



Ambient NO₂ Sampling near the BARTO Compressor Station

Hughesville, PA (Lycoming County)

Background

On January 24, 2013, the Clean Air Council (CAC) of Philadelphia released a report titled "AERMOD Modeling of NO₂ Impacts of the Barto Compressor Station." In that report, the CAC analyzed dispersion modeling of permitted nitrogen oxide (NO₂) emissions from the Barto compressor station (located at 3588 Beaver Lake Road) and suggested that ambient concentrations of nitrogen dioxide may be higher than expected. The Pennsylvania Department of Environmental Protection (DEP) operates ambient NO₂ monitors in the region, and NO₂ monitors downwind of other compressor stations across the state, but have not measured high levels of this pollutant.

As a precautionary measure and to be responsive to the CAC concerns, the DEP conducted short-term sampling of ambient NO₂ concentrations downwind of the compressor station during the week of July 22, 2013.

Findings

Over the four-day sampling period, all measured 1-hour average NO₂ concentrations were well below the 1-hour National Ambient Air Quality Standard for NO₂ of 100 parts per billion (ppb)(Table 1). The maximum 1-hour average NO₂ concentration measured during the sampling period was 5.9 parts per billion (ppb) and the maximum 5-minute average NO₂ was 20.4 ppb.

DEP Sampling

DEP's Bureau of Air Quality equipped a source-testing vehicle with a same make and model ambient EPA reference NO₂ monitor that is used in the state network (Teledyne API model 200A). Minor modifications were made to the vehicle including the construction of a Teflon sample intake manifold and a 50-foot piping system to move electric generator exhaust away from the sample intake manifold. Because electric generator exhaust could interfere with the results, the piping system was always situated downwind of the vehicle to reduce the chance of sample contamination. To ensure representative measurements, the NO₂ sensor was calibrated before, during and after conclusion of the short-term sampling period.

A portable meteorological tower was erected in the proximity of the monitor-equipped vehicle and wind speed and direction were collected during the sampling period to determine the downwind location from the Barto compressor station and to avoid any contribution of generator exhaust to measured NO₂ concentrations. A picture of the sampling vehicle and meteorological tower can be seen in Figure 1.

Figure 2 is a satellite view of the compressor station and the two DEP sampling locations. The initial forecast for the week of July 22, was for winds from the southeast for at least the first two days of the week. DEP mobilized on the morning of the July 22 (Day 1) to Location 1 and began sampling by 11:00 (EDT). Winds began to shift on Day 2, and with a new forecast for winds from the northwest, a different sampling location was secured located southeast of the Barto compressor station. The sampling vehicle and meteorological tower were relocated during the evening of Day 2 to Location 2, and remained at this location for the remainder of the sampling period (Days 3 and 4). Note that the meteorological data from Location 2 had to be invalidated due to the inability to meet monitor siting criteria. This is discussed further in this section. The sampling distance from the compressor station at both locations was in scale with the CAC's reported distance of maximum impact (0.4 km or ¼ mile).

Figures 3 and 4 summarize wind directions during the sampling period by use of a graphical tool known as a wind rose. Looking at a wind rose, the size and direction of each petal represents the direction from which the wind originated (and the percentage of time from that direction). The colors on the petals represent the wind speed when coming from that direction (and percentage of time). Although the wind roses were positioned over the Barto compressor station for demonstration purposes, the meteorological data was not collected at the station. Figure 3 uses meteorological data from the portable meteorological tower that was sited with the sampling vehicle at Location 1. Because meteorological monitor siting requirements could not be met at Location 2, data from the Selinsgrove airport was substituted and is represented in Figure 4. Sporadic rainfall occurred during the period between July 22, 14:00 and July 23, 02:00.

DEP confirmed that the Barto compressor station was operating at normal capacity during the period of sampling. This confirmation was made post-sampling so as to not alert operators to the DEP presence ahead of time.

