



Sonoma Technology, Inc.
Environmental Science and Innovative Solutions

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

September 1, 2015 – November 30, 2015

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 (the Landfill) and at Van Gogh Elementary School in the nearby community of Granada Hills in fall 2007. 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 13% 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. At least annually, the PM₁₀ and BC data are analyzed 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-Second Quarterly Report summarizes the fall quarter monitoring results from the eighth year of continuous monitoring.

ES-2. Statistics

The percent data capture for PM₁₀ was 100% at both the Sunshine Canyon Landfill monitoring site and at Van Gogh School for this quarterly period. At the Landfill site, 4.8% of the captured PM₁₀ data were invalidated, and three hourly values (0.14%) were deemed suspect. At Van Gogh School, 1.3% of the captured PM₁₀ data were invalidated, and three hourly values (0.14%) were deemed suspect. BC data capture was 99.5% at the Landfill site, with none of the data invalidated or suspect, while 99.3% was captured at Van Gogh School, with none of the data invalidated or suspect. The wind data capture percentage was 99.9% at the Landfill site and 99.9% at Van Gogh School. At the Landfill site, 2.0% of the wind data were invalidated, and 0.5% were deemed suspect. At Van Gogh School, 1.6% of the wind data were invalidated, and none were deemed suspect.

There were no exceedances of the federal 24-hr PM₁₀ standard of 150 µg/m³ during this quarter at either site. The percentage of days on which the state PM₁₀ standard of 50 µg/m³ was exceeded for the September–November quarter was 12% at the Landfill site and 0% at Van Gogh School (ten days and zero days, respectively). From 2008 to 2015, fall quarter average 24-hr BC concentrations ranged from 0.48 µg/m³ to 1.47 µg/m³ at the Landfill site, and from 0.57 µg/m³ to 1.00 µg/m³ at the Van Gogh site. This fall quarter at the Landfill site had the lowest BC average (0.48 µg/m³) of all prior fall quarters.

ES-3. Monitoring Site Infrastructure Upgrades

Republic Services (Republic) has purchased new PM₁₀ 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, electrical power) to support a new upwind monitoring site on the north rim of the Landfill. Sonoma Technology, Inc. (STI) is providing, on a monthly rental fee schedule, the monitoring trailer, monitoring equipment, and communications hardware for the site. The upwind site will measure PM₁₀, BC, and wind speed and direction, 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 as to whether to keep the site for the duration of the existing monitoring contract.

The two new PM₁₀ monitors, and the STI PM₁₀ monitor destined for the upwind site, were collocated in Fresno, California, to demonstrate the comparability of the monitors' performance. Similarly, the STI-supplied Aethalometer to be used at the upwind site has been collocated with the Aethalometer at the existing Landfill monitoring station for several months. Data from these tests are presented in this report and demonstrate 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 fall quarterly period of September 1, 2015, through November 30, 2015. Data from this period represent the eighth consecutive year of fall-season data collected from continuous monitoring at the Sunshine Canyon Landfill and Van Gogh School monitoring sites. PM₁₀ was measured via a beta-attenuation monitor (BAM), and BC was measured via an Aethalometer.

2. Data Completeness

Table 1 gives completeness statistics for all measured variables during the fall quarter. The percent data capture for PM₁₀ was 100% both at the Landfill site and Van Gogh School. At the Landfill monitoring site, approximately 4.8% of the captured PM₁₀ data were invalidated, and three hourly values (0.14%) were deemed suspect. At Van Gogh School, 1.3% of the captured data were invalidated, and three hourly values (0.14%) were deemed suspect. Suspect data are included in subsequent analyses (e.g., regional comparisons), while invalid data are not.

