2022 Monitoring Activities at the Utah Inland Port

PREPARED BY **Utah Department of Environmental Quality**
for the Utah Legislative Management Committee
and Inland Port Authority Board

Introduction

Pursuant to Utah Code 19-1-201, the following report provides a summary of stormwater and air quality monitoring data collected by the Utah Department of Environmental Quality (DEQ) within the statutorily defined area of Utah Inland Port (UIP) Authority.

Data collected by DEQ through 2023 will be used to form the baseline conditions for the UIP. Information presented in this report is intended as an overview of the monitoring locations, methods used, and results of years one and two of monitoring. This first and second year data should not be used to define or make inferences regarding the current baseline conditions until more data and information can be collected. Multiple years of quality data are needed to meaningfully assess any impact of the UIP on air and water quality.

Section 1: Stormwater Monitoring

Background

This section of the report, prepared by the Division of Water Quality (DWQ), presents the data collected during the first two years of our investigation of the effects of stormwater from the UIP on water quality. Building on the data collection in 2021, the additional stormwater data enhances DWQ's ability to discern patterns, compare sites undergoing various stages of development, and draw conclusions regarding potential land-use impacts. Furthermore, this report should inform future decision-making regarding the effectiveness of best management practices (BMPs) toward mitigation of stormwater pollution, as well as designing future stormwater monitoring plans.

Monitoring Locations and Associated Catchments

The objective of this report is to assess the condition of stormwater quality before, during and after UIP development through the analysis of chemical data including nutrients, metals and physical parameters, collected at six monitoring locations (Figure 1). Samples were collected from storm drain channels in developing areas of the UIP to assess changes in water quality over time in response to development. Monitoring locations are strategically placed within areas that are currently under development, or may be in the future.

Figure 1. UIP boundary, study catchments and monitoring sites

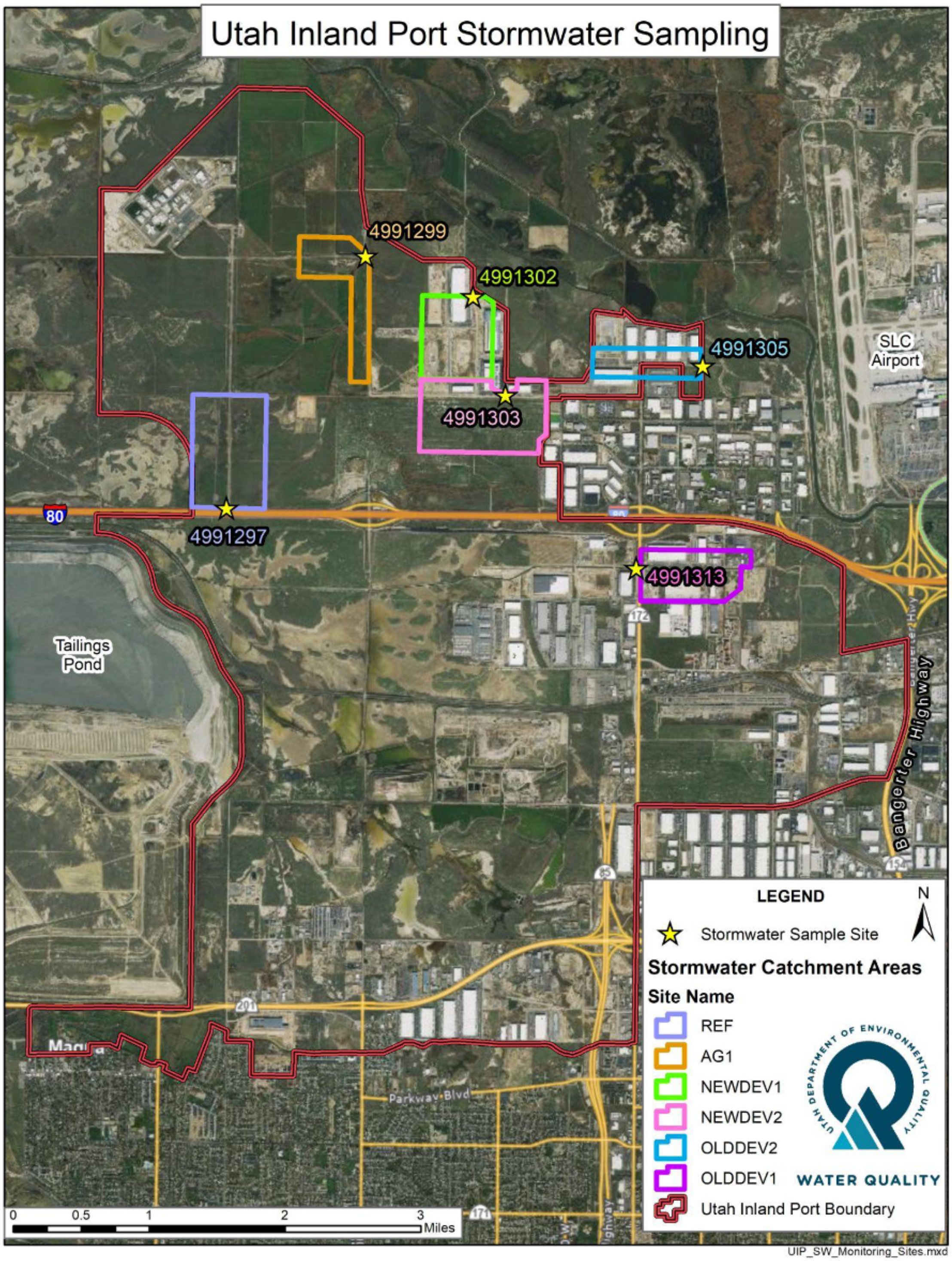


Table 1 summarizes the list of sampling sites and upstream catchments (areas where water is collected by the landscape), their approximate drainage area within the UIP, and predominant land use within that area. All sites are open channels with different characteristics depending on their drainage area and level of development.

Table 1. Summary of catchment areas, sampling frequency, and drainage area.

Site ID	Monitoring Location ID	Site Name	Dates Active	# Sampling Events	Drainage Area (ac)	Land Uses
REF	4991297	Storm Drain Channel at 8000 W North Temple	6/21 - Present	1	144	Low intensity agriculture
AG1	4991299	Storm Drain Channel at 7200 W and 1300 N	4/21 - Present	3	157	Developing Industrial/Low Intensity Agriculture
NEWDEV1	4991302	Storm Drain Channel at 1100 N 6550 W	4/21 - Present	9	204	Developing Industrial
NEWDEV2	4991303	Storm Drain Channel at 6000 W 700 N	4/21 - Present	14	316	Developing Industrial
OLDDEV1	4991313	Storm Drain Channel at 150 S 5600 W	8/21- Present	3	180	Developing Industrial
OLDDEV2	4991305	Storm Drain Channel at end of John Cannon Dr	6/21- Present	15	109	Developing Industrial

In the study area, there are existing land use characteristics within the upstream catchments that are potentially affecting stormwater quality. Most of the upstream drainage areas are influenced by farming and stock grazing activities; however, the relative intensity of these activities differs throughout the UIP study area. A retired landfill is also present and leaching from this area could influence the water quality of the shallow groundwater and subsequently stormwater sample results.

