Mist Resiliency Project

Exhibit Y: Noise Study

Northwest Natural Gas Company

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Executive Summary

SLR International Corporation (SLR) has prepared a noise study at the request of the Certificate Holder, Northwest Natural Gas Company (NWN), for the Mist Resiliency Project consisting of the Miller Station and North Mist Compressor Station (NMCS) in Columbia County, Oregon. This report presents the results from SLR's sound level survey of the existing ambient conditions and noise modeling of the upgraded stations.

An ambient sound survey for the station was conducted by SLR on September 1st through the 4th, 2023. Sound levels were measured at the two noise sensitive areas (NSAs) as identified within the line of sight analysis conducted by SLR. The measured L_{50} sound levels at the NSAs ranged from 27.0 to 32.7 dBA.

The Mist Resiliency Project sound levels are regulated by the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) noise limits. The applicable limits are based upon the measured ambient statistical sound levels and octave band sound pressure levels. The most stringent noise limitation within the regulation is the 10 dB increase over the measured nighttime L_{50}. The L_{50} sound level can be described as the sound level exceeded 50% of the time during the measurement period. As the predicted project noise impacts are well below this requirement, the additional sound level limits are also satisfied. The described 10 dB increase over the measured L_{50} sound levels will control the applicable limits from both stations and are utilized throughout the report.

A noise model has been developed of the upgraded station equipment at both stations. The station upgrade equipment includes the noise mitigation described in this report installed. **Table A**, below, summarizes the calculated sound levels at the NSAs.

Table A: Mist Resiliency Project (Miller Station and NMCS) - Sound Level Predictions

NSA	Distance and Direction from Miller Comp. Bldg to NSA, miles	Distance and Direction from NMCS Comp. Bldg to NSA, miles	Measured Existing Ambient, Nighttime Average	Station Upgrade Equipment [a]	Combined Ambient + Future Station	Increase Above Existing Ambient
			dBA L_{50}	dBA	dBA	dBA
1.0	3.3 NW	1.7 W	27.0	27.1	**30.1**	3.1
2.0	2.6 SW	3.1 SW	32.7	20.6	**33.0**	0.3

a. Per noise modeling results.

Table A shows that calculated A-weighted sound levels from the upgraded station result in increases at the NSAs ranging from 0.3 to 3.1 dBA, well below the 10 dB increase limit over the measured nighttime L_{50}.

With the noise control treatments outlined in this report, modeling predicts that the upgraded stations sound level contribution at the NSAs will range from 20.6 to 27.1 dBA. The sound level contributions from the future stations are expected to be in compliance with the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) limits.

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Acronyms and Abbreviations

dB	Decibel
dBA	A-Weighted Decibel
dBC	C-Weighted Decibel
DEQ	Department of Environmental Quality
DIL	Dynamic Insertion Loss
EFSC	Energy Facility Siting Council
FERC	Federal Energy Regulatory Commission
ga	Gauge
Hz	Hertz
IL	Insertion Loss
ISO	International Organization for Standardization
lb/cf (or PCF)	Pounds per Cubic Foot
lb/sf (or PSF)	Pounds per Square Foot
L_d	Daytime Average Sound Level
L_n	Nighttime Average Sound Level
L_{dn}	Day-Night Sound Level
L_{eq}	Equivalent Continuous Sound Level
L_p	Sound Pressure Level
L_w	Sound Power Level
ML	Measurement Location
µPa	Micropascal
NR	Noise Reduction
NRC	Noise Reduction Coefficient
NSA	Noise Sensitive Area
NSR	Noise Sensitive Receptor
NW Natural	Northwest Natural Gas Company
OAR	Oregon Administrative Rules
SLM	Sound Level Meter
SLR	SLR International Corporation
STC	Sound Transmission Class
TL	Transmission Loss
USGS	U.S. Geological Survey

1.0 Introduction and Project Description

1.1 Introduction

SLR International Corporation (SLR) has prepared a noise study at the request of the Certificate Holder, Northwest Natural Gas Company (NWN), for the Mist Resiliency Project consisting of the Miller Station and North Mist Compressor Station (NMCS) in Columbia County, Oregon. This report presents the results from SLR's sound level survey of the existing ambient conditions and noise modeling of the upgraded stations. This report includes information required by the Oregon Administrative Rule (OAR) 345-021-0010(1)(x), and is provided to support a finding by the Energy Facility Siting Council (EFSC) that the proposed facilities comply with the Oregon Department of Environmental Quality's (DEQ) noise control standards in OAR 340-35-0035.

1.2 Project Description

The proposed Miller Station upgrade consists of the addition of two Solar Taurus 60 turbine/compressor units, TEG regeneration skid, and multiple heaters. The proposed NMCS upgrade consists of the addition of three Caterpillar G3608 compressor engines, TEG regeneration skid, multiple heaters, and two emergency generators.

1.3 Description of Miller Station

Miller Station is located approximately 1 mile north of Highway 202 in the community of Mist, Oregon. The proposed modifications to Miller Station consist of the replacement of two combustion turbines. The site is surrounded by undeveloped lands in all directions. The closest residence is approximately 2.6 miles away to the southwest.

1.4 Proposed Miller Station Upgrades

The upgraded Miller Station site equipment is proposed to consist of the following:

- Two (2) Solar Taurus 60 turbine-driven compressor units
- One (1) Turbine Lube Oil Cooler
- Two (2) Horizontal Filter Scrubbers
- Two (2) Gas Coolers
- Below-Ground Suction and Discharge Gas Piping
- Fuel Gas Heater Skid
- TEG Dehydrators
- Diesel Emergency Generators

1.5 Description of North Mist Compressor Station

NMCS is located approximately 2.2 miles northwest of Miller Station. The proposed modifications to the site consist of the addition of three compressor engines. The site is surrounded by undeveloped lands in all directions. The closest residence is approximately 1.7 miles away to the west. A perimeter berm is proposed for the NMCS and will be located approximately 10 feet from the access road.

1.6 Proposed North Mist Compressor Station Upgrades

The upgraded NMCS site equipment is proposed to consist of the following:

- Proposed Three (3) Caterpillar GS3608 Compressor Engines
- Existing Two (2) Caterpillar GS3606 Compressor Engines
- Proposed and Existing Glycol Regeneration Skids
- Two (2) Horizontal Filter Scrubbers
- Below-Ground Suction and Discharge Gas Piping
- Fuel Gas Heater Skid

This report presents the results of the pre-construction noise survey conducted by SLR. The report also describes requirements for the upgrade equipment sound power levels and noise control treatments necessary to meet the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) limits.

2.0 Noise Control Regulations

2.1 Oregon Industrial Source Regulations

The environmental sound level contributions from the proposed equipment at the Miller Station and NMCS are subject to the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) noise limits. The Oregon Noise Control Regulations limit the allowable sound emissions of industrial and commercial noise sources in multiple ways. The applicable limits are based upon the measured ambient statistical sound levels, octave band sound pressure levels, and potential impulsive noise sources.

