MINNESOTA POLLUTION CONTROL AGENCY

2020

Assessing Urban Air Quality

What does this project do?

Urban areas have many sources of air pollution. Increasingly, urban residents are concerned about the effects of air pollution on human health. Understanding small-scale differences in air pollution is essential to minimizing exposure to harmful air pollutants, particularly among vulnerable populations such as children and the elderly.

The 2017 LCCMR recommended and Legislature appropriated $700,000 to install new, high-tech low-cost sensors, or monitors, in St. Paul and Minneapolis. These monitors can measure multiple types of harmful air pollution at once, and can sense small-scale differences in various air pollutants.

What work has been done so far?

- A network of 44 air quality sensors installed across St. Paul and Minneapolis.
- These sensors monitor fine particles, ozone, nitric oxide, nitrogen dioxide, sulfur dioxide and carbon monoxide.
- There is at least one monitor in each ZIP code in these two cities, and some larger ZIP codes have more than one monitor.
- In St. Paul, most of the air quality monitors are placed on light poles in school parking lots.
- In Minneapolis, these sensors are located on Xcel energy wooden light poles in neighborhoods.
- Data measured by the monitors is collected at MPCA and displayed on our website.

What questions will be answered by this project?

- Are there differences in pollution concentrations between zip codes in the urban core?
- Are there specific areas with unusually high concentrations?
- Are there similar patterns of high pollution concentrations across zip codes as high asthma hospitalization rates?

What are the expected outcomes?

The innovative monitoring approach of this program is replicable, and will achieve three objectives:

- Improve understanding of air pollution variability within densely populated areas. This information will be used to evaluate pollution reduction opportunities, and to compare with data on population vulnerability and health outcomes.
- Evaluate the use of new technologies in air pollution sensors as an innovative, cost-effective monitoring strategy.
- Expand the availability of ambient air quality data to inform decisions, especially regarding public health improvement opportunities.

What are the health impacts of these air pollutants?

Pollutants	Sources	Health effects	Environmental effects
Sulphur Dioxide (SO2)	• Industry, coal fired power plants • Burning of high Sulphur fuels	• Respiratory illness • Cardiovascular illness	Precursor to acid rain – damages lakes, rivers, plants, buildings
Nitrogen Oxides (NOX)	• Industry • Vehicles	• Respiratory illness • Cardiovascular illness	Nitrogen deposition leading to over fertilization and eutrophication
Particulate matter	• Industry • Vehicles	• Penetrate into lungs, asthma • Finer particles can enter bloodstream	Affects Visibility and AQI
Carbon Monoxide (CO)	• Vehicles	• Headaches • Fatigue	Contributes to formation of smog
Ozone (O3)	• Secondary formation from reactions of Nitrogen oxides and VOCs	• Respiratory illness • Eye and throat irritant	Reduced crop production and forest growth. It is a smog precursor

Contact:

Dr.Monika Vadali
MPCA Environmental Research Scientist
Phone: 651 757 2776
Email: monika.vadali@state.mn.us
Website: www.pca.state.mn.us/urbanair

Assessing Urban Air Quality

MINNESOTA POLLUTION CONTROL AGENCY

Monika Vadali, Ph.D | Environmental Research Scientist

Why are we doing this?