Overview of the NO₂ National Ambient Air Quality Standard

Nitrogen dioxide is a highly toxic, reddish brown gas that forms in the atmosphere primarily from fuel combustion in industrial sources and vehicles. In extreme cases, it creates an odorous brown haze that causes eye and sinus irritation, blocks natural sunlight and reduces visibility. It can severely irritate the respiratory system and has been associated with acute effects in individuals diagnosed with respiratory disease. Nitrogen dioxide contributes to the creation of acid rain, ozone formation, and plays a key role in nitrogen loading, adversely impacting forests and other ecosystems.

In January 2010, EPA promulgated a new primary NO₂ standard, established at 100 ppb, averaged over one hour. This level provides for the protection of public health, including sensitive populations. The DEP is making the assumption that the maximum 1-hour average measured during the sampling would be the design value that is normally compared (3-year average of the 98th percentile value).

Conclusion

DEP did not detect ambient NO₂ average concentrations greater than the 1-hour NO₂ NAAQS. This is consistent with 1-hour NO₂ concentrations measured at the DEP Towanda air-monitoring site in neighboring Bradford County. The Towanda site was purposefully sited to measure the impacts of the Marcellus industry, including compressor stations. In fact, the Towanda site is located among more than 25 compressor stations within a 20-mile radius. Monthly average NO₂ measurements at the Towanda site have been 2.2 to 4.3 ppb.

DEP is committed to understanding the impacts of the Marcellus industry on air quality. Ongoing Marcellus-related studies by DEP include a long-term multi-site monitoring study near a large gas processing facility in Washington County, and ozone and NO₂ monitoring in Bradford and Tioga counties.

Table 1: Measured 1-hour average NO₂ concentrations near the Barto Compressor Station in Lycoming County.

Day 1	Time (EDT)	NO ₂ (ppb)	Day 2	Time (EDT)	NO ₂ (ppb)	Day 3	Time (EDT)	NO ₂ (ppb)	Day 4	Time (EDT)	NO ₂ (ppb)
Sampling starts at Location 1			23-Jul	0:00	1.8	24-Jul	0:00	5.5	25-Jul	0:00	3.3
			23-Jul	1:00	4.0	24-Jul	1:00	5.0	25-Jul	1:00	1.7
			23-Jul	2:00	2.9	24-Jul	2:00	4.2	25-Jul	2:00	4.4
			23-Jul	3:00	2.1	24-Jul	3:00	4.2	25-Jul	3:00	2.6
			23-Jul	4:00	3.2	24-Jul	4:00	4.7	25-Jul	4:00	1.6
			23-Jul	5:00	1.5	24-Jul	5:00	3.7	25-Jul	5:00	1.7
			23-Jul	6:00	2.4	24-Jul	6:00	2.6	Sampling ended		
			23-Jul	7:00	2.0	24-Jul	7:00	1.9			
			23-Jul	8:00	1.7	24-Jul	8:00	1.9			
			Quality Assurance Procedures			24-Jul	9:00	4.2			
					24-Jul	10:00	3.7				
					24-Jul	11:00	4.5				
22-Jul	11:00	5.7									
22-Jul	12:00	4.9	23-Jul	12:00	4.0	24-Jul	12:00	2.8			
22-Jul	13:00	4.9	23-Jul	13:00	2.8	24-Jul	13:00	2.7			
22-Jul	14:00	3.2	Refueling and Generator Maintenance			24-Jul	14:00	3.6			
22-Jul	15:00	2.7				24-Jul	15:00	3.0			
22-Jul	16:00	2.2				24-Jul	16:00	2.0			
22-Jul	17:00	3.1	Sampling moved to Location 2			24-Jul	17:00	1.6			
22-Jul	18:00	4.5				24-Jul	18:00	3.6			
22-Jul	19:00	2.9				24-Jul	19:00	3.0			
22-Jul	20:00	2.9	23-Jul	20:00	5.9	24-Jul	20:00	2.1			
22-Jul	21:00	2.4	23-Jul	21:00	3.8	24-Jul	21:00	1.6			
22-Jul	22:00	1.8	23-Jul	22:00	3.8	24-Jul	22:00	1.4			
22-Jul	23:00	1.6	23-Jul	23:00	4.0	24-Jul	23:00	1.7			

