

**Report Number 052308-1**

**Preliminary Environmental Noise Assessment**  
**For**  
**The Calvert Cliffs Nuclear Power Plant (CCNPP) Expansion Project**  
May 2008

Prepared For:

**UniStar Nuclear Energy**  
750 E. Pratt Street  
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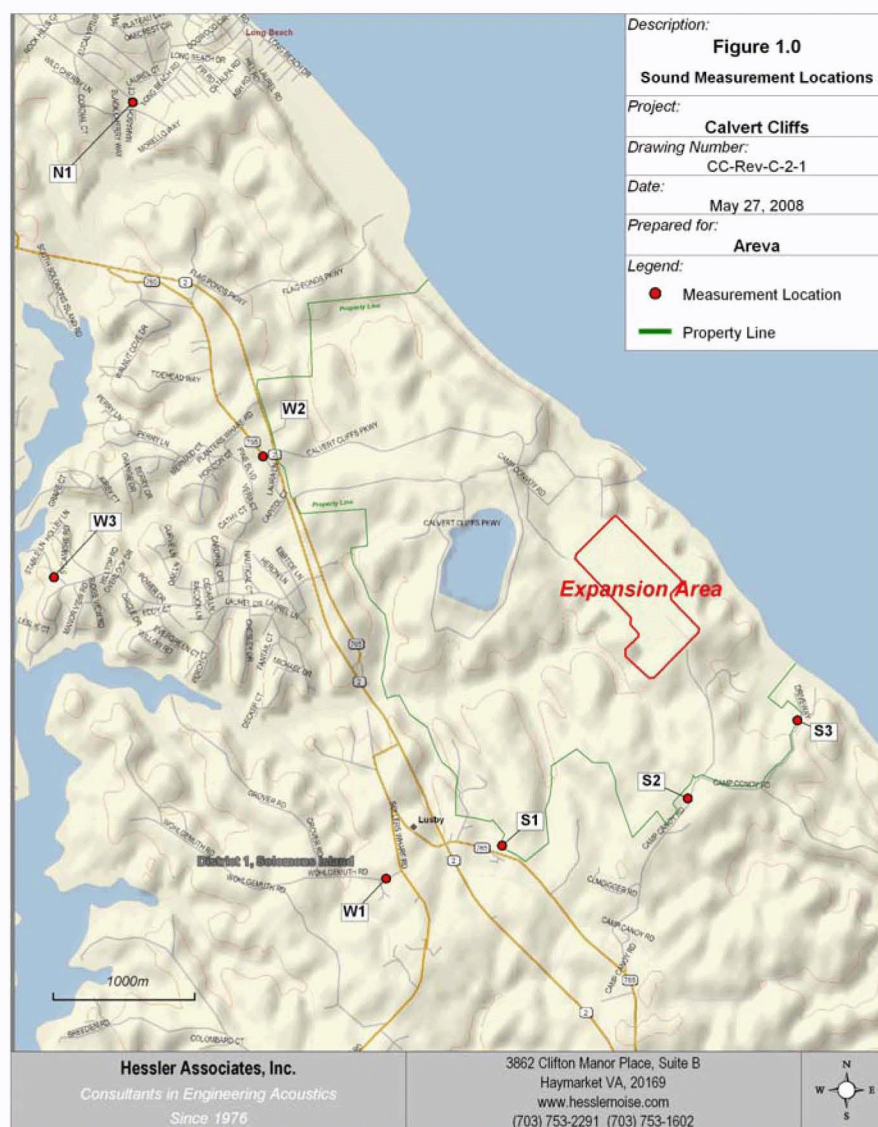
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## 1.0 Introduction

Hessler Associates has been retained by Unistar Nuclear Energy to provide an environmental noise assessment for a planned expansion to the Calvert Cliffs Nuclear Power Plant (CCNPP) located near Lusby, Maryland in Calvert County. The company plans on adding a third reactor and associated steam turbine/generator for additional plant generating capacity.

