



Sonoma Technology, Inc.
Environmental Science and Innovative Solutions

Thirty-Fourth Quarterly Report of Ambient Air Quality Monitoring at Sunshine Canyon Landfill and Van Gogh Elementary School

March 1, 2016 – May 31, 2016

Quarterly Report
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Prepared by

Ashley R. Graham, PhD
Nathan R. Pavlovic
Steven G. Brown, PhD
David L. Vaughn
Sonoma Technology, Inc.
1455 N. McDowell Blvd., Suite D
Petaluma, CA 94954-6503
Ph 707.665.9900 | F 707.665.9800
sonomatech.com

Prepared for

Planning Department, City of Los Angeles
City Hall, Room 525
200 N. Spring St.
Los Angeles, CA 90012
and
Los Angeles County Department of Regional Planning
320 West Temple Street, 13th Floor
Los Angeles, CA 90012

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Executive Summary

ES-1. Background

Continuous monitoring of meteorological and air quality parameters began at the Sunshine Canyon Landfill (the Landfill) and at Van Gogh Elementary School in the nearby community of Granada Hills in fall 2007. The Sunshine Canyon Landfill Upwind Site was installed in December 2015. PM₁₀ (particulate matter less than 10 microns in aerodynamic diameter) is measured hourly; wind speed (WS) and wind direction (WD) are measured as 1-minute averages; and black carbon (BC, a surrogate for diesel particulate matter [DPM]) is averaged over 5-minute intervals. The collected data undergo quarterly validation and are evaluated for completeness. BC data are compensated for filter tape saturation effects, which cause BC values to be underestimated. In the data collected since 2007, this compensation increases values by about 12% compared to uncompensated values.

Following data validation, all data are reported as hourly averages. PM₁₀ concentrations are then compared with federal and state PM₁₀ standards. When PM₁₀ exceedances occur, additional comparisons are made with the historical, regional, and annual ambient PM₁₀ concentrations. The PM₁₀ and BC data are analyzed at least once a year to characterize the impact of landfill operations on ambient air quality on a neighborhood scale. The validated hourly data and a summary of the analytical results and field operations are reported to the Planning Department of the City of Los Angeles and to the Los Angeles County Department of Regional Planning. This Thirty-Fourth Quarterly Report summarizes the March-May (spring) quarter monitoring results from the ninth year of continuous monitoring.

ES-2. Statistics

The percent data capture for PM₁₀ was 100.0% at the Landfill, Landfill Upwind, and Van Gogh School sites. Approximately 46.2%, 4.0%, and 24.7% of the captured PM₁₀ data at the Landfill, Landfill Upwind, and Van Gogh School sites, respectively, were invalidated. The relatively large proportion of PM₁₀ data invalidated at the Landfill and Van Gogh School sites were primarily due to failed flow checks; the pump at the Landfill site was replaced on April 27 to address the issue. No hourly PM₁₀ values were deemed suspect at the Landfill, Landfill Upwind, and Van Gogh School sites. BC data capture was 90.4% at the Landfill site, with 0.3% of the data invalidated and 0.7% deemed suspect. BC data capture was 92.3% at the Van Gogh School site, with 0.2% of the data invalidated and 0.2% deemed suspect. At the new Landfill Upwind site, BC data capture was 93.4%, with 0.2% data invalidated and 0.3% deemed suspect. There were no exceedances of the federal 24-hr PM₁₀ standard of 150 µg/m³ during this quarter at any of the three sites. The percentage of days on which the state PM₁₀ standard of 50 µg/m³ was exceeded during this spring quarter was 2% (one day) at the Landfill site, 5.7% (five days) at the Landfill Upwind site, and 0% (zero days) at Van Gogh School site.

