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DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF AIR QUALITY, TOXICS PROTECTION BRANCH

AIR TOXICS ANALYTICAL SUPPORT TEAM

FIRE AT ENVIRONMENTAL QUALITY
APEX, NC

October 6-7, 2006

ATAST Response # 06020

Final Report
October 25, 2006

Dr. James Bowyer, Ph.D.
Dr. Reginald Jordan, Ph.D. CIH
Ms. Lorene Cherry, MSEH

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ACRONYMS

AEGL	Acute Exposure Guidelines
ATAST	Air Toxics Analytical Support Team
ATSDR	Agency for Toxic Substances and Disease Registry
EMEG	Environmental Media Evaluation Guide
EQ	Environmental Quality (facility)
Cal EPA	California Environmental Protection Agency
CaREL	California Acute Reference Exposure Levels
CO	carbon monoxide
Cl_2	chlorine
DAQ	Division of Air Quality
DENR	Department of Environment and Natural Resources
ERPG	Emergency Response Planning Guidelines
FTIR	Fourier-Transform Infrared Spectrophotometer
GC/MS	gas chromatograph/mass spectrophotometer
Hazmat	Hazardous Materials
HCN	hydrogen cyanide
H_2S	hydrogen sulfide
IC	Incident Command
LEL	lower explosive limit
MAML	mobile air monitoring laboratory
NC	North Carolina
NH_3	ammonia
NO	nitric oxide
NO_2	nitrogen dioxide
PH_3	phosphine
PM	particulate matter
ppb	part per billion
ppm	part per million
REL	Reference Exposure Level
SCAPA	Department of Energy Subcommittee on Consequence Assessment and Protective Actions
SO_2	sulfur dioxide
TEEL	Temporary Emergency Exposure Limits
UAT	Urban Air Toxics Network
VOC	Volatile Organic Compound

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1.0 Abstract

The North Carolina Division of Air Quality (DAQ) responded to requests for emergency monitoring to assess air quality resulting from a fire at the Environmental Quality hazardous waste facility in Apex, North Carolina. DAQ staff took measurements at 15 locations using continuous, real-time monitors for total volatile organic compounds, lower explosive limits (LELs), oxygen levels, chlorine, nitrogen dioxide, nitric oxide, phosphine, carbon dioxide, hydrogen sulfide, sulfur dioxide, hydrogen chloride, hydrogen cyanide and ammonia. DAQ also measured meteorological parameters at a height of 10 meters. In addition, staff collected air samples from locations in the evacuated areas of Apex and analyzed those samples using gas chromatography/mass spectroscopy. Analytical methods identified typical air pollution components at extremely low levels (part per billion). Concentrations of these constituents posed no apparent short-term air quality hazards and assisted emergency officials determine if the public could re-occupy evacuated areas.

2.0 Introduction

Shortly before 10:00 p.m. on October 5, 2006, fire crews were alerted to investigate a 'gas leak' at the Environmental Quality (EQ) facility at 1005 Investment Boulevard in Apex. Upon investigation, emergency responders discovered a fire at the facility that swiftly escalated, engulfing the facility and resulting in explosions fed from material contained at the plant. EQ is a hazardous waste treatment facility possessing an operating permit to treat, store, and dispose of a variety of industrial wastes, paints, household and other chemical waste such as spent solvents, pesticides and herbicides.

The Air Toxics Analytical Support Team (ATAST) was contacted at 12:10 a.m. October 6, 2006, and requested by Raleigh Hazmat to respond with air monitoring assistance. Seven[1] ATAST members departed at approximately 1:34 a.m. and arrived at approximately 1:50 a.m., reporting to Incident Command (IC) at the Department of Corrections Warehouse location on Schieffelin Road. ATAST deployed a mobile air-monitoring laboratory, an air monitoring equipment trailer, and a mobile Fourier-transform infrared spectrophotometer (FTIR) to this location. –After reporting to the IC, they awaited further instructions.[2]

At 3:42 a.m. on October 6, IC relayed a concern that law enforcement in the area of U.S. Highway 64/NC 55 intersection; they requested air-monitoring data from that area to ensure the safety of people in a nearby shelter. ATAST was prepared to deploy at that

[1] Dr. J. Bowyer, Mr. M. Reid, Mr. T. Pasley, Mr. T. Crawford, Ms. K. Clevenger, Dr. J. Holland and Ms. L. Cherry.
[2] As required by the National Incident Management System (NIMS), after reporting to the IC, the team becomes an asset subject to the authority of the IC until released.

time, but the IC required an escort from a hazmat unit in daylight hours for safety purposes. The hazmat unit's purpose was to determine if the location was safe for entry and to give the green light for air monitoring to begin. Once daybreak occurred and the hazmat unit completed their preparations, ATAST was escorted to a point near the Hwy 64/Hwy 55 intersection. The hazmat unit went forward to check on the area, but ATAST did not receive notice that the area was released for monitoring. Traffic had resumed on Hwy 55, the westernmost border of the evacuation area. At approximately 5:50am, incident command was moved to Laura Duncan Road north of US 64W.

ATAST contacted IC for permission to begin monitor deployment, and IC approved that request at 7:00am. Air quality monitoring was conducted from approximately 7:30am October 6 until noon on October 7. Weather conditions evolved from dry, cool conditions with a predominately light east wind to cool, wet conditions near dawn with winds ranging from the northwest to northeast. Wet conditions precluded the potential use of the FTIR and the instrument was released from mobilization. ATAST completed a shift change on October 6 around noon.[3]

Monitoring during the first stages of the event - when it might have been possible to identify some of the initial, toxic air contaminants was delayed due to the timing of the request for air monitoring assistance and with concern for the safety of the hazmat unit and the ATAST staff.

3.0 Ambient Air Testing

ATAST air monitoring is of most benefit when:

- Air-monitoring activities can aid in characterizing the degree of the hazard facing responders and the public during initial stages of response
- It can provide technical assistance to responders with tools such as air dispersion modeling, chemical review or meteorology.
- The team can coordinate with and provide technical support for decision-making or for information purposes.
- It can provide ongoing evaluation of air quality as conditions change to determine if airborne concentrations of pollutants are sufficiently safe for public re-occupancy.

Early reports indicated that a cloud of green gas that was characterized as chlorine gas had formed prior to and following the explosions. News media reports described people's experiences from a range of odors to different visual descriptions of the smoke plume. Odors were described as "chlorine", "sweet", "burned-rubber", and the smoke plume described as "greenish", "black" or "yellow". The plume constituent of most interest to Incident Command was particulate matter (PM). Effective monitoring of PM under emergency response situations had previously been identified by ATAST as a need and PM monitors have been ordered but had not been delivered before this incident. ATAST was unable to provide PM monitoring during the response.

Once ATAST received clearance from Incident Command to begin monitoring, the objective was to determine if areas were safe for public re-occupancy. Incident Command allowed ATAST to begin monitoring around the perimeter of the

[3] 8:30am Mr. J. Lowder, Ms. T. Colon
12:00pm Dr. R. Jordan, Ms. R. Barrows, Mr. G. Kangkolo, Mr. C. Bender

evacuation zones. The first monitoring location was sited at the most upwind location of the evacuation area with other sites gradually progressing closer to EQ. ATAST began one of three monitoring series using Rae Systems AreaRae® units. The AreaRae® units measured virtually continuous, near real-time values. While each unit measures total volatile organic compounds, lower explosive limits (LELs) and percent oxygen, the units are also individually configured to measure two additional chemicals. Measurements were made for chlorine, nitrogen dioxide, nitric oxide, phosphine, carbon dioxide, hydrogen sulfide, sulfur dioxide, hydrogen chloride, hydrogen cyanide and ammonia. Actual unit configurations are detailed in Table 6. Tables 1, 2 and 3 show the locations where the units were placed and the time each unit operated. Table 4 is a summary of all fifteen locations. Figures 1-3 show their map locations. More than 14,300 data points from the AreaRae® units were obtained during the response.

Table 1 Continuous Monitoring (AreaRae®) Series 1		
AreaRae #	**Location**	**Sample start time**
1	Williams St. & Olive Chapel Rd.	07:34 10/06/06
2	Williams St. at Jaycee Park Entrance	08:05 10/06/06
3	Williams St. & Upchurch St.	07:56 10/06/06
4	Williams St. at Apex Funeral Home	08:11 10/06/06
5	Williams St. & Salem St.	08:00 10/06/06

Table 2 Continuous Monitoring (AreaRae®) Series 2		
AreaRae #	**Location**	**Sample start time**
1	Salem St. & W. Moore St.	09:53 10/06/06
2	Salem St. & Center St.	10:20 10/06/06
3	Salem St. & Hunter St.	10:10 10/06/06
4	Salem St. & E. Chatham St.	09:56 10/06/06
5	Salem St. & Williams St.	10:00 10/06/06

Table 3 Continuous Monitoring (AreaRae®) Series 3		
AreaRae #	**Location**	**Sample start time**
1	Tingen St. & Salem St.	12:52 October 6
2	Tingen St. & James St.	12:53 October 6
3	Tingen St. & Sparta St.	12:59 October 6
4	S. Hughes St. & Perry Rd.	01:15 October 6
5	Hughes Sts. & James St.	01:18 October 6

To supplement the continuous measurements, eight discrete, or "grab," air samples were taken by filling 6-liter Tedlar air-sampling bag at various locations on October 6 and 7. These samples were analyzed with an Inficon gas chromatograph/mass spectrophotometer (GC/MS) system on the mobile laboratory. During emergency air monitoring episodes the focus is usually on greater than part per million (ppm) concentrations of toxic materials. However, some chemicals can be toxic at very small quantities that may be difficult to detect with some of the less sensitive monitoring

instrumentation used during response situations. Samples having sufficient sample volume after analysis by the Inficon GC/MS were analyzed a second time at the ATAST main laboratory in Raleigh, NC with a Varian Saturn 2000 GC/MS system having a lower detection level. Each sample was analyzed for a suite of 57 volatile organic compounds on both GC/MS systems. Table 5 is a listing of these sample locations and further discussion of the results are found elsewhere in this report.

The Incident Commander released ATAST from service at approximately 2:45 p.m. on October 7, 2006.

Table 4 Continuous Monitoring (AreaRae®) Summary			
AreaRae	**Series 1**	**Series 2**	**Series 3**
1	Williams St. & Olive Chapel Rd.	Salem St. & W. Moore St.	Tingen St. & Salem St.
2	Williams St. at Jaycee Park Entrance	Salem St. & Center St.	Tingen St. & James St.
3	Williams St. & Upchurch St.	Salem St. & Hunter St.	Tingen St. & Sparta St.
4	Williams St. at Apex Funeral Home	Salem St. & E. Chatham St.	S. Hughes St. & Perry Rd.
5	Williams St. & Salem St.	Williams St. & Salem St.	Hughes Sts. & James St.

Table 5 Air Sampling Times, Location, and Sample Number		
Time	**Location**	**Sample Number**
09:00 a.m. October 6	Olive Chapel Rd & Williams St	10060601
09:10 a.m. October 6	Williams St. & S. Salem St.	10060602
01:30 p.m. October 6	Williams St. & S. Salem St.	10060603
12:19 p.m. October 6	A.V.Baucom Elementary	10060605
01:02 p.m. October 6	Apex Elementary	10060606
01:08 p.m. October 6	HazMat Spl, Center Heights Court	10060604
07:55 a.m. October 7	S. Hughes & Perry Rd	10070603
07:58 a.m. October 7	S. Hughes and Williams St.	10070604

4.0 Air Sampling Data and Analysis

Air sampling was conducted in three distinct series of locations in the surrounding community using AreaRae samplers and Tedlar air sampling bags. These areas are shown in Figures 1-3. Meteorological data was also collected at the Mobile Air Monitoring Laboratory vehicle (MAML) at the two incident command centers and used to produce wind speed and direction graphs (wind roses Figures 4 to 9) and to correlate the wind direction to the sampling data.

In each series, AreaRaes were deployed at the various locations as shown in the figures and had the following configuration of sensors.

Table 6 AreaRae® Sensors and Sampling Locations

AreaRae	Sensors*	Series 1	Series 2	Series 3
1	Nitrogen dioxide (NO_2) Nitrogen oxide (NO) Volatile Organic Compounds (VOC) Oxygen (O2)	Hwy 55 (Williams St) & Olive Chapel St.	Salem St. & West Moore St.	Tingen St. & Salem St.
2	Ammonia (NH_3) Hydrogen cyanide (CN) Volatile Organic Compounds (VOC) Oxygen (O2)	Hwy 55 (Williams St) at Jaycee Park Entrance	Salem St. & Center St.	Tingen St. & James St.
3	Hydrogen sulfide (H_2S) Sulfur dioxide (SO_2) Volatile Organic Compounds (VOC) Oxygen (O2)	Hwy 55 (Williams St) & Upchurch St.	Salem St. & Hunter St.	Tingen St. & Sparta St.
4	Ammonia (NH_3) Carbon monoxide (CO) Volatile Organic Compounds (VOC) Oxygen (O2)	Hwy 55 (Williams St) at Apex Funeral Home	Salem St. & Chatham St.	Hughes St. & Perry St.
5	Chlorine (Cl_2) Phosphine (PH_3) Volatile Organic Compounds (VOC) Oxygen (O2)	Hwy 55 (Williams St) & Salem St.	Salem St. & Williams St.	Hughes St. & James St.
* Lower Explosion Limit (%LEL) was also monitored but was not pertinent given that the value is based on a known single compound being present in order to calculate a % value (this was not generally the case in fire related incidents) and O2 levels were not abnormal.				

Figure 1 – Map of Series 1 Sampler Locations

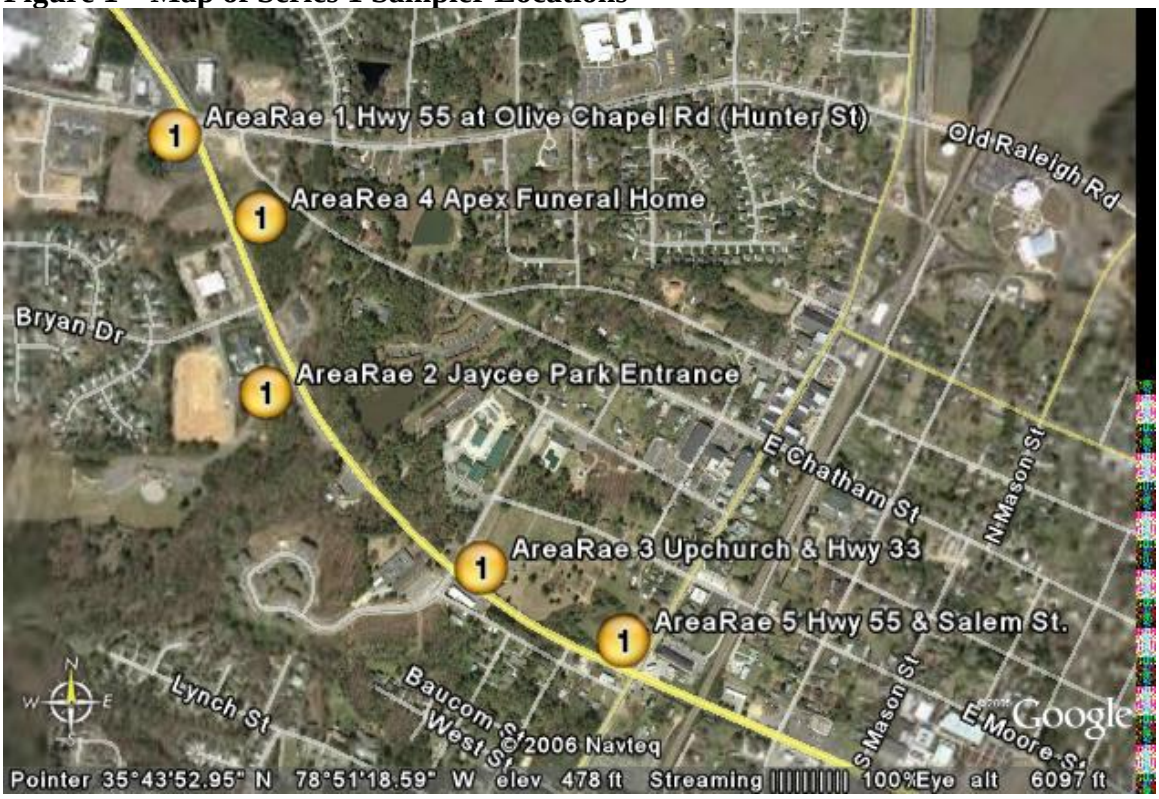


Figure 2 – Map of Series 2 Sampler Locations

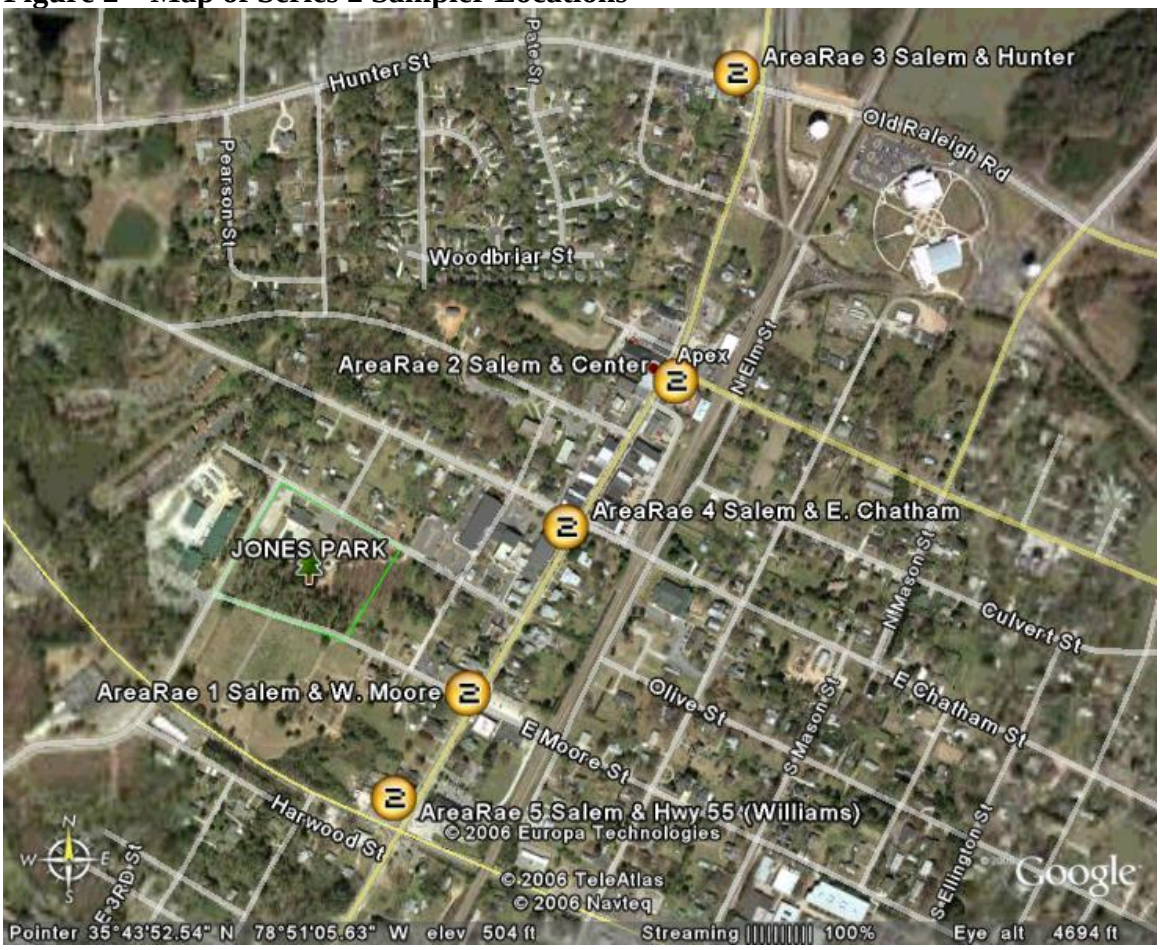
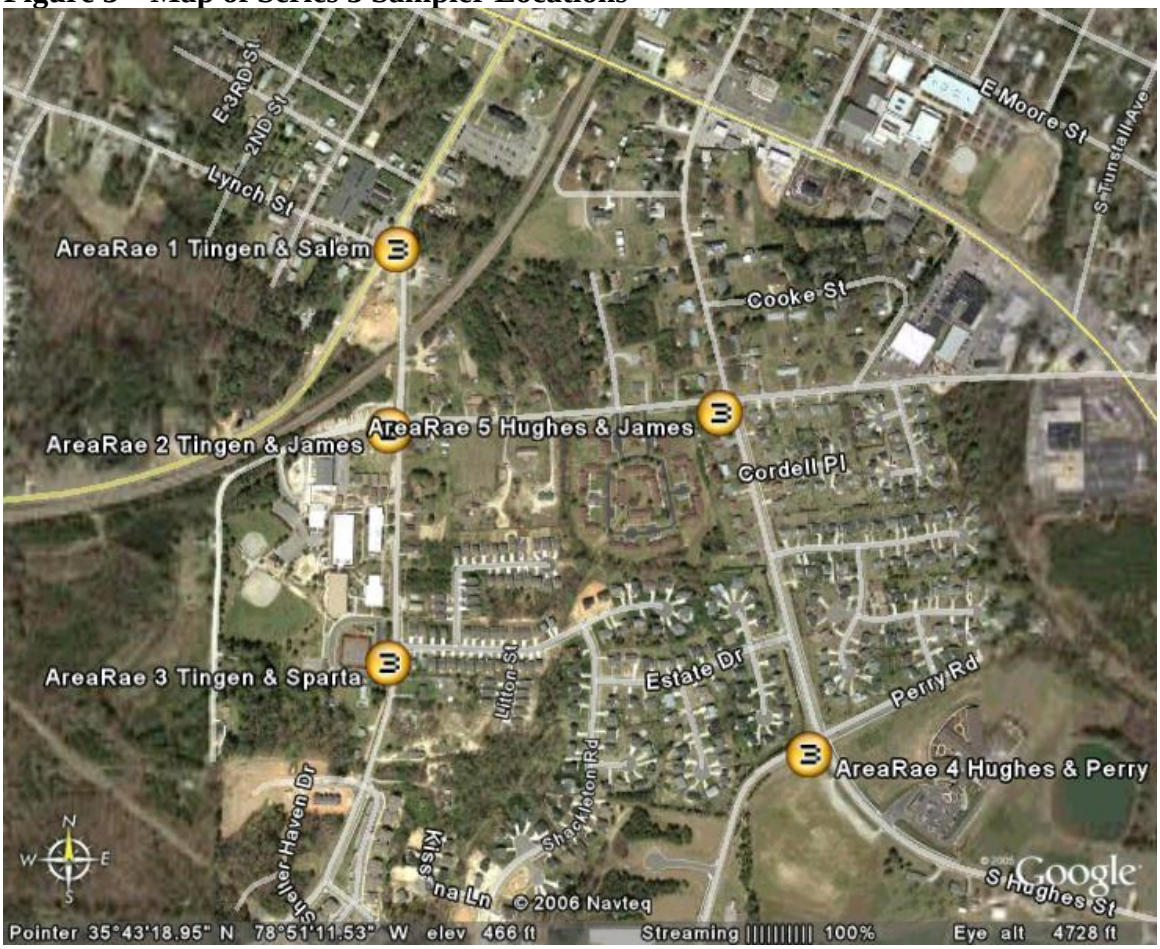


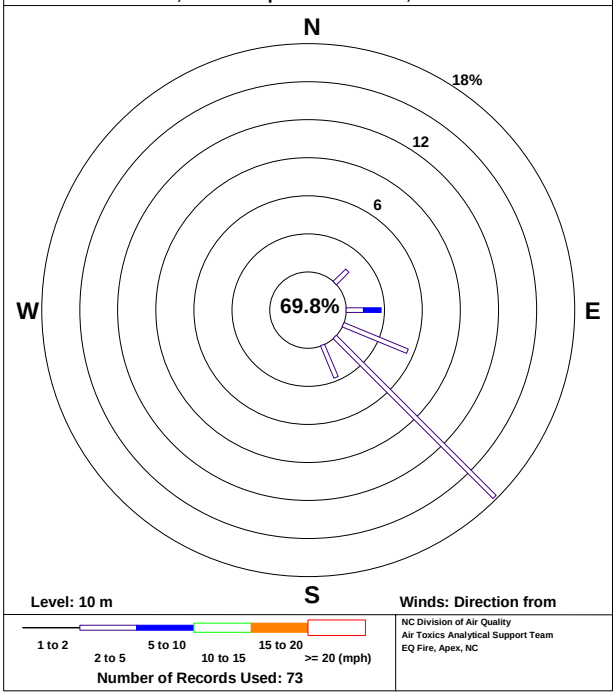
Figure 3 – Map of Series 3 Sampler Locations



4.1 Meteorological Data

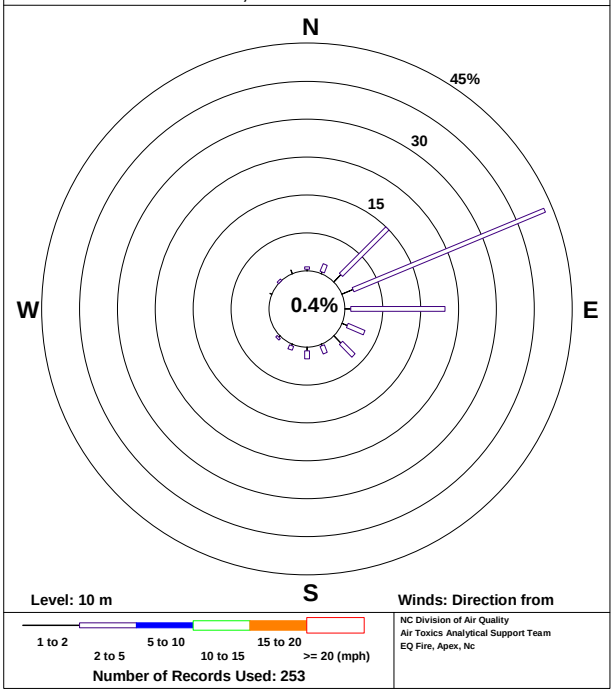
Meteorological data were used to produce the following wind roses. The wind direction is plotted as the direction from which the wind is blowing towards the sampling station. The meteorological data are divided into periods that correspond to the time periods from the beginning of the incident to ATAST meteorological station deployment through the individual sampling series and to the end of the deployment. As can be seen in the figures, the winds were changing direction associated with a low pressure from the southeast late on Thursday October 5 to the north and northeast quadrant through the event. This had the effect of pushing the plume associated with the incident initially to the northwest then gradually to the west and then south. This influenced the areas and extent of the evacuation.