Table 1. Data completeness statistics for the fall 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	9/1/15–11/30/15	100	99.5	99.9	95.2	100	97.9	0.14	0.0	0.51
Van Gogh Elem. School	9/1/15–11/30/15	100	99.3	99.9	98.7	100	98.4	0.14	0.00	0.00

^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 5-minute data, 12 data values per hour and 288 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 99.5% at the Landfill site, with none of the data invalidated or deemed suspect, while 99.3% was captured at Van Gogh School, with none of the data invalidated or deemed suspect as well.

The wind data capture percentage was 99.9% at the Landfill site and 99.9% at Van Gogh School. At the Landfill site, 2.0% of the wind data were invalidated, with 0.5% of 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 fall 2015 quarter, the fall quarters of the previous seven years (2008–2014), and the fall 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 this quarter at either site. The percentage of days on which the state standard of 50 µg/m³ was exceeded for the September–November 2015 quarter was 12% for the Landfill site (ten days) and 0% at the Van Gogh School site (zero days).

Table 2. Number of exceedances of federal and state 24-hr PM₁₀ standards during the fall quarters of the baseline year (2002) and 2008–2015. In the “Federal” column, the values are *number of exceedances* and the *date(s)* on which those exceedances occurred. In the “State” 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 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	9/1/02–11/30/02	0	51/77 (66%)
	9/1/08–11/30/08	1 (10/9/2008)	12/73 (16%)
	9/1/09–11/30/09	1 (10/27/2009)	17/89 (19%)
	9/1/10–11/30/10	0	8/86 (9%)
	9/1/11–11/30/11	1 (11/2/2011)	20/89 (22%)
	9/1/12–11/30/12	1 (10/26/2012)	9/85 (11%)
	9/1/13–11/30/13	1 (10/4/2013)	14/89 (16%)
	9/1/14–11/30/14	0	5/91 (5%)
	9/1/15–11/30/15	0	10/86 (12%)
Van Gogh Elementary School	9/1/02–11/30/02	0	8/33 (24%)
	9/1/08–11/30/08	0	12/90 (13%)
	9/1/09–11/30/09	1 (10/27/2009)	11/78 (14%)
	9/1/10–11/30/10	0	7/91 (8%)
	9/1/11–11/30/11	0	11/88 (13%)
	9/1/12–11/30/12	0	5/90 (6%)
	9/1/13–11/30/13	0	7/85 (8%)
	9/1/14–11/30/14	0	0/91 (0%)
	9/1/15–11/30/15	0	0/90 (0%)

4. Average and Maximum Black Carbon 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

Black carbon 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 bias 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 and Van Gogh sites have been adjusted to compensate for this tape saturation effect; this compensation had not been performed in quarterly reports prior to the 29th (Winter 2015) Quarterly Report. 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 (e.g., in **Table 3**) 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 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 2015 quarter and compares them to compensated BC data from the fall quarters of the seven previous years. Note that the baseline year data are *not* compensated. The fall 2015 quarter data are consistent with the previous fall quarters, though the fall 2015 BC average at the Landfill site is the lowest average for the fall recorded since the beginning of the study.

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 fall quarter of the baseline year (2002) and each year from 2008 through 2015. Asterisks (*) denote uncompensated BC values. The most recent fall 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	9/1/02–11/30/02	1.26*	2.83*
	9/1/08–11/30/08	1.47	2.88
	9/1/09–11/30/09	1.21	3.45
	9/1/10–11/30/10	0.87	2.74
	9/1/11–11/30/11	1.07	2.71
	9/1/12–11/30/12	0.95	2.63
	9/1/13–11/30/13	0.92	2.32
	9/1/14–11/30/14	0.81	2.42
	9/1/15–11/30/15	0.48	1.17
Van Gogh Elementary School	9/1/02–11/30/02	1.31*	2.92*
	9/1/08–11/30/08	0.86	6.15
	9/1/09–11/30/09	1.00	3.23
	9/1/10–11/30/10	0.80	2.47
	9/1/11–11/30/11	0.95	2.55
	9/1/12–11/30/12	0.77	2.07
	9/1/13–11/30/13	0.57	1.63
	9/1/14–11/30/14	0.83	1.98
	9/1/15–11/30/15	0.64	1.68

Figure 1 shows a notched box-whisker plot⁴ of the fall quarter PM_{10} and BC data for the eight monitoring years. 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 are shown individually.

