Appendix H - Church Road Interconnects Noise Impact Analysis Report

Appendix H-1 - Noise Impact Analysis Report Redacted

Church Road Interconnects

Noise Impact Analysis

PennEast Pipeline Project

Project number: 60414094

January 9, 2020

Quality information

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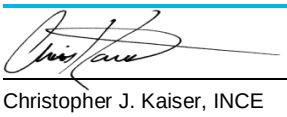		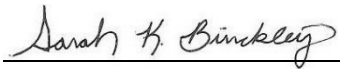
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Executive Summary

The noise study report provided results of baseline noise measurements conducted in November 2019 and analyzed predicted construction and operational noise levels for the proposed Church Road Interconnects, a new Metering and Regulation (M&R) station associated with the PennEast Pipeline Project. The Church Road Interconnects M&R station (Station) is expected to feature on-site functions including the operation of gas to flow meter runs, flow control valves, and water bath heaters.

Outdoor ambient sound level data were collected at site boundaries and representative nearest noise-sensitive areas (NSAs) in the vicinity of the Station site. Ambient existing sound levels were measured during both daytime and nighttime periods at a total of three locations in the proposed Station vicinity.

Predictions of Station operation noise were performed to assess whether adverse noise effects would be caused at adjacent community NSRs and property lines. The predicted results suggest that noise generated by the operation of the Station will be compliant with all applicable regulatory noise thresholds including the FERC criterion of 55 dBA L_{dn} at nearest NSAs and the applicable daytime and nighttime sound level limits stipulated by Bethlehem Township (BT) at the nearest property lines (PL).

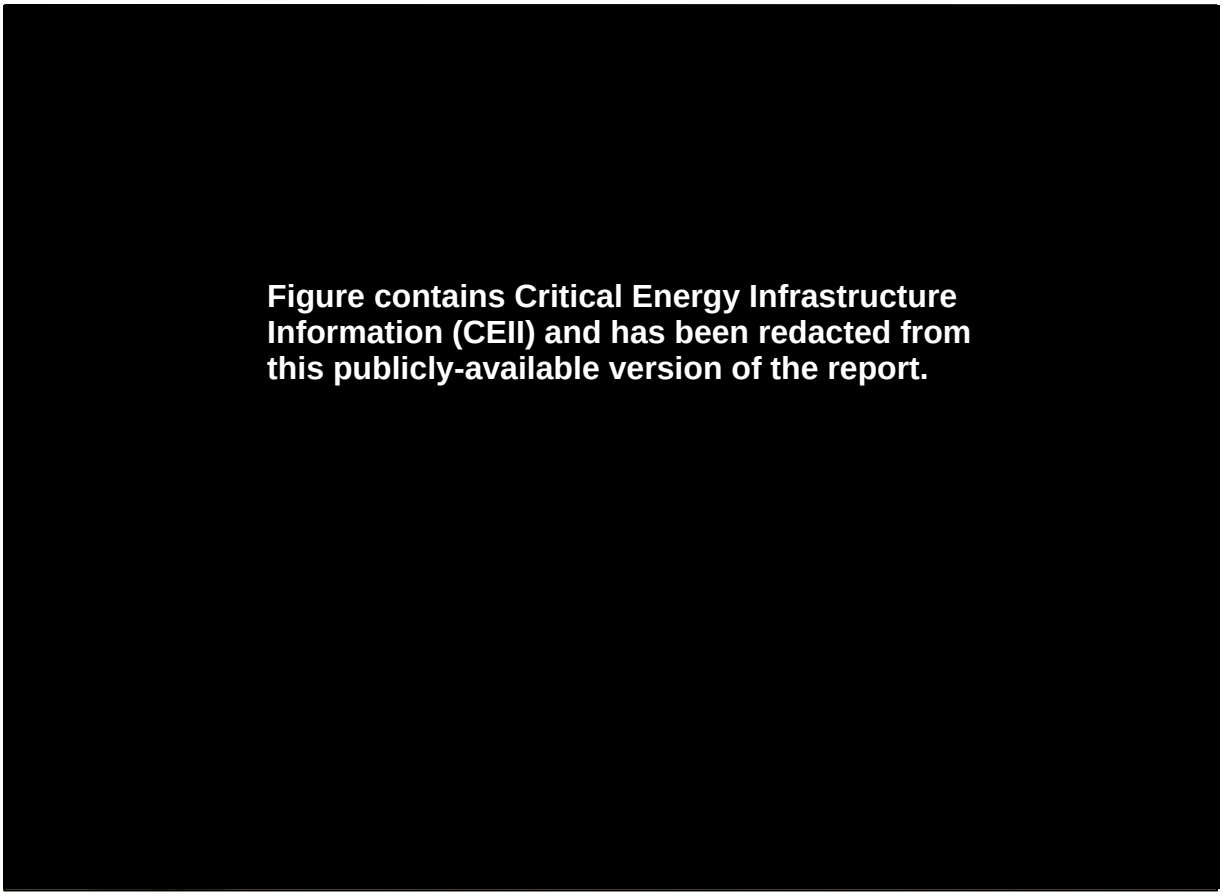
As the development of the Station reaches a detailed design phase, the operational noise analysis and recommended noise control measures discussed herein will be revisited and refined by PennEast, as needed.

1. Introduction

The proposed Church Road Interconnects would be an approximately 2.13-acre M&R Station at the PennEast Mainline Pipeline's intersection with Columbia Gas Transmission, LLC (TCO) and Adelphia Gateway, LLC (Adelphia) in Bethlehem Township, Northampton County, Pennsylvania. PennEast proposes to construct an M&R Station on one parcel that is owned by PennEast at MP 68.2R2. As shown on the site plan in Figure 1-1, a Pipe Inspection Gauge (PIG) launcher/receiver would be installed along the Projects' mainline pipeline to provide access for internal pipeline inspections during Project operations of each Project phase. Station piping would allow gas to flow to meter runs, flow control valves, heaters, and gas control/remote terminal unit (RTU) buildings south of and abutting the Certificated Route right-of-way (ROW). The M&R station would be accessed via access road number AR-066N, which is an existing driveway from Church Road.

The land uses surrounding the proposed Station site include agricultural fields to the northwest and south, sparsely-distributed single-family homes to the northeast and southwest, and a medium-density neighborhood of single-family homes across Pennsylvania Route 33 / General Anthony Clement McAuliffe 101st Airborne Memorial Highway (PA-33). The site features an existing traffic noise barrier along its southwest boundary, paralleling PA-33 at a height of approximately 12 to 14 feet, and an existing single-family home that will be demolished.

Figure 1-1 displays the proposed Station layout and features superimposed upon aerial imagery of the Station site and its surroundings.



Map Data: Google, Imagery ©2020

Figure 1. Overview of Proposed Station Location and Key Facility Features

The reader is invited to consult Appendix A for a glossary of acoustical terms and definitions that help frame the discussion of the Station operations community noise impact assessment and potential noise control measures.

2. Regulatory Setting and Noise Impact Criteria

2.1 Federal

2.1.1 EPA Guidance

The U.S. Environmental Protection Agency (EPA) has published guidance that specifically addresses issues of community noise (EPA 1974). This guidance, commonly referred to as the "levels document," contains goals for noise levels affecting residential land use of day-night sound level (L_{dn}) $\leq$ 55 A-weighted decibels (dBA) for exterior levels and $L_{dn} \leq$ 45 dBA for interior levels. The U.S. Department of Housing and Urban Development (HUD) Noise Guidebook, Chapter 2 Section 51.101(a)(8), also recommends that exterior areas of frequent human use follow the EPA guideline of 55 dBA L_{dn} (HUD, 2009).

2.1.2 Federal Energy Regulatory Commission

Volume I Section 4.9.2 Noise and Vibration of the Federal Energy Regulatory Commission's (FERC) Guidance Manual for Environmental Report Preparation (FERC 2017) stipulates that new or modified compressor station or LNG equipment should not exceed the EPA threshold of $\leq$ 55 dBA L_{dn} at NSAs (alternatively considered as a continuous 49 dBA, L_{eq}). FERC's definition of an NSA includes residences, schools and day-care facilities, hospitals, long-term care facilities, places of worship, libraries, and may also include campgrounds, parks, and wilderness areas valued specifically for their solitude and tranquility.

2.2 Local

The Church Road Interconnects site and nearest NSRs are located wholly within Bethlehem Township, Pennsylvania.

2.2.1 Bethlehem Township Ordinances

Section 275-132 of the Bethlehem Township (BT) ordinances identify hourly sound level limits for various land use types and time periods, reading as follows:

A. No person shall operate or cause to be operated on private or public property any source of continuous sound (any sound which is static, fluctuating or intermittent with a recurrence greater than one time in any 15 second interval) in such a manner as to create a sound level which exceeds the limits set forth in this section, in the following table when measured at or within the property boundary of the receiving land use.

B. The following shall be the maximum sound levels for the stated times. The sound levels shall be measured at the lot line of the receiving dwelling or zoning boundary.

