TRELINA SOLAR ENERGY CENTER

Case No. 19-F-0366

1001.19 Exhibit 19

Noise and Vibration

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Exhibit 19: Noise and Vibration

This Exhibit will track the requirements of proposed Stipulation 19, dated June 19, 2020 and therefore, the requirements of 16 NYCRR § 1001.19.

This Exhibit includes a detailed analysis of the potential sound impacts associated with the construction and operation of the Project. Exhibit 19 was prepared by Ryan Callahan, INCE of Epsilon Associates, Inc. (Epsilon). Mr. Callahan has over 14 years of experience in the areas of community noise impacts, sound modeling, monitoring, and analyses. He is a full member of the Institute of Noise Control Engineering (INCE). The modeling performed by Epsilon for the Facility is sufficiently conservative in predicting sound impacts and includes all proposed inverters and the substation operating simultaneously at their maximum capacities.

The Project has been designed so that no sensitive non-participating receptors, as defined below, will exceed 45 dBA Leq_{1hr}, and no sensitive participating receptors will exceed 50 dBA Leq_{1hr}. In addition, sound levels from the collector substation will not exceed 35 dBA at a non-participating receptor assuming it is tonal in nature. These proposed design goals, based upon the limits adopted by the Siting Board in previous certificates, minimize any adverse impacts associated with the sound produced by the construction and operation of the Project to the maximum extent practicable.

19(a) Sensitive Sound Receptor Map

As explained later in this Exhibit the Town of Waterloo was consulted to obtain any applicable numerical noise limits that would pertain to the Project. None were provided and the Applicant could not find any. A map of the Noise Impact Study Area showing the location of sensitive sound receptors and participating receptors within one mile of the Facility components which generate noise (i.e., inverters, substation, etc.) is provided in Appendix 19-1 (Figure 1-1). The distance of one mile is further than the requirements in the Stipulations (1,500 feet or extent of the 30 dBA sound contour line). Sensitive sound receptors include residences (participating, non-participating, full-time, and seasonal[1]), outdoor public facilities and areas, schools, hospitals, care centers, libraries, places of worship, cemeteries, public parks and public campgrounds, summer camps, and any historic resources listed or eligible for listing on the State or National Register of Historic Places, and Federal and New York State lands.

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[1] Seasonal residences include cabins and hunting camps (identified by property tax codes) and any other seasonal residences with septic systems/running water.

In total, 1,188 discrete receptors were analyzed for the Project. These include 1,147 year-round residences, eight seasonal residences, and 33 unknown structures. All “unknown” structures were conservatively assumed to be residences. Of the 1,188 receptors, seven were participating, and 1,181 were non-participating. Of the 1,147 year-round residences, six were participating and 1,141 were non-participating. Of the 8 seasonal residences, one was participating and seven were non-participating. Of the 33 unknown structures, none were participating and 33 were non-participating.

A desktop analysis using aerial imagery and tax classification codes from the New York Office of Real Property database were used to develop and classify sensitive sound receptors within one mile of proposed inverter and substation sites. Field verification was completed to verify the findings of the desktop analysis. If access for field verification was not possible, and aerial imagery could not provide an obvious classification of a structure (i.e. residential vs. non-residential), then the structure was classified as “unknown” and considered a sensitive sound receptor. The receptor ID, tax code, participation status, type of receptor, receptor location coordinates, ground elevations, and heights above ground are summarized in Appendix 19-1.

19(b) Evaluation of Ambient Pre-Construction Baseline Noise Conditions at Receptors

An evaluation of ambient pre-construction baseline noise conditions, including A-weighted/dBA sound levels and prominent discrete (pure) tones, was conducted at representative potentially impacted noise receptors using actual measurement data. The measurements were made in both winter and summer, and during day and night as a function of time and frequency using a suitable and suitably calibrated sound level meter (SLM), and octave band frequency spectrum analyzer. The ambient pre-construction baseline sound levels were filtered to exclude seasonal and intermittent noise.

Both A-weighted and one-third octave band sound level data were collected day and night at five locations in the study area. The winter “leaf-off” measurements were conducted from January 21-29, 2020 and the summer “leaf-on” measurements were conducted from September 10-18, 2019. The ambient pre-construction baseline sound levels were filtered to exclude seasonal and intermittent noise by using a high-frequency natural sound (HFNS) filter and the L90 metric respectively. The full details of the ambient pre-construction sound level measurement program are found in Appendix 19-2.

19(c) Evaluation of Future Noise Levels during Construction

Construction noise modeling was performed for the major phases of construction using the ISO 9613-2 sound propagation standard as implemented in the Cadna/A software package (see Section 19.d for more discussion of the sound propagation standard). Reference sound source information was obtained from either the applicant or the FHWA's Roadway Construction Noise Model (RCNM). Modeling and analysis procedures generally followed the guidelines and recommendations of the FHWA Highway Construction Noise Handbook (FHWA-HEP-06-015, U.S. DOT, August 2006).

The majority of the construction activity will occur around each of the inverter sites, at the site of the collector substation, at each of the solar arrays, and at the locations where horizontal directional drilling (HDD) will occur. By its very nature, construction activity moves around the site. Full construction activity will generally occur at one portion of the site at a time, although there will be some overlap at adjacent site areas for maximum efficiency. For modeling conservatism, it was assumed that full activity was occurring at the closest locations to their surrounding receptors. There are generally five phases of construction for a solar energy project – site preparation and grading, trenching and road construction, HDD, equipment installation, and commissioning. Table 19-1 presents the equipment sound levels for the louder pieces of construction equipment expected to be used at this site along with their phase of construction.

Construction is expected to last approximately 7-10 months and is expected to occur during the April to November period. Construction is anticipated to occur up to 12 hours per day, six days per week for much of the project. This equates to 7:00 AM to 7:00 PM Monday through Saturday. No construction activity is expected on Sundays and national holidays. Nighttime work is not expected. No blasting is planned for this project, as is spelled out in the Blasting Plan, which can be found in Appendix 21-3 of Exhibit 21, as a part of this Application.

Two areas within the Project Area were chosen to calculate worst case construction sound levels. The areas and assumed sites of simultaneous construction are:

- Area 1 – This area includes the closest receptors to a solar array panel. Modeling assumed simultaneous construction activity at this solar array panel. Site Preparation and Grading work, Trenching and Road Construction work, Equipment Installation work, and Commissioning work was modeled at this site.

- Area 2 – This area includes all receptors in the vicinity of the closest HDD entry point to a receptor. Modeling assumed simultaneous construction activity at this HDD entry point. HDD work and Commissioning work was modeled at this HDD entry point.

For both areas, cumulative construction sound levels at the ten closest receptors have been calculated. These receptors included both non-participants and participants. The results are shown as maximum 1-second Leq sound levels with all pieces of equipment for each phase operating at the sites. These results overstate expected real-world results, since under actual construction conditions, not all pieces of equipment will be operating at the same exact time, and the highest sound levels from every piece of equipment will not tend to occur at the same time as was assumed in the modeling. At other areas of construction (i.e. substation, inverter pads), sound levels due to construction would be lower, as those locations are further from receptors than the two areas that were analyzed. Figure 19-3.1 in Appendix 19-3 shows the two representative areas of construction activity.