The noise assessment consists of measuring and documenting baseline or existing conditions, predicting noise emissions from the existing and planned facilities, determining legislated noise limits and assessing any potential impact during construction and operation of the planned expansion. Seven potentially sensitive residential receptor locations have been identified that surround the expansion area and are illustrated on Figure 1.0 below:



**Figure 1.0: Seven Potentially Sensitive Receptor Locations at the CCNPP Expansion Area.**





Existing conditions have been measured during leaf-off and leaf-on conditions in November 06 and August 07 and are documented in Hessler Associates, Inc. reports:

Report Number 121106-1: Leaf-off Season Sound measurement Survey

Report Number 082007-1: Leaf-on Season Sound measurement Survey

The noise contribution attributable to the proposed hybrid cooling tower has been estimated in:

Report Number 051007-1: Estimated Cooling Tower Sound Emissions

Since this report was issued, the hybrid cooling tower has been changed to a plume-abated design with significantly different sound emissions.

This report provides a preliminary noise assessment for both construction and operation of the facilities.

## **2.0\_ Executive Summary and Results**

The most sensitive receptors are identified south of the plant at locations S2 and S3. There are less than a dozen residences at these locations and they are both the closest receptors to the plant and environmental sound levels are the quietest measured during both ambient surveys at these locations.

Construction noise was predicted and expected levels at the seven identified receptors in **Figure 1.0** are all well below that prescribed by Maryland law. Any potential annoyance due to construction noise is limited to locations S2 and S3 where construction noise levels exceed existing levels. No adverse response to construction noise is expected at all other locations due to the large wooded buffer distances between the planned expansion area and the residences.

Predicted operational noise emissions were developed by computer noise modeling for the plume-abated cooling tower that is expected to be the major acoustic source from the planned expansion. The project design is not at a late enough stage to allow noise modeling for the balance of plant equipment, but again, the cooling tower is expected to be the highest and principal source of plant noise emissions. Modeling results indicate that noise emissions from the plume-abated cooling tower will comply with the 55 dBA limit prescribed by the State of Maryland.

## **3.0\_Conclusions**

As shown in the report, the planned installation of new capacity at the Calvert Cliffs site can and will be acoustically designed to comply with the requirements of Maryland law regulating industrial noise emissions. It is concluded that construction and operational noise from the project meets all applicable regulations without restrictions or exceptions.

## **4.0\_Recommendations**

It is recommended that construction and operational noise emission modeling for the complete plant expansion is continued as more design information becomes available.



## 5.0\_ Construction Noise

### 5.1\_ Assessment Criteria

The site has large buffer distances between the expansion area and the closest sensitive receptors and all are wooded with soft sound absorptive ground. The State of Maryland regulations<sup>1</sup> limit maximum noise levels attributable to construction activities to 90 dBA at any and all sensitive receptor locations during daytime hours (7 am to 10 pm) and to 55 dBA for nighttime hours.

### 5.2\_ First Order Compliance Analysis

The Table below is taken from Table B.1 of reference<sup>2</sup>. This reference is now 30 years old but remains the most comprehensive study of construction noise specific to power plant construction, including nuclear power plants. Over 1300 hours of measurements were collected for analysis and to develop a construction noise prediction methodology. More recent equipment noise measurement data indicates there have been noise reduction improvements made for current construction equipment and current equipment is quieter than that reflected in the referenced study. Hence the results shown below can be considered conservative.

The maximum instantaneous level for each type of common construction equipment that would propagate to off-site sensitive locations is estimated for the seven identified residential receptors. It can be deduced from this table that the State daytime limit of 90 dBA will indeed be met at all locations with a very comfortable margin of safety due mainly to the large buffer distances. Maximum levels can be expected at the closest receptors to the south at locations S2 and S3.