Sound Level Limits by Receiving Land Use and Time

Receiving Land Use	Time	Sound Level Limit (dBA)
Residential or AG District or lot line of an existing dwelling or hospital	7:00 a.m. to 9:00 p.m.	57
	9 p.m. to 7 a.m., and Sundays and state holidays	53
Commercial or CR District		64
Industrial district		69

C. For any source of sound which emits a pure tone, the maximum sound level limits set forth in Subsection B shall be reduced by five dBA.

D. The maximum permissible sound level limits set forth in Subsection B shall not apply to any of the following noise sources:

(4) Repair or construction work to provide electricity, water or other public utilities within the hours of 7:00 a.m. and 9:00 p.m. except for clearly emergency repairs which are not restricted by time.

(4) Construction operations (including the occasional use of explosives in construction) and repairs of public facilities (including sidewalks and streets) within the hours of 7:00 a.m. and 9:00 p.m. except for clearly emergency repairs which are not restricted by time.

Due to the variety of noise impact thresholds and decibel metrics, Table 1 provides a summary of applicable thresholds per receptor type.

Table 1. Noise Impact Threshold Summary (Station Operation)

Receptor Type	Assessment Location	Assessment Period	Sound Level Limit (dBA)
Residential	NSA Exterior (FERC)	Any 24-Hour Period	55 (L_{dn}) / 49 (L_{eq})
Residential Land Use, Agricultural District Land use, or Lot Line a Dwelling or Hospital	Property Line (BT)	Between 7:00 a.m. and 9:00 p.m.	57 (L_{eq})
	Property Line (BT)	Between 9:00 p.m. and 7:00 a.m. or Sundays and state holidays	53 (L_{eq})
Commercial	Property Line (BT)	Any time	64 (L_{eq})
Industrial	Property Line (BT)	Any time	69 (L_{eq})

3. Baseline Ambient Outdoor Sound Level Survey

3.1 Methodology and Instrumentation

3.1.1 Methodology

After a preliminary review of online aerial imagery and other literature, multiple sound level measurement location candidates were identified in the Station vicinity for short-term (ST) measurements of sound pressure level (SPL). ST measurements were conducted in the Station vicinity at property lines and nearest NSA's to the south and north. All ST measurements were conducted with an investigator attending the sound level meter (SLM) and making simultaneous observations of perceived sound sources and environmental conditions.

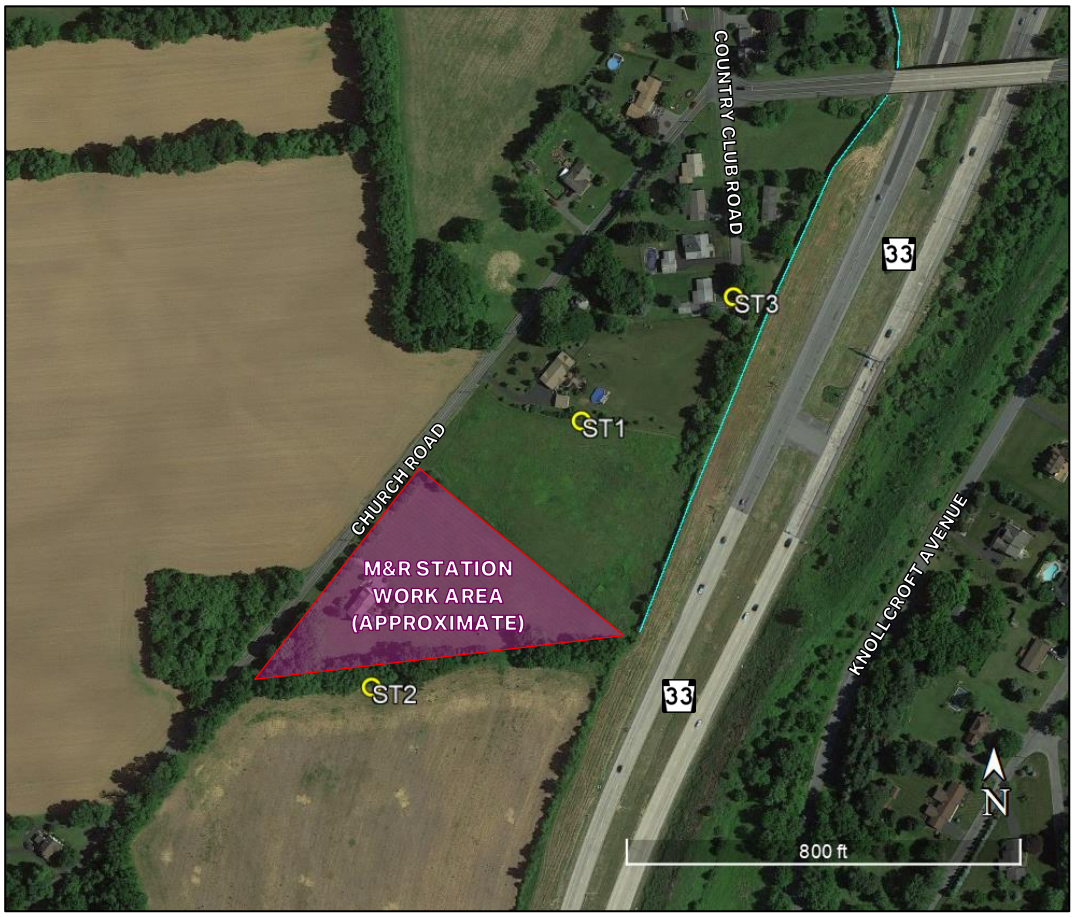
3.1.2 Instrumentation

SPL monitoring was performed with a Larson Davis Model LxT sound level meter, rated by the American National Standards Institute (ANSI) as Class 1 per ANSI S1.4-2014. The SLM microphone was fitted with standard 3.5" diameter spherical-shaped open-cell foam windscreen and positioned roughly 5 feet above grade. The microphone was also placed at least 10 feet (3 meters) from any acoustically reflecting surfaces. The SLM was set using slow time-response and the A-weighting scale. SLM calibration was field-checked before and after each measurement period with an LD Model CAL200 acoustic calibrator. Where not already described, sound level measurements performed for this field survey were conducted in a manner based on guidance from applicable portions of International Organization for Standardization (ISO) 1996-1, 1996-2, and 1996-3 standards (ISO, 1982, 1987a, 1987b).

A Kestrel Model 3000 handheld weather meter was used to determine or measure average wind speed, temperature, barometric pressure, and relative humidity at each ST noise measurement location.

3.2 Survey Results and Observations

Sound level measurements were conducted from November 14, 2019, to November 15, 2019, to collect SPL data in the Station vicinity. A total of six short-term (20-minute) measurements were conducted a total of three representative nearest NSAs and Station boundaries during daytime (07:00-22:00) and nighttime (22:00-07:00) periods. Measurement locations are shown in Figure 2.



Map Data: Google, Imagery ©2020

Figure 2. Short-Term Noise Measurement Location Map with Existing Noise Barrier (Blue Polyline)

Measured meteorological conditions during measurements ranged from 32-38 degrees Fahrenheit, humidity ranging from 30% to 49%, and wind speeds ranging from 0-4 miles per hour (mph). Detailed meteorological data can be found in the field noise measurement data forms included in Appendix B. Sample photographs documenting the SPL measurement locations can be found in Appendix B.

3.2.1 Measurement Location Details

The following narratives summarize descriptions of the sound level monitoring locations and highlight perceived or witnessed key acoustical contributors to the measured outdoor ambient sound environment.

GENERAL SITE VICINITY NOTES

At the time of the sound level survey, the AECOM field investigator observed that traffic along PA-33 was the dominant noise source at all areas surrounding in the proposed Station vicinity.

ST-1

This measurement position was located at the southern fence line of the single-family home located at 3798 Church Road, north of the Station site. The major noise source at this location was vehicular traffic on PA-33. Due to the existing traffic noise barrier located along the highway right-of-way in this area, noise emanating from the nearest segment of PA-33 was notably shielded, and PA-33 traffic noise emanating from the south, beyond the southern extent of the barrier, was dominant. Additional noise sources included a distant train horn sounding, intermittent vehicle traffic along Church Road, intermittent distant back-up alarm beeping, intermittent bird call, and distant aircraft flyovers.

ST-2

This measurement position was located at the southern property line of the single-family home located at 3790 Church Road (home to be demolished if the Station is constructed). The major noise source at this location was vehicular traffic on PA-33. Due to the existing traffic noise barrier located along the highway right-of-way near this area, noise emanating from the northern portions of PA-33 was notably shielded relative to the PA-33 traffic noise emanating from the southeast, beyond the southern extent of the barrier. Additional noise sources included intermittent rustling leaves, intermittent vehicle traffic along Church Road, intermittent bird call, and distant aircraft flyovers.

ST-3

This measurement position was located within the public right-of-way of Country Club Road at the eastern driveway edge of the single-family home located at 3805 Country Club Road. The major noise source at this location was vehicular traffic on PA-33 despite the existing traffic noise barrier located along the highway right-of-way which fully occludes line-of-sight to all traffic. Additional noise sources included intermittent rustling leaves, intermittent vehicle traffic along Country Club Road and Church Road, and distant aircraft flyovers.