The OAR provides different noise limits for new noise sources located on previously used sites (such as the Miller Station modifications) and new noise sources located on previously unused sites (such as the NMCS modifications).

Table Y-1 and Table Y-2 show the applicable nighttime octave band limits and statistical limits for new noise sources located on previously used sites, such as Miller Station. As proscribed by the OAR regulation, SLR has assessed the predicted noise impact from only the new proposed equipment at the Miller Station.

As new equipment will be located on previously unused areas of the site at NMCS, the applicable criteria is described as new noise sources located on previously unused sites. There is an additional limit on the allowable increase in two statistical noise descriptors: the L_{10} (sound level exceeded 10% of the time) and the L_{50} (sound level exceeded 50% of the time). The L_{10} and L_{50} sound levels may not increase by more than 10 A-weighted decibels (dBA) over existing measured levels in any hour or exceed the applicable statistical limits. As described by the OAR, SLR has assessed the predicted noise impact of all existing and proposed equipment located at NMCS.

As a conservative approach, the predicted noise impacts from both stations have been cumulatively assessed. Impulsive noise sources are not expected for either of the sites, so a separate impulsive noise evaluation has not been performed.

The DEQ noise regulations for industry and commerce specifically exempt noise from construction sites (OAR 340-035-0035). However, a construction assessment is required within the application as per OAR 345-021-0010.

The nighttime noise limits are the most restrictive and will be utilized to ensure that the limits have been satisfied at the identified noise sensitive areas.

Table Y-1: Nighttime Octave Band Sound Pressure Level Limits

Octave Band (Hz)	Applicable Sound Level Limit (dB)
31.5	65
63	62
125	56
250	50
500	46
1000	43
2000	40
4000	37
8000	34

Table Y-2: Applicable Statistical Limits During Nighttime Hours (10p.m. to 7 a.m.)

Statistical Parameter	Applicable Sound Level Limit (dBA)
L_1	60
L_{10}	55
L_{50}	50

2.2 Columbia County Noise Control Ordinance

Columbia County has a noise control ordinance that prohibits unreasonable noise affecting noise-sensitive units (any vehicle, building or structure adapted for overnight accommodation of persons). There is a prohibition on noise that exceeds 50 dBA during nighttime hours (10 p.m. to 7 a.m.), and 60 dBA during daytime hours (7 a.m. to 10 p.m.). The standard is exceeded if noise levels are higher than the criterion for more that 10 percent of any 20 minute period (20-minute L10). Industrial and construction activities such as the construction and operation of the Miller Station and NMCS and associated natural gas pipeline are exempt from regulation.

3.0 Noise Baseline

3.1 Noise Sensitive Receptors

Various nearby residences were identified by SLR using line of sight analysis and aerial imagery field observations. Measurement locations were chosen near each residence and are summarized in **Table Y-3**. The distance and direction from the approximate center of the site to the measurement locations are shown. The NSAs and measurement locations are shown in **Figure Y-1**.

Table Y-3: Summary of Measurement Locations

Measurement Location (ML)	Description	Approximate Distance from Miller Station to Measurement Location, Miles	Approximate Distance from NMCS Facility to Measurement Location, Miles
ML 1	Residence	3.3 NW	1.7 W
ML 2	Residence	2.6 SW	3.1 SW

3.2 Measurement Equipment

Sound level equipment used during the sound study included the following instruments:

- Larson Davis Model 831 SLM's; Type 1; s/n 001497, 0003220
- Larson Davis CAL 200 Calibrator; s/n 5731

A windscreen was used on the measurement microphones. The sound level meters were field-calibrated before and after measurement intervals. All instrumentation has current laboratory certification that can be provided upon request. Measurements were conducted approximately five feet above the ground.

3.3 Measurement Results

The sound level measurement results are summarized in **Table Y-4.** A summary of the measured statistical nighttime sound levels at ML1 and ML2 are summarized below. Daytime is considered to be the period from 7:00 am to 10:00 pm, and nighttime is from 10:00 pm to 7:00 am. The ambient environment can be described as very quiet with natural activities contributing to the baseline noise levels. These activities consisted of birds, insects, and light wind.

Table Y-4: Summary of Ambient Sound Level Measurements

NSA	Measurement Location	Duration	Observations During Measurements	Measured Nighttime Levels Period Average, dBA		
				L_1	L_{10}	L_{50}
1	ML 1	72 hours	Birds and Insects, Station Inaudible	45.7	33.2	27.0
2	ML 2	72 hours	Birds and Insects, Light Wind, Station Inaudible	43.6	37.1	32.7

3.4 Weather Conditions

Weather conditions were appropriate for a sound level study. A summary of the weather conditions is shown in **Table Y-5** below.

Table Y-5: Summary of Weather Conditions

Date	September 1 –4, 2023
Temperature Range	62°F – 90°F
Relative Humidity Range	29 % –87 %

Date	September 1 –4, 2023
Wind Speed (Average)	5 mph
Wind From	Variable
Sky Condition	Clear or Cloudy
Ground Condition	Dry

Complete weather data from the measurement survey were obtained from a nearby weather station using **www.wunderground.com** and are shown in **Appendix Y-2**.

3.5 Measurement Methodology

Sound levels were measured using the slow meter response and A-weighting. Data were collected in 1/3-octave bands and recorded in 10-second and 1-hour sampling periods.

3.6 Operating Conditions

Sound level measurements were taken with varying operating conditions at both stations. Miller Station was operational for the majority of the measurement period with brief operating conditions at NMCS as well. Existing station equipment was not audible at either measurement location and were not contributing to the ambient results during the monitoring period.

4.0 Predicted Noise Levels (OAR 345-021-0010(1)(y)(A))

4.1 Compressor Plant Configuration and Construction Activity Assumptions

Noise impacts from long-term operations will occur above ground at the described stations. Activities at the sites have been modelled as operating continuously during day time and night time hours.

As a conservative approach, the predicted noise impacts from both stations have been cumulatively assessed. Impulsive noise sources are not expected for either of the sites, so a separate impulsive noise evaluation has not been performed.

The following noise sources are considered significant:

- Noise from the turbine exhaust, including the exhaust outlet and noise radiated from the exhaust ductwork, expansion joints, and silencer shell.
- Noise from the turbine inlet air system, including the inlet opening and noise radiated from the silencer/ductwork shell and any duct joints.
- Turbine/Compressor casing noise that radiates to the exterior of the building and through building ventilation openings.
- Gas aftercoolers
- Fuel Gas Heaters
- TEG Regeneration Skids

4.2 Operations Noise

4.2.1 Noise Model Results – Typical Operation Scenario with Mitigation

Table Y-6 shows a summary of the predicted cumulative future sound level contributions of the upgraded station equipment at each NSA. The table also shows the overall NSA sound levels, including the future station and ambient environmental sources. This table indicates that with the proposed noise control treatments discussed below, the cumulative assessment of the Miller Station and NMCS noise contributions at all of the nearest NSAs are well below the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) criterion. The predicted increase in sound level ranged from 0.03 to 3.1 dBA and is below the allowable 10 dB increase over the measured L_{50} as outlined within the OAR regulation. The results are summarized within **Table Y-6** below. A noise contour map of the predicted sound levels from the 2 stations including the expansion equipment is shown as **A-2**.

