Sonoma Technology, Inc.
Innovative Environmental Solutions

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

September 1, 2016 – November 30, 2016

Quarterly Report
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Executive Summary

ES-1. Background

Continuous monitoring of meteorological and air quality parameters began at the Sunshine Canyon Landfill (Landfill South Site) and at Van Gogh Elementary School in the nearby community of Granada Hills in fall 2007. The Sunshine Canyon Landfill North site was installed in December 2015.[1] Sampling for volatile organic compounds (VOCs) and carbonyl compounds was initiated in July 2016 at the Landfill South Site and Van Gogh School. PM_{10} (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.

Following data validation, all data are reported as hourly averages. PM_{10} concentrations are then compared with federal and state PM_{10} standards. When PM_{10} exceedances occur, additional comparisons are made with the historical, regional, and annual ambient PM_{10} concentrations. The PM_{10} 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-Sixth Quarterly Report summarizes the September-November (fall) quarter monitoring results from the ninth year of continuous monitoring.

ES-2. Statistics

There was significant loss of PM_{10} data during this quarter because the BAM instruments were removed from the field and sent to the manufacturer for maintenance. This is the first time this project has experienced such a large period of data loss. The percent data captured for PM_{10} was 66.0%, 42.0%, and 59.5% at the Landfill South, Landfill North, and Van Gogh School sites, respectively. Approximately 16.5%, 12.0%, and 5.7% of the captured PM_{10} data at the Landfill South, Landfill North, and Van Gogh School sites were invalidated, respectively. No hourly PM_{10} values were deemed suspect at the Landfill North and Van Gogh School sites; approximately 0.2% of the data was deemed suspect at the Landfill South site. BC data capture was 94.0% at the Landfill South site, with 0.1% of the data invalidated and none of the data deemed suspect. BC data capture was approximately 91.9% at the Van Gogh School site, with none of the data invalidated or deemed suspect. At the Landfill North site, BC data capture was 93.3%, with 0.1% of the data invalidated and none of the data deemed suspect.

There was one exceedance of the federal 24-hr PM_{10} standard of 150 µg/m^3 during this quarter at the Landfill South site; there were no exceedances of the federal 24-hr PM_{10} standard at either the Landfill North site or the Van Gogh School site. The percentage of days on which

[1] The Landfill North 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 state PM_{10} standard of 50 µg/m^3 was exceeded during this spring quarter was 25% (12 days) at the Landfill South site, 37% (13 days) at the Landfill North site, and 2% (1 day) at Van Gogh School site.

From 2008 to 2016, fall-quarter average 24-hr BC concentrations ranged from 0.48 µg/m^3 to 1.47 µg/m^3 at the Landfill South site, and from 0.57 µg/m^3 to 1.31 µg/m^3 at the Van Gogh site. This is the first fall quarter during which the Landfill North site was operational; the average 24-hr BC concentration at this site was 0.64 µg/m^3.

1. Introduction

This report summarizes data completeness, ambient PM_{10} (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 quarterly period of September 1, 2016, through November 30, 2016. This is the ninth consecutive year that fall-season data have been collected from continuous monitoring at the Sunshine Canyon Landfill South (LSS; previously called the Berm Site) and Van Gogh Elementary School (VGS) monitoring sites, and the first year that fall-season data have been collected from continuous monitoring at the Sunshine Canyon Landfill North (LNS) monitoring site. PM_{10} was measured with a beta-attenuation monitor (BAM), and BC was measured with an Aethalometer. **Figure 1** shows the monitoring site locations. Starting on July 11, 2016, a one-year program of one-in-six-day sampling of volatile organic compounds (VOCs) and carbonyl compounds began at the LSS and VGS sites; these data will be summarized in the annual report.

Figure 1. View of Sunshine Canyon Landfill and the surrounding monitoring stations (triangles): Sunshine Canyon Landfill South (LSS), Sunshine Canyon Landfill North (LNS), and Van Gogh Elementary School (VGS).

