5.0 NOISE

5.1 Introduction

Noise is subjective and can affect individuals within audible range. For this reason, the MDEP has developed a standard that establishes methods for determining ambient sound levels and defines acceptable operational sound levels. The NECEC Project involves installation, upgrade and/or expansion of numerous transmission lines and substations throughout Maine, as discussed within this section. Both transmission lines and substations can produce sound.

Transmission Lines

For electric transmission lines, audible noise is relative to conductor (wire) size. CMP has selected conductor sizes that under ideal, dry conditions are designed to be nearly noise free; under adverse weather conditions (e.g., very high humidity and storm conditions) these same conductors may emit a slight crackling sound. Noise is produced when protrusions on the conductor surface – particularly water droplets on the conductors or dripping off the conductors – cause the electric field intensity at the conductor surface to exceed the breakdown strength of air, producing noise. The noise increase from transmission lines results from the partial electrical breakdown of air around the conductors. In small volumes near the surface of the conductors, energy and heat are dissipated. Part of this energy is in the form of small local pressure changes that result in noise. This noise can be characterized as a hissing, crackling sound, therefore noise from transmission lines is typically a foul-weather/wet conductor phenomenon.

Noise levels for conductors were modeled based upon conservative assumptions and program defaults for conditions relating to the operation of existing transmission lines and to the operation of new 345-kV and 320-kV DC transmission lines. The Bonneville Power Administration (BPA) Corona and Field Effects Program was used to calculate the expected audible noise from the transmission lines.

Based on the BPA model results for the Project, all sound levels produced by new and/or upgraded transmission lines associated with the NECEC Project are expected to remain within the levels allowed by the MDEP. It was calculated that the transmission line conductor noise levels at the edges of the various ROWs, in fair weather conditions, will be well below the applicable noise standards, with the maximum typical levels at the edge of ROW expected to be approximately 28 dBA. This level is generally negligible, and the noise in general will dissipate quickly as distance from the edges of the ROW increases.

Modeling results for foul weather/wet conditions show that additions and upgrades to the transmission lines associated with the NECEC Project would generally produce modest increases in noise levels at the edges of ROW. This noise would dissipate quickly as distance increases due to the frequency components of the noise generated (higher frequency noise dissipates quickly with distance). The expected maximum sound produced a typical conductor at the closest edge of ROW, under foul weather/wet conditions, is expected to be approximately 41 dBA (comparable to a quiet office). The distances provided are from the center of the structures, or basically from the line itself, to the edge of the ROW. The distance from the line to the edge of the ROW will vary along the transmission line path. The worst-cast (closest) distance the line could be to the edge of the ROW is 75 feet, which corresponds to approximately 41 dBA sound level generated by the 345kV transmission line under foul weather conditions. However, while louder levels of audible noise could occur during foul weather, it would generally be masked by the background noise caused by rain and wind.

Table 5-1 contains the BPA model results for fair and foul weather conditions. Predictions are provided for various distances because the distance from structure to ROW edge along the Project corridor varies. All sound levels are expected to remain below the MDEP allowable levels.

Table 5-1: BPA Model Results

Line	Audible Noise (dBA)					
	Fair Weather			Foul Weather		
	75' From Center of Structure	85' From Center of Structure	100' From Center of Structure	75' From Center of Structure	85' From Center of Structure	100' From Center of Structure
320 kVDC	28.1	27.4	26.6	22.1	21.4	20.6
345-kV, AC H-Frame	15.2	14.6	13.8	40.2	39.6	38.8
345-kV, AC Lattice Structure	15.6	15.0	14.3	40.6	40.0	39.3

Substations

Three existing substations associated with the NECEC Project – Maine Yankee Substation in Wiscasset, Surowiec Substation in Pownal, and Crowley's Substation in Lewiston – will be adding equipment such as transmission line terminal structures that are needed to permit the interconnection of the NECEC. These substations do not require noise studies, as the modifications would not install significant noise emitting equipment or increase overall noise levels in the surrounding area. Two proposed new substations – Merrill Road Converter Station in Lewiston and Fickett Road Substation in Pownal – will

include the installation of noise producing equipment, and thus warrant noise studies. Three existing substations – Larrabee Road Substation in Lewiston, Coopers Mills Substation in Windsor, and Raven Farm Substation in Cumberland – are proposed to install new noise producing equipment and thus were also determined to warrant noise studies. A general discussion of methods used for performing noise studies relevant to the NECEC Project is provided in Section 5.2. The methods and results of the individual site studies are described in Sections 5.3 through 5.7.

Construction

Noise from construction equipment will be temporary during construction of the NECEC Project. Construction of the proposed project is expected to involve site clearing, excavation, placement of concrete and the use of typical utility construction equipment and best practices. The construction contractor selected is expected to implement, where appropriate, construction methods that maintain construction noise levels below the applicable levels. Because the project involves work on an existing power system that serves customers, there may also be times that work needs to be accomplished in part outside the specified working hours. Such work generally consists of activities that must occur continuously once begun (such as filling transformers with oil). The construction contractor will comply with all applicable noise level limits.

5.2 General Information and Applicable Noise Standards

5.2.1 Standard Measurements of Sound

The term “sound level” is often used to describe two different sound characteristics: sound power and sound pressure. Every source that produces sound has a sound power level. The sound power level is the acoustical energy emitted by a sound source and is an absolute number that is not affected by the surrounding environment. The acoustical energy produced by a source propagates through media as pressure fluctuations. These pressure fluctuations, also called sound pressure, are what human ears hear and microphones measure.

Sound is physically characterized by amplitude and frequency. The amplitude of sound is measured in decibels (dB) as the logarithmic ratio of a sound pressure to a reference sound pressure (20 microPascals). The reference sound pressure corresponds to the typical threshold of human hearing. To the average listener, a 3-dB change in a continuous broadband sound is generally considered “just barely perceptible”; a 5-dB change is generally considered “clearly noticeable”; and a 10-dB change is generally considered a doubling (or halving, if the sound is decreasing) of the apparent loudness.

Sound waves can occur at many different wavelengths, also known as the frequency. Frequency is measured in hertz (Hz), and is the number of wave cycles per second that occur. The typical human ear can hear frequencies ranging from approximately 20 to 20,000 Hz. Normally, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the lower and higher frequencies. As such, the A-weighting scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighting scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighting scale has been applied is expressed in A-weighted decibels, or dBA. For reference, the A-weighted sound pressure level and subjective loudness associated with some common sound sources are listed in **Table 5-2**.

Sound in the environment is constantly fluctuating, as when cars drive by, dogs bark, or planes pass overhead. Therefore, sound metrics have been developed to quantify fluctuating environmental sound levels. These metrics include the exceedance sound level. The exceedance sound level, L_x, is the sound level exceeded during "x" percent of the sampling period and is also referred to as a statistical sound level. The L_{90} is a common L_x value and represents the sound level without the influence of short-term loud transient sound sources. The arithmetic average of the varying sound over a given time period is called the equivalent-continuous sound level and is noted as L_{eq}.

Table 5-2: Typical Sound Pressure Levels Associated with Common Sound Sources

Sound Pressure Level (dBA)	Subjective Evaluation	Environment	
		Outdoor	Indoor
140	Deafening	Jet aircraft at 75 feet	--
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 feet	--
120	Threshold of feeling	Elevated train	Hard rock band
110	--	Jet flyover at 1,000 feet	Inside propeller plane
100	Very loud	Power mower, motorcycle at 25 feet, auto horn at 10 feet, crowd sound at football game	--
90	--	Propeller plane flyover at 1,000 feet, noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately loud	Diesel truck (40 mph) at 50 feet	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner
60	Moderate	Air-conditioner condenser at 15 feet, near highway traffic	General office
50	Quiet	--	Private office
40	--	Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very quiet	Quiet residential neighborhood	Inside average residence (without TV and stereo)
20	--	Rustling leaves	Quiet theater, whisper
10	Just audible	--	Human breathing
0	Threshold of hearing	--	--

Source: Adapted from Architectural Acoustics, M. David Egan, 1988, and Architectural Graphic Standards, Ramsey and Sleeper, 1994.

5.2.2 Maine Department of Environmental Protection Noise Standards

The MDEP noise standard limits noise at protected areas, which are defined as any area accessible on foot containing a residence, house of worship, school, library, hospital, nursing home, etc. Limits are provided for protected areas based on the existing ambient noise levels and existing land use or zone.

At protected locations where the existing zoning or the existing use is predominantly commercial, transportation or industrial, Project sound levels are limited to 70 dBA during the day (7:00 AM to 7:00

PM) and 60 dBA at night (7:00 PM to 7:00 AM), measured at the property line of the receiver. For protected locations where the zoning or the existing use is not predominantly commercial, transportation or industrial, Project sound levels are limited to 60 dBA during the day and 50 dBA at night. Further, if the existing all-encompassing ambient levels (L_{eq}) are at or below 45 dBA during the day or 35 dBA at night, then the area would be considered a quiet area, and the allowable Project levels are limited to 55 dBA during the day and 45 dBA at night. The State noise standard further allows that when a physical residence is greater than 500 feet from the property line, the noise standard at that portion of the property line be relaxed to the daytime limit of 55 dBA at all hours of the day.

The MDEP requires a 5-dBA penalty be added to the measured total dBA when pure tones are observed, as defined by the standard. The substations could have nighttime property line sound level limits of 45 dBA, 50 dBA, or 55 dBA, based on zoning classification of the adjacent property, location of residence on the adjacent property, and/or existing ambient sound levels. If a tone is measured at the protected area, a 5-dBA penalty would be added to the measured overall sound level when compared to the limits. This would effectively lower the sound the substation is able to emit by 5 dBA. In order to analyze this penalty, modeled results where a tone could be present were increased by 5 dBA. The generated contours will not reflect this increase.

The MDEP provides sound level limits for construction activities. The sound from construction activities between 7:00 PM and 7:00 AM is subject to the nighttime sound level limits applicable to normal operation at the site. Sound from construction activities between 7:00 AM and 7:00 PM shall not exceed the limits provided in **Table 5-3** at any protected location.

Table 5-3: Construction Sound Pressure Level Limits at Protected Locations

Duration of Activity	Hourly Sound Level Limit
12 hours	87 dBA
8 hours	90 dBA
6 hours	92 dBA
4 hours	95 dBA
3 hours	97 dBA
2 hours	100 dBA
1 hour or less	105 dBA

Source: MDEP Chapter 375.10 (2)(b)

5.2.3 Local Noise Standards

Several municipalities that the NECEC Project passes through have their own noise regulations. The local regulations would be applied by MDEP in lieu of the MDEP noise regulation in each municipality, provided the local regulation meet the requirements of MDEP Chapter 375.10(B)(1). The municipalities with local regulation are Lewiston, Greene, Leeds, New Sharon and Pownal. The Larrabee Road Substation and the Merrill Road Converter Station are located in Lewiston and the Fickett Road Substation is located in Pownal. The other substations are not subject to municipal noise limits, and are only required to meet the limits in MDEP Chapter 375.10. There are no existing or new NECEC substations located in Greene, Leeds, or New Sharon. In these municipalities, the project consists only of transmission lines, which will comply with applicable municipal limits. The specific sound pressure level limits in each of these municipalities are summarized in **Table 5-4**.

Table 5-4: Sound Pressure Level Limits Enforced by Localities

Municipality	Sound Pressure Level Limit (dBA) Daytime / Nighttime			Source of Limit
	Residential	Business / Commercial	Industrial	
Lewiston	50	60	70	City of Lewiston Code of Ordinances Appendix A Section 19
Greene	55 / 45[a]	65 / 55[a]	70 / 60[a]	Town of Greene Code of Ordinances Section 6-501.1
Leeds	55 / 45[a]	65 / 55[a]	70 / 60[a]	Town of Leeds Code of Ordinances Section 5.F.14
New Sharon	55 / 45[b,c]	65 / 55[b]	70 / 60[b]	Town of New Sharon Site Plan Review Ordinance Section IV
Pownal	60	55/45	55/45	Town of Pownal land Use Ordinance Article 4

(a) Daytime is 7:00 AM to 10:00 PM and nighttime is 10:00 PM to 7:00 AM
(b) Daytime is 7:00 AM to 7:00 PM and nighttime is 7:00 PM to 7:00 AM
(c) New Sharon also has institutional limits identical to the residential limits

5.2.4 Monitoring Procedures

At the two new substation sites, Burns & McDonnell personnel utilized continuous noise monitors to record ambient noise data throughout the day and night. The noise monitors were unmanned for the majority of the time. Additionally, short-term measurements were performed as part of the noise survey to establish operational sound levels of the existing substations. Burns & McDonnell personnel collected the short-term data while physically present along the substation fencelines while the substations were operational.

All measurements were taken using American National Standards Institute (ANSI) S1.4 type 1 sound-level meters (Larson-Davis Model 831), and all measurements followed the applicable procedures outlined in ANSI S1.13 and S12.9. The sound level meters were field calibrated before and after each set of measurements. None of the calibration level changes exceeded ± 0.5 dB, which is within the acceptable variance per ANSI guidance. A windscreen was used at all times on the microphones to avoid the influence of wind-induced sound increases.

Six continuous, long-term noise monitors were installed at various locations along the transmission line route to monitor ambient sound levels continuously over three separate weekdays. The six noise level monitors (Meter 1 through Meter 6) were installed at locations along the transmission line route. The locations of these meters along with their measured continuous sound levels can be seen in **Exhibit 5-1**. The long-term monitors quantify the typical ambient daytime and nighttime sound levels along the transmission line route. The meters were installed at an elevation of approximately 4-5 feet above the ground surface.

The continuous sound levels fluctuated due to extraneous sources near each location. The measurement data show the high fluctuations in ambient sound levels. The 1-minute averaged sound levels included on the figures provide a smooth curve that represents the overall average sound environment. The continuous long-term noise monitors recorded overall sound, octave bands, 1/3 octave bands, and various other sound metrics each second of the measurement periods. Based on the data collected, it is assumed that the transmission lines pass through areas considered “quiet areas” by the MDEP. Therefore, the transmission lines are limited to 45 dBA at the edge of the ROW as required by the MDEP noise standard. There are no municipalities with more stringent noise standards than the MDEP where the transmission line route crosses.

Burns & McDonnell personnel took short-term far-field measurements at the fencelines of the existing substations in the directions of the nearest protected areas. Each short-term measurement was 5 minutes in duration, or as long as needed to achieve steady state. The measurements were taken to establish operational sound levels of each substation. The measurements were not taken where State or local regulations apply, but rather to establish existing sound levels in a given area that could be used as a basis for qualitative and quantitative predictive analyses. Measured sound emitted by the substations would attenuate from locations with sources as distance increases from the sources/fencelines to the neighboring property lines. Each substation was modeled with its existing equipment and the proposed noise emitting equipment to be added as a part of the NECEC, to estimate future property line sound levels.

5.2.5 Construction Noise

Noise from construction equipment will be emitted during construction of the NECEC Project. The impacts that various construction-related activities might have will vary considerably based on the proximity to the fenceline or edge of the transmission line ROW. Generic sound data ranges are available for various types of equipment at certain distances. Impact levels from the construction activities are compared to the local and State regulations. **Table 5-5** lists generic activities and their minimum and maximum instantaneous sound levels at 50 feet.

Table 5-5 Range of Typical Construction Equipment Noise Levels[a]

Generic Construction Equipment	Minimum Noise at 50 feet (dBA)	Maximum Noise at 50 feet (dBA)
Backhoes	74	92
Compressors	73	86
Concrete Mixers	76	88
Cranes (movable)	70	94
Dozers	65	95
Front Loaders	77	96
Generators	71	83
Graders	72	91
Jack Hammers and Rock Drills	80	98
Pile Driver[b]	96	101
Pumps	69	71
Scrapers	76	95
Trucks	83	96

(a) Values taken from FHWA Highway Construction Noise and the HEARS database
(b) Federal Transit Authority Noise and Vibration Impact Assessment, 2006

The types of equipment listed in the table above may be used at various times and for various periods of time. Equipment noise would be addressed during construction by the construction contractor, and sound dampening material may be used if necessary. Most construction activities will not occur simultaneously. There will be periods in which concrete needs to dry and no construction will occur. Sound levels are expected to be lower in areas where activities are occurring at distances greater than 50 feet from the construction zone. The construction contractor will complete all construction activities in a manner that will satisfy the construction noise limits provided in MDEP Ch 375(10)(C)(2).

