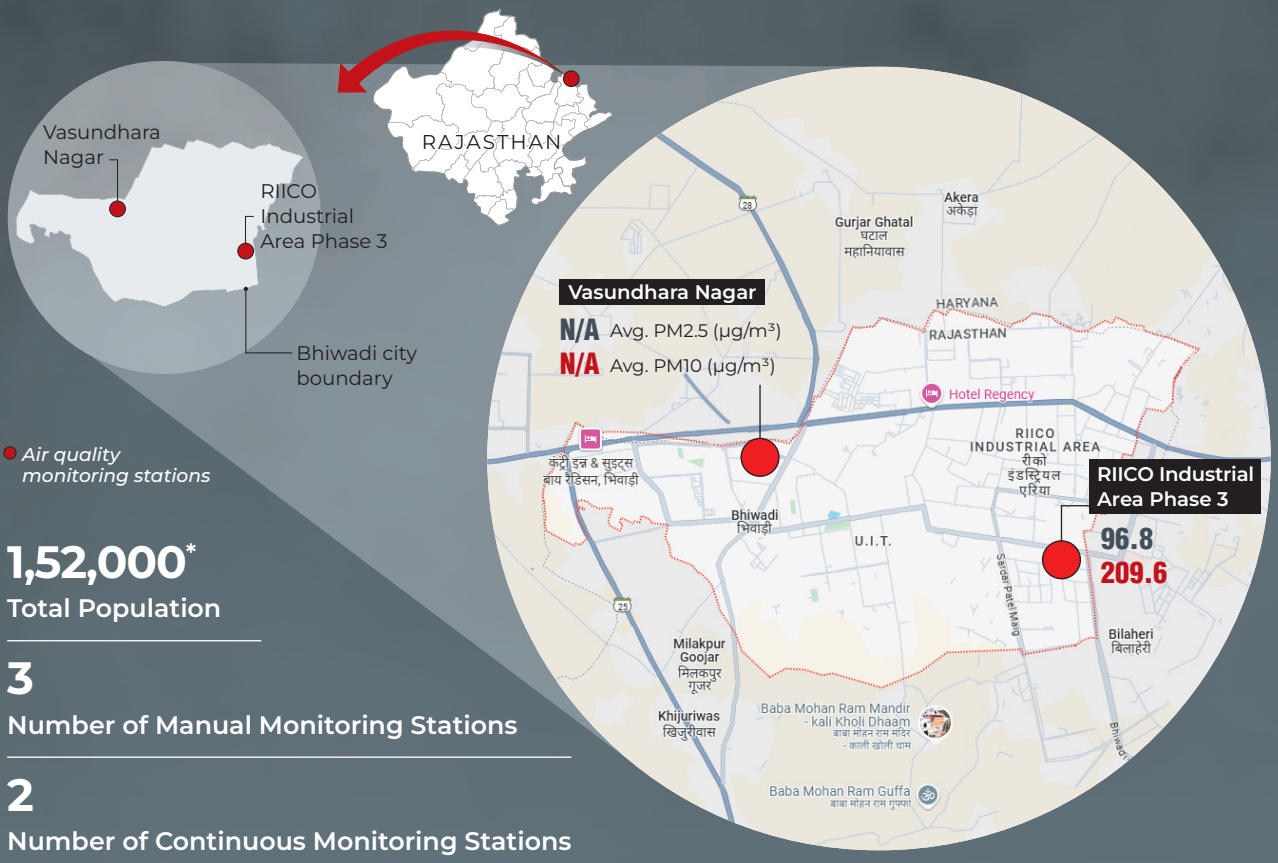

KNOW YOUR CITY AND WHAT YOU BREATHE

# BHIWADI AIR POLLUTION FACT SHEET

**The Continuous Ambient Air Quality Monitoring Stations (CAAQMS) in Bhiwadi City are located in the eastern and western parts of the city. Vasundhara Nagar Station is the latest addition, installed in 2024.**