Table 19-1. Sound Levels for Noise Sources Included in Construction Modeling

Phase	Equipment	Sound Level at 50 feet [dBA]
Site Preparation & Grading	Grader (174 hp)	85
Site Preparation & Grading	Rubber Tired Loader (164 hp)	85
Site Preparation & Grading	Scraper (313 hp)	89
Site Preparation & Grading	Water Truck (189 hp)	80
Site Preparation & Grading	Generator Set	81
Trenching & Road Construction	(2) Excavator (168 hp)	85
Trenching & Road Construction	Bar Trencher (600 hp)	89
Trenching & Road Construction	Grader (174 hp)	85
Trenching & Road Construction	Water Truck (189 hp)	80
Trenching & Road Construction	Trencher (63 hp)	83
Trenching & Road Construction	Rubber Tired Loader (164 hp)	85
Trenching & Road Construction	Generator Set	81
Equipment Installation	Crane (399 hp)	83
Equipment Installation	Crane (165 hp)	83

Phase	Equipment	Sound Level at 50 feet [dBA]
Equipment Installation	(2) Forklift (145 hp)	85
Equipment Installation	(2) Pile Driver	84
Equipment Installation	(6) Pickup Truck/ATV	55
Equipment Installation	(2) Water Truck (189 hp)	80
Equipment Installation	(2) Generator Set	81
HDD Entry	Excavator (168 hp)	85
HDD Entry	Auger Drill Rig	85
HDD Entry	Pickup Truck/ATV	55
Commissioning	(2) Pickup Truck/ATV	55

Area 1 Modeling Results

The cumulative impacts from Site Preparation and Grading work, Trenching and Road Construction work, Equipment Installation work, and Commissioning work was calculated with the Cadna model for the ten closest receptors to construction activity within Area 1. The loudest phase of construction within this area will be Trenching and Road Construction work. A sound contour figure of Trenching and Road Construction work occurring at the solar array is presented in Figure 19-3.1.

The highest sound level at a non-participating receptor within this area is 54 dBA during site preparation and grading (Receptor #12401), 56 dBA during trenching and road construction (Receptor #12401), 55 dBA during equipment installation (Receptor #12401), and 20 dBA during commissioning (Receptor #12401). The existing condition L_{eq} sound levels measured for this area are 51-53 dBA using the ANS-weighted broadband sound level data. Modeling results of construction sound levels within this area are summarized in Table 19-2.

Table 19-2 Construction Noise Modeling Results – Area 1 Construction [dBA]

Receptor ID	Distance [m]	Participation Status	Site Preparation & Grading	Trenching & Road Construction	Equipment Installation	Commissioning	Assigned Measurement ID[1]	Daytime Ambient Leq[2]
13609	74	P	72	74	72	38	2	53
11609	492	P	55	57	56	21	4	51
12401	555	NP	54	56	55	20	4	51
12402	612	NP	53	55	54	19	1	51
13217	655	NP	52	54	53	18	2	53
11206	657	NP	52	54	53	18	4	51
11608	663	NP	52	53	52	17	4	51
13601	670	NP	53	55	54	19	1	51
12802	671	NP	53	55	54	19	1	51
11607	672	NP	51	53	52	17	4	51

P = Participating
NP = Non-Participating
[1] = See Table 19-8.1
[2] = ANS-weighted values from Table 19-8.2

Area 2 Modeling Results

The cumulative impacts from Horizontal Directional Drilling (HDD) work and Commissioning work was calculated with the Cadna model for the ten closest receptors to construction activity within Area 2. The loudest phase of construction within this area will be HDD work. A sound contour figure of HDD work occurring at the HDD entry point is presented in Figure 19-3.1 of Appendix 19-3.

The highest sound level at a non-participating receptor within this area is 64 dBA during HDD (Receptor #13607) and 34 dBA during commissioning (Receptor #13607). The existing condition L_{eq} sound levels measured for this area are 51-53 dBA using the ANS-weighted broadband sound level data. Modeling results of construction sound levels within this area are summarized in Table 19-3, and a sound contour figure of results is shown in Appendix 19-3.

Table 19-3 Construction Noise Modeling Results – Area 2 Construction [dBA]

Receptor ID	Distance [m]	Participation Status	HDD	Commissioning	Assigned Measurement ID1	Daytime Ambient Leq2
13607	103	NP	64	34	2	53
13606	176	NP	59	29	2	53
13217	248	NP	57	27	2	53
13605	263	NP	56	26	2	53
13603	337	NP	54	24	1	51
13608	350	P	54	24	2	53
13218	377	NP	53	23	2	53
13602	383	NP	53	23	1	51
13610	431	NP	52	22	2	53
13612	434	P	52	22	2	53

P = Participating
NP = Non-Participating
[1] = See Table 19-8.1
[2] = ANS-weighted values from Table 19-8.2

Construction Noise Conclusions

Noise due to construction is an unavoidable outcome of construction. The five major construction phases are: site preparation and grading, trenching and road construction, HDD, equipment installation, and commissioning. Most of the construction will occur at significant distances to sensitive receptors, and therefore noise from most phases of construction is not expected to result in impacts. There are a few instances where construction will be fairly close to residences (#13606, #13607 & #13609) and coordination with these neighbors may be warranted. Predicted construction sound levels are expected to be quite typical of other major construction sites. The Noise Complaint Resolution Plan provided as Appendix 12-3 of Exhibit 12, contains the procedures to be followed in the event of a noise complaint during construction. Construction noise will be minimized through the use of best management practices (BMP).

19(d) Future Sound Levels from the Project

An estimate of the noise level to be produced by the facility, related facilities, and ancillary equipment was made using the following assumptions.

1) Future sound levels associated with the Project were predicted using the Cadna/A noise calculation software developed by DataKustik GmbH. This software implements the ISO 9613-2 international standard for sound propagation (Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation) for full octave bands from 31.5 Hertz (Hz) to 8000 Hz. As per ISO 9613-2, all calculations assumed favorable conditions for sound propagation, corresponding to a moderate, well-developed ground-based temperature inversion, as might occur on a calm, clear night or equivalently downwind propagation. In addition, the ISO 9613-2 standard assumes all receptors are downwind of every sound source simultaneously.

   Elevation contours for the modeling domain were directly imported into Cadna/A which allowed for consideration of terrain shielding where appropriate. The terrain height contour elevations for the modeling domain were generated from elevation information derived from the National Elevation Dataset (NED) developed by the U.S. Geological Survey.

   In addition to modeling at discrete points, sound levels were also modeled throughout a large grid of receptor points, each spaced 10 meters apart to allow for the generation of sound level isolines. Tabular results and sound level isolines were calculated and generated for the entire Project area.

   i. All sound sources were assumed to be operating simultaneously at maximum sound power levels during the daytime and nighttime to produce a 1-hour L_{eq}. Noise sources that will not produce sounds during the nighttime were turned-off for nighttime computer noise modeling. As described in detail in Appendix 19-4, the inverters will be able to operate during some "nighttime" hours in the summer since sunrise is before 7 AM. Therefore, to be conservative, daytime and nighttime modeling impacts can be the same. Thus, there is only one model scenario with all sound sources operating simultaneously (the inverters plus the collector substation) in this application.

ii. The collector substation was also modeled by itself operating at maximum sound power level.

iii. For all modeling scenarios, the ground absorption factor (G) was set to 0.5 for the ground and 0 for water bodies, with no meteorological correction (Cmet) in the ISO 9613-2 standard.

iv. Ground absorption values used in the modeling are discussed in Section 19.d.1.iii above. The sound power levels used in the modeling are discussed below.

Inverters

The sound level analysis includes 52 inverters as provided to Epsilon by the Applicant in Layout 20200528. The source location coordinates, ground elevations, and heights above ground are summarized in Appendix 19-5. There is one inverter manufacturer (ABB) evaluated for this analysis. All 52 of the proposed inverters will be ABB Inverters with identical specifications. The project plans to install 26 equipment pads, with two inverters located on each pad. The inverter manufacturer, power ratings, and dimensions examined for this assessment are presented below in Table 19-4.

Table 19-4 Power Inverter Analyzed for Sound Level Assessment

Manufacturer	Inverter Model	Maximum Electrical Output [kVA]	Dimensions [WxHxD] [m]
ABB	PVS980-CS-US	2,200	2.9 x 2.7 x 10.4

Broadband and one-third octave band sound power levels for the ABB Inverter operating under typical (daylight) conditions were provided by the Applicant[2]. The octave band sound power levels are presented in Table 19-5.

