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Noise Impact & Mitigation Study
Hydrogen Ready Power Plant Project
Courtright, Ontario

Prepared for:

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EXECUTIVE SUMMARY

Eastern Power Inc. retained HGC Engineering to undertake a Noise Impact and Mitigation Study of the proposed Hydrogen Ready Power Plant Project ("HRPP"), a combined cycle power plant to be located in Courtright, Ontario. The plant is proposed to comprise a "2 on 1" arrangement, with two hydrogen-ready gas turbine engines with associated generators and heat recovery steam generators ("HRSGs") feeding a steam turbine generator. The plant will be located to the south of the existing Green Electron Power Plant ("GEPP").

As the design of the facility was still in progress at the time of this study, preparation of a formal Acoustic Assessment Report – for submission to the Ministry of the Environment, Conservation and Parks ("MECP"), in support of Environmental Approvals – would be premature. Instead, the intent of this study was to predict the offsite sound levels of the facility at the nearest neighbouring residence, assess those levels against the current MECP noise limits, and determine appropriate noise mitigation measures for integration into the project design. For the transformers on site, manufacturers' published sound levels were available and were used in the analysis. For the remaining equipment on site, the same per-source sound emission levels that were specified for the GEPP in 2013 were assumed. Automated monitoring of background sound levels conducted in July and August 2021 was used to determine the noise limits applicable under MECP assessment guidelines.

The results of the study indicate that, for the most part, the sound emissions specifications and noise control measures that were previously recommended for the GEPP in 2013 will also be applicable to the HRPP and will result in offsite sound levels within the MECP limits, including a reasonable margin of safety. The exceptions are the enclosures for the gas turbines and their associated generators; whereas the gas turbine at the GEPP was located inside a building, those at the HRPP will be located outdoors and, consequently, their acoustical enclosures will require a reduced maximum sound emission level specification.

The sound emission specifications and noise control recommendations in this report can be used for equipment selection as the design of the facility progresses. It is recommended that this analysis be refined as the design is finalized, to prepare an Acoustic Assessment Report in support of an application to the MECP for an Environmental Compliance Approval ("ECA").

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1 FACILITY DESCRIPTION

Figure 1 shows a scaled satellite photograph of the site location and surrounding vicinity [1]. The closest noise sensitive points of reception are residences along the north and south sides of Oil Springs Line, shown as locations R1 through R9 in Figure 1.

A site plan is included as Figure 2. The proposed 2-on-1 combined cycle plant will have a nominal capacity of 600 MW. Ancillary equipment will include a nine-cell cooling tower, transformers, and a diesel-powered emergency fire water pump. The electrical switchgear on site is anticipated to be acoustically insignificant offsite.

For the purposes of acoustical assessment, it has been assumed that the plant could operate in steady fashion during both daytime hours (07:00 to 19:00) and nighttime/evening hours (19:00 to 23:00 and 23:00 to 07:00). Also, although periodic start-up of the facility, which includes venting of excess steam, would normally occur in the morning or afternoon, there is the possibility that it could occur prior to 07:00, which falls within the MECP definition of nighttime. So, start-up during daytime and evening/nighttime hours has been considered.

The HRPP will have separate ownership from the existing GEPP facility, have a separate municipal address and have a separate connection to the Provincial IESO power grid. Therefore, the HRPP has been assessed on its own.

2 POINTS OF RECEPTION NOISE CRITERIA

The nine assessment locations are existing single-family residences and differ in their distance from and exposure to the proposed facility, as well as the background sound levels that they experience from road traffic.

MECP Publication NPC-300 [2] is the governing noise assessment guideline, insofar as it sets out the sound level limits that the facility must meet, as one of the prerequisites to obtaining an ECA, as required under Section 9 of the Environmental Protection Act for the facility to operate legally.

The MECP noise assessment guidelines draw a distinction between sound produced by traffic sources and that produced by industrial or commercial activities, which are classified as *stationary sources of sound*. The acceptability limits for stationary sources are site dependent and are based on the existing ambient background sound levels in the area of the subject site. In essence, the sound from the stationary sources is evaluated against (i.e. compared to) the typical background sound at any potentially impacted, sound-sensitive points of reception (e.g., residences). Background sound is defined to include road traffic, but to exclude the sound of the facility under assessment. The guidelines also specify that the assessment must be based on a "predictable worst case hour" which is defined as an hour when a full "planned and predictable" mode of operation could coincide with an hour of minimum background sound.

Specifically, NPC-300 stipulates that the sound level limit for a stationary source is the greater of the minimum one-hour L_{EQ} background sound level or the applicable "exclusion limits." In a Class 1 area (defined as an area where the background sound is dominated by man-made activities during the day and evening), the exclusion limits are 50 dBA during daytime and evening hours, and 45 dBA at night. In a Class 2 area (where the background sound is dominated by man-made activities during the day but would typically consist of natural sounds during the evening), the exclusion limits are 50 dBA during the day and 45 dBA during the evening and night.

Background sound is defined to include road traffic and natural sounds, excluding the sound of the facility under assessment. It can be determined through automated monitoring for a period of at least 48 hours or modelled from hourly road traffic volumes in areas where the background sound is dominated by road traffic. The former approach was used for the purposes of this study.

HGC Engineering visited the vicinity surrounding the plant in July and August 2021, to investigate the acoustical environment and deploy automated sound level monitors. Three *Norsonic* model Nor140 precision sound level meters were deployed from July 28 to August 4, 2021 – one at each of locations R1, R3 and R6. All instrumentation was within its annual laboratory calibration period and correct calibration was verified at the beginning and end of the monitoring period using a *Brüel & Kjær* model 4231 acoustic calibrator. The weather during the monitoring period was confirmed to be suitable for outdoor acoustical measurements.

