



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

December 1, 2019 – February 26, 2020

Quarterly Report
STI-915026-7289-QR

Prepared by

Ningxin Wang
Bryan Penfold
Sonoma Technology, Inc.
1450 N. McDowell Blvd., Suite 200
Petaluma, CA 94954-6515
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

May 7, 2020

This document contains blank pages to accommodate double-sided printing.

Table of Contents

Section	Page
List of Figures.....	iv
List of Tables.....	v
Executive Summary	1
1. Introduction.....	2
2. Data Completeness.....	4
3. PM ₁₀ Exceedances.....	5
4. Average and Maximum Black Carbon Concentrations and PM ₁₀ Concentrations.....	7
5. Field Operations	14
6. References	17

List of Figures

Figure	Page
1. View of Sunshine Canyon Landfill and the surrounding monitoring stations: Sunshine Canyon Landfill and Community site.....	2
2. Distribution of 24-hr average PM ₁₀ concentrations at the Sunshine Canyon Landfill North site, Landfill site, and Community site during winter (December-February) quarters from 2008 to 2020	9
3. Trends of 24-hr average PM ₁₀ maxima and percentiles at the Sunshine Canyon Landfill site and Community site during winter (December- February) quarters from 2008 to 2020	10
4. Distribution of daily 24-hr average BC concentrations at the Sunshine Canyon Landfill North site, Landfill site, and Community site during winter (December- February) quarters from 2008 to 2020	11
5. Trends of 24-hr average BC maxima and percentiles at the Sunshine Canyon Landfill site and Community site during winter (December- February) quarters from 2008 to 2020	12

List of Tables

Table	Page
1. Data completeness statistics for hourly BC, hourly PM ₁₀ , and 1-min wind speed and wind direction data for the 2020 winter quarter monitoring period.	4
2. Number of exceedances of federal and state 24-hr PM ₁₀ standards during the winter quarters of the baseline year (2002) and each year from 2008 to 2020.....	6
3. Twenty-four-hour BC concentrations for the winter quarter of the baseline year (2002) and each year from 2008 to 2020.....	8
4. Landfill monitoring site visits, field maintenance, and operations.....	14
5. Community site visits, field maintenance, and operations.....	15
6. Flow rates for the BAM PM ₁₀ and Aethalometer BC monitors at the Landfill and Community sites.	16

Executive Summary

ES-1. Background

Continuous monitoring of meteorological and air quality parameters began at the Sunshine Canyon Landfill (Landfill site) and at Van Gogh Elementary School (Community site) in the nearby community of Granada Hills in fall 2007. At these sites, particulate matter less than 10 microns in aerodynamic diameter (PM_{10}), wind speed (WS) and wind direction (WD), and black carbon (BC), as a surrogate for diesel particulate matter (DPM), are measured. The collected data are validated and evaluated for completeness quarterly. Monitoring is conducted to fulfill stipulations in the City of Los Angeles' Conditions of Approval for the expansion of the landfill.¹ Similar conditions cover the County of Los Angeles' portion of the landfill.²

PM_{10} concentrations are compared with federal and state PM_{10} standards. When PM_{10} concentrations are above the standard (i.e., an exceedance), additional comparisons are made with the historical, regional, and annual ambient PM_{10} concentrations. The PM_{10} and BC data are analyzed annually to characterize the impact of landfill operations on ambient air quality as observed at the Community site by quantifying PM_{10} and BC concentrations and exceedances, and comparing concentrations between the Landfill and Community sites. A more in-depth analysis is performed for the annual report.

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 Forty-Ninth Quarterly Report summarizes the December 2019–February 2020 (2020 winter quarter) monitoring results from the thirteenth year of continuous monitoring. Data for February 2020 only include 26 days (i.e. February 1st - 26th) due to restrictions caused by COVID-19 to access the instruments onsite.

ES-2. Statistics

For this quarter, the percent data capture for PM_{10} was 99.1% at the Landfill site and 99.9% at the Community site. Approximately 0.5% of the captured PM_{10} data were invalidated at the Landfill site, and approximately 0.4% were invalidated at the Community site. Of the hourly PM_{10} values, none were deemed suspect at both the Landfill site and the Community site. Hourly BC data capture was 98.8% at the Landfill site and 99.8% at the Community site. Approximately 0.1% of the captured hourly BC data were invalidated at the Landfill site, while none were invalidated at the Community site. Of the hourly BC data, approximately 2.1% and 0.6% were deemed suspect at the Landfill and Community sites, respectively.

During this quarter, the state 24-hr PM_{10} standard ($50 \mu\text{g}/\text{m}^3$) was exceeded on 29% of days (25 days) at the Landfill site and none at the Community site. The federal 24-hr PM_{10} standard ($150 \mu\text{g}/\text{m}^3$) was exceeded on 1 day at the Landfill site and none at the Community site.

¹ Section C.10.a of Ordinance No. 172,933.