For PM_{10} , these plots show no statistically significant temporal trend in the concentrations over the last eight years for the fall quarter, although average PM_{10} 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 1 illustrate that, while year-to-year variability exists, the fall-quarter BC concentrations have largely declined over the past eight years at both the Landfill site and

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).

the Van Gogh School site. The fall-quarter BC concentrations in 2015 were uncommonly low at the Landfill site, representing the first measured fall quarter occurrence of a lower BC concentration measured at the Landfill site compared to the Van Gogh site. This finding was also demonstrated in the 2015 spring quarter (March-May, 30th Quarterly Report) and in the 2015 summer quarter (June-August, 31st Quarterly Report), suggesting that the lower BC concentrations measured at the Landfill are, to some extent, independent of meteorological conditions, which differ significantly during these seasonal periods. For example, onshore flow dominates during the summer months and offshore flow dominates during the winter months, with spring and fall periods exhibiting mixed flow regimes as the seasons change.

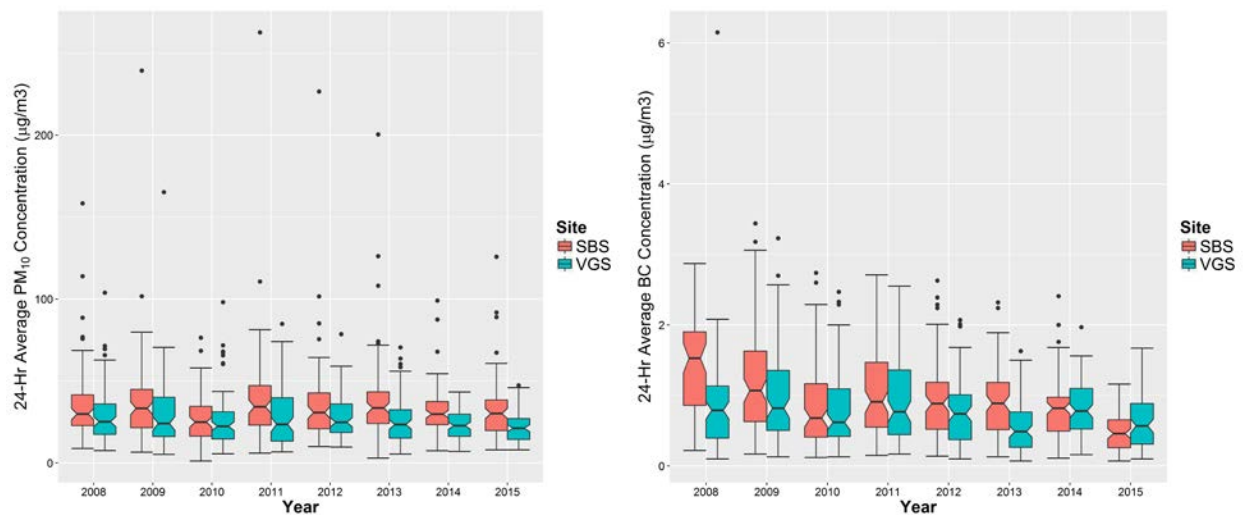


Figure 1. Notched box-whisker plot of daily 24-hr average concentrations of PM₁₀ (left) and BC (right) at Sunshine Canyon Landfill (SBS) and Van Gogh School (VGS) during fall quarters from 2008 to 2015.