Figure 4 Meteorological Data from Hadden Hall, Apex, NC WeatherUnderground Station
October 5, 2006 9:00pm to October 6, 2006 3:00am



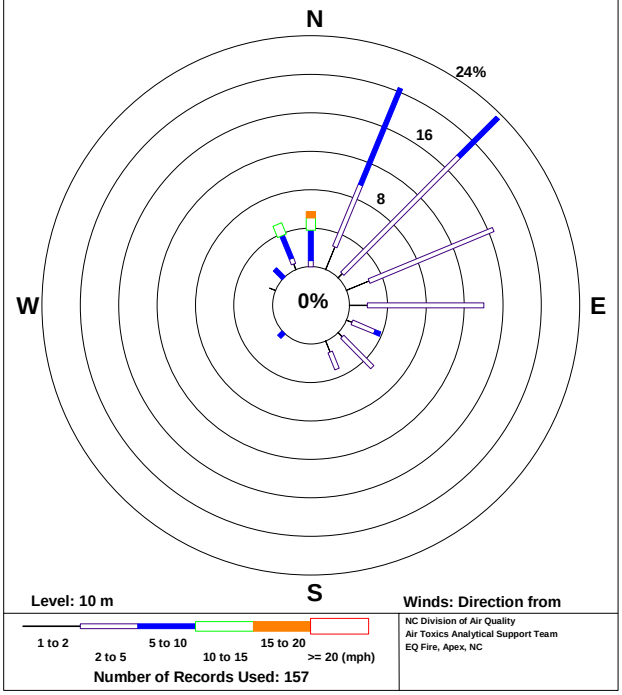
Number of Records Used: 73

Figure 5 Meteorological Data at Incident Commands 1 & 2
IC 1at DOC Warehouse Scheiffelin Rd, IC2 at Laura Duncan Rd/US 64W
October 6, 2006 from 3am - 7:30am



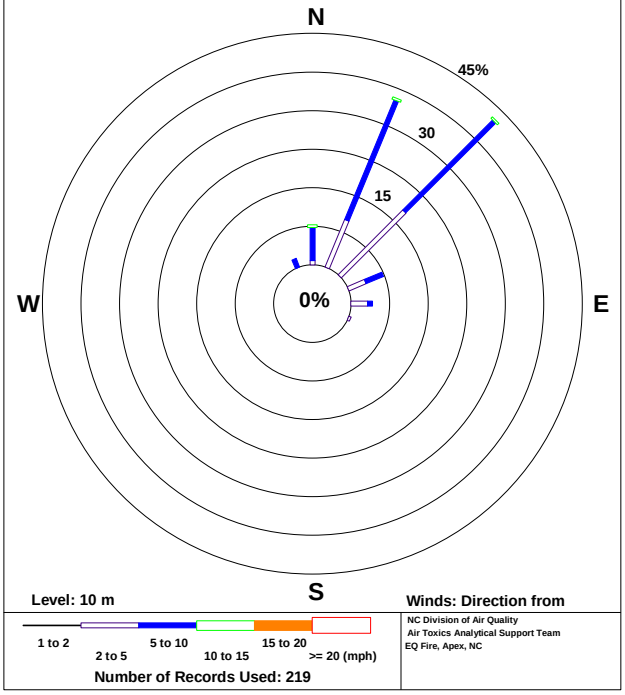
Number of Records Used: 253

Figure 6 Meteorological Data at Incident Command 2
October 6, 2006 7:30am - 10:00am

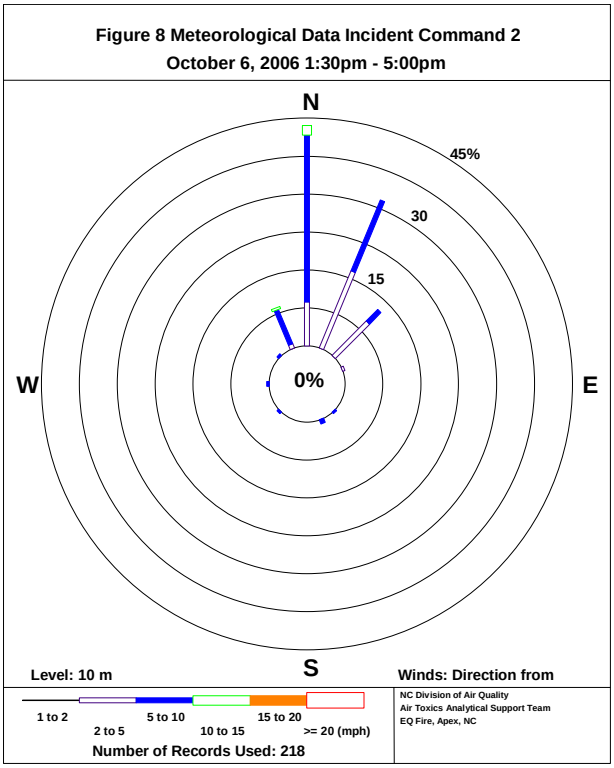


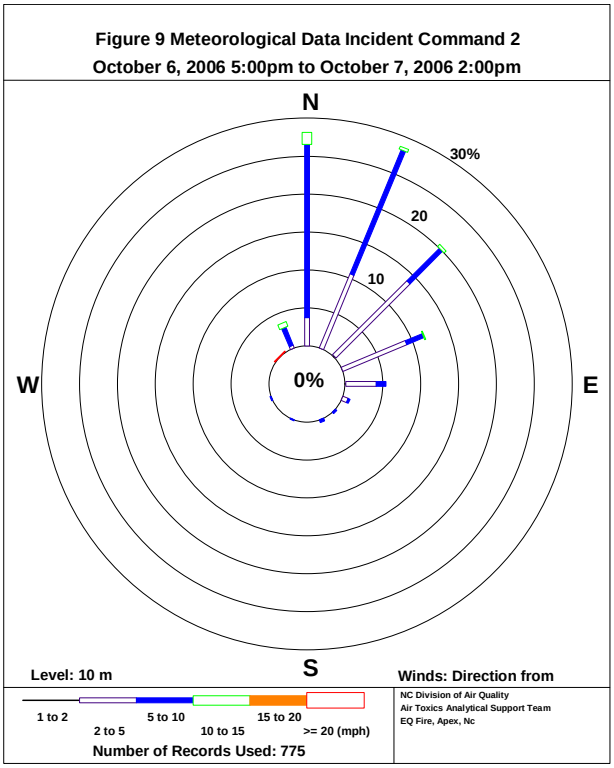
Number of Records Used: 157

Figure 7 Meteorological Data Incident Command 2
October 6, 2006 10:00am - 1:30pm



Number of Records Used: 219





The wind roses are read in the following manner: the central number is the percentage of data points that are less than the lowest range value, in this case winds below 1 mph. The overall ray lengths represent the percentage of the data points when the wind was from that particular direction and the individual sections of the ray indicate the percentage of the data points when the wind was within that particular wind speed range (as indicated by the color and width of the ray shown in the key at the bottom of the figure) from that wind direction. Example: Figure 9, winds were never below 1 mph (0%) during the sampling time. Winds came from the north 28% of the time and of that 28%, approximately 4% were 2-5mph, 23% were 5-10mph, and 1% were 10-15mph.

4.2 Continuous Monitoring Results

The results of the continuous monitors are presented in the following sections and are divided into the three series of sampling locations. The results are presented in Figures 10 to 57 and present the collected data from the various AreaRae monitors. On these figures it can be seen that no monitored concentration reached the Reference Exposure Limits (REL). A discussion of these RELs follows.

An examination of the ammonia data for AreaRae 2 (located at Jaycee Park entrance) and AreaRae 4 (located at the Apex Funeral Home) (see Figures 13 & 19), shows elevated ammonia concentrations at both locations, although not for the same time period. When coupled with the meteorological data (wind speed, wind direction) for the same time period (see Figures 25 and 27), it is observed that these ammonia measurements are not related to the EQ fire; rather they result from some other, uncharacterized source. It should also be noted that while ammonia measurements are elevated, one-hour averages of these measurements are approximately 1/3 of the screening level established for ammonia.

4.2.1 Reference Exposure Limits

Five-second and one minute data air data for airborne toxic vapors or gases, collected by the AreaRae® samplers must be compared with "reference exposure levels" for these chemicals in order to be able to determine the extent to which humans were exposed to these chemicals during the time of the incident. The primary "reference exposure levels" selected are those developed by the California Environmental Protection Agency (CalEPA), and are called California Acute Reference Exposure Levels (CaRELs)[1]. CaRELs were selected as primary screening levels because they are generally more protective than Acute Exposure Guidelines (AEGL) and Emergency Response Planning Guidelines (ERPG), and are based on human health outcomes resulting from airborne releases "…including actual or potential spilling, leaking pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of a substance into the ambient air and that results from routine operation of a facility or that is predictable, including, but not limited to continuous and intermittent releases and predictable process upsets and leaks."[2] CaRELs, unlike AEGLS and ERPGs, are not limited to emergency releases. CaRELs, except those derived for a reproductive or developmental endpoint, are based on an averaging time of one hour.

For those chemicals for which a CaREL does not exist, a one-hour AEGL-1 will be used as the reference exposure levels. If an appropriate AEGL does not exist, then a one-hour ERPG-1 will be used.

AEGLs are developed and revised by the U.S. Environmental Protection Agency.[3] There are three AEGL levels:

> AEGL-1: the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience discomforting, but not disabling, effects that are transient and reversible upon cessation of exposure.

AEGL-2: the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

AEGL-3: the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

AEGL-1 was selected as an REL candidate because it is the most protective of human health.

ERPGs (Emergency Response Planning Guidelines) are developed and revised by SCAPA[4] (Department of Energy Subcommittee on Consequence Assessment and Protective Actions) and are intended to provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects of human exposure.

ERPG-1: the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odor.

ERPG-2: the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

ERPG-3: the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

ERPG-1 was selected as an REL candidate because it is the most protective of human health.

For the AreaRAE data collected during the EQ Apex Chemical fire, the Table 7 of RELs was developed:

Table 7 Reference Exposure Limits

Chemical	Formula	CaREL (ppm)	AEGL-1 (ppm)	ERPG-1 (ppm)
Ammonia	**NH_3**	**4.6**		
Carbon Monoxide	**CO**	**20**		
Chlorine	**Cl_2**	**0.07**		
Hydrogen Cyanide	**HCN**	**0.31**		
Hydrogen Sulfide	**H_2S**	**0.03**		
Nitric Oxide	**NO**	**0.08**		
Nitrogen Dioxide	**NO_2**	**0.25**		
Phosphine	**PH_3**	**Not available**	**1.0***	
Sulfur Dioxide	**SO_2**	**0.25**		

- Due to insufficient data, an AEGL-1 value has not been established. The AEGL-2 value is considered to be not sufficiently protective; therefore a value of one-half of the one-hour AEGL-2 is used. NO RELs are needed for VOC, LEL, and OXY data.

Figure 10 AreaRae 1 NO Data (5 sec intervals)
Hwy 55 (Williams St) & Olive Chapel St.

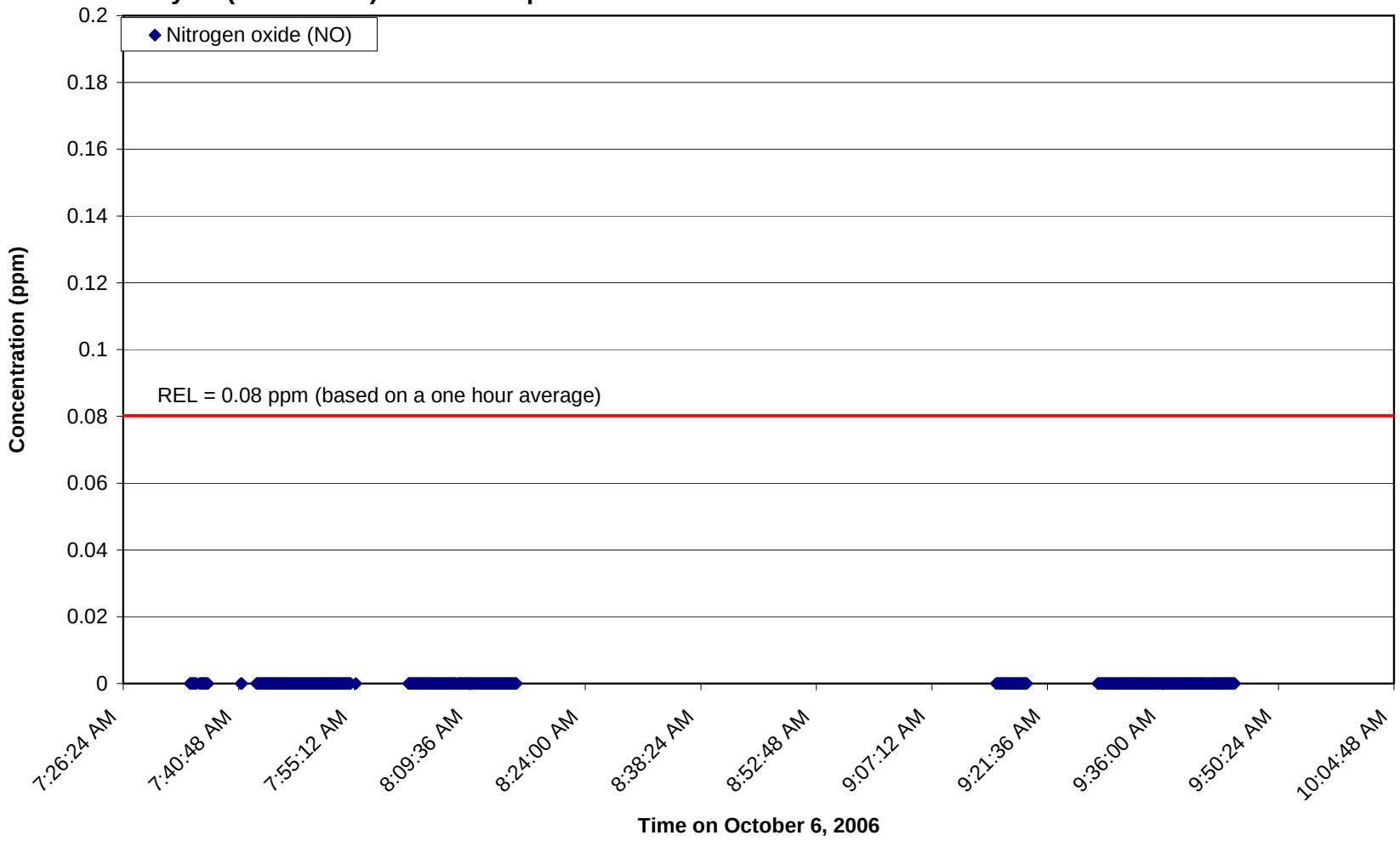


Figure 11 AreaRae 1 NO2 Data (5 sec intervals)
Hwy 55 (Williams St) & Olive Chapel St.

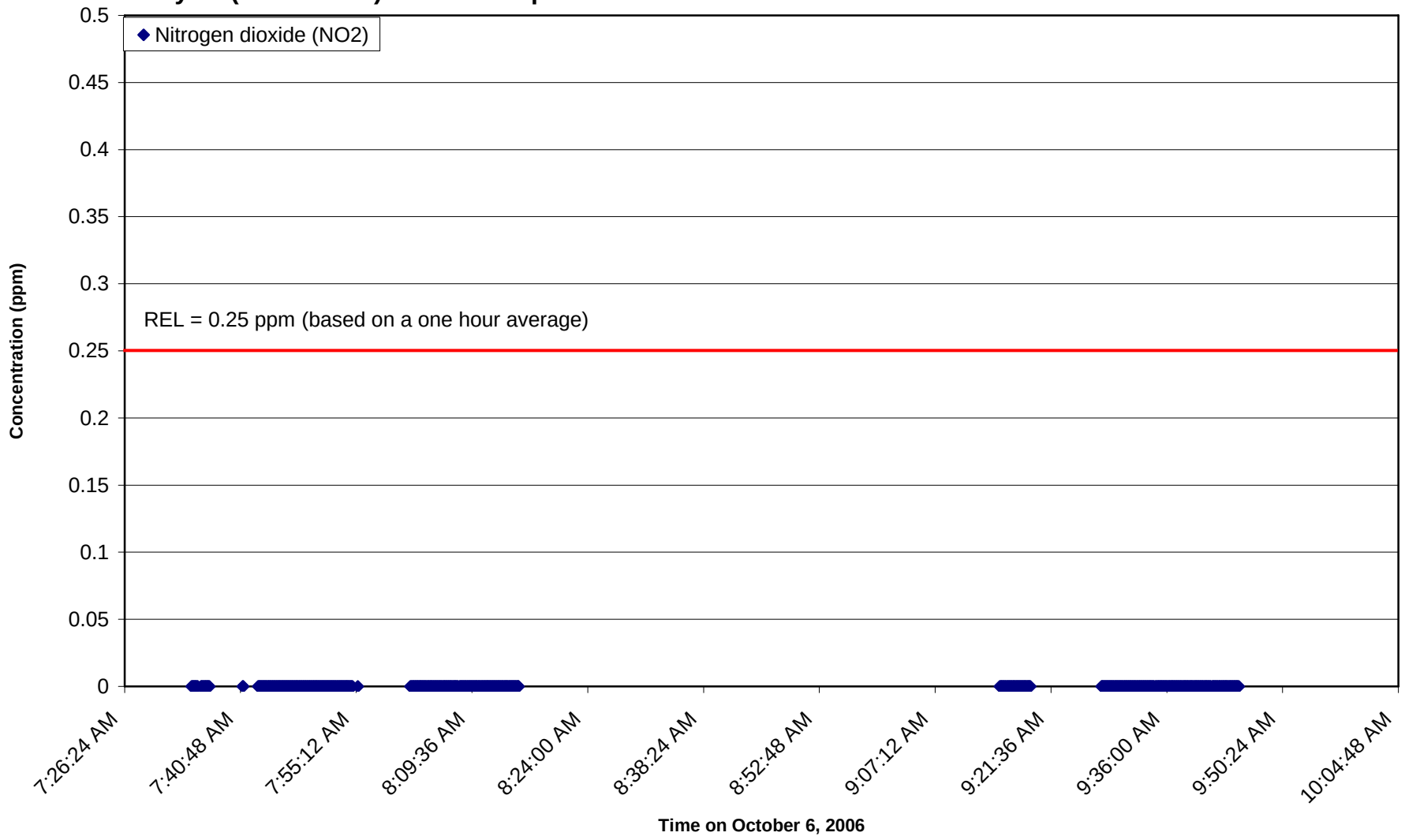


Figure 12 AreaRae 1 VOC Data (5 sec intervals)

Hwy 55 (Williams St) & Olive Chapel St.

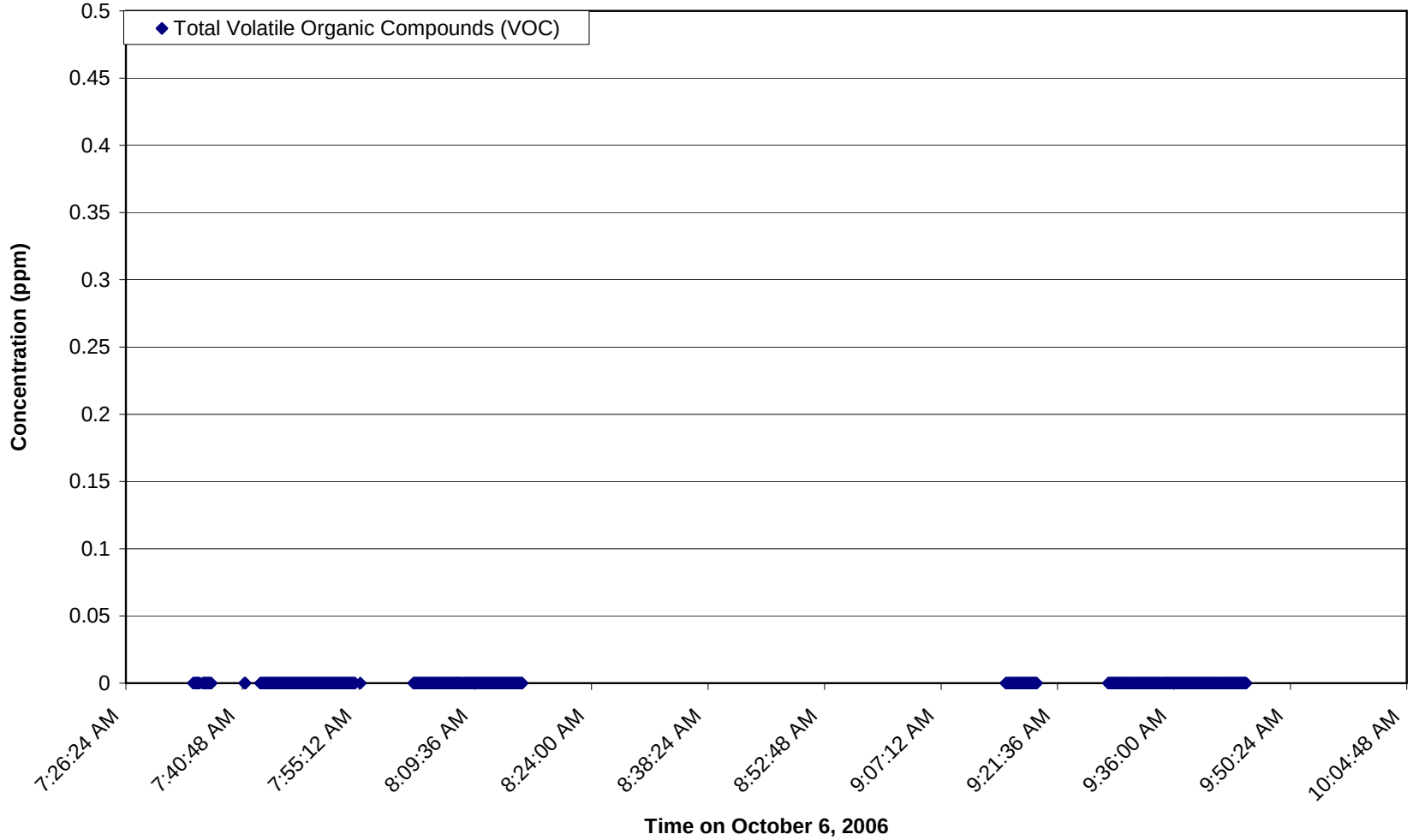


Figure 13 AreaRae 2 NH3 Data (5 sec intervals)

Hwy 55 (Williams St) at Jaycee Park Entrance

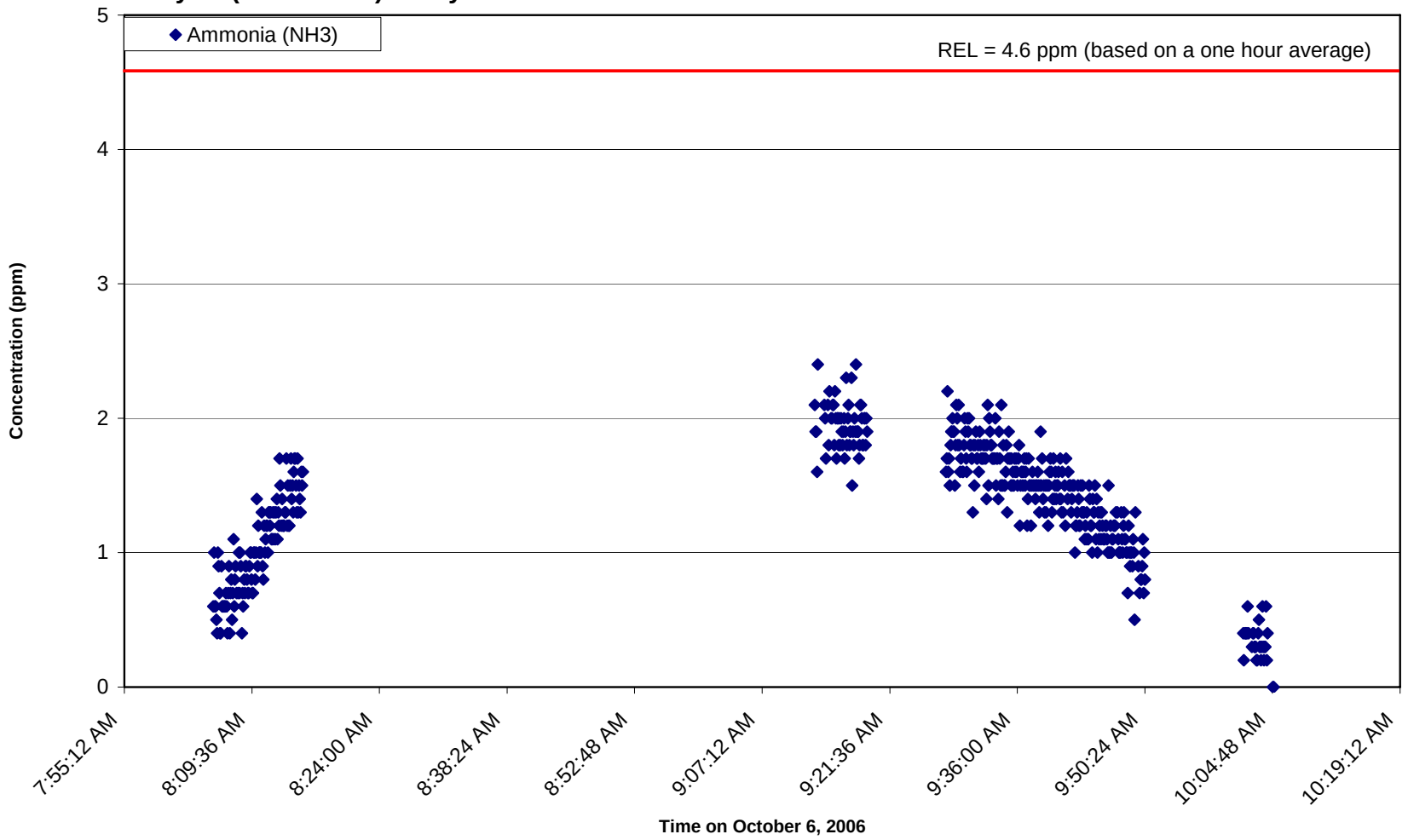


Figure 14 AreaRae 2 HCN Data (5 sec intervals)
Hwy 55 (Williams St) at Jaycee Park Entrance

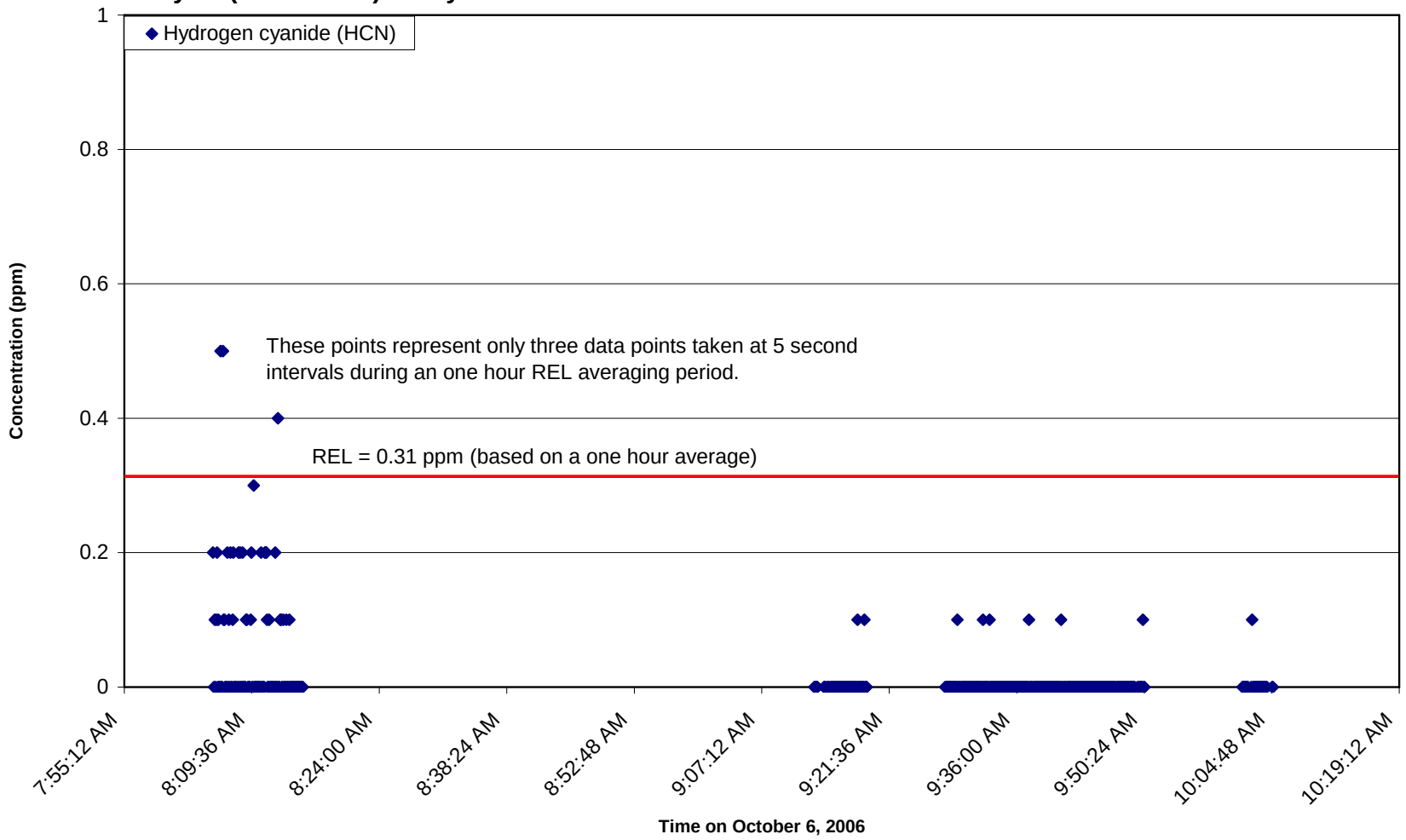


Figure 15 AreaRae 2 VOC Data (5 sec intervals)

Hwy 55 (Williams St) at Jaycee Park Entrance

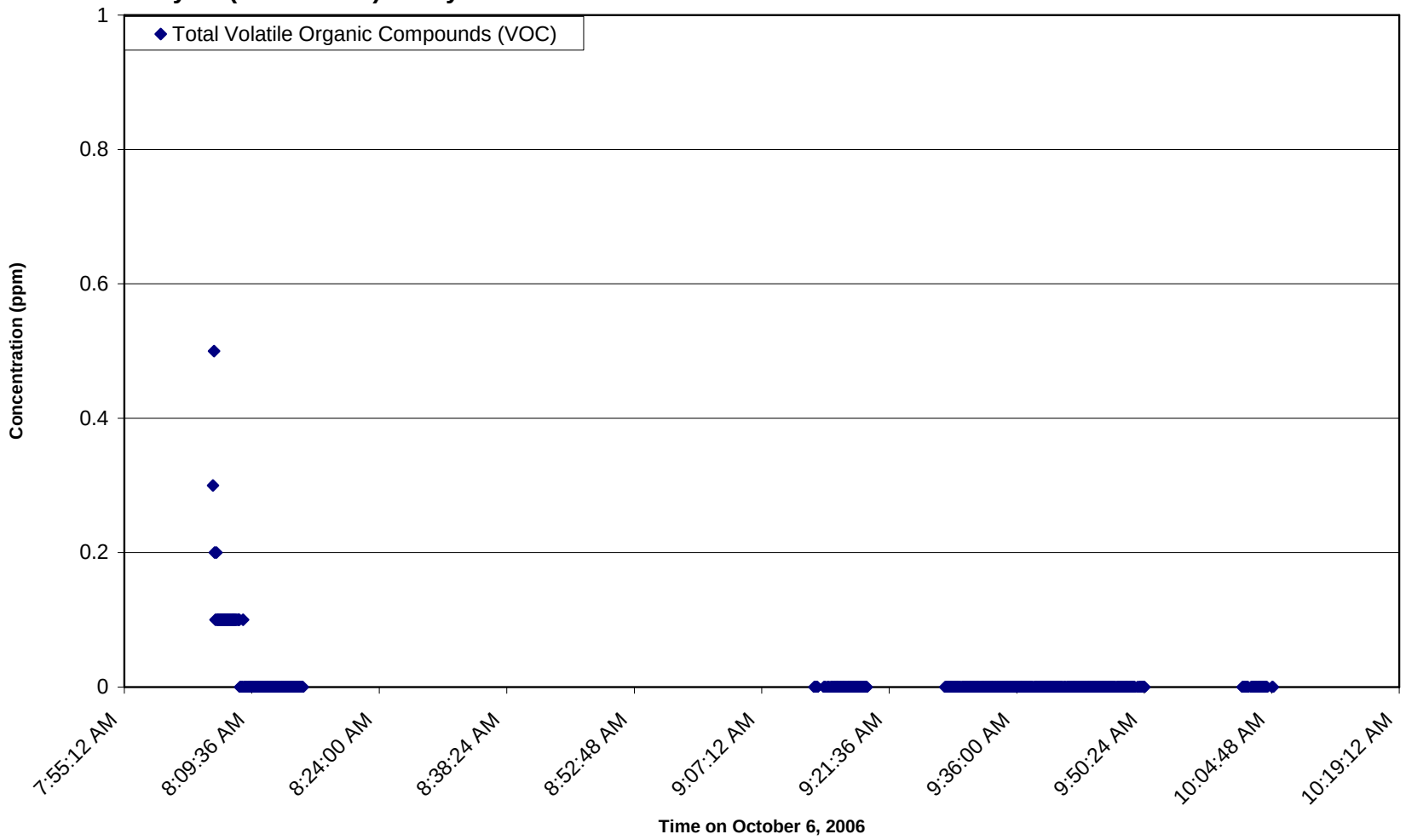


Figure 16 AreaRae 3 H2S Data (1 min intervals)
Hwy 55 (Williams St) and Upchurch St.

