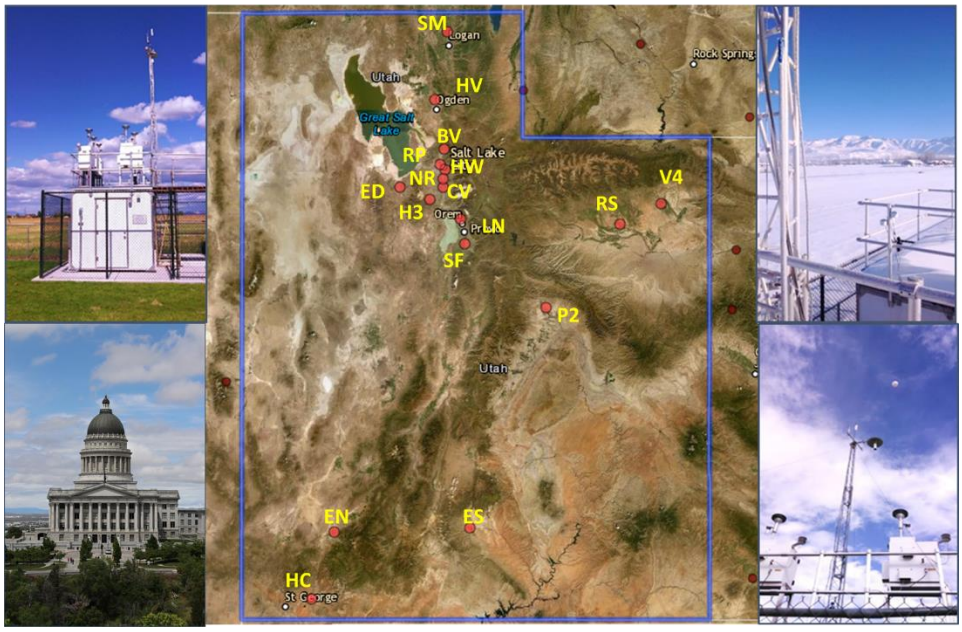
UTAH DEPARTMENT of ENVIRONMENTAL QUALITY

Utah Air Quality Monitoring Network

Five-year Network Assessment



Utah Division of Air Quality
Air Monitoring Section
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GLOSSARY

AQS	Air Quality System (EPA database)
CO	Carbon monoxide
CSA	Combined Statistical Area
FEM	Federal Equivalent Method
FRM	Federal Reference Method
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NCore	National Core multi-pollutant monitoring stations
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	Reactive nitrogen oxides
NOy	Total reactive nitrogen
O_3	Ozone
$PM_{2.5}$	Particulate matter with an equivalent diameter less than or equal to 2.5 μm
PM_{10}	Particulate matter with an equivalent diameter less than or equal to 10 μm
PWEI	Population Weighted Emissions Index
SIP	State Implementation Plan
SLAMS	State or Local Air Monitoring Stations
SO2	Sulfur dioxide
SPM	Special Purpose Monitor
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) amended its ambient air monitoring regulations to include a requisite for all state and local air quality monitoring agencies to prepare a technical assessment of their monitoring networks once every five years. This document describes the Utah Division of Air Quality (UDAQ) 2020 ambient air monitoring network assessment. The technical assessment was conducted in accordance with federal regulations (40 CFR, section 58.10) and intends to identify whether new sites are needed or existing sites are no longer needed, and whether the network meets monitoring objectives.

The monitoring objectives include determining whether the network supports compliance with the NAAQS (National Ambient Air Quality Standards), Air Quality Index (AQI) reporting, air quality models, air pollution research studies and the State Implementation Plan (SIP) development and maintenance.

Factors such as population growth, air pollution levels, monitoring network data and financial limitations were considered in the evaluation process for the Utah five-year monitoring plan.

The UDAQ's budget for the fiscal year 2020-2021 has been impacted by the global coronavirus pandemic, which may affect the resources to operate the network and may cause projected improvements to be placed on hold.

Findings

The UDAQ monitoring network meets all federal requirements and satisfactorily supports the UDAQ monitoring objectives. However, while comprehensive changes are not necessary at this time, some targeted modifications could be implemented to enhance the effectiveness of the network.

Recommendations

The proposed network modifications are summarized as follow:

- Complete the set-up of the two new multi-pollutant monitoring Inland Port stations, located at Monticello Academy and at the new State Prison. Variables to be monitored at these sites include Particulate Matter ($PM_{2.5}$), ozone (O_3), nitrogen oxides (NOx), black carbon (BC) and meteorological parameters.
- Relocation of Brigham City site. The UDAQ is currently searching for a suitable site to accommodate a Brigham City station, while the Harrisville site will be used to replace the Ogden station. Unexpected situations forced the UDAQ to shut down these existing sites.

- Establish a second monitoring site in Cache Valley. The UDAQ is in compliance with the required number of monitors at Cache valley; nevertheless, the property adjacent to the school where the Smithfield monitor is located, is being developed into a subdivision and may result in the need to relocate the current site in the future.
- Relocation of the Spanish Fork (SF) station to a nearby site due to planned construction work at its current location. This move will be a few 100 feet down the fence line and should not result in any data loss.
- Relocation of the Rose Park (RP) station to the Air Monitoring Center (AMC) once the comparability assessment criteria are attained. This will require EPA concurrence.
- Establish a third monitoring site in Provo-Orem CBSA in order to have an alternative station for Lindon and Spanish Fork sites. It should be noted that the Lindon site is located at an elementary school that is on the short list for being rebuilt. Monitoring may not be feasible during construction and we are not confident that there will still be a location for a site based on school construction needs. At this time, we do not have any sort of schedule for the rebuild and it may or may not happen in light of current conditions. However, in order to be prepared, a third site in Utah County should be established.
- Establish a second near-road NO_2 monitoring site in Salt Lake CBSA.
- The UDAQ will start updating the technology used to measure the meteorological variables. Presently, the system used to measure the wind direction and speed consist of cup anemometers and vane systems (in all the stations but Roosevelt and AMC), but it will be replaced by sonic anemometer systems (2D sonic wind sensors). Temperature and relative humidity probes and pyranometers to measure incoming solar radiation will also be updated or included in all the stations.
- Incorporate continuous PM_{10} monitoring samplers to operate in co-location with FRM filter-based measurements for comparability assessment.

The UDAQ will continue reviewing all stations to ensure that they meet required acceptance criteria and monitoring objectives. Any sites that do not meet the requirements will be evaluated for future action.

Utah Air Quality Monitoring Network

Five-year Network Assessment

1. Background and Overview

1.1 Meteorology and Topography

Given its unique topography and meteorology, Utah continually faces severe air quality challenges, mainly in the Salt Lake Valley along the Wasatch Front and in the Uinta Basin. The Wasatch Mountains east of the Salt Lake Valley, Oquirrh Mountains to the west and the Traverse Mountain to the south form a basin-like topography. The valley is open to the Great Salt Lake to the northwest, with weak nighttime down-valley flows often carrying polluted air over the lake. The air is then carried back into the valley as a lake breeze on the following day. The Uinta Basin is an enclosed basin that lies in the northeast corner of Utah. The Basin is bounded on the north by the Uinta Mountain range, on the south by the Tavaputs Plateau, on the west by the Wasatch Range and on the east by elevated terrain separating it from Piceance Basin in Colorado. Significant topographical variations on the order of tens to hundreds of feet exist within the Basin, which is mostly situated in Duchesne and Uintah Counties. High-pressure weather systems and high solar zenith angle during winter lead to cold-air pools that periodically trap precursor gases in the Uinta Basin and Salt Lake Valley.

1.2 Major Pollutants and Emission Sources

The air basins along Utah's Wasatch Range, a region with 2.4 million residents (2010 census), have historically endured some of the most severe fine particulate matter ($PM_{2.5}$) air pollution in the United States. High levels of $PM_{2.5}$ degrade visibility and are a significant public health concern associated with increased incidence of respiratory illness such as aggravation of asthma and premature mortality. During winter-time inversions, Utah is often susceptible to elevated levels of O_3 in the Uinta Basin and $PM_{2.5}$ along the Wasatch Front and the Cache Valley. These pollutants are of greatest concern in this state, particularly O_3 since its formation in the Basin occurs in winter during inversions. High-pressure weather systems during winter lead to cold-air pools that periodically trap precursor gases, most notably volatile organic compounds (VOCs) and nitrogen oxides (NOx), in the valleys between the Wasatch and Oquirrh Mountains. These precursor gases subsequently react in the stagnant air to form O_3 and $PM_{2.5}$, leading to pollution levels occasionally exceeding the federal National Ambient Air Quality Standards (NAAQS). Snow cover can also enhance O_3 formation by increasing sunlight reflection (surface albedo) into the atmosphere[1]. The complex chemical reactions and unique circumstances involving the

[1]UDAQ, 2014 Uinta Basin Winter Ozone Study Final Report.

formation of these pollutants make it challenging to develop effective control strategies. Summertime O_3 formation over the Great Salt Lake and along the Wasatch Front is also of concern. High levels of O_3 were recorded near the Great Salt Lake during 2010-2013[2]. Major industrial sources in the Salt Lake Valley include Kennecott Copper mine and smelter located at the base of the Oquirrh Mountains in addition to oil refineries located between Salt Lake City and Bountiful to the north and to the Hill Air Force Base located in Ogden. Utah's five oil refineries process nearly 200,000 barrels of crude oil per calendar day, Utah's annual crude oil production in 2018 increased to the highest level in three years, and the state accounted for about 1 in every 100 barrels of oil produced in the United States[3]. Major roadways in the valley consist of Interstates 15, 80 and 215. I-15 spans the length of the Salt Lake Valley from north to south while I-80 runs from east to west across the valley and through Salt Lake City. I-215, on the other hand, forms a loop around the northern portion of the valley. Main industrial sources in the Uinta Basin comprise oil and gas wells, which displayed a considerable increase in production in recent years. Additionally, coal-fired power plants including; Bonanza, with capacity to generate power of 500-megawatt, Hunter, with capacity of 1320-megawatt and Huntington, with capacity of 1073-megawatt operate in the Utah basin and Emery county. Utah was the 12th-largest coal producing state in 2018, about four-fifths of the coal consumed in Utah is mined in the state, and almost all of the coal is used for electric power generation[3]. There is also some agricultural production, primarily alfalfa and corn along with other hay and grain crops.

1.3 Demography

The state of Utah can be divided into 10 core-based statistical areas (CBSAs) with population estimates as shown in Table 1. Each CBSA corresponds to a metropolitan or micropolitan statistical area (MSA and μSA, respectively), depending on its population size. The list of CBSAs was derived from the U.S. Census Bureau while the population estimates for each CBSA were retrieved from the sub-county population projections report produced by Utah's Governor's Office of Management and Budget (https://gomb.utah.gov/budget-policy/utahseconomy/). The reported projections were derived using 2010 Census data as a baseline.

1.4 Emission Inventories

Table 2 lists the emission rates (in tons/year) of criteria and hazardous air pollutants, including CO, NO_x, PM_{10}, $PM_{2.5}$, SO_x and VOCs, by county. The data were acquired from the 2017 triennial emissions inventory, which corresponds to the most current inventory at the time of writing. The inventory covers over 440 individual point sources, 128 area source categories, and 12 non- and on-road source categories. Statewide source-specific emission estimates (in tons/year) are shown in Figure 1 for common criteria and hazardous air pollutants.

[2] UDAQ, 2012 Utah Ozone Study.
[3] https://www.eia.gov/state/print.php?sid=UT.

Table 1. Core Based Statistical Areas (CBSAs), including metropolitan and micropolitan statistical areas (MSA and µSA, respectively), and their corresponding population estimates in the state of Utah[4].

CBSA	Counties	Census 2010	Population estimate (2020)	Population estimate (2030)	% Change (2010-2030)
Salt Lake City MSA	Salt Lake, UT Tooele, UT	1,087,873	1,255,736	1,440,329	32
Provo-Orem MSA	Utah, UT Juab, UT	526,810	682,314	850,304	61
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	766,860	28
Heber µSA	Wasatch, UT	23,530	32,741	44,549	89
Logan UT-ID MSA	Cache, UT Franklin, ID	112,656	139,228	168,136	49
Saint George MSA	Washington, UT	138,115	196,762	280,558	103
Cedar City µSA	Iron, UT	46,163	57,055	71,687	55
Price µSA	Carbon, UT	21,403	21,602	22,092	3
Vernal µSA	Uintah, UT	32,588	38,982	41,099	26
Summit Park µSA	Summit, UT	36,324	45,491	56,890	57

[4] https://gomb.utah.gov/budget-policy/utahseconomy/

Table 2. 2017 emission inventory estimates (tons/year) by county for CO, NO_x, PM_{10}, $PM_{2.5}$, SO_x and VOCs.

County	PM_{10}	$PM_{2.5}$	SO_x	NO_x	VOCs	CO
Beaver	3,747	1,351	103	2,158	29,915	18,970
Box Elder	8,458	2,105	165	4,837	40,152	29,315
Cache	8,234	1,437	64	2,409	11,865	15,043
Carbon	4,394	826	501	2,612	17,564	9,254
Daggett	751	94	2	819	9,660	2,345
Davis	3,492	970	184	6,440	11,674	30,085
Duchesne	7,184	1,594	74	8,007	38,592	18,278
Emery	6,895	1,457	5,803	17,950	36,767	20,210
Garfield	3,114	589	23	755	46,149	13,440
Grand	3,427	492	8	2,696	40,935	13,789
Iron	4,803	968	41	3,958	35,082	18,616
Juab	2,971	923	64	2,600	34,736	17,214
Kane	3,705	922	45	946	43,737	17,153
Millard	7,382	2,262	2,537	15,318	64,166	28,455
Morgan	1,469	504	229	2,287	8,128	7,394
Piute	1,114	361	19	196	8,880	4,688
Rich	2,189	397	1	253	7,652	3,172
Salt Lake	17,419	4,615	2,557	24,469	29,465	109,751
San Juan	6,303	810	14	1,944	77,548	20,215
Sanpete	5,884	1,006	28	1,054	17,203	8,562
Sevier	5,885	1,670	99	1,911	20,372	18,242
Summit	3,575	940	179	3,746	17,462	14,341
Tooele	5,544	1,822	94	5,370	46,300	25,439
Uintah	7,325	1,557	61	7,960	93,559	22,150
Utah	15,486	2,946	141	11,357	30,611	51,266
Wasatch	4,230	877	35	1,123	14,459	10,624
Washington	6,154	1,209	51	5,036	39,636	30,087
Wayne	1,396	204	3	491	19,982	5,374
Weber	4,668	1,084	57	4,527	10,731	25,379
Statewide County Totals	**157,198**	**35,991**	**13,183**	**143,229**	**902,981**	**608,852**
Point Source Portables	*155*	*62*	*77*	*438*	*31*	*147*
Total	**157,353**	**36,053**	**13,260**	**143,667**	**903,012**	**608,999**

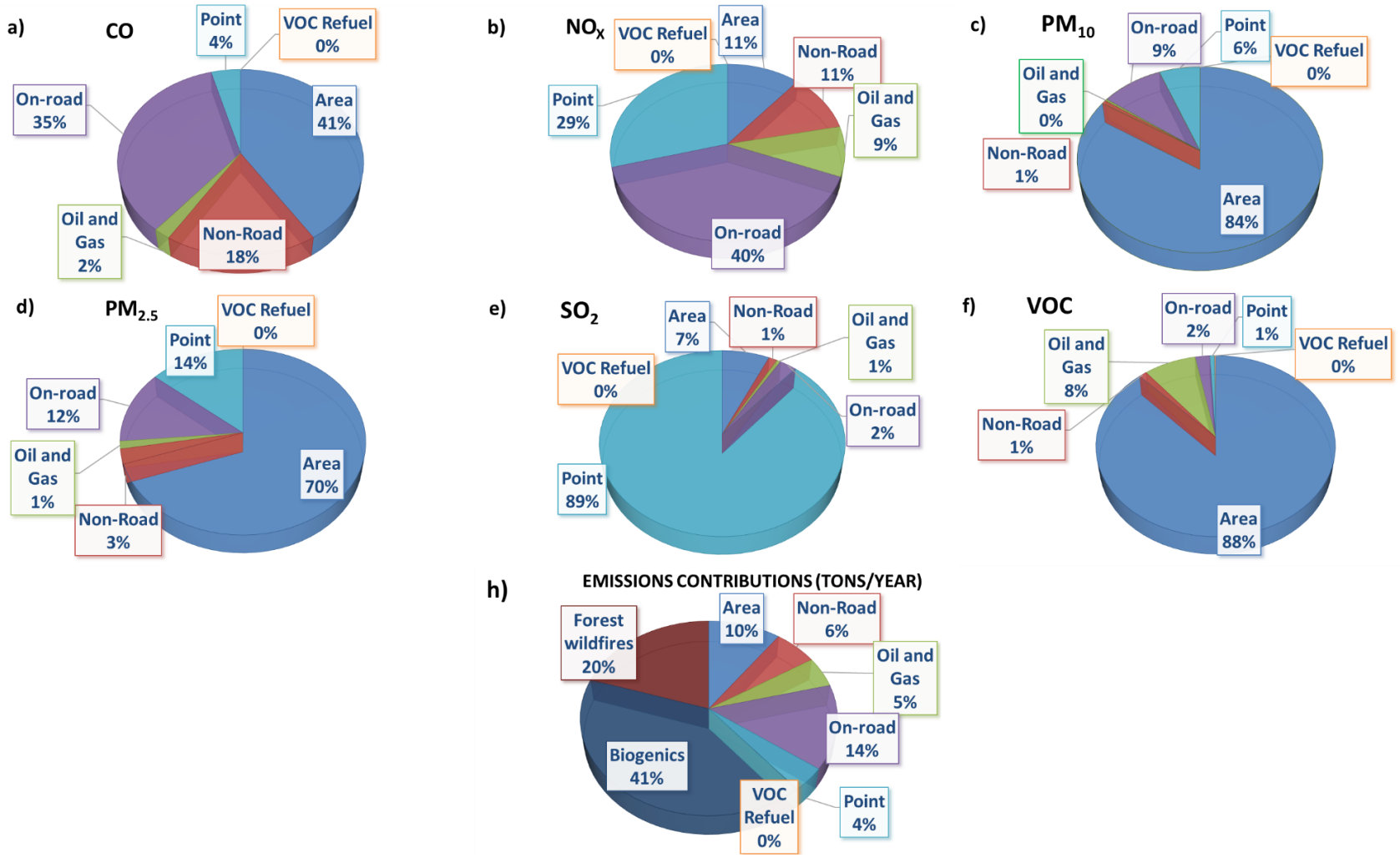

Figure 1. 2017 statewide emissions inventory (percent contribution), by source category, for a) CO, b) NOx, c) PM_{10}, d) $PM_{2.5}$, e) SO_2, f) VOCs and h) total 2017 contributions

2. Air Monitoring Network Design

The Utah air-monitoring network currently operates monitors at twenty-one locations statewide. Two new monitoring sites are currently being setup to fulfill the Utah Senate bill SB144, which directs the Department of Environmental Quality to establish and maintain monitoring facilities to measure the environmental impact from the Inland Port development project. The UDAQ monitoring stations are strategically situated to measure both local and regional levels of air pollutants, including particulate matter (PM), gaseous pollutants and meteorological variables. Currently, $PM_{2.5}$ is measured at sixteen locations, PM_{10} is monitored at seven locations, O_3 is monitored at eighteen locations, $NO_x/NO/NO_2$ is measured at seventeen locations, CO is monitored at seven locations and SO_2 at four locations. Nine out of sixteen $PM_{2.5}$ monitoring sites and all PM_{10} sites use filter-based equipment, additionally; all the sites monitoring $PM_{2.5}$ are equipped with continuous monitors. Meteorological parameters, wind speed, wind direction, temperature and relative humidity, are measured at most of the sampling sites. The location and elevation of the monitoring sites, the EPA Air Quality System (AQS) site codes and the measured variables at each station are provided in Table 3 and Table 4. Moreover, the network includes stations that participate in the National Core (NCore), Speciation Trends Network (STN), Chemical Speciation Network (CSN), Photochemical Assessment Monitoring Stations (PAMS), Toxics and Near-road station EPA monitoring programs.

Data collected at these stations are primarily used for the following objectives:

- Evaluating population exposure to air pollutants
- Tracking the spatial distribution of air pollutants
- Assessing historical trends in air pollution
- Supporting compliance with ambient air quality standards (primary and secondary)
- Supporting air quality models and research studies
- Informing the general public of air pollution levels
- Developing state implementation plans (SIPs) and legislative air pollution control measures
- Tracking the effectiveness of air pollution control strategies
- Activating control measures during high air pollution episodes, such as restricting wood burning during winter-time inversions
- Monitoring of specific emission sources and air pollutants

The sampling sites are strategically located to meet the aforementioned monitoring objectives. For instance, some sites are selected to measure PM concentrations in highly populated areas while others are selected to determine the extent of O_3 (and its precursors) transport from the Wasatch Front to the Uinta Basin. The UDAQ is continually working on optimizing the monitoring instruments in its network. Site-specific objectives as well as measurement parameters, sampling frequency and method are provided in Appendix A. The monitoring objectives and spatial scale of representativeness at each site are also provided.

However, considering the continuously-evolving federal air quality standards, growing economy and population as well as budgetary constraints, efficient and representative pollution monitoring in the state of Utah demands further optimization or expansion of the air monitoring network. This includes adding new sites or sampling equipment, focusing on monitoring pollutants of current and local concern (e.g. air toxics, O_3 and its precursors) as well as conducting special studies to address pressing air quality issues, as discussed in the subsequent sections. To that end, the following factors were considered in the air monitoring network review:

- EPA siting requirements (40 CFR, part 58).
- Compliance with the NAAQS
- Air Quality Index (AQI) reporting and forecasting
- SIP development and maintenance
- Air quality models and control strategy selection
- Air quality research studies and special monitoring programs
- Population growth
- Funding
- Logistical issues

Table 3. Utah air monitoring network.

County	AQS code	Station Name	Station Address	Latitude	Longitude	Elevation (m)
Cache County	49-005-0007	Smithfield, SM	675 W. 220 N., Smithfield	41.8428	-111.8519	1377
Weber County	49-057-1003	Harrisville, HV	425 W. 2550 N., Harrisville	41.3028	-111.9883	1331
Davis County	49-011-0004	Bountiful Viewmont, BV	1370 N. 171 W., Bountiful	40.9031	-111.8856	1309
	49-011-6001	Antelope Island, AI	No street address; on an island	41.0393	-112.2313	1359
Salt Lake County	49-035-3015	Air Monitoring Center, AMC	240 North 1950 W. Salt Lake City	40.7769	-111.9461	1296
	49-035-3012	Herriman #3, H3	14058 Mirabella Dr., Herriman	40.4964	-112.0363	1534
	49-035-3005	Saltair, SA	6640 W. 1680 N., Salt Lake City	40.8059	-112.0498	1282
	49-035-2005	Copperview, CV	8449 S. Monroe St., Midvale	40.5981	-111.8942	1290
	49-035-3006	Hawthorne, HW	1675 S. 600 E., Salt Lake City	40.7335	-111.8717	1306
	49-035-4002	Near Road, NR	5001 Galleria Dr, Murray	40.6629	-111.9012	1295
	49-035-3010	Rose Park, RP	1400 W. Goodwin Ave., Salt Lake City	40.7955	-111.9309	1295
Utah County	49-049-4001	Lindon, LN	50 N. Main St.,	40.3388	-111.7133	1442
	49-049-5010	Spanish Fork, SF	2050 N. 300 W., Spanish Fork (airport)	40.1363	-111.6602	1380
Tooele County	49-045-0004	Erda, ED	2135 W. Erda Way	40.6004	-112.3553	1320
	49-045-6001	Badger Island, BI	No street address; on an island	40.9421	-112.5620	1282
Duchesne	49-013-0002	Roosevelt, RS	290 S. 1000 W.,	40.2941	-110.0090	1588
Uintah County	49-047-1003	Vernal, V4	628 N. 1700 W.,	40.4650	-109.5607	1667
Carbon County	49-007-1003	Price, P2	351 S. 2500 E., Price	39.5958	-110.7700	1740
Iron County	49-021-0005	Enoch, EN	325 East N. Minersville., Enoch	37.7474	-113.0555	1692
Garfield	49-017-0006	Escalante, ES	755 W. Main.,	37.7756	-111.6147	1789
Washington County	49-053-0007	Hurricane, HC	147 N. 870 W., Hurricane, UT	37.1790	-113.3052	992

Table 4. Measured parameters at the sampling stations in Utah air monitoring network.