² County Condition 81.

1. Introduction

This report summarizes data completeness, ambient particulate matter less than 10 microns in aerodynamic diameter (PM_{10}) concentrations, average and maximum ambient 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 December 1, 2019, through February 26, 2020. The collected data are validated and evaluated for completeness quarterly. This is the thirteenth consecutive year that data were collected in the winter from continuous monitors at the Sunshine Canyon Landfill site (LS; previously called the Berm site) and the Van Gogh Elementary School Community site (CS). The monitoring site locations are shown in **Figure 1**. PM_{10} is measured with a beta attenuation monitor (BAM), and BC is measured with an Aethalometer. The Sunshine Canyon Landfill North (LN) monitoring site shown in Figure 1 was installed in December 2015 and decommissioned on May 31, 2017.

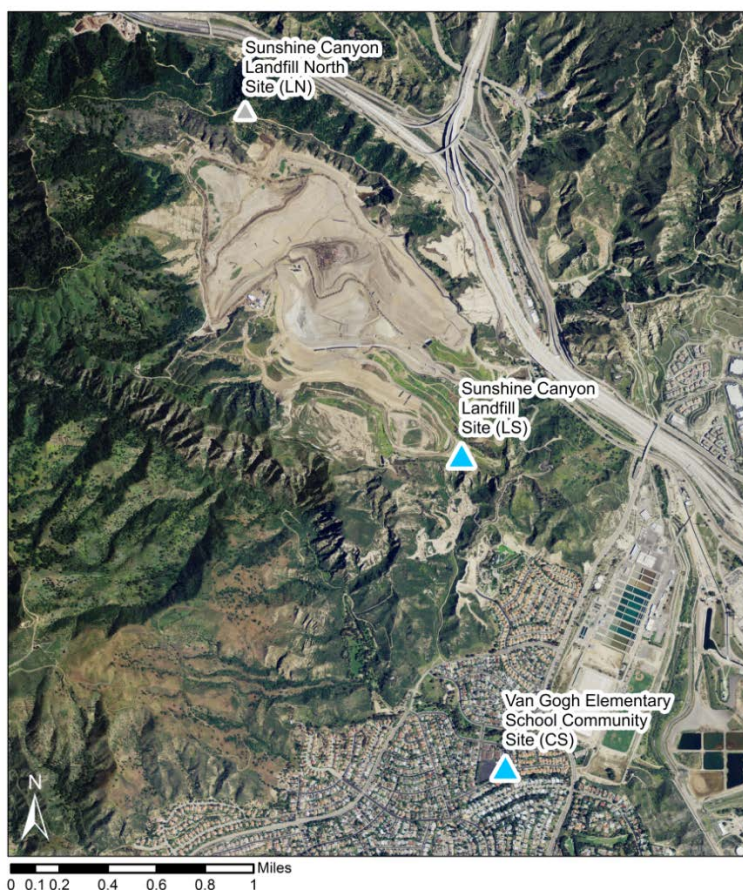


Figure 1. View of Sunshine Canyon Landfill and the surrounding monitoring stations (blue triangles): Sunshine Canyon Landfill (LS) and Community site (CS). The Sunshine Canyon Landfill North site (LN, gray triangle) collected data from December 1, 2015, through May 31, 2017, and has since been decommissioned.

Monitoring is conducted to fulfill stipulations in the City of Los Angeles' Conditions of Approval for the expansion of the landfill.³ Similar conditions cover the County of Los Angeles' portion of the landfill.⁴

³ Section C.10.a of Ordinance No. 172,933.

⁴ County Condition 81.

2. Data Completeness

Completeness statistics for all measured variables during the 2020 winter quarter are shown in **Table 1**. Data deemed as suspect are included in subsequent analyses (e.g., regional comparisons), while invalid data are not. The percent data capture for PM₁₀ was 99.1% at the Landfill site and 99.9% at the Community site. Approximately 0.5% and 0.4% of the captured PM₁₀ data were invalidated at the Landfill and Community sites, respectively. None of the PM₁₀ data were deemed suspect at either site.

Table 1. Data completeness statistics for hourly BC, hourly PM₁₀, and 1-min wind speed and wind direction data for the 2020 winter quarter monitoring period.

Monitoring Location	Dates	Data Capture (%) ^a			Data Valid or Suspect (%) ^b			Data Suspect (%) ^c		
		PM ₁₀	BC	WS/WD	PM ₁₀	BC	WS/WD	PM ₁₀	BC	WS/WD
Sunshine Canyon Landfill (LS)	12/01/19-02/27/20	99.1	98.8	99.0	99.5	99.9	100.0	0.0	2.1	0.0
Community Site (CS)	12/01/19-02/27/20	99.9	99.8	97.7	99.6	100.0	100.0	0.0	0.6	0.0

^a 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), multiplied by 100.

^b Data Valid or Suspect is the number of data values that are either valid or suspect divided by the number of captured data values, multiplied by 100.