5. Field Operations

In addition to the routine monthly field maintenance and operations tasks, some noteworthy site infrastructure upgrades have been made. New Met One Instruments PM₁₀ monitors (model BAM 1020) have been purchased by Republic Services (Republic) to replace the obsolete instruments that have been running continuously at the Landfill and Van Gogh School monitoring sites since October 2007. Additionally, in an effort to more accurately quantify the impact of landfill operations on neighborhood-scale ambient PM₁₀ and BC concentrations, Republic has funded and managed the installation of the infrastructure (concrete pad, fencing, electrical power) to support a new upwind monitoring site on the north rim of the Landfill. This new upwind site will provide data supporting a more direct, and more accurate, estimate of landfill contributions to ambient pollutant concentrations. Sonoma Technology, Inc. (STI) is providing, on a monthly rental fee schedule, the monitoring trailer, monitoring equipment, and communications hardware for the site. The upwind site will measure PM₁₀, BC, and wind speed and direction, 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 as to whether to keep the site for the duration of the existing monitoring contract.

To demonstrate the comparability of the monitoring instrumentation, the two new PM₁₀ monitors, and the STI PM₁₀ monitor destined for the upwind site, were collocated and operated at a single location in Fresno, California, from November 16 through December 8, 2015. Installation procedures followed the manufacturer's suggested protocols, including a background zero test (using a HEPA filter to eliminate all particulate matter) to assess instrument "noise." The zero test of the instruments lasted for 76 hours, and ambient PM₁₀ data were collected during the remaining days of the collocation study.

Similarly, the STI-supplied Aethalometer to be used at the upwind site has been collocated with the Aethalometer at the existing Landfill monitoring station for several months. On July 29, 2015, the STI-supplied Magee Scientific Aethalometer (Model AE22) was installed at the Landfill monitoring site at the southern berm of the landfill. The purpose of collocating this Aethalometer with the existing one at the southern berm site is to provide data that demonstrate the comparability of the two instruments' performance. This ensures that differences in BC concentrations noted between upwind and downwind measurements are due to differences in ambient BC concentrations and not to differences in machine performance. (This STI-supplied Aethalometer was placed in the upwind site at the northern rim of the landfill in December 2015, and the upwind data will be included in the next quarterly report.)

5.1 Results of the BAM PM₁₀ Monitor Collocation Test

Figure 2 compares hourly averaged PM₁₀ data recorded during the Fresno collocation study. The STI-supplied BAM (serial number H8933) will be installed at the upwind monitoring site. The Landfill monitoring site will house BAM serial number T19280, and the Van Gogh School monitoring site will house BAM serial number T19279. The high degree of correlation and low bias between instruments is clear.