To better understand small-scale differences in urban air quality

Availability of newer sensor technology to monitor air quality

The Minnesota Legislature provided funding*

Cost-saving in the long run

LCCMR: Legislative-Citizen Commission on Minnesota's Resources

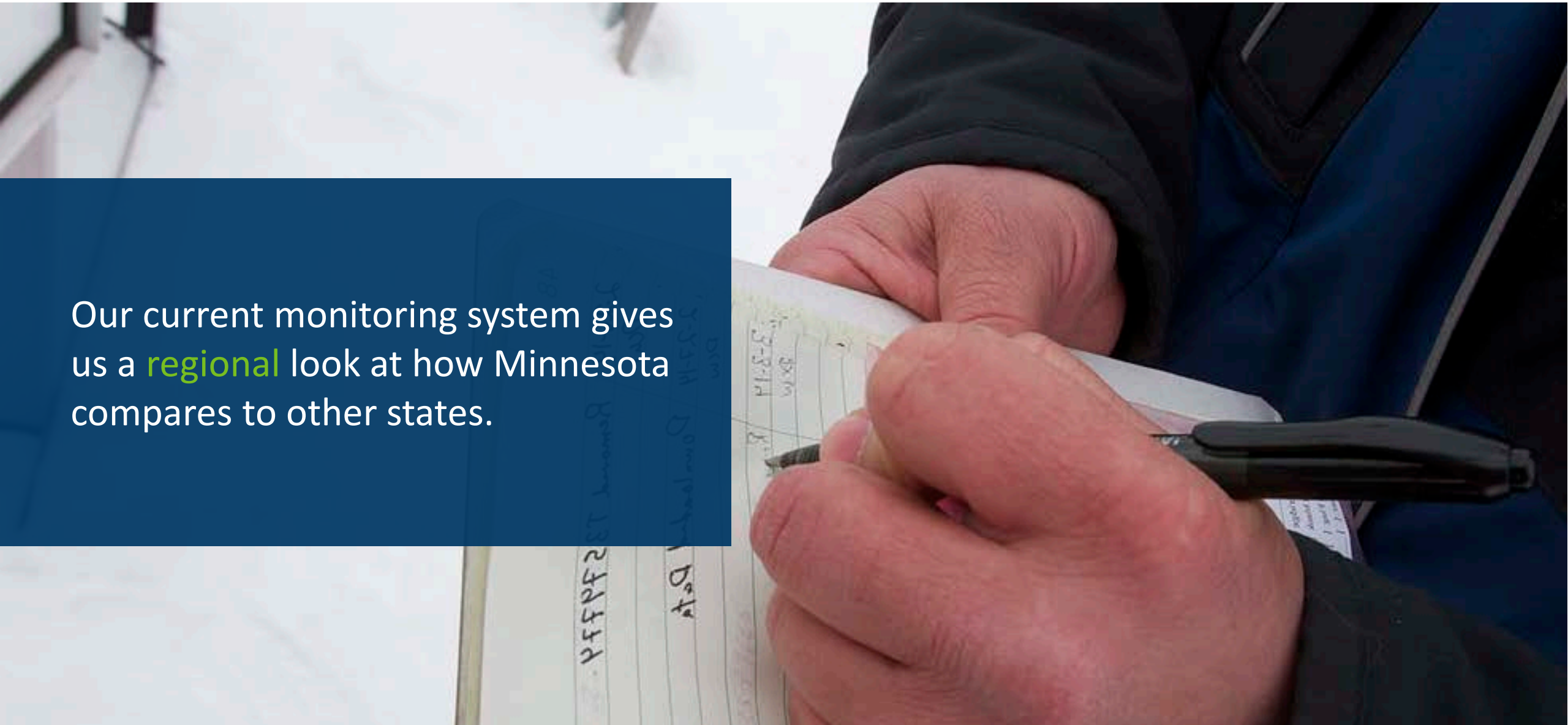
Why Minneapolis and St. Paul?

Disparities in air pollution-related health impacts in the metro area

- Rates of hospitalizations & emergency department visits
- Rates of asthma
- Populations with lower income
- People of color

Asthma rates for children living in the Twin Cities metro are 67% higher than for children living in Greater Minnesota.

Our current monitoring network

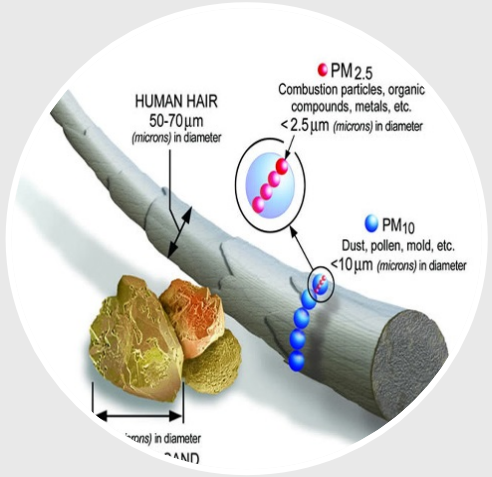


Our current monitoring system gives us a regional look at how Minnesota compares to other states.

The new sensors - AQMESH

Quick install
Little maintenance
Solar-powered

What are we monitoring?

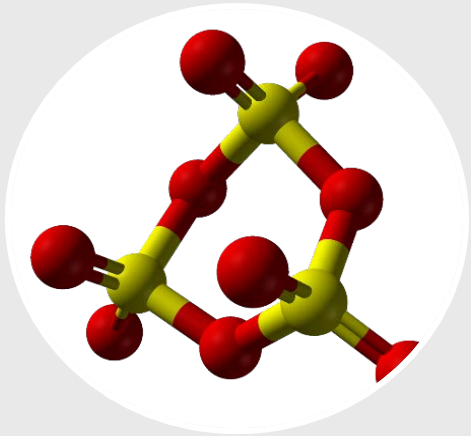


Fine particles ($PM_{2.5}$)

A mix of solid particles and liquid droplets in the air – 30x smaller than a human hair

Ground-level Ozone

When chemicals and other pollutants mix with sunlight and heat – aka “smog”