2. Data Completeness

Table 1 gives completeness statistics for all measured variables during the 2016 fall quarter. The percent data capture for PM_{10} was 66.0%, 42.0%, and 59.5% at the Landfill South, Landfill North, and Van Gogh School sites, respectively. The percent data capture is much lower than usual, as all three BAM instruments were removed for maintenance for an extended period of time during this quarter. The BAMs required repair at the manufacturer in response to frequent tape error and other issues. Approximately 16.5%, 12.0%, and 5.7% of the captured PM_{10} data were invalidated at the Landfill South, Landfill North, and Van Gogh School sites, respectively. Only 0.2% of the hourly PM_{10} data were deemed suspect at the Landfill South site; no hourly PM_{10} values were deemed suspect at the other two 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, PM_{10}, and 1-min wind speed and wind direction data for the 2016 fall quarter monitoring period.

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 South (LSS)	09/01/16-11/30/16	66.0	94.0	99.9	83.5	99.9	98.9	0.2	0.0	1.2
Sunshine Canyon Landfill North (LNS)	09/01/16-11/30/16	42.0	93.3	86.5	88.0	100.0	98.4	0.0	0.0	0.0
Van Gogh School (VGS)	09/01/16-11/30/16	59.5	91.9	99.9	94.3	99.9	98.8	0.0	0.1	0.0

[a] Percent Data Capture is the number of collected data values divided by the total number of expected data intervals during the date range indicated in the "Dates" column (e.g., for the raw BC 1-hr data, 24 data values per day are expected).
[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 94.0% at the Landfill South site, with 0.1% of the data invalidated and none of the data deemed suspect. BC data capture was approximately 91.9% at the Van Gogh School site, with none of the data invalidated or deemed suspect. At the Landfill North site, BC data capture was 93.3%, with 0.1% of the data invalidated and none of the data deemed suspect.

The wind data capture percentages were 99.8%, 86.5%, and 99.9% at the Landfill South, Landfill North, and Van Gogh School sites, respectively. Approximately 1.2% of the data were invalidated at the Landfill South and Van Gogh School sites, and 1.6% of the data were invalidated at the Landfill North site. Approximately 1.2% of the wind data at the Landfill South site were deemed suspect; a negligible percentage of wind data at the Landfill North and Van Gogh School sites were deemed suspect.

3. PM_{10} Exceedances

The federal and state PM_{10} exceedances for the fall 2016 quarter, the fall quarters of the previous eight years (2008–2015), and the fall quarter of the baseline year (November 22, 2001–November 21, 2002) are summarized in **Table 2**. The only exceedance of the federal 24-hr PM_{10} standard of 150 µg/m^3 during the fall 2016 quarter occurred at the Landfill South site. In this quarter, the percentage of days on which the state PM_{10} standard of 50 µg/m^3 was exceeded was 25% (12 days) at the Landfill South site, 37% (13 days) at the Landfill North site, and 2% (1 day) at Van Gogh School site.

Table 2. Number of exceedances of federal and state 24-hr PM_{10} standards during the fall 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 PM_{10} concentrations were measured. The most recent fall 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 South (LSS)	09/01/02–11/30/02	0	51/77 (66%)
	09/01/08–11/30/08	1 (10/09/08)	12/73 (16%)
	09/01/09–11/30/09	1 (10/27/09)	17/89 (19%)
	09/01/10–11/30/10	0	8/86 (9%)
	09/01/11–11/30/11	1 (11/02/11)	20/89 (22%)
	09/01/12–11/30/12	1 (10/26/12)	9/85 (11%)
	09/01/13–11/30/13	1 (10/04/13)	14/89 (16%)
	09/01/14–11/30/14	0	5/91 (5%)
	09/01/15–11/30/15	0	10/86 (12%)
	09/01/16 – 11/30/16	**1 (11/27/16)**	**12/48 (25%)**
Sunshine Canyon Landfill North (LNS)	**09/01/16 – 11/30/16**	**0**	**13/35 (37%)**
Van Gogh School (VGS)	09/01/02–11/30/02	0	8/33 (24%)
	09/01/08–11/30/08	0	12/90 (13%)
	09/01/09–11/30/09	1 (10/27/2009)	11/78 (14%)
	09/01/10–11/30/10	0	7/91 (8%)
	09/01/11–11/30/11	0	11/88 (13%)
	09/01/12–11/30/12	0	5/90 (6%)
	09/01/13–11/30/13	0	7/85 (8%)
	09/01/14–11/30/14	0	0/91 (0%)
	09/01/15–11/30/15	0	0/90 (0%)
	09/01/16–11/30/16	**0**	**1/50 (2%)**