**1,52,000***
Total Population

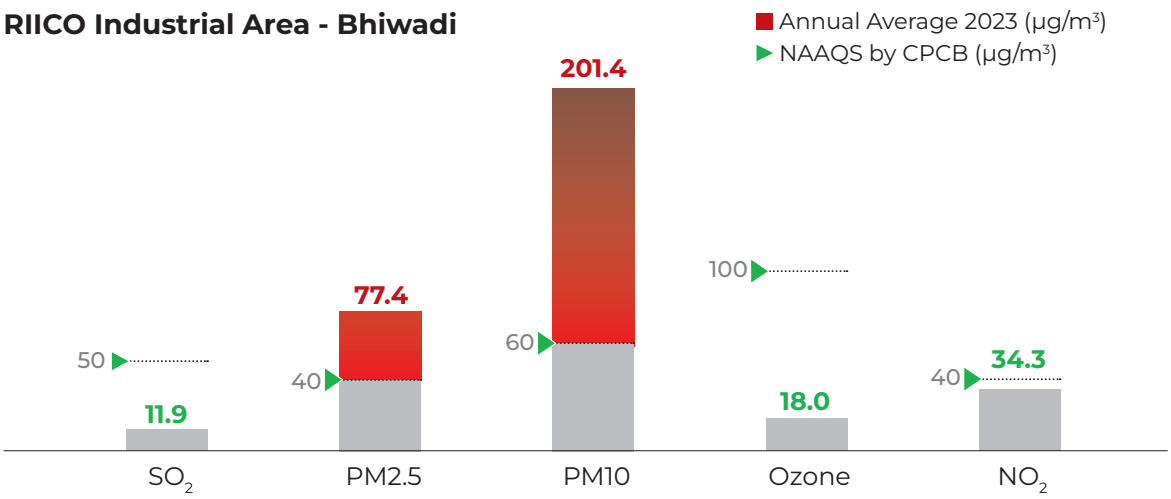
**3**
Number of Manual Monitoring Stations

**2**
Number of Continuous Monitoring Stations

** Census estimate for 2025*

# Pollutant Concentration

**RIICO Industrial Area - Bhiwadi**




Source: iFOREST Analysis

The annual average of PM2.5 concentration for 2023 was found to be 77.4 µg/m³

The same for PM10 was 201.4 µg/m³.

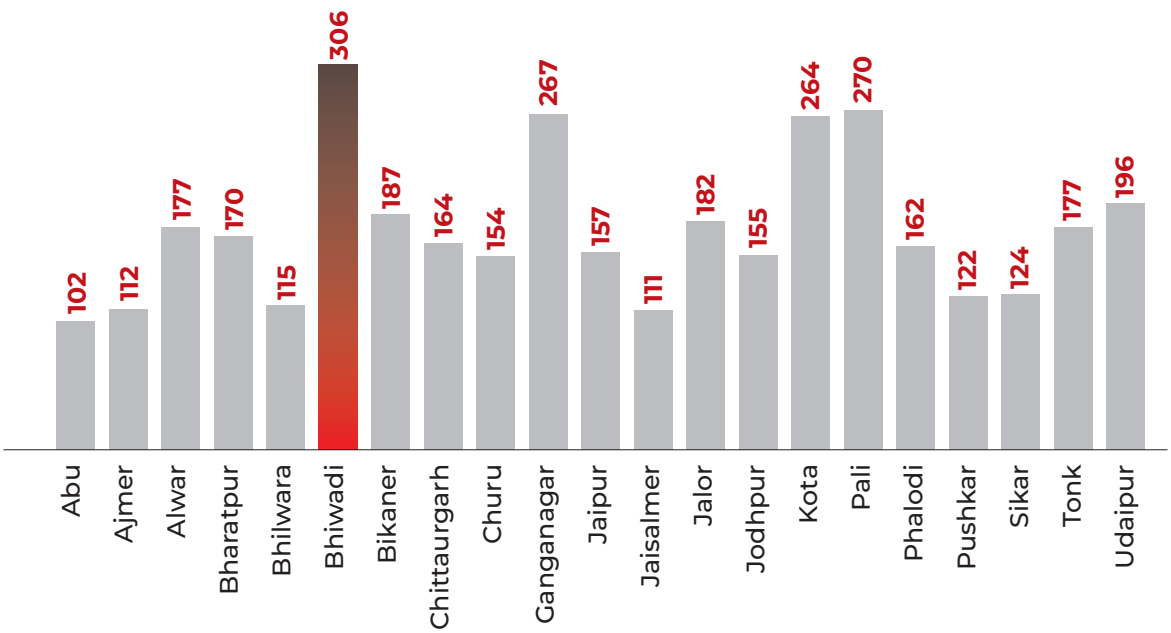
The PM2.5 concentration levels at RIICO Industrial Area, Phase 3 were around twice the permissible levels by NAAQS.

The PM10 concentration level at RIICO Industrial Area, Phase 3 was more than thrice the permissible levels by NAAQS.

