MODIFIED METHOD 327
2025 ETHYLENE OXIDE IN AMBIENT AIR ANALYSIS
DOW Chemical Company

Prepared For:

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MONTROSE
AIR QUALITY SERVICES

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Project Overview

Objectives

Montrose Air Quality Services, LLC (Montrose) was contracted by the Dow Chemical Company (Dow) to perform an ambient air study around their South Charleston and Institute, West Virginia facilities. The specific objectives of this air monitoring program were as follows:

Conduct ambient air monitoring utilizing passivated stainless steel canisters to assess the consistency of ethylene oxide concentrations across multiple canisters at the same location. Additionally, compare the ethylene oxide concentrations measured at the site perimeter of a known emission source with those found in a rural background location that lacks identified ethylene oxide sources.

Testing was conducted by Montrose Air Quality Services, LLC. Coordinating the test program was:

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Methodology

Ambient Testing Methodology

Modified EPA Method 327 was adhered to in determining the concentrations of ethylene oxide from six (6) canister locations at the Institute, West Virginia facility and at a background location. A total of 30 unique samples of ambient air was collected for analysis of ethylene oxide by a modified version of US EPA Method 327.

Sample canisters were provided pre-cleaned and certified by Enthalpy Analytical. Sampling was conducted using an Entech Instruments Silonite™ Passive Canister Sampler which utilizes a critical orifice to ensure consistent flow of ambient air into the evacuated canister.

Three rounds of sampling were conducted January 31 - February 1; February 3 - February 4; and February 6 - February 7, 2025.

A map showing the ten (10) sampling locations, six (6) located at Dow, the remaining four (4) at the background locations, and coordinates can be found on the following pages in Figures 1 through 2 and Table 1.

Figure 1 - Sampling Locations for Sites 1-6 and Background Sites B & K

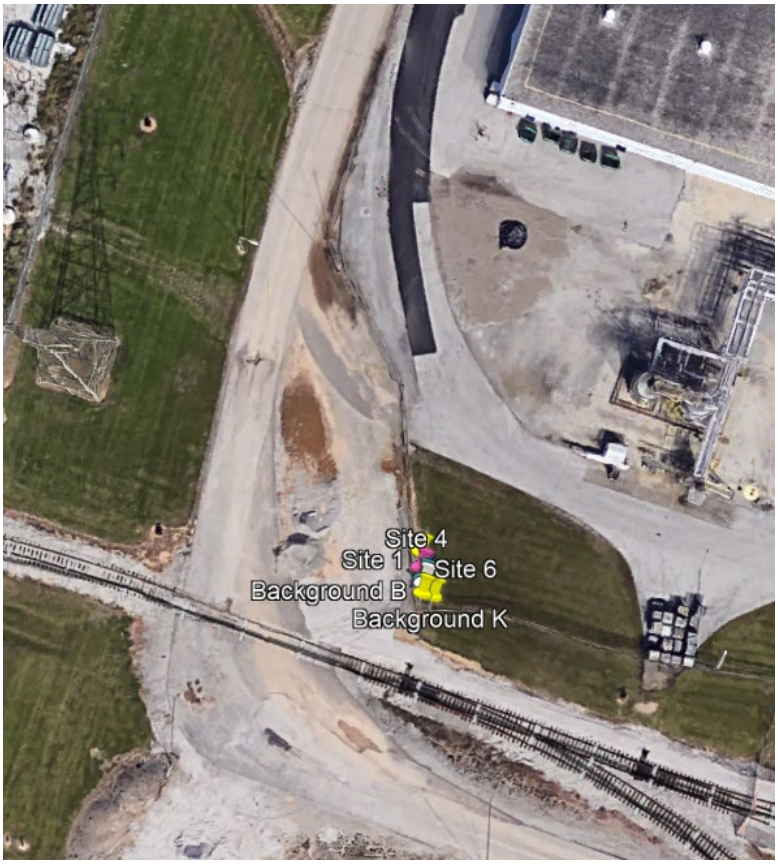


Figure 2 – Aerial View of Ambient Sampling Locations

Table 1 – Sampling Location Coordinates

Site 1	(38.386028, -81.785624)
Site 2	(38.3860067, -81.7856236)
Site 3	(38.3860067, -81.78562368)
Site 4	(38.386009, -81.785625)
Site 5	(38.385997, -81.785622)
Site 6	(38.385992, -81.785620)
Background B (BLANK)	(38.385984, -81.785622)
Background K (SPIKE)	(38.385981, -81.785607)

Results

A complete summary of test results are presented in Tables 2-7 on Page 6 and 7.