^c Data Suspect is the number of data values labeled as suspect divided by the number of captured data values, multiplied by 100.

Hourly BC data capture was 98.8% at the Landfill site and 99.8% at the Community site. Approximately 0.1% of hourly BC data were invalidated at the Landfill site, while none of hourly BC data were invalidated at the Community site. Approximately 2.1% of the BC data at the Landfill site and 0.6% of the data at the Community site were deemed suspect.

The wind data capture percentages were 99.0% at the Landfill site and 97.7% at the Community site. None of the data were deemed suspect at either site.

3. PM₁₀ Exceedances

The federal and state PM₁₀ exceedances for the winter quarter of the baseline year (2002), the winter quarters of the previous 12 years (2008–2019), and the current winter quarter (2020) are summarized in **Table 2**. In this quarter, the state PM₁₀ standard of 50 µg/m³ was exceeded on 29% of days (25 days) at the Landfill site and on no days at the Community site. This is the highest number of state PM₁₀ exceedances for the winter quarter on record at the Landfill site.

The federal 24-hr PM₁₀ standard (150 µg/m³) was exceeded on one day at the Landfill site and on no days at the Community site. Over the 14 winter quarters of PM₁₀ measurements, including the baseline year (2001-2002), there were federal 24-hr exceedances at the Landfill site during seven quarters and none at the Community site.

Table 2. Number of exceedances of federal and state 24-hr PM₁₀ standards during the winter quarters of the baseline year (2002) and each year from 2008 to 2020. 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 winter quarter is shown in **bold**.

Site	Quarter Period	Quarter Name	Exceedances of PM ₁₀ Standard	
			Federal 24-hr 150 µg/m ³	State 24-hr 50 µg/m ³
Sunshine Canyon Landfill (LS)	12/01/01–02/28/02	Baseline Year	0	8/55 (15%)
	12/01/07–02/29/08	2008 Winter	1 (02/14/08)	10/83 (12%)
	12/01/08–02/28/09	2009 Winter	1 (01/09/09)	3/51 (6%)
	12/01/09–02/28/10	2010 Winter	0	0/87 (0%)
	12/01/10–02/28/11	2011 Winter	1 (01/20/11)	7/90 (8%)
	12/01/11–02/29/12	2012 Winter	0	13/91 (14%)
	12/01/12–02/28/13	2013 Winter	0	2/88 (2%)
	12/01/13–02/28/14	2014 Winter	2 (12/04/13, 12/09/13)	14/90 (16%)
	12/01/14–02/28/15	2015 Winter	0	10/89 (11%)
	12/01/15–02/29/16	2016 Winter	0	4/91 (4%)
	12/01/16–02/28/17	2017 Winter	2 (12/02/16, 12/18/16)	12/86 (14%)
	12/01/17–02/28/18	2018 Winter	2 (12/05/17, 12/17/17)	11/43 (26%)
	12/01/18–02/28/19	2019 Winter	0	4/90 (5%)
	12/01/19-02/27/20	2020 Winter	1 (12/17/19)	25/86 (29%)
Community Site (CS)	12/01/01–02/28/02	Baseline Year	0	7/70 (10%)
	12/01/07–02/29/08	2008 Winter	0	2/73 (3%)
	12/01/08–02/28/09	2009 Winter	0	6/85 (7%)
	12/01/09–02/28/10	2010 Winter	0	0/81 (0%)
	12/01/10–02/28/11	2011 Winter	0	1/88 (1%)
	12/01/11–02/29/12	2012 Winter	0	2/86 (2%)
	12/01/12–02/28/13	2013 Winter	0	3/87 (3%)
	12/01/13–02/28/14	2014 Winter	0	1/90 (1%)
	12/01/14–02/28/15	2015 Winter	0	4/88 (5%)
	12/01/15–02/29/16	2016 Winter	0	0/91 (0%)
	12/01/16–02/29/17	2017 Winter	0	2/90 (3%)
	12/01/17–02/28/18	2018 Winter	0	4/85 (5%)
	12/01/18–02/28/19	2019 Winter	0	0/80 (0%)
	12/01/19-02/27/20	2020 Winter	0	0/88 (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 (South Coast Air Quality Management District, 2015).

BC is measured by using an Aethalometer, which passes air through a filter tape trapping the suspended particles. A light beam projected through the deposit is attenuated by light-absorbing particles. 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 widely used. All the reported BC values to date from the Landfill, Landfill North, and Community sites have been adjusted in this report 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 Quarterly Report have been compensated, with the exception of data from the baseline year, because the raw data for the baseline year are unavailable.

The 24-hr average and maximum compensated BC concentrations collected during the 2020 winter quarter, the compensated BC data from the winter quarters of the 12 previous years, and the uncompensated data from the baseline year are provided in **Table 3**. The 2020 winter quarter 24-hr BC concentration average at the Landfill site is the second lowest on record, and the maximum 24-hr BC value is also the second lowest on record. At the Community site, the 2020 winter quarter 24-hr BC concentration average is the second lowest on record, while the maximum 24-hr BC value is lower than all previous winter quarters.

