Panvel Municipal Corporation

ENVIRONMENT STATUS REPORT
2023-2024

Prepared By
Indian Institute of Technology Bombay
Powai, Mumbai- 400076

Team Members

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List of Awards Received by PMC

❖ **City Beautification Award-2023**, by Hon. Chief Minister of Maharashtra. In the state-wide Urban Development Competition 2022, the Panvel Municipal Corporation (PMC), which falls under the D category, secured the first rank among municipal corporations in its category

iii

❖ **Majhi Vasundhara Award-2023** by Hon. Chief Minister of GOM for excellence in city environment. In the year June 2023, PMC secured the third prize in the state under the category of cities with a population of three to ten lakh. As a result, the state government awarded Rs. 5 crores to PMC for its efforts in the campaign.

❖ **Panvel Municipal Corporation has been conferred with Water + status, has a 3 Star rating.**

REPORT FOR THIRD PARTY INSPECTION OF PANVEL

Date of TPI	14-August-2023 - 18-August-2023
Applied for	WATER+
Result Status	WATER+

City Profile:

State	MAHARASHTRA
District	RAIGADH
Census Code	802796
Total Population	180020

Third Party Inspection Summary:

1. **ULB Documentation Status: PASS**
2. **Field Assessment Status: PASS**

Scoring as per WATER+ Parameters:

S.No.	Indicators	Marks Obtained	Max. Marks	To Qualify	Status
1.1	Adequate treatment capacity of STP	30	40	30	PASS
1.2	Operational Efficiency	5	10	5	PASS
2.1	Safe cleaning of Sewer and Septic tanks through mechanised equipment and availability of PPEs	20	20	15	PASS
2.2	Availability of RSA and SRU	20	20	15	PASS
3	Sufficient capacity of desludging vehicles and jetting machines for cleaning of septic tanks with soak pits and sewers respectively in the city	10	10	5	PASS
4	Safe discharge of sewage including septage from CT / PT / IHHL	50	50	35	PASS
5	Re-use of treated water	15	15	5	PASS
6.1	Municipal drains receiving sullage be well maintained	15	20	15	PASS

आज़ादी का
अमृत महोत्सव

Ministry of Housing and Urban Affairs
Government of India

GARBAGE FREE CITY
STAR RATING
★ ★ ★ ★ ★ ★ ★

Star Rating Certificate

Swachh Bharat Mission (Urban)

This is to certify that city of

PANVEL

of the State of Maharashtra has been awarded

★ ★ ★ *(Three star)*

Garbage Free City

ROOPA MISHRA
Joint Secretary & Mission Director
Swachh Bharat Mission-Urban

DURGA SHANKER MISHRA
Secretary

Forward

I am glad and feel gratified to offer Panvel Municipal Corporation's Environmental Status Report for the years 2023–2024. The Environmental Status Report showcases the efforts of the members of PMC, striving for improvements and driving the city to make it sustainable with respect to the environmental factors. The Report is developed by analyzing quantitative data, vast level of monitoring across all the environmental matrices, publicly available information, suggestions, and policy documents as noted to be applicable.

Panvel Municipal Corporation takes every effort to periodically monitor environmental matrices, dispose the generated waste, maintain roads, drainage, and sewerage systems, and enhance the all-necessary green cover by planting trees to make the system more environmentally friendly and making the city inhabitable by the ever-growing population.

In the PMC region there are numerous industries that strive to maintain environmental balance while manufacturing their products. Environmental protection and conservation have always been a collective as well as individual responsibility therefore, Panvel Municipal Corporation makes all the efforts to make the city cleaner and safer not only through collective efforts but also educating individuals to make all important impacts.

The Environmental Status Report is the result of a thorough investigation conducted by the Professors and Associates of Indian Institute of Technology, Bombay. Hence, I am confident that the Environmental Status Report would assist Panvel Municipal Corporation in making the city clean, beautiful, and healthy.

Shri. Mangesh Chitale
Hon'ble Municipal Commissioner
Panvel Municipal Corporation

Foreward

The Environmental Status Report (ESR) is not just about the fulfillment of the need for a report; rather, it is a continuous process of measurement of environmental indicators and assessment of the environmental parameters. The results are not just compiled but are analyzed with deep study and discussion, on the basis of which the Panvel City Municipal Corporation will take steps for the mitigation of identified environmental issues and strive towards better environmental management.

We consider this as one of our most important duties, and for these reasons, we conduct a very detailed and comprehensive exercise to develop this report annually. It is a matter of immense pride to be part of a team trying to develop the city in an eco-friendly manner. Through our combined efforts, we are striving to constantly improve the status of Panvel City at all levels social, environmental, or economic.

Finally, I would also like to express my appreciation and thanks to all individuals and departments for their valuable inputs to this report.

Dr. Prashant Rasal
Additional Commissioner
Panvel Municipal Corporation

Foreward

Offering the Environmental Status Report for the years 2023–2024 of Panvel City Municipal Corporation makes me happy and satisfied. The Environmental Status Report is the outcome of paradigm changes that make the city more sustainable and environmentally friendly. It is developed by analyzing quantitative data, vast level of monitoring across all the environmental matrices, publicly available information, beneficial suggestions, and policy documents as noted to be applicable.

The Panvel Municipal Corporation takes every effort to periodically monitor environmental matrices with or without the assistance of an external expert, dispose the generated waste in a systematic and compliant manner, maintain roads, manage and maintain the drainage and sewerage systems, enhance the all-necessary green cover by planting trees to make the system more environmentally friendly and making the city inhabitable by the ever-growing population.

Numerous businesses in the Panvel City Municipal Corporation area make an effort to produce their goods while preserving the environment. Both community duty and individual responsibility have been a part of environmental protection and conservation. The Indian Institute of Technology, Bombay, conducted a comprehensive examination that led to the creation of the Panvel Environmental Status Report.

The Environmental Status Report will undoubtedly help the Panvel City Municipal Corporation make their city a cleaner, more attractive, and healthier place.

Dr. Vaibhav Vidhate
Deputy Commissioner
Panvel Municipal Corporation

Acknowledgement

The development of the "Environmental Status Report for Panvel Municipal Corporation" was a wonderful experience, which the Indian Institute of Technology, Bombay (IIT Bombay) credits to Panvel Municipal Corporation (PMC) officials' for their cooperation and support.

To begin, IIT Bombay wishes to express gratitude to Shri. Mangesh Chitale, Dr. Prashant Rasal, and Dr. Vaibhav Vidhate, all Municipal Administrator officers of Panvel Municipal Corporation, for their continuous support and encouragement.

While formulating the Environmental Stats Report, IIT Bombay would like to express its gratitude to the City Engineer and all the officials of PMC, who assisted us during site visits and personal interactions to collate primary as well as secondary information.

The team would also like to thank all of the Executive Engineers of the respective departments and their team members for their assistance, as well as the Hon'ble Committee Members of the PMC for their continued cooperation.

IIT Bombay by heart acknowledges the efforts put forward by all the additional officials from various government ministries, their secretarial staff, and participants in stakeholder meetings, and persons who supplied data, timely assistance, and great cooperation.

Finally, the authors express their gratitude to everyone who helped them compile this study.

Panvel, March, 2024

Table of Contents

List of Tables

List of Figures

Abbreviation

PMC	Panvel Municipal Corporation
AAQ	Ambient Air Quality
AAQMS	Ambient Air Quality Monitoring System
AQI	Air Quality Index
BDL	Below Detectable Limit
BOD	Biological Oxygen Demand
BPMC	Bombay Provisional Municipal Corporation
CAAQM	Continuous Ambient Air Monitoring Station
CETP	Common Effluent Treatment Plant
CGWB	Central Ground Water Board
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
COPD	Chronic Obstructive Pulmonary Disease
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
dBA	Weighted Decibels
DL	Detectable Limit
DMP	Disaster Management Plan
DO	Dissolved Oxygen
DPR	Detailed Project Report
DPSIR	Driving Force Pressure State Impact Response
EC	Electrical Conductivity
ENE	East- northeast
EPIP	Export Promotion Industries Park

ESR	Environmental Status Report
MoEF&CC	
GBD	Global Burden of Disease
GC- FIS	Gas Chromatography- Flame Ionization Detection
GC-FID	Gas Chromatography- Flame Ionization Detector
GIS	Geographical Information System
GOM	Government of Maharashtra
IMD	India Meteorology Department
KLD	Kilo- liters per Day
LPCD	Liters per Capita per Day
LRI	Lower Respiratory Tract Infection
LULC	Land Use Land Cover
MCM	Million Cubic Meters
MIDC	Maharashtra Industrial Development Corporation
MJP	Maharashtra Jeevan Pradhikaran
MLD	Million Liters Per Day
MMC	Maharashtra Municipal Corporation
MMR	Mumbai Metropolitan Region
MMRDA	Mumbai Metropolitan Region Development Authority
MoEF&CC	Ministry of Environment, Forest, and Climate Change
MoHFW	Ministry of Health and Family Welfare
MPCB	Maharashtra Pollution Control Board
MPN	Most Probable Ground
MSEB	Maharashtra State Electricity Board
MSL	Mean Sea Level
MSRDC	Maharashtra State Road Development Corporation
MSRTC	Maharashtra State Road Transport Corporation

MSW	Municipal Solid Waste
MT	Metric Tons
NAAQS	National Ambient Air Quality Standards
NABL	National Accreditation Board for Test & Calibration Laboratories
NAMP	National Air Quality Monitoring Programme
NDMA	National Disaster Management Authority
NE	Northeast
NGO	Non- Government Organization
NNE	North- northeast
NOx	Oxides of Nitrogen
NRW	Non- Revenue Water
NWMP	National Water Monitoring Programme
ODF	Open Defecation Free
OECD	Organization of Economic Co-corporation and Development
PMC	Panvel Municipal Corporation
PM_{10}	Particulate Matter Below 10 micrometers Diameter
$PM_{2.5}$	Particulate Matter Below 2.5 micrometers Diameter
PPP	Public Private Partnership
PWD	Public Works Department
RDS	Respirable Dust Sampler
RSPM	Respirable Suspended Particulate Matter
RTO	Regional Transport Office
SAR	Sodium Absorption Rate
SHG	Self- Help Group
SBM	Swachh Bharat Mission
SO	Sulphur Monoxide

SoE	State of Environment Report
SPM	Suspended Particulate Matter
SSW	South- southwest
STP	Sewage Treatment Plant
SW	Southwest
SWD	Social Welfare Department
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
ULB	Urban Local Bodies
UNCED	United Nation Conference on Environment and Development
WHO	World Health Organization
WIMCO	Western Indian Match Company
WQI	Water Quality Index
WQMS	Water Quality Monitoring Station
WSW	West- southwest
WTP	Water Treatment Plant

Executive Summary

As per the Maharashtra Municipal Corporation (MMC) Act 1949, section 67(A), it is mandatory for all Urban Local Bodies (ULBs) of the state of Maharashtra to submit an annual Environmental Status Report (ESR) to the General Body on or before 31st July of every year.

The 74th Amendment to the constitution has enlarged the roles and responsibilities of municipalities, specifically citing protection of the environment and promotion of ecological aspects. Preparation of an Annual ESR is mandated in the state level legislation (the BPMC Act) following the 74th Constitutional Amendment Act and the 12th Schedule of the Constitution.

Environmental Reporting finds its roots in the Local Agenda 21 mandate that was passed in the Earth Summit of 1990 in Rio. Under this mandate, Urban Local Bodies (ULBs) are required to undertake the preparation and publication of an annual State of Environment Report (SoE) or equivalent.

The ESR indicates the city's environmental concerns, growth factors and its impacts, provides information on the environmental infrastructure including water supply, sewage management, traffic & transportation, solid waste management, biodiversity, overall environmental pollution and degradation and possible mitigation measures required, information for investment and management decisions for the ULB (Urban Local Body), assessment of various natural resources, level of pollution & its direct or indirect impact on human beings and other life forms and annual budgeting and planning exercises etc.

As per the guidelines published in June 2009 by the Department of Environment, Government of Maharashtra (GOM), the ESR has to be developed as per the DPSIR (Driving Force Pressure State Impact Response) framework. This frame-work focuses on dynamic relationship between the human activities and its impact on physical and biological processes of the ecosystem.

The ESR for the financial year (FY) 2023-24 aims to fulfill the objectives stated in the guidelines stipulated by GOM pertaining to ESR. Broadly, the purpose of this study is.

- To highlight the condition of the biophysical environment of PMC

- To analyses of trends or changes in the environment as well as identify the causes of these changes of PMC

- To assess and interpret the implications and impacts of these trends

- To check adequacy of existing environmental infrastructure of PMC

- To set process for public participation

- To redevelop action plans of PMC

- To set targets, allocate responsibilities & institute monitoring and tracking mechanisms for making Panvel city environment friendly sustainable city.

To analyses the environmental health of the Panvel area, environmental survey / on-field was conducted by SAGE to analyze the current environmental health of study area i.e., Panvel area along with reviewing the secondary data accessible from PMC, MJP, MPCB, CPCB, MIDC, MoHFW, MoEF&CC, NDMA, MSEB, Panvel Tehsil etc. The purpose of the on-field survey was to know the environmental issues and efforts of PMC in mitigating the issues and also to understand the reasonable expectations of households in developing the city sustainable and environmentally friendly.

Panvel city is divided into 20 wards. Elections are reportedly conducted in every 5-year interval. As per report released by Census India 2011, total population of PMC is 5,09,901. Out of the total population, approximately 2,71,303 are males while 2,38,598 are females. In Panvel, Male literacy is around 80.38% while female literacy rate is 72.63%. PMC has total administration over 40,478 houses to which it supplies basic amenities like water and sewerage. PMC is authorized to build roads within municipal corporation limits and impose taxes on properties coming under its jurisdiction.

The increasing population due to high growth of affordable housing, well-organized railway connectivity and enlargement of industrial activities are the main drives for increasing pollution load in and around PMC. Increasing population, urbanization & industrialization resulting in the depletion of natural resources like water & biodiversity. Enormous growth of unplanned and unorganized slums, population, urbanization & industrialization in the recent years could potentially resulting in issue like low level of tree cover, high density population, at some area narrow roads at some location.

As part of the ESR analysis of air quality, water quality & noise level was conducted and the reported analytical results were found to be within the stipulated standards which are as per MPCB online monitoring data. The scientific analysis based on GIS & satellite images captures the land use & land cover in the city & also enabled an understanding of the land cover & percentage distribution of land use. Further, analyzing the status of & few changes in biodiversity helps us understand the impact of urbanization on the environment. The ESR highlights the attempts made by PMC to: a) increase tree cover through tree plantation programs since many years; b) Suggesting the use of sewage treatment plants to produce an effluent that can be reused in the city in a useful manner; C) Initiate segregation of solid waste, processing solid waste to generate unconventional sources of fuel & energy; d) banning the usage of plastic bags, strengthen dissemination of information to reduce the usage of plastic in general, to form an environment regulation body at PMC; e) to initiate to install environment monitoring station at PMC & to enhance the participation of NGOs including SHGs in conserving environment in the city.

PMC recently received an award viz. 'Three Star Garbage Free City' under Swachh Bharat Mission. These are evident for their sincere efforts in making the city clean, beautiful & environmentally friendly. The residents in Panvel appreciated the PMC for efforts relating to solid waste management, sewage system, sanitation, disaster management & services.

1. Background of ESR

ESR is one of the forms of State of Environment Reporting (SoE). This data is analyzed to show trends of environmental pollution, impacts of growth and possible environmental action planning in the city. According to the municipal legislations, the Urban Local Bodies (ULBs) in Class I cities are required to publish an annual ESR, which will indicate the status of environment management in the city and identify the areas where mitigation measures are required to be considered.

The 74th Amendment to Constitution provides that all the Class A Cities have to publish Annual Environmental Status Report (ESR). This report is indicative of the status of environment management in the city. It also identifies the areas where mitigation measures are required to be considered. As per the Maharashtra Municipal Corporation (MMC) Act 1949, section 67(A), it is mandatory for all Urban Local Bodies (ULBs) of the state of Maharashtra to submit an annual Environmental Status Report (ESR) to General body on or before 31st July. Cities in Maharashtra have been publishing ESRs since 1997.

The ESR indicates the city's environmental concerns, growth factors and its impacts, provides information on the environmental infrastructure including water supply, sewage management, traffic & transportation, solid waste management, biodiversity, overall environmental pollution and degradation and possible mitigation measures required, information for investment and management decisions for the ULB (Urban Local Body), assessment of various natural resources, level of pollution & its direct or indirect impact on human beings and other life forms and annual budgeting and planning exercises etc.

As per the guidelines published in June 2009 by the Department of Environment, Government of Maharashtra (GOM), the ESR has to be developed as per the DPSIR (Driving Force Pressure State Impact Response) framework. This frame-work focuses on dynamic relationship between the human activities and its impact on physical and biological processes of the ecosystem.

DPSIR framework assumes a chain of causal links starting with 'driving forces' (economic sectors, human activities) through 'pressures' (emissions, waste) to 'states' (physical, chemical and

biological) and 'impacts' on ecosystems, human health and functions, eventually leading to political 'responses' (prioritization, target setting, indicators).

The ESR also includes analysis of trends or changes in the environment, analysis of the causes of these changes, assessment and interpretation of the implications and impacts of these trends, and assessment of the actual and potential societal response to environmental problems. Today, ESR studies have emerged from being solely environment oriented to encompassing, interfacing with economic and social elements. Hence, an ESR report has come to identify and capture the key driving forces that influence environmental change and policies.

The ESR for the financial year (FY) 2023-24 aims to fulfill the objectives stated in the guidelines stipulated by GOM pertaining to ESR. Broadly, the purpose of this study is;

- To highlight the condition of the biophysical environment of PMC
- To analyses of trends or changes in the environment as well as identify the causes of these changes of PMC
- To assess and interpret the implications and impacts of these trends
- To check adequacy of existing environmental infrastructure of PMC
- To set process for public participation
- To redevelop action plans of PMC
- To set Annual budgeting, planning exercises and tracking mechanisms for making Panvel city environment friendly sustainable city

2. Panvel City Profile

2.1 Background

Panvel City is known for being rich in nature, history, and culture. It is a fast-growing urban area close to Mumbai, surrounded by highways, shipping and industrial zones. Trading routes such as land and sea are the major reason for its prosperity. The routes were developed during the Mughal era and later developed by Portuguese, British and Marathas. Municipal Corporation is the governing body of the city of Panvel in Raigad district.

Panvel Municipal Council was established on August 25, 1852, as the first municipal council in India by the British. The initial notification for converting Panvel Municipal Council to Municipal Corporation came in the year 1991 but was never finalized. After rapid urbanization post-2000, Panvel Municipal Corporation was eventually upgraded to Municipal Corporation in 2016. Panvel Municipal Corporation is the first Municipal Corporation in Raigad district, 9th in the Mumbai Metropolitan Region and 27th in the state of Maharashtra. The Municipal Corporation includes 29 revenue villages of Panvel taluka, including CIDCO Nodes, Taloja, Kharghar, Kalamboli and Kamothe. As per the Census Report of 2011, Panvel city spreads over 110.06 sq.km. It has a reported population of 5.09 lakhs. It includes areas of gram panchayats, CIDCO, MIDC, Panvel Municipal Corporation and Raigad District Panchayat.

Panvel has been counted as one of the major cities in North Konkan for about seventy-eight hundred years. it is in the Raigad district of Maharashtra state and it is known as Konkan Convener situated at the headquarters of Pune-Mumbai. Panvel is also a taluka and it borders the Thane district. Panvel City, coordinates at 18°59'40"N and 73°06'50"E, is located 60 km away in the suburbs of Mumbai, the capital of the state of Maharashtra.

The corporation area comprises historic temples, mosques, churches, lakes, and the people living in the city. The city is situated on the banks of Panvel Creek, surrounded by the Matheran Hills. It is known for the forts in Raigad and Khopoli. The major historical attraction in Panvel taluka is Karnala Fort which is popular for trekking & bird watching. Panvel is also famous for the two

prominent Ganesh temples in Maharashtra: Ballaleshwar, located in Pali, and Varadavinayak in Mahad village. Beth EI Synagogue is a part of the Indian heritage & one of the tourist places in Panvel.

The surface water body in Panvel City is Taloja River & Kasrdi Dam. A major source of water supply in Panvel City is from Dehrang Dam which is across Gadeshwar Lake. The other sources of water at Panvel are from MIDC, CIDCO and Patalganga MJP and from borewell installed by PMC in Panvel. Also, in the present case, the development of Panvel city is taking place at a rapid pace and CIDCO has developed "New Panvel" which adjoins Old Panvel. Due to the development of Konkan Railway passing through Panvel upcoming Navi Mumbai International Airport near Panvel City, Shivadi-Nhava Sea Link Bridge and SEZ projects Panvel city is experiencing rapid growth and urbanization with great number of people coming in Panvel for their livelihood and employment. Panvel station is a junction of railways, and it is an entry of Mumbai. Table 2.1 gives brief information on Panvel city.

Table 2.1: Brief Information of Panvel City

Sr. No	Index	Information
1	City	Panvel
2	Municipal Ground Coverage	110.06 sq. km.
3	Population (as per 2011 census)	5.09 Lakhs
4	AMC Establishment	1st October 2016
5	Municipal Class	D
6	Election Ward	20
9	River	Kasardi, Taloje & Kalundre river
10	Nearby Dam	Dehrang dam
11	MSL	28 m
12	Location	18°59′40″N and 73°06′50″E
13	National Highways No.35	- Mumbai-Pune Expressway - Sion-Panvel Expressway - NH 4B, NH 66 start from here while NH 4

		passes through Panvel
14	Railway	• Harbour line from Mumbai CSMT • Central line from Diva / Karjat • Western Freight Corridor from JNPT • Konkan railway line from Mangalore meet at Panvel
15	Heritage	Vadale Lake, Ballaleshwar Temple, Khandeshwar Shiv temple, Beth El Synagogue

Source: PMC Website

2.2 Location

Panvel with a jurisdiction of about 110.06 sq.km. is geographically located at 18°59'40"N Latitude and 73°06'50"E Longitude at about 28 meter above mean sea level. Panvel is well connected with all the nearest cities like Mumbai & Pune. Panvel falls in the Raigad district, which approximately 40 km from Mumbai by road. Panvel Municipal Corporation is adjacent to Navi Mumbai Municipal Corporation and Thane Municipal Corporation. It scores supremely high on its road connectivity as it serves as a meeting point for multiple major highways. The Sion-Panvel Expressway is a 25 km long highway that connects Sion to Panvel via Navi Mumbai. Location of Panvel city is shown in Figure 2-1. The sanction plan of Panvel city as given in the PMC website is shown in Figure 2-2.
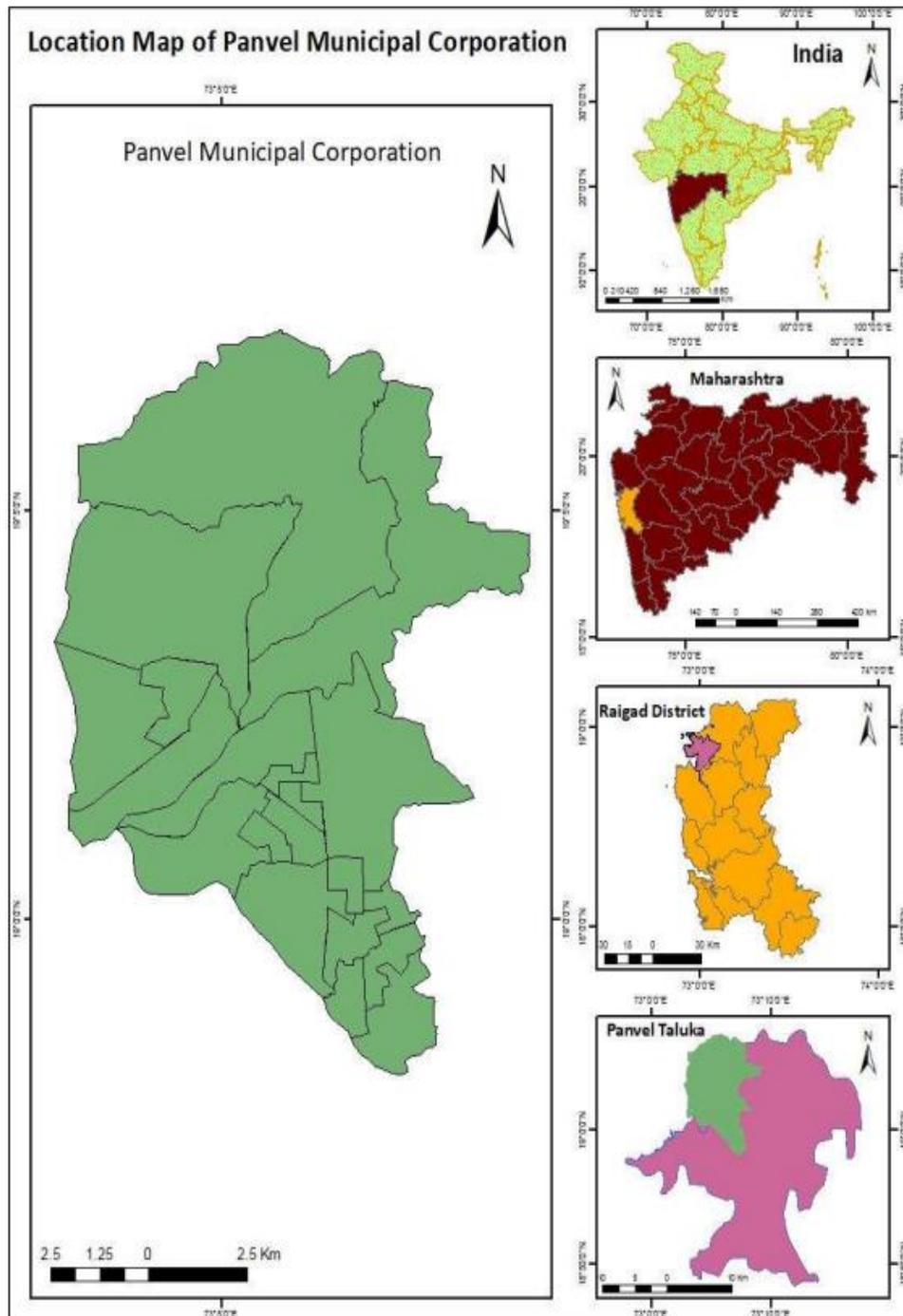
Figure 2.1: Location of Panvel City

Source: PMC Website
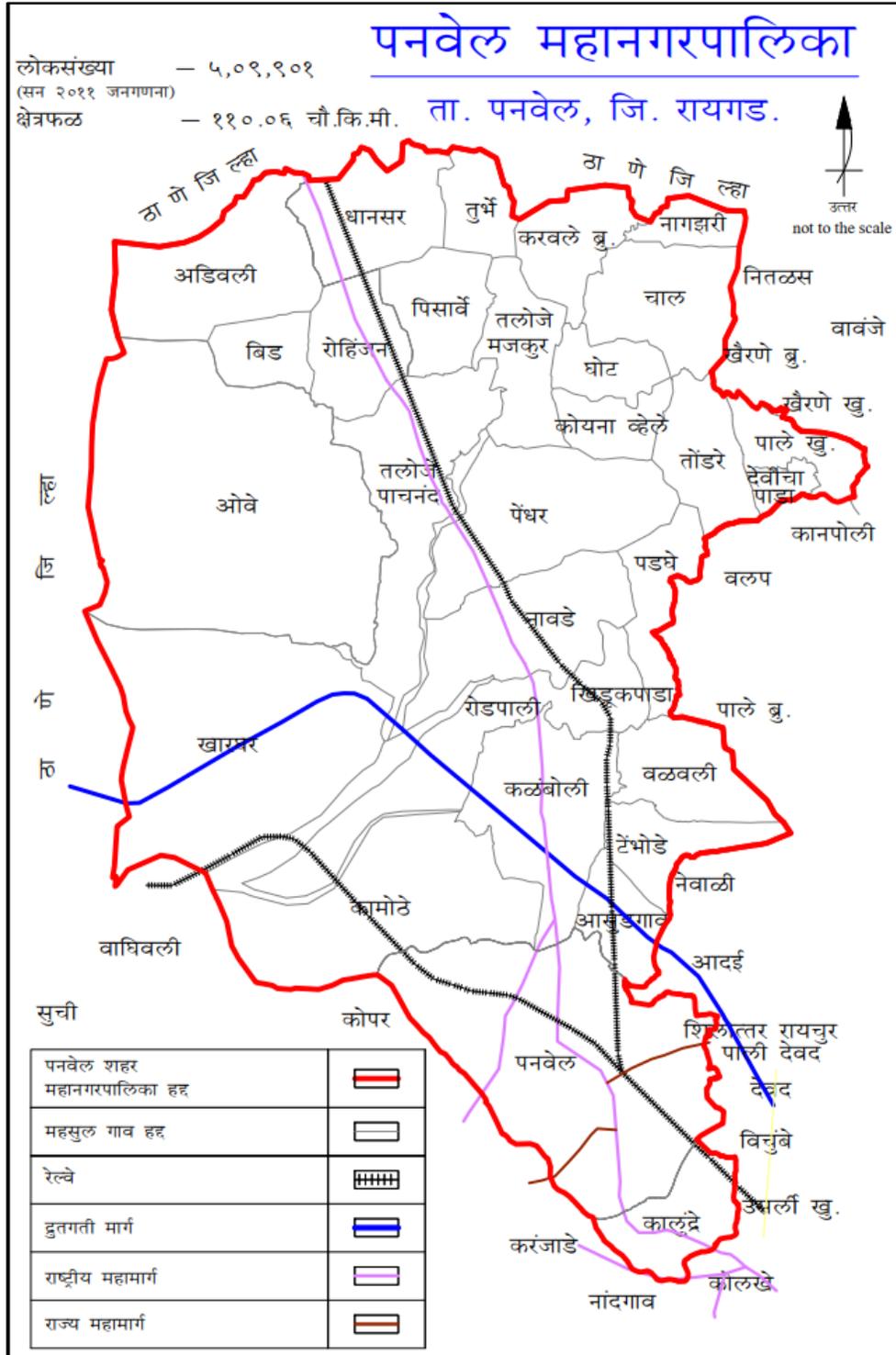
Figure 2.2: PMC Sanction Plan

Source: PMC Website

2.3   Connectivity Network

Panvel has emerged to be one of the fastest-developing cities not only in Maharashtra but in the whole of India as well. The fact that it is a neighboring city to Mumbai has led to an influx of people constantly migrating to it. These people see Panvel as the best option to not only beat the overcrowded, congested ways of Mumbai but also to tackle the paucity of land and skyrocketing rent that Mumbai is commonly infamous for. This is also one of the driving reasons why the real estate market in Panvel has boomed.

Panvel has been making quite the headlines for the upcoming Navi Mumbai International Airport. Please refer Figure 2.3 for the airport connectivity of Panvel city. Navi Mumbai International Airport will be the second international airport in MMR. It will run alongside with Chhatrapati Shivaji Maharaj International Airport (CSIA) as one of India's first urban multi-airport systems.

Figure 2.3: Navi Mumbai Airport Connectivity

Source: http://www.twenty22.in/2016/07/navi-mumbai-airport-connectivity.html

Panvel falls in the Raigad district, which lies approximately 40 km from Mumbai by road. Panvel is also very close to Navi Mumbai and Thane. It scores supremely high on its road connectivity as it serves as a meeting point for multiple major highways. The Sion Panvel Expressway is a 25 km long highway that connects Sion to Panvel via Navi Mumbai. It is undoubtedly one of the most important and busiest roads in the Mumbai Metropolitan Region (MMR). The highway is commonly used by people travelling by road from Pune, Goa and Konkan. Moreover, the Mumbai Trans Harbour Link is under construction, which would effectively connect South Mumbai to Navi Mumbai. It is a 21.8 km road bridge that will be the longest sea bridge in India on completion. It is estimated that nearly 70,000 vehicles will use the overpass every day as it will cut the travel time between Mumbai and Navi Mumbai significantly. Please refer Figure 2.4 for the road connectivity of Panvel city.
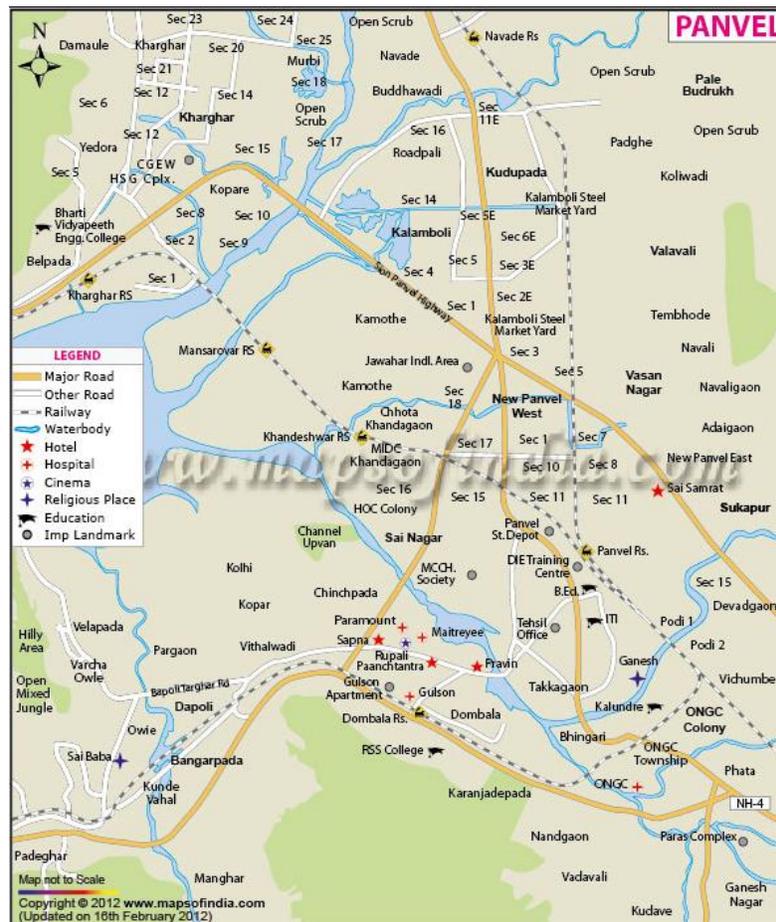
Figure 2.4: Road Connectivity to Panvel

Source: https://www.mapsofindia.com/maps/maharashtra/panvel.html

Panvel rail connectivity has become an epicenter of sorts. Panvel Railway Station functions as one of the most crucial junctions on the Central Railway. While it comes under the Mumbai Division of Central Railway, a harbour line from Mumbai CSMT, a central line from Diva / Karjat, Western Dedicated Freight Corridor from JNPT and the line from Roha, all meet at Panvel. Apart from that, under the jurisdiction of CIDCO, various railway projects are underway and are coming up with great speed. The CST–Panvel fast corridor is a proposed elevated suburban rail corridor on the Harbour Line of the Mumbai Suburban Railway wherein air-conditioned EMUs (Electrical Multiple Units) will operate. Along with that, the Panvel-Karjat railway corridor is also under construction. The proposed project would lead to greater connectivity and accentuate development in the region by connecting the far extremes of the Raigad district. Please refer Figure 2.5 for rail connectivity of Panvel city.

