State of Hawaii
2020
Ambient Air Monitoring Network
5-Year Assessment

Prepared by:
State of Hawaii
Department of Health
Environmental Management Division
Clean Air Branch

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Abbreviations and Definitions

AADT	Annual Average Daily Traffic
AQMS	Air Quality Monitoring Section
BAM	Met-One Beta-Attenuation Monitor
CAB	Clean Air Branch
CBSA	Core-based Statistical Area
CFR	Code of Federal Regulations
CIP	Campbell Industrial Park (Oahu)
CO	Carbon monoxide gas
DBEDT	State of Hawaii Department of Economic Development and Tourism
DOH	Hawaii State Department of Health
DRR	Data Requirements Rule
ECA	Emissions Control Area (MARPOL)
EPA (R9)	United States Environmental Protection Agency (Region 9)
FEM	Federal Equivalent Method
FRM	Federal Reference Method
H_2S	Hydrogen sulfide gas
HECO	Hawaiian Electric Company
HVNP	Hawaii Volcanoes National Park
IMPROVE	Integrated Monitoring of Protected Visual Environments
LERZ	Lower East Rift Zone of Kilauea Volcano
MARPOL	International Convention for the Prevention of Pollution from Ships
MSA	U. S. Census Bureau, Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NCore	National Core Multi-pollutant Monitoring Stations
NEI	National Emissions Inventory (2014)
NO_2	Nitrogen dioxide gas
NPS	U. S. National Park Service
O_3	Ozone
OMB	U. S. Office of Management and Budget
Pb	Lead
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns in aerodynamic diameter
PM_{10}	Particulate matter less than or equal to 10 microns in aerodynamic diameter
PGV	Puna Geothermal Venture
PSD	Prevention of Significant Deterioration
ppb	Parts per billion, a measurement unit for gases
ppm	Parts per million; a measurement unit for gases
PWEI	Population Weighted Emissions Index, an EPA calculation that triggers SO_2 monitoring
SLAMS	State and Local Air Monitoring Stations
SO_2	Sulfur dioxide gas
SPMS	Special Purpose Monitoring Stations
TPD	Tons per day
TPY	Tons per year
vog	Haze due to volcanic emissions
WD	Wind direction
WS	Wind speed
$\mu g/m^3$	micrograms per cubic meter of air; a measurement unit for particulate matter

I. Executive Summary

A. Purpose of Assessment

40 Code of Federal Regulations (CFR) Part 58 requires that a network assessment of the air quality surveillance system be conducted once every five years to determine if the network is effective and efficient in meeting monitoring objectives, whether new sites are needed or existing sites or monitors can be terminated and whether there are new technologies that can be incorporated.

Conducted once every five years, with the first one completed in 2010, the assessment provides a more robust and comprehensive conceptualization of the current and future needs of the state's air surveillance network. The annual network plan consequently applies, resources allowing, the recommendations and decisions resulting from the assessment.

B. Ambient Air Monitoring Networks

The State of Hawaii Department of Health (DOH) currently operates twenty (20) ambient air monitoring stations on four of the major islands, including the NCore station. The Kahului, Maui station currently operates one $PM_{2.5}$ monitor. A gas monitoring station for population based monitoring is being considered for Maui in the future. Lead (Pb) monitoring was discontinued on December 31, 2018 with EPA approval.

Ambient air monitoring is also being conducted by private industry and the U.S. National Park Service (NPS). Data from these networks are publicly available and supplements the data being collected by the DOH.

The main air surveillance concerns in the state include:

- Sulfur dioxide (SO_2) and sulfate aerosols ($PM_{2.5}$) from future Kilauea volcano eruptions;
- Hydrogen sulfide (H_2S) emissions from geothermal energy production and exploration;
- Agricultural activities and commercial/industrial/residential development on the island of Maui;
- Implementing new monitoring as required by revisions or additions to the National Ambient Air Quality Standards (NAAQS) as well as revisions and additions to 40 CFR 58;
- Cruise ship emissions on the island of Kauai;
- Continue operation of the two stations that have been collecting data since the beginning of 2017 as required by the U.S. Environmental Protection Agency (EPA) SO_2 Data Requirements Rule (DRR).

C. Summary of 2020 Findings

The biggest challenge for the program is that compliance with new monitoring requirements as well as meeting the state's monitoring priorities are outpacing funding and resources. The necessity of doing more with less was one of the

principal considerations when planning the future of the state's air monitoring network. Where allowed, DOH will partner with the private sector to accomplish monitoring goals.

Prioritization of Pollutants

DOH analyzed historical data from the monitoring network on a pollutant-by-pollutant basis to determine a priority ranking of each of the criteria pollutants. The ranking was based on each pollutant's average percentage of the NAAQS, whether the trend increased or decreased and its relative importance in meeting the state's monitoring objectives and goals. Based on those factors, the priority ranking was determined to be:

1. $PM_{2.5}$
2. SO_2
3. Nitrogen dioxide (NO_2)
4. Ozone (O_3)
5. Coarse particles (PM_{10})
6. Carbon Monoxide (CO)

Findings

DOH also considered the effects of climate and topography, population characteristics and location of emission sources before conceptualizing the future of the air monitoring network.

- Generally, the current network is effectively meeting the state's monitoring objectives and minimum federal requirements;
- The major eruption at the Lower East Rift Zone (LERZ) of Kilauea volcano on Hawaii Island that began in May 2018 and ending August 2018, created a greater need for monitoring on that island. In response to the eruption, DOH selected six (6) additional stations to be established;
- Lava from the LERZ eruption also buried the Puna E station, which was monitoring for possible H_2S emissions from the Puna Geothermal Ventures (PGV) power plant. DOH was able to work with the Leilani Community Association to secure a location at their community center to place a replacement H_2S monitor. SO_2 is also being monitored at this site, although the probe siting does not meet siting criteria in 40 CFR Part 50;
- The state has completed a minimum of three years of data collection at each of the two stations that have been in operation since the beginning of 2017 as required by the EPA SO_2 DRR. The state has submitted a request that the Waiau station be allowed to close, as the 3-year design value of 16 ppb is less than 50% of the 1-hour SO_2 NAAQS of 75 ppb. The Kahe station will remain operating as the 3-year design value of 52 ppb is greater than 50% of the 1-hour SO_2 NAAQS;
- Other than potentially needing to fulfill the requirements for other EPA initiatives (e.g. near-road NO_2, awaiting 2020 census count), no new monitoring is needed;

- Specific recommendations:
    - The Kapolei SLAMS and NCore stations are currently located on the same property. The landowner has asked that the stations be moved. Alternative sites are being considered at this time, we hope to relocate by the end of 2021.
    - Closely track population estimates for the Urban Honolulu Metropolitan Statistical Area (MSA). Should the population reach one million, monitoring at the NO_2 near-road site would need to begin, including monitoring for CO and $PM_{2.5}$.
    - Install a 10-meter meteorological tower for collection of wind speed and direction information to assist in the determination of sources contributing to the formation of O_3 at the Sand Island station.
    - The maximum sulfur content of marine fuel was reduced in August 2012 for ships operating within the Emissions Control Area (ECA) around the Hawaiian Islands. After the fuel sulfur reduction became effective, there was a correlated reduction in ambient concentrations of SO_2 at the Niumalu monitoring station. The second fuel sulfur reduction became effective January 2015. The SO_2 data at the Niumalu station was analyzed for one-year post-reduction to determine the ambient effects of the fuel sulfur limits placed on cruise ships. The analyses showed that there was a further reduction in ambient SO_2. In the future, the station may be moved to the population centers of Lihue or Kapaa, depending on the needs of the community.
    - All except one of the old $PM_{2.5}$ Beta-Attenuation continuous monitors (BAM 1020) were replaced by Continuous Beta-Attenuation monitors (BAM 1022), another Federal Equivalent Method (FEM) that do not have as much consumable costs. The current network employs sixteen (16) BAM 1022 with two (2) collocated samplers to meet the requirements of Appendix A to 40 CFR 58.

II. Introduction

In the CFR, EPA promulgated a requirement for all states to conduct and submit a network assessment once every five years [40 CFR 58.10(e)].

"*The state, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the*

agency itself, such as nearby States and Tribes or health effects studies. For $PM_{2.5}$, the assessment also must identify needed changes to population-oriented sites. The State, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator. The first assessment is due July 1, 2010."

Elements evaluated in the assessment include environmental justice concerns, location of asthma corridors, population shifts and emissions inventory. The assessment allows decision-makers to ensure that the current and future air surveillance network is established and operated efficiently and effectively to meet the state's environmental goals.

Ambient air data is used for a variety of purposes including:

- NAAQS compliance;
- Providing near real-time air quality information to the public;
- Permit modeling;
- Pollutant trend analysis;
- Health studies;
- Forecasting;
- Source monitoring; and,
- Evaluating the effects of emissions controls

Questions asked during the assessment included:

- Are the current monitoring objectives being met or should the objectives be modified?
- Based on trend evaluation, what is the priority ranking by pollutant and by station?
- Are there areas that are underserved based on population and health statistics?
- Are there monitors or stations that could/should be discontinued or moved?
- Are there new technologies that can be used to optimize, streamline, or enable the network to operate more efficiently?
- Are there hot spot areas that would benefit from the deployment of temporary or mobile monitoring?
- How can resources be used most efficiently and effectively?

III. Current Air Monitoring in the State of Hawaii

The DOH currently operates 20 monitoring stations on four islands. There are two Metropolitan Statistical Areas (MSA) in the state: Urban Honolulu (hereafter called Oahu), which encompasses the island of Oahu; and the Kahului-Wailuku-Lahaina MSA (hereafter called Maui) covering the County of Maui. There are also two Micropolitan Statistical Areas: Hilo (Hawaii County) and Kapaa (Kauai County). The state's network meets or exceeds the minimum monitoring requirements in 40 CFR 58 Appendix D.

In addition to DOH ambient air monitoring stations, there are other private as well as federal air monitoring stations operating within the state. These include:

Hawaiian Electric Company (HECO) West Oahu Air Monitoring Network

In April 2009, HECO (Oahu's only electrical utility provider) began operating three ambient air monitoring stations along the Waianae coast of Oahu. This was part of a commitment to the west Oahu communities for the development and operation of a new power generation station in the nearby Campbell Industrial Park (CIP). All three stations monitor for CO, SO_2, NO_2, O_3 and $PM_{2.5}$ as well as wind speed (WS), wind direction (WD), ambient temperature and precipitation. Data from the three stations are publicly available on their website at www.westoahuair.com

Puna Geothermal Ventures (PGV)

PGV operates a geothermal energy production facility on the island of Hawaii. As a condition of their non-covered source permit, the facility is required to operate and maintain three perimeter stations for the continuous monitoring of hydrogen sulfide gas (H_2S) as well as wind speed and direction. The three original stations that were being operated by PGV were buried by the lava flow resulting from the 2018 Kilauea volcano's Lower East Rift Zone eruption. Three new station were constructed and are now operating at different locations along the perimeter the plant. The most recent 5-minute H_2S data is publicly available on the PGV webpage.

National Park Service (NPS)

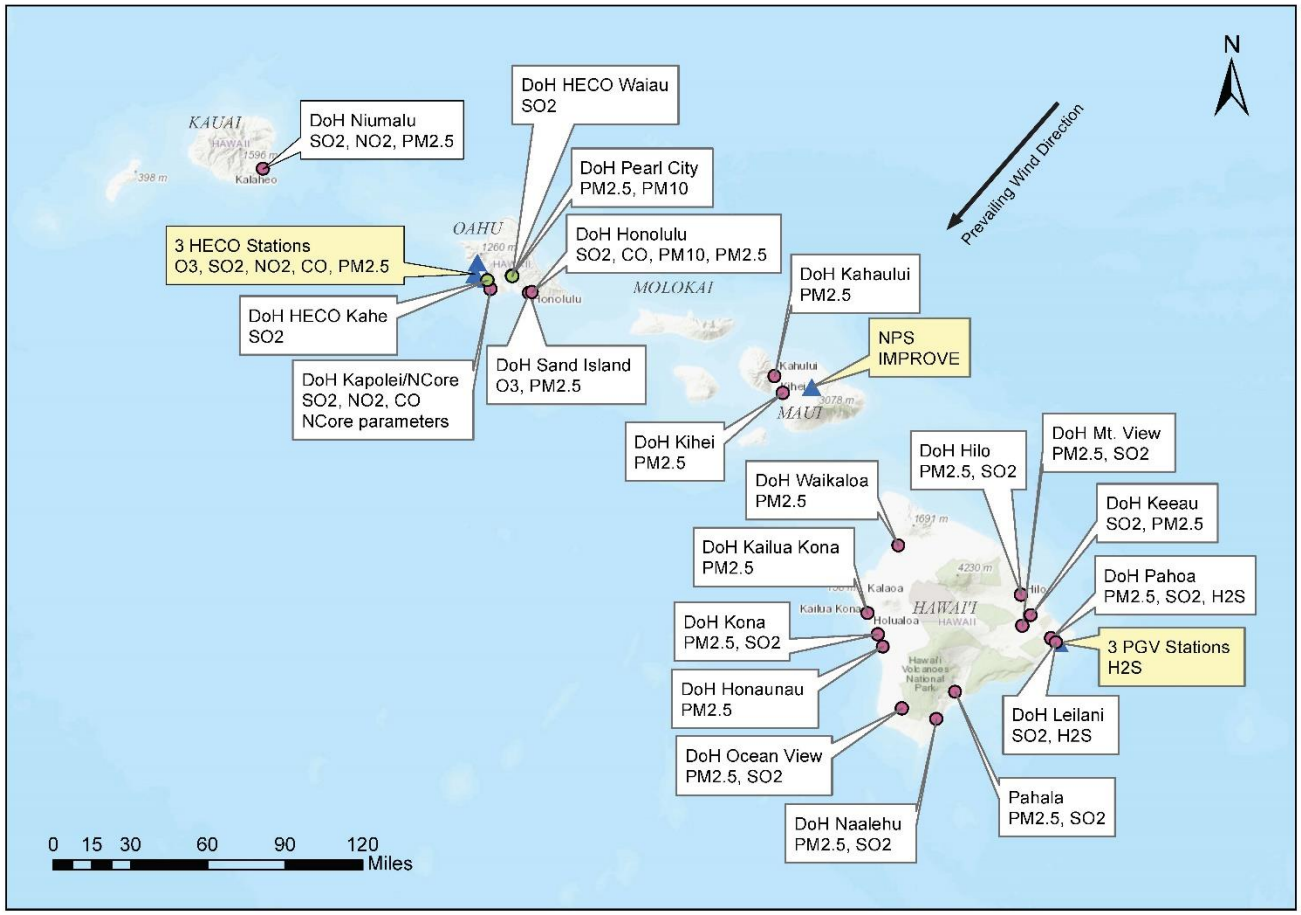
The NPS operates and maintains the two Integrated Monitoring of Protected Visual Environments (IMPROVE) stations in the state. Hawaii has two Class I visibility areas: Haleakala National Park on Maui and Volcanoes National Park on Hawaii (HVNP). Until 2018, there were two stations in HVNP that continuously monitored the SO_2 emissions from the Kilauea volcano; the two stations were destroyed by earthquakes near the summit.