Distributions of 24-hour average PM₁₀ and BC data from winter quarters from 2008 through 2020 (presented as notched box-whisker plots⁵), and percentile trends for these metrics, are shown in **Figures 2 through 5**.

⁵ A notched box-whisker plot shows the entire distribution of concentrations for each year. Each box illustrates the 25th (lower box extent), 50th (median, midline), and 75th (upper box extent) percentiles. The extent of the box indicates the interquartile range (IQR), where 50% of the data lie. The whiskers indicate values that are up to 1.5 times the IQR from the 25th or 75th percentile. Data outside of the IQR are referred to as “outliers” and are plotted individually. The boxes are notched (narrowed) at the median and return to full width at the 95% lower- and upper-confidence interval values (i.e., the extents of the notches indicate the range in which the median falls with 95% confidence). If the notches of any two boxes do not overlap, there is strong evidence that the medians are statistically different at the 95% confidence level.

Table 3. Twenty-four-hour BC concentrations for the winter quarter of the baseline year (2002) and each year from 2008 to 2020. Asterisks (*) denote uncompensated BC values. The most recent winter quarter is shown in **bold**.

Site	Quarterly Period	Quarter Name	BC Concentrations ($\mu\text{g}/\text{m}^3$)	
			Average 24-Hr	Maximum 24-Hr
Sunshine Canyon Landfill (LS)	12/01/01–02/28/02	Baseline Year	0.88*	3.49*
	12/01/07–02/28/08	2008 Winter	0.78	2.87
	12/01/08–02/28/09	2009 Winter	0.73	2.63
	12/01/09–02/28/10	2010 Winter	0.89	3.06
	12/01/10–02/28/11	2011 Winter	0.63	2.82
	12/01/11–02/28/12	2012 Winter	0.70	2.17
	12/01/12–02/28/13	2013 Winter	0.70	2.38
	12/01/13–02/28/14	2014 Winter	0.79	2.90
	12/01/14–02/28/15	2015 Winter	0.75	3.17
	12/01/15–02/29/16	2016 Winter	0.38	1.47
	12/01/16–02/28/17	2017 Winter	0.53	2.17
	12/01/17–02/28/18	2018 Winter	0.49	1.24
	12/01/18–02/28/19	2019 Winter	0.44	2.13
	12/01/19–02/27/20	2020 Winter	0.39	1.26
Community Site (CS)	12/01/01–02/28/02	Baseline Year	0.76*	3.72*
	12/01/07–02/28/08	2008 Winter	0.58	2.07
	12/01/08–02/28/09	2009 Winter	0.68	3.73
	12/01/09–02/28/10	2010 Winter	0.76	2.29
	12/01/10–02/28/11	2011 Winter	0.60	2.82
	12/01/11–02/28/12	2012 Winter	0.57	2.18
	12/01/12–02/28/13	2013 Winter	0.50	1.95
	12/01/13–02/28/14	2014 Winter	0.51	1.84
	12/01/14–02/28/15	2015 Winter	0.85	2.99
	12/01/15–02/29/16	2016 Winter	0.51	2.62
	12/01/16–02/28/17	2017 Winter	0.54	2.41
	12/01/17–02/28/18	2018 Winter	0.45	1.50
	12/01/18–02/28/19	2019 Winter	0.35	1.36
	12/01/19–02/27/20	2020 Winter	0.36	1.35