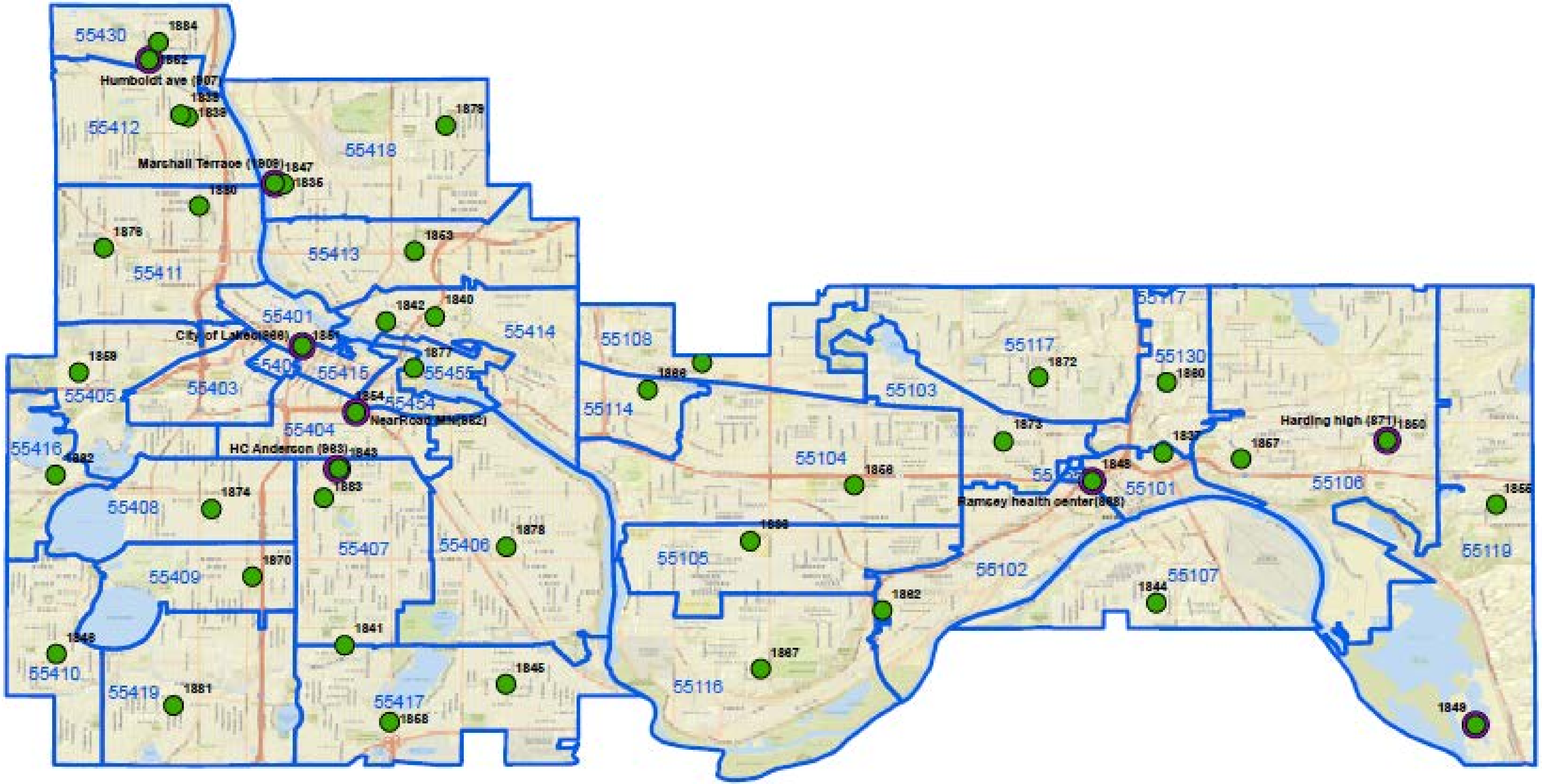


- **Nitrogen oxides (NO_x)**
  - **NO2 and NO**
- **Sulfur dioxide (SO_2)**
- **Carbon monoxide (CO)**