Table 2 presents a summary of acoustical metrics and statistical values representing the measured SPL as indexed by measurement ID. Detailed one-minute interval measurement data are presented in Appendix B.

Table 2. Short-Term Baseline Sound Pressure Level (SPL) Measurement Results

Measurement Location ID	Time (hh:mm)	Duration (Minutes)	Measured SPL Values (dBA) L_{eq}	L_{min}	L_{max}	Calculated L_{dn} (dBA)
ST-1	10:08	20	63	58	69	68
ST-1	00:10	20	61	47	70	
ST-2	10:40	20	61	55	67	66
ST-2	00:38	20	59	47	68	
ST-3	11:12	20	60	55	70	65
ST-3	01:08	20	59	45	66	

Note: For reporting purposes, values presented throughout this table have been rounded to the nearest whole-decibel. Detailed measurement data are presented in Appendix B.

4. Predicted Noise Effect Assessment

4.1 Studied NSAs and Property Lines

Due to the alternative noise impact assessment locations required by FERC and Bethlehem Township, a total of four NSAs and four property line (PL) locations were identified for noise impact assessment.

NSA 1

This assessment location is representative of the single-family home located at 3798 Church Road. Baseline ambient measurement ST-1, located at the subject property's southern fence line, is considered representative of the existing acoustic environment at this NSA.

NSA 2

This assessment location is representative of the single-family home located at 3805 Country Club Road. Baseline ambient measurement ST-3, located at the subject property's driveway entry, is considered representative of the existing acoustic environment at this NSA.

NSA 3

This assessment location is representative of the single-family home located at 3615 Knollcroft Avenue. Baseline ambient measurement ST-2, located equidistant from PA-33 on the west side of the highway, is considered representative of the existing acoustic environment at this NSA.

NSA 4

This assessment location is representative of the single-family home located at 3659 Church Road. Baseline ambient measurement ST-2, located on the southern property line of the Station site closest to the NSA, is considered representative of the existing acoustic environment at this NSA.

PL-S

Southern property line of the proposed Station site. Representative of an existing agricultural land use currently zoned “Office-Business”.

PL-NW

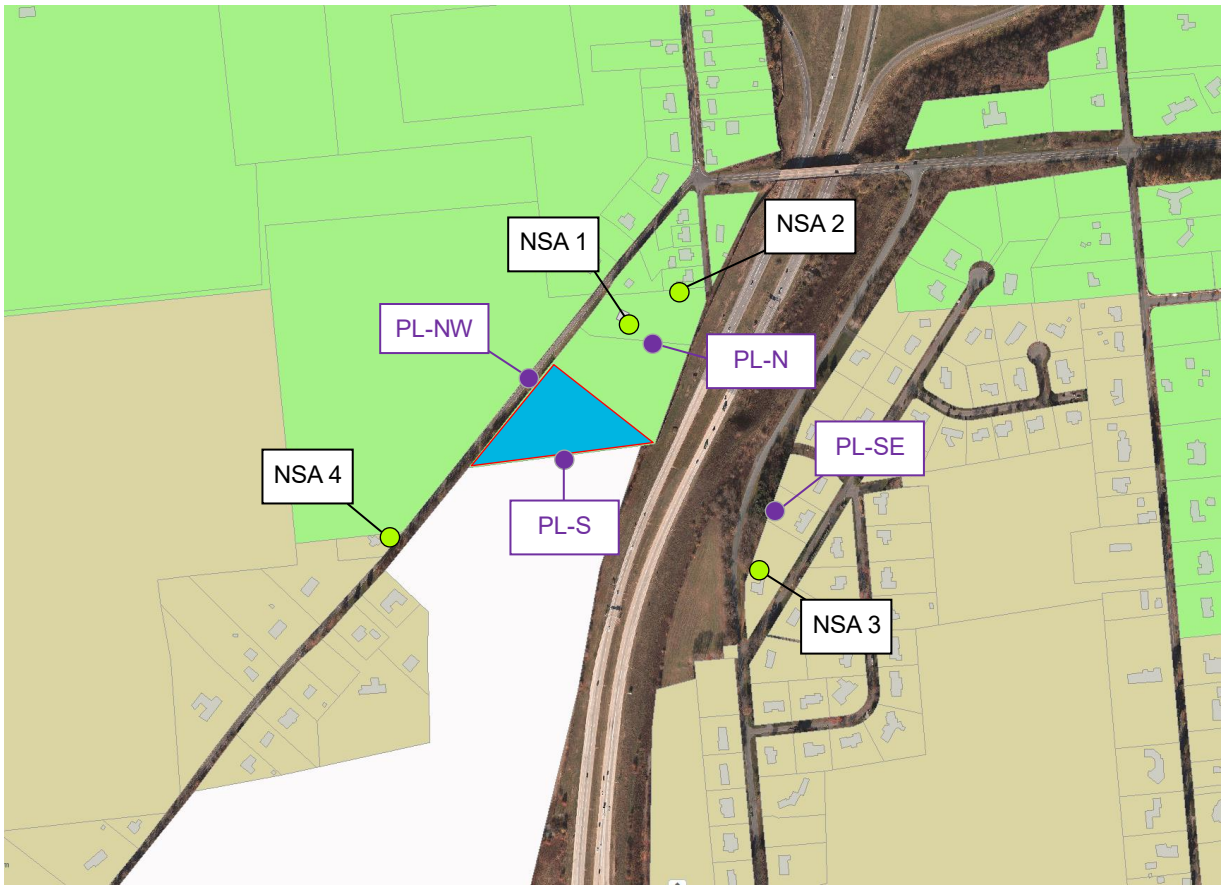
Nearest property line to the northwest of the proposed Station site, located across Church Road. Representative of an existing agricultural land use currently zoned “Agricultural”.

PL-N

Northern property line of the proposed Station site. Representative of an existing residential land use currently zoned “Agricultural”.

PL-SE

Nearest residential property line to the southeast of the proposed Station site, located across PA-33. Representative of an existing residential land use currently zoned “Rural Residential”.



Map Data: Bethlehem County GIS Maps and Apps (Bethlehem Township 2020)
Zoning Colors: Green – Agricultural, White – Office-Business, Beige – Rural Residential

Figure 3. Proposed Station Workspace (Blue) with NSAs (Green Circles), PL Assessment Locations (Purple Circles), and Zoning Status Parcel Polygons

4.2 Predicted Construction Noise Effect Assessment

The most acoustically significant construction activity at the proposed Station will likely be site clearing, grading and trenching. The key assumptions for this analysis included in this method are as follows:

- Ground absorption effects (but no greater than 4.8 dBA reduction, regardless of the distance traversed by the sound path, consistent with ISO 9613-2 (ISO 1996).
- Atmospheric absorption of -1 dBA per 1,000 feet of distance traveled.
- Line-of-sight shielding due to terrain or structures was ignored.

For this construction noise prediction, the four loudest pieces of studied equipment are assumed to operate—on average—from the same source point location at the general geographic centroid of the proposed Church Road Interconnects site. Each piece of equipment vehicle is assigned a reference maximum decibel value (L_{max}) value at a reference distance (e.g., 50 feet), and an "acoustical usage factor" (AUF) that the Federal Highway Administration (FHWA) Roadway Construction Noise Model (RCNM) User's Guide (FHWA 2006) describes as an estimated portion of a construction operation time period when the L_{max} value can be expected. These reference sound levels and AUF values are presented for each construction phase in Appendix C.

Predicted construction noise levels for the studied NSAs are expected to range from 51 to 61 dBA, L_{eq}, and will be lower than the existing ambient daytime noise levels measured at each site by 2 to 9 dBA. Detailed calculation data is provided in Appendix C.

Construction activities shall not occur between the hours of 9:00 p.m. and 7:00 a.m. of any day as stipulated by the Bethlehem Township noise ordinance. Since no construction activities are anticipated to occur during evening and nighttime hours, noise impacts from Station construction are not anticipated.

4.3 Predicted Operation Noise Effect Assessment

4.3.1 Methodology

The CadnaA® Noise Prediction Model (Version 2020) was used to estimate the propagation of sound from aggregate Station operations and thereby predict SPL at various distances from the Station. CadnaA® is a Windows-based software program that predicts and assesses noise levels near industrial noise sources based on ISO 9613-2 (ISO 1996) algorithms for noise propagation calculations. The software can accept sound power levels (in dB referenced to 1 picoWatt) in octave band center frequency resolution to describe the multiple sound propagation sources of the site processes or activity to be modeled.

The software's calculations account for classical sound wave divergence plus attenuation factors resulting from air absorption, basic ground effects, and barrier/shielding. The advantage of using CadnaA® is that it can handle the three-dimensional sound propagation complexity of considering realistic intervening natural and man-made topographical barrier effects, including those resulting from terrain features and from structures such as existing traffic noise barriers.