Table Y-6: Mist Resiliency Project (Miller Station and NMCS) - Sound Level Predictions

NSA	Distance and Direction from Miller Comp. Bldg to NSA, miles	Distance and Direction from NMCS Comp. Bldg to NSA, miles	Measured Existing Ambient, Nighttime	Station Upgrade Equipment [a]	Combined Ambient + Future Station	Increase Above Existing Ambient
			dBA L_{50}	dBA	dBA L_{50}	dBA L_{50}
1.0	3.3 NW	1.7 W	27.0	27.1	**30.1**	3.1
2.0	2.6 SW	3.1 SW	32.7	20.6	**33.0**	0.3

a. Per noise modeling results.

4.2.2 Noise Model Results – Unit Blowdown Scenarios

Under certain circumstances, the pressure in the compressor casing and unit piping must be released in a controlled manner. These events are commonly called “blowdowns” and occur when the unit is shut down for an extended period. During the blowdown, the high-pressure gas in the system is released in a controlled fashion through a blowdown silencer. Blowdown events cause a temporary increase in sound level that usually lasts for about five minutes.

A compressor blowdown scenario was modeled using a single blowdown silencer specified to limit the blowdown sound levels to a maximum of 100 dBA at 3 feet, as provided by NWN. **Table Y-7 and Table Y-8** show the predicted short-term sound pressure levels at the NSAs during a blowdown event. The unit blowdown event sound levels are compared to the nighttime measured L_{50} at each NSA, to show the potential short-term sound level impact of the stations.

Table Y-7: Unit Blowdown Sound Level Prediction- Miller Station

NSA	Distance and Direction from Miller Comp. Bldg to NSA, miles	Distance and Direction from NMCS Comp. Bldg to NSA, miles	Measured Existing Ambient, Night L_{50}	Estimated Contribution of Unit Blowdown	Combined Blowdown and Ambient	Short-Term Sound Level Increase During Blowdown
			dBA	dBA	dBA	ΔL_{eq} dBA
1.0	3.3 NW	1.7 W	27.0	17.7	27.5	0.5
2.0	2.6 SW	3.1 SW	32.7	19.7	32.9	0.2

Table Y-8: Unit Blowdown Sound Level Prediction- NMCS

NSA	Distance and Direction from Miller Comp. Bldg to NSA, miles	Distance and Direction from NMCS Comp. Bldg to NSA, miles	Measured Existing Ambient, Night L_{50}	Estimated Contribution of Unit Blowdown	Combined Blowdown and Ambient	Short-Term Sound Level Increase During Blowdown
			dBA	dBA	dBA	ΔL_{eq} dBA
1.0	3.3 NW	1.7 W	27.0	28.4	30.8	3.8
2.0	2.6 SW	3.1 SW	32.7	23.4	33.2	0.5

4.3 Construction Noise

For both Miller Station and NMCS, only standard equipment is expected to be used during construction, with no dynamic compaction or pile driving activities. Construction will take place mostly during daytime working hours of 7:00 a.m. until 7:00 p.m. Construction sound calculations were performed with the CadnaA propagation model, which accounts for local topography. Equipment usage factors were used per the Federal Highway Administration's Roadway Construction Noise Model version 1.1 (FHWA, 2006). Usage factor is the percentage of time a given piece of equipment typically operates during a given hour. The estimated sound power level utilized in the construction noise model is 118.9 dBA for all combined equipment types provided below.

The following equipment included within **Table Y-9** were included in the construction evaluation for the stations.

Table Y-9: Summary of Potential Construction Equipment

Equipment Description	Quantity
Hydro- Vac Truck	1.0
D-6 Dozer	1.0
Loader 900 Class	1.0
Excavator 320 Class	1.0
Excavator 315 Class	1.0
Excavator 336 Class	1.0
Remote Compactors	1.0
Roller Compactors	2.0
Articulated Dump Druck	1.0
Concrete Trucks	2.0
Concrete Pump Truck	1.0
Grout Mixer	1.0
Skid Steer	1.0
Crane	1.0
Telescopic Forklift	1.0
Generator 80KW	2.0
Water Truck	1.0
Pickup Truck	3.0
Welding Rigs	1.0
Air Compressor	2.0
Haul Truck	2.0
Water Pump	1.0
Boom Lift	1.0

Daytime construction noise levels, for typical construction equipment described above, are anticipated to be 25.5 dBA at NSA1 and 20.5 dBA at NSA 2. This assessment includes active construction activities occurring at both stations with all described equipment operating simultaneously. This is a very conservative approach and the expected sound levels at the noise sensitive areas would likely be significantly lower than predicted, and well below any ambient sound levels.

5.0 Assessment of Proposed Facility's Compliance with Applicable Noise Regulations (OAR 345-021-0010(1)(y)(B))

As a conservative approach, the predicted noise impacts from both stations have been cumulatively assessed. Impulsive noise sources are not expected for either of the sites, so a separate impulsive noise evaluation has not been performed.

A three-dimensional computer noise model was constructed to analyze the noise contributions expected from the future upgraded compressor station configuration. The model was developed using CadnaA, version 2023 MR 2 (build: 195.5312), a commercial noise modeling package developed by DataKustik GmbH. The software considers spreading losses, ground and atmospheric effects, shielding

from barriers and buildings, reflections from surfaces and other sound propagation properties. The software is based on published engineering standards. The ISO 9613 standard was used for air absorption and other noise propagation calculations. Topographic Meta data were taken from the U.S. Geological Survey (USGS) 10-meter National Elevation Data Set to create accurate topography within the noise model.

The Mist Resiliency Project sound levels are regulated by the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) noise limits. The applicable limits are based upon the measured ambient statistical sound levels and octave band sound pressure levels. The most stringent noise limitation within the regulation is the 10 dB increase over the measured nighttime L_{50}. The L_{50} sound level can be described as the sound level exceeded 50% of the time during the measurement period. As the predicted project noise impacts are well below this requirement, the additional sound level limits are also satisfied.

As provided within Section 4.0, the cumulative assessment of the Miller Station and NMCS noise contributions at all of the nearest NSAs are well below the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) criterion. The predicted increase in sound level ranged from 0.03 to 3.1 dBA and is below the allowable 10 dB increase over the measured L_{50} as outlined within the OAR regulation.

Table Y-10 and Table Y-11 present the sound power levels used as input to the sound model. The proposed future compressor building dimensions were used in the noise model. The proposed equipment was arranged as per the provided plot plan, with the unit suction and discharge piping on the north side; the turbine inlet on the south side; and the turbine exhaust on the west side of the compressor building. The turbine exhaust was modeled at a height of 50 feet above grade. The proposed compressor building was modeled to include a total of two wall intake fans and two exhaust vents on the east side of the building. Each opening was sized at 60 inches square. All equipment sound data provided by Solar was modeled as partial load. Partial load sound levels for this equipment are higher than full-load sound levels, so this is a conservative approach.