Table 1 lists the various monitoring stations in the state and the Figure 1 map shows the location of each station listed in the table.

Table 1. Air Monitoring in the State of Hawaii – 2020

Entity	Location of Monitoring	Program	Parameters
DOH	Honolulu, Oahu	SLAMS	SO_2, CO, $PM_{2.5}$, PM_{10}
	Kapolei, Oahu	SLAMS/NCore	SO_2, CO, NO_2, $PM_{2.5}$, PM_{10}, $PM_{10-2.5}$, O_3, NOy, $PM_{2.5}$ spec.
	Pearl City, Oahu	SLAMS	$PM_{2.5}$, PM_{10}
	Sand Island, Oahu	SLAMS	$PM_{2.5}$, O_3
	Kahe, Oahu	SLAMS/DRR	SO_2
	Waiau, Oahu	SLAMS/DRR	SO_2
	Kihei, Maui	SLAMS	$PM_{2.5}$
	Kahului, Maui	SPMS	$PM_{2.5}$
	Niumalu, Kauai	SPMS	SO_2, NO_2, $PM_{2.5}$
	Hilo, Hawaii	SLAMS/SPMS	SO_2, $PM_{2.5}$
	Kona, Hawaii	SLAMS/SPMS	SO_2, $PM_{2.5}$
	Mt. View, Hawaii	SPMS	SO_2, $PM_{2.5}$
	Ocean View, Hawaii	SPMS	SO_2, $PM_{2.5}$
	Pahala, Hawaii	SPMS	SO_2, $PM_{2.5}$
	Leilani (Puna), Hawaii	SPMS	SO_2, H_2S
	Honauanu, Hawaii	SPMS	$PM_{2.5}$
	Kailua-Kona, Hawaii	SPMS	$PM_{2.5}$
	Keeau, Hawaii	SPMS	SO_2, $PM_{2.5}$
	Naalehu, Hawaii	SPMS	SO_2, $PM_{2.5}$
	Waikoloa, Hawaii	SPMS	$PM_{2.5}$
HECO	Waianae, Oahu	West Oahu Air	SO_2, CO, NO_2, O_3, $PM_{2.5}$
	Lualualei, Oahu	West Oahu Air	SO_2, CO, NO_2, O_3, $PM_{2.5}$
	Timberline, Oahu	West Oahu Air	SO_2, CO, NO_2, O_3, $PM_{2.5}$
PGV	Pahoa, Hawaii (A-1)	PGV	H_2S
	Pahoa, Hawaii (B-1)	PGV	H_2S
	Pahoa, Hawaii (C-1)	PGV	H_2S
NPS	Haleakala National Park, Maui	IMPROVE	$PM_{2.5}$ spec.
	HVNP	IMPROVE	$PM_{2.5}$ spec.

Figure 1. Air Monitoring Stations in the State of Hawaii - 2020



IV. Climate, Population and Emission Source Characteristics

A. Climate and Topography[1]

Climate

The Hawaiian archipelago is the most isolated populated area in the world. The closest landmass is California, approximately 2,400 miles to the northeast. The climate is predominantly influenced by the surrounding ocean and its tropical latitude location producing relatively mild temperatures and moderate humidity. There are basically two seasons: summer from May through October, and winter from October through April.

The islands are actually the summits of a volcanic mountain range. The mountain and valley landscapes produce a complex air flow system with wide variability in wind speeds, rainfalls and temperatures. Strong diurnal wind patterns can be found on the southern and western leeward coasts of the islands. This diurnal pattern consists of sea breezes during the afternoon and early evening hours and land breezes at night.

The most dominant climatic attribute affecting the dispersion of air pollutants and allowing for the normally clean air is the nearly persistent trade-wind or northeasterly winds. During the summer months, the trades are prevalent 80 to 95 percent of the time, decreasing in the winter months as cold fronts move through the islands bringing with them southerly winds. During eruptions, emissions from the still active Kilauea volcano on the island of Hawaii can travel up the island chain with these southerly or “Kona” winds. The volcanic emissions, also called “vog”, may create hazy conditions sometimes as far north as Kauai.

Some of the major climatic regions are:

1. Windward lowlands
   Less than 2,000 feet on the northern to northeastern sides of the islands, these lowlands lie perpendicular to the prevailing trade-winds, is often cloudy with frequent trade showers (see Figure 2) and mild temperature fluctuations.
2. Leeward lowlands:
   Dryer, warmer weather prevail in these areas often with afternoon sea breezes. The exception is the Kona coast on the island of Hawaii which has its own distinctive climate.
3. Kona coast on the island of Hawaii:
   This is the only region where the rainfall is higher in the summer than in the winter. An eddy off the coast caused by the two large mountain peaks of Mauna Kea to the north and Mauna Loa to the south results in the volcanic plume (during eruptions) circling back onto land and allowing the vog to be nearly constant during trade-wind weather. This was a major issue prior and during the Lower East Rift Zone eruption that ended in August 2018. Since

[1] Sources for climate information from Western Regional Climate Center (www.wrcc.dri.edu) and the National Weather Service, Honolulu (www.prh.noaa.gov/hnl)

then, with little volcanic emissions from an active eruption, the Kona coast has been mostly free of vog.

Topography

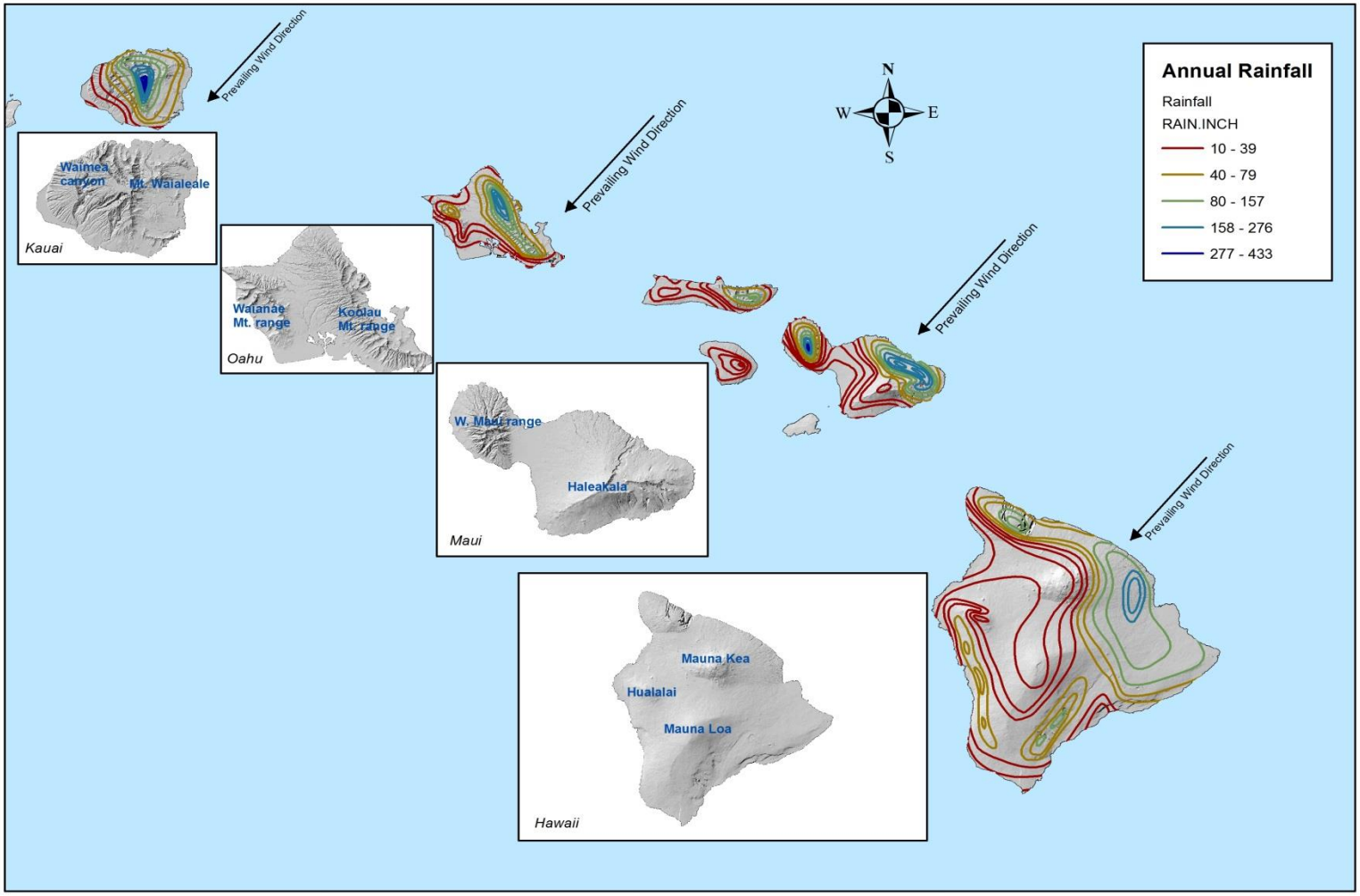
Each island has unique topographical influences:

4. Oahu
   The most significant factor influencing Oahu's environment is the urban Honolulu setting where tall, dense building structures tend to cause warmer temperatures and turbulent winds within the city center. The impact of city pollution is minimized by the trade-winds that normally blow them out to sea.
5. Kauai
   Being the northern-most major island, Kauai is largely exposed to the northwest frontal systems that bring rain during the winter months. Mt. Waialeale in the center of the island is one of the wettest spots in the world.
6. Maui
   The Maui MSA lies in the interior lowland between the two peaks of Haleakala and the West Maui mountains. The flat valley terrain can result in a night-time inversion layer that may restrict vertical transport of air pollutants.
7. Hawaii
   The largest geographical influences are the two mountain peaks of Mauna Kea (13,796 ft.) and Mauna Loa (13,678 ft.). What once was the major influence from the ongoing volcanic activity of the Kilauea volcano ended with the Lower East Rift Zone eruption which stopped in August 2018. The mountain peaks create an eddy effect along the Kona coast that may bring any volcanic plume, which would normally be moved off shore by the trade-winds, back onto land in the form of sulfate aerosols. When the winds turn southerly, as occurs during the winter months with the more frequent cold fronts, the plume can travel directly to the Hilo coast on the eastern side of the island. Because of the relatively short distance between the volcano vents and Hilo, the volcanic plume is mainly detected as SO_2.

Monitoring Assessment Findings based on Climate and Topography

1. The majority of the monitoring stations are located on the downwind side of the islands where most of the air pollution is expected.
2. The Kahului station is located in the interior lowland of central Maui where there is a potential for restricted transport of air pollutants.
3. The Kona air monitoring station is located to detect sulfate aerosols as $PM_{2.5}$ and the Hilo and Mt. View stations are located to monitor for SO_2 from the volcano when the winds come from a non-prevalent direction.
4. No new or relocated stations or monitors are proposed.

Figure 2. Climate and Topography



B. Population

There are two MSAs in the state: Oahu and Maui. The two Micropolitan Statistical Areas are Hilo (island of Hawaii) and Kapaa (island of Kauai).

The state's population increased 12.3% from 2000 to 2010 with an estimated increase of 4% from 2010 to 2019. Table 2 summarizes the population totals on each island. The areas with higher poverty rates remained unchanged from the 2000 to the 2010 census. Similarly, the areas of highest childhood asthma were unchanged since 2010[2].

Table 2. State of Hawaii Population Summary

	2010 Population	% Change 2000-2010	% Share of Population	Population (2019 est.)
State	1,360,301	+12.3		1,415,872
Oahu	953,207	+8.8	70.1	974,563
Hawaii	185,079	+24.5	13.6	201,513
Maui	144,444	+22.8	10.6	167,417
Kauai	66,921	+14.8	4.9	72,293

Monitoring Assessment Findings based on Population

1. The population of the Oahu MSA is slowly approaching one million. If it reaches or exceeds one million, more monitoring would be required. CO and $PM_{2.5}$ will need to be added to the near-road monitoring station and an area-wide NO_2 monitor with expected highest concentration may be required.
2. The poverty and asthma corridor areas on all islands have not changed since the 2010 census or the 2015 assessment (Figures 4 to 7).
3. The urbanized areas on each island remain unchanged from the 2000 to the 2010 census (Figure 3).
4. The three community monitoring stations owned and operated by HECO are all located along the Waianae coast of Oahu, which is also the area of highest poverty in the Oahu MSA. To conserve resources and prevent duplication of efforts, these three stations will be utilized to meet environmental justice concerns for Oahu.
5. No other new or relocated stations or monitors are proposed.

