

STATE OF HAWAII ANNUAL SUMMARY 2023 AIR QUALITY DATA



Aerial View of West Oahu, Hawaii

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KA 'OIHANA OLAKINO
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2023 Hawaii Air Quality Data

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Section 1

INTRODUCTION

The Department of Health, Clean Air Branch, monitors the ambient air in the State of Hawaii for various gaseous and particulate air pollutants. The U.S. Environmental Protection Agency (EPA) has set national ambient air quality standards (NAAQS) for six criteria pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, ozone, and particulate matter (PM₁₀ and PM_{2.5}). Hawaii has also established a state ambient air standard for hydrogen sulfide. The primary purpose of the statewide monitoring network is to measure ambient air concentrations of these pollutants and ensure that these air quality standards are met.

In addition to monitoring the ambient air for criteria pollutants, the State of Hawaii also participates in the NCore multi pollutant monitoring network; the NCore station in Hawaii is located at the Kapolei monitoring station. The NCore network addresses the following objectives:

- Timely reporting of data to public by supporting AIRNow, air quality forecasting, and other public reporting mechanisms;
- Support for development of emission strategies through air quality model evaluation and other observational methods;
- Accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors;
- Support for long-term health assessments that contribute to ongoing reviews of the NAAQS;
- Compliance through establishing nonattainment/attainment areas through comparison with the NAAQS;
- Support to scientific studies ranging across technological, health, and atmospheric process disciplines;
- Support to ecosystem assessments recognizing that national air quality networks benefit ecosystem assessments and, in turn, benefit from data specifically designed to address ecosystem analyses; and
- PM_{2.5} speciation monitoring that EPA determined to be essential for establishing a relationship between particle concentrations and adverse health effects and would provide valuable information in characterizing aerosols, determining the effectiveness of control strategies, and understanding the effects of particle pollution on atmospheric and regional haze.

Air pollution is caused by different man-made and natural sources, which include industrial, such as power plants and refineries; mobile, such as cars, trucks, and buses; agricultural burning; and naturally occurring, such as wildfires and volcanic activity. In 2023, the state maintained 17 air monitoring stations statewide. On Oahu, 4 stations measured air emissions from commercial, industrial, and transportation activities. On Maui, 2 stations measure particulates due to impacts from agricultural burning and wildfires. Kauai's 1 monitoring station monitors the air quality impacts from cruise ships.

The majority of the state's monitoring stations are located on the island of Hawaii to provide air quality data to communities impacted by emissions from the volcano and geothermal energy production. Although the state's ambient air monitoring network is reviewed annually, any relocations, additions and/or discontinuations can occur as the need arises.

This report summarizes the validated air pollutant data collected at the 17 monitoring stations during calendar year 2023. Tabular summaries are provided which compare the measured concentrations of criteria pollutants with federal ambient air quality standards and of the state's hydrogen sulfide standard. Particulate speciation data and graphical trend summaries are also included in this report.

The Department of Health has a web site that displays near real-time air quality data collected from the air monitoring stations. The data has not been reviewed for quality assurance and is subject to change but provides the public with viewing access to current air pollutant and meteorological information. To view this data online, go to <http://health.hawaii.gov/cab> and link to "Hawaii Ambient Air Quality Data."

Additionally, because sulfur dioxide (SO₂) emissions from the Kilauea volcano may affect communities on the island of Hawaii during an eruption, the Department of Health provides a webpage displaying short term SO₂ data (15-minute averages) from the Hawaii island stations. The website also provides an advisory level with guidance to help individuals determine what actions need to be taken to protect against possible health effects. This website can be found at <https://air.doh.hawaii.gov/home/text/118>.

The 2023 "Hawaii Air Quality Data Book" and books from 2016 through 2022 can be found at: <https://health.hawaii.gov/cab/hawaii-air-quality-data-books/>

Questions or comments regarding data in this report and other air quality information can be emailed to CAB@doh.hawaii.gov or mailed to:

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Section 2

DEFINITIONS

<i>98th Percentile Value</i>	The PM _{2.5} 24-hour average or the maximum daily 1-hour NO ₂ average in the year below which 98% of all values fall.
<i>99th Percentile Value</i>	The maximum daily 1-hour SO ₂ value in the year below which 99% of all values fall.
<i>Ambient Air</i>	The general outdoor atmosphere, external to buildings, to which the general public has access.
<i>Ambient Air Quality Standard</i>	A limit in the quantity and exposure to pollutants dispersed or suspended in the ambient air. Primary standards are set to protect public health, including sensitive populations such as asthmatics, children, and the elderly. Secondary standards are set to protect public welfare including protection against visibility degradation, and damage to animals, crops, vegetation and buildings.
<i>Carbon Monoxide</i>	Carbon monoxide (CO) is a colorless, odorless, tasteless gas under atmospheric conditions. It is produced by the incomplete combustion of carbon fuels with the majority of emissions coming from transportation sources.
<i>CFR</i>	Code of Federal Regulations is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal government. Title 40 is the Protection of the Environment.
<i>Collocated</i>	This is a procedure required for a certain percentage of PM ₁₀ and PM _{2.5} samplers in the monitoring network. Collocated samplers determine precision or variation in the PM ₁₀ or PM _{2.5} concentration measurements of identical samplers run in the same location under the same sampling conditions.
<i>Criteria Pollutants</i>	These are the six pollutants for which the EPA has established national air quality standards. The pollutants are ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead and particulate matter (PM ₁₀ and PM _{2.5}).
<i>DRR</i>	Data Requirements Rule for 1-hour SO ₂ NAAQS.

<i>EPA</i>	The U.S. Environmental Protection Agency; established to protect human health and the natural environment.
<i>Hydrogen Sulfide</i>	Hydrogen sulfide (H ₂ S) is a toxic, colorless gas with a characteristic “rotten egg” odor detectable at very low levels. It occurs naturally during the decomposition of organic matter, near geothermal sources and is also produced during certain industrial processes, including wastewater treatment facilities.
<i>Micron</i>	One micron is one millionth of a meter or approximately 1/25,000 of an inch.
<i>µg/m³</i>	Micrograms per cubic meter. This is the measurement of air quality expressed as mass per unit volume.
<i>NAAQS</i>	National Ambient Air Quality Standards. These are pollutant standards that the EPA has established to protect public health and welfare. NAAQS have been set for carbon monoxide, nitrogen dioxide, PM ₁₀ , PM _{2.5} , ozone, sulfur dioxide, and lead. These are commonly referred to as criteria pollutants.
<i>NCore</i>	A multi-pollutant network that integrates several advanced measurement systems for particles, pollutant gases and meteorology. Most NCore stations have been operating since the formal start of the network on January 1, 2011, including Hawaii’s.
<i>Nitrogen Dioxide</i>	Nitrogen dioxide (NO ₂) is a brownish, highly corrosive gas with a pungent odor. It is formed in the atmosphere from emissions of nitrogen oxides (NO _x). Sources of nitrogen oxides include electric utilities, industrial boilers, motor vehicle exhaust and combustion of fossil fuels. NO ₂ is also a component in the atmospheric reaction that produces ground-level ozone.
<i>Ozone</i>	Ozone (O ₃) is the main constituent in photochemical air pollution. It is formed in the atmosphere by a chemical reaction of nitrogen oxides (NO _x) and volatile organic compounds (VOCs) in the presence of sunlight. In the upper atmosphere, O ₃ shields the earth from harmful ultraviolet radiation; however, at ground level, it can cause harmful effects in humans and plants.

<i>Particulate Matter</i>	This refers to any solid or liquid matter dispersed in the air. Particulate matter (PM) includes dust, soot, smoke, and liquid droplets from sources such as factories, power plants, motor vehicles, construction, agricultural activities, and fires.
<i>PM₁₀</i>	Particulate matter that is 10 microns or less in aerodynamic diameter. These are considered “coarse” particles, generally from sources such as road and windblown dust, and crushing and grinding operations.
<i>PM_{2.5}</i>	Particulate matter that is 2.5 microns or less in aerodynamic diameter. Considered “fine” particles, these are generally a result of fuel combustion such as from motor vehicles, utility generation and industrial facilities. Fine particles can also be formed when gases, such as sulfur dioxide and nitrogen dioxide, are chemically transformed into particles.
<i>ppb</i>	Parts per billion is one particle in 1,000,000,000 other particles.
<i>ppm</i>	Parts per million is one particle in 1,000,000 other particles. It is approximately one drop in 13 gallons.
<i>SLAMS</i>	State and Local Air Monitoring Stations. The Clean Air Act requires that every state establish a network of air monitoring stations for criteria pollutants.
<i>SPM</i>	Special Purpose Monitoring stations. These are stations established to provide data for special studies in support of air program interests and activities. SPM stations supplement the SLAMS network as special circumstances require and adequate resources permit.
<i>Sulfur Dioxide</i>	Sulfur dioxide (SO ₂) is a colorless gas that easily combines with water vapor forming sulfuric acid. Emissions of sulfur dioxide are largely from sources that burn fossil fuels such as coal and oil. In Hawaii, another possible major source of sulfur dioxide emissions is from any active eruption of Kilauea Volcano on the Big Island.
<i>Vog</i>	Vog is a local term used to express volcanic smog. Vog occurs when volcanic gas and particles combine with air and sunlight to produce atmospheric haze.

Table 2-1 State and Federal Ambient Air Quality Standards

Sources: State standards HAR §11-59; Federal standards 40 CFR Part 50

Air Pollutant	Averaging Time	Standards		
		Hawaii State Standard	Federal Primary Standard ^a	Federal Secondary Standard ^b
Carbon Monoxide (CO)	1-hour	9 ppm	35 ppm	None
	8-hour	4.4 ppm	9 ppm	
Nitrogen Dioxide (NO ₂)	1-hour	---	100 ppb	---
	Annual	0.04 ppm	53 ppb	0.053 ppm
PM ₁₀	24-hour	150 µg/m ³	150 µg/m ³	---
	Annual ^c	50 µg/m ³	---	---
PM _{2.5}	24-hour	---	35 µg/m ³	35 µg/m ³
	Annual	---	12 µg/m ³	15 µg/m ³
Ozone (O ₃)	8-hour	0.08 ppm	0.070 ppm	0.070 ppm
Sulfur Dioxide (SO ₂)	1-hour	---	75 ppb	---
	3-hour	0.5 ppm	---	0.5 ppm
	24-hour	0.14 ppm	---	---
	Annual	0.03 ppm	---	---
Lead (Pb)	Rolling 3-month	1.5 µg/m ³ ^d	0.15 µg/m ³	0.15 µg/m ³
Hydrogen Sulfide	1-hour	25 ppb	None	None

^a **Primary Standards** set limits to protect public health, including the health of “sensitive” populations such as asthmatics, children and the elderly.

^b **Secondary Standards** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

^c Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, EPA revoked the annual PM₁₀ standard effective December 17, 2006. However, the state still has an annual standard.

^d The state standard is based on calendar quarter.

Compliance with the National Ambient Air Quality Standards

CO 1-hour: May not be exceeded more than once per year.

CO 8-hour: May not be exceeded more than once per year.

NO₂ 1-hour: The 3-year average of the 98th percentile daily maximum 1-hour averages must not exceed the standard.

NO₂ Annual: Average of all 1-hour values in the year may not exceed the level of the standard.

PM₁₀ 24-hour: Must not be exceeded more than one day per year, after compensating for days when monitoring did not occur (estimated number of exceedances).

PM_{2.5} 24-hour: The 3-year average of the 98th percentile 24-hour concentrations must not exceed the level of the standard.

PM_{2.5} Annual: The 3-year average of 24-hour values must not exceed the level of the standard.

Ozone 8-hour: The 3-year average of the fourth highest daily maximum value must not exceed the level of the standard.

SO₂ 1-hour: The 3-year average of the 99th percentile daily maximum 1-hour averages must not exceed the standard.

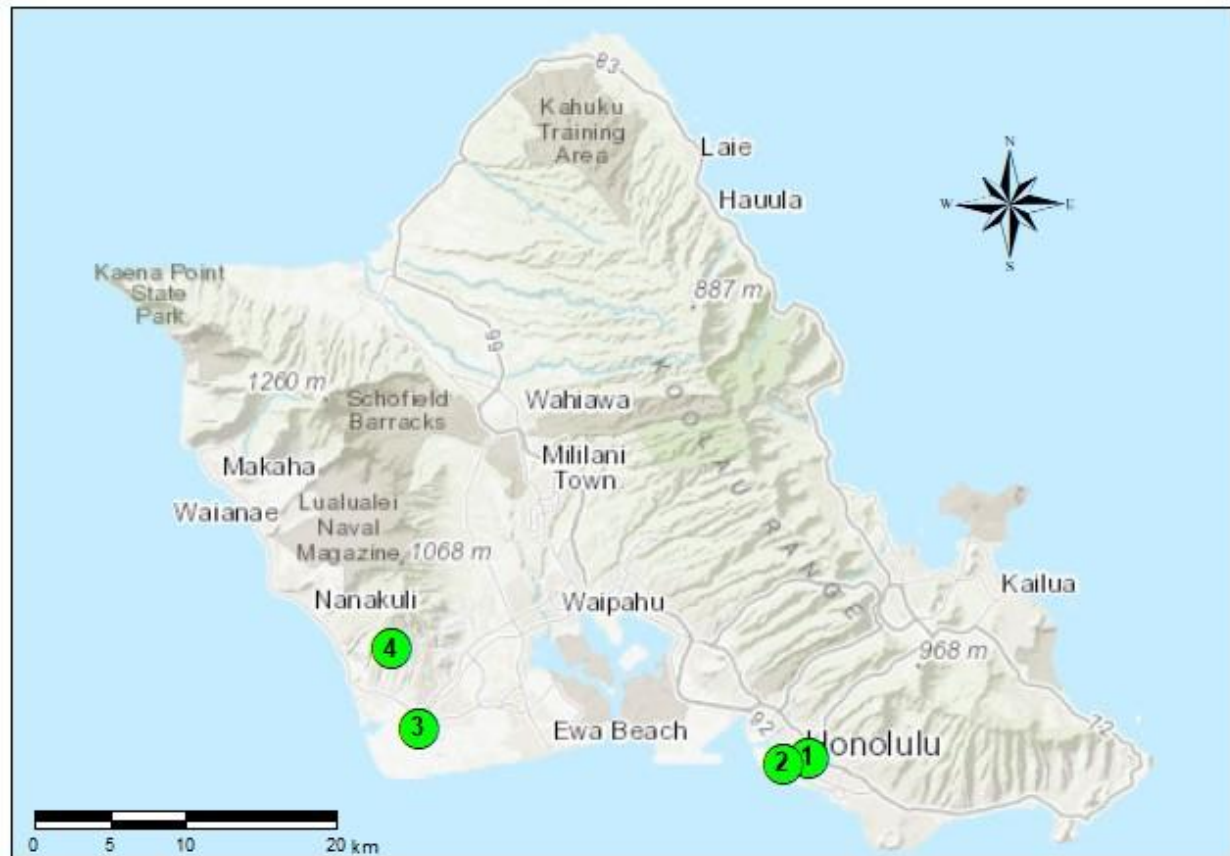
SO₂ 3-hour: Not be exceeded more than once per year.