Sites were selected with differing land use characteristics to help differentiate water quality impacts of the UIP development from those caused by other current and historical land uses, particularly agriculture (AG). The drainage area for the site identified as REF (4991297) in Table 1 is the site currently least influenced by ongoing UIP development (perhaps a small amount of stormwater from I-80 and low intensity agriculture) and can be considered to reflect reference conditions for purposes of this investigation. Finally, there are areas where land development is largely complete (OLDDEV) and other areas where development is ongoing (NEWDEV).

The sites selected for this study represent various stages of pre-development, active development, and post-development and are intended to provide multiple opportunities to compare stormwater quality between sites to discern potential impacts to water quality and the potential for pollutants to enter more sensitive water bodies downstream of the development.

Stormwater Catchment Descriptions

This section describes the catchment areas contributing stormwater flow to the monitoring stations in relation to their current land uses. The descriptive titles are used for the purposes of this study only and are subject to change in the future. The descriptions also include the main sources of stormwater within the catchment area and receiving water body.

REF (MLID-4991297): Storm Drain Channel at 8000 W North Temple: This site is intended to capture conditions minimally impacted by development. With the exception of local roads and roadside conveyances, the catchment does not include extensive industrial or agricultural development. Due to low-density impervious surfaces, stormwater in this catchment is primarily from overland flow. Runoff drains into a ditch which flows west to Lee Creek.

AG1 (MLID-4991299): Storm Drain Channel at 7200 W and 1300 N: This site is in early stages of development and is largely low intensity agriculture uses. In addition, a major transportation artery of the UIP to the northwest dominates the borders of the drainage area. As with the REF catchment, a large proportion of the stormwater likely originates as overland flow, although runoff from roads likely has a larger contribution here. Discharge from this area flows north into the Goggin Drain.

NEWDEV1 (MLID-4991302): Storm Drain Channel at 1100 N 6550 W: Currently, this site captures the most active construction and development activities in the UIP study area. It is located in an area of a large warehouse and road development with multiple retention basins and drainage ditches feeding into the sampling location. Discharge from the catchment flows northward into the Goggin Drain.

NEWDEV2 - 4991303 Storm Drain Channel at 6000 W 700 N: This location is under active development located just south of NEWDEV1 (4991302), and includes a major road, 700 North, bisecting the drainage east to west. In addition, the area includes a portion of the historic North Temple Landfill that is slated for phased re-development under the Voluntary Cleanup Program. Discharge from the catchment flows northward into the Goggin Drain.

OLDDEV1 - 4991313 Storm Drain Channel at 150 S 5600 W: This catchment encompasses the area east of 56th West and its stormwater flows west through ditches and ultimately to Lee Creek. It is representative of a fully developed industrial/commercial land use, so the stormwater characteristics may be similar to those that can be expected once UIP development is complete. For the duration of the study, this site will be used to represent a more fully developed industrial/commercial site for comparison with newly developed sites over time.

OLDDEV2 - 4991305 Storm Drain Channel at end of John Cannon Dr: This site also represents a more fully developed area within the UIP and includes a small portion of pre-existing industrial use outside the UIP. There is some potential for future development at a parcel directly south, adjacent to the Fedex facility. This area discharges to the east via open canals and ultimately into the Goggin Drain.

Stormwater Quality Evaluations

Methods

For each of the six sites listed above, composite samples were collected after a qualifying storm event. Samples were collected as a composite throughout the duration of the runoff event on a flow-weighted basis. Sampling was performed by DWQ in accordance with the UIP Sampling and Analysis Plan (SAP) and DWQ Standard Operating Procedures. Samples were analyzed by the Utah Public Health Laboratory (UPHL).

Water quality monitoring activities were designed to understand the temporal and spatial condition of stormwater within the UIP area. Stormwater samples are characterized by a suite of select parameters that are responsive to environmental conditions within their contributing area. Parameters were established to assist managers understand the temporal and spatial condition of stormwater before, during, and after UIP development.

Stormwater Chemistry

A review of scientific literature was conducted to identify important water chemistry constituents. The selected chemical constituents are intended to characterize different sources of stormwater contamination and potential threats to downstream uses.

- **Solids:** Total solids (total suspended solids (TSS), total dissolved solids (TDS) and total volatile solids (TVS)) were selected to quantify the mass of material suspended in the water column. The type and amount of material in stormwater is dependent on the substances contacted as the water flows downstream. Even at the same location, materials are likely to differ from one storm event to the next due to recent human activity and the intensity and duration of a particular storm event. Stormwater solids were evaluated to broadly characterize the total amount of material suspended in the water column during each storm event.

  Among the measures of solids, TSS quantifies the overall abundance of non-dissolved materials suspended in the water column, which can include soils, organic matter and other similar materials. TVS is the subset of solids that indicates organic materials suspended in the stormwater, which can contribute to low dissolved oxygen (DO) in downstream waters. TDS is the measure of the dissolved components of solids, and is composed of many different potential contaminants, nutrients and metals, which were further evaluated.

- **Metals:** Metals are a common stormwater contaminant that can be toxic to humans and wildlife. Metals in stormwater can come from natural sources, but human industrial activity can also introduce them to the environment, particularly at higher concentrations. For this study, metals were evaluated to be an indicator of industry-related stormwater contaminants. Given the presence of a historic landfill, legacy mining and ongoing industrial activities throughout the UIP study area, it is important to understand whether stormwater serves as a primary conduit to transport these contaminants to more sensitive waters downstream. The metals evaluated in this study include: arsenic (As), zinc (Zn), copper (Cu), lead (Pb), cadmium (Cd), selenium (Se), and mercury (Hg).

- **Nutrients:** Stormwater is often thought of as originating from water flowing over impervious surfaces such as concrete or asphalt. While this is an important aspect of stormwater, contaminants can also be introduced as precipitation moves over or through more pervious or disturbed surfaces. The macronutrients nitrogen (N) and phosphorus (P) were selected as indicators of contaminants introduced through non-industrial activities. These contaminants can also potentially threaten downstream waters by contributing to excessive richness of nutrients and associated problems such as low dissolved oxygen (DO)). The nutrients evaluated in this study include total phosphorus (TP) and total nitrogen (TN)--along with its constituents ammonia and nitrate/nitrite.