[2] Hawaii Health Data Warehouse; Hawaii State Department of Health, Behavioral Risk Factor Surveillance System, *Current Asthma Among Children and Adolescents in Hawaii, by State, County, Island, and Community, for the Years 2011-2012.* Report created 3/25/2014.

Figure 3

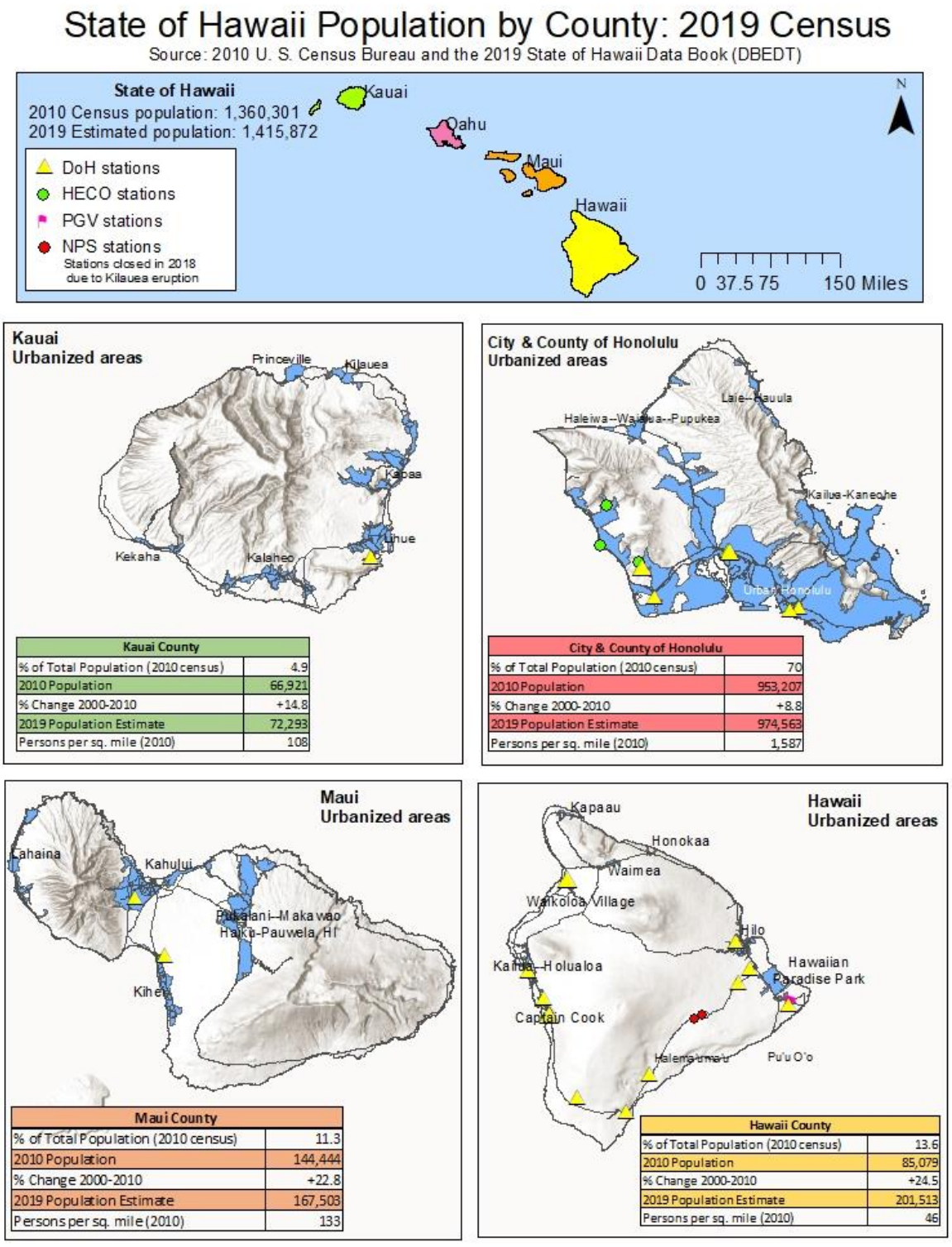

State of Hawaii Population by County: 2019 Census
Source: 2010 U. S. Census Bureau and the 2019 State of Hawaii Data Book (DBEDT)
State of Hawaii
2010 Census population: 1,360,301
2019 Estimated population: 1,415,872
DoH stations
HECO stations
PGV stations
NPS stations
Stations closed in 2018 due to Kilauea eruption
Kauai
Oahu
Maui
Hawaii
N
0 37.5 75 150 Miles
Kauai
Urbanized areas
Princeville
Kilauea
Kapaa
Lihue
Kekaha
Kalaheo
Kauai County
% of Total Population (2010 census) 4.9
2010 Population 66,921
% Change 2000-2010 +14.8
2019 Population Estimate 72,293
Persons per sq. mile (2010) 108
City & County of Honolulu
Urbanized areas
Haleiwa--Waialua--Pupukea
Laie--Hauula
Kailua-Kaneohe
Urban Honolulu
City & County of Honolulu
% of Total Population (2010 census) 70
2010 Population 953,207
% Change 2000-2010 +8.8
2019 Population Estimate 974,563
Persons per sq. mile (2010) 1,587
Maui
Urbanized areas
Lahaina
Kahului
Pukalani--Makawao
Haiku-Pauwela, HI
Kihei
Maui County
% of Total Population (2010 census) 11.3
2010 Population 144,444
% Change 2000-2010 +22.8
2019 Population Estimate 167,503
Persons per sq. mile (2010) 133
Hawaii
Urbanized areas
Kapaau
Honokaa
Waimea
Waikoloa Village
Hilo
Kailua--Holualoa
Hawaiian Paradise Park
Captain Cook
Halemaumau
Pu'u O'o
Hawaii County
% of Total Population (2010 census) 13.6
2010 Population 85,079
% Change 2000-2010 +24.5
2019 Population Estimate 201,513
Persons per sq. mile (2010) 46

Figure 4

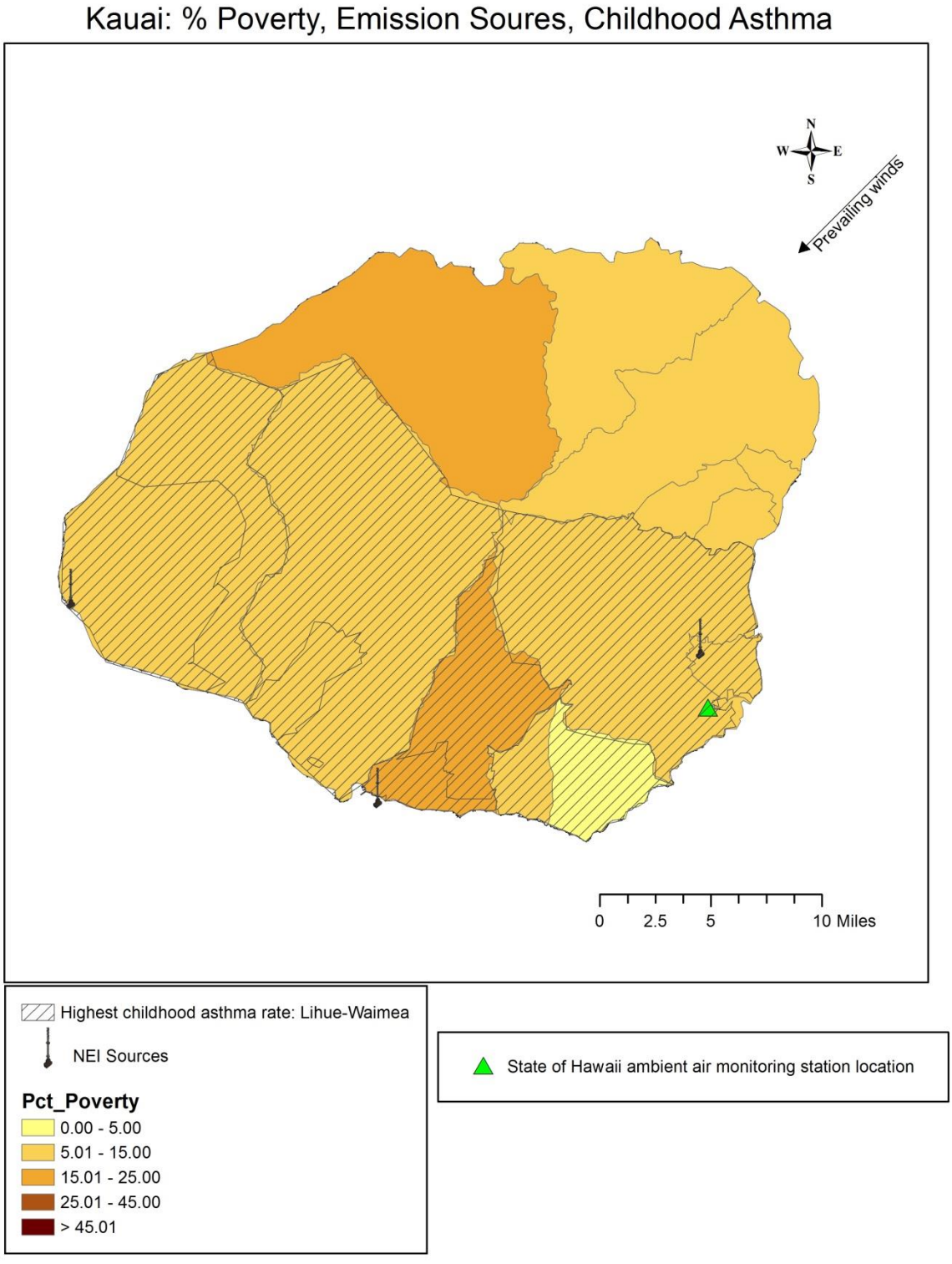

Kauai: % Poverty, Emission Soures, Childhood Asthma
N
W
E
S
Prevailing winds
0
2.5
5
10 Miles
Highest childhood asthma rate: Lihue-Waimea
NEI Sources
Pct_Poverty
0.00 - 5.00
5.01 - 15.00
15.01 - 25.00
25.01 - 45.00
> 45.01
State of Hawaii ambient air monitoring station location

Figure 5

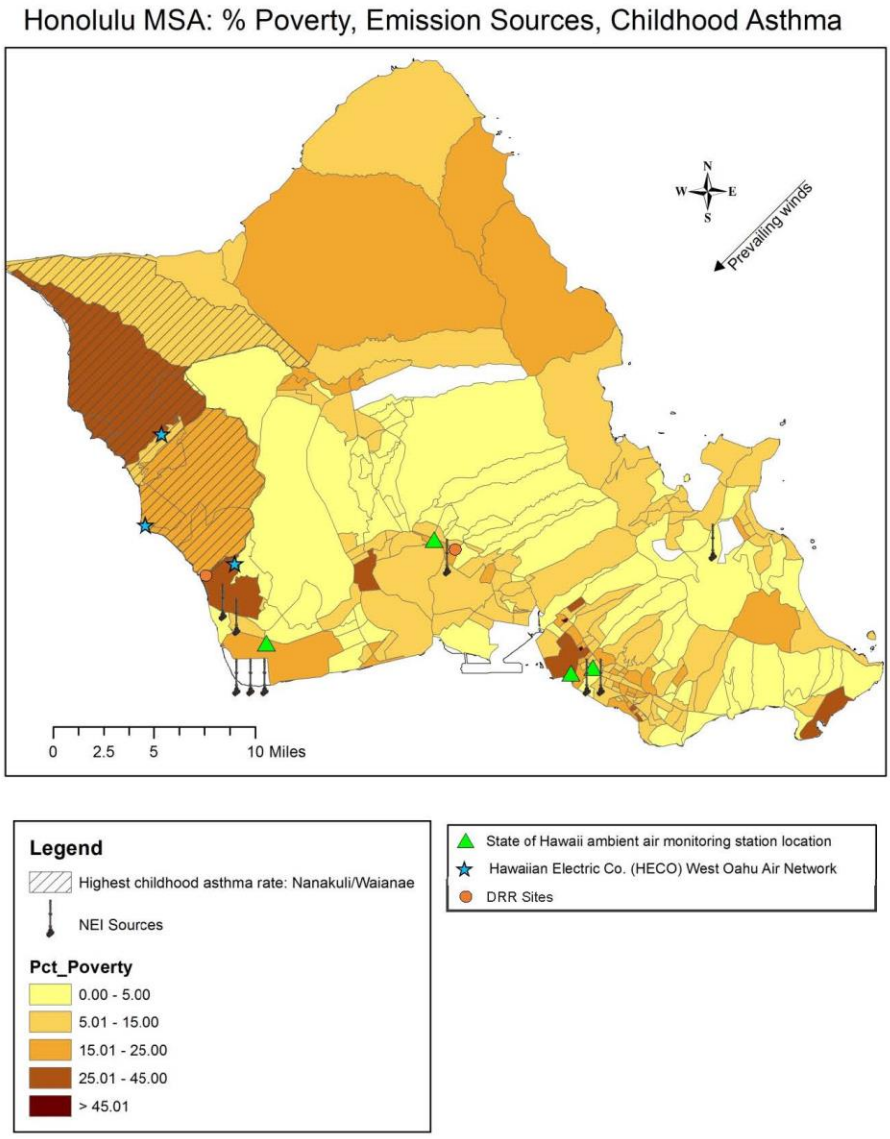

Honolulu MSA: % Poverty, Emission Sources, Childhood Asthma
N
W
E
S
Prevailing winds
0
2.5
5
10 Miles
Legend
Highest childhood asthma rate: Nanakuli/Waianae
NEI Sources
Pct_Poverty
0.00 - 5.00
5.01 - 15.00
15.01 - 25.00
25.01 - 45.00
> 45.01
State of Hawaii ambient air monitoring station location
Hawaiian Electric Co. (HECO) West Oahu Air Network
DRR Sites