2 ABB Inverter PVS-980 sound power levels provided via email, April 7, 2020.

Table 19-5 Inverter Octave Band Sound Power Levels

Inverter Type	Broadband Sound Power Level [dBA]	Sound Power Levels per Octave-Band Center Frequency [Hz]									
		16	31.5	63	125	250	500	1k	2k	4k	8k
		dB	dB	dB	dB	dB	dB	dB	dB	dB	dB
ABB PVS-980	100	91[3]	91	90	85	84	100	92	93	90	83

<u>Collector Substation</u>

In addition to the inverters, there will be a collector substation located within the Project area. The modeling inputs of the transformer, including coordinates, ground elevation, and height above ground, are summarized in Appendix 19-5. One step-up transformer rated at 90 MVA with a NEMA sound rating of 75 dB is proposed for the substation. Epsilon estimated the broadband sound power level and octave band sound level emissions using the techniques in the Electric Power Plant Environmental Noise Guide (Edison Electric Institute), Table 4.5 Sound Power Levels of Transformers. Table 19-6 summarizes the sound power level data used in the modeling.

Table 19-6 Collector Substation Transformer Sound Power Levels

Maximum Rating [MVA]	Broadband Sound Power Level [dBA]	Sound Power Levels per Octave-Band Center Frequency [Hz]								
		31.5	63	125	250	500	1k	2k	4k	8k
		dB	dB	dB	dB	dB	dB	dB	dB	dB
90	94	91	97	99	94	94	88	83	78	71

v. The ISO 9613-2 standard, clause 9, contains an "Accuracy and limitations of the method" discussion. This standard provides estimated accuracy for broadband sound levels as a function of source height and distance from the source. For example, at a distance of 0 to 100 meters from the source, sound sources between 0 and 5 meters tall have an accuracy of +/- 3 dBA while sound sources between 5 and 30 meters tall have an accuracy of +/- 1 dBA. Clause 9 in ISO 9613-2 notes that at a distance of 100 to 1000 meters from the source, sound sources between 0 and

[3] 16 Hz sound power level assumed identical to 31.5 Hz level. Sound power level data for the inverter was only available down to 25 Hz.

30 meters tall have an accuracy of +/- 3 dBA. No accuracy estimates are provided in the standard at distances beyond 1000 meters or for octave band sound levels. The meteorological conditions applicable to this standard hold under moderate downwind propagation.

vi. Some of the uncorrected modeling results (where mitigation is not applied) are above the design goals. Therefore, both corrected (where mitigation is applied) and uncorrected model results are presented (see Section 19.e). Table 19-7 lists all inverters and shows the uncorrected sound power level, corrected sound power level, and the corresponding mitigation level assumed for each inverter in the corrected modeling. This mitigation can be achieved either through selection of a quieter inverter, installation of sound barriers, or enclosures around the identified inverters. There are two inverters per equipment pad, therefore when an equipment pad required mitigation it was assumed that both inverters (designated by "A" and "B") would receive the same level of attenuation. Mitigation levels to achieve the design goals ranged from 2 to 16 dBA.

Table 19-7 Corrected Inverter Sound Power and Required Mitigation Levels

Inverter ID	Uncorrected Broadband Sound Power Level [dBA]	Corrected Broadband Sound Power Level [dBA]	Mitigation Level [dBA]
1 (A&B)	100	93	7
2 (A&B)	100	92	8
3 (A&B)	100	94	6
4(A&B)	100	94	6
5 (A&B)	100	94	6
6 (A&B)	100	96	4
7 (A&B)	100	88	12
8 (A&B)	100	95	5
9 (A&B)	100	90	10
10 (A&B)	100	96	4
11 (A&B)	100	88	12
12 (A&B)	100	92	8

Inverter ID	Uncorrected Broadband Sound Power Level [dBA]	Corrected Broadband Sound Power Level [dBA]	Mitigation Level [dBA]
13 (A&B)	100	98	2
14 (A&B)	100	90	10
15 (A&B)	100	92	8
16 (A&B)	100	94	6
17 (A&B)	100	88	12
18 (A&B)	100	92	8
19 (A&B)	100	92	8
20 (A&B)	100	94	6
21 (A&B)	100	94	6
22 (A&B)	100	96	4
23 (A&B)	100	93	7
24 (A&B)	100	92	8
25 (A&B)	100	94	6
26 (A&B)	100	84	16

2) No attenuation of sound was assumed due to transient occurrences of weather or temperature. A temperature of 10 degrees Celsius and 70% relative humidity was used to calculate atmospheric absorption for the ISO 9613-2 model. These parameters were selected to minimize atmospheric attenuation in the 500 Hz and 1000 Hz octave bands where the human ear is most sensitive, and thus provide conservative results.

3) Cumulative short-term sound level modeling was conducted using the Cadna/A noise calculation software. For this modeling scenario, cumulative impacts for existing projects and projects that are under construction, permitted or have a stipulation submitted, were taken into consideration. There was one nearby project which was taken into consideration while determining cumulative impacts of the proposed Project. The nearby project is Zotos Wind.

   The Zotos Wind project is an existing project, located approximately 1/2 mile southwest of the proposed Trelina Solar project. Data for the Zotos Wind project was obtained through publicly available information. This information included location, manufacturer and sound levels of the wind turbines. The project consists of two Hyundai HQ 1650/77 wind turbines. These wind turbines are owned and operated by Zotos Manufacturing in Ontario, NY.

All modeling inputs and assumptions discussed earlier were carried out with respect to this cumulative analysis. These inputs and assumptions were implemented in the Cadna/A software for this modeling scenario to ensure conservative results (i.e., higher sound levels).

Sound pressure levels due to the operation of all 52 inverters and the collector substation transformer for the Project, along with the two wind turbines at the Zotos site were modeled at 1,188 receptors within and surrounding the Project area. The sound levels calculated are 1-hour L_{eq} sound levels. In addition to modeling at discrete points, sound levels were also modeled throughout a large grid of receptor points, each spaced 10 meters apart to allow for the generation of sound level isolines.

19(e) Evaluation of Future Noise Levels during Operation of the Project

(1) Modeled A-weighted/dBA sound levels at all sensitive receptors.

All sources running--inverters plus the collector substation

Future 1-hour L_{eq} sound levels during worst-case operation of the Project's inverters plus the collector substation have been calculated using the methodology described above in Section 19(d). Appendix 19-6 provides the predicted A-weighted (dBA) and full octave band frequency (31.5 Hz to 8,000 Hz) sound pressure levels at all sensitive receptors. The results are sorted by receptor ID uncorrected (Table 19-6.1a), sorted by A-weighted sound level high to low uncorrected (Table 19-6.1b), sorted by receptor ID corrected (Table 19-6.2a), and sorted by A-weighted sound level high to low corrected (Table 19-6.2b).

Collector substation only

Future 1-hour L_{eq} sound levels during worst-case operation of the Project's collector substation have been calculated using the methodology described above in Section 19(d). Appendix 19-6 provides the predicted A-weighted (dBA) and full octave band frequency (31.5 Hz to 8,000 Hz) sound pressure levels at all sensitive receptors. The results are sorted by receptor ID (Table 19-6.3a) and sorted by A-weighted sound level high to low (Table 19-6.3b). No corrections due to mitigation have been assumed in the substation modeling.

Cumulative analysis -- all project sources operating plus nearby facility

Future 1-hour L_{eq} sound levels during worst-case operation of the Project's inverters (corrected) plus the collector substation plus the nearby Zotos Wind facility have been calculated using the methodology described above in Section 19(d). Appendix 19-7 provides the predicted A-weighted (dBA) sound pressure levels showing individual contributions from the proposed Trelina Project (corrected), the Zotos Wind facility, and the cumulative sound level of both projects at all sensitive receptors. The results are sorted by receptor ID (Table 19-7.1a), sorted by A-weighted sound level high to low (Table 19-7.1b).

(2) Tonal Evaluation

ANSI S12.9 Part 3, Annex B, section B.1 (informative) presents a procedure for testing for the presence of a prominent discrete tone. According to the standard, a prominent discrete tone is identified as present if the time-average sound pressure level in the one-third octave band of interest exceed the arithmetic average of the time-average sound pressure level for the two adjacent one-third bands by any of the following constant level differences: 15 dB in low-frequency one-third-octave bands (from 25 up to 125 Hz); 8 dB in middle-frequency one-third-octave bands (from 160 up to 400 Hz); or, 5 dB in high-frequency one-third-octave bands (from 500 up to 10,000 Hz). A source of sound with a tone may be more annoying at the same A-weighted sound level than a source without a tone. Typically, the tone must be loud enough so that it is prominent, and thus annoying. The State of Illinois Pollution Control Board noise regulations recognize this fact by noting that their prominent discrete tone rule does not apply if the one-third octave band levels are 10 dB or more below the octave band limits in the IPCB regulations.