From 2008 to 2016, spring-quarter average 24-hr BC concentrations ranged from 0.50 µg/m³ to 1.01 µg/m³ at the Landfill site, and from 0.49 µg/m³ to 0.81 µg/m³ at the Van Gogh site. This spring quarter, the Landfill site had the same BC average (0.50 µg/m³) as the spring 2015 quarter, the lowest BC average over all spring quarters. This is the first spring quarter where the

Landfill Upwind site was operational; the average 24-hr BC concentration at this site was 0.48 $\mu\text{g}/\text{m}^3$.

ES-3. Monitoring Site Infrastructure Upgrades

Republic Services (Republic) has purchased new PM_{10} monitors (Met One Instruments Model 1020) for the Landfill and Van Gogh School monitoring sites. Additionally, Republic has funded and managed the installation of the infrastructure (concrete pad, fencing, and electrical power) to support the new Landfill Upwind monitoring site on the north rim of the landfill. Sonoma Technology, Inc. (STI) began monitoring at the upwind site on December 11, 2015, measuring PM_{10} , BC, WS, and WD, analogous to the downwind site. The site is planned to run for a minimum of one year, at which time its utility will be assessed and a decision will be made whether to keep the site for the duration of the existing monitoring contract.

The two new PM_{10} monitors, and the STI-supplied PM_{10} monitor destined for the upwind site, were collocated in Fresno, CA, to demonstrate the comparability of the monitors' performance. Similarly, the STI-supplied Aethalometer at the upwind site was collocated with the Aethalometer at the existing Landfill monitoring station for several months. Data from these tests were presented in the 32nd quarterly report and demonstrated a high degree of correlation and low bias between similar instruments.

1. Introduction

This report provides a summary of data completeness, ambient PM₁₀ (particulate matter less than 10 microns in aerodynamic diameter) concentrations, average and maximum black carbon (BC, a surrogate for diesel particulate matter [DPM]) concentrations, instrument flow rate verification (quality control) data, and field operations for the spring quarterly period of March 1, 2016, through May 31, 2016. This is the ninth consecutive year that spring-season data have been collected from continuous monitoring at the Sunshine Canyon Landfill and Van Gogh School monitoring sites, and the first year that spring-season data have been collected from continuous monitoring at the Sunshine Canyon Landfill Upwind monitoring site. PM₁₀ was measured with a beta-attenuation monitor (BAM), and BC was measured with an Aethalometer. **Figure 1** shows the monitoring site locations.



Figure 1. Angled view of Sunshine Canyon Landfill and surrounding monitoring stations: Sunshine Canyon Landfill, Sunshine Canyon Landfill Upwind, and Van Gogh School. All monitoring stations are marked with a green cross.

2. Data Completeness

Table 1 gives completeness statistics for all measured variables during the spring quarter. The percent data capture for PM₁₀ was 100.0% at all three sites. Approximately 46.2%, 4.0%, and 24.7% of the captured PM₁₀ at the Landfill, Landfill Upwind, and Van Gogh School sites, respectively, were invalidated. The relatively large proportion of PM₁₀ data invalidated at the Landfill and Van Gogh sites were primarily due to failed flow checks; the pump at the Landfill site was replaced on April 27 to address the issue. No hourly values were deemed suspect at any of the three sites. Suspect data are included in subsequent analyses (e.g., regional comparisons), while invalid data are not.

Table 1. Data completeness statistics for hourly BC and PM₁₀ data, and 1-min wind speed and wind direction data, for the spring monitoring quarter.

Monitoring Location	Dates	Percent Data Capture ^a			Percent Data Valid or Suspect ^b			Percent Data Suspect ^c		
		PM ₁₀	BC	WS/WD	PM ₁₀	BC	WS/WD	PM ₁₀	BC	WS/WD
Sunshine Canyon Landfill	03/01/16-05/31/16	100.0	90.4	99.7	53.8	99.7	99.0	0.0	0.7	0.3
Sunshine Canyon Landfill Upwind	03/01/16-05/31/16	100.0	93.4	98.9	96.0	99.8	98.9	0.0	0.3	0.0
Van Gogh School	03/01/16-05/31/16	100.0	92.3	99.2	75.3	99.8	98.4	0.0	0.2	0.0

^a Percent Data Capture is the number of collected data values divided by the total number of expected data intervals in the date range (e.g., for the raw BC 1-hr data, 24 data values per day are expected), assuming a start date of March 1, 2016.