Chemistry Evaluation and Interpretation

The evaluation and interpretation of stormwater chemistry is notoriously challenging. Different contaminants are introduced into the environment by human activity, and those contaminants may accumulate in the drainage area until there is a storm of sufficient intensity for the contaminant to be suspended and flushed out. While some stormwater contaminants are more commonly associated with different types of land use, they may be introduced inconsistently from place-to-place, which means that chemical stormwater quality can vary at each location from one storm event to the next. For this evaluation, several additional steps were taken to better understand how chemical stormwater constituents are related to ongoing UIP development.

Another challenge is pollutant concentrations also differ considerably among parameters, sometimes by an order of magnitude or more. By its nature stormwater is not natural and does not have designated uses or associated numeric water quality criteria, so it is difficult to know what constitutes high or low concentrations for many important water quantity parameters.

To address these challenges, key water quality parameters were normalized among all samples collected for the project so that the lowest concentration (best water quality) was scored as 100 and the highest concentration observed was scored as one. This normalization allows the magnitude of different chemical contaminants to be directly compared because they are measured on the same scale and relative to all UIP water chemistry observations.

Normalized water chemistry values were used to understand whether or not there were consistent stormwater contaminant observations at each collection location. Similarly, the data were also used to find patterns of stormwater contamination, if any, associated with the type and extent of development in the upstream catchment of each sample location.

It is also possible that the storm intensity alters the contaminants observed in UIP stormwater. To evaluate this, the relative magnitude of 24-hour precipitation was used to quantify the magnitude of the associated storm as follows:

- **LOW:** Low storm intensity events were the bottom quartile of all collection event storms (≤0.27 inches).
- **MOD:** Moderate storm intensity events were those with 24-hour rainfall between the 25th and 75th percentile of all storms (0.28-0.54 inches).

- **HIGH:** High storm intensity events were those between the 75th and 95th percentile (0.54-0.78 inches).
- **V HIGH:** Very high storm intensity events were those above the 95th percentile (>0.78 inches).

Storm intensities were then compared with the normalized stormwater contaminants to see if certain types of contaminants were more likely to occur during storms of varying intensity.

Results

Weather/Precipitation

Precipitation and air temperature associated with each collection event were obtained from the Salt Lake International Airport weather station (KSLC). On average, collection events were characterized by 0.42±0.26 inches of precipitation. The minimum amount of 24-hour precipitation associated with a collection event was 0.04 inches and the maximum was 1.14 inches.

The sample locations were all affected differently by storms of varying intensity. Because the same sample collection criteria were applied to all sites, this resulted in unequal sample sizes among all sites depending on how strongly the location was influenced by stormwater. For example, REF was only sampled on one occasion, which was the largest storm event observed over the study period. In contrast, NEWDEV2 and OLDDEV2 were often the only sites sampled because the storm effects were too small at other locations.

Chemistry Data

TOTAL SOLIDS

Average TSS among all samples (159±177 milligrams per liter (mg/L)) reflects a high variability among sites and sampled events, with a low of 2.8 mg/L and a high of 990 mg/L. As expected, TSS concentrations were inversely proportional to the amount of impervious surface area among land development categories, with highest concentrations in the agricultural stormwater catchment, followed by old and then newly developed catchments (TABLE 2). It is possible that the lower TSS values at the newly developed locations is reflective of the Best Management Practices (BMPs) being put into place as UIP develops, which will be further evaluated as additional samples are collected.

Table 2. Total solids observed in stormwater samples collected in 2021 and 2022 from catchments with different densities of impervious surfaces/industrial development.

SITE ID	Rel. Imp Surface[1]	Number of Observations	TSS mg/L	TDS mg/L	TVS mg/L
REF[2]	Low	1	48	310	13.3
AG1		3	106±151	396±69	14±17 (N=2)[3]
NEWDEV1		10	292±303	663±619	25±24 (N=8)[3]
NEWDEV2		14	132±103	949±832	19±15 (N=11)[3]
OLDDEV1		3	84±73	1683±1062	21±7 (N=2)[3]
OLDDEV2	High	15	153±104	728±791	22±11 (N=10)[3]

Notes:

1. Sites are ordered with respect to the relative amount of impervious surface area. The NEWDEV and OLDDEV sites also have different industrial uses, which are more difficult to broadly characterize at the catchment scale.
2. Confidence estimates (±X, 1 SD) not provided due to a single observation at this location.
3. Calculations do not include observations (N) below the method detection limit (MDL).

METALS

As with other contaminants, there is considerable variation in the metal concentration observed at any given location among collection events. With the exception of arsenic (As), the confidence estimates are often nearly as large as the average concentration. Beyond this general observation, it is best to evaluate the relative concentration of each metal among the various collection locations because the concentration–and toxicity–of metals varies considerably from one metal to another.

Table 3. Dissolved metals observed in stormwater samples collected in 2021 and 2022 from catchments with different densities of impervious surfaces/industrial development.

SITE ID	**Rel. Imp Surface**[1]	**# of Observations**	**Arsenic** (As) µg/L	**Zinc** (Zn) µg/L	**Lead** (Pb) µg/L	**Copper** (Cu) µg/L	*Cadmium*[2] (Cd) µg/L	*Selenium*[2] (Se) µg/L	*Mercury*[2] (Hg) µg/L
REF[3]	Low	1	7.42	137	1.9	12.7	0.11	1.09	– (N=0)[5]
AG1		3	34.3±10.4	12.3±12.6	3.9±4.1	9.4±8.1	0.16±0.09 (N=2)[4]	0.64 (N=1)[3,4]	– (N=0)[5]
NEWDEV 1		10	15.4±6.5	60.3±36.6	15.7±11.1	26.8±14.1	0.31±0.25 (N=9)[4]	0.77±0.11 (N=3)[4]	0.13 (N=1)[3,4]
NEWDEV 2		14	21.0±8.5	43.8±37.4	8.6±6.4	24.2±13.7	0.18±0.12 (N=13)[4]	0.71±0.25 (N=7)	– (N=0)[5]
OLDDEV1		3	4.1±1.4	53.3±41.5	5.7±5.1	15.2±10.9	0.18±0.11 (N=2)[4]	– (N=0)[5]	– (N=0)[5]
OLDDEV2	High	15	8.4±3.7	146.3±79.8	11.2±11.1	28.3±18.3	0.45±0.46 (N=12)[4]	0.73±0.12 (N=5)[4]	– (N=0)[5]

Notes:

1. Sites are ordered with respect to the relative amount of impervious surface area. The NEWDEV and OLDDEV sites also have different industrial uses, which are more difficult to broadly characterize at the catchment scale.
2. Metals with a relatively large number of observations below method reporting limits (MRLs); not included in the generalized metal gradient.
3. Confidence estimates (±X, 1 SD) not provided due to a single observation (N=1).
4. Calculations do not include observations (N) below method detection limits (MDLs).
5. All observations were below method detection limits (MDLs).