Figure 2.5: Panvel Railway Connectivity Map

Source: https://www.thehindu.com/news/cities/mumbai/mrvc-plans-to-bolster-vasai-panvel-corridor/article29892511.ece

2.4   Climatic Conditions

The general climatic regime is fairly equitable since seasonal fluctuations of temperature are not significant. The moderating effects of the nearby sea and fairly high relative humidity in the atmosphere have restricted the variability. According to Department of Agriculture, Government of Maharashtra, the Maharashtra state is divided into 9 Agro- climatic zones. Raigad Districts form part of the North Konkan Agro-climatic zone with the following climatic conditions:

Temperature:

The mean daily maximum and minimum temperatures are 38°C and 16°C, respectively. Humidity is 98 % in monsoon and 60 % in winter.
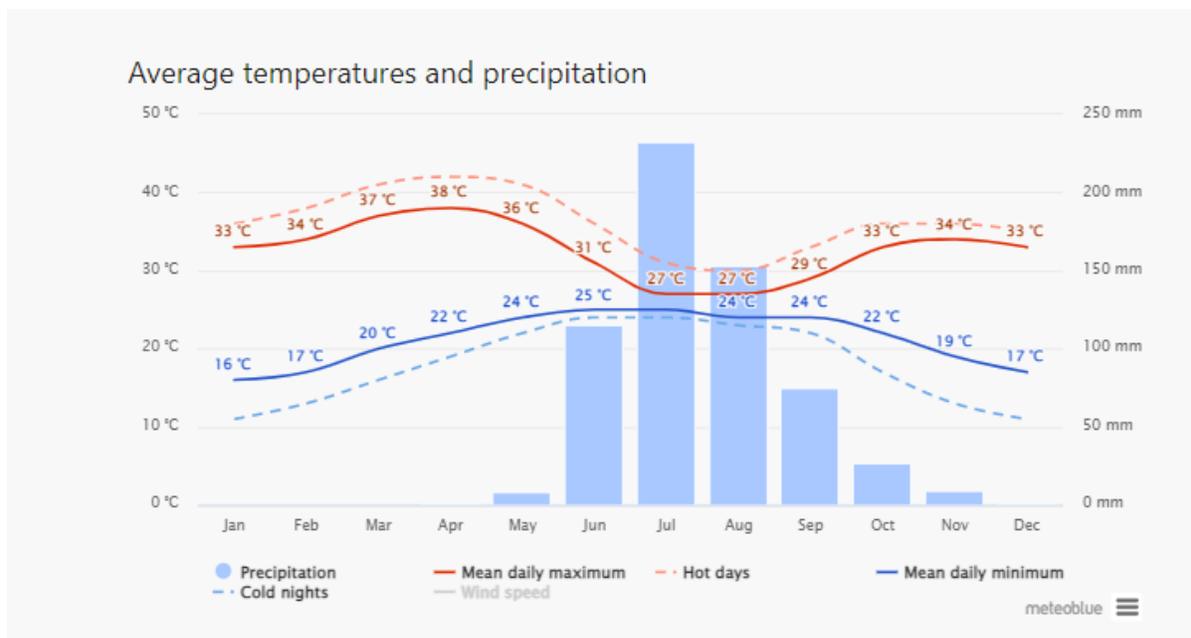
Figure 2.6: Panvel Average Temperature and Precipitation

(Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/panvel_india_1260434)

Rainfall:

The majority of the rainfall in the region is from the South–West monsoon between June and September. **The average annual rainfall is 2607 mm**. Maximum rainfall is received in the month of July.
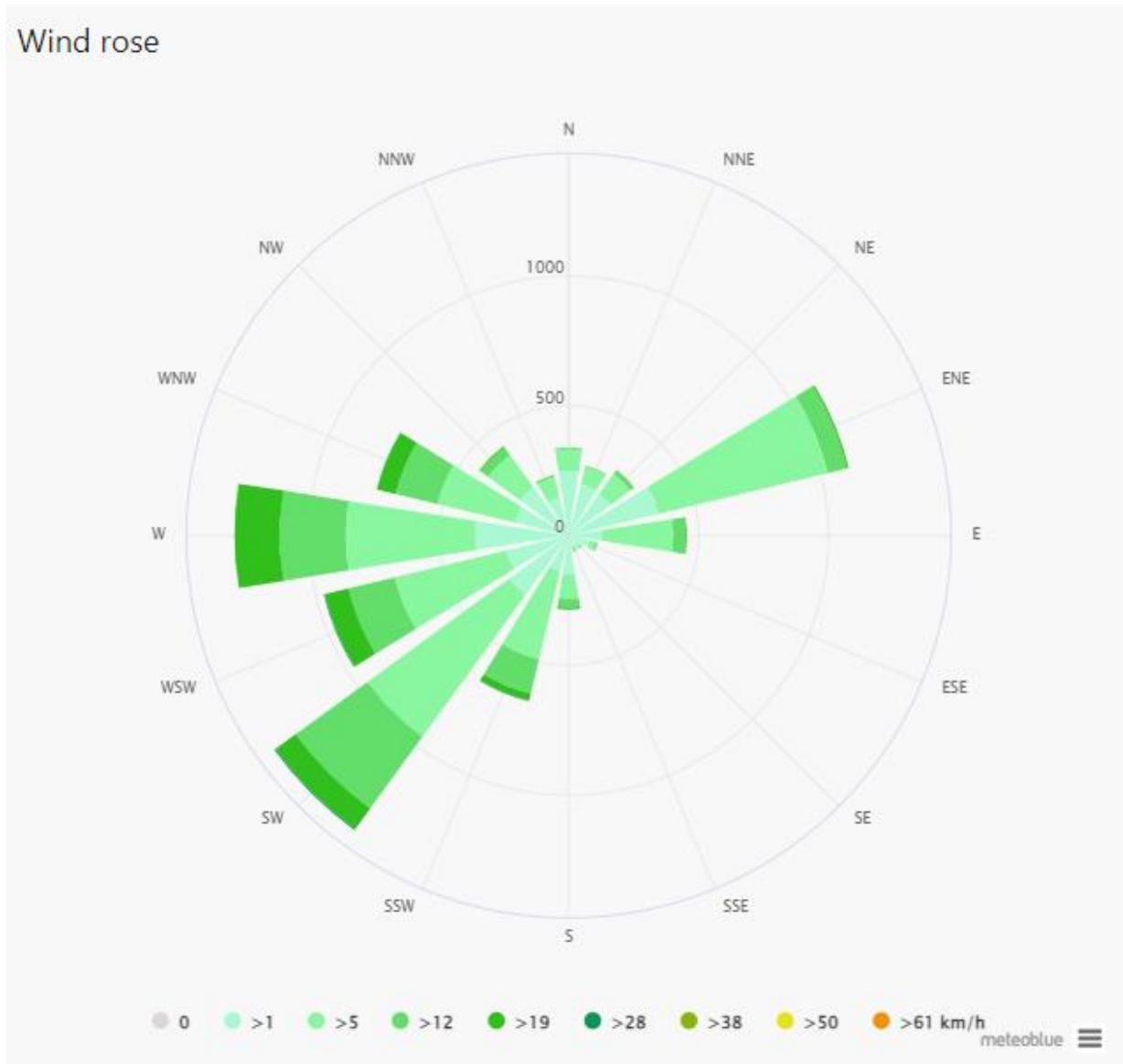
Figure 2.7: Annual Wind Rose for Panvel

(Source: https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/panvel_india_1260434)

Figure 2.7 shows the annual wind rose for Panvel. The wind rose indicates the wind-flow in hours per year in the particular direction. In Panvel, the wind blows with the speed of >1 km/hrs for around 275 hours in a year from the direction of SW to NE. Similarly, wind blows from West to East for around 350 hrs/year at the speed of > 1 km/hrs and in the direction from WSW to ENE, with the speed of 1 km/hour for around 246 hours in a year.

Land Use and Land Cover:

Panvel tehsil is in the Raigad district. The total geographical area of the Panvel tehsil covers approximately 110.6 sq.km, which is in accordance with Figure 2.8.
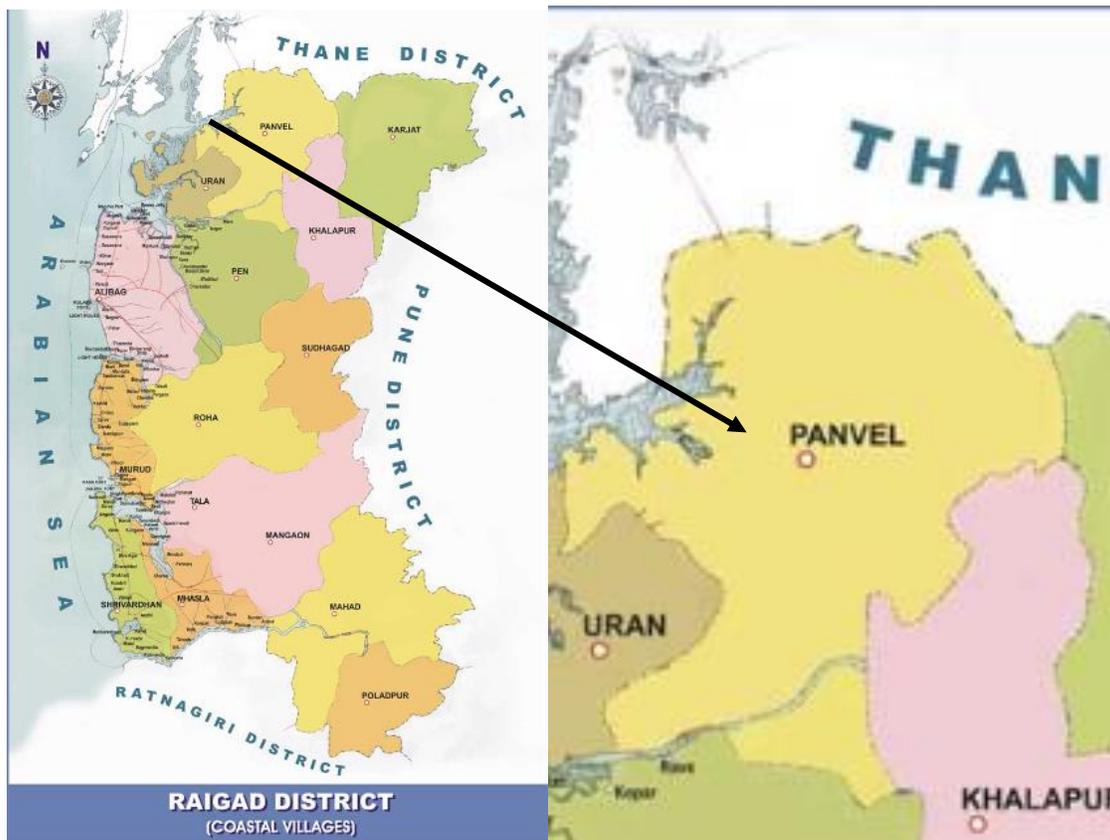
Figure 2.8: Raigad District Map and Panvel Tehsil

(Source: https://www.mapsofindia.com/maps/maharashtra/districts/raigad.htm)

Since the tehsil is in urban area the tree/green cover around the human settlements or build up area was also classified as green cover. Out of the total land cover area (110.06 m^2), as shown in Figure 2.9,

the total area under green cover class is 8.64 % (950 ha) which is followed by 61.42 % (6754 ha) as undeveloped area. This undeveloped area is classified as land which is barren and/or vacant, or under construction, etc. The agricultural area is 13.88 % (1527 ha) respectively.

Out of the total land use area (10995 ha), around 4241 ha is developed area while 6754 ha is an under developed area. Table 2.2 gives the division of land use and bifurcation of developed and under developed areas in Panvel city. Open area covers the highest percentage (around 21.03%) for undeveloped areas while for developed areas, transportation covers the highest percentage (10.49 %). Figures 2.9 and 2.10 show the bifurcation of developed and undeveloped areas graphically.

Table 2.2: Bifurcation of Developed Land Use

Sr. No.	Developed Area	Area (Ha)	Percentage (%)
1	Residential Area	1077	25
2	Commercial Area	91	2
3	Industrial Area	1010	24
4	Public & Semi -Public Use	249	6
5	Public Utilities	162	4
6	Transportation	1154	27
7	Recreational	198	5
8	Mixed Land	300	7
	Total	**4241**	100

Source: City Development Department of PMC (2022-2023)
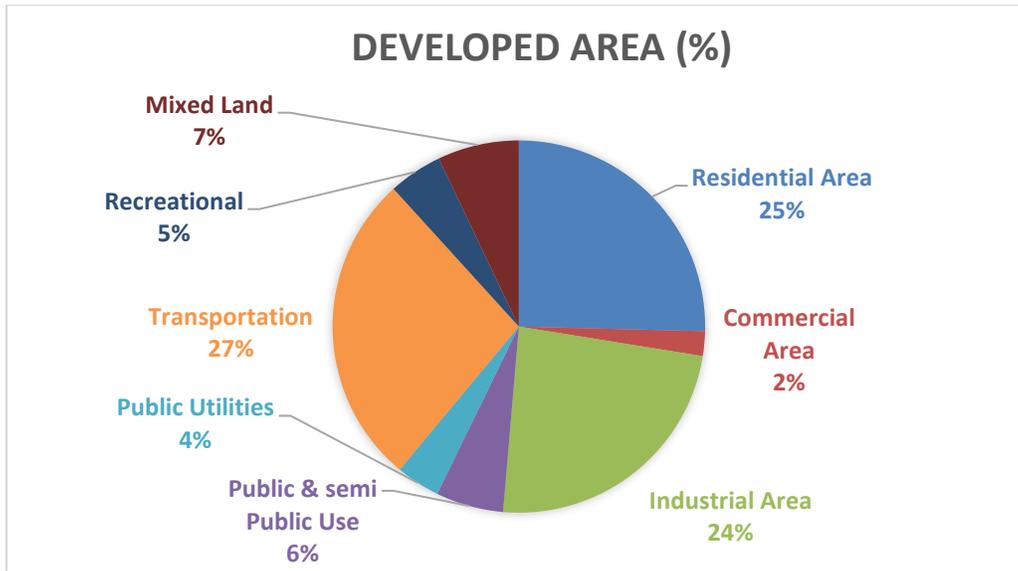
DEVELOPED AREA (%)

Figure 2.9: Bifurcation of Developed Land Use

Table 2.3: Bifurcation of Undeveloped Land Use

Sr. No.	Undeveloped Area	Area (Ha)	Percentage (%)
1	Green Cover	950	14
2	Open Area	2315	34
3	Defence	20	0.5
4	Mining Area	100	1.5
5	Rivers and Nallahs	1842	27
6	Agricultural area	1527	23
	Total	**1527**	

Source: City Development Department of PMC (2022-2023)
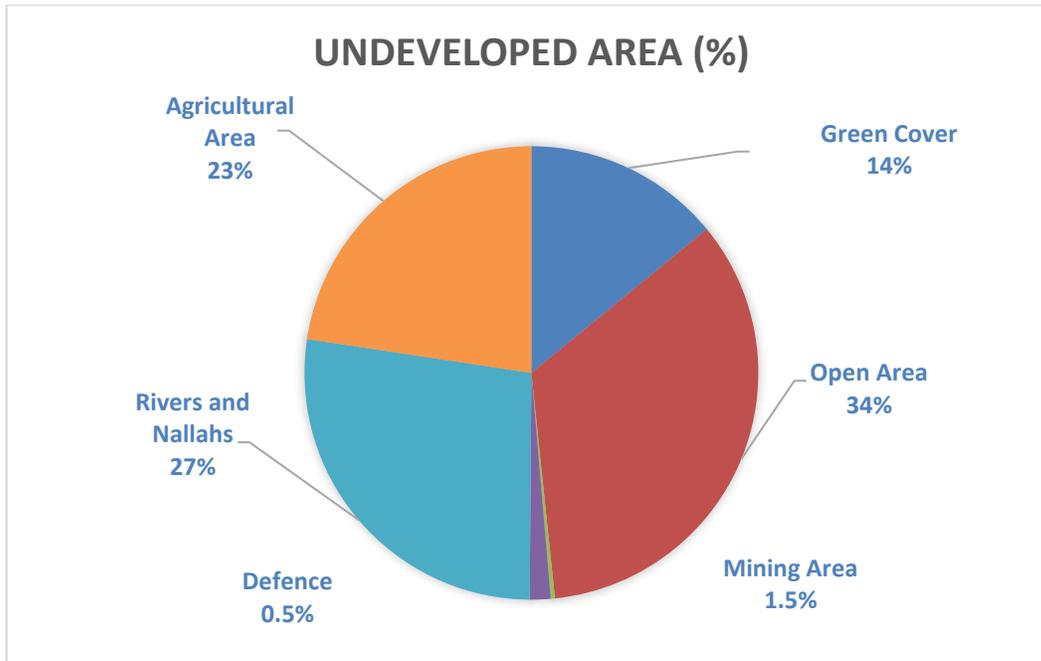
Figure 2.10: Bifurcation of Undeveloped Land Use

2.5   PMC Urban Infrastructure

PMC is comparatively less developed from the neighboring corporations. Though a slowly developing corporation, it is still a metropolitan city with all the facilities and infrastructure developing at speed. Table 2.4 gives the list of urban infrastructure facilities of PMC.

Table 2.4: Urban Infrastructure Facilities by PMC

Sr. No.	Urbanization	Planning & Design Authority	Developed by	O/M
1	**Planning & Development**	MMRDA, Local Planning Authority		
2.	**Infrastructure & Services**			
	• Water Supply	PMC/MJP/CIDCO/MIDC	PMC/MJP/CIDCO/MIDC	PMC/MJP/CIDCO

Sr. No.	Urbanization	Planning & Design Authority	Developed by	O/M
	service			
	• Sewerage service			
	• Sanitation service			
	Storm water drainage system	PMC	PMC	PMC
	• Municipal Solid Waste Management • (Collection, Disposal & Treatment)	PMC	PMC	PMC
	• Municipal roads & flyovers	PMC & Town Planning	PMC & PWD	PMC
	• Street lights facility • Fire Brigade • Municipal Gardens • Municipal Hospital • Disaster management	PMC	PMC	PMC
3	**Transportation**			

Sr. No.	Urbanization	Planning & Design Authority	Developed by	O/M
	& Traffic			
	• Urban transport facilities	MSRTC & VVMT	MSRTC & VVMT	MSRTC
	• Registration & regulations			RTO
	• Traffic Management			Traffic Police
	• Indian Railways • Mumbai Suburban Railway – Central Line	Indian Railways		
4	Metro Service	MMRDA		

Source: PMC Site

PMC   *: Panvel Municipal Corporation*

PWD   *: Public Works Department*

MMRDA   *: Mumbai Metropolitan Region Development Authority*

MSRTC   *: Maharashtra State Road Transport Corporation*

RTO   *: Regional Transport Office*

Water Supply: Dehrang Dam is the main source of water in Panvel City. A total of 16 MLD of water is lifted from the Dehrang Dam to fulfill the water demand of the PMC area and nearby villages. During summers, the level of water reduces so, only 5-6 MLD of water is available for abstraction. Panvel gets 6 MLD water from Maharashtra Industrial Development Corporation (MIDC) and 4 MLD from

Maharashtra Jeevan Pradhikaran (MJP) & rest of the demand is fulfilled by borewells constructed by PMC. Considering the current and near future water demand, the PMC need to make certain provision to meet the water demand.

Water may be treated differently in different communities depending on the quality of the source water that enters the treatment plant. The water that enters the treatment plant is either sourced from surface water or from ground water. Surface water typically requires more treatment and filtration than ground water because lakes, rivers, and streams contain more sediment (sand, clay, silt, and other soil particles), germs, chemicals, and toxins than ground water. Public drinking water systems use different water treatment methods to provide safe drinking water for their communities. Public water systems often use a series of water treatment steps that include coagulation, flocculation, sedimentation, filtration, and disinfection. The coagulation is often the first step in water treatment. During coagulation, chemicals with a positive charge are added to the water. The positive charge neutralizes the negative charge of dirt and other dissolved particles in the water. When this occurs, the particles bind with the chemicals to form slightly larger particles. Common chemicals used in this step include specific types of salts, aluminum, or iron. Flocculation follows the coagulation step. Flocculation is the gentle mixing of the water to form larger, heavier particles called flocs. Often, water treatment plants will add additional chemicals during this step to help the flocs form. Sedimentation is one of the steps water treatment plants use to separate out solids from the water which is termed as Coagulation. During coagulation, flocs settle to the bottom of the water because they are heavier than water. Once the flocs have settled to the bottom of the water, the clear water on top is filtered. During filtration, the clear water passes through filters that have different pore sizes and are made of different materials (such as sand, gravel, and charcoal). These filters remove dissolved particles and germs, such as dust, chemicals, parasites, bacteria, and viruses. Activated carbon filters also remove any bad odors. During ultrafiltration, the water goes through a filter membrane with very small pores. This filter only lets through water and other small molecules (such as salts and tiny, charged molecules). After the water is filtered, water treatment plants may add one or more chemical disinfectants (such as chlorine, chloramine, or chlorine dioxide) to kill any remaining parasites, bacteria, or viruses. To help keep water safe as it travels to homes and businesses, water treatment plants will make sure the water has low

levels of the chemical disinfectant when it leaves the treatment plant. This remaining disinfectant kill germ living in the pipes between the water treatment plant and your tap. In addition to or instead of adding chlorine, chloramine, or chlorine dioxide (as disinfectant), water treatment plants can also disinfect water using ultraviolet light. UV light and ozone work well to disinfect water in the treatment plant, but these disinfection methods do not continue killing germs as water travels through the pipes between the treatment plant and your tap and this can only be met by adding residual quantity of disinfectant in the water while they are carried using pipelines.

Source: https://www.cdc.gov/healthywater/drinking/public/water_treatment.html

2.6   PMC Education Facility

Panvel Municipal Corporation is known for quality education in with all Government and Private Infrastructure facilities available. Table 2.5 gives the list of school and College facilities of PMC.

Table 2.5 School and College facilities of PMC

Sr. No.	Name of Academic Institution	Ward No
1.	R.Z.P. School Kamothe	12
2.	R.Z.P School Jui	13
3.	R.Z.P School Navpada Kamothe	2
4.	Mansarovar Secondary Marathi Vidyalay	12
5.	Shri Siddhivinayak Secondary Marathi High School	11
6.	Shankar Rao Chavan Primary Marathi School	12
7.	St. Agrasen High School and Jr. College, Kamothe	11
8.	Shri Siddhivinayak Primary English School, Kamothe	13
9.	Sushma Patil Primary Marathi School, Kamothe	11
10.	Sushma Patil Primary English School, Kamothe	11
11.	Sushma Patil Secondary English High School, Kamothe	11
12.	Mansarovar Vidhyalav Kamothe (Marathi Medium)	12

Sr. No.	Name of Academic Institution	Ward No
13.	Shakarrao Chavan Vidyalaya, Kamothe	11
14.	Sushma Patil Secondary Marathi High School	11
15.	Shankarrao Chavan Primary English School, Kamothe	11
16.	MNR School of Excellence, Kamothe	13
17.	Mansarovar Secondary Hindi High School, Kamothe	12
18.	Mum English Primary Kamothe	11
19.	Mum Eng Madhy Kamothe	11
20.	Shankarrao Chavan Secondary English Highschool	11
21.	H B P Shree Damaji Ganpat Govari Vidyalay Kamothe	12
22.	H B P Shree Damaji Ganpat Govari Vidyalay Kamothe	12
23.	Asidhara Shaikshanik Sanstha Pri Pri & Pri.Sch	13
24.	M.A.Dattusheth Patil Primary School Marathi	12
25.	M.A.Dattusheth Patil Secondary School Marathi	12
26.	M.A.Dattusheth Patil Primary School English	12
27.	M A D P Secondary Vidyalaya Kamothe	13
28.	New English School Devichapada	2
29.	R.Z.P School Pale Khurd	2
30.	R.Z.P School Murbi	4
31.	R.Z.P School Dhamole	3
32.	R.Z.P. School Kharghar Belpada	6
33.	R.Z.P. School Kharghar	4
34.	R.Z.P. School Kopara	6
35.	Sudhagad Education Society Madhyamik Vidyalay Kopara Marathi Medium	6
36.	Gokhale Education Society's Highschool Kharghar	4
37.	Siddharth Multi.Resi. Primary Marathi School	4
38.	Siddhartha Multi. Resi Eng Pri	4

Sr. No.	Name of Academic Institution	Ward No
39.	Dnvanivot Junior College of Science and Commerce, Kharghar	4
40.	D.A.V. Inter.Sch.Kharghar	4
41.	Vishwajyot High Sch. Kharghar	4
42.	Convent Of Jesus and Mary High School and Jr. College, Kharghar	4
43.	K.P.C. Kharghar	4
44.	NEW CITY Sarswati VIDY KHARGHAR	4
45.	Apeejay School Kharghar	5
46.	R Z P School Phanaswadi	5
47.	Dnyanjyot Vidyalaya, Kharghar	4
48.	New City Sarsvati Vid M Kharghar	5
49.	New City International Kharghar Pri E	5
50.	New City International Kharghar Mady E	5
51.	Ryan International School Kharghar	4
52.	Balbharti Pub School Kharghar	4
53.	Sanjivani International Sch Kharghar	6
54.	Sidd Mlut Res School M Madhyamik	4
55.	St. Joseph's High School and Junior College of Science and Commerce,	10
56.	Sidd Multyt Per Sc Eng Mady	4
57.	Harmony Public School Primary Kharghar	5
58.	Convent of Jejus & Mary Highschool & Jr. College	5
59.	Bonny Primary School Kharghar	5
60.	Harmony International School Kharghar	5
61.	K P C Madhy Kharghar	4
62.	Harmony Public Secondary Highschool	5
63.	Gokhale Education Society's High School	5
64.	Sakshi Education Soc. B.S.J.New English	5

Sr. No.	Name of Academic Institution	Ward No
65.	Dnyanjyot Junior College of Arts, Com Science	4
66.	M.S.P.M English Primary School Kharghar	4
67.	Ryan Global School Kharghar	4
68.	Bonny Secondary School Kharghar	4
69.	Rahul Shikshan Prasarak Mandat' Latur's	4
70.	M S P M's Junior College of Arts & Com. Kharghar	4
71.	Gokhale Education Societys Primary	4
72.	New English School Medium Eng Kharghar	4
73.	Wonderland School Kharghar	5
74.	Radcliffe School Kharghar	5
75.	Almamater Public School Cbse Kharghar	4
76.	Satish Haware Divyang Centre	
77.	Shri Samarth Primary and Higher Secondary	4
78.	R.Z.P School Kalamboli	10
79.	M.E.S. Dnyanmandir, Secondary, Kalamboli.	7
80.	S.E.S.Hindi Madhymik High School	7
81.	New Mumbai English School, Kalamboli	7
82.	S.E.S. Hindi Pri Sch Kalamboli	9
83.	S.E.S.Primary Marathi School Kalamboli	9
84.	New English School Secondary English	8
85.	New English School Primary English Kalamboli	8
86.	M.E.S.Dnyanmandir Primary Marathi Kalamboli	8
87.	Pre Pri & Sec Sch Kalamboli	8
88.	S E S Urdu Pramary School Kalamboli	9
89.	Smt B. N. Patil Education and Research Society's Prayesh Marathi and English	8
90.	Sm B N Patil School & Resarch Soc. Prayesh Pri (Marathi)	8

Sr. No.	Name of Academic Institution	Ward No
91.	Madhyamik Vidhylay Kalamboli	9
92.	Sm B N Patil School & Resarch Soc. Prayesh Sec English	8
93.	Sm B N Patil School & Resarch Soc. Prayesh Sec (Secondary)	8
94.	R.Z.P School Valavali	9
95.	R.Z.P School Asudgaon	9
96.	R.Z.P School Tembhode	9
97.	P.M.C. Saraswati Vidyamandir 1	19
98.	P.M.C.Primary School No 2	19
99.	P.M.C.Primary School No 3	19
100.	P.M.C.Koleshwar Vidyamandir No 4	19
101.	P.M.C.Primary Mothe Khande 5	14
102.	P.M.C. Primary Dhakate Khande No 6	14
103.	P.M.C.Pri School Takka Marathi No 7	17
104.	P.M.C. Primary School Podi No 8	17
105.	P.M.C. Primary School Gujrati No 9	19
106.	P.M.C.Primary School Panvel Urdu No 10	18
107.	P.M.C.Primary School Takka Urdu No 11	17
108.	K E.S. Eng. Madh. Pri. School	18
109.	K F S Dattusheth Patil Primary Marathi School	18
110.	The Eng. High School Panvel	19
111.	S.E.S. Pri. Barns School Eng.	19
112.	S E.S Madhyamik Barns Sch. Eng	19
113.	Mahatma Acd & Spo.Marathi School Khanda Colony	15
114.	Mahat Sch Of Madhya. Eng. Panvel	15
115.	K F S K V Panvel Madhy. Marathi	18
116.	M. E. S. Adyakrantiveer Vasudeo Balwant Phadke Vidyalaya New Panvel English	18

Sr. No.	Name of Academic Institution	Ward No
	Medium	
117.	V.K. High School And Jr.College, Panvel	18
118.	Seth Laxmidas Bhaskar High'school Panvel	17
119.	C K Thakur Vidya. Madha. Marathi	16
120.	Yakub Beg Urdu Pri Sch Panvel	18
121.	N.E.S.Market Yard, Panvel	19
122.	K E S Indubai a Wajekar English Medium Secondary School, Panvel.	18
123.	St Joseph Highschool Khanda Colony	16
124.	Shri S. Saibaba Pri Vidy.New Panvel	16
125.	A V B P Vidy Sec E New Panvel	16
126.	The Eng Sch Mady Eng	19
127.	Oxford English Medium School Khanda Colony	16
128.	R C Of Panvel 1 T C T Hi Sch Panvel	19
129.	Huda Eng Sch Panvel	20
130.	Dew Drops Pri Sch Panvel	17
131.	Emmanual Mission Sch Panvel	18
132.	St. Thomas Academy of Education	19
133.	Mahatma Phule A.S.C. College Panvel	
134.	Mahatma International (CBSE)School Khanda	16
135.	Dr. Pillai Golbal Academy, New Panvel	17
136.	People and Parents Ass.Minority English School, Panvel	17
137.	Minority Urdu Girls Highschool Panvel	18
138.	Panvel Little Birds	18
139.	P S English School Panvel	19
140.	R.Z.P. School Koyana Wele	2
141.	P.J Mhatre Vidya Navade	2

Sr. No.	Name of Academic Institution	Ward No
142.	R.Z.P. School Rodpali	10
143.	R.Z.P. School Pendhar	1
144.	M.B.M Golden School Pendhar	1
145.	R.Z.P. School Tondare	2
146.	D.A.P. Public School Tondare	2
147.	R.Z.P. School Padghe	1
148.	R.Z.P School Khidukpada	9
149.	Hiranandani School	4
150.	R.Z.P. School Ghot Chal	1
151.	Shri Sadguru Vamanababa Madhyamik Vidyalay Ghot	1
152.	R.Z.P School Taloje Majkur	1
153.	R.Z.P. School Pisarve	1
154.	R.Z.P. School Rohinjan	1
155.	Ch.Shivaji Vidyalay Rohinjan	1
156.	R.Z.P School Pethali	3
157.	R.Z.P. School Ove Navin	3
158.	R.Z.P School Ranjanpada	3
159.	R.Z.P School Ovepeth Marathi	3
160.	J.B.S.P. New English School Owepeth Kharghar	3
161.	R.Z.P School Taloje Pachnand	3
162.	National Urdu High School Taloja	3
163.	R.Z.P Sch Inampuri	3
164.	National Urdu High Sch Pri Taloja	3
165.	B.K.Patil Jr College Cidco Colony Taloja Pachnand	3
166.	The Elite Public School Taloja (Primary)	3
167.	Rahul Shikshan Prasarak Mandal's Ajanta Internation (English Primary)	3

Sr. No.	Name of Academic Institution	Ward No
168.	Rahul Shikshan Prasarak Mandal's Ajanta Internation (English Secondary)	3
169.	Rahul Shikshan Prasarak Mandal's Dr.G.K.Dongargao Hindi	3
170.	The Elite Public School Taloja Cbse	3
171.	The Elite Public School and Jr. College Taloja.	3
172.	Kalsekar English Medum School	14
173.	ARQAM English School Taloja	3
174.	Laxmi Public School	5
175.	Vibgyor High School, Kharghar	4
176.	Greenfingers Global School, Kharghar	4
177.	New Horizon Public School & Penguin Kids, Khanda Colony	15
178.	MES AK Vasudeo Balwant Phadke Vidyalay, Panvel	
179.	Yakub Baig High School and Junior College Panvel	18
180.	Vishwajyot High School	4
181.	Dav Public School	15
182.	K E S Indubai a Wajekat English Medium Primary School Panvel	18
183.	New Horizon Public School	15
184.	Rotary Special School for Hearing Impaired Children, New Panvel	15
185.	Rao Junior College of Science Kharghar	4
186.	KPC English High School and Jr College	4
187.	Late. Namdevbuva Khutarika School Taloje Pachand	3
188.	Carmel Convent High School	8
189.	Mspm's English High School, Kharghar	4
190.	Kendriya Vidyalaya ONGC Colony, Panvel	20
191.	Changu Kana Thakur Arts Commerce and Science College New Panvel	17
192.	Mahatma Phule Arts, Commerce and Science	15
193.	Pillai College Of Arts, Commerce and Science	17