Lead: Average of all 24-hour values in any rolling 3-month period may not exceed the level of the standard.

Section 3


SITE LOCATIONS AND DESCRIPTIONS


Figure 3-1: Island of Oahu – Air Monitoring Stations




Station	Name	Location	Pollutants/Parameters Monitored
1	Honolulu	1250 Punchbowl Street	CO, SO ₂ , PM _{2.5} , PM ₁₀
2	Sand Island	1039 Sand Island Parkway	O ₃ , PM _{2.5} , PM _{2.5} Collocated
3	Kapolei / NCore	2052 Lauwiliwili Street	NO ₂ / CO trace, SO ₂ trace, NO/NO _y , O ₃ , PM _{2.5} , PM _{2.5} speciation, PM ₁₀ , PM _{10-2.5} , WS/WD
4	Kahe	Palehua Road	SO ₂

The following station descriptions include latitude and longitude in decimal degrees and altitude in meters above mean sea level.

Honolulu (DH)		
	Location:	1250 Punchbowl St., Honolulu
	Latitude:	21.30758
	Longitude:	-157.85542
	Altitude:	20 m
	Parameters:	SO ₂ , CO, PM ₁₀ , PM _{2.5}
	Established:	April 1971
	Brief Description:	Located in downtown Honolulu on the roof of the Department of Health building, across from the Queen's Medical Center, in a busy commercial, business and government district.

Kapolei (KA)		
	Location:	2052 Lauwiliwili St., Kapolei
	Latitude:	21.32374
	Longitude:	-158.08861
	Altitude:	17.9 m
	Parameters:	SO ₂ , CO, NO ₂ , PM ₁₀ , PM _{2.5} , PM _{2.5} speciation, NCore
	Established:	July 2002
Brief Description:	Located in Kapolei Business Park, southeast of Kapolei Fire Station, next to a drainage canal that separates the park from Barber's Point. Approximately 1.5 miles from Malakole Street in Campbell Industrial Park.	

Sand Island (SI)		
	Location:	1039 Sand Island Pkwy., Honolulu
	Latitude:	21.30384
	Longitude:	-157.87117
	Altitude:	5.3 m
	Parameters:	O ₃ , PM _{2.5}
	Established:	February 1981
Brief Description:	Located in a light industrial, commercial and recreational area approximately two miles downwind of downtown Honolulu near the entrance to the Sand Island State Recreation Area.	


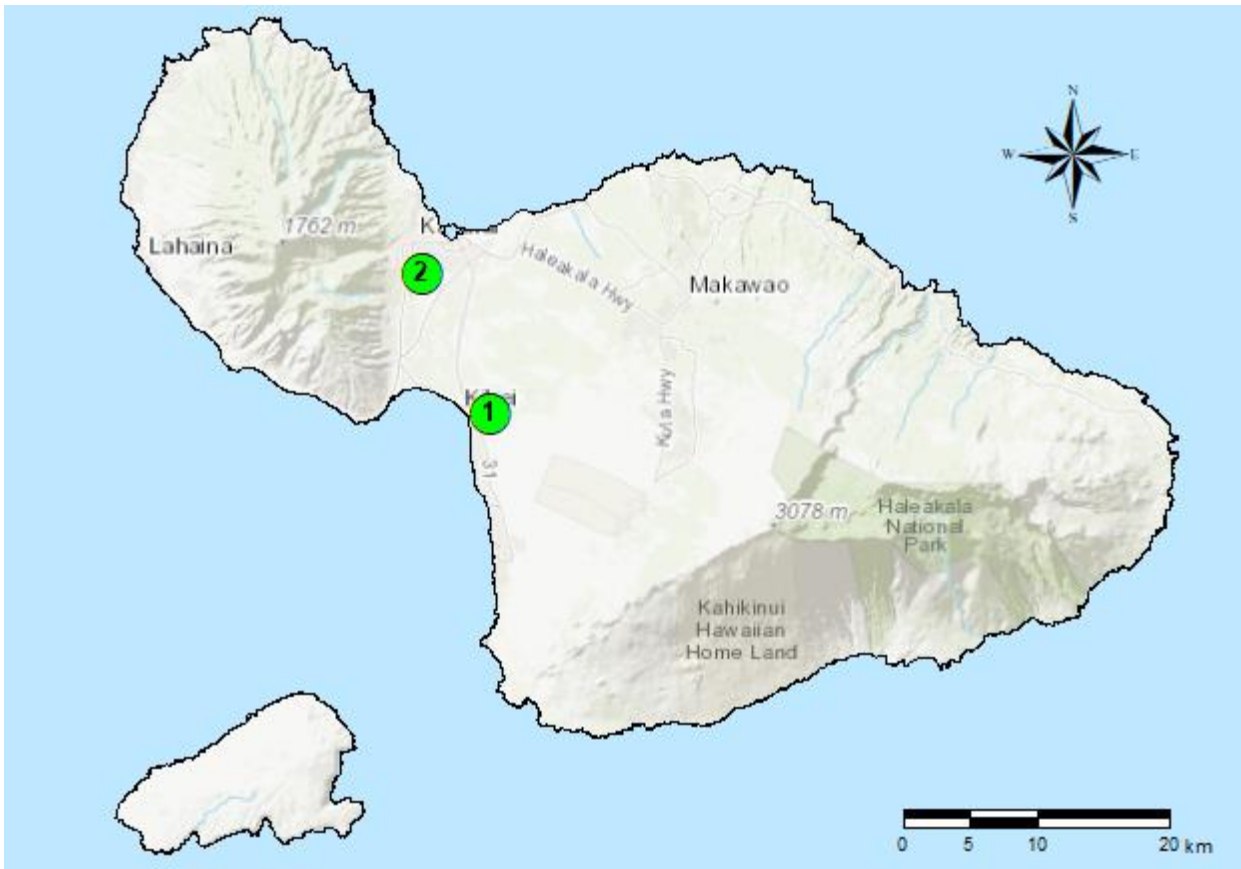

Kahe (KE) (Data Requirements Rule)		
	Location:	Palehua Road, Makakilo
	Latitude:	21.3678
	Longitude:	-158.103
	Altitude:	388 m
	Parameters:	SO ₂
	Established:	January 2017
Brief Description:		Located on the hillside south of Palehua Road, approximately 2.7 kilometers northeast of the Kahe Generating Station. The area around the station is undeveloped and is currently used for cattle grazing. The city of Makakilo is located to the east and southeast.

Figure 3-2: Island of Maui – Air Monitoring Stations



Station	Name	Location	Pollutant Monitored
1	Kihei	Hale Piilani Park	PM _{2.5}
2	Kahului	TMK (2)-3-8-007-153	PM _{2.5}

Kihei (KH)		
	Location:	Hale Piilani Park, Kihei
	Latitude:	20.780997
	Longitude:	-156.44637
	Altitude:	46.5 m
	Parameters:	PM _{2.5}
	Established:	February 1999
	Brief Description:	Located in a residential community park, next to a recent residential development on what was once agricultural land.


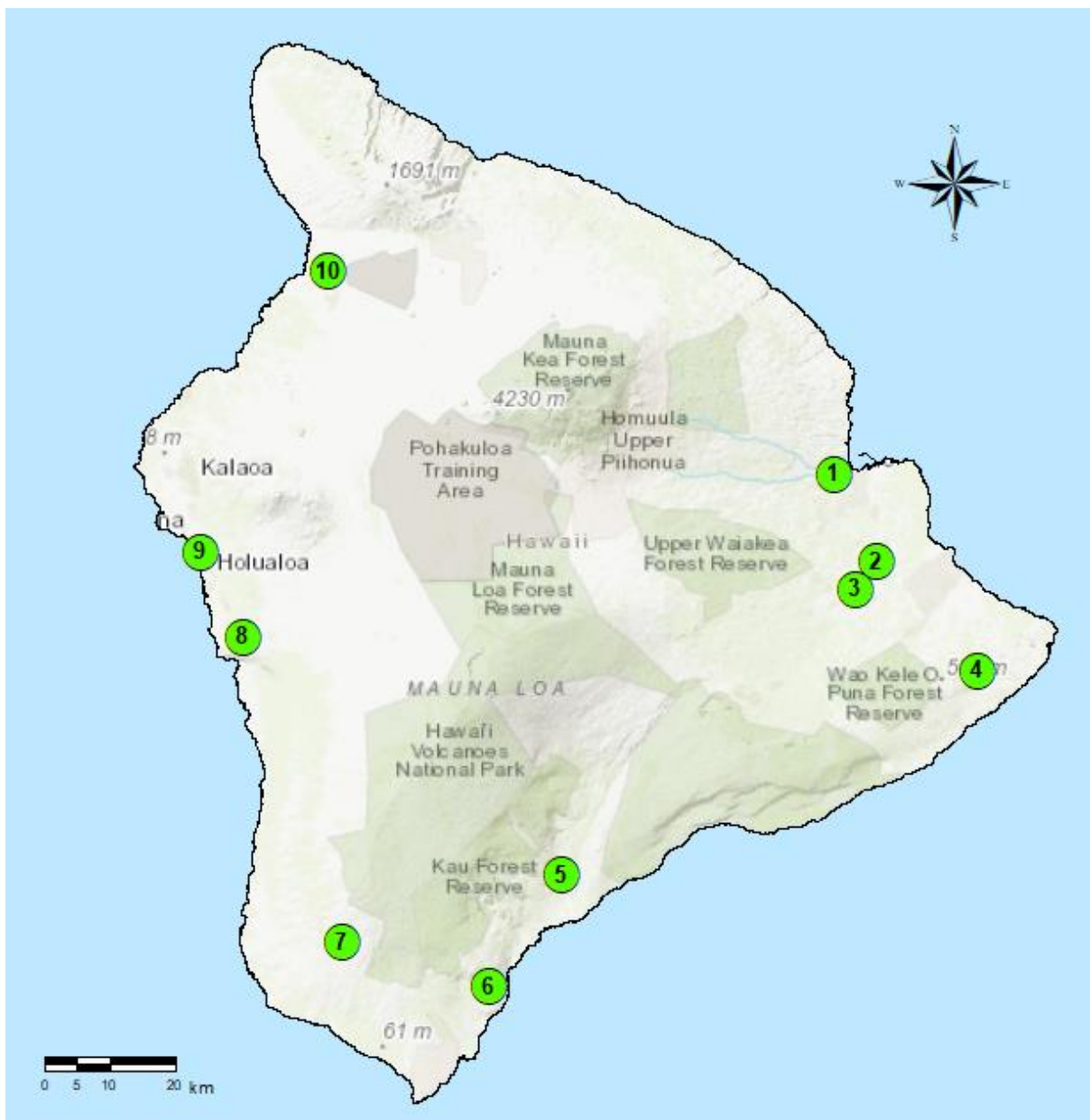


Kahului (KL)		
	Location:	TMK (2)-3—8-007-153, Kahului
	Latitude:	20.869444
	Longitude:	-156.492417
	Altitude:	55.5 m
	Parameters:	PM _{2.5}
	Established:	January 2015
Brief Description:	Located within a fenced area off Mauihni Parkway, TMK 2-3-8-007-153. The area is surrounded primarily by residential land.	


Figure 3-3: Island of Hawaii – Air Monitoring Stations




Station	Name	Location	Pollutants Monitored
1	Hilo	1099 Waianuenue Avenue	SO ₂ , PM _{2.5}
2	Keaau	16-714 Volcano Road	SO ₂ , PM _{2.5}
3	Mountain View	18-1235 Volcano Road	SO ₂ , PM _{2.5}
4	Leilani	13-3441 Moku Street	SO ₂ , H ₂ S
5	Pahala	96-3150 Pikake Street	SO ₂ , PM _{2.5}
6	Naalehu	Naalehu Elementary School	SO ₂ , PM _{2.5}
7	Ocean View	92-6091 Orchid Mauka Circle	SO ₂ , PM _{2.5}
8	Kona	81-1043 Konawaena School Road	SO ₂ , PM _{2.5}
9	Kailua-Kona	DWS Puapua'a Reservoir	PM _{2.5}
10	Waikoloa	TMK 3-6-8-002-019	SO ₂ , PM _{2.5}

Hilo (HL)		
	Location:	1099 Waianuenue Ave., Hilo
	Latitude:	19.71756
	Longitude:	-155.11053
	Altitude:	136.8 m
	Parameters:	SO ₂ , PM _{2.5}
	Established:	January 1997
	Brief Description:	
Located near the Hilo Medical Center, this station was established to monitor vog on the east side of the island of Hawaii.		