County	Site	PM 2.5			PM 10			PM Coarse	Speciation PM 2.5	Lead	O_3	NO_x NO2 NO	NO_y	SO_2	CO	NH_3	Toxics PAMS	BC	MET.
		Primary	Co-located	Real-time	Primary	Co-located	Real-time												
Cache	Smithfield	1/1	1/1	X	1/1	1/6		X	X		X	X						X	X
Weber	Harrisville	1/1	1/1	X	1/1						X	X			X				X
Davis	Bountiful (Viewmont)	1/1	1/1	X	1/1	1/6			X		X	X					X	X	X
	Antelope Island***																		X
Salt Lake	Air Monitoring Center*	1/1	1/1	X	1/1		X				X	X		X	X	X			X
	Hawthorne	1/1	1/1	X	1/1			X	X		X	X	X	X	X		X		X
	Herriman #3	1/1		X	1/1	1/1	X	X			X	X							X
	Monticello**	1/1	1/1	X	1/1						X	X			X			X	X
	Near Road	1/1		X							X	X			X				
	Prison**	1/1	1/1	X							X	X			X			X	X
	Rose Park	1/1	1/1	X							X	X		X	X				X
	Saltair***	1/1		X															X
	Copperview	1/1		X							X	X		X	X				X
Tooele	Erda	1/1	1/1	X							X	X							X
	Badger Island, BI***																		X
Utah	Lindon	1/1	1/6	X	1/1			X	X		X	X			X				X
	Spanish Fork	1/1	1/1	X							X	X							X
Uintah	Vernal	1/1		X							X	X							X
Duchesne	Roosevelt	1/1		X							X	X							X
Carbon	Price #2										X	X							X
Iron	Enoch	1/1		X							X	X							X
Garfield	Escalante										X								
Washington	Hurricane	1/1		X							X	X							X

*Site re-located in 2019; **Site setup in progress;*** remote stations. Abbreviations: MET: meteorological parameters; O_3: ozone; NO_2: nitrogen dioxide; NO_x: nitrogen oxides; NO_y: total reactive nitrogen; NH_3: ammonia; SO_2: sulfur dioxide; CO: carbon monoxide.

3. Network Technical Assessment

The network assessment was conducted using the tools provided by U.S. EPA's NetAssess2020 app[5] including the correlation matrix, removal bias, exceedance probability and area served tools. The assessment consisted of evaluating the sites' monitoring objectives and spatial scales (40 CFR, part 58 Appendix D) as well as determining redundant sites or additional sites for inclusion within a geographical area. The assessment also involved evaluating whether the number of monitors within a CBSA meets minimum federal monitoring requirements (40 CFR, part 58, appendix D 4.7) and whether the sites meet EPA siting criteria (40 CFR, part 58). Population estimates within a CBSA were determined using the latest available census data and the population projections report produced by Utah's Governor's Office of Management and Budget[4]. Sites redundancy was determined using the correlation matrix and removal bias tools. The correlation matrix provides the Pearson correlation coefficient (R), relative concentration difference and distance between pairs of sites, where potentially redundant sites exhibit low average relative difference and high correlations with their respective counterparts. The removal bias tool provides an estimate of the concentration at a given location if its existing monitor was removed. The tool uses the nearest monitors to each site to estimate the concentration at the site's location if its monitor had never existed, then calculates the bias by taking the difference between the interpolated value and the measured concentration. A near-zero value indicates a negligible bias if the monitor were removed. On the other hand, a positive or negative average bias suggests that the surrounding monitors would respectively indicate an estimated concentration that is larger or lower than the measured concentration, if the site being examined were removed. Determining whether extra sites should be added to the network was based on results obtained by applying the area served and exceedance probability tools, which provide geographic and demographic information for a given area and indicate the probability that the area will exceed a certain threshold at least once a year.

3.1 Particle Monitoring

3.1.1 FRM $PM_{2.5}$ Network

UDAQ currently operates 24-hour Federal Reference Method (FRM) $PM_{2.5}$ samplers throughout the state to demonstrate compliance with NAAQS, evaluate population exposure, support SIP development and model performance evaluation as well as monitor PM levels in source and receptor areas.

3.1.1.1 Area and Population Served

The area and population served, including sensitive groups (elderly and children), by each FRM $PM_{2.5}$ monitor are shown in Table 5. In this analysis, the sites are ranked according to the population they represent, thus reflecting the site's importance in representing population exposure.

[4] https://gomb.utah.gov/budget-policy/utahseconomy/
[5] https://www.epa.gov/amtic/ambient-air-monitoring-network-assessment-guidance-documents

Table 5. Area and population served by FRM $PM_{2.5}$ samplers in Utah air monitoring network**.**

Population Served						
Site	**Total Population**	**Total Male Population**	**Total Female Population**	**Total Population Aged 65 and over**	**Total Population Aged o to 4**	**Area Served (Km^2)**
Lindon (LN)	316,526	158,843	157,683	23,676	32,636	1,200
Spanish Fork (SF)	255,238	128,660	126,578	20,142	26,135	26,089
Hawthorne (HW)	205,851	103,533	102,318	23,204	14,235	644
Bountiful Viewmont (BV)	159,506	79,648	79,858	16,608	14,926	6,041
Smithfield (SM)	108,389	53,887	54,502	8,552	11,057	5,260
Rose Park (RP)	82,843	42,919	39,924	5,985	8,504	123
Harrisville (HV)	77,538	39,018	38,520	7,659	6,887	1,278
Erda (ED)	62,899	31,726	31,173	4,833	6,481	26,391
Air Monitoring Center (AMC)	NA	NA	NA	NA	NA	NA

3.1.1.2 Historical Trends and Deviations from NAAQS

The National Ambient Air Quality Standards for $PM_{2.5}$ were initially established in 1997 then subsequently revised in December 2006 and 2012. EPA lowered the 24-hour $PM_{2.5}$ standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$ in 2006 then lowered the annual standard from 15 $\mu g/m^3$ to 12 $\mu g/m^3$ in 2012. The 24-hour standard is met when the three-year average of the 98^{th} percentile 24-hr values is less than or equal to 35 $\mu g/m^3$. The annual standard is met when the three-year average of the annual mean is below 12 $\mu g/m^3$. Figure 2 and Figure 3 show the annual average of the 98^{th} percentile 24-hr concentration and the three-year average of the 98^{th} percentile 24-hr concentration respectively for the 2000-2019 period.

Figure 2 and Figure 3 show that the state complies with the annual standard of 12 $\mu g/m^3$ and with the 24-hour standard of 35 $\mu g/m^3$ during the last three- year average. For each site, the number of exceedances of 24-hr $PM_{2.5}$ NAAQS during 2017-2019 is shown in Table 6.

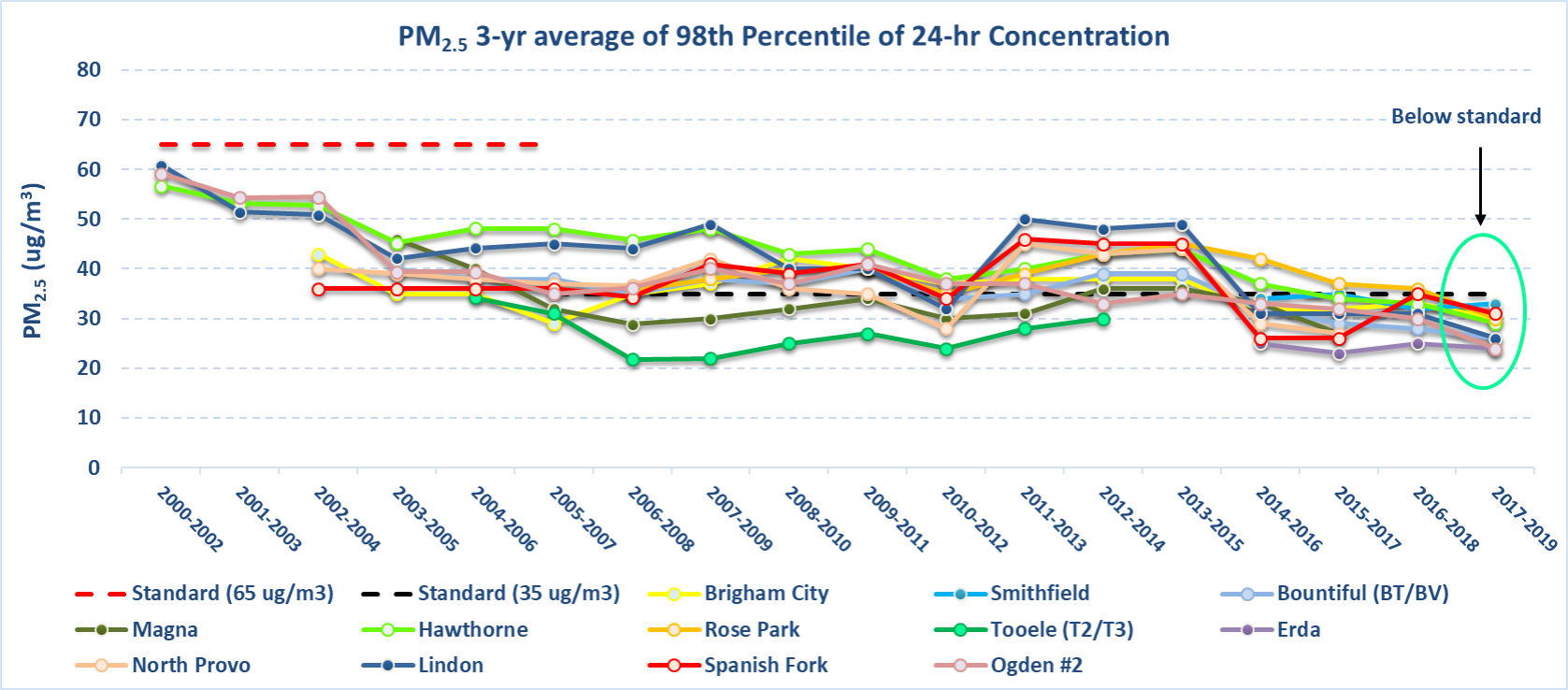

Figure 2. $PM_{2.5}$ 98th percentile 24-hr (ug/m^3) and comparison to NAAQS for FRM $PM_{2.5}$ during the period 2000-2019

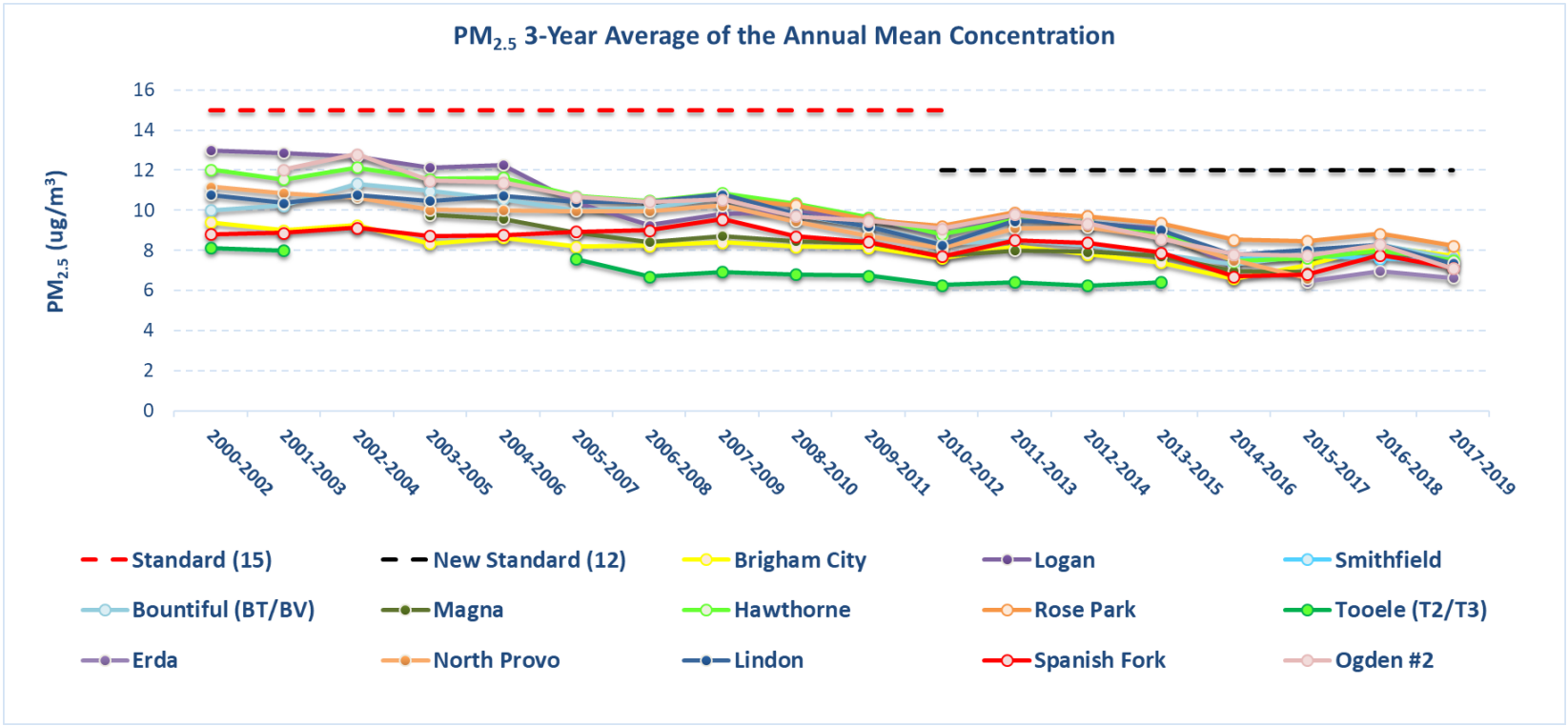

Figure 3. Annual design value trends and comparison to NAAQS for FRM/$PM_{2.5}$ during the period 2000-2019.

Table 6. Number of exceedances of $PM_{2.5}$ 24-hr NAAQS for the period 2017-2019.

Number of Exceedances of $PM_{2.5}$ 24-hr NAAQS (primary/secondary)			
Site	**2017**	**2018**	**2019**
Brigham City (BR)	7/7	0/0	1/1
Smithfield (SM)	8/8	1/1	3/3
Bountiful Viewmont (BV)	3/3	0/0	0/0
Roosevelt (RS)*	1/1	1/1	0/0
Magna (MG)	1/1	0/0	1/1
Hawthorne (HW)	8/8	1/1	2/2
Rose Park (RP)	6/6	2/2	1/1
Herriman (H3)	2/2	2/2	1/1
Erda (ED)	0/0	1/1	1/1
Vernal (V4)*	0/0	0/0	0/0
Lindon (LN)	4/4	4/4	1/1
Spanish Fork (SF)	3/3	3/3	0/0
Hurricane (HC)*	0/0	0/0	0/0
Ogden (O2)	7/7	0/0	1/1
North Provo	3/3	NA	NA
Copperview (CV)*	NA	2/2	3/3
Near Road (NR)*	NA	NA	3/3
Enoch (EN)*	NA	0/0	0/0
Harrisville (HV)	NA	NA	NA
Air Monitoring Center (AMC)	NA	NA	NA

Excluding values corresponding to special events. *denotes sites using exclusively continuously FEM $PM_{2.5}$

3.1.1.3 Site-by-Site Analysis

Federal regulations require state and local agencies to operate $PM_{2.5}$ sites for various locations, depending upon MSA boundaries and population size as well as the most recent three-year design value, expressed as a percentage of the $PM_{2.5}$ NAAQS (40 CFR, part 58, appendix D). Minimum federal monitoring requirements for $PM_{2.5}$ sampling and the number of active FRM $PM_{2.5}$ monitors in each CBSA are presented in Table 7 and Table 8, respectively.

Table 7. Minimum monitoring requirements for $PM_{2.5}$.

MSA population	Most recent 3-year design value ≥ 85% of any $PM_{2.5}$ NAAQS	Most recent 3-year design value <85% of any $PM_{2.5}$ NAAQS
>1,000,000	3	2
500,000-1,000,000	2	1
50,000-<500,000	1	0

Table 8. Number of active FRM $PM_{2.5}$ monitors in each CBSA.

CBSA	Counties	Census 2010*	Population estimate (2020)*	Population estimate (2030)*	Minimum number of required monitors	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	1,440,329	3	3
Provo-Orem MSA	Juab, UT Utah, UT	526,810	682,314	850,304	2	2
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	766,860	2	2
Heber µSA	Wasatch, UT	23,530	32,741	44,549	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	112,656	139,228	168,136	1	1
Saint George MSA	Washington, UT	138,115	196,762	280,558	0	0
Cedar City µSA	Iron, UT	46,163	57,055	71,687	0	0
Price µSA	Carbon, UT	21,403	21,602	22,092	0	0
Vernal µSA	Uintah, UT	32,588	38,982	41,099	0	0
Summit Park µSA	Summit, UT	36,324	45,491	56,890	0	0

* https://gomb.utah.gov/budget-policy/utahseconomy

Salt Lake City CBSA

The UDAQ currently operates four FRM $PM_{2.5}$ monitors in the Salt Lake City CBSA, meets federal monitoring requirements (Table 8). According to federal regulations (40 CFR, part 58, appendix D, table D-5), a CBSA with a population above 1,000,000 and the most recent three-year design value greater than 85% of $PM_{2.5}$ NAAQS, must have a minimum of three active $PM_{2.5}$ monitors. The four monitors are located at Hawthorne (HW), Erda (ED), Rose Park (RP) and the Air Monitoring Center (AMC), which operate on a daily schedule.

Figure 4 shows the surface probability map for exceedance (2014-2016) of the 24-hr $PM_{2.5}$ NAAQS. It provides information about the spatial distribution of the highest daily values for $PM_{2.5}$ and their probability to exceed 35 µg/m^3. Most monitors located at Salt Lake CBSA are in areas where the maximum probability of $PM_{2.5}$ exceeding 35 ug/m^3 is greater than 75%, except for ED where the probabilities was lower than 20%, nonetheless, a decrease in the 98th percentile of 24-hr concentrations for the last 3 years is observed in Figure 5.

Results of two-tailed paired t-test for FRM $PM_{2.5}$ pairings in Salt Lake City CBSA are shown in Table 9 and Table 10. The concentrations measured at HW and RP sites are strongly correlated ($R \geq 0.90$) with a small average relative difference. In addition, the concentrations measured at HW and RP sites exhibit moderate correlation with concentrations measured at ED site.

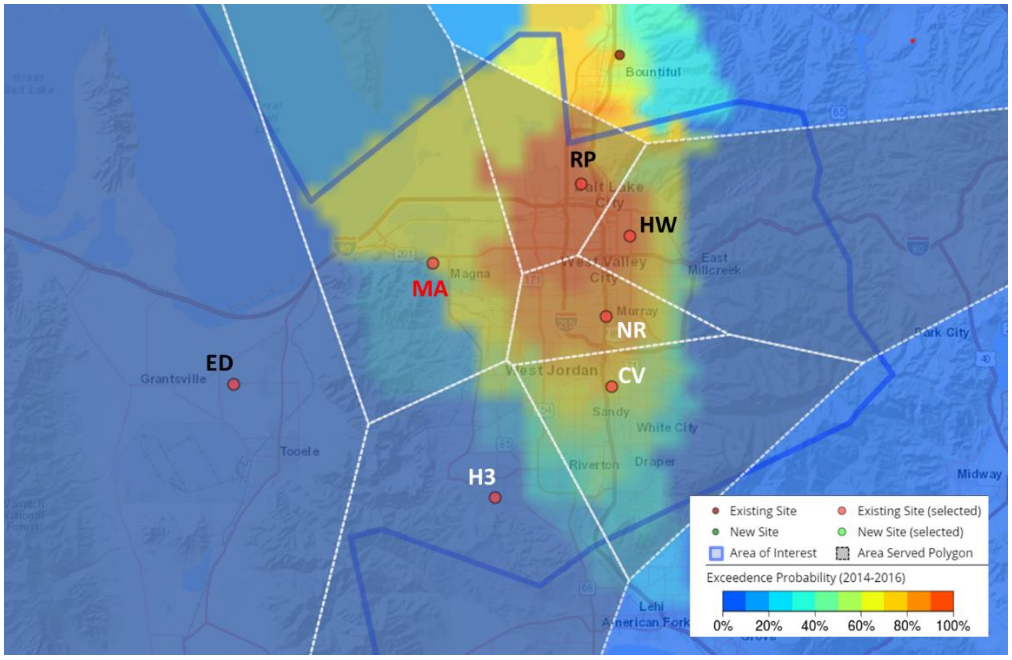

Figure 4. Area served and surface probability map for $PM_{2.5}$. 24-hr NAAQS of 35 µg/m^3. Black font: stations operating FRM and FEM instruments, white font: stations operating FEM and red font: station discontinued.

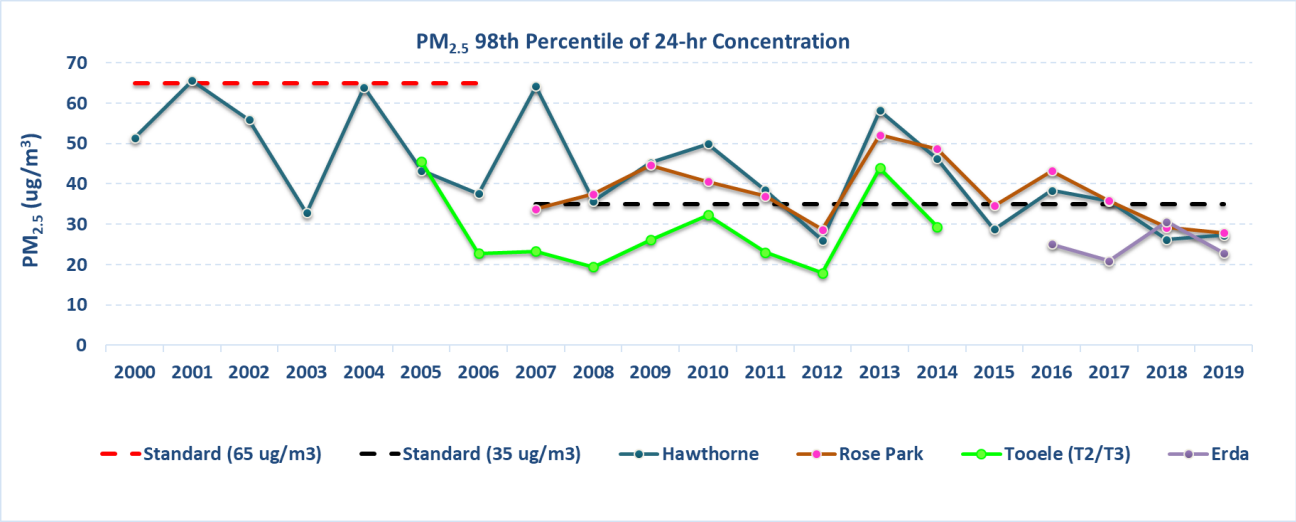

Figure 5. $PM_{2.5}$ 98th percentile 24-hr (ug/m^3) and comparison to NAAQS for FRM $PM_{2.5}$ during the period 2000-2019.