Arsenic (As) concentrations were highest at AG1 and lowest at the two older development locations (OLDDEV1 and OLDDEV2) (see Table 3). This contaminant is sometimes associated with soil disturbance, so it is possible that the higher concentrations at the agricultural locations is due to water infiltration through the soils at AG1.

Zinc (Zn), copper (Cu) and lead (Pb) showed the opposite pattern, with average concentrations being generally higher at developed locations than the agriculture catchment. For Zn, the most striking observation was at OLDDEV2, where the average Zn concentration was about 3X greater than the other locations. Average lead concentrations were highest at NEWDEV1, followed closely by OLDDEV2. Cu was also highest at OLDDEV2, followed closely by the two newly developing catchments (NEWDEV1 and NEWDEV2). Taken together, the data suggest that something within the OLDDEV2 catchment is contributing to metal contamination. While this may not be directly related to new UIP developments, it should be further evaluated to see if these sources of pollution can be reduced.

Cadmium (Cd), selenium (Se) and mercury (Hg) were more difficult to evaluate due to the large number of observations below method reporting limits (MRLs). This means the concentrations of these metals are often very low, with some exceptions. Among the measurable values, these metal concentrations also suggest that the OLDDEV2 and possibly NEWDEV1 catchments are sources of stormwater metal contamination.

NUTRIENTS

Total phosphorus (TP) among all sample locations averaged 0.37±0.22 mg/L with a low of 0.07 (OLDDEV1) and a high of 1.04 mg/L (NEWDEV1) (Table 4). On average, TP concentrations were highest at NEWDEV1 and lowest at the AG1 location. At each sample location, the variance in TN concentrations among collection events was considerable, as evidenced by the confidence estimates against the location average.

Table 4. Macronutrients observed in stormwater samples collected in 2021 and 2022 from catchments with different densities of impervious surfaces/industrial development.

SITE ID	**Rel. Imp Surface**[1]	**Number of Observations**	**Total Phosphorus** mg/L	**Total Nitrogen** mg/L	*Ammonia*[2] mg/L	*Nitrate/Nitrite*[2] mg/L
REF[3]	Low	1	0.51	3.00	0.05	0.40
AG1		3	0.18±0.12	1.56±1.26	0.11±0.08	0.80±1.11
NEWDEV1		10	0.47±0.28	1.32±0.64	0.23±0.12	0.56±0.45
NEWDEV2		14	0.33±0.19	1.87±0.68	0.18±0.13	0.80±0.59
OLDDEV1	High	3	0.21±0.12	1.41±0.77	0.17±0.20	0.39±0.11
OLDDEV2		15	0.35±0.14	1.60±0.65	0.21±0.14	0.38±0.23

Notes:

1. Sites are ordered with respect to the relative amount of impervious surface area. The NEWDEV and OLDDEV sites also have different industrial uses, which are more difficult to broadly characterize at the catchment scale.
2. Ammonia and Nitrate/Nitrite and components of total nitrogen.
3. Confidence estimates (±X, 1 SD) not provided due to a single observation at this location.

Among all stormwater samples, total nitrogen (TN) averaged 1.71±0.92 mg/L, but varied considerably from a low of 0.54 (NEWDEV1) to a high of 3.09 mg/L (OLDEV2) (Table 4). The REF site had the highest TN concentration, but this site was only sampled at a single event, so it is impossible to know if this is reflective of the site itself or the fact that this sample took place following the largest storm events over the two collection years. The average TN among the other sites was roughly comparable. As with TP, the variance in TN among different collection events was considerable.

Potential Sources of Variation among Contaminants: Further Evaluation

Normalized water chemistry allows us to directly compare different types of contaminants (Table 5). Several patterns can be observed, but the most telling observation is that it is difficult to generalize about the nature of stormwater contamination within the UIP study area.

Table 5. Normalized and color-coded[1] scores for different stormwater contaminants (2021-2022) relative to development intensity (impervious surface) in the contributing catchments.

Catchment	Rel. Imp Surface[2]	N	Solids		Nutrients			Metals				
			TSS	TDS	Comb.	TN	TP	Comb.	As	Zn	Pb	Cu
REF[3]	Low	1	98	95	34	13	55	82	89	56	96	86
AG1		3	91	55	76	64	88	77	28	98	90	90
NEWDEV1		10	75	83	66	72	60	69	71	82	57	66
NEWDEV2		14	90	73	64	53	74	62	58	87	77	24
OLDDEV1		3	94	46	78	69	86	87	97	84	85	82
OLDDEV2	High	15	87	73	67	62	72	69	87	53	70	64

Notes:

1. Color coding represents the pollutant "grade", with higher scores reflecting lower relative concentrations, as follows: dark green = 90-100, light green = 80-89, yellow = 70-79, light red = 60-69, dark red < 60.
2. Sites are listed relative to each other from low to high impervious surface area, but sites with higher impervious surface also have higher levels of industrial activity.
3. The only reference site sample collected was during the largest storm event sampled, so the values may not be reflective of more common storms.

Data from the REF site are included in these tables; however, with a single sample it is difficult to conclude anything from water chemistry at this location. The fact that this site was only sampled once between 2021 and 2022 means that a single storm event contributed measurable stormwater (within autosampler specifications). Furthermore, this suggests that the potential for stormwater runoff and contamination can be expected to increase as the UIP is developed. This reference site can provide useful background data, as intended, provided that autosampler specifications can be modified to collect additional samples.

STORMWATER CONTAMINANTS AND INTENSITY OF DEVELOPMENT

Normalized solids data do not reveal any strong patterns with respect to development intensity. With the exception of NEWDEV1, TSS values among all sites were generally low among all sampled storms with a couple of atypically higher concentrations, perhaps because solids only become strained during the largest storms. The relatively higher stormwater TDS concentrations at AG1 may reflect water picking up TDS sources such as fertilizer during soil infiltration. It is not clear why OLDDEV1 had relatively high TDS, but it is of note that this was the only contaminant that was relatively high at this location in comparison with the other sample locations.

The normalized metal concentrations show a couple of interesting patterns. With respect to arsenic, contamination is probably a lesser concern with regard to stormwater because it was only high at the agricultural catchment (AG1) where impervious surfaces were relatively low. Metal stormwater contamination may not be a concern for the OLDDEV1 catchment where relative concentrations were low for all metals, although additional observations are needed to confirm this observation. To varying degrees, all other developed watersheds have relatively high metal concentrations for at least some contaminants. The type and intensity of development may play a role in explaining differences in metal concentrations among catchments, but consistent patterns are not easily explained by this qualitative impervious surface gradient. Future contaminant data collection data or quantification of catchment impervious surface areas may reveal more consistent relationships.