4. Average and Maximum Black Carbon Concentrations and PM_{10} 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 (South Coast Air Quality Management District, 2015).

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 (Drinovec et al., 2015; Allen, 2014). Instrument response is dampened with heavier loading (i.e., higher concentrations) of BC aerosol. This artifact can cause BC concentration readings to be lower than the true concentration. 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 South, Landfill North, 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 prior to the 29th Quarterly Report. All BC data shown in this 36th Quarterly 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 fall 2016 quarter and compares them to compensated BC data from the fall quarters of the eight previous years and the baseline year (baseline-year data are *not* compensated). The fall 2016 quarter data at the Van Gogh School site are similar to those of previous fall quarters. The fall 2016 BC average at the Landfill South site is slightly higher than the BC average in the previous fall quarter, but is still relatively low over the record of study. The average 24-hr BC concentration at the Landfill North site is similarly low.

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

Site	Quarterly Period	BC Concentrations (µg/m^3)	
		Average 24-Hr	Maximum 24-Hr
Sunshine Canyon Landfill South (LSS)	09/01/02–11/30/02	1.26*	2.83*
	09/01/08–11/30/08	1.47	2.88
	09/01/09–11/30/09	1.21	3.45
	09/01/10–11/30/10	0.87	2.74
	09/01/11–11/30/11	1.07	2.71
	09/01/12–11/30/12	0.95	2.63
	09/01/13–11/30/13	0.92	2.32
	09/01/14–11/30/14	0.81	2.42
	09/01/15–11/30/15	0.48	1.17
	09/01/16–11/30/16	**0.59**	**1.64**
Sunshine Canyon Landfill North (LNS)	**09/01/16–11/30/16**	**0.64**	**1.95**
Van Gogh School (VGS)	09/01/02–11/30/02	1.31*	2.92*
	09/01/08–11/30/08	0.86	6.15
	09/01/09–11/30/09	1.00	3.23
	09/01/10–11/30/10	0.80	2.47
	09/01/11–11/30/11	0.95	2.55
	09/01/12–11/30/12	0.77	2.07
	09/01/13–11/30/13	0.57	1.63
	09/01/14–11/30/14	0.83	1.98
	09/01/15–11/30/15	0.64	1.68
	09/01/16–11/30/16	**0.64**	**1.54**

Figure 2 shows a notched box-whisker plot[2] of fall quarter PM_{10} and BC data for the Landfill South 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.

[2] 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).