Table 9. Pearson correlation coefficient (R), average relative concentration difference and distance between pairs of sites in Salt Lake City CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Hawthorne	Rose Park	0.94	1050	1.77	7
Hawthorne	Erda	0.73	1074	3.12	43
Rose Park	Erda	0.76	1029	3.31	41

Table 10. Results of two-tailed paired t-test for FRM PM2.5 pairings in Salt Lake City CBSA**.**

	HW	RP	HW	ED	RP	ED
N*	881	881	882	882	899	899
Mean	7.4	8.3	7.7	6.5	8.3	6.8
Standard deviation	7	7.2	7.3	5.9	7.2	6.7
Standard error	0.2	0.2	0.2	0.20	0.2	0.2
Mean difference	0.9		1.2		1.5	
Standard deviation	2.7		5.4		4.1	
Standard error	0.1		0.2		0.1	
Correlation	0.9		0.7		0.8	
	P < 0.001		P < 0.001		P < 0.001	

*Data covering period 01/01/2017-10/31/2019

Provo-Orem CBSA

The UDAQ operates two FRM $PM_{2.5}$ monitors within the Provo-Orem CBSA, which is in accordance with federal monitoring requirements (see Table 8). These are located at Lindon (LN) and Spanish Fork (SF) sites and operate on a daily schedule. North Provo (NP) and LN stations were consolidated in January 2017. Figure 6 shows the surface probability map for exceedance of the 24-hr $PM_{2.5}$ NAAQS for the period 2014-2016. It provides information about the spatial distribution of the highest daily values for $PM_{2.5}$ and their probability to exceed 35 µg/m^3. The two stations are located in areas where the maximum probability of $PM_{2.5}$ exceeding 35 ug/m^3 was lower than 20% for that period. Figure 7 displays a trend plot of the PM $_{2.5}$ 98th percentile of the 24-hr concentrations; it has observed a decreasing trend in the concentration levels for 24-hour standard of 35 µg/m^3 after 2014, with exception of SF 2018 average value. The concentrations measured at the two sites were discreetly correlated (R =0.74) with an average relative concentration difference of 2.73 (see Table 11). UDAQ will continue monitoring $PM_{2.5}$ at these sites to fulfill the federal monitoring requirements.

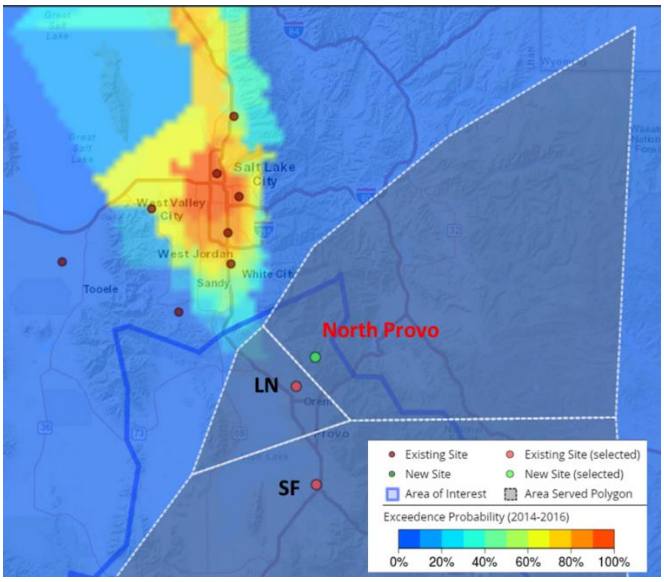

Figure 6. Area served and surface probability map for $PM_{2.5}$. 24-hr NAAQS of 35 µg/m^3. Black font: stations operating FRM and FEM instruments and red font: station discontinued or combined.

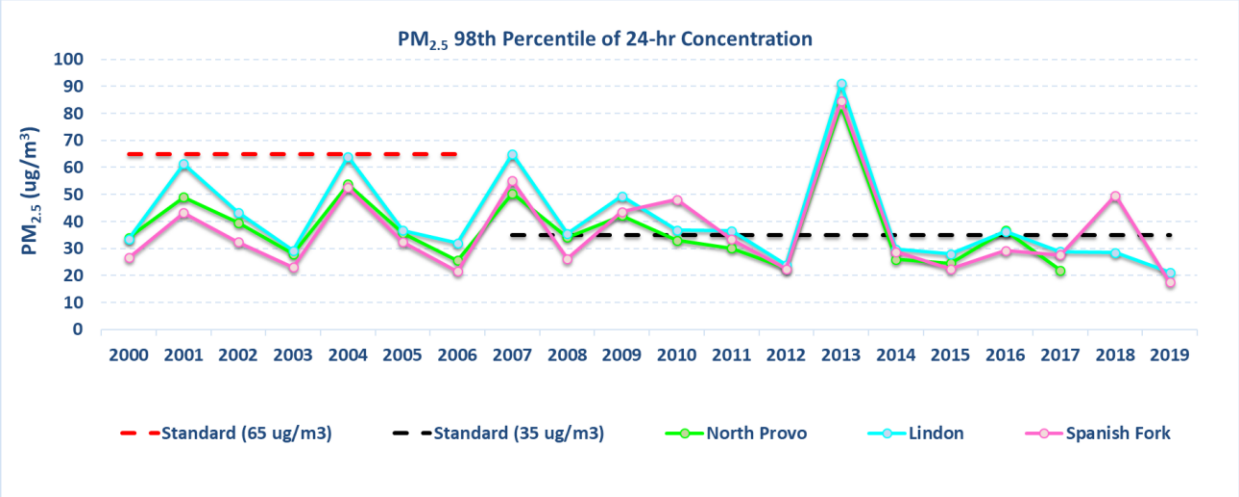

Figure 7. $PM_{2.5}$ 98th percentile 24-hr (ug/m^3) and comparison to NAAQS for FRM $PM_{2.5}$ during the period 2000-2019.

Table 11. Pearson correlation coefficient (R), average relative concentration difference between pairs of sites in Provo-Orem CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Lindon	Spanish Fork	0.74	848	2.73	23

Ogden-Clearfield CBSA

The UDAQ operates two active FRM $PM_{2.5}$ monitors within the Ogden-Clearfield CBSA, which complies with minimum federal monitoring requirements (see Table 8). The sites are located at Bountiful (BV) and Harrisville (HV) and operate on a daily schedule. The surface probability map for exceedance of the 24-hr $PM_{2.5}$ NAAQS for the period 2014-2016 (Figure 8) indicates that BV and the re-located Ogden (O2) are located in areas where the maximum probability of $PM_{2.5}$ exceeding 35 ug/m3 was greater than 70% and for Brigham City (BR), station dismissed, lower than 20%. Figure 9 shows a decrease trend of the $PM_{2.5}$ 98th percentile of the 24-hr concentration levels for the last three years and levels below the 35 ug/m^3 standard value for the last two years.

Some recent changes in the $PM_{2.5}$ monitoring network are observed in the historical trends, comprising the termination of BR (summer 2019), due to construction projects to expand the parking lot of the school where the monitoring station was sited, and the consolidation of the O2 and HV stations (summer 2019).

Table 12 displays the Pearson correlation coefficients (R), average relative concentration difference and distance between pairs of sites in Ogden-Clearfield CBSA. The concentrations at the sites were strongly correlated ($R \geq 0.82$) with relative concentration differences between 2.3 and 2.7.

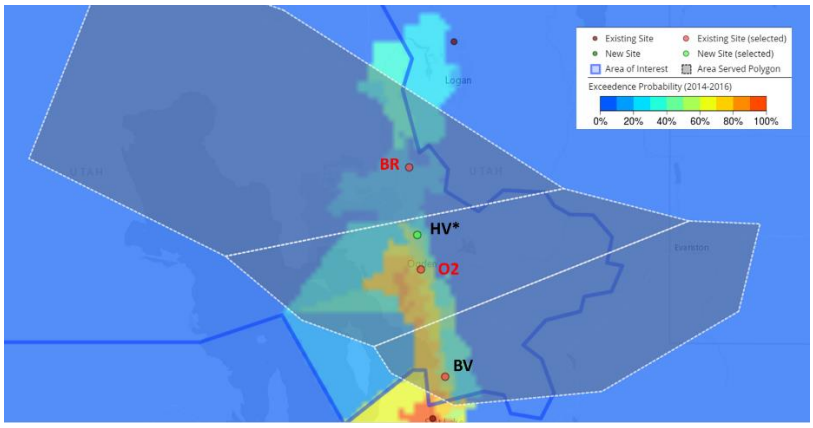

Figure 8. Area served and surface probability map for $PM_{2.5}$. 24-hr NAAQS of 35 µg/m^3. Black font, operating FRM and FEM instruments and red font station(s) discontinued or consolidated.

Table 12. Pearson correlation coefficients (R), average relative concentration difference and distance between pairs of sites in Ogden-Clearfield CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Brigham City	Bountiful	0.82	991	2.7	66
Brigham City	Ogden	0.85	964	2.3	32
Bountiful	Ogden	0.83	1061	2.4	34

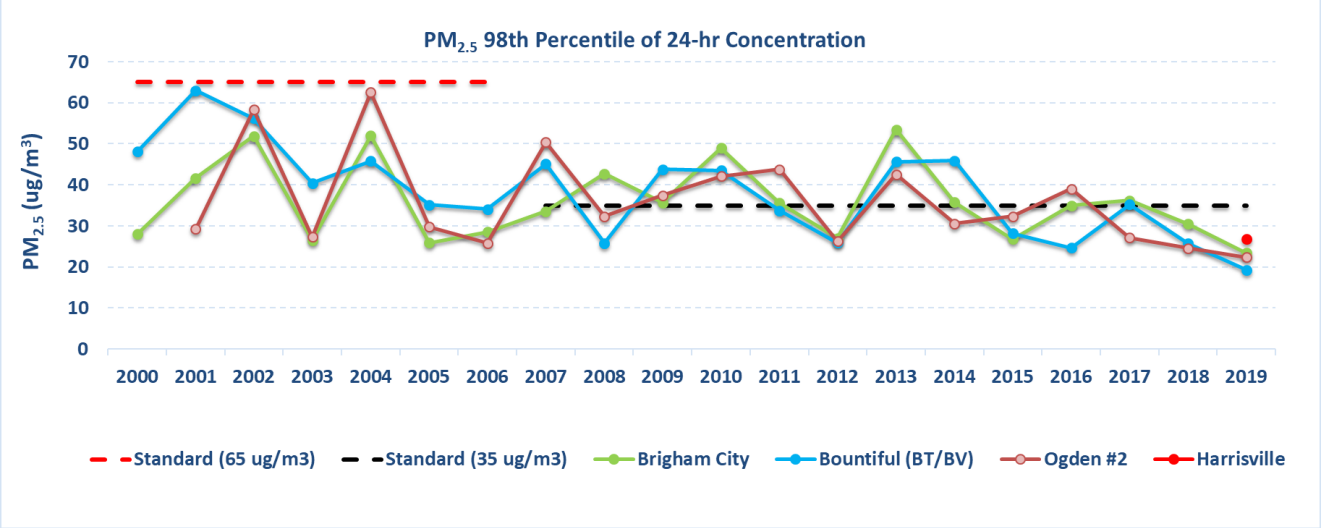

Figure 9. $PM_{2.5}$ 98th percentile 24-hr (ug/m^3) and comparison to NAAQS for FRM $PM_{2.5}$ during the period 2000-2019.

Logan CBSA

The UDAQ currently operates one FRM monitor within the Logan CBSA at Smithfield (SM), which complies with federal requirements (see Table 8). The station was established in January 2015 to replace the Logan site and is located in the same county, but farther north. SM has been operating to measure FRM $PM_{2.5}$ and its values are close or slightly exceeding the 24-hr NAAQS, as shown in Figure 10.

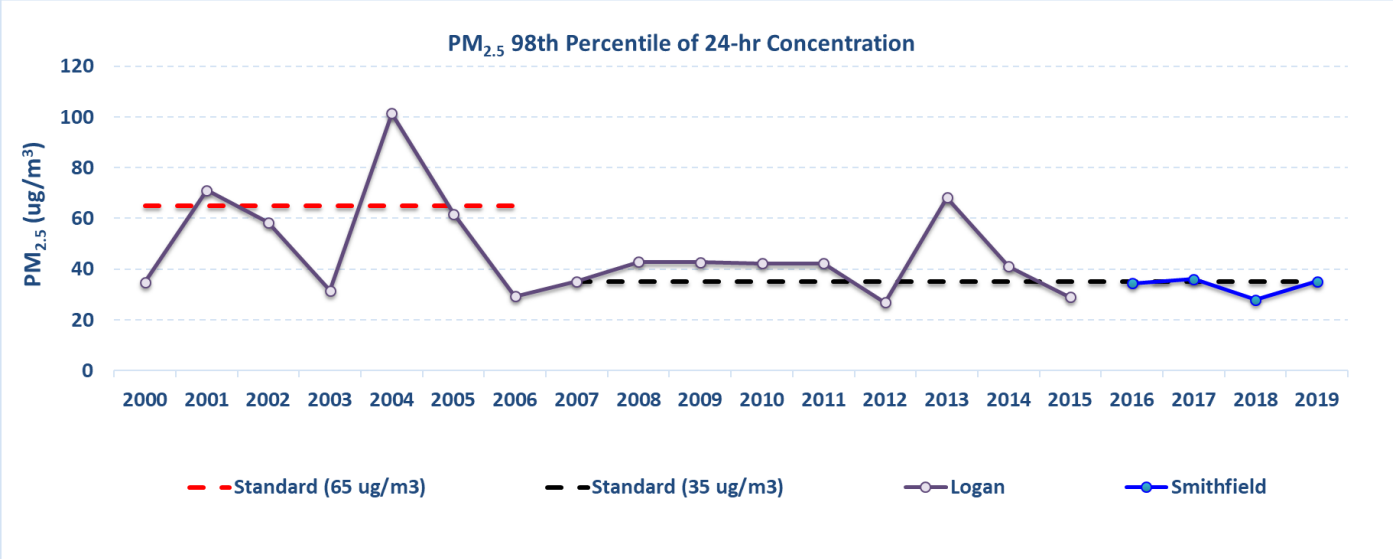

Figure 10. $PM_{2.5}$ 98th percentile 24-hr (ug/m^3) and comparison to NAAQS for FRM $PM_{2.5}$ during the period 2000-2019.

An evaluation of the FRM $PM_{2.5}$. The Utah monitoring network is presented in Table 13.

Table 13. List of FRM $PM_{2.5}$ monitors in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor type	Spatial scale	Monitoring objective	Pollutant/Method	2017-2019 DV (ug/m^3) (% of std)	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/Manual gravimetric	**29.7 (85%)**	**High**– the average last three years design value was close to $PM_{2.5}$ NAAQS, PAMS, NCore site; supports model performance evaluation and SIP development	Continue monitoring
AMC		SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**NA***	**New**- established as a potential replacement of the Rose Park station	Established in 2019 Continue monitoring
				Precision and accuracy assessment	$PM_{2.5}$ FRM/ Manual gravimetric co-located			
Rose Park		SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**30.9 (88%)**	**High**– design value above $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development; site is redundant for $PM_{2.5}$ with Hawthorne (HW) site; however, has been selected as backup station for HW	Continue monitoring
				Precision and accuracy assessment	$PM_{2.5}$ FRM/ Manual gravimetric co-located			
Erda	Tooele	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**24.8 (71%)**	**High**–established to replace Tooele #3; it exhibits temporary variations related to the others SLAMS located in Salt Lake	Continue monitoring

Table 13 (cont'd.)

Site	County	Monitor type	Spatial scale	Monitoring objective	Pollutant/Method	2017-2019 DV (ug/m^3) (% of std)	Value	Recommendation
Lindon	Utah	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**26.2 (75%)**	**High**– the average last three years design value was below $PM_{2.5}$ NAAQS; this site supports model performance evaluation/SIP development	Continue monitoring
				Precision and accuracy assessment	$PM_{2.5}$ FRM/ co-located manual gravimetric			
Spanish Fork		SLAMS	Transport Regional	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**31.6 (90%)**	**High**– the average last three years design value was close to $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development	Relocate site due to logistical issues
Brigham City	Box Elder	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**30 (86%)**	**Moderate–** the average last three years design value was close to $PM_{2.5}$ NAAQS; this site supports model performance evaluation/SIP development	Shut down in 2019 Look for a location for replaced it.
Bountiful Viewmont	Davis	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**26.7 (76%)**	**High** the average last three years design value was below $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development	Continue monitoring

* Site established in 2019

Table 13 (cont'd.)

Site	County	Monitor type	Spatial scale	Monitoring objective	Pollutant/Method	2017-2019 DV (ug/m^3) (% of std)	Value	Recommendation
Ogden #2	Weber	SLAMS	High Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**24.7 (71%)**	**Moderate**– the average last three years design value was below $PM_{2.5}$; the only site that provides $PM_{2.5}$ monitoring for Weber county; supports model performance evaluation and SIP development	Combined with Harrisville
Smithfield	Cache	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ FRM/ Manual gravimetric	**33 (94%)**	**High**- the average last three years design value was close to $PM_{2.5}$ NAAQS $PM_{2.5}$ NAAQS; supports model performance evaluation and SIP development	Continue monitoring
			Precision and accuracy assessment	$PM_{2.5}$ FRM/ co-located manual gravimetric				

3.1.2 FEM $PM_{2.5}$ Network

The UDAQ currently uses Federal Equivalent Method (FEM) $PM_{2.5}$ samplers at sixteen sampling sites distributed throughout the state. Some monitors operate in co-location with FRM filter-based measurements for comparability assessment. Once the comparability assessment criteria are met, the FEM continuous monitors will replace existing FRM monitors in the network, which will reduce the resources and labor required to maintain the FRM samplers and handle the filter samples.

Currently, data obtained from the continuous monitors are primarily used to support forecasting and reporting the Air Quality Index (AQI) information at the AIRNow website (www.airnow.gov).

A plot showing the trends for FRM and FEM $PM_{2.5}$ measurements is shown in Figure 11 and an evaluation of FEM $PM_{2.5}$ continuous monitors in Utah air monitoring network is provided in Table 14.

Remarkably, at the time of the certification of the 2019 $PM_{2.5}$ data, all locations in Utah are attaining the $PM_{2.5}$ NAAQS.

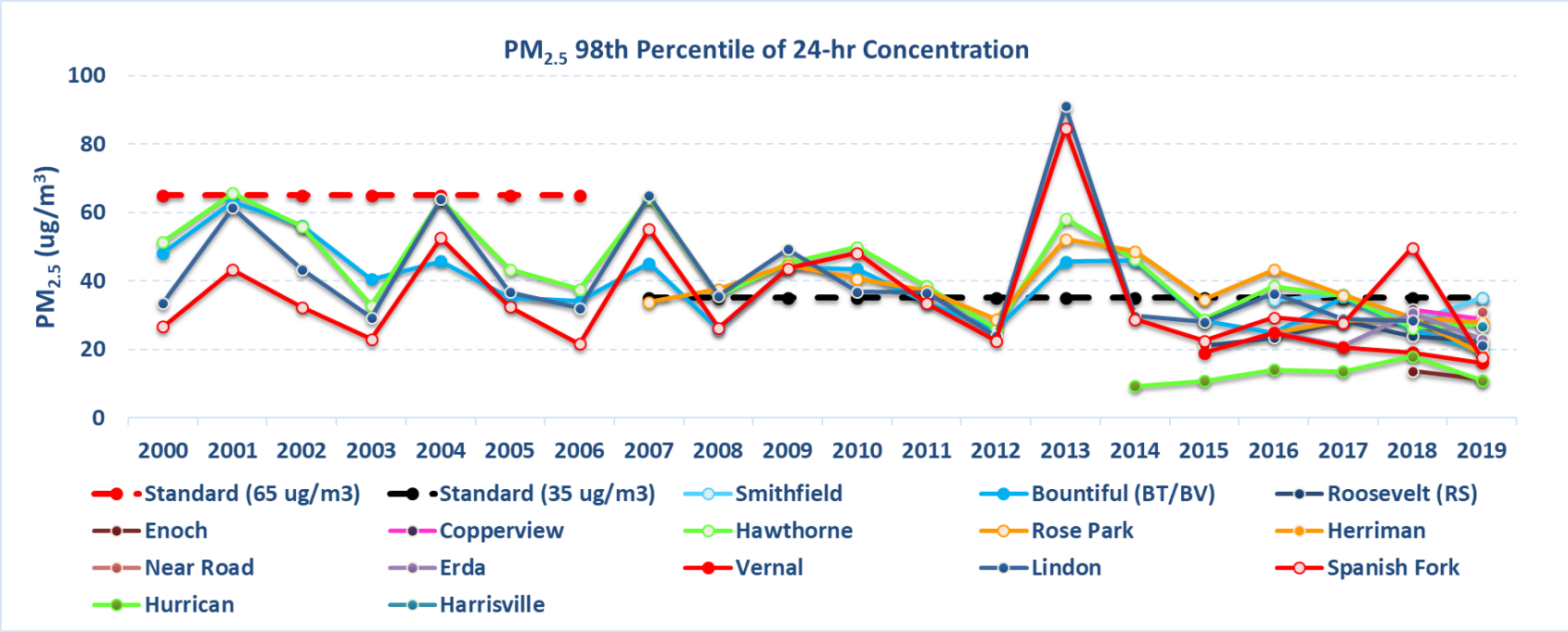

Figure 11. $PM_{2.5}$ 98th percentile 24-hr (ug/m^3) and comparison to NAAQS for FRM/FEM $PM_{2.5}$ during the period 2000-2019.

Table 14. List of FEM $PM_{2.5}$ samplers in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	2017-2019 DV (ug/m^3) (% of std)	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**29.7 (85 %)**	**High**– supports AQI reporting/forecasting; NCore site	Continue monitoring
Rose Park		SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**30.9 (88%)**	**Medium**– supports AQI reporting/forecasting	Continue monitoring
AMC		SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**NA***	**New**- established as a potential replacement of the Rose Park station	Established in 2019 Continue
Copperview		SLAMS	Population Neighborhood	Air pollution index	$PM_{2.5}$ continuous/ SHARP 5030i	**30.2 (86 %)**	**High**– Identified as area for assessing population exposure in southeast Salt Lake County. It supports measurement comparisons in south valley with those at the NCORE station and trace instruments in the network	Continue monitoring
Near Road	Murray	New SPM	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**31 (89%) ** **	**High**– recently established to assess population exposure and to monitor vehicular contribution to air pollution as part of the EPA NO_2 monitoring program	Continue monitoring
Herriman	Herriman	SLAMS	Population Neighborhood		$PM_{2.5}$ continuous/ SHARP 5030i	**25.3 (72%)**	**High**– supports AQI reporting/forecasting	Continue monitoring
Erda	Tooele	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**24.8 (71%)**	**High**–it exhibits temporary variations related to the others SLAMS located in Salt Lake CBSA	Continue monitoring

Table 14 (cont.). List of FEM $PM_{2.5}$ samplers in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	2017-2019 DV (ug/m^3) (% of std)	Value	Recommendation
Smithfield	Cache	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**33 (94%)**	**High**– supports AQI reporting/forecasting	Continue monitoring
Bountiful	Davis	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**26.7 (76%)**	**High**– supports AQI reporting/forecasting	Continue monitoring
Lindon	Utah	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**26.2 (75%)**	**High**– supports AQI reporting/forecasting	Continue monitoring
Spanish Fork	Utah	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**31.6 (90 %)**	**High**– supports AQI reporting/forecasting	Continue monitoring
Enoch	Iron	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ continuous/ SHARP 5030i	**12.5 (36%)****	**Moderate**- the only monitor that provides $PM_{2.5}$ monitoring for	Continue monitoring
Hurricane	Washington	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**14.1 (40%)**	**Moderate**- the only monitor that provides $PM_{2.5}$ monitoring for Washington county	Continue monitoring
Vernal	Uintah	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**18.6 (53%)**	**Moderate**– supports AQI reporting/forecasting	Continue monitoring
Roosevelt	Duchesne	SLAMS	Population Neighborhood	Air quality index	$PM_{2.5}$ continuous/ SHARP 5030i	**24.8 (71%)**	**Moderate**– supports AQI reporting/forecasting	Continue monitoring

*Site established in 09/01/2019; ** based only in two year values. This monitor is conducting the required 3 years of monitoring to establish a baseline DV. Once established we can determine if turning it off is called for. Baseline required due to population growth.