STORMWATER CONTAMINANTS AND RELATIVE STORM INTENSITY

To evaluate the role that storm intensity played in the differences in pollutants among the study catchments, the normalized data were also compared with the relative intensity of storms associated with each collection event (Table 6). As expected, the concentration of most pollutants increased with storm intensity. However, this trend reversed for samples collected following the highest intensity storms, likely as a result of dilution.

Table 6. Normalized and color-coded[1] scores for different stormwater contaminants relative to the intensity of the storm that preceded the collection event (2021-2022).

Relative Precip. Intensity[2]	N	Solids		Nutrients			Metals				
		TSS	TDS	Comb.	TN	TP	Comb.	As	Zn	Pb	Cu
LOW	8	90	82	73	72	73	76	81	71	78	74
MODERATE	21	86	65	62	53	71	72	57	80	78	74
HIGH	11	82	88	60	59	60	65	71	74	56	60
VERY HIGH	4	93	95	74	70	78	85	85	85	87	84

Notes:

1. Color coding represents the pollutant "grade", with higher scores reflecting lower relative concentrations, as follows: dark green = 90-100, light green = 80-89, yellow = 70-79, light red = 60-69, dark red < 60.
2. Storm intensity categories were determined using the 24-hour total precipitation prior to each collection event. LOW = bottom quartile, MODERATE = 25th – 50th percentile, HIGH = 75th – 95th percentile, VERY HIGH = >95th percentile.

Unexpectedly, there was not an obvious relationship between TSS and storm intensity. This suggests that the atypically high TSS concentrations in some samples cannot be solely explained by differing amounts of stormwater runoff. It is possible that precipitation-related TSS patterns are obscured by the fact that some sites were only sampled during larger storm events because the autosamplers were not triggered during smaller storms. In contrast, TDS did increase appreciably from low to moderate storm intensity, but the concentrations then declined at higher—high and very high—storm events, presumably as a result of sample dilution.

Normalized nutrients and metal concentrations responded more predictably, increasing as storm intensity increased. Among metals, Pb and Cu are most strongly associated with industrial activities, and these pollutants remained fairly consistent except during high intensity storms. Normalized TP concentrations revealed a similar pattern, which is notable as stormwater inputs of phosphorus to aquatic ecosystems are typically associated with particulates. It is possible that storms need to be of sufficient intensity to suspend phosphorus-associated material, but if this is true it is unclear why a similar pattern was not observed with the normalized TSS data.

Discussion

The ongoing UIP stormwater study continues to provide insight into the impact of development on water quality. The data collected so far indicates that the development of these areas may alter the type and amount of contaminants, however, the variation of stormwater contaminants from place-to-place and storm-to-storm makes understanding what specific changes can be expected challenging. Stormwater does not have designated uses, which means there are no applicable water quality standards for any pollutant until the water reaches downstream water bodies. It remains unclear the extent to which UIP stormwater pollutants evaluated in this investigation will impact the designated uses of downstream waters.

Understanding the impact of UIP stormwater pollutants to downstream waters is not possible without more extensive hydrological investigations, which is beyond the scope of this work. The areas around UIP developments contain numerous drainage ditches, and the residence time, or length of time water remains within these ditches, varies from place to place and storm to storm. Many new UIP developments include holding ponds and other BMPs to retain as much stormwater flow as possible. Infiltration of stormwater throughout the drainage network is dependent on soil saturation and the overall volume of stormwater that moves through these systems during storm events. This complicated hydrology means that there are no easy answers when it comes to understanding the extent to which pollutants are transported to more sensitive ecosystems downstream, such as Great Salt Lake wetlands.

If and when pollutants reach more sensitive waters, deleterious impacts to aquatic organisms can potentially be mitigated due to the nature of stormwater pollutants. Stormwater pollutants are intrinsically transitory because they only happen during storm events, and pollutants that make it downstream during events arrive when waters are most diluted due to the increase in flows. That said, these pollutants can still potentially degrade downstream ecosystems, particularly if the contaminants increase from one storm to the next, but the role that UIP stormwater would play relative to all other sources is difficult to quantify.

Given these challenges, perhaps the most important insight from this and future investigations is how UIP stormwater contaminants change over time. To date, these data have only been collected for two seasons, so year-to-year changes in stormwater pollutants associated with development cannot be interpreted with confidence. This data gap will likely narrow with the collection of additional stormwater samples as this monitoring effort continues. Further examination of the differences among developed catchments could provide insight into BMPs that could be implemented in the future to minimize pollutants associated with industrial activity. When this occurs, lessons learned might also be applied to other stormwater reduction efforts statewide.

Next Steps

Sampling and Analysis Plan Improvements

Since traditional measures of water chemistry may not be sufficient to document changes in water delivery or water quality due to stormwater runoff, looking at additional measures and techniques may provide significant improvements to our understanding of impacts in the UIP. For instance, where pollutant concentrations may be diluted during high runoff, measures of discharge may greatly improve estimates of overall pollutant loading at each of these sites.

Therefore, in the spring of 2022, DWQ updated the UIP Sampling Analysis Plan (SAP) to include several improvements to assist with evaluating the impacts of development on stormwater runoff. These proposed changes include adding an estimation of discharge during storm events at autosampler locations, augmenting the water sampling effort with the addition of passive samplers which can integrate measurements of pollutants over time, adding sampling locations on the receiving waters of Lee Creek and Goggin Drain, and mapping the changes in areas of impervious cover over time to assist with data interpretation.

Due to limited resources, most of these proposed elements are on hold, with the exception of discharge measurements and mapping of impervious cover. Data from these elements will be integrated into the 2023 annual report. Future improvements and additional monitoring will be contingent on funding allocated over the full period of the UIP development.

Section 2: Air Quality Monitoring

The Division of Air Quality (DAQ) established monitoring facilities at the UIP site to track pre-development or early development baseline. This monitoring includes: a sensor system consisting of monitors to measure levels of research-grade particulate matter, ozone, and oxides of nitrogen, and data logging equipment with internal data storage that are interconnected at all times to capture air quality readings and store data.

Monitoring Locations

UIP air quality monitoring sites are known as the Lake Park (LP) site and the Prison site (currently named IP). The LP site monitors for continuous and filtered PM2.5, PM10, sulfur dioxide, ozone, and nitrogen dioxide. East of the UIP and Salt Lake International Airport is the Air Monitoring Center (AMC) site that monitors for all parameters. Supporting these measurements are weather measurements for temperature, wind speed and wind direction. The IP site monitors continuous PM2.5, ozone, and nitrogen dioxide with supporting weather measurements for wind speed, direction, temperature, and ambient pressure.