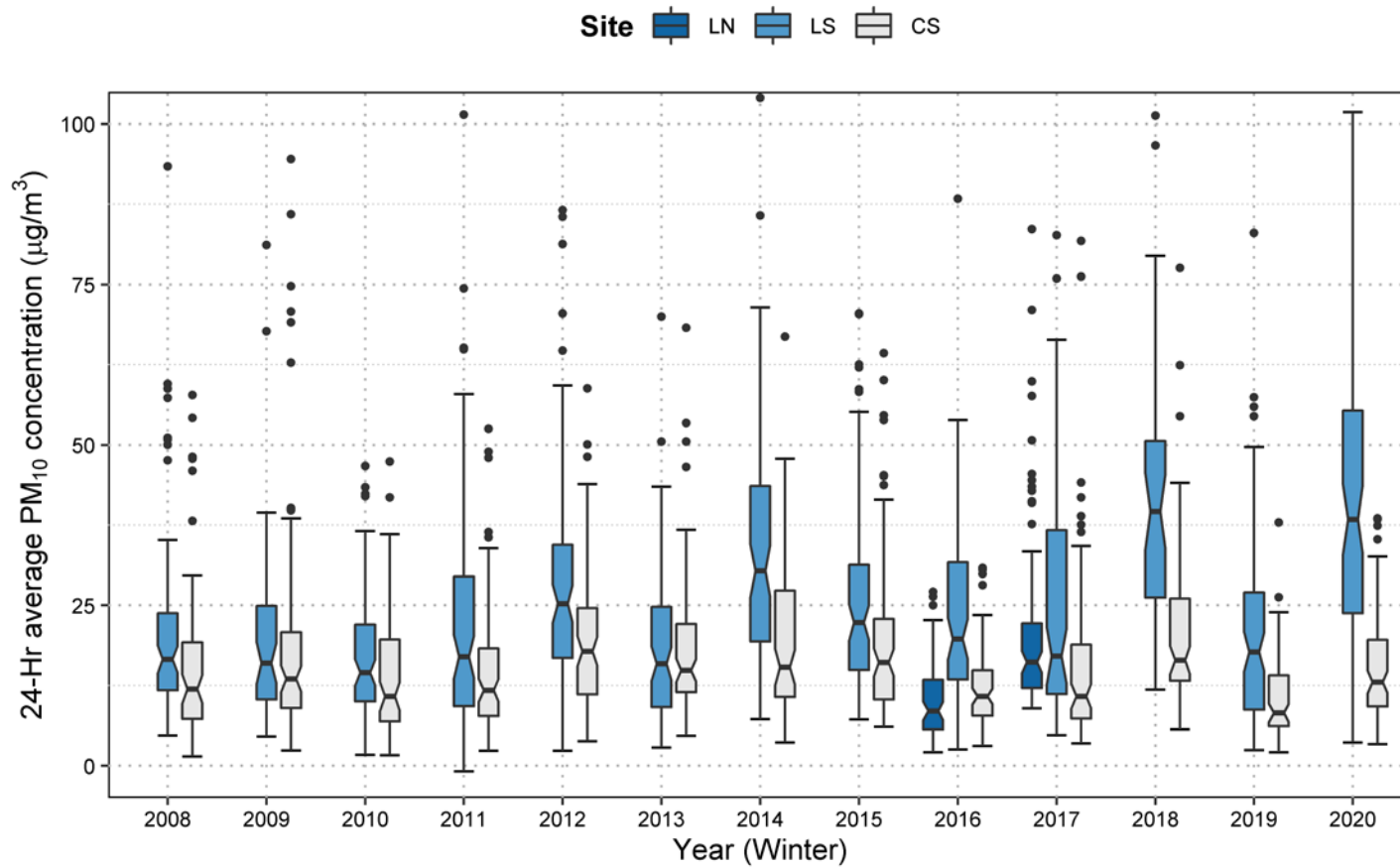


Figure 2. Distribution of 24-hr average PM₁₀ concentrations at the Sunshine Canyon Landfill North site (LN), Landfill site (LS), and Community site (CS) during winter (December–February) quarters from 2008 to 2020.