^b Percent Data Valid or Suspect is the number of data values that are either valid or suspect, divided by the number of captured data values.

^c Percent Data Suspect is the number of data values labeled as suspect divided by the number of captured data values.

BC data capture was 90.4% at the Landfill site, with 0.3% of the data invalidated and 0.7% deemed suspect. BC data capture was approximately 92.3% at the Van Gogh School site, with 0.2% of the data invalidated and 0.2% deemed suspect. At the new Landfill Upwind site, BC data capture was 93.4%, with 0.2% data invalidated and 0.3% deemed suspect.

The wind data capture percentage was 99.7%, 98.9%, and 99.2% at the Landfill, Landfill Upwind, and Van Gogh School sites, respectively. At the Landfill site, 1.0% of the wind data were invalidated, with 0.3% of wind data deemed suspect. At the Landfill Upwind site, 1.1% of the wind data were invalidated, with no wind data deemed suspect. The percentage of wind data invalidated at Van Gogh School was 1.6%, with none of the wind data deemed suspect.

3. PM₁₀ Exceedances

The federal and state PM₁₀ exceedances for the spring 2016 quarter, the spring quarters of the previous eight years (2008–2015), and the spring quarter of the baseline year (November 22, 2001–November 21, 2002) are summarized in **Table 2**. There were no exceedances of the federal 24-hr PM₁₀ standard of 150 µg/m³ during the March 2016–May 2016 quarter at any of the three sites. In this quarter, the state standard of 50 µg/m³ was exceeded 2.0% of the time (one day) at the Landfill site, 5.7% of the time (five days) at the Landfill Upwind site, and 0% of the time (zero days) at the Van Gogh School site.

Table 2. Number of exceedances of federal and state 24-hr PM₁₀ standards during the spring quarters of the baseline year (2002) and 2008–2016. In the “Federal 24-Hr” column, the values are *number of exceedances* and the *date(s)* on which those exceedances occurred. In the “State 24-Hr” column, the values are *number of exceedances/total days on which valid 24-hr averages were measured* and the *percentage of exceedances* out of the total number of days on which valid 24-hr average PM₁₀ concentrations were measured. The most recent spring quarter is shown in bold.

Site	Quarterly Period	Exceedances of PM ₁₀ Standard	
		Federal 24-Hr 150 µg/m ³	State 24-Hr 50 µg/m ³
Sunshine Canyon Landfill	03/01/02–05/31/02	0	21/56 (38%)
	03/01/08–05/31/08	1 (05/21/08)	20/89 (22%)
	03/01/09–05/31/09	1 (05/06/09)	24/89 (27%)
	03/01/10–05/31/10	0	10/90 (11%)
	03/01/11–05/31/11	1 (04/30/11)	8/49 (16%)
	03/01/12–05/31/12	1 (05/22/12)	15/89 (17%)
	03/01/13–05/31/13	2 (03/21/13 & 04/08/13)	34/91 (37%)
	03/01/14–05/31/14	0	19/92 (21%)
	03/01/15–05/31/15	0	5/91 (5%)
	03/01/16–05/31/16	0	1/49 (2%)
Sunshine Canyon Landfill Upwind	03/01/16–05/31/16	0	5/88 (6%)
Van Gogh School	03/01/02–05/31/02	0	17/55 (31%)
	03/01/08–05/31/08	1 (05/21/08)	6/92 (7%)
	03/01/09–05/31/09	0	17/88 (19%)
	03/01/10–05/31/10	0	7/91 (8%)
	03/01/11–05/31/11	0	3/92 (3%)
	03/01/12–05/31/12	0	9/70 (13%)
	03/01/13–05/31/13	0	18/92 (20%)
	03/01/14–05/31/14	0	6/92 (7%)
	03/01/15–05/31/15	0	1/91 (1%)
	03/01/16–05/31/16	0	0/69 (0%)