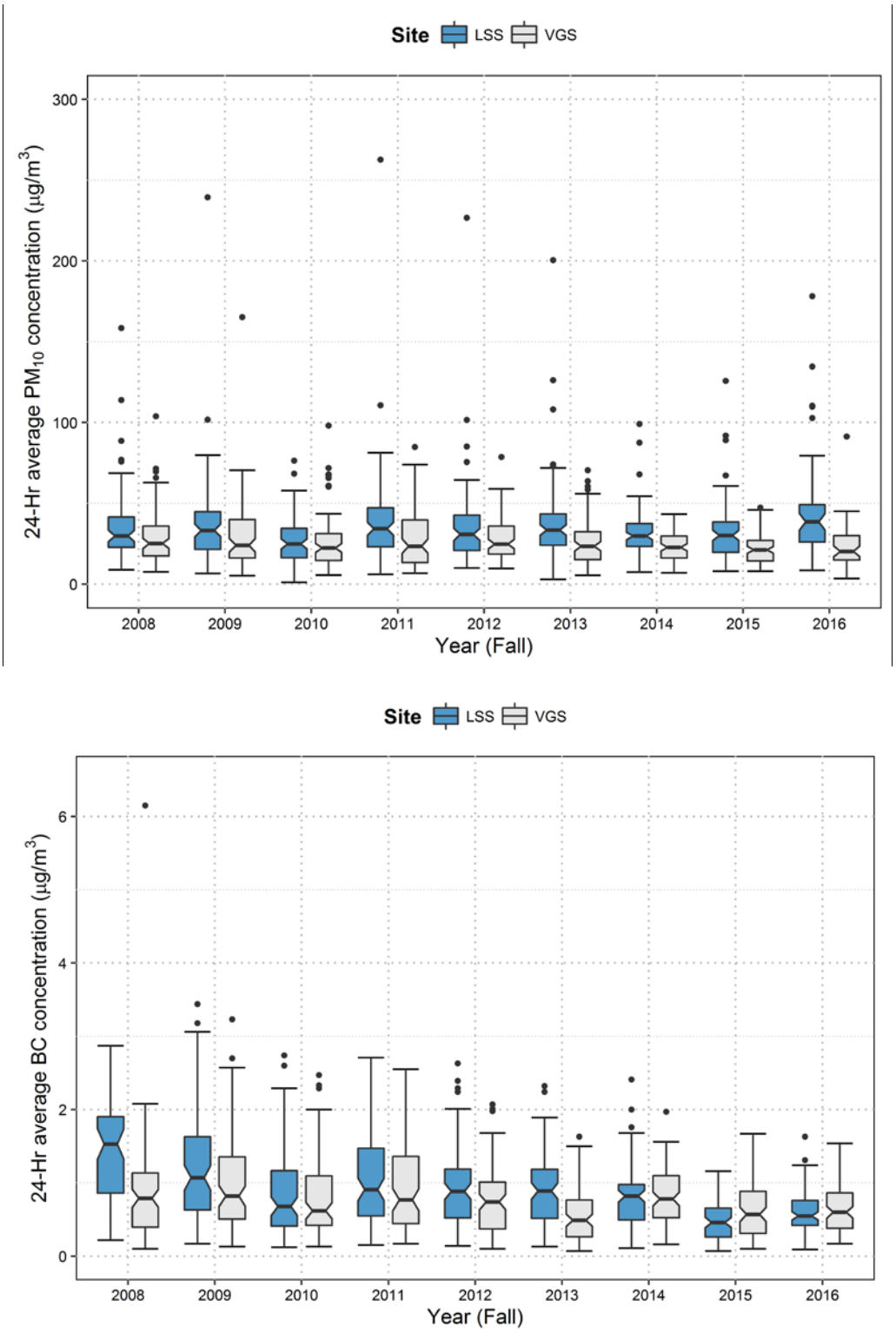

Figure 2. Notched box-whisker plot of daily 24-hr average concentrations of PM_{10} (top) and BC (bottom) at the Landfill South site (LSS) and the Van Gogh School site (VGS) during fall (September-November) quarters from 2008 to 2016.

Based on the top panel in Figure 2, there is no statistically significant temporal trend in PM_{10} concentrations over the past nine years for the fall quarter, although average PM_{10} concentrations measured at the Van Gogh School site are usually lower than those measured at the Landfill South site at this time of year.

Table 3 and Figure 2 suggest that, while there is some year-to-year variability, there is no statistically significant trend in fall-quarter 24-hr average BC over the past nine years at either the Landfill South site or the Van Gogh School site, though the range of 24-hr average BC values generally decreased for both sites over time.