Table Y-10: Sound Pressure Levels (Lp) and Sound Power Levels (Lw) for Miller Station Equipment

Source	Linear L_p or L_w at Octave Center Frequency									Total
	31.5	63	125	250	500	1k	2k	4k	8k	dBA
Engine Intake, Taurus 60, Unsilenced L_w [1]	103	113	124	125	121	123	129	159	147	160
Engine Exhaust, Taurus 60, Unsilenced, L_w [1]	121	123	120	123	130	125	114	105	96	129
Building Wall Panel Fan, L_w [1]	101	101	98	94	93	90	86	83	82	95
Sound Level in Compressor Building at Inner Wall Surface, L_p [2]	98	90	92	96	105	94	88	86	92	103
Exhaust Breakout, Taurus 60, L_w [2]	94	96	93	96	98	88	85	78	56	97
Gas Coolers, L_w [2]	104	104	103	100	95	93	87	81	75	98
Lube Oil Cooler, Taurus 60, L_w [1]	105	112	109	102	97	94	90	86	81	100
Fuel Gas Heater Skid, Lw [2]	-	-	-	-	91	96	104	103	99	108
TEG Regen Skid[2]	123	102	99	88	82	79	79	86	90	93

[1] From Solar Taurus 60 PIB 252 Rev 6– 2021

[2] From SLR Data Library from similar projects

Table Y-11: Sound Pressure Levels (Lp) and Sound Power Levels (Lw) for NMCS Equipment

Source	Linear L_p or L_w at Octave Center Frequency									Total
	31.5	63	125	250	500	1k	2k	4k	8k	dBA
Caterpillar G3608 Compressor Engine L_w[2]	-	90	101	108	114	113	115	126	114	127
Caterpillar G3608 Compressor Engine Exhaust, L_w [2]	-	100	119	122	126	128	130	136	133	139
Existing Caterpillar G3606 Compressor Engine L_w [2]	-	90	94	105	112	114	114	119	109	122
Existing Caterpillar G3606 Compressor Engine Exhaust, L_w [2]	-	100	113	117	120	124	131	136	132	139
Vertical Gas Cooler Discharge, L_w [2]	107	107	106	103	98	96	90	84	78	101
Vertical Cooler Fan Inlet, L_w[2]	107	107	106	103	98	96	90	84	78	101
Fuel Gas Heater Skids, Lw [2]	-	-	-	-	91	96	104	103	99	108
Backup Generators[2]	75	93	102	106	109	111	109	105	87	115
TEG Regen Skids[2]	123	102	99	88	82	79	79	86	90	93

[1] From NWN provided sound data

[2] From SLR Data Library from similar projects

A summary of the modeled performance of one possible set of noise control treatments is shown in **Table Y-12** and **Table Y-13**, below. The noise mitigation described applies to the proposed new equipment only. The following subsections describe the treatments. The noise control treatments shown are based on the most current station design and represent one potential set of possible mitigation measures. There are many different combinations of noise control mitigation measures that will provide similar noise control. As the station design is finalized, the noise mitigation treatments may be modified to account for other design changes, but the final noise control design will maintain compliance with the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) limits.

Table Y-12: Required Noise Control Treatments – Miller Station

Required Dynamic Insertion Loss (DIL) or Transmission Loss (TL)										
Source	Treatment Description	Required Treatment Performance								
		31.5	63	125	250	500	1k	2k	4k	8k
Turbine Inlet	Solar Silencer (per unit), DIL	-	1	3	4	18	38	46	54	45
Turbine Inlet	Pulse Updraft Filter (per unit), DIL	-	1	8	10	14	15	18	20	25
Compressor Building	STC-29 Wall and Roof System, TL	9	12	11	16	26	34	41	44	46

Personnel Door	STC-32 Standard Personnel Door, TL	9	17	23	27	32	32	31	41	41
Equipment Door	STC-21 Insulated Roll-up Door, TL	2	7	12	17	18	19	22	30	35
Building Ventilation	Unlined Hoods, DIL	1	5	8	4	3	3	3	3	3
Exhaust	Standard Solar Taurus 60 Exhaust Silencer (each unit), DIL	1	2	6	12	25	24	19	16	8

Table Y-13: Required Noise Control Treatments – NMCS

Required Dynamic Insertion Loss (DIL) or Transmission Loss (TL)									
Source	**Treatment Description**	**Required Treatment Performance**							
		31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Exhaust	Caterpillar G3608 Engine Exhaust Silencer (per unit), DIL	15	30	47	50	45	37	33	34	35

5.1 Compressor Building Walls and Roof – Miller Station

The compressor building expansion shall achieve, at minimum, the sound transmission class rating (STC) and sound transmission loss performance shown in **Table Y-12**. It is recommended that the compressor building manufacturer supply laboratory test results for their proposed wall system, showing a transmission loss equal to or greater than the required performance in each octave band. The building should be well sealed with no cracks or gaps. All piping penetrations through the building walls should be well insulated, flashed, and caulked.

The interior surface of the compressor building walls should be acoustically absorptive, having a noise reduction coefficient (NRC) of at least NRC 0.8. The inside of the compressor building can be lined with perforated metal of at least 23 percent open area for insulation protection, if so desired.

Based upon the current project design, an acoustical compressor building will not be utilized at NMCS.

5.2 Compressor Building Doors - Miller Station

The compressor building section will have a 14-foot by 14-foot steel roll-up equipment door. A standard insulated over-head door will be sufficient for the equipment door. The performance shown in **Table Y-12** is the required transmission loss performance of the roll-up door.

The personnel doors should achieve the STC rating per **Table Y-12**, or better. These are industrial metal doors with good perimeter seals. Small glass windows in the personnel doors are acceptable as long as the door STC rating is achieved.

5.3 Compressor Ventilation - Miller Station

All building ventilation openings should include acoustical louvers or silencers as described in **Table Y-12**. The ventilation openings include the sound level contribution of both the mechanical equipment inside the building (turbines, etc.) along with the sound levels due to the ventilation fans. The sound pressure level calculated for the interior of the building due to the turbine and compressor equipment is shown in **Table Y-10**. The ventilation system supplier should submit the sound power level of the proposed building ventilation fans during the bidding process for review.

The approximate ventilation silencer performance is shown in **Table Y-12**. The final performance requirements of these silencers will depend on the size, number, and type of ventilation fans used in the design.

5.4 Turbine Exhausts – Miller Station

For the operation of dual-shaft SoLoNox turbines, Solar notes that sound levels during partial-load operation can be higher than sound levels during full-load operation. In an analysis of manufacturer data for these turbines, increases of up to 14 dB at 1 kHz have been noted by Solar for Taurus 70 exhaust. Silencer specification and bidding should be developed with such potential variability in mind, in order to satisfy the noise targets for all steady-state operational conditions.

