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CONSULTING ENGINEERS
& SCIENTISTS

January 21, 2013

Mr. Bob Schilling
Champlin Architects
424 East Fourth Street
Cincinnati, OH 45202
bob.schilling@thinkchamplin.com

Re: Final Letter - Air Quality and Noise Impact Assessments
New Energy Plant
Jewish Hospital – Mercy Health Center
Kenwood, OH
RWDI #1300959

Dear Bob,

Air quality and noise impact assessments have been completed for the equipment proposed for the New Energy Plant at The Jewish Hospital – Mercy Health Center in Kenwood, OH. This letter summarizes the findings and recommendations for your consideration in order for the design of the plant to move forward. Details on the air quality methodology and design criteria applied in the assessment are included in this letter as Appendices A and B, respectively. Details on the input sound data and predicted impacts are included as Appendices C and D, respectively.

Figure 1 is based on an annotated sketch received from the design team that shows the locations of proposed exhausts and air and noise-sensitive locations considered in the assessments, which include:

- **Exhaust Source A1:** One proposed 2,500 kW emergency diesel generator
- **Exhaust Source A2:** One future 2,500 kW emergency diesel generator
- **Exhaust Sources B1-B2:** Two proposed 600-ton single cell cooling towers
- **Exhaust Sources B3-B4:** Two future 600-ton single cell cooling towers
- **Air and Noise-Sensitive Location R1:** Residence to south of the new Energy Plant
- **Air-Sensitive Location R2:** Penthouse air intake on south façade of existing hospital
- **Air-Sensitive Location R3:** Grade-Level air intake at west end of existing hospital.

It is understood that the second diesel generator (Source A2) and the two additional cooling towers (Sources B3-B4) are proposed for installation at the Energy Plant at some point in the future. A discussion on the air quality and noise implications of these proposed exhausts is included in this letter.

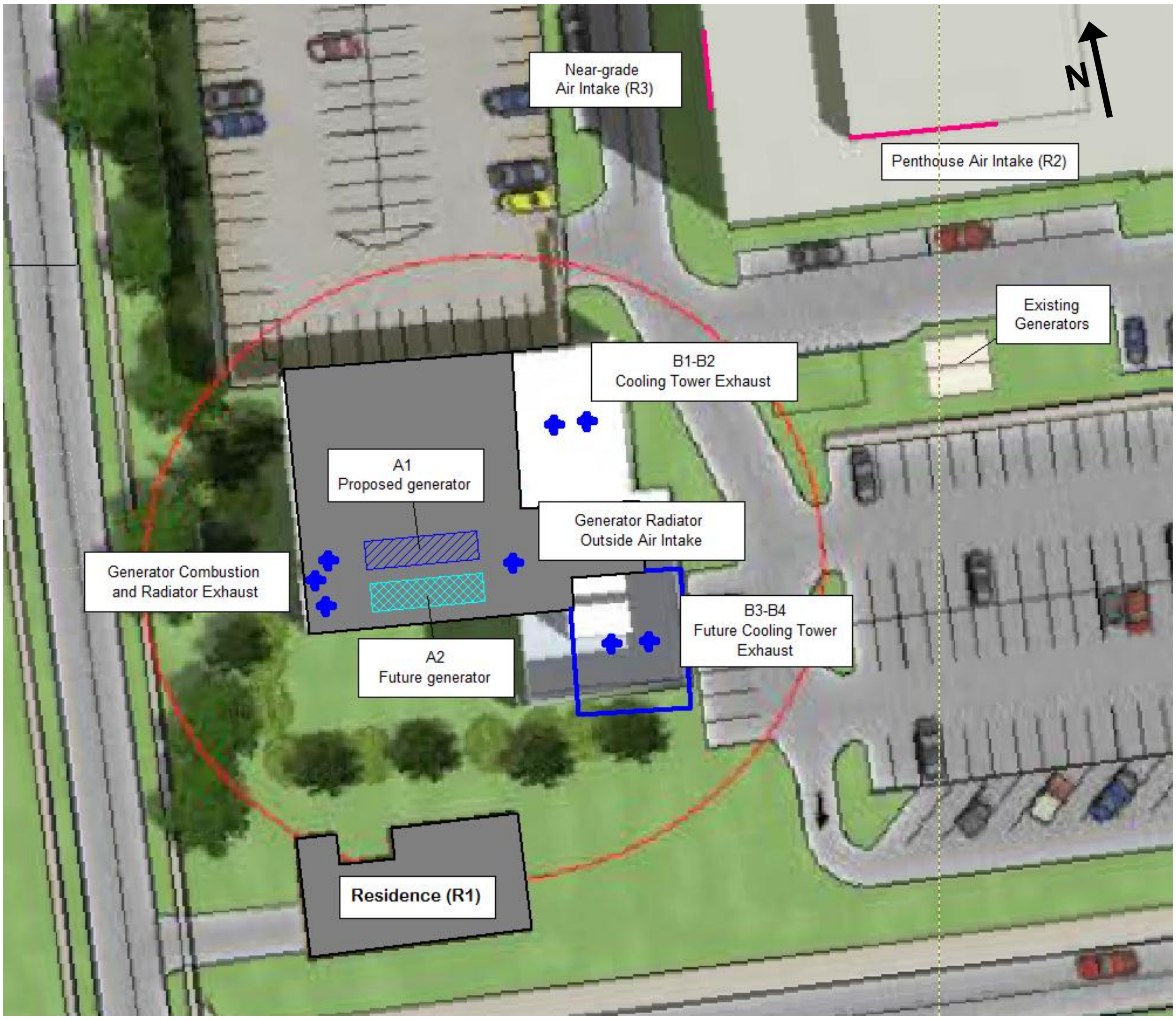

Figure 1: Plan Sketch of Equipment Layout for New Energy Plant

AIR QUALITY IMPACTS

Source A1: Proposed Emergency Diesel Generator

Table 1 summarizes the results of the assessment of the proposed emergency diesel generator (Source A1). Please refer to Appendix A for details on the assessment methodology.

Table 1: Summary of Results for the Proposed Emergency Diesel Generator

Source Label & Description	Operating Scenario	Recommended Dilution Criteria	Worst-Case Dilution Levels	Criteria Met?
Source A1 2,500 kW Emergency Diesel Generator CAT 3516C DM8266 *Stack diameter:* 20 in. *Discharge height:* 8 ft above local roof	**Testing Scenario** 75% Load (assumed) 15,510 cfm & 7,110 fpm	Health: **280:1** Odor: **4,000:1**	**525:1** (R1) **710:1** (R2)	**Yes** (Health) **No** (Odor)
	Emergency Scenario 100% Load 19,050 cfm & 8,730 fpm	Health: **370:1** Odor: **4,000:1**	**520:1** (R1) **640:1** (R2)	**Yes** (Health) **No** (Odor)

As shown in Table 1, RWDI's recommended health criterion to meet air quality standards related to combustion pollutants (refer to Appendix B for discussion on the derivation of this criterion) is met at both the existing residence to the immediate south (Receptor R1) and the hospital penthouse air intake (Receptor R2) for the monthly testing (75% load, approximated from information received from the design team) and emergency (100% load) loading conditions. The weekly no-load test condition was not assessed as it is of less concern. **These findings are based on a vertical and uncapped stack extending 8 ft above the generator room roof. Please note that a 'flip' cap would be acceptable provided it opens fully under all generator loading conditions.**

Occasional diesel odors could present nuisance issues at nearby residences and hospital intakes when the generator operates during certain wind conditions. In particular, north through northeast winds could result in odors at the residence to the immediate south, which occur with an estimated annual frequency of about 10 to 15%. Additionally, light to moderate southwesterly winds could result in odors at the existing hospital penthouse intake, which occur with an estimated annual frequency of about 20%.