4. Average and Maximum Black Carbon Concentrations and PM₁₀ Concentrations

Although no federal or state standards exist for BC concentrations in ambient air, BC is a measurable component of ambient air that correlates well with DPM. Because of growing evidence that DPM is associated with several negative health effects, BC is often measured in an attempt to quantify the relative amounts of DPM in ambient air. Findings from the Multiple Air Toxics Exposure Study IV (MATES IV), conducted by the South Coast Air Quality Management District (SCAQMD), found DPM to be the most important toxic air pollutant contributing to risk in the Los Angeles basin.¹

Aethalometers are subject to a saturation effect, where the buildup of BC on the air sampling tape causes an artifact that affects the accuracy of the measured concentration.^{2,3} Instrument response is dampened with heavier loading (i.e., heavier concentrations) of BC aerosol. This artifact can cause BC concentration readings to be lower. However, mathematical methods to correct the BC concentration values are available and are widely used. All the reported BC values to date from the Landfill, Landfill Upwind, and Van Gogh School sites have been adjusted to compensate for this tape saturation effect; this compensation had not been performed in quarterly reports prior to the 29th Quarterly Report (winter 2015). Because the compensation process changes the reported concentration, and because uncompensated values were used in previous reports, prior-year BC concentrations shown in this report do not match concentrations reported in reports prior to the 29th Quarterly Report. All BC data shown in this report have been compensated, with the exception of data from the baseline year; raw data for the baseline year are unavailable for compensation.

Table 3 provides the 24-hr average and maximum compensated BC concentrations collected during the spring 2016 quarter and compares them to compensated BC data from the spring quarters of the eight previous years. The spring 2016 quarter data at the Van Gogh School site are similar to those of previous spring quarters. The spring 2016 BC average at the Landfill site is the lowest spring average recorded since the beginning of the study. The average 24-hr BC concentration at the Landfill Upwind site is similarly low.

¹ South Coast Air Quality Management District (2015) MATES-IV: Multiple Air Toxics Exposure Study in the South Coast Air Basin. Final report, May. Available at <http://www.aqmd.gov/docs/default-source/air-quality/air-toxic-studies/mates-iv/mates-iv-final-draft-report-4-1-15.pdf?sfvrsn=7>.

² Drinovec L. et al. (2014) The "dual-spot" Aethalometer: an improved measurement of aerosol black carbon with real-time loading compensation. *Atmos. Meas. Tech. Discuss.*, 7(9), 10179-10220, doi: 10.5194/amtd-7-10179-2014. Available at <http://www.atmos-meas-tech-discuss.net/7/10179/2014/>.

³ Allen G. (2014) Analysis of spatial and temporal trends of black carbon in Boston. Report prepared by Northeast States for Coordinated Air Use Management (NESCAUM), Boston, MA, January. Available at nescaum.org/documents/analysis-of-spatial-and-temporal-trends-of-black-carbon-in-boston/nescaum-boston-bc-final-rept-2014.pdf/.

Table 3. Twenty-four-hour BC concentrations for the spring quarter of the baseline year (2002) and each year from 2008 through 2016. Asterisks (*) denote uncompensated BC values. The most recent spring quarter is shown in bold.