4.3.2 Hellertown M&R Station Noise Impact Analysis Assumptions

A noise study for a similar M&R station was conducted for PennEast in 2016 by Mr. Brian Hellebuyck of Hoover & Keith Inc. At the request of PennEast, several assumptions within this noise study are based on those presented in the Hellertown M&R Station Ambient Sound Survey and Impact Analysis (Hellebuyck 2016). The Station operation predictive modeling conducted for this section relies entirely on the noise source and noise reduction values provided in the Hellertown study and assumes that all data are either representative or innately conservative with respect to their noise generation or acoustic performance.

4.3.3 Sound Source Definitions

Noise sources associated with Station operation are based on assumptions provided in the Hellertown M&R station report (Hellebuyck 2016). Sound power level (PWL or L_w) for nominal steady-state operation is shown in Table 4. Specific derivations of each reference sound level, as well as detailed octave band center frequency (OBCF) characteristics, are provided in Appendix D.

Table 3. Major Station Operations Noise-Producing Sources

Equipment/Source Type	Individual Reference Sound Power Level (L_w, dBA)
Interstate Meter Runs	102
TCO Flow Control Valves	111
TCO Meter Runs	102
Water Bath Heaters	89

While the Station piping systems may generate pipe gas flow noise, the sources listed in Table 5.1 represent the loudest features and are thus expected to have the greatest effect on the ambient sound environment. Some equipment not appearing in Table 5.1 are expected to produce noise, but not at a magnitude that will challenge the expected dominance of meter runs, control valves, and the water bath heaters at the noise impact assessment locations. Should the PIG launcher/receiver be relocated closer to NSAs in future site layouts, an additional analysis of gas flow noise may be required.

4.3.4 Noise Control Assumptions

4.3.4.1 Hellertown M&R Noise Control Assumptions

This analysis assumed the implementation of noise control measures as implemented in the Hellertown M&R station report (Hellebuyck 2016). These noise control measures include:

- **Meter Runs** - Acoustical pipe lagging of 3" thick fiberglass or mineral wool with a mass-loaded vinyl jacket.
- **Control Valves** - Globe style valves with low noise trim with upstream and downstream acoustical pipe lagging.
- **Water Bath Heaters** – Low-noise box-type burner shall be utilized, and the heater must generate a maximum a-weighted sound pressure level of 55 dBA at 50 feet from the heater perimeter at rated maximum operating condition.

Octave-band noise reduction values are provided in Appendix D.

4.3.4.2 Additional Noise Control Measures

In addition to the Hellertown M&R noise control assumptions, a total of three site-specific perimeter barrier walls were incorporated into the prediction model along the southern, northwestern, and northern site boundaries. The location of these barriers in relation to the Station site is shown in Figure 4-2.

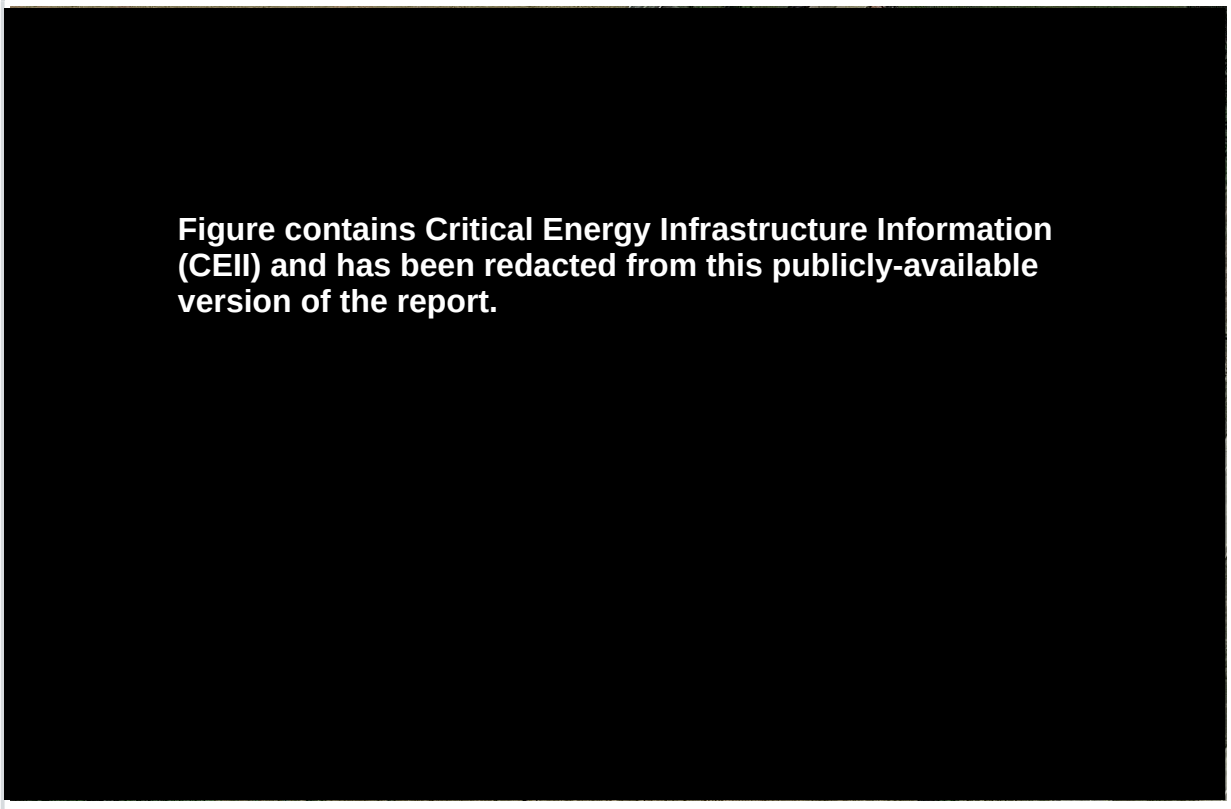


Figure 4. Recommended Noise Barrier Structures and Dimensions

The site perimeter barriers displayed in Figure 4 should be of solid construction with no gaps or holes throughout their length. Barrier heights represent top-of-wall heights relative to ground elevation.

4.3.5 Predictive Operation Noise Model Configuration Settings

Additional CadnaA model configuration settings and operations noise analysis assumptions are as follows: 10 degrees Celsius (ºC) outdoor temperature, 70% relative humidity (RH), calm wind conditions (< 0.5 meters per

second), one order of acoustic reflections, and an average acoustical ground absorption coefficient of 0.6 (representing an estimate for the observed Station vicinity - a conservative blend of hard, reflective surfaces [roadways and other pavement] that tend towards zero, and highly absorptive ground cover [loose soils and/or vegetative ground cover] that approaches unity). All structures in the model are configured as reflective surfaces with an acoustical absorption coefficient of 0.03.

4.3.6 Predictive Operation Noise Modeling Results

Predicted aggregate Station operation noise levels at the nearest property lines and NSAs are shown in Table 4. Figure 5 and 6 display future operation noise contours superimposed upon aerial imagery of the Station site and its surroundings, displaying propagation of sound using hourly L_{eq} and the 24-hour L_{dn} metrics, respectively. Note that the Station-attributed noise contours appearing in contour figures do not include the acoustical contribution of the existing outdoor sound environment (e.g. traffic noise from PA-33).

Table 4. Predicted Station Operation Noise Levels (L_{eq})

Receiver ID	Receiver Type	Receiver Address (if applicable)	Sound Level Limit (dBA, L_{eq})	Predicted Aggregate Operation Noise (dBA, L_{eq})	Loudest Station Noise Source
PL-S	Commercial	N/A	69	61	Interstate Meter Runs
PL-NW	Agricultural	N/A	53	50	Interstate Flow Control Valves
PL-N	Residential	3798 Church Road	53	48	TCO Flow Control Valves
PL-SE	Residential	3633 Knollcroft Avenue	53	33	TCO Flow Control Valves

As analyzed and reflecting the definition of sound sources, noise control measures, and analysis configuration settings as described in Sections 4.3.3, 4.3.4, and 4.3.5, combined Station operation noise would be expected to comply with the applicable local sound level limits at all PLs.

Table 5 summarizes the anticipated increase in ambient sound level experienced at each studied NSA.

Table 5. Noise Quality Analysis for the Church Road Interconnects M&R Station (L_{dn})

NSA ID	Distance (feet) and Direction of NSA to Site Center	Ambient Noise Level (L_{dn}, dBA)	Estimated Station-Only Noise Level (L_{dn}, dBA)	Station Plus Ambient Noise Level (L_{dn}, dBA)	Potential Noise Level Increase
NSA-1	490 | NE	68	51	68	0
NSA-2	1408 | NE	65	49	66	0
NSA-3	1066 | SE	66	36	66	0
NSA-4	869 | SW	66	48	66	0

Due to the elevated existing ambient noise levels of 65 to 68 L_{dn}, operational noise generated by the Station is expected to increase ambient existing noise levels at studied NSAs by less than 1 dBA.

Figure contains Critical Energy Infrastructure Information (CEII) and has been redacted from this publicly-available version of the report.