Exhibit 5-1: Transmission Line Sound Monitoring Figures

Figure 5.1.1 – Continuous Monitoring Locations

Figure 5.1.2 – Meter 1 Sound Level Data

Figure 5.1.3 – Meter 2 Location A Sound Level Data

Figure 5.1.4 – Meter 2 Location B Sound Level Data

Figure 5.1.5 – Meter 3 Sound Level Data

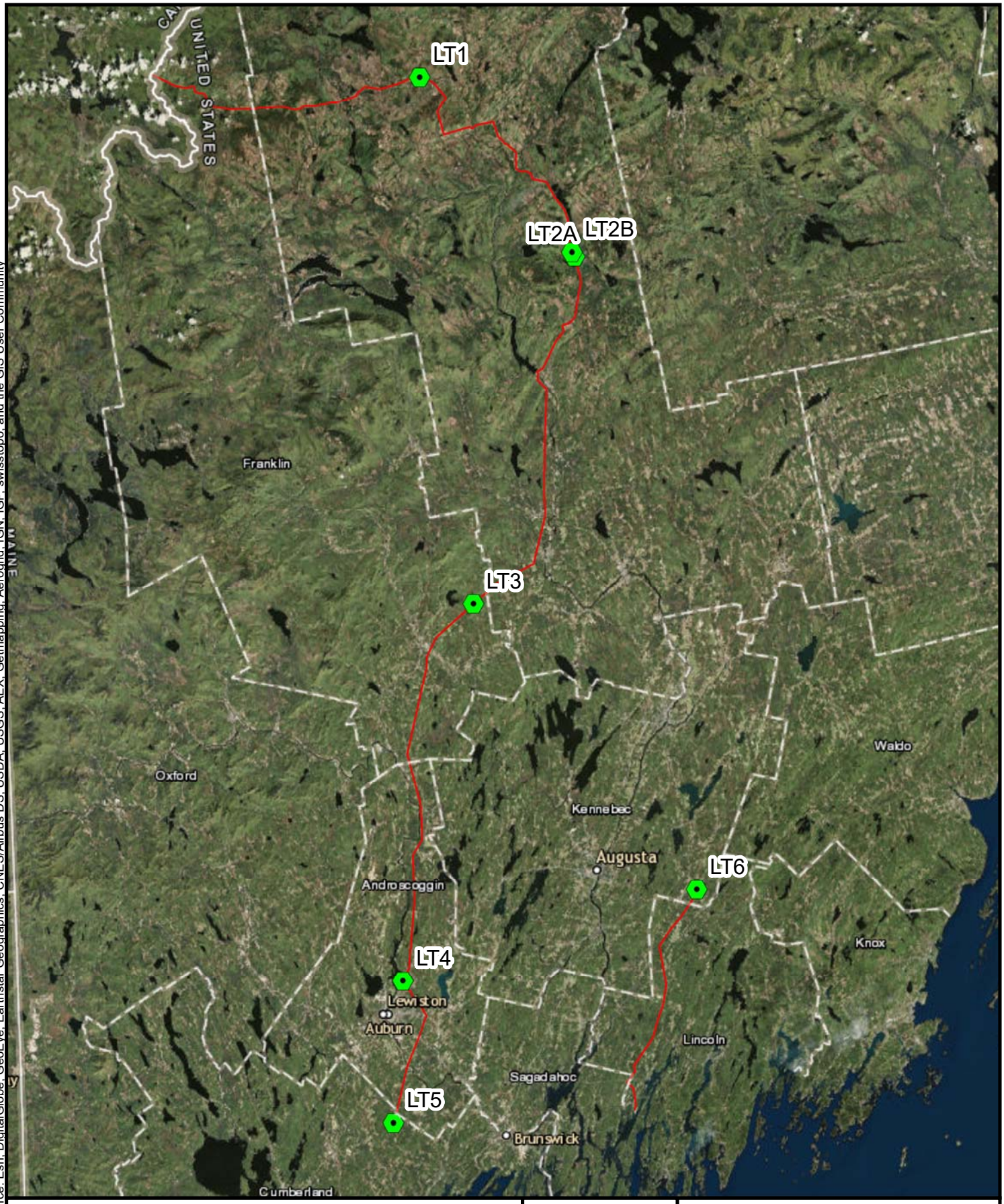


Figure 5.1.1
Continuous
Monitoring Locations

BURNS McDONNELL

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.2.1 Continuous Monitoring Locations.mxd gweger 8/23/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 8/23/2017

Figure 5.1.2 - Meter 1 Sound Level Data

Measurement: Central Main Power Transmission Line Ambient
Location: Long-Term Meter 1

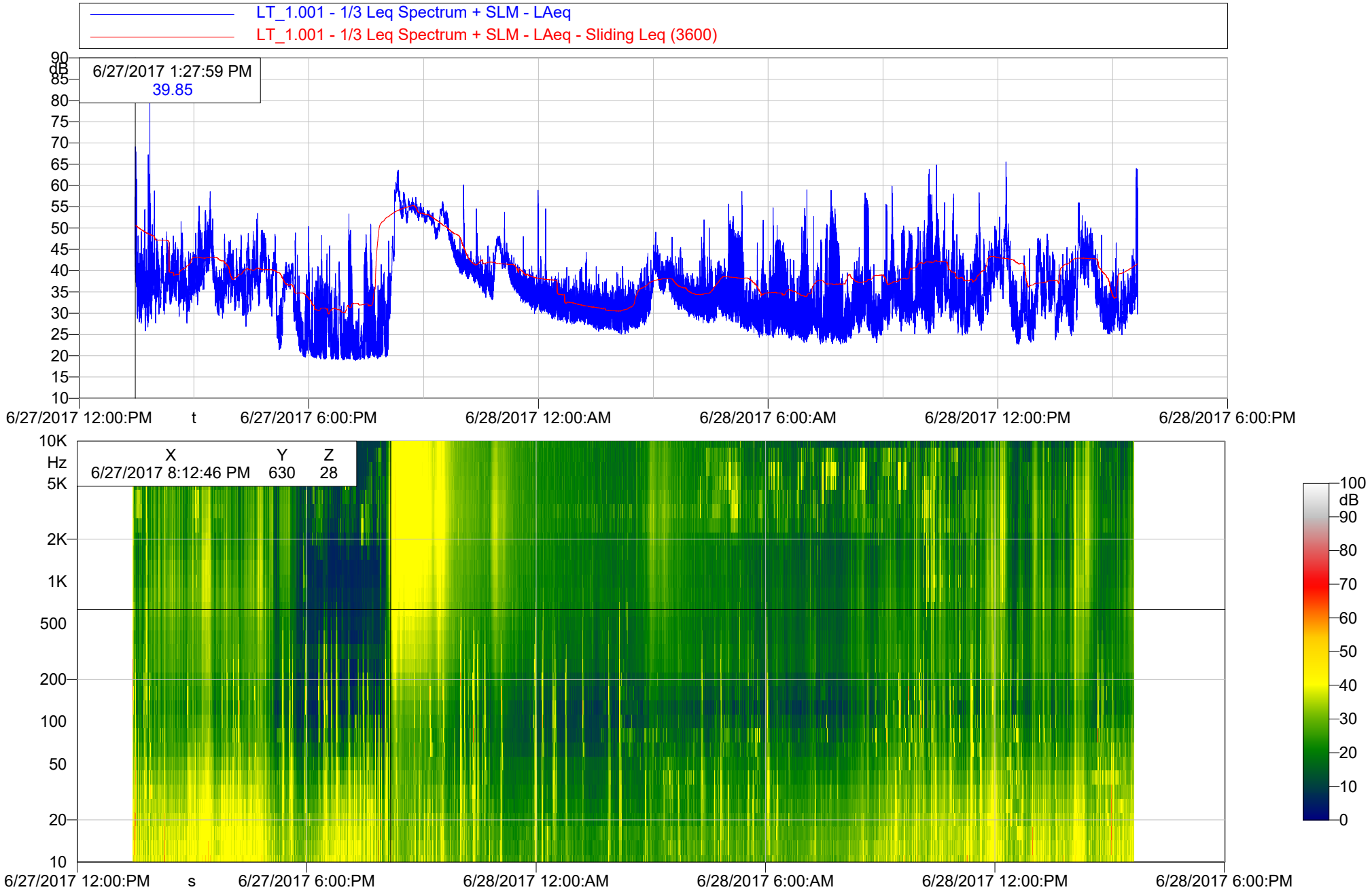


Figure 5.1.3 - Meter 2 Sound Level Data

Measurement: Central Main Power Transmission Line Ambient
Location: Long-Term Meter 2 - First Location

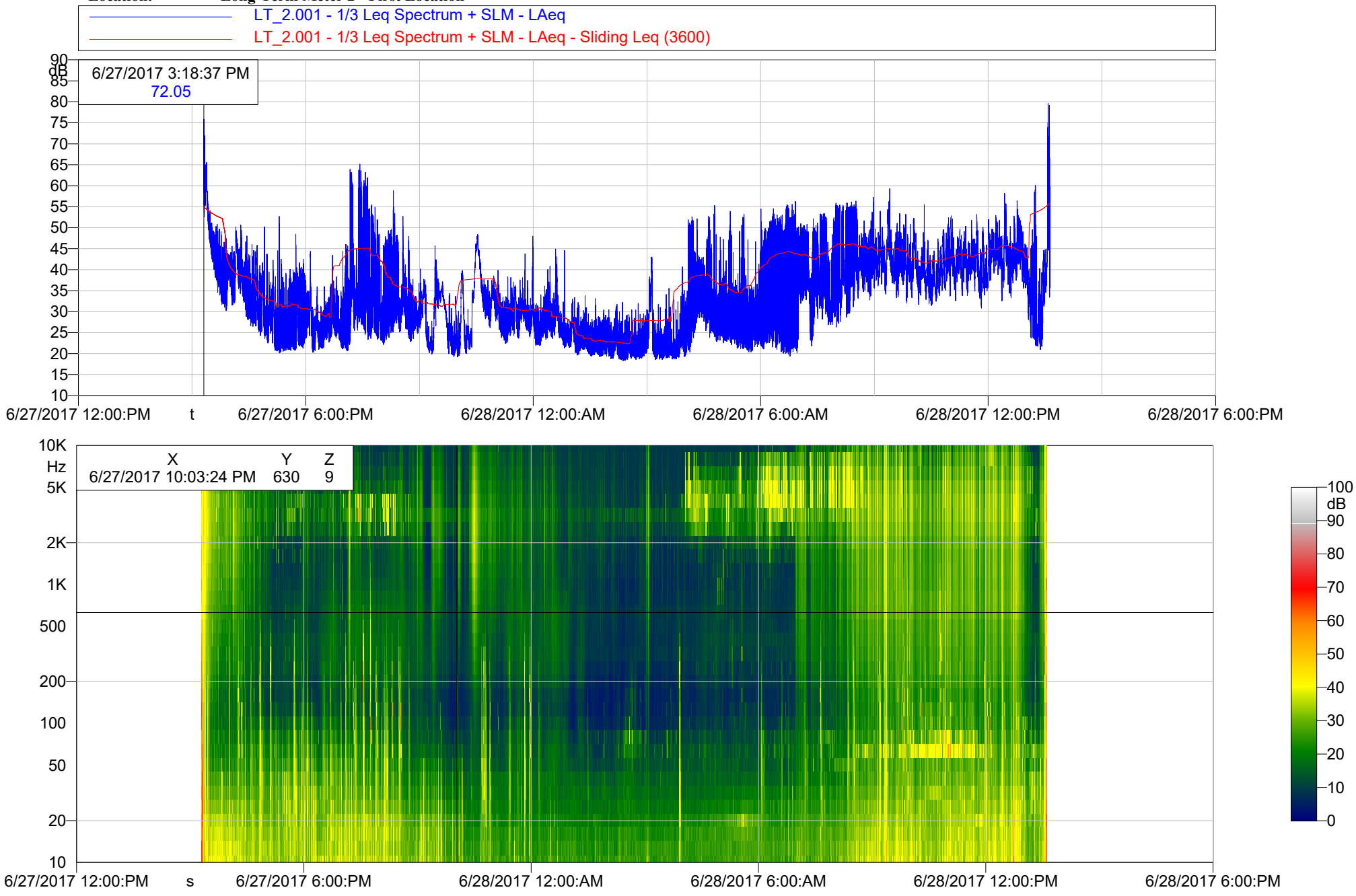


Figure 5.1.4 - Meter 2 Sound Level Data

Measurement: Central Main Power Transmission Line Ambient
Location: Long-Term Meter 2 - Second Location

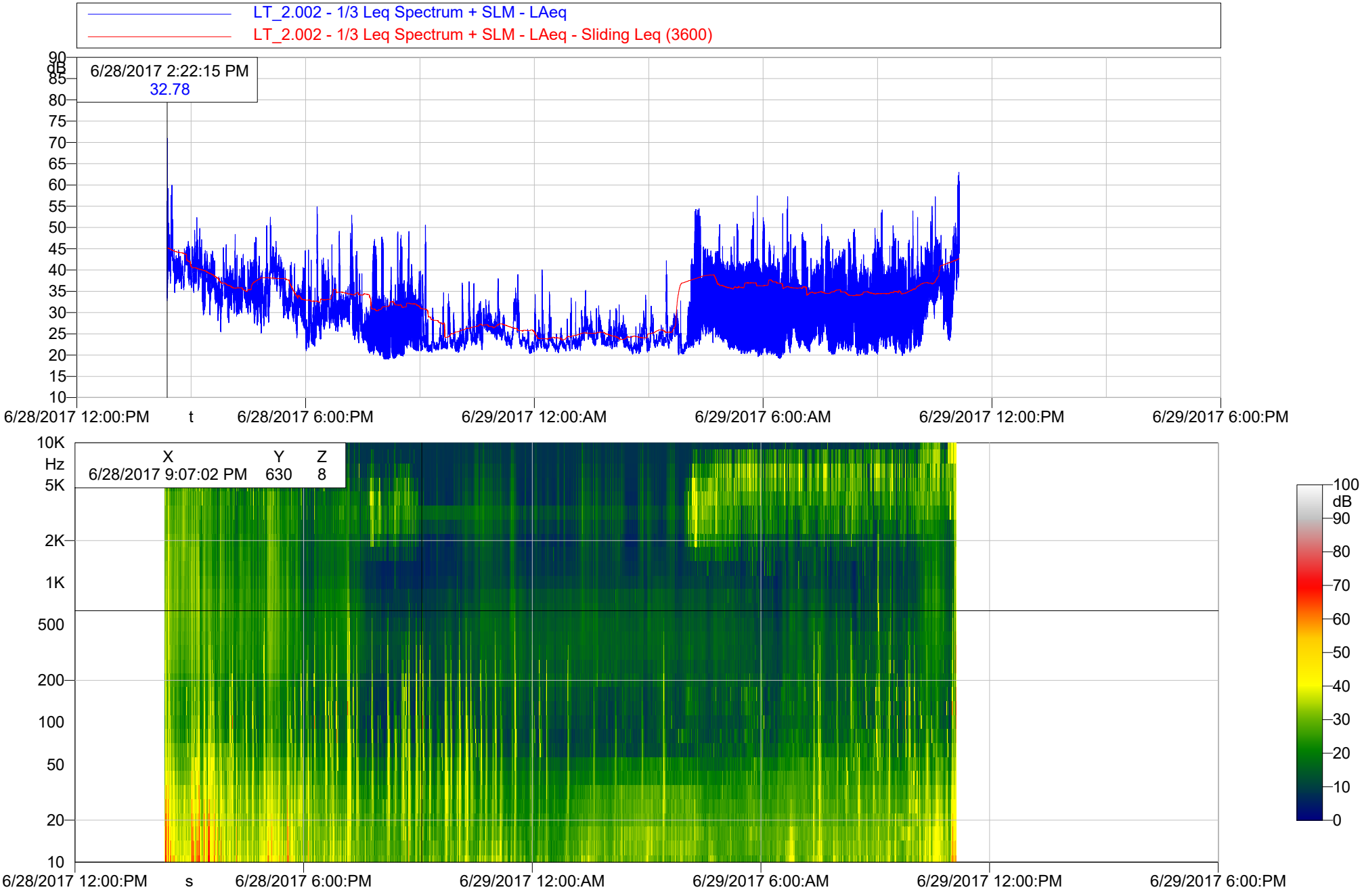
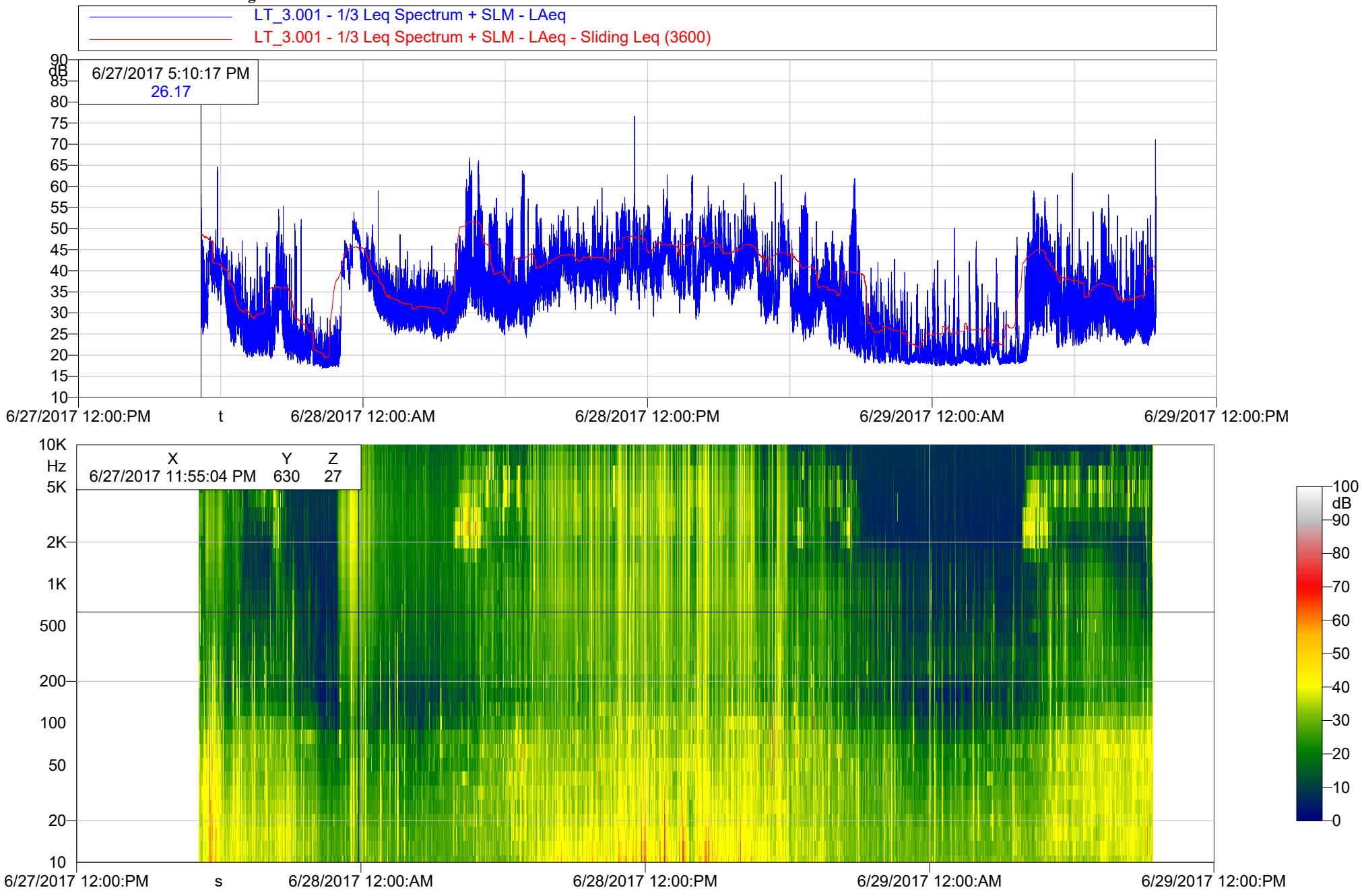


Figure 5.1.5 - Meter 3 Sound Level Data

Measurement: **Central Main Power Transmission Line Ambient**
Location: **Long-Term Meter 3**



5.3 Merrill Road Converter Station

CMP is proposing to build the Merrill Road Converter Station in Lewiston, Maine. The Merrill Road Converter Station will consist of converter transformers, valves, reactors, capacitors, and switches. The station will convert DC power to AC power. The DC lines entering the station will have a nominal operating voltage of approximately +/-320 kV DC. The DC power will be converted to 345kV AC power.