Site	Quarterly Period	BC Concentrations ($\mu\text{g}/\text{m}^3$)	
		Average 24-Hr	Maximum 24-Hr
Sunshine Canyon Landfill	03/01/02–05/31/02	0.72*	2.18*
	03/01/08–05/31/08	0.80	2.30
	03/01/09–05/31/09	1.01	3.44
	03/01/10–05/31/10	0.64	1.88
	03/01/11–05/31/11	0.62	1.63
	03/01/12–05/31/12	0.65	1.60
	03/01/13–05/31/13	0.84	3.17
	03/01/14–05/31/14	0.64	1.46
	03/01/15–05/31/15	0.50	1.22
	03/01/16–05/31/16	0.50	1.47
Sunshine Canyon Landfill Upwind	03/01/16–05/31/16	0.48	1.58
Van Gogh School	03/01/02–05/31/02	0.72*	2.22*
	03/01/08–05/31/08	0.61	1.37
	03/01/09–05/31/09	0.81	1.95
	03/01/10–05/31/10	0.64	1.80
	03/01/11–05/31/11	0.54	1.47
	03/01/12–05/31/12	0.66	1.70
	03/01/13–05/31/13	0.66	1.49
	03/01/14–05/31/14	0.49	1.44
	03/01/15–05/31/15	0.61	1.68
	03/01/16–05/31/16	0.56	1.97

Figure 2 shows a notched box-whisker plot⁴ of spring quarter PM₁₀ and BC data for the Landfill site and the Van Gogh School site for all nine monitoring years (2008-2016). Each box indicates the interquartile range (IQR), where 50% of the data lie, with the notch at the median. If notches do not overlap, this indicates that the median concentrations are statistically different at the 95% confidence level. The whiskers go to 1.5 times the IQR; points beyond this (outliers) are shown individually.

⁴ A notched box-whisker plot shows the entire distribution of concentrations for each year. Each box shows the 25th, 50th (median), and 75th percentiles. The whiskers indicate values that are up to 1.5 times the inter-quartile range from the 25th or 75th percentile. The boxes are notched (narrowed) at the median and return to full width at the 95% lower- and upper-confidence interval values. These plots indicate that we are 95% confident that the median falls within the notch. If the 95% confidence interval is beyond the 25th or 75th percentile, then the notches extend beyond the box (hence a “folded” appearance).

For PM₁₀, these plots show no statistically significant temporal trend in the concentrations over the last nine years for the spring quarter, although average PM₁₀ concentrations measured at the Van Gogh School site are consistently lower than those measured at the Landfill site at this time of the year.

Table 3 and Figure 2 suggest that, while there is some year-to-year variability, there is no statistically significant trend in spring-quarter 24-hr average BC over the past nine years at either the Landfill site or the Van Gogh School site. The average 24-hr spring-quarter BC concentrations at the Landfill site in 2016 are the lowest on record, and the maximum 24-hr BC concentration is the second lowest on record. The average and maximum 24-hr spring-quarter BC concentrations at the Landfill site are also lower than those for the Van Gogh School site during the same period.

The 24-hr average PM₁₀ and BC data from the three sites for the current spring quarter are shown in notched box-whisker plots in **Figures 3 and 4**, respectively. The 24-hr average PM₁₀ and BC are not significantly different between the Landfill, Landfill Upwind, and Van Gogh School sites.