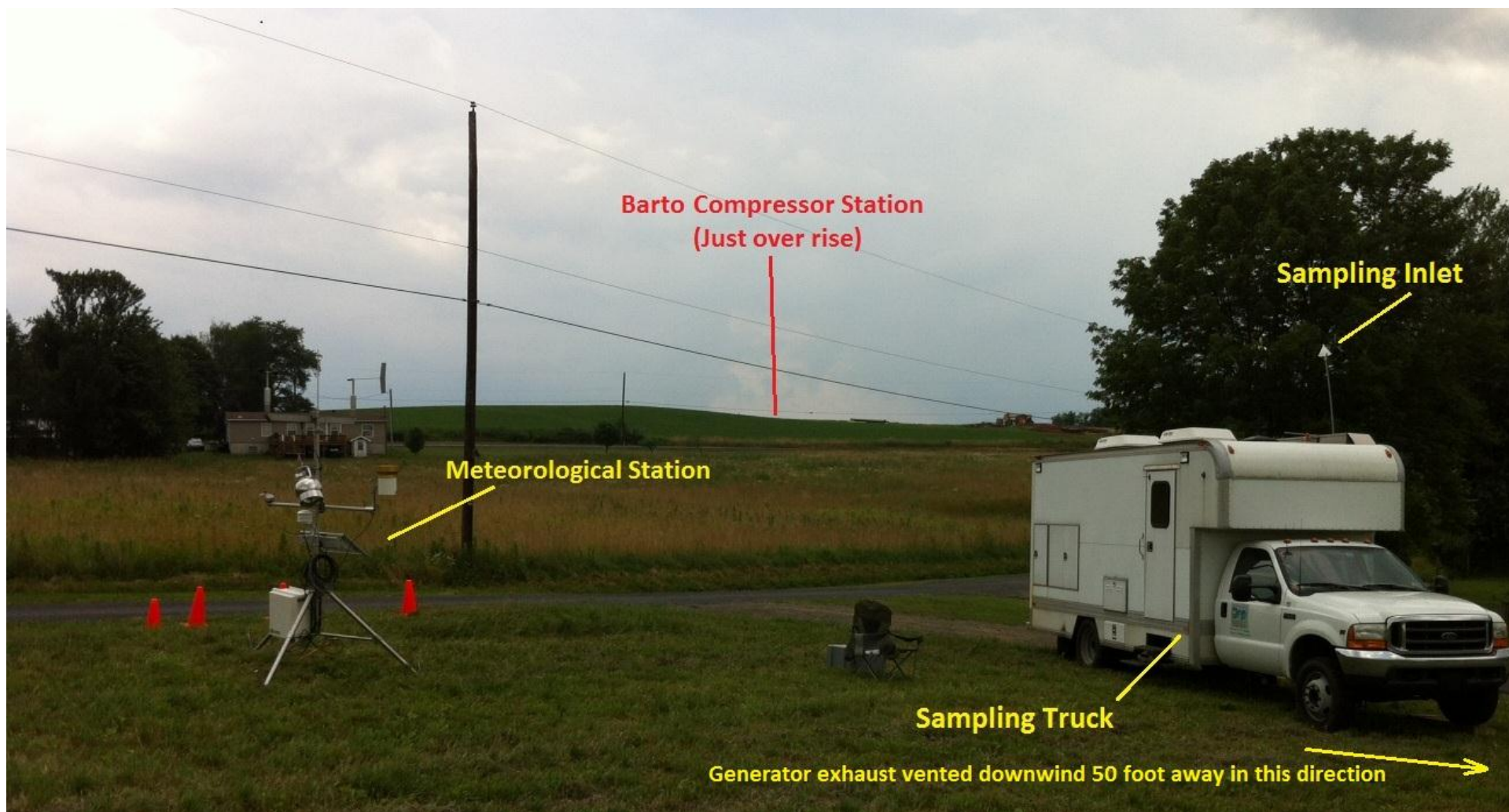


Figure 1: Picture of sampling vehicle and portable meteorological tower at sampling Location 1.