Sr. No.	Name of Academic Institution	Ward No
194.	Shikshan Maharshi Dadasaheb Limaye College	17
195.	Govt. Of Maharashtra's Govt. College of Education (CTE), Panvel	17
196.	Adarsh Shikshan Prasrak Mandal's D.D Vispute College of Education, Plot No. 41	17
197.	B.P Marine Academy Nautical Science, Panvel, Raigad-410206	14
198.	Balasaheb Thackeray Law College Taloja Navi Mumbai	3
199.	Bhagubai Changu Thakur College of Law, New Panvel	15
200.	Modern Shikshan Prasarak Mandal Junior College of Art And Commerce	17
201.	ITM Institute of Hotal Management, Kharghar (E), Navi Mumbai-10	5
202.	Kamalgauri Hiru Patil Shikshan Sanstha Sadguru Vamanbaba Commerce & Science College Taloje Raigad	2
203.	Karnala Sports Academy's KSA's Barns College of Arts, Science & Commerce, At Plot No.7, Sector 16	14
204.	Karnataka Lingayat Education Society's KLE College Of Law	10
205.	Kle Society Science & Commerce College, Kalamboli, Navi Mumbai	10
206.	Mahatma Gandhi Mission's College of Education & Reserch	15
207.	Mahatma Gandhi Mission's College of Commerce, Kamothe, Navi Mumbai	12
208.	Mahatma Gandhi Mission's College of Science, Kamothe, Sector 18, Navi Munbai-410209	12
209.	National Institute for The Mentally Handicapped Regional Centre (NIMH RC), Navi Mumbai	5
210.	Navi Mumbai College Balgandhrva Sukapur, Panvel	17
211.	Rahul Shikshan Prasarak Mandal's Satyagraha Mahavidyalaya, At Supparak Bhavan	4
212.	Ramsheth Thakur College of Commerce & Science	3
213.	RSPM's Satyagraha College of Education	4
214.	Shri.D.D. Vispute Collge of Science, Commerce & Management	17
215.	Mahatma Education Society's Vidyabhiraj College Of Phy.Edu.Panvel	15

Sr. No.	Name of Academic Institution	Ward No
216.	Jananta Shikshan Prasarak Mandal Women's College of Education, Kharbghar	4
217.	A.D. Mhatre High School & Jr. College	2
218.	Agri Shikshan Sansth's Higher Secondary School, Panvel	15
219.	B.K. Patil Junior College, Taloja	3
220.	Barns Junior College, Panvel	14
221.	Changu Kana Thakur Secondary & Higher Secondary Vidyalaya,New Panvel	17
222.	Convent Of Jesus and Mary High School and Jr College, Kharghar	3
223.	D G Tatkare Junior College, Kalamboli	10
224.	Dnyanjyot Junior College of Arts, Com, Sci, Near Abms Hospital, Kharghar	4
225.	Gokhle Education Society's Jr College of Science	12
226.	H.B.P. Shree Damaji Ganpat Gowari Vidyalaya & Jr College, Kamothe	5
227.	K.E.S. K.V. Kanya Vidyalaya & Jr. College, Panvel	14
228.	K.E.S. V.K. High School & Jr.College, Panvel	14
229.	Khimji Palan Chheda Junior College of Science & Commerece, Kharghar	10
230.	Loknete Ramsheth Thakur English Medium School & Jr College, Kamothe	5
231.	M S P M's Junior College of Arts & Commerece, Kharghar	12
232.	Mahatma Education Society's High School & Jr. College, Khanda Colony, New Panvel	5
233.	Maji Amdar Dattushet Patil Junior College, Kamothe	15
234.	Mansarovar Vidyalaya And Junior College	12
235.	New City International School & Jr College, Kharghar	4
236.	P.E.S. English School & Junior College, Panvel	14
237.	Prayesh Marathi & English Jr College, Sector 9, Kalamboli	10
238.	Ramsheth Thakur Higher Secondary Vidyalaya Kharghar	4
239.	Rao Junior College of Science, Kharghar, Navi Mumbai	5
240.	S.E.S Secondary & Higher Secondary School Kalamboli	10

Sr. No.	Name of Academic Institution	Ward No
241.	S.E.S Banthiya Mady N N Paliwala Jr College New Panvel	17
242.	S.S.H School &Jr College Kamothe	12
243.	Sanjivani Junior College, Kharghar	6
244.	Satyagraha Junior College, Kharghar	4
245.	Shankarrao Chavan Vidyalaya & Jr College, Kamothe	11
246.	St Agrase High School Jr College	12
247.	St. Joseph High School & Jr College, Kalamboli	8
248.	Sunrise Global School & Jr College	9
249.	Sushma Patil Secondary and Junior College Kamothe	12
250.	The Elite Public School & Jr College, Taloja	8
251.	Yakub Baig High School & Jr College, Panvel	14
252.	Yashwant Memorial Trustsymt Junior College of Vocational Education, Panvel	14

3. Driving Forces of Panvel City

3.1 Driving Forces, Pressure, State, Impact, Responses (DPSIR) Framework

This framework was initially developed by the Organization for Economic Co-operation and Development (OECD), 1994 and has been used extensively by various national/international environmental agencies to relate effects of human activities on the state of environment. The DPSIR framework can be used as an analytical framework for assessing the environmental issues by examining inter-linkages between each of these elements of DPSIR. Refer Figure 3.1 below which shows the DPSIR framework.

It is the most effective form of conveying environmental status to the citizens and government authorities. This framework helps policy/decision makers in getting ground level/real time feedback about the impacts of various pressures on the states thereby helping prepare a forward action plan necessary for implementation of any future changes in policies useful for mitigating environmental issues.
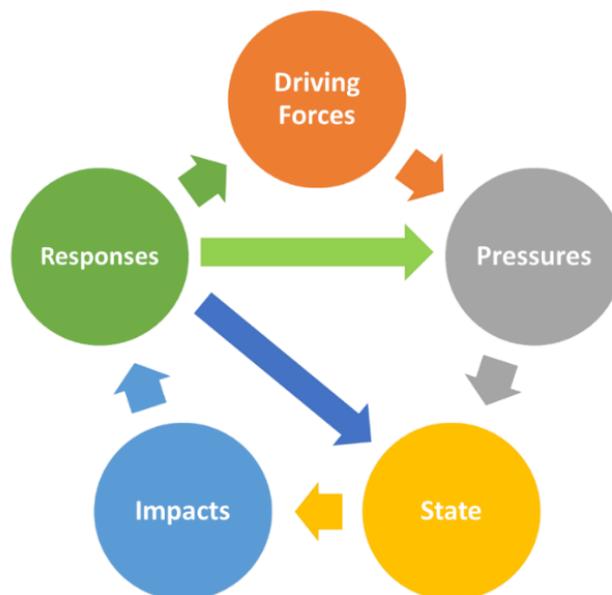
Figure 3.1: DPSIR Framework

Driving Forces: *Socio-economic and socio-cultural forces driving human activities which increase or mitigate pressures on the environment*

Pressures: *Stresses that human activities place on the environment (e.g. Wastewater)*

State of the Environment (SoE): *The condition of the environment (e.g. Air or water quality assessment)*

Impacts: *Effects of environmental degradation (e.g., biodiversity loss, economic damage)*

Responses: *Responses by society to the environmental situation (e.g. Cleaner production, regulations)*

The state of the environment is represented by the qualitative and quantitative indicators of environmental resources as well as the quality of services it offers. Environmental monitoring data for air and water quality, and the extent of land contamination are some typical quantitative indicators.

Environment is being degraded due to human intervention like shifting cultivation, over exploitation of forest resources, cattle grazing and changes in land use by converting forests to agricultural lands, urbanization and dwelling sites. These activities have been continuing ever since man started cultivation and exploiting the natural resources for livelihood. The local urban bodies suffer from large human intervention in managing increasing demand for resources that generates pressure on environment and also attempt to conserve and protect the environment with its efforts in creating more environmental resources. Human intervention creates pressure on land and land cover in urban spaces. And hence it becomes imminent to understand the status of land use and resource extraction and evaluate its impact on environment.

3.2   Driving Forces of Panvel City

Urbanization refers to the growth in towns and cities. The process of urbanization is one of the most important dimensions of economic, social and physical change. Although it provides opportunities for job, better housing, education, knowledge, and technology etc. it also exerts enormous stress on natural resources. The growth of the industries results in expansion of the business sector and economic growth of the city, which in turn attracts the inflow of population from other towns, villages, thus setting a continuous and ever-expanding cycle. Thus, population, industrial, economic and spatial growths act as primary driving forces in the growth of any city. Similarly, availability of resources like

Air, water, and land act as key factors in the growth of cities. All these factors have been analyzed in the separate sections for their status, the—Pressures being exerted on them, impact of various urban activities on these resources and the response taken by PMC to reduce the impacts.

3.3   Population Growth

The size of the population is one of the main factors that impact the environment by generating pressure on environmental resources available in a region. Natural resources like land and water are scarce and they are to be used efficiently and sustainably. These resources get exhausted as a large population makes use of them unsustainably. Hence there is some threshold level of population that can sustain the use of environmental resources. An area's carrying capacity can be defined as the maximum number of people that the environment of that area can support through optimum utilization of the available resources (ILPWRM, 2012). Perhaps this carrying capacity is crossed in many regions globally, increasing the pressure on the environment, resulting caused environmental degradation. Crutzen (2016) introduced the concept of Anthropocene Epoch which describes human influence on the environment. Hence one has to contextualize the population and its impact on the environment.

According to the ESR Report of the FY 2022-2023, the total numbers of households residing in Panvel city are 3,43,618 which accounts total population of 5,09,901 of which 2,61,987 are male and 2,47,914 are female. The details are given in the Tables 3.1 The PMC is administratively divided into 20 wards. Figure 3.2 below which shows the Panvel Municipal Corporation Ward Map
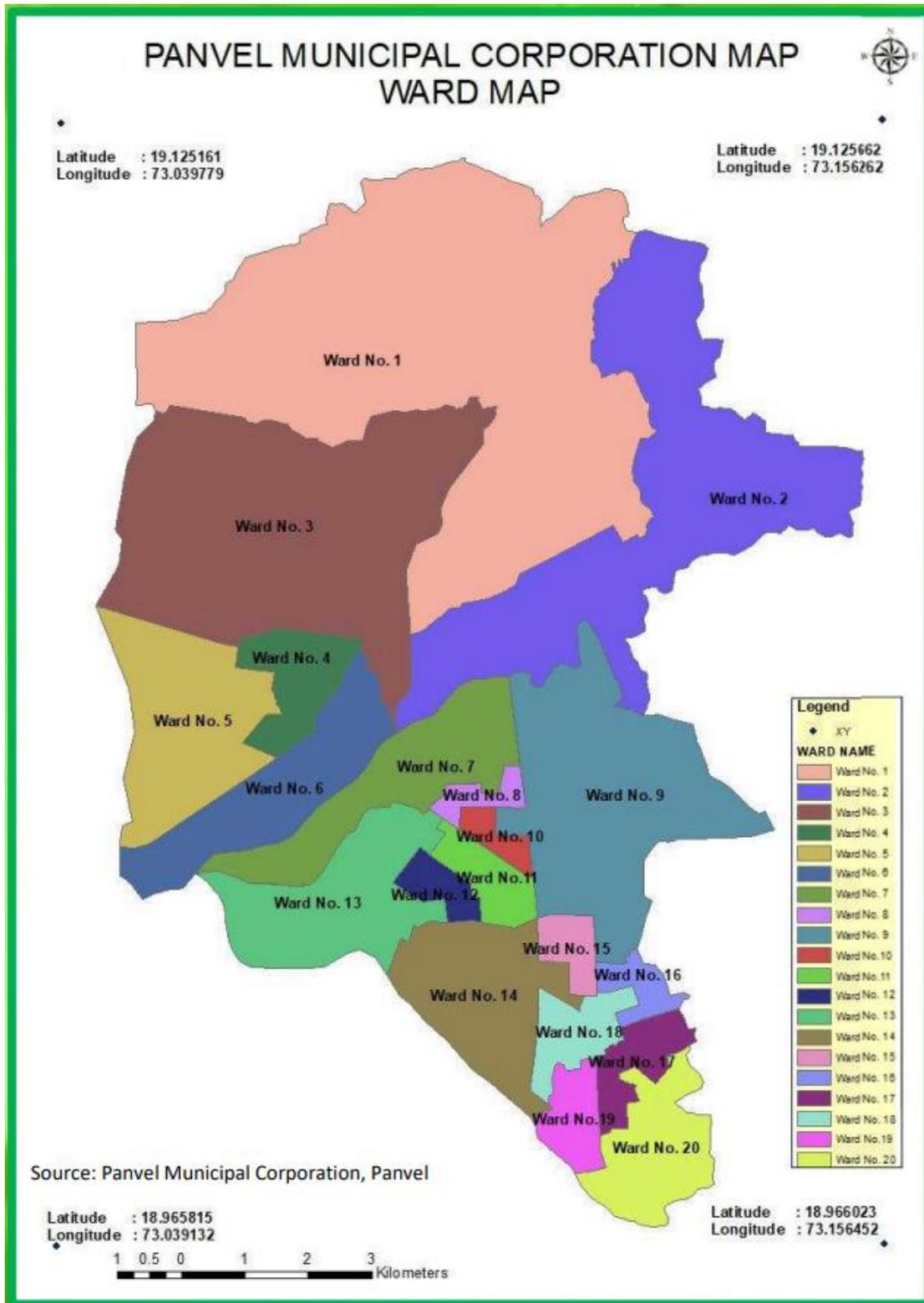
Figure 3.2 Panvel Municipal Corporation Ward Map

Table 3.1: Ward-wise Classification of Concentration of Population in Panvel City

Sr. No.	Size of Population	Wards	Population density
1	Up to 25,000	3,6,7,8,10,11,13,18,20	Low
2	25,001-30,000	1,2,4,5,9,12,14,15,16,17,19	High

Source: Election Department, PMC

Table 3.2: Ward- Wise Total and Percentage Population in Panvel City

Ward No.	Population	Percentage to Total Population	Ward No.	Population	Percentage to Total Population
1	26237	5.15	11	18523	3.63
2	25847	5.07	12	26154	5.13
3	24064	4.72	13	24989	4.90
4	28415	5.57	14	28308	5.55
5	28530	5.60	15	27526	5.40
6	23667	4.64	16	28239	5.54
7	23995	4.71	17	28510	5.59
8	23727	4.65	18	24380	4.78
9	28102	5.51	19	25483	5.00
10	23805	4.67	20	21400	4.20
Total Population & Percentage				5,09,901	100

Source: Election Department, PMC

As per the Tables above, relatively low population density was observed in 9 wards (#: 3,6,7,8,10,11,13,18,20) with population up to 25,000. High population density was observed in 11 wards, with a population density in the range of 25,001- 30,000.

It has a total SC population of 37,923, and that of ST is 12,727. It is important to note that all the wards of PMC have some population belonging of SC and ST as shown below in the Table 3.3.

Table 3.3: Ward-wise Proportion of SC and ST Population

Ward No.	SC Population	Percentage to Total SC Population	ST Population	Percentage to Total ST Population
1	1320	3.48	711	5.59
2	1378	3.63	759	5.96
3	851	2.24	1115	8.76
4	1888	4.98	270	2.12
5	1547	4.08	829	6.51
`6	2315	6.10	435	3.42
7	1329	3.50	478	3.76
8	930	2.45	370	2.91
9	1611	4.25	1162	9.13
10	1080	2.85	420	3.30
11	1976	5.21	390	3.06
12	3729	9.83	736	5.78
13	3331	8.78	569	4.47
14	1163	3.07	782	6.14
15	2827	7.45	544	4.27
16	2546	6.71	498	3.91
17	3169	8.36	596	4.68
18	1867	4.92	350	2.75
19	1555	4.10	992	7.79
20	1510	3.98	721	5.67
Total	**37,923**	**100.0**	**12,727**	**100.0**

Source: Election Department, PMC

3.4 Industrial Growth

The rapid growth of Panvel has made the city a prime region for commercial growth. The upcoming project of Navi Mumbai International Airport has made this city an attractive destination for new businesses and many industries are interested in initializing a new trade in this area. Panvel is

surrounded by some major Maharashtra Industrial Development Corporation (MIDC) regions like Patalganga, Taloja, Nagothane, Roha, Khopoli, and Bhiwandi. Some of the Indian industries like Larsen & Toubro Limited, Reliance, Hindustan Organic Chemicals Ltd, ISRO's Propellant Complex., ONGC, IPCL etc. are providing ample job opportunities for the local population. Apart from the aforementioned industries, many more companies and manufacturers are based out of Panvel. The Jawaharlal Nehru Port Trust (JNPT), also known as Nhava Sheva Port, which is the second largest container port in India is also located near Panvel. Panvel also is anticipated to have a New Special Economic Zone (SEZ) in the near future, as declared by the government.

3.5   Religious Tourism

Panvel is an incredible tourist destination because of its pleasant weather, which keeps its visitor comfortable all the time. It is the most crowded locality in Raigad District of Maharashtra. The place has been developed as a good tourist destination while maintaining its natural rawness.

The city is situated on the banks of Panvel Creek, surrounded by the Matheran Hills. It is known for the forts in Raigad and Khopoli. The major historical attraction in Panvel taluka is Karnala Fort which is popular for trekking & bird watching. Panvel is also famous for the two prominent Ganesh temples in Maharashtra: Ballaleshwar, located in Pali, and Varadavinayak in Mahad village. Beth EI Synagogue is a part of the Indian heritage & one of the tourist places in Panvel. The best time to visit Panvel is during winters as the city receives substantial rainfall during monsoons and scorching summers.

| **Karnala Bird Sanctuary** | **Karnala Fort** |

Beth El Synagogue Panvel

Ballaleshwar Mandir

Khandeshwar Shiv Temple
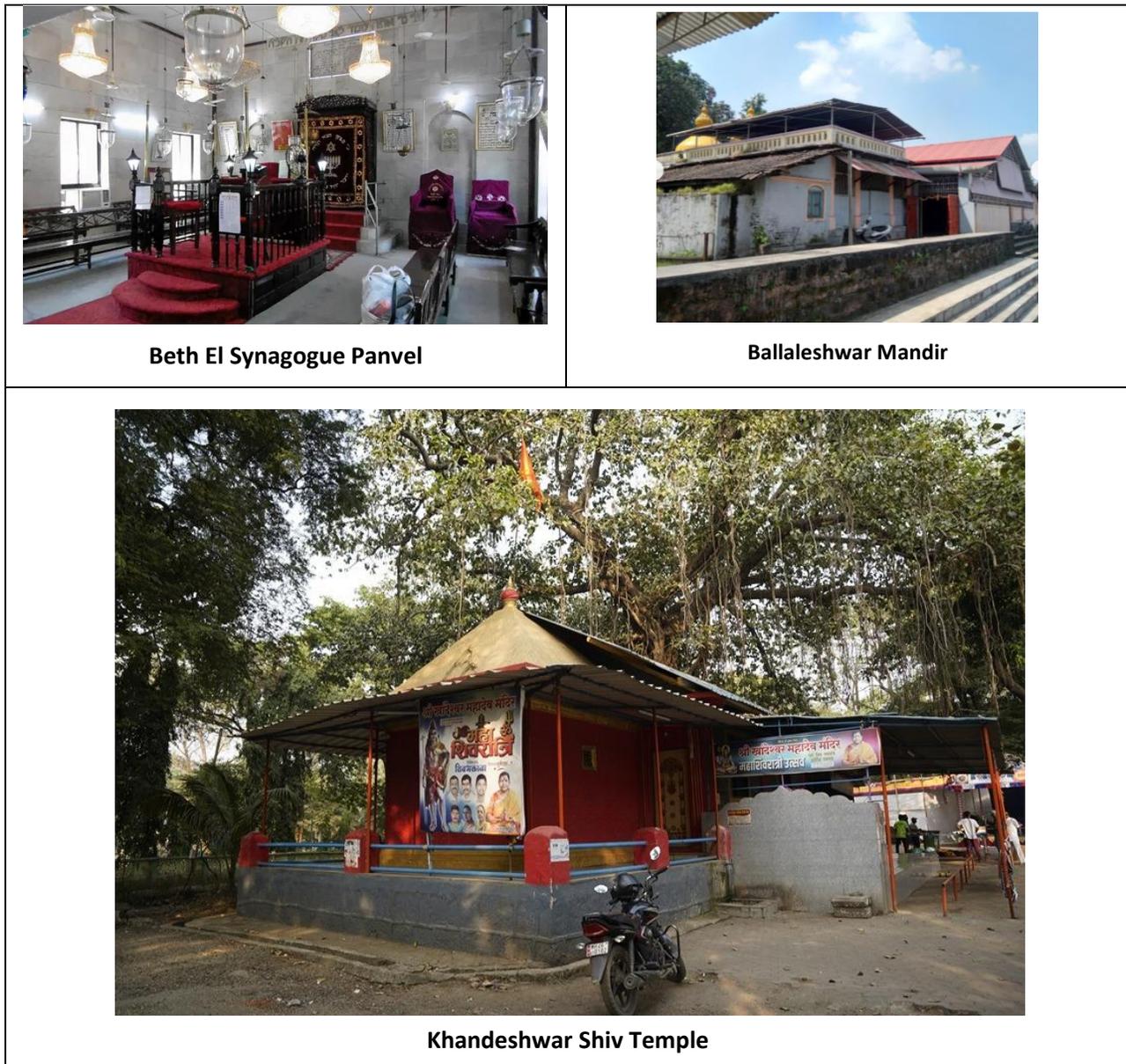
Figure 3.3: Tourist destinations in Panvel

Source: http://www.indianjews.org/en/research/jewish-sites-in-india/65-beth-el-panvel-synagogue

3.6 Economic Development

If not managed properly, population and economic growth tend to affect the natural environment adversely. While the economic growth may positively impact measures such as nutrition, health, and life expectancy, coupled with population growth, it also significantly impacts the local eco-systems.

Unsustainable natural resource extraction, disturbs the waste management systems and unregulated habitat settlements can significantly impact the mid-term sustainability of natural resources. Hence it is vital to assess the effects of economic activities on environment.

Panvel City is located 35 km away from Mumbai city. It is also close to MIDC Trance Thane Creek (TTC) and has Taloja MIDC situated within its region. MIDC Taloja Industrial area is a reserved Chemical Industrial hub developed by MIDC. MIDC Taloja Industrial area is situated adjacent to Navi-Mumbai and Panvel. It is one of the fully developed industrial areas having industries involved in various activities. The dominating industrial activities are Chemical, Food and Fish Processing, Dairy Products & Cold stores, and Engineering services. Panvel is also close to Jawaharlaal Nehru Port Trust (JNPT) which generates heavy traffic in and around the city. The city of Panvel has housed the human resources required for industrial and logistic purposes for these industrial zones. It was observed that semi-Skilled & unskilled human resources are readily available in the Taloja and Kalamboli parts of Panvel City. The managerial and senior managerial people travel from Panvel and Kharghar.

4. Air Environment

Earth's atmosphere is a layer of gases surrounding the planet. This mixture of gases that envelopes the earth is commonly known as air. The composition of pure air consists majorly of 78% nitrogen & 21% oxygen, while other gases like argon, carbon dioxide, methane and so on are present in trace amounts. Change in natural composition of air occurs due to addition of undesirable elements arising from anthropogenic activities like the combustion of fossil fuels. Emissions from power plants, industries, automobiles, construction activities and so on emit tones of air pollutants (any solid, liquid, or gaseous substance, including noise) into the atmosphere, which deteriorates the air quality and exposes citizens to great health risks.

Higher concentrations of air pollutants may be or tend to be injurious to human beings, other living creatures, plants, property, or environment. The Global Burden of Disease (GBD) stated about 4.2 million deaths due to exposure to $PM_{2.5}$ (Particulate Matter <2.5 microns) have occurred, thus ranking fifth for total deaths worldwide. In 2015, about 17.1% of deaths occur from ischemic heart disease, 14.2% from stroke, 16.5% from lung cancer, 24.7% from LRIs (Lower Respiratory tract Infections), and 27.1% from COPD (Chronic Obstructive Pulmonary Disease) were recorded due to exposure for Particulate Matter. As per the WHO (World Health Organization), almost 80% of urban population is exposed to air quality which fails to meet the WHO guidelines thus resulting in respiratory disease and other health problems.

In order to monitor the ambient air quality, Central Pollution Control Board (CPCB) at national level, compares the status of ambient air quality parameters, which indicate the comparative status of various cities. In addition to this, at state level, Maharashtra Pollution Control Board (MPCB) and at city level, PMC monitor the air quality parameters. This section discusses the status of the ambient air quality monitoring network and the ambient air quality recorded for various air pollutants and the processing comparisons.

4.1   Ambient Air Quality Monitoring Station

MPCB has established one Ambient Air Quality Monitoring Station (AAQMS) at Panvel. The monitoring station is non-continuous and it is under National Air Quality Monitoring Program (NAMP). The monitoring station is at Panvel Water Supply behind State Transport (ST) bus stand. The details of the monitoring station are given in Table 4.1.

Table 4.1: Details of AAQMS at Panvel

City	Panvel
Program	NAMP
Implementing Agency	MPCB
Location	Panvel Water Supply Behind ST Stand
MPCB Region	Panvel
Frequency	Two Days in a Week
Parameters Monitored	SO_2, NO_x, RSPM, SPM

4.1.1 Sulphur Dioxide (SO_2)

Sulfur dioxide is a highly toxic, colorless, nonflammable gas with a pungent odour. SO_2 belongs to sulfur oxides (SO_x) group. Among the oxides, SO_2 is of major concern related to human health compared to other gases within the group. SO_2 is primarily emitted from anthropogenic sources like burning fossil fuels by power plants and other industrial facilities and fuel combustion in mobile sources such as locomotives, ships, and other equipment.

Annual Trend in SO₂ Concentration
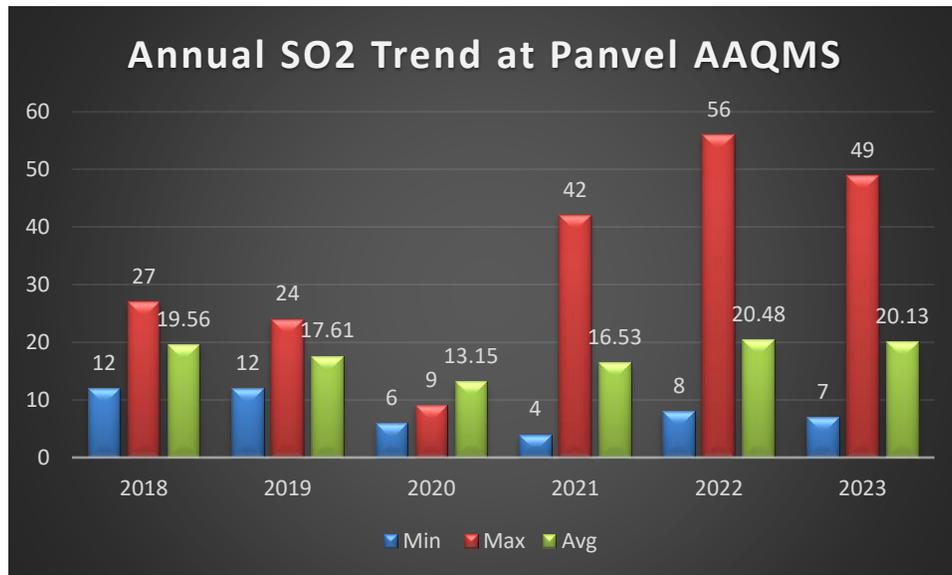
Annual average standards for SO_2 (50 µg/m³)

Figure 4.1: Annual SO₂ Trend at Panvel AAQMS

Data Source: MPCB

As per Figure 4.1, it can be observed that SO₂ concentration level was minimum during the year 2020. It can be due to the nationwide lockdown because of COVID- 19 pandemic resulting in shutdown of industrial operations across India. As shown in Figure 4.1, annual average measured SO₂ concentrations is within the annual average standards for SO₂ (50 µg/m³) as per NAAQS set by CPCB. However, an increasing trend of SO2 concentration from the year 2021 can be seen.   This can be primarily because of the gradual increase of traffic, industrialization post covid-19 as the normalcy in businesses has returned.

Monthly Trend in SO₂ Concentration for the Year 2023
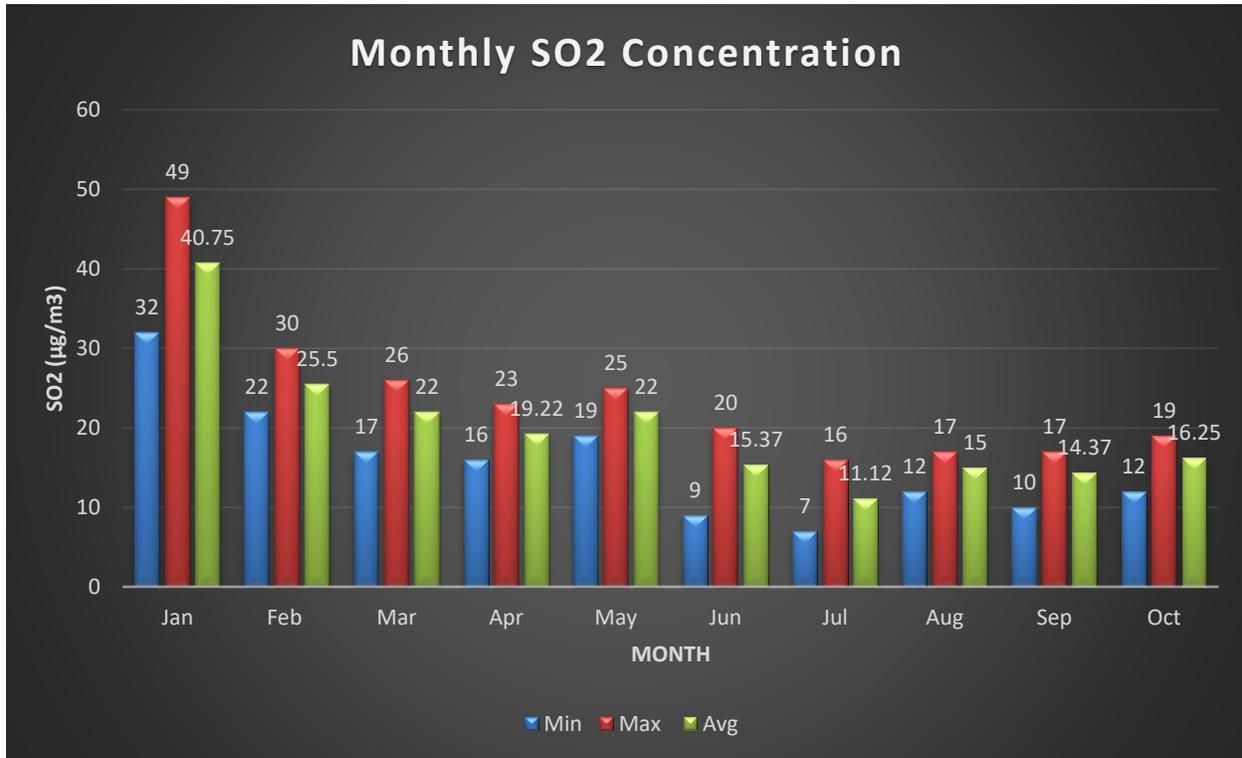
Figure 4.2: Monthly SO$_2$ Trend at Panvel AAQMS in 2023

Data Source: MPCB

Note *The data is available only till October on the MPCB

website (https://www.mpcb.gov.in/air-quality/Panvel/0000000124?fdate=03-06-2024&tdate=03-07-2024).

It can be seen from Figure 4.2 that the minimum and maximum concentration of SO$_2$ has remained below 35 µg/m^3 throughout the year, except in the month of January, where the maximum reported concentration has gone up to 49 µg/m^3.

4.1.2 Nitrogen Oxides (NO$_X$)

NO$_X$ represents seven compounds (N$_2$O, NO, N$_2$O$_2$, N$_2$O$_3$, NO$_2$, N$_2$O$_4$ and N$_2$O$_5$). Among the NO$_X$ family, NO$_2$ can have adverse effects on human health since reportedly it can cause lung disorders and contributes to the formation of secondary pollutants such as ozone and acid rain.

Annual Trend in NO$_X$ Concentration
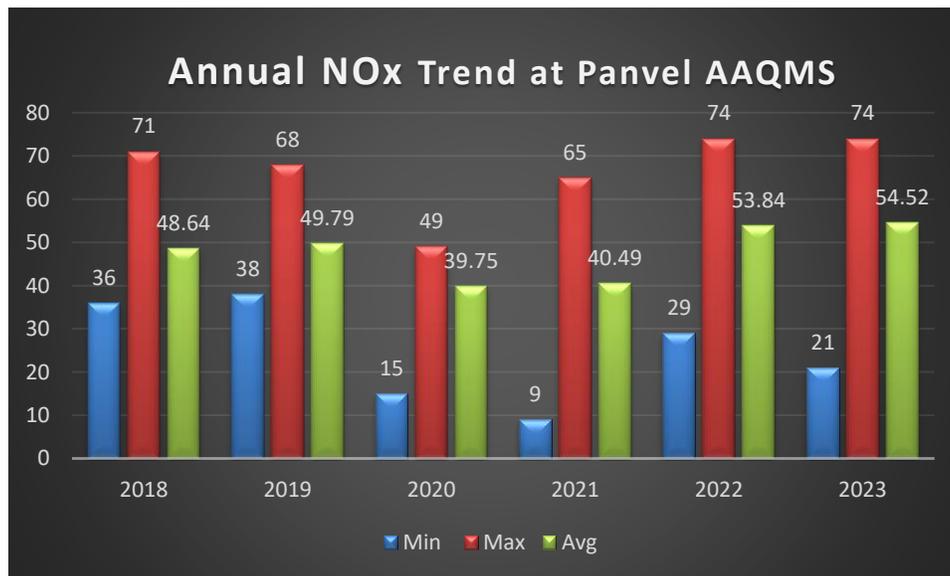
Annual average standards for NO$_X$ (40 μg/m^3)

Figure 4.3: Annual NO$_X$ Trend at Panvel AAQMS

Data Source: MPCB

Note *The data is available only till October on the MPCB website (https://www.mpcb.gov.in/air-quality/Panvel/0000000124?fdate=03-06-2024&tdate=03-07-2024).