3.1.3 FRM PM_{10} Network

The UDAQ currently operates seven 24-hour Federal Reference Method (FRM) PM_{10} samplers throughout the state (Figure 12) to demonstrate compliance with NAAQS, evaluate population exposure, support PM maintenance plans and monitor PM levels in high-concentration areas.

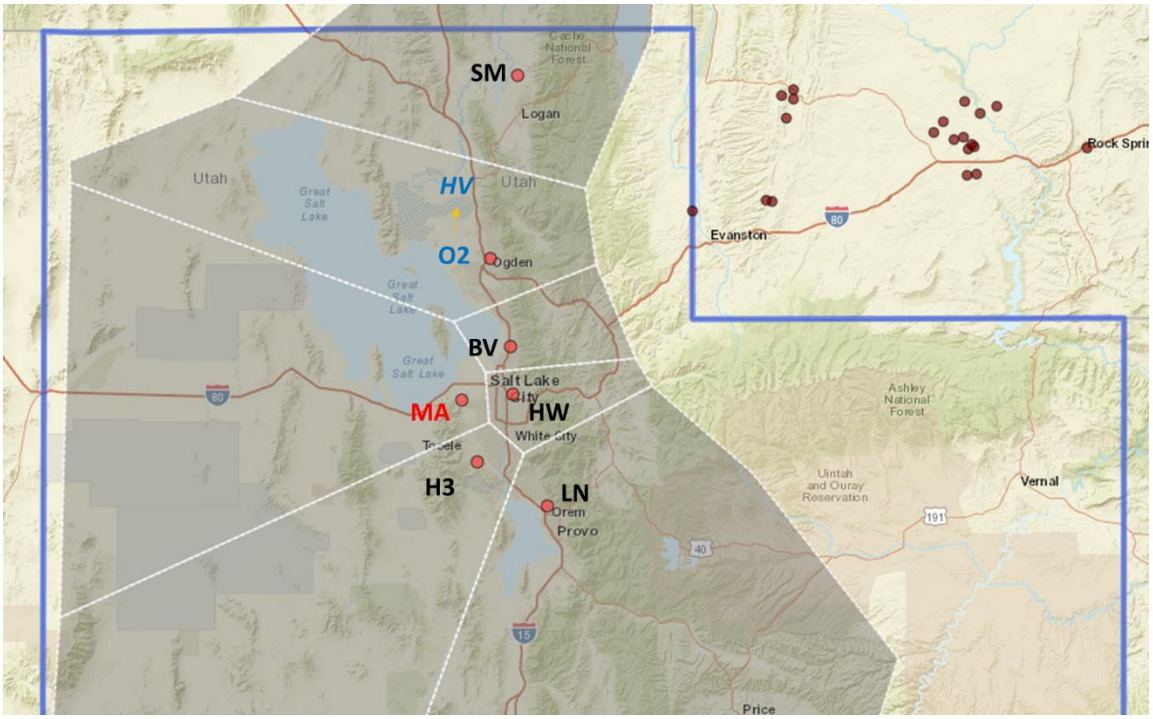

Figure 12. Location of the PM $_{10}$ monitoring sites. Black font represents sites that are currently operating; blue denotes relocated or consolidated (HV is the site for the re-located O2) and red denotes stations discontinued.

3.1.3.1 Historical trends and deviations from NAAQS

In 1987, EPA established a 24-hour air quality standard of 150 $\mu g/m^3$ for PM_{10}. The standard cannot be exceeded more than once per year on average over three years.

Utah is occasionally affected by exceptional events, such as dust storms and wildfires, leading to high PM_{10} concentrations. Excluding data impacted by exceptional events, Utah has been in compliance with the PM_{10} NAAQS, as revealed in Figure 13, which shows the second-highest 24-hour PM_{10} concentration (excluding values influenced by exceptional events). Moreover, only one exceedance of the 24-hr PM_{10} standard was recorded during the period 2017-2019, as shown in

Table 15.

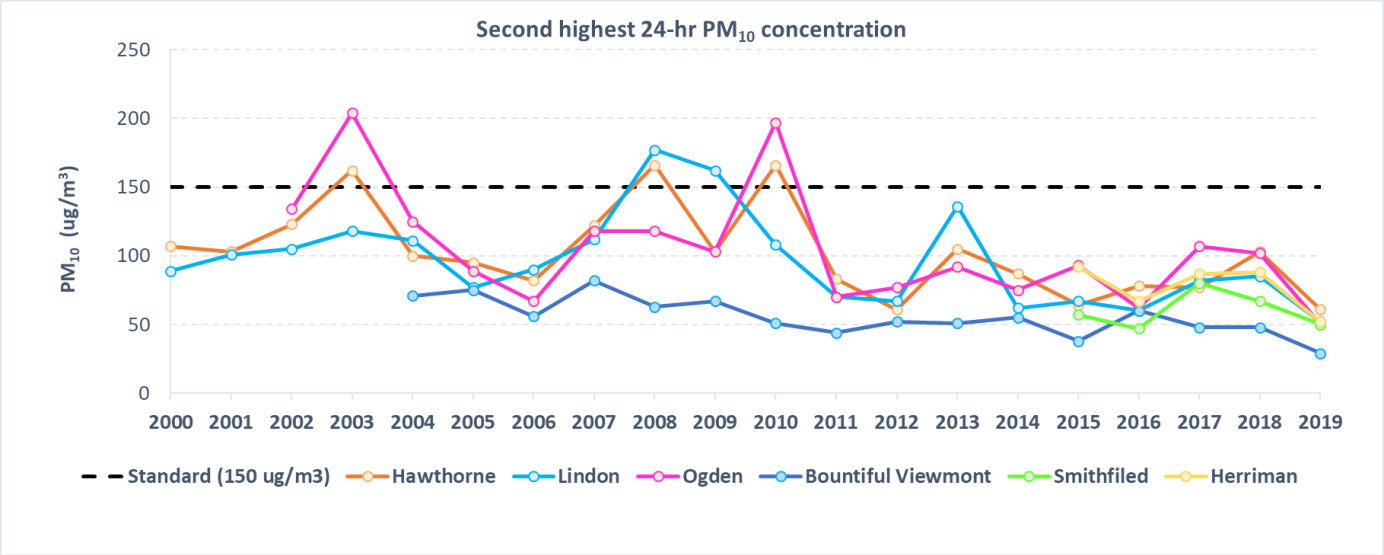

Figure 13. Comparison to NAAQS and trends in second-highest 24-hour PM_{10} concentration for the period 2000-2019. BV site considered SPM for PM_{10}.

Table 15. Number of exceedances of PM_{10} 24hr-2006 NAAQS for the period 2017-2019.

Number of Exceedances of PM_{10} 24-hr NAAQS (primary/secondary)			
Site	**2017**	**2018**	**2019**
Smithfield (SM)	0/0	0/0	0/0
Bountiful Viewmont (BV)*	0/0	0/0	0/0
Hawthorne (HW)	0/0	0/0	0/0
Herriman (H3)	1/1	0/0	0/0
Lindon (LN)	0/0	0/0	0/0
Ogden (O2)	0/0	0/0	0/0

***Special Purpose Monitor (SPM) for PM_{10}

3.1.3.2 Site-by-Site Analysis

Federal regulations require that state and local agencies operate PM_{10} sites for various locations, depending upon MSA boundaries and population size, as well as ambient PM_{10} concentrations relative to the PM_{10} NAAQS (40 CFR, appendix D, part 58). Minimum federal monitoring requirements for PM_{10} sampling and for the number of active FRM PM_{10} monitors in each CBSA are presented in Table 16 and Table 17, respectively.

Table 16. Minimum monitoring requirements for PM_{10}.

MSA population	High concentration[1]	Medium concentration[2]	Low concentration[3]
>1,000,000	6-10	4-8	2-4
500,000-1,000,000	4-8	2-4	1-2
250,000-500,000	3-4	1-2	0-1
100,000 - 250,000	1-2	0-1	0

[1]High concentration areas are those for which ambient PM_{10} data show ambient concentrations exceeding the PM_{10} NAAQS by 20 percent or more.

[2]Medium concentration areas are those for which ambient PM_{10} data show ambient concentrations exceeding 80 percent of the PM_{10} NAAQS.

[3]Low concentration areas are those for which ambient PM_{10} data show ambient concentrations less than 80 percent of the PM_{10} NAAQS.

Table 17. Number of active FRM PM_{10} monitors in each CBSA.

CBSA	Counties	Census 2010*	Population estimate (2020)	Population estimate (2030)	Minimum number of required monitors*	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	1,440,329	2-4	2 1**
Provo-Orem MSA	Juab, UT Utah, UT	526,810	682,314	850,304	1-2	1
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	766,860	1-2	1
Heber µSA	Wasatch, UT	23,530	32,741	44,549	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	112,656	139,228	168,136	1	1
Saint George MSA	Washington, UT	138,115	196,762	280,558	0	0
Cedar City µSA	Iron, UT	46,163	57,055	71,687	0	0
Price µSA	Carbon, UT	21,403	21,602	22,092	0	0
Vernal µSA	Uintah, UT	32,588	38,982	41,099	0	0
Summit Park µSA	Summit, UT	36,324	45,491	56,890	0	0

* Excluding exceptional events; ** established in 2019.

Salt Lake City CBSA

The UDAQ currently operates three FRM PM_{10} monitors in Salt Lake City CBSA to meet federal monitoring requirements. According to federal regulations (40 CFR, part 58, appendix D, table D-5), a CBSA with a population above 1,000,000 and ambient PM_{10} concentrations less than 80 percent of the PM_{10} NAAQS, must have a minimum of two active PM_{10} monitors. The monitors located at Hawthorne (HW), Herriman #3 (H3) and the Air Monitoring Center (AMC) operate on a daily schedule.

Results of the two-tailed paired t-test for FRM PM_{10} monitoring stations at Salt Lake City CBSA are shown in Table 18. The correlation analysis showed that PM_{10} levels at H3 and HW were moderately correlated (R = 0.69), with HW displaying larger concentrations than H3. Moreover, the relative difference between the concentrations at the two sites suggest a difference in PM_{10}

levels between the monitoring sites. The UDAQ, therefore, recommends continuing PM_{10} sampling at all sites in the Salt Lake City CBSA.

Table 18. Results of two-tailed paired t-test for FRM PM_{10} pairings in Salt Lake City CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Hawthorne	Herriman	0.69	946	8.38	30

Provo-Orem CBSA

The UDAQ operates one FRM PM_{10} monitor within the Provo-Orem CBSA, which is located at Lindon (LN) and satisfies minimum federal monitoring requirements (see Table 17).

Ogden-Clearfield CBSA

The UDAQ operates one FRM PM_{10} monitor within the Ogden-Clearfield CBSA, which satisfies minimum federal monitoring requirements (see Table 17). The monitor located at Ogden #2 (O2) was re-located at Harrisville (HV) station and operates on a daily schedule. Bountiful (BV) station operates one PM_{10} sampler every six days but it is considered as SPM.

Logan CBSA

The UDAQ operates one FRM monitor at the Logan CBSA, which satisfies federal monitoring requirements (see Table 17). This is located at Smithfield site. The UDAQ does not recommend making any changes to the monitoring network within this CBSA.

3.1.4 Continuous PM_{10} Network

Currently, the UDAQ is not operating continuous PM_{10} samplers; however, it is considering collocating continuous PM_{10} monitors with FRM filter-based measurements for comparability assessment. Once the comparability assessment criteria are met, the FEM continuous monitors will replace existing FRM monitors in the network, which will reduce the resources and labor required to maintain the FRM samplers and handle the filter samples.

A summary of the FRM PM_{10} samplers in Utah air monitoring network and recommendations for network modification are presented in Table 19.

Table 19. List of FRM PM_{10} samplers in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**High**– design value location for PM_{10} NAAQS; NCore site; supports PM_{10} maintenance demonstration	Continue monitoring
Herriman #3		SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**High**– site established to assess population exposure in southwest Salt Lake County	Continue monitoring
Lindon	Utah	SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**High**– site supports PM_{10} maintenance demonstration and it is a design value location for PM_{10} NAAQS	Continue monitoring
Smithfield	Cache	SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**High-** site supports PM_{10} maintenance demonstration and it is a design value location for PM_{10} NAAQS	Continue monitoring
Harrisville	Weber	SLAMS	Population Neighborhood	Population exposure	PM_{10} FRM/ Manual gravimetric	**High**– design value location for PM_{10} NAAQS, this is the only monitor that provides PM_{10} for Weber county	Continue monitoring

3.2 Gaseous Monitoring

3.2.1 Ozone Network

3.2.1.1 Area and Population Served

The area and population served, including sensitive demographics, by each O_3 monitor are shown in Table 20, where the sites are sorted according to the population they represent.

Table 20. Area and population served by O_3 monitors in Utah air monitoring network.

Site	Population Served					Area Served (km^2)
	Total Population	Total Male Population	Total Female Population	Total Population, Age 65 and over	Total Population, Age 0 to 4	
Copperview	295565	148965	146600	26116	23656	262
Lindon	286756	143604	143152	21137	30029	378
Spanish Fork	219728	110750	108978	15269	23125	10681
Near Road	261818	130374	131444	26612	22835	131
Hawthorne	180815	90920	89895	12801	20799	377
Herriman	156024	78046	77978	4899	21288	1170
Bountiful	146880	73231	73649	15527	13868	1946
Hurricane	131979	65044	66935	22485	12529	15423
Smithfield	119608	59519	60089	10426	12043	6923
Erda	62899	31726	31173	4833	6481	26391
Harrisville	77538	39018	38520	7659	6887	1278
Enoch	59808	29962	29846	6508	5482	22461
Escalante	36583	18481	18102	4999	3024	35863
Price	41662	20901	20761	5516	3543	18025
Vernal	9511	4844	4667	862	1099	37
Rose park	8243	42919	39924	5985	8504	126
Roosevelt	7632	3784	3848	630	971	71

3.2.1.2 Exceedance Probability

Figure 14 shows the probability that O_3 in a given area will exceed 70 ppb at least one day in a year. It is shown that most monitors are in areas where the maximum probability of O_3 exceeding

70 ppb is greater than 70%. Note that some of the monitors shown in Figure 14 are located at sites within the Interagency Monitoring of Protected Visual Environments (IMPROVE) network.

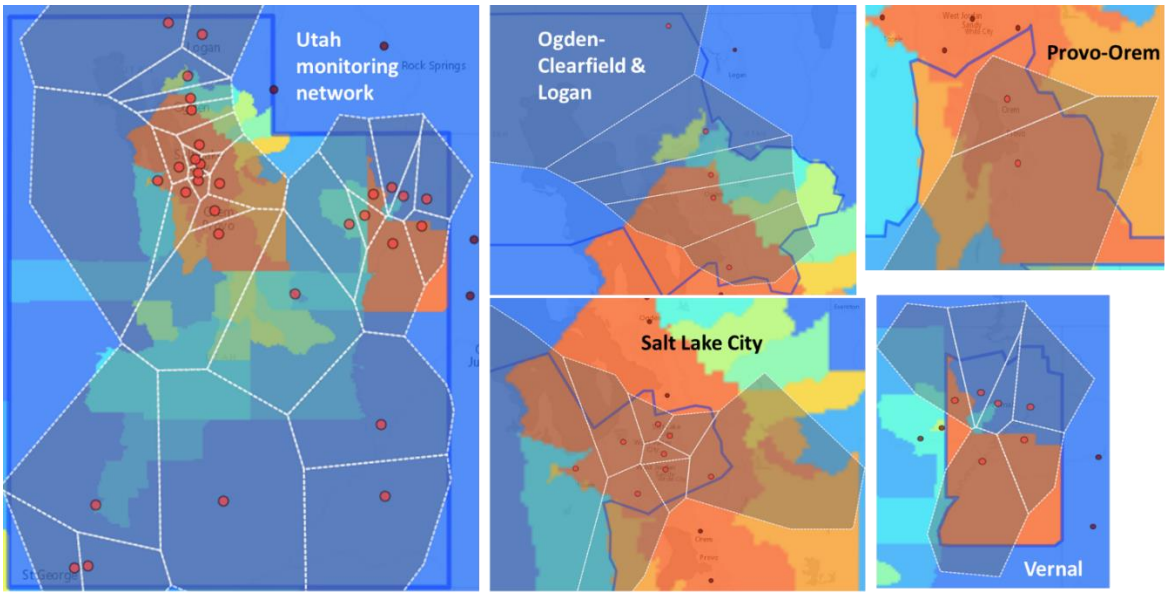

Figure 14. Area served and surface probability map for O_3.

3.2.1.3 Historical Trends and Deviations from NAAQS

Ozone is formed through photochemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs). Its production is a year-round phenomenon, with highest O_3 levels generally occurring during summer when solar radiation and temperature are strongest. However, Utah is often susceptible, during wintertime inversions, to elevated levels of O_3 in the Uinta Basin. High-pressure weather systems and high solar zenith angle during winter lead to cold-air pools that periodically trap precursor gases, most notably VOCs and NO_x, in the valleys between the Wasatch and Oquirrh Mountains. These precursor gases subsequently react in the stagnant air to form O_3. Snow cover can also enhance O_3 formation by increasing sunlight reflection (surface albedo) into the atmosphere.

The current 8-hr NAAQS for O_3 is 70 ppb. The standard is met when the annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years, is less than 70 ppb. The number of NAAQS exceedances at the sampling sites for the period 2017-2019 is provided in **Error! Reference source not found.**. Figure 15 and Figure 16 show the three-year average of the annual fourth-highest daily maximum 8-hour O_3 concentration and the trends of the annual fourth-highest 8-hour O_3 concentration at the sampling sites. The same information presented in Figure 16 was sorted by site locations for better visualization of the values and is shown in Figure 17. Figures 15-17 show that the 2017-2019 standard was exceeded for most of the monitoring and it is observed that the O_3 levels in 2019 are above the NAAQS standards for Salt Lake City, Davis and Duchesne counties.

Number of Exceedances of O_3 NAAQS (primary)			
Site	**2017**	**2018**	**2019**
Smithfield	0/0	3/3	0/0
Bountiful Viewmont	24/24	15/15	5/5
Hawthorne	22/22	11/11	8/8
Herriman	23/23	23/23	4/4
Lindon	0/0	22/22	0/0
Spanish Fork	4/4	7/7	0/0
Copperview	17/17	19/19	1/1
Hurricane	0/0	2/2	0/0
Erda	0/0	8/8	1/1
Harrisville	14/14	14/14	1/1
Enoch	NA	0/0	0/0
Escalante	0/0	3/3	0/0
Vernal	0/0	2/2	16/16
Near Road	NA	0/0	0/0
Rose park	NA	20/20	5/5
Roosevelt	8/8	9/9	12/12
Price	0/0	5/5	1/1
Brigham City	3/3	8/8	0/0
Ogden	16/16	22/22	0/0
Air Monitoring Center	NA	NA	NA

Table 21. **Number of exceedances of O_3 8-hr 2008 NAAQS for the period 2017-2019.**

* Excluding values corresponding to concurred events.

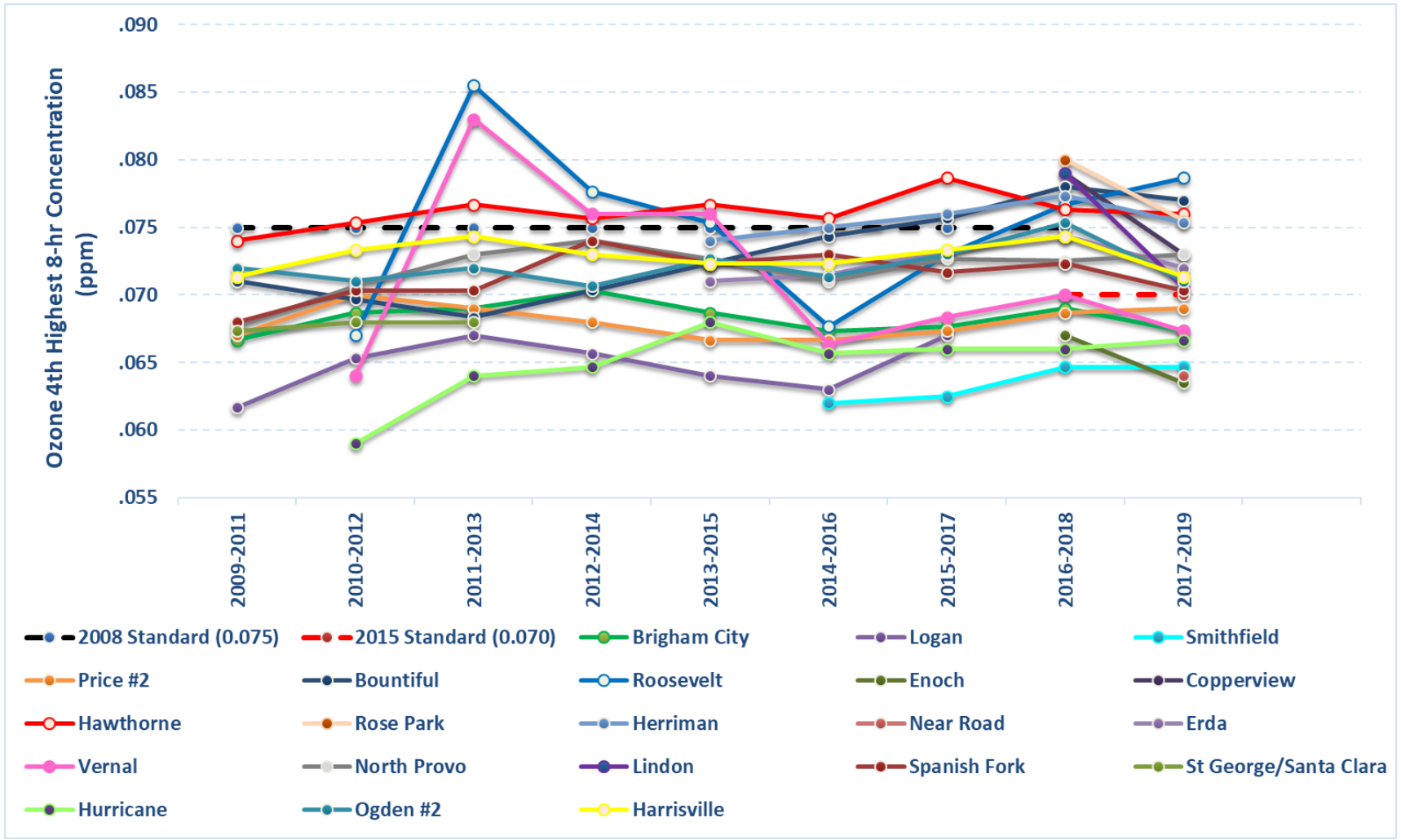

Figure 15. 8-hr design value trends and comparison to NAAQS for O_3 during the period 2009-2019.