N	Date Created: 01/09/2020	**Figure 5**
	Created by: CK	**Church Road Interconnects M&S Station Operation - Leq** **Hellertown M&S and Barrier Noise Control Measures Applied**
AECOM Imagine it. Delivered. Acoustics & Noise Control Practice		**Predicted Project Operation Noise Contours** **PennEast Amendment 2 - Church Road Interconnects** **Bethlehem Township, PA**

Figure contains Critical Energy Infrastructure Information (CEII) and has been redacted from this publicly-available version of the report.

N	Date Created: 01/09/2020	**Figure 6**
	Created by: CK	**Church Road Interconnects M&S Station Operation - Ldn** **Hellertown M&S and Barrier Noise Control Measures Applied**
AECOM Imagine it. Delivered. Acoustics & Noise Control Practice		**Predicted Project Operation Noise Contours** **PennEast Amendment 2 - Church Road Interconnects** **Bethlehem Township, PA**

5. Findings and Recommendations

5.1 Church Road Interconnects Noise Effects

Under typical operating conditions, Tables 4 and 5 show that aggregate Station operation noise levels should be compliant with both local regulations and the FERC/EPA guidance at all studied property lines and NSAs. Due to the existing elevated ambient noise levels generated by traffic in the Station vicinity, noise generated by the proposed Station is not expected to generate a significant noise level increase at any studied NSAs. Combined ambient-plus-Station operation noise levels are less than 1 dBA greater than the existing ambient, a change that is considered imperceptible with healthy human hearing (FHWA 2011).

As the development of the Station reaches the detailed design phase, the noise analysis and assumptions presented herein will be revisited and refined by PennEast, as needed, to ensure post-construction compliance. The noise analysis conducted at a later stage would include more-detailed acoustical requirements, such as acoustic performance requirements for on-site equipment, source noise control measures, and updated noise barrier design(s).

6. References

Bethlehem Township. 2019. Code of Ordinances, Part II: General Legislation.

Hellebuyck, Brian R. / Hoover & Keith Inc. 2016. Hellertown M&R Station Ambient Sound Survey and Noise Impact Analysis.

International Organization for Standardization (ISO). 1982. Description and Measurement of Environmental Noise, Basic Quantities and Procedures Part 1, ISO 1996/1.

_____. 1987a. Description and Measurement of Environmental Noise, Basic Quantities, and Procedures, Acquisition of Data Pertinent to Land Use, Part 2, ISO 1996/2.

_____. 1987b. Description and Measurement of Environmental Noise, Basic Quantities and Procedures, Application to Noise Limits, Part 3, ISO 1996/3.

_____. 1996. Acoustics – Attenuation of Sound During Propagation Outdoors, Part 2, ISO 9613/2.

U.S. Department of Housing and Urban Development (HUD), 2009. The Noise Guidebook.

U.S. Department of Transportation Federal Highway Administration. 2011. Highway Traffic Noise: Analysis and Abatement Guide.

U.S. Environmental Protection Agency (EPA), 1974. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety. (USEPA 550/9-74-004).

U.S. Federal Energy Regulatory Commission (FERC) Office of Energy Projects, 2017. Guidance Manual for Environmental Report Preparation, Volume I.

7. Statement of Limitations

The findings, opinions, and recommendations presented herein are based in part upon field measurements and observations of what are believed to be typical and representative conditions of normal activity and environmental factors in the vicinity of the planned Church Road Interconnects facility as presented in this report. The sound measurements and analyses were conducted using reasonable care as practiced in the industry and are, as appropriate, representative of the activity being measured as influenced by environmental conditions existing during the measurement period. Because of the variability of factors not within the control of the investigators, no warranty can be made that the exact sound or activity levels would be obtained by subsequent field measurements. However, for similar climatic and seasonal conditions and neighboring community activities, the sound levels measured would be very similar to those reported or predicted, as applicable, herein.

This report is for the sole use and benefit of PennEast Pipeline Company, LLC. The scope of services performed in execution of this effort may not be appropriate to satisfy the needs of other users, and any use or reuse of this document or the findings, conclusions, or recommendations presented herein is at the sole risk of said user. No express or implied representation or warranty is included or intended in this report except that the work was performed within the limits prescribed by PennEast with the customary thoroughness and competence of professionals working in the same area on similar projects.

To prepare this report, AECOM has used information that includes data obtained from sources and background information on the Project received from PennEast and Hoover & Keith. The limited report context surrounding the acoustical data sourced from Hoover & Keith is not readily verifiable for appropriateness but was used in this analysis specifically at the request PennEast. AECOM has relied on the information as furnished and is neither responsible for nor has confirmed the accuracy of this information.

Portions of this document have been prepared based on certain key assumptions made by AECOM which substantially affect predictive analysis results and corresponding findings and/or recommendations. These assumptions are thought to be reasonable, appropriate for the development of this report and have been reviewed by Institute of Noise Control Engineering (INCE) Board-Certified members. The predictive analyses of AECOM are conditioned upon several assumptions, some of which may or may not be applicable should the Station design change in a manner that would affect the accuracy of the predicted results.

Noise levels found in this report include those predicted with CadnaA sound propagation modeling software, a commercially-available program not proprietary to AECOM.

Appendix A Acoustical Terminology

- Noise – Whether something is perceived as a noise event is influenced by the type of sound, the perceived importance of the sound, and its appropriateness in the setting, the time of day and the type of activity during which the noise occurs and the sensitivity of the listener. Local jurisdictions may have legal definitions of what constitutes "noise" and such environmental parameters to consider.
- Sound – For purposes of this analysis, is a physical phenomenon generated by vibrations that result in waves that travel through a medium, such as air, and result in auditory perception by the human brain.
- Frequency – Sound frequency is measured in Hertz (Hz), which is a measure of how many times each second the crest of a sound pressure wave passes a fixed point. For example, when a drummer beats a drum, the skin of the drum vibrates a number of times per second. When the drum skin vibrates 100 times per second it generates a sound pressure wave that is oscillating at 100 Hz, and this pressure oscillation is perceived by the ear/brain as a tonal pitch of 100 Hz. Sound frequencies between 20 and 20,000 Hz are within the range of sensitivity of the best human ear.
- Amplitude or Level – Is measured in decibels (dB) using a logarithmic scale. A sound level of zero dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above approximately 110 dB begin to be felt inside the human ear as discomfort and eventually pain at 120 dB and higher levels. The minimum change in the sound level of individual events that an average human ear can detect is about one to two dB. A three to five dB change is readily perceived. A change in sound level of about 10 dB is usually perceived by the average person as a doubling (or if decreasing by 10 dB, halving) of the sound's loudness.
- Sound pressure – Sound level is usually expressed by reference to a known standard. This report refers to sound pressure level (SPL), which is expressed on a logarithmic scale with respect to a reference value of 20 micropascals (µPa). SPL depends not only on the power of the source, but also on the distance from the source and on the acoustical characteristics of the space surrounding the source.
- Sound power – Unlike sound pressure, which varies with distance from a source, sound power (and its counterpart sound power level, PWL or Lw) is the acoustic power of a source typically expressed in Watts.
- A-weighting – Sound from a tuning fork contains a single frequency (a pure tone), but most sounds one hears in the environment do not consist of a single frequency and instead are composed of a broad band of frequencies differing in sound level. The method commonly used to quantify environmental sounds consists of evaluating all frequencies of a sound according to a weighting system that reflects the typical frequency-dependent sensitivity of average healthy human hearing. This is called "A-weighting," and the decibel level measured is referred to as dBA. In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA "curve" of decibel adjustment per octave band center frequency (OBCF) from a "flat" or unweighted SPL.
- Equivalent sound level (L_{eq}) – Environmental noise levels vary continuously and include a mixture of noise from near and distant sources. A single descriptor, L_{eq}, may be used to describe such sound that is changing in level from one moment to another. L_{eq} is the energy-average sound level during a measured time interval. It is the "equivalent" constant sound level that would have to be produced by a single, steady source to equal the acoustic energy contained in the fluctuating sound level measured.
- Day-Night Average Sound Level (L_{dn}) – represents the average sound level for a 24-hour day and is calculated by adding a 10-dB penalty only to sound levels during the night period (10:00 p.m. to 7:00 a.m.).