As seen in Figure 4.3, it can be noted that NO$_X$ concentration level was minimum during the year 2020. It can be due to the nationwide lockdown because of COVID- 19 pandemic resulting in shutdown of industrial operations across India. NO$_X$ is majorly emitted from combustion of fuel from automobiles and mobile sources (50%), electric power plants (20%) and other domestic usage (30%) *(EPA 456/F-99-006R, November 1999)*. Annual measured NO$_X$ concentrations for the years 2018 to 2022 exceed the

annual average standards for NO$_X$ (viz. 40 µg/m^3) as per NAAQS set by CPCB. The highest average concentration of NO$_X$ was reported in 2023 (viz. 54.52 µg/m3) and the lowest was reported in 2020 (viz. 39.75 µg/m^3).

Monthly Trend in NO$_X$ Concentration for the Year 2023
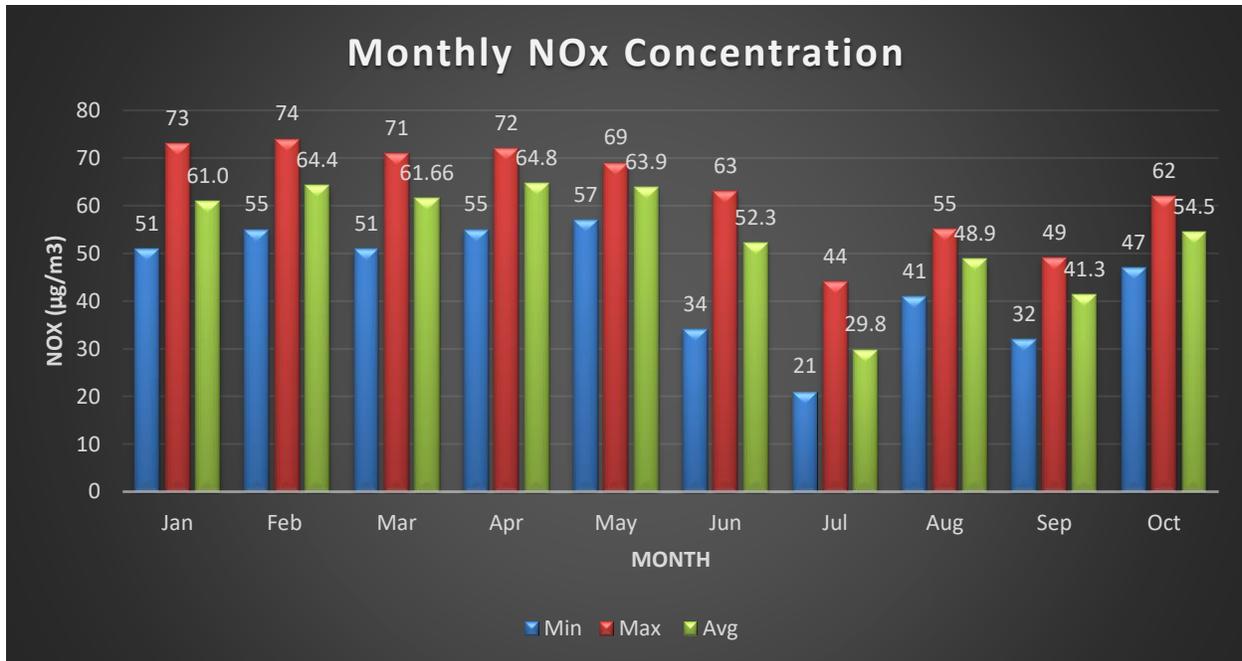
Figure 4.4: Monthly NO$_X$ Trend at Panvel AAQMS in 2023

Data Source: MPCB

It can be seen from Figure 4.4 that the minimum & maximum monthly concentrations of NO$_X$ were 21 & 74 µg/m^3, reported in July and February, respectively.

4.1.3 Respirable Suspended Particulate Matter (RSPM)

RSPM (Respirable Suspended Particulate Matter) refers to particulate matter with an aerodynamic diameter of less than or equal to 10 micrometers. They are produced from combustion processes, vehicles, and industrial sources. Particulate matter is a complex mixture of extremely small particles and liquid droplets made up of several components, including acids (such as nitrates and sulfates),

organic chemicals, metals and soil or dust particles. Particles that are 10 micrometers in diameter or smaller can pass through the throat and nose and enter the lungs, commonly referred to as RSPM. Once inhaled, these particles can affect the heart and lungs and cause serious health effects

Annual Trend in RSPM Concentration

Annual RSPM Trend at Panvel AAQMS

RSPM (μg/m3)

| Year | 38 | 74 | 53.38 |
| 2019 | | | |

Min: 38, Max: 74, Avg: 53.38 (2019)
Min: 32, Max: 58, Avg: 45.56 (2020)
Min: 5, Max: 71, Avg: 50.34 (2021)
Min: 25, Max: 76, Avg: 50.91 (2022)
Min: 24, Max: 80, Avg: 53.11 (2023)

YEAR

■ Min ■ Max ■ Avg
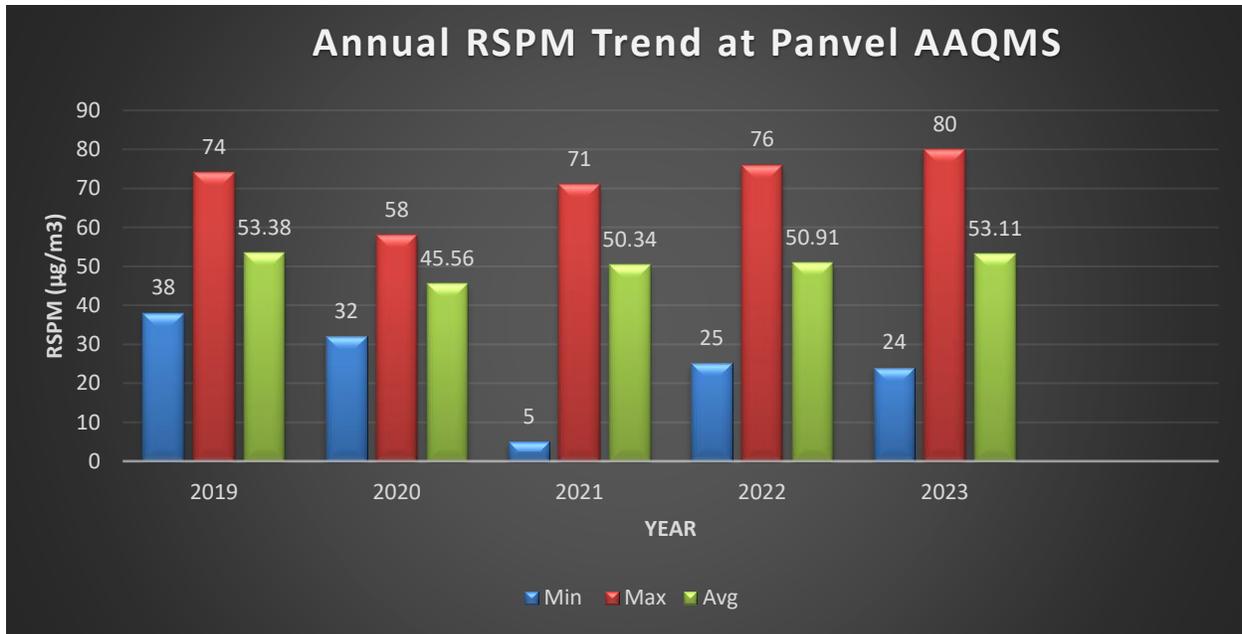
Figure 4.5: Annual RSPM Trend at Panvel AAQMS

Data Source: MPCB

It was observed that RSPM average concentration level was minimum during the year 2020 because of restrictions on use of private & public vehicles as well as industrial operations (because of covid-19 induced nationwide lockdown), except for biomedical waste (generated from hospitals). The projected emissions observed due to operations of vehicles, which were operated under emergency services. It can be seen from Figure 4.5 that the average reported annual RSPM is lower than the CPCB prescribed annual standard of 60μg/m^3 for all the years. The maximum RSPM concentration is seen in 2023 (80 μg/m^3), and the minimum RSPM concentration was reported in 2021 (5 μg/m^3).

Monthly Trend in RSPM Concentration for the Year 2023
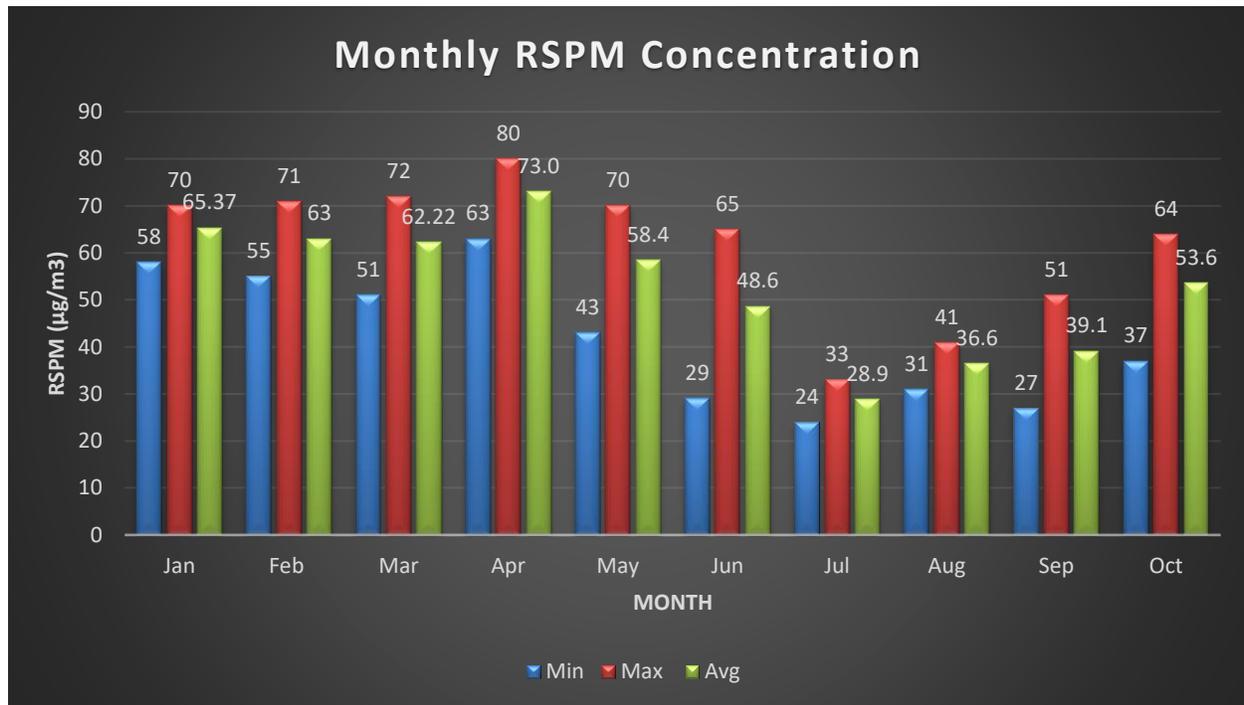
Figure 4.6: Monthly RSPM Trend at Panvel AAQMS in 2023

Data Source: MPCB

As seen in Figure 4.6, the minimum, maximum and average monthly concentration of RSPM is within CPCB standards. The maximum concentration of RSPM was 80 µg/m³ in the month of April. The average concentration of RSPM was highest in the month of April while it was lowest in the month of July. The minimum yearly concentration of RSPM was 24 µg/m³ in the month of July. This can be due to the monsoon season.

4.1.4 Suspended Particulate Matter (SPM)

SPM (Suspended Particulate Matter) is usually defined as comprising particles less than 10 µm in diameter suspended in the atmosphere. In particular, air particulates less than 2 µm in diameter, which mainly originate from such sources as incinerators, boilers and automobiles, may reach deeply into

human lungs during respiration and thus cause respiratory diseases. SPM can be also produced by photochemical reactions of gaseous substances in the atmosphere.

Annual Trend in SPM Concentration
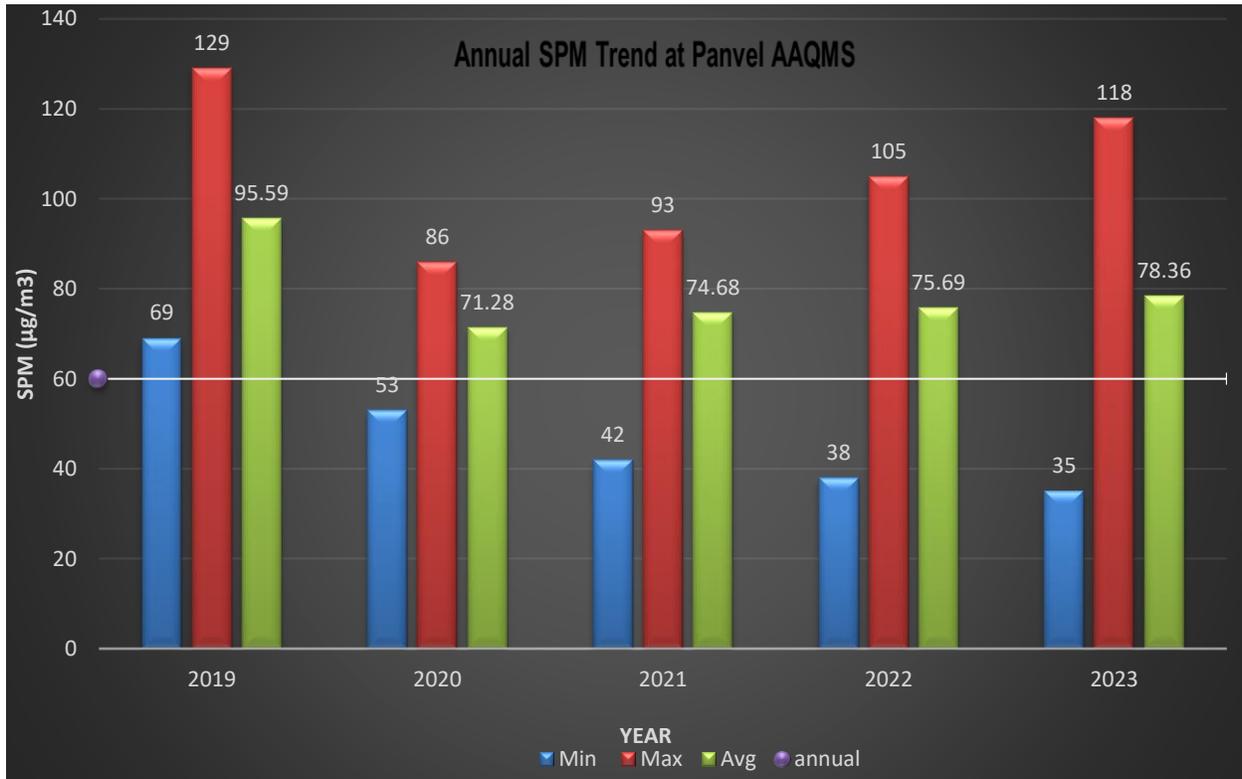
Figure 4.7: Annual SPM Trend at Panvel AAQMS

Source: MPCB

It was observed that the annual SPM average concentration is more than the CPCB prescribed annual standard of 60 µg/m^3 in all the years. The maximum concentration of SPM was seen in the year 2019 (129µg/m^3), while the minimum concentration was seen in the year 2023 (35 µg/m^3).

Monthly Trend in SPM Concentration for the Year 2023
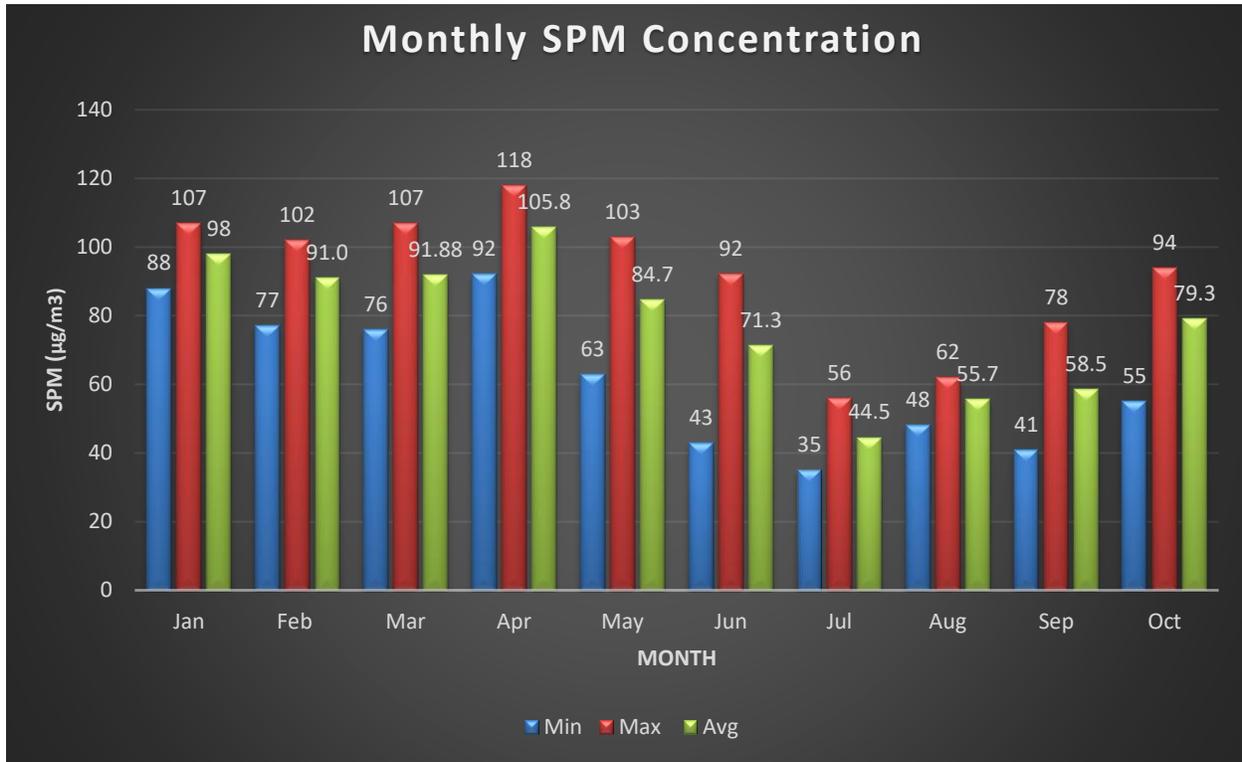
Figure 4.8: Monthly SPM Trend at Panvel AAQMS in 2023

Source: MPCB

The monthly highest SPM concentration was reported in the month of April (118 µg/m^3) while the lowest concentration can be seen in the month of July (35 µg/m^3).

Air Quality Index

Air Quality Index (AQI) is the most convenient way to convey the information on outdoor air quality which could be easily understood by general public. AQI transforms complex air quality data of various pollutants into a single index value. AQI is calculated using the AQ sub index and the health breakpoints, which are evolved for eight pollutants (PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO, O_3, NH_3, and Pb) for which short-term (up to 24-hours) are prescribed by NAAQS. Based on the measured ambient concentrations of a pollutant, sub-index is calculated, which is a linear function of concentration. The

worst sub-index determines the overall AQI. The sub-indices for individual pollutants at a monitoring location are calculated using its 24-hourly average concentration value (8-hourly in case of CO and O_3) and health breakpoint concentration range.[1] AQI are within a range of 0 to 500 and is categorized into 'Good', 'Satisfactory', 'Moderate', 'Poor', 'Very Poor' or 'Severe' based on the concentration of various pollutants and their health impacts at various concentrations. Higher value of AQI indicates high level of pollution. Figure 4.9 shows he AQI classification.

Table 4.2: AQI Classification

AQI	Quality Classification	Remarks	Colour Code
0-50	Minimal Impact	Good	
51-100	Minor breathing discomfort to sensitive people	Satisfactory	
101-200	Breathing discomfort to the people with lung, heart disease, children and older adults	Moderate	
201-300	Breathing discomfort to people on prolonged exposure	Poor	
301-400	Respiratory illness to the people on prolonged exposure	Very Poor	
> 401	Respiratory effects even on healthy people	Severe	

Source: MPCB

AQI for Panvel was collected from MPCB website for the years 2019-2023. As seen in Figure 4.9, it can be noted that for the year 2019, 2020, 2021, 2022,2023 the AQI index was in the range of good and satisfactory. It can be due to the COVID– 19 induced lockdown there were restrictions on the use of vehicles and industrial operations. Higher values of AQI could potentially cause minor breathing discomfort to the sensitive people. For the years 2019-2023, there can be seen a trend of decreasing AQI. The highest numbers of days with good ranges of AQI was good reported for the year of 2020 (viz. 35 days) while the lowest numbers of days with good ranges of AQI was reported in the year of 2019

(viz. 4 days). The percentage of 'Satisfactory' AQI was 80.6% in 2019, while it was 95.3%, 53.3%, 77.3% and 89.4% in 2019, 2020, 2021 and 2022, 2023 respectively. 'Moderate' AQI was 11.7% in 2019, respectively.
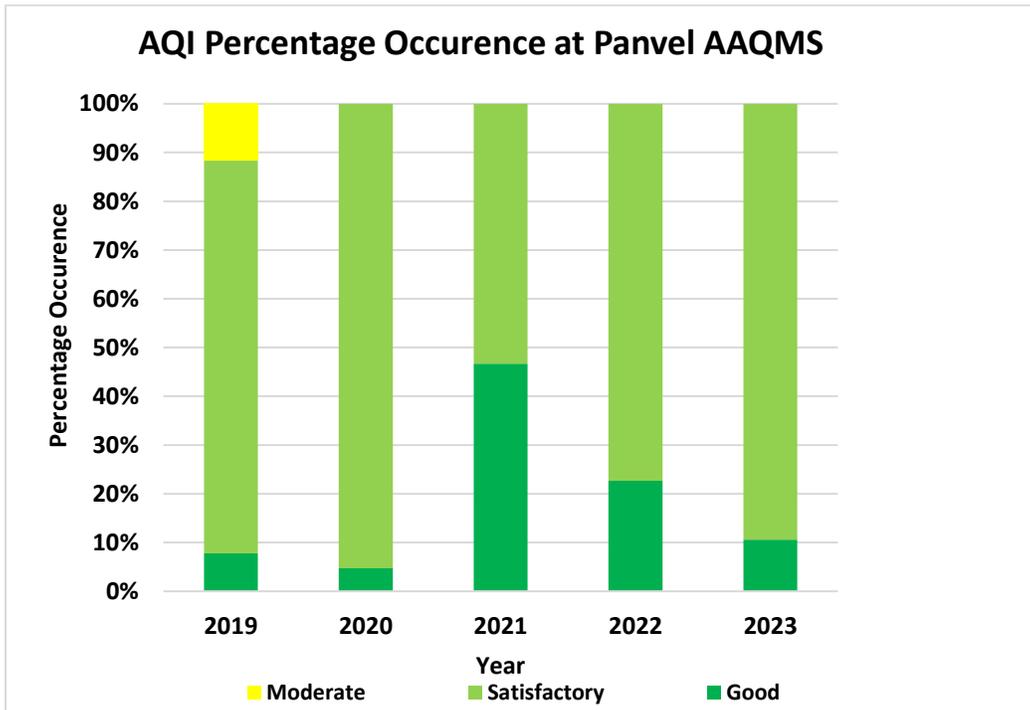
Figure 4.9: Annual AQI Percentage Occurrence at Panvel AAQMS

Source: MPCB

5. Noise Environment

Noise pollution is caused by an unwanted sound that is produced by various natural or anthropogenic sources such as construction, industries, transportation etc. Noise pollution is one of the major environmental pollutants that are encountered in daily life and has a direct effect on human performance. Noise pollution is regarded as a public nuisance as per Sections 268, 290 & 291 of the Indian Penal Code. There are several other legislations relating to noise pollution such as The Factories Act, 1948 (under which 'noise induced hearing loss' is notified as a disease); Motor Vehicles Act, 1988 (which specifies rules for horns and silencers); Law of Torts (civil suits can be filed for claiming damages); The Air (Prevention and Control of Pollution) Act, 1981 (ambient noise standards have been given), The Environment (Protection) Act, 1986; Noise Pollution (Regulation and Control) Rules, 2000 and regulations in respect of Loudspeakers/Public Address System.

Noise pollution is generally defined as regular exposure to elevated sound levels that may lead to adverse effects in humans or other living organisms. Further, there are standards and guidelines for ambient noise quality, automobiles, domestic appliances and construction equipment, generator sets and firecrackers as notified under the Environment (Protection) Act, 1986. According to the World Health Organization, sound levels less than 70 dBA are not damaging to living organisms, regardless of how long or consistent the exposure is. Exposure for more than 8 hours to constant noise beyond 85 dBA may be hazardous. If you work for 8 hours daily in close proximity to a busy road or highway, you are very likely exposed to traffic noise pollution around 85dBA. CPCB Limits for Ambient Noise is given in the Table 5.1 below.

Table 5.1: CPCB Limits for Ambient Noise

Area Code	Category of Area	Limit in dB (A), L_{eq}	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45

| D | Silent Zone | 50 | 40 |

Source: MPCB

- Day time shall mean from 6:00 a.m. to 10:00 p.m.

- Night time shall mean from 10:00 p.m. to 6:00 a.m.

- Silence Zone is an area comprising not less than 100 m around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.

- Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

- dB (A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

- A "decibel" is a unit in which noise is measured.

- "A", in dB (A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

- Leq is the energy mean of the noise level over a specified period.

Noise pollution is inevitable in today's society that we often fail to notice it anymore:

- Street traffic sounds from cars, buses, pedestrians, ambulances etc.

- Construction sounds like drilling or other heavy machinery in operation.

- Airports, with constant elevated sounds from air traffic, i.e., planes taking off or landing.

- Workplace sounds, often common in open-space offices.

- Constant loud music in or near commercial venues.

- Industrial sounds like fans, generators, compressor, mills etc.

- Strain stations traffic.

- Household sounds, from the television set to music playing on the stereo or computer, vacuum cleaners, fans and coolers, washing machines, dishwashers, lawnmowers etc.

- Events involving fireworks, firecrackers, loudspeakers etc.

- Conflicts generate noise pollution through explosions, gunfire etc. The dysfunctions, in this case, are likely caused by the conflict and insecurity and less by the noise pollution in itself, although that compounds stress levels too.

Consequences of Noise Pollution:

Whether we realize to it or not, noise pollution can be hazardous to our health in various ways.

- Hypertension is a direct result of noise pollution caused elevated blood levels for a longer period of time.

- Hearing loss can be directly caused by noise pollution, whether listening to loud music in your headphones or being exposed to loud drilling noises at work, heavy air or land traffic or separate incidents in which noise levels reach dangerous intervals, such as around140 dB for adult or 120 dB for children.

- Sleep disturbances are usually caused by constant noise because of air or land traffic during night house. These are serious condition as they can impact the daytime performance and lead to serious diseases.

- Child development. Children appear to be more sensitive to noise pollution and a number of noise-pollution-related diseases and dysfunctions are known to affect children, from hearing impairment to psychological and physical effects. Also, children who regularly use music players at high volumes are at risk of developing hearing dysfunctions. Various cardiovascular dysfunctions, Elevated blood pressure caused by noise pollution, especially during the night, can lead to various cardiovascular diseases.

- Dementia isn't necessarily caused by noise pollution, but its onset can be favored or compounded by noise pollution.

- Psychological dysfunctions and noise annoyance. Noise annoyance is, in fact, a recognized name for an emotional reaction that can have an immediate impact. Land animals are also affected by noise pollution in the form of traffic, firecrackers etc., and birds are especially affected by the increased air traffic.

6. Water Environment

Earth is termed as '*Blue Planet*' because 71% of the earth's surface if covered with water. The earth has an abundance of water yet majority of water (97.5%) is saline water. Out of the remaining 2.5% of fresh water, around two thirds if it is in frozen form in ice caps and glaciers. Only about 0.3% of freshwater is available for human use majority of which comes from rivers. Water is one of the vital renewable resources on earth. Lakes, rivers, streams groundwater are important fresh water sources. The majority of freshwater is found in surface water as soil moisture and in aquifers.

6.1 Surface Water

Rivers, lakes, oceans and wetlands are commonly known as surface water bodies. The surface water body in Panvel City is Taloja River & Kasrdi dam. A major source of water supply in Panvel City is from Dehrang Dam which is across Gadeshwar Lake. The other sources of water at Panvel are from MIDC, CIDCO, MJP, Patalganga, and from borewell installed by PMC in Panvel. Table 6.1 captures the PMC water profile and Figure 6.1 shows the distribution of water supply in Panvel City.

Table 6.1: PMC Water Profile

Water Availability	210 MLD
Source of Water Supply	Dehrang Dam, Hetavne Dam (CIDCO), Morbe Dam (NMMC), Barvi Dam (MIDC), MJP & MIDC Patalganga River
Water Requirement	245 MLD
Water Coverage	98%
Net Supply Per Person	110 LPCD

Source: Water Supply Department, PMC
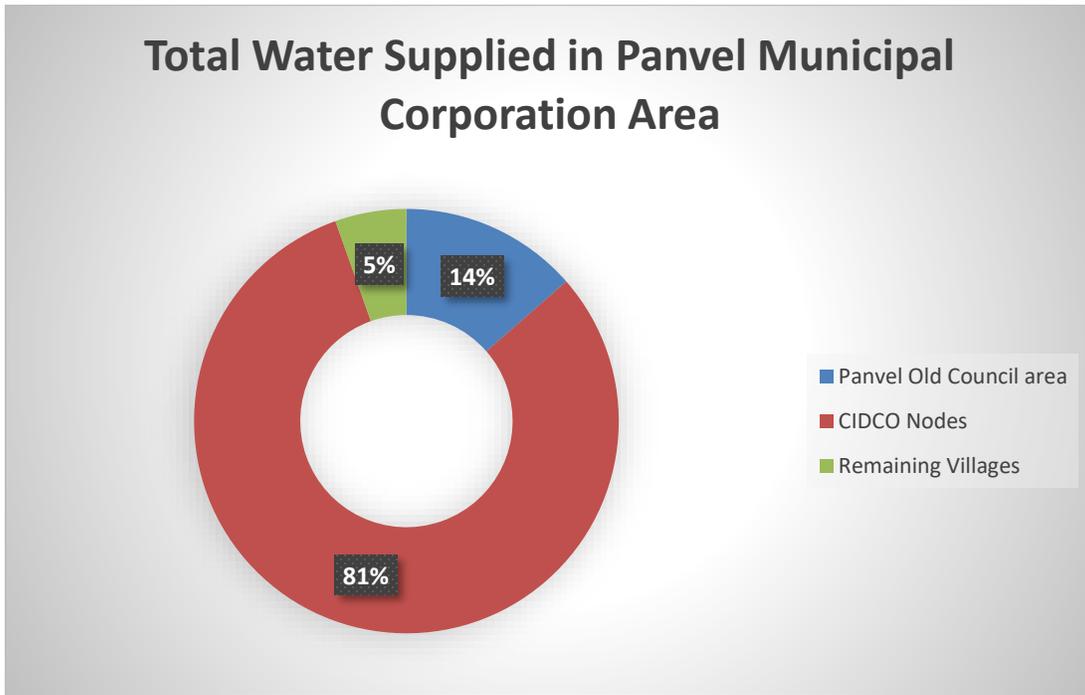
Figure 6.1: Total Water Supplied in Panvel Municipal Corporation Area

6.1.1 Dehrang Dam, Gadeshwar Lake
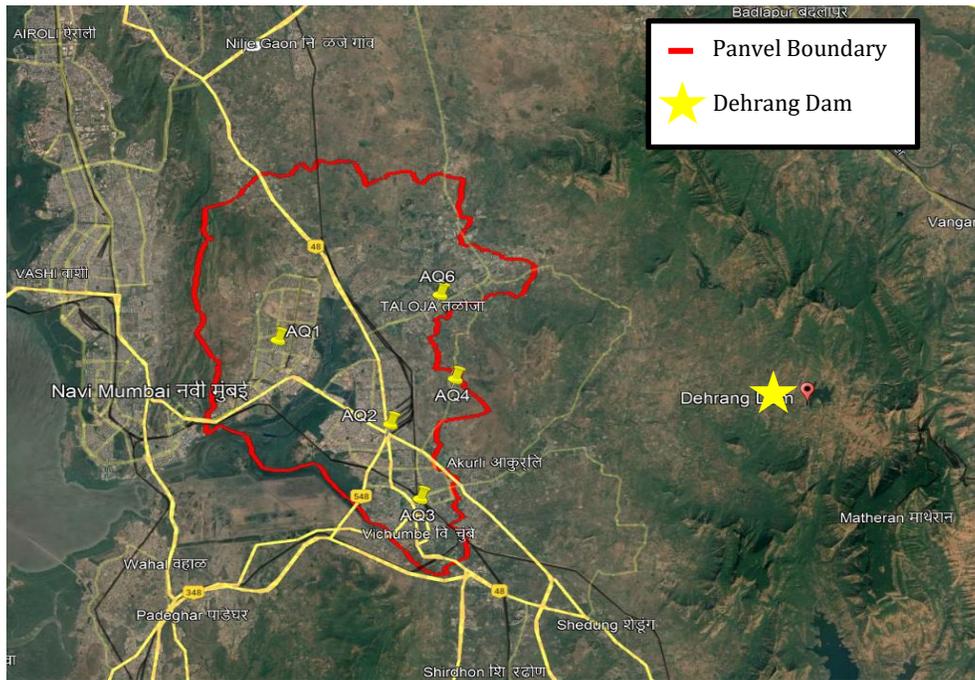
Figure 6.2: Location of Dehrang Dam

Figure 6.3: Gadeshwar Lake, Panvel

Under the ownership of PMC, Deharanga Dam was constructed in the year 1964 and is spread over 277 acres of land. The Dehrang Dam has been PMC's main source of water supply for around 1.45 lakhs people of old Panvel region, comprising three villages, namely old Khanda, Takka & Podi gaothan area. For remaining population, PMC needs to buy more water from Maharashtra Jeevan Pradhikaran (MJP), Maharashtra Industrial Development Corporation (MIDC) and Navi Mumbai Municipal Corporation (NMMC) and CIDCO.