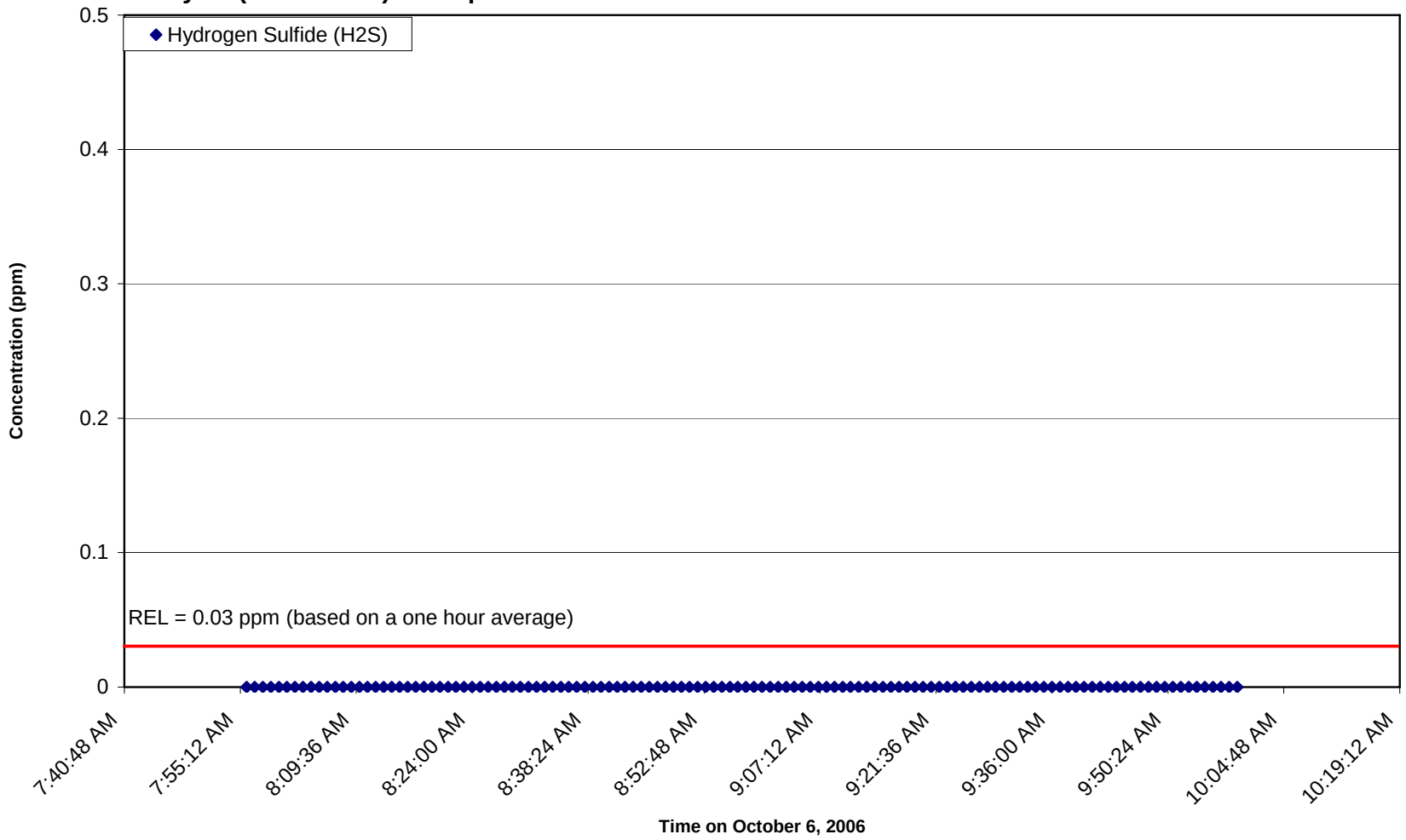


Figure 17 AreaRae 3 SO2 Data (1 min intervals)
Hwy 55 (Williams St) and Upchurch St.

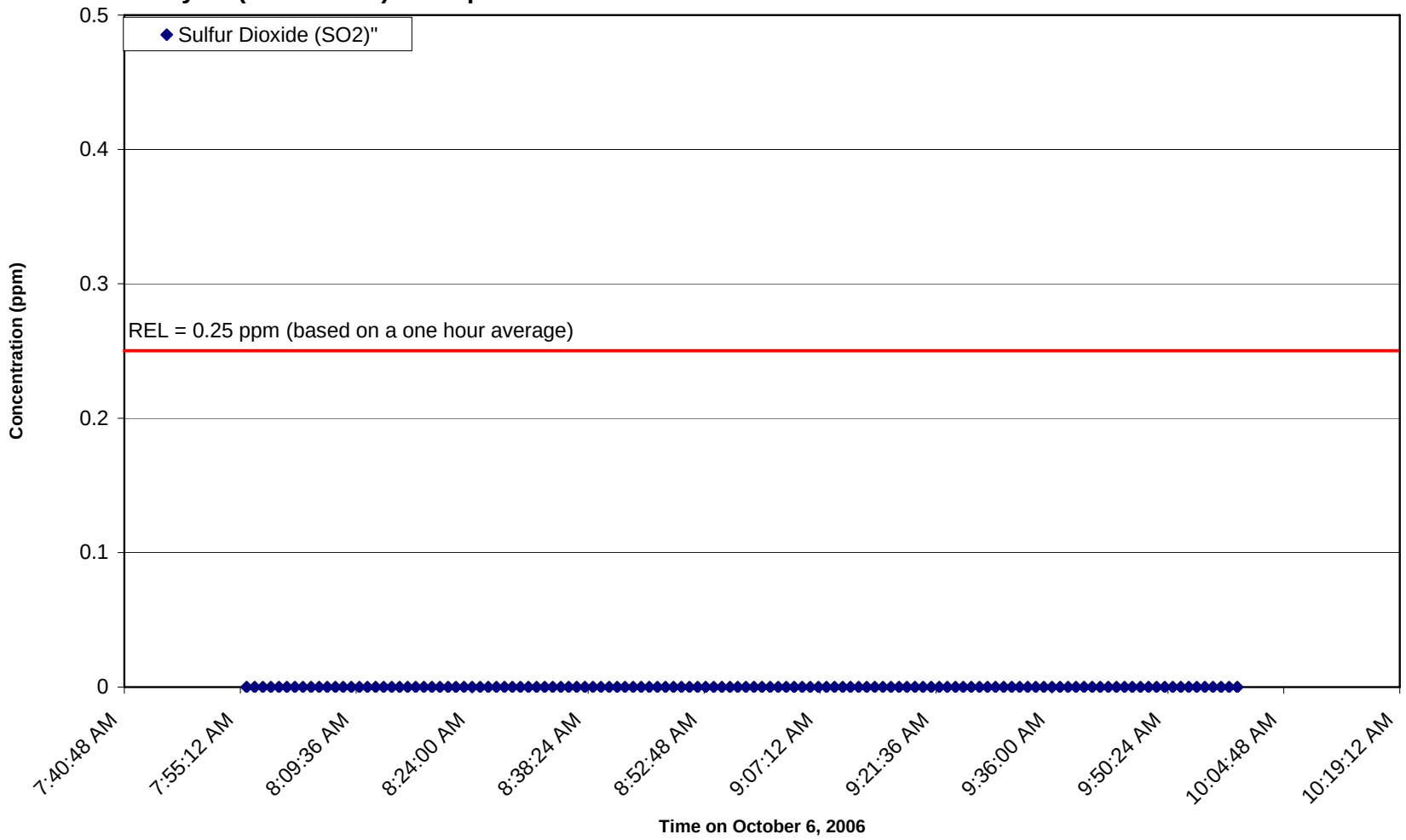


Figure 18 AreaRae 3 VOC Data (1 min intervals)
Hwy 55 (Williams St) and Upchurch St.

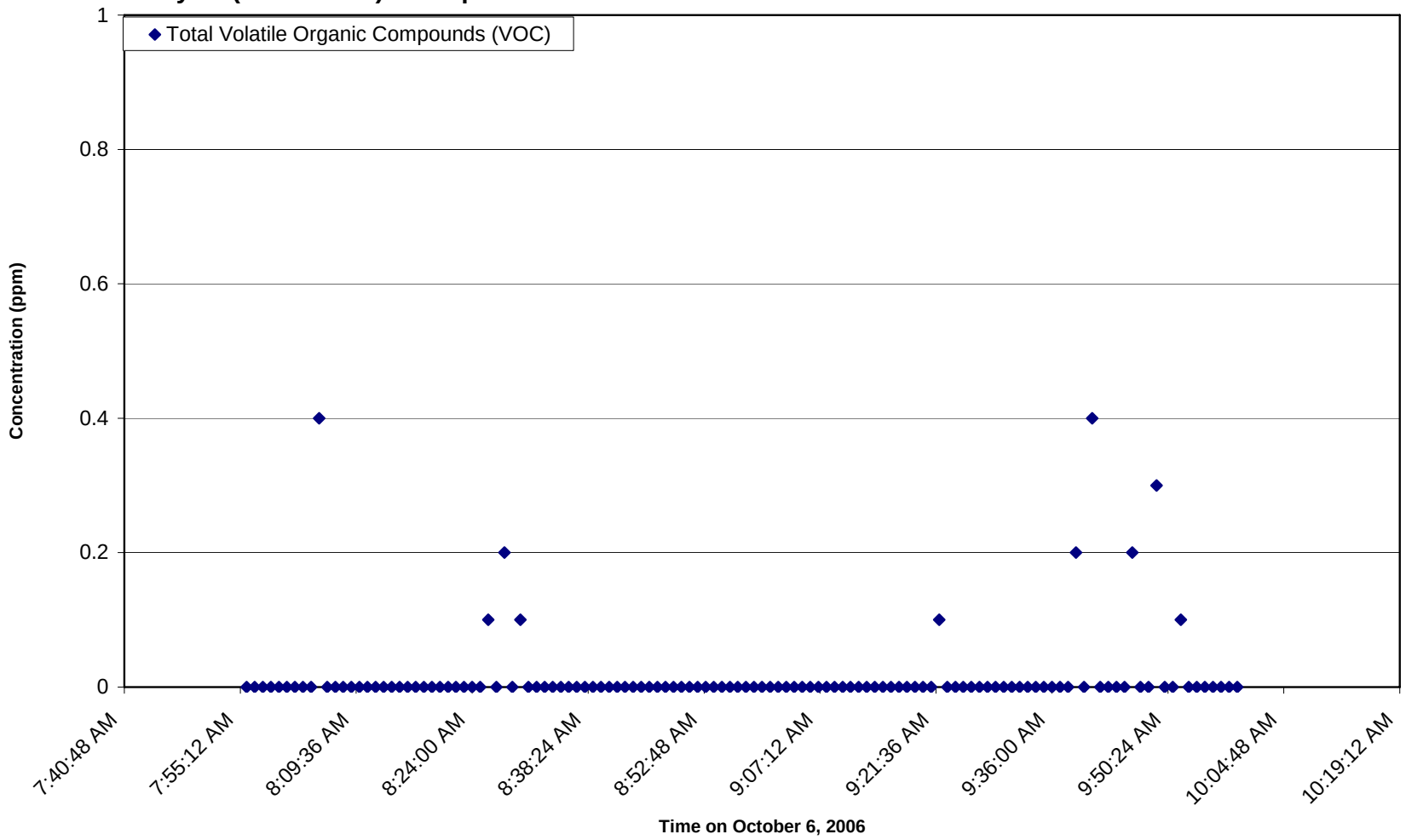


Figure 19 AreaRae 4 NH3 Data (1 min intervals)
Hwy 55 (Williams St) at Apex Funeral Home

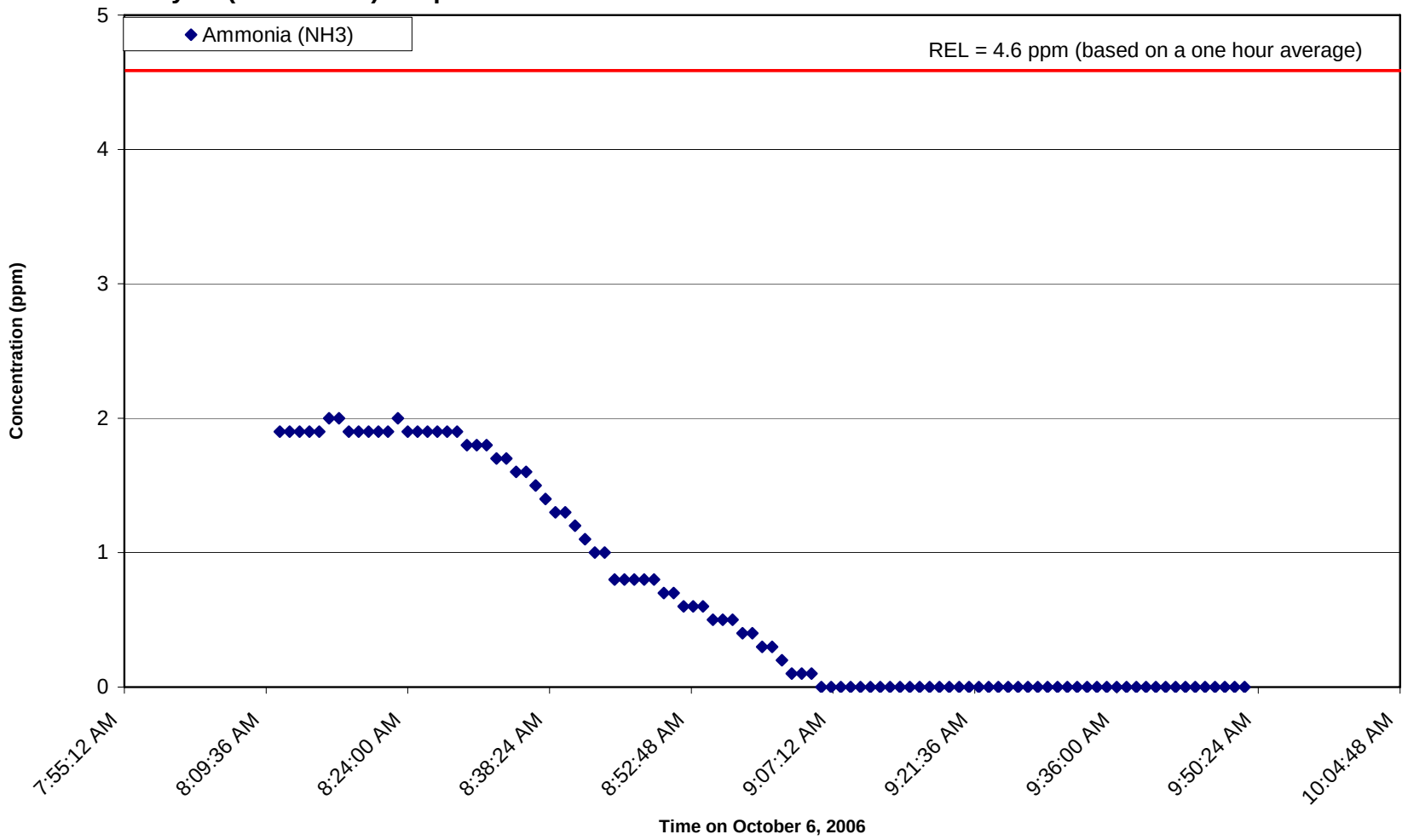


Figure 20 AreaRae 4 CO Data (1 min intervals)
Hwy 55 (Williams St) at Apex Funeral Home

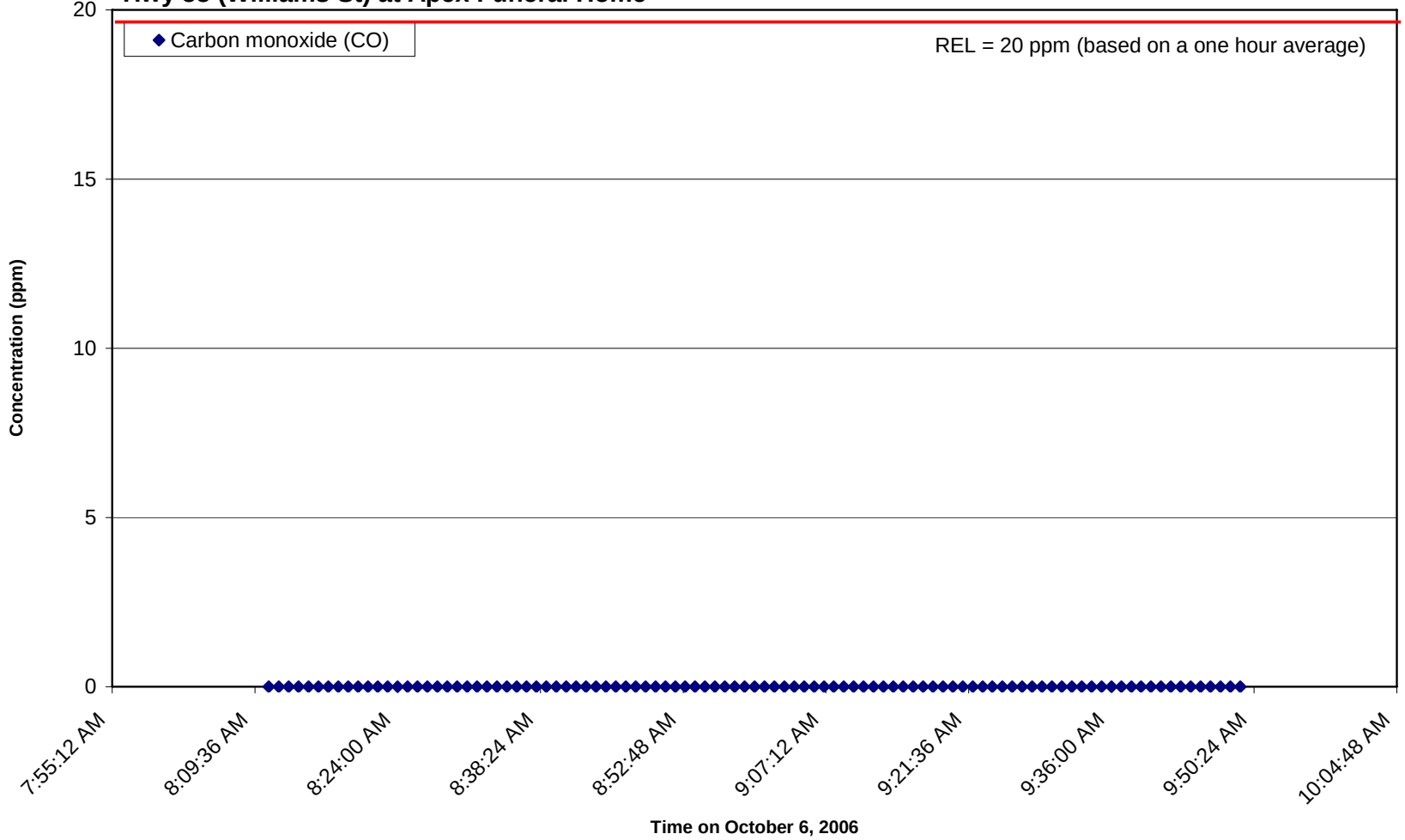


Figure 21 AreaRae 4 VOC Data (1min intervals)
Hwy 55 (Williams St) at Apex Funeral Home

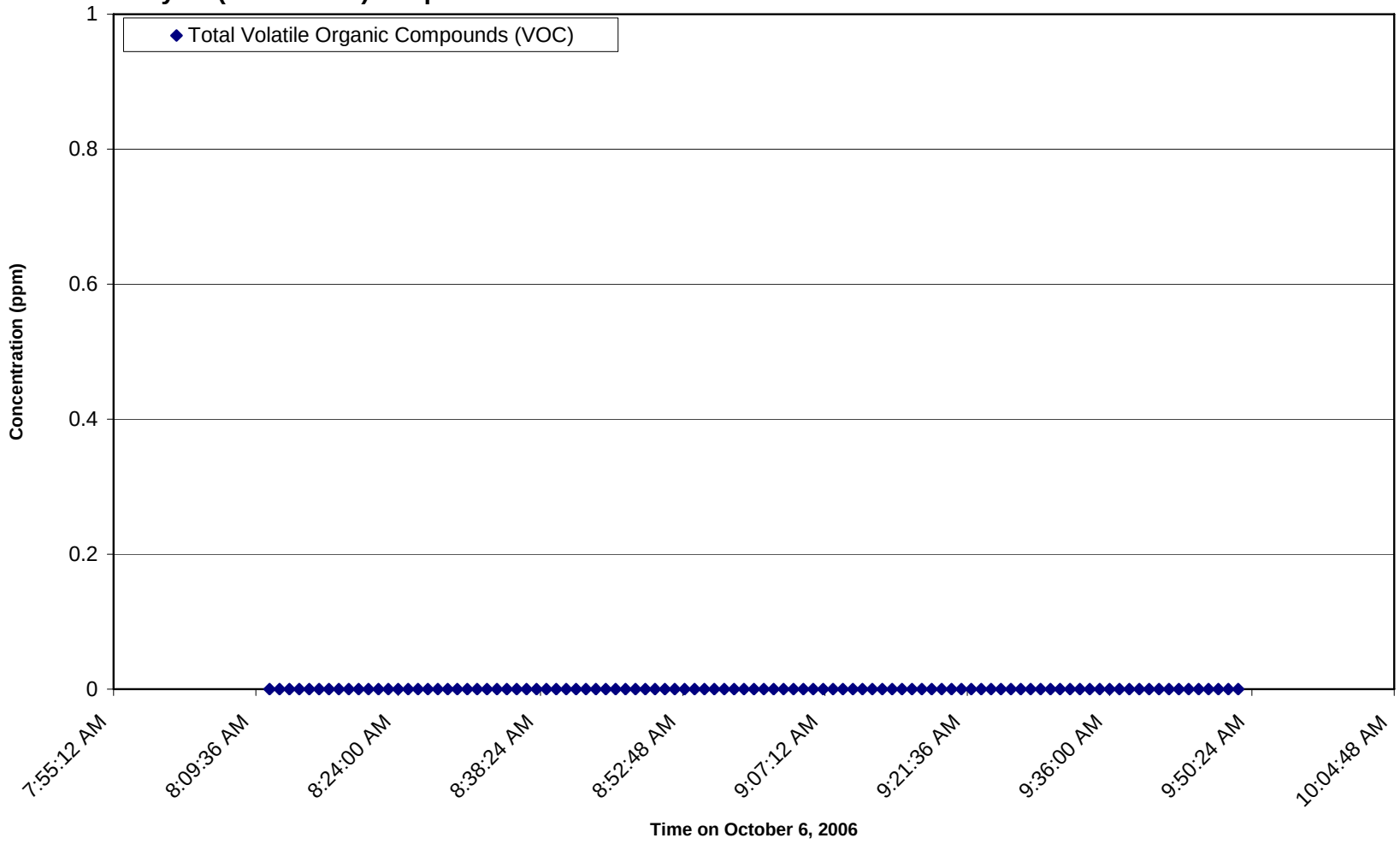


Figure 22 AreaRae 5 CL2 Data (5 sec intervals)

Hwy 55 (Williams St) and Salem St.

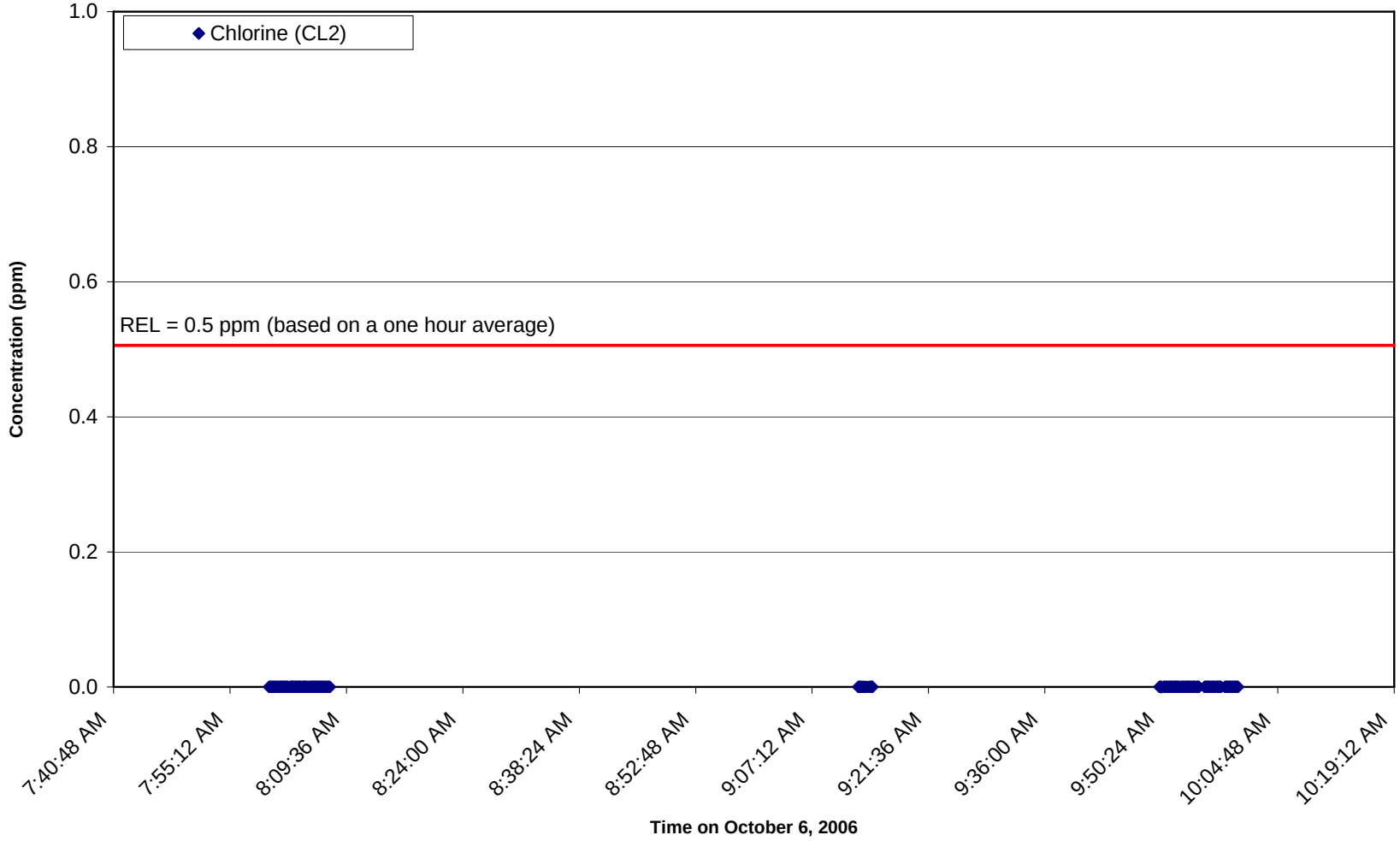


Figure 23 AreaRae 5 PH3 Data (5 sec intervals)
Hwy 55 (Williams St) and Salem St.

