

Abstract

Since Autumn 2021 our TY students have participated in this citizen science project to monitor the air quality of our outdoor school environment. Students have installed diffusion tubes at different locations to measure nitrogen dioxide (NO₂) concentrations. Data collected over the past three years indicate that NO₂ pollutant levels are in the low to medium and medium range. As these levels exceed those recommended by the WHO, students have worked with our Green-Schools committee and staff to find ways to reduce emissions and their impact.

Research questions

1. How much NO₂ is there in different parts of our outdoor school environment?
2. Is our school air quality within the WHO recommended level (less than 10 µg/m³) of healthy NO₂ exposure?
3. Do weather conditions such as wind speed and direction affect our air quality?
4. How do our current results compare with our previous results?
5. How can we improve air quality for our students and staff around our school?

Introduction

Rockford Manor is a Secondary School located on Stradbrook Road, Blackrock, Co. Dublin. The school is situated next to a main road and a busy roundabout, as shown in our site map. The school is in a suburban area, which has mixed, commercial and residential use. Due to the location of the school, we think that there could possibly be higher NO₂ levels in the air at the front of the school grounds and lower NO₂ levels in the green space to the rear of our school building, as it is sheltered from traffic.

NO₂ is a red-brown gas that is emitted into the air by traffic and other harmful human activity. High levels of this gas can cause respiratory health issues and damage to our atmosphere. Longer exposures to elevated concentrations of NO₂ may contribute to the development of asthma and potentially increase susceptibility to respiratory infections.^{1,3}

With this project, we aim to gather and analyse data in efforts to reduce NO₂ levels around our school area and therefore improve air quality for our staff and fellow students.

Research Methods

- Diffusion tubes supplied by Globe Ireland were installed at several locations around our school campus to measure NO₂ levels.
- Locations close to traffic at the front of our school next to the main road and to the rear of our school in the green space were chosen to compare pollutant levels in areas exposed to traffic and those sheltered from traffic.
- Diffusion tubes were installed at these locations for a 4-week period and then sent to a laboratory for analysis.
- During this monitoring period traffic surveys were conducted and daily weather conditions recorded.



Wind direction and speed

The wind rose shows the wind speed and direction during our Autumn 2023 monitoring campaign. This chart shows that wind came mostly from the southeast and southwest. The prevailing winds in Autumn 2021 were from the south and southwest, while in 2022 they were from the north and east. These data may be used to show the impact of wind direction on the spreading of pollution from traffic next to our school towards or away from our school grounds.

Results

Diffusion tube results - average NO₂ concentration

Location	Autumn 2021	Spring 2022	Autumn 2022	Autumn 2023
Tube 1- traffic lights	18.29	22.15	18.32	25.52
Tube 2- basketball court (elevated)	16.12	21.86	13.49	20.72
Tube 3- green space (sheltered)	13.13	13.30	13.36	16.37
Tube 4- front gate	N/A	N/A	N/A	20.46
Tube 5- outdoor classroom (sheltered)	N/A	N/A	N/A	17.19

1. Concentrations of NO₂ are in units of µg/m³
2. Roadside sites show higher concentrations of NO₂ than sheltered green space sites as expected:
 - Average roadside - 20.9 µg/m³
 - Average basketball court (elevated site) – 18.05 µg/m³
 - Average sheltered - 14.7 µg/m³

3. Highest overall average concentrations of NO₂ measured Autumn 2023:

- Autumn 2021 – 15.8 µg/m³
- Spring 2022 – 19.1 µg/m³
- Autumn 2022 - 15 µg/m³
- Autumn 2023 – 20 µg/m³