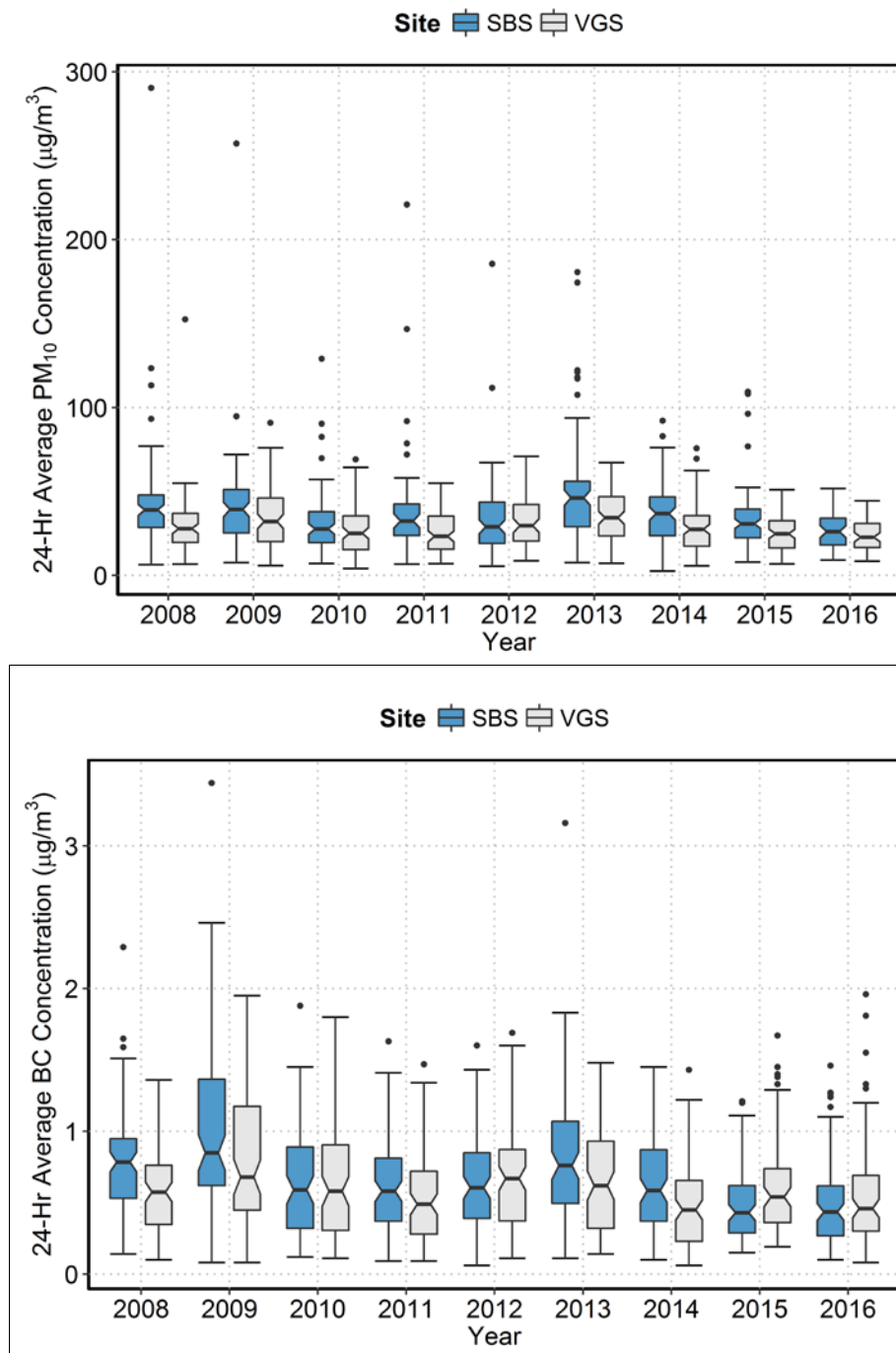


Figure 2. Notched box-whisker plot of daily 24-hr average concentrations of PM₁₀ (top) and BC (bottom) at the Landfill site (SBS) and the Van Gogh School site (VGS) during spring (March-May) quarters from 2008 to 2016.