There are a total of four water distribution systems in PMC through which PMC manages the water supply. They are:

- Water Supply from behind ST stand WTP to Old Municipal Council area.
- From Maharashtra Jeevan Pradhikaran (MJP) Water being Supplied to Kalamboli, New Panvel & Old Panvel.
- NMMC pipe Taping at kamothe-to-kamothe Node.
- At Kharghar & Taloja Node water is being supplied from CIDCO Hetavne Dam & Barvi Dam (MIDC).
- Some villages of Corporation area water being Supplied from MIDC Barvi Dam pipeline Taping & Patalganga River feeder Main Taping.

Heat Hetromd Dam for the village water being supplied from the MIDC Barvi dam source. The Central Government sanctioned a water supply scheme as well as an underground sewerage system in 29 villages to maintain the screening water. The PMC has a total of 45,684 tap connections. Out of which 41,531 are residential & 4,153 are industrial connection.

Figure 6.4: Dehrang Dam, Panvel

6.1.2 Surface Water Quality

Currently, surface water sources are facing a lot of pressure due to anthropogenic activities. Surface water sources are the major receivers of solid waste, industrial effluent and domestic sewage. This causes water pollution and degrades the quality of surface water. It is very detrimental to the aquatic ecosystem and overall components of the ecosystem. The industrial residues are likely to get bio accumulated in the aquatic organisms (fishes etc.) which are in turn consumed by the humans. This will have a very harmful effect on humans. It is very important to continuously track the level of pollutants in water bodies. Therefore, MPCB has installed water quality monitoring stations (WQMS) across the Maharashtra state to monitor the overall water quality of a particular surface water resource. Water quality is monitored per month across all the stations.

MPCB, under **NWMP - National Water Quality Monitoring Programme** has set up Water Monitoring Stations around at Kopra Bridge which is around Panvel city.

Details of the monitoring station, monitoring frequency and the reported concentration of the pollutants from 2018 till 2023 are captured in Table 6.2 and 6.3 below.

Table 6.2: Details of the Monitoring Station – Kopra Bridge (Panvel Creek sample)

Water Quality Monitored at: Kopra Bridge (Panvel Creek sample)			
Name of the Program	NWMP	Type of Sample	Surface
Station Code	2803	Frequency	Monthly (Trend)
Regional Office	Navi Mumbai	Regional Lab	-

Table 6.3: Annual Average Water Quality Monitoring Data of Panvel Creek at Kopra Bridge

Year		pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Nitrate (mg/l)	Fecal Coliform (MPN/ 100ml)
2018	Min.	6.4	3	3	20.0	0.1	17
	Max.	8.2	6.9	18	224	7.9	170
	Avg.	7.17	5.18	7.71	65.33	3.38	74.5
2019	Min.	6.5	4.5	4	12	0.1	21
	Max.	8.7	7	11	120	2.8	94
	Avg.	7.18	5.88	5.92	41.67	1.33	40.92
2020	Min.	6.8	4	3.2	16	0.1	13
	Max.	7.5	7	10	128	2	110
	Avg.	7.21	6.03	4.98	37.67	1.03	47.5
2021	Min.	6.5	4.6	3.4	12	0.3(BDL)	4.5
	Max.	7.9	7.4	8	80	9.2	140
	Avg.	7.2	5.99	5.55	35	2.6	52.21

Year		pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	Nitrate (mg/l)	Fecal Coliform (MPN/ 100ml)
2022	Min.	7.1	3.8	4	12	0.3(BDL)	22
	Max.	7.8	6.9	12	184	20.2	94
	Avg.	7.36	5.4	7.44	68.89	3.89	54.11
2023	Min.	7	4	2.2	8	1.33	21
	Max.	7.9	7	14	92	3.17	130
	Avg.	7.49	5.83	5.58	42.67	2.14	64.42

Source: MPCB
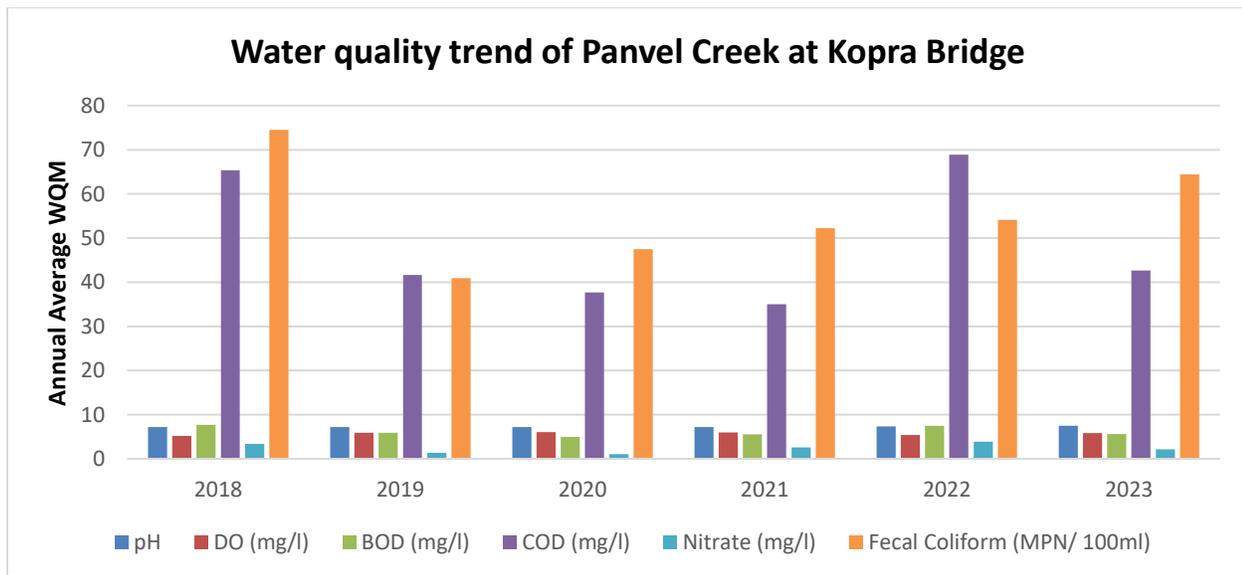
Figure 6.5: Water quality trend of Panvel Creek at Kopra Bridge

The annual water quality trend of Panvel Creek at Kopra Bridge has been depicted in Figure 6.5. As reported, the concentration of COD and fecal coliform are high due to domestic effluent discharge from the nearby area.

Water Quality Index

The water quality index (WQI) provides a single number that expresses the overall water quality, at a certain location and time, based on several water quality parameters. The objective of WQI is to turn

complex water quality data into information that is understandable and usable by the public. The water quality index of Panvel creek water samples is shown in Tables 6.4 and 6.5.

Table 6.4: Water Quality Index

WQI	Quality Classification	Remarks	Colour Code
63-100	Good to Excellent	Non-Polluted	(Green)
50-63	Medium to Good	Non-Polluted	(Yellow)
38-50	Bad	Polluted	(Orange)
38 and less	Bad to very Bad	Heavily Polluted	(Red)

Table 6.5: Trend of the WQI for Panvel Creek Water Samples (At Kopra Bridge)

Station Code	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2803	2018	Orange	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green
2803	2019	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
2803	2020	Green	Green	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Green
2803	2021	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Yellow	Yellow
2803	2022	Yellow	Yellow	Green	Yellow	Green	Green	Green	Green	Green	NA	NA	NA
2803	2023	Green	Green	Green	Green	Yellow	Green	Green	Green	Green	Green	Green	Green

Data Source: MPCB

*For the year 2022, data is available only till September. NA: Not Available

As seen from Table 6.5, the WQI of the locations (station code) have been equal to or more than 63 (non-polluted) throughout the year from 2018-2023.

6.2   Water Resource Management

PMC has water supply from Maharashtra Jeevan Pradhikaran (MJP), MIDC and from borewell installed by PMC in Panvel City. With the inception of PMC, 29 villages from Raigad Zilla Parishad and CIDCO

developed areas were transferred to PMC. In these areas, independent water supply systems are available.

As per the draft water supply master plan report 2021, the domestic water demand is 265 MLD and other is 51.7 MLD (Industrial Water Demand, Institutional and Commercial, Waste and Theft demand, Fire Demand) Hence, it indicates that the water demand is more than the water availability. The villages nearby corporation area gets some of the water supply from Dehrang Dam & rest of the demand is fulfilled by borewells constructed by PMC.

The total water supplied in Panvel old corporation area is around 30 MLD & in CIDCO nodes, it is around 179 MLD. In the remaining villages, MIDC supplies around 9 MLD water and CIDCO supplies around 3 MLD of water. As per water supply department of PMC, the total water supply across Panvel City is around 210 MLD which, after treatment goes to the Water Distribution System as depicted in Table 6.6. The system experiences a net approximate water loss of around 9.52%.

Table 6.6: Water Distribution at PMC

Water Distribution from Source	210 MLD
Water Received after Treatment	210 MLD
Actual Distribution of Water	190 MLD
Per capita/day? supply of water	110 L
Overall Water Loss	9.52%

Source: Water Supply Department, Panvel

Details about Water Treatment Plants

- Water Treatment Facility (WTP) Behind Panvel ST Stand supplies water to Panvel Corporation area
- At Kharghar & Taloja Node, water is being supplied through CIDCO from Hetavane Dam.
- Maharashtra Jeevan Pradhikarn lifted Water from Patalganga River and it is treated at Bhokarpada and being supplied to Panvel corporation area i.e. Kalamboli, new Panvel and Old Panvel.
- For Kamothe water is supplied by the Navi Mumbai Municipal Corporation from Morbe Dam, and the water is treated at the Bhokarpada treatment plant.

The satellite image locations of the three aforementioned WTFs are shown in Figures 6.6, 6.7 and 6.8 below.
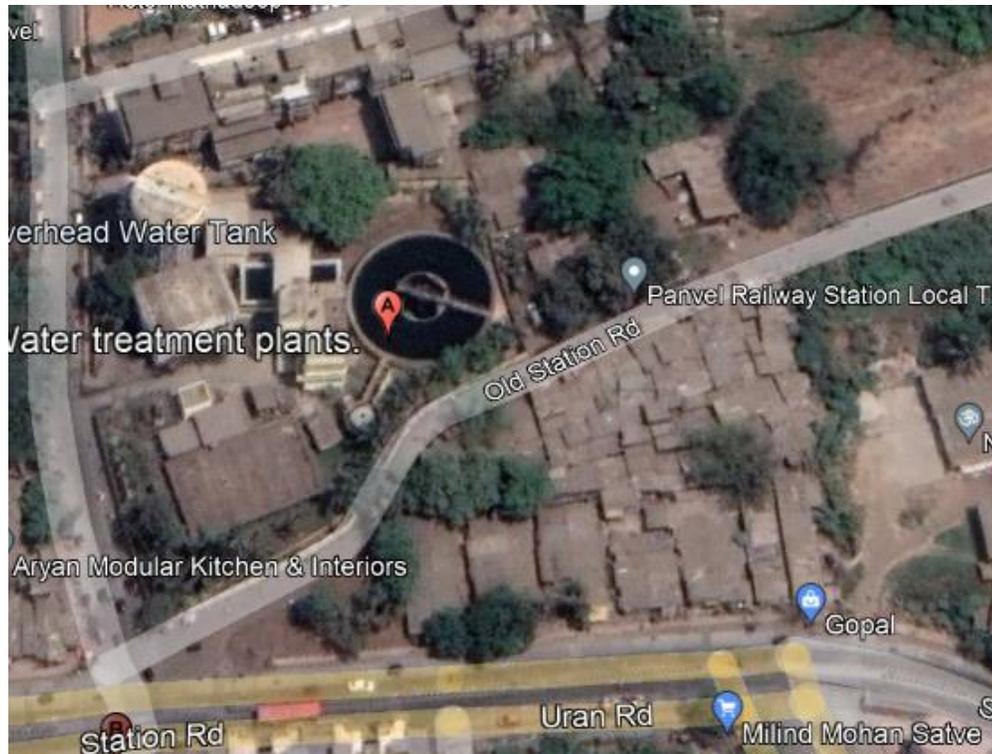
Figure 6.6: Panvel ST Stand WTP (18°59'24.59"N, 73° 7'4.63"E)
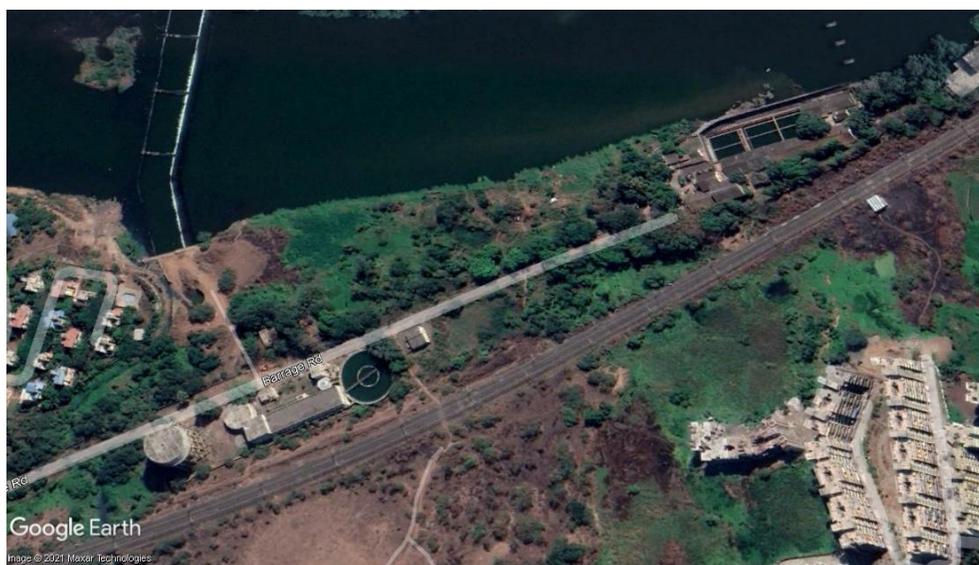
Figure 6.7: Badlapur Barrage Dam WTP (19°08'53.81" N, 73°15'09.89" E)
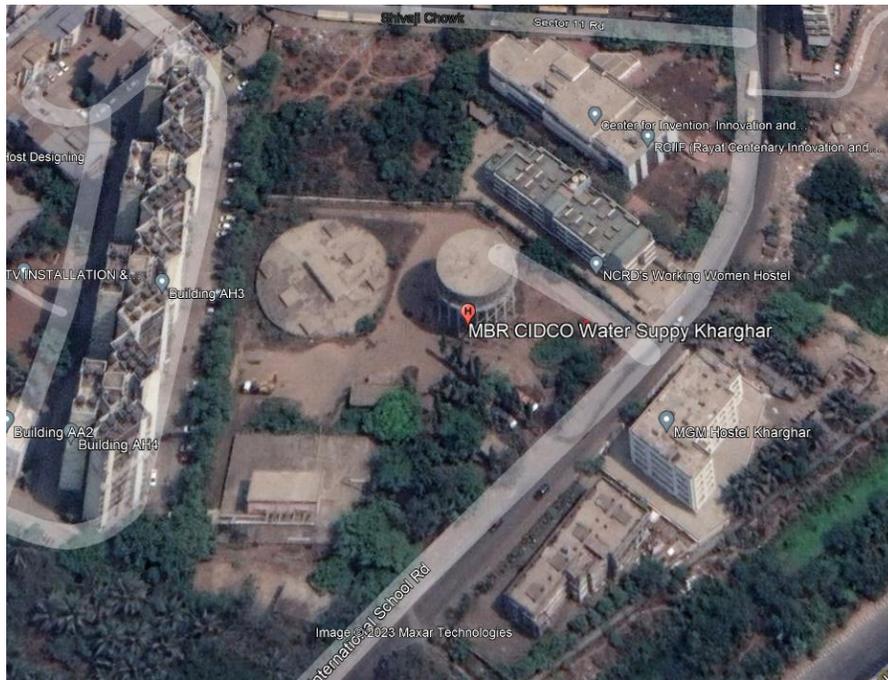
Figure 6.8: CIDCO Water Supply, Kharghar (19° 2'12.32"N, 73° 4'13.51"E)

The per-capita supply of treated water along with the sources is captured in Table 6.7 and Table 6.8 below.

Table 6.7: Per Capita Supply of Water

Details	Period	Mode of supply	Total water supply	LCPD
Existing Water Supply	4 hours	Metering	210 MLD	110
Minimum Water requirements as per norms.	24 hours	Metering	Not Applicable	135

Source: Water supply department of Panvel

Table 6.8: Water Supply by Type

Type	Numbers	Percentage (%)
Total no. of Tap	45,684	
Residential Connection	41,531	90%

Type	Numbers	Percentage (%)
Industrial Connection	4153	10%
Hand Pump	134	-
Borewells	183	-
Well	97	-

Source: Water supply department
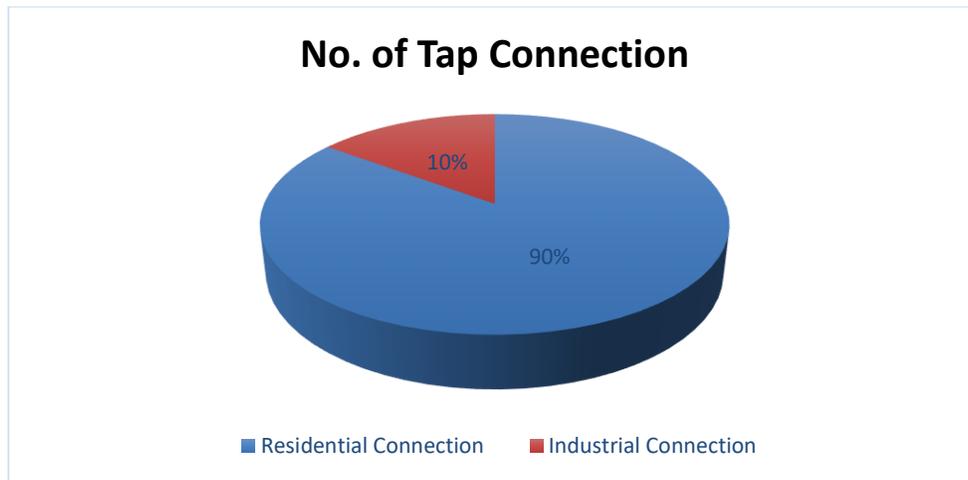
Figure 6.9: Tap Connections in Panvel

6.3   Ground Water

Due to rapid growth and urbanization, the dependency of PMC region on ground water for its daily activities are high compared to other regions in Raigad district. According to the block wise ground water assessment conducted by Central Ground Water Board (CGWB) in 2017, the ground water in Panvel Taluka was deemed 'safe'. Table 6.9 gives the details of ground water resources of Panvel Taluka.

Table 6.9: Ground Water Resources of Panvel Taluka (As on March 2009)

Net annual Ground Water Availability (ham)	**5098.74**
Existing Gross Ground Water Draft for Irrigation (ham)	824.84
Existing Gross Ground Water Draft for Domestic and Industrial Water Supply (ham)	359.42
Existing Gross Ground Water Draft for All Uses (ham)	1184.26
Provision for Domestic and Industrial Requirement Supply to 2025 (ham)	718.83
Net Ground Water Availability for Future Irrigation Development (ham)	3555.03
Stage of Ground Water Development (%)	22.23
Category	SAFE

Source: Central Ground information, Raigad District, CGWB Repot

6.3.1 Depth to water: Pre-monsoon and Post-monsoon at Raigad District
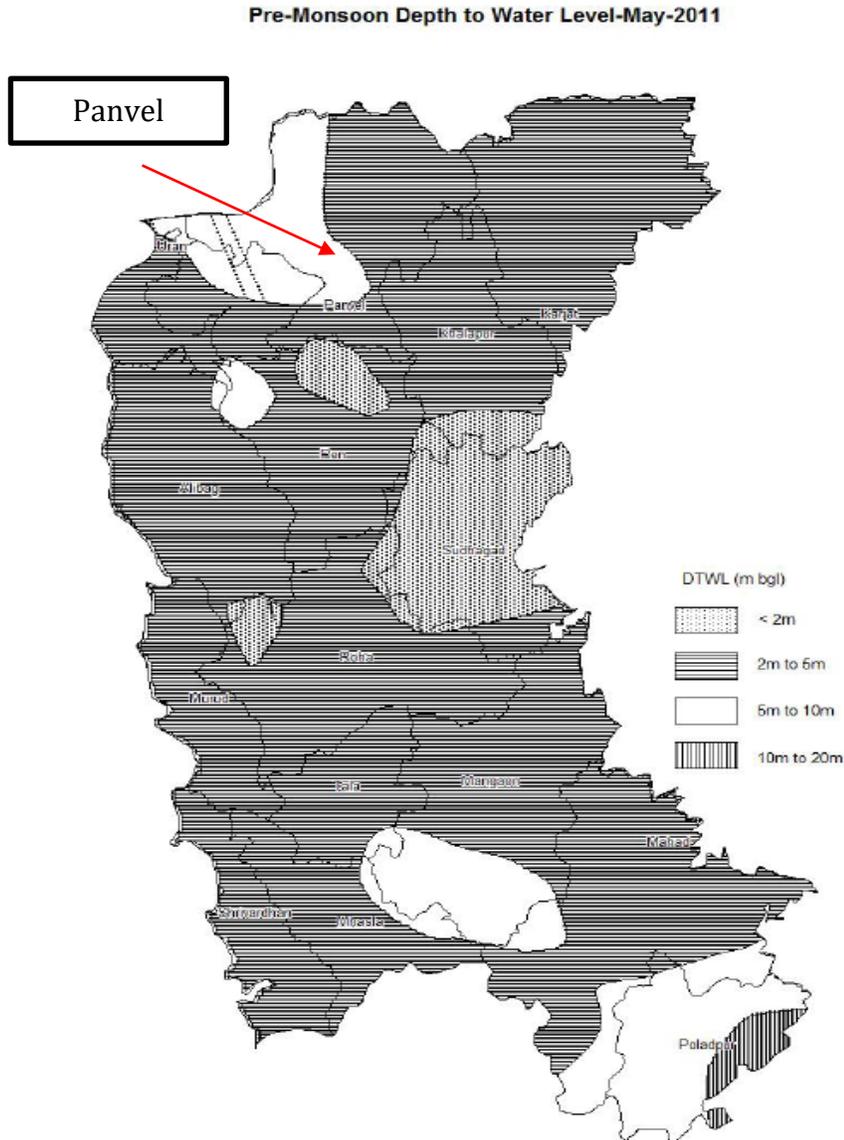
Figure 6.10: Pre-Monsoon Depth of Water Level in Raigad District, May 2011

(Source: Ground Water Information, Raigad District, CGWB Report)

Depth to water: Post-monsoon at Raigad District

Figure 6.11: Post-Monsoon Depth of Water Level in Raigad District November 2011

(Source: Ground Water Information, Raigad District, CGWB Report)

As shown in Figure 6.10, the pre-monsoon depth to groundwater in the eastern part of Panvel Taluka was reported to be in the range of 2m to 5m below ground level. The water table at the western part of Panvel Taluka was reported to be in the range of 5m to 10m below ground level. The post monsoon depth to water was reported in the range of 2 to 5 m below ground level, as seen in Figure 6.11.

6.4   Sewage Treatment

Sewerage systems are networks for collecting wastewater, conveying it via pipes, conduits, and ancillary works from origin to treatment before discharge back into the environment (Read, 1997). There are two types of sewage residual generated in urban areas, which are industrial sewage and residential sewage. The Panvel City consists of the areas earlier governed by CIDCO, Raigad Zilla Parishad, MIDC and PMC and hence different levels of development of sewerage systems exist in the city.
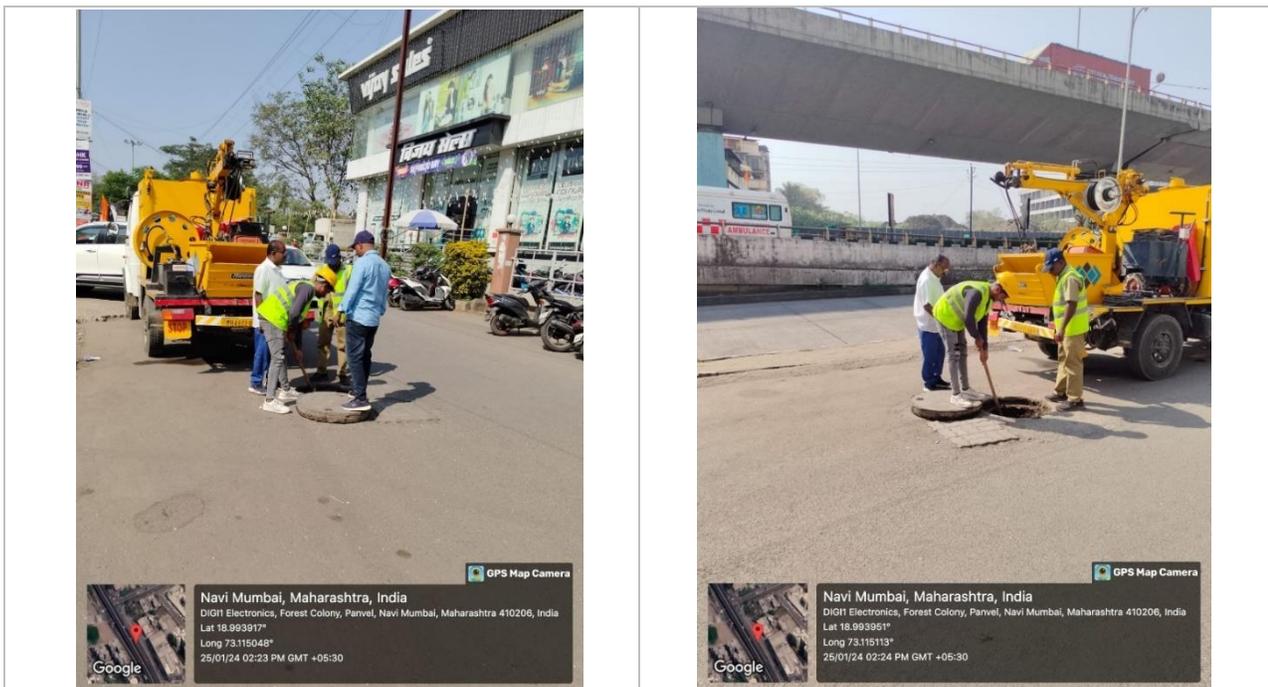
Source: Drainage Department, PMC

Figure 6.12: Sewerage systems

The PMC has its sewage treatment plant (STP) at Bandar Road with a capacity of 14 million liters per day (MLD). The remaining 6 STP Plants are in CIDCO Nodes and all the individual, public and common

toilets are connected through sewerage pipeline to these STPs. One STP Plant at Kamothe with the capacity of 85 MLD and another two STP's are at Kharghar with the capacity of 70 MLD, respectively. Taloja MIDC has a Common Effluent Treatment Plant (CETP) named Taloja CETP Cooperative Society Ltd located in Taloja, which is of 32 MLD capacity. Taloja CETP Co-operative Society Ltd. has a cluster of 1036 member industries. The remaining STPs are located in Kalamboli and Kalundre and their capacities are 50 MLD & 2 MLD, respectively. STPs and their capacities are given in table 6.10.

Table 6.10: Sewage Treatment Plant and capacities

Sr. No.	Sewage Treatment Plant and Location	Capacity (MLD)
1	STP at Bandar Road	14 MLD
2	Kamothe	85 MLD
3	STP at Kharghar	70 MLD
4	Taloja CEPT	32 MLD
5	Kalamboli	50 MLD
6	Kalundre	2 MLD

Source: Drainage Department, PMC

The satellite images of all the STP locations are provided under Figures 6.12 to 6.16. The technology used at STP is Sequencing Batch Reactor (SBR). The SBR is an advanced technology that uses a fill and draws activated sludge system for wastewater treatment. It is best for treating both industrial and municipal wastes. The main difference between SBR technology and other STP technologies is that SBR uses a single batch reactor/single tank to process the equalization, aeration, and clarification compared to other technologies that use different batch reactors for various processes.

Source: Drainage Department, PMC

SBR technology is considered to be one of the highest performed solutions for wastewater treatment. It requires minimum maintenance and has low costs. It can handle continuous batch operations successfully. The distinct qualities of SBR technology are as follows:

1. High removal capacity- SBRs efficiently remove pollutants from wastewater, making them suitable for both municipal and industrial applications1. They can handle fluctuating hydraulic and organic loads effectively

2. Versatile- SBRs can operate in both batch and continuous flow modes. They adapt well to varying influent conditions and can handle intermittent flow conditions1. Their versatility allows for flexible operation

3. Compliant with stringent discharge standards- SBRs meet stringent water quality standards. Their high removal efficiency ensures that treated effluent meets regulatory requirements

4. Economical Operation- SBRs have minimal maintenance requirements and lower costs compared to conventional systems. Their simple tank construction and geometry contribute to cost-effectiveness

The process of SBR is explained in the Figure 6.13 Below.
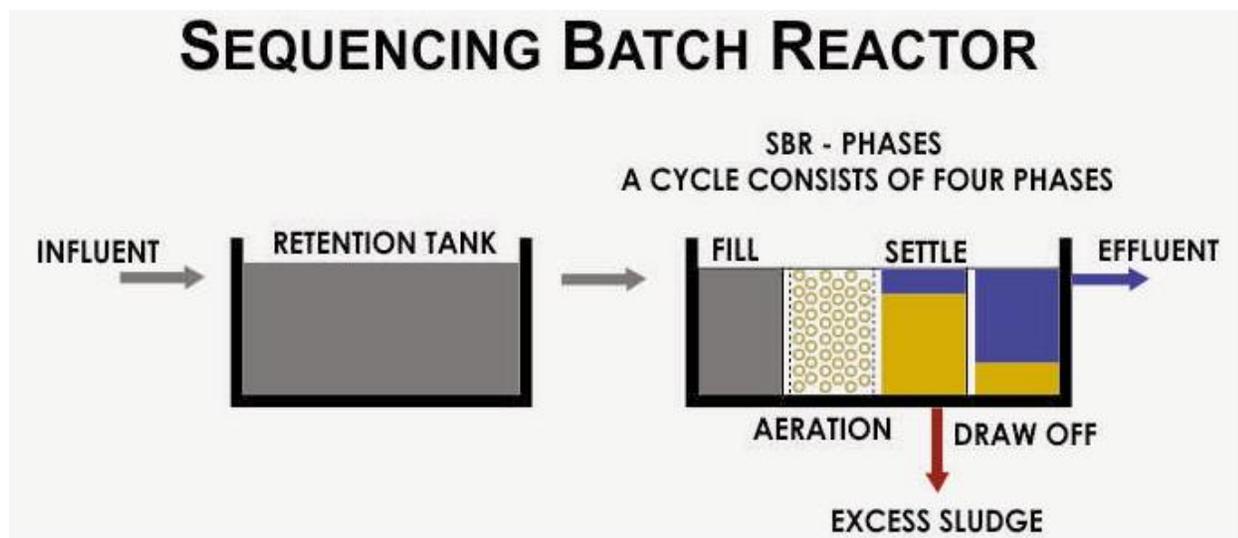
Figure 6.13The process of Sequencing Batch Reactor SBR

Figure 6.14: Kamothe STP (19° 0'48.62"N 73° 5'13.02"E), Capacity – 85 MLD
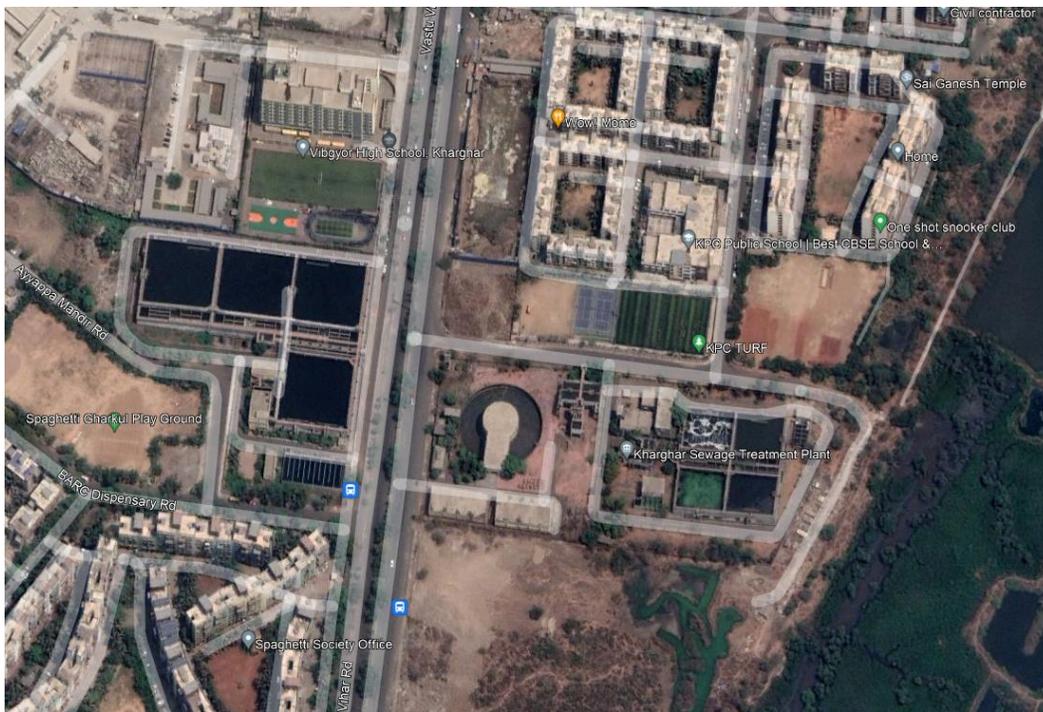
Figure 6.15: Kharghar STP (19° 2'31.38"N 73° 4'49.38"E), Capacity – 70 MLD

Figure 6.16: Kalamboli STP (19° 2'6.59"N 73° 5'52.45"E), Capacity – 50 MLD

Figure 6.17: Taloja STP (19° 4'21.72"N 73° 5'33.21"E), Capacity – 32 MLD
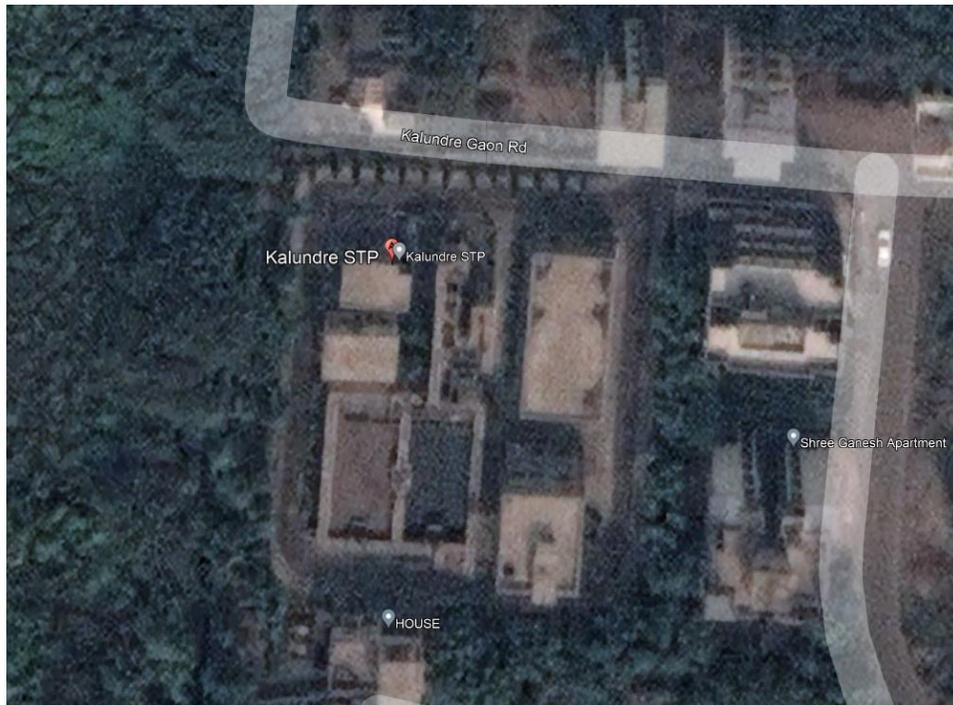
Figure 6.18: Kalundre STP (18°58'40.02"N 73° 7'32.12"E), Capacity – 2 MLD

Source: www.mapsofindia.com

The effluent generated by the industries is collected through gravity lines in two collection sumps, one near Ghot Village and the other at CETP. From the Collection Sump at Ghot village, effluent is pumped to the collection sumps of the CETP. The equalization tank is used to dampen the variations in the quality and flow rate. To keep the effluent suspended solids away from settling and ensure proper mixing floating aerators are installed in old plants and diffused coarse aeration are there in the expanded plant. The pH correction is carried out with lime, if required.