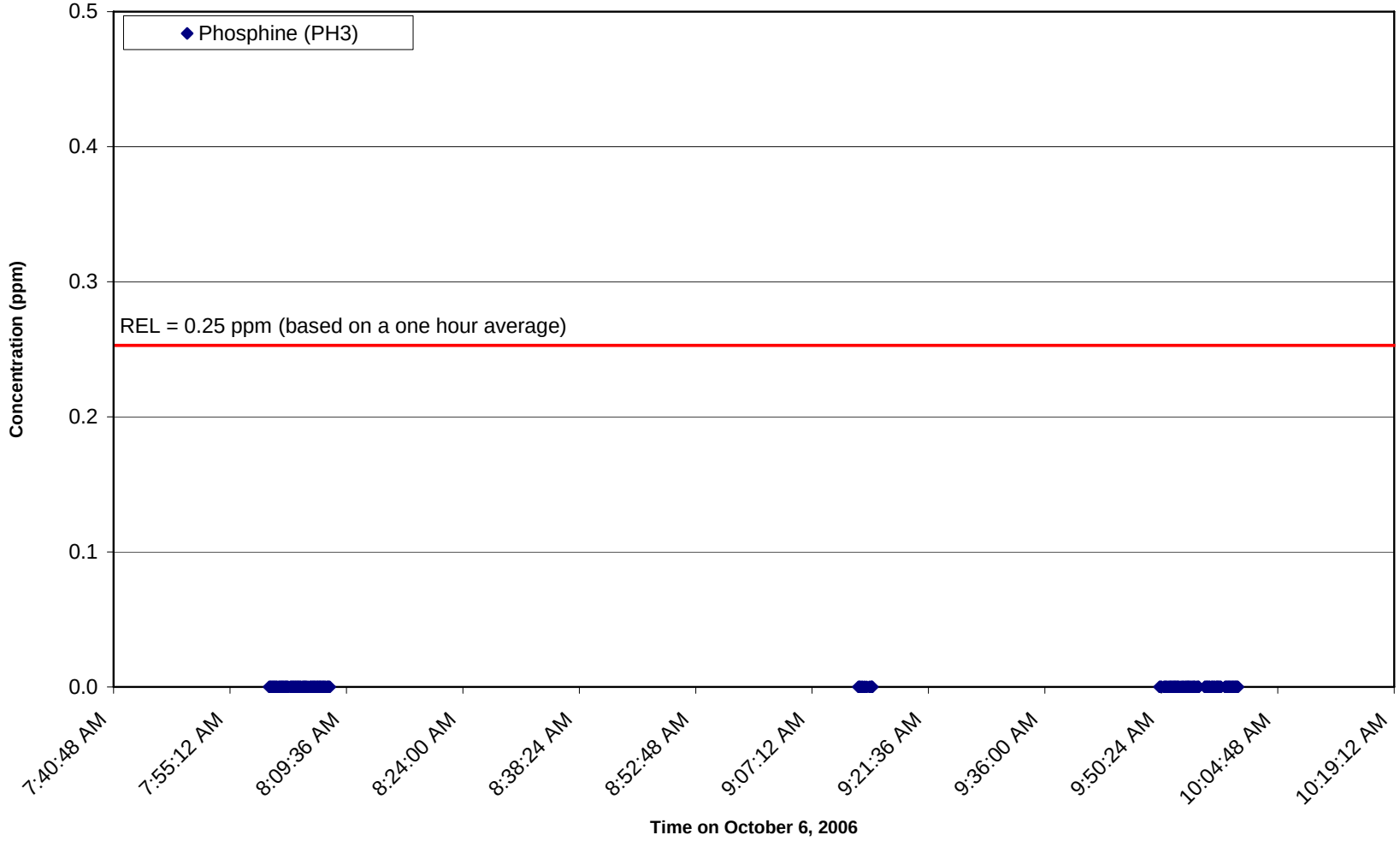


Figure 24 AreaRae 5 VOC Data (5 sec intervals)
Hwy 55 (Williams St) and Salem St.

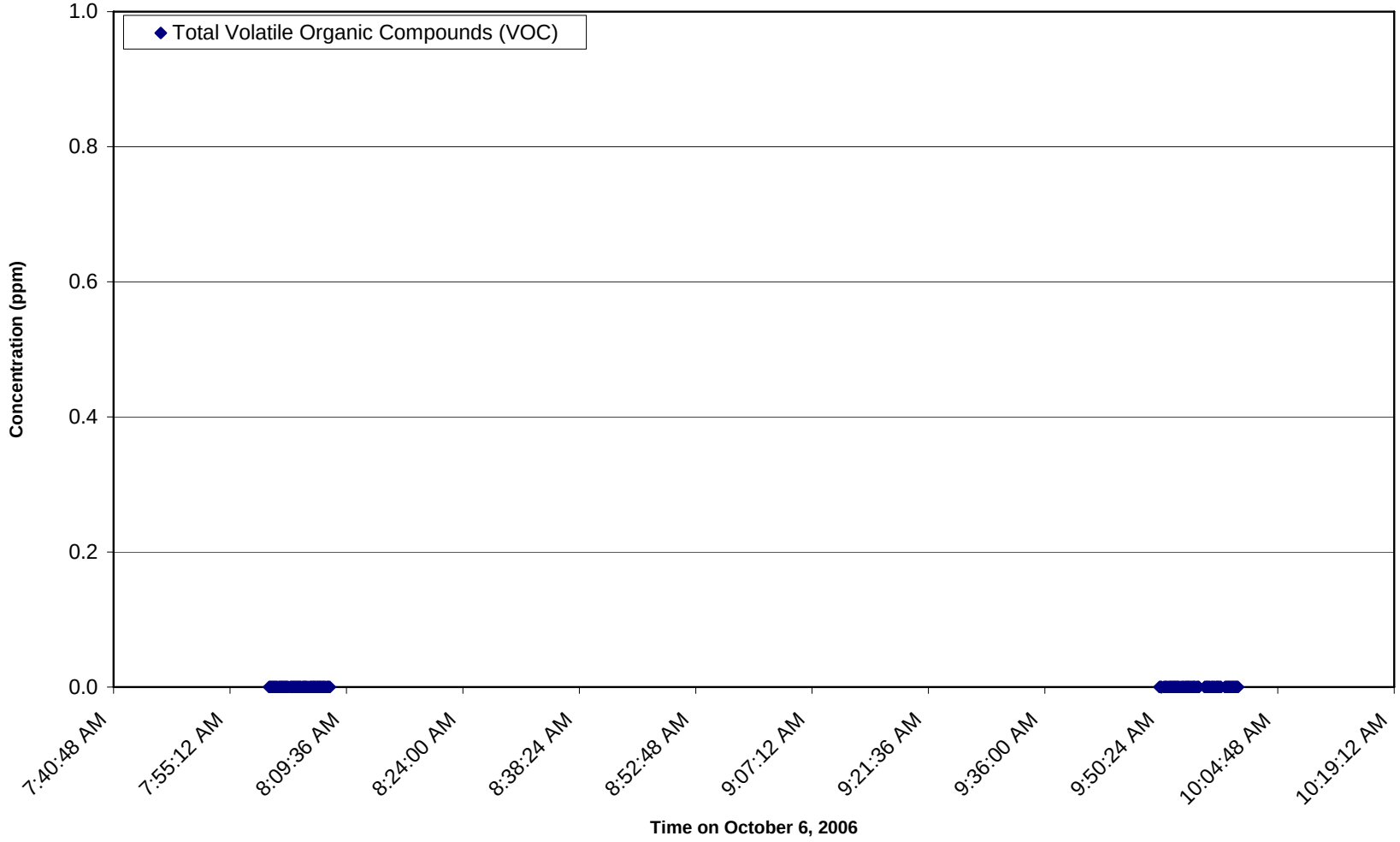
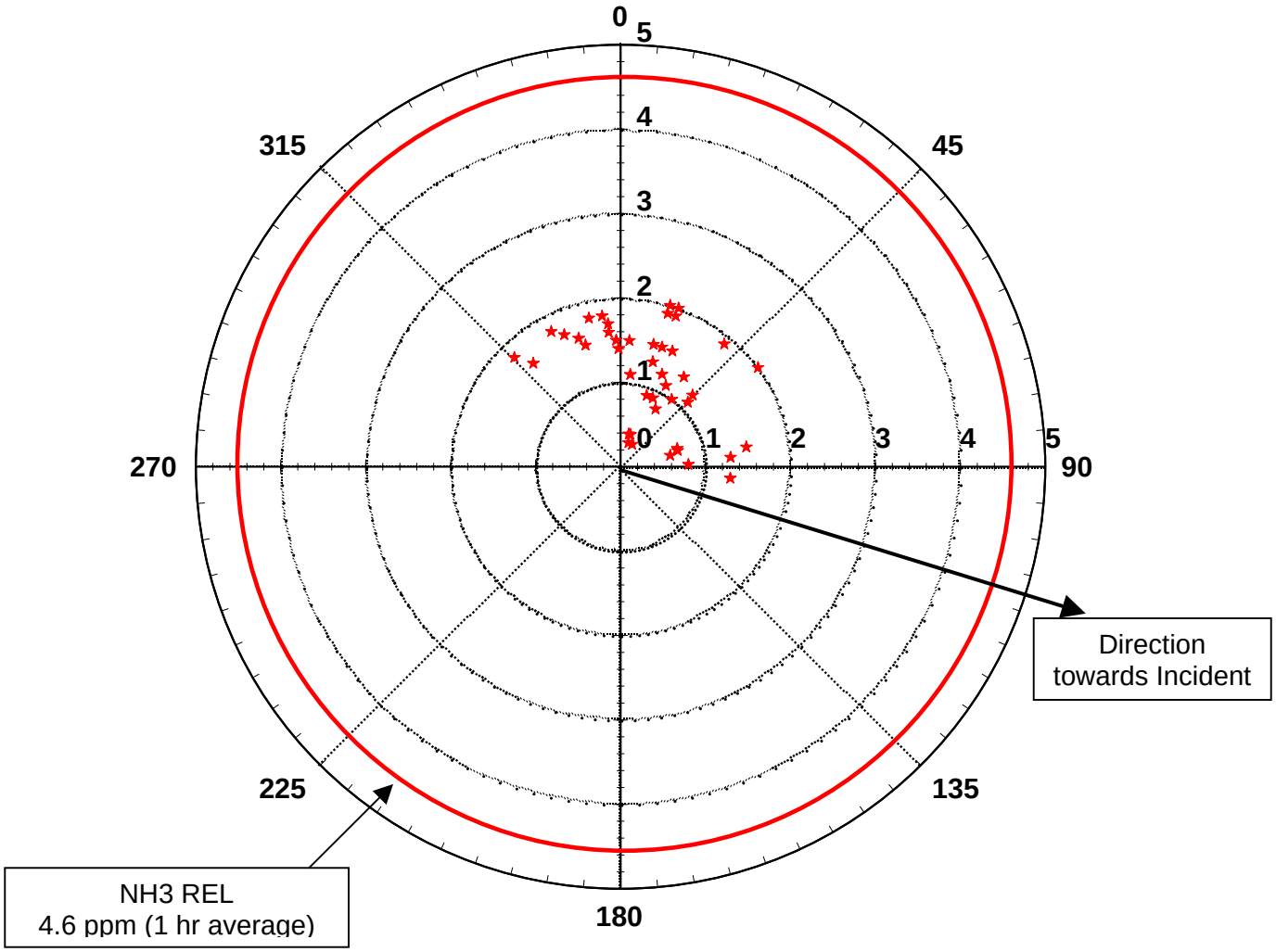
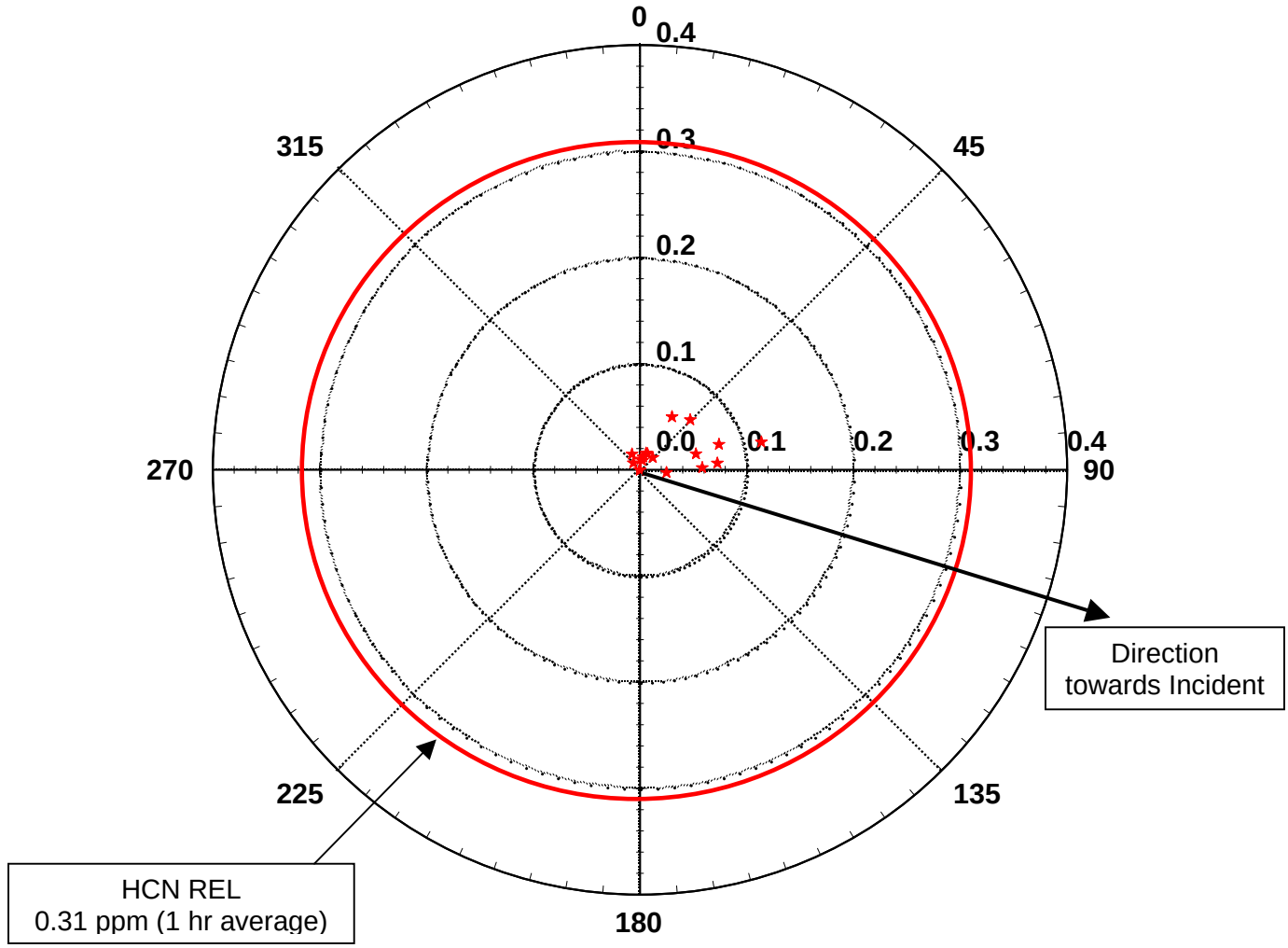


Figure 25
EQ Fire - Apex, NC
October 6, 2006
AreaRae-2 at Jaycee Park Entrance
8:05 am - 10:04 am



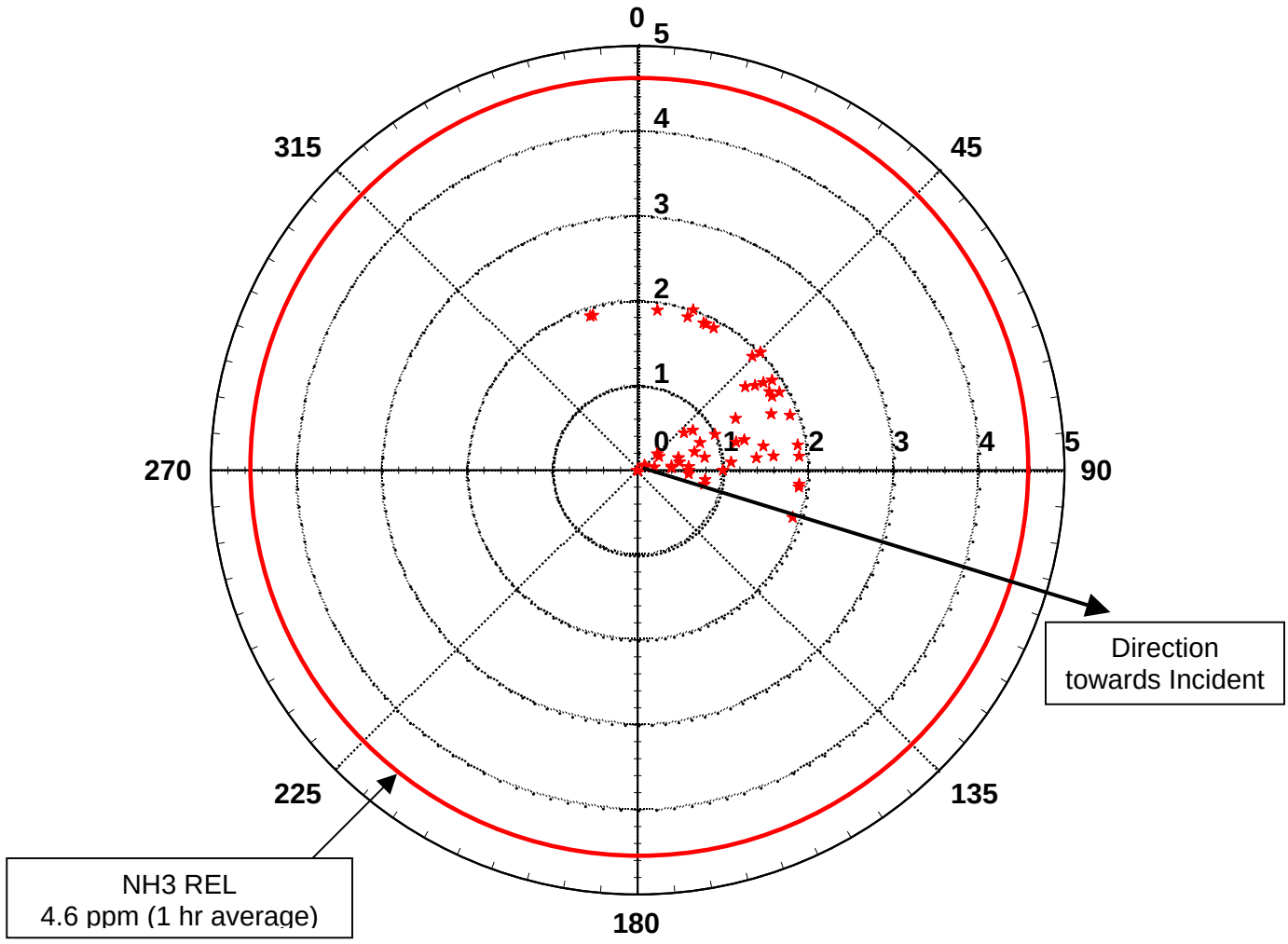
NH3 (ppm) Vs. Wind Direction
1-minute averages

Figure 26
EQ Fire - Apex, NC
October 6, 2006
AreaRae-2 at Jaycee Park Entrance
8:05 am - 10:04 am



HCN (ppm) Vs. Wind Direction
1-minute averages

Figure 27
EQ Fire - Apex, NC
October 6, 2006
AreaRae-4 at Apex Funeral Home
8:11 am - 9:49 am



NH_3 (ppm) Vs. Wind Direction

1-minute intervals

Figure 28 AreaRae 1 NO Data (5 sec intervals)
Salem St. and West Moore St.

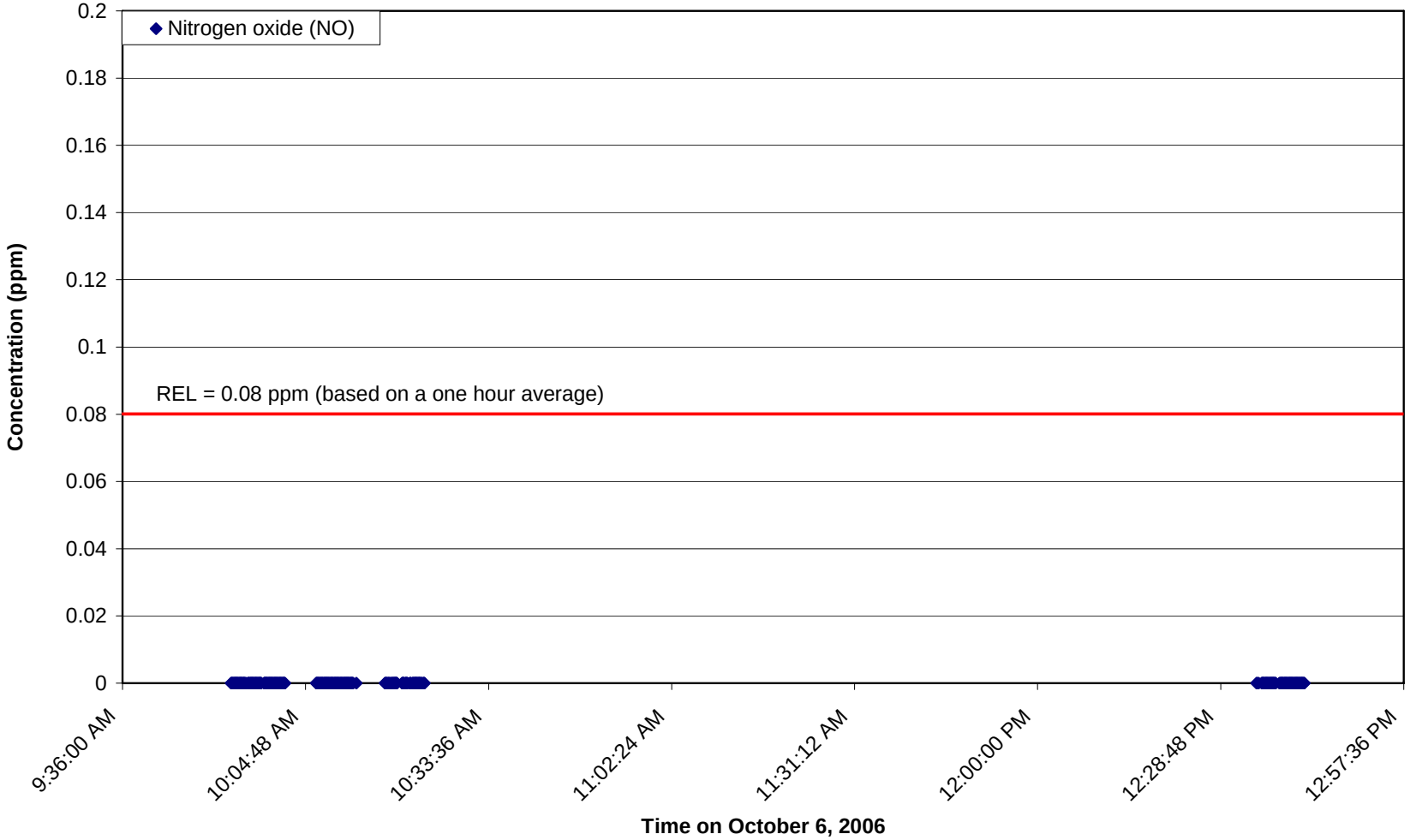


Figure 29 AreaRae 1 NO2 Data (5 sec intervals)
Salem St. and West Moore St.

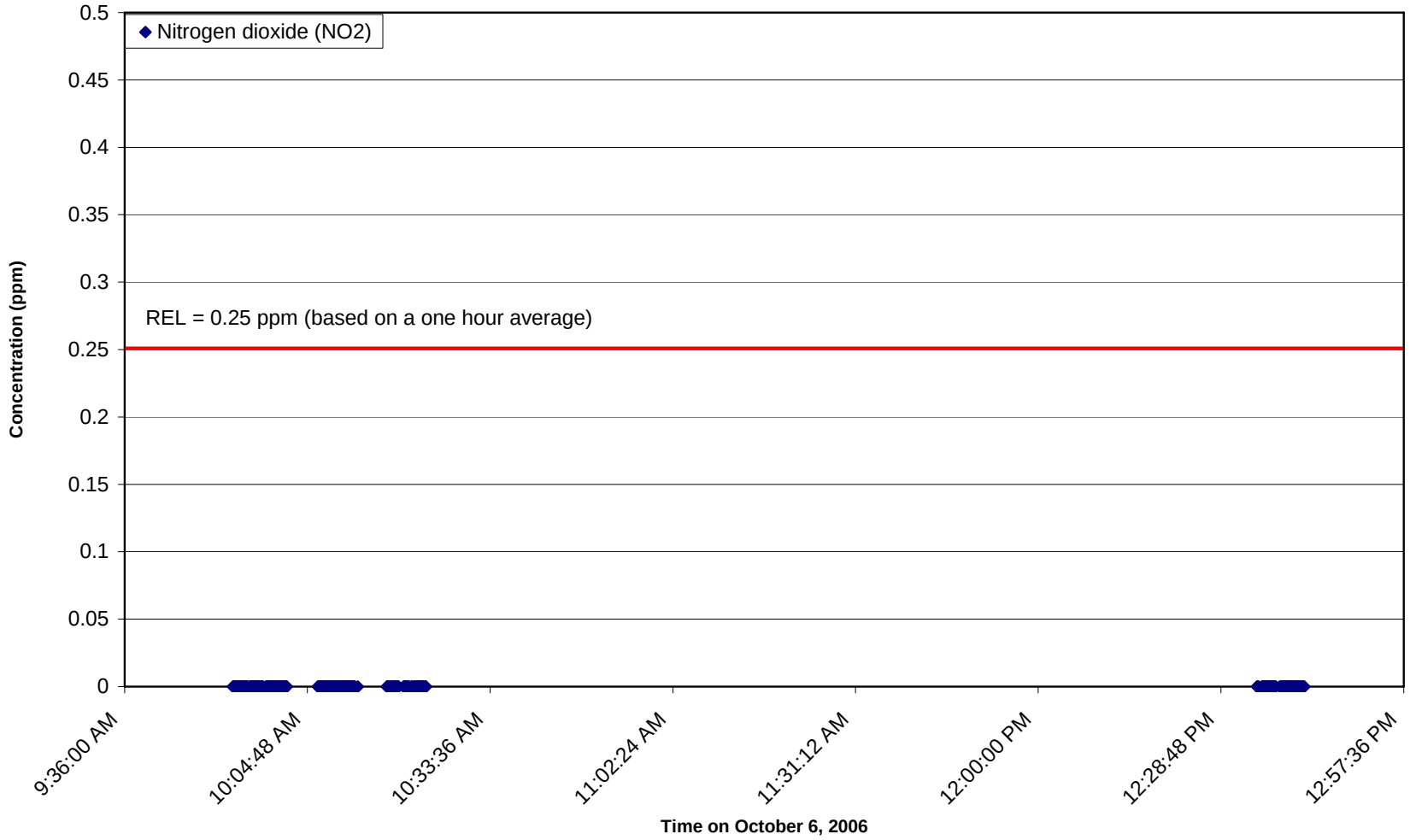


Figure 30 AreaRae 1 VOC Data (5 sec intervals)
Salem St. and West Moore St.