Note that these are annual frequencies and do not take generator operation time into account. For instance, if the new generator is load tested once per month for one hour, one would expect approximately 2.5 hours within the year that diesel odors could be detected at the penthouse air intake (12 hours per year x 20% = 2.4 hours per year). However, the design team is not aware of any odor complaints related to the two existing diesel generators situated closer to the penthouse intake (see Figure 1); as a result, odors from the new generator at this intake may not present a concern as it is located farther away from the existing hospital air intakes.

It is understood that an additional diesel generator may be installed in the future, adjacent to the proposed unit (see Source A2 in Figure 1). **To avoid potential health concerns at air-sensitive locations, it is recommended that the future generator have the same exhaust design as the currently proposed unit (vertical and uncapped exhaust 8 ft above the roof) and that the generators not be tested at the same time.**

Sources B1-B2: Proposed Cooling Towers

Table 2 summarizes the results of the assessment of the proposed cooling towers.

Table 2: Summary of Results for the Proposed Cooling Towers

Source Label & Description	Operating Scenario	Recommended Dilution Criterion	Worst-Case Dilution Levels	Criterion Met?
Sources B1-B2 2 x 600 Ton Cooling Towers Marley NC8412 *Fan diameter:* 12 ft *Discharge height:* flush with screen wall (27 ft above grade)	**Peak Loading:** 2 Cells x 65% 106,100 cfm & 940 fpm each	Health & Odor: **10:1**	**35:1** (R1) **12:1** (R2)	**Yes**

As shown in Table 2, RWDI's recommended criterion for cooling tower exhausts (refer to Appendix B for discussion on the derivation of this criterion) is met at the existing residence (Receptor R1) and the penthouse air intake (Receptor R2) when both cooling towers operate at the design team's estimated maximum loading of 65%. **These findings are based on both cooling towers discharging at a height flush with the top of the surrounding screen wall (27 ft above grade).**

It is understood that two additional cooling towers may be installed in the future, at the southeast corner of the energy plant (see Sources B3-B4 in Figure 1). **RWDI recommends the southeast location be pursued for the future towers in order to reduce the frequency of merging of all four plumes which can increase impact concentration levels of air pollutants, potentially causing adverse air quality at sensitive receptors.**

NOISE IMPACTS

Noise Source Summary

Manufacturer's sheets were provided that include sound data for the 600-ton cooling towers (Sources B1 through B4) and 2,500 kW generators (Sources A1 and A2) (see Appendix C). The generators are used for emergency power only. However, testing of the generators occurs during daytime (7 AM – 10 PM) hours only while the cooling towers can operate 24 hours a day. Conservatively, all equipment was modeled as operating at 100% load. However, it is expected the cooling towers will operate at a maximum of 65% load, and the generators will operate at a maximum of 75% load during monthly testing, and 0% load during weekly testing.

Noise reducing options have been previously recommended by a 3rd party noise consultant for both the cooling towers (B1 through B4) and generator (A1 and A2) and were considered in the noise modeling for this assessment. The selected cooling towers include low noise fans, intake and outlet silencers. The 2,500 kW generator includes a combustion silencer, and radiator inlet and outlet silencers. The anticipated performance of these features, have been chosen, to significantly reduce the sound levels of each unit to levels lower than normal.

Four scenarios were developed to describe the proposed installation and the future expansion to the Energy Plant:

1. Proposed installation during Daytime (one 2,500 kW generator testing (Source A1) and two cooling towers operating (Source B1 and B2);
2. Proposed installation during Night-time (two cooling towers operating (Sources B1 and B2) only);
3. Future installation during Daytime (two 2,500 kW generators testing (Sources A1 and A2), and four cooling towers operating (Sources B1 through B4); and
4. Future installation during Night-time (four cooling towers (Sources B1 through B4) only).

Noise Sensitive Receptors

The closest noise sensitive receptor R1 is a single-story residence located approximately 80 ft to the south (see Figure 1). Due to the proximity of the proposed and future sources, the receptor to the south (R1) was used a worst-case representative receptor. Additionally, there are single and two-story residences located approximately 150 ft to the west across Frolic Drive. The predicted sound level at these residences is anticipated to be lower than the receptors noted above.

Assessment Criteria

The Hamilton County Zoning Resolution, dated December 10, 2010, outlines restrictions on noise levels for residential zones. The summary of the sound level limits form the document states:

> "Noise levels must be controlled to prevent sound levels beyond the property line, at locations zoned or used for residential purposes, to exceed 62 decibels (dBA) between the hours of 7:00 AM to 10:00 PM and 52 decibels (dBA) between the hours of 10:00 PM and 7:00 AM."

The predicted sound level of the New Energy Plant, was added to the existing ambient sound levels and the combined results were compared to the sound level limit for the appropriate time of day.

Noise Impact Assessment

Modeling of sound level propagation to the points of reception was completed using Cadna/A, a commercially available implementation of the ISO 9613 algorithms. Cadna/A is produced by Datakustik GmbH. The modeling took into account the following factors:

- Source sound power level and directivity;
- Distance attenuation;
- Source-receptor geometry including heights, elevations and topography;
- Barrier effects of the onsite buildings;
- Ground and air (atmospheric) attenuation; and
- Meteorological effects on sound propagation.

Environmental noise impacts were modeled for daytime (7 AM – 10 PM) and night-time (10 PM – 7 AM) were calculated for the proposed and future installations. For the proposed installation (Scenarios 1 and 2), the sound levels at the property line of the residence to the south (R1) were predicted to be 45 dBA and 29 dBA during the daytime (Scenario 1) and night-time (Scenario 2), respectively. For the future installation (Scenarios 3 and 4), the sound levels at the residence to the south were predicted to be 49 dBA and 35 dBA during the daytime (Scenario 3) and night-time (Scenario 4), respectively. Noise contours (isopleths of equal noise level) have been generated for each of the daytime scenarios (proposed and future installations) and are presented in Appendix D.

Ambient sound measurements were taken by Champlin personnel around the existing hospital with and without existing generators being testing. It was assumed that all other equipment on The Jewish Hospital was operating under normal conditions during measurements. The measurement including generator testing, was assumed to represent daytime conditions and was approximately 55 dBA. The measurement without generator testing, was assumed to represent night-time and was approximately 50 dBA.

The cumulative sound levels from the proposed Energy Plant and the existing hospital operations are predicted to be 55 dBA during daytime and 50 dBA during night-time. Including the future equipment installation and all sources listed above, the predicted sound level is 56 dBA during daytime (Scenario 3) and 50 dBA during night-time (Scenario 4). Hamilton County specifies sound level restrictions of 62 dBA during daytime (7 AM – 10 PM) and 52 dBA during night-time (10 PM – 7 AM). A summary of the predicted sound levels and the applicable guidelines are summarized below in **Table 3.**

Table 3: Summary of Predicted Sound Levels for the New Energy Plant

Time of Day	Installation Scenario	Measured Ambient (dBA)	Predicted Energy Plant Impact (dBA)	Total Predicted Sound Level (dBA)[1]	Sound Level Limit (dBA)	Compliant with limit? (Y/N)
Daytime	Proposed – Scenario 1	55	45	55	62	Y
	Future – Scneario 2		49	56		Y
Night-time	Proposed – Scenario 3	50	29	50	52	Y
	Future-Scenario 4		35	50		Y

Note: [1] This is the logarithmic addition of “Measured Ambient” and “Predicted Energy Plant Impact”.