The effluent is pumped to a flash mixer wherein Poly Aluminum Chloride (PAC) is dosed with rapid mixing and led to clariflocculator to flocculate. The flocculated mass then coagulates and settles resulting in the removal of certain portion of suspended organic matter. The Suspended Solids settle down in Primary Clariflocculator, leaving the clear supernatant overflow from the weir top, which is termed as primary treated effluent. The primary treated effluent goes to the Aeration Tank for secondary biological treatment. The settled sludge is scrapped with a scrapper mechanism and

pumped to the sludge sump, further thickened in a thickener and dewatered with Centrifuge Decanter. The centrate water of the Centrifuge Decanter is taken to Equalization Tank for further treatment. In the Aeration Tank, only sludge remains, which is a heterogenic microbial culture. Diffused Aeration System supplies the oxygen required for micro-organism. The bacteria consume the organic matters present in the effluent as their food source and produce Carbon Dioxide and water as by-products. The overflow of the Aeration Tank flows to the Secondary Clarifier where Mixed Liquor Suspended Solids (MLSS), which is a form of biomass only, settle down, leaving clear supernatant at the top, which is treated water. The treated water is discharged in the *Waghivali Creek* by pumping through High Density Polyethylene (HDPE) closed pipeline. The settled sludge is partially recycled back to Aeration Tank to maintain the MLSS concentration in it and partially wasted in the sludge sump. The MLSS is dewatered and dried along with the sludge which is generated in the primary treatment. The dried sludge is sent to Mumbai Waste Management Ltd. for further disposal by secured landfilling as per the consent conditions.

Though the waste residual from industries is treated by CETP, it is observed that many industries in Taloja discharge residual water in Kasadi River. It is also observed that severe pollutants are discharged at Waghivali Creek by CEPT which are hazardous for residents' health, ecosystem of the river and biodiversity in that region. The sludge is also a matter of grave concern. Lead metal and many chemical components in the sludge generate harmful effects on the ecosystem, including vegetation, aqua system and wildlife in the vicinity.

6.4.1 Reuse of Treated wastewater in Panvel

The sewage Treatment Plants in Panvel process around 80 MLD of wastewater daily. Which further highlights the significant reuse of treated water from the five sewage treatment plants (STPs) in Panvel, collectively capable of treating 221 MLD of wastewater. Importantly, around 30 to 40% of this treated water is repurposed for various beneficial applications, contributing to sustainable water management practices.

Table 6.11Detail of STP Plant

Sr. No.	Sewage Treatment Plant and Location	Capacity (MLD)	Treated waste Water generated (MLD)	Treated water Reused (MLD)
1	STP at Bandar Road	14 MLD	8.10	4.06
2	Kamothe	85 MLD	0.72	
3	STP at Kharghar	70 MLD	17.22	1.07
4	Kalamboli	50 MLD	29.98	14.08
5	Kalundre	2 MLD	10.12	3.20

Source: Drainage department

One notable aspect of the reuse initiative is the utilization of treated water to irrigate green spaces within the region. Specifically, the Panvel Municipal Corporation leverages this resource to water 98 gardens under its jurisdiction. This reuse strategy not only conserves freshwater resources but also promotes the health and vitality of urban greenery, enhancing the aesthetic appeal and environmental quality of the community.

Source: Drainage Department, PMC

Figure 6.19: Reuse of Treated wastewater

Furthermore, the report underscores the direct supply of treated water from the STPs to prominent public amenities, namely Central Park and the golf course in Kharghar. Through dedicated pipe

connections, these facilities receive a reliable and sustainable water source, reducing dependency on freshwater reserves and mitigating the environmental impact associated with conventional water sourcing methods.

Overall, the reuse of treated water from the Panvel STPs exemplifies a proactive approach to environmental stewardship and resource conservation. By repurposing wastewater for irrigation and public amenities, the region not only minimizes water wastage but also contributes to the creation of resilient and sustainable urban landscapes. This initiative aligns with broader efforts to address water scarcity challenges and promote holistic environmental management practices within the community.

Ongoing Projects in support for Improvement in Water Conveyance system:

Projects Comes Under AMRUT 2.0

1. **Water supply distribution system in gaothan area of 29 revenue villages**
    *   Road restoration work and pipes of different diameters are part of the water distribution network system.
    *   The feeder main, which includes the pumping machinery, SCADA, sump construction, tapping point to ESR of different widths, etc.
2. **Pisarve lake Rejuvenation**- Desilting, walkway, tree plantation, Pergola structure. hawker zone, a parking area (2-wheeler- 49 & 4-wheeler-51), immersion pond, security cabin, parking fountain, toilet block
3. **Construction of STP-15.50 MLD-Panvel city**- Construction of STP, Sewage pumping station, electromechanical equipment, rising main and piping of various diameter
4. **Providing sewer line system to Gaothan area of 29 revenue villages**- Providing sewer lines of various diameters, pumping stations, construction of sewer manholes, construction of STP and Portable treatment plants
5. **Providing, installing, testing of AMR domestic and non-domestic water meter excl. CIDCO nodes under Panvel Municipal Corporation**- Battery operated/water meters total 11,561 nos. Bulk water meter total 414 nos.

7. Soil Environment

Soil may be defined as a thin layer of earth's crust which serves as a natural medium for the growth of plants. It is the unconsolidated mineral matter that has been subjected to, and influenced by genetic and environmental factors – parent material, climate, organisms and topography all acting over a period of time. They serve in varying degree as a reservoir of nutrients and water for crops, provide mechanical anchorage and favorable tilt. The components of soil are mineral material, organic matter, water and air, the proportion of which vary and which together form a system for plants growth; hence the need to study the soils in perspective.

A study of the soil profile is important from a crop husbandry point of view, since it reveals the surface and the sub- surface characteristic and qualities, namely, depth, texture, structure, drainage conditions and soil moisture relationship which directly affect the plant growth. A study of soil profile supplemented by physical, chemical and biological properties of the soil will give full picture of soil fertility and productivity. Physical properties of the soil include water holding capacity, aeration, plasticity, texture, structure, density and color etc. Chemical properties refer to the mineralogical composition and the content of the type of minerals such as Kaolinite, illite and montmorillonite, base saturation, humus and organic matter content. The biological property refers to a content of extent and types of microbes in the soil, which include bacteria, fungi, worms, and insects. Soil formation in Maharashtra mainly depends on the organic components, original rock, climate, the slope of the land and time. According to the climates in different regions and types of rocks, different classifications of soils are formed. A long time is required for the formation of mature soil, as it is a very slow process.

Some dominant groups of Indian soil, classified according to soil taxonomy and chemical property:
1) **Red Soil**: They are widely spread. The red color is due to diffusion of iron in the soil.
2) **Lateritic Soil**: They are composed of mixture of hydrated oxides of Aluminum and Iron with small amounts of fertility.
3) **Black Soil**: It contains a high proportion of Calcium and Magnesium Carbonates and has a high degree of fertility.

4) **Alluvial Soil:** This forms the largest and agriculturally most important form of soil.

5) **Desert Soil**: Occurs mostly in dry areas and important content is quartz.

6) **Forest and Hill Soils:** high in organic matter.

Source: https://www.gktoday.in/types-of-soils-in-india/

In Konkan zone, mostly laterite and acidic coarse, shallow soil is found and in western ghat zone, light, laterite and reddish-brown soil is found. Most of the rivers flowing in the Konkan area are small and flow with great speed. Therefore, the silt brought by them accumulates at the mouth of the rivers. These categories of soil / silt are found along the mouths of the rivers along the west coast, e.g., the Panvel-Uran coast, Dharamtar Bay etc.

To study the soil quality, soil samples were collected from all the four wards of Panvel. The activities around the sample sites were conducted by taking into consideration to understand the sources of pollution or the factors governing the physico-chemical properties of the soil. Analytical soil sampling results from the laboratory are tabulated and attached in Annexure IV of the report below. The analytical results indicates that the soil texture is sandy and the pH of the soil is ranged between 6.43- 8.56. "Mild Alkaline" soil was observed at the residential area. In other locations, it varied from "Slightly acidic" to "Moderately alkaline". Especially in industrial areas the reported results indicate that the pH is slightly acidic due to the use of toxic chemical in industrial processes. The values for nitrogen at all locations varied between 147-206 kilograms per hectare (kg ha^{-1}) This indicates that Nitrogen is 'Low' as per the classification at all the locations. Sandy soil may lose nitrogen through leaching, while heavy, poorly drained soils may lose nitrogen through denitrification. Without enough nitrogen in the plant, the plant cannot grow taller, or produce enough food (usually yellow). The concentration of phosphate was estimated to be between 19-28 kg ha^{-1}. The highest concentration can be observed at location SQ2, while the lowest concentration can be observed at location SQ1 during the monitoring period (for the monitoring locations, please refer Annexure IV). It is observed that phosphate concentration was reported to be in the 'Medium' range as per chemical classification of soil quality. The concentration of potassium was found to be ranging between 869-1290 kg ha^{-1}. Here it is observed that potassium concentration was reported to be in the 'Very High' range as per chemical classification of soil quality. A severe excess concentration of potassium in the soil will cause the clay particles to disperse and clog needed pore space so that water will tend to stand on top instead of infiltrating the soil. Plants need

significant amounts of nitrogen, phosphorus, and potassium (NPK) to grow and thrive. Well-fed plants are healthier and more productive. For the optimal growth of crops, sufficient amounts of nutrients should be available in the root zone of the crops. These nutrients are supplied by the soil and should be partly added with organic manures and fertilizers. Soils will contain different amounts of available nutrients, depending of the parent material (e.g., sand, clay, peat), and differences in the management history such as preceding crops, management of crop residues and use of manure and fertilizers in the past. Also, differences in climatic conditions may alter the available nutrients. For that reason, it is of utmost importance for farmers to know the NPK content of their soil, so that they know how much N, P and/or K they should add with organic or mineral fertilizers, to optimize crop growth, production and yield.

8. Biodiversity

Biodiversity is the variety of life on Earth, it includes all organisms, species, and populations; the genetic variation among these; and their complex assemblages of communities and ecosystems. Biodiversity is a variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystem. Biodiversity forms the foundation of the vast array of ecosystem services that critically contributed to human well-being. Biodiversity is important in human managed as well as natural ecosystem.

Our planet's essential goods and services depend on the variety and variability of genes, species, populations and ecosystems. Biological resources feed us, provide housing infrastructures, provide medicines and also support spiritual nourishment. The natural ecosystems of forests, savannah, pastures and rangelands, deserts, tundra's, rivers, lakes and seas contain most of the Earth's biodiversity. The decline in biodiversity is largely the result of human activities and represents a serious threat to human development. The loss of biological diversity may reduce the resilience of ecosystems to climatic variations and air pollution damage. Atmospheric change can have an important impact on forests, biodiversity, and freshwater and marine ecosystem, as well as on economic activities, such as agriculture (UNCED, 1992).

All of the Earth's species work together to survive and maintain their ecosystems. However, much of the Earth's biodiversity is in jeopardy due to anthropogenic activities and other activities that disturb and even destroy ecosystems. Pollution, climate change, and population growth are all threats to biodiversity. These threats have caused an unprecedented rise in the rate of species extinction. Some scientists estimate that half of all species on Earth will be wiped out within the next century. Conservation efforts are necessary to preserve biodiversity and protect endangered species and their habitats.

Urbanization is often cited as a major reason for loss of native biodiversity and its replacement with non-native vegetation across the world (McKinney, 2002; Sanderson *et al.*, 2002). While urbanization

does have an intense effect on native biodiversity and dramatic transformation of biophysical processes, there is also a growing recognition that urban areas are heterogeneous with variations and transitions in the synthesis of social, political, economic, biophysical processes at different scales (Cadenasso, Pickett, & Schwarz, 2007). Urban ecosystems serve as key sites where scholars across disciplines find common ground to explicitly integrate the dynamics of social-ecological and political processes (Francis, Lorimer, & Raco, 2011).

Measures of Biodiversity

In spite of many tools and data sources, biodiversity remains difficult to quantify precisely. But precise answers are seldom needed to effectively understand where biodiversity is, how it is changing over space and time, the drivers responsible for such change, the consequences for ecosystem services and well-being, and the response options available. Ideally, to assess the conditions and trends of biodiversity either internationally or nationally, it is necessary to measure the abundance of all organisms over space and time, using taxonomy (such as the number of species), functional traits (for example, the ecological type such as nitrogen- fixing plants like legumes versus non- nitrogen fixing plants), and the interaction among species that affect their dynamic and function (predation, parasitism, competition, and facilitation such as pollination, for instance, and hoe strongly such interactions affect ecosystems).

Currently, it is not possible to do this with much accuracy because the data is reportedly lacking. Even for the taxonomic component of biodiversity, where information is the best, considerable uncertainty remains about the true extent and changes in taxonomic diversity (Hassan, Scholes, and Ash, 2005). There are many measures of biodiversity; species richness (the number of species in a given area) represents a single but important metric that is valuable as the common currency of the diversity of life but it must be integrated with other metrics to fully capture biodiversity (Hassan, Scholes and Ash, 2005).

Panvel is a locality of the Konkan Division of Raigad District in the state of Maharashtra. The region is situated on the banks of the Gadhi River (Kalundre river) with coordinates

18°59'40"N 73°06'50"E and MSL 28 m. it falls in between the geographical zone of western ghats and Malabar Coastal region. The place is by far the largest and most popular city in the Raigad district. It is the node of Navi Mumbai as it in the center. The whole area of Panvel comprises a small patch of forest, open grass, scrub, agriculture and plantations, freshwater wetlands, urban parks, gardens, or avenues. The adjoining river opens into a creek known as Panvel Creek. Panvel soil is rich in minerals, but the human-dominated localities in Panvel range from rural agro landscapes to core urban zones. In addition to this, the area has substantial numbers of estuarine habitats that harbor many mangrove species. Environmentalists and some local citizens pointed out that the Gadhi River, is in a poor condition due to unreated sewage wastewater is reportedly getting dumped. Local citizens of Panvel have urged the authorities to clean the river, but the situation of the river has only deteriorated

Suggestion

Environmental protection is an integral component of sustainable development. The environment is threatened in all its biotic and abiotic components: animals, plants, microbes and ecosystems comprising biological diversity; water, soil and air, which from the physical components of habitats and ecosystems; and all the interactions between the components of biodiversity and their sustaining habitats and ecosystem. With the continued increase in chemicals usage, energy and non- renewable resources by an expanding global population, associated environmental damage caused by over consumption, the quantities of waste generated, and the degree of unsustainable land use appear likely to continue growing (UNCED, 1992).

The need for a diverse genetic pool of plant, animal and microbial germ plasma for sustainable development is well established. Biotechnology is one of the tools that can play an important role in supporting the rehabilitation of degraded ecosystems and landscapes (UNCED, 1992).

As per newsband news release on 31 Jan, 2023, Panvel will soon have around ten new parks with different themes. One of them is the bio-diversity park in Panvel sector-5, the work of which is likely to get completed by end of Q3 FY 2024. Since there are no zoos or animal related parks in the city, this shall ideally be the first garden with information on various local animals and birds of Raigad- Panvel region. Another news published in Hindustan Times on 24 May, 2023 was on the aspects of

reforestation at Taloja Hill forest. A barren patch of Taloja Hill is now brimming with greenery and wildlife because of the three-year reforestation drive by local NGOs with the help of the State Forest Department's Alibaug unit and the local community.

A survey for biodiversity was carries out in 2016, where thousands of different tree types were found along with animals and birds which are common in Panvel and Raigad District. Source: www.newsband.in

Few of the identified species are shown in Figure 8.1 below.

Common Indian Toad	**Common Tree Frog**
Fungoid Frog	**Bush Frog sps.**

Northern cricket frog	**Common Skittering Frog**
Indian Spectacled Cobra	**Common Green Frog**
Saw-scaled Viper	**Common Krait**

Gram Blue	**Tiny Grass Blue**
Common Iora	**Wood Sandpiper**
Crested Serpent Eagle	**White-throated Fantail**

White-eyed Buzzar

Rufous Woodpecker

Hibiscus

Khair

Babul

Adulsa

| Kaju Tree | Jackfruit Trees |

Figure 8.1: Common Species of Flora & Fauna Found in Panvel

Tree Cover

Urban tree ecosystem provides a range of social and ecological services, but due to the heterogeneity of these canopies, their spatial extent us difficult to quantify and monitor. Traditional pre-pixel classification methods have been used to map urban canopies; however, such techniques are not generally appropriate for assessing these highly variable landscapes. Landsat imagery has historically been used for pre-pixel driven land use/land cover (LULC) classifications, but the spatial resolution limits our ability to map small urban features. In such cases, hyper spatial resolution imagery, such as aerial or satellite imagery with a resolution of one meter or below is preferred. Analysis and classification of remote sensing imagery, along with geographic information system (GIS) analysis and modeling provide the most efficient method for assessment. The detailed survey of biodiversity reveals that there has been a decrease in tree cover and trees are cut due to construction activities by private builders in the city.

The state of biodiversity is very well rich in Panvel city. As the temperature of the city is moderate this facilitates a better living environment for human beings and also for the ecosystem. There might be changes is the biodiversity count in the past few years due to changing climatic conditions and natural calamities. Up to 2607 mm of precipitation was observed in the month of July 2022. Various species of birds and butterflies were observed in that area. Also, various reptile species can also be spotted in the city.

India is one of the recognized mega-diverse countries of the world, harboring nearly 7-8% of the recorded species of the world, and representing 4 of the 34 globally identified biodiversity hotspots (Himalaya, Indo-Burma, Western Ghats and Sri Lanka, Sundaland).

Source: Main Details (cbd.int)

India is also a vast repository of traditional knowledge associated with biological resources. So far, over 91,200 species of animals and 45,500 species of plants have been documented in the ten biogeographic regions of the country. Inventories of floral and faunal diversities are being progressively updated with several new discoveries through the conduct of continuous surveys and exploration. Along with species richness, India also possesses high rates of endemism. In terms of endemic vertebrate groups, India's global ranking is tenth in birds, with 69 species; fifth in reptiles with 156 species; and seventh in amphibians with 110 species. Endemic-rich Indian fauna is manifested most prominently in Amphibian (61.2%) and Reptilian (47%). India is also recognized as one of the eight Vavilov Ian centers of origin and diversity of crop plants, having more than 300 wild ancestors and close relatives of cultivated plants, which are still evolving under natural conditions.

The main threats to biodiversity include habitat fragmentation, degradation and loss; over-exploitation of resources; shrinking genetic diversity; invasive alien species; declining forest resource base; climate change and desertification; impact of development projects; impact of pollution. Against the backdrop of the varying socio-cultural milieu and often conflicting demands of various stakeholders, there is an urgent need for augmenting and accelerating the efforts for the conservation and sustainable use of biodiversity, and for the fair and equitable sharing of benefits arising from the utilization of genetic resources.

Human activities are disturbing both structure and functions of ecosystem and altering biodiversity. Such disturbances reduce the abundance of some organisms, causing an increase in the population of other organisms, modifying the interaction among organisms, and altering the interactions between the organisms and their physical and chemical environments. Patterns of infectious diseases are sensitive to these disturbances.

9. Solid Waste Management

Municipal solid waste (MSW) is defined as waste collected by the municipality or disposed of at the municipal waste disposal site and includes residential, institutional, commercial, municipal, and construction and demolition waste. MSW management includes the collection, transportation, and responsible disposal of waste generated in the city.

"Solid Waste" means and includes solid or semi-solid domestic waste, sanitary waste, commercial waste, institutional waste, catering and market waste and other non-residential wastes, street sweepings, silt removed or collected from the surface drains, horticulture waste, agriculture and dairy waste, treated bio-medical waste excluding industrial waste, bio-medical waste and e-waste, battery waste, radio-active waste generated in the area under the local authorities and other entities mentioned in rule 2 (SWM Rules 2016)

Solid waste generation is a continuously growing problem at all levels including local levels. Solid wastes are those organic and inorganic waste materials produced by various activities of the society, which have lost their value to the first user. Improper disposal of solid wastes pollutes all the vital components of the living environment (i.e., air, land and water) at local and global levels. Urban society rejects and generates solid material regularly due to rapid increase in production and consumption. The problem in India is more acute as its economic growth and urbanization have been very rapid in recent times. This necessitates management of solid waste at generation, storage, collection, transfer and transport, processing and disposal stages in an environmentally sound manner in accordance with the best principles of public health, economics, engineering, conservation, aesthetics and environmental considerations. Thus, solid waste management includes all administrative, financial, legal, planning, and engineering functions.

Source: www.sciencedirect.com/topics/engineering/municipal-solid-waste

The daily average solid waste generated and collected by PMC in 2023 was about 470.8 tons per day (TPD). (As per recent property tax survey 2021- current population will be 15,01,132 (HH 3,10,689))

The main source of solid waste is primarily from the residential areas and commercial areas, falling within the PMC area. The other sources of solid waste in PMC area are Residential area waste, vegetable market waste, Institutional waste etc. Total waste generation in PMC is mentioned in Table 9.1

Table 9.1: Category wise Quantity of Waste Generated in PMC

Waste Generating Source	Waste (in TPD)	(%) share of waste generated
Residential area- colonies, apartment complexes	350	74.34
Commercial establishments, malls	62	13.17
Hotels and Restaurant	20	4.25
Markets (Vegetable Markets, Mandi, etc.)	30	6.37
Institutional areas, office, schools, universities	5.8	1.23
Hospital and nursing homes (excluding biomedical waste)	3	0.64
Total Waste Generated	**470.8**	**100**

Source: SWM Department, Panvel 2023

At present, the total waste generated in the city is estimated to be around 470.80 TPD

PMC has implemented a door-to-door collection mechanism to collect solid waste effectively. PMC has approximated 95-100%door to door collection facility.

9.1   Segregated Waste Transport

More than 90% of the municipal wastes are transported through segregated waste transport system. There is 58 *Ghanta Gadis* that collect and transport municipal solid waste. These *Ghanta Gadis* go door to door to collect solid waste. There are 25 compactors for the transport of solid

Figure 9.1: Ghanta Gadi

waste to the processing facility at Taloja. All the vehicles are monitored with the help of GPS technology.
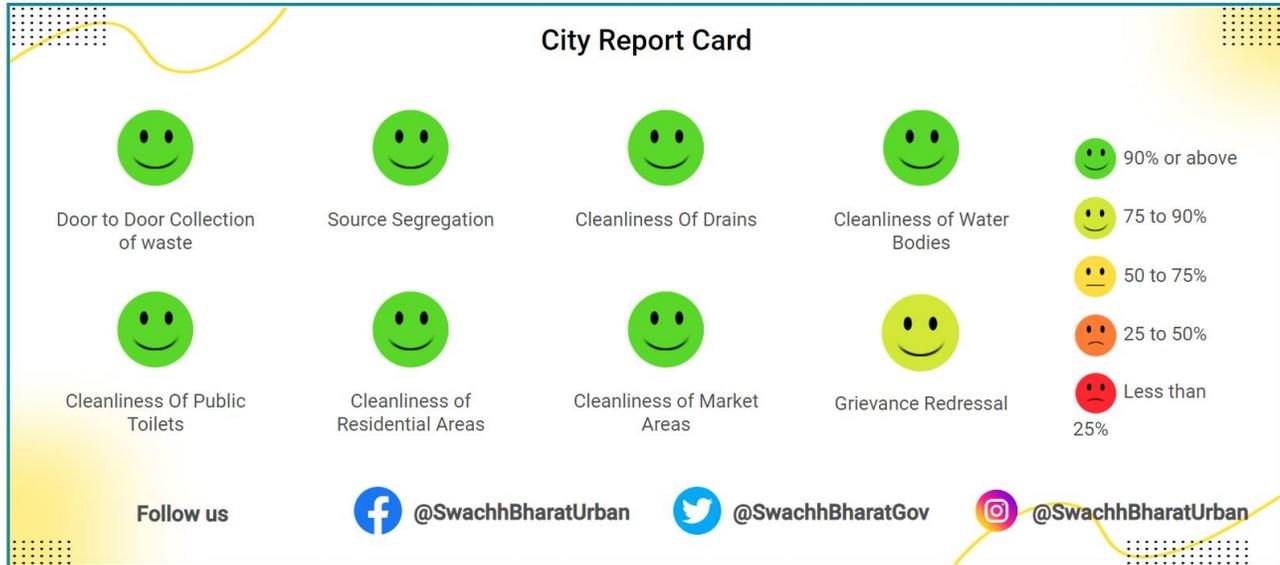
Note: The above results are based on citizen feedback and field assessment of Swachh Survekshan 2022

9.2 Segregation, Treatment and Disposal

The processing of solid waste is also an important task in solid waste management. Total 470.8 TPD municipal wastes are processed in CIDCO Solid Waste Management Plant, Taloja. Segregated organic waste is processed at a materials recovery facility (MRF), a place where solid wastes are delivered to be separated, processed, and stored for later use as raw materials for remanufacturing and reprocessing refuse-derived fuel (RDF) is produced. The PMC has its landfill site at which old solid waste is processed. Sanitary waste, Domestic Hazardous waste and Bio-Medical waste is transported to Mumbai West Management Company, run By RAMKY at Taloja. RAMKY process it with the help of an incineration facility and then a scientific landfill disposal happens at a secured landfill is carried out.

9.2.1 Dry Waste Processing Plant

The residents and students in schools and colleges are trained to segregate organic and inorganic waste and process organic waste to compost fertilizer. Panvel Municipal Corporation launched Dry

waste collection passbook program, through which PMC have spread awareness on waste segregation with the help of School Children's. As shown in figure 9.2

Figure 9.2 Dry Waste Processing Plant

Source: SWM Dept, PMC

9.2.2 Wet Waste Processing Plant

Panvel Municipal Corporation has mandated 23 residential societies, who are producing more than 100Kg waste/Per day, to install on site wet waste processing plants. These societies are called as **Bulk Waste Generators.** As per Solid waste Management Rules 2016, "**Bulk Waste Generator"** means anyone having an [Grab your reader's attention with a great quote

Figure 9.3:Wet Waste Processing Plant

from the document or use this space to emphasize a key point. To place this text box anywhere on the page, just drag it.]

average waste generation rate exceeding 100 kg per day (of all waste streams put together).

At PMC, more than 100 kg per day waste is processed in compost fertilizer trunks and the produced fertilizer is used from plants in the area. In addition, 780 litter- bins with separated compartments for organic and inorganic waste installed in residential and commercial areas in the city, which are maintained and monitored by Collection and Transportation contractor. Other physical components of the waste and their quantities are tabulated in Table 9.2 below.

Table 9.2: Average Waste Composition from PMC

Sr. No.	Components	Percentage
1	Plastic, Plastic bags etc.	9.86
2	Paper waste	8.01
3	Glass & metals	3.45
4	Leather, rubber & synthetics	2.58
5	Tetra Packs and laminated plastics	5.78
6	Clothes and rags	7.70
7	Food waste/ organic	42.87
8	Horticulture waste & wood	5.36
9	Miscellaneous inert, ash, soil, silt	14.41
	Total	100.00

Source: SWM DPR for PMC

9.3 Action on Single Use Plastic Waste

Panvel Municipal Corporation conducts regular awareness campaign for ban on single use plastic. As per recent update, single use plastic with <100 microgram size is banned in city. Panvel Municipal Corporation conducts raids and penalizes the shops, restaurants and other institutions that use singe use plastic. In 2023-24 more than 1141.36 kg single use plastic seized and more than 1.95 lakh rupees fine levied on violators.

9.4 Waste to Art and RRR

Panvel Municipal Corporation installed 10 Reduce Reuse and Recycle Center across 20 wards in the city. These centers are located at high-footfall area and PMC organized awareness campaign regarding RRR centers and their benefits. Thousands of needy are benefitted from these RRR centers. Important squares and rotaries in the city are beautified by using waste material. Art structures are produced out of the waste material. One of the most beautiful wastes to Art Structure is "City Bus" Structure installed at Shilp Chowk Kharghar

9.5 Biomedical Waste

Medical care is crucial for human health but the wastes associated with medical facilities causes a direct impact on community. Hence it is crucial to scientifically manage and dispose biomedical waste to reduce its direct impact on the environment as well as on humans. According to Biomedical Waste Management Rules, 2016, it is mandatory to follow notified rules for all persons who generate, collect, receive, store, transport, treat, dispose or handle biomedical waste in any form including hospitals, nursing homes, clinics, dispensaries, veterinary institutions, animal houses, pathological labs, blood banks, research and educational institutions, health camps, vaccination camps, forensic labs, blood donation camps, first aid rooms of schools.

Figure 9.4: Bio-Medical Plant

RAMKY Engineering (RE) collect, transport and process Biomedical Waste generated from medical facilities across the city. Incineration plant is one of the best plants in MMR region and real time data synchronizes with Central Pollution Control Board (CPCB) portal.

10. Primary Monitoring

Primary environmental monitoring was carried at selected locations at Panvel city in the month of December 2023. Monitoring for water quality, soil quality, ambient air quality, and ambient noise level monitoring was done by Ultra-Tech Lab. The number of sampling locations for primary monitoring are given in Table 10.1. The results of the primary monitoring are described in the following sub-sections.

Table 10.1: Number of Sampling Locations for Primary Monitoring

Particulars	No. of Sampling Locations
Ambient Air Quality	4
Ground Water Quality	5
Surface Water Quality	8
Ambient Noise Levels	4
Soil Quality	4

10.1 Ambient Air Quality

Ambient air quality was monitored at four locations inside Panvel city to assess the ambient air quality status of the area and also to check its conformity with the National Ambient Air Quality Standards (NAAQS) specified by Central Pollution Control Board (CPCB).