Type of Equipment	Engine Rating HP	Range of Maximum Sound Levels at 50 feet, dBA	Maximum level from Any Individual Source at Location:						
			N1	S1	S2	S3	W1	W2	W3
Crawler	101-250	81-85	15	38	45	45	32	28	21
Dozers	251-700	85-90	20	43	50	50	37	33	26
Front End Loaders	300-750	86-90	20	43	50	50	37	33	26
Tractor Shovels	116-299	82-86	16	39	46	46	33	29	22
Backhoe Excavators	336-760	88-90	20	43	50	50	37	33	26
Self Propelled Scrapers	551-1000	88-91	21	44	51	51	38	34	27
Graders	351-600	86-89	19	42	49	49	36	32	25
Off-Highway Haulers	501-800	88-90	20	43	50	50	37	33	26
Steel Rollers	89-110	80-82	12	35	42	42	29	25	18
Rubber Tired Rollers	121-150	82-83	13	36	43	43	30	26	19
Derrick Crane	121-280	82-86	16	39	46	46	33	29	22
Mobile Crane	161-240	83-85	15	38	45	45	32	28	21
Concrete Pumps	51-220	78-84	14	37	44	44	31	27	20
Air Compressors	401-600	87-89	19	42	49	49	36	32	25
Portable Generators	101-400	81-87	17	40	47	47	34	30	23
Trucks	201-400	84-87	17	40	47	47	34	30	23
Rock Drills		83-99	29	52	59	59	46	42	35
Chain Saw		72-88	18	41	48	48	35	31	24
Warning Horns		98-102	32	55	62	62	49	45	38

**Table 5.2.1:** Estimated individual construction noise sources at the seven identified residential locations surrounding the site.

It should be noted that the above are for individual equipment sources operating at their maximum noise output.

<sup>1</sup> Title 26, Maryland Department of the Environment, Chapter 03 Control of Noise Pollution, Environmental Noise Act of 1974

<sup>2</sup> "Power Plant Construction Noise Guide", BBN Report 3321, Prepared for the Empire State Energy Research Corporation, NY, NY, May 1977.

### 5.3\_Second Order Construction Noise Assessment

Actual construction noise contains an accumulation of many transient sources of varying noise from countless individual sources at varying degrees of usage from day to day, and is far more complex than a table of individual sources given above. There are five distinct phases common to all power plant construction projects tabulated below. For this project, these construction phases are expected to commence in 2009 and conclude in 2015.

Construction Phases:

1. Excavation
2. Concrete Pouring
3. Steel Erection
4. Mechanical Equipment
5. Commissioning and Clean-up

Reference 1 documents the long term measured sound level from 15 power plant construction projects and derives a prediction scheme from the measurements. Based on this methodology that has been simplified for purposes of this preliminary report, the following table shows the estimated long term average sound level for each construction phase at each of the seven evaluation receptors. Although these results are conservatively estimated they are considered adequate for this preliminary assessment.

CONSTRUCTION PHASE	ESTIMATED LONG TERM Leq CONSTRUCTION NOISE AT LOCATION						
	N1	S1	S2	S3	W1	W2	W3
EXCAVATION	36	46	50	50	43	41	38
CONCRETE POURING	32	42	46	46	39	37	34
STEEL ERECTION	36	46	50	50	43	41	38
MECHANICAL	31	41	45	45	38	36	33
CLEAN UP & CHECKOUT	26	36	40	40	33	31	28

**Table 5.3.1: Predicted Long-Term Average Construction Noise Levels at Seven Residential Receptors**

The results show again that the long term average sound levels attributable to construction noise are well below both the daytime and nighttime limits promulgated by the State of Maryland (90 and 55 dBA, respectively). To assess these results it is necessary to compare them to the existing noise environment. The change or increase to existing levels is the relevant assessment parameter. The daily hourly measured Leq for the leaf-off survey in November 06 is tabulated below in **Figure 5.3.2**. This data represents the spring, fall and winter seasons.

Leq data from the leaf-on summertime survey conducted in August 07 contains high levels of insect sound, particularly at locations S2 and S3 that is heavily wooded with natural underbrush and ground cover. Insect noise occurs at very high frequencies (2000 Hz and above for this case) and controls and dominates the measured Leq metric. The measured Leq leaf-on data is magnitudes higher than the leaf-off results due only to this single source. While a natural environmental sound, high frequency insect sound provides no masking of construction or operational noise and should not be used for comparative assessment purposes.