The predicted sound levels from the cumulative impact (both the proposed and future scenarios of the new Energy Plant and the existing hospital) are expected to meet the The Hamilton County Zoning Resolution noise limits for both daytime and night-time operations at all noise sensitive receptors.

CLOSING

We hope that this letter suits your needs and helps with the completion of the energy plant's design. Please do not to hesitate to contact us if you have any questions or concerns.

Yours very truly,

ROWAN WILLIAMS DAVIES & IRWIN Inc.

John Alberico, M.Sc., CCEP
Senior Project Manager / Principal

Mark Hallman, P.Eng., LEED AP BD&C
Project Engineer

Gillian Redman, MSc.
Project Coordinator

Ray Sinclair, Ph.D.
Project Director / Principal

JJA/kpk

Attach.

APPENDIX A

CONSULTING ENGINEERS
& SCIENTISTS

APPENDIX A: AIR QUALITY ASSESSMENT METHODOLOGY

The potential for air quality concerns from the proposed exhausts was evaluated using numerical dispersion modeling calculations combined with our experience in wind tunnel testing, wind flow around buildings, and knowledge of re-entrainment issues.

The numerical modeling involved the use of a proprietary model developed by RWDI based on the methodologies published in the American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Handbook of Applications. The ASHRAE building-wake dispersion equations are semi-empirical, based on wind tunnel tests on generic building shapes with rooftop exhausts. ASHRAE equations are best suited for receptors on the same roof or lower than the exhaust point.

A proprietary version of a Gaussian plume model was also employed to evaluate elevated receptors that were situated above the exhaust source. This model is patterned after similar models from the U.S. EPA (e.g., ISC PRIME, AERMOD). Since there is some uncertainty in using Gaussian models in the vicinity of buildings, impacts were evaluated over a range of receptor heights.

Numerical dispersion modeling results are presented in the form of exhaust dilution levels (D), which represent the factor by which pollutant concentrations are reduced between the tip of the exhaust (Co) and the receptor location (C):

$$\mathbf{D} = \frac{\mathbf{C_o}}{\mathbf{C}}$$

These dilution levels are compared to design dilution criteria that are applied for design purposes to assess the level of impact from the various exhausts. Appendix B provides additional discussion on the derivation of these criteria.

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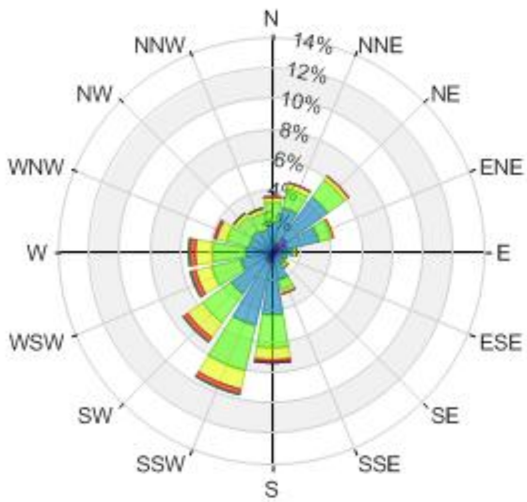
Wind Climate

To understand the probable wind directionality at the project site, wind data from the nearby Lunken Airport were reviewed. A summary of the directional distribution of winds measured at this station over a period from 1989 to 2009 is shown below. The wind directions in the figure refer to the directions from which the wind blows, and the frequency of a given wind direction is shown as a distance radially from the center on an annual basis. Prevailing winds at this meteorological station are primarily from south through west and northeast directions, occurring approximately 35% and 15% of the time on an annual basis, respectively.



Directional Distribution (%) of Winds (Blowing From)
Station: Lunken Airport, OH (1989-2009)

APPENDIX B

APPENDIX B - DISCUSSION OF AIR QUALITY CRITERIA

Source A: Emergency Diesel Generator

Health-Based Criterion

There are different health criteria that can be applied to emergency diesel generators. Several occupational and ambient air quality standards were considered when determining the target criteria for this exhaust. The State of Ohio has adopted the National Ambient Air Quality Standards (NAAQS) published by the Environmental Protection Agency. There are also short-term occupational limits as published by the American Conference of Governmental Industrial Hygienists (ACGIH) and the National Institute for Occupational Safety and Health (NIOSH), which are directly applicable to healthy workers in an occupational setting. The pollutant of concern with generator combustion exhausts is primarily nitrogen dioxide (NO_2). However, since it is a combustion source, the other criteria pollutants (carbon monoxide (CO), particulate matter (PM) and sulfur dioxide (SO_2)) are also a concern.

It is our opinion that the application of the occupational standards may not be sufficiently stringent for the higher risk demographic that can be found in the general population (i.e., children, elderly, or other individuals that are more susceptible to respiratory ailments or other health effects of poor air quality). Several studies, as summarized by the California Environmental Protection Agency[1], have been published citing the acute health effects of NO_2 in humans exposed to varying concentrations in a non-occupational setting. Based on scientific evidence in support of these concerns, we recommend that generator exhausts meet a short-term (one-hour), 'not to exceed' NO_2 limit of 338 $\mu g/m^3$ given that there is the potential for these higher risk groups (i.e., general public) to be exposed to diesel exhaust. The application of this recommended limit is in our opinion more stringent than the NAAQS and occupational standards and should therefore be applied.

For the proposed 2,500 kW generator with U.S. EPA Tier 2-rated emissions, the exhaust must be diluted by a factor of **370:1** at 100% load or **280:1** at 75% load to meet the suggested NO_2 limit. These health-based dilution criteria were developed using not-to-exceed nitrogen oxides (NO_x) emission rates of 6.1 g/bhp-hr at 100% load and 4.9 g/bhp-hr at 75% load.

It is important to note that regulatory modeling has not been undertaken, and we are not aware of specific requirements that may apply for the operation of the generator.

Odor-Based Criterion

Diesel combustion sources such as the emergency generators are very odorous, and require a considerable amount of dilution to meet odor thresholds compared to meeting health-based air quality standards. Odor is very subjective, and there is a varying degree of sensitivity within the human population. It is often very difficult to eliminate diesel odor entirely. Instead, design targets can be used for minimizing detection and objection of the odorous exhaust.

[1] California Environmental Protection Agency (CalEPA), Air Resources Board (ARB) and Office of Environmental Health Hazard Assessment (OEHHA). January 2007. Review of the California Ambient Air Quality Standard for Nitrogen Dioxide. Available online at http://www.arb.ca.gov/research/aaqs/no2-rs/no2tech.pdf

To address odor from diesel generator exhaust, RWDI recommends designing to achieve an exhaust dilution of **4,000:1** at nearby receptors of concern (i.e., the exhaust is diluted 4,000 times before reaching the receptor location). This design target is based on odor panel testing conducted previously by RWDI using field samples from diesel generator exhausts.