All samples were received and analyzed by Enthalpy Analytical (Enthalpy) located in Deer Park, Texas.

All samples began sampling on 01/31/25, 02/03/25 and 02/06/25 and were manually stopped by closing the valve on the summa canister inlet 23 to 24 hours later. It was known that the summa canister was still sampling at the time of closing the valve due to the vacuum gauge on the summa canister reading greater than 3 inHg, therefore the summa canister was still under a vacuum.

Samples were ID'd before being sent to Enthalpy.

Ethylene oxide results are expressed in part per billion by volume (ppbv) 24-hour time.

Prepared by: Reviewed by:

Summary of Results

Table 2 – Summary of Ambient Data (24-Hour) January 31, 2025

Site Information	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**
Latitude	38.386028	38.3860067	38.3860067	38.386009	38.385997	38.385992
Longitude	-81.785624	-81.7856236	-81.7856236	-81.785625	-81.785622	-81.785620
Start Date	01/31/2025	01/31/2025	01/31/2025	01/31/2025	01/31/2025	01/31/2025
Start Time	12:49	12:49	12:49	12:49	12:49	12:49
End Date	02/01/2025	02/01/2025	02/01/2025	02/01/2025	02/01/2025	02/01/2025
End Time	12:49	12:49	12:49	12:49	12:49	12:49
Results	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Ethylene Oxide (ppbv)	0.034	0.028	0.036	0.026	0.041	0.034

Table 3 – Summary of Ambient Data (24-Hour) February 3, 2025

Site Information	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**
Latitude	38.386028	38.3860067	38.3860067	38.386009	38.385997	38.385992
Longitude	-81.785624	-81.7856236	-81.7856236	-81.785625	-81.785622	-81.785620
Start Date	02/03/2025	02/03/2025	02/03/2025	02/03/2025	02/03/2025	02/03/2025
Start Time	13:05	13:05	13:05	13:05	13:05	13:05
End Date	02/04/2025	02/04/2025	02/04/2025	02/04/2025	02/04/2025	02/04/2025
End Time	13:05	13:05	13:05	13:05	13:05	13:05
Results	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Ethylene Oxide (ppbv)	0.57	0.60	0.59	0.60	0.55	0.55

Table 4 – Summary of Ambient Data (24-Hour) February 6, 2025

Site Information	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**	**Site 6**
Latitude	38.386028	38.3860067	38.3860067	38.386009	38.385997	38.385992
Longitude	-81.785624	-81.7856236	-81.7856236	-81.785625	-81.785622	-81.785620
Start Date	02/06/2025	02/06/2025	02/06/2025	02/06/2025	02/06/2025	02/06/2025
Start Time	12:27	12:27	12:27	12:27	12:27	12:27
End Date	02/07/2025	02/07/2025	02/07/2025	02/07/2025	02/07/2025	02/07/2025
End Time	12:27	12:27	12:27	12:27	12:27	12:27
Results	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Ethylene Oxide (ppbv)	0.039	0.028	0.023	0.027	0.02	0.025

Table 5 - Summary of Ambient Data (24-Hour) January 31, 2025

Site Information	**Background B**	**Background K**	**Background S**	**Background D**
Latitude	38.385984	38.385981		
Longitude	-81.785622	-81.785607		
Start Date	01/31/2025	01/31/2025	01/31/2025	01/31/2025
Start Time	13:05	13:05	14:57	14:57
End Date	02/01/2025	02/01/2025	02/01/2025	02/01/2025
End Time	13:05	13:05	15:00	15:00
Results	Background B	Background K	Background S	Background D
Ethylene Oxide (ppbv)	0.018 (BLANK)	1.146 (SPIKE)	0.039 (SAMPLE)	0.027 (DUP)