Figure 6

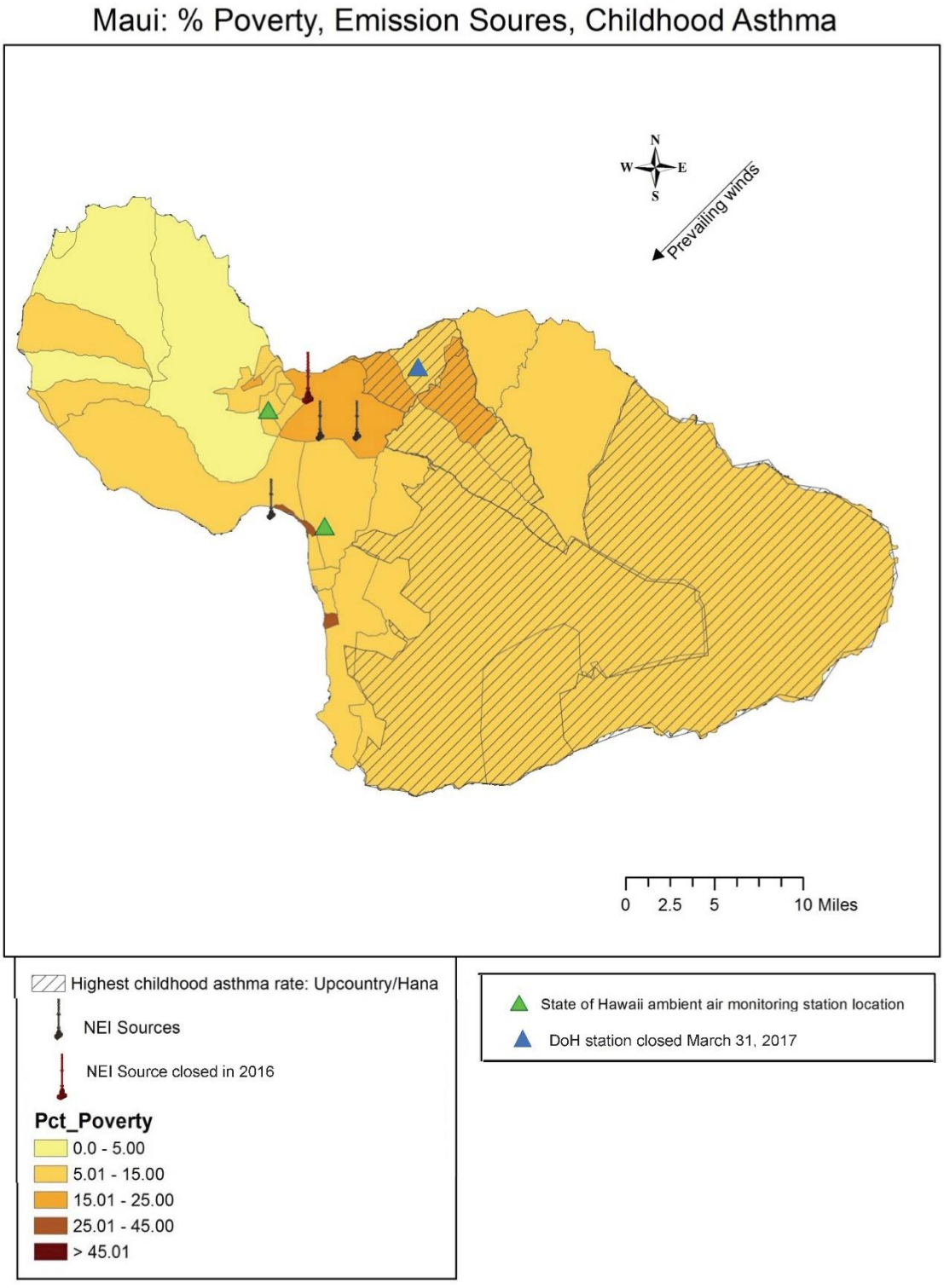
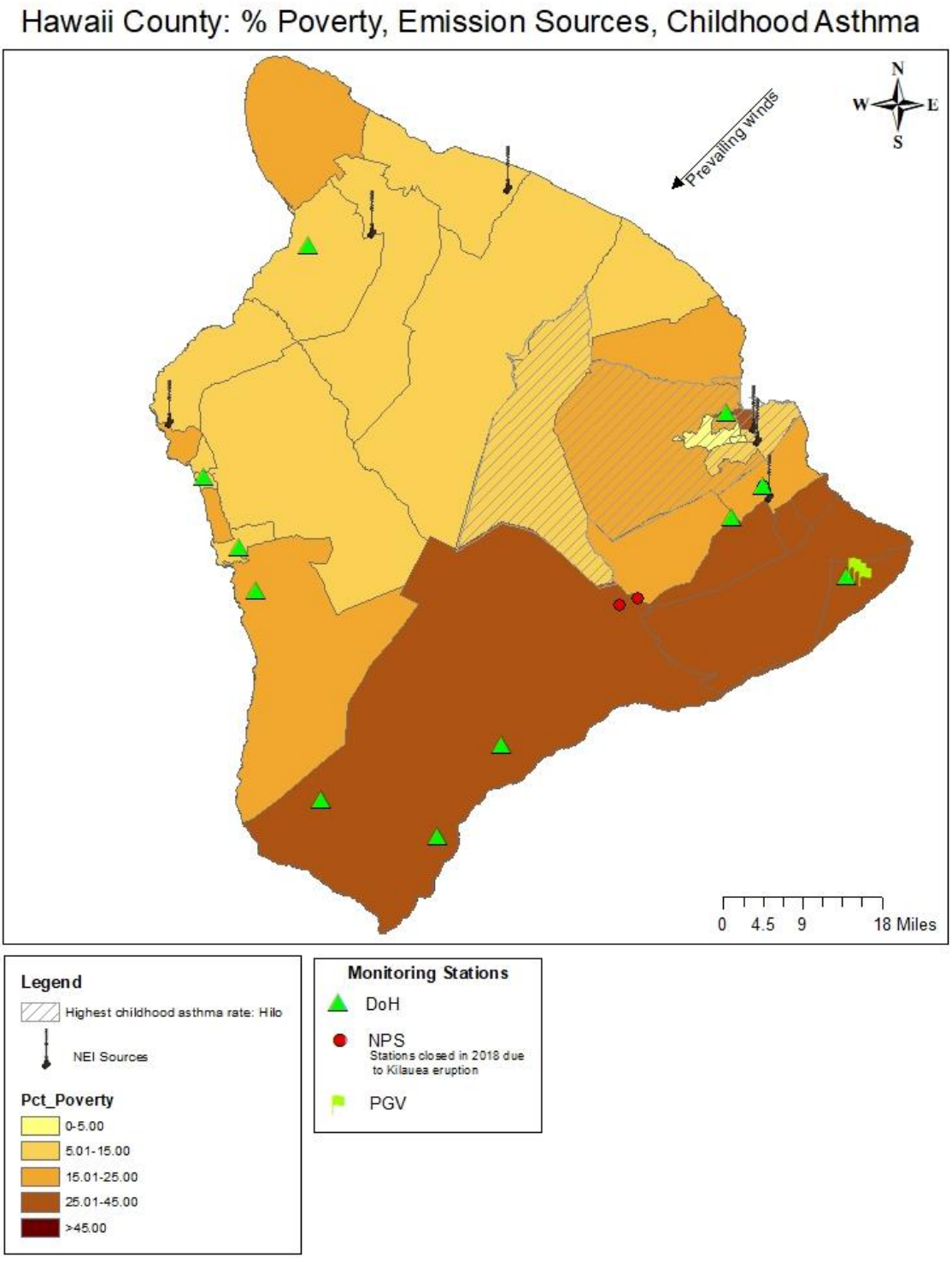

Maui: % Poverty, Emission Soures, Childhood Asthma
N
W
E
S
Prevailing winds
0
2.5
5
10 Miles
Highest childhood asthma rate: Upcountry/Hana
NEI Sources
NEI Source closed in 2016
Pct_Poverty
0.0 - 5.00
5.01 - 15.00
15.01 - 25.00
25.01 - 45.00
> 45.01
State of Hawaii ambient air monitoring station location
DoH station closed March 31, 2017

Figure 7


Hawaii County: % Poverty, Emission Sources, Childhood Asthma
N
W
E
S
Prevailing winds
0 4.5 9 18 Miles
Legend
Highest childhood asthma rate: Hilo
NEI Sources
Pct_Poverty
0-5.00
5.01-15.00
15.01-25.00
25.01-45.00
>45.00
Monitoring Stations
DoH
NPS
Stations closed in 2018 due to Kilauea eruption
PGV

C. Emission Sources

There have not been a significant number of new or relocated major emission sources in the past five years since the 2015 assessment was conducted.

Summary of Emission Sources by Island

- Kauai
  The predominant air pollution concern on this island has been cruise ship emissions from Nawiliwili harbor. The harbor is located in Lihue on the eastern side of the island and the prevailing trade-winds carry the emissions on-shore impacting nearby residential communities.

  An important consideration will be the MARPOL (International Convention for the Prevention of Pollution from Ships) Annex VI treaty. This treaty requires ships to use fuel with lower sulfur content when entering any ECA, which includes a 200 mile radius around the Hawaiian islands.

  In August 2012, ships were required to use fuel with a sulfur content of not more than 10,000 ppm (1%) when operating within the ECA. Data from the DOH Niumalu station showed a correlating decrease in ambient levels of SO_2. Beginning January 2015, the fuel sulfur limit was further reduced to 1,000 ppm (0.1%). Data from the station again showed a correlating decrease in ambient levels of SO_2.

- Oahu
  Most of the major anthropogenic sources are located on Oahu and concentrated in the CIP area on the southwest side of the island. With 70% of the population residing on 602 square miles of land, mobile source pollution is the greatest on Oahu and will be the site of any future near-road NO_2 station. Additionally, there are currently four electrical generating facilities (HECO Kahe, HECO Waiau, Kalaeloa and AES) that ae being monitored per the SO_2 DRR. If the Waiau station is approved to be shut down, then the number of electrical generating facilities that are being monitored per the DRR would be three.

- Maui
  The major concerns for residents on Maui are impacts from agricultural activities including agricultural burning, commercial/residential development and emissions for a few major emission sources. There are approximately 36,000 acres in the central valley that once grew sugar cane, but are now a mix of unharvested cane, new agricultural investments and commercial/residential development.

- Hawaii
  What once was the largest emission source in the state was from the still active Kilauea volcano. Although not currently erupting, areas of persistently elevated ground temperatures and minor release of gases are still found in

the vicinity of the 2018 LERZ fissures. These include steam (water), very small amounts of hydrogen sulfide, and carbon dioxide. These conditions are expected to be long-term. The U.S. Geological Survey estimates the SO_2 output at low rates. This source by far generates the greatest air pollution impact statewide when erupting.

Additionally, there are concerns of H_2S emissions as a result of geothermal energy exploration and production, especially for residents in the Puna area.

Summary of Emissions by Pollutant

A summary of the criteria pollutant emissions from the 2014 National Emissions Inventory (NEI) is provided in Table 3. As expected, the majority of anthropogenic emissions occur on the island of Oahu where most of the industrial and mobile sources are located.

When only major source emissions are considered, the Hawaiian Commercial & Sugar facility in Maui County was the largest CO emitter; the power plant has since shut down after the 2016 harvesting season. Currently, when all sources are included, Oahu by far has the most CO, primarily from mobile sources. Increases in PM_{10} and $PM_{2.5}$ emissions on Oahu when all sources are considered are primarily due to construction dust.

Table 3. 2014 NEI

County	CO (tpy)[1]	NOx (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Major sources – Kauai	589	1,592	63	76	73
All sources – Kauai	11,595	2,785	87	3,889	626
Major sources – Oahu	4,125	18,833	14,484	1,859	1,618
All sources – Oahu	108,267	29,337	14,778	16,685	4,649
Major sources – Maui	4,737	4,249	2,457	456	403
All sources – Maui	40,324	7,500	2,747	11,526	2,910
Major sources – Hawaii	1,276	1,487	2,539	192	165
All sources - Hawaii	123,728	9,948	3,101	40,911	13,955
Major sources – State	10,742	26,163	19,543	2,583	2,259
All sources – State	283,938	49,574	20,714	73,042	22,144

