



## Bull Run TREATMENT PROJECTS

# Technical Memorandum

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**Subject:** Overview of Acoustics and Nighttime Generator Sound Levels

**Project #s:** **PWB:** W02563                      **Jacobs:** D3460500

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## Exhibit

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Figure 1 Predicted Sound Pressure Levels (dBA) Nighttime Generator Operations

## 1.0 Introduction

This technical memorandum responds to Exhibit I.39 that was submitted by the Cottrell CPO related to noise levels. The memo clarifies and corrects information provided in the CPO document related to conversion of decibel increases to a linear scale.

As decibels, the fundamental metric used in acoustics, is a logarithmic quantity and the human response to sound is complex, there are multiple opportunities for misunderstanding. Construction noise is addressed by multiple state and federal agencies which have published typical construction equipment sound levels as well as background information to facilitate greater understanding of the science of noise.

### 1.1 Decibels and Human Hearing

Sound is the rapid fluctuation in air pressure above and below the atmospheric pressure. While these fluctuations are small in absolute magnitude, they can span a large range. Logarithms are used to compress this large range as:

$$\text{Log}_{10}(10) = 1$$

$$\text{Log}_{10}(100) = 2$$

$$\text{Log}_{10}(1000) = 3$$

Thus a range in values spanning from 10 to 1000 is compressed to a range between 1 and 3. This is a useful feature of logarithms when the range in the linear quantity of interest is large.

A sound pressure level ( $L_p$ ) is defined as:

$$L_p = 20 \log_{10} \left[ \frac{P}{P_0} \right] \text{ dB} \quad \text{or equivalently,}$$

$$L_p = 10 * \text{Log}_{10}(P/P_0)^2 \text{ dB}$$

where  $P$  is the measured pressure and  $P_0$  is the reference pressure level of  $2 \times 10^{-5}$  Pascals.

Thus, a sound pressure level of 30 dB has ten times more energy than 20 dB (analogous to 1000 vs 100 in the above example). A doubling of the sound energy results in a 3 dB increase. However, the human ear does not respond to sound energy in a linear manner. The Oregon Department of Transportation's (ODOT's) noise manual explains:

*“People cannot usually detect a 1 dBA increase in sound; a 2–3 dBA increase is typically needed before a change can be perceived. A 10-dBA increase, such as from 50 dBA to 60 dBA, is usually perceived as a doubling of loudness. Doubling of the acoustic output of a sound source will increase the sound level by 3 dBA. For example, two 50 dBA sound sources will produce a total*

*sound level of 53 dBA. Thus, a doubling of traffic volumes on a road will create a change in loudness that is just barely noticeable."* Source: Appendix A, ODOT Noise Manual.

[https://www.oregon.gov/odot/GeoEnvironmental/Docs\\_Environmental/Noise-Manual1.pdf](https://www.oregon.gov/odot/GeoEnvironmental/Docs_Environmental/Noise-Manual1.pdf)