At all locations, the background sound was found to be dominated by road traffic on Oil Springs Line and Highway 40 during daytime hours, and to varying degrees during the evening. Observably, the background sound at R2, R4, and R5 was found to be similar to that at R3, and at R7 through R9 was found to be similar to that at R6. Based on observations of the acoustical environment and on the monitored background sound levels, locations R1 and R6 to R9 are best categorized as Class 1 areas, and R2 to R5 as Class 2 areas. Table I summarizes the minimum measured one hour background sound levels and the applicable MECP Limits.

Table I: Minimum One-Hour Background Sound Levels & Applicable Limits, L_{EQ}[dBA]

Location	Background Sound			Applicable Limits		
	Day	Eve	Night	Day	Eve	Night
R1	39	43	37	50	50	**45**
R3 (R2, R4, R5 similar)	44	40	33	50	45	**45**
R6 (R7 to R9 similar)	46	44	39	50	50	**45**

Some sounds have a distinctive character which tends to increase their audibility. For tonal sounds, such as those exhibiting "a pronounced… whine, screech, buzz, or hum," MECP Publication NPC-104 [3] stipulates that an adjustment of +5 dBA be added to the sound level for the purposes of assessment, to account for their increase potential to disturb. Transformers typically produce a humming sound at a frequency of 120 Hz (and integer multiples), so the adjustment has been applied to the transformers in the analysis discussed below.

Although operation of emergency equipment, such as emergency generators or fire water pumps, during an actual power outage is exempt from assessment under MECP guidelines, the periodic testing, for maintenance purposes must be assessed. The sound from testing of emergency equipment is assessed separately from non-emergency equipment, and the limits are 5 dBA less restrictive than for non-emergency equipment. There will be a diesel power emergency fire water pump at the facility, and assuming that it will be tested during daytime hours only, the applicable limit at all points of reception is 55 dBA.

3 ACOUSTICAL ANALYSIS METHODS & RESULTS

The sound levels of the proposed facility were predicted using computational acoustical modelling. The model was prepared using Cadna/A software (version 2021 MR2) which is a computer implementation of ISO Standard 9613-2 [4], and accounts for reduction in sound level with distance due to geometrical spreading, air absorption, ground attenuation and acoustical shielding by intervening structures (or by topography and foliage where applicable). The ISO 9613-2 method is widely preferred by regulators and municipalities in Ontario and elsewhere. Figure 3 shows the locations of the sources considered in the acoustical model. Where applicable, the identifiers used for the various sources follow the equipment designations provided by Eastern Power. For miscellaneous noise sources that are not defined items of equipment, an identifier has been assigned in this report, of the form NS-##.

The sound emission levels for each of the sources are listed in Table A1 of Appendix A. The sound levels for the transformers were provided by the manufacturers only in terms of single-number "dBA" spectral sums; so the apportion of the overall sound level into octave frequency bands was estimated based on published methods [5]. With the exception of the transformers and the enclosures for the gas turbines and their associated generators, the sound emission levels in Table A1 were based on the maximum levels specified in 2013 for the design of the existing GEPP.

For the gas turbine and generator enclosures, preliminary modelling showed that the 2013 sound emission specification (maximum 85 dBA free-field sound pressure level at 1 metre) could result in offsite noise excesses, as that specification was derived on the basis that the gas turbine and generator at the GEPP would be located inside a building. That preliminary modelling also showed that the sound emission levels of the (outdoor) enclosures for the gas turbines and generators at the HRPP would need to be 10 dBA less – i.e., maximum 75 dBA at 1 metre. The equivalent sound power level specification has been included for these enclosures, in Table A1 of Appendix A.

Table II, below, summarizes the predicted sound levels at the points of reception, from steady operations and start up, all of which are within the most restrictive nighttime limit of 45 dBA. The results are presented graphically as sound level contours in Figures 4 through 7.

Table II: Predicted Sound Levels – Non-Emergency Equipment, L_{EQ}[dBA]

Location	Steady Operation		Start-up		MECP Limits			Within Limits?
	Day/Eve	Night	Day/Eve	Night	Day	Eve	Night	
R1	38	37	38	37	50	50	45	Y
R2	43	42	43	42	50	45	45	Y
R3	41	41	41	41	50	45	45	Y
R4	41	41	42	41	50	45	45	Y
R5	44	42	44	43	50	45	45	Y
R6	39	34	39	35	50	50	45	Y
R7	38	34	38	34	50	50	45	Y
R8	37	33	37	33	50	50	45	Y
R9	37	32	37	33	50	50	45	Y

The differences between daytime/evening sound levels and nighttime sound levels in Table II are attributable to the low-speed operation of the cooling towers at night.

Table III, below, lists the sound levels from the daytime testing of the emergency fire water pump, all of which are well within the applicable limits. Those results are shown graphically as sound level contours in Figure 8.

Table III: Predicted Sound Levels
Daytime Testing of Emergency Fire Water Pump, L_{EQ}[dBA]

Location	Sound Level	MECP Limit	Within Limit?
R1	27	55	Y
R2	29	55	Y
R3	30	55	Y
R4	31	55	Y
R5	43	55	Y
R6	37	55	Y
R7	36	55	Y
R8	35	55	Y
R9	35	55	Y

4 NOISE CONTROL RECOMMENDATIONS

The sound power levels listed in Table A1 should be provided to the prospective suppliers as maximum allowable sound emission specifications. For many sources, the sound emission levels in

Table A1 include the effects of engineered noise control hardware, necessary to meet the offsite noise limits, as discussed in the following sub-sections.