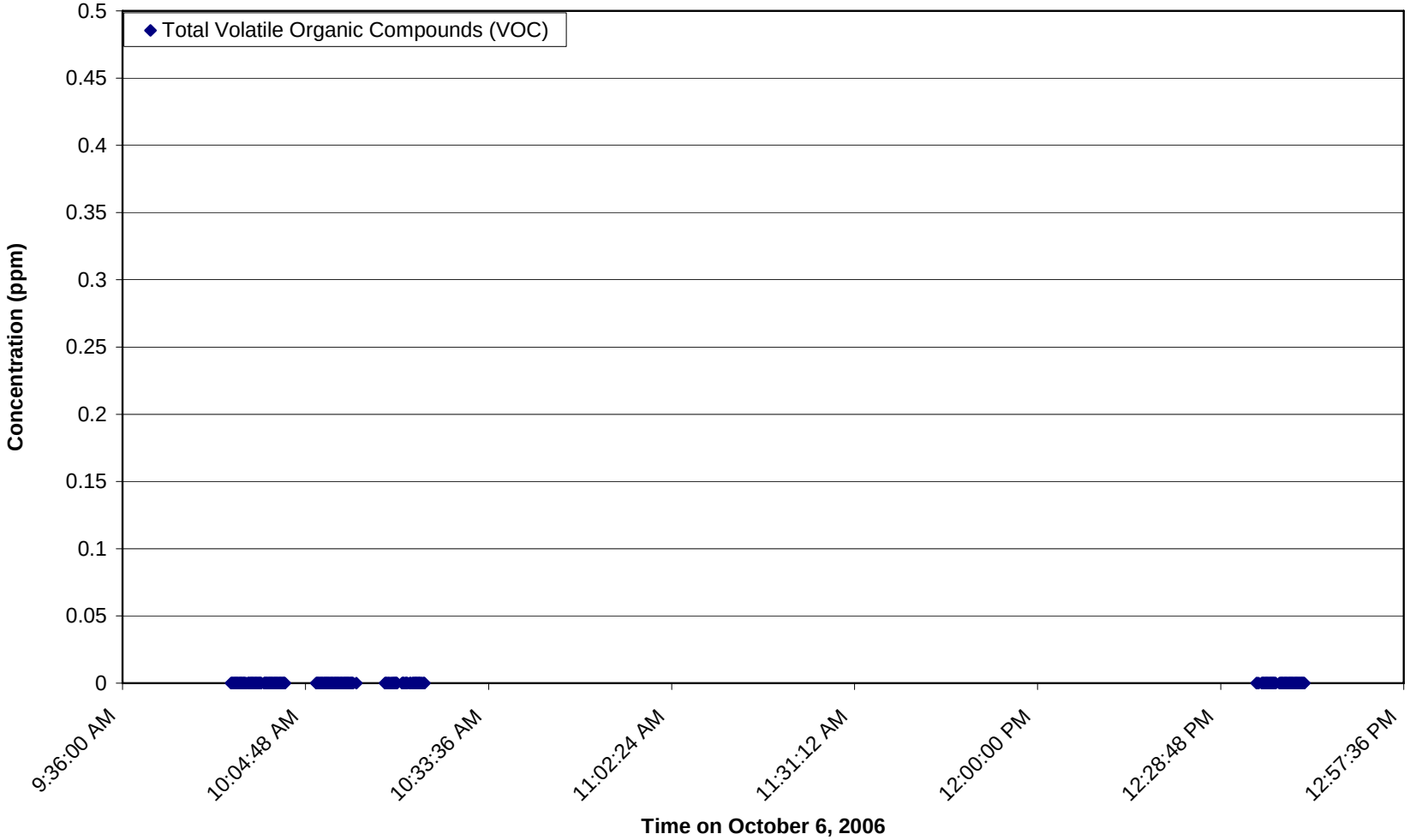


Figure 31 AreaRae 2 NH3 Data (5 sec intervals)
Salem St. and Center St.

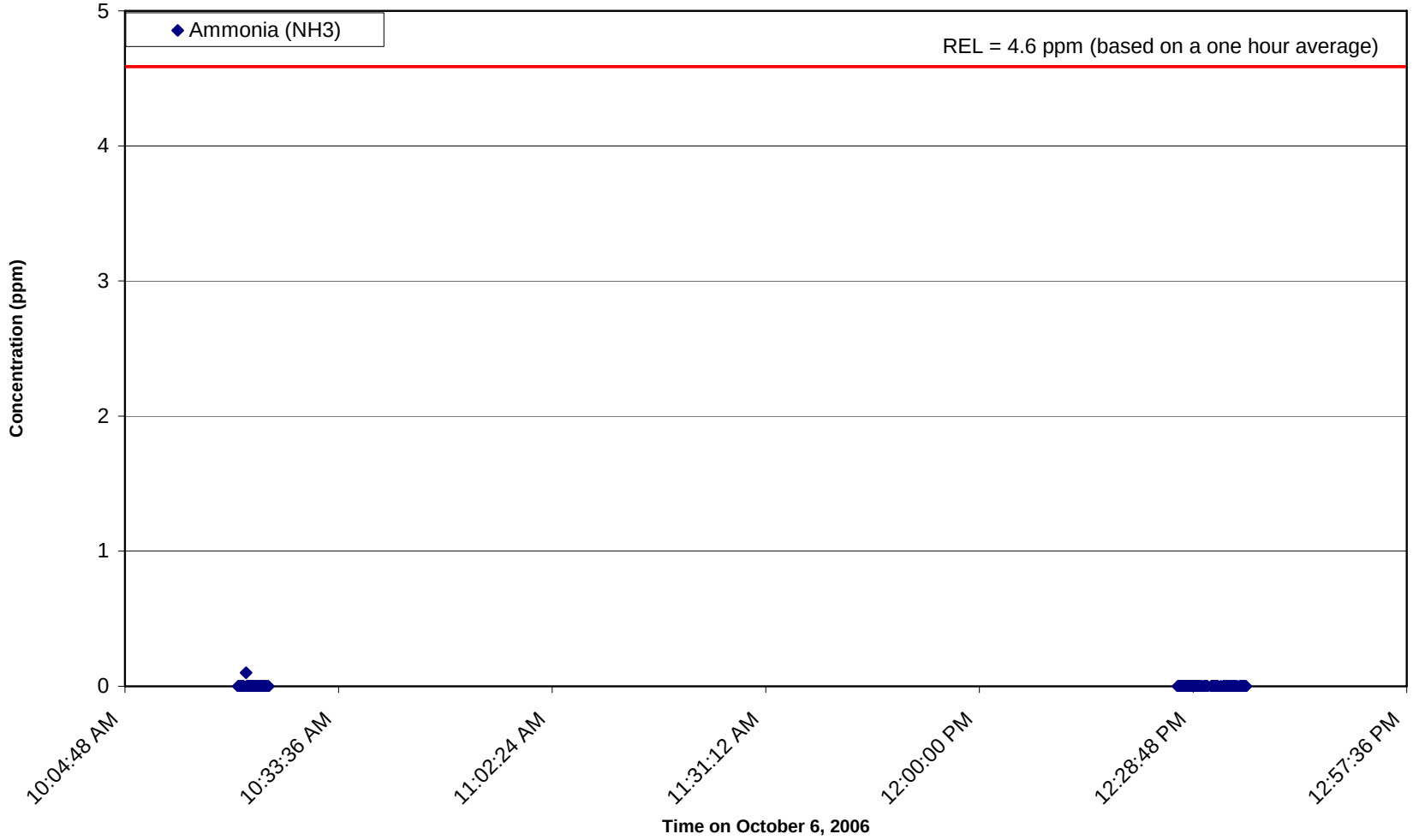


Figure 32 AreaRae 2 HCN Data (5 sec intervals)
Salem St. and Center St.

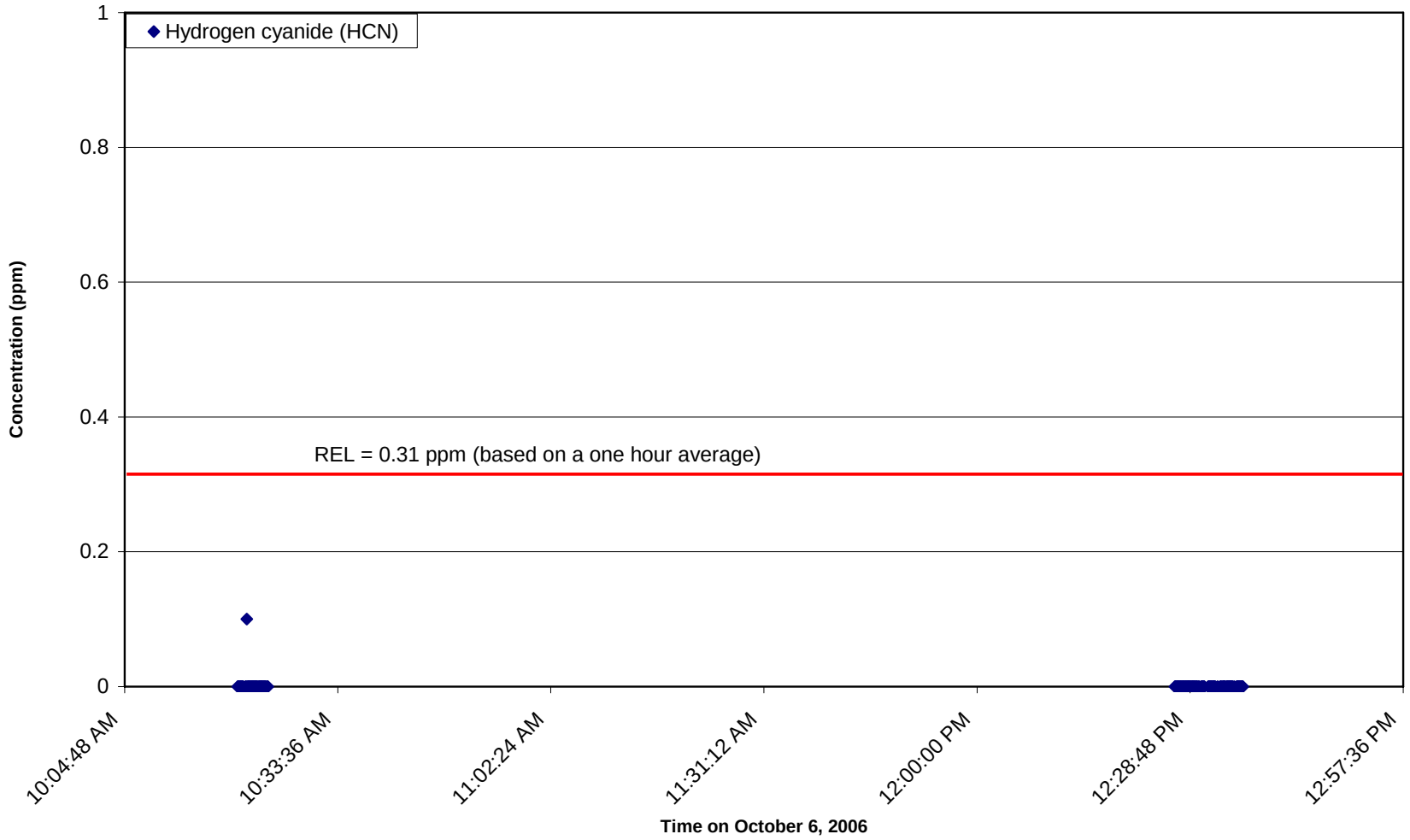


Figure 33 AreaRae 2 VOC Data (5 sec intervals)
Salem St. and Center St.

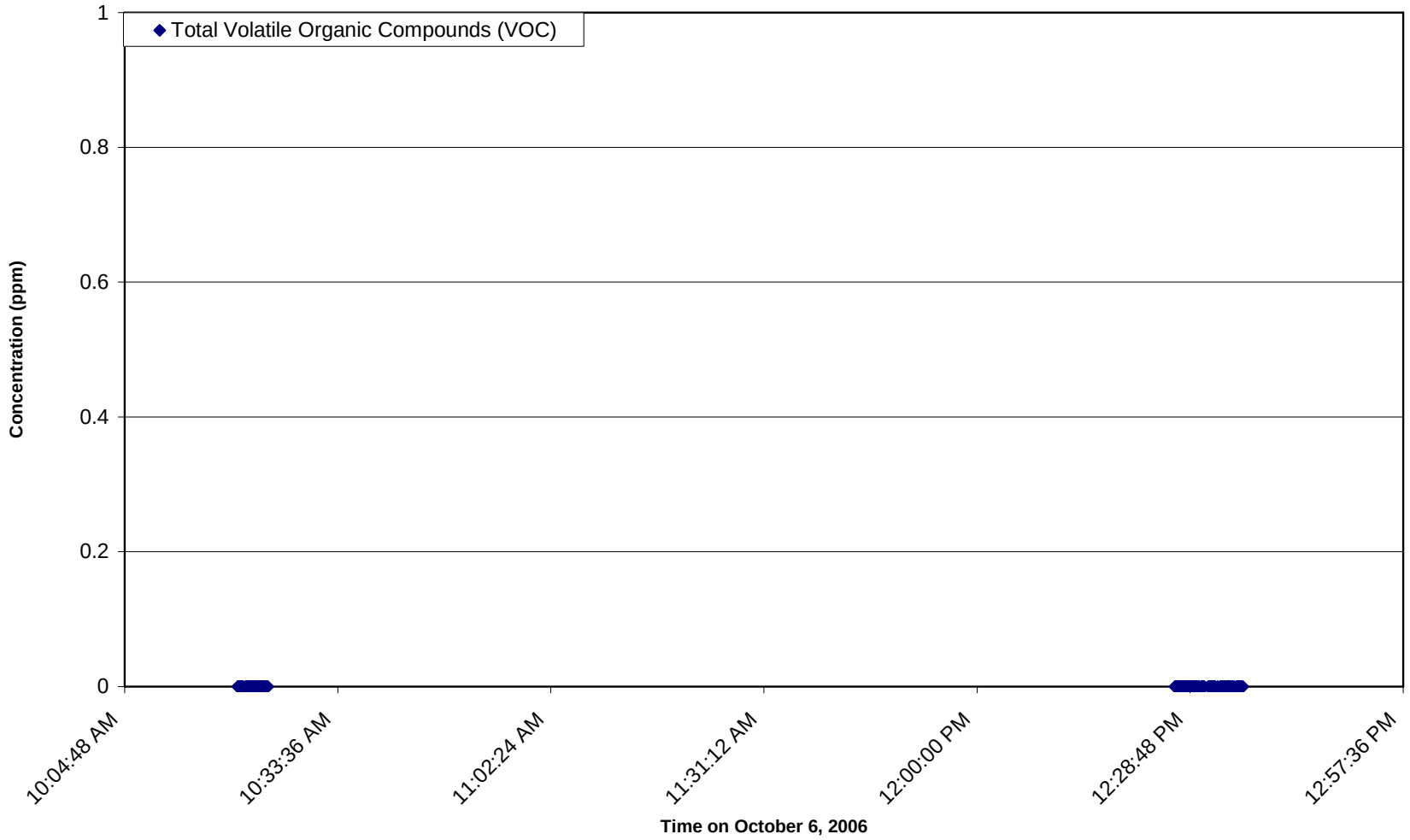


Figure 34 AreaRae 3 H2S Data (1 min intervals)
Salem St. and Hunter St.

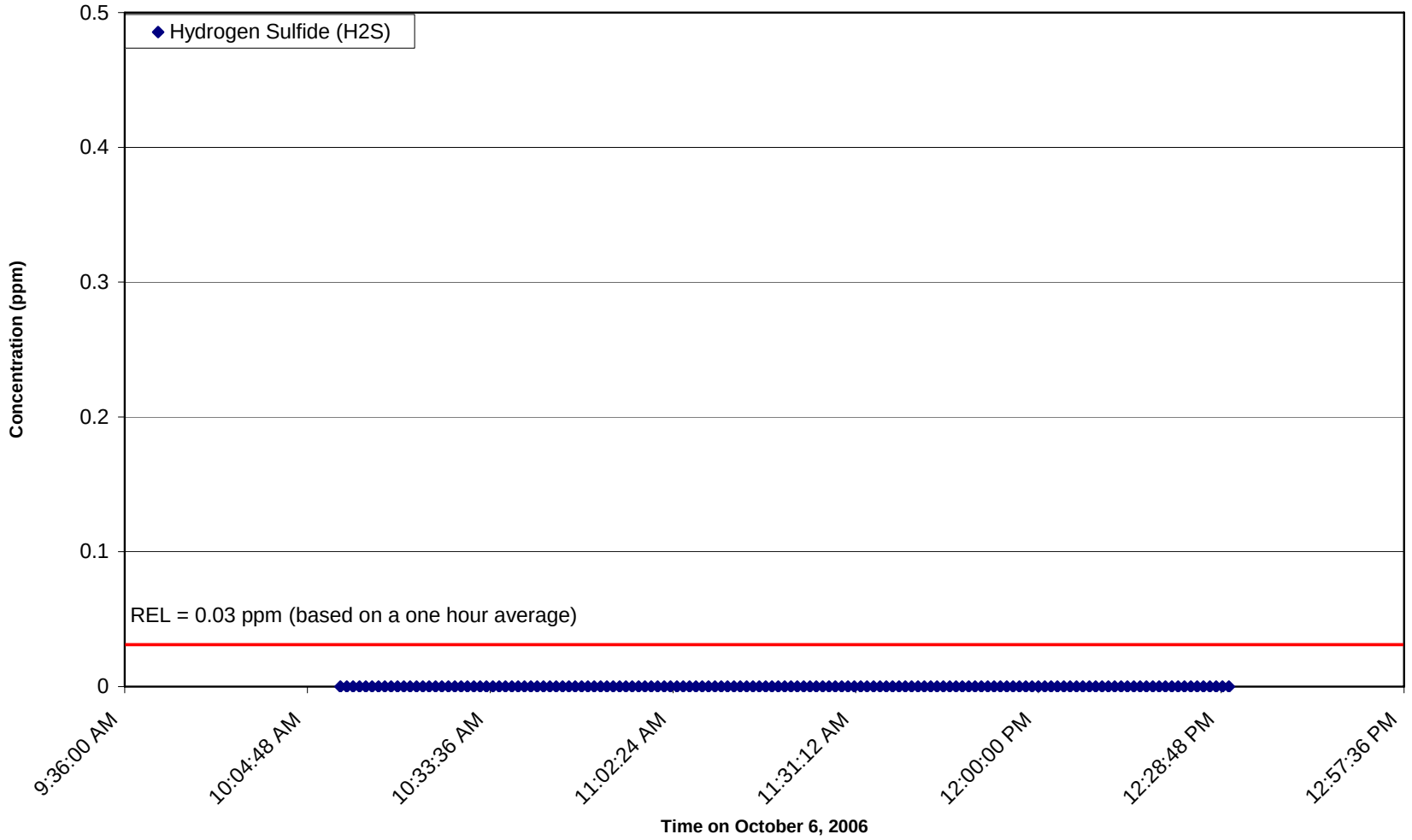


Figure 35 AreaRae 3 SO2 Data (1 min intervals)
Salem St. and Hunter St.

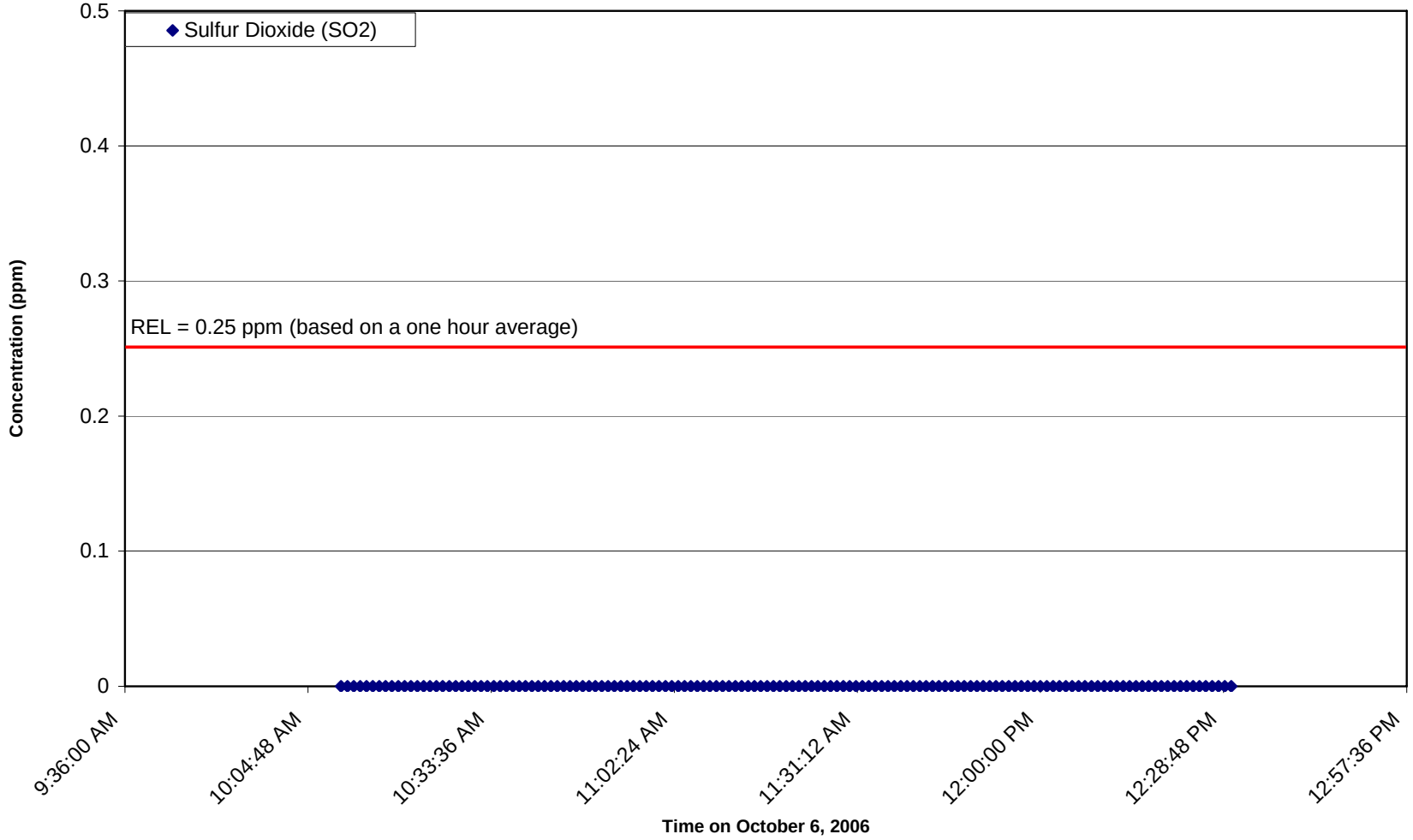


Figure 36 AreaRae 3 VOC Data (1 min intervals)
Salem St. and Hunter St.

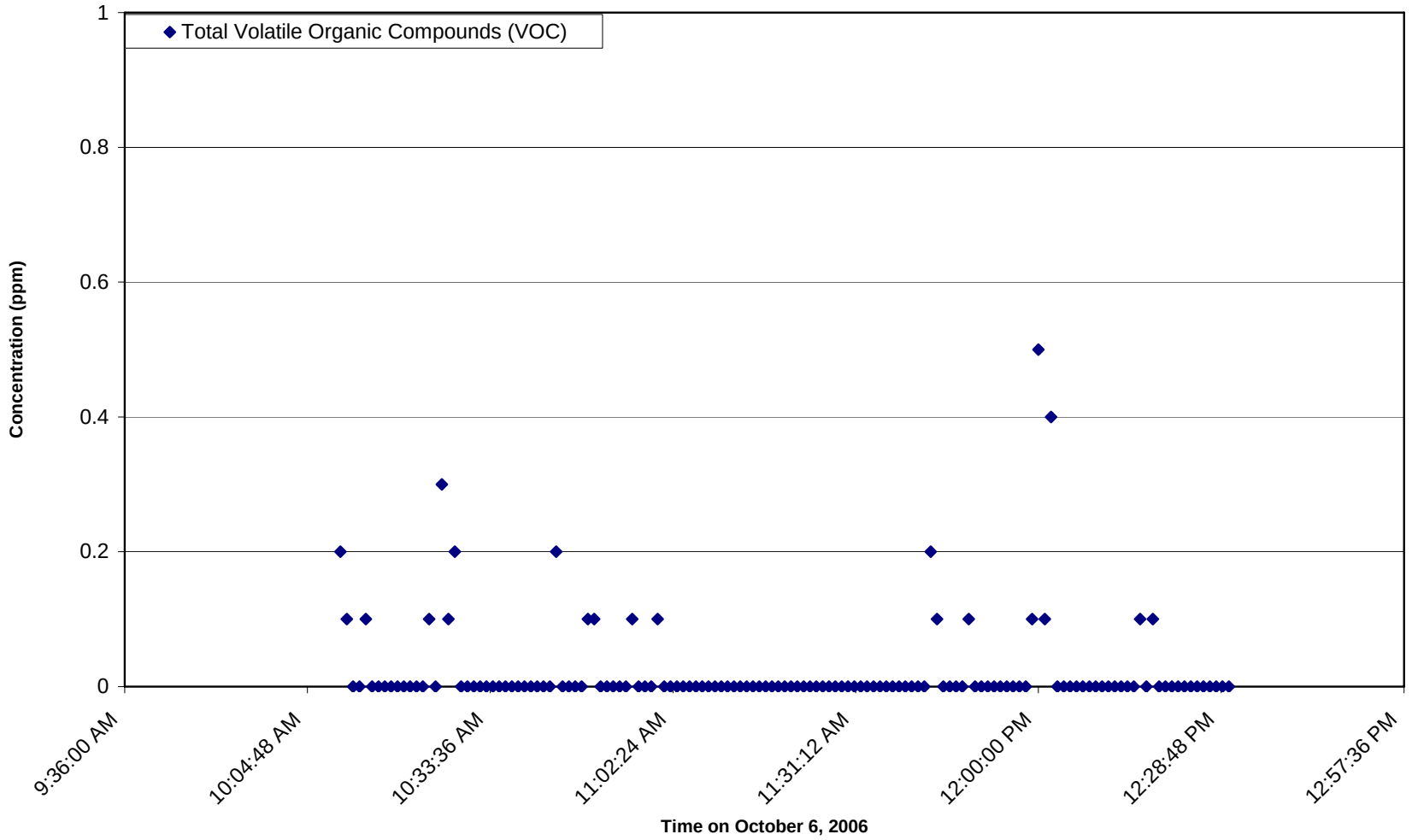


Figure 37 AreaRae 4 NH3 Data (1 min intervals)
Salem St. and East Chatham St.

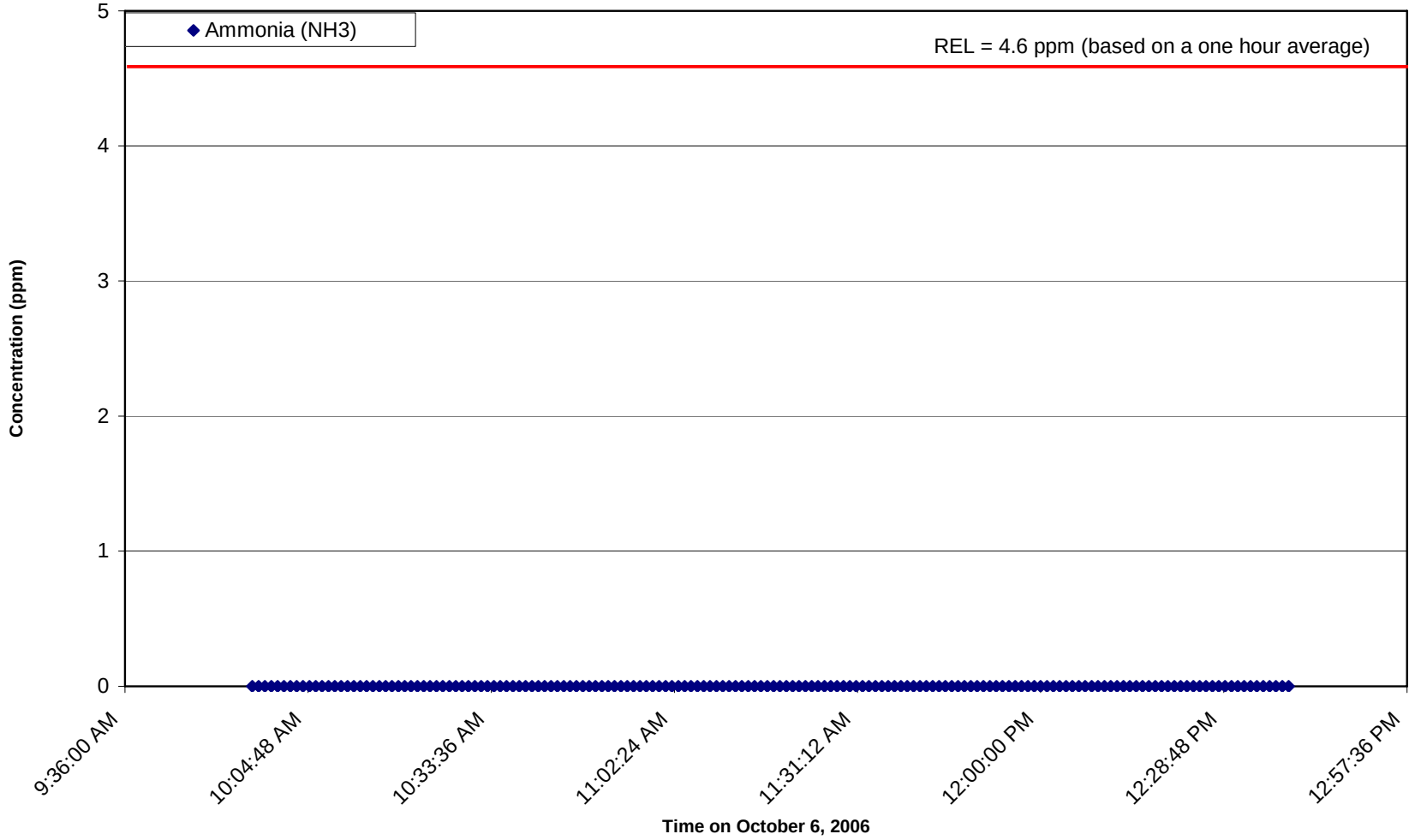


Figure 38 AreaRae 4 CO Data (1 min intervals)
Salem St. and East Chatham St.