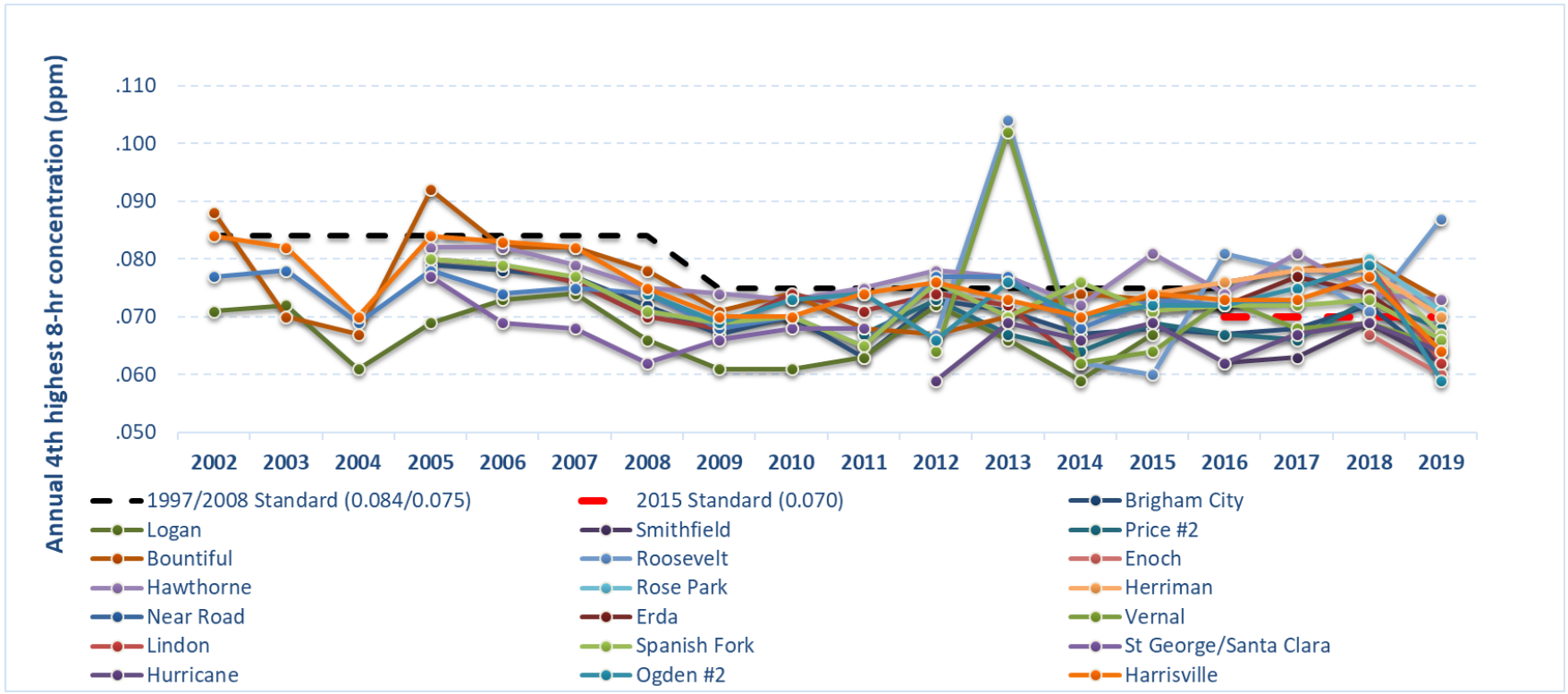

Figure 16. Trends in annual fourth-highest eight-hour O_3 concentration and comparison to NAAQS.

Figure 17. Trends in annual fourth-highest eight-hour O_3 concentration and comparison to NAAQS

3.2.1.4 Site-by-Site Analysis

Federal regulations require state and local agencies to operate O_3 sites for various locations, depending on MSA boundaries and population size as well as most recent three-year design value, expressed as a percentage of the O_3 NAAQS (40 CFR, appendix D, part 58). Minimum federal monitoring requirements for O_3 sampling and for the number of active O_3 monitors in each CBSA are presented in Table 22 and Table 23, respectively.

Table 22. Minimum monitoring requirements for O_3.

MSA population	Most recent 3-year design value ≥85% of any O_3 NAAQS	Most recent 3-year design value <85% of any O_3 NAAQS
>10,000,000	4	2
4,000,000-10,000,000	3	1
350,000-<4,000,000	2	1
50,000-<350,000	1	0

Table 23. Number of active O_3 monitors in each CBSA.

CBSA	Counties	Census 2010*	Population estimate (2020)*	Population estimate (2030)*	Minimum number of required monitors	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,255,736	1,440,329	2	3 3*
Provo-Orem MSA	Juab, UT Utah, UT	526,810	682,314	850,304	2	2
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	681,907	766,860	2	2
Heber µSA	Wasatch, UT	23,530	32,741	44,549	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	112,656	139,228	168,136	0	1
Saint George MSA	Washington, UT	138,115	196,762	280,558	1	1
Cedar City µSA	Iron, UT	46,163	57,055	71,687	0*	1
Price µSA	Carbon, UT	21,403	21,602	22,092	0	1
Vernal µSA	Uintah, UT	32,588	38,982	41,099	0	2
Summit Park µSA	Summit, UT	36,324	45,491	56,890	0	0

*3-year design value unavailable as sites established in 2018 and 2019

Salt Lake City CBSA

According to federal regulations (40 CFR, part 58, table D2), a CBSA with a population between 350,000 and 4,000,000 and the most recent 3-year design value greater than 85% of O_3 NAAQS, must have a minimum of two active O_3 monitors. Furthermore, at least one O_3 site for each MSA, or CSA, must be designed to record the maximum concentration for that particular area. The UDAQ currently operates seven O_3 monitors in the Salt Lake City CBSA located at Hawthorne (HW), Herriman #3 (H3), Erda (ED, Copperview (CV), Rose Park (RP), Near Road (NR) and the Air Monitoring Center (AMC) stations. The NR station is a Special Purpose Monitor (SPM), which satisfies the near-road NO_2 EPA requirement. CV, RP and AMC sites have been established or modified to include O_3 measurements in the last two years.

The Pearson correlation coefficient (R), average relative concentration difference and distance between pairs of sites in Salt Lake City CBSA is presented in Table 24. The correlation analysis shows that the concentrations at all the sites are strongly correlated ($R \geq 0.9$) and their average relative differences are small, suggesting possible redundancy among the sites. However, the UDAQ recommends continuing monitoring at all the stations that currently measure O_3, which supply air quality data and support air pollution modeling efforts.

Table 24. Pearson correlation coefficient (R), average relative concentration difference and distance between pairs of sites in Salt Lake City CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Hawthorne	Herriman	0.92	955	0.0055	30
Hawthorne	Rose Park	0.95	303	0.0032	7
Hawthorne	Erda	0.91	897	0.0055	43
Copperview	Herriman	0.95	240	0.0054	16
Copperview	Erda	0.93	245	0.0068	39
Copperview	Rose Park	0.94	204	0.0036	21
Copperview	Hawthorne	0.94	234	0.0046	15
Rose Park	Erda	0.94	294	0.0043	41
Herriman	Erda	0.90	988	0.0044	29
Rose Park	Herriman	0.94	309	0.0044	33

Provo-Orem CBSA

The UDAQ currently operates two O_3 monitors within the Provo-Orem CBSA in compliance with minimum federal monitoring requirements for a CBSA with a population between 350,000 and 4,000,000. The monitors are located at Lindon (LN) and Spanish Fork (SF) monitoring sites, which operate on a daily schedule. The LN station started to monitoring O_3 in 2018 after merging with North Provo station. The correlation analysis (see Table 25) showed that the concentrations at the two sites were strongly correlated ($R = 0.95$) and their relative difference was low. Both sites also displayed three-year design values that exceed the current NAAQS of 70 ppb. Given

these design values and minimum federal monitoring requirements, UDAQ is continuing measuring O_3 at these sites.

The UDAQ is required to relocate the SF site within the next two years due to planned construction work at its current location. To maintain consistency with the current site's objectives, a potential location is on the same street as the existing site, which would still allow the UDAQ to monitor both local and regional levels of O_3.

Table 25. Pearson correlation coefficient (R), average relative concentration difference and distance between pairs of sites in Provo-Orem CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Lindon	Spanish Fork	0.95	301	0.004	23

Ogden-Clearfield CBSA

The UDAQ currently operates two O_3 monitors within the Ogden-Clearfield CBSA, which fulfills the minimum federal monitoring requirements for a CBSA with a population above 350,000 but less than 4,000,000. The monitors are located at the Bountiful Viewmont (BV) and Harrisville (HV) sites that operate continuously. The site at HV was established in response to an O_3 saturation study, which identified the site as a potentially high-ozone concentration area. The results of the correlation analysis showed that the concentrations, at each pair of sites, were strongly correlated ($R \geq 0.92$), with Ogden # 2 and HV being the mostly correlated stations (see Table 26). The monitor at BV is located in a well-urbanized, highly-populated area and is essential for O_3 measurement on neighborhood scales. Additionally, the O_3 data collected at BV provides valuable information that can be used in conjunction with CO, NOx, and VOC data, also monitored at this location. The O_3 monitor at HV is crucial for monitoring high levels of O_3 in the area and the UDAQ will continue measuring O_3 at these sampling sites within this CBSA. The UDAQ also recommends looking for a suitable place to add an additional station to this CBSA as a backup option.

Table 26. Pearson correlation coefficient (R), average relative difference and distance between pairs of sites for O_3 in Ogden-Clearfield CBSA.

Site 1	Site 2	R	N	Absolute average relative difference	Distance (km)
Brigham City	Bountiful	0.92	1027	0.0046	66
Brigham City	Ogden #2	0.96	955	0.0037	32
Brigham City	Harrisville	0.94	992	0.0044	21
Bountiful	Ogden #2	0.96	1008	0.0032	34
Bountiful	Harrisville	0.94	1042	0.0039	45
Ogden #2	Harrisville	0.98	973	0.003	11

*Based on 8-hr average O_3 concentration data

Roosevelt site, Price and Vernal CBSAs

The UDAQ operates one O_3 monitor at each of these sites or CBSAs, which exceeds minimum federal monitoring requirements (see Table 23). These monitors were installed to investigate the atypical high wintertime O_3 levels in the Uinta Basin. The UDAQ, therefore, does not recommend making any changes to these ozone-monitoring sites.

Logan, St. George and Cedar City CBSAs

The UDAQ operates one O_3 monitor at each of these CBSAs to meet federal monitoring requirements (see Table 23). These monitors were installed to represent population exposure in their respective counties. The monitor at Cedar City was established for O_3 and $PM_{2.5}$ monitoring as a response to the predicted increase in population to 57,055 (see Table 23) in 2020, which is above the threshold of federal monitoring requirements. UDAQ does not recommend making any changes to the ozone-monitoring network within these CBSAs.

In addition, a Special Purpose Monitor (SPM) was established at Escalante, Garfield County, with the purpose of measuring O_3 near Escalante National Monument

An evaluation of O_3 monitors in UDAQ network is provided in Table 27.

Table 27. List of O_3 monitors in UDAQ network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	2017-2019 DV (ppm)	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	High Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.076**	**High**– NCore site; design location for O_3 NAAQS; supports model performance evaluation and O_3 maintenance	Continue monitoring
Herriman #3		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.075**	**High**– established to assess population exposure in southwest Salt Lake County	Continue monitoring
Copper View		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.073***	**High**– identified as area for assessing population exposure in southeast Salt Lake County	Continue monitoring
Rose Park		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.076 ***	**High**–population exposure; monitoring gaseous species started in 2018 as a backup measurements for HW station	Continue monitoring
Erda	Tooele	SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.072**	**High**– identified in assessment as high-ozone concentration area	Continue monitoring

Table 27 (cont.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	2017-2019 DV (ppm)	Value	Recommendation
Near Road	Salt Lake	SPM	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.064***	**High**– site established to monitor vehicular contribution to air pollution as part of the EPA NO_2 monitoring program	Continue monitoring
Air Monitoring Center		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**NA**	**New-** established at 1 mile from Rose Park station. Instruments has been set up on the roof of the building with the objective of eventually be the replacement of the Rose Park station	Continue monitoring
Lindon	Utah	SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.071***	**High**– design value location for O_3 NAAQS; supports model performance evaluation/ O_3 maintenance demonstration	Continue monitoring
Spanish Fork		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/ Continuous	**0.070**	**High**– design value location for O_3 NAAQS; supports model performance evaluation/O_3 maintenance demonstration; local high-ozone concentration area	Relocate site due to logistical issues and continue monitoring

Table 27 (cont.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	Value		Recommendation
Bountiful Viewmont	Davis	SLAMS	High Neighborhood	Population exposure	Instrumental Ultra Violet/Seasonal	**0.077**	**High–** design value location for O_3 NAAQS; historically reported highest O_3 concentrations in the network; supports model performance evaluation and maintenance plan	Continue monitoring
Harrisville	Weber	SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Seasonal	**0.071**	**High–** established in response to an O_3 saturation study; high-ozone concentration area, this site was consolidated with Ogden #2	Consolidated with HV; Continue monitoring
Smithfield		SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.065**	**Moderate-** established to assess population exposure, provide a baseline of levels in Logan area	Continue monitoring

Table 27 (cont.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	Value		Recommendation
Price#2	Carbon	SPM	Regional	Population exposure	Instrumental Ultra Violet/Seasonal	**0.069**	**High**– design value location for O_3 NAAQS; potentially highest O_3 concentrations area	Continue monitoring
Roosevelt	Duchesne	SLAMS	Regional	Population exposure	Instrumental Ultra Violet/Seasonal	**0.079**	**High**– established to determine maximum O_3 concentrations in Duchesne county; design value above NAAQS	Continue monitoring
Vernal #4	Uintah	SLAMS	Regional	Population exposure	Instrumental Ultra Violet/Seasonal	**0.067**	**High**– established to replace Vernal site (VL), which was established in response to an O_3 study and displayed a design value above O_3 NAAQS	Continue monitoring
Hurricane	Washington	SLAMS	Regional	Population exposure	Instrumental Ultra Violet/Continuous	**0.067**	**Moderate**–established to provide a baseline of levels in the St. George MSA; monitor is the only monitor that provides O_3 monitoring for Washington County.	Continue monitoring
Enoch	Iron	SLAMS	Population Neighborhood	Population exposure	Instrumental Ultra Violet/Continuous	**0.064**	**Moderate-** established to assess population exposure provide a baseline of levels in the Cedar City MSA; monitor is the only monitor that provides O_3 monitoring for Iron County.	Continue monitoring
Escalante	Garfield	SPM	Regional	Population exposure	Instrumental Ultra Violet/Continuous	**NA**	**High-** This site is established to measure O_3 near Escalante National Monument	Continue monitoring

*3-year design value unavailable as sites established in 2018 and 2019

3.2.2 Sulfur Dioxide (SO_2) Network

3.2.2.1 Historical trends and deviations from NAAQS

The UDAQ currently operates four SO_2 monitors, located at Hawthorne (HW) (NCore site), Copperview (CV), Rose Park (RP) and the Air Monitoring Center (AMC) sites within the Salt Lake City CBSA. The monitor at HW was designated as population-oriented and satisfies NCore requirements.

For each site, the number of exceedances of the primary 1-hr 2010 SO_2 NAAQS is shown in Table 28, respectively. SO_2 monitoring at Bountiful Viewmont and Roosevelt was discontinued in 2012/2013 since the samplers did not record any exceedances of the 1-hr NAAQS. The 1-hr primary standard for SO_2 is 75 ppb. The Magna site was re-located from its previous location at 2935 South 8560 West, Magna, to its new location at 9228 West 2700 South, Magna, to better monitor the impact of emissions from Kennecott Utah Copper coal-fired power plant. The new Magna station resumed measurements on January 1, 2019, nonetheless only operated for 1 year because Kennecott Utah Copper shut down its coal-fired power plant in 2019.

The standard is met when the 99th percentile of the 1-hour daily maximum concentrations, averaged over 3 years, is less than 75 ppb. As illustrated in Figure 18 and Figure 19, no SO_2 NAAQS violations occurred in the state of Utah during the period 2007-2019. Moreover, all sites displayed a decreasing trend in SO_2 concentration, with levels reaching less than 10 ppb.

Number of Exceedances of $PM_{2.5}$ 24-hr NAAQS (primary)			
Site	**2017**	**2018**	**2019**
Hawthorne	0/0	0/0	0/0
Rose Park	NA	0/0	0/0
Copperview	NA	0/0	0/0

Table 28. Number of exceedances of primary 1-hr SO_2 NAAQS during 2017-2019.

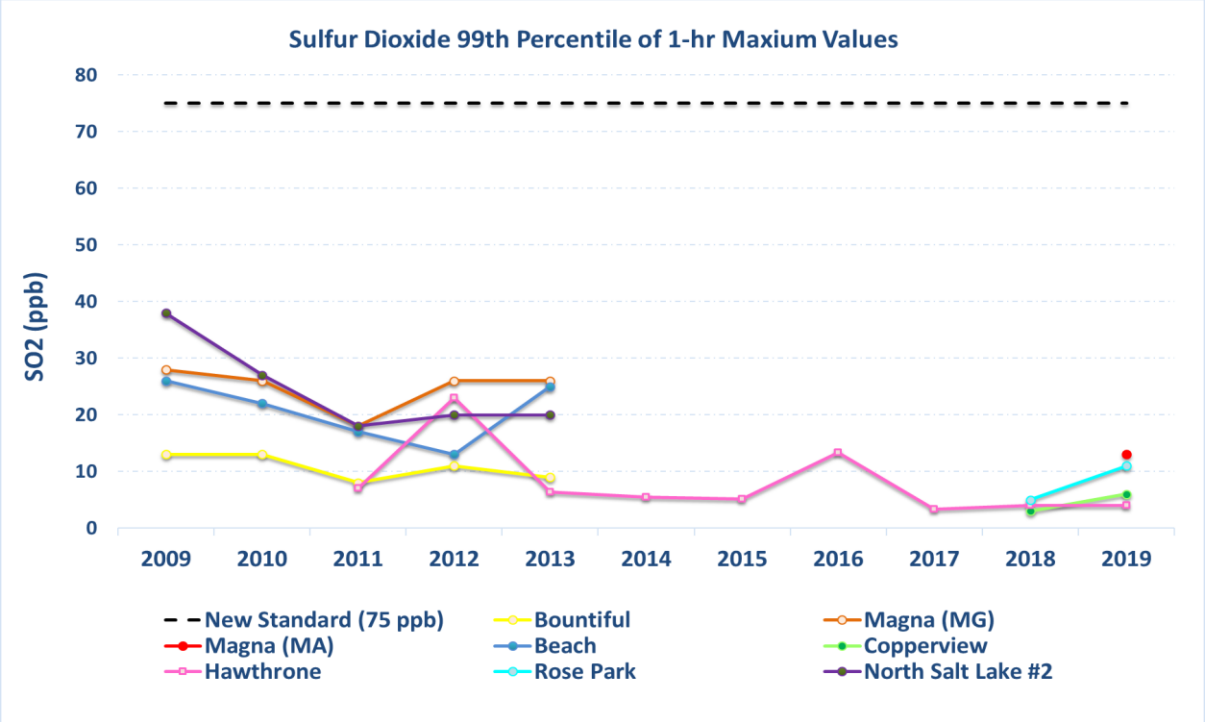

Figure 18. 1-hr 99th percentile maximum value trends and comparison to NAAQS for SO_2 during the period 2009-2019

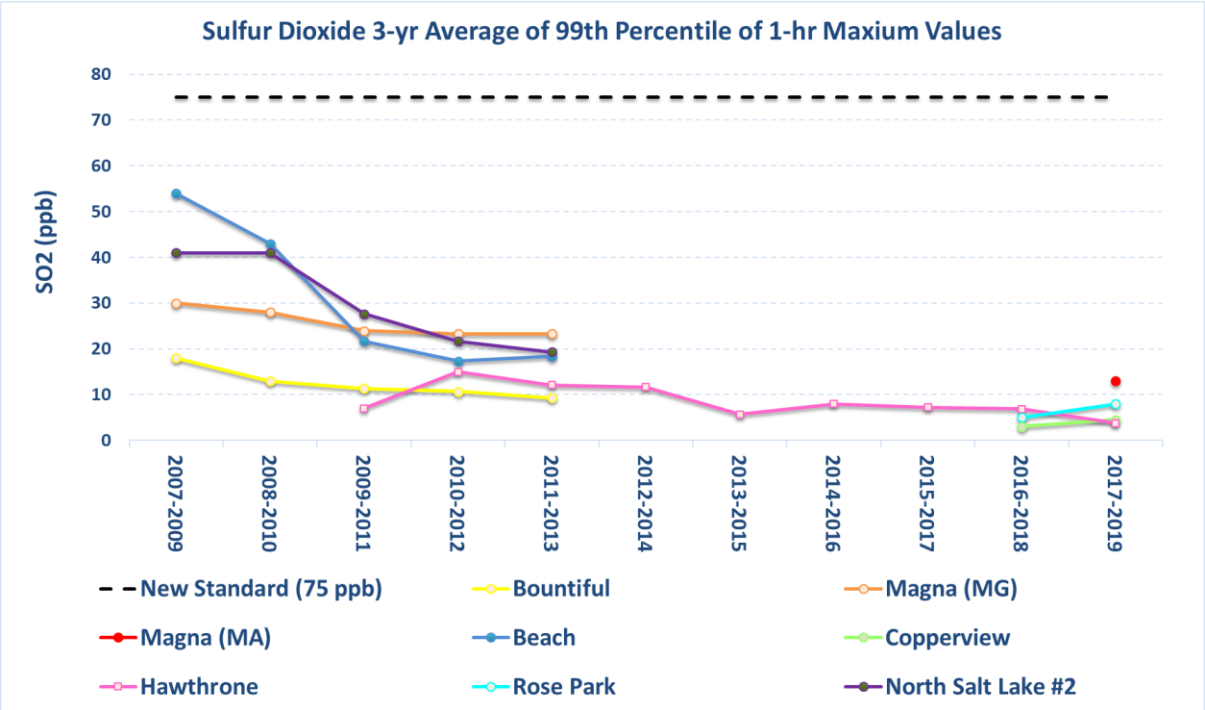

Figure 19. 1-hr average of 99th percentile value trends and comparison to NAAQS for SO_2 during the period 2017-2019

3.2.2.2 Site-by-site analysis

Federal regulations require a minimum of three SO_2 monitors within a CBSA with a calculated Population Weighted Emissions Index (PWEI) value equal to or greater than 1,000,000. The PWEI is calculated by multiplying the population of each CBSA by the total amount of SO_2 (in tons per year) emitted within the CBSA area, then dividing the resulting product by one million. The population is estimated using the most current census data or estimates while SO_2 emissions are calculated using an aggregate of the most recent county level emissions data available in the National Emissions Inventory. For any CBSA with a calculated PWEI value equal to or greater than 100,000, but less than 1,000,000, a minimum of two SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 5,000, but less than 100,000, a minimum of one SO_2 monitor is required within that CBSA. PWEI for the Salt Lake CBSA is 3,329, suggesting that no monitor is needed within these, CBSAs (see Table 29). Given the consistent decrease in SO_2 concentration, non-violation of the NAAQS and the compliance of the NCore minimum monitoring requirements, the UDAQ will maintain SO_2 monitoring at Hawthorne (HW), Copperview (CV), Rose Park (RP) and the Air Monitoring Center (AMC) sites. An evaluation of SO_2 monitors in UDAQ network is provided in Table 30.