The monitoring locations were selected based on the data analysis done for the past years, topography of the study area and the location of potential sensitive receptors. The factors considered while selecting of the monitoring locations include:

• Topography of the study area

• Representative nature of the sample

• Accessibility

- Location of the receptors

- Availability of power

Particulate Matter – size less than 2.5 µg/m^3 (PM$_{2.5}$), Particulate Matter -– size less than 2.5 µg/m^3 (PM$_{10}$), Nitrogen Oxides (NO$_X$), Sulphur Dioxide (SO$_2$), and Carbon Monoxide (CO) were monitored at four locations. Monitoring was done on 19 January 2024. Monitoring locations for ambient air quality was selected based on the guidelines given in Environmental Impact Assessment manual from the Ministry of Environment, Forest and Climate Change (MoEF&CC). The purpose is to ascertain the baseline pollutant concentrations in ambient air in and around the study area. Ambient air quality monitoring locations are shown in Figure 10.1 below. The details of the monitoring stations are given in Table 10.2 below. The sampling methodology and protocol are given in Table 10.3. The monitoring results are given in Table 10.4 below.
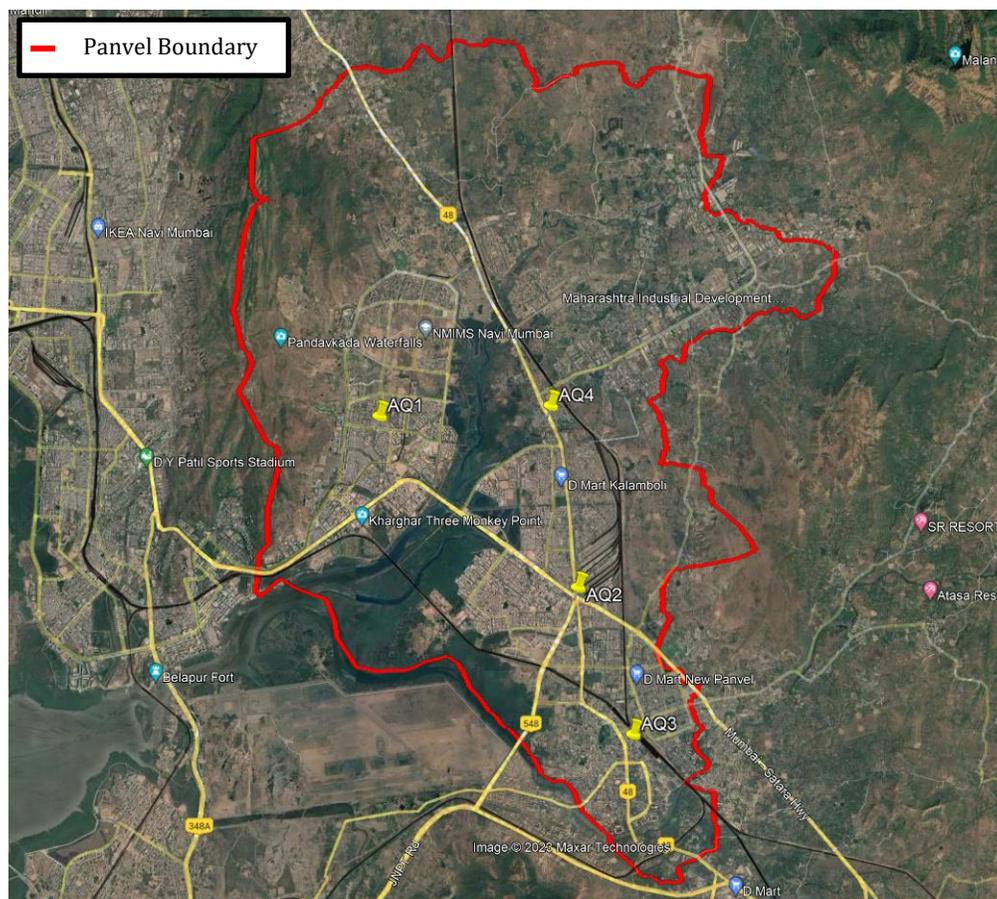
Figure 10.1: Ambient Air Quality Monitoring Locations

Table 10.2: Ambient Air Quality Monitoring Locations and Parameters

Code	Site Location	Location Coordinates	Landmark	Parameters
AQ1	Shilp Chowk	19°2'50.23"N 73° 4'11.65"E	Residential Area	PM_{10}, $PM_{2.5}$, SO_2, NO_X, CO
AQ2	Kalamboli Circle	19° 1'3.56"N 73° 6'22.49"E	Industrial Area	
AQ3	Panvel Bus Depot	18°59'31.95"N 73° 6'58.74"E	Commercial Area	
AQ4	Navade Gram Panchyat	19° 2'56.77"N 73° 6'4.42"E	Industrial Area	

Table 10.3: Sampling Methodology and Protocol

Sampling Parameters	Standard referred	Sample Collection	Sample Analysis	Methodology
		Sampling Equipment	Analytical Equipment	
PM_{10}	IS 5182-Part 23	Respirable Dust Sampler	Electronic Balance	Gravimetric Method
$PM_{2.5}$	-	Fine Dust Sampler		
SO_2	IS 5182-Part 2	RDS with impinger	Spectrophotometer	Improved West & Gaeke Method
NO_x	IS 5182-Part 2			Na Arsenite Method
CO	IS 5182-Part 10	Tadler Bag	GC-FID	Chromatography

Source: Standard Practices

*Particulate Matter (PM_{10} & $PM_{2.5}$), SO2 & NOx were sampled for 24 hrs. CO was sampled for 8 hr.

Figure 10.2: Photograph during Ambient Air Monitoring

Table 10.4: Ambient Air Quality Monitoring Results (Pre- Monsoon)

Code	Parameters / Locations	SO$_2$ (µg/m³) 24 Hourly	NO$_x$ (µg/m³) 24 Hourly	PM$_{10}$ (µg/m³) 24 Hourly	PM$_{2.5}$ (µg/m³) 24 Hourly	CO (mg/m³) 8 Hourly
AQ1	Shilp Chowk	BDL(DL=5)	20	125	28	1.3
AQ2	Kalamboli Circle	BDL(DL=5)	28	145	39	1.5
AQ3	Panvel Bus Depot	BDL(DL=5)	7	91	23	1.2
AQ4	Navade Gram Panchyat	BDL(DL=5)	17.6	98.2	53.13	1.40
NAAQS		80	80	100	60	2

Inference:

As seen in Table 10.4, the SO$_2$, NO$_x$, CO and PM 2.5 concentrations are below the NAAQS across all the selected locations. However, the concentrations of PM$_{10}$ are above the NAAQS at Shilp Chowk and kalamboli Circle. Generally, PM$_{10}$ concentration increases mainly due to by traffic, industrial activities, domestic fuel burning, as well as from unspecific sources of human origin. In the post-monsoon scenario, the pollution load is usually low as rain depends on particles floating in the air, its falls with them to the ground reducing the concentration of pollutants.

The maximum PM$_{10}$ concentrations are seen at Kalamboli Circle and Shilp Chowk 145 µg/m³ & 125 µg/m³, respectively. The location is a circle with vehicles coming from all the directions which explains the increased concentration. Also, the major transport route, Mumbai - Satara Highway, Kalamboli Flyover Bridge, MIDC area with cement industries are in the proximity of Kalamboli circle that adds up to increased pollution in the said area.

Table 10.5: Ambient Air Quality Monitoring Results (Post-Monsoon)

Code	Parameters / Locations	SO_2 ($\mu g/m^3$) 24 Hourly	NOx ($\mu g/m^3$) 24 Hourly	PM_{10} ($\mu g/m^3$) 24 Hourly	$PM_{2.5}$ ($\mu g/m^3$) 24 Hourly	CO (mg/m^3) 8 Hourly
AQ1	Shilp Chowk	BDL(DL=5)	20	65	22	1.9
AQ2	Kalamboli Circle	BDL(DL=5)	28	160	43	1.3
AQ3	Panvel Bus Depot	BDL (DL=5)	9	285	77	1.7
AQ4	Navade Gram Panchyat	BDL(DL=5)	21	339	53	1.4
NAAQS		80	80	100	60	2

Inference:

As seen in Table 10.5, the SO_2, NOx, and CO concentrations are below the NAAQS in all the areas. The highest $PM_{2.5}$ concentration which exceeded the standard concentration was observed at Panvel bus depot, which is 77 $\mu g/m^3$. The highest PM_{10} concentration which exceeded the standard concentration was observed at Panvel bus depot, Kalamboli Circle, and Navade Gram Panchayat which is 285, 160, 339$\mu g/m^3$. Generally, PM_{10} & $PM_{2.5}$ concentration increases mainly due to by traffic, industrial activities, domestic fuel burning, as well as from unspecific sources of human origin. The location is a circle with vehicles coming from all the directions which explains the increased concentration. Also, the major transport route, Mumbai - Satara Highway, Kalamboli Flyover Bridge, MIDC area with cement industries are in the proximity of Kalamboli circle that adds up to increased pollution in the said area.

10.2 Ambient Noise Environment

Baseline noise levels were monitored at the locations where the ambient air quality monitoring was conducted. The ambient noise monitoring was conducted using a spot noise measurement device. Noise level measurement locations were identified for assessment of existing sound level status, keeping in view the land use pattern, residential areas, schools, bus stands etc. The noise

monitoring locations are shown in Figure 10.6 below. The day and night time hours as prescribed by CPCB are from 06:00 AM to 10:00 PM and from 10:00 PM to 06:00 AM. CPCB noise limits for day and night time are given in Table 10.6. The results of ambient noise level monitoring for day time and night time are given in Table 10.8.

Table 10.6: CPCB Limits for Ambient Noise

Area Code	Category of Area	Limit in dB (A), L_{eq}	
		Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silent Zone	50	40

- Day time shall mean from 6:00 a.m. to 10:00 p.m.

- Night time shall mean from 10:00 p.m. to 6:00 a.m.

- Silence Zone is an area comprising not less than 100 m around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority

- Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.

- dB (A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

- A "decibel" is a unit in which noise is measured.

- "A", in dB (A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of the human ear.

- Leq is the energy mean of the noise level over a specified period.

The noise monitoring location details are given in below Table 10.7 below.

Table 10.7: Ambient Noise Monitoring Locations

Code	Site Location	Location Coordinates	Landmark
NQ1	Shilp Chowk	19°2'50.23"N 73° 4'11.65"E	Residential Area
NQ2	Kalamboli Circle	19° 1'3.56"N 73° 6'22.49"E	Industrial Area
NQ3	Panvel Bus Depot	18°59'31.95"N 73° 6'58.74"E	Commercial Area
NQ4	Navade Gram Panchyat	19° 2'56.77"N 73° 6'4.42"E	Industrial Area
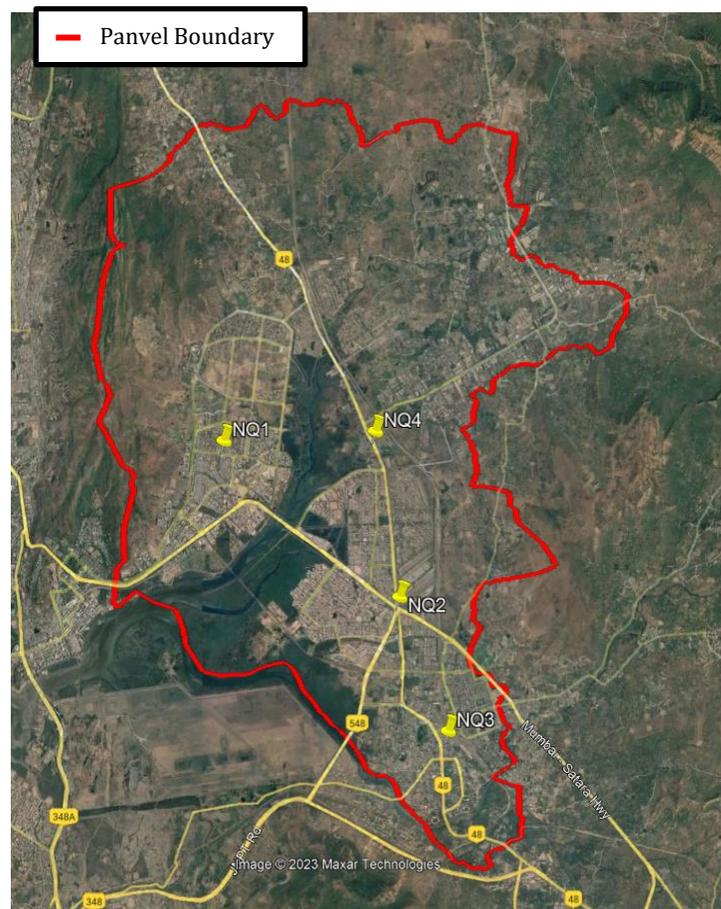
Figure 10.3: Ambient Noise Monitoring Locations

Table 10.8: Results for Noise Level Monitoring (Pre-Monsoon)

Code	Parameters / Locations	Zone	Minimum L$_{eq}$, dB(A)	Maximum L$_{eq}$, dB(A)	Average Leq, dB(A)
NQ1	Shilp Chowk	Residential	73.1	102.6	85.54
NQ2	Kalamboli Circle	Industrial	70.1	109.4	81.21
NQ3	Panvel Bus Depot	Commercial	72.9	93.4	78.67
NQ4	Navade Gram Panchyat	Industrial	72.4	95.6	80.32

Table 10.9: Results for Noise Level Monitoring (Post-Monsoon)

Code	Parameters / Locations	Zone	Minimum L$_{eq}$, dB(A)	Maximum L$_{eq}$, dB(A)	Average Leq, dB(A)
NQ1	Shilp Chowk	Residential	60.5	89.8	71.15
NQ2	Kalamboli Circle	Industrial	66	87.1	75.56
NQ3	Panvel Bus Depot	Commercial	73.5	87.3	78.69
NQ4	Navade Gram Panchyat	Industrial	90.6	97.2	93.82

Inference:

As seen in Tables 10.8 & 10.9, the noise level in commercial, residential and industrial areas were reported above the CPCB limits. The average noise level is highest in Navade gram panchayat and Shilp Chowk area, which is 93.82 dB (A) and 85.54 db (A). It can be due to its proximity to the railway station and the highway

10.3 Water Quality

The water quality of PMC was assessed for physio-chemical and bacteriological analysis of ground and surface water samples. Five groundwater and eight surface water samples were collected from Panvel city for analysis of the existing water quality in the area. For surface water, samples were collected from the rivers in the city and groundwater samples were collected from bore wells and

hand pumps. The surface water samples were rated according to the CPCB Water Quality Criteria against A, B, C, D and E class of water based on the parameters identified in the criteria. The parameters of the ground water samples were compared with the drinking water quality standards specified in IS 10500: 2012.

The details of the CETP, ground water and surface water quality locations and parameters are tabulated under Table 10.10. The sample collection locations of surface water and ground water are shown in Figure 10.4

Table 10.10: Surface & Ground Water Sample Collection Locations and Parameters

Code	Site Location	Location Coordinates	Area	Parameters
SW1	Shree Shiv Samarth	19°2'36.25"N 73° 4'24.29"E	Kharghar	pH, Turbidity, Total Coliform, Free Ammonia, TDS, Nitrate, Total hardness as CaCO3, Total alkalinity as CaCO$_3$, COD, BOD, DO, TSS, Sodium Absorption Ratio
SW2	Shiv Temple Pond	19° 1'0.34"N 73° 5'37.24"E	Kamothe	
SW3	Roadpali	19° 2'25.75"N 73° 5'54.51"E	Kalamboli	
SW4	Dewale Lake	18°59'21.75"N 73° 6'27.51"E	New Panvel	
SW5	Taloje River	19° 4'56.61"N 73° 6'1.72"E	Up Stream	
SW6	Taloje River	19° 4'2.91"N 73° 5'36.68"E	Down Stream	
SW7	Kasardi River	19° 2'51.25"N 73° 6'33.92"E	Up Stream	
SW8	Kasardi River	19° 2'48.56"N 73° 6'13.00"E	Down Stream	
GW1	Kharghar Gram	19° 2'42.51"N	Kharghar	pH, Turbidity, TDS,

Code	Site Location	Location Coordinates	Area	Parameters
	Panchayat	73° 4'14.87"E		Arsenic, Total hardness as CaCO$_3$, Total alkalinity as CaCO$_3$, DO, Chloride, TSS, Fluoride, Mercury, Lead
GW2	Kamothe gram panchyat office	19° 0'59.40"N 73° 5'25.34"E	Kamothe	
GW3	Kalamboli gram panchyat office	19° 1'20.72"N 73° 6'10.73"E	Kalamboli	
GW4	Panvel panchyat samiti	18°59'18.67"N 73° 6'51.85"E	Panvel	
GW5	Taloje MIDC	19° 3'40.58"N 73° 7'2.89"E	Taloja MIDC	

10.3.1 Surface Water Analysis

Surface & Ground water samples were collected from all four wards of PMC and also from major rivers around the city. The parameters of the surface water samples were compared against the designated best use classification of CPCB as given in Table 10.11.
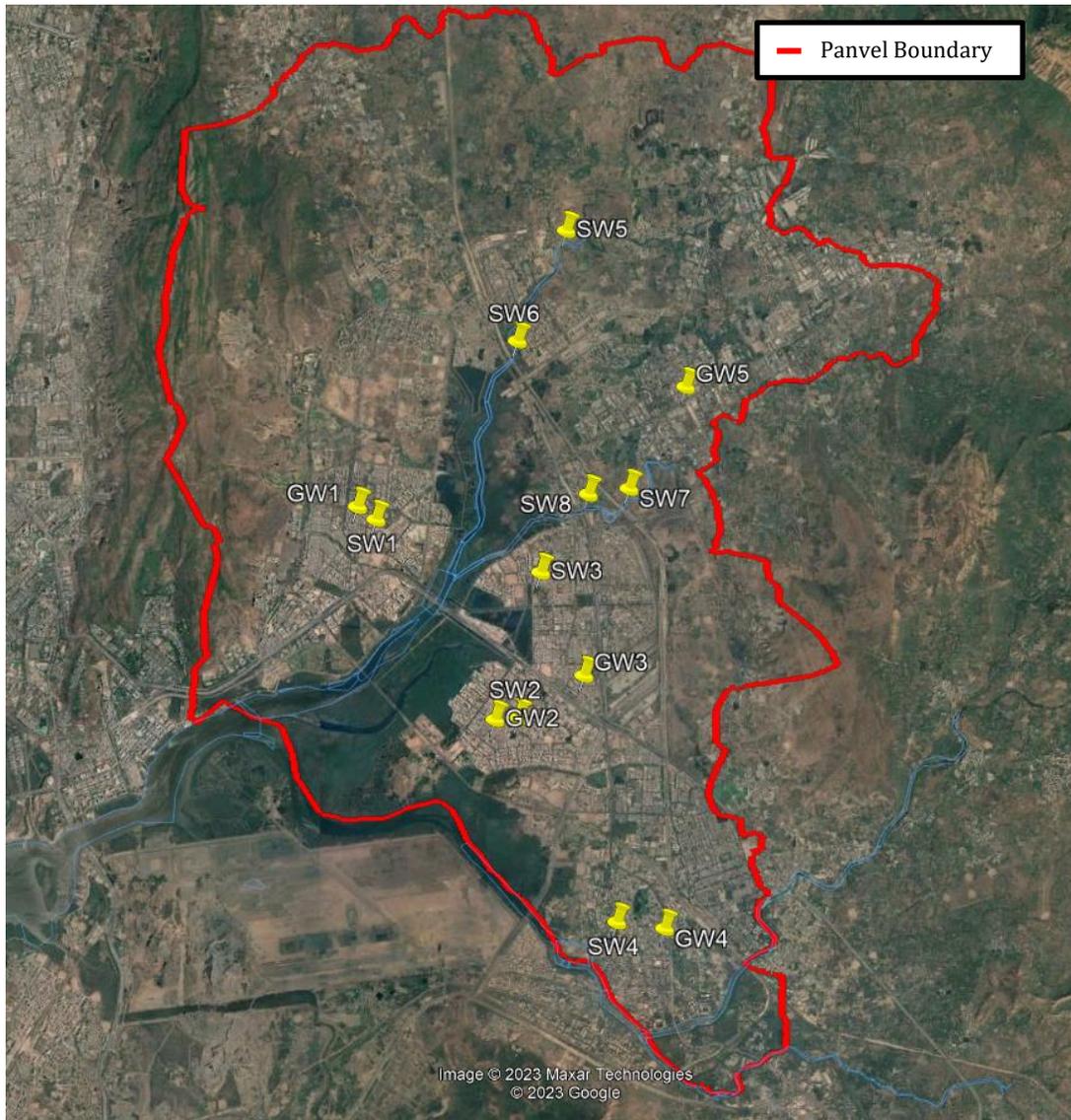
Figure 10.4: Ground Water and Surface Water Monitoring Locations

Table 10.11: Water Quality Standards by CPCB for Best Designated Usage

Designated- Best-Use	Class of Water	Criteria
Drinking Water Source Without Conventional Treatment but After Disinfection	A	Total Coliforms Organism MPN/100 ml shall be 50 or less.
		pH between 6.5 – 8.5

Designated- Best-Use	Class of Water	Criteria
		Dissolved Oxygen: 6 mg/l or more
		Biochemical Oxygen Demand 5 Days 20 °C: 2 mg/l or less
Outdoor Bathing (Organized)	B	Total Coliforms Organism MPN/100 ml shall be 500 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen: 5 mg/l or more
		Biochemical Oxygen Demand 5 Days 20 °C: 3 mg/l or less
Drinking Water Source After Conventional Treatment and Disinfection	C	Total Coliforms Organism MPN/100 ml shall be 500 or less
		pH between 6.5 and 9
		Dissolved Oxygen: 4 mg/l or more
		Biochemical Oxygen Demand 5 Days 20 °C: 3 mg/l or less
Propagation of Wildlife and Fisheries	D	pH between 6.5 and 8.5
		Dissolved Oxygen: 4 mg/l or more
		Free Ammonia (as N): 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Water Disposal	E	pH between 6.5 and 8.5
		Electrical Conductivity at 25°C micro mhos/cm: Max 2250
		Sodium Absorption Ration: Max. 26
		Boron: Max. 2 mg/l
		Free Ammonia (as N): 1.2 mg/l or less
		Chlorides: 600 mg/l
		Sulphates: 1000 mg/l
-	Below-E	Not Meeting A, B, C, D & E Criteria
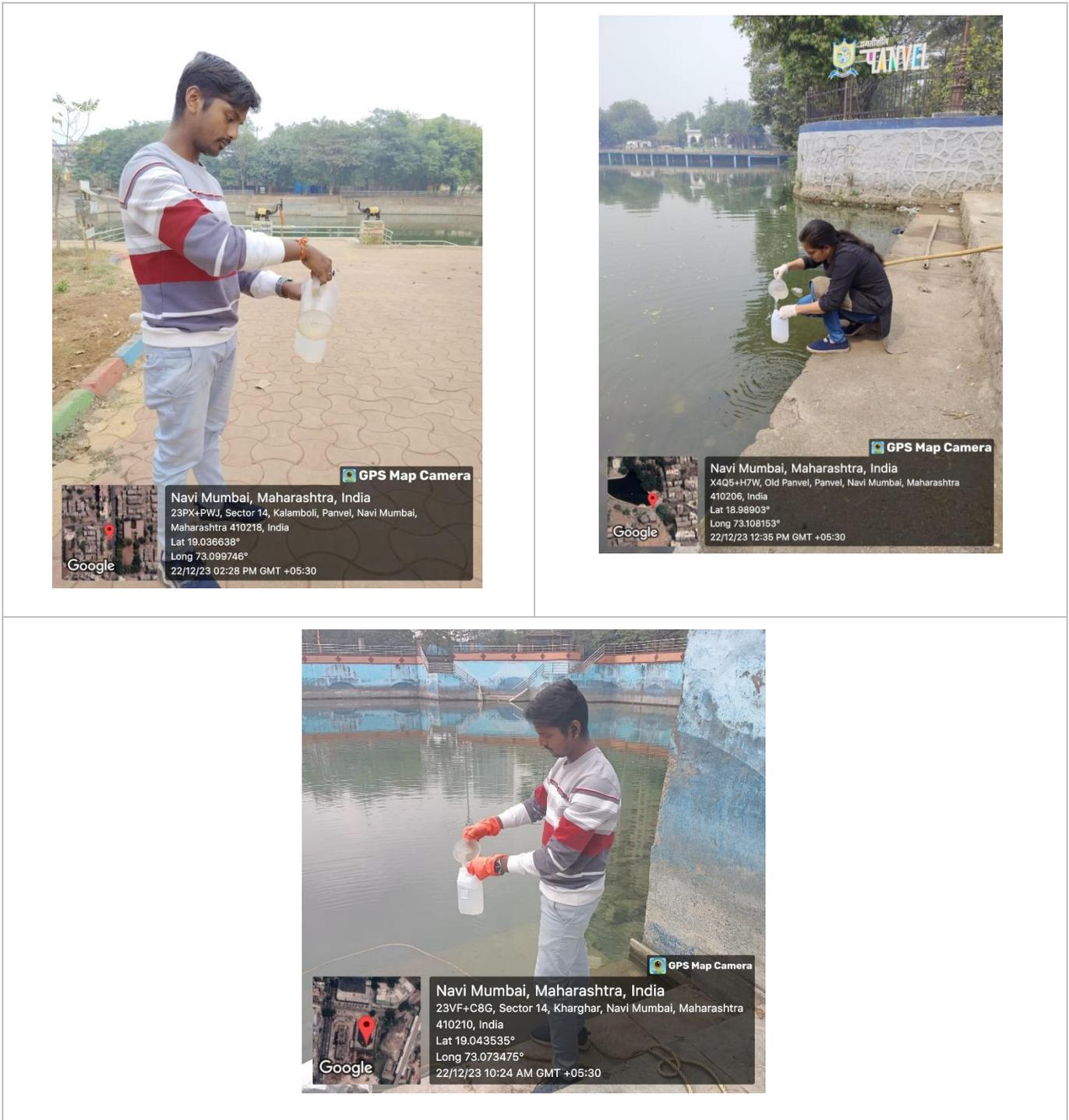
Figure 10.5: Photograph during Surface Water Sample Collection

The Results of Surface Water Samples Analysis (Post-Monsoon) is captured in Table 10.12 below.

Table 10.12: Results of Surface Water Samples Analysis (Post-Monsoon)

Sr. No.	Parameter	Normal Range	Units	(SW1)	(SW2)	(SW3)	(SW4)
1.	pH	6.5-8.5		7.6	7.4	7.6	8
2.	Electrical Conductivity	<2250	µS/cm	2074	1294	1412	399
3.	Taste	NS	---	Agreeable	Agreeable	Agreeable	Agreeable
4.	Colour	NS	Hazen	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)
5.	Odour	NS	---	Agreeable	Agreeable	Agreeable	Agreeable
6.	Turbidity	>5	NTU	1.9	2.1	6.7	0.4
7.	TSS	NS	mg/L	8	28	9	23
8.	TDS	<2100	mg/L	1348	837	918	254
9.	COD	NS	mg/L	16	36	83.2	16
10.	BOD@ 27°C for 3 days	NS	mg/L	3.9	8.4	27.6	3.4
11.	DO	NS	mg/L	5.6	5.1	3.2	5.5
12.	Total Hardness as CaCO3	NS	mg/L	1545	305	1313	125
13.	Total Alkalinity as CaCO3	NS	mg/L	77	180	91	83
14.	Free Ammonia as N	NS	mg/L	0.03	0.18	0.28	0.08
15.	Nitrates as NO^3	NS	mg/L	0.3	0.5	0.4	0.2
16.	SAR	NS	%	0.8	3	1.4	3.1
17.	Total Coliform	NS	MPN/100ml	140	170	90	80

NS: Not Specified

Sr. No.	Parameter	Normal Range	Units	(SW5)	(SW6)	(SW7)	(SW8)
1.	pH	6.5-8.5		7.3	7.2	7.4	6.5
2.	Electrical Conductivity	<2250	µS/cm	2320	2722	1518	1686
3.	Taste	NS	---	Agreeable	Agreeable	Agreeable	Agreeable
4.	Colour	NS	Hazen	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)
5.	Odour	NS	---	Agreeable	Agreeable	Agreeable	Disagreeable
6.	Turbidity	NS	NTU	5.6	4.2	2.9	6.7
7.	TSS	NS	mg/L	59	53	64	97
8.	TDS	<2100	mg/L	3012	4256	3950	6322
9.	COD	NS	mg/L	60.4	53.2	76	91
10.	BOD@ 27oC for 3 days	NS	mg/L	26.5	33.2	37.5	29.6
11.	DO	NS	mg/L	2.9	2.1	2.5	0.8
12.	Total Hardness as CaCO3	NS	mg/ L	890	740	750	570
13.	Total Alkalinity as CaCO3	NS	mg/L	66	74	70	62
14.	Free Ammonia as N	NS	mg/L	NIL	NIL	0.18	0.28
15.	Nitrates as NO3	NS	mg/L	3.15	4.15	4.8	5.25
16.	SAR	NS	%	12.5	14.1	13.4	16.2

Sr. No.	Parameter	Normal Range	Units	(SW5)	(SW6)	(SW7)	(SW8)
17.	Total Coliform	NS	MPN/100 ml	44	62	75	48

*NS: Not Specified

The Results of Surface Water Samples Analysis (Pre-Monsoon) is captured in Table 10.13 below.

Table 10.13: Results of Surface Water Samples Analysis (Pre-Monsoon)

Sr. No.	Parameter	Normal Range	Units	(SWI)	(SW2)	(SW3)	(SW4)
1.	pH	6.5 -8.5		6.9	7.69	7.63	7.82
2.	Electrical Conductivity	<2250	µS/cm	2437	972	2720	483
3.	Taste	NS	---	Agreeable	Agreeable	Agreeable	Agreeable
4.	Colour	NS	Hazen	BDL[DL=1]	BDL[DL=1]	BDL[DL=1]	BDL[DL=1]
5.	Odour	NS	---	Agreeable	Agreeable	Agreeable	Agreeable
6.	Turbidity	NS	NTU	2.5	3.6	8.4	5.2
7.	TSS	NS	mg/L	5	5	13	10
8.	TDS	< 2100	mg/L	1584	632	1770	314
9.	COD	NS	mg/L	28	74	69	35
10.	BOD@ 27°C for 3 days	NS	mg/L	3.7	12	19	4.3
11.	DO	NS	mg/L	5.5	4.5	4.6	5.2
12.	Total Hardness as CaCO3	NS	mg/ L	1720	540	1131	144

Sr. No.	Parameter	Normal Range	Units	(SWI)	(SW2)	(SW3)	(SW4)
13.	Total Alkalinity as CaCO3	NS	mg/L	773	280	82	126
14.	Free Ammonia as N	NS	mg/L	0.02	0.23	0.33	0.05
15.	Nitrates as NO^3	NS	mg/L	0.4	0.3	0.3	0.3
16.	SAR	By Calculation	%	2	3	5	5
17.	Total Coliform	NS	MPN/100ml	110	280	110	90

Sr. No.	Parameter	Normal Range	Units	(SW5)	(SW6)	(SW7)	(SW8)
1.	pH	6.5 -8.5		7.7	8.7	7.26	7.3
2.	Electrical Conductivity	<2250	µS/cm	2237	2172	2720	496
3.	Taste	NS	---	Agreeable	Agreeable	Agreeable	Agreeable
4.	Colour	NS	Hazen	BDL[DL=1]	BDL[DL=1]	BDL[DL=1]	BDL[DL=1]
5.	Odour	NS	---	Agreeable	Agreeable	Agreeable	Agreeable
6.	Turbidity	NS	NTU	2.6	3.6	7.4	5.7
7.	TSS	NS	mg/L	4	5	14	18
8.	TDS	< 2100	mg/L	1584	632	1770	314

Sr. No.	Parameter	Normal Range	Units	(SW5)	(SW6)	(SW7)	(SW8)
9.	COD	NS	mg/L	27	54	62	48
10.	BOD@ 27ºC for 3 days	NS	mg/L	3.6	10	18	4.3
11.	DO	NS	mg/L	4.5	6.5	4.7	3.2
12.	Total Hardness as CaCO3	NS	mg/ L	1630	440	1011	125
13.	Total Alkalinity as CaCO3	NS	mg/L	623	260	94	96
14.	Free Ammonia as N	NS	mg/L	0.04	0.25	0.42	0.43
15.	Nitrates as NO^3	NS	mg/L	0.4	0.3	0.3	0.3
16.	SAR	By Calculation	%	2	4	5	4
17.	Total Coliform	NS	MPN/100ml	130	250	140	70

Inference:

The summary of inferences of the analysis of surface water samples results is as follows:

- pH of the surface water samples was observed to be in the range of 6.5 – 8.7.
- The Chemical Oxygen Demand (COD) value was reported to be in the range of 16 mg/l to 91 mg/l. The highest level of COD (91 mg/l) was seen in sample SW8 (Kasrdi River is downstream of Navade bridge). All values obtained were within the desirable limit for COD as prescribed by CPCB.

- The maximum concentrations of Biochemical Oxygen Demand (BOD) were observed at SW7 (37.5 mg/l), whereas the minimum concentration was observed at SW5 (3.6 mg/l); but all the values are within the permissible limits.

- Total Hardness was observed to be ranging between 125 to 1720 mg/l. The highest value of hardness was recorded at Shree Shiv Samarth Talav, Kharghar & minimum value was recorded at SW8; which is a sample collected in Kasardi river in the study area.

- The concentrations of Total Dissolved Solids were in the range of 254 mg/l to 6322 mg/l.