MEASURED 11/21/06	HOURLY Leq AT LOCATION						
START OF HOUR	N1	S1	S2	S3	W1	W2	W3
7AM	44	43	40	45	41	60	49
8AM	46	43	41	46	42	59	49
9AM	44	42	41	46	42	58	49
10AM	43	42	40	46	42	58	54
11AM	43	42	40	44	43	56	47
12N	45	43	40	45	44	57	48
1PM	44	42	40	45	42	57	50
2PM	44	41	39	43	41	58	47
3PM	45	43	41	45	42	58	50
4PM	46	42	39	43	42	59	50
5PM	47	43	42	47	41	59	50
6PM	47	43	44	50	42	58	49
7PM	49	45	45	51	44	58	50
8PM	51	47	47	52	45	57	50
9PM	51	45	46	51	46	56	49
<b>AVERAGE DAYTIME Leq</b>	<b>47</b>	<b>43</b>	<b>42</b>	<b>48</b>	<b>43</b>	<b>58</b>	<b>50</b>

*Table 5.3.2: Measured Existing Daytime Ambient Sound Levels at Residential Receptors*

The change or increase to existing levels attributable to construction noise is calculated and tabulated below for assessment purposes.

ESTIMATED INCREASE FROM CONSTRUCTION NOISE AT LOCATIONS							
CONSTRUCTION PHASE	N1	S1	S2	S3	W1	W2	W3
EXCAVATION	0	3	8	2	0	0	0
CONCRETE POURING	0	0	4	0	0	0	0
STEEL ERECTION	0	3	8	2	0	0	0
MECHANICAL	0	0	3	0	0	0	0
CLEAN UP & CHECKOUT	0	0	0	0	0	0	0

*Table 5.3.3: Estimated Increases to Existing Daytime Ambient Sound Levels at Residential Receptors*

It can be observed that construction activities will have no effect at locations N1, W1, W2 and W3 where the change or increase to the ambient is zero for all construction phases. The maximum increase to the ambient occurs at location S2.





It is generally agreed in the scientific community that an increase of 5 to 10 dBA to the ambient is the threshold for potential adverse impact for construction noise. This leaves location S2 as the only location where adverse impact may occur based on this preliminary analysis. More accurate detailed modeling that accounts for topography shielding and quieter construction equipment may also show that actual expected construction noise levels increases are below 5 dBA at all locations.

Nevertheless, this preliminary study shows that locations to the south are the only locations that may experience adverse response from construction noise. There are less than a dozen residences along Camp Conoy road at locations S1 and S2.

#### **5.4\_Construction Noise Mitigation Measures**

It is shown that no special mitigation measures are required to comply with the State of Maryland regulations as long as noisy construction activities are restricted to daytime hours defined as 7 a.m. to 10 p.m. by the State. Nevertheless, it is recognized that the most effective mitigation measure is to restrict noisy construction activities to normal daytime hours of 7 a.m. to 7 p.m. This scheduling effort is under consideration by the owner to the extent possible. However, there may be times when a continuous work activity (such as a large concrete pour), or scheduling constraints may necessitate some nighttime activities past 7 p.m.

#### **6.0\_Operational Noise Analysis**

##### **6.1\_ Noise Requirement**

About a dozen states and many local communities publish “Emission Limits” or maximum sound level limits for operational plant noise emissions, regardless of existing conditions. A search of the Calvert County web site did not turn up any noise rules. The State of Maryland limits maximum sound levels from industrial sources at residential receptors to 65 dBA and 55 dBA during day (7 am-10pm) and night periods (10 pm to 7 am), respectively.

The Maryland statute also states that a limit of DNL = 55 dBA is the environmental “goal” of the state standards. DNL is a complex metric developed by EPA that weights or penalizes levels that occur after 10 p.m. A DNL goal of 55 dBA would require maximum day and night limits of 55 dBA and 45 dBA, fully 10 dBA *lower* than the State *maximum* levels to achieve this goal.