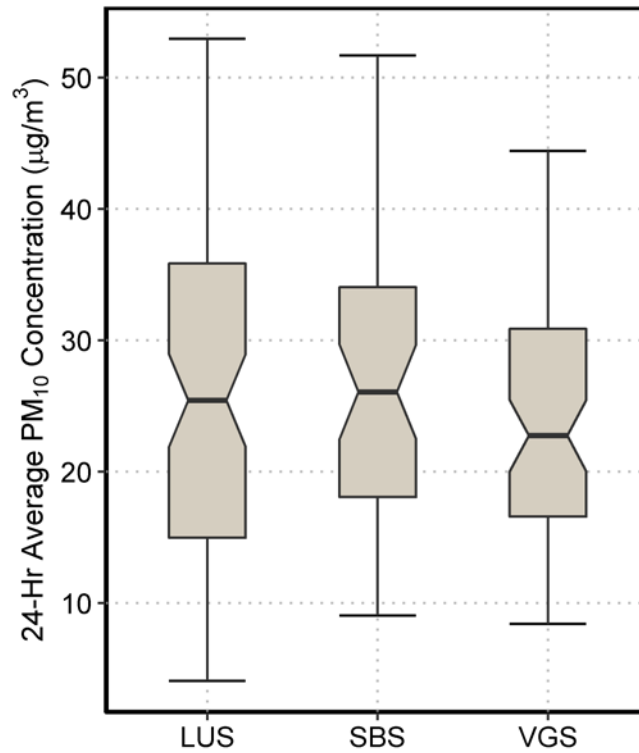


Figure 3. Notched box-whisker plot of daily 24-hr average PM₁₀ concentrations measured during the spring 2016 quarter (March 1, 2016–May 31, 2016) at the Landfill Upwind site (LUS), the Landfill site (SBS), and the Van Gogh School site (VGS).

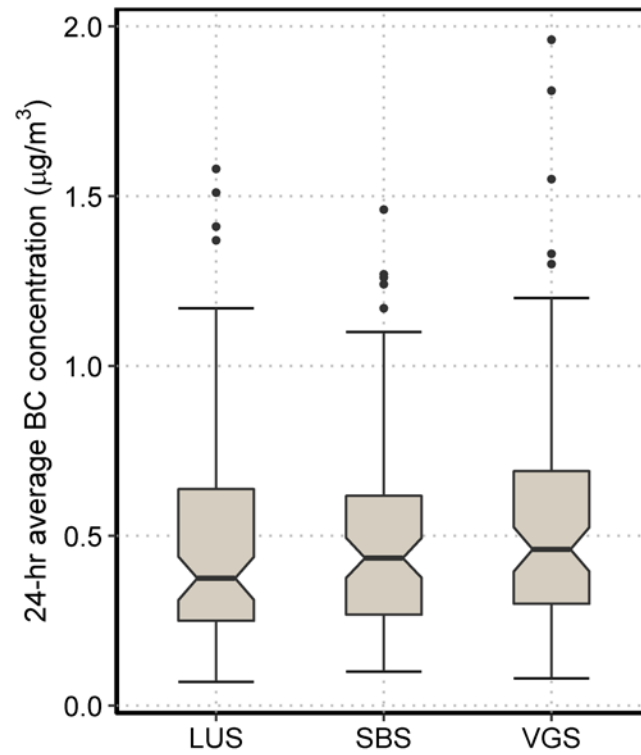


Figure 4. Notched box-whisker plot of daily 24-hr average BC concentrations measured during the spring 2016 quarter (March 1, 2016–May 31, 2016) at the Landfill Upwind site (LUS), the Landfill site (SBS), and the Van Gogh School site (VGS).

5. Field Operations

Table 4 through Table 6 list dates and major tasks associated with visits to the Landfill, Landfill Upwind, and Van Gogh School sites during the spring 2016 quarter.

Table 4. Landfill monitoring site visits, field maintenance, and operations.

Date of Site Visit	Description of Work
March 16, 2016	Collected PM ₁₀ and BC data. Performed flow check on BC and BAM samplers. Changed BAM tape supply.
April 20, 2016	Collected PM ₁₀ and BC data. Performed flow check on BC and BAM samplers. Performed BAM calibration. Found BAM tape supply good, approximately 50% remaining. Cleaned BAM roller, vane, and nozzle.
April 27, 2016	Performed flow check on BAM sampler. Replaced pump. Reset flow, performed calibration, and rechecked flow.
May 17, 2016	Collected PM ₁₀ and BC data. Performed flow check on BC and BAM samplers. Found BAM tape supply low; installed new tape and restarted. Cleaned BAM roller and nozzle.