5.3.1 Baseline Conditions

A long-term noise monitor (Meter 4) was installed near the proposed location of the Merrill Road Converter Station, within the existing transmission line ROW, to monitor ambient sound levels over a three-day, two-night period. The location of Meter 4 can be seen in **Exhibit 5-2**. Short periods of precipitation occurred during the measurement period. However, most of the measurements were collected in favorable weather conditions. Temperatures varied, ranging from around 60 degrees Fahrenheit to 80 degrees Fahrenheit. Skies were typically partly cloudy to clear. Winds also varied, with mostly calm winds. In general, strong or excessive winds did not occur during the measurements.

The continuous 1-second and 1-hour average sound levels recorded by Meter 4 are provided in Exhibit 5-. The measured sound levels fluctuated due to extraneous sources. Meter 4 recorded overall sound, octave bands, 1/3 octave bands, and various other sound metrics throughout the measurement period to establish the ambient environment surrounding the proposed converter station. The average daytime and nighttime ambient sound levels are provided below in **Table 5-6**.

Table 5-6: Average Long-Term Existing Sound Levels

Monitor Location	Total Daytime Sound Level[a]		Total Nighttime Sound Level[a]	
	L_{eq} (dBA)	L_{90} (dBA)	L_{eq} (dBA)	L_{90} (dBA)
Meter 4	47.0	46.8	39.0	38.8

(a) Daytime is 7:00 AM to 7:00 PM, nighttime is 7:00 PM to 7:00 AM

The continuous monitor recorded sound data from June 27 through 29, 2017. The data shows that the area surrounding the Merrill Road Converter Substation would not be considered a quiet area according to the MDEP criteria, as both the daytime and nighttime hourly average L_{eq} are greater than 45 dBA and 35 dBA, respectively. The sound level limits per the MDEP would be 50 dBA and 60 dBA at residential property lines during the night and day, respectively. The City of Lewiston Code of Ordinances Appendix A Section 19 – Environmental Performance Standards limits noise based on the adjacent lot's zoning classification. According to the code, the Merrill Road Converter Substation would be limited to 50 dBA during the day and night at nearest residential property lines. The City of Lewiston regulation would

apply at all residential property lines in lieu of the MDEP noise regulation, as the regulation meets the requirements of MDEP Chapter 375.10(B)(1). The City of Lewiston regulation is not more than 5 dBA less stringent than MDEP's regulation and addresses the noises contained in the MDEP regulation.

5.3.2 Construction Noise Levels

Sound from construction activities between 7:00 PM and 7:00 AM is limited to the nighttime sound level limit of 50 dBA at all protected locations, as applicable to normal. Sound from daytime construction activities, between 7:00 AM and 7:00 PM, is limited to the limits provided in **Table 5-3** at any protected location.

Noise from construction equipment will be temporary during construction of the Merrill Road Converter Station. Construction is expected to involve site clearing, excavation, placement of concrete and the use of typical utility construction equipment and practices. Construction activities will be limited in the area to the extent possible. The construction contractor will take the necessary steps to address elevated construction sound levels (e.g., limiting idling equipment).

5.3.3 Operational Sound Levels

The Merrill Road Converter Station will convert DC power to AC power. To estimate the converter station's noise impacts at nearby locations, a noise model was developed for the noise emitting equipment at the Converter Station. Noise modeling was performed using the industry-accepted sound modeling software Computer Aided Design for Noise Abatement (CadnaA). The software is a scaled, three-dimensional program, which takes into account air absorption, terrain, ground absorption, and reflections and shielding for each piece of noise-emitting equipment, and predicts sound pressure levels. The model calculates sound propagation based on International Organization for Standardization (ISO) 9613-2:1996, General Method of Calculation. ISO 9613-2 assesses the sound level propagation based on the octave band center-frequency range from 31.5 to 8,000 Hz. The noise model includes the converter station's transformers, valves, reactors, and radiators. The valves and reactors are located inside a building. The transformers and radiators will be located outside the building.

The modeled converter station sound levels at nearby protected locations are provided in Table 5-7. The data reveal that sound levels from the converter station will not exceed the applicable noise level standards at any of the adjacent residential property lines.

Table 5-7: Modeled Operational Sound Levels

Modeled Receptor	Modeled Sound Level (dBA)	Sound Level Limit[a] (dBA)
PL1 – Property Line	41.9	50
PL2 – Property Line	40.4	50
PL3 – Property Line	37.1	50
PL4 – Property Line	33	50
PL5 – Property Line	48.3	50
PL6 – Property Line	40.9	50

(a) City of Lewiston noise ordinance limits sound to 50 dBA during the day and night at residential property lines.

In addition to the tabular data presented above, noise contour maps are included in **Exhibit 5-2**, that depict the expected noise levels in the areas surrounding the converter station. This figure shows that all protected locations are outside of the limiting noise contour.

5.3.4 Noise Control Measures

Installing equipment capable of meeting the sound levels provided in **Table 5-8** below would be required to achieve compliance with the MDEP and Lewiston noise standards for construction and operation of the proposed Merrill Road Converter Station under the modeled operating conditions. No additional noise control measures outside of meeting the required equipment sound levels would be necessary to meet the applicable noise limits at the nearest protected areas.

Table 5-8: Equipment Sound Level Requirements

Equipment	Sound Level Requirement
Reactor/Valve Building[a] (1)	66 dBA (SPL)[b] at 3 feet
Transformers (4)	90 dBA (SWL)[c] per transformer
Radiators (10)	80 dBA (SWL) per radiator

(a) Reactor valve building sound levels are estimated, as construction material properties are not currently available.
(b) SPL – Sound Pressure Level, averaged along acoustical envelope
(c) SWL – Sound Power Level

5.3.5 Conclusion

Burns & McDonnell prepared a detailed noise study on behalf of CMP to assess the potential noise impacts associated with the proposed Merrill Road Converter Station. The study included identification of nearby protected locations, an ambient noise monitoring program to identify baseline conditions, detailed computer noise modeling, and compliance with MDEP and local noise standards.

The City of Lewiston has noise standards contained in the City of Lewiston Code of Ordinances. The ordinance limits noise at residential properties to 50 dBA during the day and night. The MDEP limits sound at protected areas to 50 dBA at night, with a 5-dBA penalty when tonal sounds are present. The City of Lewiston regulation will be followed at all points along the property lines.

The ambient noise monitoring program, conducted continuously over three days and two nights, revealed that the daytime hourly average sound levels were greater than 45 dBA, and the nighttime hourly average sound level was greater than 35 dBA. As such, the areas surrounding the converter substation would not be defined as quiet areas under MDEP's noise standard. The Project noise is limited to 50 dBA, per the City of Lewiston noise ordinance, along the adjacent property lines as outlined in **Exhibit 5-2**. The noise modeling study revealed that by installing equipment capable of meeting the modeled sound levels provided in Section **5.3.3.**, no additional noise control measures would be required to achieve compliance with the Lewiston noise standards for the modeled operating conditions.

In summary, construction and operation of the proposed Merrill Road Converter Station will comply with the applicable City of Lewiston noise standards at all residential property lines.

Exhibit 5-2: Merrill Road Converter Station Figures

Figure 5.2.1 – Meter 4 Monitoring Location

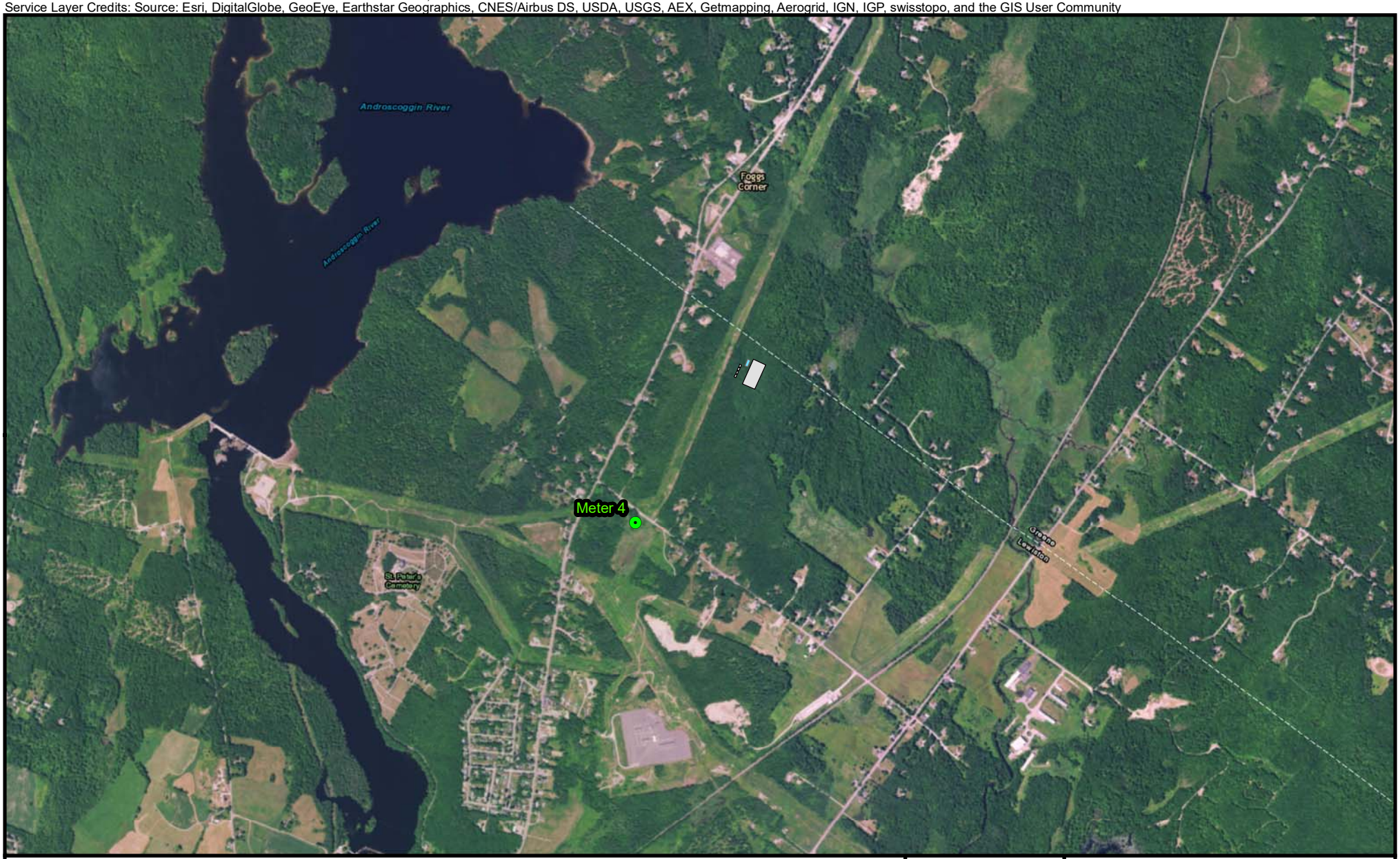
Figure 5.2.2 – Meter 4 Sound Level Data

Figure 5.2.3 – Merrill Road Converter Station Modeling Layout

Figure 5.2.4 – Merrill Road Converter Station Sound Level Contours

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.3.1 - Meter 4 Monitoring Location.mxd gweger 9/19/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Meter 4

Converter Substation

NORTH

2,000 1,000 0 2,000

Scale in Feet

BURNS McDONNELL

Figure 5.2.1

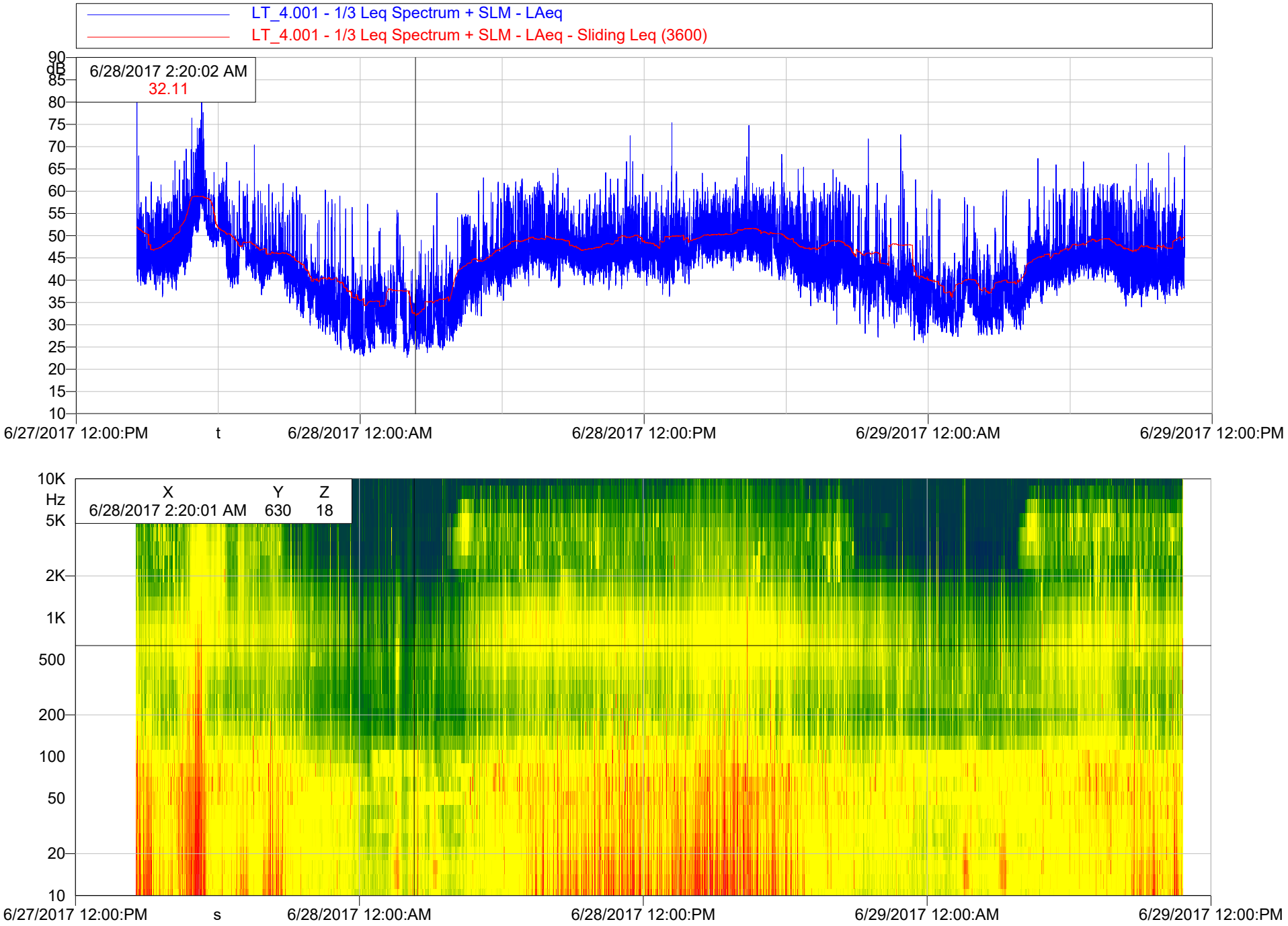
CMP NECEC
Meter 4 Monitoring Location

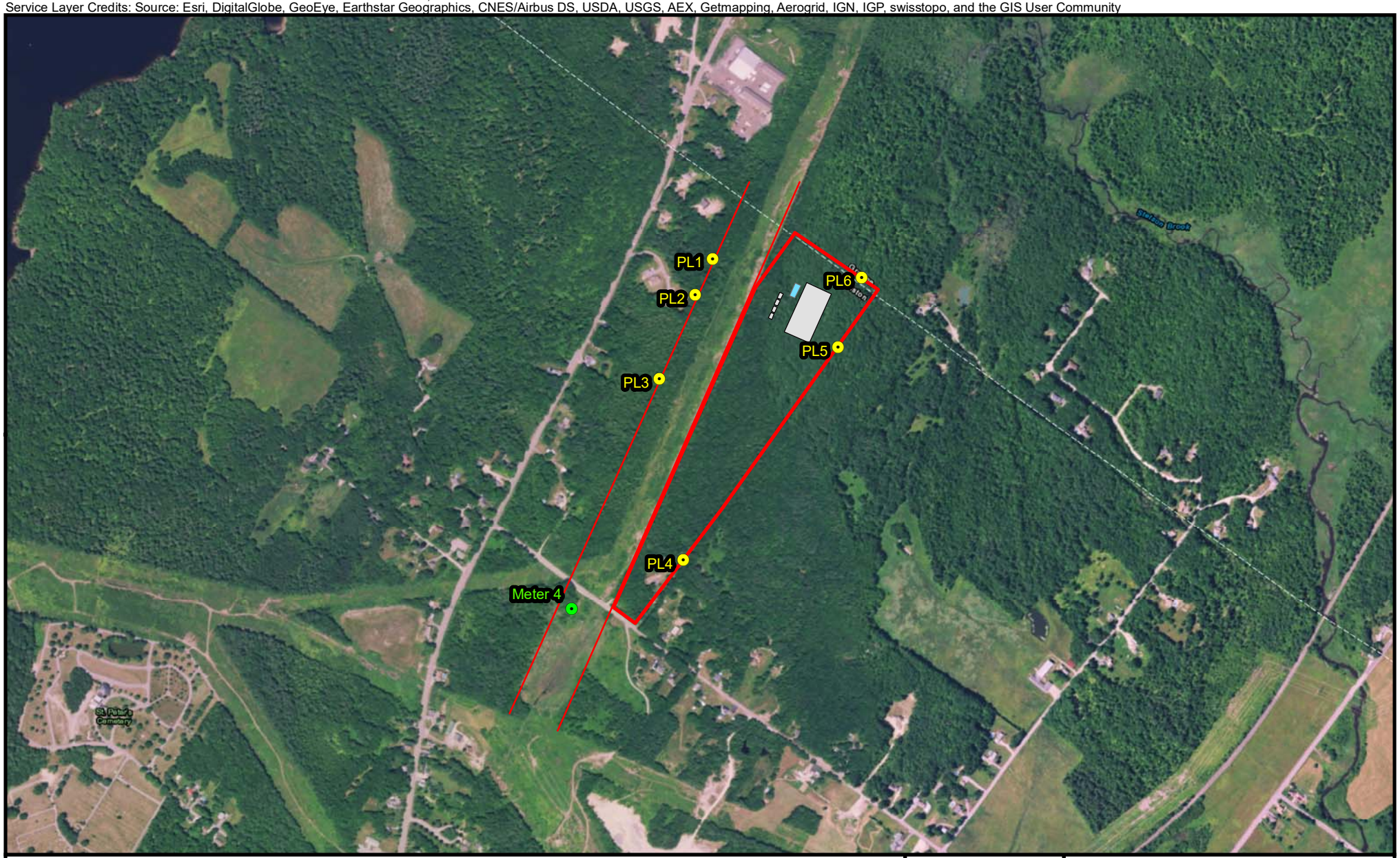
Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/19/2017