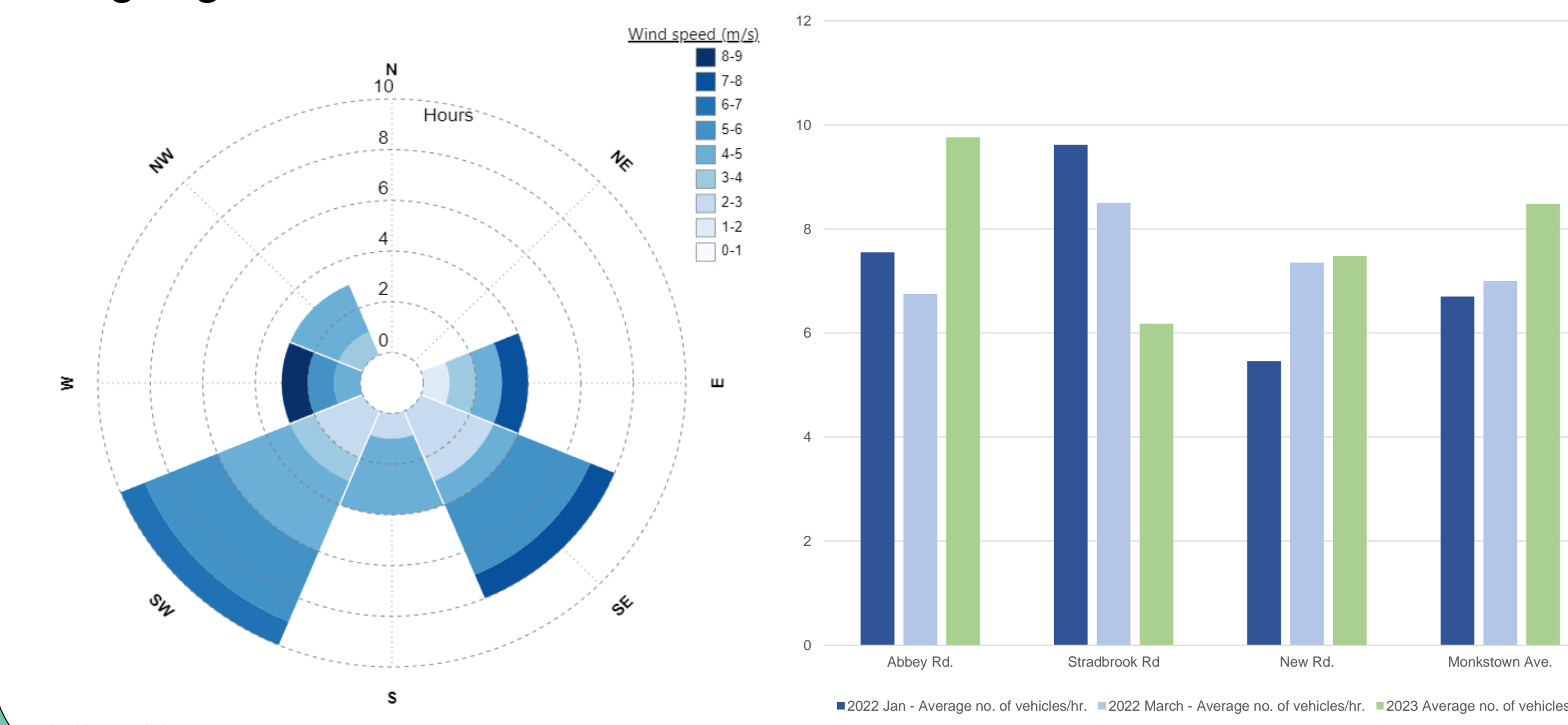
Nitrogen dioxide scale

µg/m ³	Colour Code	NO ₂ Pollutant Level
>40	Red	High
30-40	Orange	Medium to High
20-30	Yellow	Medium
10-20	Green	Low to Medium
0-10	Blue	Low

4. We propose that recent overall increases in NO₂ levels may be due to increased traffic levels. There is more traffic on the roads now, compared to the last few years due to Covid restrictions. A greater number of people were working from home during 2021 and 2022 than during Autumn 2023. This is something we would like to investigate further.

Traffic survey results

Traffic surveys were done during school time and show that there was a slight increase in traffic last Autumn which might explain the higher NO₂ levels. We would like to survey rush hour traffic which might give us a better indication of traffic levels.



Discussion

The EU and World Health Organization (WHO) have created the nitrogen dioxide scale for good health.⁴ The EU has set an annual mean limit of 40 µg/m³ NO₂ and the WHO has set an annual mean limit of 10 µg/m³ NO₂ for good health. Our results indicate that the air quality around Rockford Manor is in the low-medium (10-20 µg/m³) and medium (20-30 µg/m³) categories on the scale. This is safe for our health according to the EU Annual standards but exceeds the limit set by the WHO. This means that the NO₂ levels may be too high and requires action. If the NO₂ levels keep increasing in the area due to exhaust fumes and human activity around the school, it could have a serious long-term effect on our respiratory health.

Our Clean Air Plan

Our school community has implemented the following actions to improve air quality and reduce the impact of NO₂ pollution on our health.

- We have a new pathway around our school to encourage students to hang out in our green space where air quality is better.
- WOW : Walk on Wednesdays, walk to school campaign
- #AndSheCycles : cycle to school campaign

Future Plans

- Plant more trees and greenery on our campus
- Anti-Idling campaign to reduce NO₂ emissions



Bibliography

1. The Globe Program Health and Environment Impacts
2. The Globe Program Air Quality Model
3. EPA Website <https://www.epa.gov/no2-pollution/basic-information-about-no2>
4. <https://www.eea.europa.eu/data-and-maps/figures/nitrogen-dioxide-annual-limit-values-for-the-protection-of-human-health>
5. www.met.ie