Table 29. Number of active SO_2 monitors in each CBSA and minimum number of required monitors.

CBSA	Counties	Population estimate (2020)*	PWEI (Million persons-tons/year)	Minimum number of required monitors	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,255,736	3,329	1*	1 3**
Provo-Orem MSA	Juab, UT Utah, UT	682,314	140	0	0
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	681,907	433	0	0
Heber µSA	Wasatch, UT	32,741	1.1	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	139,228	8.9	0	0
Saint George MSA	Washington, UT	196,762	10.1	0	0
Cedar City µSA	Iron, UT	57,055	2.4	0	0
Price µSA	Carbon, UT	21,602	10.8	0	0
Vernal µSA	Uintah, UT	38,982	2.4	0	0
Summit Park µSA	Summit, UT	45,491	8.1	0	0

*Ncore station. **measurements starting 2018 and 2019

Table 30. List of SO_2 monitors in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor	Spatial scale	Monitoring objective	Sampling and Analysis Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	Continuous Pulsed fluorescence	**High–** NCore site	Continue monitoring
Copperview		SLAMS	Population Neighborhood	Population exposure	Continuous Pulsed fluorescence	**High–** Identified as area for assessing population exposure in southeast Salt Lake County; support modeling	Continue monitoring
Rose Park		SLAMS	Population Neighborhood	Population exposure	Continuous Pulsed fluorescence	**High–** Identified as area for assessing population exposure; monitoring gaseous species started in 2018; site selected as backup for Hawthorne station	Continue monitoring
Air Monitoring Center		SLAMS	Population Neighborhood	Population exposure	Continuous Pulsed fluorescence	**New-** re-located just 1 mile from Rose Park station. Instruments has been set up on the roof; selected as a potential replacement of the Rose Park station	Continue monitoring

3.2.3 Nitrogen Dioxide (NO_2) Network

3.2.3.1 Historical trends and deviations from NAAQS

National standards for NO_2 include hourly and annual standards of 100 and 53 ppb, respectively. The hourly standard is met when the 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years, is less than 100 ppb. The annual standard is met when the annual mean is less than 53 ppb. Utah has been in compliance with these standards (see Figure 20 and Figure 21), with the exception of only one 1-hr value above the hourly NAAQS during 2017-2019 (see Table 31).

Table 31. Number of exceedances of primary 1-hr NO_2 NAAQS during 2017-2019

	Number of exceedances of primary 1-hr 2010 SO2 NAAQS		
	2017	**2018**	**2019**
Bountiful Viewmont	0	1	0
Smithfield	0	0	0
Price	0	0	0
Roosevelt	0	0	0
Hawthorne	0	0	0
Vernal	0	0	0
Copperview	NA	0	0
Hurricane	0	0	0
Ogden #2	0	0	0
Harrisville	0	0	0
Enouch	0	0	0
Lindon	0	0	0
Spanish Fork	0	0	0
Erda	0	0	0
Near Road	NA	0	0
Rose Park	NA	0	0
Herriman	0	0	0
Magna	0	0	0
Air Monitoring Center	NA	NA	0

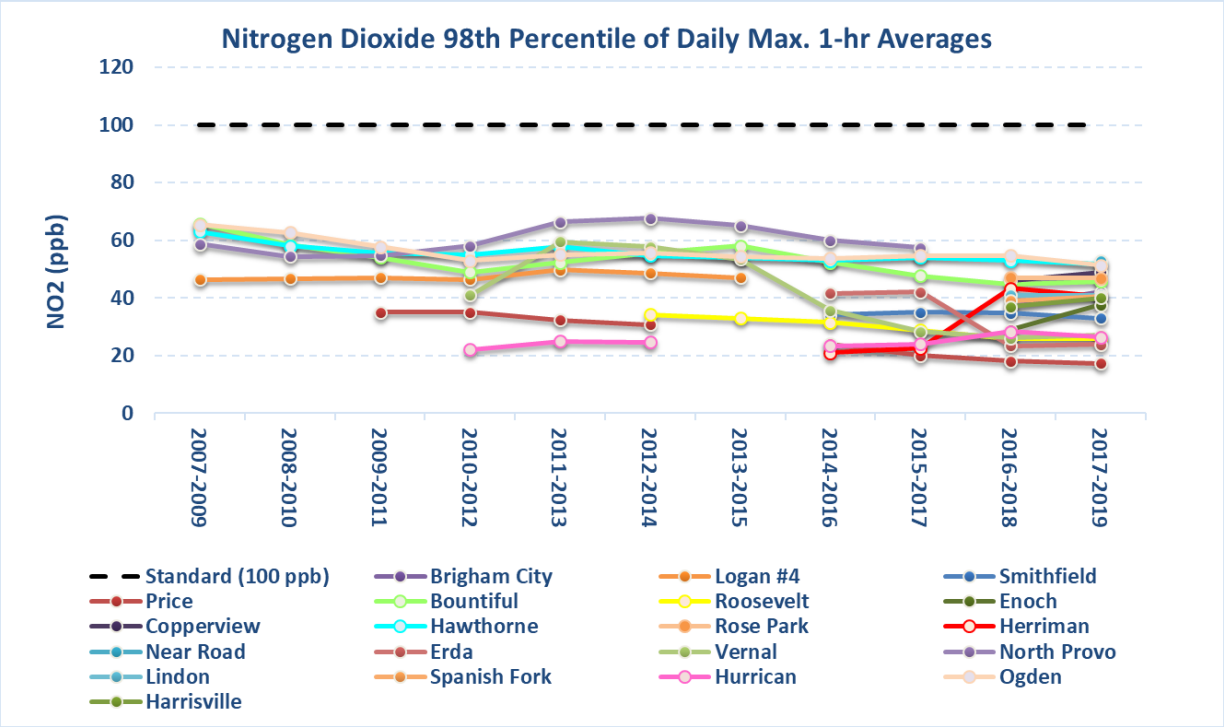

Figure 20. 1-hr design value trends and comparison to NAAQS for NO_2 during the period 2007-2019.

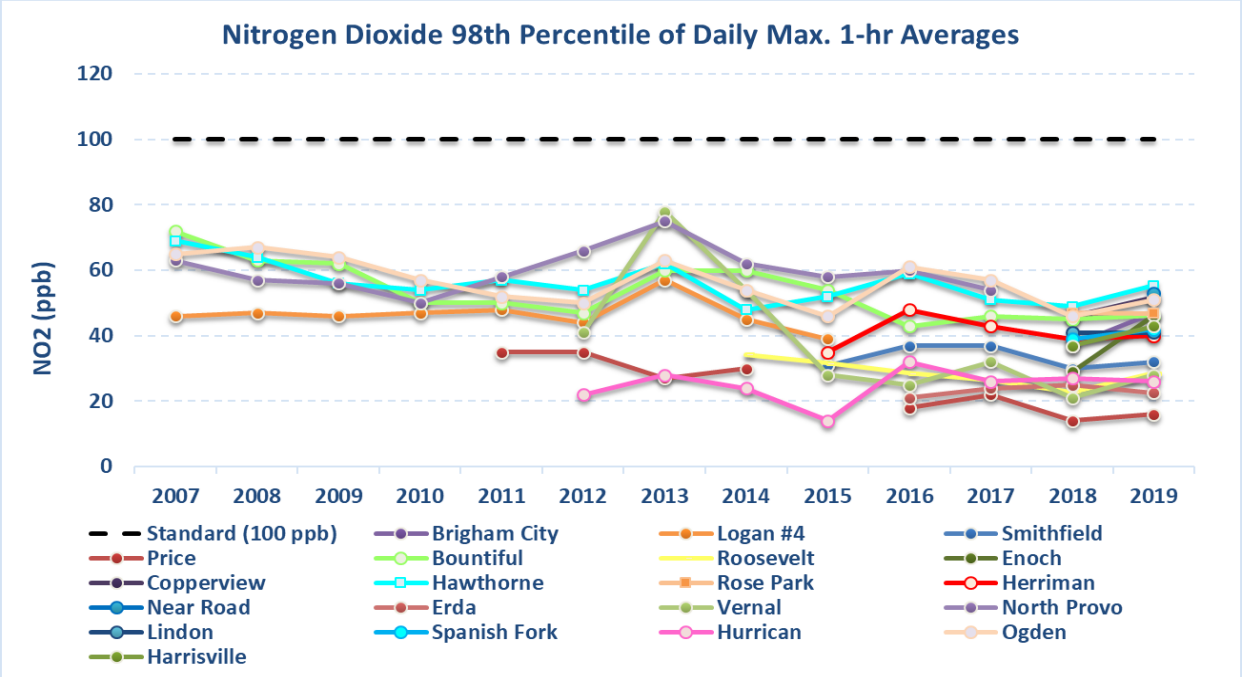

Figure 21. Annual design value trends and comparison to NAAQS for NO_2 during the period 2000-2019.

3.2.3.2 Site-by-Site Analysis and Near-Road NO_2 Monitoring

The UDAQ currently operates NO_2 monitors in seventeen out of twenty-one monitoring stations that are presently operational. Although Utah has demonstrated compliance with NO_2 standards, the UDAQ would like to maintain NO_2 monitoring at all sites since emissions of this pollutant can lead to increased O_3 levels and $PM_{2.5}$ formation, often resulting in pollution levels exceeding the NAAQS. Photochemical reactions between NO_2 and volatile organic compounds lead to the formation of ground-level O_3 along the Wasatch Front and the Uinta Basin during summer and winter, respectively[6,7]. NO_2 can also react with ammonia to form nitrate-$PM_{2.5}$ during winter. Therefore, to support efforts towards understanding and controlling high $PM_{2.5}$ and O_3 levels, particularly during winter, the UDAQ would like to maintain NO_2 monitoring at all current sites. A Near Road station was established in January 2019 on I-15 at the address 5001 Galleria Dr, Murray, to satisfy federal monitoring requirements. Federal regulations require a minimum of one monitor to be placed in any urban area with a population greater than or equal to one million people in order to assess community-wide concentrations. Regulations also require at least one monitor to be located near a major road in urban areas with a population greater than or equal to 500,000 people and monitors to be placed in other areas where maximum concentrations are expected. All sites satisfy minimum federal NO_2 monitoring requirements, with a few stations exceeding the requirements. The minimum number of required NO_2 monitors and a count of active NO_2 monitors in the UDAQ network are provided in Table 32. The Salt Lake City CBSA has six NO_2 monitors located at Hawthorne (HW), Herriman (H3), Erda (ED), Copperview (CV), Rose Park (RP) and the Air Monitoring Center (AMC) stations. The monitors satisfy federal requirements for community-based (area-wide) NO_2 monitoring and the near-road monitoring at this CBSA; however, an additional near-road monitor is required within the Salt Lake CBSA. The UDAQ will work on establishing near-road sites in Utah and Davis counties but it will not be until funding becomes available. Other monitoring objectives currently have a higher priority due to the scarcity of resources. An evaluation of NO_2 monitors in UDAQ network is provided in Table 33.

[6] UDAQ, 2012 Utah Ozone Study
[7] UDAQ, 2014 Uinta Basin Winter Ozone Study Final Report

Table 32. Number of active NO_2 monitors in each CBSA and minimum number of required monitors.

CBSA	Counties	Census 2010	Population estimate (2030)	Minimum number of required near-road monitors	Minimum number of required area-wide monitors	Number of active monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,440,329	1	1	3 plus 3*(area-wide) 1 (near-road)
Provo-Orem MSA	Juab Utah	526,810	850,304	1	0	2 (area-wide)
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	766,860	1	0	2 (area-wide)
Heber µSA	Wasatch, UT	32,741	44,549	0	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	Total: 125,442 Cache County, UT: 112, 656	Cache County: 168,136	0	0	1
Saint George UT MSA	Washington, UT	138, 115	280,558	0	0	1
Cedar City µSA	Iron, UT	46,163	71,687	0	0	1
Price µSA	Carbon, UT	21, 403	22,092	0	0	1
Vernal UT µSA	Uintah, UT	32, 588	41,099	0	0	1
Summit Park	Summit, UT	36, 324	56,890	0	0	0

*measurements starting 2018 and 2019

Table 33. List of NO_2 monitors in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	High Neighborhood	Population exposure	Nitrogen dioxide/Instrumental Chemiluminescence	**High–** NCore site; supports model performance evaluation and NAAQS maintenance demonstration; high-exposure area	Continue monitoring
Herriman #3		SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High–** established to assess population exposure in southwest Salt Lake County	Continue monitoring
CopperView		SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High–** Identified as area for assessing population exposure in southeast Salt Lake County	Continue monitoring
Rose Park		SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**Moderate-** started monitoring gaseous species in 2018; site selected as a backup measurement for HW station	Continue monitoring
Erda	Tooele	SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**Moderate-**identified in assessment as high O_3 exposure area	Continue monitoring

Table 34 (cont.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	Value	Recommendation
Near Road	Salt Lake	SPM	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High–** site recently established to assess population exposure to and to monitor vehicular contribution to air pollution as part of the EPA NO2 monitoring program	Continue monitoring
Air Monitoring Center		SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**New-** re-located just 1 mile from Rose Park station. Instruments has been set up on the roof; selected as a potential replacement of the Rose Park station	Continue monitoring
Lindon	Utah	SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High–** supports model performance evaluation and NAAQS maintenance demonstration; high-exposure	Continue monitoring
Spanish Fork		SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**Moderate–** supports model performance evaluation/O_3 maintenance demonstration; local high-ozone concentration area	Relocate site due to logistical issues and continue monitoring

Table 34 (cont.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	Value	Recommendation
Bountiful Viewmont	Davis	SLAMS	High Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High** – supports model performance evaluation	Continue monitoring
Harrisville	Weber	SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High**– established in response to an O_3 saturation study; high-ozone concentration area, this site was combined with Ogden #2	Continue monitoring
Hurricane	Washington	SLAMS	Regional	High winter O_3 study	Nitrogen oxides/Instrumental Chemiluminescence	**Moderate**– supports model performance evaluation and control of high winter-time O_3 levels	Continue monitoring
Smithfield	Cache	SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**Moderate-** established to assess population exposure, provide a baseline of levels in Logan area	Continue monitoring

Table 34 (cont.)

Site	County	Monitor Type	Spatial scale	Monitoring objective	Method/Schedule	Value	Recommendation
Price#2	Carbon	SPM	Regional	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High-** supports model performance evaluation and control of high winter-time O_3 levels	Continue monitoring
Roosevelt	Duchesne	SLAMS	Regional	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High–** supports model performance evaluation and control of high winter-time O_3 levels	Continue monitoring
Vernal #4	Uintah	SLAMS	Regional	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**High–** established in response to an O_3 study and displayed a design value above O_3 NAAQS	Continue monitoring
Hurricane	Washington	SLAMS	Regional	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**Moderate–**established to provide a baseline of levels in the St. George MSA; it is the only monitor that provides O_3 monitoring for Washington County	Continue monitoring
Enoch	Iron	SLAMS	Population Neighborhood	Population exposure	Nitrogen oxides/Instrumental Chemiluminescence	**Moderate-** established to assess population exposure	Continue monitoring

3.2.4 Carbon Monoxide (CO) Network

3.2.4.1 Historical Trends and Deviations from NAAQS

The national 1-hr and 8-hr standards for CO are 35 and 9 ppm, respectively. The standards are not to be exceeded more than once per year. Three cities in Utah, Salt Lake City, Ogden and Provo, were at one time designated as non-attainment areas for CO. However, given recent improvements in motor vehicle technology, Salt Lake City, Ogden and Provo have been successfully re-designated as attainment areas in 1999, 2001 and 2006, respectively. All areas in Utah are currently in compliance with CO NAAQS, as shown in Table 34, Figure 22 and Figure 23. Note that CO monitoring at Washington Boulevard and Cottonwood stations was discontinued in 2013 and 2012, respectively. Cottonwood station was closed due to violations of EPA siting criteria and data redundancy with Hawthorne site. Washington Boulevard was shut down because CO was the only measured parameter at this site and the collected data was redundant with that monitored at Ogden site, located about 1 mile south. North Provo station was permanently discontinued in 2018 and CO measurements at this site was no longer required as part of the CO maintenance plan.

Table 34. Number of exceedances of primary 1-hr and 8-hr CO NAAQS during 2017-2019

	Number of exceedances of 1-hr/8-hr 1971 CO NAAQS		
	2017	**2018**	**2019**
Hawthorne	0	0	0
Copperview	0	0	0
Rose Park	0	0	0
Near Road	0	0	0
Lindon	0	0	0
North Provo*	0	0	NA
Harrisville	0	0	0

*The station was discontinued As of Q1 of 2018 all of the instruments at the station were taken offline. Complete station removal will be finished by the end of Q2 of 2018.

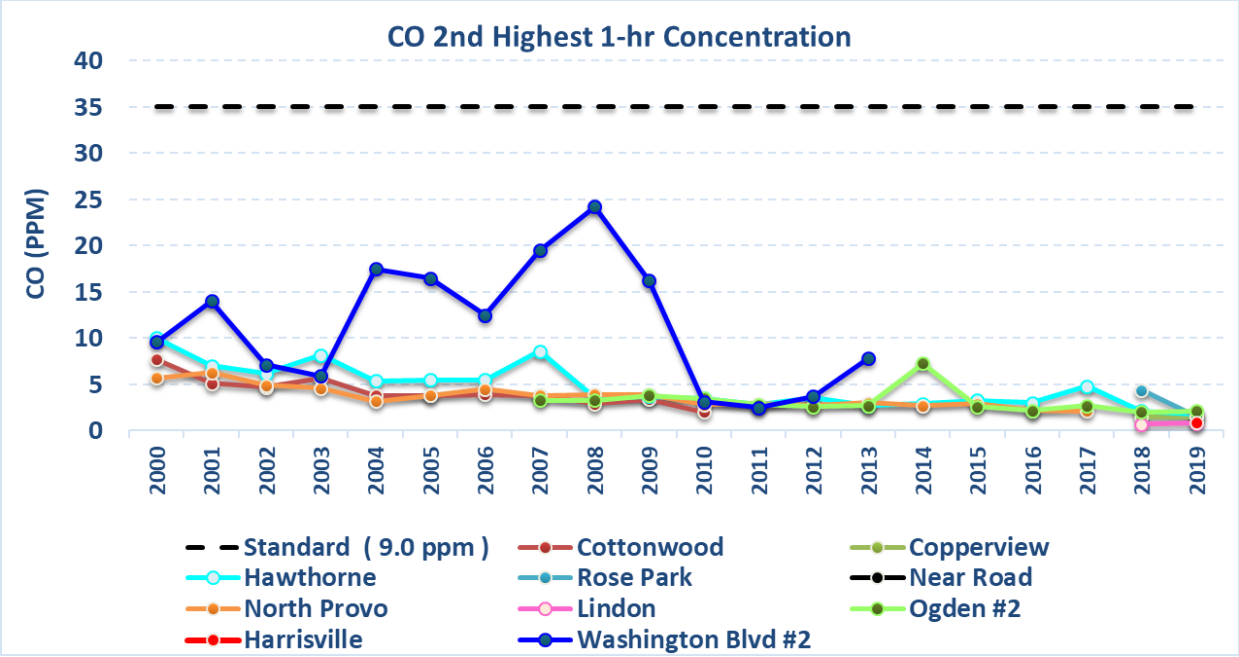

Figure 22. Second-highest 1-hr concentration trends and comparison to NAAQS for CO during the period 2000-2019. **Note**: Washington Blvd # 2 site was located right on the sidewalk next to a BBQ joint that would roll out the grills on the sidewalk to grill within a few feet of our monitor inlet, it may be affecting the CO concentration levels at the site.

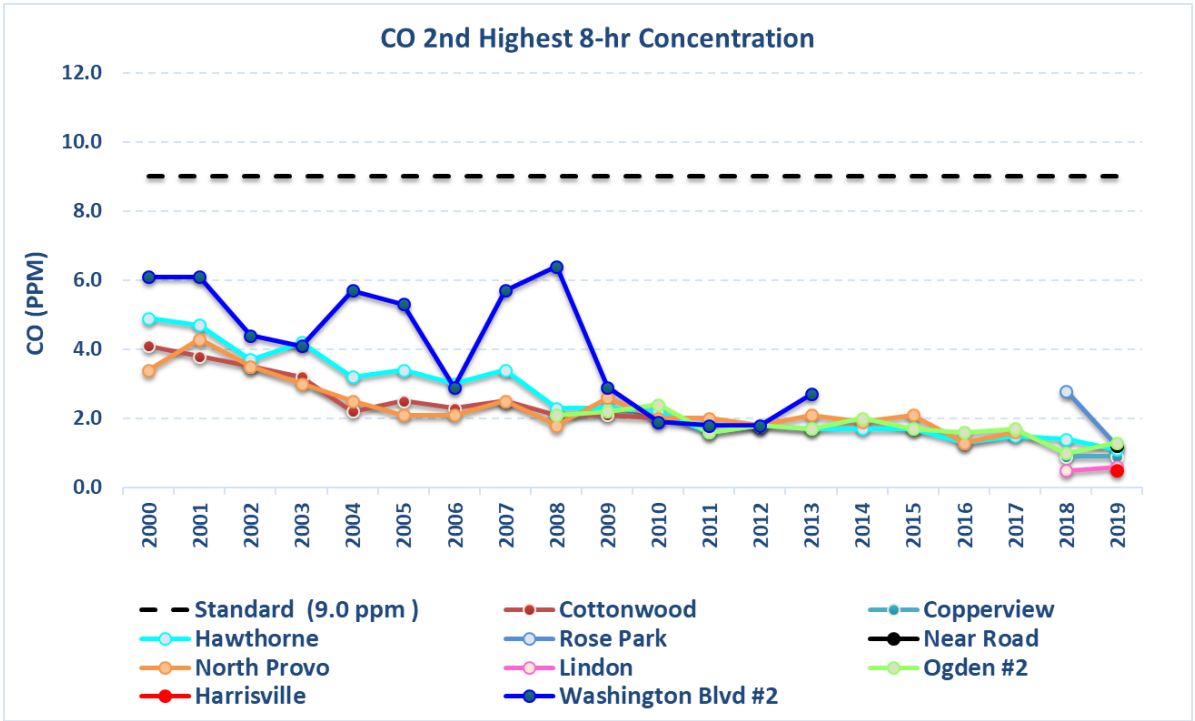

Figure 23. Second-highest 8-hr concentration trends and comparison to NAAQS for CO during the period 2000-2019.

3.2.4.2 Site-by-Site Analysis

The UDAQ currently operates seven CO monitors within its network. These are located at Hawthorne (HW), Rose Park (RP), Harrisville (HV), Copperview (CV), Lindon (LN), Air Monitoring Center (AMC) and the Near Road (NR). The minimum federal monitoring requirements for CO and an evaluation of CO monitors in UDAQ network are provided in Table 35 and Table 36, respectively.

Salt Lake City CBSA

According to federal regulations, one CO monitor is required to operate co-located with one required near-road NO_2 monitor in CBSAs having a population of 1,000,000 or more. If a CBSA has more than one required near-road NO_2 monitor, only one CO monitor is required to be co-located with a near-road NO_2 monitor within the CBSA. The UDAQ currently operates a co-located CO at the Near Road station.

Provo-Orem and Ogden-Clearfield CBSAs

The UDAQ currently operates one CO monitor in each of the Provo-Orem and Ogden-Clearfield CBSAs, which exceeds minimum federal monitoring requirements. The samplers located at Lindon and Harrisville are used to monitor population exposure to emissions from anthropogenic activities in the area as well as to support CO maintenance plans. The UDAQ would therefore like to maintain CO monitoring at these sites.