Table 6 - Summary of Ambient Data (24-Hour) February 3, 2025

Site Information	**Background B**	**Background K**	**Background S**	**Background D**
Latitude	38.385984	38.385981		
Longitude	-81.785622	-81.785607		
Start Date	02/03/2025	02/03/2025	02/03/2025	02/03/2025
Start Time	13:05	13:05	14:01	14:01
End Date	02/04/2025	02/04/2025	02/04/2025	02/04/2025
End Time	13:05	13:05	14:01	14:01
Results	Background B	Background K	Background S	Background D
Ethylene Oxide (ppbv)	0.013 (BLANK)	1.225 (SPIKE)	0.029 (SAMPLE)	0.025 (DUP)

Table 7 - Summary of Ambient Data (24-Hour) February 6, 2025

Site Information	**Background B**	**Background K**	**Background S**	**Background D**
Latitude	38.385984	38.385981		
Longitude	-81.785622	-81.785607		
Start Date	02/06/2025	02/06/2025	02/06/2025	02/06/2025
Start Time	12:27	12:27	13:17	13:17
End Date	02/07/2025	02/07/2025	02/07/2025	02/07/2025
End Time	12:27	12:27	13:17	13:17
Results	Background B	Background K	Background S	Background D
Ethylene Oxide (ppbv)	0.0054 (BLANK)	1.116 (SPIKE)	0.018 (SAMPLE)	0.021 (DUP)

Summary of Results

On January 31, 2025, as detailed in Tables 2 and 5, the measured ethylene oxide concentrations displayed a range of values. Most samples recorded concentrations between 0.026 and 0.041 parts per billion by volume (ppbv). During this sampling period, the winds predominantly came from the southwest. Wind roses were used from the West Virginia Department of Environmental Protection (WVDEP) at the Altivia meteorological tower.

The results from February 3, 2025, listed on Table 3 and 6, indicate minimal variability of the ethylene oxide concentrations across the samples for this day. The majority of the samples fall in the range of 0.55 to 0.60 ppbv, with these values appearing multiple times. During this sample period, winds were predominantly from the southwest.

The results from February 6, 2025, listed on Table 4 and 7, the ethylene oxide concentrations in this set of samples are predominantly within the range of 0.020 to 0.039 ppbv. Most values are clustered around 0.025 and 0.028 ppbv. During this time period, winds were predominantly from the west.

The overall dataset of ethylene oxide samples presents a mixture of concentration readings. The majority of the results fall within a narrow range, predominantly between 0.020 and 0.041 ppbv, with many values clustering around 0.034 and 0.028 ppbv. In total, most of the samples show low ethylene oxide concentrations, except the samples collected on February 3rd that deviate from the general trend.

The Ambient Monitoring Program generated valid ethylene oxide results for each of the ten samples collected. It should be noted that this study is not intended to address modeling of ethylene oxide emissions from any specific facility. This study provides ethylene oxide concentration measurements in ambient air at the previously-described monitoring site locations; a relatively short time period. The scope of monitoring and methods employed in conducting this study are consistent with determining a range of ambient ethylene oxide concentrations at monitoring site locations at the Institute, West Virginia facility for comparison to ambient “background” ethylene oxide concentrations concurrently measured at rural background location that lacks identified ethylene oxide sources. The variability of ethylene oxide concentrations measured at each site location over the course of the study appears to be within a reasonable range.

Test Procedures

Method Listing

The test method used during the test program aligns with EPA-approved sampling techniques for ambient air quality assessment. The specific method utilized was:

Modified Method 327 – Collection of Ambient Air Samples in Passivated Canisters for the Determination of Fugitive Emissions and Area Sources.

Method Descriptions

Modified Method 327

Modified Method 327 was employed for the collection of fugitive emissions and area source samples using passivated stainless-steel canisters. This method ensures compliance with EPA sampling protocols and project-specific monitoring plans. Deviations from the method were outlined in the Quality Assurance Project Plan for this project.

A 6-liter passivated stainless-steel canister with a NIST-certified flow controller was used to collect a 24-hour integrated air sample. The sampling system included a vacuum regulator, ensuring a consistent flow rate over the sampling period. The flow controllers used during the pilot study were used for each round of sampling before being sent back to the lab. The pre and post-sample measurements did "purge" the flow controllers.