Figure 5.2.2 - Meter 4 Sound Level Data

Measurement: Central Main Power Ambient
Location: Long-Term Meter 4





BURNS McDONNELL

Figure 5.2.3

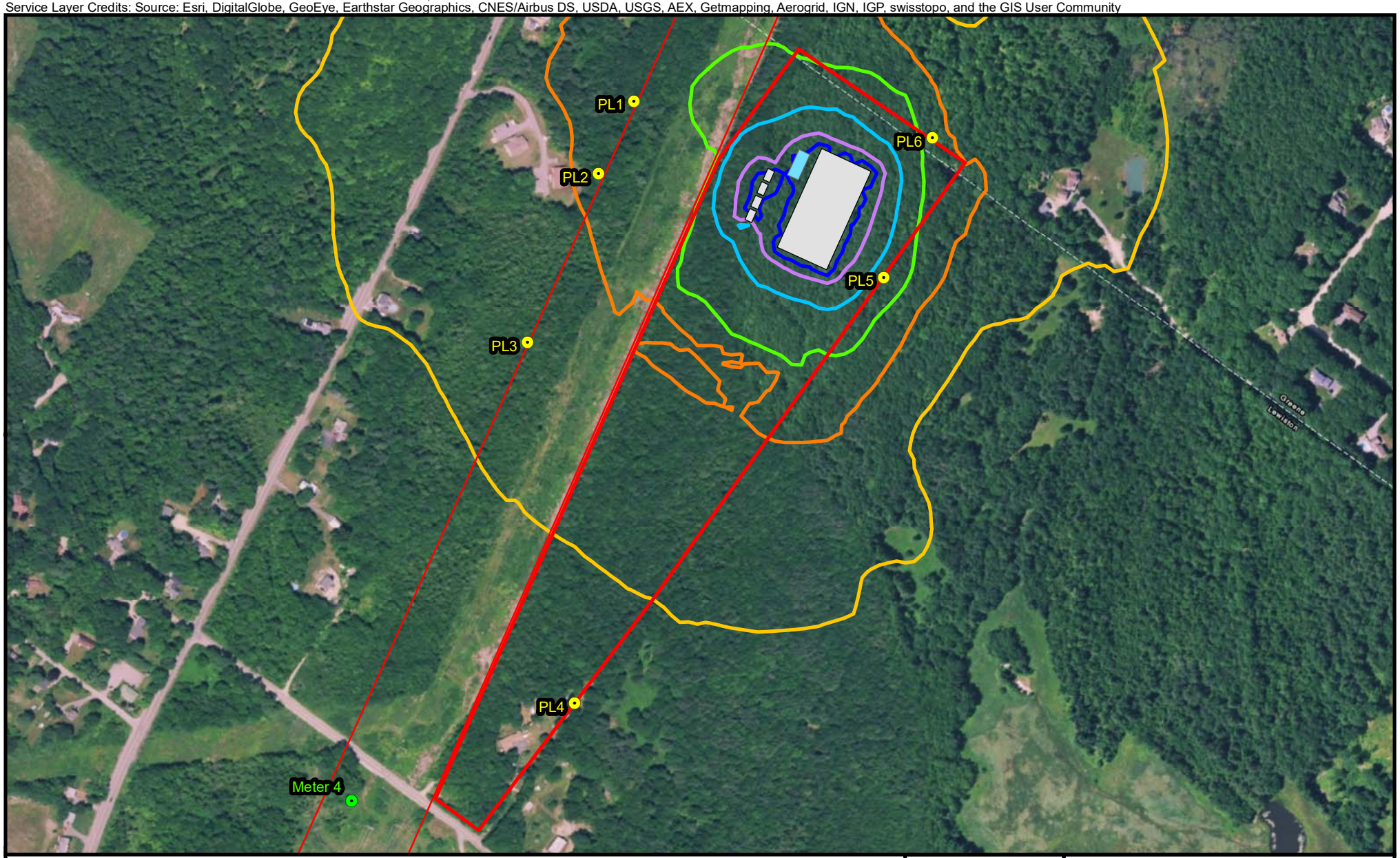
CMP NECEC
Merrill Road Converter Station
Modeling Layout

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/19/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.3.4 - Merrill Road Converter Station Sound Level Contours.mxd gweger 9/19/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



BURNS McDONNELL

Figure 5.2.4

CMP NECEC
Merrill Road Converter Station
Sound Level Contours

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/19/2017

5.4 Larrabee Road Substation

CMP is proposing to expand the terminal at the existing Larrabee Road Substation in Lewiston, Maine. The terminal expansion will require the addition of a 345-kV line termination structure, a 345-kV circuit breaker, disconnect switches, instrument transformers, surge arrestors, buswork modifications, support structures, foundations, and modifications to the existing protection and control systems. CMP also will replace the existing three-phase T1 transformer at the Larrabee Road Substation with a set of three, single-phase autotransformers rated at 600 MVA (an increase from 448 MVA of the three-phase unit) to mitigate thermal overloads under contingency conditions.

5.4.1 Baseline Conditions

Burns & McDonnell personnel took short-term far-field measurements multiple times from June 27 to 29, 2017, at the fenceline of the Larrabee Substation. Each short-term measurement was 5 minutes in duration, or as long as needed to achieve steady state. The measurements were taken to establish operational sound levels of the substation. The locations of the short-term measurement points can be seen in **Exhibit 5-3**. The short-term measurements were taken during times when meteorological conditions were favorable for conducting sound measurements, with the exception of some light rain during the daytime of the June 27 measurements.

CMP provided operational data for the substation during the measurement periods. Larrabee Road had its capacitors on during each of the measurements, but the reactors were not in service. The operating conditions were incorporated into the noise model in order to estimate future sound levels with all noise emitting equipment operational. Estimated reactor sound levels were incorporated into the model based on reactor sound level data from operational measurements taken in 2013 at CMP's Albion Road Substation. Albion Road has similar equipment which would emit very similar types of sound and sound levels and represents the most current, best available data.

Extraneous sounds during the measurement periods included sounds associated with vehicular traffic from nearby roads, airplanes flying overhead, birds, and insects. The average measured, A-weighted L_{eq} and L_{90} sound levels measured at the substation fenceline are presented in **Table 5-9**. Sound levels are not dependent on time of day, because the substation dominates sound levels at each fenceline location and operates continuously throughout the day and night.

Table 5-9: Average Short-Term Existing Sound Levels

Measurement Point	Measured Average		Operating Conditions
	L_{eq} (dBA)	L_{90} (dBA)	
MP1	45.2	43.3	Main transformer and capacitors operating.
MP2A	52.4	51.4	
MP2B	45.0	43.0	
MP3	48.4	46.8	

The average daytime and nighttime ambient sound levels, at locations where the substation is inaudible, are represented by long-term Meter 4 and are provided in **Table 5-6** of Section 5.3.1 The continuous monitor recorded sound data from June 27 through 29, 2017. The data show that the area just north of the Larrabee Road Substation would not be considered a quiet area according to the MDEP criteria (substation was inaudible at this location). The sound level limits per the MDEP would be 50 dBA and 60 dBA at residential property lines during the night and day, respectively. The City of Lewiston Code of Ordinances Appendix A Section 19 – Environmental Performance Standards limits noise based on the adjacent lot's zoning classification. According to the code, the Larrabee Road Substation would be limited to 50 dBA during the day and night at nearest residential property lines. The City of Lewiston regulation would apply at all residential property lines in lieu of the MDEP noise regulation, as the regulation meets the requirements of MDEP Chapter 375.10(B)(1). The City of Lewiston regulation is not more than 5 dBA less stringent than MDEP's regulation and addresses the noises contained in the MDEP regulation.

5.4.2 Construction Noise Levels

Sound from construction activities between 7:00 PM and 7:00 AM is limited to the nighttime sound level limit of 50 dBA at all protected locations, as applicable to normal operation at the site. Sound from daytime construction activities, between 7:00 AM and 7:00 PM, is limited to the limits provided in **Table 5-3** at any protected location.

Noise from construction equipment would be temporarily emitted during construction of the Larrabee Road Substation. Construction is expected to involve placement of concrete and the use of typical utility construction practices. Construction activities will be limited in the area to the extent possible. The construction contractor will take the necessary steps to address elevated construction sound levels, if and when appropriate.

5.4.3 Operational Sound Levels

CMP will replace the existing T1 transformer at the Larrabee Road Substation with three single-phase units rated at 600 MVA to mitigate thermal overloads under contingency conditions. The new autotransformers will operate at the same voltage on the high and low sides of the unit, and the sound levels of the new unit are expected to be similar to the existing transformer. To estimate the substation's noise impacts at nearby locations, a noise model was developed for the existing noise emitting equipment at the substation with the addition of the three single-phase autotransformers. Noise modeling was performed using CadnaA. The noise model includes the substation's autotransformers, reactors, and capacitors.

The modeled substation sound levels at nearby protected locations are provided in **Table 5-10.** A review of the data reveals that sound levels from the substation would not exceed the applicable noise level standards at any of the adjacent residential property lines.

Table 5-10: Modeled Operational Sound Levels

Modeled Receptor	Modeled Sound Level (dBA)	Sound Level Limit[a] (dBA)
PL1 – Property Line	38.1	50
PL2 – Property Line	40.2	50
PL3 – Property Line	41.5	50
PL4 – Property Line	43.1	50
PL5 – Property Line	42.8	50
PL6 – Property Line	39.4	50
PL7 – Property Line	30.9	50

(a) City of Lewiston noise ordinance limits sound to 50 dBA during the day and night at residential property lines.

In addition to the tabular data presented in the table above, noise contour maps are included in **Exhibit 5-3** that depict the expected noise levels in the area and the locations of the modeled receptors. This figure shows that all of the protected locations are outside of the limiting noise contour.

5.4.4 Noise Control Measures

Installing new autotransformers capable of meeting the sound levels provided in **Table 5-11** would be in compliance with the MDEP and Lewiston noise standards for construction or operation of the Larrabee Road Substation under the modeled operating conditions. This is an estimated noise level rating of the new autotransformers. No additional noise control measures will be required in order to achieve compliance with the MDEP and Lewiston noise standards.

Table 5-11: Modeled Equipment Sound Level

Equipment	Modeled Sound Level[a]
New Autotransformer (3)	82 dBA (SPL)[b] at 3 feet

(a) Modeled sound level. Louder units could be installed but additional noise control measures may need to be taken.
(b) SPL – Sound Pressure Level, averaged along acoustical envelope

5.4.5 Conclusion

Burns & McDonnell prepared a detailed noise study on behalf of CMP to assess the potential noise impacts associated with operation of the Larrabee Road Substation after modifications are made. The study included identification of nearby protected locations, an ambient noise monitoring program to identify baseline conditions, detailed computer noise modeling, identification of required noise mitigation measures, and compliance with MDEP and local noise standards.

The City of Lewiston has noise standards contained in the City of Lewiston Code of Ordinances. The ordinance limits noise at residential properties to 50 dBA during the day and night.

The ambient noise monitoring program, conducted continuously over three days and two nights, revealed that the daytime hourly average sound levels (at a location where the existing substation was not audible) were greater than 45 dBA, and the hourly nighttime sound level was greater than 35 dBA. As such, the areas surrounding the substation are not defined as quiet areas under MDEP's noise standard, but are considered protected areas. Therefore, Project noise is limited to 50 dBA along the adjacent property lines as outlined in **Exhibit 5-3**. The noise modeling study revealed that the new equipment would require no additional noise control measures to achieve compliance with the City of Lewiston standards for the modeled operating conditions. The current substation operations are below the sound level requirements and the replacement autotransformers are expected to emit similar sound levels to the existing unit.

In summary, construction and operation of the Larrabee Road Substation are expected to be in compliance with the applicable MDEP and Lewiston noise standards.

Exhibit 5-3: Larrabee Road Substation Figures

Figure 5.3.1 – Larrabee Road Substation Monitoring Locations

Figure 5.3.2 – Larrabee Road Substation Modeling Layout

Figure 5.3.3 – Larrabee Road Substation Sound Level Contours

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.4.1 - Larrabee Road Substation Monitoring Location.mxd gweger 8/23/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Montoring Locations

NORTH

500 250 0 500

Scale in Feet

BURNS McDONNELL

Figure 5.3.1

CMP NECEC
Larrabee Road Substation
Monitoring Locations

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 8/23/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.4.2 - Larrabee Road Substation Modeling Layout.mxd gweger 9/7/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Residential Property Line Receptors

Sound Sources

Property Line w/ 50 dBA Limit

NORTH

500 250 0 500

Scale in Feet

BURNS McDONNELL

Figure 5.3.2

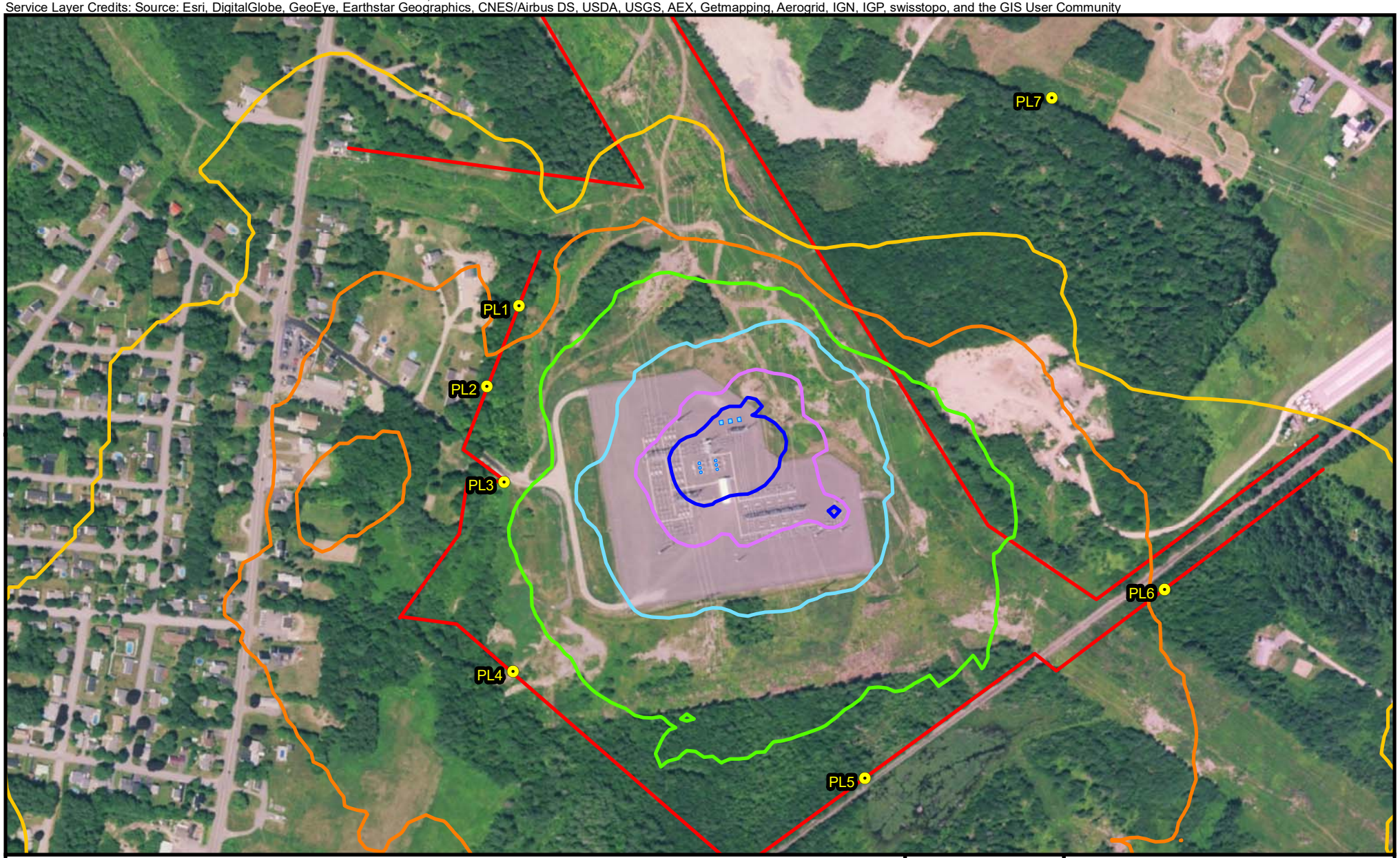
CMP NECEC
Larrabee Road Substation
Modeling Layout

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/7/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.4.3 - Larrabee Road Substation Sound Level Contours.mxd gweger 9/7/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
Property Line w/ 50 dBA Limit

NORTH

500 250 0 500

Scale in Feet

BURNS McDONNELL

Figure 5.3.3

CMP NECEC
Larrabee Road Substation
Sound Level Contours

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/7/2017

5.5 Fickett Road Substation

CMP is proposing to expand the terminal at the existing Surowiec Substation in Pownal, Maine. To facilitate the new Static Synchronous Compensator (STATCOM), CMP will add a 345-kV line terminal at the substation. The expansion will require the addition of 345-kV line termination structure, 345-kV circuit breakers, disconnect switches, instrument transformers, surge arrestors, buswork modifications, support structures, foundations and modifications to the existing protection and control system. The line terminal expansion at the Surowiec Substation will be built within the existing yard. All Surowiec substation equipment is excluded from the Fickett Road Substation analysis as the substation was constructed prior to 1970 and is not jurisdictional. No new sound sources will be installed at the existing Surowiec substation.