Kona (KN)		
	Location:	81-1043 Konawaena School Rd., Kona
	Latitude:	19.50978
	Longitude:	-155.91342
	Altitude:	517.2 m
	Parameters:	SO ₂ , PM _{2.5}
	Established:	September 2005
	Brief Description:	
Located on the upper campus of Konawaena High School, this station monitors for vog on the west side of the island of Hawaii.		

Mt. View (MV)		
	Location:	18-1235 Volcano Rd., Mt. View
	Latitude:	19.57002
	Longitude:	-155.08046
	Altitude:	436.5 m
	Parameters:	SO ₂ , PM _{2.5}
	Established:	December 2010
	Brief Description:	
Located on the grounds of the Mt. View Elementary School, this station was established to monitor vog during southerly wind conditions.		

Ocean View (OV)		
	Location:	92-6091 Orchid Mauka Circle, Ocean View
	Latitude:	19.11756
	Longitude:	-155.77814
	Altitude:	862.6 m
	Parameters:	SO ₂ , PM _{2.5}
	Established:	April 2010
	Brief Description:	
Located at the Ocean View Fire Station in Hawaii Ocean View Estates, this station monitors for volcanic emissions.		

Pahala (PA)



Location:	96-3150 Pikake St., Pahala
Latitude:	19.2039
Longitude:	-155.48018
Altitude:	320 m
Parameters:	SO ₂ , PM _{2.5}
Established:	August 2007

Brief Description:

Located on the grounds of the Kau High and Pahala Elementary School, this station monitors for volcanic emissions.

KAILUA-KONA (KK)



Location:	DWS Puapua'a Reservoir, Kailua-Kona
Latitude:	19.61815833
Longitude:	-155.9711111
Altitude:	92.4 m
Parameters:	PM _{2.5}
Established:	November 2018

Brief Description:

This station is in the middle of Kailua-Kona town within the County of Hawaii's water reservoir and pump house, monitoring for volcanic emissions.


KEAAU (KS)




Location:	Kamehameha Schools, 16-714 Volcano Road, Keaau, HI 96749
Latitude:	19.605424
Longitude:	-155.051379
Altitude:	179.8 m
Parameters:	SO ₂ , PM _{2.5}
Established:	June 2022

Brief Description:

This station is in the town of Keaau on the Kamehameha Schools Hawaii campus, monitoring for volcanic emissions during southerly wind conditions.

Leilani (LE)		
	Location:	13-3441 Moku St., Pahoa
	Latitude:	19.46555556
	Longitude:	-154.91583333
	Altitude:	229 m
	Parameters:	H ₂ S, SO ₂
	Established:	June 2021
	Brief Description:	Located at the Leilani Community Association Center in a residential subdivision, the station monitors emissions from the nearby geothermal energy facility.

Naalehu (NA)		
	Location:	Naalehu Elementary School, 95-5547 Mamalahoa Hwy., Naalehu
	Latitude:	19.060656
	Longitude:	-155.579167
	Altitude:	196.3 m
	Parameters:	SO ₂ , PM _{2.5}
	Established:	September 2018
	Brief Description:	This station is located at the USGS Seismograph building on the campus of Naalehu Elementary School, monitoring for volcanic emissions.


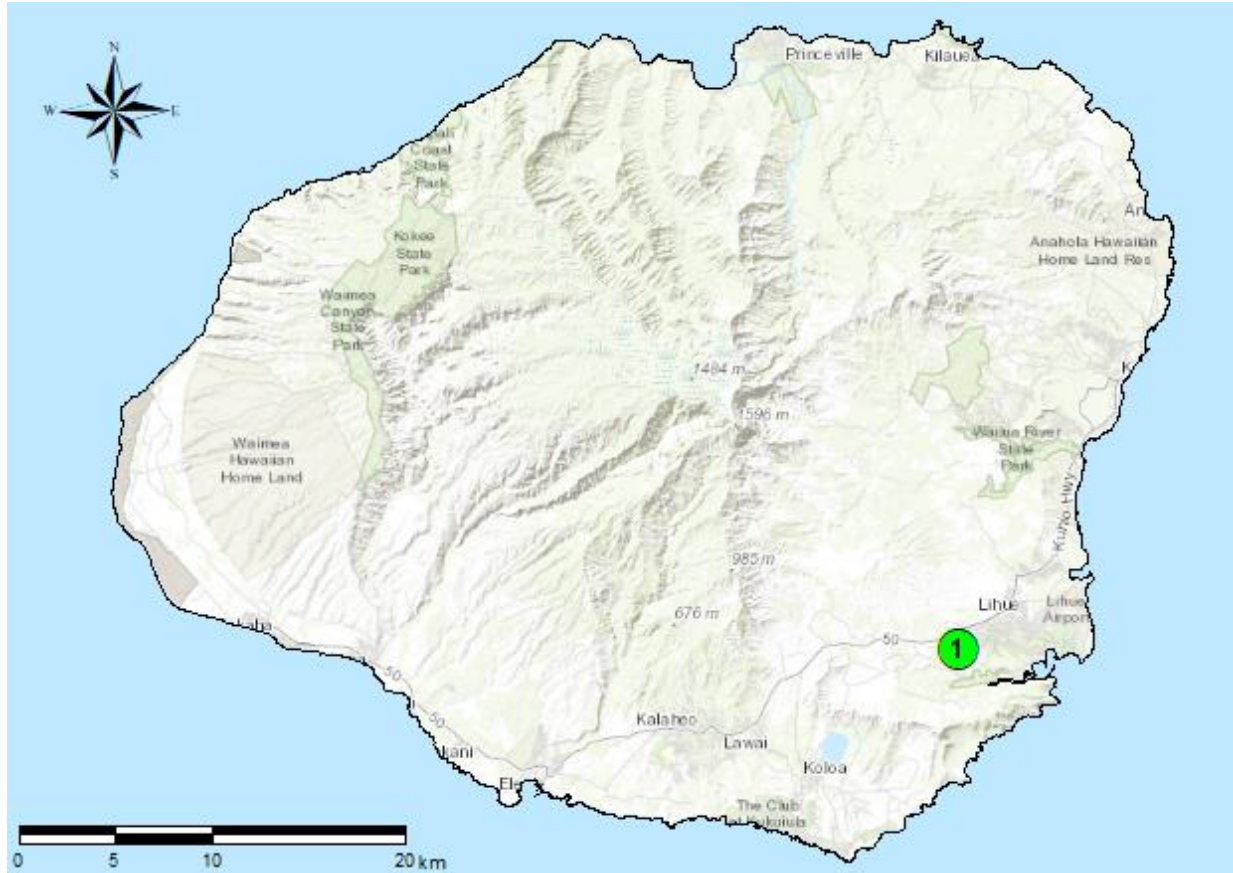
Waikoloa (WL)		
	Location:	TMK 3-6-8-002-019, Waikoloa
	Latitude:	19.977500
	Longitude:	-155.798056
	Altitude:	182.9 m
	Parameters:	SO ₂ , PM _{2.5}
	Established:	July 2021
	Brief Description:	Located within the County of Hawaii's water tank and pump house, approximately 3 km northeast of Waikoloa, this station monitors for volcanic emissions.

Figure 3-4: Island of Kauai – Air Monitoring Station



Station	Name	Location	Pollutant Monitored
1	Niumalu	2342 Hulemalu Road	SO ₂


Niumalu (NI)	
	Location: 2342 Hulemalu Road, Lihue
	Latitude: 21.9495
	Longitude: -159.365
	Altitude: 11 m
	Parameters: SO ₂
	Established: April 2011
Brief Description:	
Located in the Niumalu residential subdivision, this station monitors for emissions from the cruise ships in Nawiliwili Harbor approximately 1.0 mile upwind.	

Table 3-1 State of Hawaii Ambient Air Monitoring Network

SITE	Pollutants Monitored and Station Type							MONITORING OBJECTIVE	LOCATION SETTING
	PM ₁₀	PM _{2.5}	CO	O ₃	SO ₂	NO ₂	H ₂ S		
OAHU									
Honolulu	S	S	S	-	S	-	-	Population Exposure	Urban and Center City
Kapolei ¹	S	S,C	S	S	S	S	-	Population Exposure	Suburban
Sand Island	-	S,C	-	S	-	-	-	Maximum Concentration (O ₃)/ Transport (PM _{2.5})	Urban and Center City
Kahe ²	-	-	-	-	S	-	-	Source Impact (DRR)	Neighborhood
MAUI									
Kihei ³	-	SPM	-	-	-	-	-	Population Exposure	Suburban
Kahului	-	SPM	-	-	-	-	-	Population Exposure	Neighborhood
HAWAII									
Hilo	-	SPM	-	-	S	-	-	Population Exposure	Suburban
Kona	-	SPM	-	-	S	-	-	Population Exposure (SO ₂)/ Maximum concentration (PM _{2.5})	Suburban
Mountain View	-	SPM	-	-	SPM	-	-	Source Impact	Suburban
Ocean View	-	SPM	-	-	SPM	-	-	Welfare Impact (SO ₂)/ Source Impact (PM _{2.5})	Rural
Pahala	-	SPM	-	-	SPM	-	-	Maximum concentration (SO ₂)/ Source Impact (PM _{2.5})	Rural
Kailua-Kona	-	SPM	-	-	-	-	-	Source Impact	Suburban
Keaau	-	SPM	-	-	SPM	-	-	Source Impact	Suburban
Leilani	-	-	-	-	SPM	-	SPM	Source Impact (geothermal)	Rural
Naalehu	-	SPM	-	-	SPM	-	-	Source Impact	Rural
Waikoloa ⁴	-	SPM	-	-	SPM	-	-	Source Impact	Rural
KAUAI									
Niimalu	-	-	-	-	SPM	-	-	Source Impact (cruise ships)	Suburban

C = Collocated Site

S = (SLAMS) State and Local Air Monitoring Station

SPM = Special Purpose Monitoring Station (for monitoring vog, geothermal energy production and cruise ships)

¹ Includes NCore station.

² As required by the Data Requirements Rule.

³ The Kihei station was discontinued in March of 2022 but restarted on August 22, 2023 for purposes of monitoring the impacts from wildfires. **Data is preliminary.**

⁴ Monitoring for SO₂ began on 12/8/2022 at the Waikoloa station.

Table 3-2 Sampling Equipment at Each Monitoring Station

Monitoring Station	PM ₁₀ Continuous Ambient Particulate Monitor	PM _{2.5} Manual Particulate Monitor	PM _{2.5} Continuous Monitor	CO Continuous Gas Filter Correlation Analyzer	SO ₂ Continuous Pulsed Fluorescence Ambient Air Analyzer	O ₃ Continuous UV Photometric Analyzer	NO ₂ Continuous Chemiluminescence Analyzer	H ₂ S Continuous Pulsed Fluorescence Ambient Air Analyzer
OAHU								
Honolulu	■		■	■	■			
Kapolei	■	■	■	■	■	■	■	
Sand Island			■			■		
MAUI								
Kihei			◆					
Kahului			■					
HAWAII								
Hilo			■		■			
Kona			■		■			
Mt. View			■		■			
Ocean View			■		■			
Pahala			■		■			
Kailua-Kona			■					
Keaau			■		■			
Leilani					■			■
Naalaehu			■		■			
Waikoloa			■		▲			
KAUAI								
Niumalu					■			

◆ The Kihei station was discontinued in March of 2022 but restarted on August 22, 2023 for purposes of monitoring the impacts from wildfires. **Data is preliminary.**
 ▲ Monitoring for SO₂ began on 12/8/2022 at the Waikoloa station.

Section 4

AIR QUALITY DATA

To protect the state's air quality from degradation, the Department of Health's Clean Air Branch is responsible for regulating and monitoring pollution sources to ensure that the levels of criteria pollutants remain well below the state and federal ambient air quality standards. Data collected from the ambient air network is validated and audited to ensure that the reported data is of good quality and meets all quality control and assurance requirements.

In 2023 the State of Hawaii was in attainment of all NAAQS.

Description of Summary Tables 4-1 through 4-17:

- Summaries are by pollutant and averaging period, with the number of occurrences exceeding the NAAQS;
- Table 4-11, provides the number of exceedances of the state's H₂S standard (there is no federal H₂S standard);
- The "Maximum" is the highest and second highest valid values recorded in the year for the averaging period;
- For PM_{2.5}, the maximum and 98th percentile concentrations are provided;
- For O₃, the 4th highest daily maximum value is also displayed;
- The "Annual Mean" is the arithmetic mean of all valid values recorded in the year;
- "Possible Periods" is the total number of possible sampling periods in the year for the averaging period;
- "Valid Periods" is the total number of acceptable sampling periods after data validation;
- "Percent Recovery" represents the amount of quality data reported;
- Attainment with the NAAQS is determined according to 40 CFR 50.

Description of Tables 4-18 through 4-27:

- For each pollutant and averaging period, the highest concentration for each month is presented;
- The month with the highest value recorded in the year for each site is highlighted.

Table 4-1. 2023 Summary of the 24-Hour PM₁₀ Averages

	Maximum		Annual Mean	No. of 24-Hour Averages Greater than 150 µg/m ³												Possible Periods	Valid Periods	Percent Recovery	
	1 st High	2 nd High		All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov				Dec
OAHU																			
Honolulu ¹	33	28	12.4	0	0	0	0	0	0	0	0	0	0	0	0	0	365	365	100.0%
Kapolei ¹	76	46	16.7	0	0	0	0	0	0	0	0	0	0	0	0	0	365	328	89.9%

¹ Data recovery was <75% in 2nd quarter.

Table 4-2. Attainment Determination of the 24-Hour PM₁₀ NAAQS

Station	Exceedances in 2021	Exceedances in 2022	Exceedances in 2023	Sites in Violation of the NAAQS
Honolulu	0	0	0	0
Kapolei	0	0	0	0

Attainment: The standard not to be exceeded more than once per year on average over 3 years.
In 2023, Hawaii was in attainment with the 24-hour PM₁₀ NAAQS.