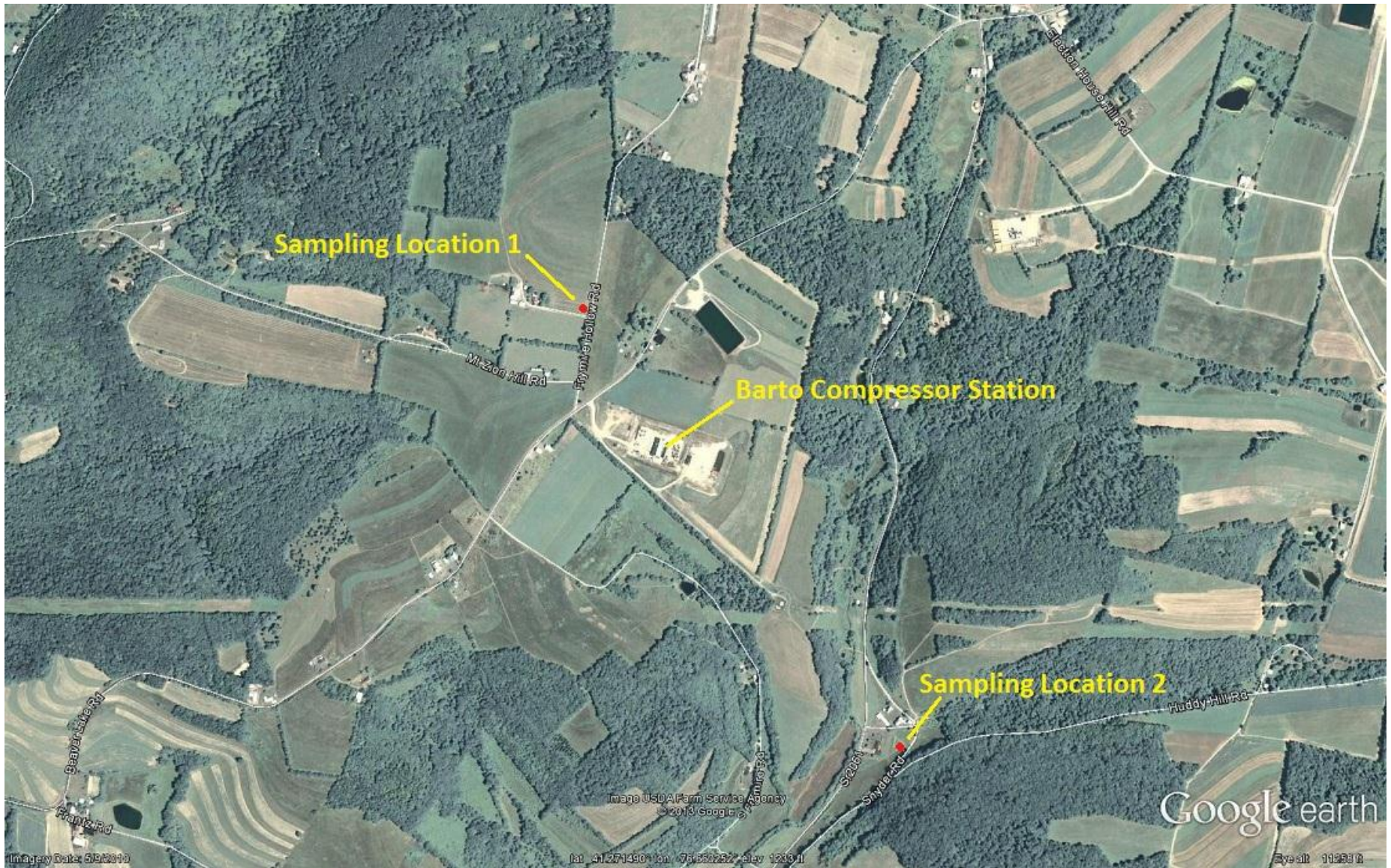


Figure 2: Satellite view of the Barto Compressor Station and the two sampling locations.