Table 5. Landfill Upwind monitoring site visits, field maintenance, and operations.

Date of Site Visit	Description of Work
March 16, 2016	Collected PM ₁₀ and BC data. Performed flow check on BC and BAM samplers.
April 20, 2016	Collected PM ₁₀ and BC data. Performed flow check on BC and BAM samplers. Cleaned BAM roller, vane, and nozzle. Changed BAM tape supply.
May 17, 2016	Collected PM ₁₀ and BC data. Performed flow check on BC and BAM samplers. Cleaned BAM roller, vane, and nozzle.

Table 6. Van Gogh School monitoring site visits, field maintenance, and operations.

Date of Site Visit	Description of Work
March 16, 2016	Collected PM ₁₀ and BC data. Found new spool of tape required for Aethalometer. Replaced and tensioned tape. Found rocker switch is broken. Performed flow check on BC and BAM samplers. Found BAM Delta Cal flow out of calibration. Performed flow calibration, temp, BP references adjusted first. Changed BAM tape supply.
March 23, 2016	Found breaker tripped inside Y classroom. Reset breaker. Performed flow check on BAM sampler. Found BAM flow out of range. Performed flow calibration.
March 28, 2016	Performed flow check on BAM sampler.
April 20, 2016	Collected PM ₁₀ and BC data. Performed flow check on BC and BAM samplers. Calibrated BAM flow. Cleaned BAM roller, vane, and nozzle.
April 27, 2016	Performed flow check on BAM sampler.
May 17, 2016	Collected PM ₁₀ and BC data. Performed flow check on BC and BAM samplers. Recalibrated BAM flow. Found BAM tape supply low; replaced BAM tape supply. Cleaned BAM roller, vane, and nozzle.

Table 7 shows the PM₁₀ and BC flow rates as reported by the monitors and measured with a NIST-traceable flow standard. BAM flow rates are volumetric (local temperature and pressure), and Aethalometer flow rates are at standard temperature and pressure. The BAM target flow rate is 16.7 liters per minute (lpm) volumetric to meet the 10-micron cut point of the inlet, with an acceptable range of 16.0 to 17.3 lpm. The Aethalometer has no size cut point.

Table 7. Flow rates for the BAM PM₁₀ and Aethalometer BC monitors at the Landfill, Landfill Upwind, and Van Gogh School sites.

Location	Date	Flow Rates (lpm)					
		BAM as Found	Reference as Found	BAM as Left	Reference as Left	Aethalometer as Found	Reference as Found
Sunshine Canyon Landfill	03/16/16	16.7	16.3	16.7	16.3	3.0	3.0
	04/20/16	16.7	13.5 ^a	16.7	16.8	3.0	3.2
	04/27/16	20.5 ^a	-	16.7	16.8	-	-
	05/17/16	16.7	16.9	16.7	16.9	3.0	3.1
Sunshine Canyon Landfill Upwind	03/16/16	16.7	16.6	16.7	16.6	4.0	4.3
	04/20/16	-	-	-	16.5	4.0	4.1
	05/17/16	16.7	16.5	16.7	16.5	4.0	4.5
Van Gogh School	03/16/16	16.7	13.3 ^a	16.7	16.6	2.9	3.3
	03/23/16	19.7	-	16.7	16.8	-	-
	03/28/16	-	16.3	-	16.3	-	-
	04/20/16	16.7	15.6	16.7	16.7	2.9	3.0
	04/27/16	16.7	16.7	16.7	16.7	-	-
	05/17/16	16.7	15.7	16.7	16.7	3.0	3.2

^a Outside flow criteria