Silencers for HRSG Exhaust Stack Outlets – Sources STCK 2002 and STCK 2003

The approach to specifying exhaust silencers for the HRSG stacks that affords the greatest assurance to Eastern Power is to specify the maximum allowable sound emission levels at the stack outlet (i.e., provide the sound power levels in Table A1 as a specification to the prospective silencer supplier), rather than cite a sound insertion loss. Whereas the latter approach is easier for the silencer supplier, any uncertainties associated with the unsilenced sound power emissions of the gas turbine or the natural sound attenuation afforded by the HRSG become the responsibility of Eastern Power. However, should Eastern Power wish to specify the silencer performance in terms of minimum sound insertion loss values, the measurements of the actual sound emissions of the stack outlet at the GEPP, conducted by HGC Engineering in July 2021, indicate that the sound emissions of the gas turbine and the sound reduction through the HRSG were within the expected range, such that the silencer performance specified in Table IV will suffice.

Table IV: Sound Insertion Loss Requirements – HRSG Exhaust Stack Outlets

Octave Band Centre Frequency [Hz]	31	63	125	250	500	1k	2k	4k	8k
Dynamic Sound Insertion Loss [dB]	10	20	35	35	35	30	25	25	25

The purchase specification for the gas turbine and HRSG should also require the absence of excessive low frequency sound (no more than 73 dB unweighted sound pressure at 100 meters at 31 Hz) from the exhaust system and should include allowance for statistical uncertainty in accordance with ISO 10494.

Gas Turbine Air Intakes – Sources NS-11 and NS-12

The gas turbine supplier should provide sufficient silencing such that the sound power emitted from the inlet does not exceed 100 dBA. Based on the assumed unsilenced turbine intake sound levels, the following minimum sound insertion loss values will suffice for the intake silencer and filters

combined, although the sound power level of 100 dBA from the intake should be verified by the supplier to ensure compliance with the performance target.

Table V: Sound Insertion Loss Requirements – Gas Turbine Intakes

Octave Band Centre Frequency [Hz]	31	63	125	250	500	1k	2k	4k	8k
Dynamic Sound Insertion Loss [dB]	20	30	35	40	45	50	50	50	40

Cooling Tower – Sources CT Fan 2006 to CT Fan 2014 & NS-01 to NS-05

Note that the sound power levels in Table A1 assume that the fans will operate at low speed during nighttime hours (23:00 to 07:00).

STG Transformer – Source MT 2003

The STG transformer will require a three-sided noise barrier surrounding it on the west, north, and east sides, having a height level with the top of the transformer tank (estimated at 7.5 metres from the manufacturer's outline drawing), and returning on the south ends of the east and west sides to within 1 meter of the north wall of the steam powerhouse. The barrier should have a minimum solid density of 20 kg/m^2 and be free of gaps and cracks within its full extent. The side facing the transformer should be acoustically absorptive with a minimum Noise Reduction Coefficient ("NRC") rating of 0.7.

Acoustic Enclosures for the Gas Turbines and Generators – Sources CTG 2002 & CTG 2003

The sound power levels listed in Table A1 should be used as maximum sound emission specifications for the enclosures housing the gas turbines, associated generators and exhaust ducts, inclusive of any ventilation-air inlets/outlets or any other openings.

Building Envelope Assemblies – Sources NS-08 to NS-10 & NS-15

The exterior wall and roof assemblies and roll-up door of the steam turbine powerhouse should be designed to meet or exceed the performance listed in Table VI. The interior surface should have a sound absorption rating of at least NRC-0.75.

Table VI: Sound Transmission Loss Requirements – Envelope Components

Octave Band Centre Frequency [Hz]	63	125	250	500	1k	2k	4k	8k
Transmission Loss [dB] – Walls & Roof	12	19	32	40	45	50	50	47
Transmission Loss [dB] – Rollup Door	9	15	18	21	22	22	24	18

Start-up Steam Vents – Sources NS-16 through NS-18

Based on information from Eastern Power and observations at the existing GEPP, it is understood that there will be two vents atop each HRSG that will typically exhaust excess steam during start-up: one hot reheat vent and one low pressure vent per HRSG. Steam vent silencers should be provided for these vents, equipped with diffuser baskets and acoustically absorptive baffles, in order to meet the maximum sound emission levels listed in Table A1.

Emergency Fire Water Pump – Source NS-21

The exhaust outlet of the diesel engine driving the emergency fire water pump should be equipped with a silencer meeting the performance specifications in TableVII.

Table VII: Sound Insertion Loss Requirements – Fire Water Pump Exhaust

Octave Band Centre Frequency [Hz]	63	125	250	500	1k	2k	4k	8k
Dynamic Sound Insertion Loss [dB]	12	17	25	25	25	25	10	10

5 CONCLUSIONS

The analysis indicates that, with the sound level specifications in Appendix A and the noise control recommendations presented in Section 4, above, the sound levels of the HRPP will be within the limits set out in MECP Publication NPC-300.

REFERENCES

1. Google Maps Aerial Imagery, Internet application: *maps.google.com*

2. Ontario Ministry of the Environment and Climate Change. "Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning – Publication NPC-300," August, 2013.

3. Ontario Ministry of the Environment Publication NPC-104, "Adjustments," August 1978.

4. International Organization for Standardization, Standard 9613-2, "Acoustics – Attenuation of Sound during Propagation Outdoors – Part 2: General Method of Calculation," Switzerland, 1996.

5. R. Stevens & C.Hung, "Toward a Realistic Estimate of Octave Band Sound Levels for Electric Transformers", *Canadian Acoustics*, Vol.38, No.1, March, 2010.