Table 4-3. 2023 Summary of the 24-Hour PM_{2.5} Averages: SLAMS Stations

	Maximum		Annual Mean	No. of 24-Hour Averages Greater than 35 µg/m ³												Possible Periods	Valid Periods	Percent Recovery	
	1 st High	98 th %		All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov				Dec
OAHU																			
Honolulu	22.0	9.0	4.2	0	0	0	0	0	0	0	0	0	0	0	0	0	365	365	100%
Kapolei ¹	15.8	10.0	4.4	0	0	0	0	0	0	0	0	0	0	0	0	0	365	328	89.9%
Sand Island	42.0 ²	10.0	3.7	1	0	0	0	0	0	0	0	0	0	0	0	0	365	356	97.5%

¹ Data recovery was <75% in 2nd quarter, valid periods supplemented by collocated monitor, providing an additional 8 back-up sampling periods – design value valid for attainment determination.

² Due to New Year's fireworks celebration.

Table 4-4. Attainment Determination of the 24-Hour PM_{2.5} NAAQS: SLAMS Stations

Station	2021 98 th Value	2022 98 th Value	2023 98 th Value	3-Year Average	Sites in Violation of the NAAQS
Honolulu	5.9	7.2	8.3	7	0
Kapolei	6.7	8.1	9.3	8	0
Sand Island	6.2	8.2	10.0	8	0

Attainment: The 3-year average of the 98th percentile values must be less than or equal to 35 µg/m³; design values are calculated to the nearest µg/m³.
In 2023, Hawaii was in attainment with the 24-hour PM_{2.5} NAAQS.

Table 4-5. Attainment Determination of the Annual PM_{2.5} NAAQS: SLAMS Stations

Station	2021 Annual Average	2022 Annual Average	2023 Annual Average	3-Year Average	Sites in Violation of the NAAQS
Honolulu	2.9	3.3	4.1	3.4	0
Kapolei	2.9	3.8	4.4	3.7	0
Sand Island	3.3	3.7	3.9	3.6	0

Attainment: The 3-year average of annual mean values must be less than 12 µg/m³; design values are calculated to the nearest 0.1 µg/m³.
In 2023, Hawaii was in attainment with the annual PM_{2.5} NAAQS.

Table 4-6. 2023 Summary of the 24-Hour PM_{2.5} Averages: SPM Stations

	Maximum		Annual Mean	No. of 24-Hour Averages Greater than 35 µg/m ³												Possible Periods	Valid Periods	Percent Recovery	
	1 st High	98 th %	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
HAWAII																			
Hilo	10.1	6.2	3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	365	343	94.0%
Kona	18.7	11.5	3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	365	360	98.6%
Mt. View	20.0	5.3	2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	365	359	98.4%
Ocean View	16.4	10.2	2.6	0	0	0	0	0	0	0	0	0	0	0	0	0	365	360	98.6%
Pahala	10.2	7.0	3.6	0	0	0	0	0	0	0	0	0	0	0	0	0	365	359	98.4%
Kailua-Kona	17.6	11.2	3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	365	360	98.6%
Keaau	8.6	5.3	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	365	355	97.3%
Naalehu	11.2	6.7	3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	365	364	99.7%
Waikoloa	13.0	9.9	2.8	0	0	0	0	0	0	0	0	0	0	0	0	0	365	357	97.8%
MAUI																			
Kahului	57.2 ¹	8.3	4.0	1	0	0	0	0	0	0	0	0	0	0	0	0	365	341	93.4%
Kihei ²	6.1	5.3	2.3	-	-	-	-	-	-	-	0	0	0	0	0	0	132	126	95.5%

The special purpose stations on Hawaii island were established to monitor ambient air concentrations of PM_{2.5} from volcanic emissions. The special purpose station on Maui was established to monitor air quality impacts from agricultural burning activities.

¹ Due to New Year's fireworks celebration.

² The Kihei station was discontinued in March of 2022 but restarted on August 22, 2023 for purposes of monitoring the impacts from wildfires. **Data is preliminary.**

Table 4-7. 2023 Summary of the 8-Hour O₃ Averages

	Maximum			Annual Mean	No. of Daily Maximum 8-Hour Averages Greater than 0.070 ppm												Possible Periods	Valid Periods	Percent Recovery
	1 st High	2 nd High	4 th High		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
OAHU																			
Sand Island	0.048	0.046	0.046	0.027	0	0	0	0	0	0	0	0	0	0	0	0	6200	6015	97.0%
Kapolei	0.045	0.044	0.043	0.026	0	0	0	0	0	0	0	0	0	0	0	0	6200	5880	94.8%

Table 4-8. Attainment Determination of the 8-Hour O₃ NAAQS

Station	2021 4 th Highest	2022 4 th Highest	2023 4 th Highest	3-Year Average	Sites in Violation of the NAAQS
Sand Island	0.045	0.044	0.046	0.045	0
Kapolei	0.047	0.041	0.043	0.043	0

Attainment: The 3-year average of the annual 4th highest daily maximum 8-hour average must be less than or equal to 0.070 ppm.
In 2023, Hawaii was in attainment with the 8-hour O₃ NAAQS.

Table 4-9. 2023 Summary of the 1-Hour and Annual NO₂ Averages

	Maximum		Annual Mean	No. of Daily Maximum 1-Hour Averages Greater than 100 ppb												Possible Periods	Valid Periods	Percent Recovery	
	1 st High	98 th %		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
OAHU	SLAMS Station																		
Kapolei	34.3	23.2	3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	8760	8366	95.5%

Attainment of the annual NO₂ NAAQS: The annual mean shall not exceed 53 ppb.
In 2023, Hawaii was in attainment with the annual NO₂ NAAQS.

Table 4-10. Attainment Determination of the 1-Hour NO₂ NAAQS

Station	2021 98 th Value	2022 98 th Value	2023 98 th Value	3-Year Average	Sites in Violation of the NAAQS
OAHU	SLAMS Station				
Kapolei	21.5	23.1	23.2	23	0
Attainment: The 3-year average of the 98 th percentile values must be less than or equal to 100 ppb; design values are rounded to the nearest ppb. In 2023, Hawaii was in attainment with the 1-hour NO₂ NAAQS.					

Table 4-11. 2023 Summary of the 1-Hour H₂S Averages (State Standard)

	Maximum		Annual Mean	No. of 1-Hour Averages Greater than 25 ppb												Possible Periods	Valid Periods	Percent Recovery	
	1 st High	2 nd High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
HAWAII																			
Leilani	2.4	2.4	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	8760	8308	94.8%
State standard: 1-hour values not to exceed 25 ppb. In 2023, Hawaii did not exceed the state 1-hour H₂S standard.																			

Table 4-12. 2023 Summary of the 1-Hour SO₂ Averages

	Maximum		Annual Mean	No. of 1-Hour Averages Greater than 75 ppb												Possible Periods	Valid Periods	Percent Recovery
	1 st High	99 th %	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
OAHU	SLAMS Stations																	
Honolulu	4.8	2.9	1.2	0	0	0	0	0	0	0	0	0	0	0	0	8760	8475	96.7%
Kapolei/NCORE	23.8	11.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	8760	8377	95.6%
Kahe	62.7	60.3	1.1	0	0	0	0	0	0	0	0	0	0	0	0	8760	8602	98.2%
HAWAII	SPM Stations (see NOTE)																	
Hilo ¹	144.3	92.1	1.3	4	0	0	0	0	0	0	0	0	0	0	0	8760	8527	97.3%
Kona ¹	69.0	18.0	1.7	0	0	0	0	0	0	0	0	0	0	0	0	8760	8584	98.0%
Mt. View ¹	132.0	42.9	1.0	1	0	0	0	0	0	0	0	0	0	0	0	8760	8593	98.1%
Ocean View ¹	1,083.4	213.0	3.8	4	0	0	0	0	5	0	0	4	0	0	0	8760	8564	97.8%
Pahala ¹	293.0	236.1	3.4	12	4	0	0	0	0	0	0	4	0	0	0	8760	8329	95.1%
Keaau ¹	84.7	27.2	0.0	1	0	0	0	0	0	0	0	0	0	0	0	8760	8227	93.9%
Leilani	4.2	2.6	1.1	0	0	0	0	0	0	0	0	0	0	0	0	8760	8308	94.8%
Naalehu ¹	337.5	94.8	2.3	4	1	0	0	0	1	0	0	1	0	0	0	8760	8582	98.0%
Waikoloa ²	11.5	6.2	0.3	0	0	0	0	0	0	0	0	0	0	0	0	8760	8528	97.4%
KAUAI	SPM Station (see NOTE)																	
Niumalu ³	3.0	1.9	0.8	0	0	0	0	0	0	0	0	0	0	0	0	8760	7851	89.6%

Attainment: The 3-year average of the 99th percentile values must be less than or equal to 75 ppb.

In 2023, Hawaii was in attainment with the 1-hour SO₂ NAAQS (SLAMS stations only).

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO₂ from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, high levels of SO₂ attributed to volcanic emissions is comparable to the NAAQS. Volcanic eruptions are considered natural events, EPA concurrence of an exceptional event demonstration allows the exclusion of data for attainment determinations.

The SPM station on Kauai was established to monitor emissions from cruise ships.

¹ Elevated values due to emissions from eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

² Monitoring for SO₂ began at the Waikoloa station on 12/8/2022.

³ Data recovery was <75% in 4th quarter, substitution test valid.

Table 4-13. Attainment Determination of the 1-Hour SO₂ NAAQS: SLAMS Stations

	2021 99 th Value	2022 99 th Value	2023 99 th Value	3-Year Average	Violation of the NAAQS
OAHU SLAMS Stations					N= NO Y= YES
Honolulu	1.6	1.6	2.9	2	N
Kapolei/NCORE	5.8	1.9	11.4	6	N
Kahe	44.1	63.1	60.3	56	N
HAWAII SPM Stations (see NOTE)					
Hilo ¹	26.7	25.3	92.1	48	N
Kona ¹	9.5	8.2	18.0	12	N
Mt. View ¹	61.4	55.6	42.9	53	N
Ocean View ¹	140.5	107.3	213.0	154	Y
Pahala ¹	420.0	229.2	236.1	295	Y
Keaau ¹	44.9	36.1	27.2	36	N
Leilani	3.2	2.2	2.6	3	N
Naalehu ¹	66.8	39.0	94.8	67	N
Waikoloa ²	-	1.5	6.2	4	N
KAUAI SPM Station (see NOTE)					
Niumalu ³	2.8	1.8	1.9	2	N
<p>Attainment: The 3-year average of the 99th percentile values must be less than or equal to 75 ppb; design values are rounded to the nearest ppb. In 2023, Hawaii was in attainment with the 1-hour SO₂ NAAQS (SLAMS stations only).</p> <p>NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO₂ from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, high levels of SO₂ attributed to volcanic emissions is comparable to the NAAQS. Volcanic eruptions are considered natural events, EPA concurrence of an exceptional event demonstration allows the exclusion of data for attainment determinations. The SPM station on Kauai was established to monitor emissions from cruise ships.</p>					

¹ Elevated values due to emissions from eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

² Monitoring for SO₂ began at the Waikoloa station on 12/8/2022, the 2022 99th value is based on only 24 days of operation during the year.

³ Data recovery was <75% in 4th quarter, substitution test valid.

Table 4-14. 2023 Summary of the 3-Hour SO₂ Averages

	Maximum		Annual Mean	No. of 3-Hour Averages Greater than 0.5 ppm												Possible Periods	Valid Periods	Percent Recovery
	1 st High	2 nd High		All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov			
OAHU	SLAMS Stations																	
Honolulu	0.004	0.003	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	2755	94.3%
Kapolelei/NCORE	0.015	0.012	0.000	0	0	0	0	0	0	0	0	0	0	0	0	2920	2733	93.6%
Kahe	0.042	0.042	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	2844	97.4%
HAWAII	SPM Stations (see NOTE)																	
Hilo ¹	0.109	0.095	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	2819	96.5%
Kona ¹	0.045	0.023	0.002	0	0	0	0	0	0	0	0	0	0	0	0	2920	2785	95.4%
Mt. View ¹	0.066	0.054	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	2786	95.4%
Ocean View ¹	0.413	0.225	0.004	0	0	0	0	0	0	0	0	0	0	0	0	2920	2806	96.1%
Pahala ¹	0.203	0.196	0.003	0	0	0	0	0	0	0	0	0	0	0	0	2920	2720	93.2%
Keaau ¹	0.032	0.021	0.000	0	0	0	0	0	0	0	0	0	0	0	0	2920	2687	92.0%
Leilani	0.003	0.003	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	2726	93.4%
Naalehu ¹	0.153	0.087	0.002	0	0	0	0	0	0	0	0	0	0	0	0	2920	2832	97.4%
Waikoloa ²	0.007	0.007	0.000	0	0	0	0	0	0	0	0	0	0	0	0	2920	2803	96.0%
KAUAI	SPM Station (see NOTE)																	
Niumalu ³	0.002	0.002	0.001	0	0	0	0	0	0	0	0	0	0	0	0	2920	2506	85.8%

Attainment: 3-hour values not to exceed 0.5 ppm more than once per year.

In 2023, Hawaii was in attainment with the 3-hour SO₂ NAAQS.

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO₂ from volcanic emissions. Although Hilo and Kona stations are designated SLAMS, high levels of SO₂ attributed to volcanic emissions is comparable to the NAAQS. Volcanic eruptions are considered natural events, EPA concurrence of an exceptional event demonstration allows the exclusion of data for attainment determinations.

The SPM station on Kauai was established to monitor emissions from cruise ships.

¹ Elevated values due to emissions from eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

² Monitoring for SO₂ began at the Waikoloa station on 12/8/2022.