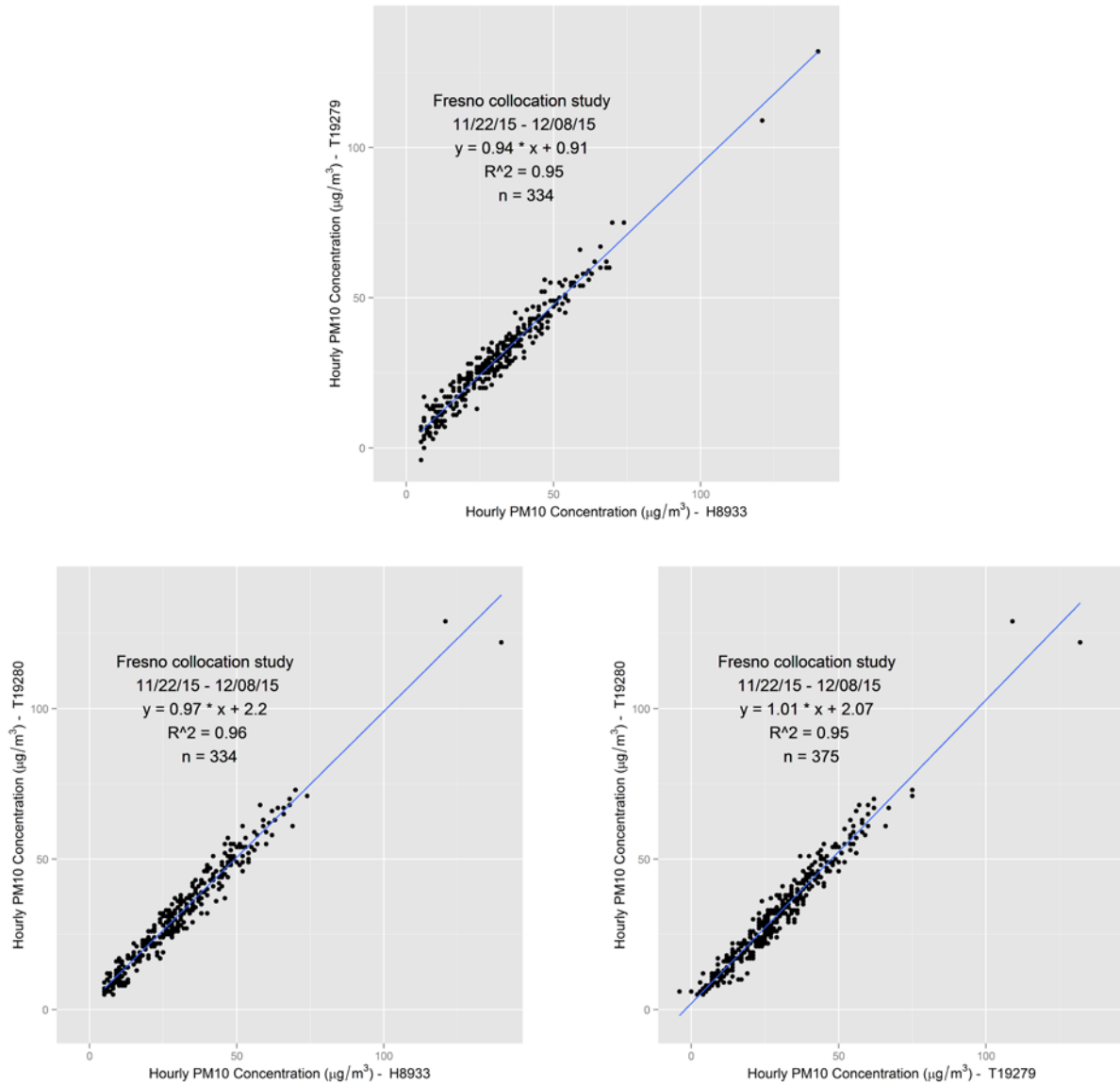


Figure 2. Scatter plots and linear regression statistics of PM₁₀ concentrations from the PM₁₀ collocation study conducted in Fresno, CA. The BAM PM₁₀ monitors were subsequently deployed at the south berm at the Landfill (serial number T19280), Van Gogh Elementary School (serial number T19279), and the new upwind monitoring site (serial number H8933).

5.2 Results of the Aethalometer Collocation Test

Figure 3 is a scatter plot of the first 125 days of hourly averaged BC concentrations from the collocated Aethalometers at the monitoring site on the southern berm of the landfill. There is a strong, positive correlation, with very little bias shown between the two monitors.