Appendix B Field Survey Notes and Data

B.1 Field Survey Data Sheets

GENERAL

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: PENNEAST INTERCONNECT Project #: _____ Date: 11/14/19 Page _____ of _____

Measurement Location: ST-1 N PROP LINE Analyst: CK

Sound Level Meter

Model #: LD LxT

Serial #: 4486

Weighting: (A) / C / Flat

Response: (S)low / Fast / Impl

Windscreen: (Yes) / No (explain)

Field Calibration

Model #: CAL200

Serial #: 3704

Calibration Level (dB): 94 / (114)

Pre-Test +0.23 dBA

Post-Test -0.31 dBA

Meteorological Data

Model #: K35 K3000 Time Obs/Meas:

Serial #: 1711928 10:08

Precipitation: Yes (explain) / (No)

Wind: Steady / Gusty / (Calm)

Avg Wind Speed/Direction: 1-4/SW m/s / MPH

Temp (°F): 35.6 RH (%): 36.4

Bar Psr (Hg): N/A Cloud Cover (%): 90

Topo: (Flat) / Hilly

Terrain: Hard / (Soft) / Mixed / Agg / Snow

GPS Coordinates (at SLM location)#

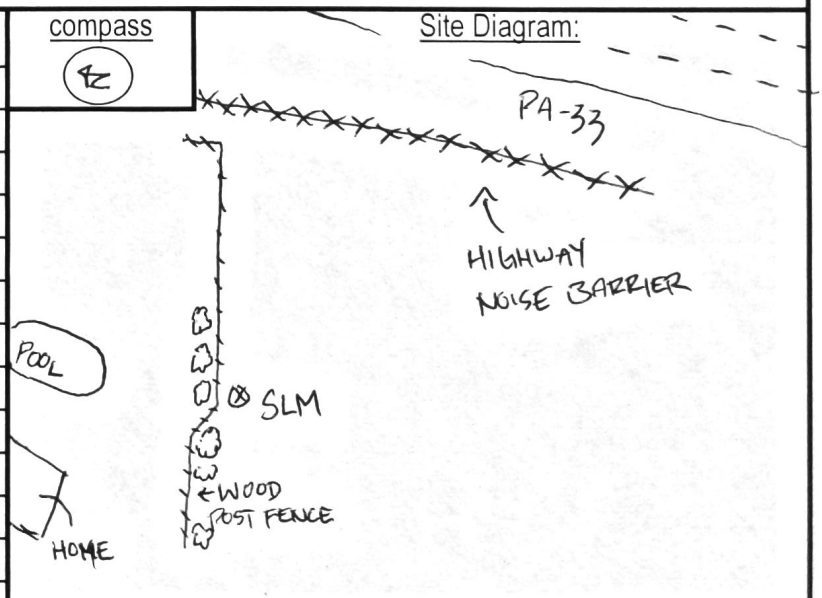
DROPPED PIN MANUALLY

Loc. ID	Start Time (hh:mm)	Stop Time (hh:mm)	Notes/Events
ST1	10:08	10:28	TRAFFIC NOISE DOMINANT, SIGNIFICANLY LOUDER FROM
DAY			SEGMENT WITHOUT TRAFFIC NOISE BARRIER
			10:16 DISTANT TRAIN HORN
			10:18 DISTANT FIXED-WING OVERFLIGHT
			10:27 DISTANT FIXED-WING OVERFLIGHT
NIGHT			PRE-CAL: +0.24 POST-CAL: -0.27 TEMP: 37.7 WIND: 0/NA RH%: 48.2%
	00:10	00:30	TRAFFIC NOISE DOMINANT, SIGNIFICANTLY LOUDER FROM
			SEGMENT WITHOUT TRAFFIC NOISE BARRIER
			00:25 DISTANT FIXED-WING OVERFLIGHT

Roadway Name/Dir.		
Speed (post/obs*)		
Number of Lanes		
Width (pave/row)		
1- or 2- way		
Grade		
Bus Stops		
Stoplights		
Motorcycles		
Automobiles		
Medium Trucks		
Heavy Trucks		
Buses		
Count duration		

compass (E)

Site Diagram:



- note coordinate system if other than NAD83 * - Speed estimated by Radar / Driving / Observation

Additional Notes/Comments:

DAYTIME NOTES

CONSTANT FROM 33 INTERMITTENT ON CHURCH RD.

CONSTRUCTION VEHICLE BACK-UP ALARM (DISTANT)

Photos Taken? (Yes) / No

INTERMITTENT

Noise Sources (circle all that apply): distant aircraft • (roadway traffic) • rail ops • landscaping • rustling leaves • children playing • dogs barking/(birds) • vocalizing/insects/mechanical

Additional Notes and Sketches on Reverse or Indicated Separate Sheet(s)

GENERAL

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: PENNEAST INTERCONNECT Project #: _____ Date: 11/14/19 Page _____ of _____

Measurement Location: ST-2 Analyst: CK

Sound Level Meter
Model #: LD LxT
Serial #: 4486
Weighting: (A) / C / Flat
Response: (Slow) / Fast / Impl
Windscreen: (Yes) / No (explain)

Field Calibration
Model #: CAL200
Serial #: 3704
Calibration Level (dB): 94 / (114)
Pre-Test +0.23 dBA
Post-Test -0.31 dBA

Meteorological Data
Model #: K3000 Time Obs/Meas: 10:08
Serial #: 1711928
Precipitation: Yes (explain) / (No)
Wind: Steady / Gusty / (Calm)
Avg Wind Speed/Direction: 1-4/SW m/s / MPH
Temp (°F): 35.6 RH (%): 36.4
Bar Psr (Hg): N/A Cloud Cover (%): 90

Topo: (Flat) / Hilly
Terrain: Hard / (Soft) / Mixed / Agg / Snow

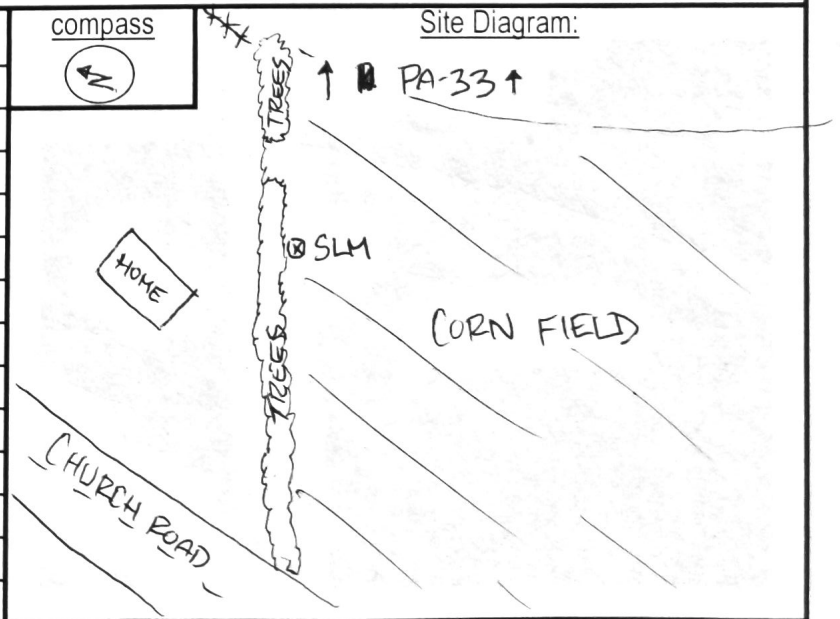
GPS Coordinates (at SLM location)#
MANUALLY ENTERED ON AERIAL

Loc. ID	Start Time (hh:mm)	Stop Time (hh:mm)	Notes/Events
ST-2	10:40	11:00	TRAFFIC NOISE DOMINANT FROM NON-BARRIER SEGMENTS
DAY			10:41 DISTANT FIXED-WING OVERFLIGHT
			10:51 DISTANT FIXED-WING OVERFLIGHT
			10:59 DISTANT FIXED-WING OVERFLIGHT
NIGHT			PRE-CAL: +0.24 POST-CAL: -0.27 TEMP: 37.7 WIND: 0/NA RH: 48.2%
	00:37	00:57	TRAFFIC NOISE DOMINANT
			00:49 DISTANT FIXED-WING OVERFLIGHT
			00:52 DISTANT FIXED-WING OVERFLIGHT

Roadway Name/Dir.		
Speed (post/obs*)		
Number of Lanes		
Width (pave/row)		
1- or 2- way		
Grade		
Bus Stops		
Stoplights		
Motorcycles		
Automobiles		
Medium Trucks		
Heavy Trucks		
Buses		
Count duration		

compass (N)

Site Diagram:



- note coordinate system if other than NAD83 * - Speed estimated by Radar / Driving / Observation

INTERMITTENTLY AUDIBLE BACK-UP ALARMS (DISTANT) Photos Taken? (Yes) / No

Additional Notes/Comments:

DAYTIME NOTES

CONSTANT

INTERMITTENT FROM CORN FIELD

INTERMITTENT (RARE)

Noise Sources (circle all that apply): distant aircraft • (roadway traffic) • rail ops • landscaping • (rustling leaves) • children playing • dogs barking/birds • vocalizing/insects/mechanical

Additional Notes and Sketches on Reverse or Indicated Separate Sheet(s)

GENERAL

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: PENNEAST INTERCONNECT Project #: _____ Date: 11/14/19 Page _____ of

Measurement Location: ST-3 3805 COUNTRY CLUB ROAD Analyst: CK

Sound Level Meter

Model #: LD LxT

Serial #: 4486

Weighting: (A) / C / Flat

Response: Slow / Fast / Impl

Windscreen : Yes / No (explain)