Given space constraints and a nearby stream around the existing substation, CMP will establish a new substation yard across the road from Surowiec to house the +/-200 MVAR STATCOM device, the Fickett Road Substation. In addition, the proposed Fickett Road Substation will include: a 345-kV line termination structure, 345-kV circuit breakers, disconnect switches, instrument transformers, surge arrestors, associated buswork, support structures, foundations, and the required protection and control systems. The STATCOM will be constructed with similar major components as the HVDC converter station but arranged in a different electrical configuration to provide system reactive support instead of real power transfer capability.

5.5.1 Baseline Conditions

Burns & McDonnell personnel took short-term far-field measurements multiple times from June 27 to 29, 2017, at the fenceline and surrounding area of the Surowiec Substation where the Fickett Road substation will be constructed. In addition to the short-term measurements, a long-term noise monitor (Meter 5) was installed near the proposed location of the Fickett Road Substation, within the existing transmission line ROW, to monitor ambient sound levels over three days and two nights. The location of Meter 5 can be seen in **Exhibit 5-4**. Each short-term measurement was 5 minutes in duration, or as long as needed to achieve steady state. The measurements were taken to establish operational sound levels of the Surowiec Substation, adjacent to the proposed Fickett Road Substation. The locations of the short-term measurement points can be seen in **Exhibit 5-4**. Short periods of precipitation occurred during the measurement period. However, the majority of the measurements were collected in favorable weather conditions. Temperatures varied, ranging from around 60 degrees Fahrenheit up to 80 degrees Fahrenheit. Skies were typically partly cloudy to clear. Winds also varied, with mostly calm winds. In general, strong or excessive winds did not occur during the measurements.

The continuous 1-second and 1-hour average sound levels recorded by Meter 5 are provided in **Exhibit 5-4**. The sound levels measured fluctuated due to extraneous sources. Meter 5 recorded overall sound, octave bands, and various other sound metrics throughout the measurement period to establish the ambient environment surrounding the proposed converter station. The average daytime and nighttime ambient sound levels are provided below in **Table 5-12**.

Table 5-12: Average Long-Term Existing Sound Levels

Monitor Location	Total Daytime Sound Level[a]		Total Nighttime Sound Level[a]	
	L_{eq} (dBA)	L_{90} (dBA)	L_{eq} (dBA)	L_{90} (dBA)
Meter 5	38.4	38.2	35.5	35.3

(a) Daytime is 7:00 AM to 7:00 PM, nighttime is 7:00 PM to 7:00 AM

The continuous monitor recorded sound data from June 27 through 29, 2017. The data show that the area surrounding the substation would be considered a quiet area according to the MDEP criteria since the daytime sound levels are below 45 dBA. Therefore, the sound level limits per the MDEP would be 45 dBA and 55 dBA at residential property lines during the night and day, respectively. The nearest residential receiver is located 500 feet south of the substation.

Extraneous sounds during the measurement periods included sounds associated with vehicular traffic from nearby roads, airplanes flying overhead, birds and insects. The Suroweic Substation was audible at multiple measurement points, but did not dominate the overall sound levels. The average measured, A-weighted L_{eq} and L_{90} sound levels measured near the substation are presented in **Table 5-13**.

Table 5-13: Average Short-Term Existing Sound Levels

Measurement Point	Daytime Measured Average		Nighttime Measured Average		Operating Conditions
	L_{eq} (dBA)	L_{90} (dBA)	L_{eq} (dBA)	L_{90} (dBA)	
MP1	53.2	41.6	36.4	34.1	Main transformer, reactors and capacitors operating.
MP2	59.5	40.2	35.9	33.8	
MP3	50.5	36.9	33.6	31.1	
MP4	44.1	36.9	35.4	30.7	
MP5	47.3	37.3	38.1	34.0	
MP6	52.9	41.6	42.8	42.1	

5.5.2 Construction Noise Levels

Sound from construction activities between 7:00 PM and 7:00 AM is limited to the nighttime sound level limit of 45 dBA at all protected locations, as applicable to normal operation at the site without a tonal

penalty. Sound from daytime construction activities, between 7:00 AM and 7:00 PM, is limited to the limits provided in **Table 5-3** at any protected location.

Noise from construction equipment will be temporarily emitted during construction of the Fickett Road Substation. Construction is expected to involve site clearing, excavation, placement of concrete and the use of typical utility construction practices. Construction activities will be limited in the area to the extent possible. The construction contractor will take the necessary steps to address elevated construction sound levels.

5.5.3 Operational Sound Levels

CMP plans to install a +/-200 MVAR STATCOM device across the street from the Surowiec Substation. The STATCOM will be built with similar major components as the HVDC converter arranged in a different electrical configuration to provide system reactive support instead of real power transfer capability. To estimate the new substation's noise impacts at nearby locations, a noise model was developed for the new noise emitting equipment at the Fickett Road Substation. Noise modeling was performed using CadnaA. The noise model includes the new substation's STATCOM equipment.

The modeled substation sound levels at nearby protected locations are provided in **Table 5-14**. The dominant sound sources from the STATCOM to the north are the cooling fans and HVAC system. These sources would not have a strong tonal component; therefore, the measured sound levels would likely not be assessed the MDEP 5-dBA penalty. Without the operation of the cooling fans, the STATCOM would be under 40 dBA at the north property line, which would be below the MDEP limit after a 5-dBA penalty was added. Review of the data reveals that sound levels from the substation would not exceed the applicable noise level standards at the adjacent residential property lines.

Table 5-14: Modeled Operational Sound Levels

Modeled Receptor	Modeled Sound Level[a] (dBA)	Sound Level Requirement[b] (dBA)
PL1 – Property Line	40.7	45
PL2 – Property Line	41.9	45
PL3 – Property Line	35.9	45
PL4 – Property Line	36.4	45
PL5 – Property Line	27.5	45
PL6 – Property Line	30.7	45

(a) Modeled sound level is the substation sound level with an expected 5-dBA tonal penalty added
(b) No tonal penalty applied to this location. Sound is dominated by cooling modules which are not tonal.

In addition to the tabular data presented in the table above, noise contour maps are included in **Exhibit 5-4** that depict the expected noise levels in the area and the locations of the modeled receptors. Noise contours do not reflect a 5-dBA penalty.

5.5.4 Noise Control Measures

Installing the STATCOM with equipment capable of meeting the sound levels provided in **Table 5-15** would be in compliance with the MDEP noise standards for construction or operation of the Fickett Road Substation under the modeled operating conditions. No additional noise control measures will be required in order to achieve compliance with the MDEP noise standards.

Table 5-15: Modeled Equipment Sound Level

Equipment	Modeled Sound Level[a,b]
Transformers (2)	91 dBA (SWL)
Air Core Reactor – D1 (3)	74 dBA (SWL)
Air Core Reactor – CA1 (3)	64 dBA (SWL)
Capacitor Bank (3)	71 dBA (SWL)
Dry Air Cooler (5)	80 dBA (SWL)
HVAC Fans (2)	80 dBA (SWL)

(a) Modeled sound level. Louder units could be installed but additional noise control measures would need to be taken.
(b) SWL – Sound Power Level

5.5.5 Conclusion

Burns & McDonnell prepared a detailed noise study on behalf of CMP to assess the potential noise impacts associated with operation of the Fickett Road Substation with the new STATCOM equipment installed. The study included identification of nearby protected locations, an ambient noise monitoring program to identify baseline conditions, detailed computer noise modeling, identification of required

noise mitigation measures, and compliance with MDEP noise standards. The MDEP limits sound at protected quiet areas to 45 dBA at night, and assesses a 5-dBA penalty to measured sound levels when tonal sounds are present. Therefore, the new substation equipment is limited to 40 dBA at protected locations where a pure tone could be measured.

The ambient noise monitoring program, conducted continuously over three days and two nights, revealed that the daytime hourly average sound levels were below 45 dBA. As such, the areas surrounding the substation are considered protected quiet areas. Project noise is limited to 45 dBA along the adjacent property lines, inclusive of a 5-dBA penalty added to measured levels when a tone is present, as outlined in **Exhibit 5-4**. Properties near the cooling fans would not experience tonal noise and would have a limit of 45 dBA with no inclusion of a penalty for measured levels. The noise modeling study revealed that the new equipment would require no additional noise control measures to achieve compliance with the MDEP standards for the modeled operating conditions. The current substation operations are below the MDEP sound level requirements.

In summary, construction and operation of the new Fickett Road Substation will be in compliance with the applicable MDEP noise standards.

Exhibit 5-4: Fickett Road Substation Figures

Figure 5.4.1 – Meter 5 Monitoring Location

Figure 5.4.2 – Meter 5 Sound Level Data

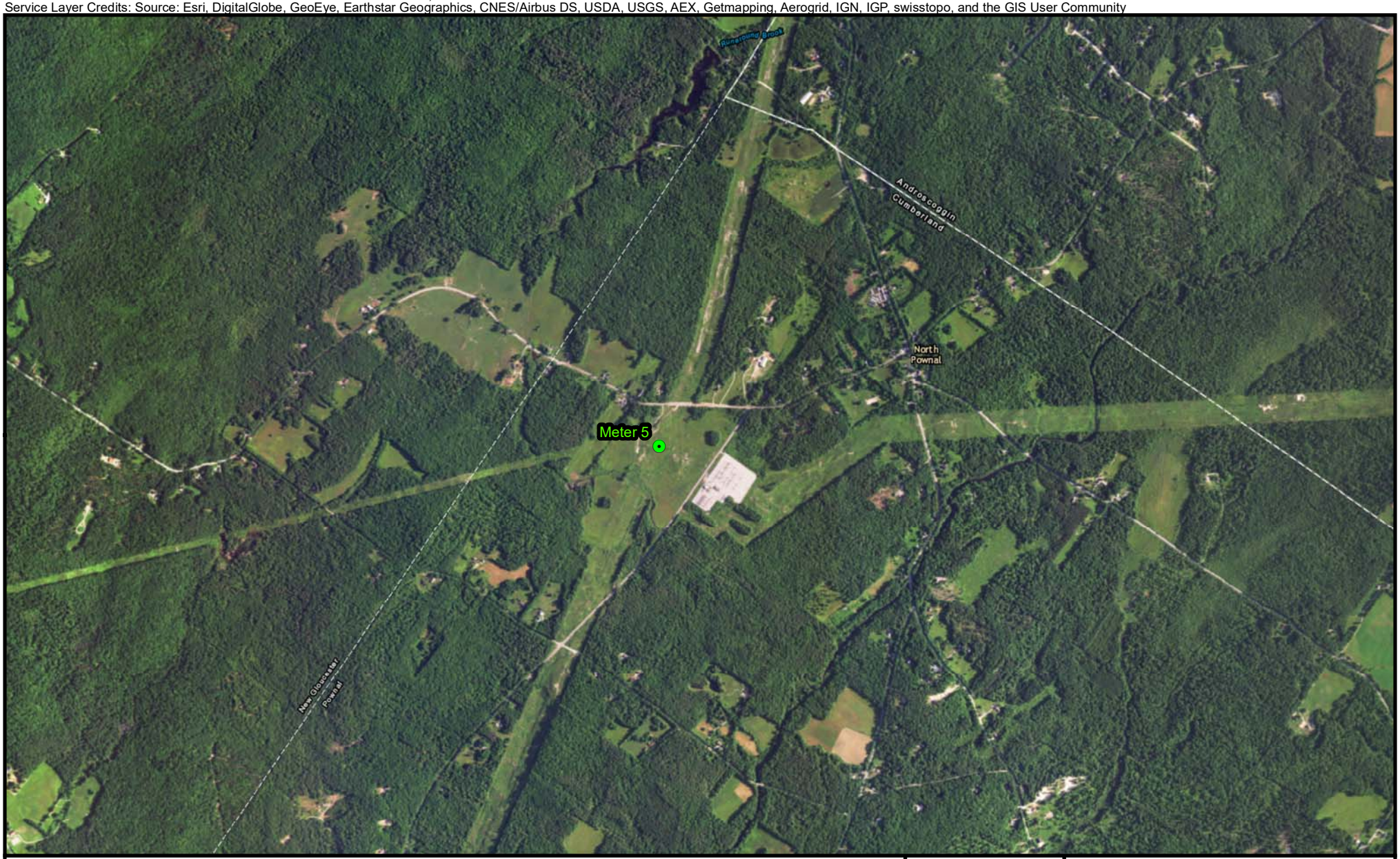
Figure 5.4.3 –Fickett Road Substation Monitoring Locations

Figure 5.4.4 –Fickett Road Substation Modeling Layout

Figure 5.4.5 –Fickett Road Substation Sound Level Contours

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.5.1 - Meter 5 Monitoring Location.mxd gweger 8/22/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Meter 5