³ Data recovery was <75% in 4th quarter, substitution test valid.

Table 4-15. 2023 Summary of the 24-Hour and Annual SO₂ Averages

	Maximum		Annual Mean	No. of 24-Hour Averages Greater than 0.14 ppm												Possible Periods	Valid Periods	Percent Recovery
	1 st High	2 nd High	All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
OAHU	SLAMS Stations																	
Honolulu	0.002	0.002	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	350	95.9%
Kapolelei/NCore	0.002	0.002	0.000	0	0	0	0	0	0	0	0	0	0	0	0	365	354	97.0%
Kahe	0.012	0.010	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	364	99.7%
HAWAII	SPM Stations (see NOTE)																	
Hilo ¹	0.033	0.024	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	360	96.2%
Kona ¹	0.012	0.012	0.002	0	0	0	0	0	0	0	0	0	0	0	0	365	361	98.9%
Mt. View ¹	0.014	0.009	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	362	99.2%
Ocean View ¹	0.088	0.051	0.004	0	0	0	0	0	0	0	0	0	0	0	0	365	355	97.3%
Pahala ¹	0.075	0.054	0.003	0	0	0	0	0	0	0	0	0	0	0	0	365	349	95.6%
Keaau ¹	0.010	0.003	0.000	0	0	0	0	0	0	0	0	0	0	0	0	365	341	93.4%
Leilani	0.002	0.002	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	348	95.3%
Naalehu ¹	0.034	0.027	0.002	0	0	0	0	0	0	0	0	0	0	0	0	365	362	99.2%
Waikoloa ²	0.004	0.003	0.000	0	0	0	0	0	0	0	0	0	0	0	0	365	354	97.0%
KAUAI	SPM Station (see NOTE)																	
Niumalu ³	0.002	0.002	0.001	0	0	0	0	0	0	0	0	0	0	0	0	365	324	88.8%
<p>Attainment: 24-hour values not to exceed 0.14 ppm more than once per year. In 2023, Hawaii was in attainment of the state 24-hour SO₂ standard. Attainment: Annual average (from SLAMS stations only) not to exceed 0.03 ppm. In 2023, Hawaii was in attainment of the state annual SO₂ standard. NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO₂ from volcanic emissions. Hilo and Kona stations are designated as SLAMS, high levels of SO₂ attributed to volcanic emissions is comparable to the NAAQS. Volcanic eruptions are considered a natural event, EPA concurrence of an exceptional event demonstration allows the exclusion of data for attainment determinations. The SPM station on Kauai was established to monitor emissions from cruise ships.</p>																		

¹ Elevated values due to emissions from eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

² Monitoring for SO₂ began at the Waikoloa station on 12/8/2022.

³ Data recovery was <75% in 4th quarter, substitution test valid.

Table 4-16. 2023 Summary of the 1-Hour CO Averages

	Maximum		Annual Mean	No. of 1-Hour Averages Greater than 35 ppm												Possible Periods	Valid Periods	Percent Recovery	
	1 st High	2 nd High		All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov				Dec
OAHU	SLAMS Stations																		
Honolulu ¹	0.7	0.6	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	8760	6987	79.8%
Kapolei/NCORE ¹	0.6	0.5	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	8760	7129	81.4%

Attainment: 1-hour values not to exceed 35 ppm more than once per year.
In 2023, Hawaii was in attainment with the 1-hour CO NAAQS.

¹ Data recovery was <75% in 3rd quarter.

Table 4-17. 2023 Summary of the 8-Hour CO Averages

	Maximum		Annual Mean	No. of 8-Hour Averages Greater than 9 ppm												Possible Periods	Valid Periods	Percent Recovery	
	1 st High	2 nd High		All Hours	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov				Dec
OAHU	SLAMS Stations																		
Honolulu ¹	0.4	0.4	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	8755	7024	80.2%
Kapolei/NCORE ¹	0.3	0.3	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	8755	7130	81.4%

Attainment: 8-hour values not to exceed 9 ppm more than once per year.
In 2023, Hawaii was in attainment with the 8-hour CO NAAQS.

¹ Data recovery was <75% in 3rd quarter.

Table 4-18. 2023 Monthly Maximum of 24-Hour PM₁₀ Values (µg/m³)

The month with the highest value in the year is highlighted

The state and federal 24-hr PM₁₀ standard is 150 µg/m³

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Honolulu	24	28	28	22	19	18	21	33	20	13	20	21
Kapolei ¹	40	39	33	25	28	14	44	76	32	22	27	24

¹ Data recovery was <75% in 2nd quarter, substitution test valid.

Table 4-19. 2023 Monthly Maximum of 24-Hour PM_{2.5} Values (µg/m³)

The month with the highest value in the year is highlighted

The federal 24-hr PM_{2.5} standard is 35 µg/m³

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SLAMS Stations												
Honolulu	22.0	8.4	8.0	6.4	6.0	6.6	8.4	12.7	7.8	4.9	6.4	10.9
Kapolei ¹	15.8	10.3	10.1	7.2	9.3	3.2	7.2	13.3	7.9	10.4	8.6	6.6
Sand Island	42.0 ²	7.5	7.2	8.6	5.1	4.4	10.1	20.7	6.5	5.2	5.4	15.9
Kihei ³	no data	no data	no data	no data	no data	no data	no data	5.6	6.1	4.0	4.6	4.5
SPM Stations												
Kahului	57.2 ²	10.2	8.4	5.6	6.9	5.7	6.2	7.4	6.4	4.3	6.2	5.5
Hilo (volcano)	5.1	5.9	7.4	4.5	5.1	4.9	5.6	10.1	6.7	3.4	4.7	4.1
Kona (volcano)	12.4	7.8	4.9	3.7	5.0	11.1	4.7	6.7	18.7	3.2	2.7	2.8
Mt. View (volcano)	20.0	5.5	6.7	4.3	4.9	3.7	5.1	7.5	4.7	2.7	3.1	7.2
Ocean View (volcano)	10.5	7.8	4.2	3.0	3.3	11.2	4.4	6.3	16.4	3.2	3.0	3.2
Pahala (volcano)	8.9	6.0	5.7	4.5	6.0	5.5	7.0	8.2	7.0	4.3	5.8	10.2
Kailua-Kona (volcano)	12.7	8.4	5.4	3.9	4.9	10.3	5.5	8.9	17.6	3.7	3.5	5.7
Keaau (volcano)	8.6	5.3	6.3	3.7	4.6	4.6	5.2	8.6	5.5	3.1	4.2	4.0
Naalehu (volcano)	7.8	7.5	5.7	4.5	6.0	5.2	6.2	11.2	7.5	4.5	4.9	4.1
Waikoloa (volcano)	13.0	9.5	5.7	4.3	4.6	4.2	4.4	11.2	9.3	2.7	3.7	2.9

¹ Data recovery was <75% in 2nd quarter, substitution test valid.

² Exceedance was due to New Year's fireworks celebration.

³ The Kihei station was discontinued in March of 2022 but restarted on August 22, 2023 for purposes of monitoring the impacts from wildfires. **Data is preliminary.**

Table 4-20. 2023 Monthly Maximum of 1-Hour NO₂ Values (ppb)

The month with the highest value in the year is highlighted

The federal 1-hour standard for NO₂ is 100 ppb

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kapolei	34.3	22.6	25.9	24.1	17.2	16.2	10.5	12.8	11.5	17.7	18.7	25.6

Table 4-21. 2023 Monthly Maximum of 1-Hour H₂S Values (ppb)

The month with the highest value in the year is highlighted

The state 1-hour standard for H₂S is 25 ppb

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leilani	1.6	1.8	2.0	2.3	2.4	0.6	0.7	0.9	1.0	1.3	1.3	1.6

Table 4-22. 2023 Monthly Maximum of 1-Hour CO Values (ppm)

The month with the highest value in the year is highlighted

The federal 1-hr CO standard is 35 ppm, the state standard is 9 ppm

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Honolulu ¹	0.6	0.7	0.5	0.4	0.4	0.5	0.3	0.3	0.0	0.5	0.4	0.5
Kapolei/NCore ¹	0.6	0.5	0.3	0.3	0.5	0.2	0.1	0.4	0.2	0.4	0.4	0.4

¹ Data recovery was <75% in 3rd quarter.**Table 4-23. 2023 Monthly Maximum of 8-Hour CO Values (ppm)**

The month with the highest value in the year is highlighted

The federal 8-hr CO standard is 9 ppm, the state standard is 4.4 ppm

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Honolulu ¹	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.0	0.2	0.3	0.3
Kapolei/NCore ¹	0.2	0.3	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.3	0.2	0.2

¹ Data recovery was <75% in 3rd quarter.**Table 4-24. 2023 Monthly Maximum of 8-Hour O₃ Values (ppm)**

The month with the highest value in the year is highlighted

The federal 8-hr O₃ standard is 0.070 ppm

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sand Island	0.047	0.045	0.049	0.040	0.047	0.038	0.035	0.026	0.031	0.033	0.044	0.043
Kapolei/NCore	0.041	0.039	0.045	0.035	0.039	0.031	0.028	0.025	0.030	0.038	0.044	0.043

Table 4-25. 2023 Monthly Maximum of 1-Hour SO₂ Values (ppb)

The month with the highest value in the year is highlighted

The federal 1-hr SO₂ standard is 75 ppb

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SLAMS Stations												
Honolulu	3.3	1.6	3.2	1.5	1.4	1.4	1.4	1.5	1.6	2.8	2.8	4.8
Kapolei/NCORE	0.2	3.5	10.2	19.7	11.2	23.8	4.2	4.1	2.6	7.4	2.5	8.1
Kahe	62.7	54.3	47.4	48.0	38.9	17.0	4.2	3.3	43.6	62.1	60.4	23.5
SPM Stations (see NOTE)												
Niuhama ¹ (cruise ships)	1.9	1.6	0.7	1.4	0.6	1.3	3.0	1.5	1.3	2.0	1.3	1.0
Hilo ² (volcano)	144.3	13.0	7.6	10.7	8.4	6.7	10.1	2.8	5.6	3.7	7.8	3.8
Kona ² (volcano)	69.0	5.8	2.0	1.5	1.3	4.9	1.8	1.7	25.7	2.5	2.8	2.5
Mt. View ² (volcano)	132.0	43.6	24.2	2.8	2.2	2.0	2.4	1.8	2.6	3.6	5.4	0.9
Ocean View ² (volcano)	370.7	58.0	15.6	5.3	3.8	427.8	7.2	3.7	1,083.4	3.6	3.3	5.7
Pahala ² (volcano)	293.0	125.9	15.5	12.5	13.8	73.8	16.2	7.6	254.8	10.9	10.7	8.7
Keaau ² (volcano)	84.7	6.7	11.4	0.6	0.1	-0.2	0.3	1.0	0.0	0.8	1.4	1.5
Leilani (volcano)	2.7	3.2	4.2	2.4	2.6	0.6	0.9	1.0	1.3	1.3	1.2	1.7
Naalehu ² (volcano)	178.0	78.3	9.8	8.7	5.8	26.6	5.2	5.9	337.5	9.5	4.9	7.8
Waikoloa ³ (volcano)	7.1	4.1	0.7	0.5	0.4	1.2	0.6	1.2	11.5	1.6	1.2	1.1

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO₂ from volcanic emissions. Hilo and Kona stations are designated as SLAMS, high levels of SO₂ attributed to volcanic emissions is comparable to the NAAQS. Volcanic eruptions are considered a natural event, EPA concurrence of an exceptional event demonstration allows the exclusion of data for attainment determinations.

¹ Data recovery was <75% in 4th quarter, substitution test valid.

² Elevated values due to emissions from eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

³ Monitoring for SO₂ began at the Waikoloa station on 12/8/2022.

Table 4-26. 2023 Monthly Maximum of 3-Hour SO₂ Values (ppm)

The month with the highest value in the year is highlighted

The state and federal 3-hr SO₂ standard is 0.5 ppm

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SLAMS Stations												
Honolulu	0.003	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.004
Kapolei/NCore	0.000	0.003	0.004	0.012	0.004	0.015	0.003	0.003	0.002	0.004	0.001	0.005
Kahe	0.035	0.022	0.026	0.029	0.030	0.006	0.003	0.002	0.026	0.042	0.036	0.015
SPM Stations (see NOTE)												
Niimalu ¹ (cruise ships)	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.002	0.001	0.001
Hilo ² (volcano)	0.109	0.010	0.004	0.004	0.006	0.003	0.004	0.003	0.004	0.003	0.003	0.003
Kona ² (volcano)	0.045	0.005	0.002	0.001	0.001	0.005	0.002	0.002	0.023	0.002	0.003	0.002
Mt. View ² (volcano)	0.066	0.025	0.022	0.002	0.001	0.001	0.002	0.001	0.002	0.003	0.004	0.001
Ocean View ² (volcano)	0.216	0.028	0.009	0.004	0.003	0.225	0.006	0.002	0.413	0.003	0.003	0.004
Pahala ² (volcano)	0.203	0.072	0.009	0.007	0.009	0.044	0.011	0.005	0.152	0.008	0.007	0.006
Keaau ² (volcano)	0.032	0.004	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Leilani (volcano)	0.002	0.003	0.003	0.002	0.003	0.000	0.001	0.001	0.001	0.001	0.001	0.002
Naalehu ² (volcano)	0.073	0.038	0.008	0.007	0.004	0.020	0.004	0.005	0.153	0.006	0.004	0.004
Waikoloa ³ (volcano)	0.006	0.003	0.001	0.000	0.000	0.001	0.000	0.001	0.007	0.002	0.001	0.001

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO₂ from volcanic emissions. Volcanic eruptions are considered natural events.

¹ Data recovery was <75% in 4th quarter, substitution test valid.

² Elevated values due to emissions from eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

³ Monitoring for SO₂ began at the Waikoloa station on 12/8/2022.