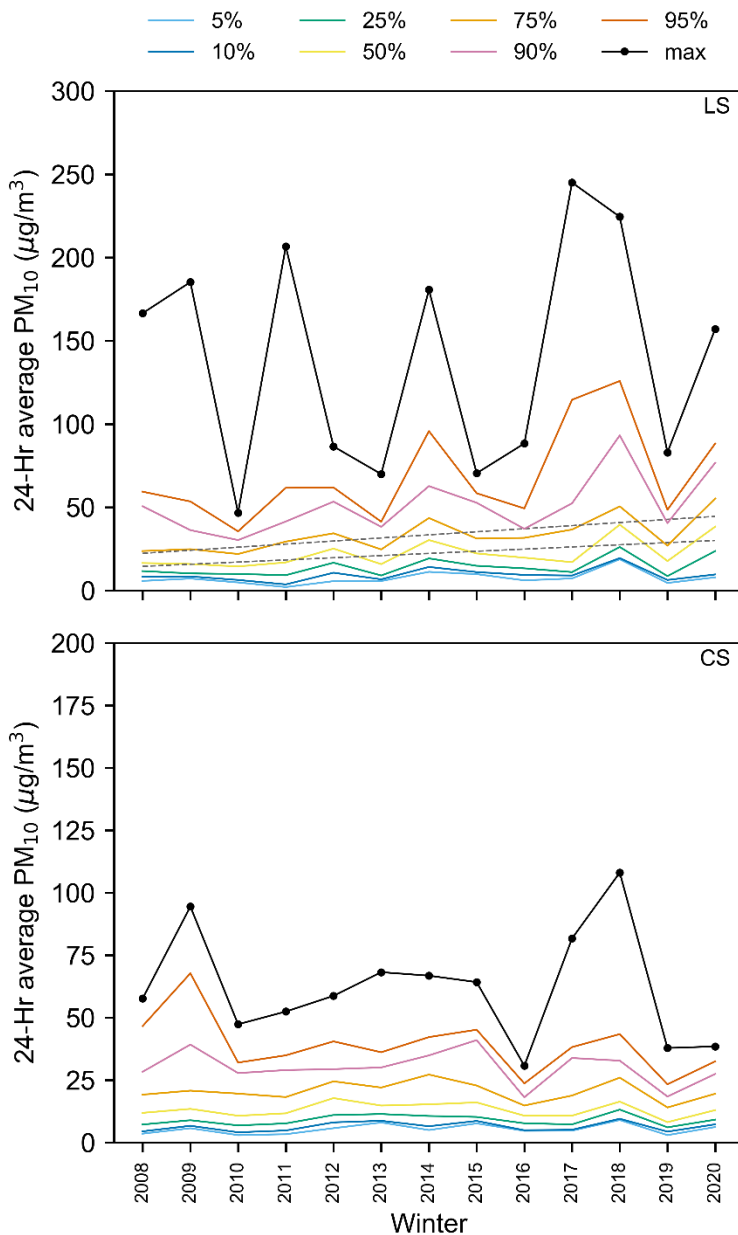


Figure 3. Trends of 24-hr average PM₁₀ maxima and percentiles at the Sunshine Canyon Landfill site (LS, top) and Community site (CS, bottom) during winter (December–February) quarters from 2008 to 2020. The gray dashed lines denote statistically significant increasing linear trend in the corresponding percentiles. Statistical significance was defined at the 95% confidence level (p-value ≤ 0.05).

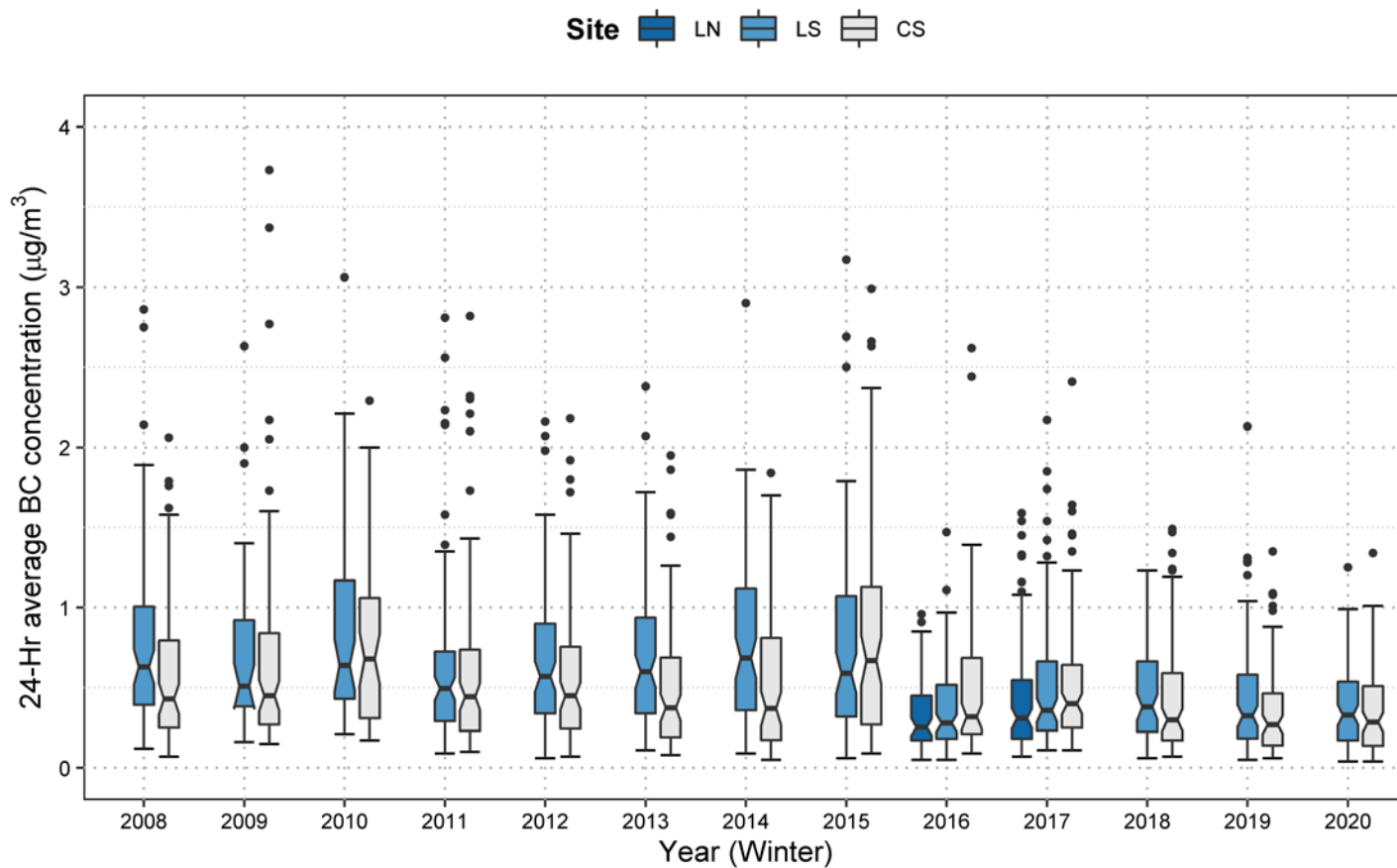


Figure 4. Distribution of daily 24-hr average BC concentrations at the Sunshine Canyon Landfill North site (LN), Landfill site (LS), and Community site (CS) during winter (December–February) quarters from 2008 to 2020.

