APPENDIX 1
SAMPLING METHODOLOGY AND DATA SOURCES FOR EMISSIONS INDICATORS

SAMPLING METHODOLOGY

NYCCAS air quality monitoring began in December 2008. Field teams sampled the air at 150 NYC locations per year during the first two years and at 60 to 100 locations per year in subsequent years. Samples are collected in all seasons for all pollutants, except O_3 and SO_2, where samples are collected in the summer and winter seasons, respectively.

The original 150 monitoring sites were selected to ensure that the range of traffic conditions, size and number of buildings, and land uses in NYC were adequately included while providing a balance in spatial coverage throughout the city. To do this, a digital map of the city was divided into a grid of more than 7,500 squares, each 300 by 300 meters (m), and each square was classified based on its traffic and building density. A random selection of squares was then drawn from this set, with high building and traffic density areas having an increased chance of selection as these areas are concentrated in a relatively small area of the city. This random site selection was used to locate 80% of the sampling sites. The remaining 20% of sites were selected in places with large remaining gaps in coverage from the random selection or near areas of interest, such as high traffic areas, transportation facilities, or major ongoing construction.

Figure 1: NYCCAS Monitor in the Field

Each NYCCAS site is monitored for a two-week period in each season. The schedule of monitoring is assigned randomly so that the same number of sites across the city are monitored in each two-week period. In addition, 'reference' sites — centrally located and away from nearby traffic and commercial or industrial activities — are monitored during every two-week period, year round. Data from these 'reference sites' are used to adjust the measurements made at other sites for variation that occurs across the city over time, mainly due to weather conditions. For additional details on the 150 site selection methods, visit (NYCCAS First Winter Results, NYCCAS Design and Implementation).

After the first two years of the study, the number of sites was reduced to between 60 and 100 sites, depending on the year, because of budget constraints and to free up resources to measure other pollutants and conduct additional air quality and health studies. The balance of source density and spatial density was preserved, through use of random selection methodologies similar to those described

above. The patterns in air pollutant concentrations remained consistent year after year – areas of the city with higher concentrations tend to remain higher over time, while cleaner areas of the city remain cleaner – due to major emissions sources such as buildings and traffic remaining in fixed locations. Because of this, NYCCAS is able to track the geographic pattern of air quality over time with fewer locations than in the original design. Currently, routine NYCCAS air sampling occurs once per season at 60 of the original 150 sites, known as the 'core' monitoring sites, and 30 additional locations which include 15 of the original 150 sites and 15 sites located in low income neighborhoods with previously lower monitoring density. The number of reference sites was reduced from five to three after the first four years. NYCCAS sampling is conducted using monitoring units mounted on lamp-posts 10 to 12 feet off the ground. The monitors include an air pump and filters to collect $PM_{2.5}$ while passive samplers mounted on the outside of unit absorb the gaseous pollutants NO_x, SO_2, and O_3. Laboratory analysis of the filters and passive samplers determines the quantities of pollutants collected and their concentration in air is calculated. Quality control steps included confirming that the sampling pump was operating normally and collecting duplicate and unexposed samples for comparison with study samples.

Figure 2: NYCCAS team member deploys a monitor in the field

NYCCAS data were analyzed using a "land-use regression" (LUR) model. LUR models estimate associations among pollution levels, average traffic, building emissions, land use, and other neighborhood factors around the monitoring sites. These associations were used to estimate the seasonal average air pollution levels at locations across the city, including locations where no measurements were taken. The LUR model is also used to assess sources that appear to contribute most to differences in pollution concentrations. For more details on the analysis methods, please see the technical appendices and scientific manuscripts available at nyc.gov/health/nyccas.

The results of NYCCAS monitoring have been published in multiple public reports, scientific manuscripts, and periodic online data updates. All reports and DOHMH scientific studies are available on the NYCCAS website at nyc.gov/health/nyccas. All neighborhood-level data and detailed neighborhood air quality reports are available for download through the Department's Environment & Health Data Portal.

DATA SOURCES FOR EMISSIONS INDICATORS

Source Category	Variables Examined (most calculated in buffers of 50 to 1,000 m)	Data Source
Cumulative Traffic Indicators	Road surface area	Land Cover, Classified LiDAR data, 2017
	Traffic NOx and PM2.5 emissions assigned to NYC roads using vehicle class specific volume	NYMTC traffic data 2019; county total on-road NOx and PM2.5 emissions, National Emissions Inventory 2017
Road-specific Measures	Average daily traffic (ADT) on nearest major road	NYMTC traffic data 2019
	Location on a bus route	NYC DOT, 2020
Truck/ Diesel-Related Measures	average daily truck traffic on designated truck routes	NYMTC traffic data, 2019
	Truck and bus traffic NOx and PM2.5 emissions assigned to NYC roads using	NYMTC traffic data by vehicle class, 2019; county total on-road NOx and PM2.5 emissions by vehicle class, National Emissions Inventory
	Density of loading docks	CoStar data, 2022 (https://www.costar.com/)
	Distance to nearest truck route	NYC DOT , 2020
Built Space	Density of built space (building floor area)	NYC Department of City Planning Primary Land Use Tax Lot Output (PLUTO™) data, 2022
	Estimated building boiler emissions for building heat and hot water by fuel type	PLUTO™ data 2019, EPA AP 42, NYC Department of Environmental Protection (NYC DEP) Registration and Certificate Permit Data, updated annually
Land Use	Area of tree cover	NYC Department of Parks and Recreation LiDAR data, 2017
	Percent impervious surface	Land Cover, Classified LiDAR data, 2017
	Area of tax lots labelled as having "industrial and manufacturing" land-use	PLUTO™, 2022
Distributed Facilities	Number of commercial cooking appliances	NYC Fire Department Rangehood permitting program