5.4.1 Silencer Performance

The turbine will include an exhaust silencer system with insertion loss shown in **Table Y-12**

5.4.2 Exhaust Duct and Shell Noise

In large turbine-powered installations, it is common for a significant amount of sound energy to radiate from the exhaust system ductwork, expansion joints, and exhaust silencer shell. This sound energy is often termed “shell-radiated” noise. Shell-radiated noise is not necessarily calculated by exhaust system manufacturers, but it can be a dominant noise source for NSAs close to the station. The modeled breakout noise sound power levels are shown in **Table Y-10**. These levels were based on SLR database of previous measurements and adjusted to be approximately 5 dB less than the mitigated turbine exhaust.

5.5 Compressor Engine Exhausts – NMCS

The compressor engines for the proposed Caterpillar G3608 Units will include an exhaust silencer system that results in the insertion loss shown in **Table Y-13**.

5.6 Turbine Inlet – Miller Station

The proposed expansion unit will include the standard Solar intake silencer and pulse-updraft filter. The insertion losses of each of these two elements are shown in **Table Y-12.**

5.7 Gas Aftercooler Fans – Miller Station

The sound power level of the gas cooler fans should not exceed the sound power level given in **Table Y-12.** This is the total sound power for each cooling tower.

6.0 Proposed Measures to Reduce Noise Levels and Address Public Complaints (OAR 345-021-0010(1)(y)(C))

6.1 Proposed Methods to Reduce Noise

As included within Section 5.3.2, construction noise is currently exempt. Despite the exemptions, an overall prediction of sound levels from construction is required as per OAR (345-021-0010). Construction noise can generally cause annoyance to people living and enjoying environmental areas within close proximately to the project area.

All reasonable methods of minimizing the adverse impacts of construction should be incorporated into the plans and specifications of the contract. Methods include reducing idling, broadband backup alarms, and maintaining the noise mitigation equipment. As discussed within this report, the predicted noise impact from operations from the Mist Resiliency Project are well below the applicable limits with the noise controls provided within this report.

6.2 Proposed Methods to Reduce Noise

As the nearest noise sensitive area is approximately 1.7 miles from the nearest station, NWN does not anticipate receiving any complaints. The established methods for documenting and responding to complaints will be utilized as per existing EFSC Site Certificates.

7.0 Proposed Method for Monitoring Noise (OAR 345-021-0010(1)(y)(D))

NWN proposes to conduct post construction monitoring and testing once upgrades have been completed at both Miller Station and NMCS. The monitoring locations and duration will be consistent with the provided noise sensitive locations established within this report.

8.0 List of Noise Sensitive Property Owners within 1 Mile of Mist Resiliency Project (OAR 345-021-0010(1)(y)(E))

There are no noise sensitive properties located within 1 mile of the proposed site boundaries.

9.0 Submittal Requirements and Approval Standards.

Table Y-14 below provides a summary of the submittal requirements as per OAR (345-021-0010).

Table Y-14: Submittal Requirements Matrix

Submittal Requirements Matrix	
Requirement	**Location within Report**
OAR 345-021-0010(1)(y) Information about noise generated by construction and operation of the proposed facility, providing evidence to support a finding by the Council that the proposed facility complies with the Oregon Department of Environmental Quality's noise control standards in OAR 340-35-0035. The applicant shall include:	See below
OAR 345-021-0010(1)(y)(A) Predicted noise levels resulting from construction and operation of the proposed facility	Section 4
OAR 345-021-0010(1)(y)(B) An analysis of the proposed facility's compliance with the applicable noise regulations in OAR 340-35-0035, including a discussion and justification of the methods and assumptions used in the analysis.:	Section 5
OAR 345-021-0010(1)(y)(C) Any measures the applicant proposes to reduce noise levels or noise impacts or to address public complaints about noise from the facility.	Section 6
OAR 345-021-0010(1)(y)(D) Any measures the applicant proposes to monitor noise generated by operation of the facility.	Section 7
OAR 345-021-0010(1)(y)(E) A list of the names and addresses of all owners of noise sensitive property, as defined in OAR 340-035-0015, within one mile of the proposed site boundary.	Section 8

10.0 Summary

SLR International Corporation (SLR) has prepared a noise study at the request of Northwest Natural Gas (NWN) for the Mist Resiliency Project consisting of upgrades to the existing Miller Station and NMCS in Columbia County, Oregon. This report presents the results from SLR's sound level survey of the existing ambient conditions and noise modeling of the upgraded stations.

An ambient survey was conducted near the project NSA's and the measurements show that current ambient sound levels range from L_{50} 27.0 to 32.7 dBA.

A noise model has been developed of the proposed upgraded stations. With the noise control treatments outlined in this report, modeling predicts that the upgraded station sound level contribution at the NSAs will range from 20.6 to 27.1 dBA. The sound level contributions from the future station are expected to be in compliance with the Oregon Noise Control Regulations for Industry and Commerce (OAR 340-35-0035) limits.

Regards,

SLR International Corporation

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Appendix Y-1 Figures

Mist Resiliency Project

Northwest Natural Gas Company

SLR Project No.: 108.00481.00028

March 15, 2024

Figure Y-1.1: Aerial Image Showing Measurement Locations and Noise Sensitive Receptors