Limitations

Figure 1: Scaled Satellite Photograph of Site and Points of Reception

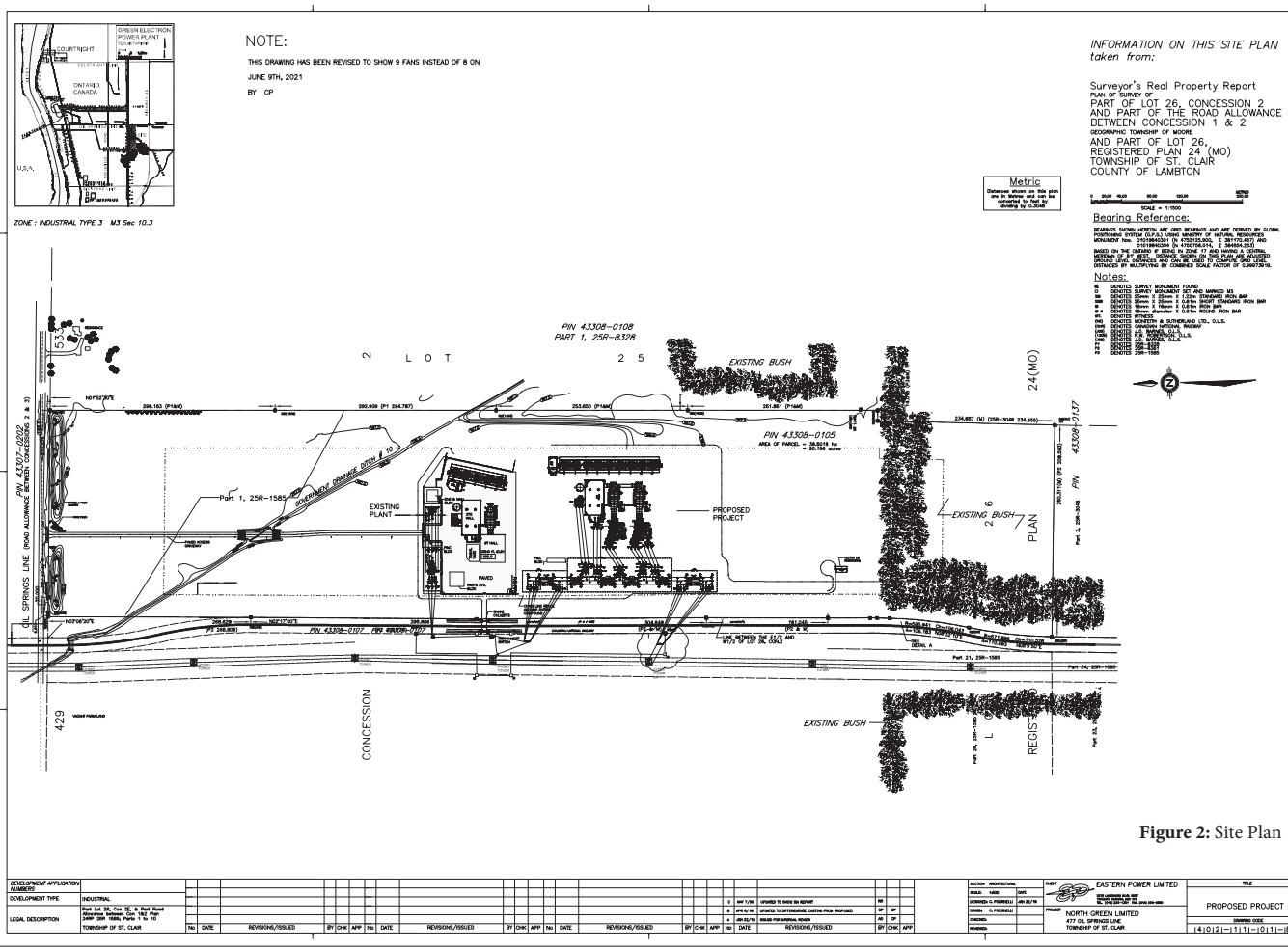

Figure 2: Site Plan

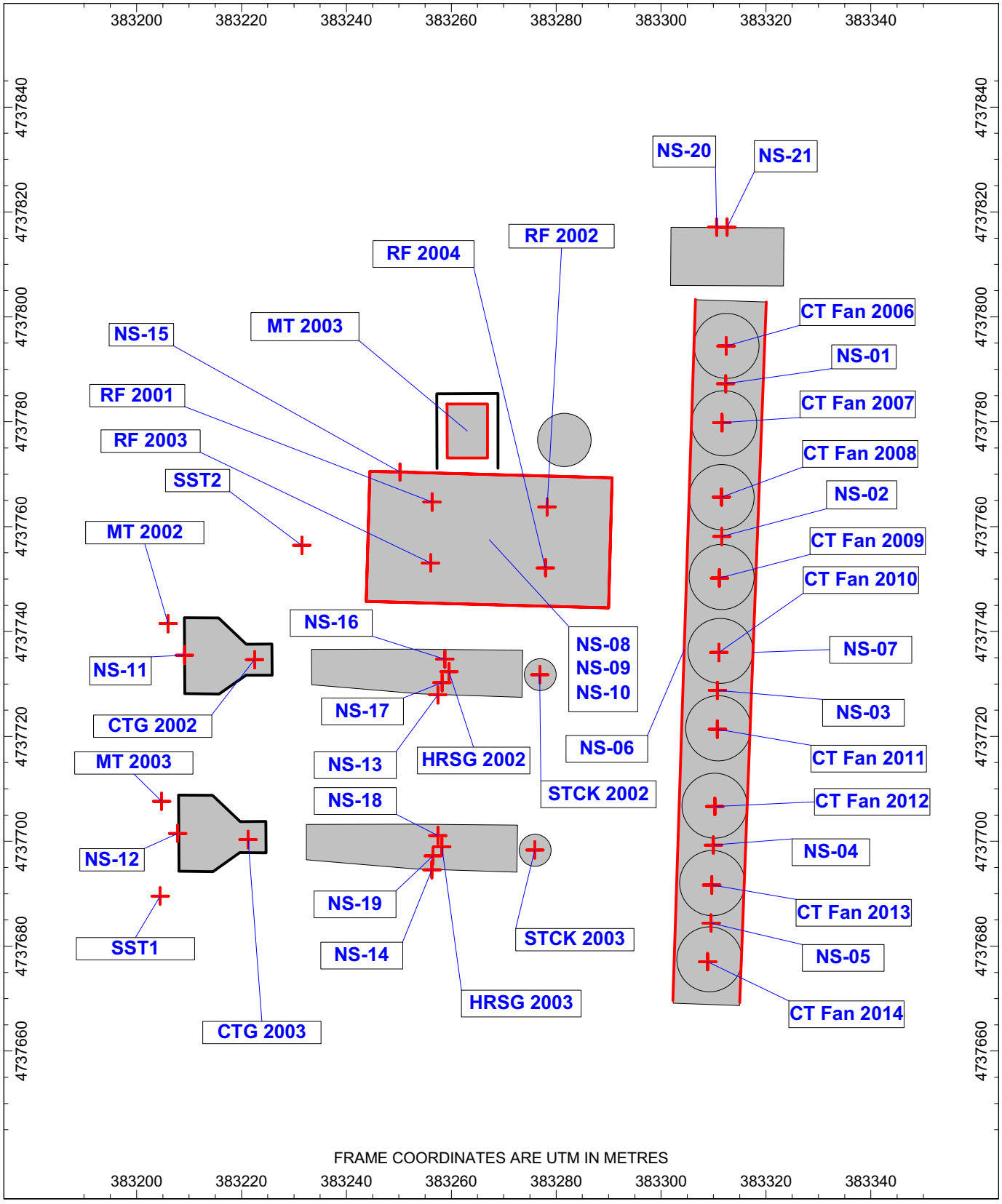