10.3.2   Ground Water Analysis

The ground water samples were analyzed for parameters as specified in IS: 10500 (2012) standards, "Drinking Water- Specifications" and analyzed as per methods specified in IS: 3025, "Methods of sampling and test (physical and chemical) for water and wastewater". The results of the analysis are presented in Table 10.14 & 10.15. The summary of results is presented in the following sub section.
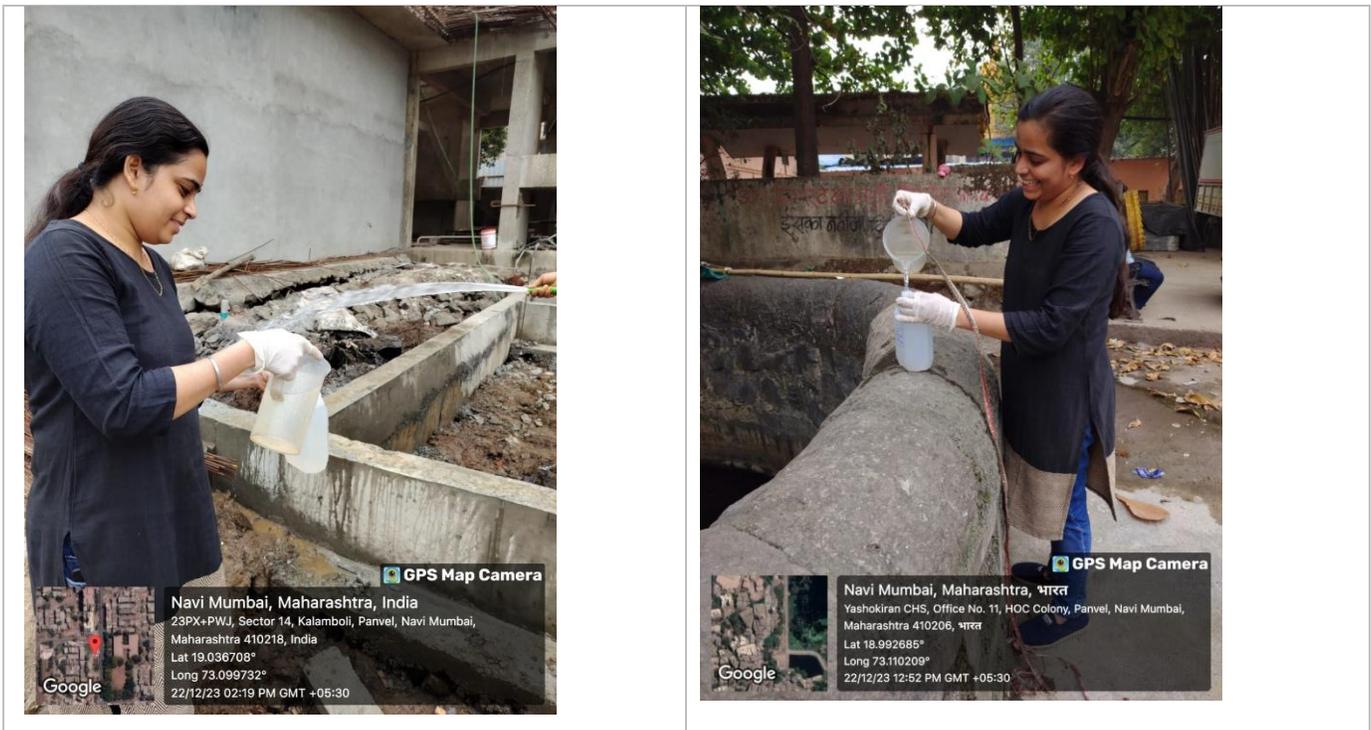
Figure 10.6: Photograph during Ground Water Sample Collection

Table 10.14: Results of Ground Water Samples Analysis (Pre-Monsoon)

Sr. No	Parameters	Units	Normal Range	(GW1)	(GW2)	(GW3)	(GW4)	(GW5)
1	pH	-	6.5-8.5	7.4	7.6	7.9	7.3	7.2
2	Colour	Hazen	NS	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)
3	Turbidity	NTU	NS	4.4	0.5	0.5	0.3	0.6
4	Odour	-	NS	Agreeable	Agreeable	Agreeabl	Agreeable	Agreeabl
5	Taste	-	NS	Agreeable	Agreeable	Agreeabl	Agreeable	Agreeabl
6	Electrical Conductivity	mS/cm	<2250	573	1176	2512	660	842
7	Total Hardness	mg/L	< 200.00	169	352	399	220	196
8	TDS	mg/L	<500	372	767	1633	429	462

Sr. No	Parameters	Units	Normal Range	(GW1)	(GW2)	(GW3)	(GW4)	(GW5)
9	TSS	mg/L	<500	9	3	4	2	4
10	Chloride as	mg/L	<	41	64	306	51	72
11	Total Alkalinity as	mg/L	< 400.00	190	309	350	212	294
12	Lead as Pb	mg/L	< 0.01	BDL (DL=0.6)	BDL (DL=0.6)	BDL (DL=0.6)	BDL (DL=0.6)	BDL (DL=0.6)
13	Arsenic as As	mg/L	< 0.01	BDL (DL=0.003	BDL (DL=0.003	BDL (DL=0.00	BDL (DL=0.003	BDL (DL=0.00
14	Fluoride as F	Mg/L	< 1.00	BDL (DL=0.2)	BDL (DL=0.2)	BDL (DL=0.2)	BDL (DL=0.2)	BDL (DL=0.2)
15	Mercury as Hg	mg/L	< 0.001	BDL (DL=0.006)	BDL (DL=0.006)	BDL (DL=0.00 6)	BDL (DL=0.006)	BDL (DL=0.00 6)

BDL: Below Detectable Limit, DL: Detectable Limit

Inference:

- The below results indicate that the pH of all the ground water samples was observed to be in the range of 7.2 – 7.9.

- Total Dissolved Solids in the samples were in the range of 372 – 1633 mg /l.

- Total Hardness was found to vary between 169-399 mg/l.

- Chloride was detected in the range of 41 to 306 mg/l.

Table 10.15: Results of Ground Water Samples Analysis (Post-Monsoon)

Sr. No	Parameters	Units	Normal Range	(GW1)	(GW2)	(GW3)	(GW4)	(GW5)
1	pH	-	6.5-8.5	7.3	7.96	7.6	7.7	8.49
2	Colour	Hazen	NS	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)
3	Turbidity	NTU	NS	0.8	0.6	0.4	0.6	0.4
4	Odour	-	NS	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Taste	-	NS	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6	Electrical Conductivity	mS/cm	<2250	737	822	1228	772	852
7	Total Hardness	mg/L	< 200.00	226	196	149	285	296
8	TDS	mg/L	<500	474	525	795	495	482
9	TSS	mg/L		4	6	7	9	8
10	Chloride as Cl	mg/L	< 250.00	54	53	179	16	49
11	Total Alkalinity as CaCO3	mg/L	< 400.00	246	250	137	279	284
12	Lead as Pb	mg/L	< 0.01	BDL (DL=0.6)	BDL (DL=0.6)	BDL (DL=0.6)	BDL (DL=0.6)	BDL (DL=0.6)
13	Arsenic as	mg/	< 0.01	BDL	BDL	BDL	BDL	BDL

Sr. No	Parameters	Units	Normal Range	(GW1)	(GW2)	(GW3)	(GW4)	(GW5)
	As	L		(DL=0.003)	(DL=0.003	(DL=0.003	(DL=0.003	(DL=0.003
14	Fluoride as F	Mg/L	< 1.00	BDL (DL=0.2)	BDL (DL=0.2)	BDL (DL=0.2)	BDL (DL=0.2)	BDL (DL=0.2)
15	Mercury as Hg	mg/L	< 0.001	BDL (DL=0.006)	BDL (DL=0.006)	BDL (DL=0.006)	BDL (DL=0.006)	BDL (DL=0.006)

BDL: Below Detectable Limit, DL: Detectable Limit

Inference:

- The above results indicate that the pH of all the ground water samples was observed to be in the range of 7.3-8.49.

- Total Dissolved Solids in the samples were in the range of 472 – 795 mg /l.

- Total Hardness was found to vary between 149-296 mg/l.

- Chloride was detected in the range of 16 to 179 mg/l.

- Heavy metal concentrations in all the samples were found to be well within the limits.

10.4 Soil Sample Analysis

Four soil sample were collected three from Commercial, Residential area and One from Industrial area.

Table 10.16: Soil Sample Locations

Code	Site Location	Location Coordinates	Landmark	Parameters
SQ1	Shilp Chowk	19°2'50.23"N 73° 4'11.65"E	Residential Area	pH, Texture, Total Organic Matter, Sodium Adsorption Ratio (SAR), Water holding Capacity, NPK.
SQ2	Kalamboli Circle	19° 1'3.56"N 73° 6'22.49"E	Industrial Area	

SQ3	Panvel Bus Depot	18°59'31.95"N 73° 6'58.74"E	Commercial Area
SQ4	Navade Gram Panchyat	19° 2'56.77"N 73° 6'4.42"E	Industrial Area

Table 10.17: Soil Sample Analysis Results (Pre-Monsoon)

Location Code / Parameter	Unit	Normal Range	SQ1	SQ2	SQ3	SQ4
pH	---	6.5-8.5	7.7	7.5	7.1	6.7
Texture	---	-	Silt Loam	Silt Loam	Silt Loam	Silt Loam
EC	µS/cm	-	642	947	654	596
WHC	%	-	48.4	54.5	54.1	35.6
SAR	(meq/kg)1/2	-	BDL[DL=1]	BDL[DL=1]	BDL[DL=1]	BDL[DL=1]
Available P	(mg/kg)	-	34	58	213	53
Available K	(mg/kg)	-	8	27	40	39
Total Organic Matter	%	< 10	0.62	1.98	2.80	1.52

Table 10.18: Soil Sample Analysis Results (Post-Monsoon)

Location Code / Parameter	Unit	Normal Range	SQ1	SQ2	SQ3	SQ4
pH	-	6.5-8.5	8.4	7.6	7.8	7.2
EC	µS/cm	-	378	684	352	452
WHC	%	-	50.2	48.9	40.3	52.3
Organic Matter	%	< 10	0.33	1.23	0.95	0.86
SAR	(meq/kg)1/2	-	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)	BDL(DL=1)
Available N	(mg/kg)	-	357	843	386	402

Location Code Parameter	Unit	Normal Range	SQ1	SQ2	SQ3	SQ4
Available P	(mg/kg)	-	20	28	55	19
Available K	(mg/kg)	-	2	9	2	3
Texture	-	-	Silt Loam	Silt Loam	Silt Loam	Silt Loam

Inference:

- pH of the soil in the study area ranged between 6.7- 8.4. The "Moderately alkaline" soil was observed at first location (SQ1). In other locations, it varied from "Neutral" to "Slightly alkaline".

- The concentration of Phosphate was estimated to be between 19-58 mg/kg. The highest concentration can be observed at location SQ2, while the lowest concentration can be observed at location SQ4 during the monitoring period. Here it is observed that Phosphate concentration is 'High' as per chemical classification of soil quality.

- The large variation is observed in the values due to their use or application and also due to the variation in the use of fertilizers.

Figure 10.7: Photograph during Soil Sample Collection

11. Conclusion and Recommendation

Panvel City has been the most popular place to live among all the MMR neighboring cities. The city's population is rapidly expanding as a result of urbanization, industrialization, and because of an upcoming airport near to Panvel City. Realizing the potential, many renowned builders started new housing projects in and around Panvel City, which is anticipated to place additional pressure on the city's municipal facilities as well as on the natural resources which includes land, water, and air. The Municipal Corporation must improve the quality of life for city residents. The local administration and the government are found to be capable of addressing the most pressing environmental issues, and they have begun the process of making the city sustainable. The conclusion and recommendations are discussed as follows:

- In order to address the rising housing demand, rising population, and increasing ward-wise population density, an appropriate urban development plan should be created.

Water supply and Wastewater management

    Safe and sufficient drinking water is a necessity. The availability of water in the Deharang Dam is a major factor in determining Panvel's water supply. Panvel City's growing population has had an impact on the city's water supply.

    Currently, 245 MLD of water is accessible each day. The remaining obtained from other water sources. PMC may manage the water supply through four main sources, including a Dehrang Dam, MIDC, CIDCO, and Patalganga MJP. During summer season, few villages near the corporation area reported facing water shortage issues. To solve this issue, PMC built a borewell in the hamlet to meet the surplus water demand.

- CIDCO's Kondhane Dam Project is an endeavor to meet the additional drinking water demand in CIDCO nodes and Navi Mumbai International Airport area (e.g., Kharghar, Kamothe, Kalamboli, Taloja, Karanjade, Kalundre, Dronagari, Ulwe, Pushpak, and so on).

- The main concern in the PMC is the reported contamination of the rivers, viz. Taloja and Kasadi rivers. MPCB does not monitor the quality of the water in these two rivers since water from these rivers are not used for drinking purposes. Pollution in water bodies, on the other hand, has a lot of severe repercussions on the ecosystem and biodiversity in the area. Hence, we

encourage PMC to insist MPCB to monitor the water quality of these two rivers and if found to be contaminated, implement ways to remediate the water quality.

- The PMC must take specific measures to address future water demands while taking into account the anticipated water demands.

- Strict controls must be implemented to avoid the discharge of industrial effluent into the surface water bodies.

- Identify the points of sewage disposal into the nallahs and treat them locally before discharge into the nallahs. A suitable technology should be identified and adopted for improving the water quality of nallahs.

- CETPs shall be assessed and plausibility of enhancing the capacity, if possible, should be exercised. The CETP unit operations must be cleaned on a regular basis.

- All bodies of water, including rivers, lakes, and ponds, must be cleaned on a regular basis using the appropriate equipment.

- Presence of industrial estates in and around Panvel city indicates that an environmental management framework should be developed and implemented.

Air Quality improvement
- The COVID- 19 scenario-imposed restrictions, which invariably resulted in improved AQI in Panvel. With restrictions on business and anthropogenic activities becoming relaxed, the AQI has deteriorated. All four wards of PMC reported elevated concentration of PM10 and PM2.5 which were found to exceed the standards provided by CPCB. Increased traffic along the Mumbai-Satara Highway and the Kalamboli Flyover Bridge pass could potentially be one of the prime reasons for elevated concentrations of PM10 and PM2.5. Along with the increase in traffic, presence of cement industries can also be attributed for the elevated concentration of air pollutants.

- It is recommended that PMC should set up three real-time monitoring stations in densely populated areas. According to the Primary ambient air monitoring study conducted, increased traffic density around Kalmaboli Circle can be attributed for the increased concentrations. Therefore, Kalmaboli Circle should ideally be one of the main points to set up the monitoring stations.

- Increased urban mobility post Covid restrictions has significantly caused the presence of increased concentration of air pollutants. The majority of the population, it has been found, commutes in single vehicles. Residents of the city should have access to a subsidized low-cost local public transit system to help reduce automotive pollution.

- Encouragement to the commuters to use electric vehicles should be initiated by PMC. Electric buses should also be implemented as a mean of public transportation. PMC is recommended to put implement charging infrastructures across all the residential societies.

- CNG based public transport vehicles - The change in fuel type in public vehicles (buses, taxis, rickshaws) from conventional fuels like petrol, diesel to CNG can potentially result in reduction of nitrous oxide by 40%, hydrocarbons by 90%, CO by 80%. The noise level of Compressed natural gas (CNG) engine is also low as compared to conventional diesel-based engine.

- Improvement of road quality and introduction of one-way routes to regulate the traffic is highly recommended to help reduce the air pollution of the city.

- In order to help minimize automobile pollution, PMC should launch its own low-cost, heavily subsidized municipal transportation system. This system should primarily consist of electric buses, and it should also incorporate renewable energy sources to cut down on CO2 emissions.

- Panvel is a center for industry, so the city's vegetation is less dense. We can significantly lower PM10 levels by increasing the city's vegetation, or the area along the highways.

- The air pollution mitigation measures for domestic and commercial sector are, to use of Piped Natural Gas (PNG)as effective alternative for firewood and LPG for cooking purposes. Enhance the production and use of biogas and bio-methanation as sources of fuel for cooking.

Control and mitigation measures for noise pollution

- Noise levels were measured using a noise level meter across the city's key areas, which includes the silent zone, industrial area, commercial area, and residential area. The data was collected for 24 hours. Noise levels were found to be exceed the CPCB standards falling in the residential, commercial, and industrial zones. Noise levels reported to exceed the standard of comparison primarily due to the increased human activity.

- The Navade gram panchayat region was reported to have the highest average noise intensity. It might be as a result of its proximity to the highway and the railway station. Panvel ST Stand is close to the commercial district, which contributes to increased noise levels.

- To reduce traffic and noise pollution, encourage people to take the bus or train instead of driving their own automobile. Create programs that raise awareness and educate the public about the effects of noise pollution.

- Plant trees; it has been proven that trees are good at reducing noise levels in metropolitan areas Plant trees along busy highways along with at residential locations. Additionally, trees enhance air quality and provide other aesthetic benefits.

Solid waste Management

- The PMC area produces around 470.80 TPD of MSW. PMC provided collection and transportation services, and Panvel Municipal Corporation paid CIDCO for solid waste management services such as processing and disposal.

- According to the daily weighted report at the MSW plant, around 56% of the total municipal wastes constitute of wet waste. Approximately 40% is dry waste and approximately 1% constitutes hazardous waste. Rest around 3% is sanitary waste.

- PMC through CIDCO has been processing Approximate 100% dry waste and 100% wet waste since January 2021.

- Domestic and sanitary hazardous garbage noted to be used entirely by Mumbai garbage Management, RAMKY Group.

- Initially the corporation should understand the nature of solid waste of the city and develop a DPR with a long-term vision to mitigate the issues pertaining to solid waste management.

- PMC has sanitary landfill and leachate treatment plant available to treat the solid wastes which are generated. It is use for effective collection and segregation of municipal waste from households.

- Incorporate waste to energy method for effective disposal of solid waste such as bio methanation plant, biomass gasifier, pyrolysis technique etc.

- Adjacent to the Taloja SWM site as well as the nearby to the MIDC region notified, approval for the construction of new homes or housing projects should not be encouraged.

- There are 63 total gardens inside the corporation's boundaries. Fifty-three of which are cleaned and maintained by PMC staff, and the remaining gardens are managed by CIDCO.

12. Initiative by Panvel Municipal Corporation

2023-2024

1. **Budget Approval**: The administrative general body of the PMC approved the revised budget of ₹ 2316 crore for the financial year 2023-24. The budget emphasizes increasing health infrastructure within the city.

2. **Vaccination Campaign**: The PMC is actively participating in Mission Indradhanush 5.0, a vaccination campaign targeting children aged zero to five years and pregnant women. The campaign was conducted in three rounds, with the first round starting on August 7, 2023

3. **Procure Mobile Air Quality Monitoring Vehicle:** The civic body has floated a tender to purchase a mobile van with an estimated cost of over ₹ 1 crore. The air monitoring van will cover at least two locations daily on rotational basis to collect the data of air quality.

4. **PMC Launches Multi-Purpose Dust Suppression Vehicles for Pollution Control**:

With the aim to improve environmental quality and ensure good public health, the Panvel Municipal Corporation (PMC) has procured multi-purpose dust suppression vehicles (dust removal vehicles) for dust control in its operational area. These vehicles are equipped to effectively tackle dust pollution and come with features such as a water tank with a capacity of 6000 litres, an air-cart based water mist suppression system, front and rear road flushing systems, green belt gardening cleaning system, and specialized equipment for cleaning dust on tall trees. These vehicles cover an estimated distance of 80 kilometres daily, making it easier for the Panvel Municipal Corporation to maintain cleanliness in its extensive jurisdiction. These versatile vehicles not only reduce dust but also assist in cleaning roads and green areas. The water used in these vehicles for dust suppression and cleaning comes from a water recycling center, resulting in significant savings of good quality water. The Panvel Municipal Corporation has allocated a budget of Rs. 2.66 crores for these two vehicles as part of its commitment to addressing environmental challenges. These vehicles are expected to provide long-term benefits in terms of environmental quality and public health

Initiatives under Swachha Bharat Abhiyan & Majhi Vasundhra Abhiyan

Swachha Bharat Abhiyan or Swachha Bharat Mission is a campaign, officially launched on 2nd October, 2014 at Rajghat, New Delhi. The aim of this campaign is to clean up the streets, roads, infrastructure of Indian cities, towns and village. The main objective of this campaign is to eliminate open-defecation through the construction of community and household toilets and to create a mechanism for monitoring toilet use. The Government of India wants to achieve the status of OD free India by 2 October, 2019. As per the guidelines of Swachha Bharat Mission (Urban), all the urban local bodies have to provide toilet facility to all households having no latrines within premises and an effective solid waste management. Towards this, Government of Maharashtra launched 'Swachha Maharashtra Abhiyan' with its own ambitious target of achieving this feat by 2nd October, 2019. The objectives of this Abhiyan includes elimination of Open defecation, eradication of manual scavenging, provision of modern and scientific solid waste management, awareness about sanitation and public health, capacity augmentation for ULB's and creating healthy environment for private sector participation in Capital expenditure, Operation and maintenance. Swachha

Maharashtra Abhiyan in urban areas is being implemented by Urban Development Department (UDD) through a dedicated Swachha Maharashtra Mission Directorate. At city level, the mission is being implemented by Urban Local Bodies.

Awareness and Initiatives

- **Swachhotsav Women Led Sanitation:** Women have been a mighty pillar in transforming

#Swachhata into a Jan Andolan. On the eve of #Swachhotsav2023, the Panvel Municipal Corporation launched a three-week campaign championing Urban India's transition from 'Women in Swachhata' to 'Women Led Swachhata'. This initiative highlights the crucial role women play in leading and sustaining cleanliness and hygiene efforts across the city, furthering the nationwide movement for a cleaner, greener India.

- **International Zero waste Event:** - Panvel Municipal Corporation had conducted

International Zero Waste Event, showcasing its commitment to sustainability and waste reduction. The event featured stalls by women's Self-Help Groups (SHGs) that highlighted innovative recycling methods, handmade products, and other eco-friendly initiatives. These SHGs displayed a range of items crafted from recycled materials, demonstrating the community's dedication to reducing waste and promoting environmental awareness. This initiative not only supports local artisans but also emphasizes the importance of sustainable living practices

- **International yoga day Event**: - International Yoga Day was celebrated with enthusiasm under the joint presence of Divisional Commissioner's Office, Konkan Division, Panvel Municipal Corporation and Revenue Department.
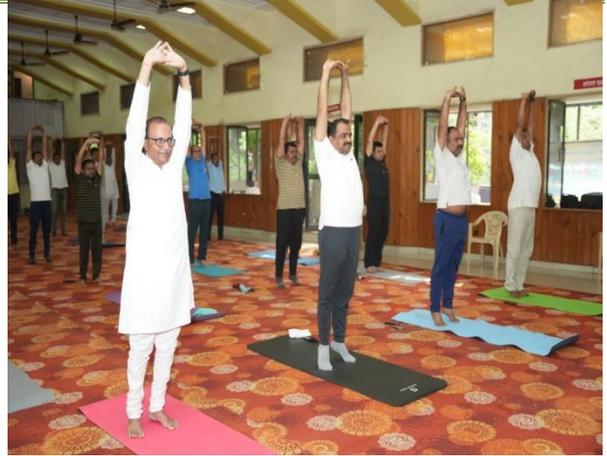
- **Deep Clean Drive- Super 150**: Citizen's joining hands with Panvel Municipal Corporations "Super 150" in Deep Cleaning Drive Transforming our city with a splash of innovation and dedication towards cleanliness.

➢ **Clean Toilet Campaign:** In a dedicated effort to enhance the city's sanitation infrastructure, the Panvel Municipal Corporation (PMC) has initiated a comprehensive "Clean Toilets Campaign. The campaign, set to continue from November 19 to December 25, aims to repair, maintain, and thoroughly clean all public toilets across the various nodes and wards of the civic body.

Anil Kokare, Head of Solid Waste Management at PMC, emphasized the significance of the campaign in ensuring that every public toilet in the corporation is in optimal condition, discouraging instances of open defecation within the city.

Anil Kokare stated, "We have launched a 'Clean Toilets Campaign, urging everyone to join us in promoting clean and safe sanitation for community development. Our focus is on repairing and

cleaning all toilets in the city, ensuring they are not only routinely cleaned but also maintained in proper working condition. We encourage residents to inform us about any toilets in disrepair so that we can promptly address the issues. Our primary goal is to ensure that everyone has access to clean and functional toilets.

- **Swachh Teerth Campaign:** Along with Ex Mayor, Corporators and Cleanliness worker, citizens joined hand for the Swachh Tirth Campaign. During which Jai Ambe Mata Mandir Sanctum Sanctorum and Temple area Deep cleaning drive was carried out.

➢ **Swachhata hi Seva:** The Panvel Municipal Corporation (PMC) has launched an effective cleanliness campaign called "Swachhata Pandharwada - Swachhata Hi Seva" under the Swachh Bharat Abhiyan, as per the directives of the Central Government. As per the information provided by the Central Government, under the guidance of the Municipal Commissioner, Ganesh Deshmukh, the "Swachhata Pandharwada - Swachhata Hi Seva 2023" program will be conducted from September 15, 2023, to October 2, 2023. This program will culminate on October 1, 2023, coinciding with Mahatma Gandhi Jayanti, where a massive cleanliness drive called 'One Date - One Hour, One Together Shramdaan' will be organize.
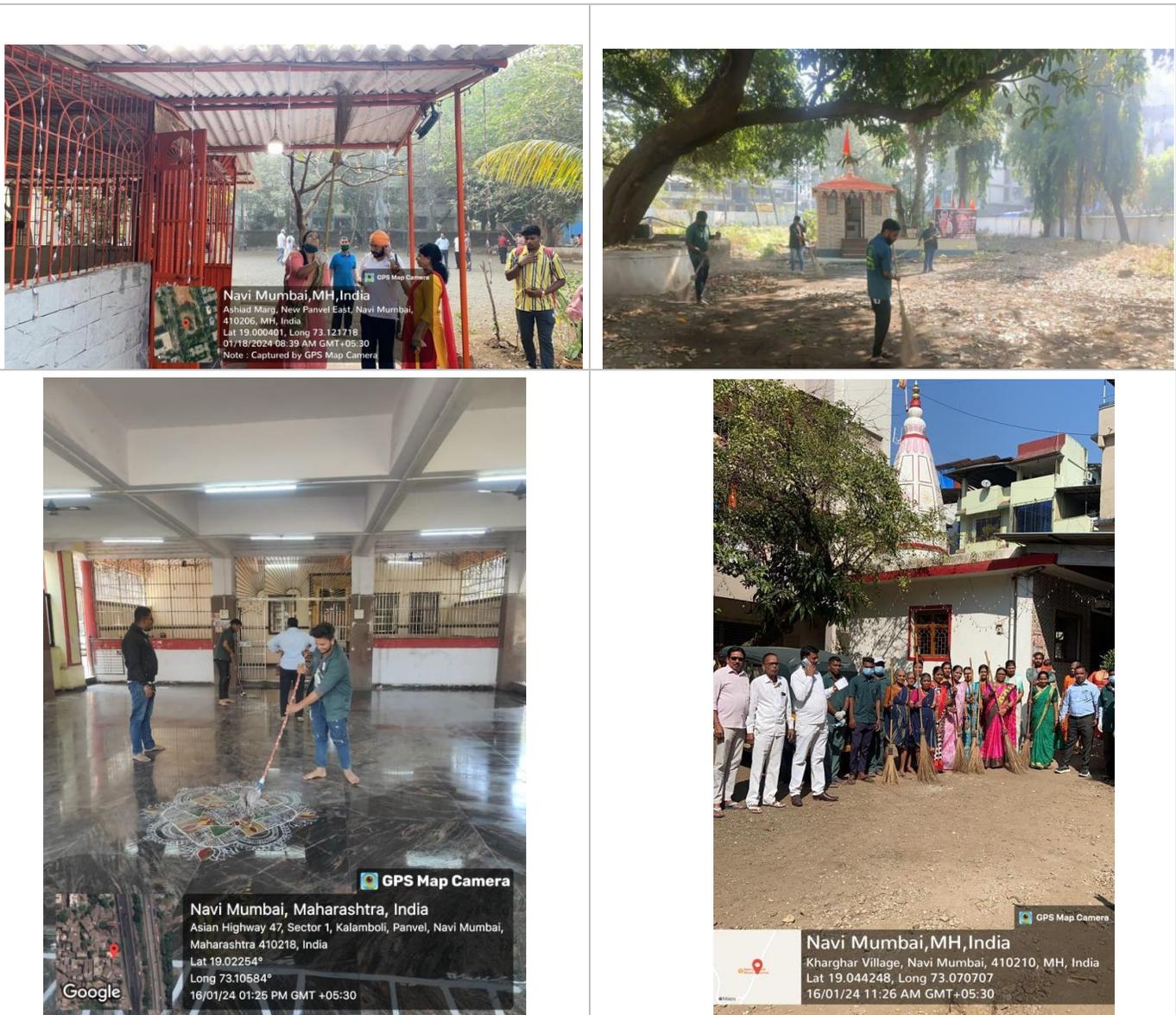
➢ **Mission Life Felicitation:** Shining a spotlight on impact-makers. At the Majhi Vasundhara and Panvel Municipal Corporation event, they proudly recognize and felicitate the clubs whose initiatives are leaving a lasting impact on our surroundings. Here's to their unwavering commitment and passion.

Partnerships for Change: Strengthening partnerships for a sustainable future! Panvel Municipal Corporation signs MOUs with 7 colleges to boost environmental initiatives.

Cycle Marathon: Riding towards a sustainable future. At the cycle marathon organized by Majhi Vasundhara Panvel Municipal Corporation every rider took a pledge to protect and preserve our environment. Let's pedal together for a greener tomorrow

Certificates of Excellence: The Panvel Municipal Corporation (PMC) has Celebrating dedication and participation in promoting a greener tomorrow" under the Majhi Vasundhara Abhiyan

Zero Waste Event:
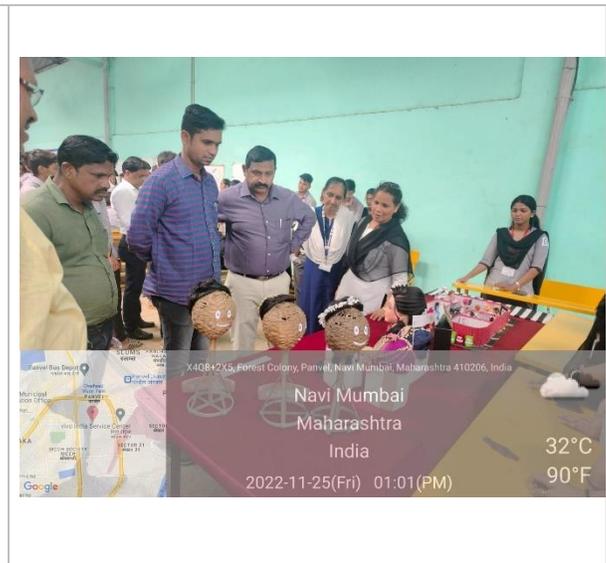
Quiz Competition: The Panvel Municipal Corporation (PMC) promoting environmental awareness and the Quiz Competition under the Majhi Vasundhara Abhiyan at Sanjivani International School Kharghar.

Environment Awareness programme: Awareness programme organised by PMC under Majhi Vasundhara Under the guidance of Commissioner Shri Ganesh Deshmukh, under the guidance of My Vasundhara Abhiyan 4.0, Panvel Municipal Corporation organized an awareness program on climate change at New Horizon Public School on November 4.

Day by day, climate change is also adversely affecting the environment. On the instructions of Dr Vaibhav Vidhate, Deputy Commissioner, Environment Department, an awareness programme was organized at New Horizon Public School under The My Vasundhara Abhiyan 4.0 to make the school children aware of this adverse effect.

Amrit Kalash Yatra: Nation -wide "Meri Mati Mera Desh" Campaign, launched on 9th August 2023, is to pay tribute to the 'Veers' who laid down their lives for the country.

Solid Waste Event:
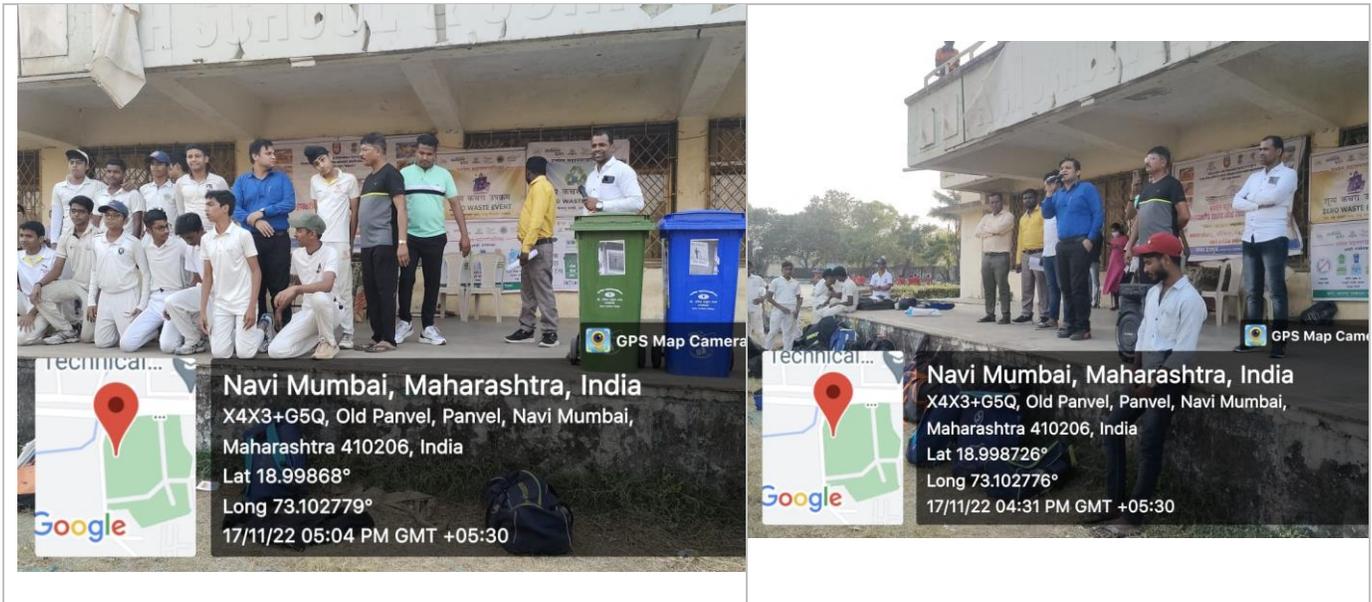
Awareness: Paryavaran Seva Yojana Meeting and Seminar on Water Conservation at Panvel Municipal Corporation Gujarati School, Panvel under the Banner of Majhi Vasundhara Abhiyan 4.0

Waste to Art

Outcome from Awareness

1. Swachhta Har Kadam App" an innovation for improving toilets in Panvel Municipal Corporation. Scalability of this app is very high, Novelty is unique. Mr. Sharad Shingade has come up with this new innovation with the support from Panvel Municipal Corporation.

2. Under the initiative of Majhi Vasundhara Abhiyan and Swachh Sarvekshan 2023, PMC gave more importance to City beautification and Cleanliness for which various awareness drives and activities were taken. Activities included Beautification of walls, installation of banners and hoardings, distribution of booklets, advertisement via workshops and skits.

3. Between April 2023 to March 2024, around 75 Cleanliness Drives were successfully conducted

4. Proposal of 'Cleanup Marshal Scheme' is under consideration for not only creating awareness among citizens on Maintaining Cleanliness' and Hygiene but also to effectively implement it.

5. Under Swatchha Bharat Mission, issues related to cleanliness are immediately resolved by PMC. During the financial year of 2023-24, total 27,692 persons downloaded the Swachhta Har Kadam App.on mobile.

6. PMC has made available the information regarding initiatives taken under Swachh Bharat Mission on its portal.

7. PMC has 20 E-Toilets