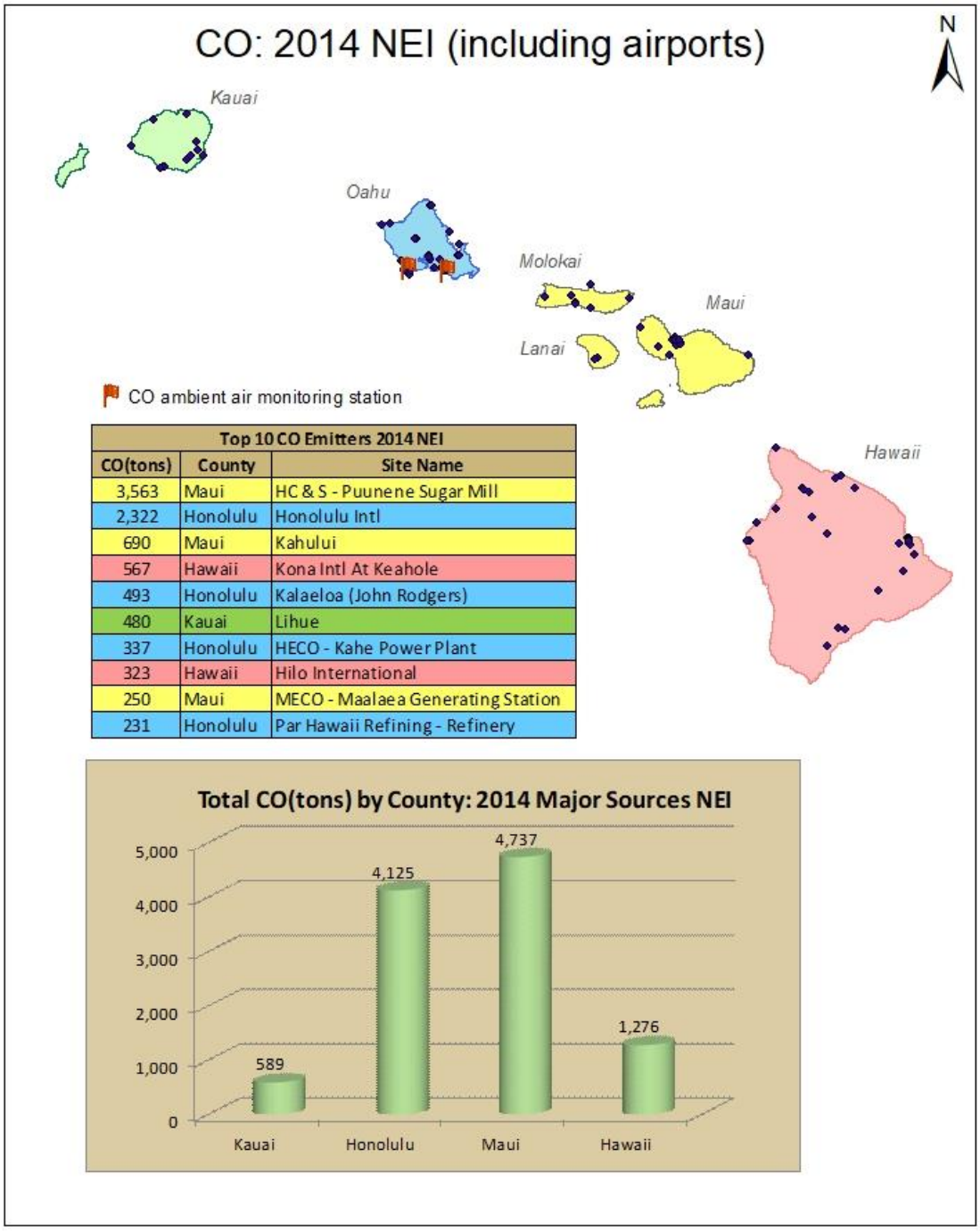
Monitoring Assessment Findings based on Emission Sources

1. Continue monitoring for cruise ship emissions at the Niumalu, Kauai station. If resources allow, with community input, either close the station or move it to a population based area within Lihue or Kapaa.
2. Continue monitoring at the one remaining source-oriented SO_2 monitoring site, Kahe station on Oahu. If at the end of 2020, the design value for 2018-2020 is <50% of the SO_2 NAAQS, then a request to shut down the station will be submitted to EPA. If the design value for 2018-2020 is >50% of the NAAQS, then keep collecting data until at least the end of 2021, when there will have been at least 5 years of data collected, and the data can be compared to the 1-hour SO_2 NAAQS again. (Note: the Kahe station ended with a design value of 52 ppb for the 3-year period 2017-2019, which was greater than fifty (50%) of the 1-hour SO_2 NAAQS of 75 ppb, thus exceeding

the threshold for closing. The Waiau station that had started monitoring in January 2017 at the same time as Kahe has collected at least 3 years of data with a design value that is less than 50% of the 1-hour SO_2 NAAQS. The design value at Waiau from 2017 to 2019 was 16 ppb, thus DOH has submitted a request to EPA to shut down the Waiau station.

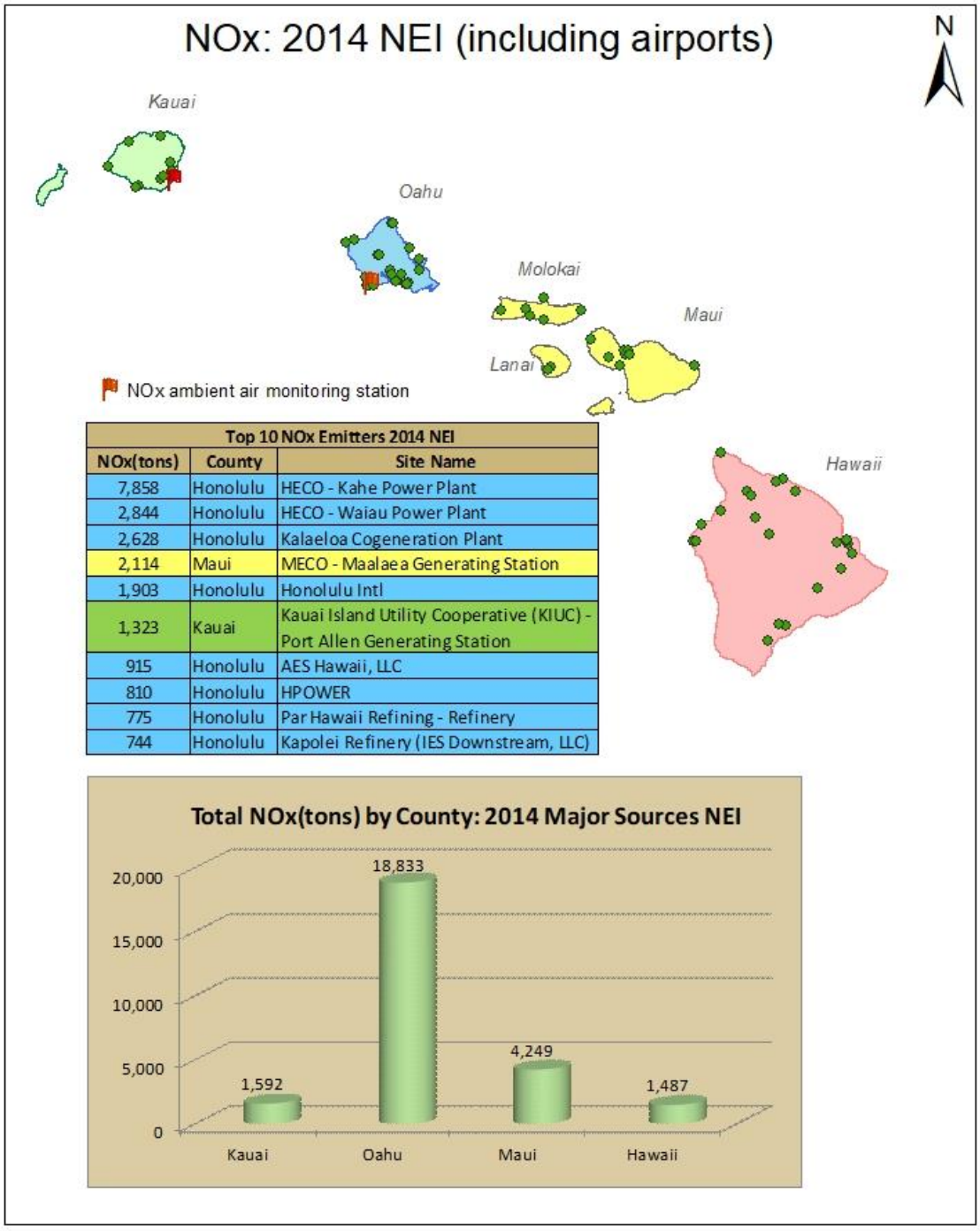
3. Continue to operate the two $PM_{2.5}$ monitoring stations in Kihei and Kahului. If and when resources allow, DOH may add continuous monitoring for CO, NO_2, and SO_2 on Maui.
4. Continue the nine SO_2 and ten $PM_{2.5}$ volcanic emissions monitoring stations on the island of Hawaii.
5. Continue monitoring for H_2S in Puna for emissions from geothermal energy production and exploration.
6. No other new or relocated stations or monitors are proposed.

Figure 8.



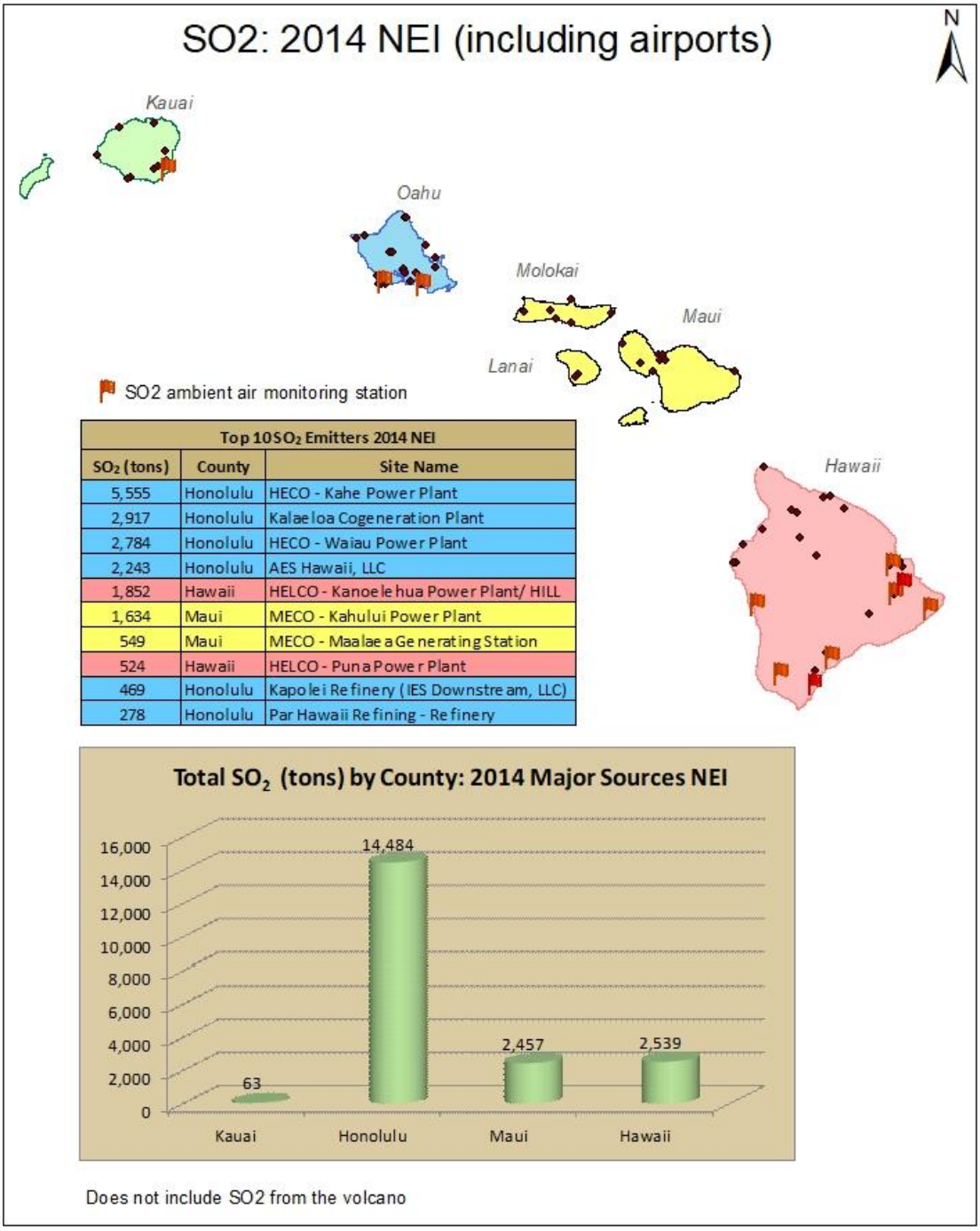
Top 10 CO Emitters 2014 NEI		
CO(tons)	County	Site Name
3,563	Maui	HC & S - Puunene Sugar Mill
2,322	Honolulu	Honolulu Intl
690	Maui	Kahului
567	Hawaii	Kona Intl At Keahole
493	Honolulu	Kalaeloa (John Rodgers)
480	Kauai	Lihue
337	Honolulu	HECO - Kahe Power Plant
323	Hawaii	Hilo International
250	Maui	MECO - Maalaea Generating Station
231	Honolulu	Par Hawaii Refining - Refinery

Figure 9.



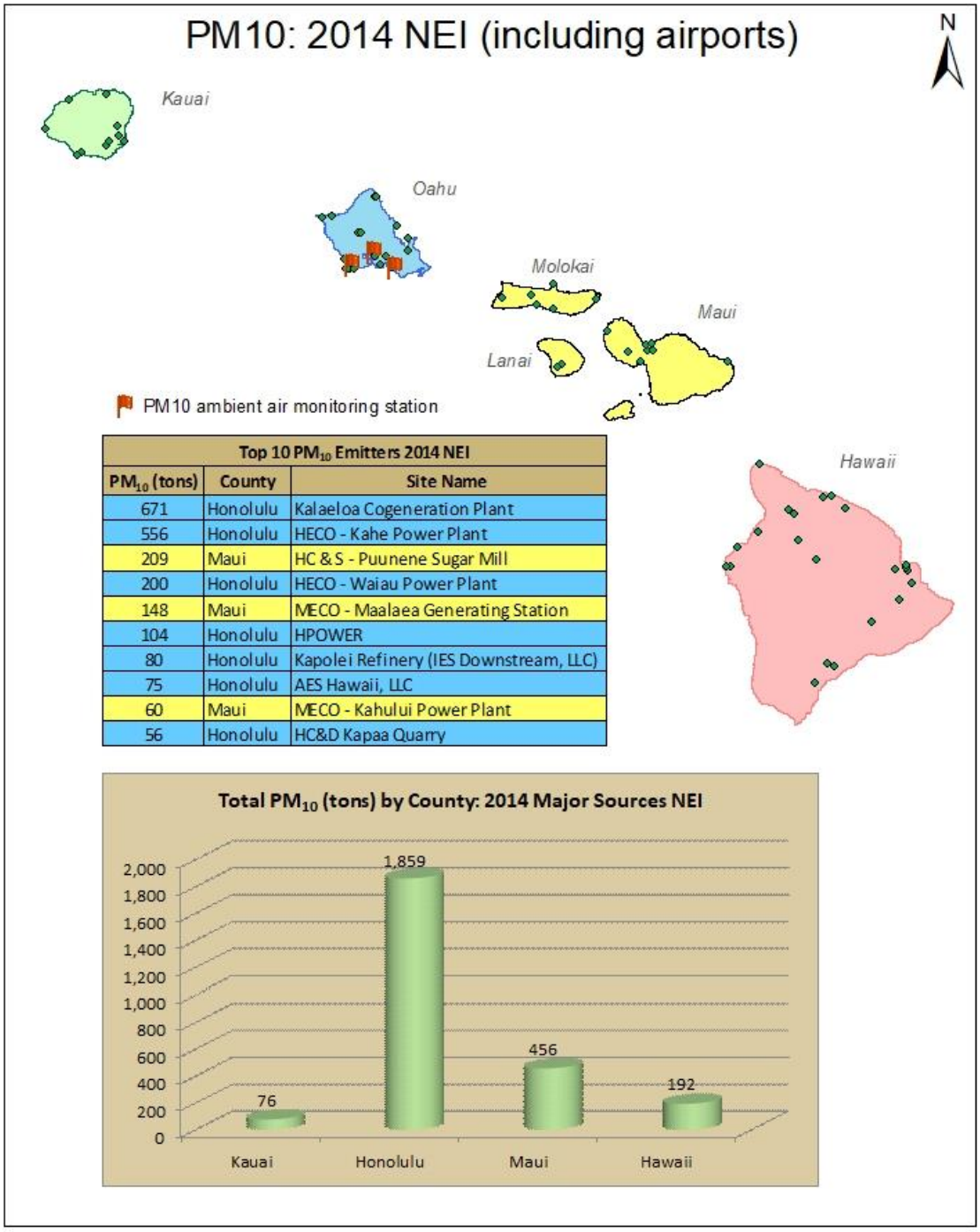
Top 10 NOx Emitters 2014 NEI		
NOx(tons)	County	Site Name
7,858	Honolulu	HECO - Kahe Power Plant
2,844	Honolulu	HECO - Waiau Power Plant
2,628	Honolulu	Kalaeloa Cogeneration Plant
2,114	Maui	MECO - Maalaea Generating Station
1,903	Honolulu	Honolulu Intl
1,323	Kauai	Kauai Island Utility Cooperative (KIUC) - Port Allen Generating Station
915	Honolulu	AES Hawaii, LLC
810	Honolulu	HPOWER
775	Honolulu	Par Hawaii Refining - Refinery
744	Honolulu	Kapolei Refinery (IES Downstream, LLC)