Figure 3: Source Location Diagram

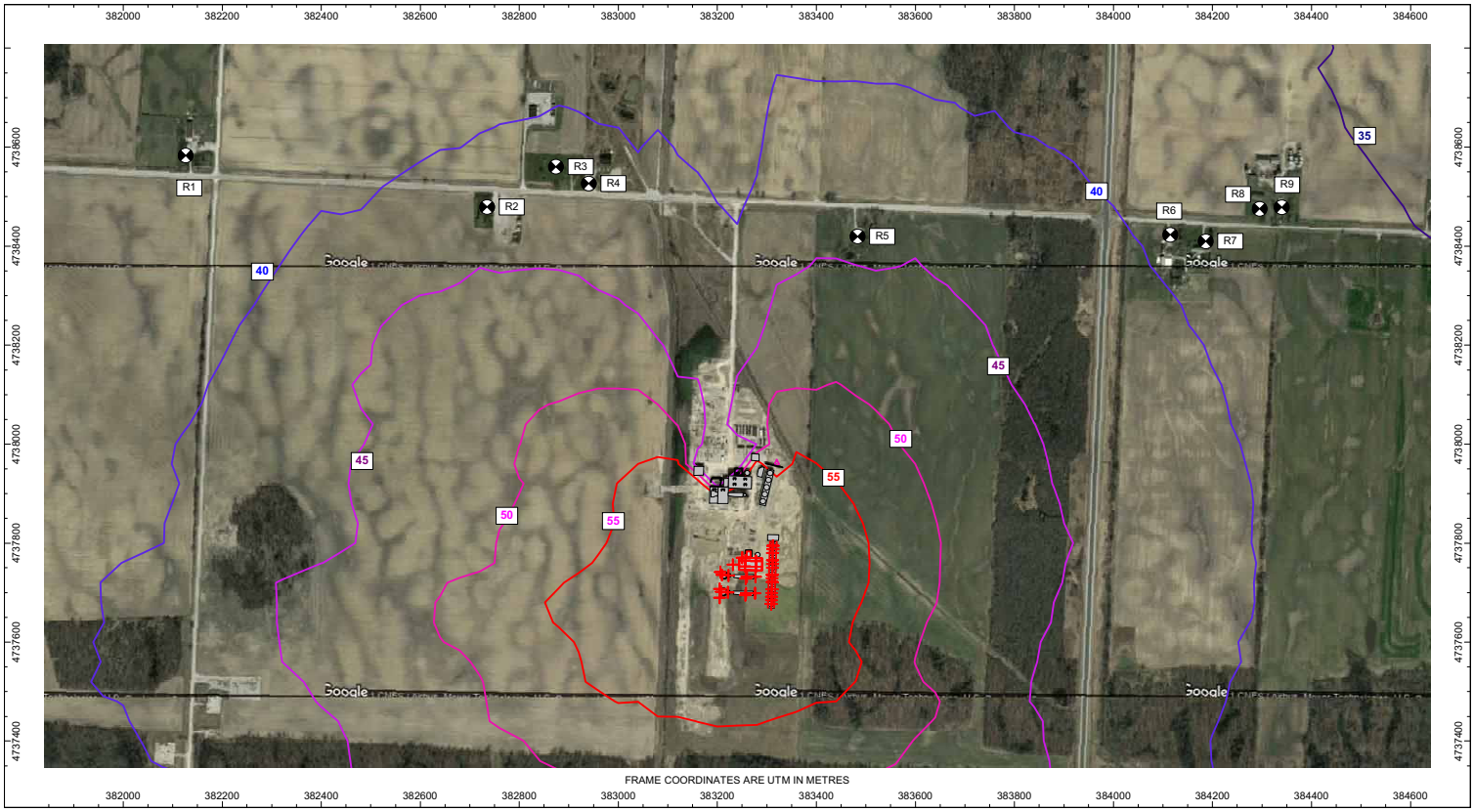

Figure 4: Daytime/Evening Sound Levels, Steady Operations, Leq [dBA]
Contours at 4.5 m Above Grade