Table 4-27. 2023 Monthly Maximum of 24-Hour SO₂ Values (ppm)

The month with the highest value in the year is highlighted

The state 24-hr SO₂ standard is 0.14 ppm

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SLAMS Stations												
Honolulu	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
Kapolei/NCore	0.000	0.001	0.002	0.002	0.001	0.002	0.001	0.001	0.001	0.001	0.000	0.001
Kahe	0.007	0.009	0.008	0.007	0.007	0.001	0.001	0.001	0.006	0.012	0.009	0.003
SPM Stations (see NOTE)												
Niimalu ¹ (cruise ships)	0.002	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Hilo ² (volcano)	0.033	0.004	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Kona ² (volcano)	0.011	0.004	0.001	0.001	0.001	0.003	0.002	0.002	0.012	0.002	0.002	0.002
Mt. View ² (volcano)	0.014	0.008	0.005	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001
Ocean View ² (volcano)	0.045	0.013	0.004	0.003	0.003	0.051	0.004	0.001	0.088	0.002	0.002	0.002
Pahala ² (volcano)	0.075	0.027	0.004	0.003	0.004	0.013	0.003	0.002	0.054	0.002	0.003	0.002
Keaau ² (volcano)	0.010	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Leilani (volcano)	0.002	0.002	0.002	0.002	0.002	0.000	0.001	0.001	0.001	0.001	0.001	0.001
Naalehu ² (volcano)	0.027	0.012	0.005	0.004	0.003	0.005	0.002	0.002	0.034	0.002	0.002	0.002
Waikoloa ³ (volcano)	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.001	0.001	0.001

NOTE: The SPM stations on Hawaii Island were established to monitor ambient air concentrations of SO₂ from volcanic emissions. Volcanic eruptions are considered natural events.

¹ Data recovery was <75% in 1st quarter, substitution test valid.

² Elevated values due to emissions from eruptions at Halema'uma'u crater on the summit of Kilauea volcano.

³ Monitoring for SO₂ began at the Waikoloa station on 12/8/2022.

Section 5

PM_{2.5} SPECIATION DATA

Atmospheric aerosols are solid or liquid particles suspended in air that come directly from a variety of sources (primary) or are formed by chemical reactions (secondary). Primary and secondary particles tend to have long lifetimes in the atmosphere and can travel long distances, up to hundreds or perhaps thousands of miles. Sources include dust from roads, construction, and agriculture; combustion particles from motor vehicles, electric utilities and agricultural burning; and particles from natural sources such as the ocean or volcano.

Most of the PM_{2.5} is a combination of the following components: sulfates, nitrates, ammonium, elemental carbon, organic compounds, water and metals. The EPA selected target particulates of interest based on data use objectives, primary constituents of PM_{2.5}, and the capability and availability of current analytical methods.

The filter-based speciation sampler collects samples once every 3 days for analyses performed by an EPA contract laboratory. The speciation sampler is located at the Kapolei NCore monitoring station.

Table 5-1 lists the parameters measured, highest and second highest values recorded in the year, the annual arithmetic mean of all valid samples and the total number of samples collected in the year. Table 5-2 lists the analysis methods for each parameter.

Except for lead, there are no ambient air quality standards for the individual components of speciated PM_{2.5}.

For more information on EPA's speciation program, go to:
www.epa.gov/ttn/amtic/speciepg.html

Table 5-1. Annual Summary of PM_{2.5} Speciation Data

Parameter	1st High (µg/m³)	2nd High (µg/m³)	Annual Mean (µg/m³)	No. of Samples	Percent Recovery
CARBON					
Organic Carbon	3.286	1.312	0.3161	118	98%
Elemental Carbon	0.671	0.359	0.1062	118	98%
METALS					
Aluminum	0.161	0.135	0.0159	114	94%
Antimony	0.031	0.029	0.0007	114	94%
Arsenic	0.000	0.000	0.0000	114	94%
Barium	0.069	0.066	0.0069	114	94%
Bromine	0.002	0.002	0.0001	112	93%
Cadmium	0.021	0.017	0.0010	114	94%
Calcium	0.213	0.207	0.0582	114	94%
Cerium	0.055	0.038	0.0033	114	94%
Cesium	0.039	0.038	0.0030	114	94%
Chlorine	1.715	1.656	0.4770	112	93%
Chromium	0.012	0.011	0.0010	111	92%
Cobalt	0.003	0.002	-0.0002	111	92%
Copper	0.005	0.003	-0.0008	111	92%
Indium	0.032	0.024	0.0022	114	94%
Iron	0.085	0.084	0.0301	111	92%
Lead	0.013	0.012	0.0012	114	94%
Magnesium	0.214	0.172	0.0004	114	94%
Manganese	0.010	0.008	0.0004	114	94%
Nickel	0.010	0.009	0.0022	111	93%
Phosphorus	0.005	0.002	0.0001	114	94%
Potassium	0.089	0.081	0.0234	114	94%
Rubidium	0.005	0.004	0.0003	114	94%
Selenium	0.006	0.004	0.0001	114	94%
Silicon	0.176	0.175	0.0354	114	94%
Silver	0.019	0.017	-0.0002	114	94%
Sodium	1.120	1.034	0.3127	114	94%
Strontium	0.005	0.005	0.0008	114	94%
Sulfur	1.583	0.856	0.2012	114	94%
Tin	0.027	0.024	0.0030	114	94%
Titanium	0.009	0.009	0.0025	114	94%
Vanadium	0.009	0.004	0.0008	114	94%
Zinc	0.097	0.037	0.0051	114	94%
Zirconium	0.022	0.021	0.0011	114	94%

Table 5-1 Continued

Parameter	1 st High (µg/m ³)	2 nd High (µg/m ³)	Annual Mean (µg/m ³)	No. of Samples	Percent Recovery
IONS					
Ammonium Ion	1.03	0.44	0.028	107	88%
Potassium Ion	0.09	0.09	0.019	107	88%
Sodium Ion	1.14	1.09	0.369	107	88%
Total Nitrate	0.53	0.39	0.168	107	88%
Sulfate	4.38	2.39	0.624	107	88%

Table 5-2. Speciation Collection and Analysis Methods

Parameter	Collection Method	Analysis Method
Carbon	URG 300N Quartz Filter	Thermal Optical Transmittance
Metals	Met-One SASS Teflon Filter	Energy Dispersive X-Ray Fluorescence
Ions	Met-One SASS Nylon Filter	Ion Chromatography

Section 6

AMBIENT AIR QUALITY TRENDS

The following graphs illustrate 5-year trends for PM₁₀, PM_{2.5}, SO₂, NO₂, O₃, and CO from 2019 to 2023 at all SLAMS stations monitoring for those pollutants.

Figures 6-1 and 6-2 are graphs of the PM₁₀ annual and maximum 24-hour averages. PM₁₀ monitoring at the Pearl City station was discontinued on April 6, 2022.

Figure 6-3 is the graph of the PM_{2.5} annual averages. Attainment of the PM_{2.5} 24-hour standard is based on the 98th percentile value at each station, which is depicted in Figure 6-4. PM_{2.5} monitoring at the Pearl City station was discontinued on March 31, 2022. PM_{2.5} monitoring was discontinued at the Kihei station on March 30, 2022 but restarted on August 22, 2023 with the purpose of monitoring impacts from agricultural activities or wildfires.

Figures 6-5 and 6-6 are graphs of the SO₂ annual and maximum 24-hour averages.

Figure 6-7 and 6-8 shows the annual and maximum 1-hour averages of NO₂ compared to the federal NAAQS.

Attainment of the 8-hour ozone standard is achieved by averaging 3 years of the fourth highest daily maximum 8-hour average concentrations, which must not exceed 0.070 ppm. Figure 6-9 is a graph of the fourth highest daily maximum values recorded at the Sand Island and Kapolei ozone monitoring stations in the past five years.

The graphs for 1-hour and 8-hour carbon monoxide (figures 6-10 and 6-11, respectively) represent the maximum 1-hour or 8-hour values recorded in the year.

Criteria pollutant levels remain below state and federal ambient air quality standards at all SLAMS stations in the state.