Figure 10.



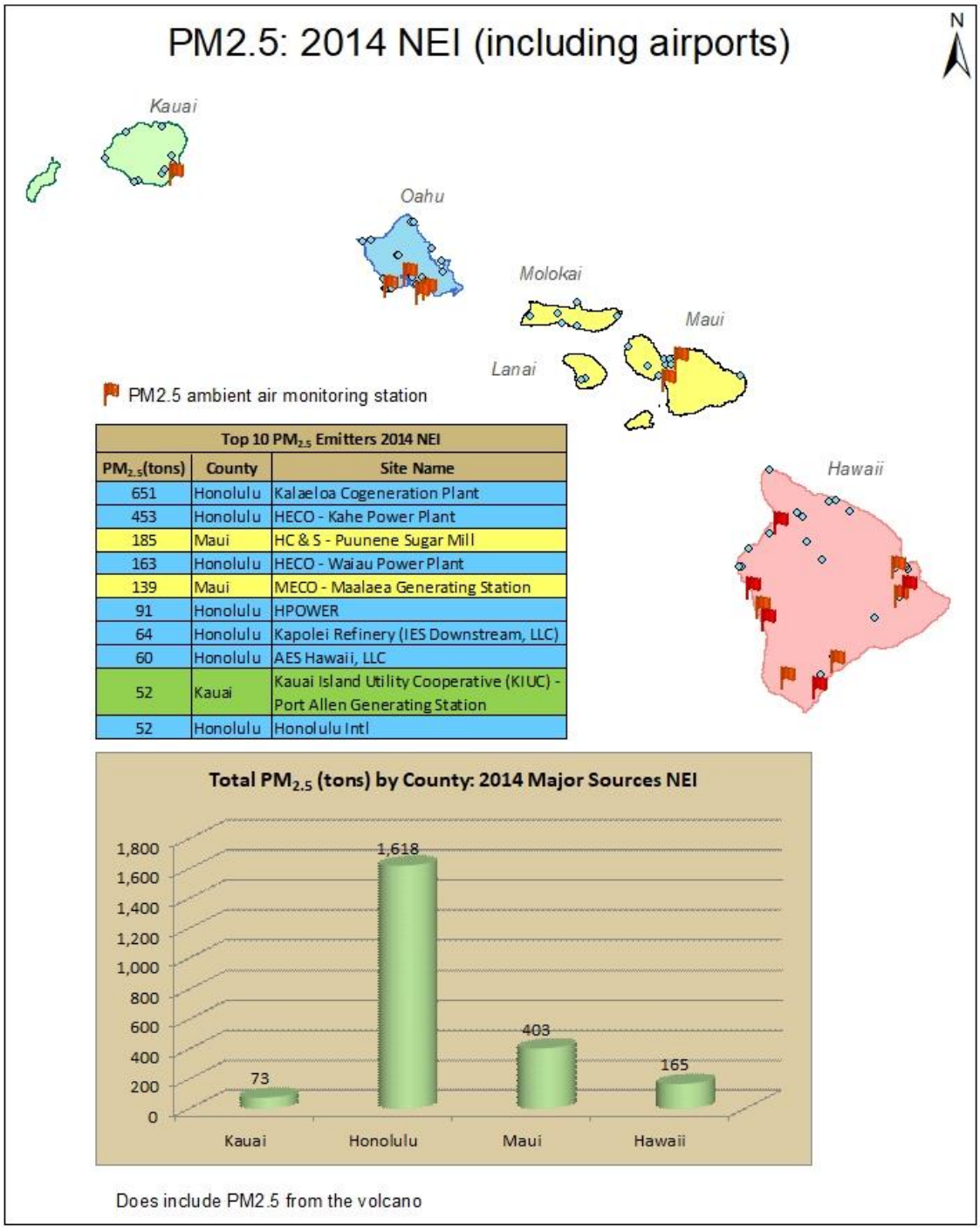
Top 10 SO_2 Emitters 2014 NEI		
SO_2 (tons)	County	Site Name
5,555	Honolulu	HECO - Kahe Power Plant
2,917	Honolulu	Kalaeloa Cogeneration Plant
2,784	Honolulu	HECO - Waiau Power Plant
2,243	Honolulu	AES Hawaii, LLC
1,852	Hawaii	HELCO - Kanoelehua Power Plant/ HILL
1,634	Maui	MECO - Kahului Power Plant
549	Maui	MECO - Maalaea Generating Station
524	Hawaii	HELCO - Puna Power Plant
469	Honolulu	Kapolei Refinery (IES Downstream, LLC)
278	Honolulu	Par Hawaii Refining - Refinery

Figure 11.



Top 10 PM_{10} Emitters 2014 NEI		
PM_{10} (tons)	County	Site Name
671	Honolulu	Kalaeloa Cogeneration Plant
556	Honolulu	HECO - Kahe Power Plant
209	Maui	HC & S - Puunene Sugar Mill
200	Honolulu	HECO - Waiau Power Plant
148	Maui	MECO - Maalaea Generating Station
104	Honolulu	HPOWER
80	Honolulu	Kapolei Refinery (IES Downstream, LLC)
75	Honolulu	AES Hawaii, LLC
60	Maui	MECO - Kahului Power Plant
56	Honolulu	HC&D Kapaa Quarry

Figure 12.


PM2.5: 2014 NEI (including airports)
N
Kauai
Oahu
Molokai
Maui
Lanai
Hawaii
PM2.5 ambient air monitoring station
Top 10 PM2.5 Emitters 2014 NEI
PM2.5(tons) | County | Site Name
651 | Honolulu | Kalaeloa Cogeneration Plant
453 | Honolulu | HECO - Kahe Power Plant
185 | Maui | HC & S - Puunene Sugar Mill
163 | Honolulu | HECO - Waiau Power Plant
139 | Maui | MECO - Maalaea Generating Station
91 | Honolulu | HPOWER
64 | Honolulu | Kapolei Refinery (IES Downstream, LLC)
60 | Honolulu | AES Hawaii, LLC
52 | Kauai | Kauai Island Utility Cooperative (KIUC) - Port Allen Generating Station
52 | Honolulu | Honolulu Intl
Total PM2.5 (tons) by County: 2014 Major Sources NEI
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
73
1,618
403
165
Kauai
Honolulu
Maui
Hawaii
Does include PM2.5 from the volcano

V. Data Assessment

Trends

Data from the past 10 years (2010 through 2019) was analyzed to determine trends and pollutants of significance for the state. As expected, the SO_2 and $PM_{2.5}$ remain steadily elevated until the various eruptions in the LERZ from May to August of 2018, during which the emissions dramatically increased until the eruption ended. The emissions have since dropped dramatically to little or no emissions. NO_2 concentrations have increased, although remaining well below the NAAQS. O_3 has increased slightly in the past 10 years, however concentrations are still about 70% of the NAAQS. On Oahu, PM_{10} has remained steady from 2012 to 2019 after the initial significant decrease from the New Year's consumer fireworks ban that began in 2011. CO levels have remained relatively unchanged and well below any of the NAAQS.

Figure 13.

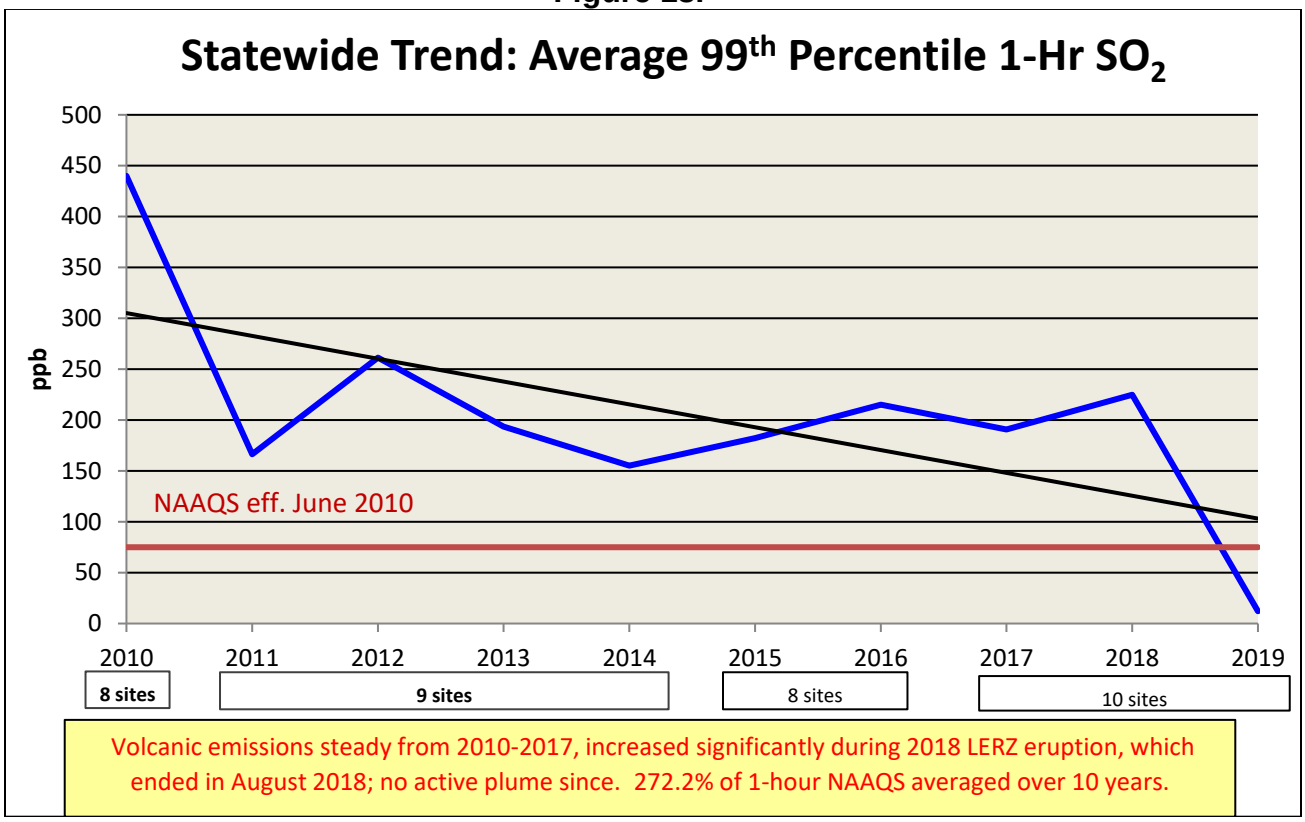


Figure 14.