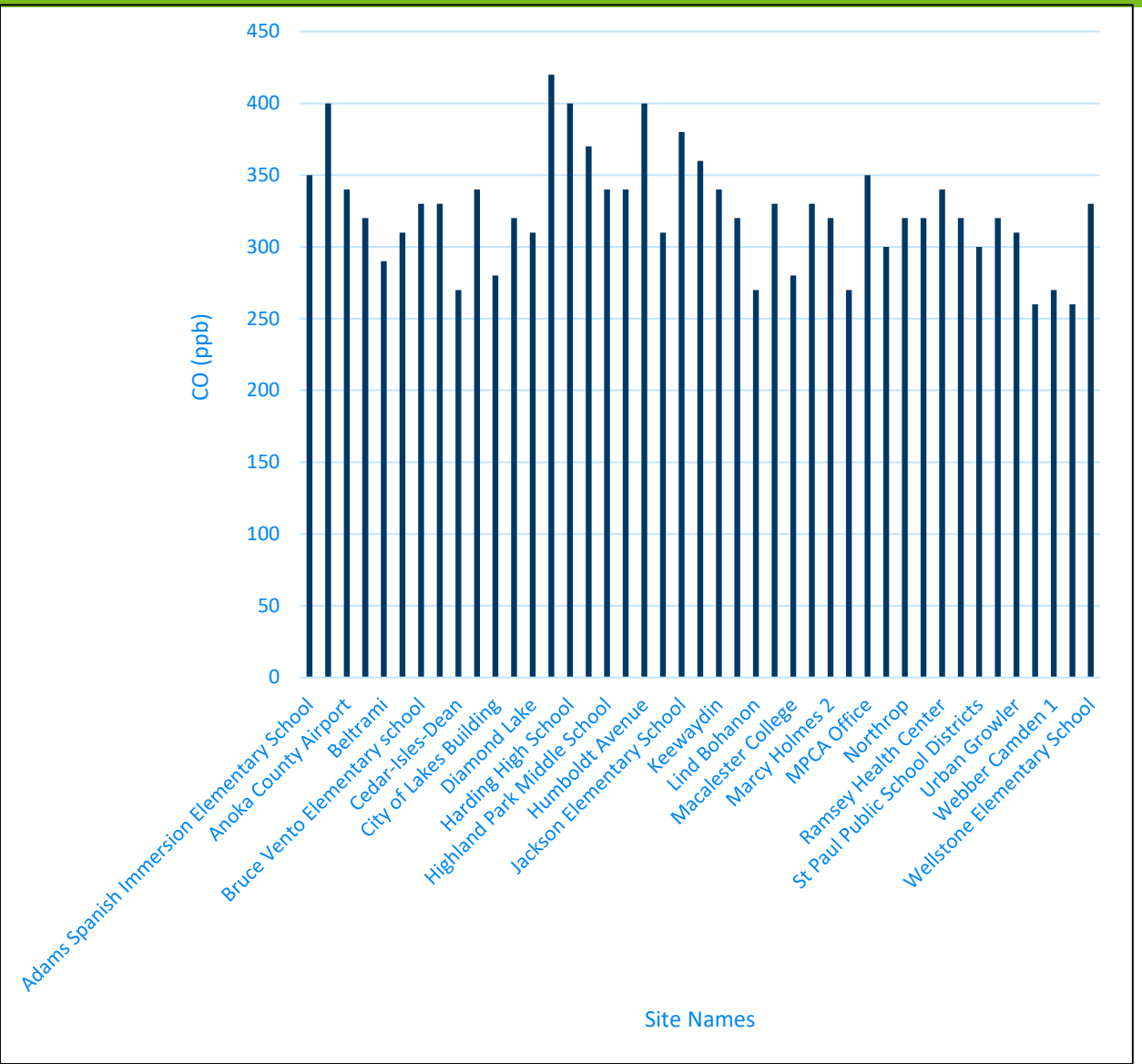
- **Temperature**
- **Relative Humidity**