Figure 6-1. PM₁₀ Annual Average: 2019-2023

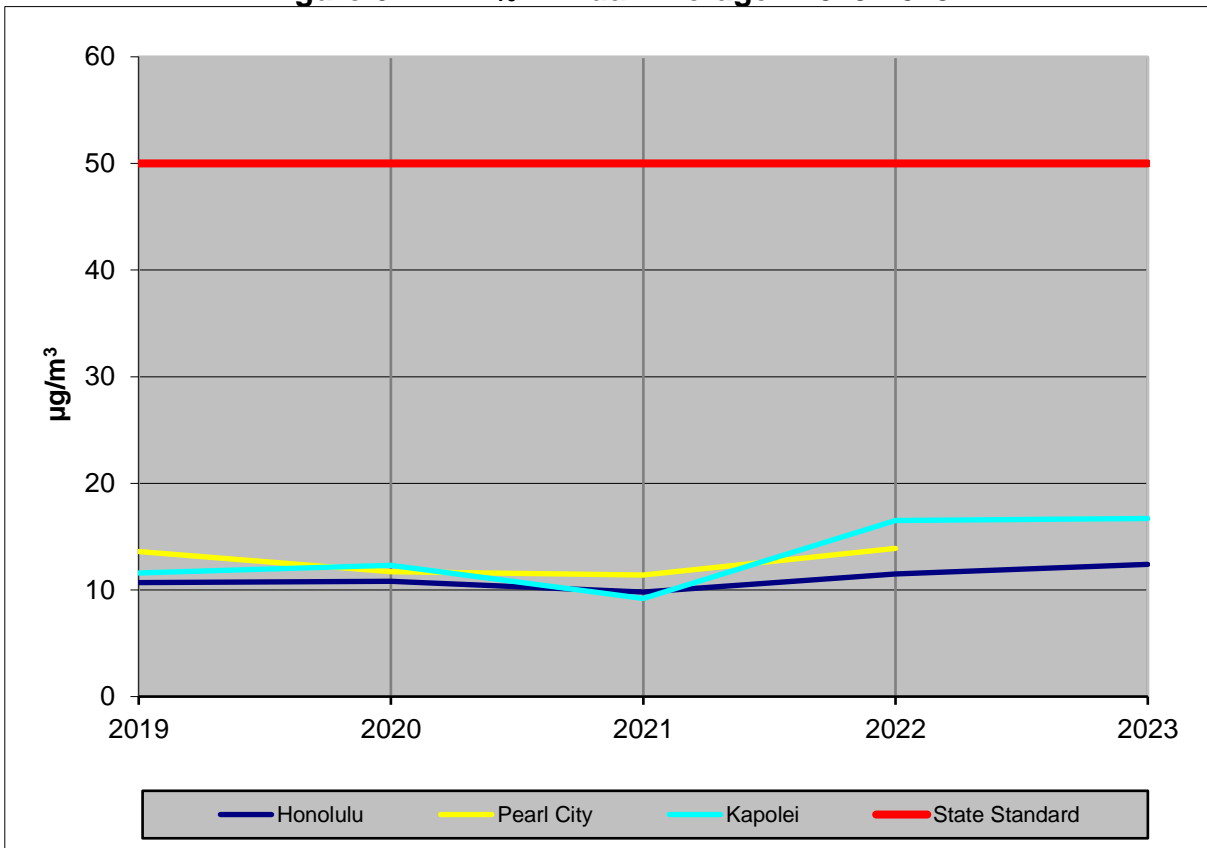


Figure 6-2. PM₁₀ Maximum 24-Hour Average: 2019-2023

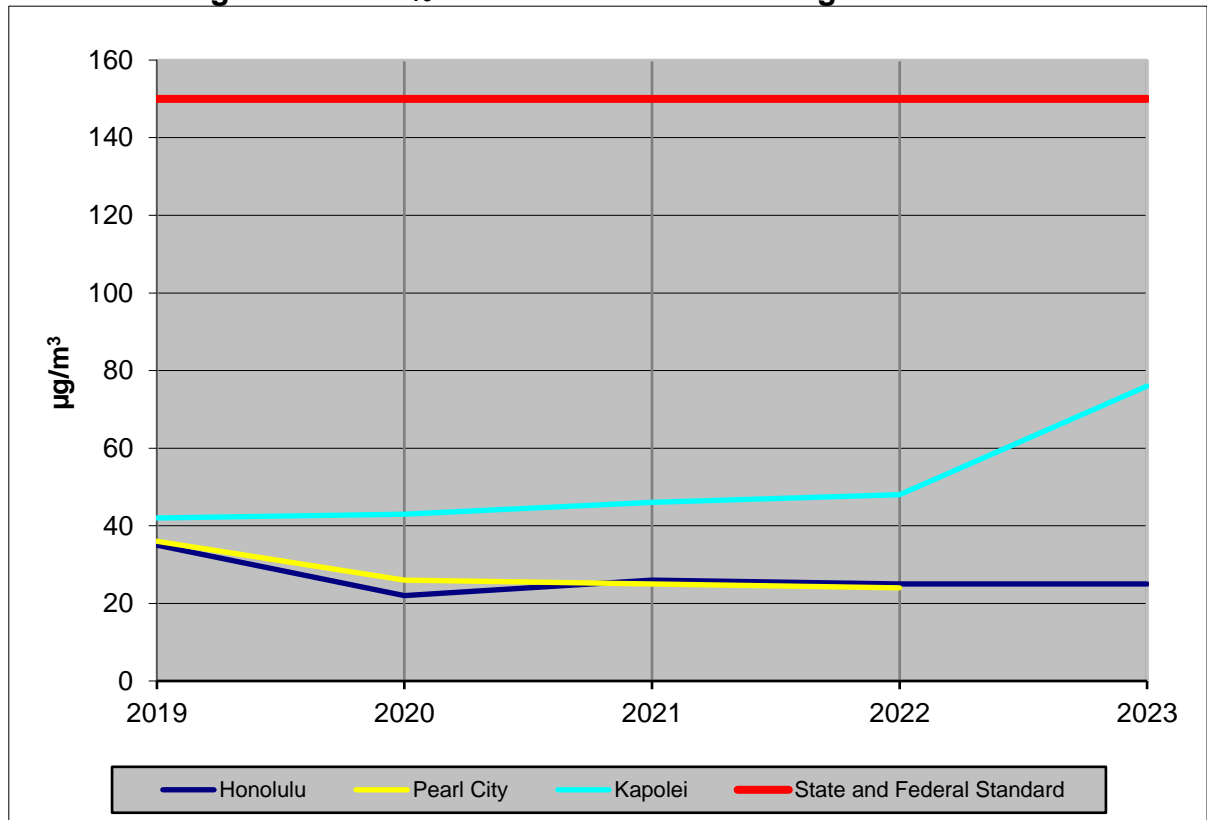


Figure 6-3. PM_{2.5} Annual Average: 2019-2023

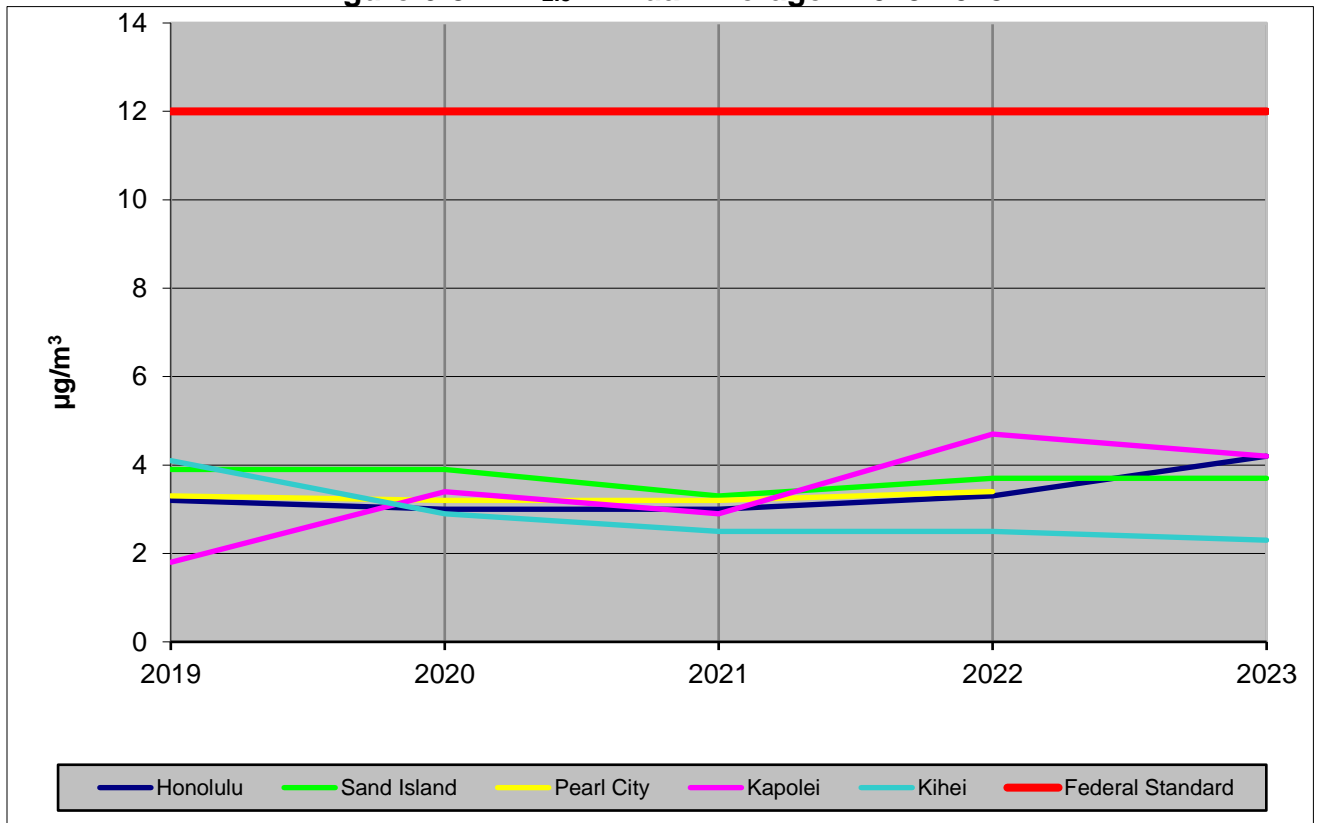


Figure 6-4. PM_{2.5} 98th Percentile 24-Hour Average: 2019-2023

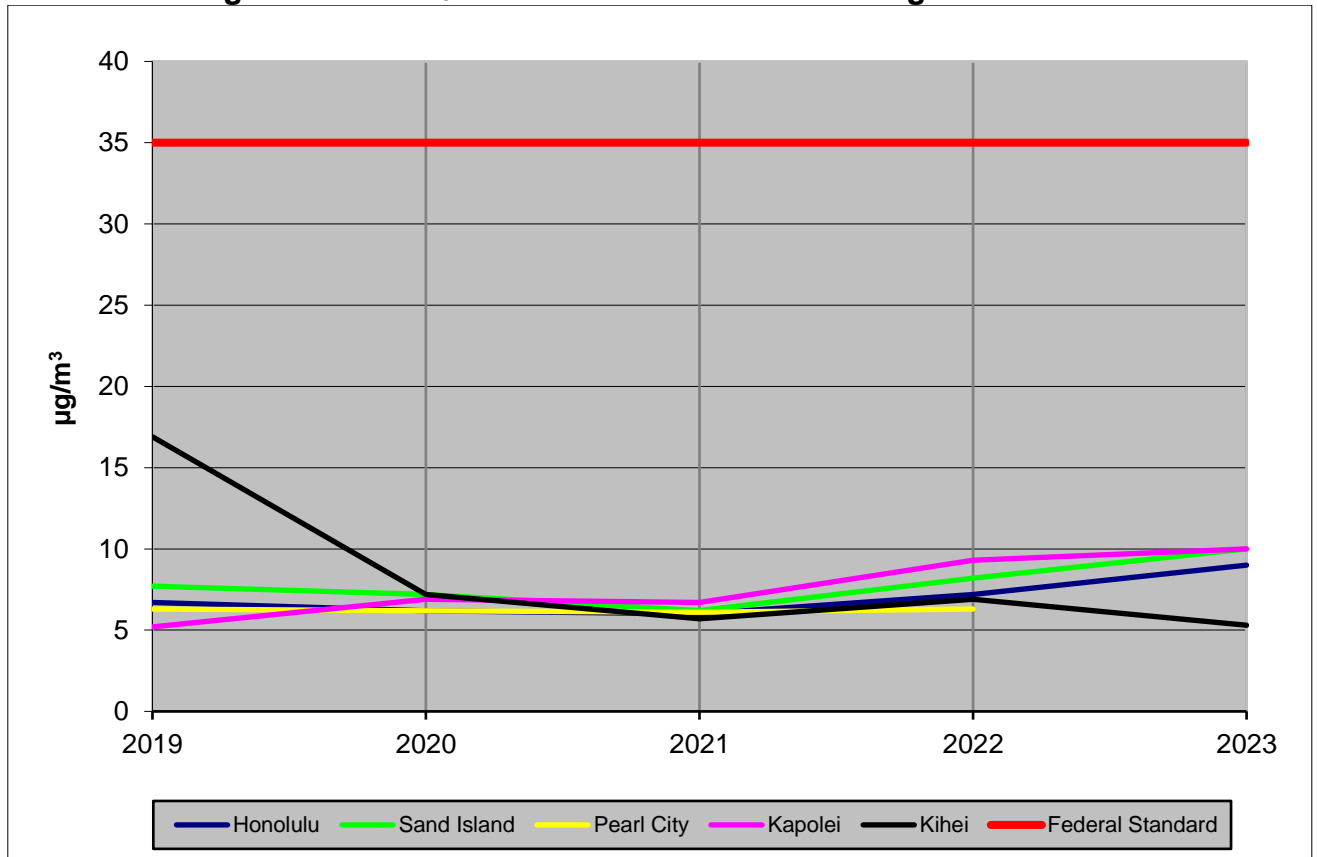


Figure 6-5. SO₂ Annual Average: 2019-2023

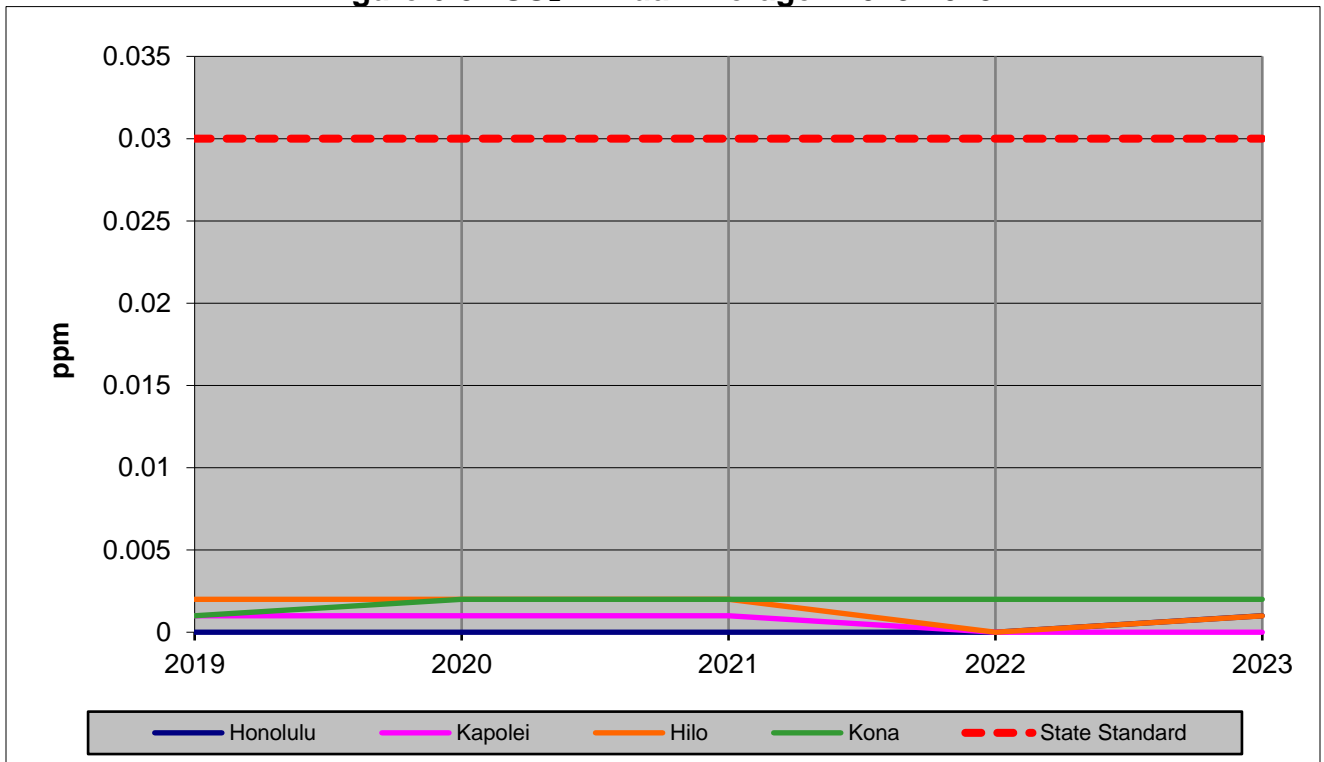


Figure 6-6. SO₂ Maximum 24-Hour Average: 2019-2023