Field sampling involved:

- Pre-sampling verification, including a bias check, standard check, and flow control verification conducted annually.
- Deployment of the canister at a height of 5.0 to 9.5 feet above ground level to capture representative air samples.
- Recording essential data, such as GPS coordinates, weather conditions, and potential contamination sources in the Field Data Sheet.
- Leak checks before and after sampling to confirm sample integrity.

At the conclusion of the 24-hour sampling period, the canister valve was sealed, and the sample was shipped to the designated laboratory for analysis. Chain of custody procedures were followed to maintain data integrity and compliance with EPA Modified Method 327.

Appendix

Wind Roses

Figure 1 - January 31, 2025 Wind Rose

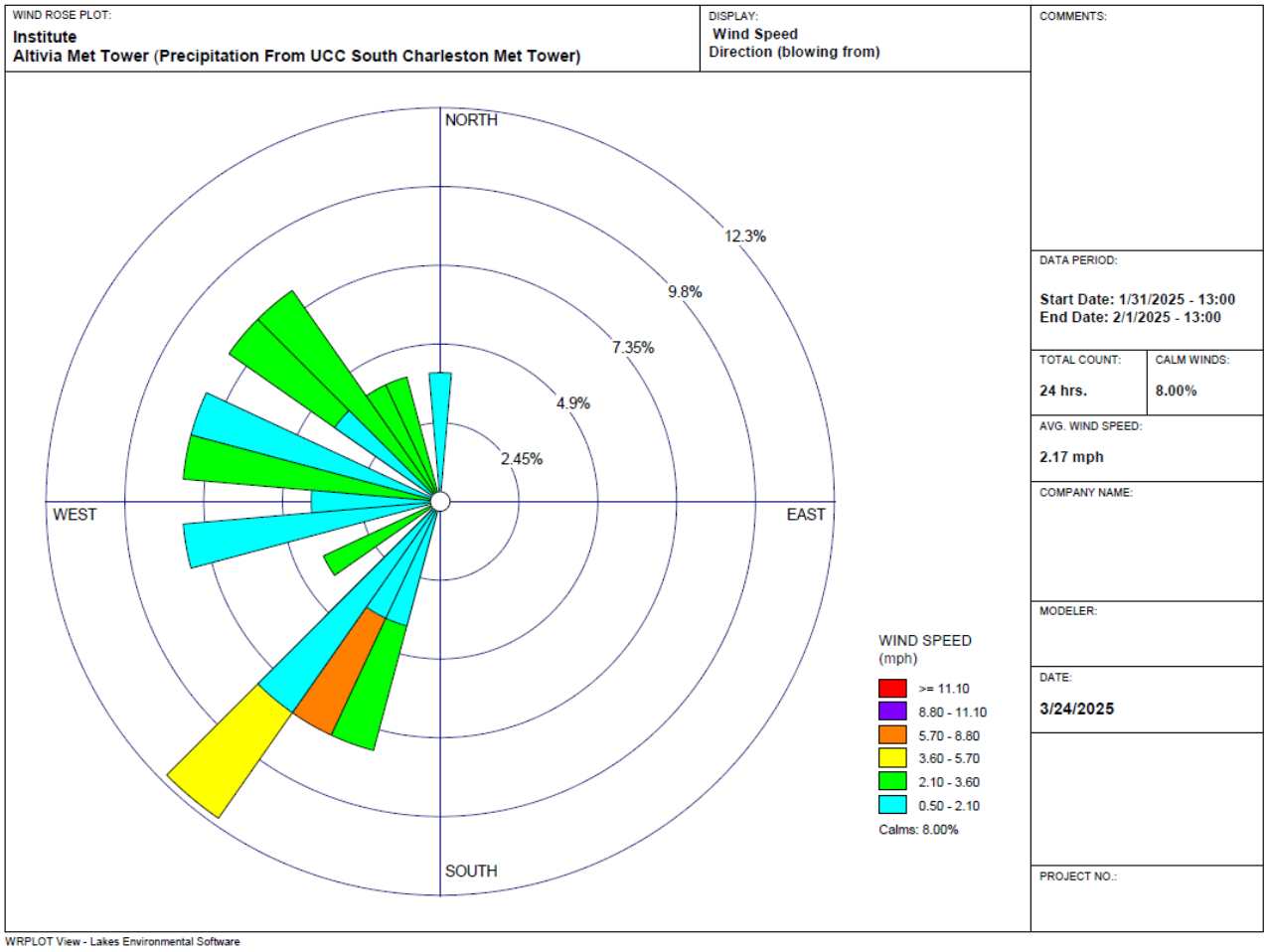


Figure 2 - February 3, 2025 Wind Rose

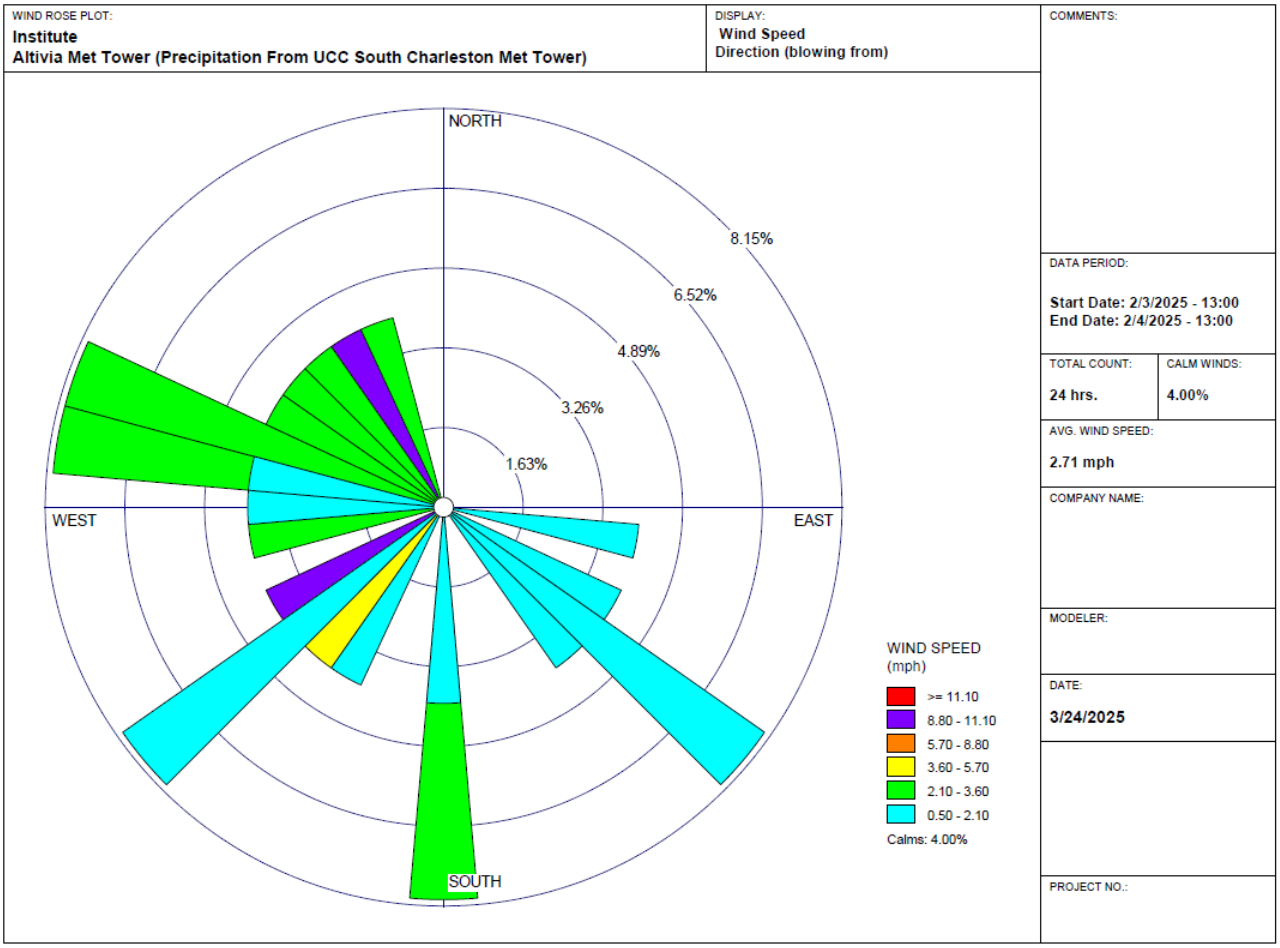
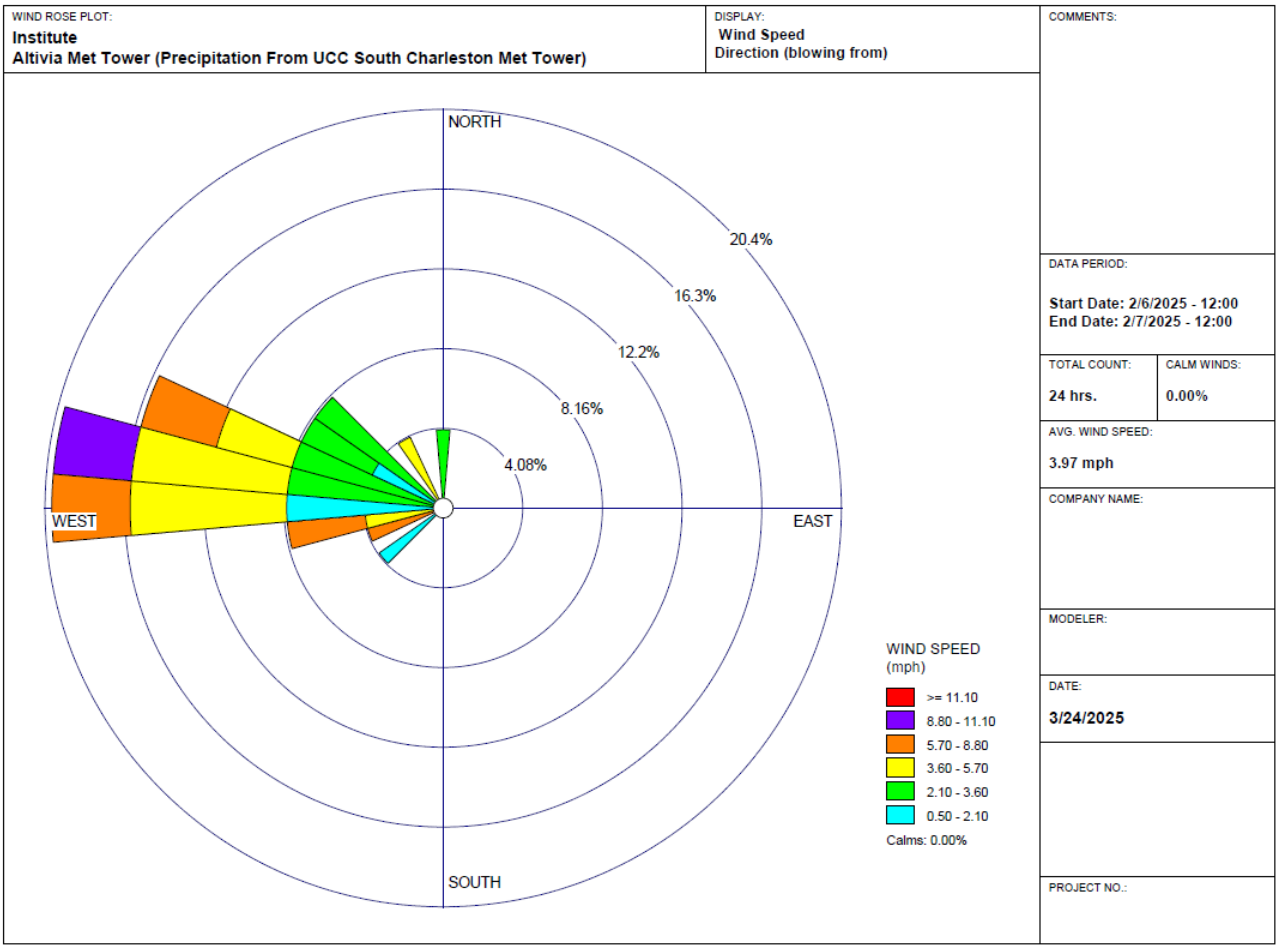


Figure 3 - February 6, 2025 Wind Rose



Laboratory Data