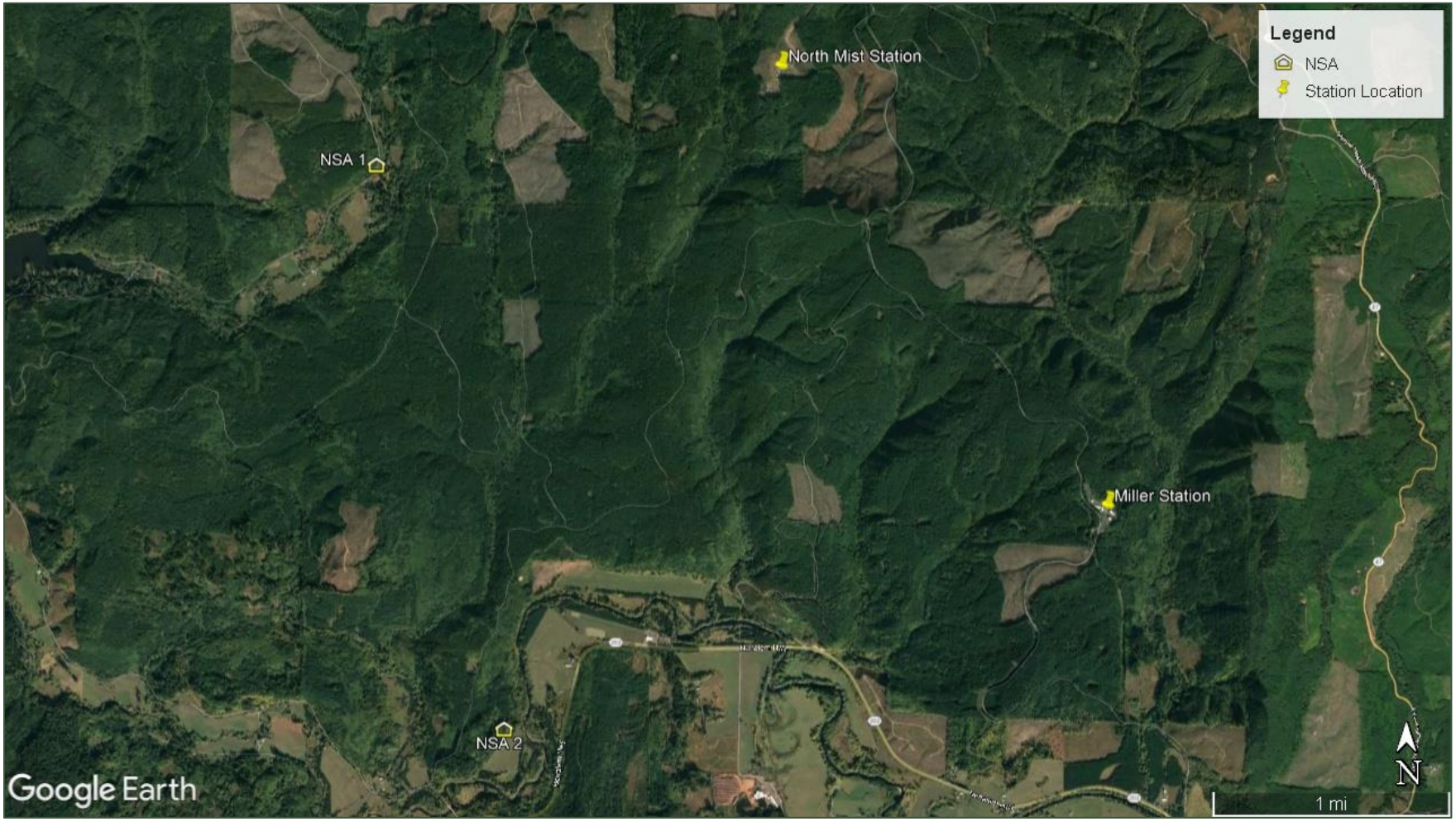
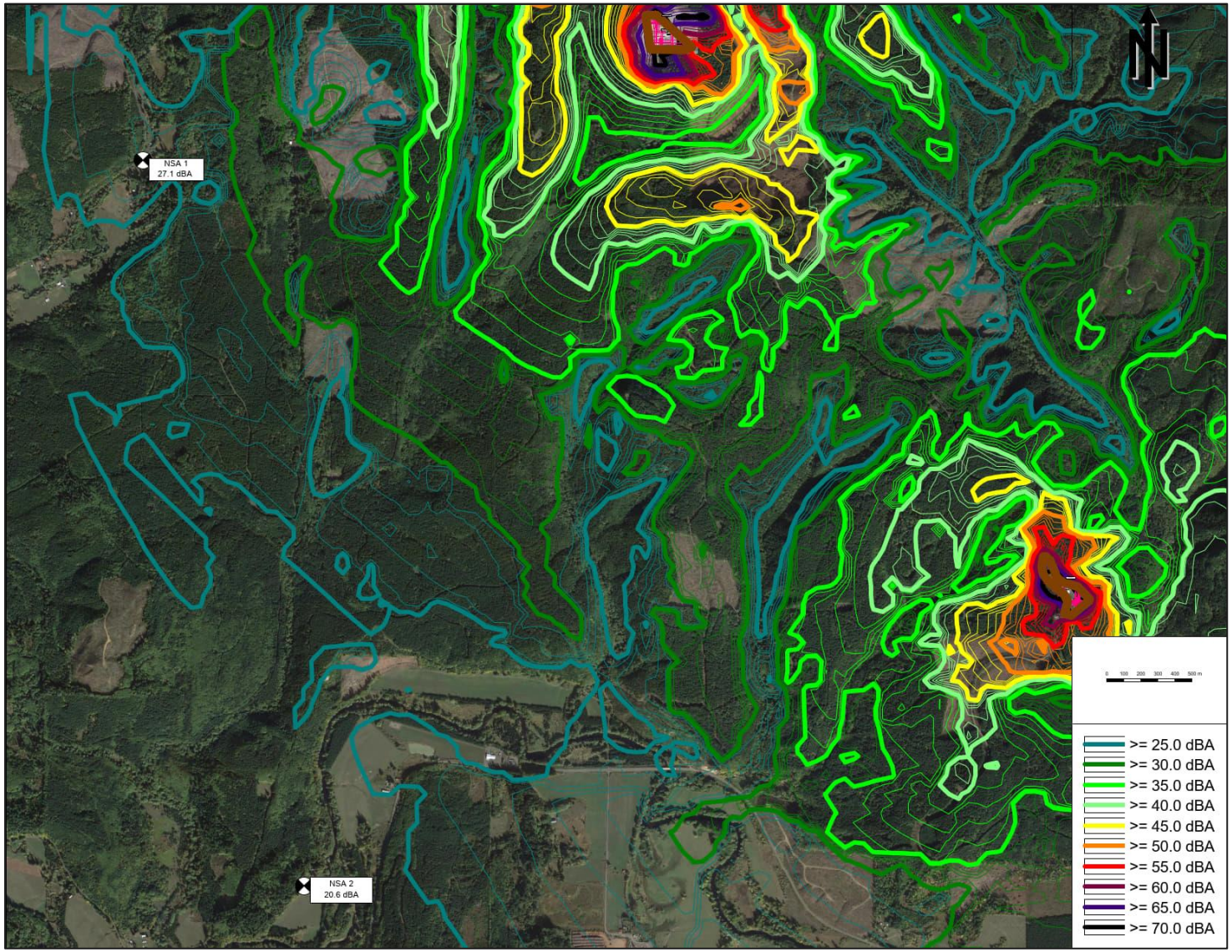