The 4,000:1 target corresponds to a 50% detection level (i.e., approximately 50% of the population will be able to detect diesel odor at this dilution level). The 4,000:1 dilution criterion also corresponds to a 20% objection level (i.e., approximately 20% of the population will find the diesel odor objectionable at this dilution level). Table B1 provides the approximate levels of response that could be expected at various levels of dilution for diesel odor based on the odor panel testing.

Table B1: Approximate Levels of Population Response to Diesel Odor

Level of Exhaust Dilution	Diesel Odor Detection Response (% of population)	Diesel Odor Objection Response (% of population)
1,000:1	95 %	90 %
2,000:1	85 %	60 %
4,000:1	50 %	20 %
8,000:1	15 %	< 5 %

The information in the above table can be used to demonstrate the expected strength of diesel odors at various levels of exhaust dilution. Stronger odors elicit higher levels of response, while milder odors elicit lower levels of response. For example, with a dilution on the order of 1,000:1, nearly everyone exposed to the odor can be expected to detect it, with most also finding the odor objectionable. In general, very high levels of dilution are required in order to minimize the level of response to diesel odors.

Sources B1-B2: Cooling Towers

There are two air quality issues associated with cooling tower exhausts: 1) the spread of legionnella bacteria causing Legionnaires' disease (legionellosis); and 2) evaporative emissions of cooling water treatment chemicals. RWDI generally recommends a dilution criterion of **10:1** for cooling tower exhausts. The 10:1 dilution criterion is intended to reduce ambient concentrations of evaporative emissions of cooling water treatment chemicals that are used to control scaling and biological growth (such as legionella bacteria) in the cooling tower system. The 10:1 criterion does not apply to the control of Legionnaires' disease. The most effective control against Legionnaires' disease is to reduce the growth of bacteria by use of treatment chemicals. An effective design will allow the use of these chemicals without concern for re-entrainment impacts at nearby pedestrian areas or air intakes. To reduce the potential for Legionnaires' disease, we recommend following the guidelines and suggested maintenance practices outlined by ASHRAE[2] and the Cooling Technology Institute[3] for all cooling towers.

2 ASHRAE. Guideline 12-2000. Minimizing the Risk of Legionellosis Associated with Building Water Systems. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, Georgia

3 Cooling Technology Institute. July 2008. Legionellosis Guideline: Best Practices for Control of Legionella.

Air pollutant emissions (resulting from the treatment chemicals used) from cooling towers can adversely affect indoor air quality through exhaust re-entrainment at nearby air intakes and can also affect ground level pedestrian areas in close proximity to the cooling towers. The air pollutants are primarily emitted from the cooling towers in gaseous form as part of the evaporative exhaust plume. A small amount (< 10% of the total) of the pollutants can also be discharged in the form of water droplets. These droplets can contain dissolved particulate and chemical additives and will drop out of the exhaust airstreams downwind of the tower. The release of these water droplets from cooling towers is often referred to as drift loss.

The design of cooling towers includes drift eliminators: a series of baffles that serve to reduce the release of water droplets from the towers. The efficiency of modern drift eliminators can reduce this drift loss to less than 0.0005% of the circulating water flow. However, drift loss from an existing cooling tower or a tower with less efficient drift eliminators can be as high as 0.2% of the circulating water flow. **In general, the modeling and prediction of potential impacts from cooling towers focuses on the concentration of the gaseous-phase emissions contained in the exhaust air plume from the cooling towers.**

Vanderheyden and Schuyler[4] provided a range of required dilutions based on the gaseous-phase emissions for commonly used cooling tower treatment chemicals. Based on their data, the 10:1 criterion meets the dilution requirements for the majority of commonly used treatment chemicals, assuming that odorous chemicals (such as glutaraldehydes and chlorines) are not used. The actual dilution that is needed for a given cooling tower system depends on the type of treatment chemicals being used, the concentration of the chemicals in the cooling water and the air quality criteria that are applied (e.g., occupational health limits, state legislated air toxics limits, or published odor thresholds).

In general, we recommend that less toxic and low odor chemicals be used in water treatment programs where available. We do not recommend designing cooling towers for a dilution of less than 10:1 due to the higher potential risk associated with these levels of dilution (health and odor from chemicals, moisture loading, etc.).

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[4] Vanderheyden, M.D., and Schuyler, G,D., 1994. Evaluation and Quantification of the Impact of Cooling Tower Emission on Indoor Air Quality. ASHRAE Transactions.

APPENDIX C

UPDATE™ Version 4.14.9
Product Data: 5/31/2012 (Current)

10/23/2012 11:16:06 AM

Job Information

Selected By

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Tel 513-527-2300
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Cooling Tower Definition

Manufacturer	Marley	Fan Motor Speed	1200 rpm
Product	NC Steel	Fan Motor Capacity per cell	20.00 BHp
Model	NC8412QTN1	Fan Motor Output per cell	20.00 BHp
Cells	1	Fan Motor Output total	20.00 BHp
CTI Certified	Yes	Air Flow per cell	163200 cfm
Fan	12.00 ft, 8 Blades	Air Flow total	163200 cfm
Fan Speed	160 rpm, 6031.9 fpm	Static Lift	19.19 ft
Fans per cell	1	Distribution Head Loss	0.00 ft
		ASHRAE 90.1 Performance	117 gpm/Hp

Model Group: Quiet Fan w/ 4 ft Inlet & 4 ft Outlet Attenuators (T)
Sound Pressure Level: 56 dBA (Single Cell), 5.00 ft from Air Inlet Face. See sound report for details.

Conditions

Tower Water Flow	1200 gpm	Air Density In	0.07094 lb/ft³
Hot Water Temperature	100.00 °F	Air Density Out	0.07091 lb/ft³
Range	15.00 °F	Humidity Ratio In	0.01712
Cold Water Temperature	85.00 °F	Humidity Ratio Out	0.03084
Approach	7.00 °F	Wet-Bulb Temp. Out	89.66 °F
Wet-Bulb Temperature	78.00 °F	Estimated Evaporation	18 gpm
Relative Humidity	50.0 %	Total Heat Rejection	8964300 Btu/h
Capacity	131.8 %		

- This selection satisfies your design conditions.

Weights & Dimensions

	Per Cell	Total
Shipping Weight	32030 lb	32030 lb
Heaviest Section	10750 lb	
Max Operating Weight	57130 lb	57130 lb
Width	31.50 ft	31.50 ft
Length	13.90 ft	13.90 ft
Height	22.92 ft	

Weights and dimensions do not include options; refer to sales drawings.

Minimum Enclosure Clearance

Clearance required on air inlet sides of tower without altering performance. Assumes no air from below tower.

Solid Wall	4.40 ft
50 % Open Wall	3.00 ft

Cold Weather Operation

Heater Sizing (to prevent freezing in the collection basin during periods of shutdown)

Heater kW/Cell	30.0	24.0	18.0	15.0	12.0	9.0	7.5
Ambient Temperature °F	-19.70	-6.98	5.75	12.11	18.47	24.83	28.01

UPDATE™ Version 4.14.9
Product Data: 5/31/2012 (Current)

10/23/2012 11:19:02 AM

Job Information

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lmh@stoermer-anderson.com

Tel 513-527-2300
Fax 513-527-2306

Cooling Tower Definition

Manufacturer	Marley	Fan Speed (100.0 %)	160 rpm
Product	NC Steel	Fan Tip Speed (100.0 %)	6031.9 fpm
Model	NC8412QTN1	Fan Motor Speed (100.0 %)	1200 rpm
Cells	1	Fan Motor Capacity per cell	20.00 BHp
Fan	12.00 ft, 8 Blades	Fan Motor Output per cell	20.00 BHp
Fans per cell	1	Fan Motor Output total	20.00 BHp

Model Group Quiet Fan w/ 4 ft Inlet & 4 ft Outlet Attenuators (T)

Sound

1-Cell sound data for an unobstructed environment.