NORTH

2,000 1,000 0 2,000

Scale in Feet

BURNS McDONNELL

Figure 5.4.1

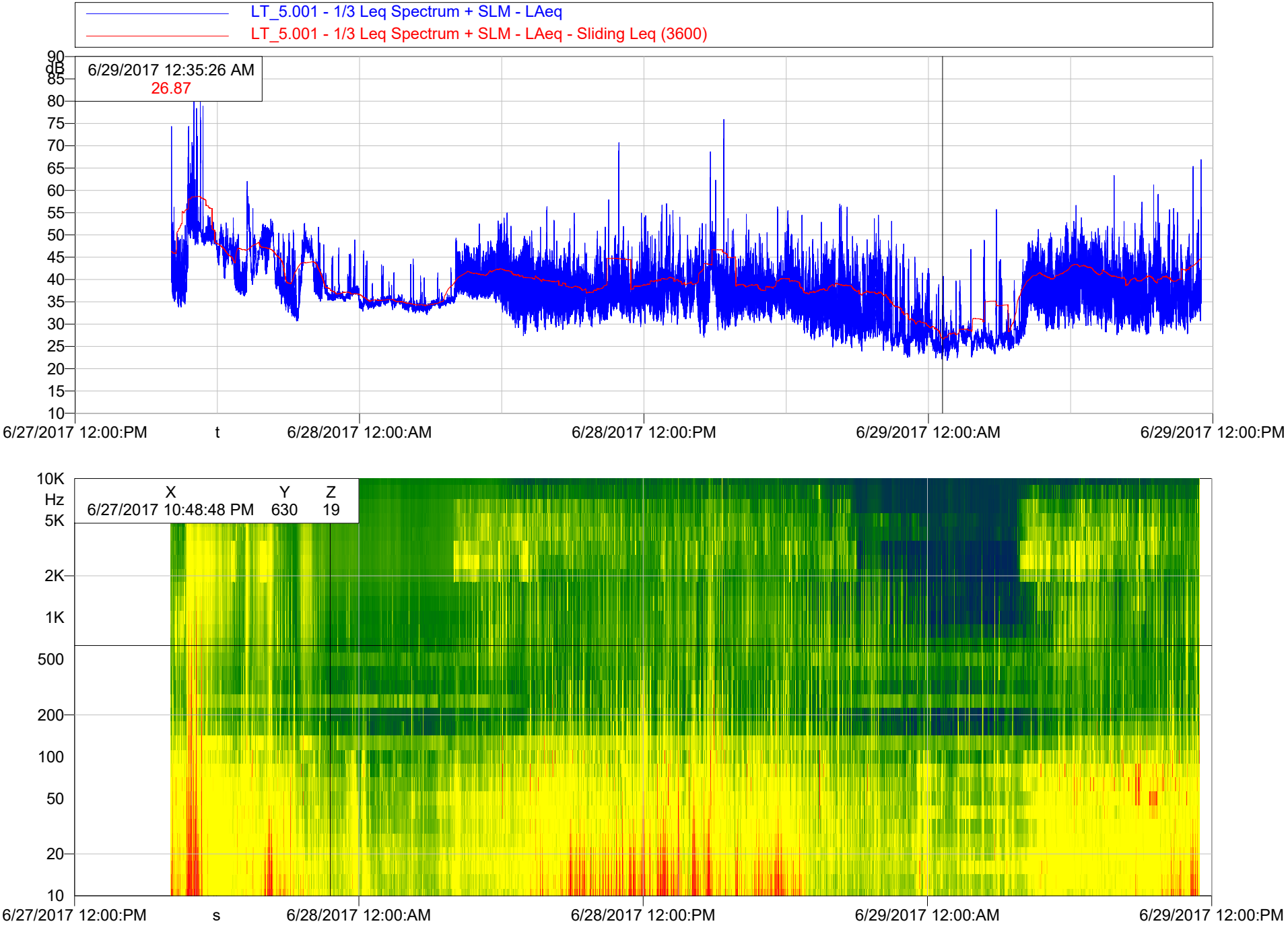
CMP NECEC
Meter 5 Monitoring Location

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 8/22/2017

Figure 5.4.2 - Meter 5 Sound Level Data

Measurement: Central Main Power Ambient
Location: Long-Term Meter 5



Meter 5

Monitoring Locations

NORTH

500 250 0 500

Scale in Feet

BURNS McDONNELL

Figure 5.4.3

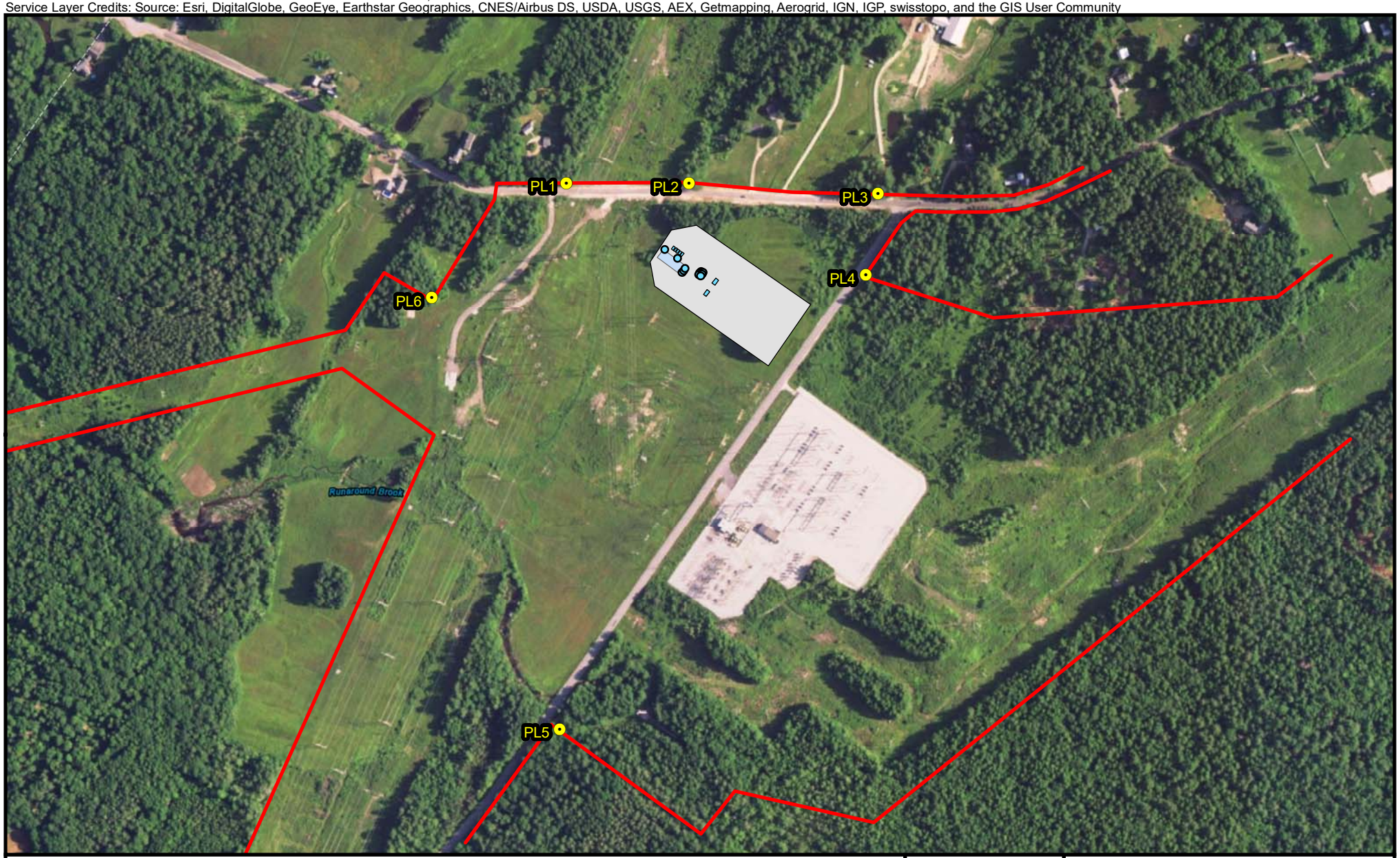
CMP NECEC
Fickett Road Substation
Monitoring Locations

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/19/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.5.4 - Surowiec and Fickett Road Substation Modeling Layout.mxd gweger 9/19/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Property Line Receptors
Sound Sources
Substation Structures
Property Line w/ 45 dBA Limit

NORTH
500 250 0 500
Scale in Feet

BURNS McDONNELL

Figure 5.4.4

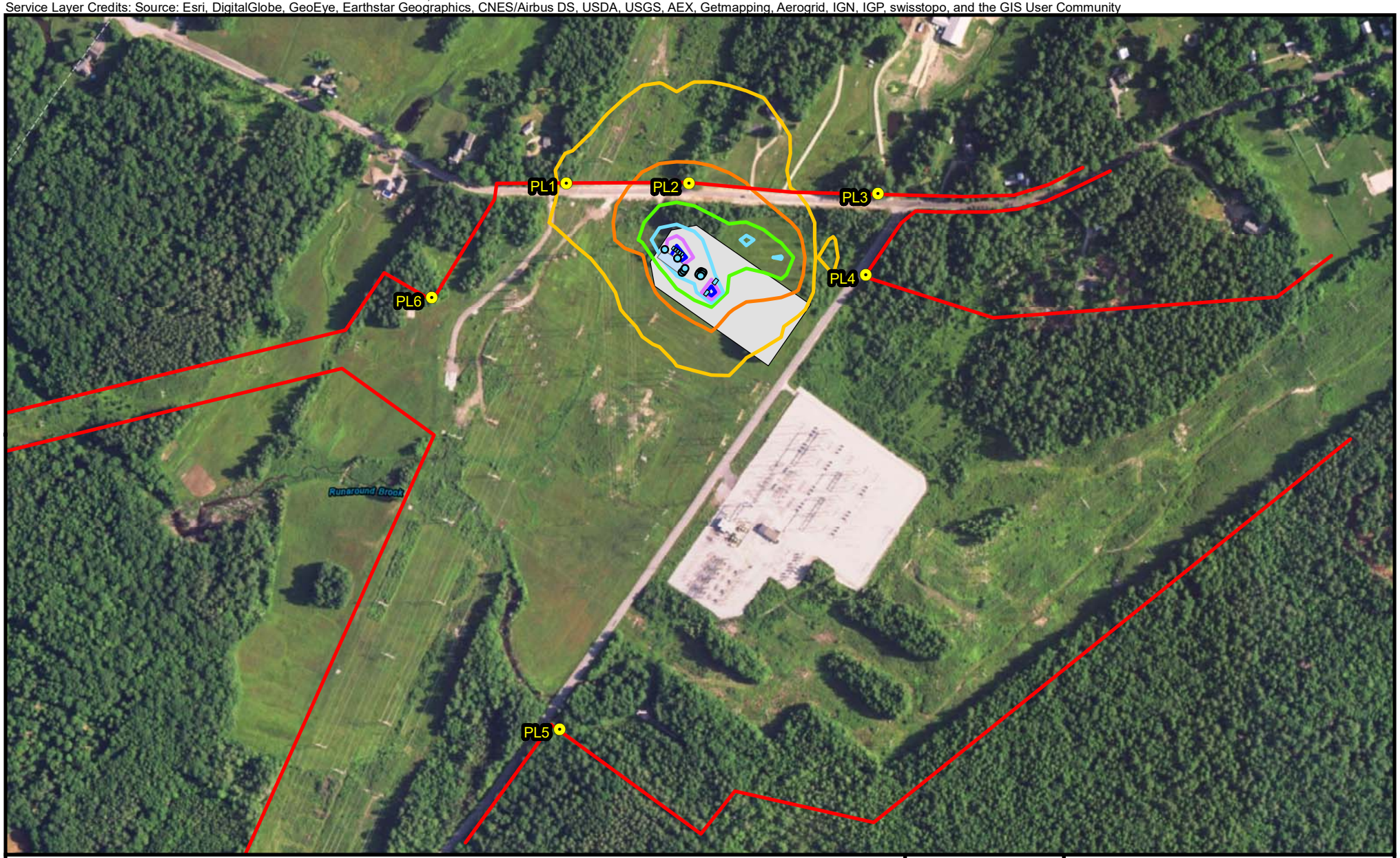
CMP NECEC
Fickett Road Substation
Modeling Layout

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/19/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.5.5 - Surowiec and Fickett Road Substation Sound Level Contours.mxd gweger 9/19/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



35 dBA
50 dBA
Property Line
40 dBA
55 dBA
45 dBA
60 dBA

NORTH

500 250 0 500

Scale in Feet

BURNS McDONNELL

Figure 5.4.5

CMP NECEC
Fickett Road Substation
Sound Level Contours

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/19/2017

5.6 Coopers Mills Road Substation

CMP is proposing to expand the Coopers Mills Substation located in Windsor, Kennebec County, Maine. The expansion will require the addition of 345-kV line termination structure, 345-kV circuit breakers, disconnect switches, instrument transformers, surge arrestors, buswork modifications, support structures, and foundations, and modifications to the existing protection and control system. In addition, it will require reconfiguration of the existing 345-kV lines to accommodate the new Section 3027 345-kV line. The NECEC project also requires the addition of a +/-200 MVAR STATCOM at the Coopers Mills Substation to provide dynamic reactive support (+/-400 MVAR total with the existing +/-200 MVAR currently under construction). The addition of the STATCOM will include multiple noise sources, which could increase sound levels at the property line and beyond. The STATCOM will be constructed with similar major components as the HVDC converter arranged in a different electrical configuration to provide system reactive support instead of real power transfer capability.

5.6.1 Baseline Conditions

Burns & McDonnell personnel took short-term far-field measurements multiple times from June 27 to 29, 2017, at the fenceline and surrounding area of the Coopers Mills Substation. In addition to the short-term measurements, a long-term noise monitor (Meter 6) was installed near the substation, within the existing transmission line ROW, to monitor ambient sound levels over three days and two nights. The location of Meter 6 can be seen in **Exhibit 5-5**. Each short-term measurement was 5 minutes in duration, or as long as needed to achieve steady state. The measurements were taken to establish operational sound levels of the Coopers Mills Substation. The locations of the short-term measurement points can be seen in **Exhibit 5-5**. Short periods of precipitation occurred during the measurement period. However, the majority of the measurements were collected in favorable weather conditions. Temperatures varied, ranging from around 60 to 80 degrees Fahrenheit. Skies were typically partly cloudy to clear. Winds also varied, with mostly calm winds. In general, strong or excessive winds did not occur during the measurements.

The continuous 1-second and 1-hour sound levels recorded by Meter 6 are provided in **Exhibit 5-5**. The sound levels measured fluctuated due to extraneous sources. Meter 6 recorded overall sound, octave bands, and various other sound metrics throughout the measurement period to establish the ambient environment surrounding the substation. The average daytime and nighttime ambient sound levels are provided below in **Table 5-16**.

Table 5-16: Average Long-Term Existing Sound Levels

Monitor Location	Total Daytime Sound Level[a]		Total Nighttime Sound Level[a]	
	L_{eq} (dBA)	L_{90} (dBA)	L_{eq} (dBA)	L_{90} (dBA)
Meter 6	40.9	40.8	33.8	33.6

(a) Daytime is 7:00 AM to 7:00 PM, nighttime is 7:00 PM to 7:00 AM

The continuous monitor recorded sound data from June 27 through 29, 2017. The data show that the area surrounding the substation would be considered a quiet area according to the MDEP criteria since the daytime sound levels are below 45 dBA and nighttime levels are below 35 dBA. Therefore, the sound level limits per the MDEP would be 45 dBA and 55 dBA at residential property lines during the night and day, respectively. The nearest residential receiver is located 900 feet northwest of the substation.

CMP provided operational data for the substation during the measurement periods. The Coopers Mills Substation had its capacitors on during each of the measurements, but the reactors were not in service. The operating conditions were incorporated into the noise model in order to estimate future sound levels with all noise emitting equipment operational. Estimated reactor sound levels were incorporated into the model based on reactor sound level data from operational measurements taken in 2013 at CMP's Albion Road Substation.

Extraneous sounds during the measurement periods included sounds associated with vehicular traffic from nearby roads, airplanes flying overhead, birds and insects. The substation was audible at multiple measurement points, and dominated the overall sound levels along the fenceline. The average measured, A-weighted L_{eq} and L_{90} sound levels measured at the substation fenceline are presented in **Table 5-17**.

Table 5-17: Average Short-Term Existing Sound Levels

Measurement Point	Daytime Measured Average		Nighttime Measured Average		Operating Conditions
	L_{eq} (dBA)	L_{90} (dBA)	L_{eq} (dBA)	L_{90} (dBA)	
MP1	43.3	41.2	45.1	43.8	Main transformer, distribution transformers and capacitors operating.
MP2	39.7	37.6	37.8	36.7	
MP3	43.4	41.9	42.5	41.5	

5.6.2 Construction Noise Levels

Sound from construction activities between 7:00 PM and 7:00 AM is limited to the nighttime sound level limit of 45 dBA at all protected locations, as applicable to normal operation at the site without a tonal penalty. Sound from daytime construction activities, between 7:00 AM and 7:00 PM, is limited to the limits provided in **Table 5-3** at any protected location.

penalty. Sound from daytime construction activities, between 7:00 AM and 7:00 PM, is limited to the limits provided in **Table 5-3** at any protected location.

Noise from construction equipment would be temporarily emitted during construction of the Coopers Mills Substation. Construction is expected to involve placement of concrete and the use of typical utility construction practices. Construction activities will be limited in the area to the extent possible. The construction contractor will take the necessary steps to address elevated construction sound levels.

5.6.3 Operational Sound Levels

CMP plans to install a +/-200 MVAR STATCOM device at the existing Coopers Mills Substation. The STATCOM will be built with similar major components as the HVDC converter arranged in a different electrical configuration to provide system reactive support instead of real power transfer capability. The line expansion at the Coopers Mills Substation will be built within the existing yard. To estimate the substation's noise impacts with the STATCOM installed, a noise model was developed for the existing noise emitting equipment and the new noise emitting equipment at the Coopers Mills Substation. Noise modeling was performed using CadnaA. The noise model includes the existing substation's transformers, reactors, capacitors, and the two new sets of STATCOM equipment (one currently permitted for construction and one as a part of NECEC).

The modeled substation sound levels at nearby protected locations are provided in **Exhibit 5-18**. The sound level limits at the nearby protected areas may be assessed the MDEP 5-dBA penalty. Sound levels from the substation will need to be mitigated to meet the applicable noise level standards at two of the adjacent residential property lines.

Table 5-18: Modeled Operational Sound Levels

Modeled Receptor	Modeled Sound Level (dBA)	Sound Level Limit[a] (dBA)
PL1 – Property Line	36.2	45
PL2 – Property Line	45.5	45
PL3 – Property Line	45.8	45

(a) Modeled sound level is the substation sound level with an expected 5-dBA tonal penalty added

In addition to the tabular data presented in the table above, noise contour maps are included in **Exhibit 5-6** that depict the expected noise levels in the area and the locations of the modeled receptors. Noise contours do not reflect a 5-dBA penalty.

5.6.4 Noise Control Measures

The STATCOM equipment sound levels provided by ABB are included in **Table 5-19** for the new STATCOM. It is assumed the sound levels provided by ABB for the new STATCOM are similar to the sound levels of the STATCOM being constructed at this time. The two STATCOMs were modeled with equipment of the same sound levels to estimate offsite impacts. Installing two new STATCOMs with the equipment sound levels in the table below may exceed the MDEP noise standards without additional mitigation, if a pure tone is measured. It is unclear at this time whether the new equipment will introduce enough tonal noise to measure a tone offsite. Additional noise control measures will be implemented as needed to achieve compliance with the MDEP noise standards.

Table 5-19: Modeled Equipment Sound Level

Equipment	Modeled Sound Level[a]
Transformers (2)	91 dBA (SWL)
Air Core Reactor – D1 (3)	74 dBA (SWL)
Air Core Reactor – CA1 (3)	64 dBA (SWL)
Capacitor Bank (3)	71 dBA (SWL)
Dry Air Cooler (5)	80 dBA (SWL)
HVAC Fans (2)	80 dBA (SWL)

(a) SWL – Sound Power Level

5.6.5 Conclusion

CMP prepared a detailed noise study to assess the potential noise impacts associated with operation of the Coopers Mills Substation after modifications are made. The study included identification of nearby protected locations, an ambient noise monitoring program to identify baseline conditions, and detailed computer noise modeling. The MDEP limits sound at protected quiet areas to 45 dBA at night, inclusive of a 5-dBA penalty added to measured sound levels when tonal sounds are present.

The ambient noise monitoring program, conducted continuously over three days and two nights, revealed that the daytime hourly average sound levels were below 45 dBA and nighttime sound levels were below 35 dBA. As such, the areas surrounding the substation are protected quiet areas. Project noise is limited to 45 dBA along the adjacent property lines. A 5-dBA penalty is applied to measured values when a tone is present, in order to remain below the MDEP limit of 45 dBA, as outlined in **Exhibit 5-5**. The noise modeling study revealed that the new equipment may require additional noise control measures to achieve compliance with the MDEP standards for the modeled operating conditions. Additional noise control measures will be implemented during detailed design as needed to achieve compliance with the MDEP

noise standards. Noise mitigation will be applied to the sources in order to meet all property line sound level limits and may include, but not be limited to, specification of quieter equipment, sound barriers, and potential acquisition of property. CMP will provide the specific sound mitigation measures required as supplemental information prior to the MDEP decision.

In summary, construction and operation of the Coopers Mills Substation STATCOM, in combination with sound generated by the existing substation, will be in compliance with the applicable MDEP noise standards.