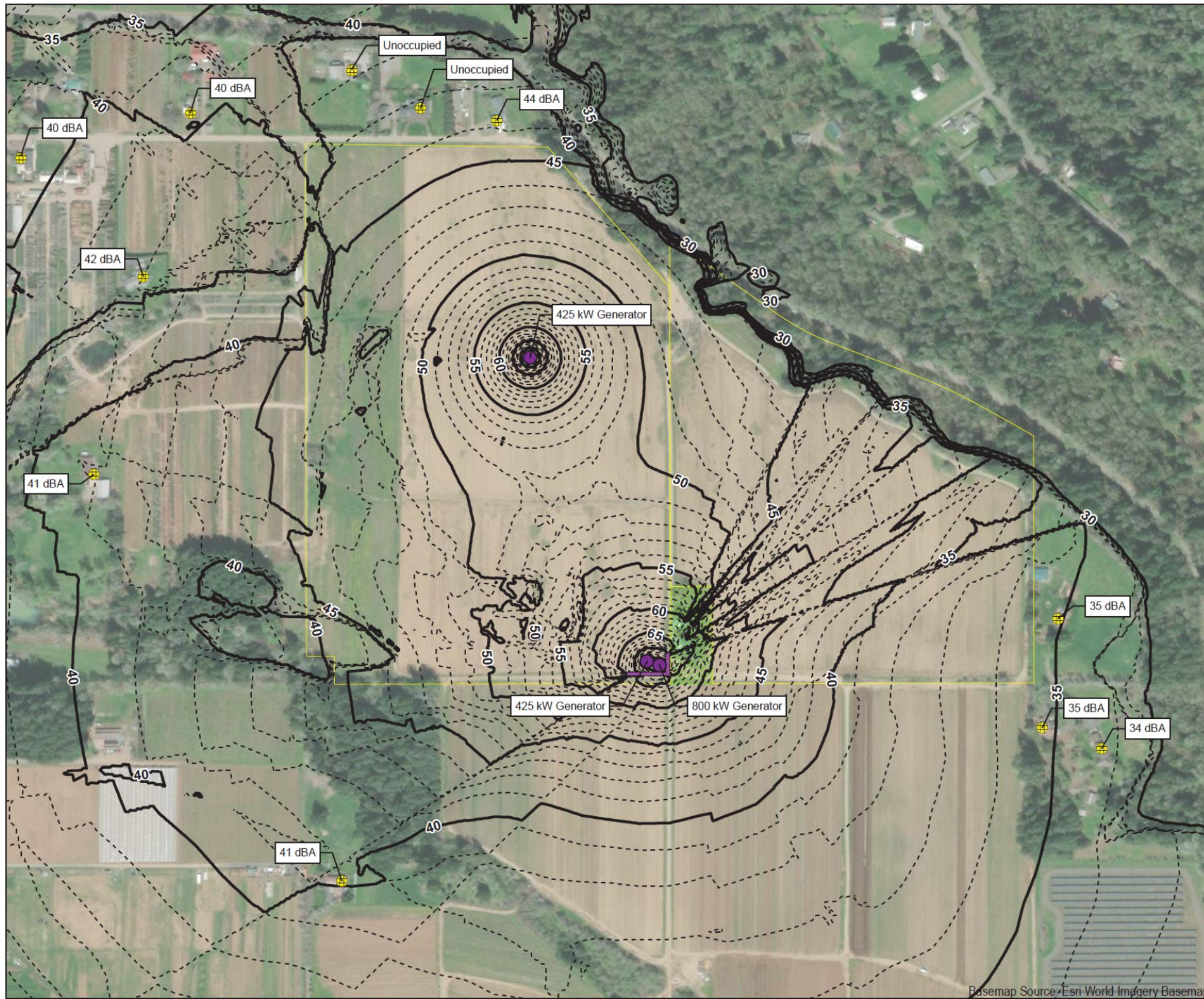
Thus, while a **10 dBA increase is a 10-fold increase in energy**, it is perceived by humans as only **twice as loud rather than ten times** as loud when comparing similar sounds. Therefore, the discussion and table of ratios included in the Cottrell CPO memo are incorrect.

## 2.0 Temporary Nighttime Generator Noise

Sound levels from contractors' temporary operations of generators during the nighttime have been evaluated. The contractors have indicated that three generators are needed during the nighttime hours. These generators will be supplied in sound attenuating enclosures that yield a sound level of 74 dBA at 23 feet. One generator is located in the center of the site, while two others are located along the southern boundary. A sound wall has been modeled on the southern and eastern side of the southernmost generators. Figure 1 depicts the predicted sound levels from these generators and documents the nighttime criteria of 50 dBA is not exceeded at any residence.

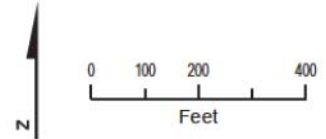
## 3.0 Conclusions

Although Multnomah County Code (MCC) Section 15.270(F) provides an exemption for sounds from construction activities, the Water Bureau will require the contractor to use noise mitigation strategies in order to ensure that the nighttime noise level during construction meets the County's noise ordinance nighttime standard. As shown by the modeling above, it is feasible for the contractor to use sound walls or other methods to achieve this goal.



**LEGEND**

- Residence
- Generator Location
- Predicted Sound Level (dBA)**
- 5 dBA Contour Interval
- 1 dBA Contour Interval
- Sound Barrier
- Project Parcel
- Parcel Owned by Pleasant Home Water District



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Figure 1  
 Predicted Sound Pressure Levels (dBA)  
 Nighttime Generator Operations  
 Bull Run Filtration Plant