All instruments/data, with the exception of PM2.5 filter measurements, are connected to the air monitoring network and report data in near real time, hourly, to the network data collection system. This data is then posted to DAQ web pages, the UtahAir mobile application, and EPA's AirNow site on an hourly basis. All data is reported to federal databases at least quarterly as required by EPA.

UIP Air Monitoring Locations and Parameters

County	EPA AIRS Code	Station Name (Code)	Station Address	Latitude	Longitude	Elevation (Meters)	Monitored Parameters
Salt Lake	490353011	Air Monitoring Center (UT)	240 N 1950 West, Salt Lake City	40.7769	-111.9461	1286	PM2.5, PM10, O3, NOx, SO2, CO, NH3, Meteorology
Salt Lake	**490351007**	**Inland Port (IP)**	**1480 N 8000 W, Salt Lake City**	**40.8079**	**-112.0877**	**1285**	**PM2.5, BC, O3, NOx, Meteorology**

Salt Lake	490353005	Lake Park (LP)	2782 S. Corporate Park Dr., West Valley City	40.7098	-112.0086	1295	PM2.5, PM10, BC, O3, NOx,CO, Meteorology

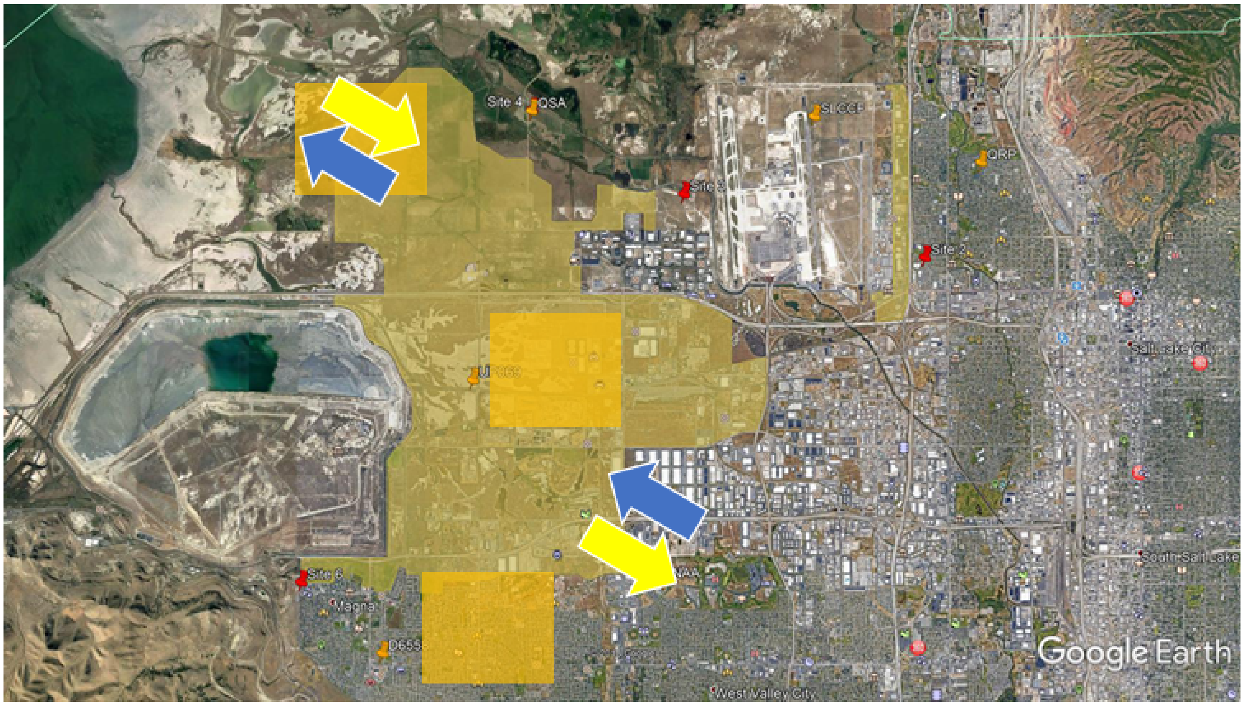
Monitors that were partially funded through a legislative appropriation are noted in bold.

A summary of the monitors found at all sites, including UIP sites, can be found on page 15 of the "Division of Air Quality Annual Monitoring Network Report 2022." Site specific information related to instrument type and other related information can be found on pages 47 and 63. Please note that IP is referred to as "ZZ" in this document.

Air Monitoring Data Collection and Certification

Air monitoring data is collected annually and is certified at the end of the year once comprehensive quality control checks have been completed. The data is then certified with EPA, and can be used for regulatory purposes to demonstrate compliance with federal air quality standards. The due date for data certification is May 1 of each year.

Requirements for data certification can be found in 40 CFR part 58. All data certification is reviewed by EPA and they either concur, or not, to the states' assertion of data completeness. Analyzing site data before the end of the year or on a daily, monthly, or quarterly basis when collecting baseline data is of limited value as all standards and parameters are based on the data of an entire year, January 1 - December 31. Data completeness and efficiency is also based on the data collected for the entire year.



Winter Winds
Yellow arrows: Daytime
Blue arrows: Nighttime
Yellow overlay: Inland Port region
Orange overlay: Possible monitor location