Exhibit 5-5: Coopers Mills Substation Figures

Figure 5.5.1 – Meter 6 Monitoring Location

Figure 5.5.2 – Meter 6 Sound Level Data

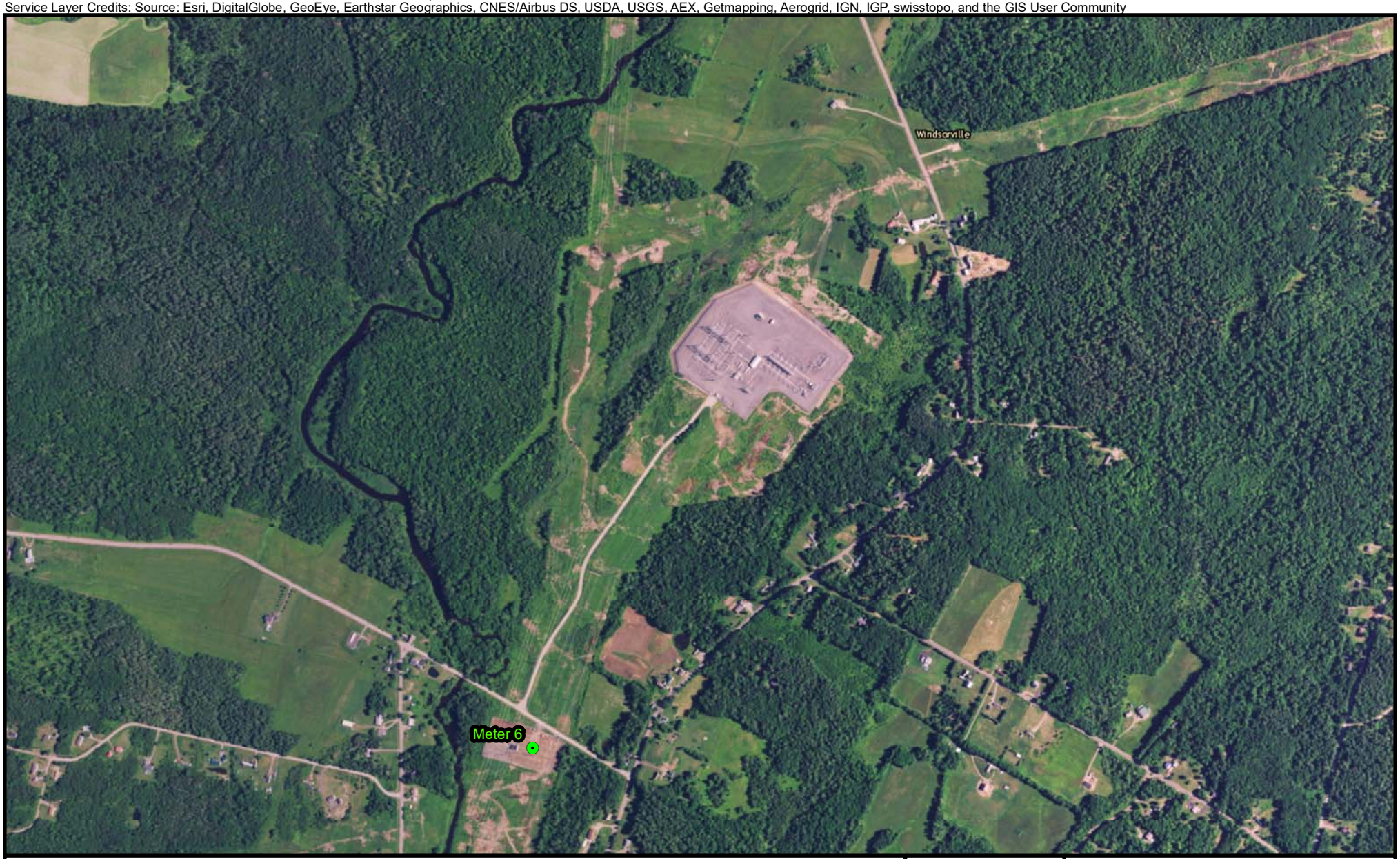
Figure 5.5.3 – Coopers Mills Substation Monitoring Locations

Figure 5.5.4 – Coopers Mills Substation Modeling Layout

Figure 5.5.5 – Coopers Mills Substation Sound Level Contours

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.7.1 - Meter 6 Monitoring Location.mxd gweger 8/24/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Meter 6

NORTH

1,000 500 0 1,000

Scale in Feet

BURNS McDONNELL

Figure 5.5.1

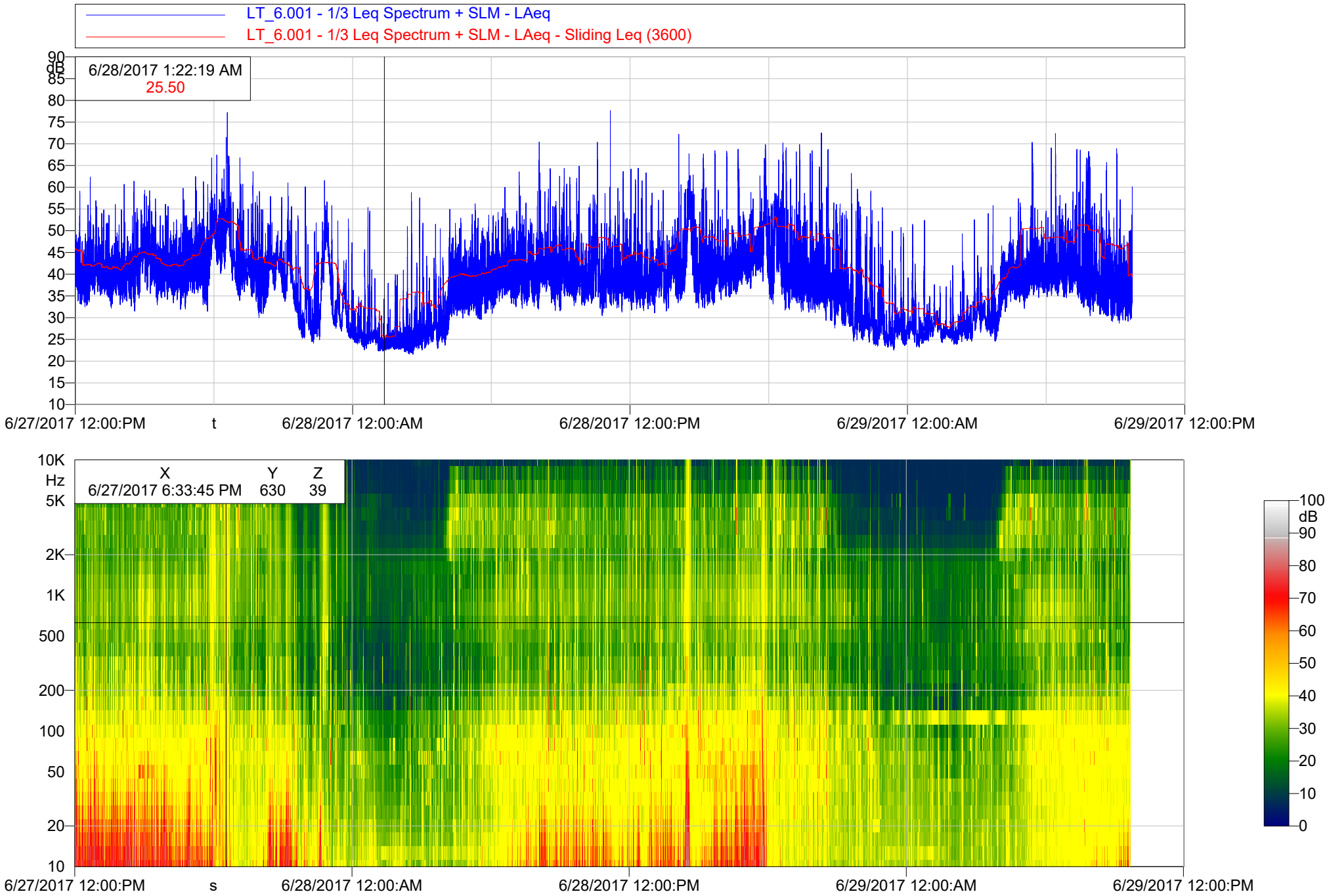
CMP NECEC
Meter 6 Monitoring Location

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 8/24/2017

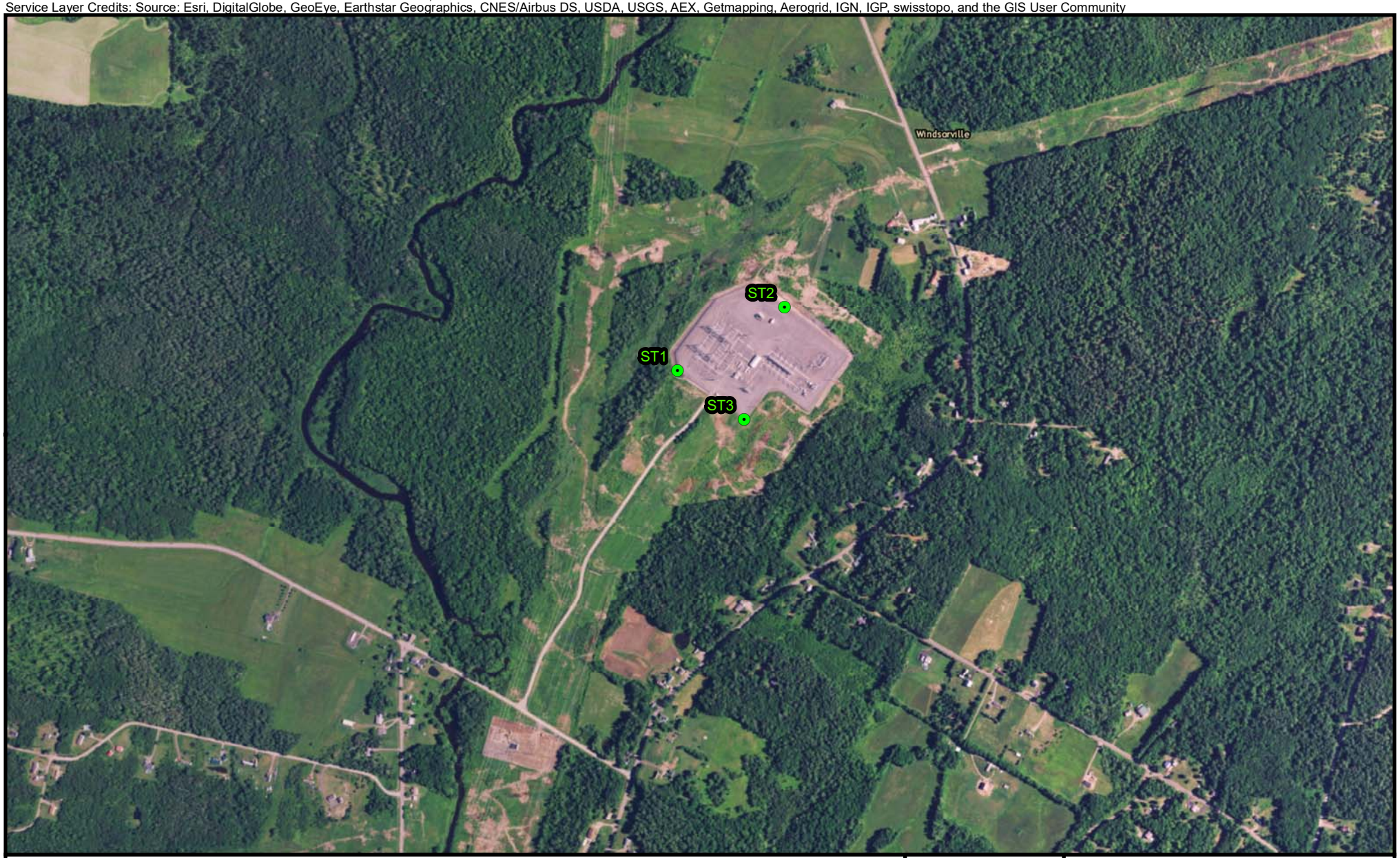
Figure 5.5.2 - Meter 6 Sound Level Data

Measurement: Central Main Power Ambient
Location: Long-Term Meter 6



Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.7.3 - Coopers Mills Road Substation Monitoring Location.mxd gweger 8/24/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Monitoring Locations

NORTH

1,000 500 0 1,000

Scale in Feet

BURNS McDONNELL

Figure 5.5.3

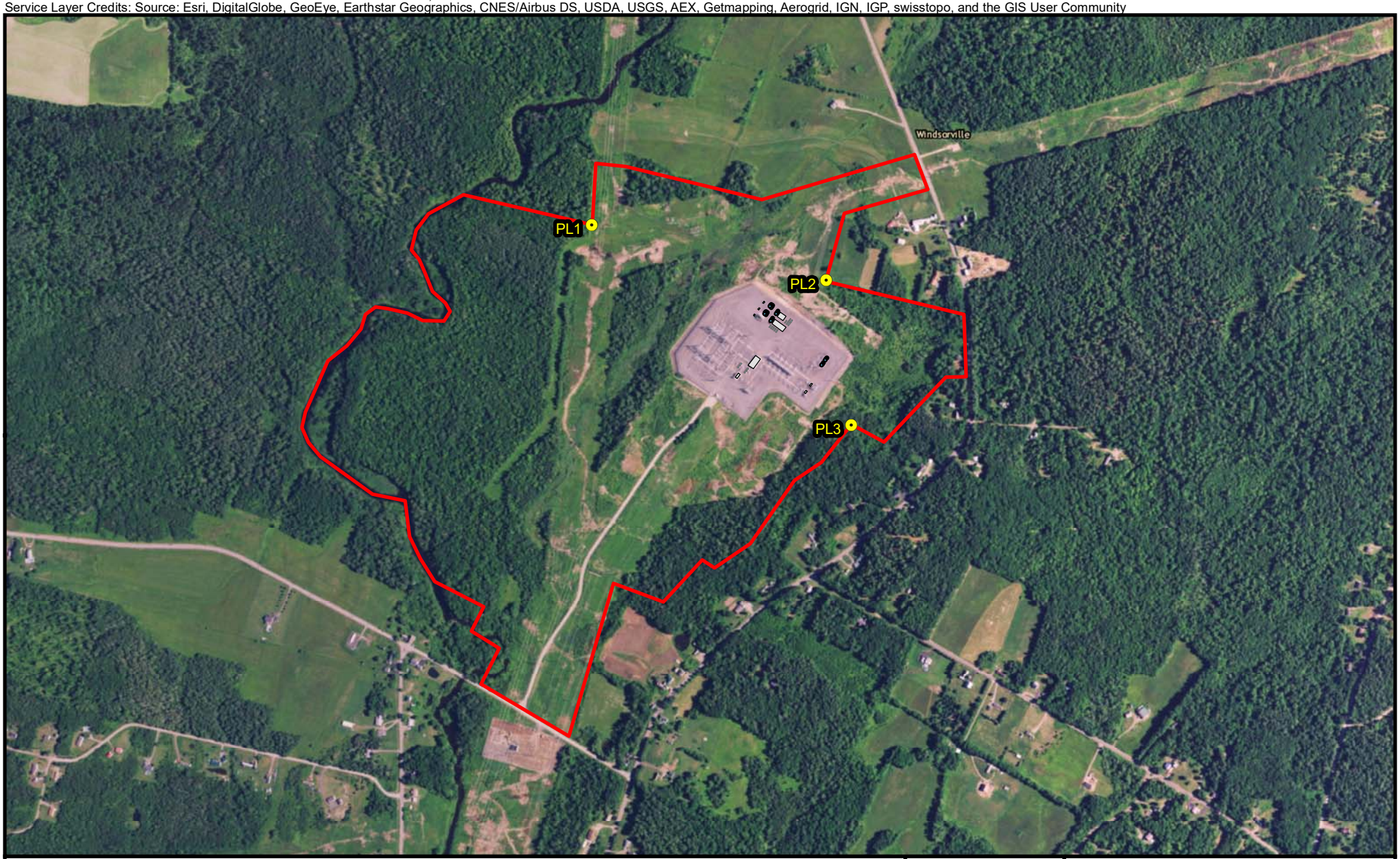
CMP NECEC
Coopers Mills Road
Substation Monitoring Locations

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 8/24/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.7.4 - Coopers Mills Road Substation Modeling Layout.mxd gweger 8/24/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



- Sound Sources
- Property Line Receptors
- Property Line
- Buildings

NORTH

1,000 500 0 1,000

Scale in Feet

BURNS McDONNELL

Figure 5.5.4

CMP NECEC
Coopers Mills Road
Substation Modeling Layout

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 8/24/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.7.5 - Coopers Mills Road Substation Sound Level Contours.mxd gweger 8/24/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