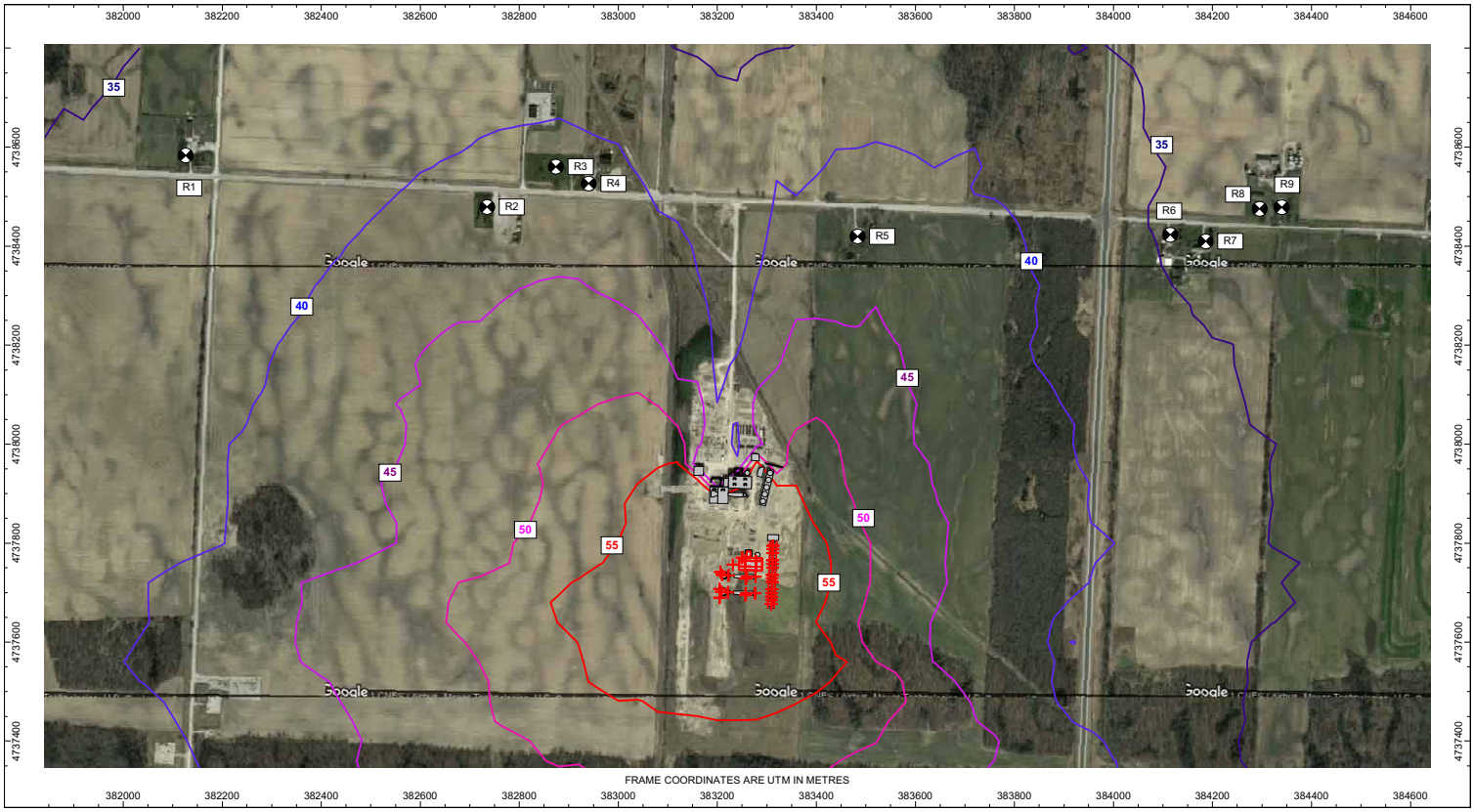

Figure 5: Nighttime Sound Levels, Steady Operations, Leq [dBA]
Contours at 4.5 m Above Grade