Sound pressure level calculations using the Cadna/A modeling software which incorporates the ISO 9613-2 standard is limited to octave band sound levels; therefore, a quantitative evaluation of one-third octave band sound levels using the modeling software was not possible. Instead, one-third octave band sound pressure levels due to the closest inverters were calculated at the nearest five potentially impacted and representative receptor locations (both non-participants and participants) using equations accounting for hemispherical radiation and atmospheric absorption. The results presented in Table 19-8 shows that received sound pressure levels due to the closest inverters at each of these locations are predicted to result in prominent discrete tones in the 500 Hz, 1,000 Hz, 4000 Hz, and 8,000

Hz one-third octave bands. Due to these tones, the mitigation levels for each inverter have been designed so that short term broadband sound pressure levels at any non-participating receptor do not exceed 40 dBA, or 45 dBA at any participating receptor.

One-third octave band sound power levels for the substation transformer were not supplied by the vendor for the substation equipment; therefore, a quantitative evaluation of one-third octave band sound using the spreadsheet modeling approach was not possible. In general, substation transformers have the potential to create a prominent discrete tone at nearby receptors, specifically during the ONAN (fans off) condition. For this Project the substation is modeled to be less than 30 dBA at all non-participating sensitive receptors[4]. Therefore, prominent discrete tones from the substation are not a concern with this Project.

(3) Amplitude Modulation

Amplitude modulation is not an issue with solar projects and therefore an analysis was not included in the Application.

(4) An Evaluation of the Potential for Low Frequency and Infrasound

"Infrasound" is sound pressure fluctuations at frequencies below about 20 Hz. Sound below this frequency is only perceptible at relatively high magnitudes. "Low frequency sound" is in the nominal audible range of human hearing, that is, above 20 Hz, but below 200 Hz.

i) Low frequency sound levels for the full octave bands equal to or greater than 31.5 Hertz were calculated for each receptor by Cadna/A at all sensitive receptors. The results are presented in Appendix 19-6. No receptors with sound levels equal to or greater than 65 dB at 31.5 or 63 Hz were found.

ii) Since the ISO 9613-2 standard does not include the 16 Hz frequency (infrasound), results for 16 Hz at each receptor were extrapolated from the 31.5 Hz results. The extrapolation is the difference between the inverter's sound power data at 16 Hz and the sound power data at 31.5 Hz as presented earlier in Table 19-5. The results are presented in Appendix 19-6. No receptors with sound levels equal to or greater than 65 dB at 16 Hz were found. Solar projects do not produce significant levels of infrasound, and therefore infrasound below 16 Hz was not analyzed in the Application.

[4] For perspective, a quiet library is around 35 dBA.

Table 19-8 Tonal Analysis & Compliance Evaluation: Modeled Sound Pressure Levels

Rec. ID	One-Third Octave Band Center Frequency [Hz]	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
	Tonal Limit	-	15	15	15	15	15	15	15	8	8	8	8	8	5	5	5	5	5	5	5	5	5	5	5	5	5	-
13607	Received Sound Pressure Level (dB)	39	40	42	41	39	37	36	32	32	32	33	34	35	53	46	34	45	39	43	43	39	35	41	33	32	34	25
	Average Sound Pressure Level of Contiguous Bands	-	41	41	41	39	38	35	34	32	32	33	34	43	40	43	45	36	44	41	41	39	40	34	37	34	29	-
	Difference between Sound Pressure Level and Contiguous Average	-	-1	2	0	0	0	2	-2	0	0	0	0	-8	13	3	-11	9	-5	2	2	-1	-5	7	-4	-2	5	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	-
12401	Received Sound Pressure Level (dB)	38	39	41	40	38	36	35	31	31	31	32	33	34	52	45	33	44	38	42	42	38	35	41	33	32	34	25
	Average Sound Pressure Level of Contiguous Bands	-	40	40	40	38	37	34	33	31	32	32	33	43	40	43	45	36	43	40	40	39	40	34	37	34	29	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	2	0	0	0	2	-2	0	0	0	0	-8	13	3	-11	9	-5	2	2	-1	-5	7	-4	-2	5	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	-
13232	Received Sound Pressure Level (dB)	37	38	40	39	37	35	34	30	30	30	31	32	32	50	43	31	42	36	39	39	34	30	34	23	18	14	0
	Average Sound Pressure Level of Contiguous Bands	-	38	38	38	37	35	32	32	30	30	31	32	41	38	41	43	33	41	37	37	34	34	26	26	18	9	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	2	0	0	0	2	-2	0	0	0	0	-8	13	3	-11	9	-5	2	2	0	-4	7	-3	0	5	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	-
11609	Received Sound Pressure Level (dB)	38	39	41	40	38	36	35	31	31	31	32	33	34	52	44	32	43	37	40	40	35	30	34	23	17	12	0
	Average Sound Pressure Level of Contiguous Bands	-	40	40	40	38	36	33	33	31	31	32	33	42	39	42	44	35	42	38	38	35	34	26	25	17	8	-
	Difference between Sound Pressure Level and Contiguous Average	-	0	2	0	0	0	2	-2	0	0	0	0	-8	13	3	-11	9	-5	2	2	0	-4	8	-3	0	3	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	-
12802	Received Sound Pressure Level (dB)	36	37	39	38	36	34	33	29	29	29	30	31	32	50	43	31	42	36	40	40	36	33	39	31	30	32	23
	Average Sound Pressure Level of Contiguous Bands	-	38	38	38	36	35	32	31	29	30	30	31	41	38	41	43	34	41	38	38	37	37	32	34	31	26	-
	Difference between Sound Pressure Level and Contiguous Average	-	-1	2	0	0	0	2	-2	0	0	0	0	-8	13	3	-11	9	-5	2	2	-1	-5	7	-4	-2	5	-
	Below Tonal Limit?	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	-

19(f) Tabular Sound Level Data

For Sections 19.f.4, 19.f.5, 19.f.6, and 19.f.9, measured ambient data were assigned to each modeling receptor based on proximity between measurement points and the similarity of the soundscape between the evaluated position and the location where the ambient noise levels were measured. Assumptions regarding the similarities of soundscapes were based on personal observations at each of the sound level measurement locations and on a review of the aerial imagery for the area. The modeling receptors were not visited during the measurement program to confirm/deny assumptions made regarding the soundscapes. Table 19-8.1 in Appendix 19-8 presents the sound level modeling locations with their assigned ambient measurement location.

(1) Daytime Ambient Noise Level

The daytime ambient noise level was calculated from summer and winter background sound level monitoring data. This is equal to the lower tenth percentile (L90) of sound levels measured during the daytime (7:00 AM – 10:00 PM) at each of the monitoring locations. These results are provided in Table 19-9. Sound levels in this section are presented both "as measured" and "ANS-weighted" (dBA) which removes all sound energy above the 1,250 Hertz frequency band. The ANS methodology is as specified in ANSI/ASA S12.100-2014 and is primarily aimed at removing high-frequency insect noise.

Table 19-9 Daytime Ambient L90 (dBA) Sound Pressure Level Summary

Location	Overall (dBA)		Winter (dBA)		Summer (dBA)	
	Measured	ANS	Measured	ANS	Measured	ANS
Location 1	32	27	32	32	38	30
Location 2	31	26	33	32	37	28
Location 3	31	27	32	32	41	30
Location 4	34	29	34	34	42	32
Location 5	35	28	35	35	42	31

(2) Summer Nighttime Ambient Noise Level

The summer (leaf-on) nighttime ambient noise level was calculated from summer background sound level monitoring data. This was equal to the L_{90} of sound levels measured at night (10:00 PM – 7:00 AM) during the summer at each of the monitoring locations. These results are provided below in Table 19-10.