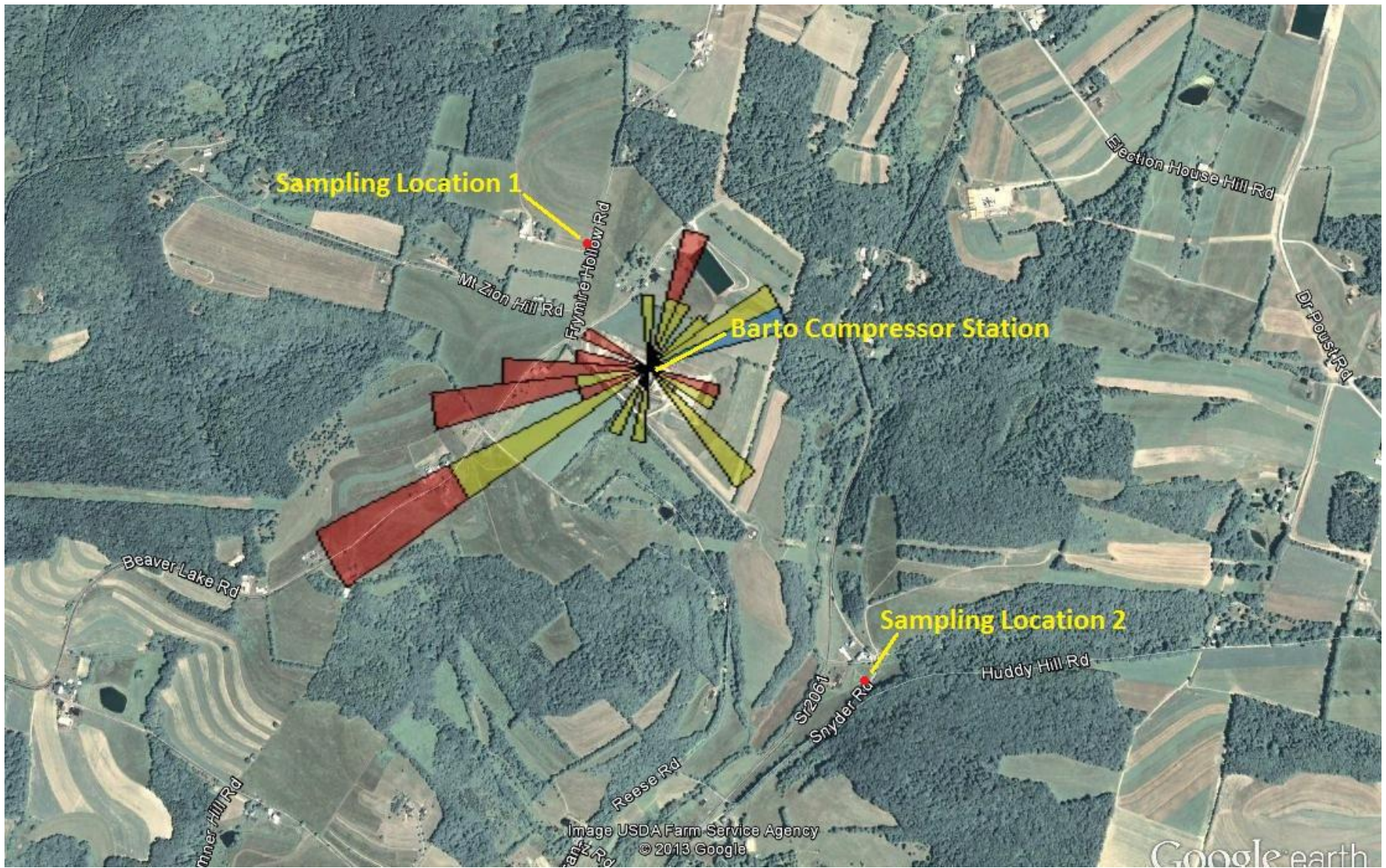


Figure 3: Wind rose during the Location 1 sampling period. Petals indicate “wind direction from”.