Sound Pressure Level (SPL) expressed in dB (re: 20x10-6 Pa)
Sound Power Level (PWL) expressed in dB (re: 1x10-12 watts)

		Octave Band Center Frequency (Hz)								Overall
Distance	Location	63	125	250	500	1000	2000	4000	8000	dBA
50.00 ft	Air Inlet Face SPL	52	49	46	41	39	40	33	26	46
50.00 ft	Cased Face SPL	55	47	47	46	47	44	36	25	51
50.00 ft	Fan Discharge SPL	59	54	51	48	46	46	41	30	52
	Tower PWL	88	83	81	78	78	76	69	60	82

Notes

- Sound Pressure Levels at Fan Discharge are measured on the cased face side opposite the motor, far enough outside the air stream to prevent air noise from affecting the reading.
- Sound data is in accordance with ATC-128.

Performance Number: DM8266 **Change Level:** 04

Sales Model: 3516C
Application: PACKAGED GENSET
Rating Level: STANDBY

Rated Speed (RPM): 1,800
Rated Power (BKW): 2,710.0
Rated Power (BHP): 3,634

EXHAUST Sound Pressure Data (OBCF) **Distance: 1.5 Meters (4.9 Feet)**

GENSET POWER WITH FAN EKW	PERCENT LOAD %	ENGINE POWER BKW	ENGINE POWER BHP	OVERALL DB(A)	125 HZ DB	250 HZ DB	500 HZ DB	1000 HZ DB	2000 HZ DB	4000 HZ DB	8000 HZ DB
2,500.0	100	2,709.3	3,633	119	124	120	112	110	112	111	110
2,250.0	90	2,448.5	3,283	118	123	119	111	109	111	110	108
2,000.0	80	2,188.3	2,935	117	122	118	110	108	109	109	107
1,875.0	75	2,058.3	2,760	116	121	117	109	108	109	109	107
1,750.0	70	1,928.1	2,586	115	120	116	108	107	108	108	106
1,500.0	60	1,668.3	2,237	114	119	115	107	106	107	107	105
1,250.0	50	1,408.6	1,889	113	118	114	106	104	106	105	103
1,000.0	40	1,153.2	1,547	111	116	112	104	103	104	104	102
750.0	30	896.9	1,203	110	115	111	103	101	102	102	100
625.0	25	767.6	1,029	109	114	110	102	100	101	101	99
500.0	20	636.9	854	108	113	109	101	99	100	100	98
250.0	10	370.5	497	105	110	106	98	97	98	98	96

EXHAUST Sound Pressure Data (OBCF) **Distance: 7 Meters (23.0 Feet)**

GENSET POWER WITH FAN EKW	PERCENT LOAD %	ENGINE POWER BKW	ENGINE POWER BHP	OVERALL DB(A)	125 HZ DB	250 HZ DB	500 HZ DB	1000 HZ DB	2000 HZ DB	4000 HZ DB	8000 HZ DB
2,500.0	100	2,709.3	3,633	105	113	108	99	97	98	98	95
2,250.0	90	2,448.5	3,283	104	112	107	98	96	97	97	94
2,000.0	80	2,188.3	2,935	103	111	105	97	95	96	96	93
1,875.0	75	2,058.3	2,760	103	111	105	96	95	95	95	92
1,750.0	70	1,928.1	2,586	102	110	104	96	94	95	95	92
1,500.0	60	1,668.3	2,237	101	109	103	94	93	93	93	91
1,250.0	50	1,408.6	1,889	99	107	102	93	91	92	92	89
1,000.0	40	1,153.2	1,547	98	106	100	92	90	91	90	88
750.0	30	896.9	1,203	96	104	98	90	88	89	89	86
625.0	25	767.6	1,029	95	103	97	89	87	88	88	85
500.0	20	636.9	854	94	102	96	88	86	87	87	84
250.0	10	370.5	497	92	100	94	85	84	85	84	82

EXHAUST Sound Pressure Data (OBCF) **Distance: 15 Meters (49.2 Feet)**

GENSET POWER WITH FAN EKW	PERCENT LOAD %	ENGINE POWER BKW	ENGINE POWER BHP	OVERALL DB(A)	125 HZ DB	250 HZ DB	500 HZ DB	1000 HZ DB	2000 HZ DB	4000 HZ DB	8000 HZ DB
2,500.0	100	2,709.3	3,633	99	107	101	92	91	92	91	89
2,250.0	90	2,448.5	3,283	98	106	100	91	90	90	90	88
2,000.0	80	2,188.3	2,935	97	105	99	90	89	89	89	86
1,875.0	75	2,058.3	2,760	96	104	98	90	88	89	89	86
1,750.0	70	1,928.1	2,586	95	103	98	89	87	88	88	85
1,500.0	60	1,668.3	2,237	94	102	96	88	86	87	87	84
1,250.0	50	1,408.6	1,889	93	101	95	86	85	85	85	83
1,000.0	40	1,153.2	1,547	91	99	93	85	83	84	84	81
750.0	30	896.9	1,203	90	98	92	83	82	82	82	79
625.0	25	767.6	1,029	89	97	91	82	81	81	81	78
500.0	20	636.9	854	88	96	90	81	80	80	80	77
250.0	10	370.5	497	85	93	87	79	77	78	78	75

Performance Number: DM8266 **Change Level:** 04

Sales Model: 3516C
Application: PACKAGED GENSET
Rating Level: STANDBY

Rated Speed (RPM): 1,800
Rated Power (BKW): 2,710.0
Rated Power (BHP): 3,634

MECHANICAL Sound Pressure Data (OBCF) **Distance: 1 Meters (3.3 Feet)**

GENSET POWER WITH FAN EKW	PERCENT LOAD %	ENGINE POWER BKW	ENGINE POWER BHP	OVERALL DB(A)	125 HZ DB	250 HZ DB	500 HZ DB	1000 HZ DB	2000 HZ DB	4000 HZ DB	8000 HZ DB
2,500.0	100	2,709.3	3,633	105	100	101	99	100	101	99	103
2,250.0	90	2,448.5	3,283	105	100	101	99	100	101	99	103
2,000.0	80	2,188.3	2,935	105	100	101	99	100	101	99	103
1,875.0	75	2,058.3	2,760	105	100	101	99	100	101	99	103
1,750.0	70	1,928.1	2,586	105	100	101	99	100	101	99	103
1,500.0	60	1,668.3	2,237	105	100	101	99	100	101	99	103
1,250.0	50	1,408.6	1,889	105	100	101	99	100	101	99	103
1,000.0	40	1,153.2	1,547	105	100	101	99	100	101	99	103
750.0	30	896.9	1,203	105	100	101	99	100	101	99	103
625.0	25	767.6	1,029	105	100	101	99	100	101	99	103
500.0	20	636.9	854	105	100	101	99	100	101	99	103
250.0	10	370.5	497	105	100	101	99	100	101	99	103