Table 19-10 Nighttime Ambient L90 (dBA) Sound Pressure Level Summary

Location	Overall (dBA)		Winter (dBA)		Summer (dBA)	
	Measured	ANS	Measured	ANS	Measured	ANS
Location 1	27	20	27	27	39	25
Location 2	26	19	27	26	38	25
Location 3	22	18	24	22	41	26
Location 4	31	24	31	31	45	30
Location 5	29	22	30	30	44	28

(3) Winter Nighttime Ambient Noise Level

The winter (leaf-off) nighttime ambient noise level was calculated from winter background sound level monitoring data. This was equal to the L_{90} of sound levels measured at night (10:00 PM – 7:00 AM) during the winter at each of the monitoring locations. These results are provided above in Table 19-10.

(4) Worst-Case Future Daytime Noise Level

The worst-case future noise level during the daytime period (7:00 AM – 10:00 PM) at all receptors was determined by logarithmically adding the daytime ambient sound level (L_{90}) (Table 19-9) as related to the use and soundscape of the location being evaluated, calculated from background sound level monitoring in the summer and winter, to the modeled upper 10th percentile sound level (L_{10}) of the Facility. The L_{10} statistical noise descriptor corresponds to estimates for one year of operation using site-specific sunrise/sunset data coupled with monthly sunshine probabilities. In this case, the L_{10} is the same as the short-term sound power levels and thus the modeled L_{10} is the same as the modeled 1-hour L_{eq}. For a detailed description of the methodology used for this calculation see Appendix 19-4.

These worst-case future noise levels during the daytime period are presented in Table 19-8.2 in Appendix 19-8. Worst-case future total daytime noise levels range from 27 to 41 dBA for any non-participating receptor and from 35 to 41 dBA for any participating receptor. The highest L_{10} sound level at any sensitive non-participating receptor is 40 dBA. The highest L_{10} sound level at any sensitive participating receptor is 41 dBA.

(5) Worst-case Future Summer Nighttime Noise Levels

The worst-case future noise level during the summer leaf-on nighttime period at all receptors was determined by logarithmically adding the summer nighttime ambient sound level (L_{90}) (Table 19-10) as related to the use and soundscape of the location being evaluated, calculated from background sound level monitoring, to the modeled upper 10th percentile sound level (L_{10}) of the Facility. The L_{10} statistical noise descriptor corresponds to estimates for one year of operation using site-specific sunrise/sunset data coupled with monthly sunshine probabilities. In this case, the L_{10} is the same as the short-term sound power levels and thus the modeled L_{10} is the same as the modeled 1-hour L_{eq}. For a detailed description of the methodology used for this calculation see Appendix 19-4.

These worst-case future noise levels during the summer nighttime period are presented in Table 19-8.2 in Appendix 19-8. Worst-case future total summer nighttime noise levels range from 26 to 41 dBA for any non-participating receptor and from 35 to 42 dBA for any participating receptor. The highest L_{10} sound level at any sensitive non-participating receptor is 40 dBA. The highest L_{10} sound level at any sensitive participating receptor is 41 dBA.

(6) Worst-case Future Winter Nighttime Noise Levels

The worst-case future noise level during the winter (leaf-off) nighttime period at all receptors was determined by logarithmically adding the winter nighttime ambient sound level (L_{90}) (Table 19-10) as related to the use and soundscape of the location being evaluated, calculated from background sound level monitoring, to the modeled upper 10th percentile sound level (L_{10}) of the Facility. The L_{10} statistical noise descriptor corresponds to estimates for one year of operation using site-specific sunrise/sunset data coupled with monthly sunshine probabilities. In this case, the L_{10} is the same as the short-term sound power levels and thus the modeled L_{10} is the same as the modeled 1-hour L_{eq}. For a detailed description of the methodology used for this calculation see Appendix 19-4.

These worst-case future noise levels during the winter nighttime period are presented in Table 19-8.2 in Appendix 19-8. Worst-case future winter nighttime noise levels range from 23 to 41 dBA for any non-participating receptor and from 35 to 42 dBA for any participating receptor. The highest L_{10} sound level at any sensitive non-participating receptor is 40 dBA. The highest L_{10} sound level at any sensitive participating receptor is 41 dBA.

(7) Daytime Ambient Average Noise Level

Measured daytime average ambient levels are presented in Table 19-11 below. The daytime ambient average noise level was calculated by logarithmically averaging sound pressure levels (L_{eq}) (after exclusions) from the background sound level measurements over the daytime period at each monitoring location. These calculations include both summer and winter data combined.

Table 19-11 Daytime Ambient Leq (dBA) Sound Pressure Level Summary

Location	Overall (dBA)	
	Measured	ANS
Location 1	53	51
Location 2	54	53
Location 3	50	48
Location 4	53	51
Location 5	54	52

(8) Typical Facility Noise Levels

Typical Facility noise levels for each sensitive receptor were calculated as the median sound pressure level emitted by the Facility at each evaluated receptor (L_{50}). The median sound pressure level was calculated by determining the frequency of site-specific meteorological conditions during periods when the facility has the potential to be operating. The L_{50} statistical noise descriptor corresponds to estimates for one year of operation using site-specific sunrise/sunset data coupled with monthly sunshine probabilities. In this case, the L_{50} is the same as the short-term sound power levels and thus the modeled L_{50} is the same as the modeled 1-hour L_{eq}. For a detailed description of the methodology used for this calculation see Appendix 19-4. The typical Facility sound levels are presented in Table 19.8-2 in Appendix 19-8.

(9) Typical Facility Daytime Noise Levels

The typical Facility daytime (7:00 AM – 10:00 PM) noise level at all receptors was determined by logarithmically adding the daytime equivalent average sound level (L_{eq}) calculated from background sound level monitoring (Table 19-11) as related to the use and soundscape of the location being evaluated, to the modeled median Facility sound pressure level (L_{50}). The L_{50} statistical noise descriptor corresponds to estimates for one year of operation. These typical Project daytime noise levels are presented in Table 19.8-2 in Appendix 19-8. Typical Project daytime noise levels range from 48 to 53 dBA for any non-participating receptor and from 48 to 53 dBA for any participating receptor. These sound levels are mainly attributable to the existing sound sources in the Project Area and are not due to the Project.

19(g) Applicable Noise Standards, Local Requirements, and Noise Design Goals for the Facility

Noise standards applicable to the Project, as well as noise guidelines that are required by or recommended by various agencies, are described below. The input parameters, assumptions and standards that were used for purposes of predicting sound pressure levels from the Facility's substation and inverters are discussed in detail in Section 19(d) above. The compliance with these standards is discussed below and in Table 19-16 in Section 19(h).

A balance must be struck between avoiding or minimizing potential impacts to the maximum extent practicable from Project generated sound while not imposing regulatory standards which are so stringent that they do not afford additional benefits but instead are prohibitive to Project viability. Regulatory limits for other power generation and mechanical processes never seek inaudibility but rather to limit noise from a source to a reasonably acceptable level. Noise design goals were developed in order to balance reasonable development and minimize annoyance to the community.

Noise Standards—Federal

There are no federal community noise regulations applicable to solar facilities.

Noise Standards—New York State

This project falls under the jurisdiction of the NY State Board on Electric Generation Siting and the Environment "Article 10" regulations. Part 1001.19 "Exhibit 19: Noise and Vibration" contains the required elements of the regulation. These regulations do not list quantitative sound limits applicable to this project, but rather all the factors that must be considered in the noise study. Standards and design goals have been established in this exhibit based on previous approved Article 10 projects, and the Project's understanding of the expected New York State Department of Public Service (NYSDPS) scope of studies.