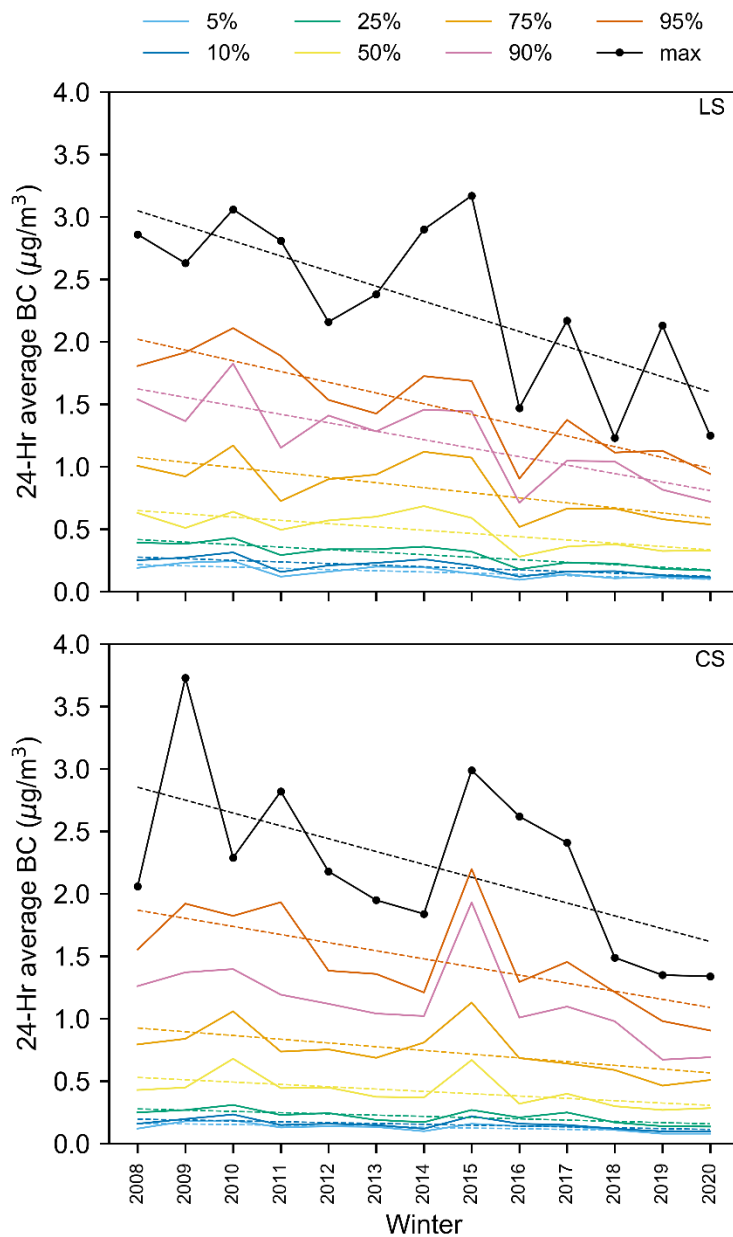


Figure 5. Trends of 24-hr average BC maxima and percentiles at the Sunshine Canyon Landfill site (LS, top) and Community site (CS, bottom) during winter (December–February) quarters from 2008 to 2020. The dashed lines denote statistically significant decreasing linear trend in the corresponding percentiles. Statistical significance was defined at the 95% confidence level (p -value ≤ 0.05).

At this time of year, the median 24-hr average PM₁₀ concentrations measured at the Community site are typically lower than those measured at the Landfill site (Figure 2). As indicated by the non-overlapping notches (and the entire interquartile range) in the box-whisker plot, the difference between the median 24-hr PM₁₀ concentrations at the Community and the Landfill sites in the 2020 winter quarter is statistically significant. At the Landfill site, there is a year-to-year variability in the 24-hr average PM₁₀ percentiles (Figure 3).⁶ The maximum 24-hr average PM₁₀ concentrations recorded in winter quarter 2017 and winter quarter 2018 at the Landfill were the highest on record. The 50th and 75th percentiles of the 24-hr average PM₁₀ concentrations generally increased over the past 13 winter quarters at the Landfill site, while no significant trends were observed at the Community site.