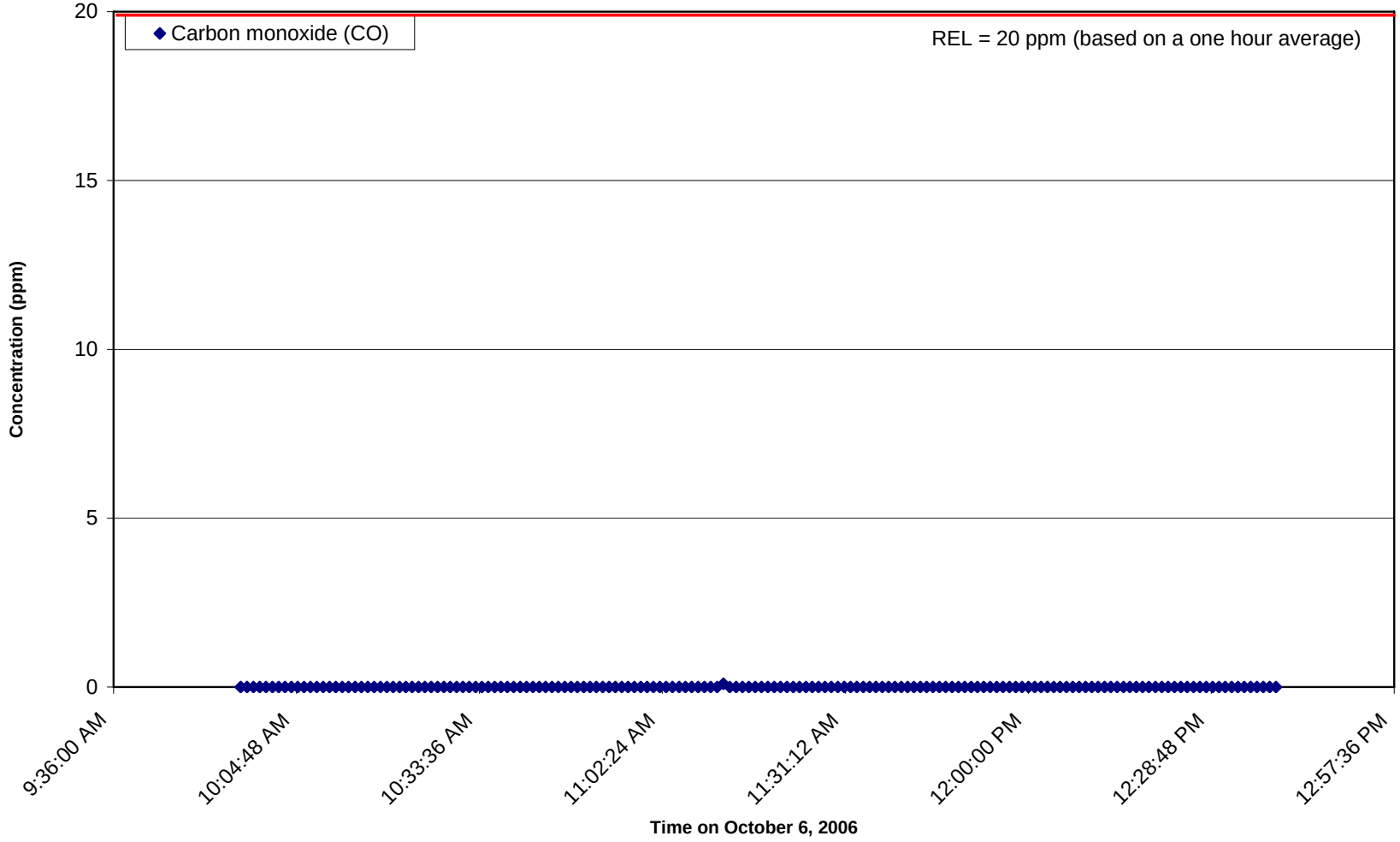


Figure 39 AreaRae 4 VOC Data (1 min intervals)
Salem St. and East Chatham St.

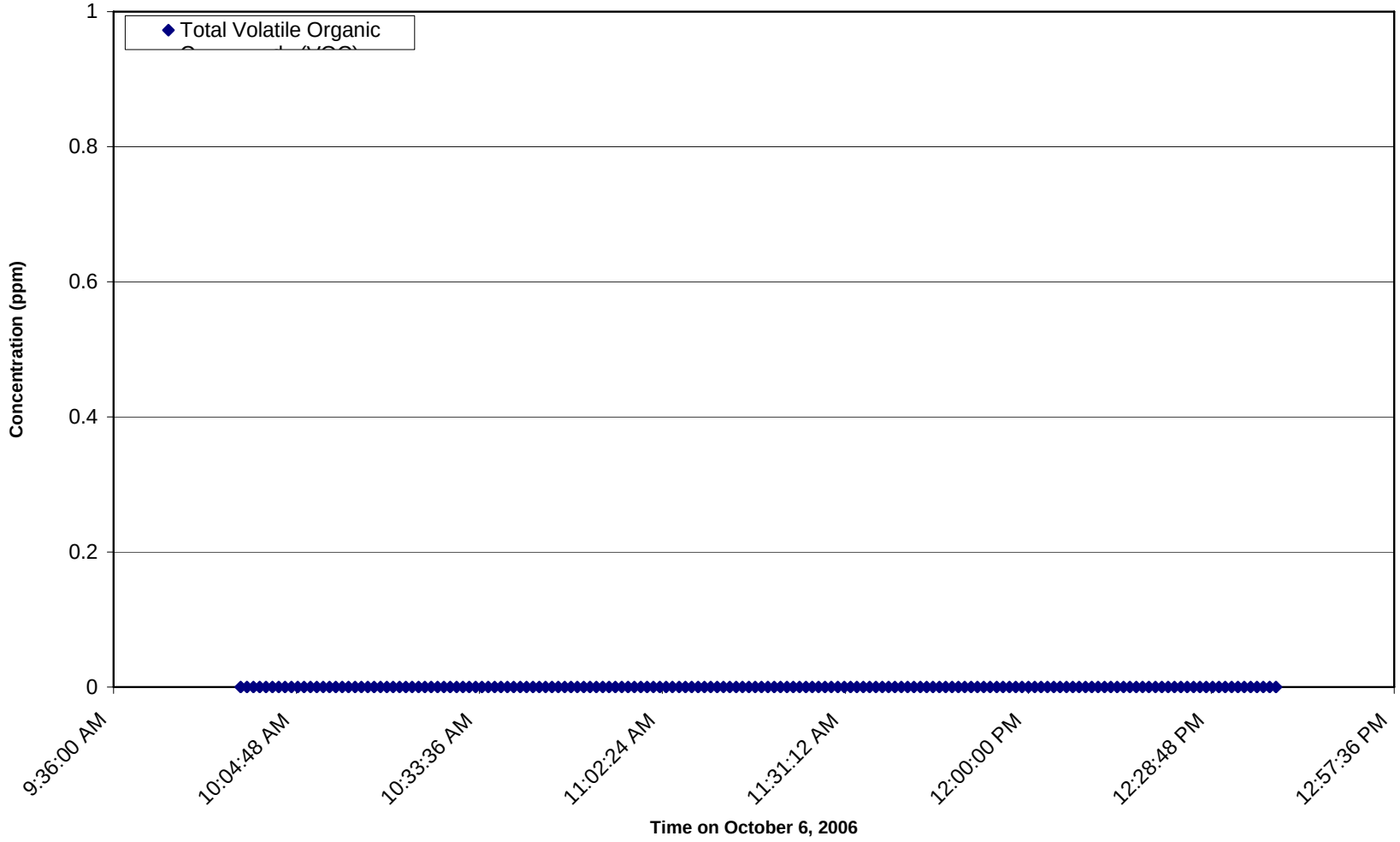


Figure 40 AreaRae 5 CL2 Data (5 sec intervals)
Hwy 55 (Williams St) and Salem St.

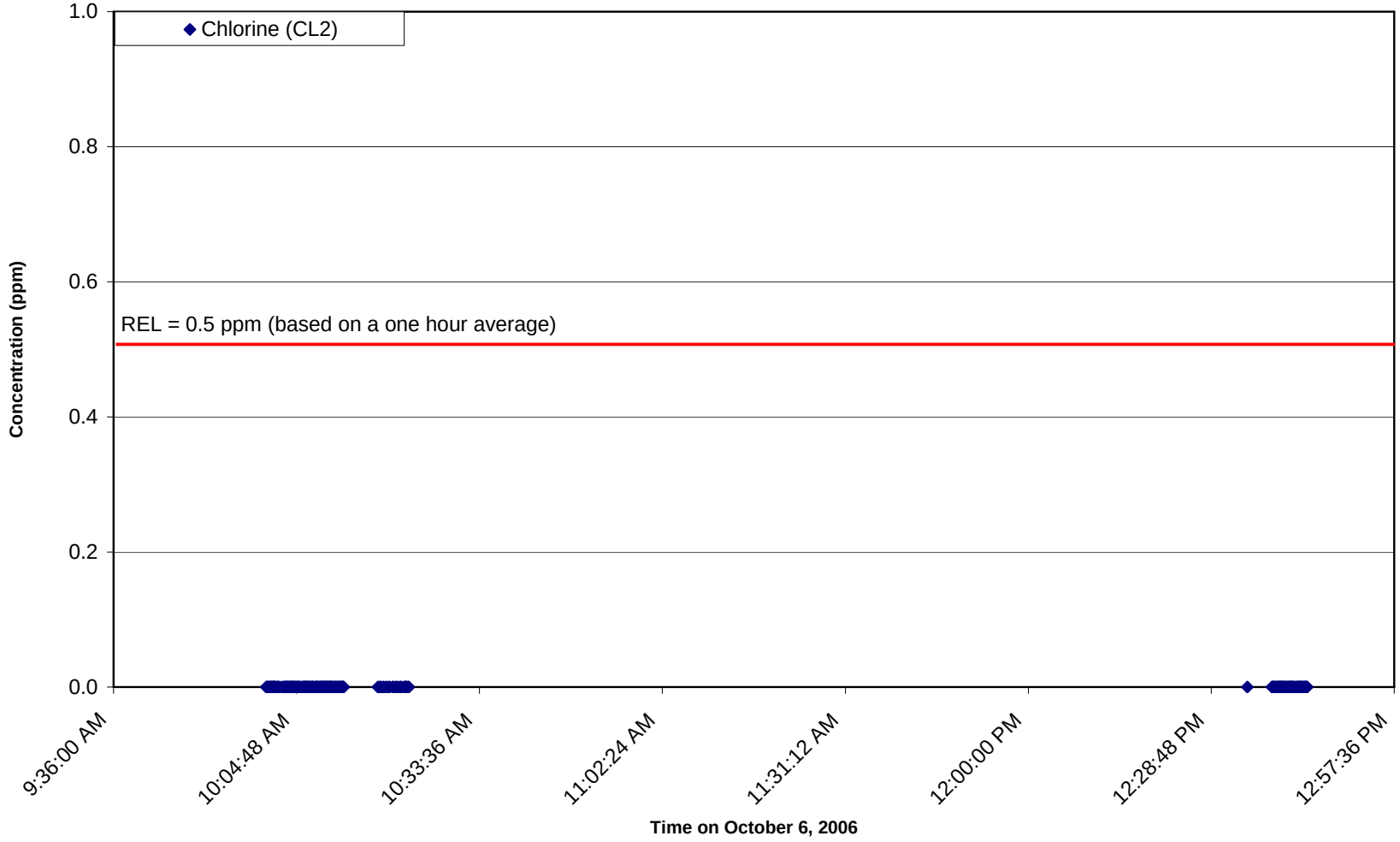


Figure 41 AreaRae 5 PH3 Data (5 sec intervals)
Hwy 55 (Williams St) and Salem St.

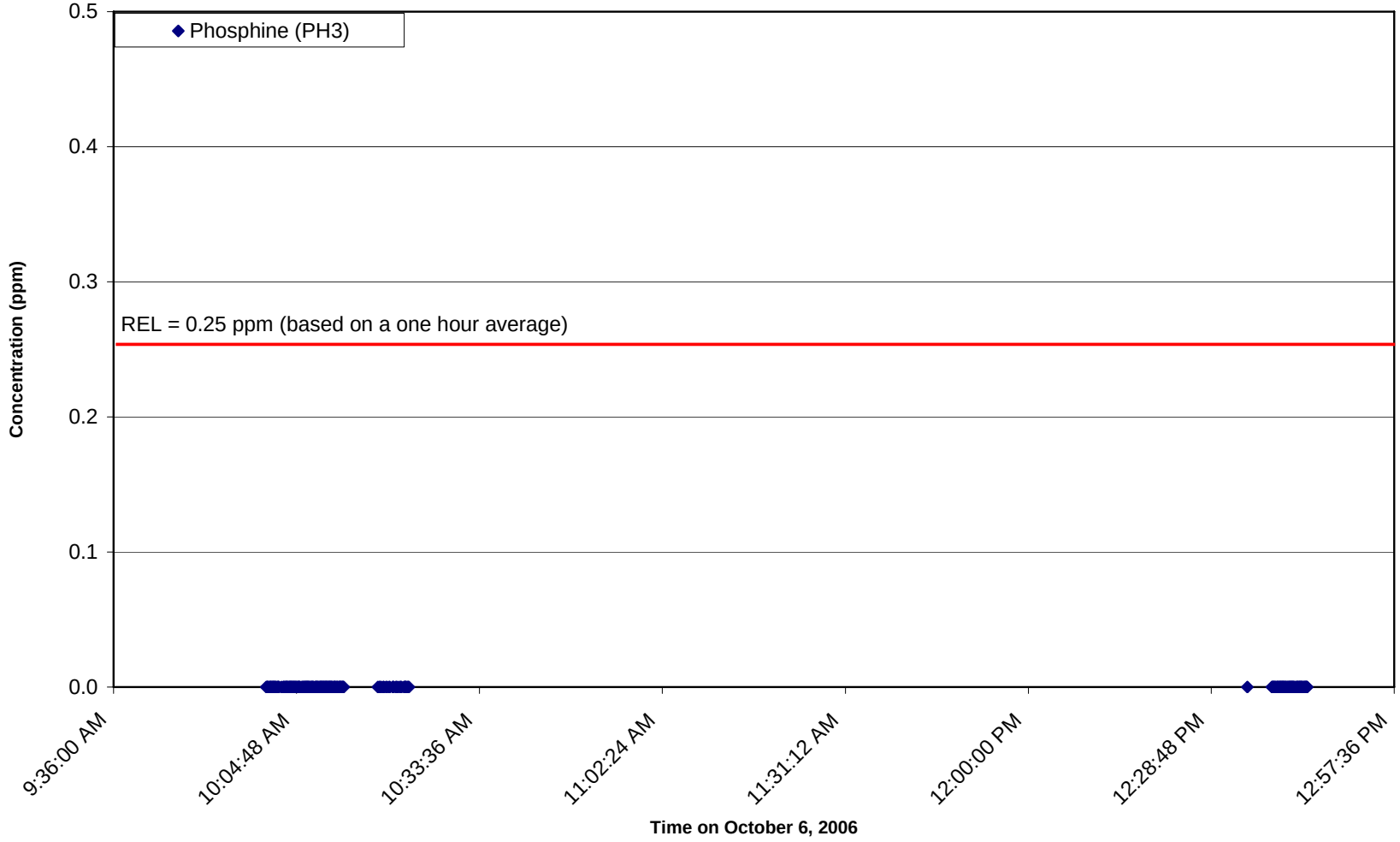


Figure 42 AreaRae 5 VOC Data (5 sec intervals)
Hwy 55 (Williams St) and Salem St.

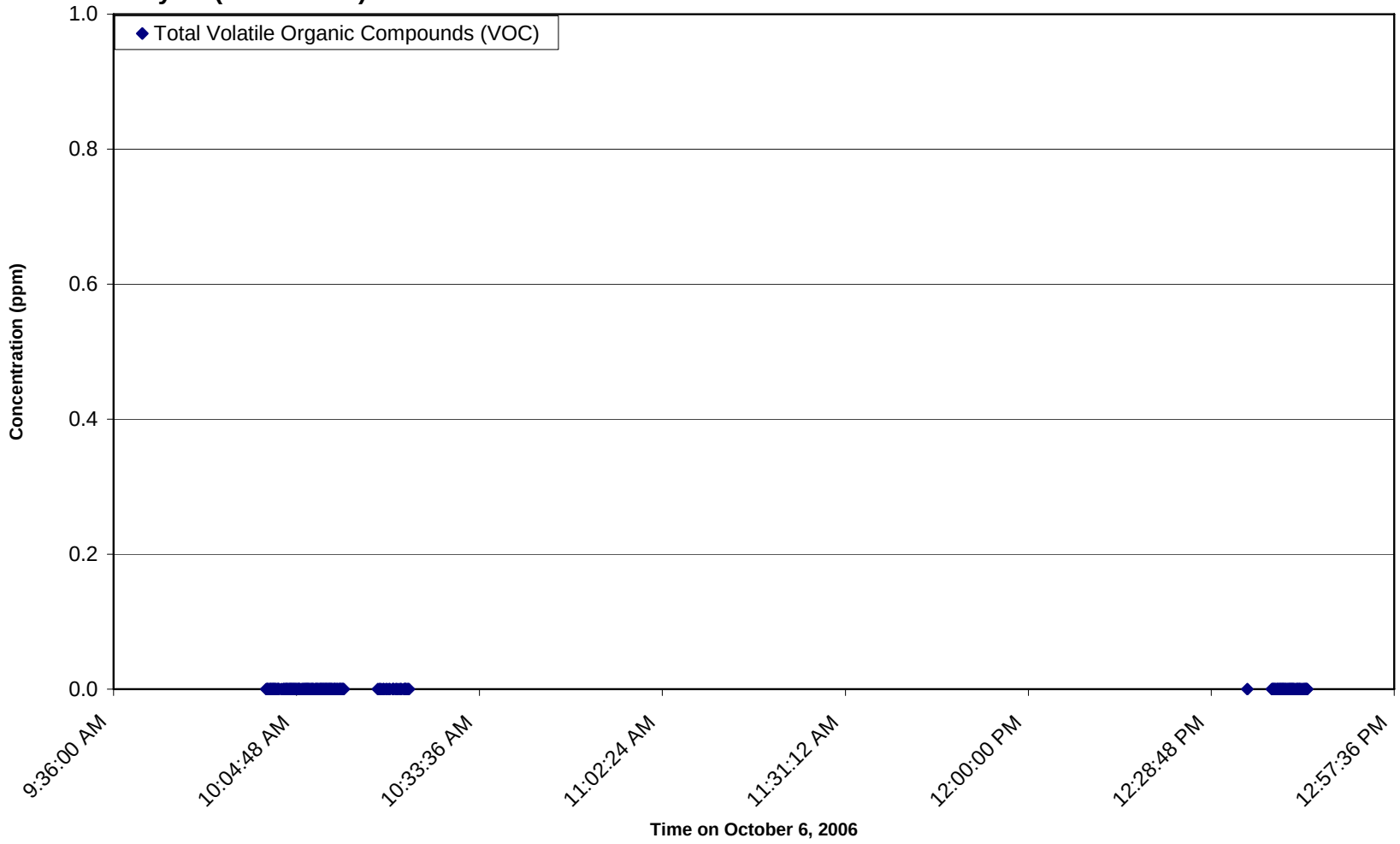


Figure 43 AreaRae 1 NO Data (5 sec intervals)
Tingen St. and Salem St.

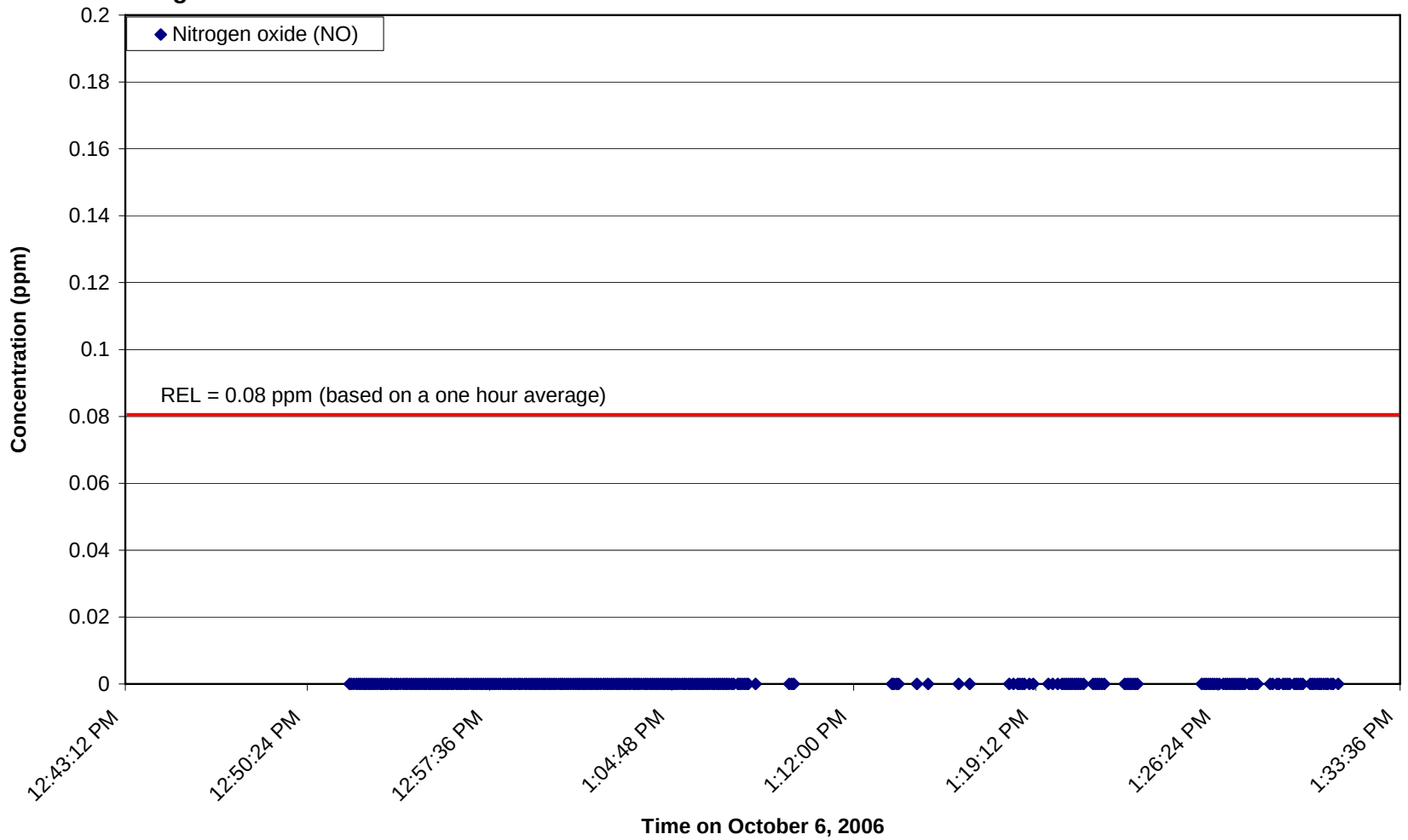


Figure 44 AreaRae 1 NO2 Data (5 sec intervals)
Tingen St. and Salem St.

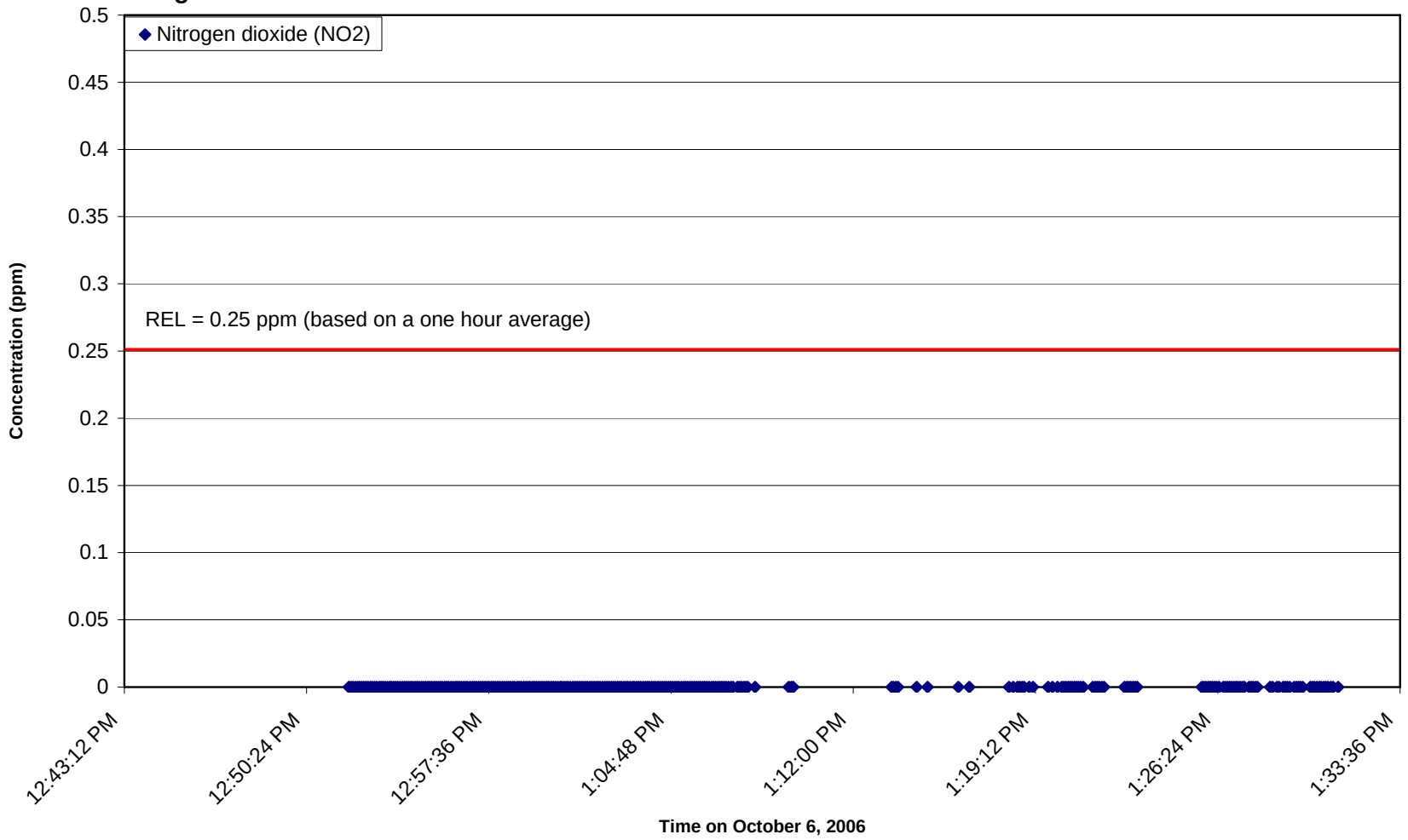


Figure 45 AreaRae 1 VOC Data (5 sec intervals)
Tingen St. and Salem St.

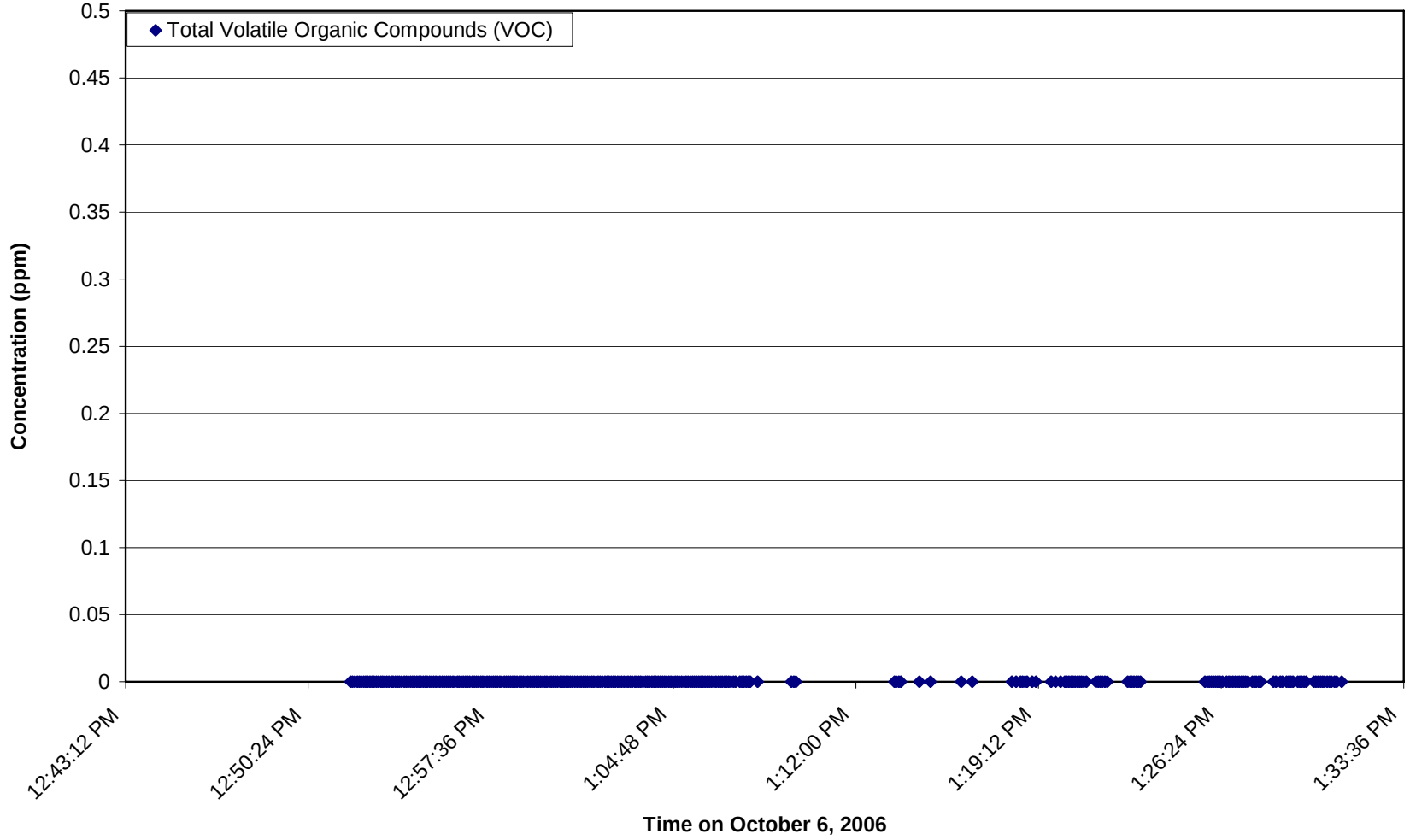


Figure 46 AreaRae 2 NH3 Data (5 sec intervals)

Tingen St. and James St.