Table 35. Number of active CO monitors in each CBSA and minimum number of required monitors.

CBSA	Counties	Census 2010	Population estimate (2030)	Minimum number of required near-road NO_2 monitors	Minimum number of required CO monitors	Number of active CO monitors
Salt Lake City MSA	Tooele, UT Salt Lake, UT	1,087,873	1,440,329	1	1* (co-located with near-road NO_2 monitor)	1 (area-wide) 3* (area-wide)
Provo-Orem MSA	Juab, UT Utah, UT	526,810	850,304	1	0	1 (area-wide)
Ogden-Clearfield MSA	Box Elder, UT Davis, UT Morgan, UT Weber, UT	597,159	766,860	1	0	1 (area-wide)
Heber µSA	Wasatch, UT	23, 530	44,549	0	0	0
Logan UT-ID MSA	Cache, UT Franklin, ID	112, 656	168,136	0	0	0
Saint George MSA	Washington, UT	138, 115	280,558	0	0	0
Cedar City µSA	Iron, UT	46,163	71,687	0	0	0
Price µSA	Carbon, UT	21, 403	22,092	0	0	0
Vernal µSA	Uintah, UT	32, 588	41,099	0	0	0
Summit Park µSA	Summit, UT	36, 324	56,890	0	0	0

*sites established in 2018 and 2019.

Table 36. List of CO monitors in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Sampling and Analysis Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	High Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**High–** NCore site; high-exposure area; design value location for CO NAAQS; supports CO maintenance plan and model performance evaluation	Continue monitoring
Rose Park		SLAMS	Population Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**moderate-** started monitoring gaseous species in 2018 as a backup measurement for HW station	Continue monitoring
Air Monitoring Center		SLAMS	Population Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**New-** re-located just 1 mile from Rose Park station. Instruments has been set up on the roof with the objective to replace Rose Park station	Continue monitoring
Near Road		SPM	Population Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**High–**established to assess population exposure to and to monitor vehicular contribution to air pollution as part of the EPA NO_2 (CO co-located) monitoring program	Continue monitoring
Harrisville	Weber	SLAMS	Population Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**High– started** in 2019 to monitoring CO as Ogden #2 station was shut down; supports CO maintenance plan and model performance evaluation;	Continue monitoring
LN	Utah	SLAMS	Population Neighborhood	Population exposure	Instrumental Gas Phase Correlation/ Continuous	**High–** supports CO maintenance plan/model performance evaluation; design value location for CO NAAQS	Continue monitoring

3.3 Lead (Pb) Network

3.3.1 Historical trends and deviations from NAAQS

Historically, major sources of lead emissions came from combustion of leaded fuel as on-road motor vehicle fuel emissions. However, given that leaded gasoline for automobiles was completely eliminated by the end of 1995 in the U.S., the only sources of lead in Utah include extraction and processing of metallic ores as well as piston-engine aircrafts.

On November 12 2008, EPA revised the primary and secondary NAAQS for lead to 0.15 µg/m^3 in total suspended particles (TSP). The previous standards, which were issued by EPA in 1978, were ten times higher (1.5 µg/m^3). To meet the standard, a rolling three-month average lead concentration may not exceed 0.15 µg/m^3. The state of Utah has been in compliance with the lead NAAQS since 1982, with EPA authorizing the discontinuation of lead monitoring in Utah in 2005. However, given that EPA established new requirements for lead monitoring in 2008 and 2010, UDAQ resumed lead monitoring at Magna, a point source site near the Kennecott copper smelter, from 2010 through June 2017 (data shown in Figure 24). EPA approved the discontinued monitoring in 2017 due to extremely low concentrations.

UDAQ and EPA will continue observing the requirements, such as source emission thresholds, population, and NAAQS revisions that may trigger the need to resume monitoring lead in Utah.

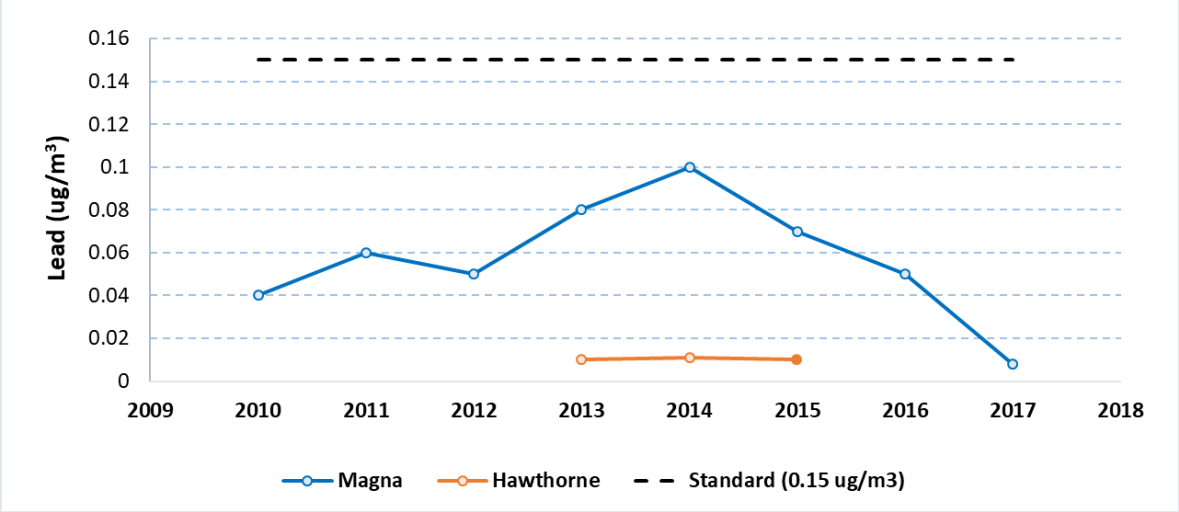

Figure 24. Trends in maximum three-month average 24-hr Pb concentration during the period 2010-2017 and comparison to NAAQS.

3.4 Chemical Speciation Network (CSN)

UDAQ currently operates four $PM_{2.5}$ chemical speciation sites, including Hawthorne (HW), Bountiful Viewmont (BV), Lindon (LN) and Smithfield (SM). HW site in Salt Lake County is an EPA-designated CSN monitoring station, operating on a 1-in-3-day sampling schedule. BV in Davis County, LN in Utah County and SM in Cache County are SLAMS $PM_{2.5}$ speciation sites, operating on a 1-in-6-day sampling schedule. Data from the speciation network are primarily used

to determine $PM_{2.5}$ chemical composition and sources as well as the spatial and temporal variation in its components. A list of measured parameters and analyses methods at this site is provided in Table 37.

3.5 NCore Network

UDAQ currently operates one NCore site, Hawthorne, located in Salt Lake County. The site is equipped with several advanced measurement systems to monitor PM ($PM_{2.5}$ and PM_{10}), O_3, NO_2, trace levels of CO, SO_2, total reactive nitrogen (NO_y), Carbonyl Compounds, organic and elemental carbon as well as meteorological parameters (ambient temperature, ambient pressure, solar radiation, wind speed, wind direction and relative humidity). On January 1, 2019 a gas chromatograph was installed at this site to monitor volatile organic compounds (VOCs) from methane (C1) to n-Dodecane (C-12). This site satisfies federal requirements for the Photochemical Assessment Monitoring Station (PAMS) network program. A list of measured parameters and analyses methods at this site is provided in Table 38.

3.6 Air Toxics Trends Network

UDAQ has been participating in the EPA-funded Urban Air Toxics Monitoring Program since 1999. In January 2003, the air toxics monitoring equipment was re-located from West Valley to Bountiful Viewmont (BV) in order to co-locate the air toxics monitors with $PM_{2.5}$ speciation samplers, which would provide a more complete characterization of monitored air pollutants. In addition, aldehydes and PM_{10}-metals is also provided at this site. A list of measured parameters and analyses methods at this site is shown in Table 39.
A Map showing the sites that take part of the EPA special programs is presented in Figure 25.

3.7 Mercury Deposition Network

Mercury is of significant health and environmental concern in Utah. Advisories limiting the consumption of fish have been issued for certain lakes and watersheds due to their elevated mercury levels. UDAQ was part of the National Mercury Deposition Network, measuring mercury dry deposition from 2009 to summer 2017 and measurements were discontinued after consultation with the EPA.

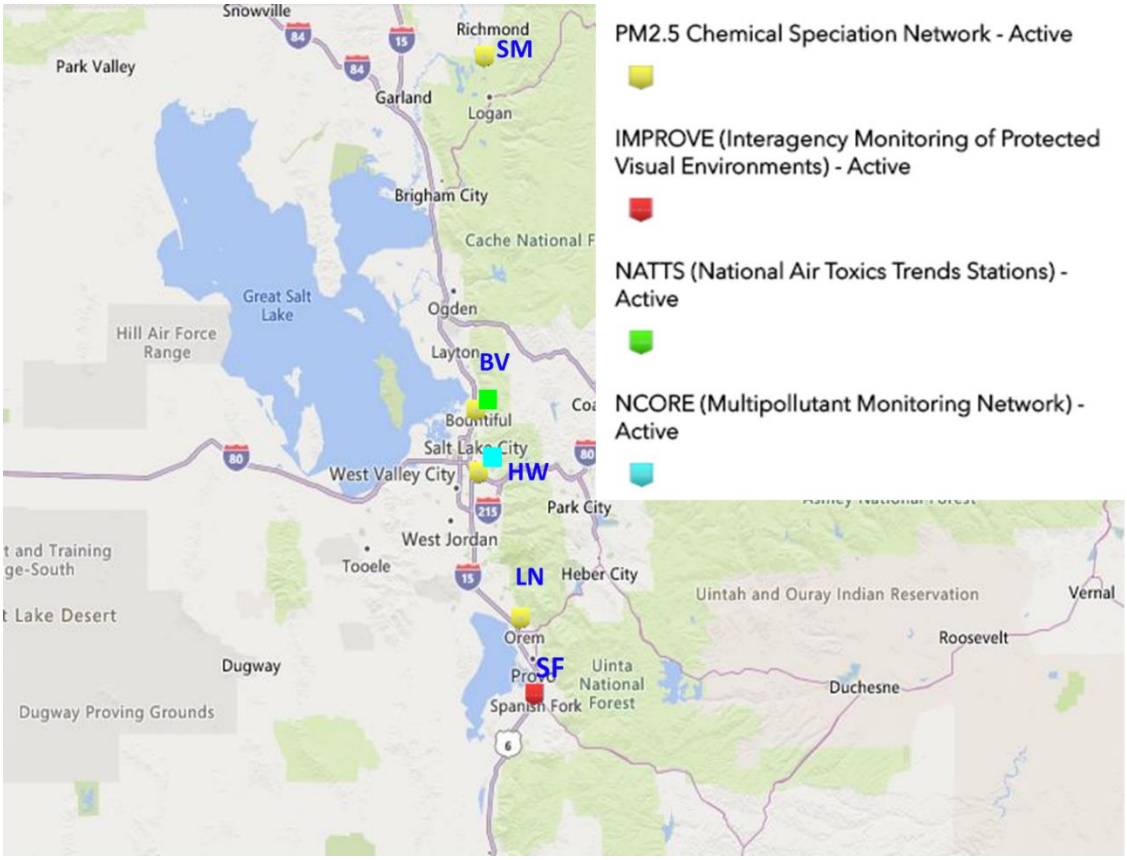

Figure 25. Monitoring stations designed for chemical Speciation, NCore, Air Toxic Trends and IMPROVE.

Table 37. List of chemical speciation sites in Utah air monitoring network and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Bountiful Viewmont	Davis	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**High**–The average last three years design value was below $PM_{2.5}$ NAAQS; supports model performance, evaluation and SIP development	Continue monitoring
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**High**– The average last three years design value was below $PM_{2.5}$ NAAQS; NCore site; supports model performance, evaluation and SIP development	Continue monitoring
Lindon	Utah	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**High**– the average last three years design value was below $PM_{2.5}$ NAAQS; supports model performance evaluation/SIP development	Continue monitoring
Smithfield	Cache	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**Moderate**– The average last three years design value was below $PM_{2.5}$ NAAQS; supports model performance, evaluation/SIP development	Continue monitoring

Table 38. List of NCore network sites and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Hawthorne	Salt Lake	SLAMS	Population Neighborhood	Population exposure	$PM_{2.5}$ speciation/ Manual EPA CSN	**High**– supports air quality model evaluation, SIP development and NAAQS maintenance plans; design value location for NAAQS; design value above $PM_{2.5}$ NAAQS; supports AQI reporting/forecasting	Continue monitoring
					$PM_{2.5}$ FRM/Manual gravimetric		
					PM_{10} FRM/Manual gravimetric		
					$PM_{10-2.5}$/Manual gravimetric subtraction		
			High Neighborhood		NO_2/ Instrumental Chemiluminescence		
			Population Neighborhood		NOy/ Instrumental Chemiluminescence		
					SO_2/Pulsed fluorescence		
			High Neighborhood		O_3/Instrumental Ultra Violet		
					CO/ Instrumental Gas Phase Correlation		
			Population Neighborhood		OC, EC/NIDR		
				Air Quality Index	PM_{10} continuous /TEOM FDMS		
					$PM_{2.5}$ continuous /TEOM FDMS		
				O_3 modeling input	PAMS C2 to C12/ Instrumental gas chromatography		
			Urban	-	Surface meteorology		

Table 39. List of National Air Toxics Trends Stations (NATTS) and recommendations for network modification.

Site	County	Monitor Type	Spatial scale	Monitoring objective	Pollutant/Method	Value	Recommendation
Bountiful Viewmont	Davis	SLAMS	Population Neighborhood	Population exposure	VOCs/ Manual EPA NTTN	**High**– NATTS site; toxics data co-located with $PM_{2.5}$ speciation data and gaseous monitors; monitors emissions from nearby oil refineries	Continue monitoring
					Semi-volatiles/ Manual EPA NTTN		
					Carbonyl Compounds/Manual EPA NTTN		
					PM_{10} metals/ Manual Gravimetric		
					PM_{10} metals co-located/ Manual Gravimetric		
					Hexavalent Chromium/ Manual EPA NTTN		

3.8 Meteorological Monitoring Network

Meteorological parameters, including ambient temperature, temperature differential, relative humidity, ambient pressure, solar radiation as well as wind speed and direction, are currently measured at multiple sites throughout the state of Utah in order to represent properly the complex wind patterns and micrometeorology in Utah's airshed and to support air quality models and trends in co-located air pollutants. The UDAQ does not recommend making any changes to the meteorological monitoring network; however, beginning this year the UDAQ will start updating the technology used to measure the meteorological variables. Presently, the system used to measure the wind direction and speed consist of cup anemometers and vane systems (in all the stations but Roosevelt), but, it will be replaced by sonic anemometer systems (2D sonic sensors, RM Young Ultrasonic 86004). The modifications will yield in a lower maintenance of the meteorological systems and a lower detection threshold, which will allow the UDAQ to capture and better understand the small eddies and transports during our cold pool seasons, where the typical analog sensor will read no wind flow. The new system will be smaller and more cost effective than the current set up, which is favorable for the limited space in the monitoring shelters.

A second crucial update is to get a combination of temperature and relative humidity sensors (Campbell Scientific HMP60) at every site, currently few sites are monitoring relative humidity, which will be beneficial for air quality modeling application. In addition, pyranometers (Campbell Scientific CS301) to measure incoming solar radiation will also be installed.

Table 40 lists measured meteorological parameters, including a) relative humidity, b) ambient temperature and temperature difference, c) barometric pressure, d) wind speed, e) wind direction, f) standard deviation in wind direction (WD sigma) and g) solar radiation, in Utah's air monitoring network.

Table 40. List of measured meteorological parameters, including a) relative humidity, b) ambient temperature and temperature difference, c) barometric pressure, d) wind speed, e) wind direction, f) standard deviation in wind direction (WD sigma) and g) solar radiation, in Utah air monitoring network and recommendations for network modification.

a) Relative humidity

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Roosevelt	Duchesne	Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– MET data co-located with O_3 measurements	Continue monitoring
Air Monitoring Center	Salt Lake	Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Saltair		Urban	Relative humidity/Elec. Thin film	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Erda		Urban	Relative humidity/Elec. Thin film	Continuous	3	**High**– MET data co-located with air pollutants	Continue monitoring
Herriman		Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Hawthorne		Urban	Relative humidity/Elec. Thin	Continuous	10	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring
Antelope Island	Davis	Urban	Relative humidity/Elec. Thin film	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring

Badger Island	Tooele	Urban	Relative humidity/Elec. Thin film	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring
Lindon	Utah	Urban	Relative humidity/Elec. Thin film	Continuous	10	**High** – MET data co-located with air pollutants	Continue monitoring
Price #2	Carbon	Regional	Elec. Thin Film	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Hurricane	Washington	Regional	Elec. Thin Film	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring

b) Ambient temperature and temperature difference

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Price #2	Carbon	Regional	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Antelope Island	Davis	Urban	Ambient temperature/Elec. resistance	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring

Roosevelt	Duchesne	Urban	Ambient Temperature/Elec. resistance	Continuous	10	**High–** MET data co-located with O_3 measurements	Continue monitoring
					2		
			Temperature difference/Math Channel		10-2		
Air Monitoring Center	Salt Lake	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High–** MET data co-located with mercury deposition measurements	Continue monitoring
Saltair		Urban	Ambient temperature/Elec. resistance	Continuous	10	**Moderate–** supports air quality modeling	Continue monitoring
Hawthorne		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High–** NCore site; MET data co-located with air pollutants	Continue monitoring
Erda		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High–** MET data co-located with air pollutants	Continue monitoring
Rose Park		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High–** MET data co-located with mercury deposition measurements	Continue monitoring
Copperview		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High–** MET data co- located with air pollutants	Continue monitoring
Badger Island	Tooele	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High–** supports modeling of lake emissions	Continue monitoring
Vernal #4	Uintah	Regional	Ambient temperature/Elec. resistance	Continuous	10	**High–**MET data co-located with air pollutants	Continue monitoring

Lindon	Utah	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Spanish Fork		Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Relocate site due to logistical issues
Hurricane	Washington	Regional	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Harrisville	Weber	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Enoch	Iron	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Smithfield	Cache	Urban	Ambient temperature/Elec. resistance	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring

c) Barometric pressure

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Bountiful Viewmont	Davis	Urban	Barometric pressure/Pressure transducer	Continuous	1	**High**– MET data co-located with air pollutants	Continue monitoring
Hawthorne		Urban	Barometric pressure/Pressure transducer	Continuous	3	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring
Herriman		Urban	Barometric pressure/Pressure transducer	Continuous	10	**High**– MET data co-located with air pollutants measurements	Continue monitoring

d) Wind speed

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Price #2	Carbon	Regional	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Antelope Island	Davis	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Roosevelt	Duchesne	Urban	Wind speed/Sonic method	Continuous	10	**High**– MET data co-located with O_3 measurements	Continue monitoring

Enoch	Iron	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Air Monitoring Center	Salt Lake	Urban	Wind speed/Sonic 2D	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Saltair		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Erda		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Copperview		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Herriman		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Rose Park		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Hawthorne		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring
Badger Island	Tooele	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring
Vernal #4	Uintah	Regional	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Lindon	Utah	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with North Provo	Consolidate with North Provo at a new location

Spanish Fork		Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Relocate site due to logistical issues
Hurricane	Washington	Regional	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Harrisville	Weber	Urban	Wind speed/Elec. Chopped signal Level 1	Continuous	10	**Moderate**– MET data co-located with air pollutants	Continue monitoring

e) Wind direction

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Price #2	Carbon	Regional	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Antelope Island	Davis	Urban	Wind direction/Elec. Resistance Level 1	Continuous	6	**High**– supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Roosevelt	Duchesne	Urban	Wind direction/Sonic method	Continuous	10	**High**– MET data co-located with O_3 measurements	Continue monitoring
Enoch	Iron	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring

Air Monitoring Center	Salt Lake	Urban	Wind direction/Sonic 2D	Continuous	4	**High**– MET data co-located with air pollutants	Continue monitoring
Saltair		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Moderate**– supports air quality modeling	Continue monitoring
Erda		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Copperview		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Herriman		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Rose Park		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Hawthorne		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– NCore site; MET data co-located with air pollutants	Continue monitoring
Badger Island	Tooele	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring
Vernal #4	Uintah	Regional	Wind direction /Elec. Chopped signal Level 1	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Lindon	Utah	Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with North Provo	Consolidate with North Provo at a new location

Spanish Fork		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**High–** MET data co-located with air pollutants	Relocate site due to logistical issues
Hurricane	Washington	Regional	Wind direction/Elec. Resistance Level 1	Continuous	10	**High** – MET data co-located with air pollutants	Continue monitoring
Harrisville		Urban	Wind direction/Elec. Resistance Level 1	Continuous	10	**Moderate–** MET data co-located with O_3 measurements	Continue monitoring

f) WD sigma

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Price #2	Carbon	Regional	WD Sigma/Elec. EPA method	Continuous	10	**High–** MET data co-located with air pollutants	Continue monitoring
Antelope Island	Davis	Urban	WD Sigma/Elec. EPA method	Continuous	6	**High–** supports modeling of lake emissions	Continue monitoring
Bountiful Viewmont		Urban	WD Sigma/Elec. EPA method	Continuous	10	**High** – MET data co-located with air pollutants	Continue monitoring
Roosevelt	Duchesne	Urban	WD Sigma/Elec. EPA method	Continuous	10	**High–** MET data co-located with O_3 measurements	Continue monitoring
Air Monitoring Center	Salt Lake	Urban	WD Sigma/Elec. EPA method	Continuous	4	**High–** MET data co-located	Continue monitoring
Saltair		Urban	WD Sigma/Elec. EPA method	Continuous	10	**Moderate–** supports air quality modeling	Continue monitoring
Hawthorne		Urban	WD Sigma/Elec. EPA method	Continuous	10	**High–** NCore site; MET data co-located with air pollutants	Continue monitoring

Badger Island	Tooele	Urban	WD Sigma/Elec. EPA method	Continuous	10	**High**– supports modeling of lake emissions	Continue monitoring
Vernal #4	Uintah	New Regional	WD Sigma/Elec. EPA method	Continuous	10	**New**–established to replace Vernal site (VL), which was shut down due to property development; MET data co-located with air pollutants	Continue monitoring
Lindon	Utah	Urban	WD Sigma/Elec. EPA method	Continuous	10	**Low**– MET data co-located with air pollutants but site redundant with North Provo	Consolidate with North Provo at a new location
Spanish Fork		Urban	WD Sigma/Elec. EPA method	Continuous	10	**High**– MET data co-located with air pollutants	Relocate site due to logistical issues
Hurricane	Washington	Regional	WD Sigma/Elec. EPA method	Continuous	10	**High**– MET data co-located with air pollutants	Continue monitoring
Harrisville		Urban	WD Sigma/Elec. EPA method	Continuous	10	**Moderate**– MET data co-located with O_3 measurements	Continue monitoring

g) Solar radiation

Site	County	Spatial scale	Pollutant/Method	Operating schedule	Tower height (m)	Value	Recommendation
Saltair	Salt Lake	Urban	Solar radiation/Elec. Licor	Continuous	2	**Moderate**– supports understanding of atmospheric photochemistry	Continue monitoring
Hawthorne		Urban	Solar radiation/Elec. EPPLY	Continuous	4	**High**– NCore site; data co-located with air pollutants; supports understanding of atmospheric photochemistry	Continue monitoring
Lindon	Utah	Urban	Solar radiation/Elec. EPPLY	Continuous	4	**High**–data co-located with air pollutants; supports understanding of atmospheric photochemistry	Continue monitoring
Smithfield	Cache	Urban	Solar radiation/Elec. EPPLY	Continuous	4	**High**–data co-located with air pollutants; supports understanding of atmospheric photochemistry	Continue monitoring
Badger Island	Tooele	Urban	Solar radiation/Elec. Licor	Continuous	2	**High**– supports modeling of lake emissions	Continue monitoring

4. **Summary of Proposed Network Modifications**

During the last five years, the UDAQ Monitoring Network system underwent the following changes:

- Wet and dry mercury sampling performed at the Air Monitoring Center (previous location) was dismissed in 2017 after approval by EPA.
- The North Provo station was consolidated with the Lindon station and was permanently discontinued at the end of 2017.
- Lead (pb) measurements were discontinued in 2017 after approval by EPA.
- The Rose park station was provided with gaseous monitors in 2018 with the objective to have backup measurements for the Salt Lake City Hawthorne station.
- The Enoch site located at Iron County was established due to the expected population growth that will exceed the threshold of federal monitoring requirements by 2020. The station started collecting data on January 2018.
- The Copperview monitoring station was installed in the southeast area of Salt Lake County, to support air pollution modeling efforts and supply air quality data to the increasing population in the southern area of Salt Lake Valley. The station is collecting data since April 2018.
- A Near-Road station was established in Salt Lake City CBSA, which includes NO_2 and CO measurements which are required by the EPA NO_2 program and started collecting data on January 1, 2019.
- The Brigham City station was removed on June 2019 because the school at which the station was housed needed the land to develop a carpool lane.
- The Ogden #2 station was removed because the location where the station was operating was used by the city for development area. The particulate monitoring instruments ($PM_{2.5}$ and PM_{10}) were re-located at Harrisville station, which is within the same CBSA area.
- A gas chromatograph and other PAMS instruments including carbonyl samplers and a Ceilometer were installed at the Hawthorne site to monitor O_3 precursors for O_3 production including volatile organic compounds (VOCs) from methane (C1) to n-Dodecane (C-12). This instrument has been collecting data but it is still being fine-tuned for optimal performance. The Hawthorne site is also the primary PAMS site for the Salt Lake City MSA.
- The newly constructed Technical Support Center was opened on May 21, 2019, and houses the Air Monitoring Center (AMC). A variety of instruments, including co-located equipment and instruments with new technology, have been set up on the roof of the building with the purpose of being the upcoming replacement to the Rose Park station.
- Several stations in the network have been adapted to measure additional pollutants to improve the efficacy of the network.