Figure Y-1.2: Noise Contour – Mitigated Condition, Leq, dBA



Appendix Y-2 Weather Data

Mist Resiliency Project

Northwest Natural Gas Company

SLR Project No.: 108.00481.00028

March 15, 2024

Figure Y-2.1: Weather Data – Sept 1st, 2023

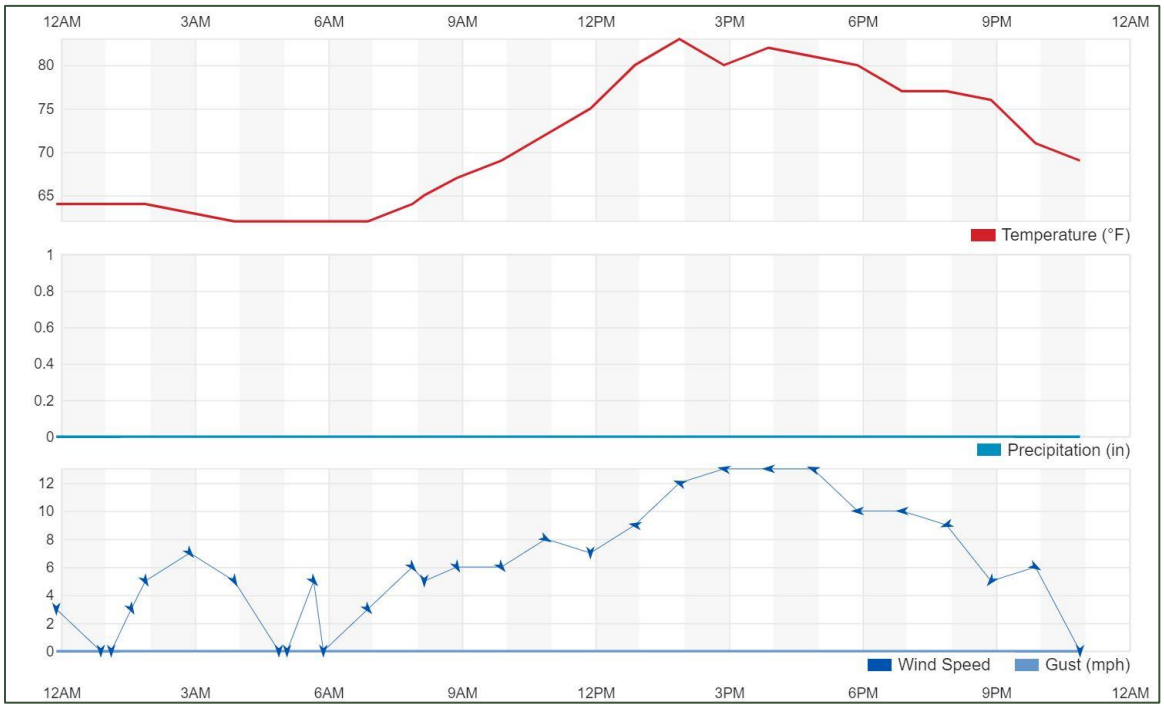


Figure Y-2.2: Weather Data – Sept 2nd, 2023

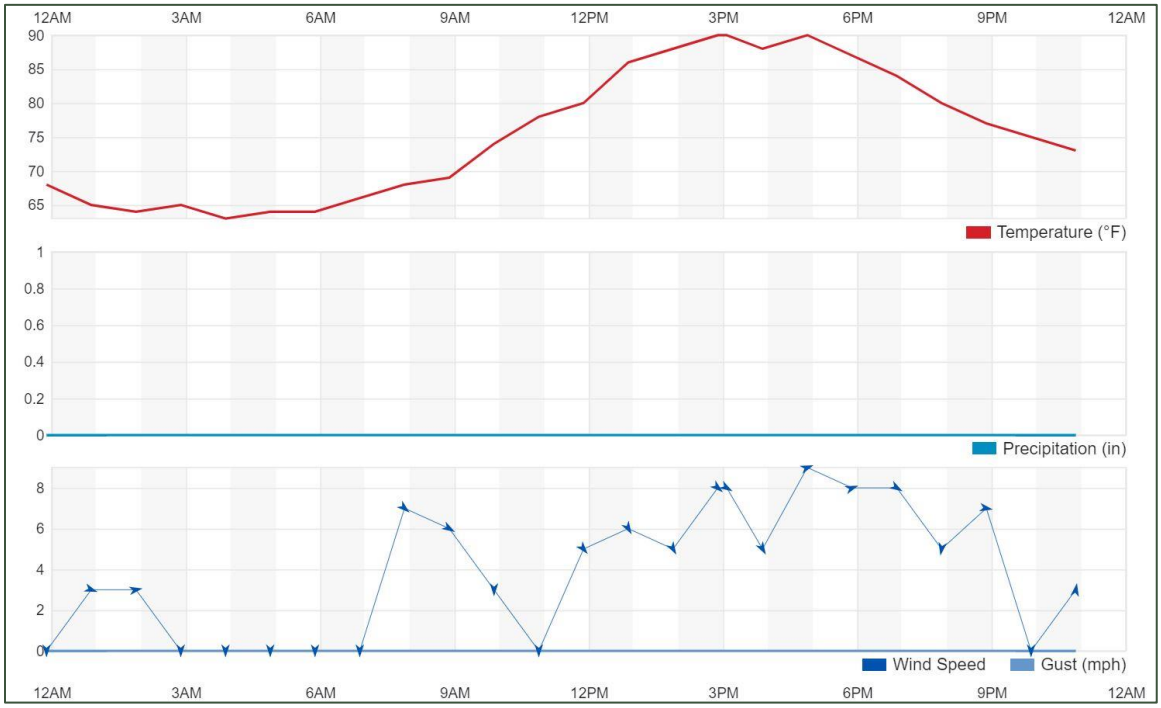


Figure Y-2.3: Weather Data – Sept 3rd, 2023

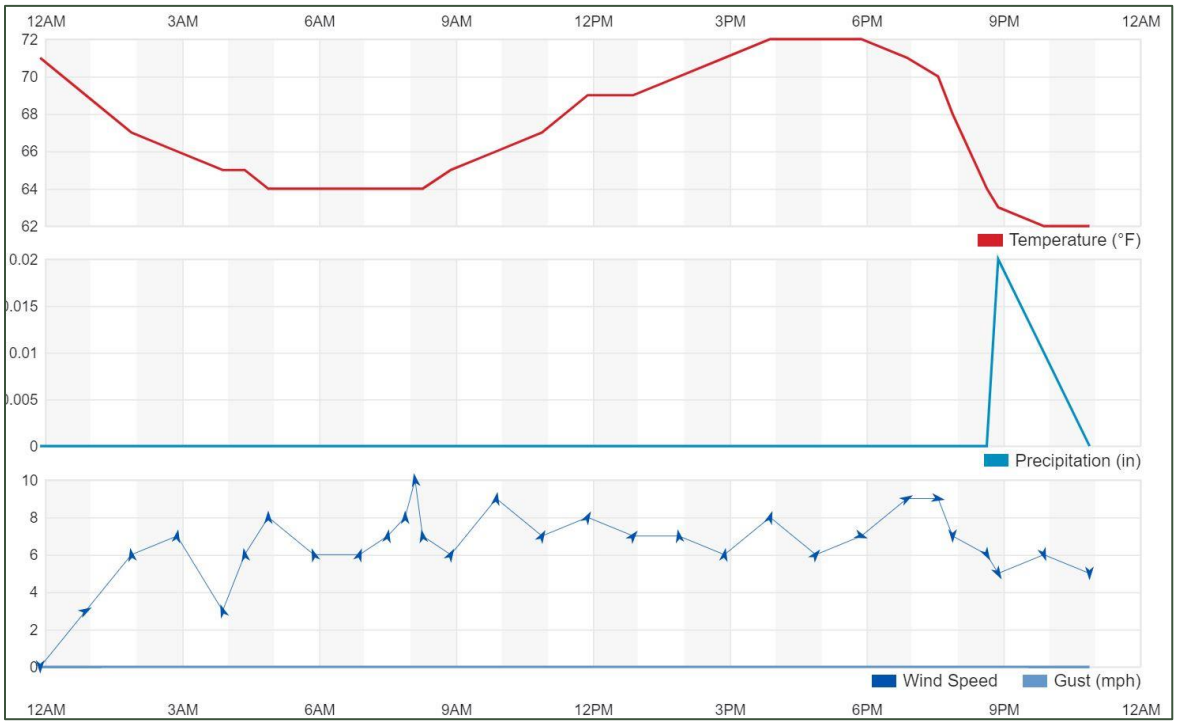
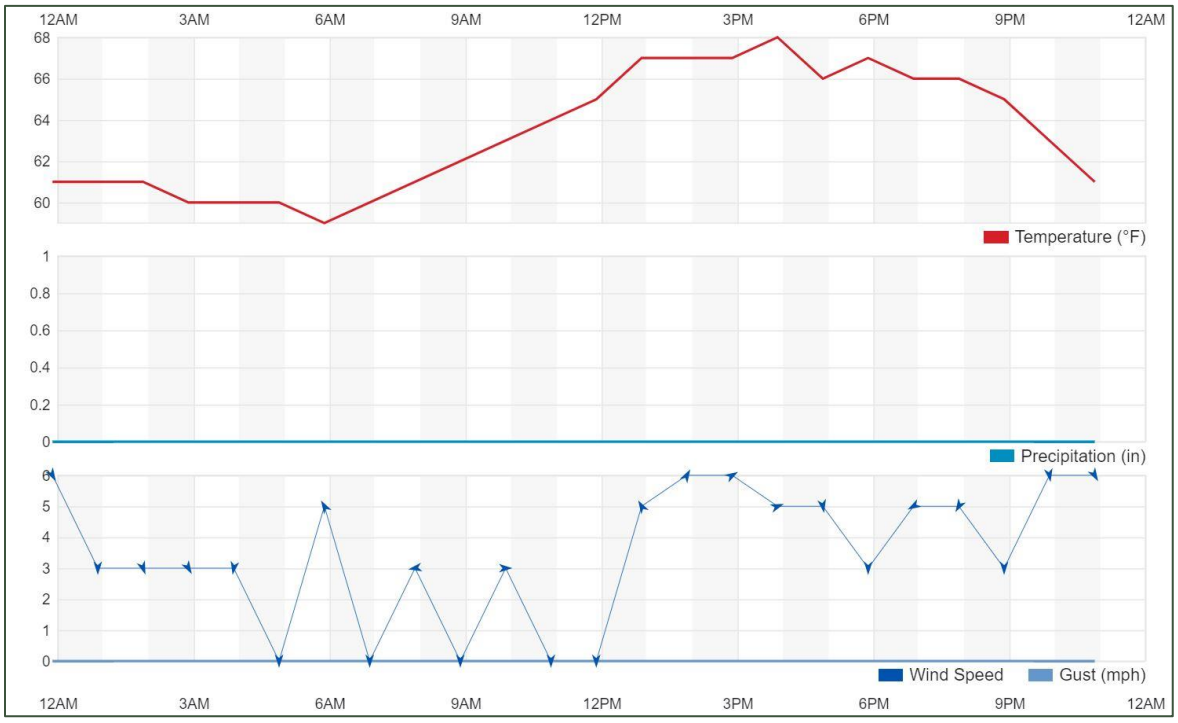


Figure Y-2.4: Weather Data – Sept 4th, 2023



Appendix Y-3 Glossary of Common Acoustical Terminology

Mist Resiliency Project

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A-weighting: a weighting scale in which sound pressure levels in individual frequency bands are adjusted to match the response for the human ear. The reference adjustment is 0 dB at 1,000 Hz. The human ear is much less responsive at low frequencies. An A-weighted sound level is the total contribution from all sound frequencies, with the appropriate weighting factors applied and is designated as dBA.

C-weighting: a weighting scale that is relatively flat from 31.5 Hz to 8,000 Hz with a roll-off higher and lower than those frequencies. The adjustment is 0 dB from 200 Hz to 1,250 Hz. A C-weighted sound level is the total contribution from all sound frequencies, with the appropriate weighting factors applied and is designated as dBC.

Hertz (Hz): the unit of measure of frequency or the speed of vibration of a sound wave. Also referred to as "cycles per second".

Insertion Loss (IL): the decrease (in decibels, dB) in sound power level measured at the location of the receiver when a sound attenuator (e.g., muffler), barrier, or other sound reduction element is inserted in the transmission path between the source and receiver.

L_d: the daytime average sound level. The L_{eq} averaged over daytime hours. Daytime hours may be defined differently by various ordinances and regulations. The hours between 7:00 am and 10:00 pm is the interval used by the U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Department of Housing and Urban Development (HUD).

L_{dn} (also DNL): the day-night average sound level, a metric used by many regulatory bodies (including FERC and HUD) as an overall representation of the sound at a measurement location. The L_{dn} is calculated by averaging the sound measured over a 24-hour period, with 10 decibels added to sound levels measured during nighttime hours.