# How Bhiwadi compares to other cities in Rajasthan

Of all the 21 cities in Rajasthan, where Particulate Matter 10 (PM10) is monitored, Bhiwadi city has the highest PM10. It is the most polluted city in the state.

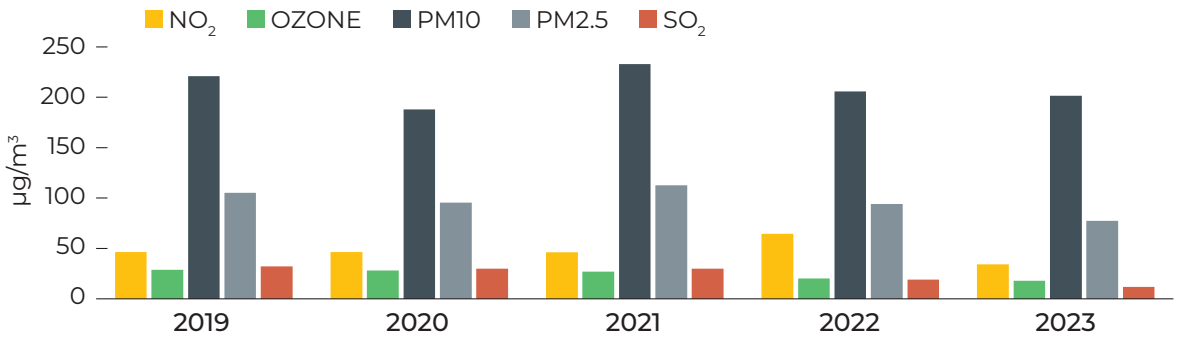
**PM10 concentration levels**



# Concentration trends

**ANNUAL**

**Average Concentration of key pollutants 2019-2023**




The avg annual **PM10** concentration has **decreased by 9%** since 2019.

The avg annual **PM2.5** concentration **decreased by 27%** since 2019.

The avg annual **$NO_2$** concentration **decreased by 26%** since 2019.

The avg annual **Ozone** Concentration **decreased by 37%** since 2019.

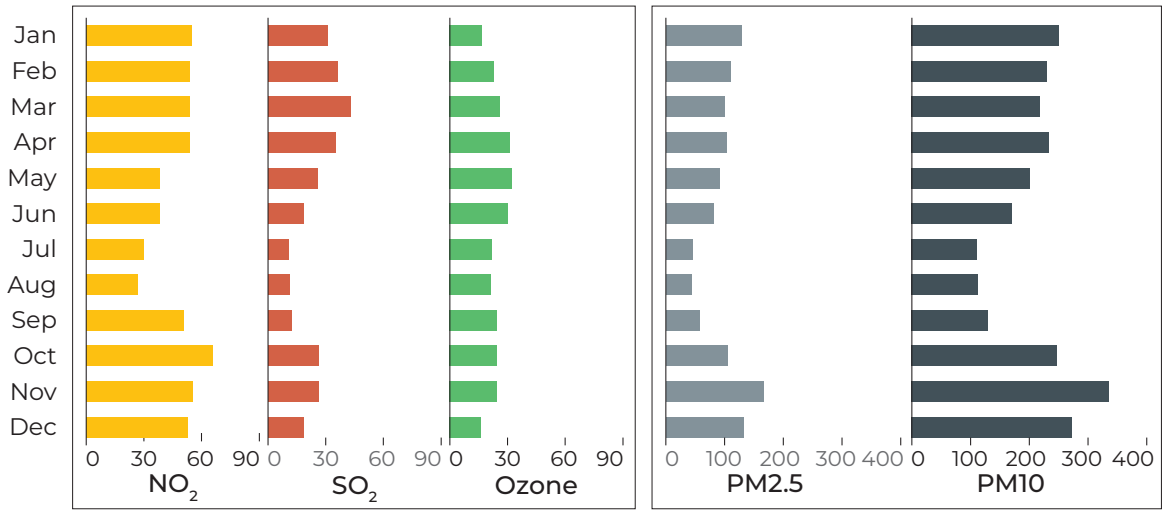
The avg annual **$SO_2$** concentration **decreased by 63%** since 2019.