The UDAQ monitoring network meets all federal requirements and satisfactorily supports UDAQ monitoring objectives. However, while comprehensive changes are not necessary at this time, some targeted modifications could be implemented to enhance the effectiveness of the network.

Sites Recommended for Relocation:

- Relocate the Spanish Fork (SF) station to a nearby site due to planned construction work at its current location. The SF site, which is located at the Spanish Fork Airport in Utah County, should be moved in the near future due to airport construction. An alternative location within the Spanish Fork airport will be used. The UDAQ, however, will evaluate other sites in the area before proceeding with any changes.
- Relocate the Rose Park (RP) station to the Air Monitoring Center (AMC) once the comparability assessment criteria are attained.

Recommended New Sites/Monitors:

- Two monitors, located at Monticello Academy (2782 S Corporate Park Drive, West Valley City, UT, 84120) and at the new State Prison (located north of I-80 on the southern border of the Great Salt Lake in Salt Lake County) are in the process of being set up. The main purpose of these two sites is to measure the impact of the Inland Port and its effect on population exposure. Desired variables to be monitored at these sites include $PM_{2.5}$, O_3, nitrogen oxides (NO_x), black carbon (BC) and meteorological parameters.
- The UDAQ will start updating the technology used to measure the meteorological variables. Presently, the system used to measure the wind direction and speed consist of cup anemometers and vane systems (in all the stations but Roosevelt), but, it will be replaced by sonic anemometer systems (2D sonic wind sensors). Temperature and relative humidity probes and pyranometers to measure incoming solar radiation will also updated or included in all the stations.
- Establish a site in Box Elder County to replace the previous Brigham City station. The site will help assess population exposure in this area and will help the forecasters with the $PM_{2.5}$ predictions.
- The UDAQ is fulfilling the number of monitors necessary for each criteria pollutant requirements, however, due to unexpected situations that forced the UDAQ to shut down the existing sites at Ogden-Clearfield CBSA. The UDAQ will find suitable sites to establish a third monitoring site (at the other side of Provo Lake) in Provo-Orem CBSA to have a backup station in this CBSA and to support modeling and a second monitoring site at Cache Valley.
- Establish a second near-road NO_2 monitoring site in Salt Lake CBSA. Other monitoring objectives currently have a higher priority due to the lack of resources.

Monitors' Addition:

- Incorporate continuous PM_{10} monitoring samplers to operate in co-location with FRM filter-based measurements for comparability assessment. Once the comparability assessment criteria are met, the FEM continuous monitors will replace existing FRM monitors in the network, which will reduce the resources and labor required to maintain the FRM samplers and handle the filter samples.

Lastly, the UDAQ will continue reviewing all stations to ensure that they constantly meet acceptance criteria and monitoring objectives. Any sites that do not meet the requirements will be evaluated for future action.

Appendix A- Site Information

Site:	Air Monitoring Center (AMC)	Longitude:	-111.9461	Station Type:	SLAMS
AQS#:	49-035-3015	**Latitude:**	40.7769	**MSA:**	Salt Lake City
Address:	240 North 1950 West	**Elevation (m):**	1296		
City:	Salt Lake City				
County:	Salt Lake				

Site Objective:
The Air Monitoring Center site is established to replace the Rose Park station as an area of further investigation of $PM_{2.5}$ in Salt Lake County.
Does the site meet the objective:
Yes, all objectives are met.

Site Description:
The site is located near to the Multi- Agency State Office Building (MASOB) at the North West of Salt Lake City, Salt Lake County**.**
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ammonia	Manual NADP AMoN	Integrated 14 days	Population Exposure	SPM-Transport Regional
Trace Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- High Neighborhood
Ozone	Instrumental Ultraviolet	Continuous	Population Exposure	SLAMS- High Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- High Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
Carbon Monoxide	Instrumental Gas Phase Correlation	Continuous	Population Exposure	SLAMS- High Neighborhood
Sulfur Dioxide, Trace	Pulsed Fluorescence	Continuous	Population Exposure	SLAMS- High Neighborhood

Meteorological Parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale

Relative Humidity	Air Temperature and Relative Humidity Sensor- Electronic Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Air Temperature and Relative Humidity Sensor- Electronic Resistance	Continuous	10 meters	Urban
Wind Direction	2D-ultrasonic anemometer transducers	Continuous	10 meters	Urban
Wind Speed	2D-ultrasonic anemometer transducers	Continuous	10 meters	Urban
Ambient Pressure	Barometric Pressure Transducer	Continuous	10 meters	Urban
WD Sigma	Electronic EPA Method	Continuous	10 meters	Urban

Site:	Antelope Island (AI)	Longitude:	-112.2313	Station Type:	SPM
AQS#:	49-011-6001	Latitude:	41.0393	MSA:	Ogden-Clearfield
Address:	Antelope Island	Elevation (m):	1359		
City:	N/A				
County:	Davis				

Site Objective:
This site is established to collect meteorological information for air quality modeling inputs.
Does the site meet the objective: Yes, all objectives are met.

Site Description:
The site is on Antelope Island State Park, near the ranger residences, in Davis County.
Can data from this site be used to evaluate NAAQS?: No

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	6 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	6 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	6 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	6 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	6 meters	Urban

Site:	Bountiful Viewmont (BV)	Longitude:	-111.8845	Station Type:	SLAMS
AQS#:	49-011-0004	**Latitude:**	40.903	**MSA:**	Ogden-Clearfield
Address:	1370 North 171 West	**Elevation (m):**	1309		
City:	Bountiful				
County:	Davis				

Site Objective:
The Bountiful Viewmont site is established to determine public exposure to air pollution. The site also monitors emissions from nearby oil refineries and local sand and gravel operations. Previous monitoring and saturation studies have recorded high O_3 concentrations. This site is chosen for intensive speciation of $PM_{2.5}$ under the EPA Chemical Speciation Network (CSN) and gaseous Volatile Organic Compounds under the EPA National Air Toxics Trends Network (NTTN) including hexavalent chromium and carbonyl compounds. Nitrogen dioxide is monitored in support of the O_3 monitoring.
Does the site meet the objective: Yes, all objectives are met.

Site Description:
The site is located near Viewmont High School at the north end of the city of Bountiful, Davis County.
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
PM_{10} Metals	Manual Gravimetric	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
PM_{10} Metals Co-located	Manual Gravimetric	6 samples/year	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Speciation	Manual EPA CSN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
VOC	Manual EPA NTTN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
Semi-volatile	Manual EPA NTTN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
Carbonyl compounds	Manual EPA NTTN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
Black Carbon	Aethalometer	Continuous	Population Exposure	SLAMS- Population Neighborhood

Meteorological Parameters				
Parameter	**Sampling & Analysis Method**	**Operating Schedule**	**Tower Height**	**Spatial Scale**
Ambient Pressure	Barometric Pressure Transducer	Continuous	1 meter	Urban
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Copperview (CV)	Longitude:	-111.894127	Station Type:	SLAMS
AQS#:	49-011-0004	Latitude:	40.597938	MSA:	Salt Lake City
Address:	1380 North 200 West	Elevation (m):	1309		
City:	Midvale				
County:	Salt Lake				

Site Objective:
Site established to assess population exposure in southeast Salt Lake County
Does the site meet the objective: Yes, all objectives are met.

Site Description:
The site is located in a neighborhood area of Midvale in Salt Lake County.
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Carbon Monoxide, Trace	Instrumental Gas Phase	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Sulfur Dioxide, Trace	Pulsed Fluorescence	Continuous	Population Exposure	SLAMS- Population Neighborhood

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Enoch (EN)	Longitude:	-113.055525	Station Type:	SLAMS
AQS#:	490210005	Latitude:	37.74743	MSA:	Not in MSA
Address:	325 East N. Minersville	Elevation (m):	1692		
City:	Enoch				
County:	Iron				

Site Objective:
Site established to contain SPM equipment to assess population exposure in Iron County prior to full-scale monitoring
Does the site meet the objective:
Yes, all objectives are met.

Site Description:
The site is located in a neighborhood area of Midvale in Salt Lake County.
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Carbon Monoxide, Trace	Instrumental Gas Phase	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Sulfur Dioxide, Trace	Pulsed Fluorescence	Continuous	Population Exposure	SLAMS- Population Neighborhood

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Erda (ED)	Longitude:	-112.3550	Station Type:	SLAMS
AQS#:	49-045-0004	Latitude:	40.6005	MSA:	Salt Lake City
Address:	2163 West Erda Way	Elevation (m):	1320		
City	Erda				
County:	Tooele				

Site Objective:
This site is established to determine population exposure to air pollutants.

Does the site meet the objective:
Yes, all objectives are met.

Site Description:
The site is located in the city of Erda, Tooele County. It is the main monitor for the Tooele county.

Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood

Meteorological Parameters:

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	3 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Escalante (ES)	Longitude:	-111.614722	Station Type:	SPM
AQS#:	49-017-0004	**Latitude:**	37.775556	**MSA:**	NA
Address:	755 West Main	**Elevation (m):**	1789		
City	Escalante				
County:	Garfield				

Site Objective:
This site is established to measure O_3 near Escalante National Monument

Does the site meet the objective:
Yes, all objectives are met.

Site Description:
The site is located at the Escalante National Monument visitor's center in Escalante, Garfield County. This site is funded by the Bureau of Land Management

Can data from this site be used to evaluate NAAQS?: No

Gaseous/Particulate Parameters:				
Parameter	**Sampling & Analysis Method**	**Operating Schedule**	**Monitoring Objective**	**Spatial Scale**
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	Regional

Site:	Harrisville (HV)	Longitude:	-111.9865	Station Type:	SLAMS
AQS#:	49-057-1003	**Latitude:**	41.3028	**MSA:**	Ogden-Clearfield
Address:	425 West 2550 North	**Elevation (m):**	1331		
City:	Harrisville				
County:	Weber				

Site Objective:
This site is established in response to an O_3 saturation study indicating this as a potentially high O_3 concentration area. It is monitoring Particulate matter
Does the site meet the objective: Yes, all objectives are met.

Site Description:
The site is located on the grounds of Majestic Elementary School in the city of Harrisville, Weber County.
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
Carbon Monoxide Trace	Instrumental Gas Phase	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Hawthorne (HW)	Longitude:	-111.8721	Station Type:	SLAMS
AQS#:	49-035-3006	Latitude:	40.7343	MSA:	Salt Lake City
Address:	1675 South 600 East	Elevation (m):	1306		
City:	Salt Lake City				
County:	Salt Lake				

Site Objective:
This site is established to represent population exposure in the Salt Lake City area. This site is also designated as the EPA NCORE site for Utah.
Does the site meet the objective: Yes, all objectives are met.

Site Description:
The site is located at Hawthorne Elementary School in the southeast section of Salt Lake City, Salt Lake County.
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
Carbon Monoxide Trace	Instrumental Gas Phase	Continuous	Population Exposure	SLAMS-High Neighborhood
NOy Trace Level	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
SO2 Trace Level	Pulsed Fluorescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Speciation	Manual EPA CSN	1 in 3 days	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real Time NCore	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
PM_{coarse}	Manual Gravimetric Subtraction	Daily	Population Exposure	SLAMS- Population Neighborhood

Organic & Elemental	NIDR	Daily	Population Exposure	SLAMS- Population Neighborhood
PAMS C2 to C12	Instrumental Gas Chromatography	Continuous	O_3 modeling input	Population Neighborhood
Visibility	Instrumented	Continuous	Public Information	Population Neighborhood

Meteorological Parameters				
Parameter	**Sampling & Analysis Method**	**Operating Schedule**	**Tower Height**	**Spatial Scale**
Ambient Pressure	Barometric Pressure Transducer	Continuous	3 meters	Urban
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Solar Radiation	Elec. EPPLY	Continuous	4 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Herriman #3 (H3)	Longitude:	-112.036305	Station Type:	SLAMS
AQS#:	49-035-3012	**Latitude:**	40.496408	**MSA:**	Salt Lake City
Address:	14058 Mirabella Drive	**Elevation (m):**	1534		
City:	Herriman				
County:	Salt Lake				

Site Objective:
This site is established to represent population exposure in southwest the Salt Lake City area.
Does the site meet the objective: Yes, all objectives are met.

Site Description:
The site is located at Fort Herriman Middle School in southwest Salt Lake County
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Ambient Pressure	Barometric Pressure Transducer	Continuous	10 meters	Urban
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Hurricane (HC)	Longitude:	-113.3051	Station Type:	SLAMS
AQS#:	49-053-0007	Latitude:	37.1791	MSA:	St George
Address:	147 North 870 West	Elevation (m):	992		
City:	Hurricane				
County:	Washington				

Site Objective: This site is established to determine population exposure to O_3 in Washington County
Does the site meet the objective: Yes, all objectives are met.

Site Description: This site is located behind the Hurricane City offices
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Barometric Pressure	Barometric Pressure Transducer	Continuous	2 meters	Regional
WD Sigma	Elec. EPA Method	Continuous	10 meters	Regional
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Regional
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Regional
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Regional

Site:	Lindon (LN)	Longitude:	-111.7133	Station Type:	SLAMS
AQS#:	49-049-4001	Latitude:	40.3396	MSA:	Provo - Orem
Address:	50 North Main	Elevation (m):	1442		
City:	Lindon				
County:	Utah				

Site Objective: This site is established to determine PM emissions from commercial and industrial sources. Historically, this site has reported the highest PM values in Utah County
Does the site meet the objective: Yes, all objectives are met.

Site Description: The site is located at the Lindon Elementary School in the City of Lindon, Utah County
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population
$PM_{2.5}$	Manual Gravimetric Co-located	1 in 6 days	Precision and Accuracy	SLAMS- Population
$PM_{2.5}$	Manual EPA CSN	1 in 6 days	Population Exposure	SLAMS- Population
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS-Impact Neighborhood
Carbon Monoxide	Instrumental Gas Phase	Continuous	Population Exposure	SLAMS-High Neighborhood

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Regional
WD Sigma	Elec. EPA Method	Continuous	10 meters	Regional
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Regional

Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Regional
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Regional

Site:	Near Road (NR)	Longitude:	-111.9012	Station Type:	SPM
AQS#:	49-035-4002	Latitude:	40.6629	MSA:	Salt Lake City
Address:	5001 Galleria Dr.	Elevation (m):	1295		
City:	Murray				
County:					

Site Objective: This site recently established to assess population exposure to and to monitor vehicular contribution to air pollution as part of the EPA NO_2 monitoring
Does the site meet the objective: Yes, all objectives are met.

Site Description: A site was found for the Near Road monitor on I-15 at the address 5001 Galleria Dr, Murray
Can data from this site be used to evaluate NAAQS?: No

Gaseous/Particulate Parameters				
Parameter	**Sampling & Analysis Method**	**Operating Schedule**	**Monitoring Objective**	**Spatial Scale**
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
Carbon Monoxide	Instrumental Gas Phase	Continuous	Population Exposure	SLAMS-High Neighborhood

Site:	Price #2 (P2)	Longitude:	-110.77	Station Type:	SPM
AQS#:	49-007-1003	Latitude:	39.5958	MSA:	Price
Address:	351 South Weasel Run Road	Elevation (m):	1740		
City:	Price				
County:	Carbon				

Site Objective: This site is established in response to a three state O_3 study. It is funded by the Bureau of Land Management
Does the site meet the objective: Yes, all objectives are met.

Site Description: This site is located in a farm field 3.6 Km east of Price
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS-High Neighborhood

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
WD Sigma	Elec. EPA Method	Continuous	10 meters	Regional
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Regional
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Regional
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Regional

Site:	Roosevelt (RS)	Longitude:	-110.009	Station Type:	SPM
AQS#:	49-013-0002	Latitude:	40.2941	MSA:	NA
Address:	290 South 1000 West	Elevation (m):	1588		
City:	Roosevelt				
County:	Duchesne				

Site Objective: This site is established to determine maximum O_3 and $PM_{2.5}$ concentrations in Duchesne County
Does the site meet the objective: Yes, all objectives are met.

Site Description: The site is located in the city park North West section of Roosevelt.
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	High O_3 Winter Study	Regional
Ozone	Instrumental Ultra Violet	Continuous	High O_3 Winter Study	Regional
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	Regional

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	2 meters	Urban
Temperature	Math Channel	Continuous	2 meters	Urban

Site:	Rose Park (RP)	Longitude:	-111.9309	Station Type:	SLAMS
AQS#:	49-035-3010	Latitude:	40.7955	MSA:	Salt Lake City
Address:	1354 West Goodwin Avenue	Elevation (m):	1295		
City:	Salt Lake City				
County:	Salt Lake				

Site Objective: This site is established to better represent PM2.5 exposure in this area of Salt Lake City
Does the site meet the objective: Yes, all objectives are met.

Site Description: The site is located in the community of Rose Park at the north end of Salt Lake City, Salt Lake County
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS- Population Neighborhood
Carbon Monoxide	Instrumental Gas Phase	Continuous	Population Exposure	SLAMS- Population Neighborhood
Sulfur Dioxide	Pulsed Fluorescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population
$PM_{2.5}$	Manual Gravimetric Co-located	Daily	Precision and Accuracy	SLAMS- Population

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Saltair (SA)	Longitude:	-112.0497	Station Type:	SPM
AQS#:	49-035-3005	Latitude:	40.8061	MSA:	Salt Lake City
Address:	6640 West 1680 North	Elevation (m):	1282		
City:	Salt Lake City				
County:	Salt Lake				

Site Objective: This site is established to collect meteorological information for air quality models
Does the site meet the objective: Yes, all objectives are met.

Site Description: The site is located west of the Salt Lake Airport in Salt Lake County**.**
Can data from this site be used to evaluate NAAQS?: No

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban
Solar Radiation	Elec. LiCor	Continuous	2 meters	Urban

Site:	Smithfield (SM)	Longitude:	-111.851944	Station Type:	SLAMS
AQS#:	49-005-0007	Latitude:	41.842778	MSA:	Logan
Address:	675 West 220 North	Elevation (m):	1377		
City:	Smithfield				
County:	Cache				

Site Objective: Site established to replace Logan site and determine general population exposure.
Does the site meet the objective: Yes, all objectives are met.

Site Description: This site is located at Birch Creek Elementary School in Cache County. It is approximately 7 miles north of Logan
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters				
Parameter	**Sampling & Analysis Method**	**Operating Schedule**	**Monitoring Objective**	**Spatial Scale**
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
PM_{10}	Manual Gravimetric Co-located	1 in 6 days	Precision and Accuracy	SLAMS- Population Neighborhood
$PM_{2.5}$ Speciation	Manual EPA CSN	1 in 6 days	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor Co-located	Continuous	Precision and Accuracy	SLAMS- Population Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric Co-located	Daily	Precision and Accuracy	SLAMS- Population Neighborhood

Meteorological Parameters				
Parameter	**Sampling & Analysis Method**	**Operating Schedule**	**Tower Height**	**Spatial Scale**

WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Urban
Solar Radiation	Elec. EPPLY	Continuous	10 meters	Urban

Site:	Spanish Fork (SF)	Longitude:	-111.6603	Station Type:	SLAMS
AQS#:	49-049-5010	**Latitude:**	40.1364	**MSA:**	Provo - Orem
Address:	312 West 2050 North	**Elevation (m):**	1380		
City:	Spanish Fork				
County:	Utah				

Site Objective: This site is established to determine the boundary of the high O_3 and $PM_{2.5}$ concentrations in Utah County.
Does the site meet the objective: Yes, all objectives are met.

Site Description: The site is located at the Spanish Fork airport in the city of Spanish Fork, Utah County.
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	SLAMS- Population Neighborhood
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	SLAMS- Population Neighborhood
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS- Population Neighborhood
$PM_{2.5}$	Manual Gravimetric	Daily	Population Exposure	SLAMS- Population Neighborhood

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
WD Sigma	Elec. EPA Method	Continuous	10 meters	Urban
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Urban
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Urban
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Urban

Site:	Vernal (V4)	Longitude:	-109.560733	Station Type:	SLAMS
AQS#:	49-047-1003	Latitude:	40.464971	MSA:	NA
Address:	628 North 1700 West	Elevation (m):	1667		
City:	Vernal				
County:	Uintah				

Site Objective: This site is established was set up in response to an O_3 study**.**
Does the site meet the objective: Yes, all objectives are met.

Site Description: The site is located at the northwest of the city of Vernal.
Can data from this site be used to evaluate NAAQS?: Yes

Gaseous/Particulate Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Monitoring Objective	Spatial Scale
Nitrogen Dioxide	Instrumental Chemiluminescence	Continuous	Population Exposure	Regional
Ozone	Instrumental Ultra Violet	Continuous	Population Exposure	Regional
$PM_{2.5}$ Real Time	Synchronized Hybrid Ambient Real Time Particulate Monitor	Continuous	Air Quality Index	SLAMS-Population

Meteorological Parameters

Parameter	Sampling & Analysis Method	Operating Schedule	Tower Height	Spatial Scale
WD Sigma	Elec. EPA Method	Continuous	10 meters	Regional
Ambient Temperature	Elec. Resistance	Continuous	10 meters	Regional
Wind Direction	Elec. Resistance Level 1	Continuous	10 meters	Regional
Wind Speed	Elec. Chopped Signal Level 1	Continuous	10 meters	Regional
Relative Humidity	Elec. Thin Film	Continuous	10 meters	Regional
Barometric pressure	Pressure Transducer	Continuous	2 meters	Regional