A nuclear power plant is base load generation operating 24/7. Any nighttime noise requirement becomes the plant design requirement since noise emissions are essentially constant throughout the day and night. For purposes of this report, the project noise requirement is established at 55 dBA or less at all potentially sensitive receptors.

##### **6.2\_Predicted Operational Noise**

Detailed operating information and vendor supplied noise source information is not yet available for a comprehensive noise model. The major sources of operational noise emissions from a nuclear power plant are tabulated below:

1. Condensate cooling tower
2. Steam turbine/generator building walls and ventilation including all air inlets and exhausts.
3. Core building walls and ventilation including all air inlets and exhausts.
4. Electrical transformers
5. Standby diesel generator set building walls and ventilation including all air inlets and exhausts.

Noise emission data is available for the cooling tower thought to be the major source of operational noise. Appendix A contains this data and an illustration of the hybrid plume-abated cooling tower. The program used for predicting cooling tower emissions is Version 3.0 of "Cadna A"; an acronym for Computer Aided Design for Noise Abatement, published by DataKustik, Ltd., Munich, Germany. All calculations are carried out in accordance with international standard ISO 9613. There is no equivalent U.S. standard for outdoor sound propagation modeling. The program calculates the sound level from the cooling tower at grid points, typically a 1 meter square pattern, covering the whole project area resulting in multi-thousands of calculations. Equal level noise contours can then be plotted over the whole project area.

Appendix B contains Graphic A and B showing the equal noise contours from the cooling tower during Leaf-on and Leaf-off seasons, respectively. The table below summarizes the results at the seven identified receptors from Figure 1.0:

<b>ESTIMATED Leq, dBA FROM COOLING TOWER AT LOCATIONS:</b>							
	<b>N1</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>W1</b>	<b>W2</b>	<b>W3</b>
LEAF-ON SEASONS	<<30	44	51	49	39	35	<30
LEAF-OFF SEASONS	<30	48	54	53	43	39	32
<b>AMBIENT LEVEL</b>							
AVERAGE DAYTIME Leq	47	43	42	48	43	58	50
<b>INCREASE TO AMBIENT</b>							
LEAF-ON SEASONS	0	1	9	1	0	0	0
LEAF-OFF SEASONS	0	5	12	5	0	0	0

**Table 6.2.1:** *Estimated Cooling Tower levels at Seven Receptors Compared to Existing levels.*

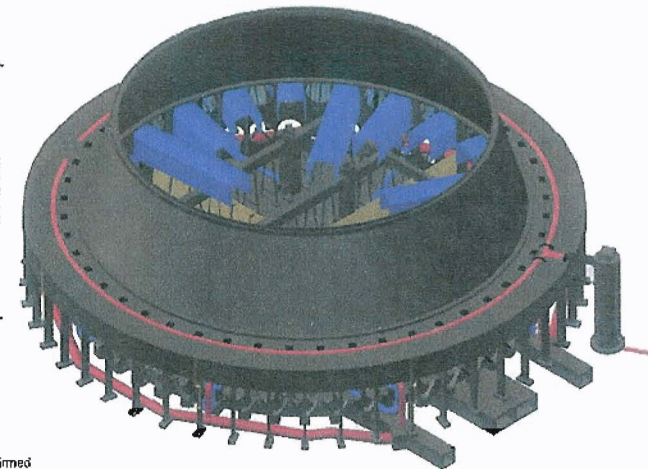
Two points can be deduced from the results table. The levels propagated to the community from the cooling tower are all in full compliance with the Maryland limit of 65 and 55 dBA during day and night hours at all locations. As for the previous construction analysis, the cooling tower noise emissions may have some effects at locations to the south, but no effects at any other location where there is no increase to the ambient.