**Annual PM10 and PM2.5 Trends**

| Years | PM10 | % Decrease/Increase | | PM2.5 | % Decrease/Increase | |
|---|---|---|---|---|---|---|
| 2019 | 220.9 | | | 105.3 | | |
| 2020 | 187.9 | -15% | ↓ Fall | 95.6 | -9% | ↓ Fall |
| 2021 | 232.9 | 24% | ↑ Rise | 112.6 | 18% | ↑ Rise |
| 2022 | 205.7 | -12% | ↓ Fall | 94.2 | -16% | ↓ Fall |
| 2023 | 201.4 | -2% | ↓ Fall | 77.4 | -18% | ↓ Fall |

## MONTHLY

### Average Concentration (µg/m³) of key pollutants 2019-2023



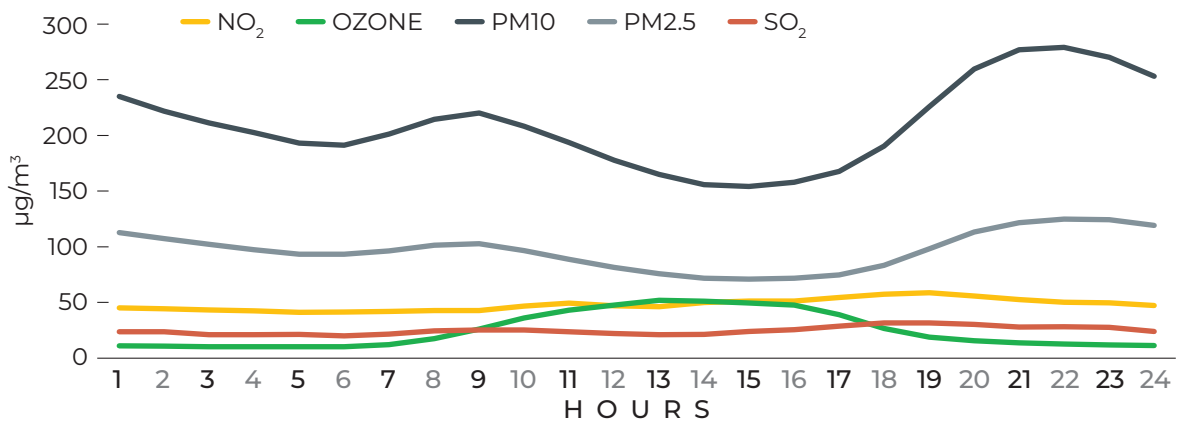

| Pollutants | $NO_2$ | $SO_2$ | Ozone | PM2.5 | PM10 |
|---|---|---|---|---|---|
| Most polluted month | October | March | May | November | November |
| Least Polluted month | August | July | December | August | July |

The PM10 and PM2.5 concentrations during monsoon months are almost 50% less compared to the rest of the year

$NO_2$ concentrations are high during the winter and summer season.

## HOURLY

### Average Concentration (µg/m³) of key pollutants 2019-2023




| | | | |
|---|---|---|---|
| **The morning and evening peaks for PM10 and PM2.5 is observed around 8 to 10am and 9 to 11PM.** | **Huge dip in both PM10 and PM2.5 is observed during noon hours around 2 to 4PM.** | **$SO_2$ and $NO_2$ hourly concentrations are found to be stable through the day except between 6 to 8 PM.** | **Ozone concentration is found to be high between 12 to 3PM.** |

**What does PM2.5/PM10 reveal?**

**The PM2.5/ PM10 value varies between 0.38 and 0.5 in the assessment years. A lower value (<0.5) indicates existence of higher PM particles.**

# Air Pollution data availability at RIICO Industrial Area, Bhiwadi

## ANNUAL AVERAGE (2019-2023)

| Years | $NO_2$ | OZONE | PM10 | PM2.5 | $SO_2$ |
|---|---|---|---|---|---|
| 2019 | 87% | 88% | 83% | 87% | 82% |
| 2020 | 89% | 91% | 87% | 88% | 77% |
| 2021 | 90% | 91% | 87% | 88% | 79% |
| 2022 | 94% | 96% | 93% | 93% | 85% |
| 2023 | 89% | 91% | 86% | 88% | 76% |

## MONTHLY AVERAGE (2019-2023)

| Months | $NO_2$ | OZONE | PM10 | PM2.5 | $SO_2$ |
|---|---|---|---|---|---|
| January | 93% | 93% | 92% | 92% | 86% |
| February | 91% | 93% | 87% | 92% | 85% |
| March | 91% | 91% | 88% | 90% | 82% |
| April | 93% | 91% | 87% | 90% | 81% |
| May | 88% | 90% | 86% | 87% | 80% |
| June | 88% | 89% | 84% | 87% | 77% |
| July | 89% | 90% | 84% | 87% | 79% |
| August | 87% | 90% | 87% | 88% | 79% |
| September | 88% | 92% | 91% | 90% | 82% |
| October | 91% | 93% | 89% | 90% | 82% |
| November | 96% | 96% | 90% | 93% | 83% |
| December | 86% | 87% | 83% | 84% | 63% |

Refer to the methodology adopted in *page 7*.