The 24-hr average PM_{10} and BC data from the three sites for the current fall quarter are shown in notched box-whisker plots in **Figures 3 and 4**, respectively. The median 24-hr average PM_{10} concentration is highest at the Landfill North site and lowest at the Van Gogh School site. There is strong evidence that the median 24-hr average PM_{10} concentration at the Van Gogh School site is statistically different (lower) than those at the two Landfill sites (indicated by non-overlapping notches). The median 24-hr average BC concentrations are not significantly different among the Landfill South, Landfill North, and Van Gogh School sites.

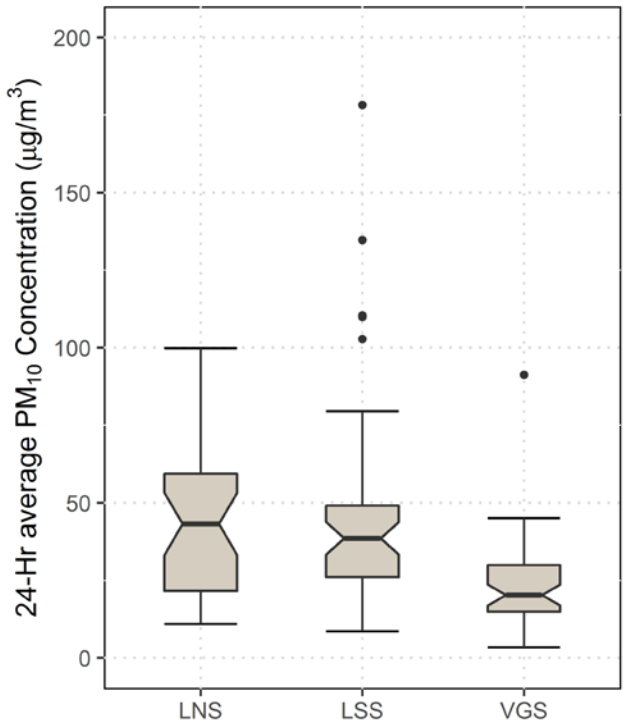

Figure 3. Notched box-whisker plot of daily 24-hr average PM_{10} concentrations measured during the fall 2016 quarter (September-November) at the Landfill North site (LNS), the Landfill South site (LSS), and the Van Gogh School site (VGS).