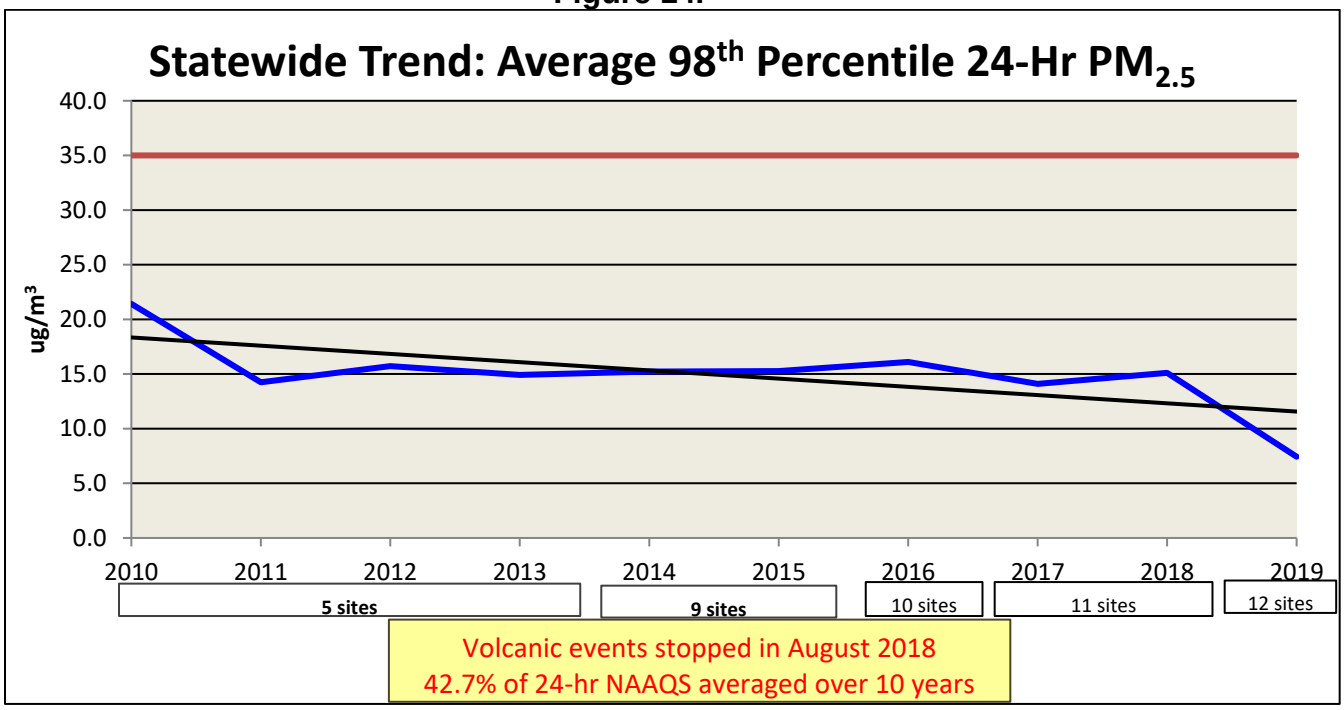


Figure 15.

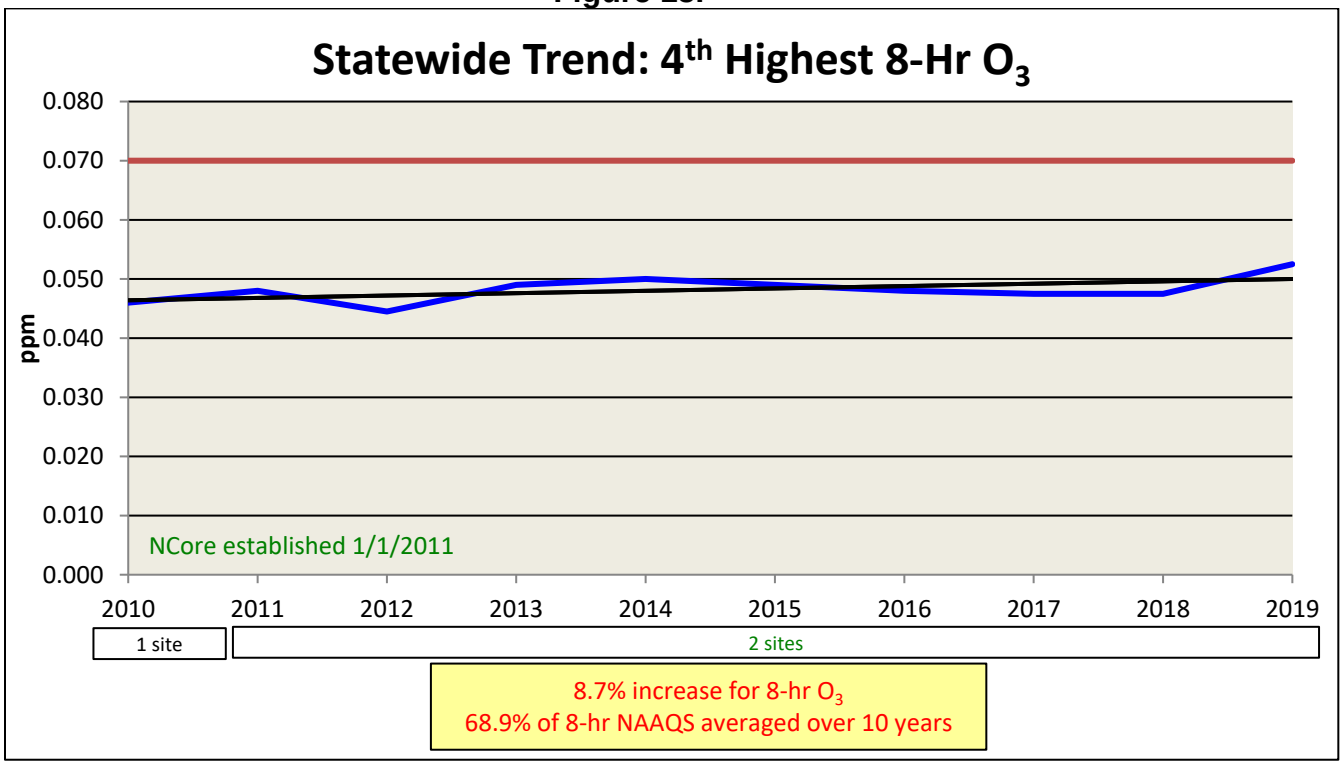


Figure 16.

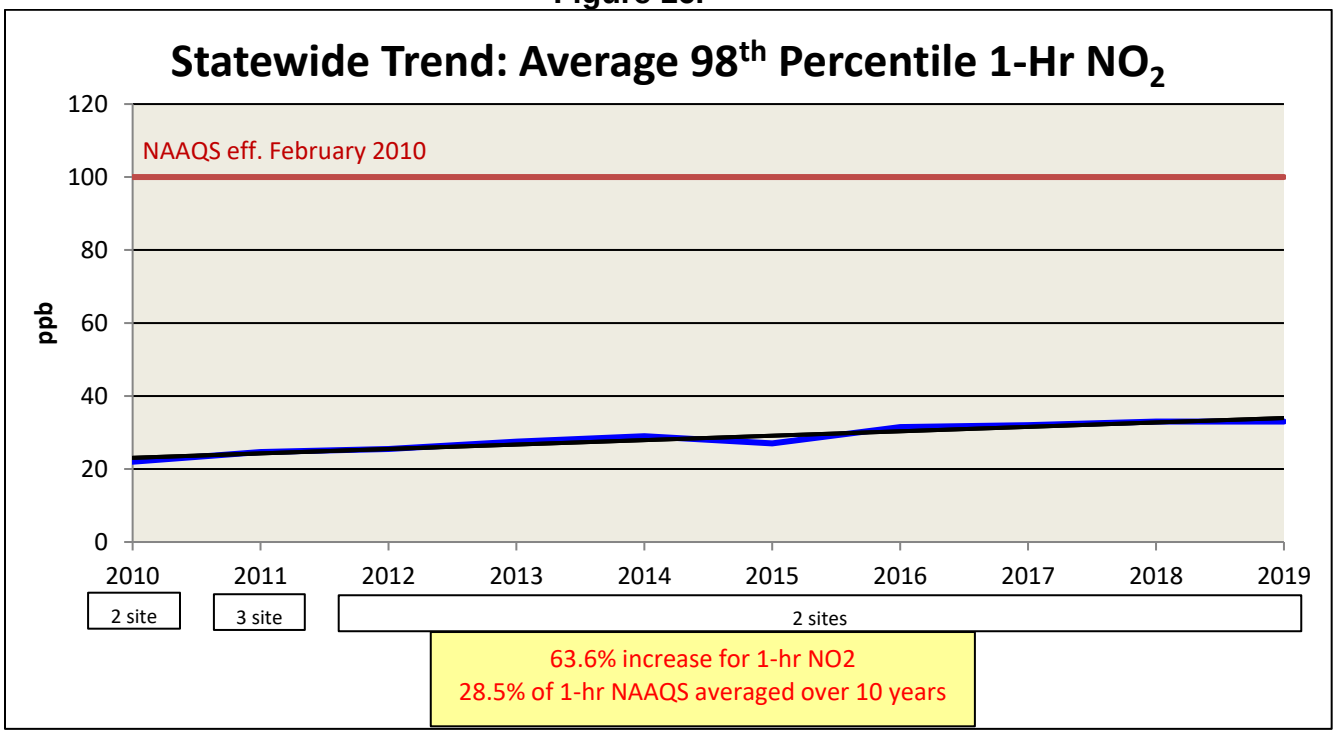


Figure 17.

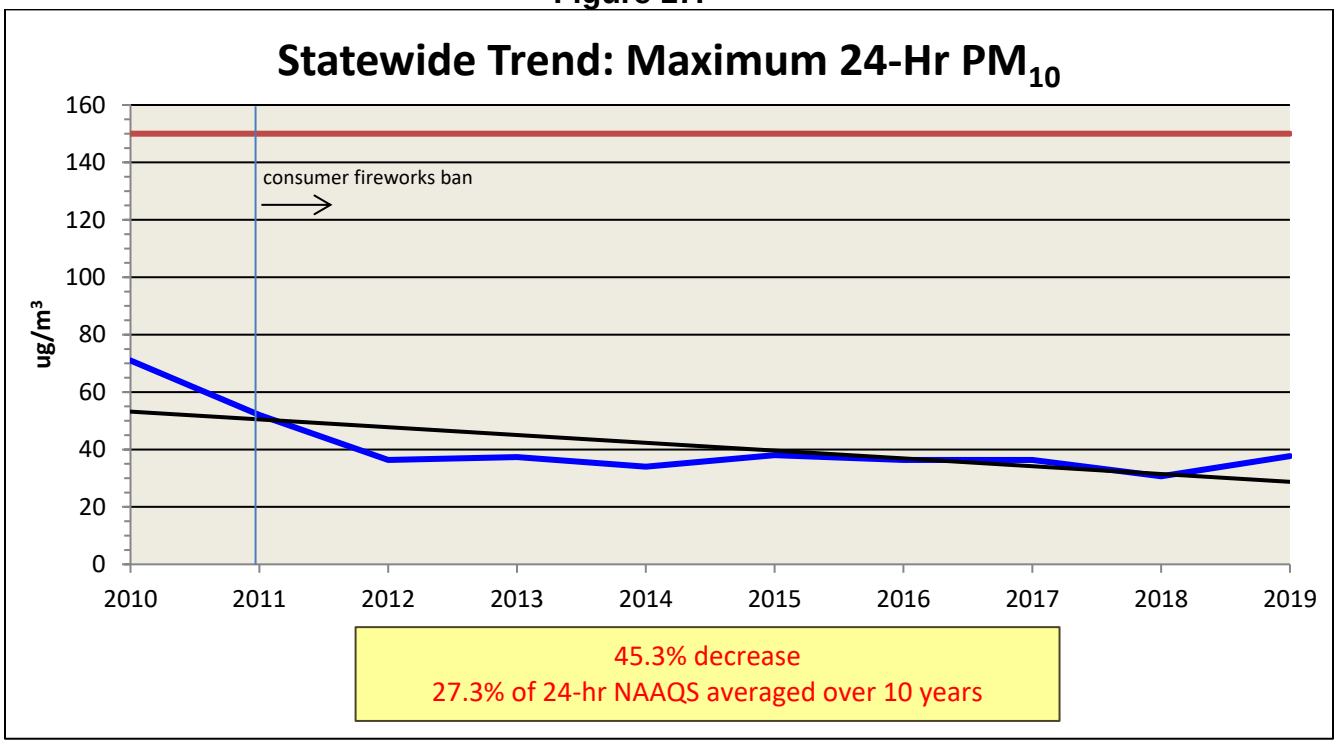


Figure 18.