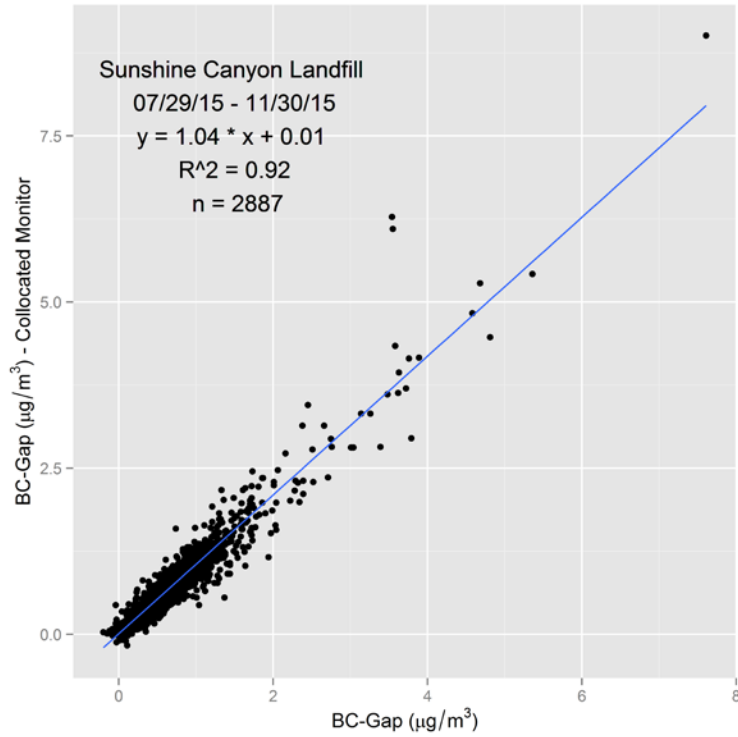


Figure 3. Scatter plot and linear regression statistics for the collocated Aethalometers at the southern berm of the Landfill site. The X-axis represents the existing monitor.

Tables 4 and 5 list dates and major tasks associated with visits to the Sunshine Canyon Landfill and Van Gogh School sites in fall 2015.

Table 4. Sunshine Canyon Landfill monitoring site visits and field maintenance and operations.

Date of Site Visit	Description of Work
September 1, 2015	Performed flow check on BC and BAM samplers. Changed tape supply on BAM and adjusted tension. Collected PM ₁₀ and BC data.
October 9, 2015	Performed flow check on BC and BAM samplers. Cleaned BAM roller and nozzle. Collected PM ₁₀ and BC data.
November 9, 2015	Performed flow check on BC and BAM samplers. Cleaned BAM roller, vane, and nozzle. Found BAM out of tape; installed new tape spool and restarted. Collected PM ₁₀ and BC data.

Table 5. Van Gogh School monitoring site visits and field maintenance and operations.

Date of Site Visit	Description of Work
September 1, 2015	Performed flow check on BC and BAM samplers. Recalibrated flow on BAM sampler. Collected PM ₁₀ and BC data.
September 10, 2015	Spot-checked BAM sampler; no issues detected.
October 9, 2015	Performed flow check on BC and BAM samplers. Cleaned BAM roller, and nozzle. Collected PM ₁₀ and BC data.
November 9, 2015	Performed flow check on BC sampler. Changed tape supply on BAM. Collected BC data.

Table 6 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 6. Flow rates for the BAM PM₁₀ monitors and Aethalometer BC monitors at the Sunshine Canyon Landfill and Van Gogh School sites. Sunshine Canyon flow rates include the existing, collocated, and reference Aethalometers. The reference flow rates are combined, as both Aethalometers operate off of one main sample line.

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	9/1/15	16.7	16.9	16.7	16.9	3.1 ^a , 4.0 ^b	7.3 ^c
Sunshine Canyon Landfill	10/9/15	16.7	16.5	16.7	16.5	3.1 ^a , 4.0 ^b	7.4 ^c
Sunshine Canyon Landfill	11/9/15	-	16.9	16.7	16.9	3.0 ^a , 4.0 ^b	6.8 ^c
Van Gogh Elementary School	9/1/15	16.7	19.2 ^d	16.7	16.9	3.1	3.4
Van Gogh Elementary School	9/10/15	16.7	16.7	16.7	16.7	-	-
Van Gogh Elementary School	10/9/15	16.7	16.9	16.7	16.9	3.0	3.3
Van Gogh Elementary School	11/9/15	16.7	-	16.7	-	3.0	3.2

^a Existing Aethalometer

^b Collocated Aethalometer

^c Reference for combined flow

^d Outside flow criteria