# **APPENDIX A**

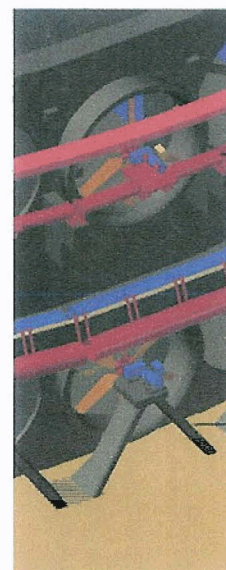
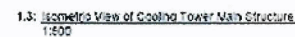
## **NOISE MODELS FOR EXISTING GENERATION**





166500 mm (546 ft 1")

### 1.3. removal of Cooling Tower Main Structure



#### 1.4: Details of Wet and Dry Fans

Plume Design Point	
Parameter	Value
Flow =	800,000 gpm
TF1 =	25.00°F
TL1 =	23.30°F
RH =	80.00%
Pb =	29.92 in HgA
Range =	28.0°F

04/30/08



**BECHTEL** Bechtel US EPR PROJECTS  
Constellation Calvert Cliffs  
Round Hybrid Mechanical Draft Cooling Tower  
Preliminary Arrangement


**SPX**  
SPX Cooling Technologies

TYPE OF EQUIPMENT: <i>Forced Draft Hybrid Cooling Tower</i>					SUPPLIER/ MANUFACTURER: <i>SPX Cooling Technologies *</i>						
EQUIPMENT NO.: <i>Bechtel/UniStar Calvert Cliffs</i>					MECHANICAL POWER(kW/HP): <i>See Appendix A Data Sheet *</i>						
SIZE l x w x h (ft): <i>See Arrangement Drawing *</i>											
<b>NOISE DATA – LEVELS GUARANTEED BY SELLER NOT TO BE EXCEEDED BY EQUIPMENT</b>											
<ol style="list-style-type: none"> <li>The noise generated by the equipment shall not exceed the noise limits of <del>[Project derived, typically 85 dBA @ 3 feet]</del>, for any of the conditions of operation for which the equipment may normally be expected to be used</li> <li><math>L_p</math> is the maximum sound pressure level, re 20<math>\mu</math> Pascal in dB, at any location at 1 m from the equipment surface, <math>L_w</math> is the maximum sound power level, ref. 1 pico Watt</li> <li>If the equipment generates noise with audible tonal or impulsive components, this shall be indicated on the following page</li> <li>Noise level will be verified in accordance with ISO 3740 series or equipment specific noise test protocols (no test tolerances or uncertainty corrections allowed)</li> <li>The supplier shall state which noise mitigation features were added to meet the noise requirements</li> </ol>											
Equipment Items/Locations		Sound Pressure/Power levels guaranteed by supplier									Remarks (noise mitigating measures)
		Un-weighted octave band levels									
		31.5	63	125	250	500	1000	2000	4000	8000	dBA
At Dry Section Inlet	$L_p$										
	$L_w$	95.8	102.6	112.8	116.5	119.2	120.1	116.8	116.2	113.4	125.6
At Wet Section Inlet	$L_p$	68.1	74.9	85.0	88.6	91.1	91.6	86.4	84.7	81.3	96.7
	$L_w$	100.8	107.6	117.7	121.3	123.8	124.3	119.1	117.4	114.0	129.4
At Tower Outlet	$L_p$										
	$L_w$	90.3	101.5	113.1	118.0	116.8	117.9	115.5	112.1	102.9	124.0
	$L_p$										
	$L_w$										
	$L_p$										
	$L_w$										
	$L_p$										
	$L_w$										
	$L_p$										
	$L_w$										

SUBMITTED DATA BASED ON: <i>[Supplier] *</i>					TEST LOCATION: <i>[Supplier] *</i>				
<input type="checkbox"/> TEST ON SIMILAR UNIT <input type="checkbox"/> TEST ON ACTUAL UNIT <input type="checkbox"/> TEST ON SCALE MODEL <input type="checkbox"/> CALCULATION <input type="checkbox"/> OTHER					<input type="checkbox"/> SELLER'S PLANT <input type="checkbox"/> SIMILAR PLANT <input type="checkbox"/> REVERBERATION CHAMBER <input type="checkbox"/> ANECHOIC CHAMBER OR OUTDOORS <input type="checkbox"/> OTHER				