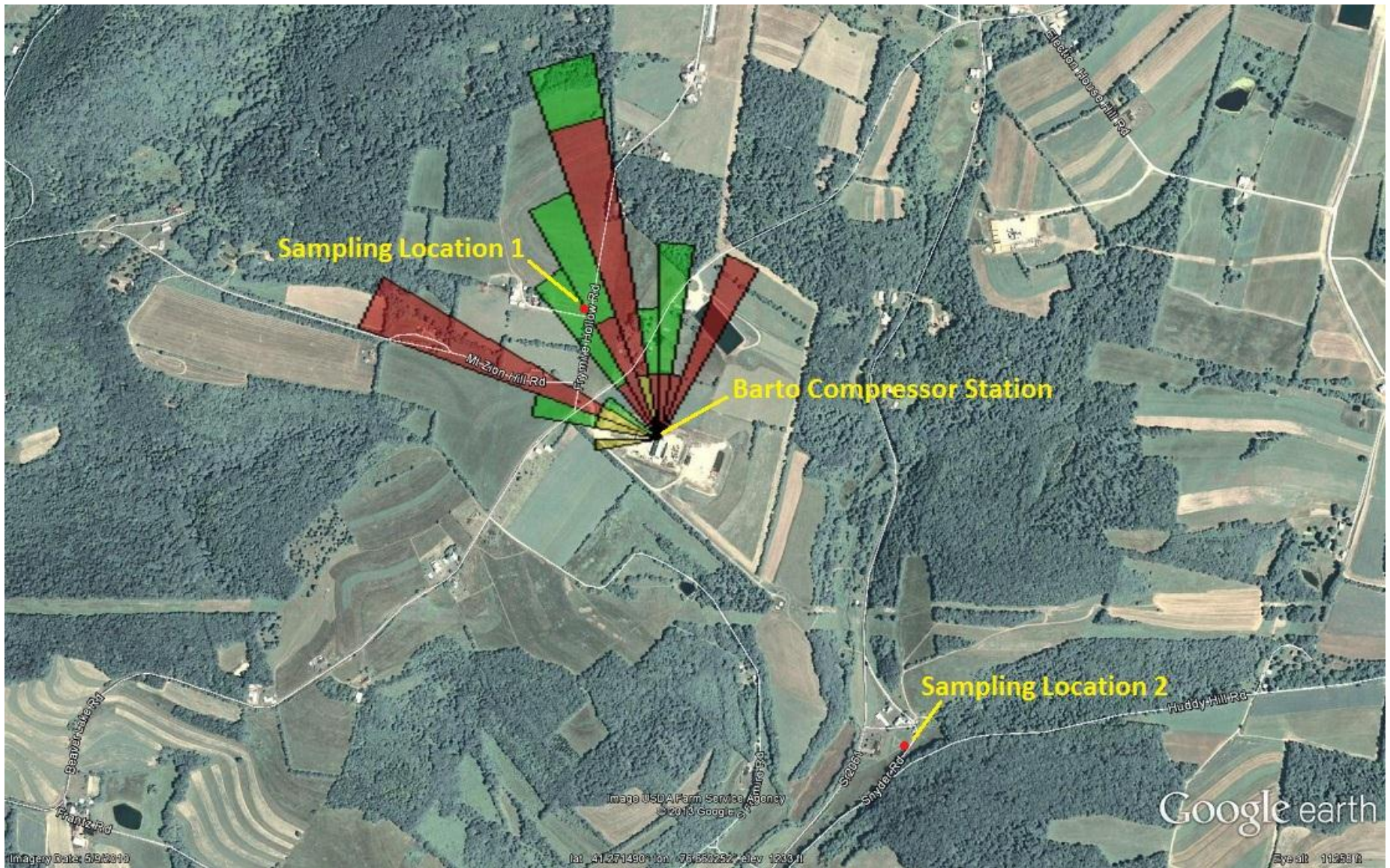


Figure 4: Wind rose during the Location 2 sampling period. Petals indicate “wind direction from”.