Field Calibration

Model #: CAL200

Serial #: 3704

Calibration Level (dB): 94 / 114

Pre-Test +0.23 dBA

Post-Test -0.31 dBA

Meteorological Data

Model #: K3000 Time Obs/Meas:

Serial #: 1711928 11:12

Precipitation: Yes (explain) / (No)

Wind: Steady / Gusty / (Calm)

Avg Wind Speed/Direction: 4-6/SW m/s / MPH

Temp (°F): 38.1 RH (%): 49.1

Bar Psr (Hg): N/A Cloud Cover (%): 70

Topo: (Flat) / Hilly

Terrain: Hard / Soft / (Mixed) / Agg / Snow

GPS Coordinates (at SLM location)#

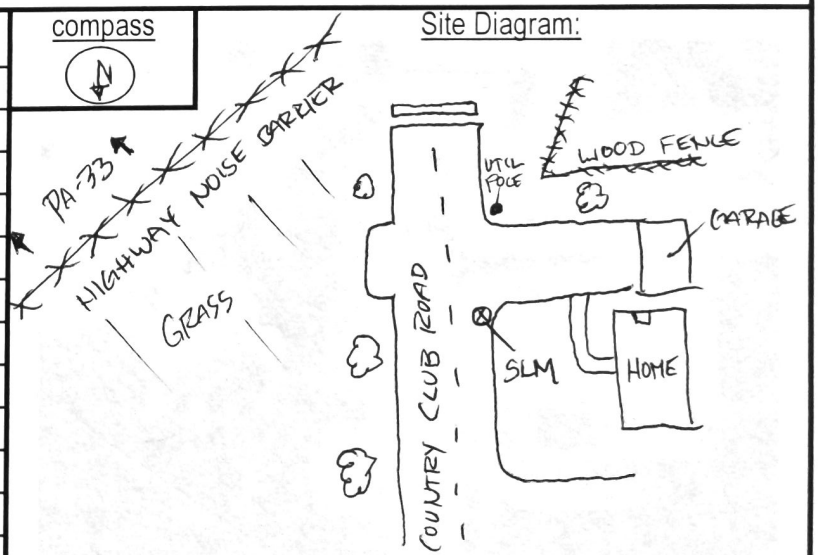
MANUALLY ENTERED ON AERIAL

Loc. ID	Start Time (hh:mm)	Stop Time (hh:mm)	Notes/Events
ST3	11:12	11:32	TRAFFIC NOISE DOMINANT, NOTABLY LOUDER TO SOUTHWEST
			11:13 - DISTANT FIXED-WING OVERFLIGHT
			11:17 - RESIDENT LEAVES - REMOVE INTERVAL IF AFFECTED
			11:19 - DISTANT FIXED-WING OVERFLIGHT
			11:28 - FIXED-WING OVERFLIGHT
			11:31 - DISTANT FIXED-WING OVERFLIGHT
NIGHT			
01	01:08	01:28	PRE CAL: +0.24 POST CAL: -0.22 TEMP: 32.1 WIND: 0/NA CLOUD: 20 RH: 48.4%
			TRAFFIC NOISE DOMINANT
			01:26 - LOUD MOTORCYCLE ON PA-33.

Roadway Name/Dir.		
Speed (post/obs*)		
Number of Lanes		
Width (pave/row)		
1- or 2- way		
Grade		
Bus Stops		
Stoplights		
Motorcycles		
Automobiles		
Medium Trucks		
Heavy Trucks		
Buses		
Count duration		

compass (N)

Site Diagram:



- note coordinate system if other than NAD83 * - Speed estimated by Radar / Driving / Observation

Photos Taken? (Yes) / No

Additional Notes/Comments:

Noise Sources (circle all that apply): distant aircraft • roadway traffic (CONSTANT) • rail ops • landscaping • rustling leaves (INTERMITTENT) • children playing • dogs barking/birds • vocalizing/insects/mechanical

Additional Notes and Sketches on Reverse or Indicated Separate Sheet(s)

B.2 Field Survey Photo Log

	**Measurement Location:** ST-1 **Photo Direction:** East **Date:** November 14, 2019
	**Measurement Location:** ST-1 **Photo Direction:** North **Date:** November 14, 2019

	**Measurement Location:** ST-2 **Photo Direction:** East **Date:** November 14, 2019
	**Measurement Location:** ST-2 **Photo Direction:** West **Date:** November 14, 2019

	**Measurement Location:** ST-3 **Photo Direction:** West **Date:** November 14, 2019
	**Measurement Location:** ST-3 **Photo Direction:** South **Date:** November 14, 2019

B.3 Field Survey Detailed Measurement Results

All data presented in A-weighted decibels.

	Date	Time	Leq	Lmin	Lmax	L10	L50	L90
	2019-11-14	10:08	64.6	60.9	67.1	66.0	64.5	62.8
	2019-11-14	10:09	64.0	61.0	67.1	65.6	63.5	62.4
	2019-11-14	10:10	63.4	60.7	66.6	65.7	62.5	61.2
	2019-11-14	10:11	63.3	61.4	66.4	64.4	63.2	62.0
	2019-11-14	10:12	61.7	59.4	66.3	63.4	61.0	59.8
	2019-11-14	10:13	64.8	61.5	67.5	66.3	65.1	62.0
	2019-11-14	10:14	62.9	58.9	67.0	65.8	62.1	59.8
	2019-11-14	10:15	61.4	58.8	63.7	62.9	61.0	59.9
	2019-11-14	10:16	61.3	59.4	63.6	62.8	61.0	60.0
	2019-11-14	10:17	61.7	59.7	63.6	63.0	61.5	60.6
	2019-11-14	10:18	63.1	60.5	65.2	64.5	63.0	61.6
	2019-11-14	10:19	62.8	59.0	66.0	64.6	62.6	60.4
	2019-11-14	10:20	63.1	60.6	66.1	64.6	62.7	61.6
	2019-11-14	10:21	63.7	59.7	68.4	66.2	62.8	60.9
	2019-11-14	10:22	64.0	61.4	68.6	66.0	63.4	62.1
	2019-11-14	10:23	62.6	60.1	65.3	64.1	62.5	60.8
	2019-11-14	10:24	62.4	57.7	66.8	64.1	62.0	59.9
	2019-11-14	10:25	62.2	59.3	66.9	63.7	61.5	60.3
	2019-11-14	10:26	63.1	59.5	66.4	64.4	62.9	60.8
	2019-11-14	10:27	64.5	60.1	68.5	67.1	63.9	61.9
ST1 Daytime			**63.1**	**57.7**	**68.6**	**64.8**	**62.6**	**61.0**
	2019-11-14	10:40	61.6	57.6	63.7	63.1	61.4	59.3
	2019-11-14	10:41	61.9	59.2	65.6	63.1	61.6	60.6
	2019-11-14	10:42	60.5	57.2	62.5	61.7	60.5	59.1
	2019-11-14	10:43	62.3	59.9	65.6	63.8	62.1	60.4
	2019-11-14	10:44	59.7	57.0	62.7	62.0	58.9	57.4
	2019-11-14	10:45	62.2	57.3	64.8	64.1	62.4	58.4
	2019-11-14	10:46	61.8	57.5	64.7	63.5	61.8	58.7
	2019-11-14	10:47	60.7	57.5	64.7	63.2	59.9	58.4
	2019-11-14	10:48	60.4	58.3	62.8	61.7	60.4	58.9
	2019-11-14	10:49	61.3	58.8	64.0	62.7	61.0	59.7
	2019-11-14	10:50	62.0	57.9	66.1	63.9	61.7	59.4
	2019-11-14	10:51	60.4	56.8	63.3	62.4	60.3	57.6
	2019-11-14	10:52	60.8	56.8	65.1	63.7	59.6	58.1
	2019-11-14	10:53	61.8	57.7	67.3	64.0	61.2	58.7
	2019-11-14	10:54	61.9	57.1	66.6	64.5	61.4	58.2
	2019-11-14	10:55	61.1	57.7	63.6	62.9	61.1	58.9
	2019-11-14	10:56	60.9	56.8	64.1	63.1	60.6	58.0
	2019-11-14	10:57	61.1	58.8	63.7	62.3	61.0	59.5
	2019-11-14	10:58	61.8	59.5	64.5	63.2	61.8	60.2
	2019-11-14	10:59	59.4	55.2	63.0	61.7	58.9	56.2
ST2 Daytime			**61.3**	**55.2**	**67.3**	**63.0**	**60.9**	**58.8**
	2019-11-14	11:12	59.9	58.1	62.9	61.2	59.6	58.6
	2019-11-14	11:13	59.2	57.4	61.7	60.4	58.9	58.2
	2019-11-14	11:14	61.0	57.2	66.8	62.2	60.4	58.0
	2019-11-14	11:15	60.3	56.9	63.8	62.2	59.6	57.6
	2019-11-14	11:16	58.2	55.3	62.3	60.5	57.1	56.1
	2019-11-14	11:17	62.7	58.0	70.4	65.1	61.2	59.0
	2019-11-14	11:18	61.1	59.2	63.8	62.3	60.9	59.8
	2019-11-14	11:19	61.0	58.1	63.3	62.3	60.8	59.5
	2019-11-14	11:20	59.4	56.9	61.9	60.6	59.3	57.8
	2019-11-14	11:21	59.6	57.7	62.6	61.0	59.2	58.2
	2019-11-14	11:22	59.9	57.2	63.5	61.6	59.7	57.9
	2019-11-14	11:23	59.2	57.3	61.5	60.8	58.9	57.9
	2019-11-14	11:24	59.7	57.6	62.1	60.8	59.6	58.3
	2019-11-14	11:25	61.2	58.2	64.8	63.0	60.8	58.9
	2019-11-14	11:26	59.0	55.9	60.8	60.0	59.1	57.7
	2019-11-14	11:27	58.7	56.4	60.9	60.0	58.9	57.0
	2019-11-14	11:28	62.2	59.2	65.3	63.7	62.0	60.2
	2019-11-14	11:29	61.4	58.7	64.3	63.0	61.2	59.8
	2019-11-14	11:30	58.8	56.0	61.5	60.7	58.3	56.5
	2019-11-14	11:31	61.7	59.3	64.1	63.1	61.4	60.1
ST3 Daytime			**60.4**	**55.3**	**70.4**	**61.7**	**59.8**	**58.4**
	2019-11-15	0:10	63.7	57.7	69.1	66.8	62.1	59.2
	2019-11-15	0:11	61.6	57.7	65.3	63.9	61.1	58.3
	2019-11-15	0:12	59.0	54.2	63.9	63.2	57.6	55.5