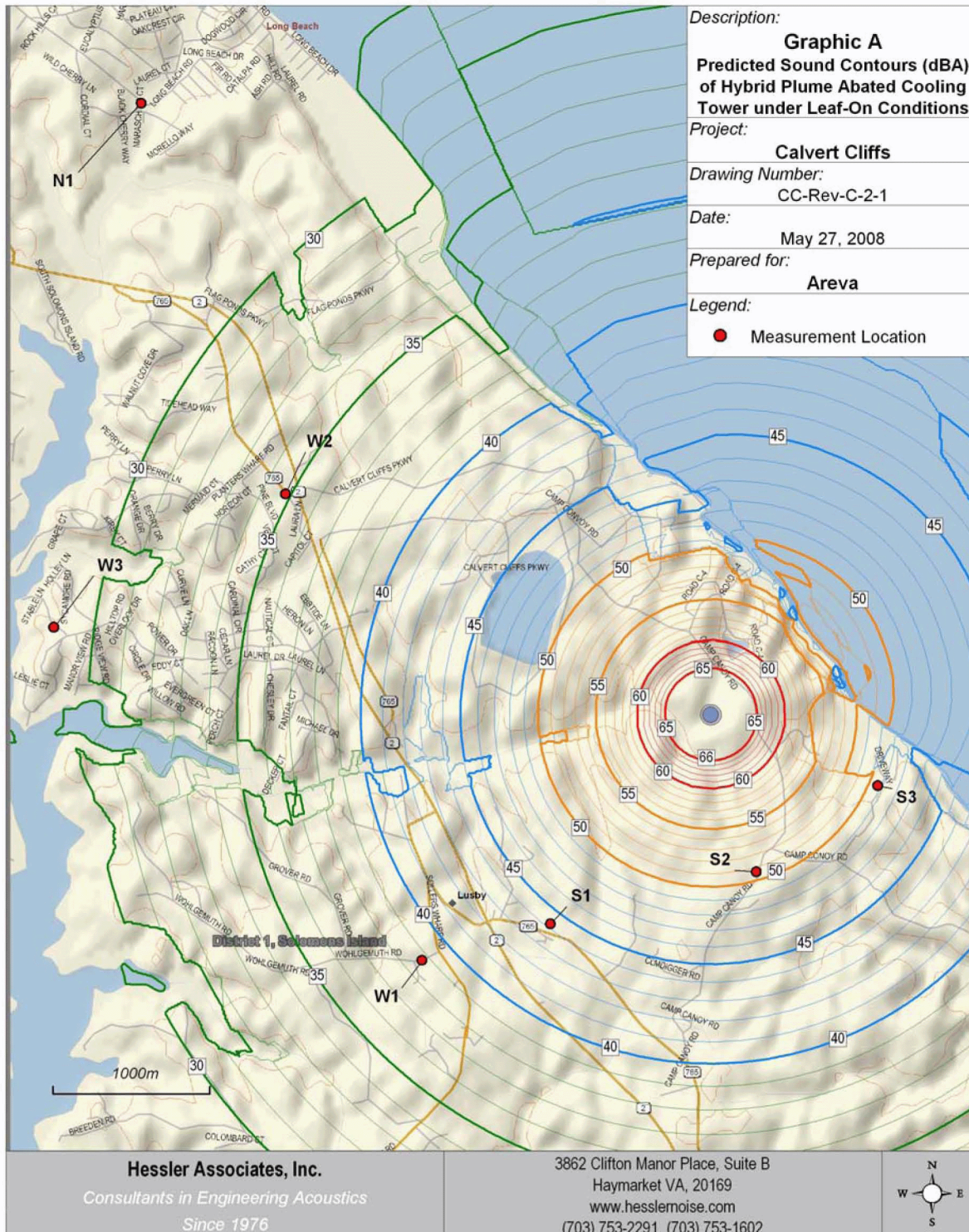
	EQUIPMENT NOISE DATA SHEET		Job No	
	PROJECT		MR	
			Appendix	Rev.
			Sheet 1 of 2	



## **APPENDIX B**

### **GRAPHICAL NOISE MODELS**





**Graphic A: Predicted Noise Contours from Hybrid Cooling Tower during Leaf-on Seasons**