**Overall availability of yearly air pollution data from CAAQMS at RIICO Industrial Area in Bhiwadi City is in Category 'Excellent' for years 2019-2023.**

# ANNEXURE

### Context and significance of big data analytics for air pollution

- Understanding air pollution phenomena using big data analysis techniques helps support critical decision making for improving air quality
- The real time and continuous pollutant concentration data recorded by the ground air pollution monitoring stations in the city, typically known as Continuous Ambient Air Quality Monitoring Stations (CAAQMS), can be aggregated to form the big data that can be analysed to understand pollution patterns.
- CAAQMS record concentration of various pollutants at an average frequency of 15 seconds. Data recording at such short intervals of 15 seconds provides rich data for correlation with economic activities for source mapping.
- Big data regarding concentration of pollutants can also help policy makers understand the trends- Yearly, Monthly and Hourly of different pollutants in different locations and identify hot spots for suitable action.
- However, data cleaning to remove biases and poor quality data, is a critical step while using big data analysis before calculating average pollutant concentrations at every location.
- Recommendations based on this assessment can help in formulation of hyper-local action plans for the city.

### Guidelines available for Air Pollution measurements

| PM10 | PM2.5 | $NO_2$ | $SO_2$ | Ozone |
|---|---|---|---|---|

- The key pollutants, as per the CPCB guidelines, for calculation of Air Quality Index and consideration of a zone as non-attainment or polluted zone are PM10, PM2.5, $NO_2$, $SO_2$ and Ozone .
- According to CPCB, the region or location is considered as polluted or is considered as a non-attainment region, if the annual average, taken of 104 measurements, that is 2-day data for each week, 4-hour sample for gaseous and 8-hour sample for PM, exceeds the values mentioned in the National Ambient Air Quality Standards (NAAQS). The permissible level or standard for the key pollutants are:
  - PM 10 : 60 µg/$m^3$.
  - PM2.5 : 40 µg/$m^3$.
  - $NO_2$ : 40 µg/$m^3$.
  - $SO_2$ : 50 µg/$m^3$.
  - Ozone : 100 µg/$m^3$.
- According to World Health Organization (WHO), a region or a zone is considered as prone to health risks, if the Annual average concentration and 99th percentile of day's average, particularly in case of $SO_2$, exceeds the values mentioned in the guidelines. The WHO guidelines for the key pollutants are :
  - PM 10 : 15 µg/$m^3$.
  - PM2.5 : 5 µg/$m^3$.
  - $NO_2$ : 10 µg/$m^3$.
  - $SO_2$ : 40 µg/$m^3$.
- According to National Centre for Biotechnology Information PM2.5/ PM 10 ratio is an important factor in understanding the source of pollution in the region. A high PM2.5/PM10 ratio (>0.5) typically suggests that fine particles and secondary particulates such as $NO^3-$, $SO^42-$ NH4+, and organics, are major contributors. Conversely, a lower PM2.5/ PM10 ratio indicates the dominance of coarse particles.

# METHODOLOGY ADOPTED

For Continuous Ambient Air Quality Monitoring Station (CAAQMS) data to be reliable, especially in cases where pollutant concentrations and meteorological parameters like wind speed are being recorded, a robust methodology for data cleaning, aggregation, and analysis is crucial. This ensures accurate yearly, monthly, and hourly trend analysis as well as hot spot identification based on 'Good' quality data.

## Methodology

Collection of time series data ( 15 minute frequency) of pollutants recorded at different CAAQMS in the city from Central Pollution Control Board website.

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Aggregating data to form big-data of the complete city.

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Clearing out the monthly data points of pollutant, if the data recorded in any month for any year is less than 60%.

↓

Clearing out daily data points of pollutant, if the data recorded on any day is less than 60%.

↓

Data Visualisation and Analysis.

## Data Quality Based on clean data availability

| Data Availability % | Data Quality |
|---|---|
| >80% | Excellent |
| 60%-80% | Good |
| 40%-59% | Moderate |
| <40% | Poor |

Major pollutant hots pots have been identified in this factsheet on the basis of relative average annual concentration of the pollutants across locations and the guidelines specified by Central Pollution Control Board.

Cleaned data → Relative pollutant concentration analyzed by taking an average of the pollutant for available data points

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