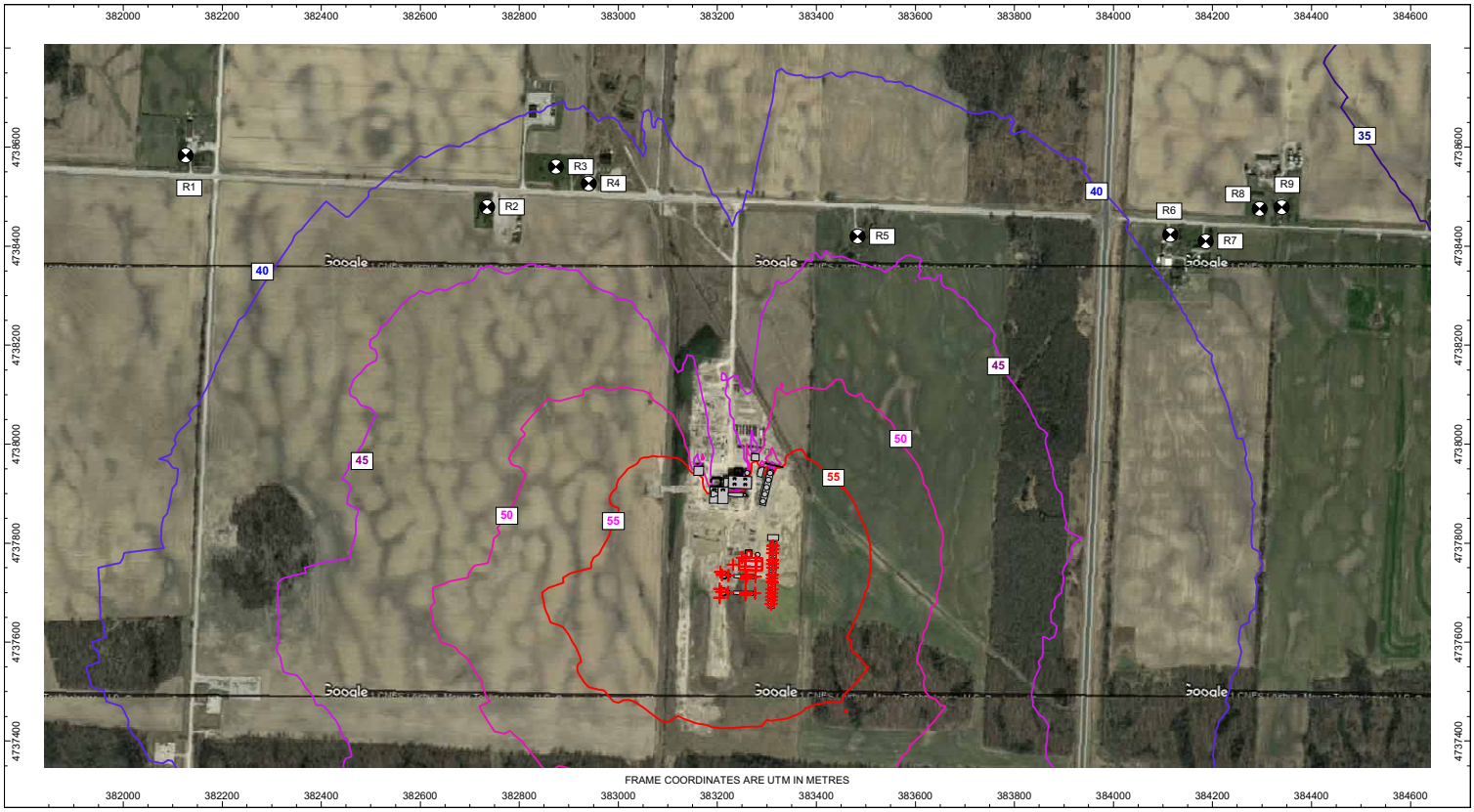

Figure 6: Daytime/Evening Sound Levels, Startup Operations, Leq [dBA]
Contours at 4.5 m Above Grade

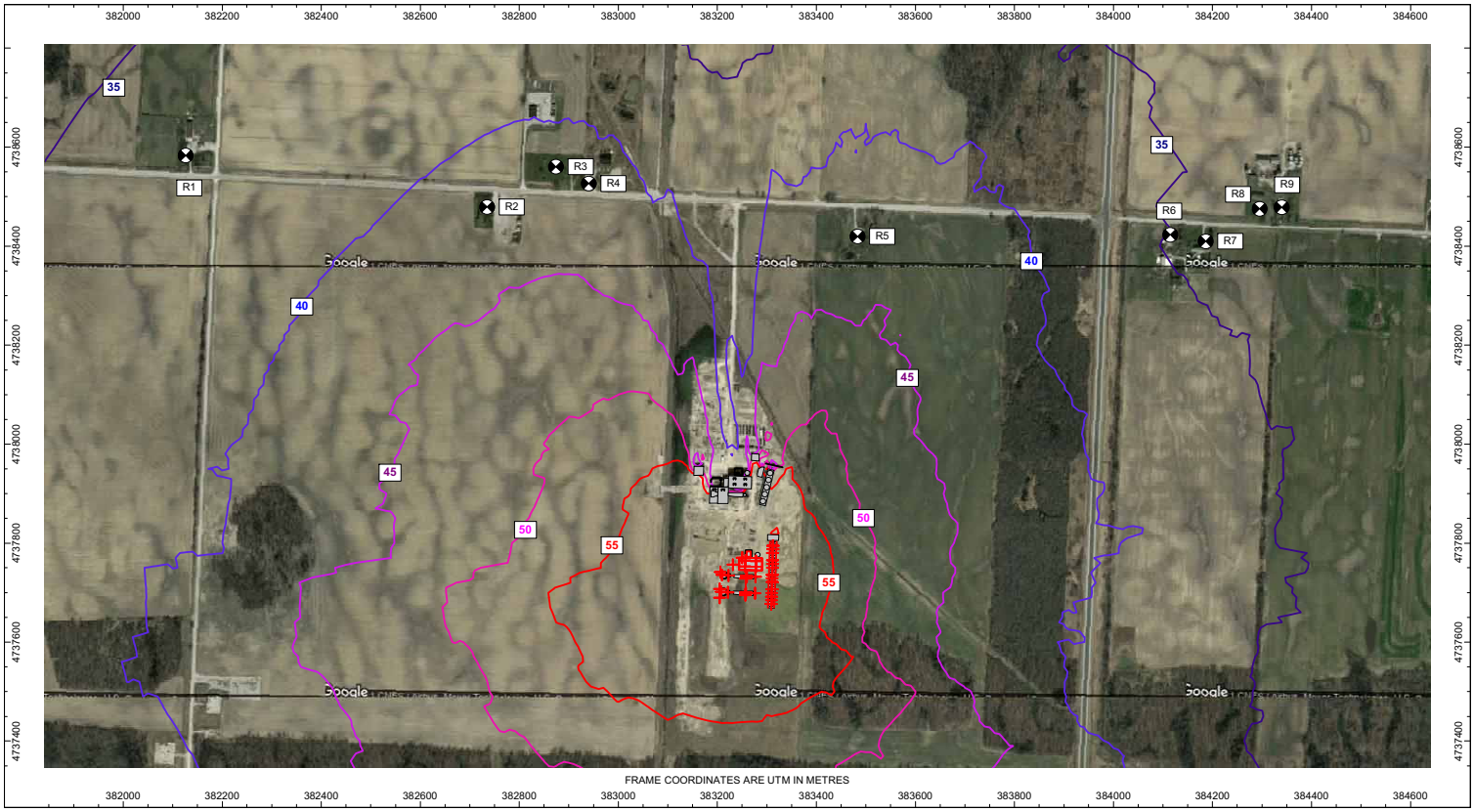

Figure 7: Nighttime Sound Levels, Startup Operations, Leq [dBA]
Contours at 4.5 m Above Grade