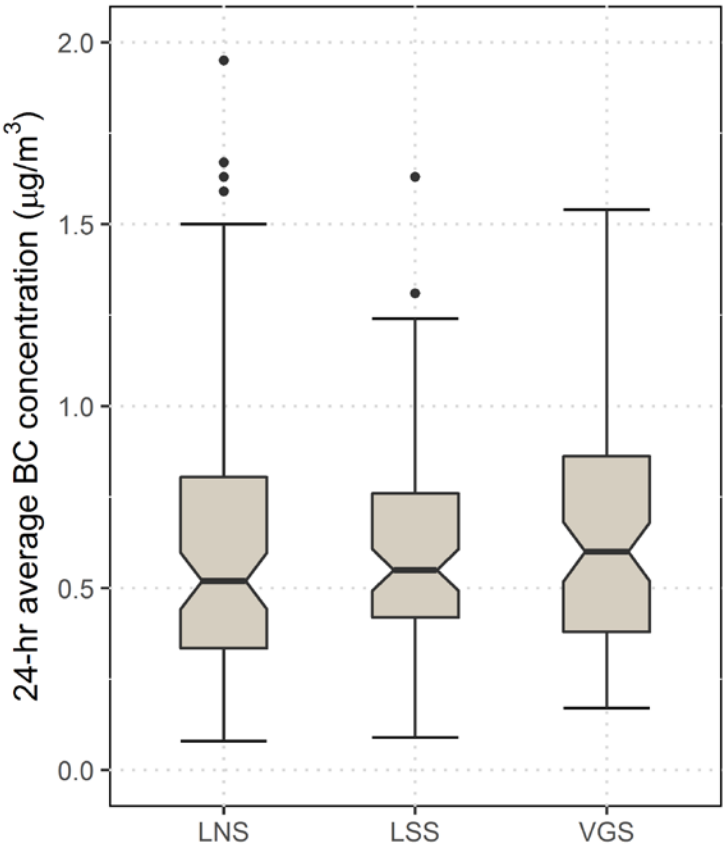

Figure 4. Notched box-whisker plot of daily 24-hr average BC concentrations measured during the fall 2016 quarter (September-November) at the Landfill North site (LNS), the Landfill South site (LSS), and the Van Gogh School site (VGS).

5. Field Operations

Tables 4 through 6 list dates and major tasks associated with visits to the Landfill South, Landfill North, and Van Gogh School sites during the fall 2016 quarter.

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

Date of Site Visit	Description of Work
September 14, 2016	Collected PM_{10} and BC data. Cleaned BAM roller, vane, and nozzle and performed leak check. Re-spooled BAM tape supply. Performed flow check on Aethalometer and BAM samplers.
October 1, 2016	BAM removed for maintenance.
November 3, 2016	Re-installed BAM onsite. Powered up the instrument, re-spooled, and checked BAM tape. Performed flow and leak checks on BAM.
November 22, 2016	Collected PM_{10} and BC data. Restarted Aethalometer. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on Aethalometer and BAM samplers.

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

Date of Site Visit	Description of Work
September 14, 2016	Collected PM_{10} and BC data. Restarted Aethalometer. Found tape supply for Aethalometer low; did not replace as there was none available on site. Replaced BAM tape supply. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on Aethalometer and BAM samplers.
October 19, 2016	Collected PM_{10} and BC data. BAM found non-operational; scheduled for repair. Replaced Aethalometer tape supply.
October 20, 2016	BAM removed for maintenance.
November 22, 2016	Collected BC data. Restarted Aethalometer. Re-installed BAM onsite. Powered up the instrument, re-spooled, and checked BAM tape. Replaced BAM tape supply and returned to normal operating mode. Performed flow check on Aethalometer and BAM samplers.

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

Date of Site Visit	Description of Work
September 14, 2016	Collected PM_{10} data. Replaced BAM tape supply. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on Aethalometer and BAM samplers.
September 23, 2016	BAM removed for maintenance.
November 2, 2016	Re-installed BAM onsite. Powered up the instrument, re-spooled, and checked BAM tape. Performed BAM flow and leak check and returned to normal operating mode.
November 22, 2016	Collected PM_{10} and BC data. Powered down and restarted Aethalometer. Cleaned BAM roller, vane, and nozzle and performed leak check. Performed flow check on Aethalometer and BAM samplers.

Table 7 shows the PM_{10} 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 PM_{10} and Aethalometer BC monitors at the Landfill South, Landfill North, and Van Gogh School sites.

Location	Date	Flow Rates (lpm)					
		BAM as Found	Reference as Found	BAM as Left	Reference as Left	Aethalo-meter as Found	Reference as Found
Sunshine Canyon Landfill South (LSS)	09/14/16	16.7	16.99	16.7	16.99	3.1	3.2
	11/03/16	-	16.91	-	16.91	-	-
	11/22/16	16.7	16.99	16.7	16.99	3.0	3.0
Sunshine Canyon Landfill North (LNS)	09/14/16	16.7	16.80	16.7	16.80	4.0	4.3
	11/22/16	-	16.57	-	16.57	4.0	4.4
Van Gogh School (VGS)	09/14/16	16.7	16.92	16.7	16.92	3.1	3.5
	11/02/16	-	16.74	-	16.74	-	-
	11/22/16	16.7	16.80	16.7	16.80	3.0	3.3

6. References

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