MECHANICAL Sound Pressure Data (OBCF) **Distance: 7 Meters (23.0 Feet)**

GENSET POWER WITH FAN EKW	PERCENT LOAD %	ENGINE POWER BKW	ENGINE POWER BHP	OVERALL DB(A)	125 HZ DB	250 HZ DB	500 HZ DB	1000 HZ DB	2000 HZ DB	4000 HZ DB	8000 HZ DB
2,500.0	100	2,709.3	3,633	94	88	89	87	89	90	87	91
2,250.0	90	2,448.5	3,283	94	88	89	87	89	90	87	91
2,000.0	80	2,188.3	2,935	94	88	89	87	89	90	87	91
1,875.0	75	2,058.3	2,760	94	88	89	87	89	90	87	91
1,750.0	70	1,928.1	2,586	94	88	89	87	89	90	87	91
1,500.0	60	1,668.3	2,237	94	88	89	87	89	90	87	91
1,250.0	50	1,408.6	1,889	94	88	89	87	89	90	87	91
1,000.0	40	1,153.2	1,547	94	88	89	87	89	90	87	91
750.0	30	896.9	1,203	94	88	89	87	89	90	87	91
625.0	25	767.6	1,029	94	88	89	87	89	90	87	91
500.0	20	636.9	854	94	88	89	87	89	90	87	91
250.0	10	370.5	497	94	88	89	87	89	90	87	91

MECHANICAL Sound Pressure Data (OBCF) **Distance: 15 Meters (49.2 Feet)**

GENSET POWER WITH FAN EKW	PERCENT LOAD %	ENGINE POWER BKW	ENGINE POWER BHP	OVERALL DB(A)	125 HZ DB	250 HZ DB	500 HZ DB	1000 HZ DB	2000 HZ DB	4000 HZ DB	8000 HZ DB
2,500.0	100	2,709.3	3,633	88	83	84	82	83	84	82	86
2,250.0	90	2,448.5	3,283	88	83	84	82	83	84	82	86
2,000.0	80	2,188.3	2,935	88	83	84	82	83	84	82	86
1,875.0	75	2,058.3	2,760	88	83	84	82	83	84	82	86
1,750.0	70	1,928.1	2,586	88	83	84	82	83	84	82	86
1,500.0	60	1,668.3	2,237	88	83	84	82	83	84	82	86
1,250.0	50	1,408.6	1,889	88	83	84	82	83	84	82	86
1,000.0	40	1,153.2	1,547	88	83	84	82	83	84	82	86
750.0	30	896.9	1,203	88	83	84	82	83	84	82	86
625.0	25	767.6	1,029	88	83	84	82	83	84	82	86
500.0	20	636.9	854	88	83	84	82	83	84	82	86
250.0	10	370.5	497	88	83	84	82	83	84	82	86

SPECTRA TECH

Champlin: Jewish Hospital Kenwood Utility Courtyard Noise Calcualtions revised 11/05/12 10:30 AM

ORDER OF MAGNITUDE estimate of Utility Courtyard noise and transmission to bldg & property line

Generator Stack Noise Level @ 15 m (49.2') - 60 degrees (at Frolic Drive property line)

FREQUENCY:	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	COMBINED dBA	COMBINED dB
97 dBA stack noise spectrum @15 m -2000KW load - one unit - dB unhoused exhaust (no muffler) - data obtained from manufacturer	105	105	99	90	89	89	89	86		
Attenuation values for GT Exhaust EXTREME Muffler	-46	-50	-50	-49	-48	-47	-41	-47		
Adder for multiple (4) generator units	6	6	6	6	6	6	6	6		
6 dB adder for 2 reflective surfaces (driveway + 1 wall)	6	6	6	6	6	6	6	6		
Total Unweighted noise SPL @ 15 m - 60 degrees from vertical - dB	71	67	61	53	53	54	60	51		
Attenuation values for GT Exhaust Super Critical Muffler in series (50%)	-20	-23	-23	-22	-21	-21	-21	-21		
Total Unweighted noise SPL @ 15 m - with 2 mufflers in series	51	44	38	31	32	33	39	30		52 dB
dB to dBA correction	-26	-16	-9	-3	0	1	1	1		
Radiated noise estimate @ 15 m - 60 degrees from vertical - dBA	25	28	29	28	32	34	40	31	43 dBA	

GENERATOR COMBUSTION EXHAUST SILENCER.

Generator Mechanical Noise Level @ 15 m (49.2') - 60 degrees (at Frolic Drive property line) discharged through concrete building wall

FREQUENCY:	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		
88 dBA mech noise spectrum @15 m -2000KW load - one unit - dB data obtained from manufacturer	80	83	84	82	83	84	82	86		
Adder for multiple (4) generator units	6	6	6	6	6	6	6	6		
6 dB adder for 2 reflective surfaces (driveway + 1 wall)	6	6	6	6	6	6	6	6		
Attenuation provided by 4" solid concrete wall (addition)	-35	-36	-36	-41	-45	-50	-54	-58		
Attenuation provided by interior wall absorption (2 surfaces)	-5	-5	-5	-5	-5	-5	-5	-5		
Total Unweighted noise SPL @ 15 m - 60 degrees from vertical - dB	53	55	56	49	46	42	36	36		60 dB
dB to dBA correction	-26	-16	-9	-3	0	1	1	1		
Radiated noise estimate @ 15 m - 60 degrees from vertical - dBA	27	39	47	46	46	43	37	37	52 dBA	

SPX Estimate - NC8412QTN1 Cooling Tower (4' inlet + 4' outlet silencers) Noise Level @ 50'

58 dBA noise spectrum @50' -76% speed - dB ** (combined 1 cell data obtained from SPX design program)	55	51	47	43	42	45	36	26		
Adder for 4 units	6	6	6	6	6	6	6	6		
6 dB adder for 2 reflective surfaces (street + 1 wall)	6	6	6	6	6	6	6	6		
Deduct for absorptive treatment on all exterior reflective surfaces	-6	-6	-6	-6	-6	-6	-6	-6		
Total Unweighted noise SPL @ 50' - 90 degrees from vertical - dB	61	57	53	49	48	51	42	32		64 dB
dB to dBA correction	-26	-16	-9	-3	0	1	1	1		
Total A-weighted noise SPL @ 50' - 90 degrees from vertical - dBA	35	41	44	46	48	52	43	33	55 dBA	

(**these dB values are the best option from prior Mercy Hospital West project

Generator Mechanical Noise Level @ 15 m (49.2') - 60 degrees (at Frolic Drive property line) discharged through intake & exhaust openings

FREQUENCY:	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		
88 dBA mech noise spectrum @15 m -2000KW load - one unit - dB data obtained from manufacturer	80	83	84	82	83	84	82	86		
Adder for multiple (4) generator units	6	6	6	6	6	6	6	6		
3 dB adder for 1 reflective surface (street)	3	3	3	3	3	3	3	3		
Install 6' Kinetics baffle silencers in shaft	-10	-15	-21	-23	-24	-18	-24	-24		
Attenuation provided by interior wall absorption (2 surfaces)	-5	-5	-5	-5	-5	-5	-5	-5		
Total Unweighted noise SPL @ 15 m - 60 degrees from vertical - dB	75	73	68	64	64	71	63	67		79 dB
dB to dBA correction	-26	-16	-9	-3	0	1	1	1		
Radiated noise estimate @ 15 m - 60 degrees from vertical - dBA	49	57	59	61	64	72	64	68		
									75 dBA	