L_{eq}: the equivalent-continuous sound level is a time-average sound level for a specified time period. It is the most commonly used form of sound level averaging. Specifically, the Leq is the level of a steady sound that has the same sound energy as a time-varying sound during a stated time period and at a stated location.

L_n: the nighttime average sound level. The L_{eq} averaged over nighttime hours. Nighttime hours may be defined differently by various ordinances and regulations. The hours between 10:00 pm and 7:00 am is the interval used by the U.S. Federal Energy Regulatory Commission (FERC) and the U.S. Department of Housing and Urban Development (HUD).

L_{90}: a statistical parameter (percentile) that describes the sound level that is exceeded 90 percent of the time during a stated time period. For example, for a stated hourly L_{90} of 45 dBA, the sound level at the measurement location has a 90% chance of being greater than 45 dBA and a 10% chance of being less than or equal to 45 dBA. The L_{90} is often used as the "background" or "ambient" sound level for a given measurement period. Other percentile values are defined similarly (e.g., L_{50}, L_{10}, etc.).

Sound Power Level (PWL or L_w): a logarithmic parameter that describes the power characteristics of a noise source, relative to a reference power value, expressed in decibels, dB or dBA. The sound power level should not be confused with the sound pressure level. The sound power level is a characteristic of a noise source analogous to the wattage rating of a light bulb, and it is independent of the surroundings. It is calculated from measurements of the sound pressure level. A 75-watt light bulb will look much brighter in a white, reflective room than in a black, absorptive one. A noise source rated with a sound power level if 95 dBA will produce a much higher sound pressure level (will be much louder) in a small hard box than outside in a soft grass meadow.

Sound Pressure Level (SPL or L_p): a logarithmic parameter that describes the quantity of sound relative to a reference pressure value, expressed in decibels, dB or dBA. The SPL is the quantity that is measured with a sound level meter, and it is dependent upon the surroundings of a noise source.

Sound Transmission Class (STC): a single number rating for describing sound transmission loss of a wall or partition. A rating system designed to facilitate comparison of the sound transmission characteristics of various architectural materials and constructions.

Transmission Loss (TL): the difference (in decibels) between sound power incident upon a sound reduction element (wall or muffler) to that transmitted. The less sound energy is transmitted, the higher the TL value.

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