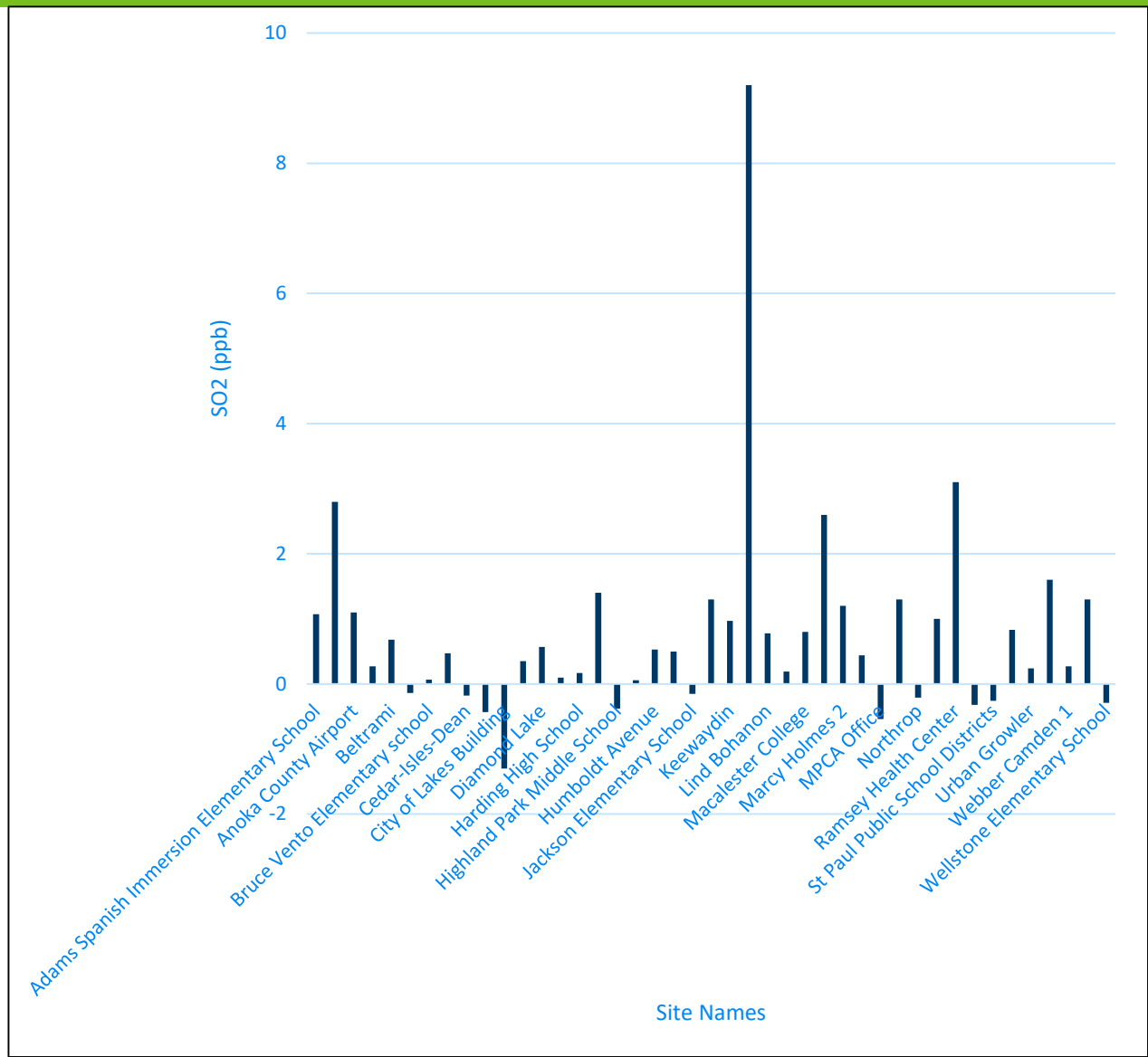
Project Updates

- Phase I collocation all sensors– Fall/Spring 2017-18 – *50 pods*
- Community meetings R1 in study area – Fall 2017
- Finalize locations in St.Paul – Fall 2018
- Finalize locations in Minneapolis - Winter 2019
- All sites deployed – Spring/Summer 2019 – *44 pods, 264 sensors*
- Community meetings R2 in study area – Fall 2019