Noise Standards--Local

The Town of Waterloo has adopted a noise ordinance that includes several provisions applicable to the Project (Chapter 93), including the following:

§ 93-6. Machinery and mechanical devices. Section ninety-three - five in Chapter 65 of the 1980 Code is hereby amended to read as follows: Except by a variance from the Town of Waterloo Zoning Board of Appeals it shall be unlawful for any person to operate any machinery, equipment, pump, fan, air-conditioning apparatus or similar mechanical device in any manner so as to exceed the noise levels permitted in any residential area where the noise created during either the nighttime or daytime hours exceeds the limits in the appendix.

§ 93-7. Construction. During the nighttime hours it shall be unlawful for any person within a radius of 500 feet of a residence, to operate equipment or perform any outside construction or repair work except that of an emergency nature on buildings, structures or projects, or to operate any pile driver, pneumatic hammer, derrick, electric hoist or other construction equipment except to perform emergency work.

The Project will comply with both of these provisions. As to 93-7, construction will be limited to the hours of 7:00 AM to 7:00 PM Monday through Saturday so no construction noise will be generated during the Town's nighttime hours of 10:00 PM to 7:00 AM Sunday through Thursday or 12:00 PM to 7:00 AM on Friday and Saturday. Further, as to 93-6, no machinery or mechanical devices will exceed noise levels in the ordinance as none are listed. The ordinance refers to limits in the appendix but includes a note that the appendix is incorporated as § 93-3, which are the definitions. The definitions do not include any restrictions or numerical noise level limits. Therefore, there are no limits with which to comply.

Noise Design Goals

At a minimum, the Application will employ the following guidelines and precedent from other recent NYS solar energy projects.

i) 45 dBA L_{eq} 1-hour at a non-participating residence from daytime-only operational sound sources such as inverters, medium voltage transformers, and any battery storage facility (if applicable). If the sound emissions from these sources are found to contain a prominent discrete tone at any non-participating residence, then the sound levels at the receptors shall be subject to a 5 dBA penalty; i.e. a reduction in the permissible sound level to 40 dBA L_{eq}

1-hour. This is consistent with the limits adopted by the Siting Board in its certification of the Alle-Cat Wind Energy project (Case 17-F-0282-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated June 3, 2020); the Canisteo Wind Energy project (Case 16-F-0205-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated March 13, 2020); the Bluestone Wind project (Case 16-F-0559-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated December 16, 2019); the Number Three Wind project (Case 16-F-0328-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated November 12, 2019); the Baron Winds project (Case 15-F-0122-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated September 12, 2019); the Cassadaga Wind project (Case 14-F-0490-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated January 17, 2018).

ii) 50 dBA L_{eq} 1-hour sound level from the Facility outside any participating residence from daytime-only operational sound sources such as inverters, medium voltage transformers, and any battery storage facility (if applicable). No penalties for prominent tones will be added in this assessment. This is 5 dBA lower than the limits adopted by the Siting Board in its certification of the Alle-Cat Wind Energy project (Case 17-F-0282-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated June 3, 2020); the Canisteo Wind Energy project (Case 16-F-0205-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated March 13, 2020); the Bluestone Wind project (Case 16-F-0559-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated December 16, 2019); the Number Three Wind project (Case 16-F-0328-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated November 12, 2019); the Baron Winds project (Case 15-F-0122-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated September 12, 2019); the Cassadaga Wind project (Case 14-F-0490-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated January 17, 2018).

iii) 55 dBA L_{eq} 1-hour sound level from the Facility across any portion of non-participating property, except for portions delineated as wetlands or utility rights of way. No penalties for prominent tones will be added. This is consistent with the limits adopted by the Siting Board in its certification of the Alle-Cat Wind Energy project (Case 17-F-0282-Order Granting

Certificate of Environmental Compatibility and Public Need, With Conditions, dated June 3, 2020); the Eight Point Wind project (Case 16-F-0062-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated August 20, 2019.

iv) Not produce any audible prominent tones, as defined under ANSI S12.9 Part 4-2005, Annex C at any non-participating residence from daytime-only operational sound sources such as inverters, medium voltage transformers, and any battery storage facility (if applicable). If the sound emissions from these sources are found to contain a prominent discrete tone at any non-participating residence, then the sound levels at the receptors shall be subject to a 5 dBA penalty; i.e. a reduction in the permissible sound level to 40 dBA L_{eq} 1-hour. This is consistent with the limits adopted by the Siting Board in its certification of the Alle-Cat Wind Energy project (Case 17-F-0282-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated June 3, 2020); the Canisteo Wind Energy project (Case 16-F-0205-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated March 13, 2020); the Bluestone Wind project (Case 16-F-0559-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated December 16, 2019); the Number Three Wind project (Case 16-F-0328-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated November 12, 2019); the Baron Winds project (Case 15-F-0122-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated September 12, 2019); the Eight Point Wind project (Case 16-F-0062-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated August 20, 2019; the Cassadaga Wind project (Case 14-F-0490-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated January 17, 2018).

v) 40 dBA L_{eq} 1-hour at a non-participating residence from the collector substation equipment. If the sound emissions from these sources are found to contain a prominent discrete tone at any non-participating residence, then the sound levels at the receptors shall be subject to a 5 dBA penalty; i.e. a reduction in the permissible sound level to 35 dBA L_{eq} 1-hour. This is consistent with the limits adopted by the Siting Board in its certification of the Alle-Cat Wind Energy project (Case 17-F-0282-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated June 3, 2020); the Canisteo Wind Energy project (Case 16-F-0205-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated March 13, 2020); the Bluestone Wind project (Case 16-F-0559-Order Granting Certificate of Environmental Compatibility and Public Need, With

Conditions, dated December 16, 2019); the Number Three Wind project (Case 16-F-0328-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated November 12, 2019); the Baron Winds project (Case 15-F-0122-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated September 12, 2019); the Eight Point Wind project (Case 16-F-0062-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated August 20, 2019; the Cassadaga Wind project (Case 14-F-0490-Order Granting Certificate of Environmental Compatibility and Public Need, With Conditions, dated January 17, 2018).

19(h) Summary of Noise Standards and Compliance of the Facility

Design goals for the Facility are summarized below in Table 19-16. Based on the detailed analyses presented in this report, once necessary mitigation is included, the future Project sound levels will meet all design goals.

<u>All sources running--inverters plus the collector substation</u>

Future 1-hour L_{eq} sound levels during worst-case operation of the Project's inverters plus the collector substation are listed in Appendix 19-6. The highest corrected sound levels under this scenario are:

- Non-participating residence = 40 dBA
- Participating residence = 41 dBA

These sound levels are below the design goals of 45 dBA and 50 dBA respectively.

Sound level contours generated from the modeling grid are presented in an overview figure, in Appendix 19-6 (Figure 19-6.1), accompanied by a series of inset maps that provide a higher level of detail at all modeled receptors. These figures represent the mitigated (corrected) results. As these figures show, sound levels will be below the design goal of 55 dBA at all non-participating property lines.

<u>Collector substation only</u>

Future 1-hour L_{eq} sound levels during worst-case operation of the Project's collector substation are listed in Appendix 19-6. The highest sound levels under this scenario are 28 dBA at a Non-participating residence. These sound levels are below the design goal of 35 dBA, assuming the 5 dBA tonal penalty which is likely for a substation transformer.

Cumulative analysis -- all project sources operating plus nearby facility

Future 1-hour L_{eq} sound levels during worst-case operation of the Project's inverters plus the collector substation plus the nearby Zotos Wind facility are listed in Appendix 19-7. The highest corrected sound levels under this scenario are:

- Non-participating residence = 46 dBA
- Participating residence = 42 dBA

The Non-participating receptor predicted to receive 46 dBA is due to the Zotos Wind facility (contribution of 46 dBA), and not the project (contribution of 29 dBA). Therefore, the cumulative sound levels due to the project are below the design goals of 45 dBA and 50 dBA respectively.

Sound level contours generated from the modeling grid are presented in an overview figure in Appendix 19-7 (Figure 19-7.1), accompanied by a series of inset maps that provide a higher level of detail at all modeled receptors. These figures represent the mitigated (corrected) results. As these figures show, sound levels will be below the design goal of 55 dBA at all non-participating property lines.