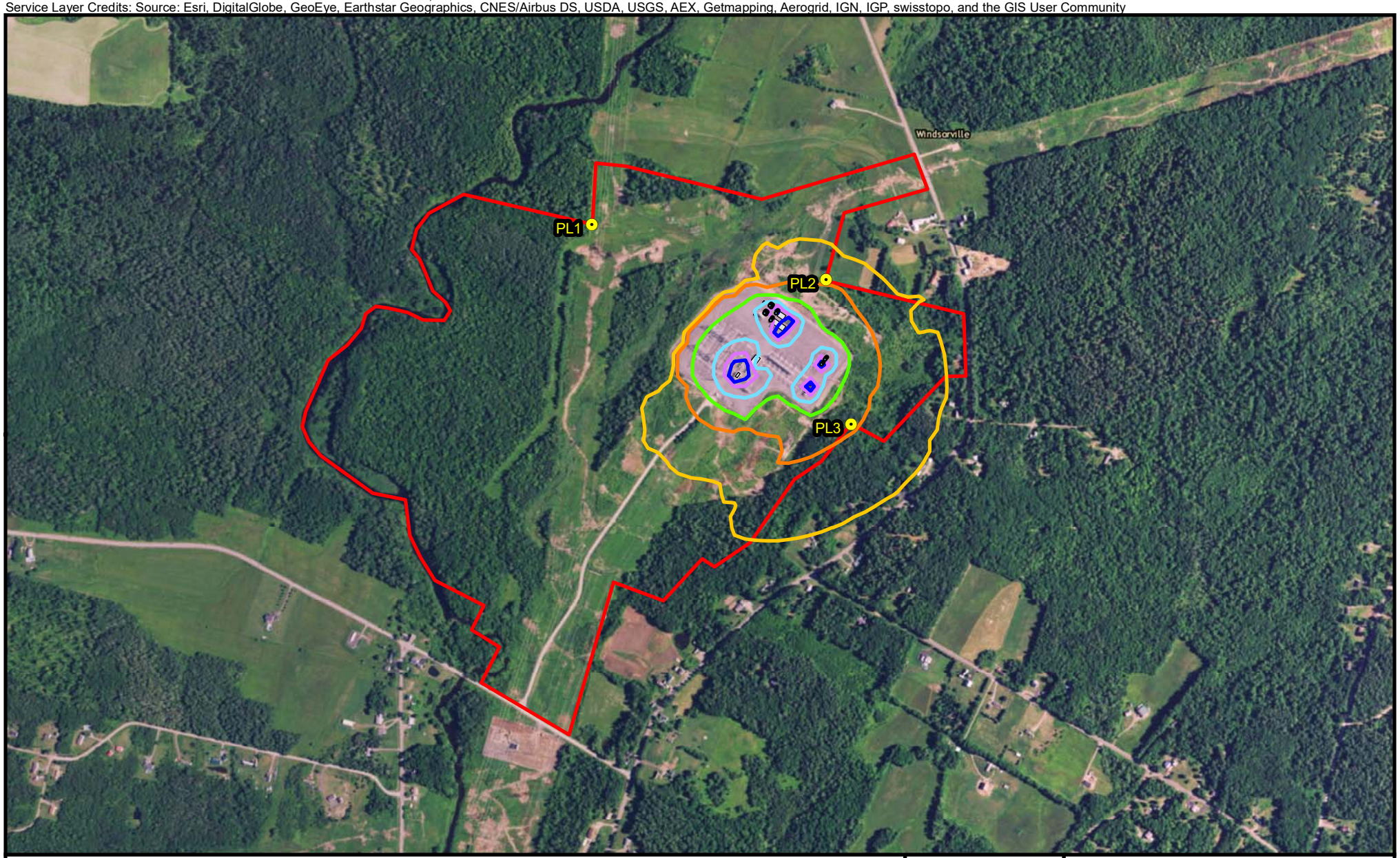


Figure 5.5.5

CMP NECEC
Coopers Mills Road
Substation Sound Level Contours

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 8/24/2017

5.7 Raven Farm Substation

CMP is proposing to expand the terminal at the existing Raven Farm Substation in Cumberland, Maine. CMP will add a 345-/115-kV, 448-MVA auto-transformer and a breaker and one half 115-kV bus at the existing Raven Farm Substation. These substation upgrades will sectionalize the existing 115-kV Section 164, 165, and terminate the existing 164A tap into the substation. Improvements will require the addition of circuit breakers, disconnect switches, instrument transformers, surge arrestors, buswork, support structures, and foundations, and modifications to the existing protection and control system.

5.7.1 Baseline Conditions

Burns & McDonnell personnel took short-term measurements multiple times from August 15 to 16, 2017, around the existing Raven Farm Substation. Each short-term measurement was 5 minutes in duration. The measurements were taken to establish ambient sound levels in the substation area, as there is currently no noise emitting equipment onsite. The locations of the short-term measurement points can be seen in **Exhibit 5-7**. The short-term measurements were taken during times when meteorological conditions were favorable for conducting sound measurements. Temperatures varied, ranging from around 65 to 80 degrees Fahrenheit. Skies were typically partly cloudy to clear. Winds also varied, with mostly light winds.

Extraneous sounds during the measurement periods included sounds associated with vehicular traffic from nearby roads, airplanes flying overhead, birds and insects. The average measured, A-weighted L_{eq} and L_{90} sound levels measured are presented in **Table 5-20**.

Table 5-20: Average Short-Term Existing Sound Levels

Monitor Location	Average Daytime Sound Level[a]		Average Nighttime Sound Level[a]	
	L_{eq} (dBA)	L_{90} (dBA)	L_{eq} (dBA)	L_{90} (dBA)
MP1	50.2	46.3	42.4	39.9
MP2	47.8	45.3	46.4	45.6
MP3	46.4	43.0	43.5	40.7
MP4	45.6	42.7	44.4	37.5
MP5	45.3	42.8	46.1	40.7

(a) Daytime is 7:00 AM to 7:00 PM, nighttime is 7:00 PM to 7:00 AM

The data show that the area surrounding the Raven Farm Substation would not be considered a quiet area according to the MDEP criteria (substation was inaudible). Therefore, the sound level limits per the MDEP would be 50 dBA and 60 dBA at residential property lines during the night and day, respectively. The MDEP code also applies a 5-dBA penalty to measured sources that emit tonal noise. It is possible

that the substation may emit tonal noise; therefore, the substation will be designed to meet 45 dBA at all adjacent residential property lines that have residential living spaces within 500 feet (i.e., measure 45 dBA, then add a 5-dBA penalty to stay below 50 dBA). If the residential living space is located outside of 500 feet from the property line, the substation would only need to meet 55 dBA (i.e., measure 55 dBA, then add 5 dBA to stay below 60 dBA), provided a tone is present. The nearest residential receiver is located 200 feet east of the substation.

5.7.2 Construction Noise Levels

Sound from construction activities between 7:00 PM and 7:00 AM is limited to the nighttime sound level limit of 50 dBA at all protected locations, as applicable to normal operation at the site without a tonal penalty. Sound from daytime construction activities, between 7:00 AM and 7:00 PM, is limited to the limits provided in **Table 5-3** at any protected location.

Noise from construction equipment will be temporarily emitted during construction of the Raven Farm Substation. Construction is expected to involve site clearing, excavation, placement of concrete and the use of typical utility construction practices. Construction activities will be limited in the area to the extent possible. The construction contractor will take the necessary steps to address elevated construction sound levels.

5.7.3 Operational Sound Levels

CMP will add a new transformer at the Raven Farm Substation rated at 448 MVA. The sound levels of the unit are expected to be similar to the existing transformers of similar size at other CMP substations (e.g., the existing Larrabee Road Substation). To estimate the substation's noise impacts at nearby locations, a noise model was developed for the new noise emitting equipment at the substation. Noise modeling was performed using CadnaA. The noise model includes the substation's transformer only as it is the only significant sound source at the substation.

The modeled substation sound levels at nearby protected locations are provided in **Table 5-21**. Review of the data reveals that sound levels from the substation would not exceed the applicable noise level standards at any of the adjacent residential property lines.

Table 5-21: Modeled Operational Sound Levels

Modeled Receptor	Modeled Sound Level (dBA)	Sound Level Requirement[a] (dBA)
PL1 – Property Line	47.5	50
PL2 – Property Line	48.1	50
PL3 – Property Line	49.0	50

(a) Modeled sound level is the substation sound level with an expected 5-dBA tonal penalty added

In addition to the tabular data presented in the table above, noise contour maps are included in **Exhibit 5-** that depict the expected noise levels in the area and the locations of the modeled receptors. Noise contours do not reflect a 5-dBA penalty. This figure shows that all of the protected locations are outside of the limiting noise contour.

5.7.4 Noise Control Measures

Installing a new transformer capable of meeting the sound levels provided in **Table 5-22** would be in compliance with the MDEP noise standards for construction or operation of the Raven Farm Substation under the modeled operating conditions. No additional noise control measures will be required in order to achieve compliance with the MDEP noise standards.

Table 5-22: Modeled Equipment Sound Level

Equipment	Modeled Sound Level
New Transformer (1)	82 dBA (SPL)[a] at 3 feet

(a) SPL – Sound Pressure Level, averaged along acoustical envelope

5.7.5 Conclusion

Burns & McDonnell prepared a detailed noise study on behalf of CMP to assess the potential noise impacts associated with operation of the Raven Farm Substation after modifications are made. The study included identification of nearby protected locations, an ambient noise monitoring program to identify baseline conditions, detailed computer noise modeling, identification of required noise mitigation measures, and compliance with MDEP noise standards. The MDEP limits sound at protected areas to 55 dBA at night, and requires a 5-dBA penalty be applied to measured tonal sounds.

The ambient noise monitoring program, conducted continuously over three days and two nights, revealed that the daytime hourly average sound levels (the existing substation was not audible) were greater than 45 dBA and nighttime sound levels were greater than 35 dBA. As such, the areas surrounding the substation are protected areas, but are not defined as quiet areas under MDEP's noise standard. Ambient

noise in the area is dominated by the nearby Interstate 295 which is located approximately 2,000 feet from the center of the substation. Project modeled noise is limited to 45 dBA along the adjacent property lines, in order to remain below the MDEP limit of 50 dBA limit when a tone is present, as outlined in **Exhibit 5-6**. The noise modeling study revealed that the new equipment would require no additional noise control measures to achieve compliance with the MDEP standards for the modeled operating conditions. The current substation operations are below the State sound level requirements.

In summary, construction and operation of the Raven Farm Substation will comply with the applicable MDEP noise standards.

Exhibit 5-6: Raven Farm Substation Figures

Figure 5.6.1 – Raven Farm Substation Monitoring Locations

Figure 5.6.2 – Raven Farm Substation Modeling Layout

Figure 5.6.3 – Raven Farm Substation Sound Level Contours

Raven Farm Measurement Points

NORTH

500 250 0 500

Scale in Feet

BURNS McDONNELL

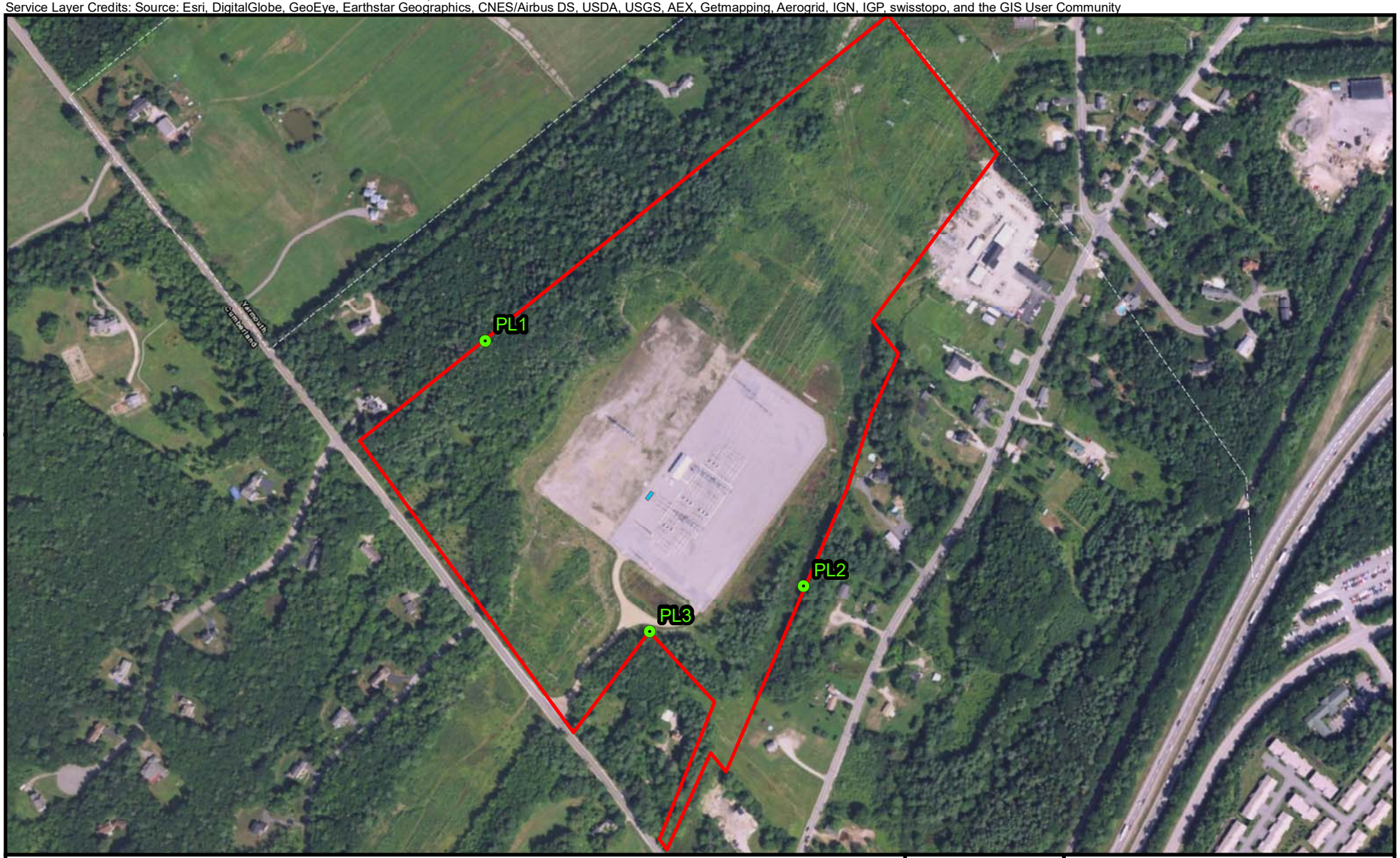
Figure 5.6.1

CMP NECEC
Raven Farm Substation
Monitoring Locations

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 8/24/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.6.2 - Raven Farm Substation Modeling Layout.mxd gweger 9/7/2017



Raven Farm Measurement Points
Sound Source
Property Line

NORTH

500 250 0 500
Scale in Feet

BURNS McDONNELL

Figure 5.6.2

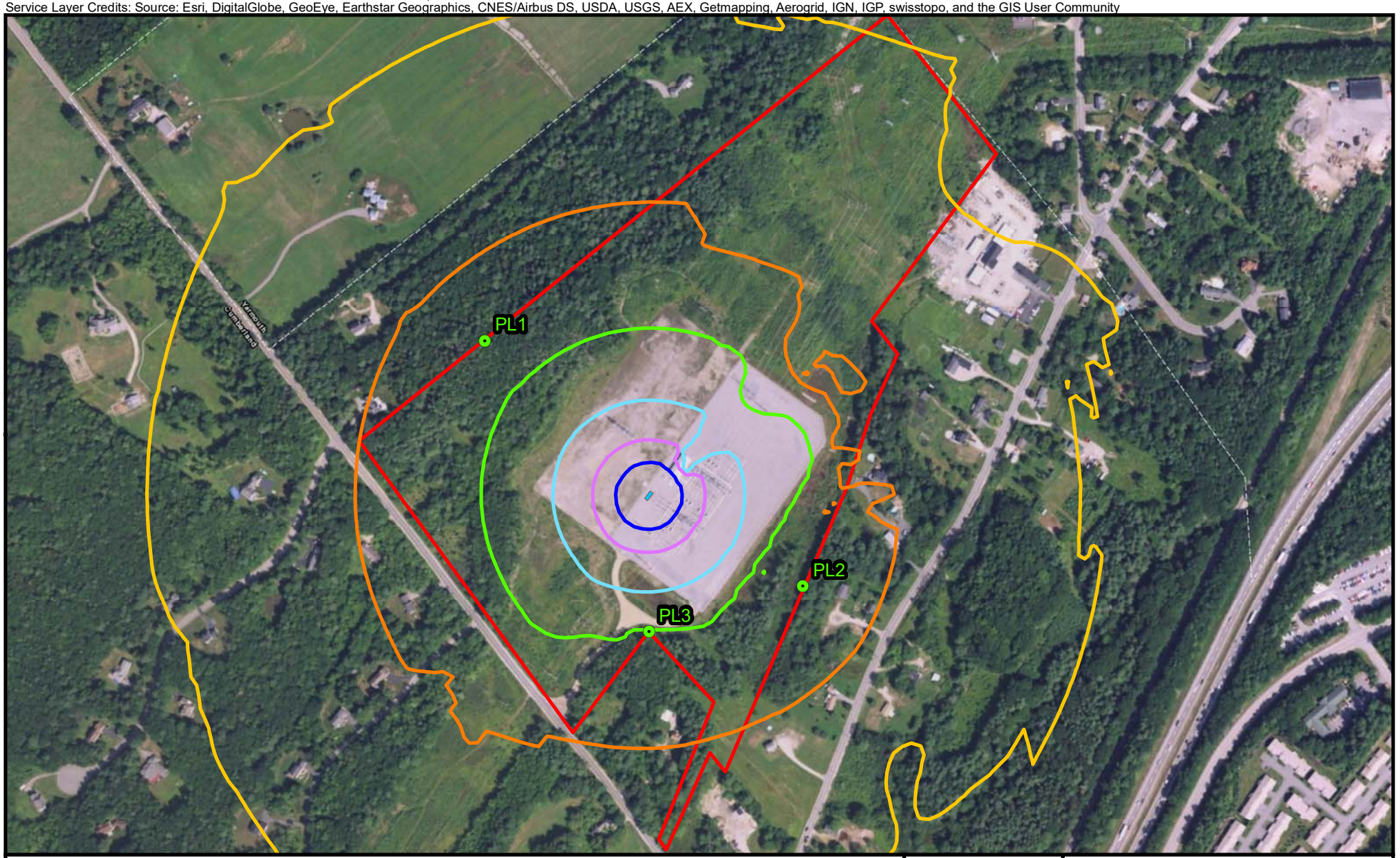
CMP NECEC
Raven Farm Substation
Modeling Layout

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/7/2017

Path: Z:\Clients\ENS\CMP\99382_QMIPermitSOW\Studies\Permitting\Modeling\Noise\GIS\Figure 5.6.3 - Raven Farm Substation Sound Level Contours.mxd gweger 9/7/2017

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



35 dBA
40 dBA
45 dBA
50 dBA
55 dBA
60 dBA
Property Line

NORTH

500 250 0 500

Scale in Feet

BURNS McDONNELL

Figure 5.6.3

CMP NECEC
Raven Farm Substation
Sound Level Contours

Source: Burns & McDonnell Engineering Company, Inc.

Issued: 9/7/2017