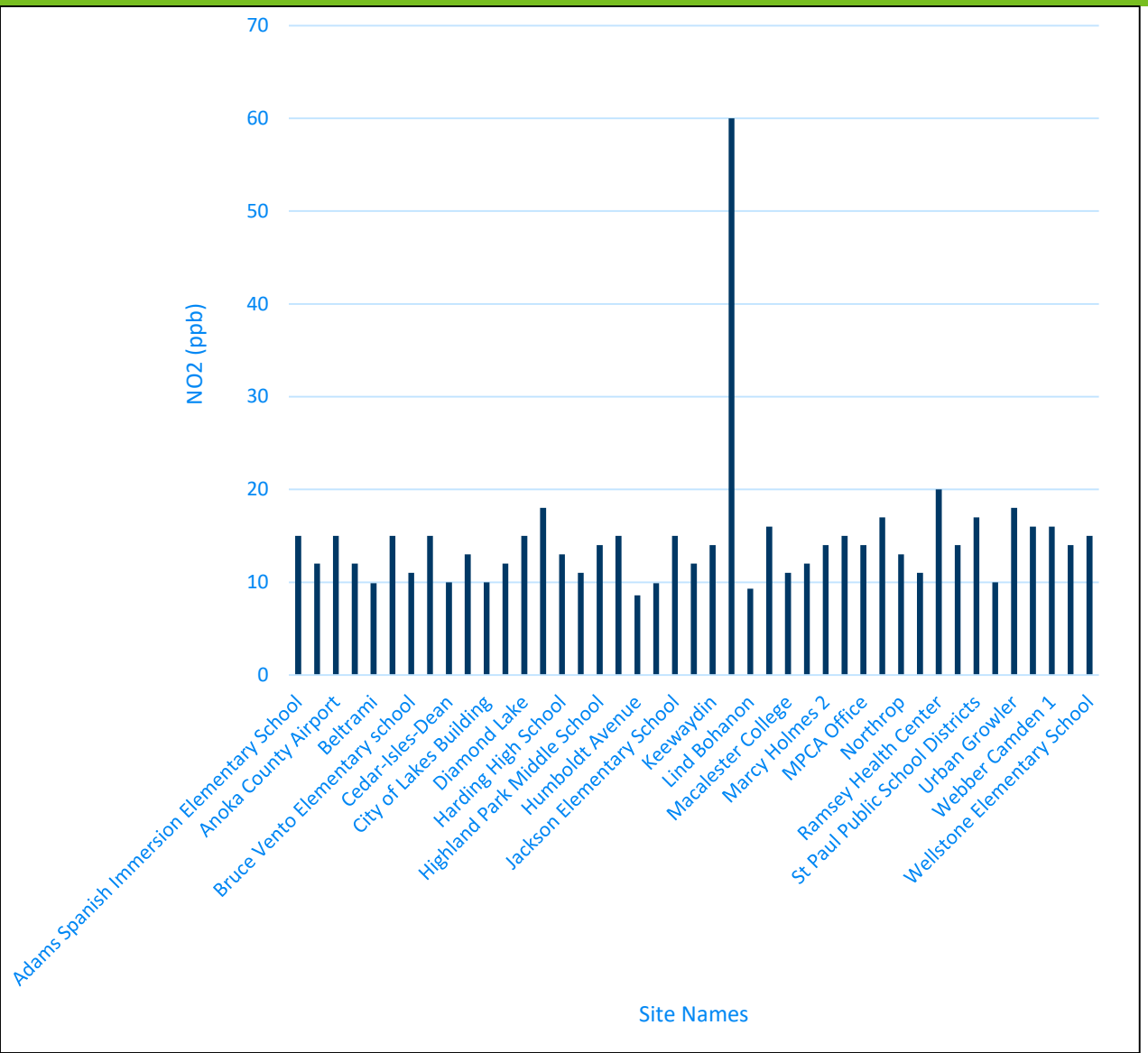

55430
55412
55418
55411
55413
55401
55414
55108
55117
55130
55405
55403
55415
55455
55454
55404
55114
55103
55416
55104
55101
55106
55408
55407
55406
55105
55102
55119
55409
55107
55410
55419
55417
55116

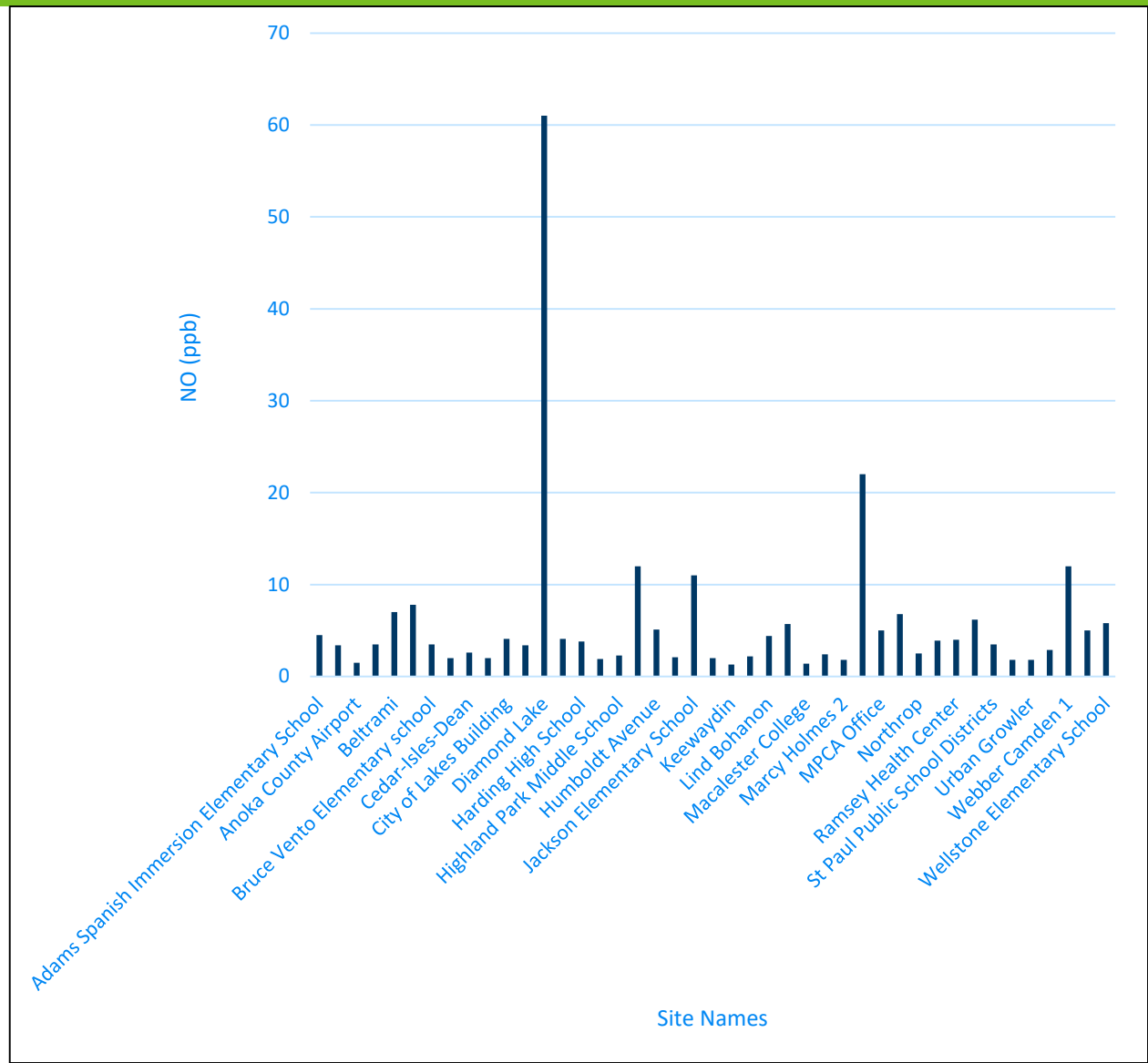
Site averages for CO & SO_2(2019)