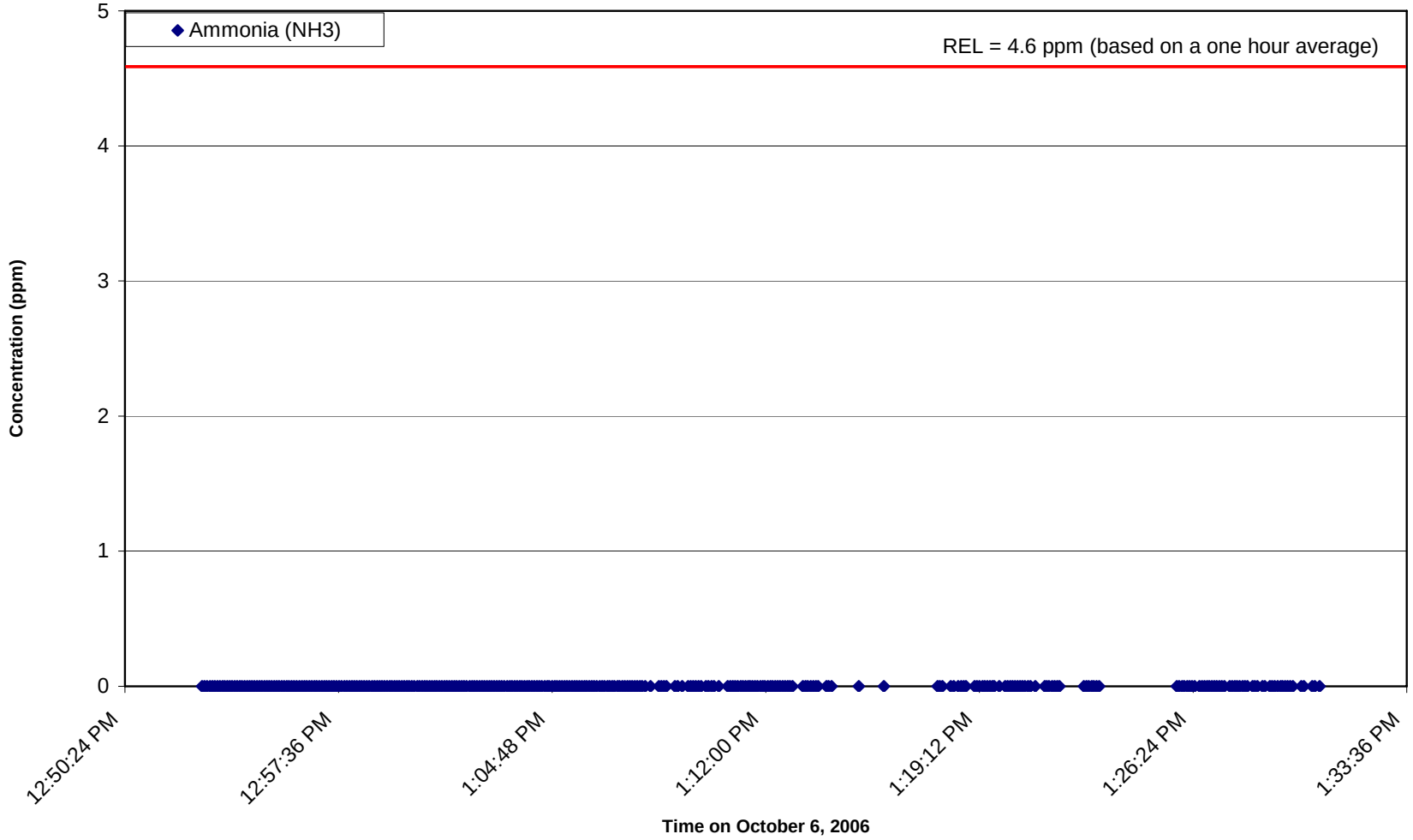


Figure 47 AreaRae 2 HCN Data (5 sec intervals)
Tingen St. and James St.

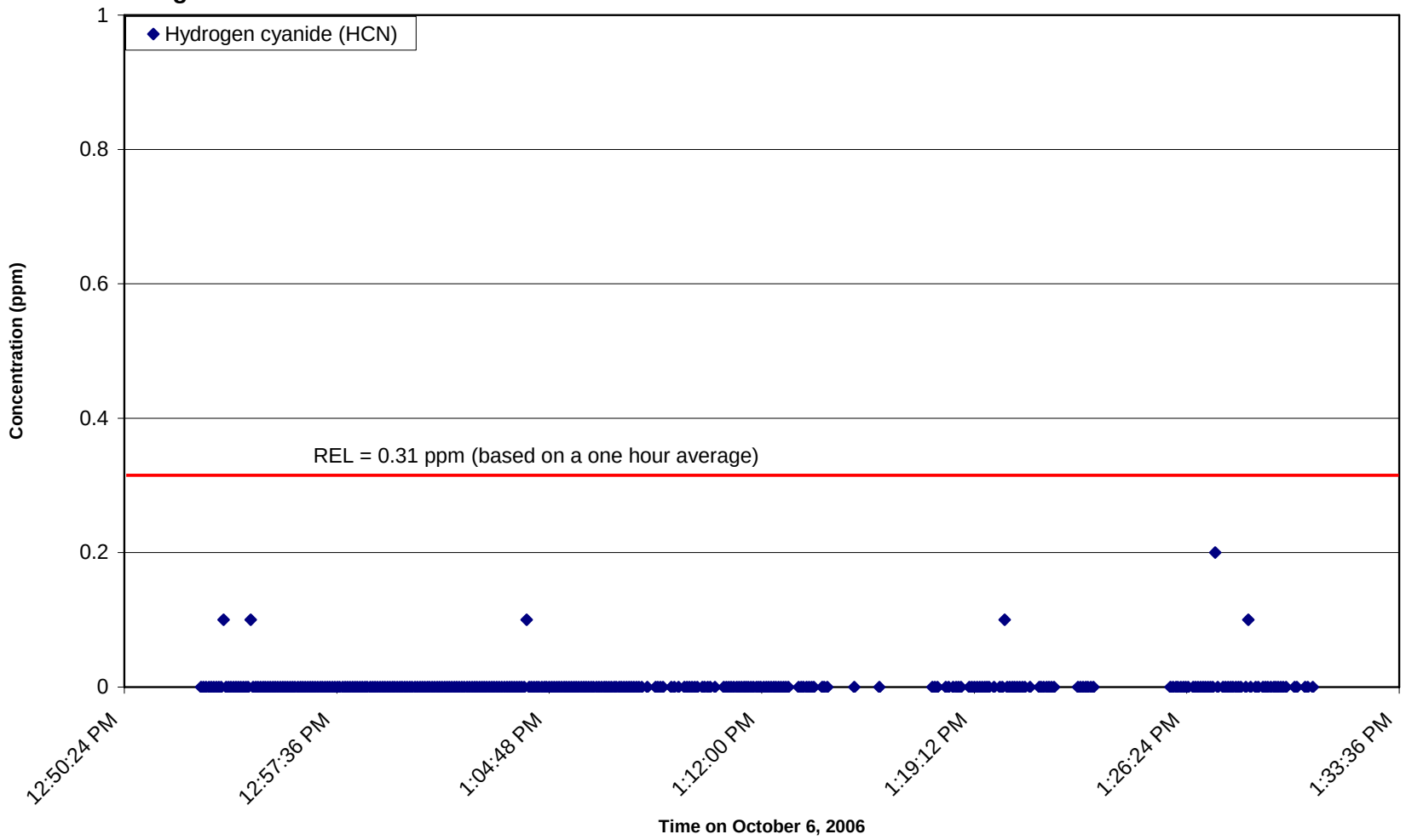


Figure 48 AreaRae 2 VOC Data (5 sec intervals)
Tingen St. and James St.

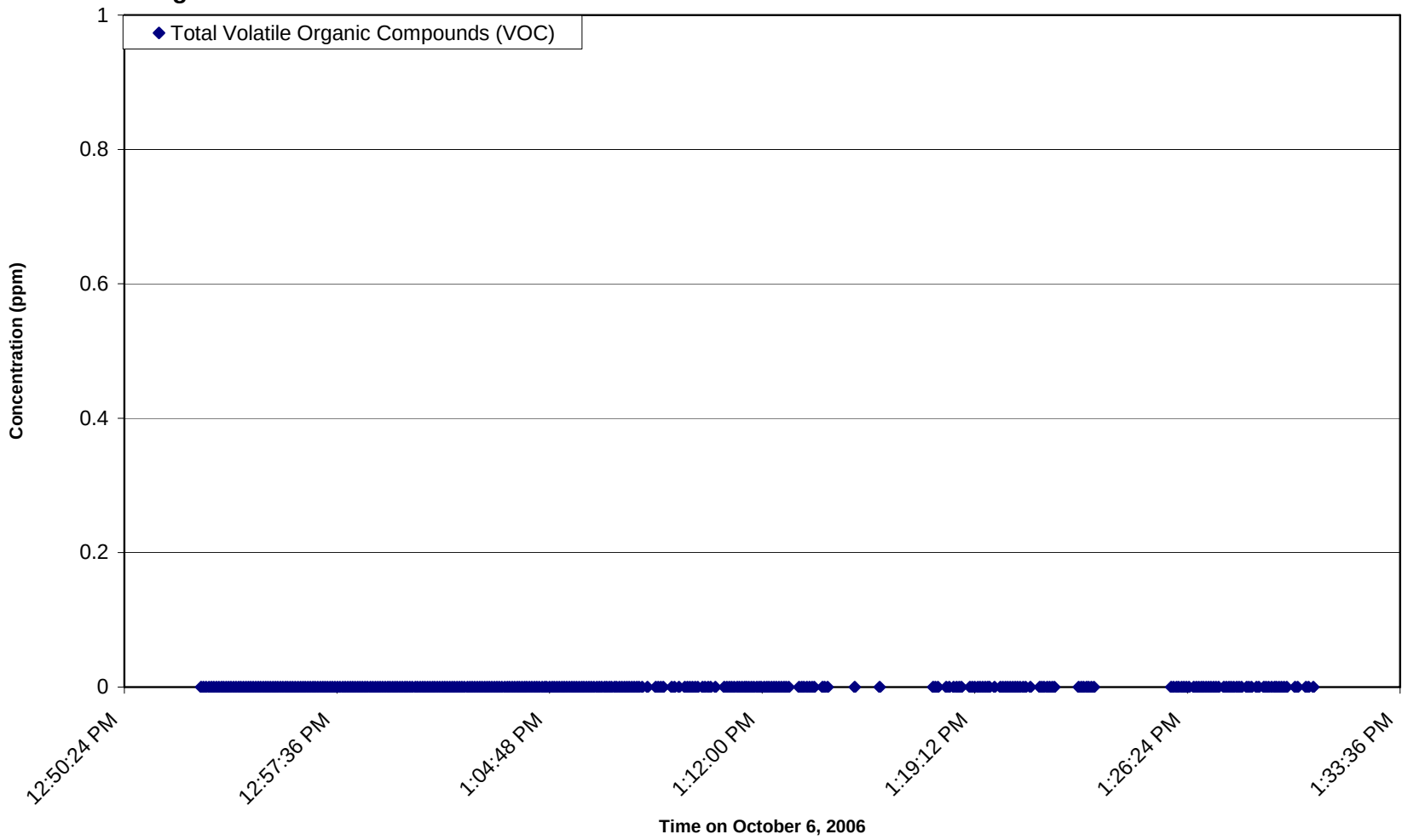


Figure 49 AreaRae 3 H2S Data (1 Min intervals)
Tingen St. and Sparta St.

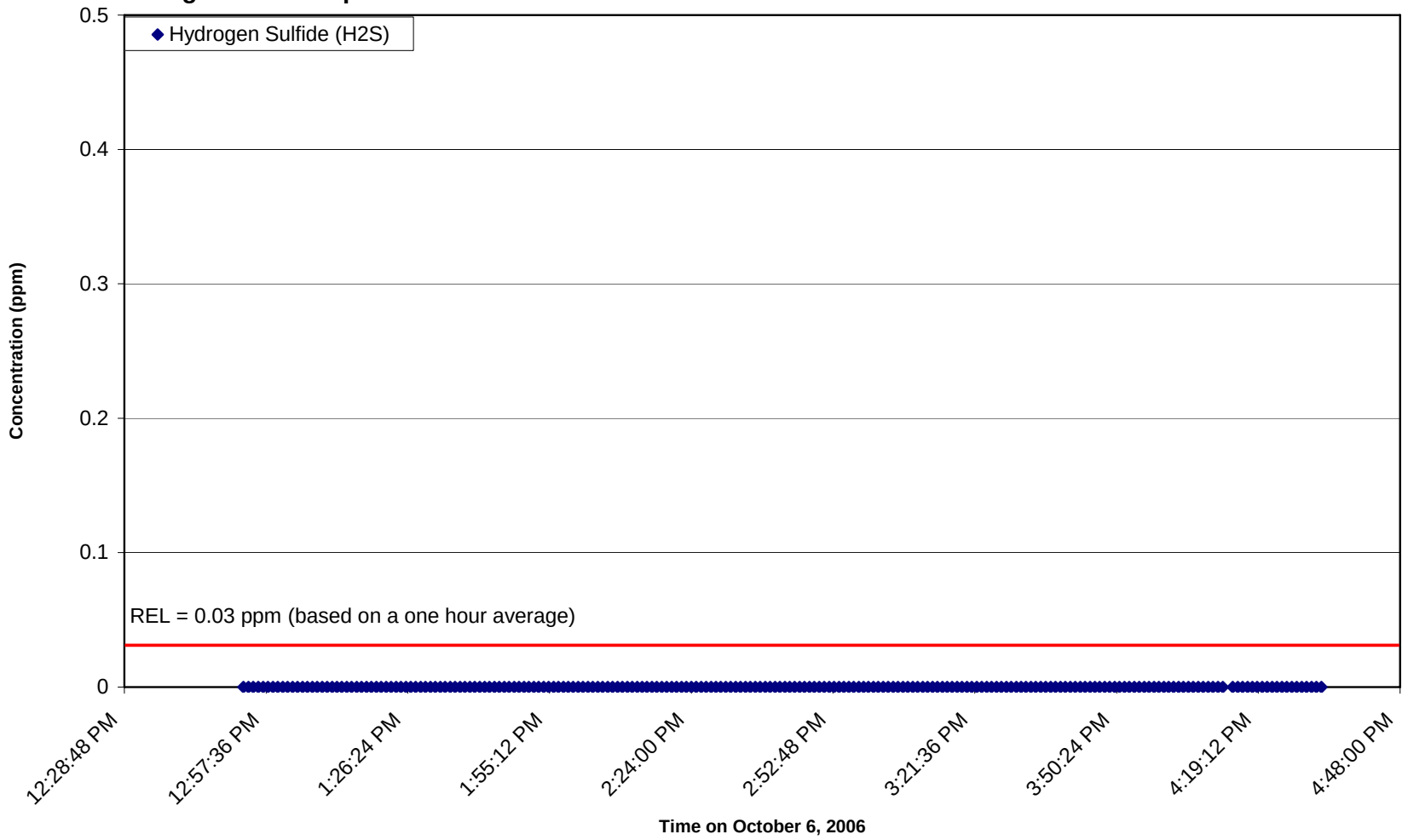


Figure 50 AreaRae 3 SO2 Data (1 Min intervals)
Tingen St. and Sparta St.

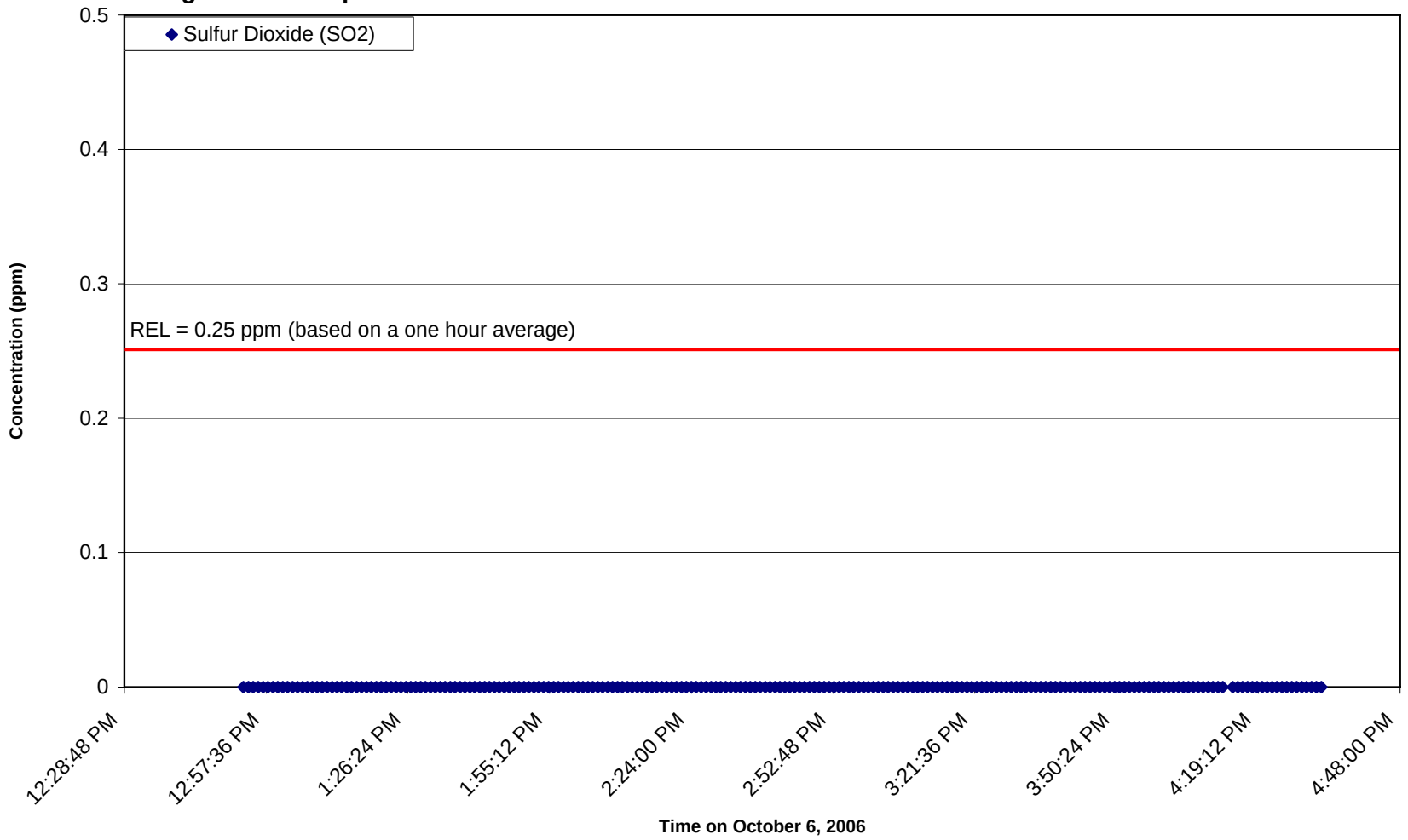


Figure 51 AreaRae 3 VOC Data (1 Min intervals)
Tingen St. and Sparta St.

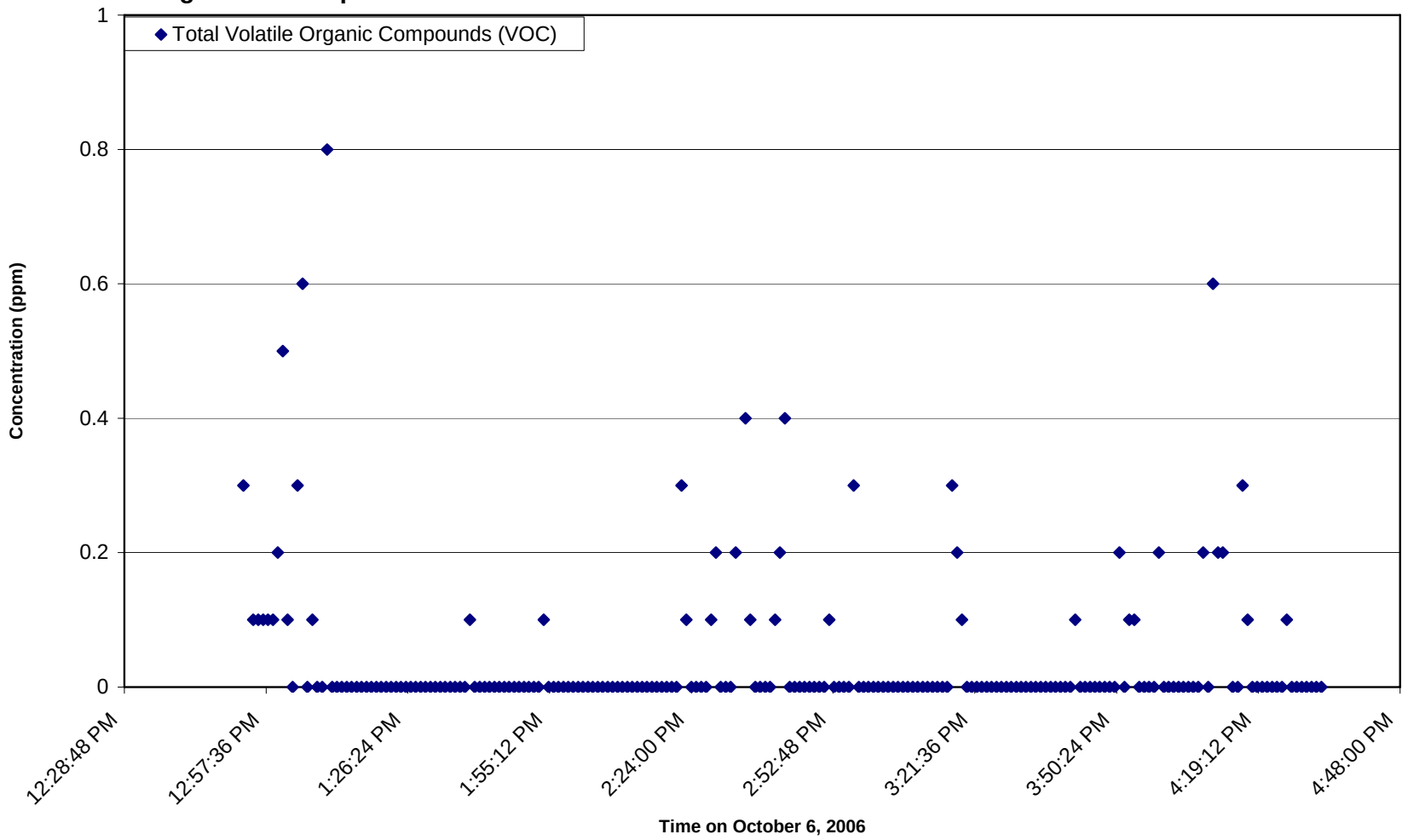


Figure 52 AreaRae 4 NH3 Data (1 Min intervals)
Hughes St. and Perry St.

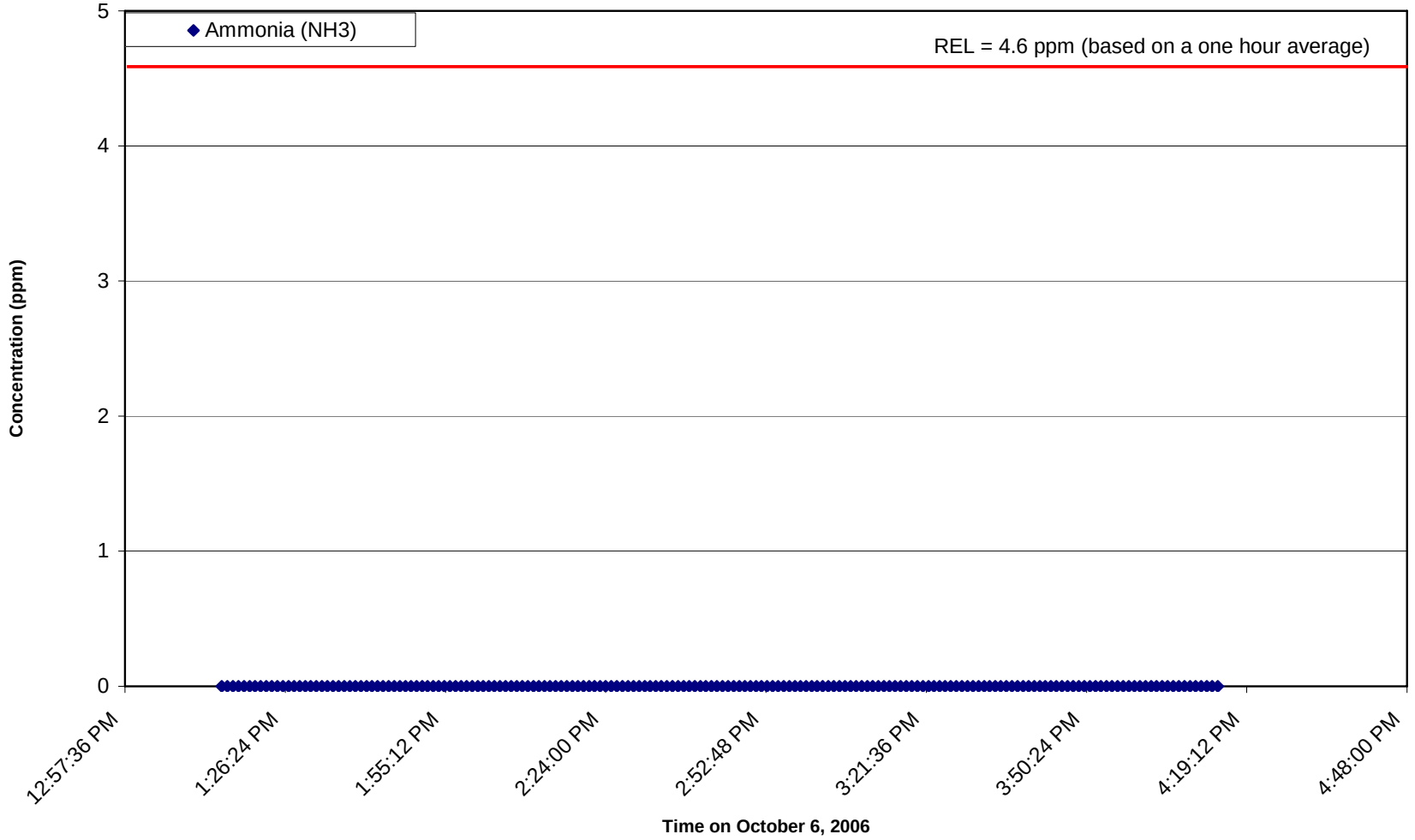


Figure 53 AreaRae 4 CO Data (1 Min intervals)
Hughes St. and Perry St.