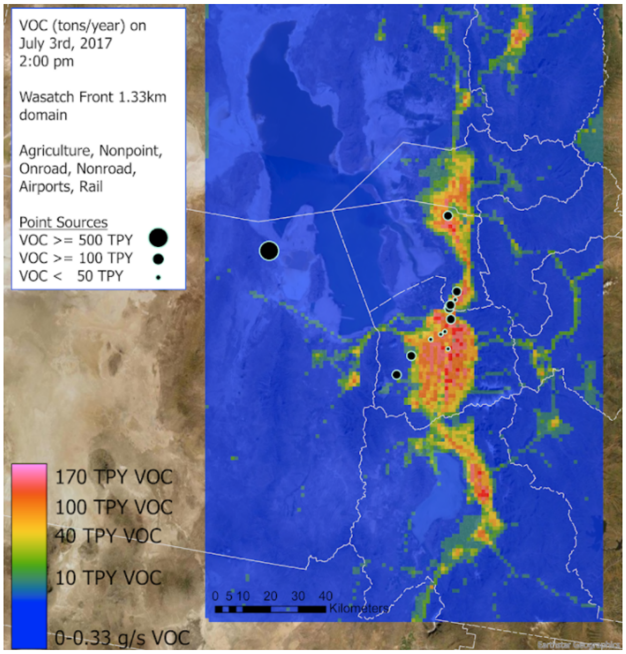
Inland Port Analysis

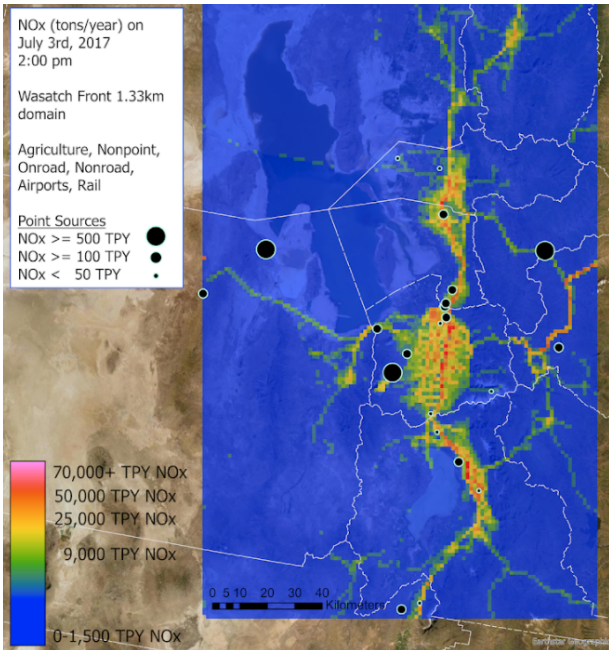
Monitoring began at the LP site in September 2020 and at the IP site in March of 2021. To date, the IP and LP sites have reported 96.7% of data during the period of operation, as of November 4, 2022. Most parameters report an hourly value and it is these sampling opportunities that are used to determine data reporting. Some data values will be eliminated due to quality control checks, instrument malfunction, routine maintenance, power outages etc. The final numbers for 2022 will not be determined until the data certification process, which will be conducted by April 2023.

UIP Baseline Air Quality Data Limitations

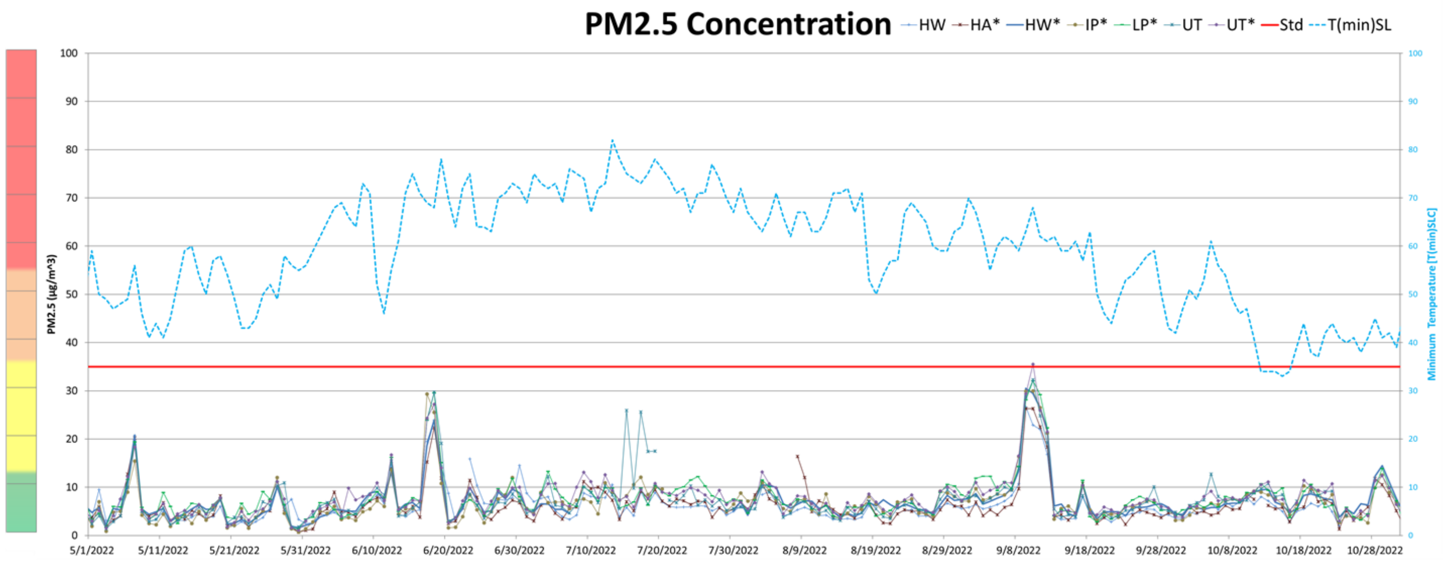
The two current UIP air monitoring locations, LP and IP, have been in operation for less than three years, limiting the conclusions that can be drawn from the available measurements. Additionally, the information collected during operations are dominated by non-normal monitoring years. The year 2020 saw reduced emissions levels due to the global pandemic, and the summers of 2021 and 2022 were impacted by wildfire smoke.

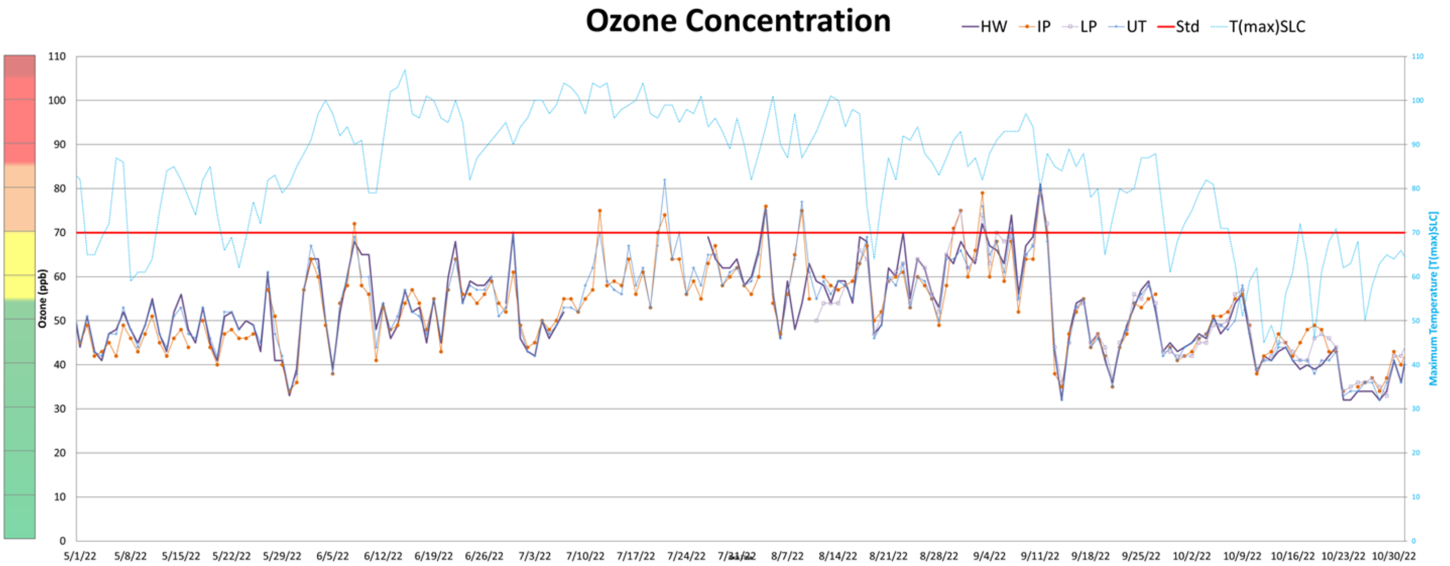
The IP site is located at the new prison site, which is under construction. Given the ongoing construction activity, the frequent power outages that are impacting data collection should be considered normal baseline activity. Please also note that 2022 measurements are not fully quality certified, and the Design Value calculation, the statistic that describes the air quality status of a given location relative to the level of the National Ambient Air Quality Standards (NAAQS), cannot be made on partial years of data.