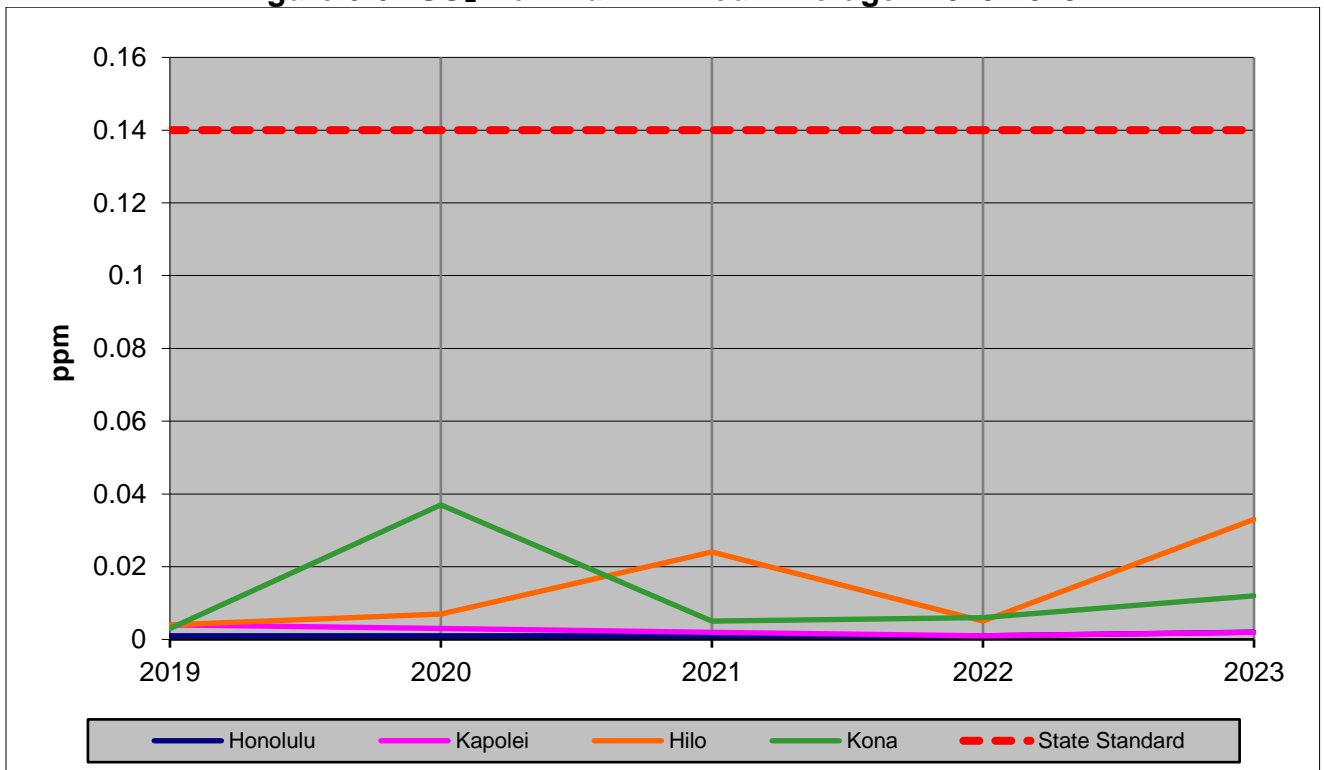


Figure 6-7. NO₂ Annual Average: 2019-2023

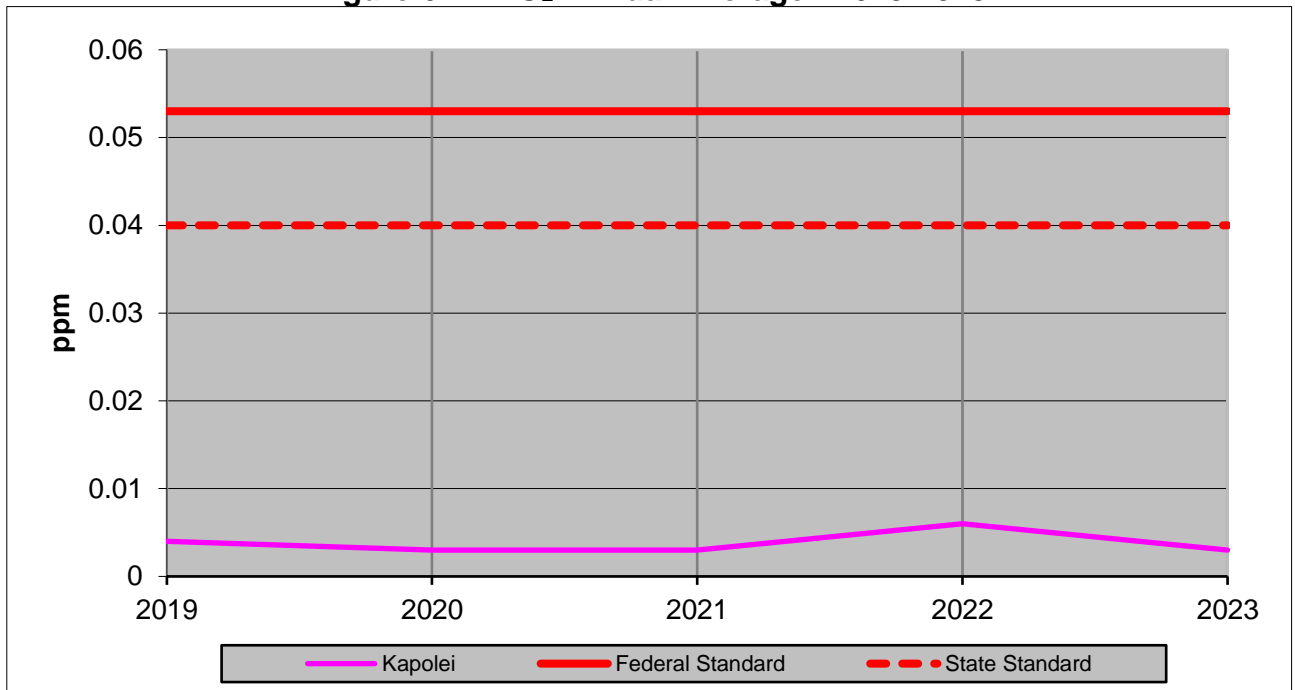


Figure 6-8. NO₂ Maximum 1-Hour Average: 2019-2023

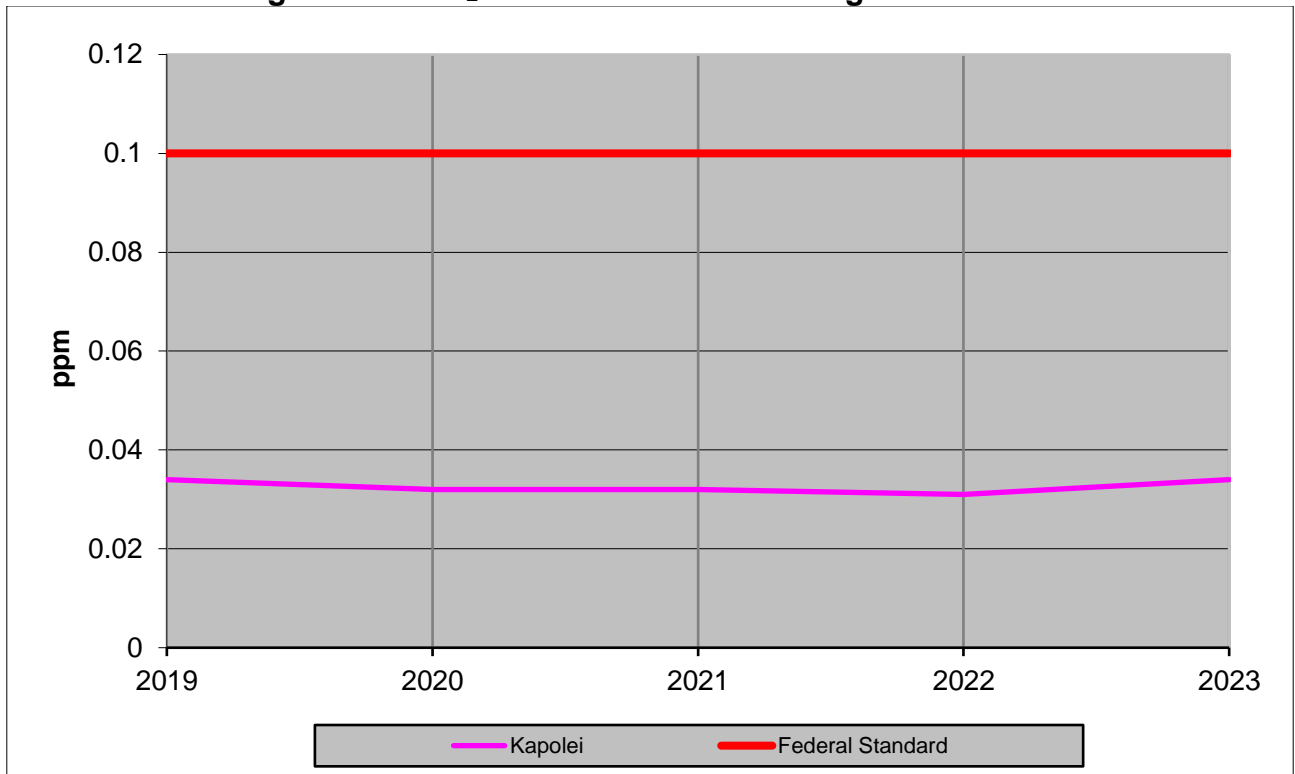


Figure 6-9. O₃ Fourth Highest Daily Maximum 8-Hour Average: 2019-2023

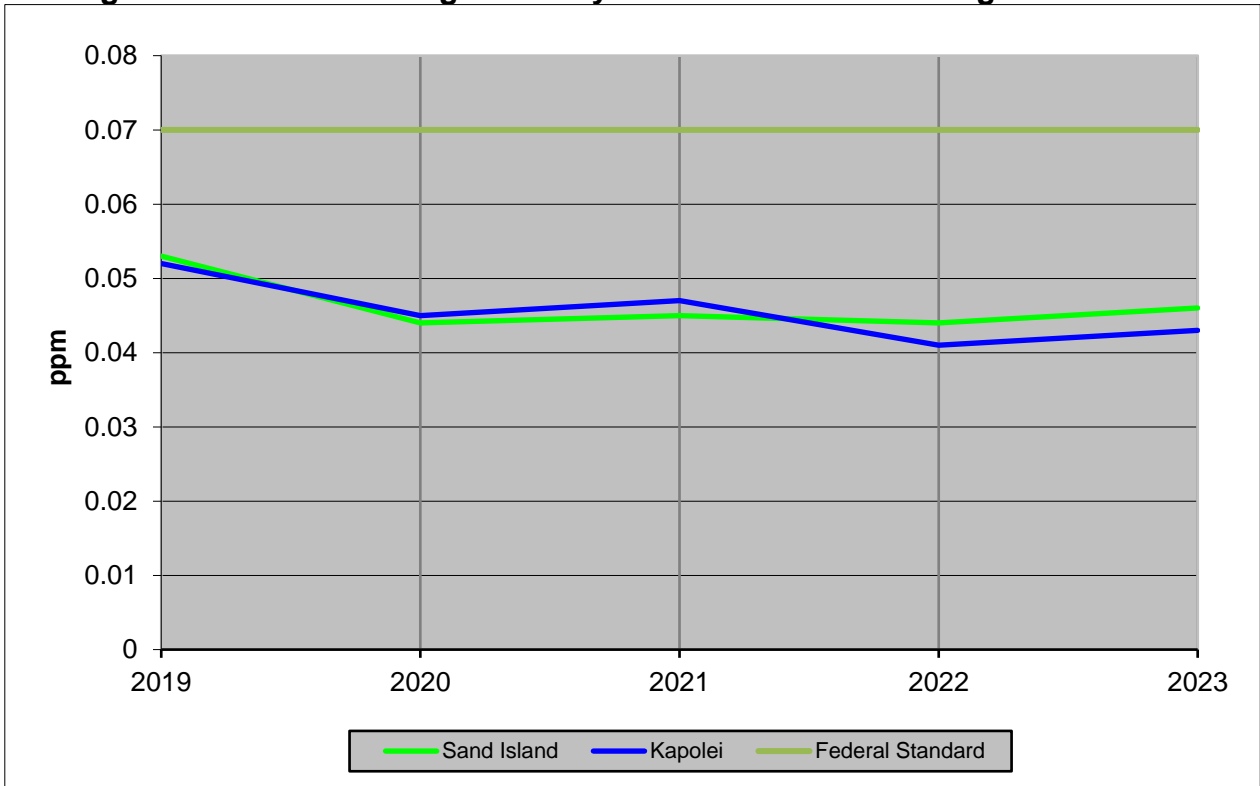


Figure 6-10. CO Maximum 1-Hour Average: 2019-2023

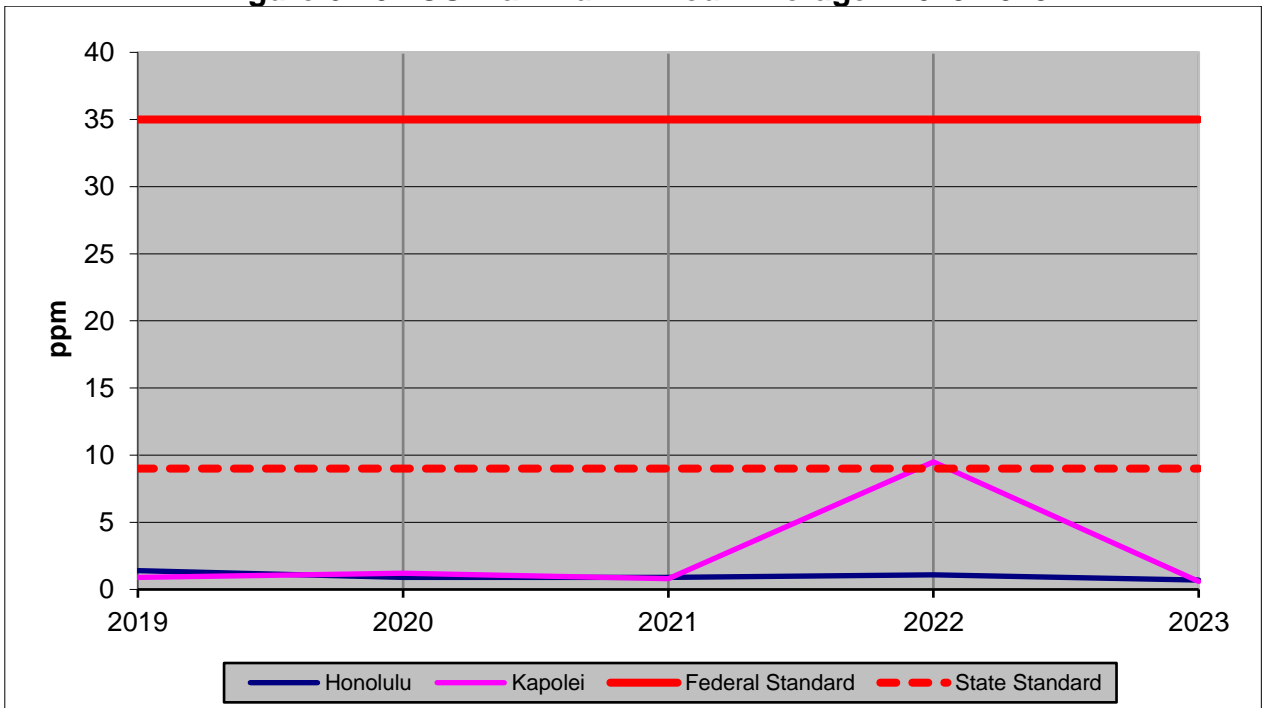


Figure 6-11. CO Maximum 8-Hour Average: 2019-2023