	Date	Time	Leq	Lmin	Lmax	L10	L50	L90
	2019-11-15	0:13	60.4	57.1	64.4	62.4	59.9	58.0
	2019-11-15	0:14	59.4	56.3	63.5	61.2	58.9	56.9
	2019-11-15	0:15	60.2	57.3	62.6	61.6	60.0	58.1
	2019-11-15	0:16	56.2	46.6	61.8	59.0	55.8	47.8
	2019-11-15	0:17	60.3	54.1	65.3	63.2	59.4	55.6
	2019-11-15	0:18	58.0	52.8	62.6	60.5	56.9	54.4
	2019-11-15	0:19	61.1	52.3	67.8	65.9	57.9	53.4
	2019-11-15	0:20	62.5	57.1	66.3	65.2	61.6	58.3
	2019-11-15	0:21	61.7	57.5	65.0	63.5	61.4	59.0
	2019-11-15	0:22	59.9	55.2	65.0	63.2	58.4	56.5
	2019-11-15	0:23	62.0	54.9	69.1	65.3	60.7	55.5
	2019-11-15	0:24	62.8	53.8	69.9	65.7	61.4	55.6
	2019-11-15	0:25	60.0	51.8	65.0	62.3	60.2	52.7
	2019-11-15	0:26	60.9	54.7	66.6	63.3	59.8	56.7
	2019-11-15	0:27	63.8	58.3	70.4	67.0	62.8	59.1
	2019-11-15	0:28	62.5	56.2	68.4	65.4	61.3	57.5
	2019-11-15	0:29	59.2	50.2	64.4	62.6	57.9	51.7
ST1 Nighttime			**61.1**	**46.6**	**70.4**	**63.6**	**59.8**	**56.0**
	2019-11-15	0:38	57.1	50.1	61.6	60.9	55.6	51.3
	2019-11-15	0:39	59.0	47.3	63.7	62.7	57.6	49.5
	2019-11-15	0:40	56.8	50.5	62.2	60.7	55.4	51.9
	2019-11-15	0:41	56.8	50.2	62.6	61.3	53.4	51.3
	2019-11-15	0:42	56.5	52.5	60.4	59.4	55.6	53.8
	2019-11-15	0:43	57.8	52.2	61.6	60.3	57.4	52.9
	2019-11-15	0:44	55.3	48.3	60.1	58.3	55.0	49.5
	2019-11-15	0:45	57.2	53.4	61.5	59.8	56.3	54.6
	2019-11-15	0:46	60.3	56.4	63.4	62.3	59.9	57.8
	2019-11-15	0:47	57.6	48.6	63.1	60.5	56.9	51.4
	2019-11-15	0:48	56.9	49.6	60.8	59.4	56.7	52.3
	2019-11-15	0:49	58.5	52.9	62.0	61.1	58.1	55.4
	2019-11-15	0:50	58.1	49.4	63.6	62.4	55.5	50.1
	2019-11-15	0:51	57.9	51.6	63.5	60.6	56.9	53.2
	2019-11-15	0:52	60.5	50.7	66.7	63.8	59.4	51.9
	2019-11-15	0:53	57.1	50.6	63.8	59.9	55.4	52.1
	2019-11-15	0:54	61.5	53.8	68.2	64.3	59.7	55.3
	2019-11-15	0:55	60.8	57.2	65.3	63.2	59.9	58.2
	2019-11-15	0:56	61.5	52.6	66.2	65.2	61.0	53.3
	2019-11-15	0:57	59.1	46.6	67.9	64.1	54.8	49.1
ST2 Nighttime			**58.7**	**46.6**	**68.2**	**61.5**	**57.0**	**52.7**
	2019-11-15	1:08	61.4	54.4	63.6	63.0	61.2	59.5
	2019-11-15	1:09	59.7	53.9	65.3	62.7	58.2	55.5
	2019-11-15	1:10	58.2	52.1	62.1	60.2	57.8	53.9
	2019-11-15	1:11	58.3	54.4	62.4	61.3	57.4	55.1
	2019-11-15	1:12	59.6	55.5	64.1	62.1	58.9	57.2
	2019-11-15	1:13	58.1	52.3	62.2	61.4	57.4	54.0
	2019-11-15	1:14	59.2	52.1	65.2	62.9	57.4	54.2
	2019-11-15	1:15	54.6	45.4	62.2	57.5	50.7	46.2
	2019-11-15	1:16	57.3	54.0	61.8	59.0	56.7	55.0
	2019-11-15	1:17	54.7	46.9	59.8	58.4	53.3	48.5
	2019-11-15	1:18	51.8	44.9	55.6	54.0	51.9	46.4
	2019-11-15	1:19	56.7	48.6	62.5	59.7	55.9	50.6
	2019-11-15	1:20	61.1	54.9	64.3	63.5	60.7	57.0
	2019-11-15	1:21	59.0	55.3	62.4	61.8	58.1	56.2
	2019-11-15	1:22	56.3	51.5	61.3	59.1	55.1	52.2
	2019-11-15	1:23	59.4	50.7	64.3	62.3	58.4	51.7
	2019-11-15	1:24	58.9	50.7	64.6	62.3	57.8	51.7
	2019-11-15	1:25	60.0	53.6	64.2	62.8	59.1	55.6
	2019-11-15	1:26	60.1	56.4	63.6	62.3	60.0	56.7
	2019-11-15	1:27	60.1	51.5	65.6	63.9	58.4	54.3
ST3 Nighttime			**58.7**	**44.9**	**65.6**	**61.0**	**57.2**	**53.6**

Appendix C Construction Noise Prediction Detail

C.1 Roadway Construction Noise Model Sources

Equipment Description	No. of Units	RCNM acoustical usage factor (%)	RCNM Lmax @ 50ft Spec 721.560	Single Unit Leq	Aggregate Leq	Sum of Construction Noise at 50' (Leq, dBA)
Grader	1	40	84.0	80.0	80.0	86.0
Dozer	1	40	84.0	80.0	80.0	
Backhoe	2	40	84.0	80.0	83.0	

C.2 Construction Noise Level Calculation

NSR ID	Distance to Center of Construction (Feet)	Predicted Construction Noise Level (Leq, dBA)	Measured Daytime Ambient Existing (Leq, dBA)	Predicted Construction Noise - Measured Existing	Combined Noise Level (Leq, dBA)
R-01	490	61.4	63.1	-1.8	65.4
R-02	1408	51.0	60.4	-9.4	60.8
R-03	1066	53.8	61.3	-7.5	62.0
R-04	869	55.8	61.3	-5.5	62.4

Appendix D Operational Modeling Inputs

D.1 Noise Source Sound Power Levels

	1/1 Octave Band Center Frequency (Lw)									
Noise Source	31.5	63	125	260	500	1000	2000	4000	8000	Overall Lw
Water Bath Heaters	99	97	93	89	85	83	81	77	73	102
TCO Regulators	100	97	100	100	102	106	106	104	100	112
TCO Meter Runs	85	84	88	89	93	96	98	94	88	102

Source: Hoover & Keith Inc.

D.2 Noise Control Measure Performance

	1/1 Octave Band Center Frequency Reduction								
Noise Source Reductions	31.5	63	125	260	500	1000	2000	4000	8000
Regulators	-5	-10	-15	-20	-20	-20	-20	-20	-20
Meter Runs	0	0	-3	-5	-8	-12	-12	-12	-12
Heaters	0	0	-3	-5	-8	-12	-12	-12	-12

Source: Hoover & Keith Inc.