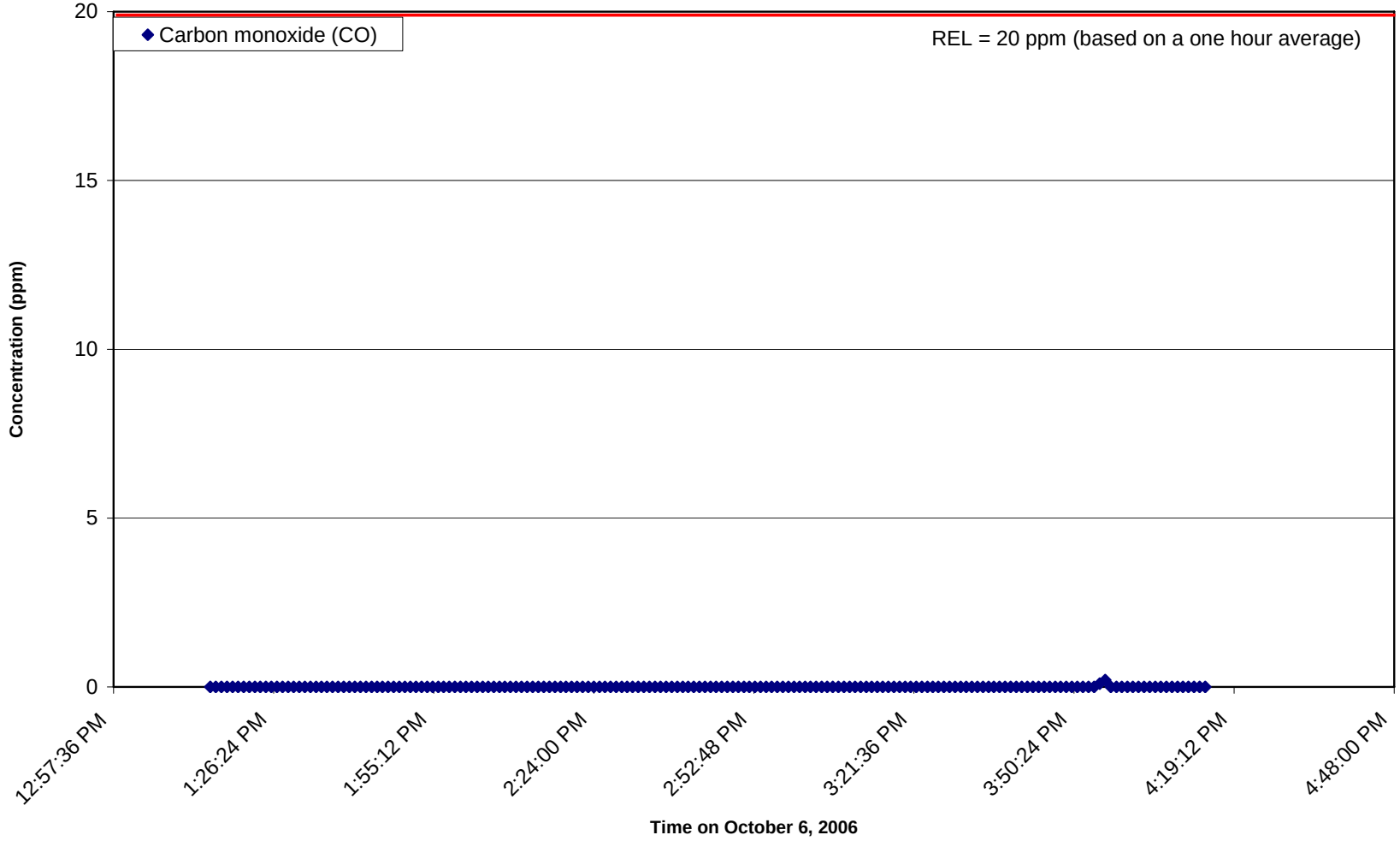


Figure 54 AreaRae 4 VOC Data (1 Min intervals)
Hughes St. and Perry St.

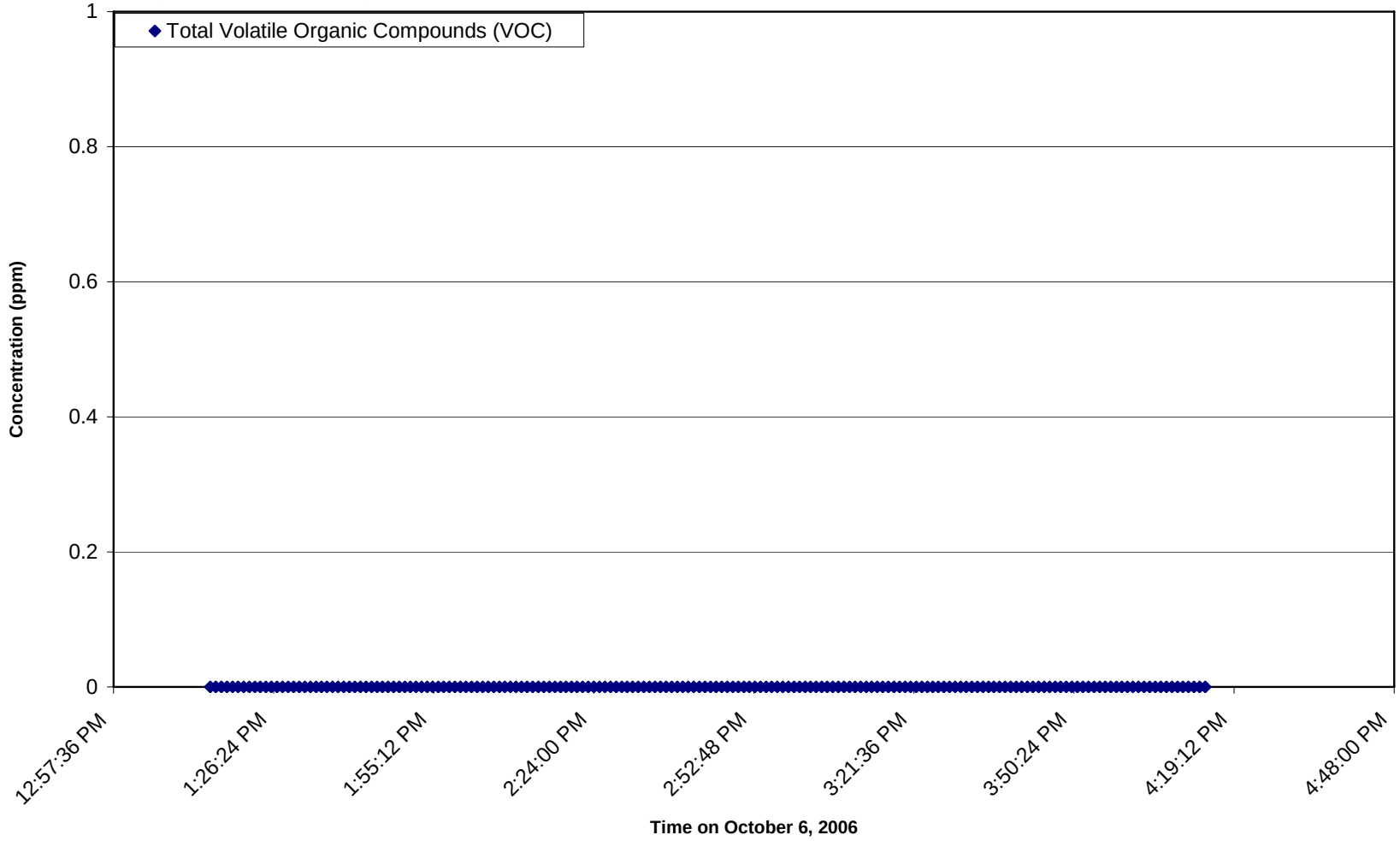


Figure 55 AreaRae 5 CL2 Data (5 sec intervals)
Hughes St. and James St.

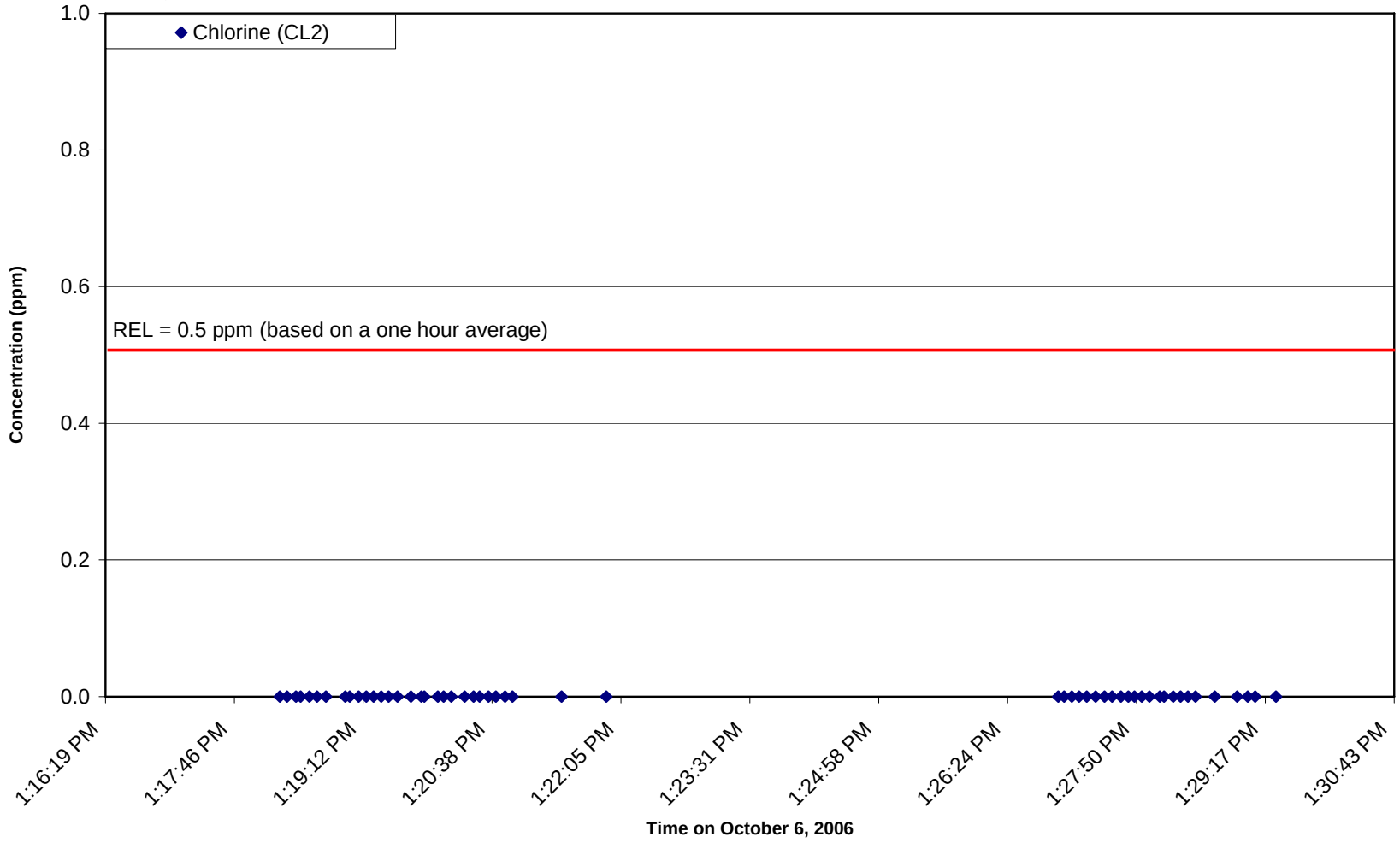


Figure 56 AreaRae 5 PH3 Data (5 sec intervals)
Hughes St. and James St.

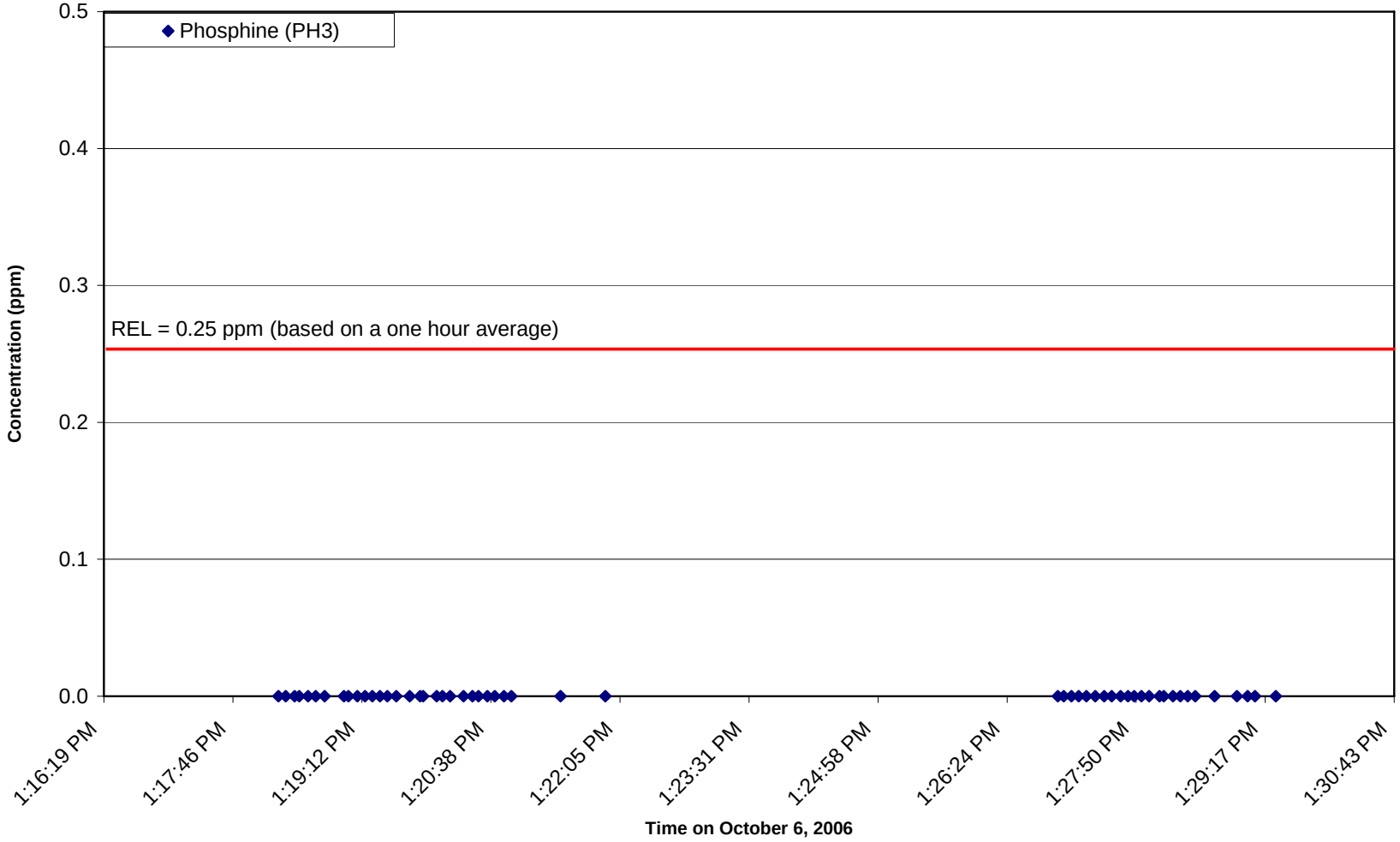
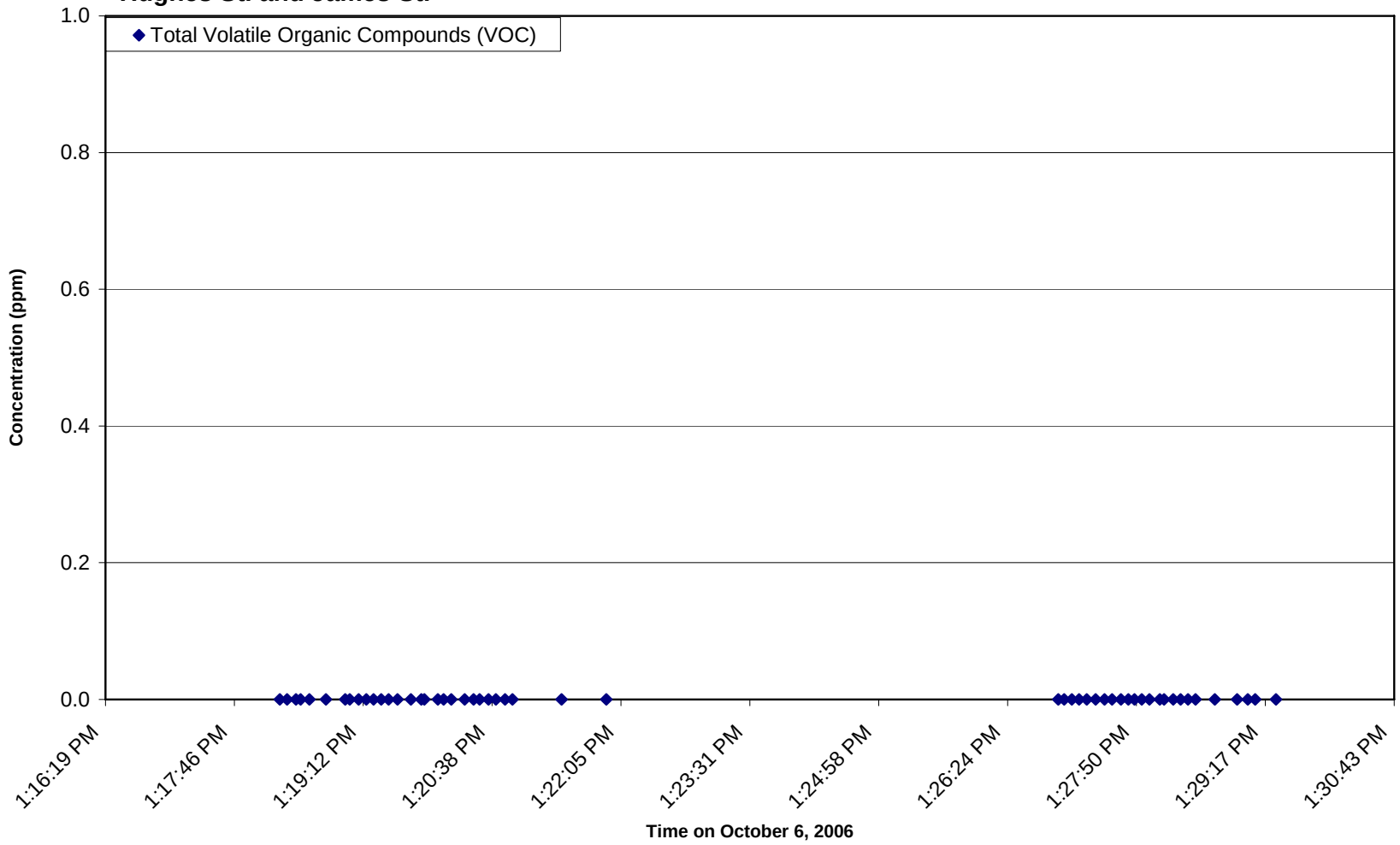


Figure 57 AreaRae 5 VOC Data (5 sec intervals)
Hughes St. and James St.



4.3 Grab Samples

As stated earlier in this report, to supplement the continuous measurements, eight discrete air samples were taken by filling 6-liter Tedlar air-sampling bag at various locations on October 6 and 7. These samples were analyzed with an Inficon gas chromatograph/mass spectrophotometer (GC/MS) system on the mobile laboratory. During emergency air monitoring episodes, the focus is usually on concentrations of toxic materials greater than part per million (ppm). However, some chemicals can be toxic at very small quantities that may be difficult to detect with some of the less sensitive monitoring instrumentation used during response situations. Samples having sufficient sample volume after analysis by the Inficon GC/MS were analyzed a second time at the ATAST main laboratory in Raleigh, NC with a Varian Saturn 2000 GC/MS system having a lower detection level. The summarized results are presented in the following section.

4.4 Wipe Sampling

After the fire was extinguished, DAQ conducted exterior wipe sampling at a selected number of homes, schools, and businesses for metals, semi-volatile organic chemicals, and cyanides. Wipe sampling for metals was conducted using ghost wipes (cotton towelettes moistened with de-ionized water); semi-volatiles were sampled using glass fiber filters dampened with de-ionized water; and cyanides were sampled with cellulose filters dampened with de-ionized water. The results of this sampling project will be discussed in the Exterior Wipe Sampling Report that will be published when these data are returned from the laboratory.

5.0 HEALTH IMPLICATIONS

The data presented in the Section 4.2 has been summarized in Table 8. These values were use to compare data to the RELs. NO RELs are needed for VOC, LEL, and OXY data.

Table 8 Summary of AreaRae® Data

AreaRae 1	Sampling Times
Hwy 55 and Olive Chapel	0730 - 0952
Salem and West Moore	0953 - 1251
Salem and Tingen	1252 - 1331

	1-hr average				
	NO	VOC	NO2	LEL	O2
	ppm	ppm	ppm	%	%
REL	0.08		0.25		
0700 - 0800	0	0	0	0	20.9
0800 - 0900	0	0	0	0	20.9
0900 - 1000	0	0	0	0	20.9
1000 - 1100	0	0	0	0	20.9
1100 - 1200	0	0	0	0	20.9
1200 - 1300	0	0	0	0	20.9
1300 - 1331	0	0	0	0	20.9

AreaRae 2	Sampling Times
Jaycee Park Entrance	0805 - 1004
Center and Salem	1020 - 1235
Tingen and James	1253 - 1330

	1-hr average				
	NH3	VOC	HCN	LEL	O2
	ppm	ppm	ppm	%	%
REL	4.6		0.31		
0800 - 0900	1.0	0.04	0.05	0	20.1
0900 - 1000	1.5	0.0	0.0	0	20.1
1000 - 1020	0.3	0.0	0.0	0	19.8
1020 - 1100	0.0	0.0	0.0	0	20.9
1200 - 1235	0.0	0.0	0.0	0	20.9
1253 - 1300	0.0	0.0	0.0	0	20.9
1300 - 1330	0.0	0.0	0.0	0	20.9

AreaRae 3	Sampling Times
Hunter and Salem	0700 - 0819
Sparta and Tingen	0843 - 1632

	1-hr average				
	H2S	VOC	SO2	LEL	OXY
	ppm	ppm	ppm	%	%
REL	0.03		0.25		
0700 - 0800	0.00	0.00	0.00	0	20.9
0800 - 0819	0.00	0.02	0.00	0	20.9
0843 - 0900	0.00	0.00	0.00	0	20.9
0900 - 1000	0.00	0.02	0.00	0	20.9
1000 - 1100	0.00	0.03	0.00	0	20.9
1100 - 1200	0.00	0.06	0.00	0	20.9
1200 - 1300	0.00	0.05	0.00	0	20.9
1300 - 1400	0.00	0.04	0.00	0	20.9
1400 - 1500	0.00	0.06	0.00	0	20.9
1500 - 1600	0.00	0.02	0.00	0	20.9
1600 - 1700	0.00	0.05	0.00	0	20.9

AreaRae 4	Sampling Times
Apex Funeral Home	0712 - 0949
Salem and E. Chatham	0956 - 1239
Perry and Hughes	1315 - 1614

	1-hr average				
	NH3	VOC	CO	LEL	OXY
	ppm	ppm	ppm	%	%
REL	4.6		20		
0700 - 0800	1.36	0.00	0.00	0.0	20.9
0800 - 0900	1.46	0.00	0.00	0.0	20.9
0900 - 1000	0.02	0.00	0.00	0.0	20.9
1000 - 1100	0.00	0.00	0.00	0.0	20.9
1100 - 1200	0.00	0.00	0.00	0.0	20.9

AreaRae 4 (cont)	NH3	VOC	CO	LEL	OXY
REL	ppm	ppm	ppm	%	%
1200 - 1300	0.00	0.00	0.00	0.0	20.9
1300 - 1400	0.00	0.00	0.00	0.0	20.9
1400 - 1500	0.00	0.00	0.00	0.0	20.9
1500 - 1600	0.00	0.00	0.01	0.0	20.9
1600 - 1700	0.00	0.00	0.00	0.0	20.9

AreaRae 5	Sampling Times
Salem and Williams Sts	0913 - 1243
James and Hughes Sts	1318 - 1329

	1-hr average				
	Cl2	VOC	PH3	LEL	OXY
	ppm	ppm	ppm	%	%
REL	0.07		1.0		
0900 - 1000	0.0	13.2	0.0	0.0	20.9
1200 - 1300	0.0	1.0	0.0	0.0	20.9
1300 - 1400	0.0	1.0	0.0	0.0	20.9

RESULT: **For continuous monitoring, no airborne contaminant for which sampling was conducted exceeded 33% of its reference exposure level.**

Table 9 summarizes the results of grab samples collected in Tedlar bags at several locations around the EQ Apex site during the incident.

Table 9 Grab Sample VOC Analysis Summary

Compound	INFICON	VARIAN	Conc. Range (ppb)	NC Average (ppb)	REL (ppb)	REL Source
1, 2, 4-trichlorobenzene		5/5	0.03 - 0.09	**0.06**	5,000	TEEL
1, 2-dibromoethane				*nd*		
1, 4-dioxane				*nd*		
1,1,1-trichloroethane		1/5	0.14	*nd*	2,000	EMEG/ATSDR
1,1,2,2-tetrachloroethane				*nd*		
1,1,2-trichlorotrifluoroethane		5/5	0.21 - 0.22	**0.08**	1,000,000	ERPG
1,1-dichloroethane				*nd*		
1,2,4-trimethylbenzene		5/5	0.43 - 0.54	**0.12**	25,000	ERPG
1,2-dichloroethane				*nd*		
1,2-dichloropropane				*nd*		
1,3,5-trimethylbenzene		5/5	0.13 - 0.22	**0.06**	25,000	ERPG
1,3-butadiene		1/5	0.2	**0.12**	10,000	ERPG
1-ethyl-4-methylbenzene		5/5	0.17 - 0.22	**0.08**	29,000	ERPG
Acetone	5/8	5/5	6.4 - 18	**3.66**	26,000	EMEG/ATSDR
Benzene	8/8	5/5	0.24 - 0.29	**0.33**	50	EMEG/ATSDR
Benzyl chloride		4/5	0.14 - 0.22	**0.08**	1,000	ERPG
Bromoform				*nd*		
Bromomethane				*nd*		
Carbon disulfide	8/8	5/5	1.8 - 3.5	**0.12**	900	ERPG
Carbon Tetrachloride		4/5	0.20 - 0.24	**0.10**	200	EMEG/ATSDR
Chlorobenzene				*nd*		
Chloroethane				**0.31**		
Chloroform				*nd*		
cis-1,2-dichloroethene				*nd*		
cis-1,3-dichloro-1-propene				*nd*		
Cyclohexane		4/5	0.12 - 0.15	*nd*	900,000	TEEL
Dibromochloromethane				*nd*		
Ethanol		5/5	1.4 - 3.4	**3.36**	1,000,000	TEEL
Ethyl Acetate				**0.10**		
Ethylbenzene	8/8	5/5	0.22 - 0.34	**0.11**	100,000	ERPG
Freon 11		5/5	0.34 - 0.37	**0.63**	500,000	ERPG
Freon 114		5/5	0.1 - 0.7	*nd*	1,000,000	ERPG
Freon 12		5/5	0.6 - 0.72	**0.60**	1,000,000	ERPG
Heptane		3/5	0.03 - 0.7	**0.07**	440,000	ERPG
Hexachloro-1, 3-butadiene				*nd*		
Hexane		5/5	0.51 - 1.2	**0.23**	50,000	ERPG

Isopropyl Alcohol		5/5	0.29 - 2.9	**0.12**	1,300	CaREL
m/p-xylene	8/8	5/5	0.63 - 1.1	**0.36**	1,000	EMEG/ATSDR
m-dichlorobenzene				*nd*		
Methyl Isobutyl Ketone		1/5	0.78	*nd*	300,000	TEEL
Methyl Chloride	8/8	5/5	0.6 - 0.74	**0.38**	200,000	TEEL
Methyl Ethyl Ketone		4/5	0.47 - 0.53	**0.11**	5000	CaREL
Methylene Chloride		5/5	0.94 - 2.53	**0.19**	600	EMEG/ATSDR
MTBE				*nd*		
o-dichlorobenzene				*nd*		
o-xylene	8/8	5/5	0.24 - 0.39	**0.12**	1,000	EMEG/ATSDR
p-dichlorobenzene				*nd*		
Styrene		4/5	0.39 - 0.48	**0.13**	4,900	CaREL
Tetrachloroethylene				*nd*		
Tetrahydrofuran		2/5	0.66 - 0.79	*nd*	100,000	ERPG
Toluene	8/8	5/5	0.84 - 1.2	**0.57**	1,000	EMEG/ATSDR
trans-1,2-dichloroethene				*nd*		
trans-1,3-dichloro-1-propene				*nd*		
Trichloroethylene	0/8	1/5	0.13	**0.07**	100	EMEG/ATSDR
Vinyl Acetate				*nd*		
Vinyl Chloride				*nd*		
Vinylidene Chloride				*nd*		
Notes:						
nd: not detected						
NC Average -- UAT 2002 to 2005 Average for Urban Sites						

RESULT: **For some chemicals detected, the concentration range includes values in excess of the average NC urban air concentration. However, it should be stressed that no airborne contaminant collected and analyzed exceeded 0.5% of its reference exposure level.**

6.0 SUMMARY

- For continuous monitoring, **no airborne contaminant for which sampling was conducted exceeded 33% of its reference exposure level**.

- For some chemicals detected in the grab samples, the concentration range exceeds the average NC urban air concentration. However, it should be stressed that **no airborne contaminant sampled and analyzed exceeded 0.5% of its reference exposure level.**

- Results from exterior wipe sampling will be published in a separate report when laboratory results have been received.

- Three sites have been established to continuously monitor the air during the remediation phase. Site 1 is approximately 0.2 miles SSW of EQ. Site 2 is approximately 0.2 miles E of EQ. Site 3 is approximately 0.25 miles NW of EQ. Continuous monitoring will be conducted for elemental mercury vapor, carbonyl compounds, volatile organic compounds (VOCs), and airborne particulate matter.

7.0 REFERENCES

i. California Environmental Protection Agency. Air Toxics Hot Spots Program Risk Assessment Guidelines. Part 1. The Determination of Acute Reference Exposure Levels for Airborne Toxicants. Office of Environmental Health Hazard Assessment, Air Toxics and Epidemiology Section. March 1999. http://www.oehha.ca.gov/air/pdf/acuterel.pdf

ii. California Health and Safety Code Section 44303.

iii. http://www.epa.gov/oppt/aegl/

iv. http://www.orau.gov/emi/scapa/erpgdefinitions.htm