1) The Project will comply with the applicable substantive provisions of the Town of Waterloo's noise regulations. Refer to Section 19 (g) for further discussion.

2) All residences will meet the design goals for the facility with necessary mitigation measures in place.

All sources running--inverters plus the collector substation

Table 19-12 presents the number of uncorrected sensitive noise receptors that have been modeled to experience a worst-case sound level of 40 dBA or greater (1-hour L_{eq}).

Table 19-13 presents the number of corrected sensitive noise receptors that have been modeled to experience a worst-case sound level of 40 dBA or greater (1-hour L_{eq}).

Table 19-12 Participating and Non-Participating Receptors Modeled at 40 dBA or Greater (uncorrected)

Modeled Leq Sound Level [dBA][1]	# of Receptors					
	Year-Round Residence		Seasonal Residence		Unknown	
	Participating	Non-Participating	Participating	Non-Participating	Participating	Non-Participating
51	0	1	0	0	0	0
50	1	1	0	0	0	0
49	0	0	0	0	0	0
48	1	5	1	0	0	0
47	3	10	0	0	0	0
46	0	9	0	0	0	0
45	0	11	0	0	0	3
44	0	18	0	0	0	1
43	0	21	0	0	0	0
42	0	27	0	0	0	0
41	1	20	0	0	0	2
40	0	30	0	0	0	3

Table 19-13 Participating and Non-Participating Receptors Modeled at 35 dBA or Greater (corrected)

Modeled Leq Sound Level [dBA][1]	# of Receptors					
	Year-Round Residence		Seasonal Residence		Unknown	
	Participating	Non-Participating	Participating	Non-Participating	Participating	Non-Participating
41	2	0	1	0	0	0
40	3	14	0	0	0	0
39	0	9	0	0	0	0
38	0	8	0	0	0	0
37	0	24	0	0	0	2
36	0	34	0	0	0	2
35	1	28	0	0	0	4

Collector substation only

Future 1-hour L_{eq} sound levels during worst-case operation of the Project's collector substation only are listed in Appendix 19-6. The highest worst-case sound level due to the collector substation only at a non-participating sensitive noise receptor is 28 dBA (1-hour L_{eq}). The highest worst-case sound level at a participating receptor is 33 dBA (1-hour L_{eq}).

Cumulative analysis -- all project sources operating plus nearby facility

Table 19-14 presents the number of sensitive noise receptors that have been modeled to experience a corrected "Cumulative" worst-case L_{eq} 1-hour sound level of 40 dBA or greater. The highest predicted sound levels (45 dBA and 46 dBA) are mainly due to the nearby Zotos Wind facility and are not attributable to the proposed project.

Table 19-14 Participating and Non-Participating Receptors Modeled at 40 dBA or Greater – Cumulative Analysis (corrected)

Modeled Leq Sound Level [dBA][1]	# of Receptors	
	Participating	Non-Participating
46	0	1
45	0	3
44	0	2
43	0	3
42	2	7
41	1	7
40	3	18

3) All non-participating property boundary lines meet the design goal as shown by the contour figures presented in Appendix 19-6. In these figures, participant and non-participant boundary lines are differentiated. Sensitive sound receptors are identified with unique ID numbers in the results tables and on the contour drawings.

Table 19-15 Summary of Compliance with Sound Standards and Design Goals - Trelina Solar Energy Center (includes mitigation)

Design Goal. (Not to exceed)	Assessment Location	Noise descriptor	Period of Time	Participant Status	Meet?
45 dBA	At residence, Outdoor	Leq	1-hour; daytime or nighttime	Non-participant	Yes
50 dBA	At residence, Outdoor	Leq	1-hour; daytime or nighttime	Participant	Yes
55 dBA	Property line except for portions delineated as wetlands	Leq	1-hour; daytime or nighttime	Non-Participant	Yes
No audible prominent tones or 5 dBA penalty if they occur.	At residence, Outdoor	Leq	1-hour; daytime and nighttime	Non-participant	Yes (Penalty Applied)
40 dBA from the collector substation; 5 dBA penalty if tonal	At residence, Outdoor	Leq	1-hour; daytime or nighttime	Non-participant	Yes

19(i) Noise Abatement Measures for Construction Activities

(1) Noise Abatement Measures

Noise due to construction is an unavoidable outcome of construction. Project construction noise will be typical of any major construction project. Construction activity in a particular area is expected to be of short duration, as construction moves throughout the Project site.

The Applicant will communicate with the public to notify them of the beginning of construction of the Facility. Most of the construction will occur at significant distances to sensitive receptors, and therefore noise from most phases of construction is not expected to result in impacts. Nonetheless construction noise will be minimized through the use of best management practices (BMP) such as those listed below.

- Blasting is not anticipated at this site. However, if necessary, blasting will be limited to daytime hours and conducted in accordance with the Project's Preliminary Blasting Plan included as Appendix 21-2.
- Post installation and horizontal direction drilling (HDD) will be limited to daytime hours. Refer to the Project's Preliminary Geotechnical Report (Appendix 21-1) for more detail.

- Using construction equipment fitted with exhaust systems and mufflers that have the lowest associated noise whenever those features are available.
- Maintaining equipment and surface irregularities on construction sites to prevent unnecessary noise.
- Configuring, to the extent feasible, the construction in a manner that keeps loud equipment and activities as far as possible from noise-sensitive locations.
- Using back-up alarms with a minimum increment above the background noise level to satisfy the performance requirements of the current revisions of Standard Automotive Engineering (SAE) J994 and OSHA requirements.
- Develop a staging plan that establishes equipment and material staging areas away from sensitive receptors when feasible.
- Contractors shall use approved haul routes to minimize noise at residential and other sensitive noise receptor sites.

(2) Complaint Resolution Plan

Complaints due to construction or operation of the Project have the potential to occur. If complaints do arise, the Complaint Resolution Plan provides information on how and when the public may file a complaint, as well as an identification of any procedures or protocols that may be unique to each phase of the Project or complaint type. Complaint filing methods are described in greater detail in Appendix 12-3.

19(j) Noise Abatement Measures for Facility Design and Operation

(1) Noise Abatement Measures

Adverse noise impacts will be avoided or minimized through careful siting of Facility components. The noise emitted by a solar project is limited to daytime periods only for the majority of the components. As explained in Subsection 19(d), mitigation measures such as sound barriers or quieter inverters will be employed to achieve the design goals for this Project.

(2) Alternatives Analysis

The use of alternative designs, alternative technologies, and alternative facility arrangements is discussed in Exhibit 9 (Alternatives).

19(k) Community Noise Impacts

(1) Potential for Hearing Damage

The Project's potential to result in hearing damage was evaluated against three guidelines established by the OSHA, USEPA, and WHO. Comparison of sound propagation modeling to these guidelines shows that construction and operation of the Project will not result in potential for hearing damage. Each of the standards and the Facility's compliance with them is further described below.

OSHA protects against the effects of noise exposure in the workplace. Permissible noise exposure levels for an 8-hour day are 90 dBA. At sound levels above 85 dBA over an 8-hour workday, employers shall provide hearing protection to employees. Sound pressure levels as generated by Project construction and operation at sensitive sound receptors will be under this threshold, so the Project will be in compliance with OSHA standards. Therefore, based on the OSHA standard, the Project will not result in potential for hearing damage.

The USEPA established a noise guideline for protection against hearing loss in the general population (USEPA, 1974). The guideline identifies a sound level of 70 dBA over a 24-hour period as protective against hearing loss from intermittent sources of environmental noise. The highest predicted sound level at a non-participating residence is 40 dBA.

According to the WHO 1999 Guidelines, the threshold for hearing impairment is 110 dBA (Lmax, fast) or 120/140 dBA (peak at the ear) for children/adults. The only construction noise source for this Project capable of exceeding the WHO hearing impairment threshold is blasting, but no blasting is anticipated for this Project. All other construction activities will produce noise below the WHO hearing impairment threshold.

In addition, if any blasting is required, the contractor responsible for blasting will have a Health & Safety Plan approved by the Applicant This plan will include the appropriate worker hearing protection and procedures to prevent hearing loss from impulse noise.