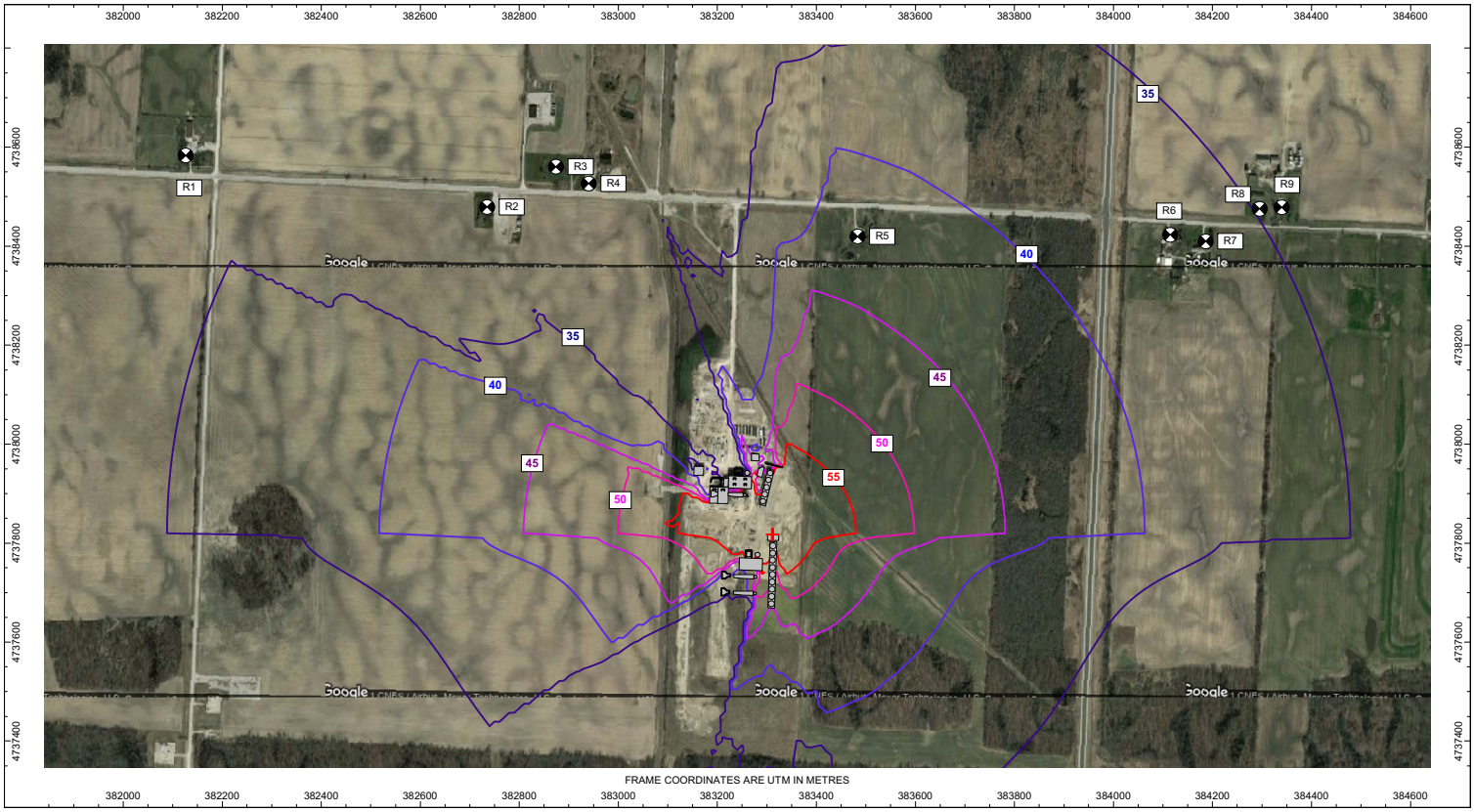

Figure 8: Sound Levels from Daytime Testing of Emergency Equipment, Leq [dBA]
Contours at 4.5 m Above Grade

APPENDIX A

Sound Emission Data

Table A1: Maximum Sound Power Level Specifications [dB re 10^{-12}W]

Source Identifier	Description	Octave Band Centre Frequency [Hz]									Overall
		31	63	125	250	500	1k	2k	4k	8k	LwA
STCK 2002/3	HRSG Exhaust Stack (ea of 2)	117	109	98	96	92	92	94	93	95	101
HRSG 2002/3	HRSG Walls (per ea of 2 HRSGs)	118	115	107	102	100	102	103	99	89	108
CTG 2002/3	Enlcosure: sum of gas turbine, generator & duct (ea of 2)	105	116	109	102	95	97	99	97	92	105
CT Fan 2006-14	Cooling Tower Fan Outlet, Day, Full speed (ea of 9)		111	110	107	103	102	97	92	86	107
CT Fan 2006-14	Cooling Tower Fan Outlet, Day, Low speed (ea of 9)		94	89	84	79	77	70	65	58	82
MT 2002/3	CTG Transformer (ea of 2)	93	97	100	98	98	92	87	82	74	98
MT 2003	STG Transformer	102	106	109	107	107	101	96	91	83	107
RF 2001-4	Powerhouse Rooftop Exhaust Fan (ea of 4)	0	102	96	92	91	89	86	84	81	94
SST1-2	Station Service Transformer (ea of 2)	90	94	97	95	95	89	84	79	71	95
NS-01 to -05	Cooling Tower Fan Motors (ea of 9)			79	83	87	86	82	79	86	91
NS-11 to -12	Gast Turbine Intake System (ea of 2)	122	107	97	88	84	82	83	87	95	96
NS-13	HRSG Duct Burner (ea of 2)	96	86	85	73	72	100	106	105	98	111
NS-16/18	HRSG LP Vent During Startup (ea of 2)	113	108	107	97	91	92	91	108	108	111
NS-17/19	HRSG HRH Vent During Startup (ea of 2)	123	111	105	95	87	92	95	102	107	108
NS-06	Cooling Tower Side Inlet (ea of 2)		74	81	84	97	98	99	104	101	108
--	Steam Turbine System	103	118	126	113	109	109	103	98	94	114