ESTIMATED COMBINED NOISE LEVELS - 4 gensets + 4 cooling towers: 75 dBA 79 dB

PRESENT AMBIENT NOISE AT SITE (per noise tests on 11/01/12 @ 12:30 - 1:00 PM) 52 dB

ESTIMATED NOISE INCREASE RESULTING FROM PROPOSED GENSETS + COOLING TOWERS @ Frolic Dr. property line: 27 dB

Kenwood / Sycamore Township Noise Limitations Likely Applicable 7 AM to 10 PM 62 dBA

ESTIMATED NOISE EXCEEDANCE RESULTING FROM PROPOSED GENSETS + COOLING TOWERS @ Frolic Dr. property line: 13 dBA

Kenwood / Sycamore Township Noise Limitations Likely Applicable 10 PM to 7 AM 52 dBA

ESTIMATED NOISE EXCEEDANCE RESULTING FROM PROPOSED GENSETS + COOLING TOWERS @ Frolic Dr. property line: 23 dBA

STRAIGHT RECTANGULAR SILENCER SUBMITTAL

KINETICS Noise Control

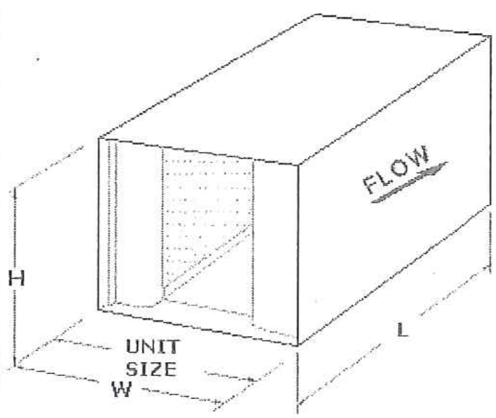
PROJECT DETAILS	
Project Number:	121110S
Project Name:	Project ----X----
Customer:	K & W - Jim Shirk
Project Date:	November/15/12
Revision No:	
Revision Date:	

SILENCER DIMENSIONS (in)	
Tag:	SA-1-straight
Qty:	4
System:	Genset Radiator Discharge
Width:	144
Height:	144
Length:	132
Model:	48VRS-F/0.5-132x144x144
Weight (lb):	6921
VRS Type:	0.5
Unit Size:	48

Face Velocity (fpm):	378
Flow Volume (CFM):	54491
Pressure drop (in wg):	0.07
SILENCER MODULE DIMENSIONS (in)	
Qty of Pieces:	9
W:	48
H:	48
L:	132
Weight each (lb):	769

APPROXIMATELY 50% OF AIRFLOW PER GENERATOR

Dynamic Insertion Loss		Airflow Generated Noise	
Hz	**dB**	**Hz**	**dB**
63:	34	**63:**	55
125:	36	**125:**	50
250:	42	**250:**	43
500:	54	**500:**	41
1000:	54	**1000:**	42
2000:	56	**2000:**	43
4000:	27	**4000:**	41
8000:	22	**8000:**	39



- Silencer dimensions to be confirmed by customer prior to fabrication.
- The installed silencer pressure drop may be higher due to system effects caused by the location of duct elements upstream and downstream of the silencer.
- Tolerances are ±1/8" on all silencer units. If silencers are banked or paired the compounded tolerance needs to be allotted by the contractor.
- Silencer acoustic and aerodynamic performance data are in accordance with ASTM E 477-06a.
- Flame spread/smoke developed indexes in accordance with ASTM C 1071-05
- Tested data tolerances are in accordance with AMCA 1011-03.
- Any structural support steel required for banked silencers to be provided by others.

Notes:

SILENCER CONSTRUCTION OPTIONS	
Casing Thickness:	16 gauge
Perforated Lining Thickness:	22 gauge
Material:	Galvanized steel
Acoustic Media:	Fiberglass (standard)
Media Covering:	None
Inlet connection:	2 in slip connection (standard)
Outlet connection:	2 in slip connection (standard)
Seams locked and caulked:	Yes

Version 11.00

STRAIGHT RECTANGULAR SILENCER SUBMITTAL

KINETICS Noise Control

PROJECT DETAILS	
Project Number:	121110S
Project Name:	Project ----X----
Customer:	K & W - Jim Shirk
Project Date:	November/15/12
Revision No:	
Revision Date:	

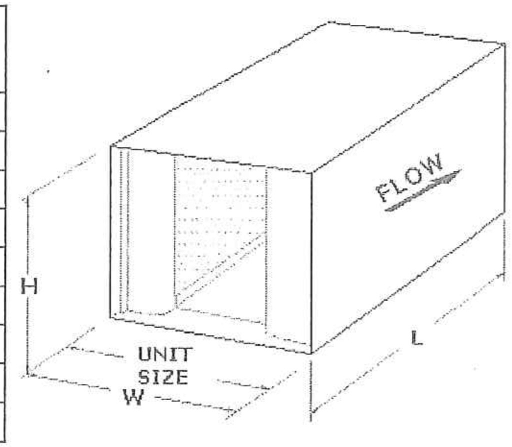
SILENCER DIMENSIONS (in)	
Tag:	RA-1-straight
Qty:	4
System:	Genset OA Intake
Width:	144
Height:	144
Length:	132
Model:	48VRS-F/0.5-132x144x144
Weight (lb):	6921
VRS Type:	0.5
Unit Size:	48

Face Velocity (fpm):	-378
Flow Volume (CFM):	54491
Pressure drop (in wg):	0.07

SILENCER MODULE DIMENSIONS (in)	
Qty of Pieces:	9
W:	48
H:	48
L:	132
Weight each (lb):	769

APPROXIMATELY 50% OF AIRFLOW PER GENERATOR

Dynamic Insertion Loss		Airflow Generated Noise	
Hz	dB	Hz	dB
63:	35	63:	52
125:	37	125:	48
250:	43	250:	46
500:	55	500:	48
1000:	55	1000:	51
2000:	55	2000:	51
4000:	28	4000:	48
8000:	22	8000:	45



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Notes:

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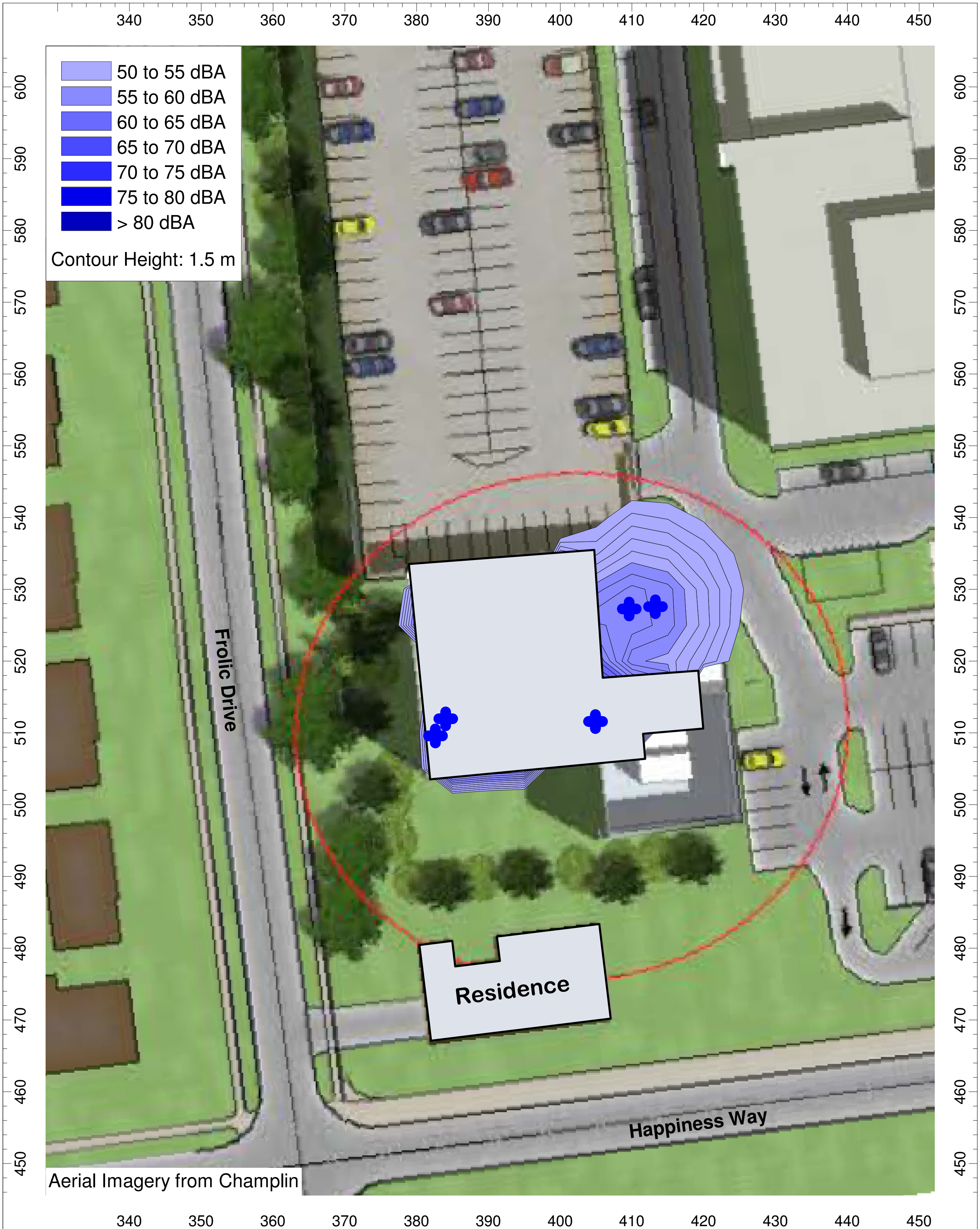
Perforated Lining Thickness:	22 gauge
Material:	Galvanized steel
Acoustic Media:	Fiberglass (standard)
Media Covering:	None
Inlet connection:	2 in slip connection (standard)
Outlet connection:	2 in slip connection (standard)
Seams locked and caulked:	Yes

Version 11.00

APPENDIX D



Predicted Noise Contours

Proposed Installation - Daytime

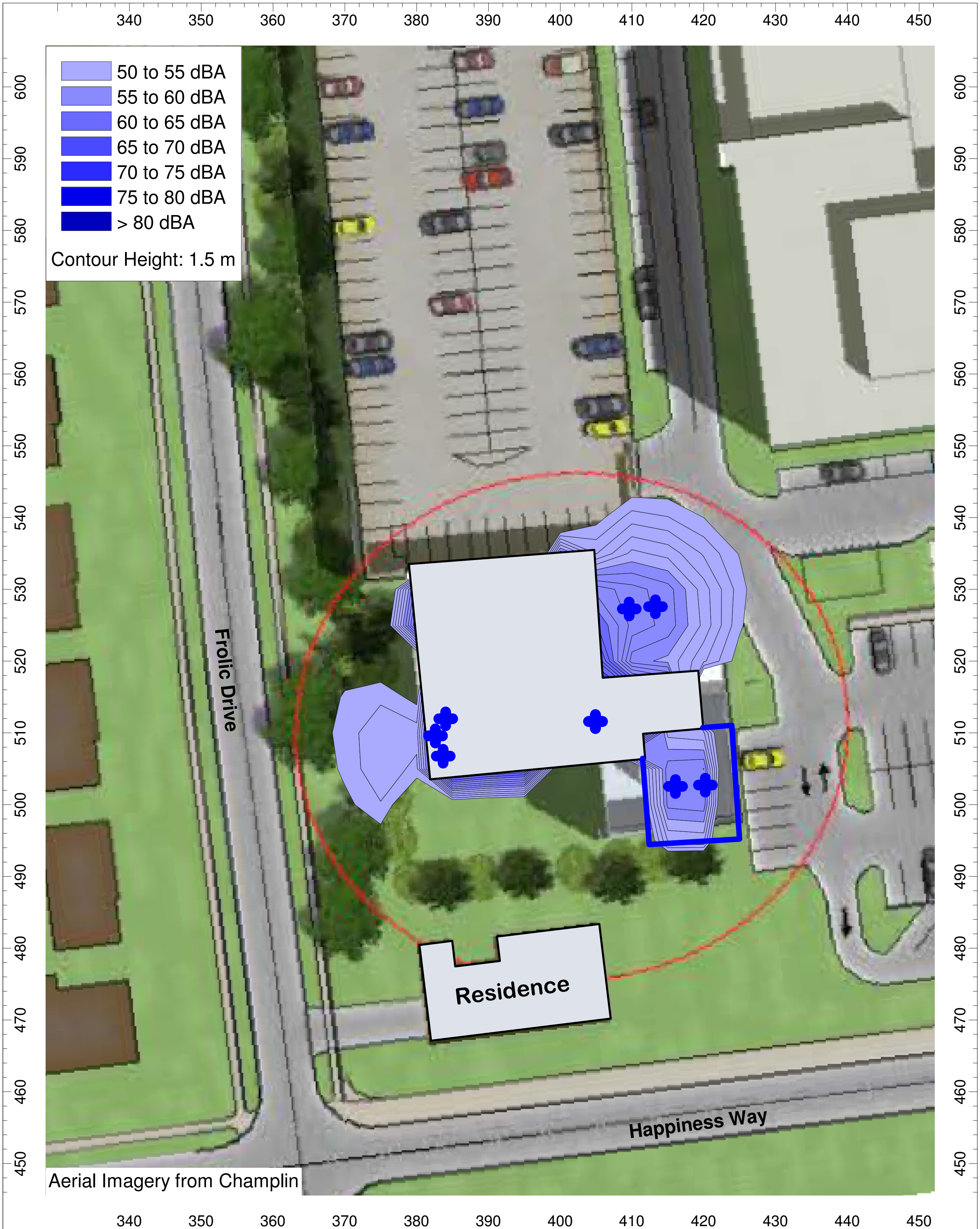
New Energy Plant Mercy Health - Kenwood, OH

True North

Project #1300959

Drawn by: GER	Figure: **D1**
Scale:	1:750
Date:	Jan. 18, 2013

RWDI



Predicted Noise Contours
Future Installation - Daytime

New Energy Plant Mercy Health - Kenwood, OH

True North

Project #1300959

Drawn by: GER	Figure: **D2**
Scale:	1:750
Date:	Jan. 18, 2013

RWDI