During the winter quarters, the median 24-hr average BC concentrations are not usually significantly different between the Landfill and Community sites, as indicated by overlapping notches in the box-whisker plot (Figure 4). The 2020 winter 24-hr average BC concentrations at the Landfill site are not statistically different from those at the Community site. There is some year-to-year variability in median 24-hr average BC concentrations over the past 13 years, and the range of 24-hr average BC values generally decreased over time at both monitoring sites.

Similar to the previous four winter quarters (2016, 2017, 2018 and 2019), the 2020 winter quarter at both sites exhibits much lower median 24-hr average BC concentrations and smaller ranges of 24-hr average BC than those of the rest of the winter quarters. At the Landfill site, there is a statistically significant decrease in 24-hr average BC concentrations during winter quarters over the observational record. At the Community site, the maximum and the 95th percentile of the 24-hr average BC concentration generally decreased over the past 13 winter quarters.

⁶ These results depend on the percentiles chosen in the trend analysis. Other percentiles may exhibit different trends, which may or may not be statistically significant.

5. Field Operations

Tables 4 and 5 list dates and major tasks associated with visits to the Landfill site and the Community site during the 2020 winter quarter.

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

Date of Site Visit	Description of Work
12/18/19	Collected PM ₁₀ and BC data. Spooled new roll of tape for Aethalometer. Restarted Aethalometer. Checked BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
01/24/20	Collected PM ₁₀ and BC data. Restarted Aethalometer. Checked Aethalometer tape supplies. Cleaned BAM roller, vane, and nozzle, and spooled new roll of tape. Performed leak check on BAM sampler. Performed flow check on Aethalometer and BAM samplers.
02/27/20	Collected PM ₁₀ and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers. MET tower leaning ~10° northwest due to soil erosion at base (on-going).

* The next site visit that occurred after the current quarter is included in this report. The information from this site visit is used to assess the quality of the last portion of data from the current quarter.

Table 5. Community site (CS) visits, field maintenance, and operations.

Date of Site Visit	Description of Work
12/18/19	Collected PM ₁₀ and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.
01/08/20	Rebooted MET logger, and restored communications.
01/24/20	Collected PM ₁₀ and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers. Restarted DR DAS.
02/27/20	Collected PM ₁₀ and BC data. Restarted Aethalometer. Checked Aethalometer and BAM tape supplies. Cleaned BAM roller, vane, and nozzle, and performed leak check. Performed flow check on Aethalometer and BAM samplers.

* The next site visit that occurred after the current quarter is included in this report. The information from this site visit is used to assess the quality of the last portion of data from the current quarter.

Aethalometer and BAM flow rates measured with a National Institute of Standards and Technology (NIST)-traceable flow standard are shown in **Table 6**. BAM flow rates are volumetric (i.e., they depend on local temperature and pressure), and Aethalometer flow rates are at standard temperature and pressure. The target flow rate of the BAM is 16.7 liters per minute (lpm) volumetric to meet the 10-micron particle cut point of the inlet, with an acceptable range of 16.0 lpm to 17.3 lpm. The Aethalometer has no particle size cut point.

Table 6. Flow rates for the BAM PM₁₀ and Aethalometer BC monitors at the Landfill and Community sites. “Ref.” is the Reference and “Aeth.” is the Aethalometer.

Location	Date	Flow Rate (lpm)					
		As Found		As Left		As Found	
		BAM	Ref.	BAM	Ref.	Aeth.	Ref.
Sunshine Canyon Landfill (LS)	12/18/19	16.7	17.04	16.7	17.04	4.0	3.7
	01/24/20	16.7	17.02	16.7	17.02	4.0	4.0
	02/27/20	16.7	16.98	16.7	16.98	4.0	4.2
Community Site (CS)	12/18/19	16.7	16.70	16.7	16.70	4.1	3.9
	01/24/20	16.7	16.81	16.7	16.81	4.1	4.2
	02/27/20	16.7	16.71	16.7	16.71	4.0	4.01

* The next site visit that occurred after the current quarter is included in this report. The information from this site visit is used to assess the quality of the last portion of data from the current quarter.

6. References

- 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 <http://www.nescaum.org/documents/analysis-of-spatial-and-temporal-trends-of-black-carbon-in-boston/nescaum-boston-bc-final-rept-2014.pdf/>.
- Drinovec L., Močnik G., Zotter P., Prévôt A.S.H., Ruckstuhl C., Coz E., Rupakheti M., Sciare J., Müller T., Wiedensohler A., and Hansen A.D.A. (2015) The "dual-spot" Aethalometer: an improved measurement of aerosol black carbon with real-time loading compensation. *Atmospheric Measurement Techniques*, 8, 1965-1979, doi: 10.5194/amt-8-1965-2015. Available at <http://www.atmos-meas-tech.net/8/1965/2015/amt-8-1965-2015.pdf>.
- South Coast Air Quality Management District (2015) Multiple Air Toxics Exposure Study in the South Coast Air Basin: MATES IV. 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>.