(2) Potential for Speech Interference

The Facility's potential to result in indoor and outdoor speech interference was assessed using the framework provided in the WHO (1999) document Guidelines for Community Noise and in the USEPA (1974) document Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety.

The 1974 USEPA document states that for an outdoor level of 55 dBA (L_{dn}) there is 100% sentence intelligibility indoors, and 99% sentence intelligibility at 1 meter outdoors. These are the maximum sound levels below which there are no effects on public health and welfare due to interference with speech or other activity. This includes a 5 dBA margin of safety. An outdoor L_{dn} is equivalent to a 24-hour sound level of 49 dBA. Because all non-participating sensitive sound receptors were modeled to have the highest operational sound level less than or equal to 40 dBA, the Facility will not result in interference with indoor or outdoor speech, as defined by USEPA guidelines.

The WHO recommends an indoor sound level of 35 dBA (L_{eq}) to protect speech intelligibility. This is equivalent to approximately 50 dBA L_{eq} outdoors based on reduction from outside to inside by approximately 15 dBA with windows open, and 25 dBA with windows closed (USEPA, 1974). Because all non-participating sensitive sound receptors were modeled to have the highest operational sound level of less than or equal to 40 dBA, the Project will not result in interference with indoor or outdoor speech, as defined by USEPA guidelines.

(3) Potential for Annoyance/Complaints

Sound produced by a solar facility is relatively low compared to other types of power generation facilities. The main components of a solar facility are the photovoltaic (PV) panel arrays, the power inverter units, the DC collection system, the AC collection system, and the collector substation. The operational sounds from a solar facility include the inverters which are typically located in the center of the solar panel arrays, and the transformer located at the collector substation. The main source of sound from the inverters and substation are their cooling fans, and the electrical components within the inverter cabinet and substation transformer. The inverters produce a low humming sound during time periods when sunlight is shining onto the panels, when the array generates electricity. The substation has switching, control equipment, and a transformer.

As part of the Project, noise design goals were developed based on a literature review in order to balance reasonable development and minimize annoyance to the community. An extensive search was made of noise-related publications from professional organizations such as the Institute of Noise Control Engineering (INCE) and the Acoustical Society of America (ASA) along with their associated annual conference proceedings. Very few papers have been published on sound from solar energy facilities, and none were located that analyzed potential annoyance from solar energy facilities. This is not surprising given that sound from PV solar systems is a very minor source of sound energy. Therefore, annoyance due to sound from solar energy is expected to be negligible to non-existent.

For some perspective, there has been a fair amount of research done into potential for complaints from wind turbines. Although the sound from wind turbines is not at all similar to the sound from a PV solar facility, a review of complaints at specific sound levels is illustrative. Observations of neighbors' reactions to newly operational wind farms suggest that it is not necessary to rigidly impose a maximum noise level of 40 dBA in order to avoid complaints. A report from the National Association of Regulatory Utility Commissioners (NARUC) recommends 40 dBA as an *ideal* design goal, if it can reasonably be achieved, but 45 dBA as an appropriate regulatory limit. Adverse reactions to wind turbine noise between 40 and 45 dBA is still quite low, at roughly 2 percent of wind-park neighbors, even in rural environments with low background levels.[5] This would suggest that adverse reaction to a solar PV facility at these same levels would be even lower to non-existent.

(4) Potential for Structural Damage

At this time, blasting is not planned as part of construction for the Project. If blasting becomes necessary, a Preliminary Blasting Plan is provided as Appendix 21-2 and the Preliminary Geotechnical Report is provided as Appendix 21-1. Summaries of these reports are in Exhibit 12 and Exhibit 21 of the Application. It is anticipated that post installation will be needed to construct the Project. The use of HDD during construction is discussed in Section 19.c. The potential for any cracks or structural damage due to impact activities during construction is analyzed in Exhibits 12 and 21.

(5) Potential for Interference with Technological, Industrial, or Medical Activities

Solar facilities do not produce significant levels of ground-borne vibration. Nonetheless, the potential for air-borne induced vibrations from the operation of the Project to generate annoyance, cause vibrations, rumbles or rattles in windows, walls or floors of sensitive receptor buildings was analyzed by applying the outdoor criteria established in annex D of ANSI standard S12.9 - 2005/Part 4 and applicable portions of ANSI 12.2 (2008). These recommend limits of 65 dB at the 16, 31.5, and 63 Hz octave bands.

Modeling results at the 31.5 Hz and 63 Hz low frequency octave bands have been calculated using Cadna/A acoustic model. Results at the 16 Hz octave band, for each receptor, were extrapolated from the 31.5 Hz results. The extrapolation is the difference between the inverter's

[5] Wind Energy & Wind Park Siting and Zoning Best Practices and Guidance for States, NARUC, prepared by National Regulatory Research Institute, January 2012.

sound power data at 16 Hz and the 31.5 Hz sound power data used for computer modeling. All receptors were modeled well below 65 dB at the 16, 31.5, and 63 Hz octave bands.

The potential of low-frequency noise, including infrasound and vibration, from operation of the Project to cause interference with the closest seismological and infrasound stations within 50 miles of the Project site was investigated. The Preparatory Commission for the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) website was reviewed for the nearest location of any infrasound monitoring stations. The closest locations are in Bermuda (IS51) and Lac du Bonnet, Manitoba, Canada (IS10). Bermuda (IS51) is approximately 915 miles from the Trelina Solar Energy Center, while Lac du Bonnet, Manitoba, Canada (IS10) is approximately 1,100 miles from the Trelina Solar Energy Center. There are also some auxiliary seismic stations to monitor shock waves in the Earth as part of the CTBTO program. The nearest seismic monitor to the Trelina Solar Energy Center is located in Sadowa, Ontario, Canada (AS014) which is approximately 240 miles away. Given these large distances and the relatively low levels of infrasound emissions from this project, we conclude there will be no impact to the CTBTO's ability to monitor infrasound. There are no US Geological Survey (USGS) seismological stations within 50 miles of the site. The nearest station is located at Binghamton, New York, approximately 75 miles to the southeast. The two nearest hospitals to the project are St Joseph's Hospital in Waterloo, NY approximately 1 mile southeast of the nearest inverter, and Geneva General Hospital in Geneva, NY approximately 2 miles to the west of the nearest inverter. Distances are "as the crow flies."

19(l) Post-Construction Noise Evaluation Studies

Recent experience with other Article 10 solar projects has seen NYSDPS advocate for pre-construction modeling analyses to be reviewed in the Compliance Filing, thereby displacing the need for post-construction sound level testing as part of the certificate conditions. Nonetheless, for the sake of completeness with the regulations, the Applicant has provided a post-construction sound monitoring protocol with this application. The Sound Monitoring and Compliance protocol is attached as Appendix 19-9.

19(m) Post-Construction Operational Controls and Mitigation Measures to Address Complaints

The Applicant takes seriously any complaints that it receives from members of the public. The Complaint Resolution Plan for the Facility includes a complaint response protocol specific to noise during Project construction and operation. Should a resident feel the Project is creating noise levels above those specified in the Project's Certificate Conditions, the resident may issue a complaint. Complaints will be able to be made in person, via phone, or by email. The Applicant will contact the individual within specified time limits. The Applicant will implement a comprehensive response for all registered, reasonable complaints, which will include community engagement, gathering information, response to the complaint, a follow up after the response has been issued, and further action if the complainant believes that the issue continues to exist. The applicant expects to employ recent agreed-to certificate conditions from other Article 10 proceedings proving noise complaint procedures, in particular a noise complaint resolution protocol.

19(n) Software Input Parameters, Assumptions, and Associated Data for Computer Noise Modeling

Specific modeling parameters are included in Appendices 19-1 and 19-5. GIS files containing modeled topography, modeled inverter and substation locations, sensitive sound receptors, and all external boundary lines identified by Parcel ID number are being provided to NYSDPS under separate cover in digital format. The digital Cadna/A input files will not be provided unless requested by NYSDPS.