.4	1	31.2
10/5/2012 15:00	236.3	5.6	2.1	2.2	1	30.3
10/5/2012 16:00	245.9	4.8	2.7	2.7	1	29
10/5/2012 17:00	258.2	3.3	1.3	2.8	2	28.6
10/5/2012 18:00	203.4	2	2	4.7	2	25.7
		4.8	1.8	2.5		40.0