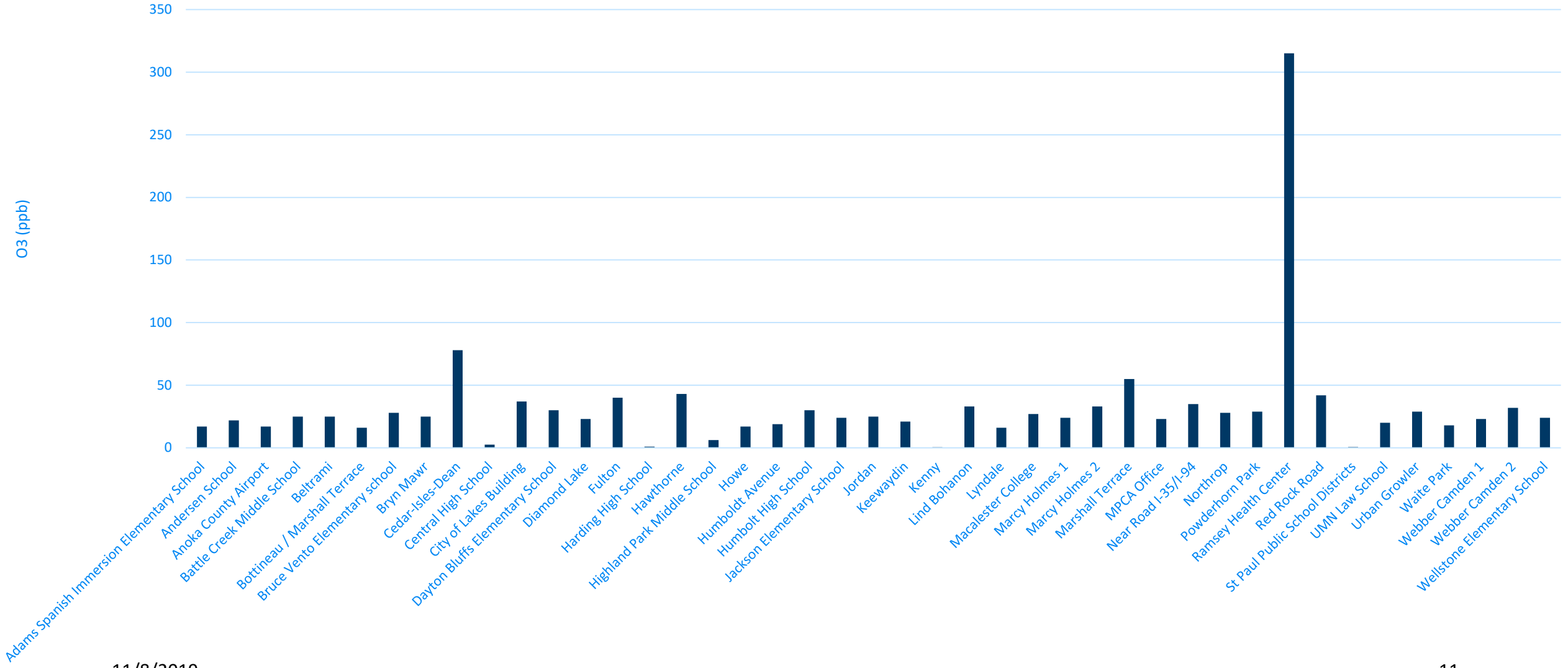


Site averages for NOx(2019)