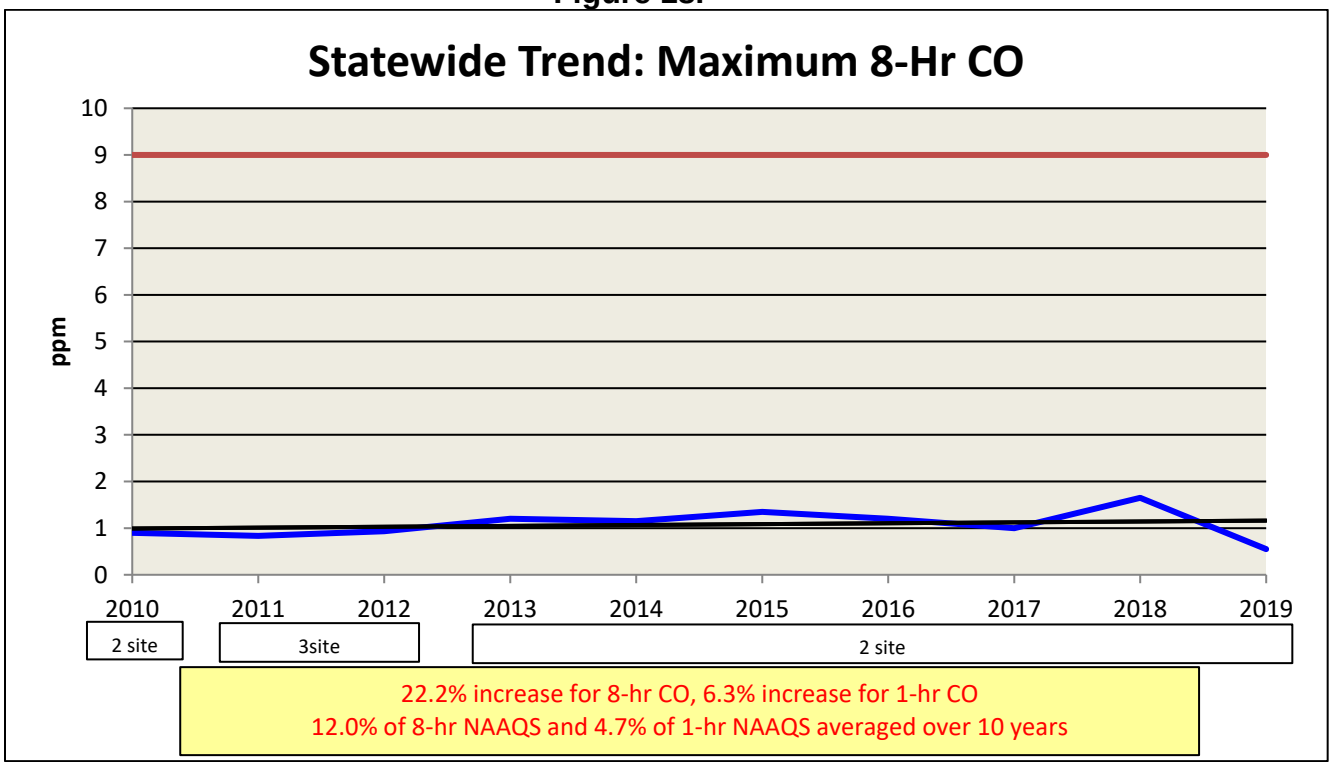
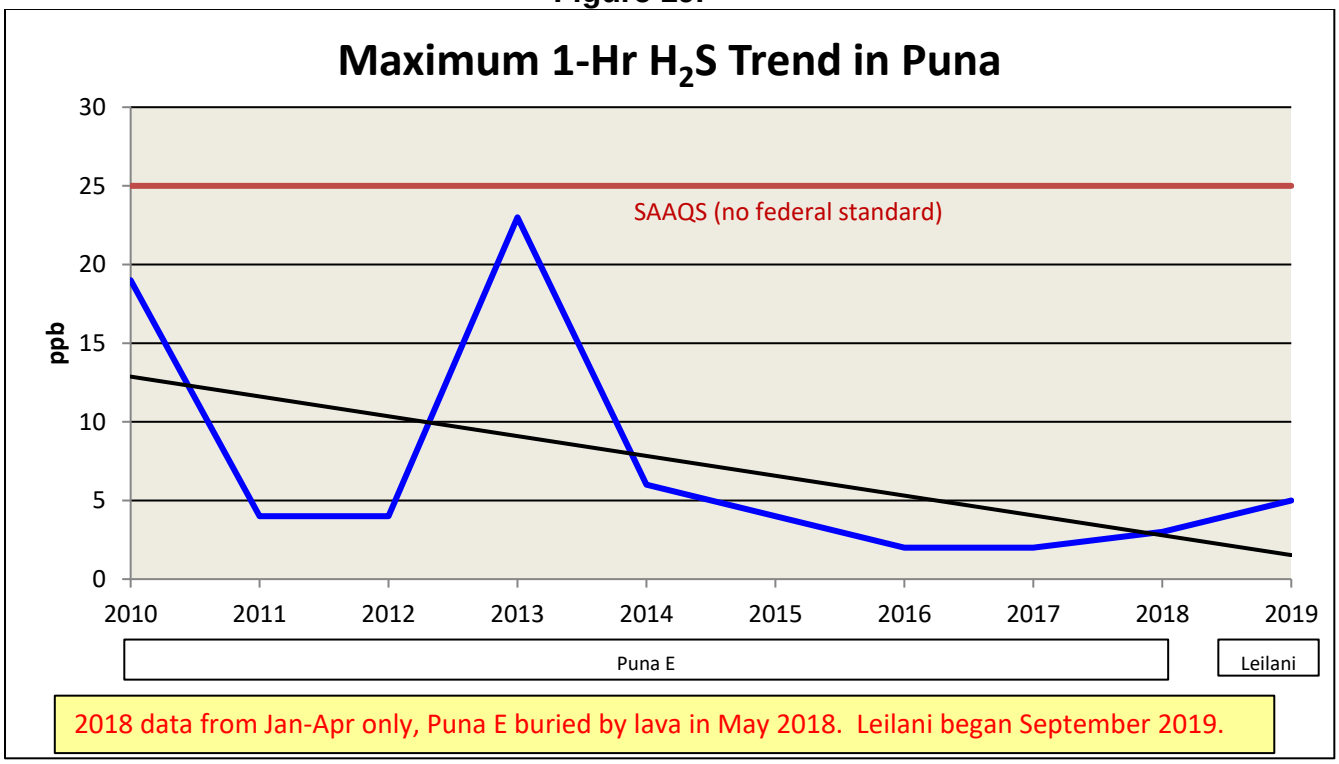


Figure 19.



Monitoring Assessment Findings Based on Data and Trends

1. Criteria pollutant prioritization: SO_2, $PM_{2.5}$, NO_2, O_3, PM_{10}, CO
    a. The primary pollutants of concern for the state remain $PM_{2.5}$ and SO_2, mainly due to possible future volcanic events.
        i. No new SO_2 monitors are required.
        ii. Since 17 of the state's 20 stations monitor for $PM_{2.5}$, no new or relocated $PM_{2.5}$ monitors are needed.
    b. Other than monitoring the population of the Honolulu MSA as it hovers below the one million mark (with a slight estimated downward trend), to meet the near-road NO_2 requirement - data trends do no indicate a need for any new monitoring.
    c. Towards the end of 2015, EPA lowered the 8-hour O_3 NAAQS to the current 70 ppb standard. The data collected at the two O_3 sites will be closely monitored for any significant increase. To better characterize the formation of O_3 at the Sand Island station, a 10 meter meteorological tower for WS and WD should be installed.
    d. PM_{10} values have remained steady on Oahu since the City & County began regulating the use of fireworks for the New Year's celebrations. The state currently meets the minimum PM_{10} monitoring requirements in 40 CFR 58, no new or relocated monitors are needed.
    e. CO values have been consistently low at all monitors with no indication of an increase in CO emission sources. Discontinue the redundant CO monitor at the Kapolei SLAMS station since CO is being monitored at Kapolei NCore.

VI. New NAAQS

In June 2010, EPA promulgated a new 1-hour SO_2 NAAQS, replacing the 24-hour and annual standards. DOH chose to conduct monitoring to demonstrate compliance with the new 1-hour NAAQS. As previously discussed, two stations were established to meet the SO_2 DRR.

Monitoring Assessment Findings Based on New NAAQS Requirements

Partnered and establish two new SO_2 monitoring stations near the HECO Kahe and Waiau generating stations:

- The Kahe station ended with a design value of 52 ppb for the 3-year period 2017-2019, which was greater than fifty (50%) of the 1-hour SO_2 NAAQS of 75 ppb, thus exceeding the threshold for closing. The station will continue to operate.
- The Waiau station ended with a design value of 16 ppb for the 3-year period 2017-2019, that is less than 50% of the 1-hour SO_2 NAAQS. DOH has submitted a request to EPA to shut down the Waiau station.

VII. Technology

In the last couple of years, the DOH has replaced all but one of the original Met-One Beta-Attenuation continuous $PM_{2.5}$ monitors (BAM 1020s) with new BAM 1022s, also

with Federal Equivalent Method (FEM) designation. Currently, there are sixteen (16) BAM 1022s in use with two (2) collocated monitors in place as required by 40 CFR 58.

VIII. 2020 Assessment Findings

Implementation of the 2015 Assessment Findings

Most of the network proposals resulting from the 2015 assessment were implemented within the past five years. One lesson learned from the first two assessments was that we need to be flexible, things change including funding, the economy, new rules, new NAAQS, resources, the pandemic.

The major obstacles to the monitoring program as a whole have been and continue to be inadequate funding and resources. As more unfunded federally mandated programs become effective, such as NCore and NO_2 near-road monitoring, the funding and staffing resources are being persistently challenged. However, despite these issues, the DOH managed to establish four new monitoring stations as proposed in the 2015 assessment (Table 4).

Table 4. 2015 Assessment Implementation

2015 Assessment Recommendation	Implementation
Merge the Kapolei SLAMS and Kapolei NCore stations	The two sites have yet to be merged and may instead need to be split up as both stations need to be relocated from the current site due to change in property ownership.
Establish the near-road NO_2 station.	Near-road NO_2 monitoring requirement for CBSAs with a population of greater than 500,000 but less than one million, which includes the Honolulu MSA, has been removed by EPA as of December 22, 2016. The population and Annual Average Daily Traffic (AADT) for the Honolulu CBSA will be monitored, and in the event they hit the minimum threshold in the future, the near-road monitoring will be implemented.
Install a 10 meter meteorological tower at the Sand Island station to better characterize the formation of O3 from sources originating in downtown Honolulu.	The 10 meter meteorological tower has yet to be installed.
Continue cruise ship monitoring on Kauai for at least one year.	The Niumalu station continues to monitor for $PM_{2.5}$, SO_2 and NO_2.
Establish two new stations to monitor for SO_2 to satisfy the requirements of the Data Requirement Rule (DRR).	The state has completed a minimum of three years of data collection at each of the two stations that have been in operation since the beginning of 2017 as required by the DRR, The state is under preparations to request that the Waiau station be allowed to closed, as the 3-year design value of 16 ppb is less than 50% of the 1-hour SO_2 NAAQS of 75 ppb. The Kahe station will remain as the 3-year design value of 52 ppb is greater than 50% of the 1-hour SO_2 NAAQS.
Research alternative continuous $PM_{2.5}$ monitors having little consumable costs and if one is found that meets monitoring needs, begin replacing the Met-One BAMS as they breakdown while ensuring that all collocation requirements are met.	DOH has replaced all but one of the original Met-One Beta-Attenuation continuous $PM_{2.5}$ monitors (BAM 1020s) with new BAM 1022s, also with Federal Equivalent Method (FEM) designation. Currently, there are sixteen (16) BAM 1022s in use with two (2) collocated monitors in place as required by 40 CFR 58.

Summary of 2020 Assessment Findings

1. Relocate the Kapolei SLAMS and Kapolei NCore stations; EPA approval will be needed. The current site, which belongs to the Board of Water Supply, is undergoing site renovations and construction to be transformed into a baseyard:
   - The SLAMS station began operating at the current location in 2002 monitoring for CO, SO_2, NO_2, PM_{10} and $PM_{2.5}$;
   - In 2011, the state's required NCore station began operating at this site monitoring for the NCore parameters CO (trace), SO_2 (trace), NO/NOy, O_3, $PM_{2.5}$, PM_{10}, $PM_{10\text{-}2.5}$, WS/WD, ambient temperature, relative humidity and Pb (beginning in 2012);
2. Be prepared to establish the near-road NO_2 station if the urban Honolulu MSA reaches one million in population:
   - The site has already been selected near the roadway on Oahu with the highest Annual Average Daily Traffic (AADT);
   - Include details of the station in the appropriate Annual Network Plan;
   - CO and $PM_{2.5}$ monitoring will be needed in addition to NO_2.
3. Install a 10 meter meteorological tower at the Sand Island station to better characterize the formation of O_3 from sources originating in downtown Honolulu.
4. Continue cruise ship monitoring on Kauai. Data analyses from the Niumalu station has shown significant reduction in SO_2, consult with the community on possibly moving the station, if resources allow, to the population centers of Lihue or Kapaa which is listed as a micropolitan statistical area.
5. Continue to operate the Kahe station to monitor for SO_2 to satisfy the requirements of the Data Requirement Rule:
   - The state has completed a minimum of three years of data collection at each of the two DRR stations , Kahe and Waiau, that have been in operation since December 2016. The state will request that the Waiau station be allowed to close, as the 3-year design value of 16 ppb is less than 50% of the 1-hour SO_2 NAAQS of 75 ppb. The Kahe station had a 3-year design value of 52 ppb, greater than 50% of the 1-hour SO_2 NAAQS.
   - The affected facilities being monitored by the Kahe station are the HECO Kahe electrical generating facility, Kalaeloa Power Partners and AES Hawaii all located in West Oahu;
   - Continue utilizing the private/public partnership with HECO in operating, and maintaining this station.
6. The FRM co-located sampler at Hilo was relocated to the Pearl City station to meet department budgetary needs and to improve program efficiency.
7. Finalize site improvements at Leilani Community Association Center per the association's requirements and relocate the monitor to its long-term location from its current temporary location at the center.
8. Finalize site improvements at Kailua-Kona. This long-term site selections was finalized in 2018 and AQMS had been directed to complete set up of this SPMS stations in accordance with DWS direction and using DWS power until DOH could set up its own poles. However, continuous site improvement delays have kept the sampler from being moved to its intended long-term location on the property.

9. Finalize site improvements at Waikoloa DWS long-term site and relocate the $PM_{2.5}$ sampler from the temporary site at Waikoloa Elementary School. This station on the northwest side of Hawaii island was selected to be sited within a fenced area that contains a water tank and pump house; this is the same exact site that DOH had operated a station (15012021) from 2012-14. AQMS had set up a non-regulatory temporary station at the Waikoloa Elementary School during the 2018 LERZ eruption; it has been monitoring for $PM_{2.5}$ at the school since June 29, 2018 as a non-regulatory temporary station as the sampler was neither sited properly nor installed for long-term use. The long-term site was selected by CAB in August 2018 and a final request was made to AQMS in October 2018 to relocate the sampler as the new site was already prepped and secured for a $PM_{2.5}$ sampler to be immediately deployed. However, AQMS has yet to relocate the sampler to the DWS site as an electric power meter has yet to be installed there.
10. Finalize site improvements at the Naalehu Elementary School long-term site and relocate the $PM_{2.5}$ sampler from the temporary site at the Naalehu Volunteer Fire Station to the long-term site next to the USGS Seismograph Building at Naalehu Elementary School, where the SO_2 monitor is located. This long-term site selection was also finalized in 2018 and AQMS had been directed to move the $PM_{2.5}$ sampler next to the SO_2 monitor, as the sampler was placed there at the beginning of the emergency and was neither properly sited nor installed for long-term use. AQMS has yet to relocate the sampler.
11. Finalize site improvements at the Kamehameha Schools Hawaii campus in Keeau. The long-term site was selected to be at the Switch Gear Building on campus. The monitors for this station are currently located at the Keeau – Temporary station, approximately 827 meters to the NNW and will need to relocate.
12. Site improvements at Honaunau and Pahoa are on hold due to funding and resource issues.