We can see that monitored air quality for the spring and summer of 2022 at the established UIP monitoring sites correlates very well with the air quality monitors within the Salt Lake region, indicating that regional air quality is impacted by the combination of all emissions sources. Emissions sources within the geographical IP area are predominantly from transportation, manufacturing and warehousing. The baseline daily emissions are represented by the 2017 statewide air emissions inventory.



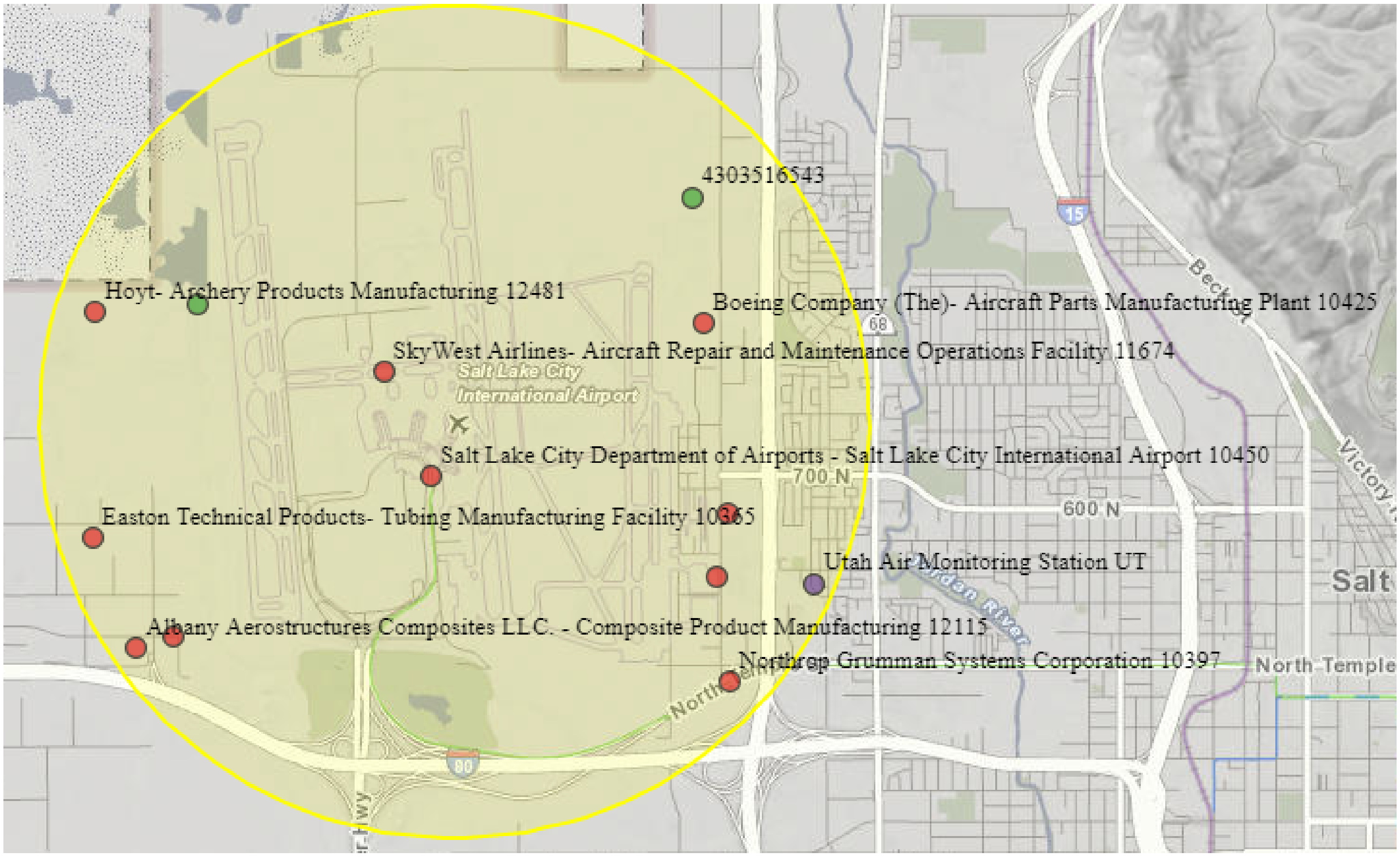


In the figure above, PM2.5 (top) and ozone (bottom) concentrations are shown between May and October of 2022. Pollution concentrations were measured at UIP sites (IP, LP) and further away in the urban Salt Lake Valley (HW, UT) for comparison. IP PM2.5 concentrations are noted by the gray dotted line in the top panel, while IP ozone is represented by the orange dotted line in the bottom panel. Similarly, LP PM2.5 concentrations are represented by the green line in the top panel, while LP ozone is depicted by the gray dotted line in the bottom panel.

Temperature (dashed blue lines) is displayed to indicate how pollution concentrations change during warmer and cooler periods. Solid horizontal red lines indicate federal air quality standards for 24-hour PM2.5 (35 µg/m3) and 8-hour daily maximum ozone (70 ppb). Color bars on the left-hand side depict good (green), moderate (yellow), unhealthy for sensitive groups (orange), and generally unhealthy (red) levels for both pollutants.

Salt Lake International Airport (SLIA) Air Quality Data

Air quality monitoring data is not being collected within the SLIA. The SLIA is bracketed by the Department of Environmental Quality Technical Support Center AMC monitor to the east, the IP site to the west, the LP site to the southwest and the Bountiful Viewmont site to the northeast.



Air quality compliance inspections are routinely performed at the permitted sources that are within or supporting the SLIA to determine compliance with air emissions and control requirements. Emissions trends will be tracked through the air emissions inventory process along with projections for emissions increases through the development of State Implementation Plans that will occur during future reporting periods.