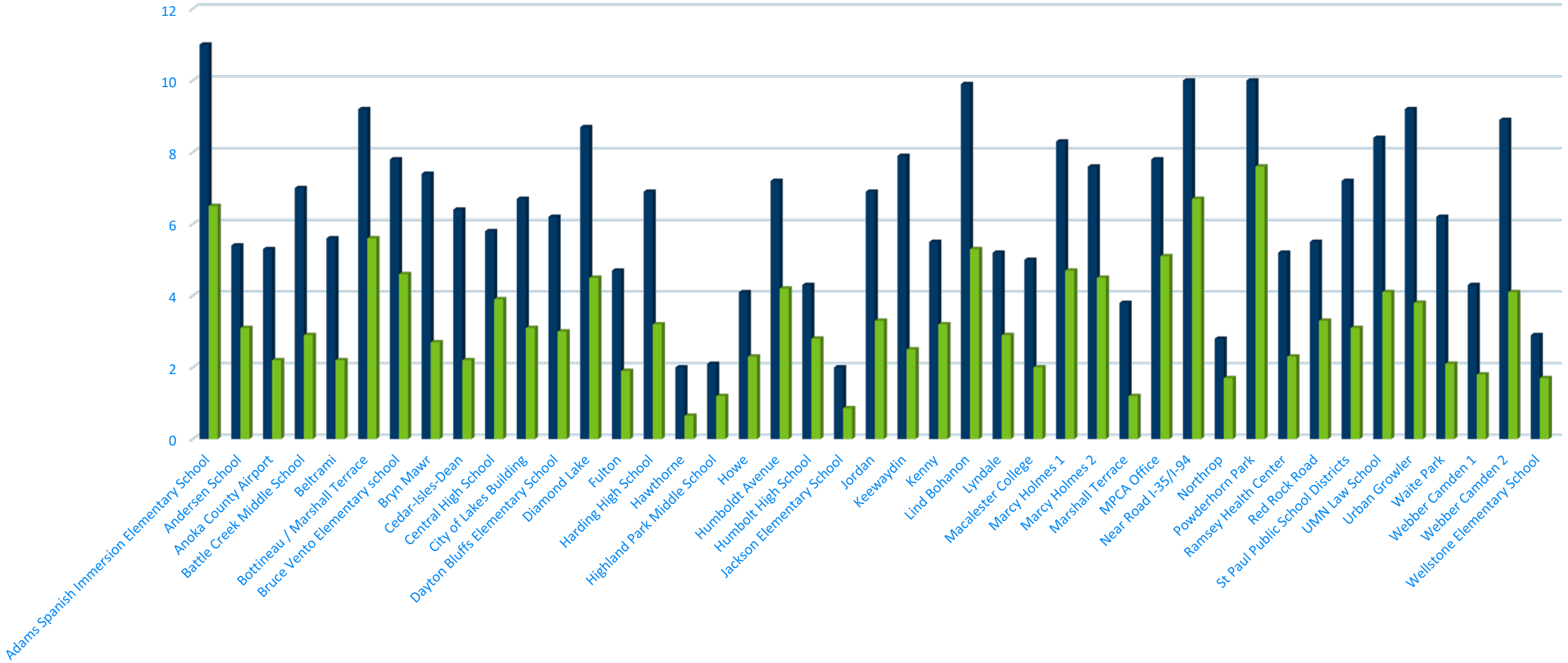




Site averages for ozone concentrations (2019)



Site averages for Particulate matter(2019)



Summary

Pollutant	Minimum	Maximum
CO (ppb)	260	420
NO (ppb)	1.3	61
NO_2 (ppb)	8.6	60
O_3 (ppb)	0.5	315
SO_2 (ppb)	-1.3	9.2
$PM_{2.5}$ (µg/m^3)	0.6	7.6
PM_{10} (µg/m^3)	2	11

Pollutant	NAAQS Standard
CO (ppb)	35,000 (1 Hr)
NO (ppb)	----
NO_2 (ppb)	100 (1Hr)
O_3 (ppb)	70 (8Hr)
SO_2	75 (1 Hr)
$PM_{2.5}$ (µg/m^3)	35 (24 Hr)
PM_{10} (µg/m^3)	150 (24 Hr)

Data will inform air quality concerns

Partners and Collaborators

- City of Minneapolis
- Saint Paul School District
- Minnesota State University, Mankato
- Xcel Energy
- AQMESH
- Minnesota Department of Health
- LCCMR

Thank you!

Monika Vadali, Ph.D

Monika.Vadali@state.mn.us

www.pca.state.mn.us/urbanair

MINNESOTA POLLUTION CONTROL AGENCY

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND